Open PHA Process Hazards Analysis Software

User's Manual

Rev 0

Introduction

This guide describes how to use the Open PHA and Open PHA 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 and security professionals with a cloud-based multi-user platform for the design of engineered safeguards. Open PHA Premium has a collection of premium tools which are not available in the desktop edition. You can request a free Open PHA 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. We use the same skills for industrial control systems (ICS) network design, cyber security assessments, and industrial network performance analysis.

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Section 0 – Quick Reference

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.	PHA
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.)	CM

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

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

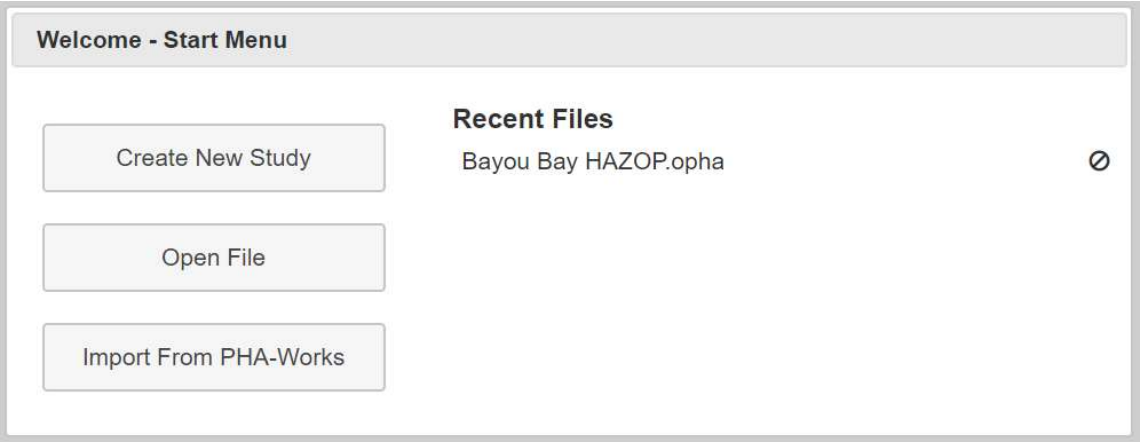
With Cell(s) Active – Blue Border	
Hot Key	**Action**
Ctrl + Enter	Create New Row
Ctrl + A	Select All Text in Active Cell
Alt + Arrow Key	Make Neighbor Cell Active

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 Premium. In Open PHA Premium, studies are either created or opened from the KISS study manager.



The Start Menu consists of three 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 three buttons to the left of the recent files list can be used to create new studies, open existing studies, or import studies from PHA Works. For more information on PHA-Works import see *Section 5.7* of this manual.

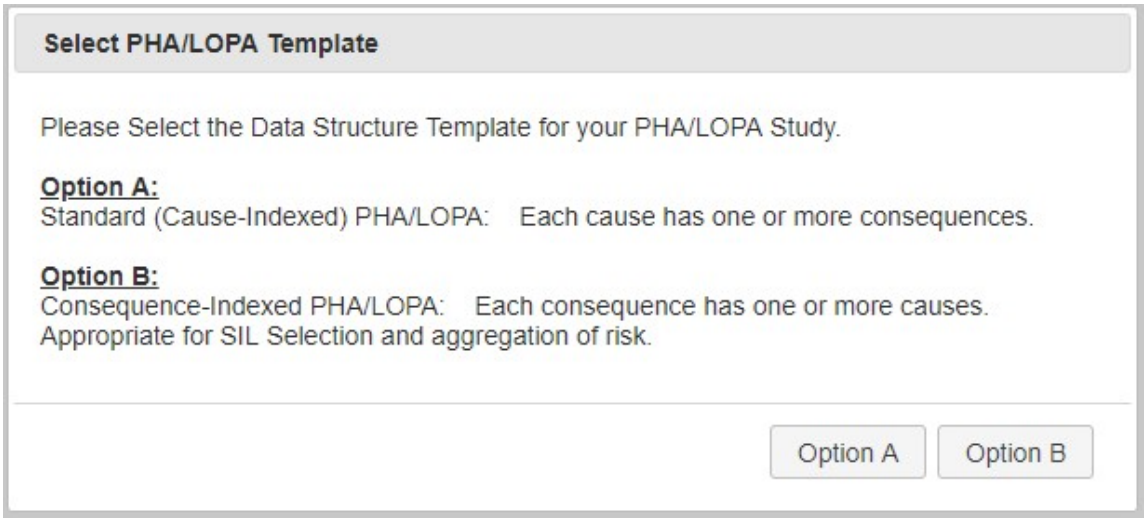
When selecting to create a new study, you will be presented with a series of dialogues to guide you through configuring you PHA/LOPA data structure.

Section 1 – Getting Started

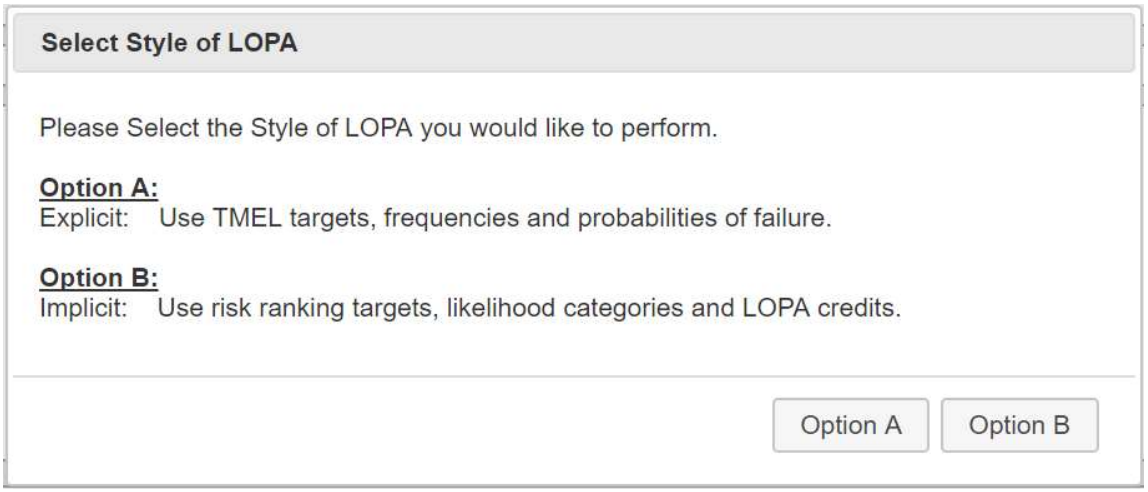
To create a new PHA/LOPA study in Open PHA premium first select a facility from the facility list. The new study you create will be located inside this facility. With a facility selected (highlighted blue), click on the "add new study" button in the main action ribbon and select Open PHA for the study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

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



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.



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.

Section 2 – Interface

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

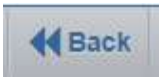
The navigation toolbar serves as the primary means for navigating the Open PHA study editor interface and appears on all pages in the editor. This section details the available buttons on the toolbar:

Button	Description
	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: • General Information (Location, Facility, Operating Company, etc.) • Documents List • Participant List • Sessions • Revision History Additionally, column visibility can be adjusted from the study data section
	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.)
	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.

Section 2 – Interface

Button	Description
	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.
	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.
	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.
	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.
	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.
	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.
	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.

Section 2 – Interface

Button	Description
	The Back button navigates back to the Study Manager page (Only In Open PHA Premium).

Section 2 – Interface

2.1.1 Application Toolbar - Desktop Version

File View Security Help

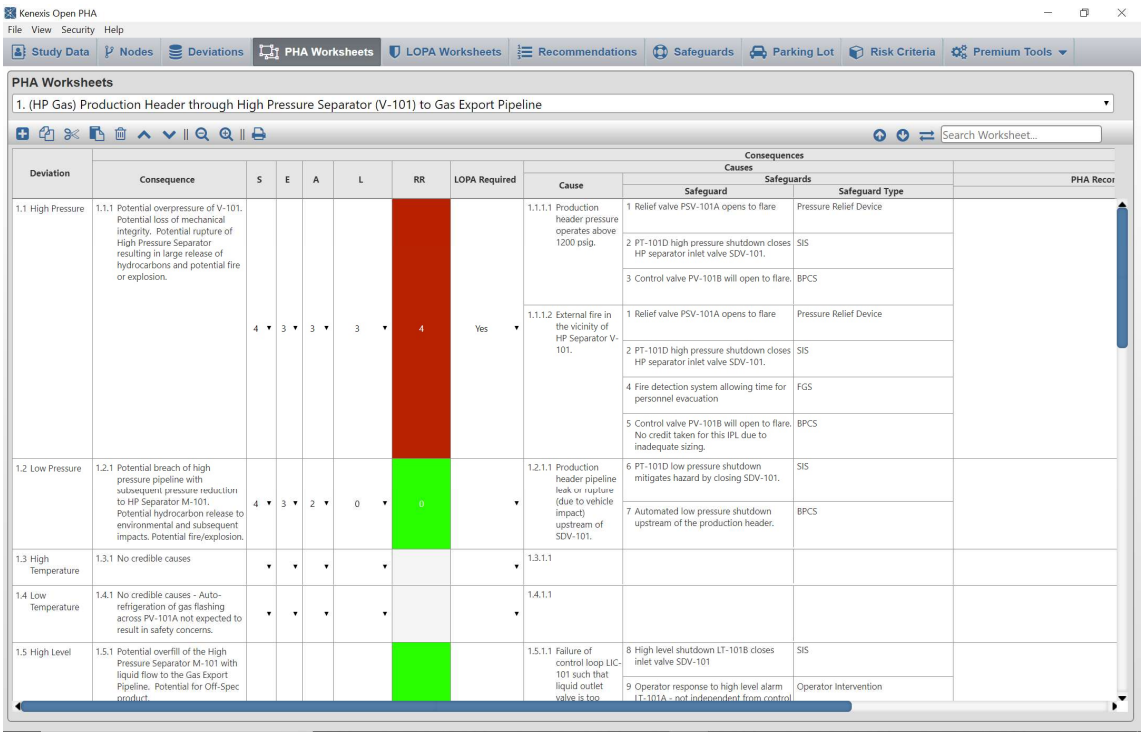
In addition to the navigation toolbar, the desktop version of the software also has an application toolbar. The table below provides details on the four buttons available in this toolbar.

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.

Section 3 – Workspace

3.1 Open PHA Interface

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.



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):

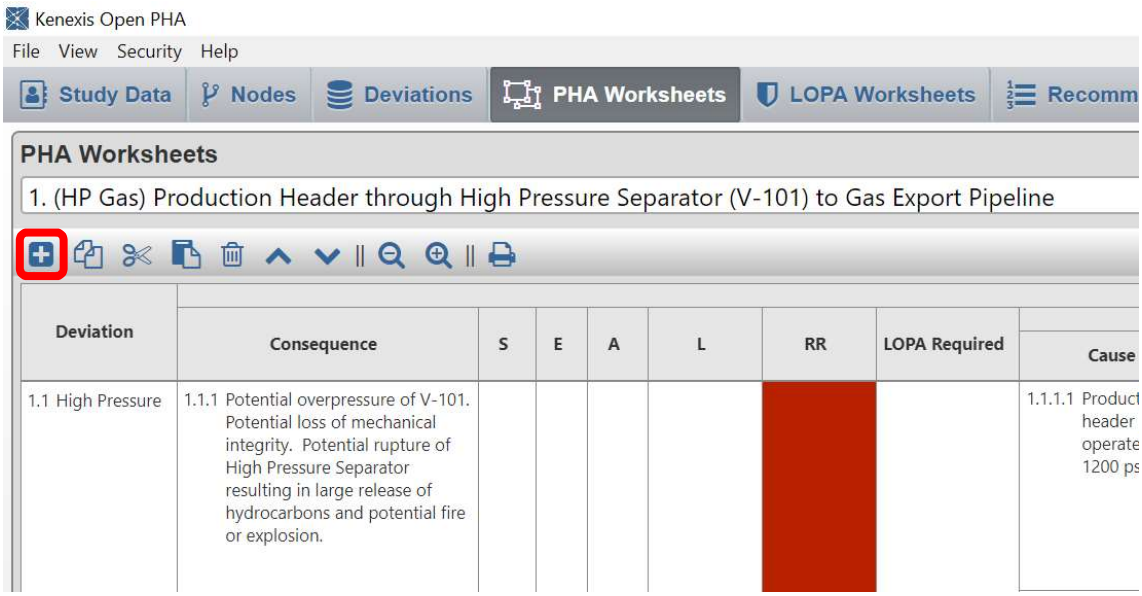
1. Add New Row
2. Copy Row(s)

Section 3 – Workspace

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.

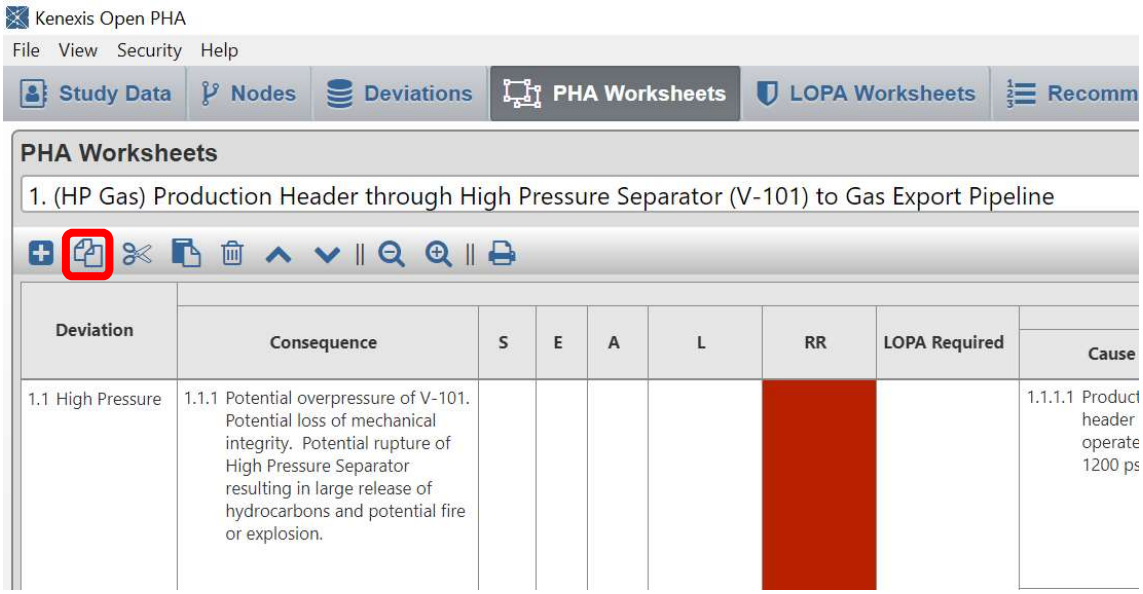


Alternatively, rows can be added to tables by selecting a row and pressing the Ctrl and Enter keys on the keyboard.

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

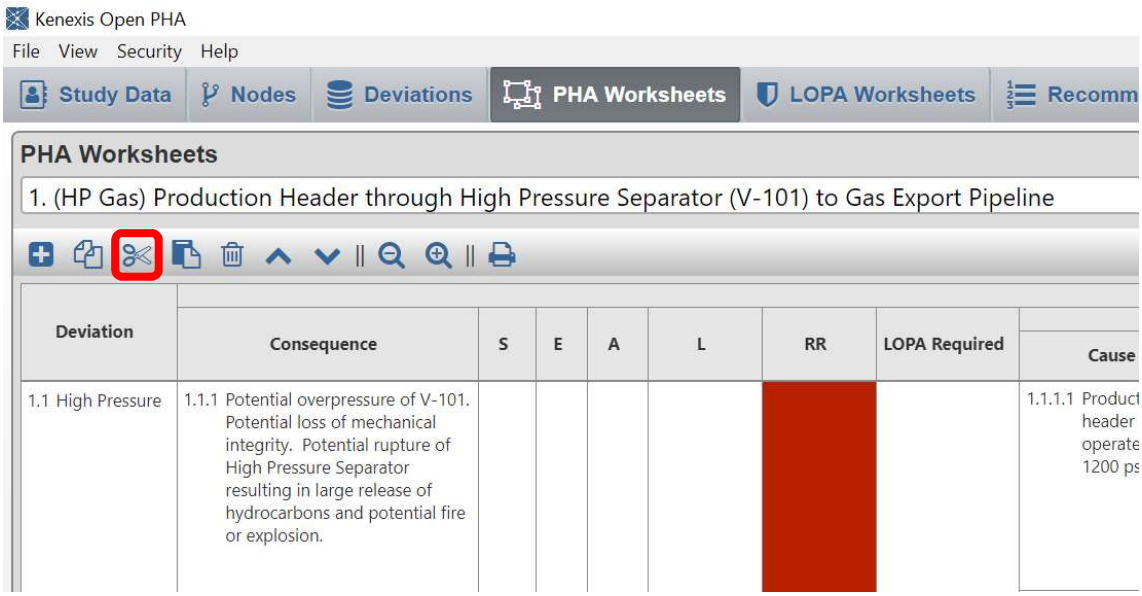
it, then hold the “Control” key and click to select the additional row(s) you would like to copy; or if you want to select rows, use the “Shift” key and click to select every row two rows that you have selected.



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.

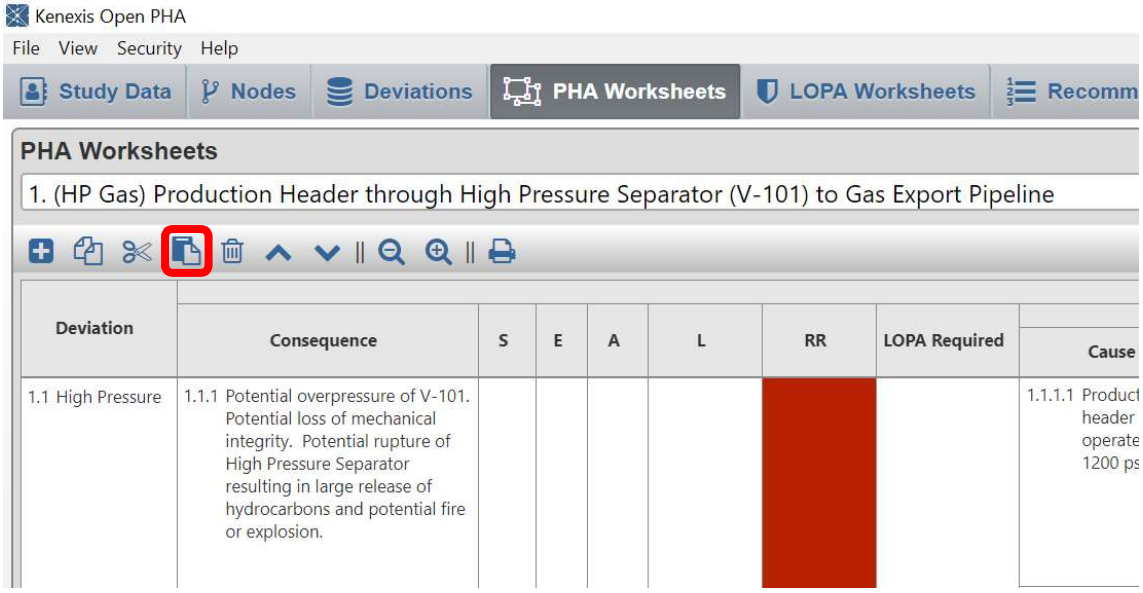


Alternatively, rows can be cut by selecting a row and pressing the “Control” key along with the “X” key (Ctrl + X) on the keyboard.

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.

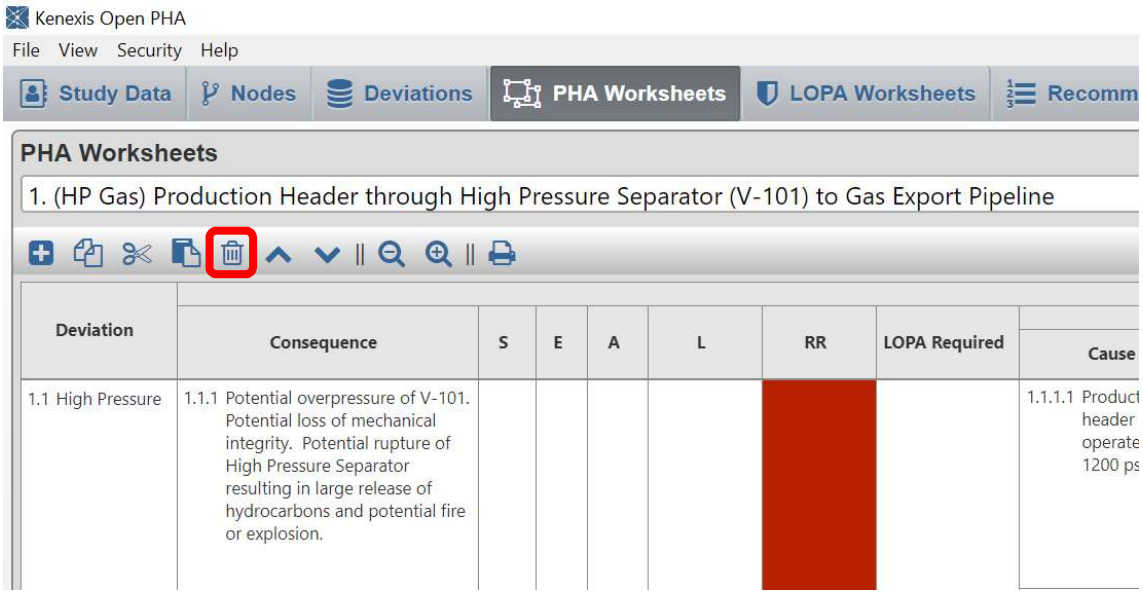
Section 3 – Workspace



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.

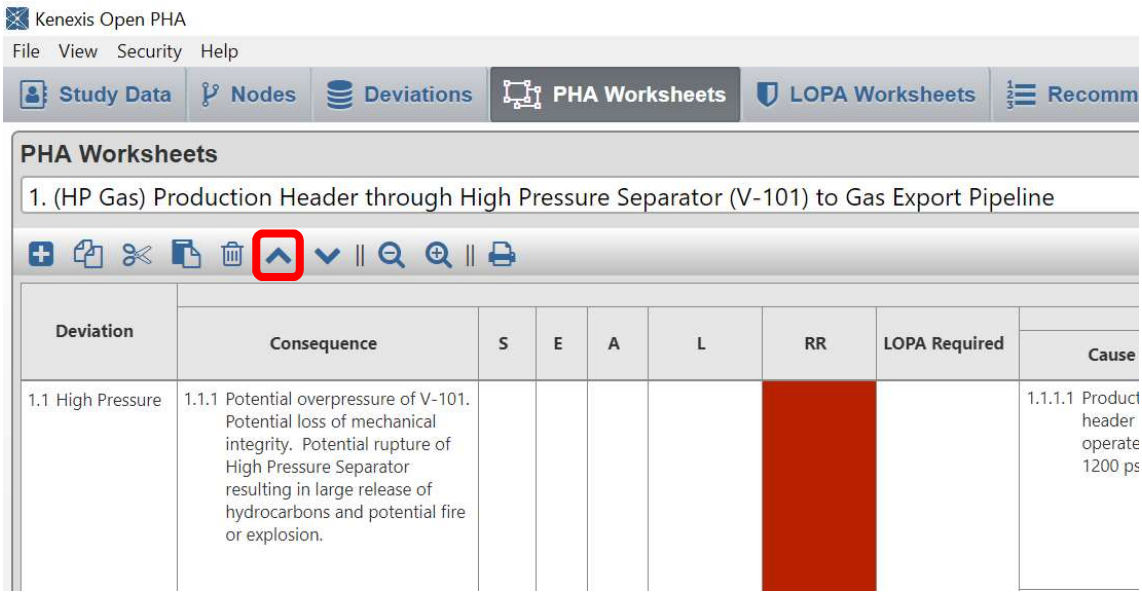


Section 3 – Workspace

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

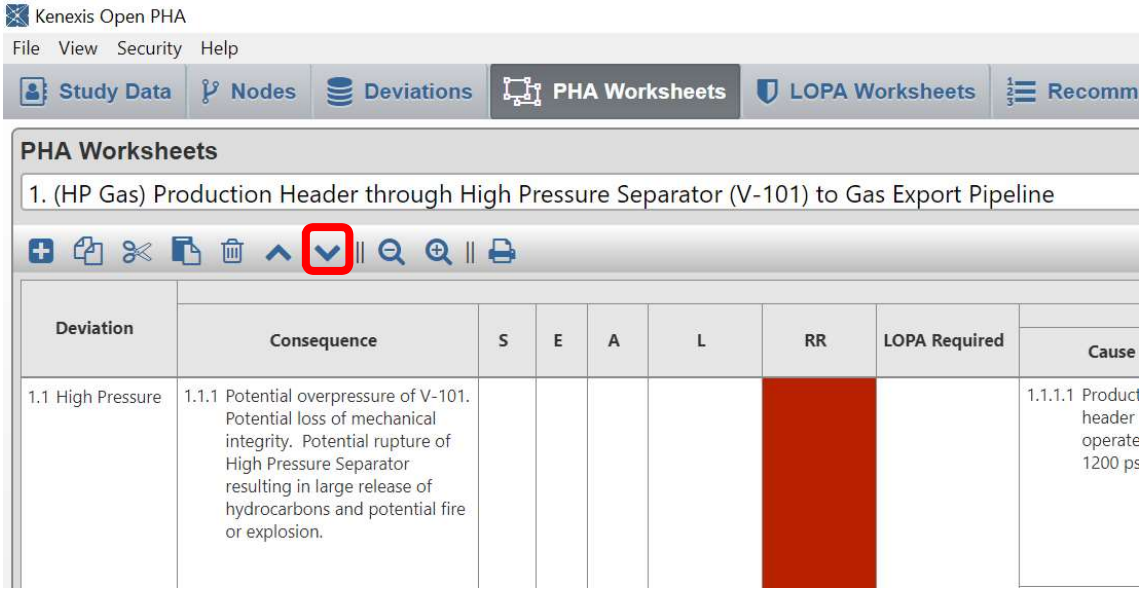
Rows in a table can be moved up by clicking on the “Move Row Up” button located at the top left corner of the table, above the headers as shown below. This moves the selected row up.



3.1.1.7 Moving Rows Down in a Table

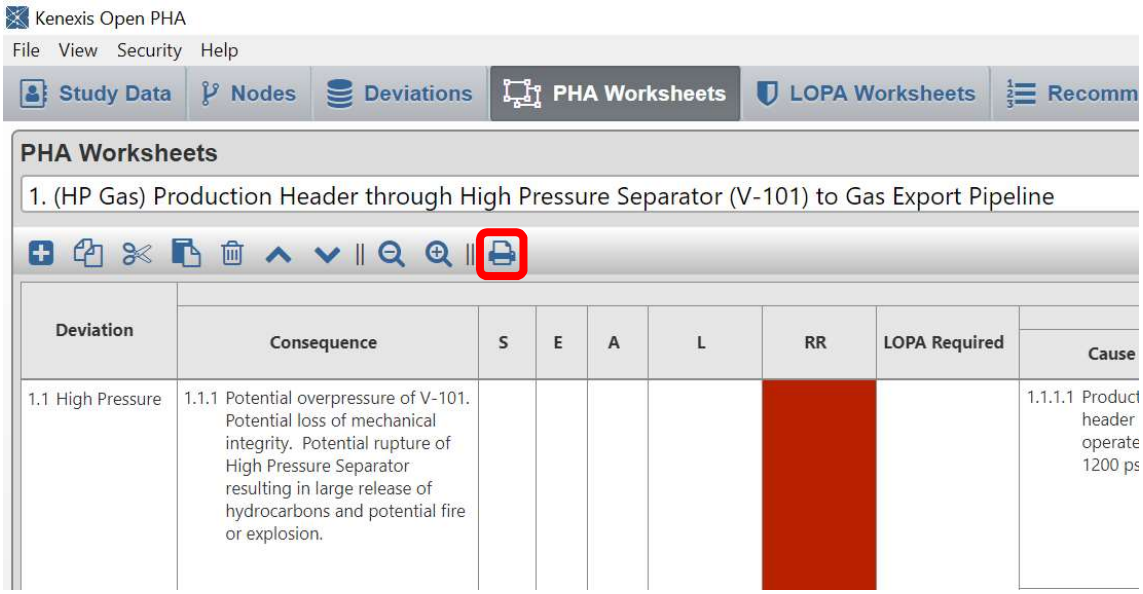
Rows in a table can be moved down by clicking on the “Move Row Down” button located at the top left corner of the table, above the headers as shown below. This moves the selected row down.

Section 3 – Workspace



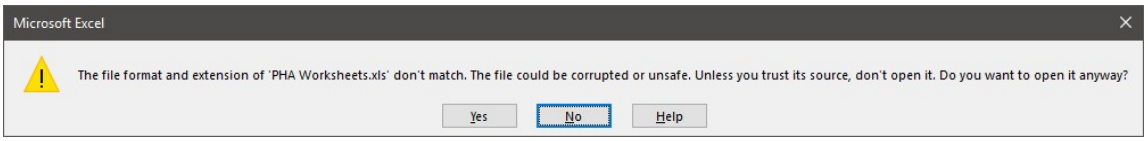
3.1.1.8 Exporting to Excel

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.



Section 3 – Workspace

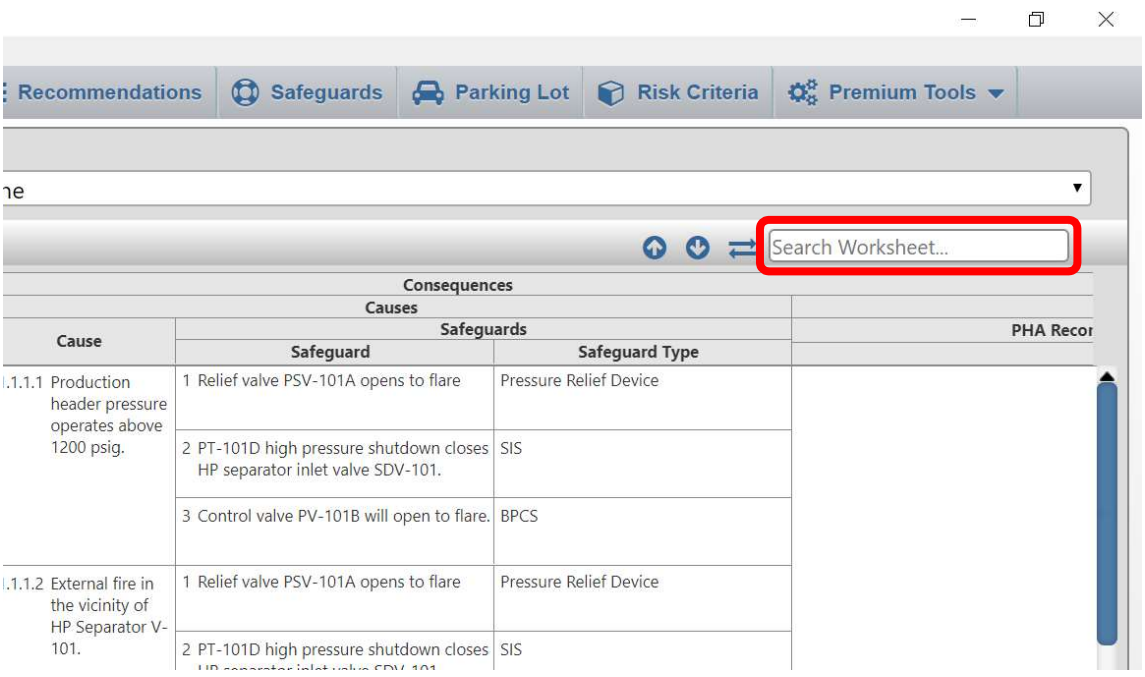
When opening files generated with the excel export tool you may receive messages from your spreadsheet application about the file format and extension of the file being opened, similar to the message shown below.



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.

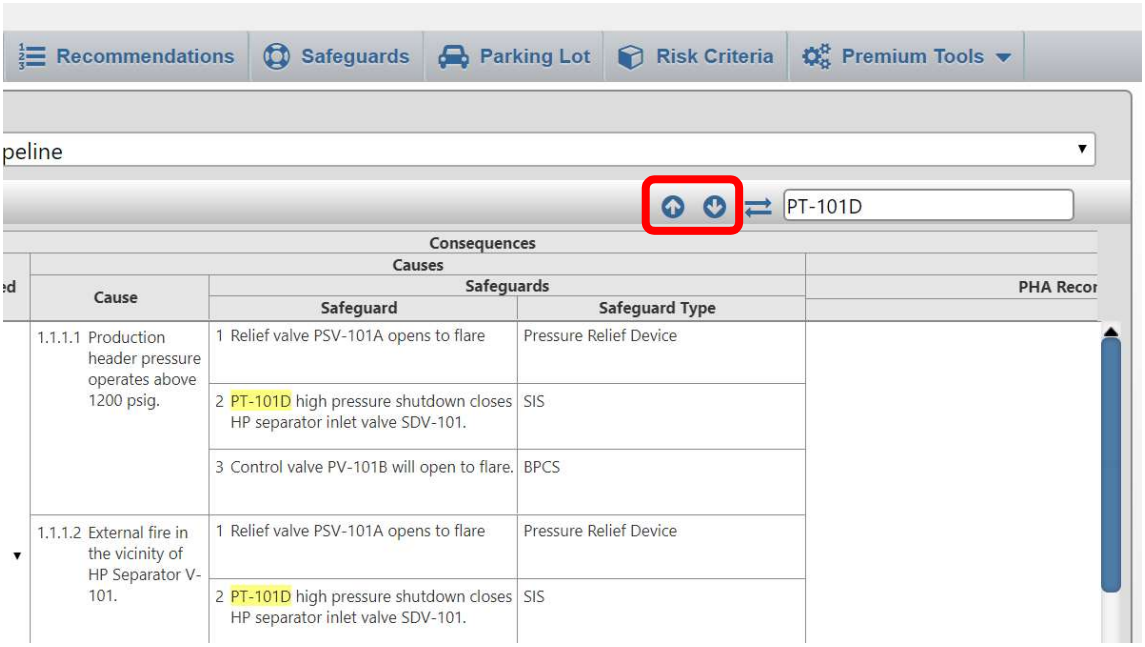
3.1.1.9 Searching a Table

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.

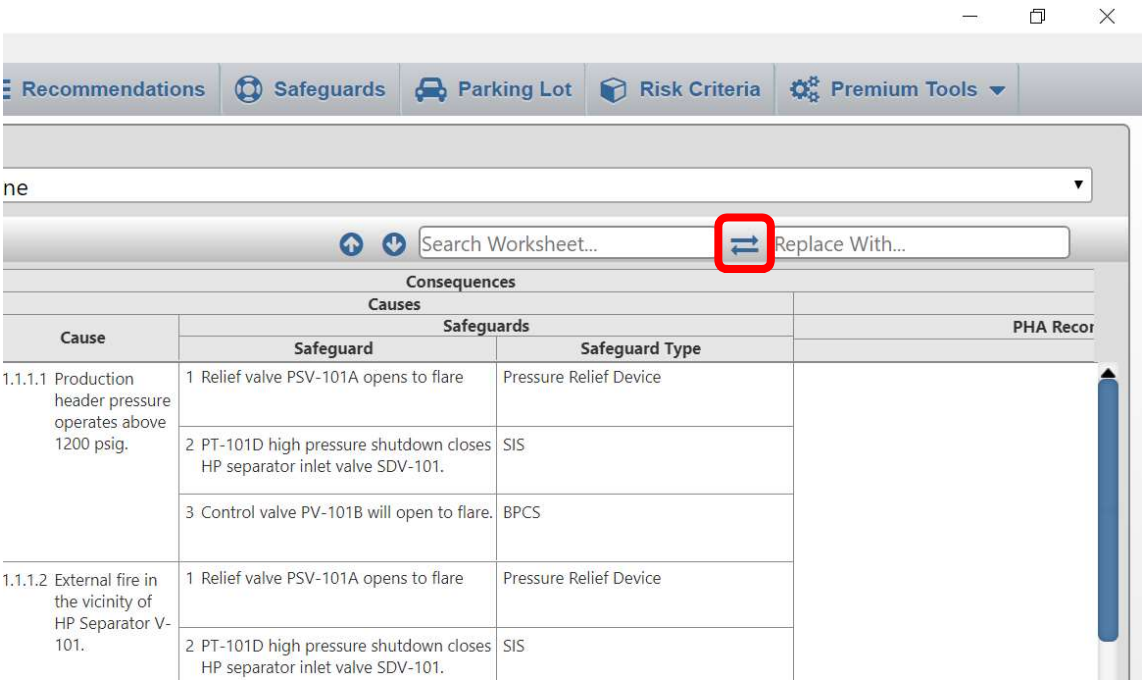


When the search results in a hit, the searched text will be highlighted in the table. Additionally, the search function features buttons to find and jump to search hits.

Section 3 – Workspace



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.



Section 4 - PHA / LOPA

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

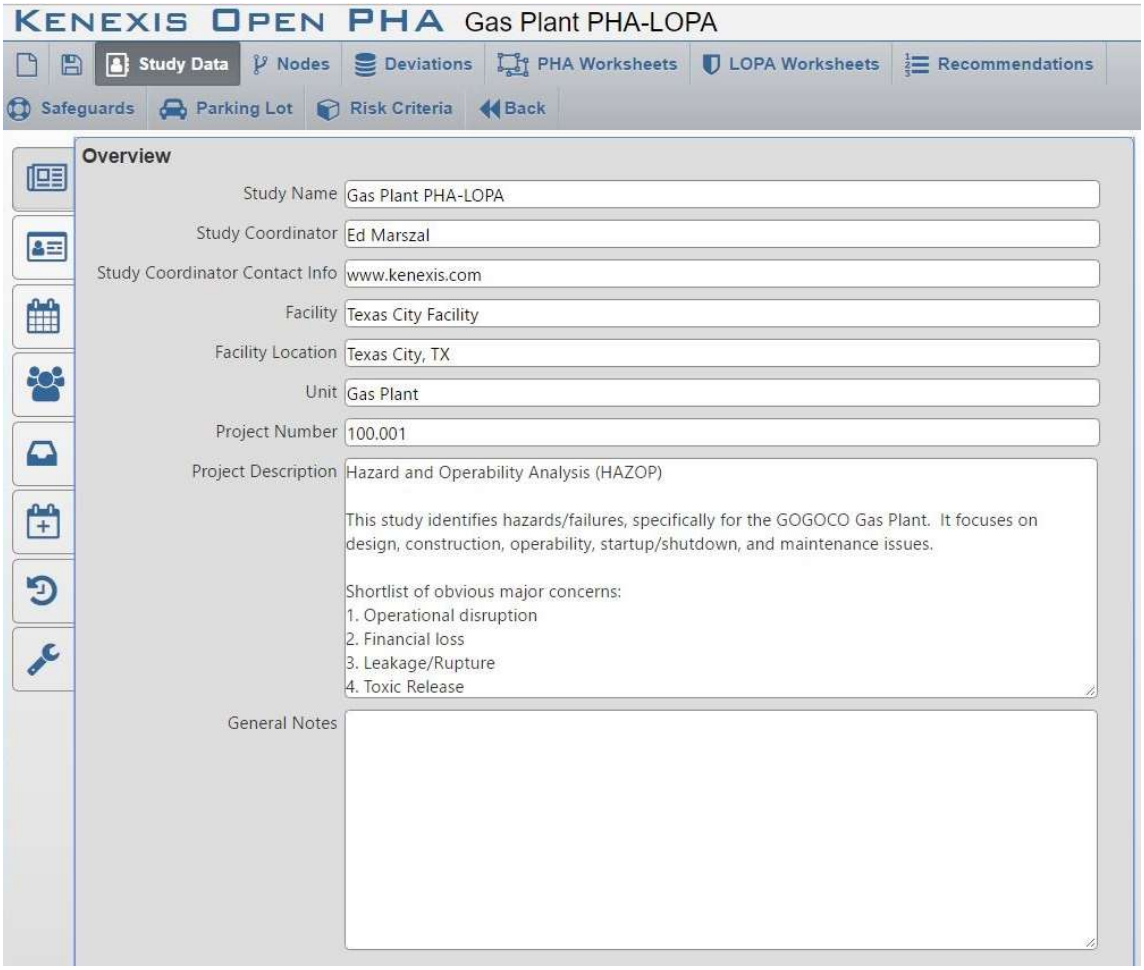
The table below consists of the pages that make up the Study Data tab, as well as a short description of each page.

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.
	The Revision History page contains a table to keep track of revisions
	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.

Section 4 - PHA / LOPA

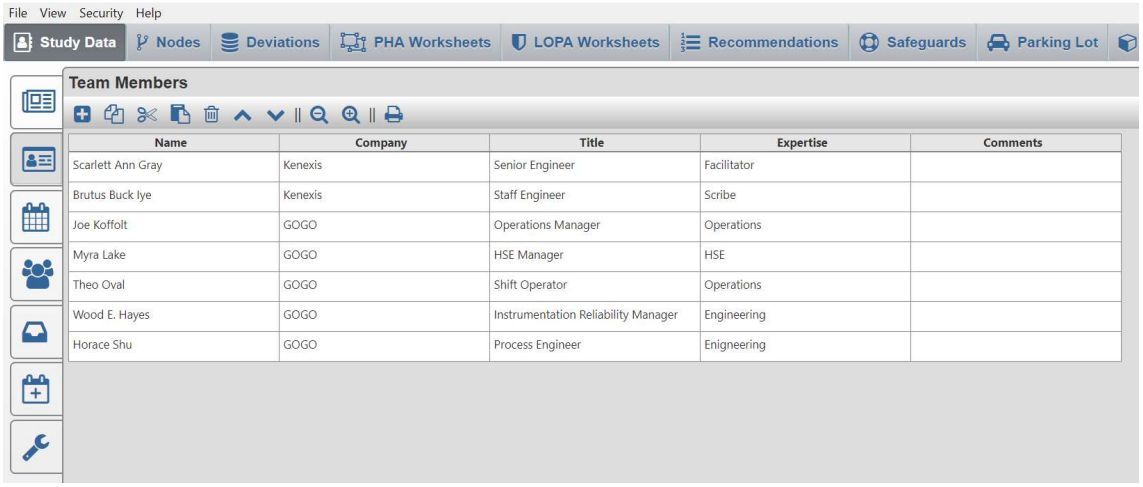


PHA / LOPA

Section 4 - PHA / LOPA

4.1.3 Team Members Page

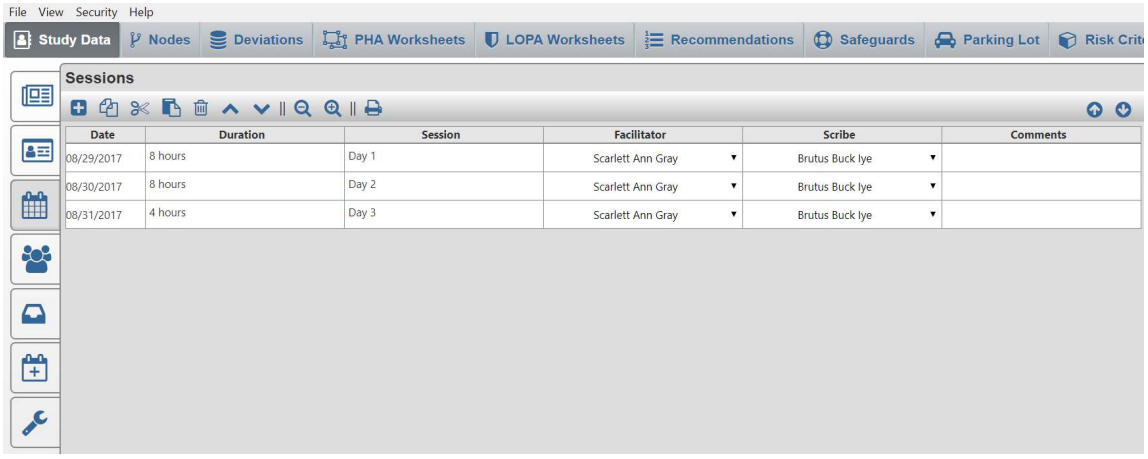
The Team Members page contains a table to record the meetings participants, as well as information about them, such as company, expertise, and contact info.



Name	Company	Title	Expertise	Comments
Scarlett Ann Gray	Kenexis	Senior Engineer	Facilitator	
Brutus Buck Iye	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	

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.

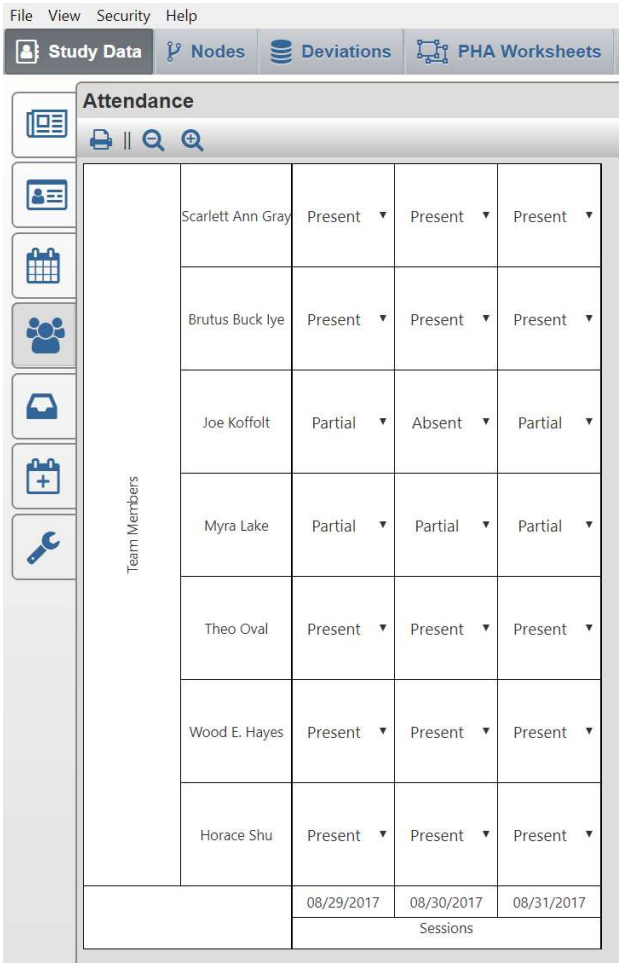


Date	Duration	Session	Facilitator	Scribe	Comments
08/29/2017	8 hours	Day 1	Scarlett Ann Gray	Brutus Buck Iye	
08/30/2017	8 hours	Day 2	Scarlett Ann Gray	Brutus Buck Iye	
08/31/2017	4 hours	Day 3	Scarlett Ann Gray	Brutus Buck Iye	

Section 4 - PHA / LOPA

4.1.5 Attendance Page

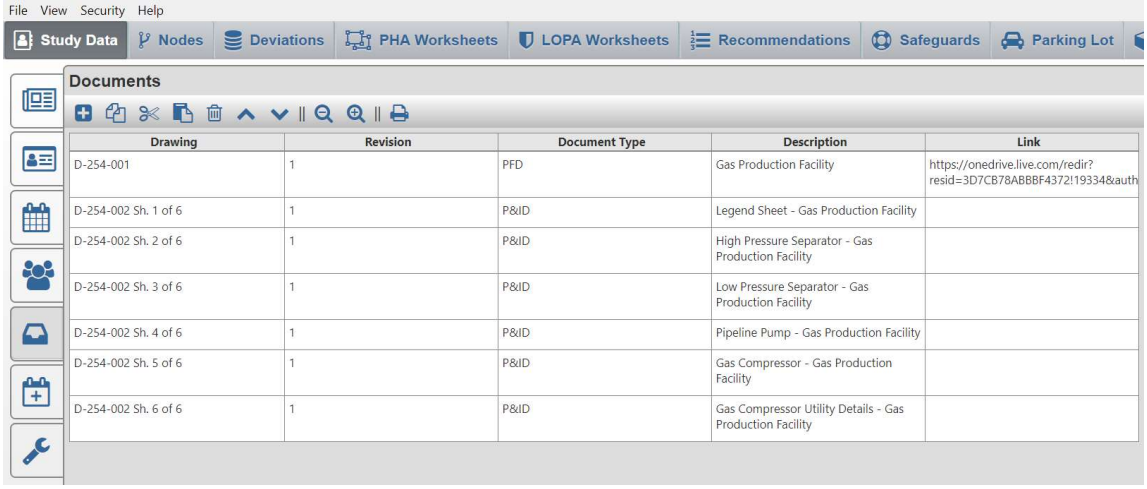
The Attendance page (shown below) displays a grid to keep track of which participants were present during the sessions. Each participant can be marked as Absent, Partial, or Present for each session.



Section 4 - PHA / LOPA

4.1.6 Documents Page

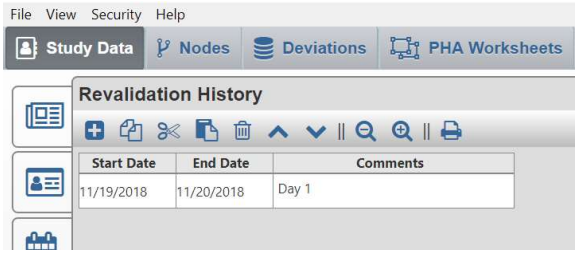
The Documents page contains a table to record the documents that were available to the team for the PHA sessions. In this table, you can record document numbers/titles, revision numbers, and descriptions of the documents.



Drawing	Revision	Document Type	Description	Link
D-254-001	1	PFD	Gas Production Facility	https://onedrive.live.com/redir?resid=3D7CB78ABBBF4372!19334&auth
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	

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.

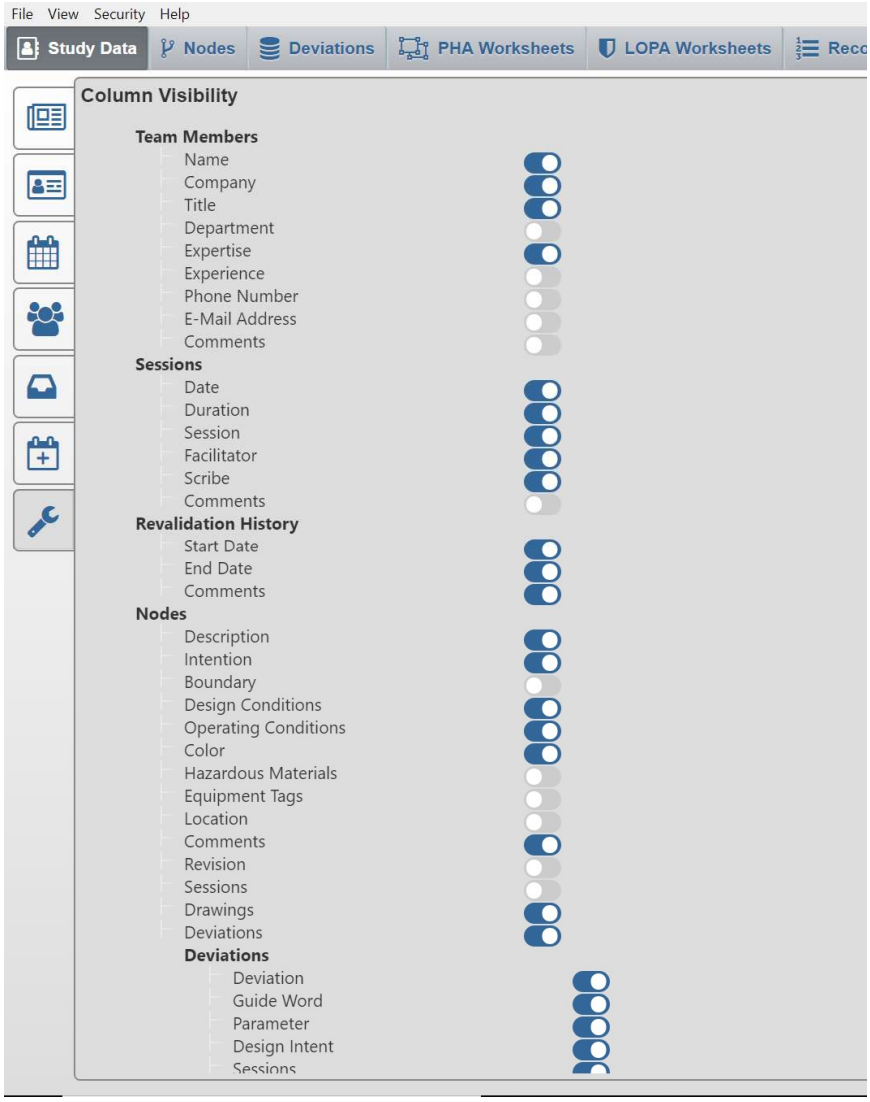


Start Date	End Date	Comments
11/19/2018	11/20/2018	Day 1

Section 4 - PHA / LOPA

4.1.8 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.



Section 4 - PHA / LOPA

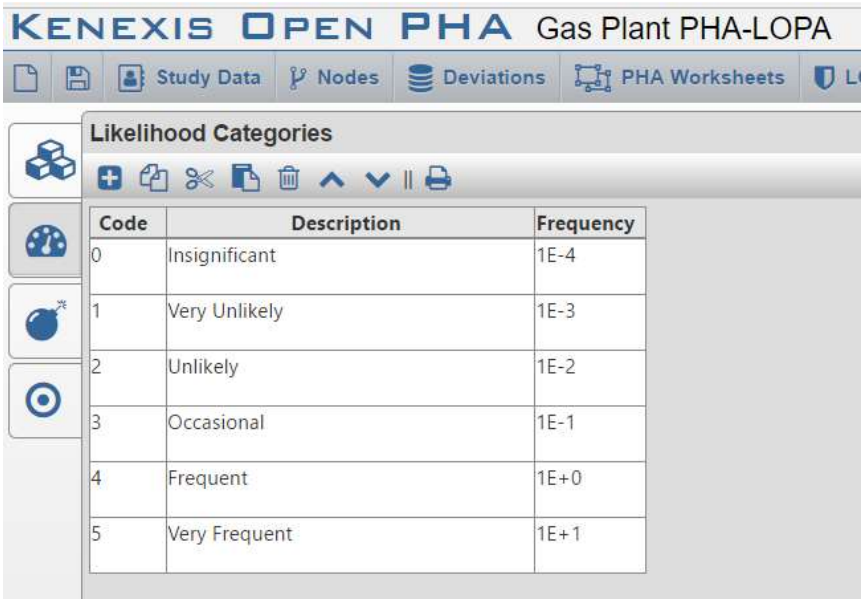
4.2 Risk Criteria

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.

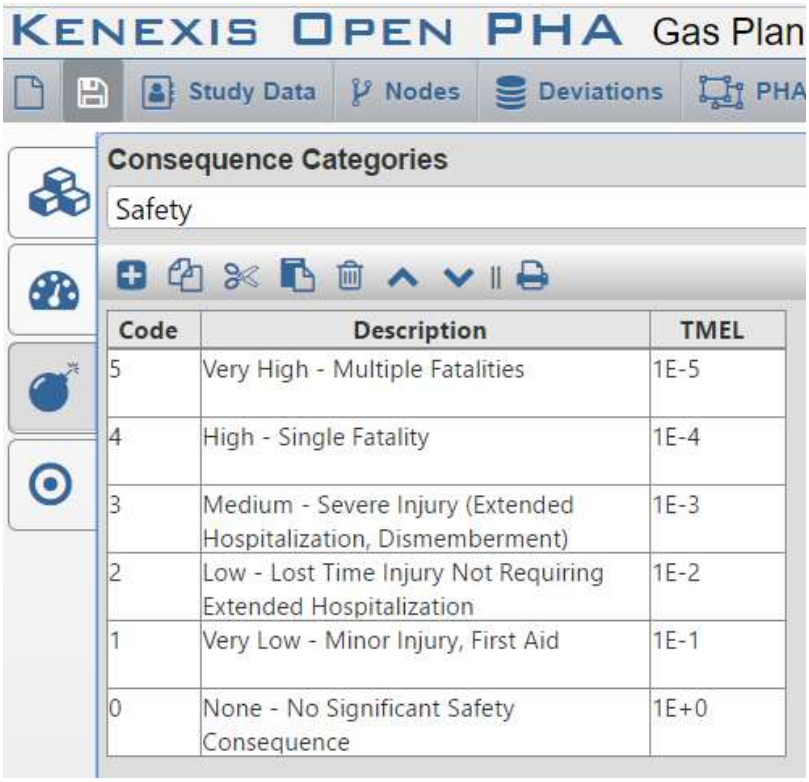


Code	Description	Frequency
0	Insignificant	1E-4
1	Very Unlikely	1E-3
2	Unlikely	1E-2
3	Occasional	1E-1
4	Frequent	1E+0
5	Very Frequent	1E+1

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.

Section 4 - PHA / LOPA



Code	Description	TMEL
5	Very High - Multiple Fatalities	1E-5
4	High - Single Fatality	1E-4
3	Medium - Severe Injury (Extended Hospitalization, Dismemberment)	1E-3
2	Low - Lost Time Injury Not Requiring Extended Hospitalization	1E-2
1	Very Low - Minor Injury, First Aid	1E-1
0	None - No Significant Safety Consequence	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.

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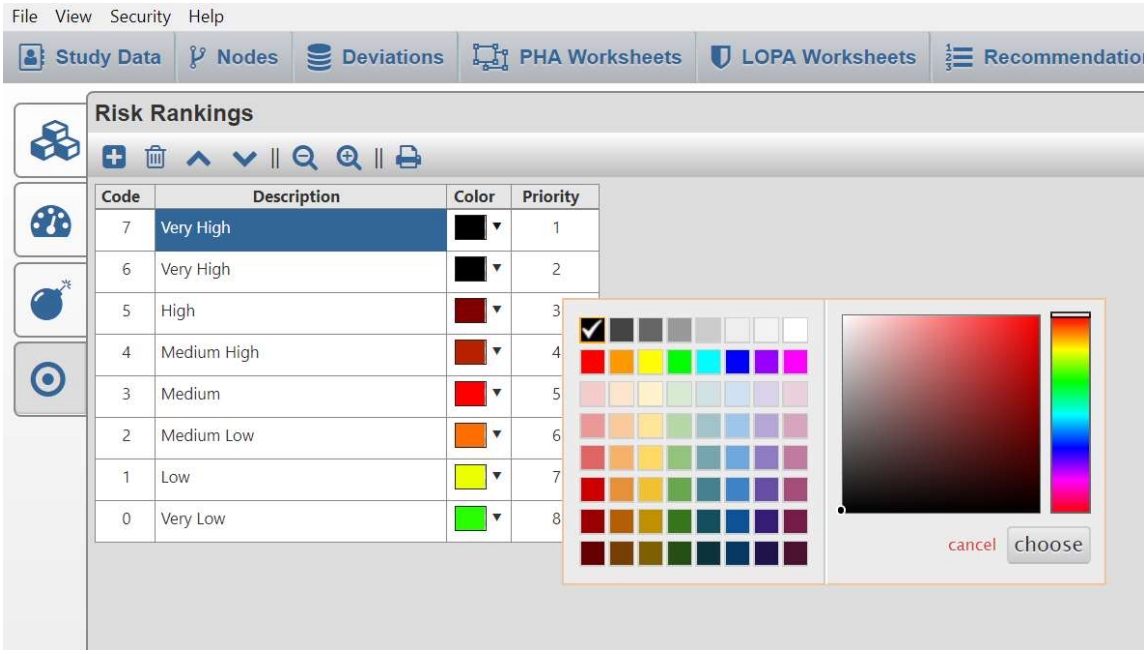
4.2.3 Risk Rankings Page

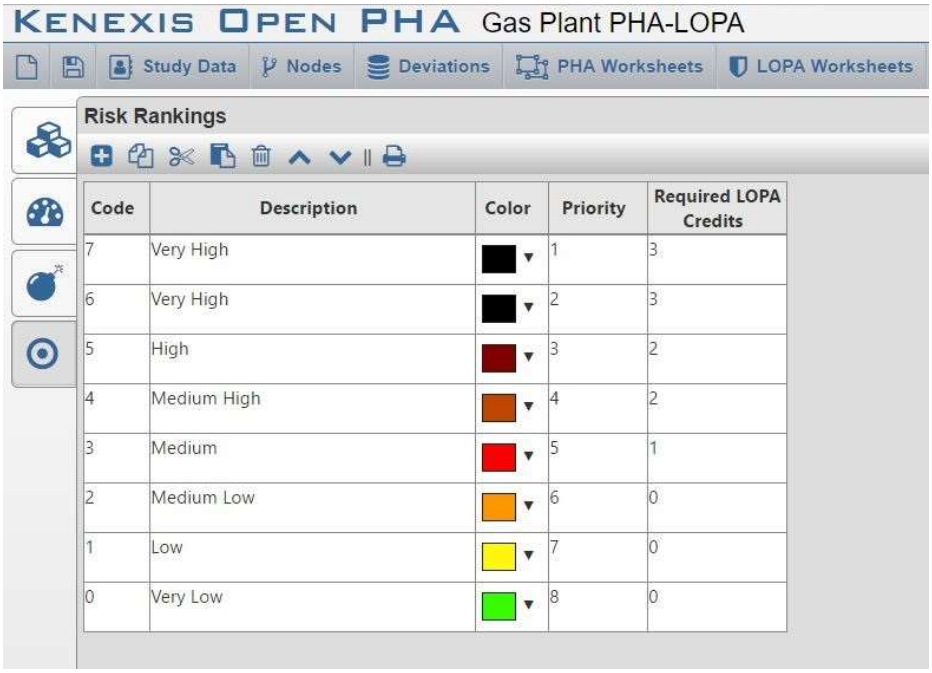
The Risk Rankings Page houses the risk ranking table. This table allows the user to identify, describe and rank risk. Below is an example of the Risk Rankings Page from a study that uses the explicit LOPA method.



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.

Section 4 - PHA / LOPA

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.



Code	Description	Color	Priority	Required LOPA Credits
7	Very High		1	3
6	Very High		2	3
5	High		3	2
4	Medium High		4	2
3	Medium		5	1
2	Medium Low		6	0
1	Low		7	0
0	Very Low		8	0

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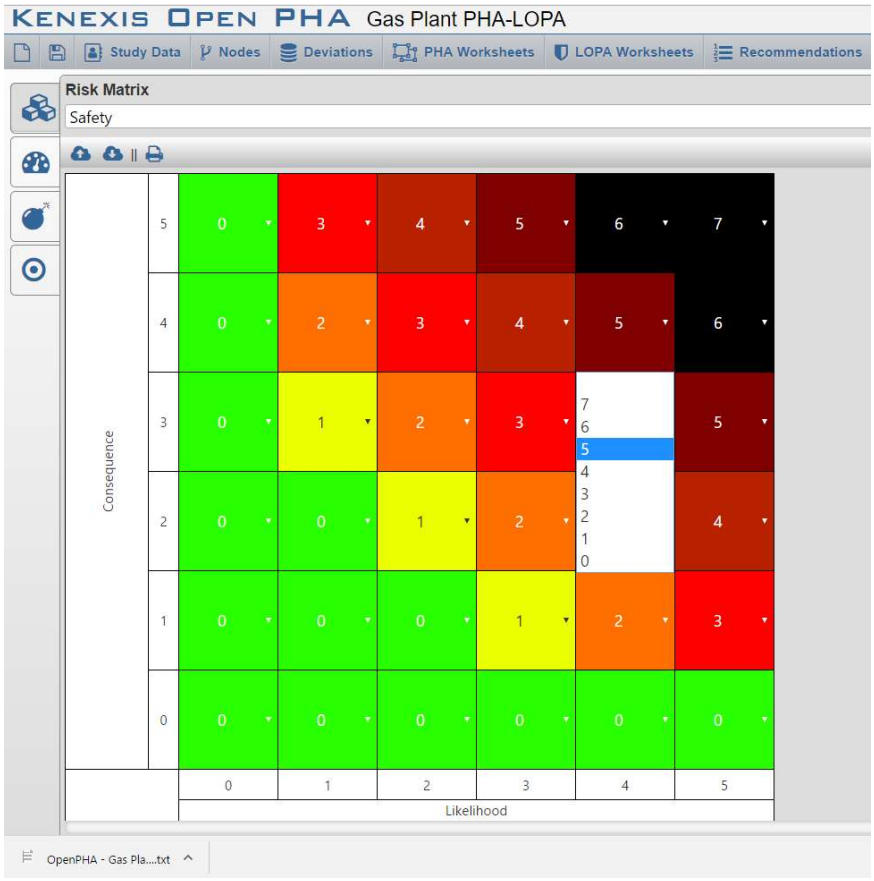
4.2.4 Risk Matrix Page

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.



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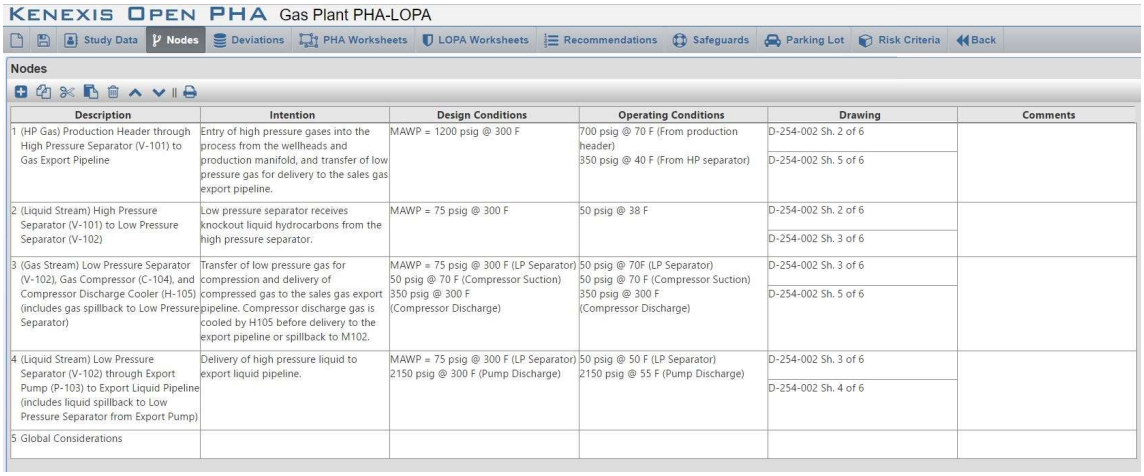
4.3 Nodes

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.


KENEXIS OPEN PHA Gas Plant PHA-LOPA

Study Data | Nodes | Deviations | PHA Worksheets | LOPA Worksheets | Recommendations | Safeguards | Parking Lot | Risk Criteria | Back

Nodes

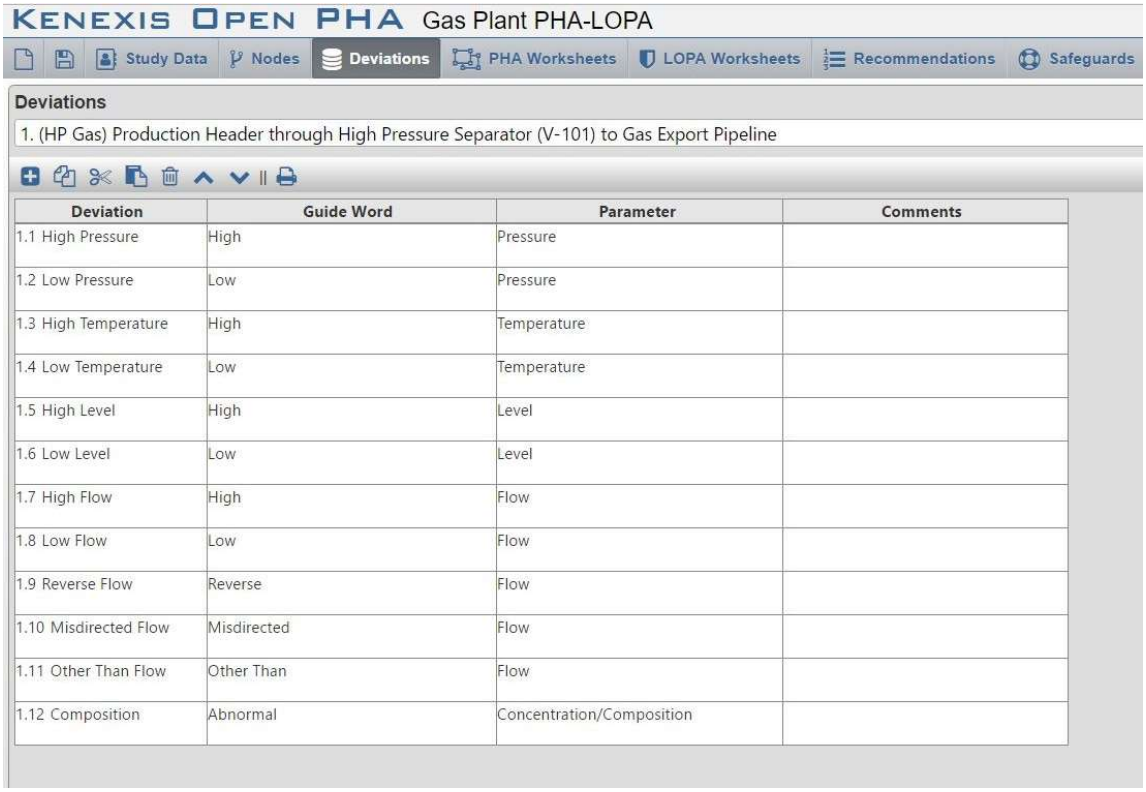
	Description	Intention	Design Conditions	Operating Conditions	Drawing	Comments
1	(HP Gas) Production Header through High Pressure Separator (V-101) to Gas Export Pipeline	Entry of high pressure gases into the process from the wellheads and production manifold, and transfer of low pressure gas for delivery to the sales gas export pipeline.	MAWP = 1200 psig @ 300 F	700 psig @ 70 F (From production header) 350 psig @ 40 F (From HP separator)	D-254-002 Sh. 2 of 6 D-254-002 Sh. 5 of 6	
2	(Liquid Stream) High Pressure Separator (V-101) to Low Pressure Separator (V-102)	Low pressure separator receives knockout liquid hydrocarbons from the high pressure separator.	MAWP = 75 psig @ 300 F	50 psig @ 38 F	D-254-002 Sh. 2 of 6 D-254-002 Sh. 3 of 6	
3	(Gas Stream) Low Pressure Separator (V-102), Gas Compressor (C-104), and Compressor Discharge Cooler (H-105) (includes gas spillback to Low Pressure Separator)	Transfer of low pressure gas for compression and delivery of 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.	MAWP = 75 psig @ 300 F (LP Separator) 50 psig @ 70 F (Compressor Suction) 350 psig @ 300 F (Compressor Discharge)	50 psig @ 70F (LP Separator) 50 psig @ 70 F (Compressor Suction) 350 psig @ 300 F (Compressor Discharge)	D-254-002 Sh. 3 of 6 D-254-002 Sh. 5 of 6	
4	(Liquid Stream) Low Pressure Separator (V-102) through Export Pump (P-103) to Export Liquid Pipeline (includes liquid spillback to Low Pressure Separator from Export Pump)	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 F (Pump Discharge)	D-254-002 Sh. 3 of 6 D-254-002 Sh. 4 of 6	
5	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.

Section 4 - PHA / LOPA



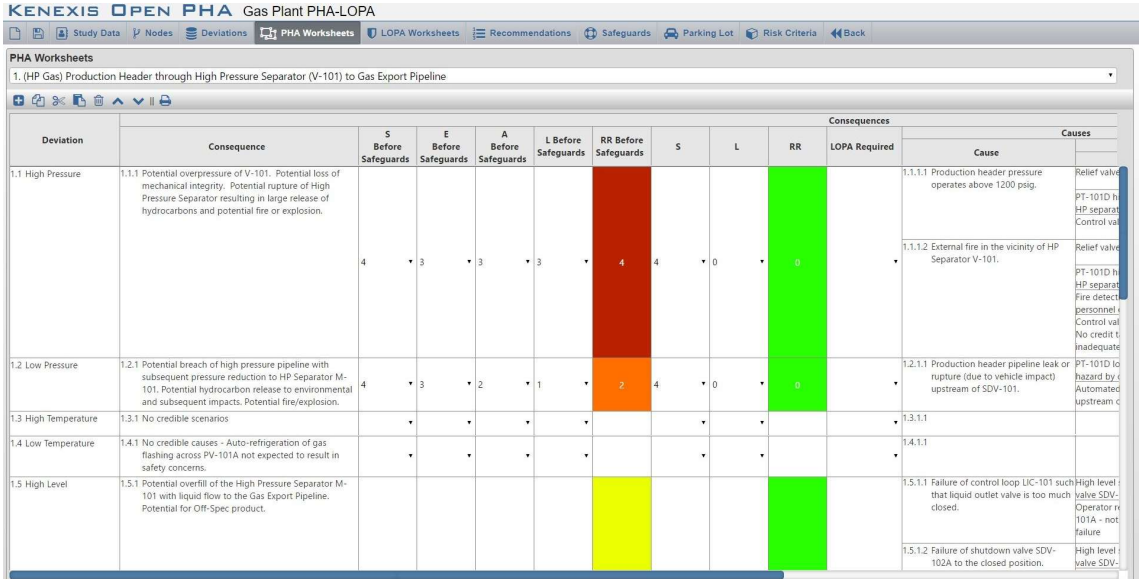
Deviation	Guide Word	Parameter	Comments
1.1 High Pressure	High	Pressure	
1.2 Low Pressure	Low	Pressure	
1.3 High Temperature	High	Temperature	
1.4 Low Temperature	Low	Temperature	
1.5 High Level	High	Level	
1.6 Low Level	Low	Level	
1.7 High Flow	High	Flow	
1.8 Low Flow	Low	Flow	
1.9 Reverse Flow	Reverse	Flow	
1.10 Misdirected Flow	Misdirected	Flow	
1.11 Other Than Flow	Other Than	Flow	
1.12 Composition	Abnormal	Concentration/Composition	

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.

Section 4 - PHA / LOPA



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.

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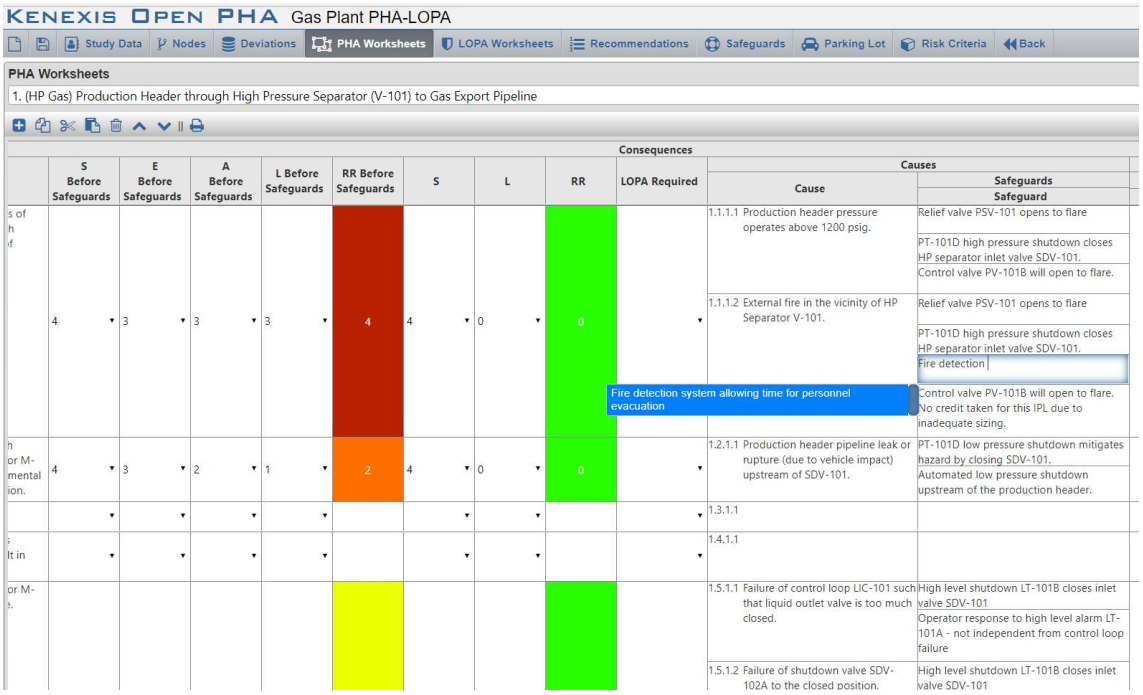
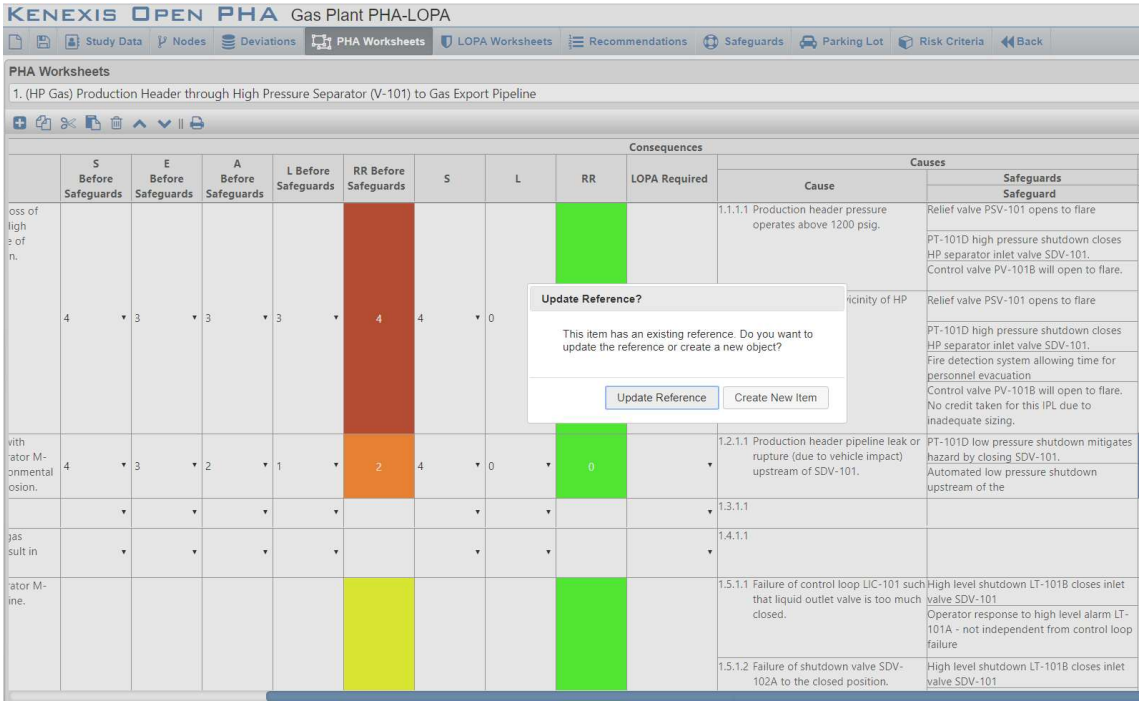


p



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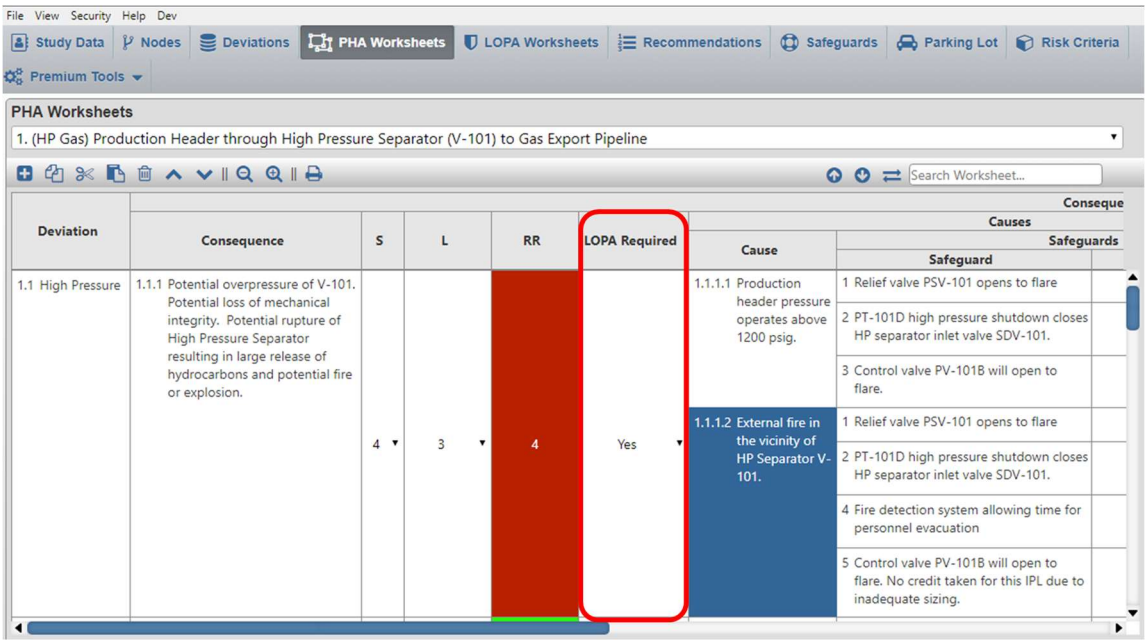
4.6 LOPA Worksheets

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

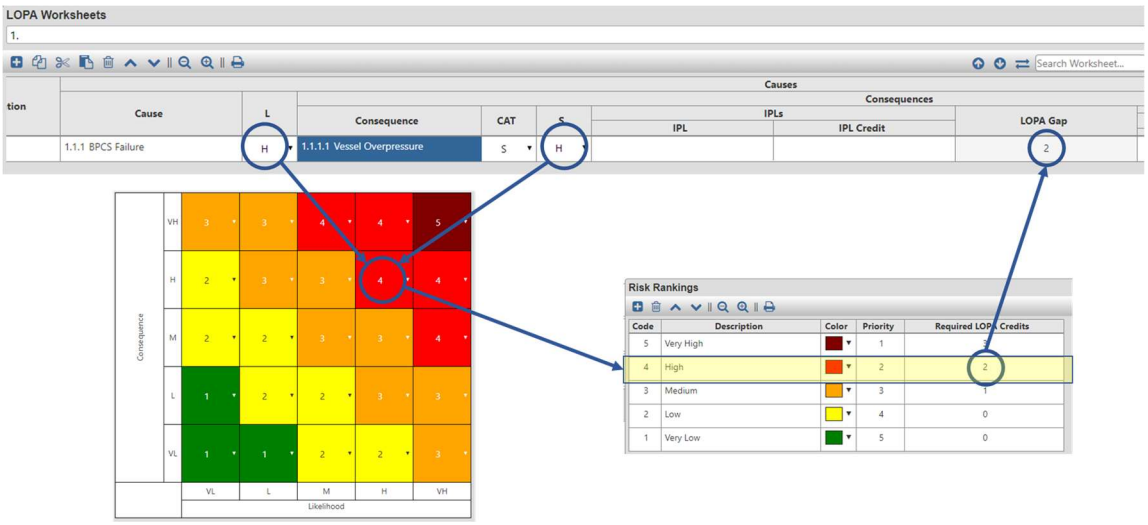
When creating a new Open PHA study you are prompted to select a LOPA style. The options include Implicit and Explicit.

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

Section 4 - PHA / LOPA

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.

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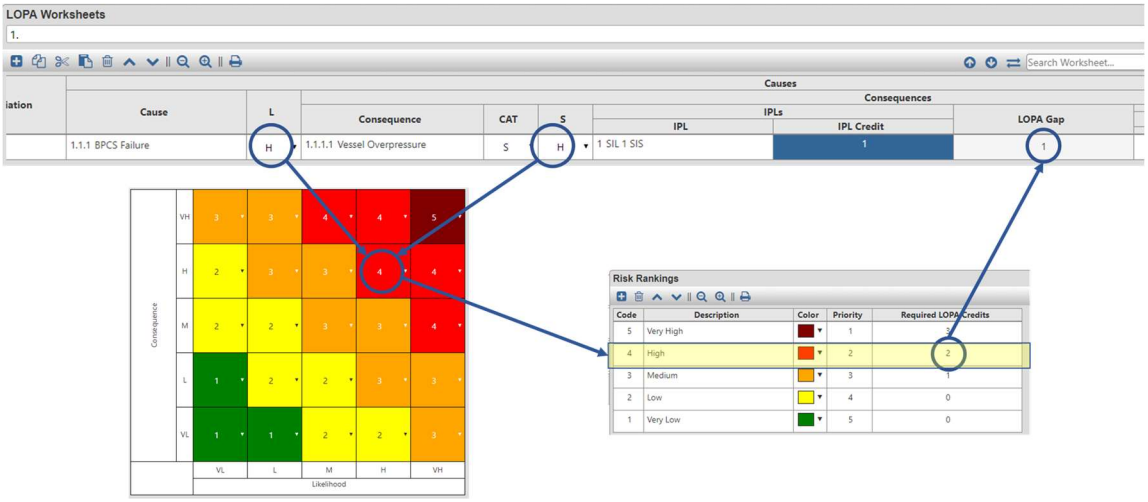
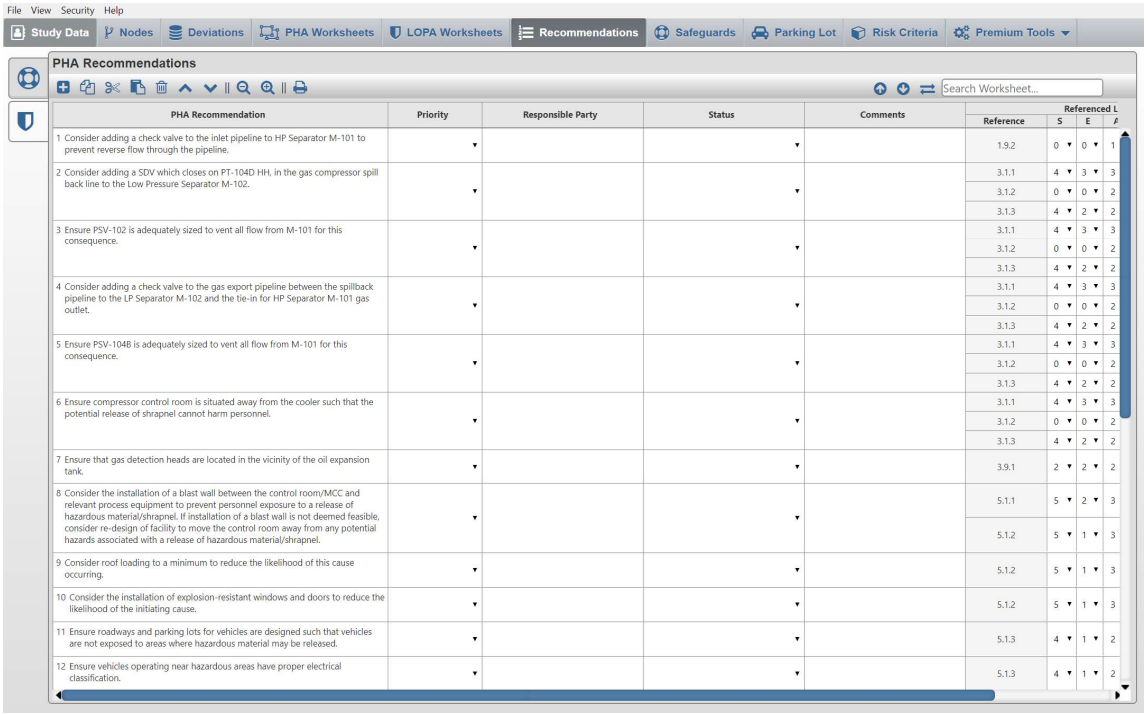


4.7 Recommendations

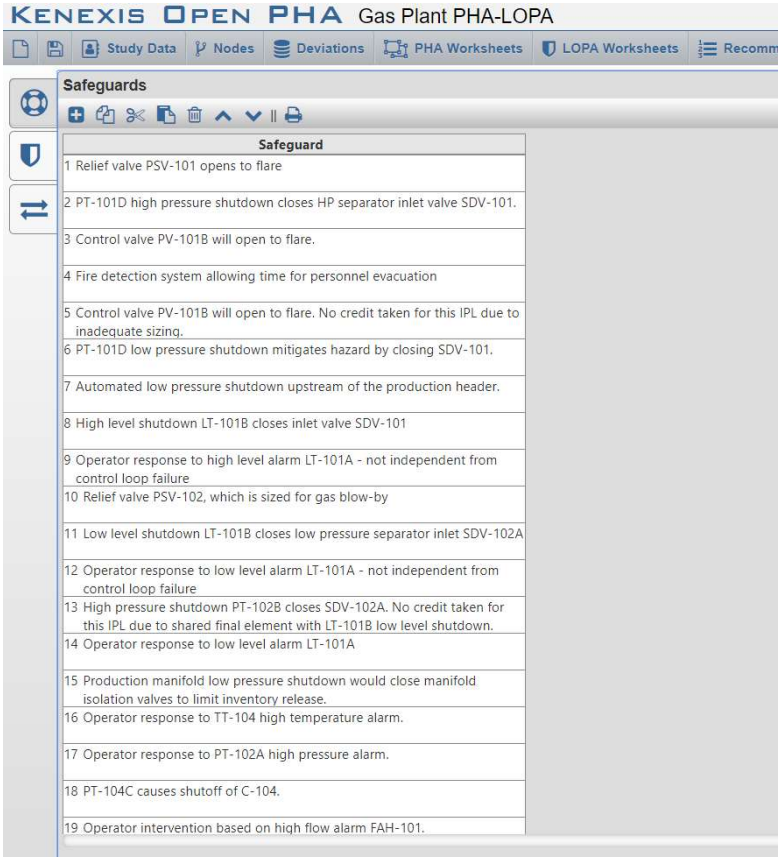
The Recommendations tab contains a table that is used to keep track of the recommendations that were made throughout the course of the study. This table helps to manage the recommendations by allowing you to designate the priority which should be placed on the recommendation, the responsible party, the status of the recommendation, and a reference for the recommendation to help track down the recommendation within the study.



Section 4 - PHA / LOPA

4.8 Safeguards

Safeguards entered in the Safeguards column of the PHA Worksheet will also exist in the Safeguard table within the Safeguards Tab. Each time a different safeguard is put into the worksheet, an entry is also created in this table. The Safeguards tab contains a list of both safeguards used in the PHA, and IPL safeguards used in the LOPA. 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.



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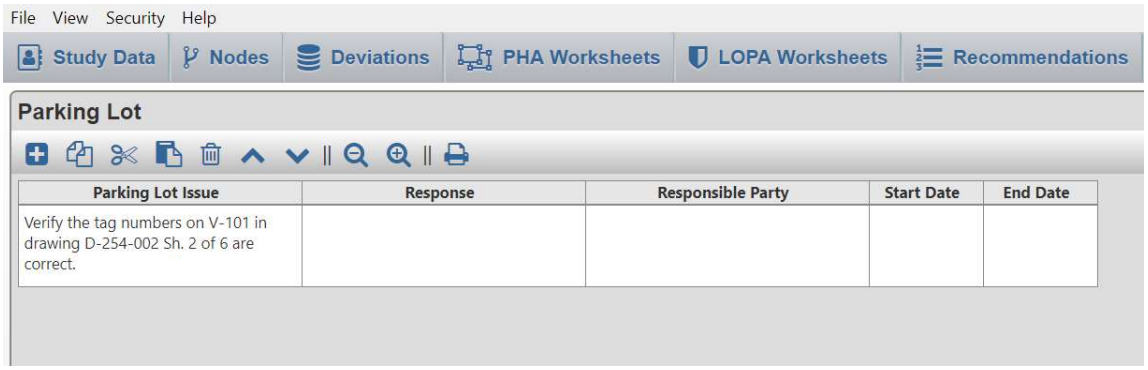
4.9 Parking Lot

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.



Section 5 - Premium Features

PREMIUM FEATURES

5.1 Premium Features Overview

This section of the user's manual is dedicated to premium features which are only available in Open PHA 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 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 https://kiss.kenexis.com. This will navigate your browser to the KISS login page, shown below.

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 support@kenexis.com 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.

Section 5 - Premium Features

5.2 Importing and Exporting Studies in Open PHA Premium

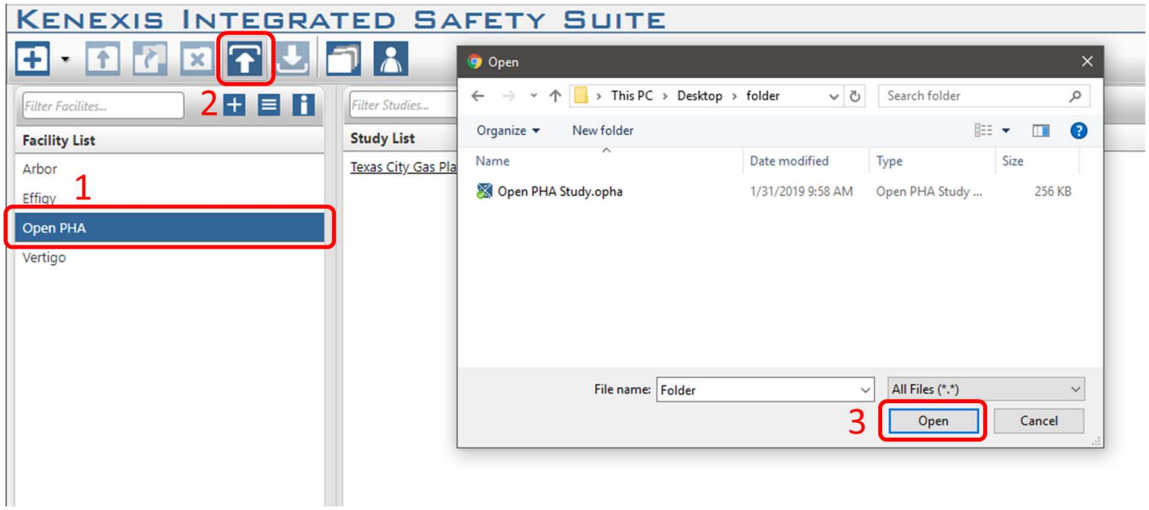
The Open PHA desktop edition and Open PHA Premium are designed to work in tandem. The Open PHA desktop edition gives you the ability to work with Open PHA studies without an internet connection. This is particularly useful when facilitation of PHA studies takes you to places where internet connection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



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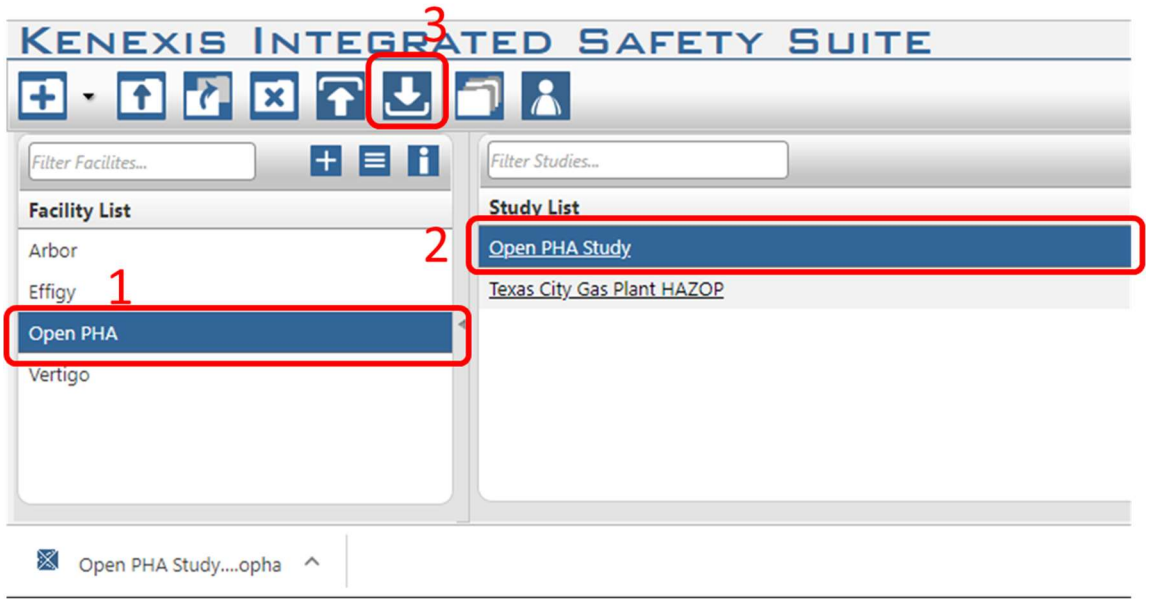
The process can be reversed using the export study tool allowing you to move your study from Open PHA Premium to a file stored locally on your computer which can be opened with the Open PHA desktop edition.

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.

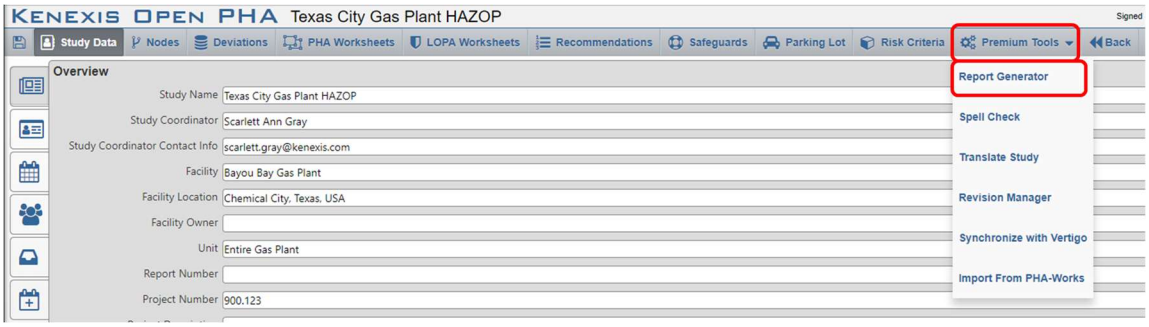


Section 5 - Premium Features

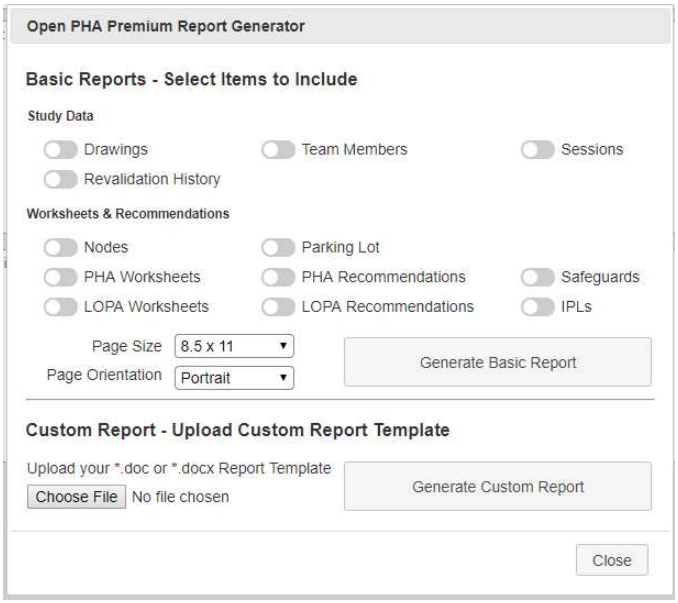
5.3 Premium Report Generation

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.



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



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

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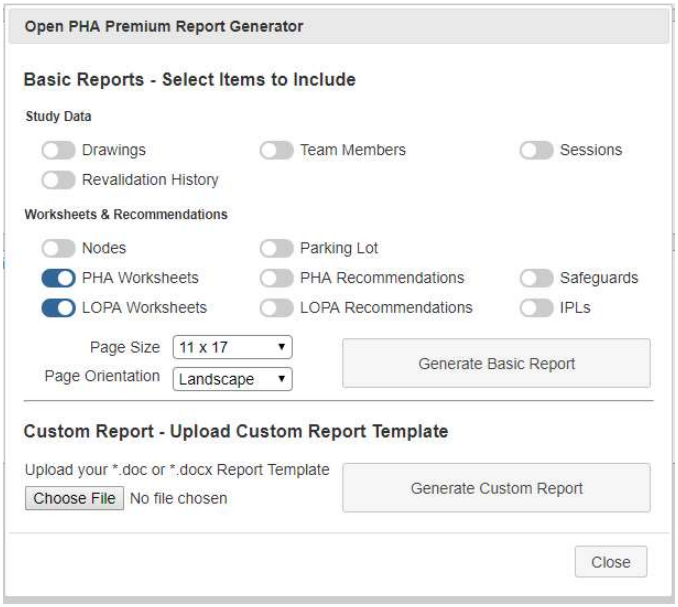
5.3.1 Generating a Basic Report

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.



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

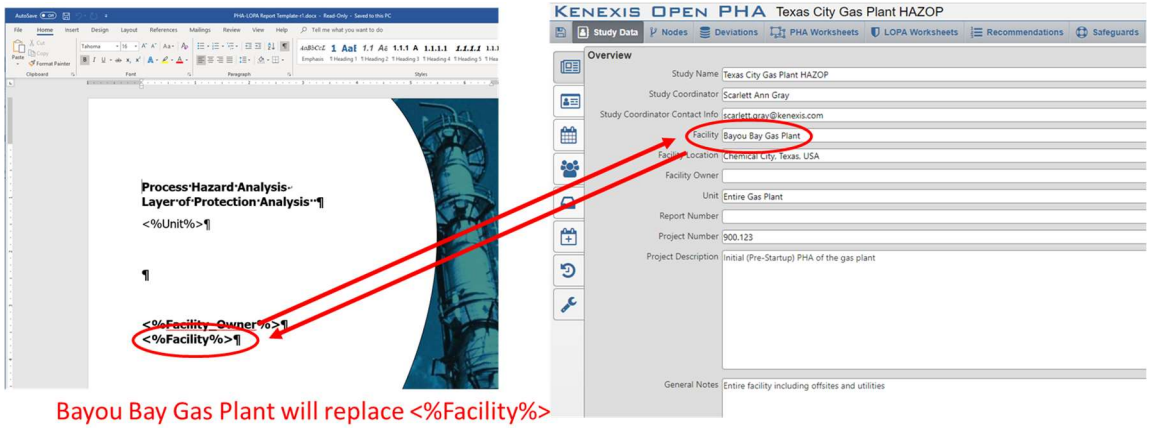
Section 5 - Premium Features

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.



Bayou Bay Gas Plant will replace <%Facility%>

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.

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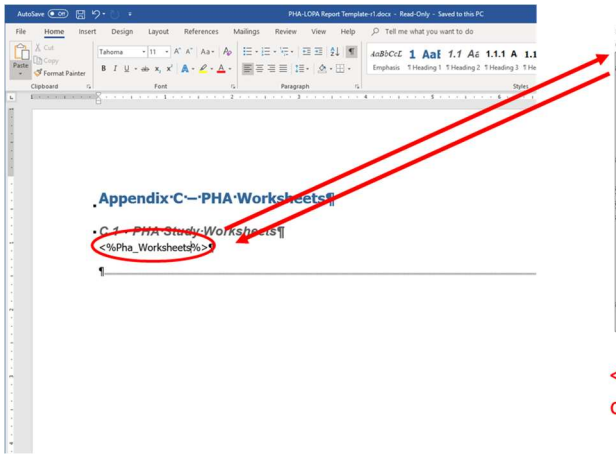

<%Pha_Worksheets%> will be replaced by one or more PHA Worksheet tables.

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.

PREMIUM FEATURES

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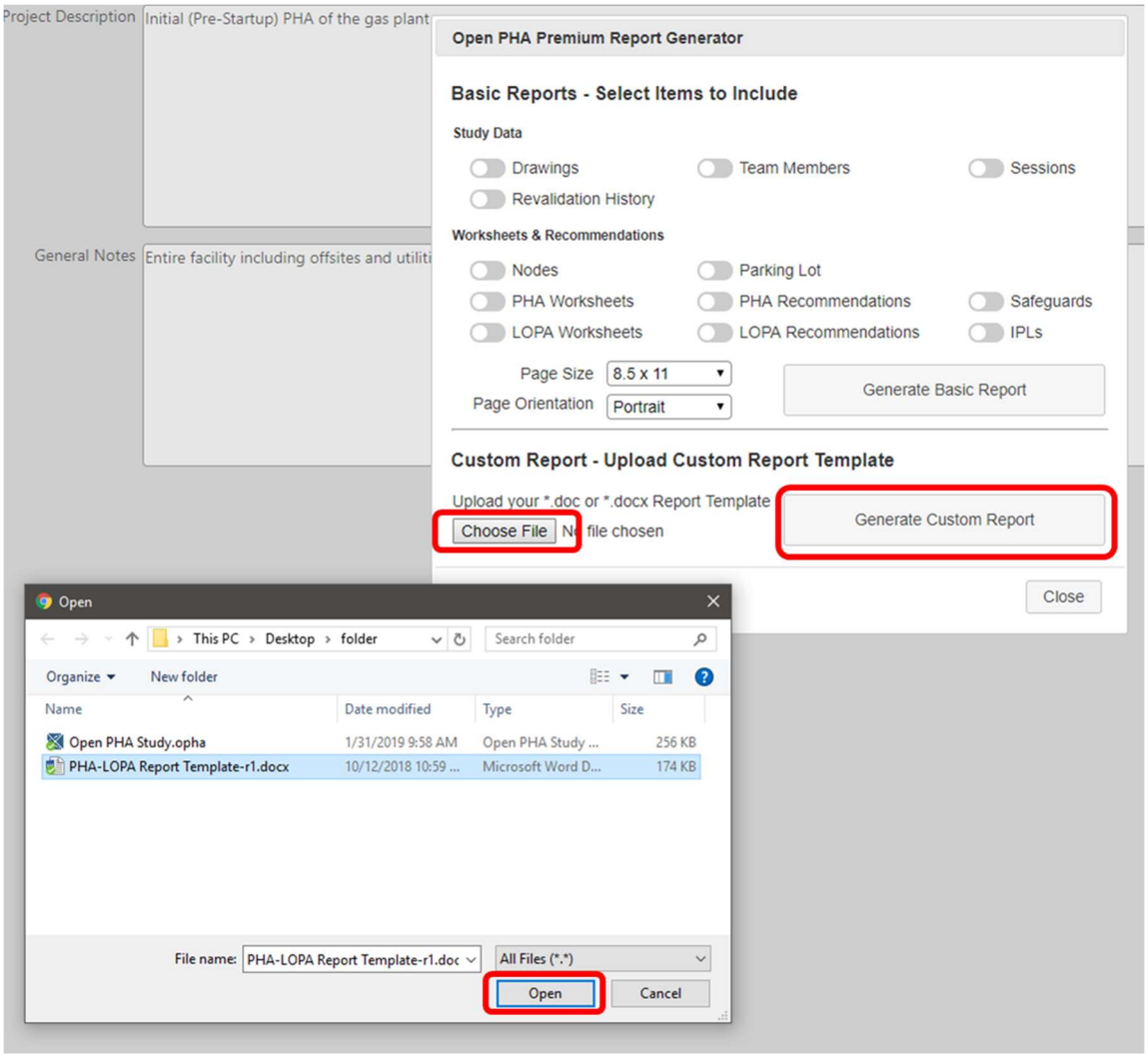

PREMIUM FEATURES

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.

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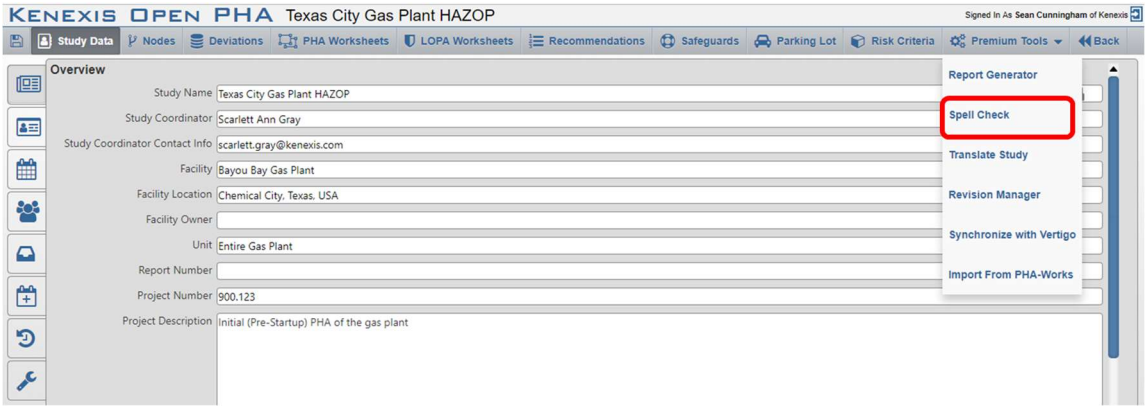
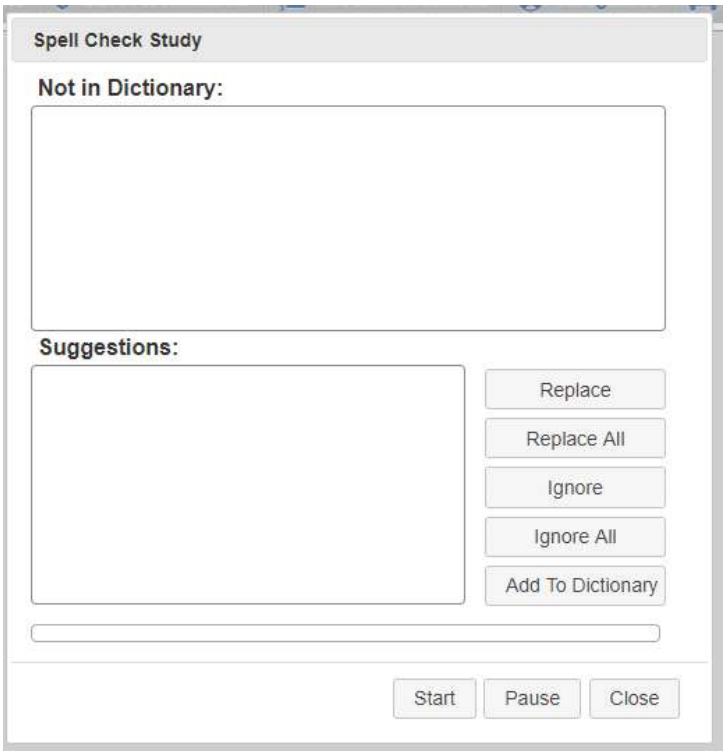


You be presented with the following window. Click start to begin spell checking the study. The spell-checker will review the entire study, not just the visible worksheets.



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.

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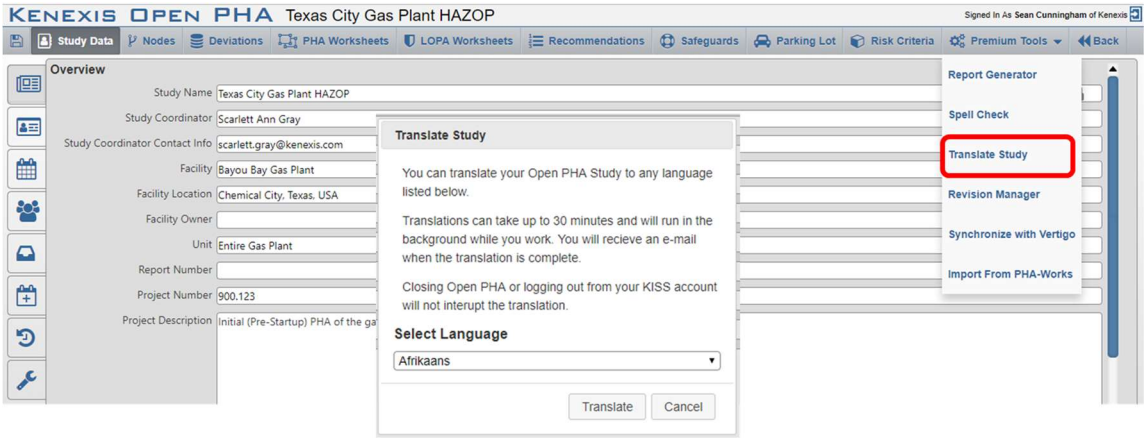
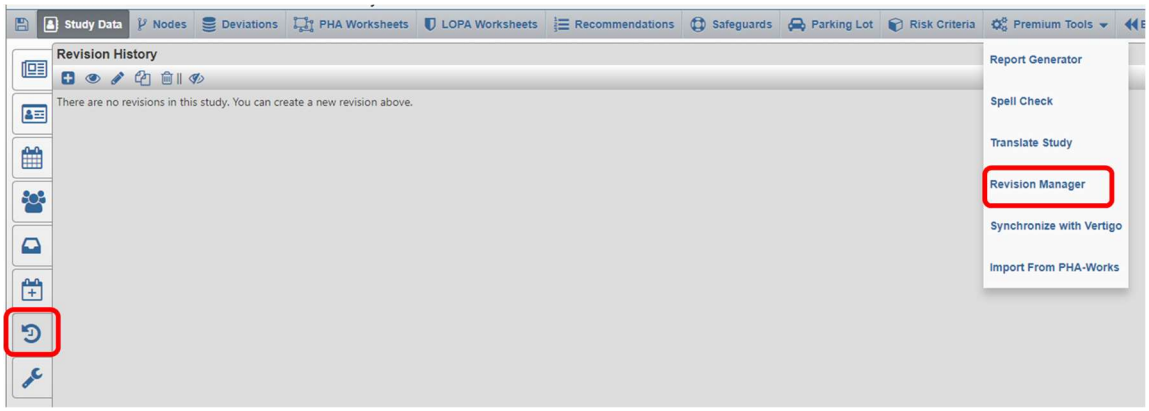


5.5 Revision Management

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.



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.

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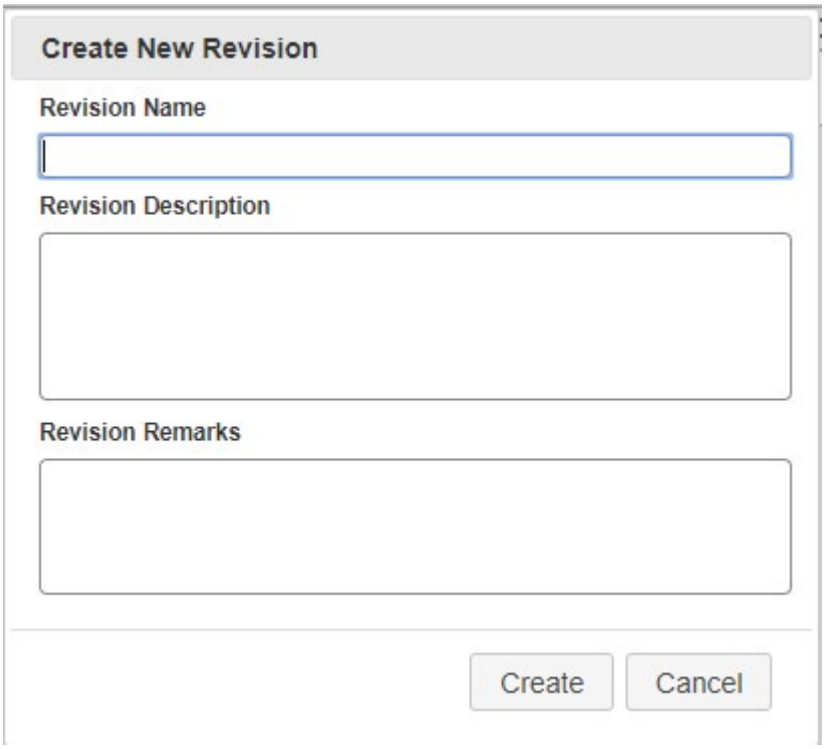
5.5.1 Adding a New Revision

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.



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.

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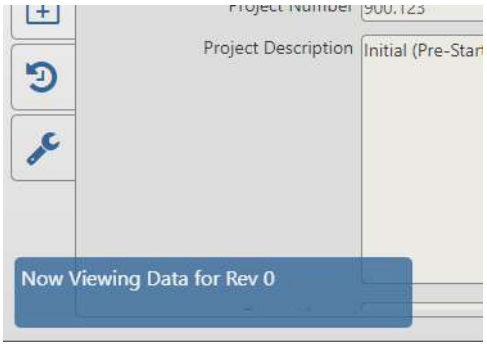


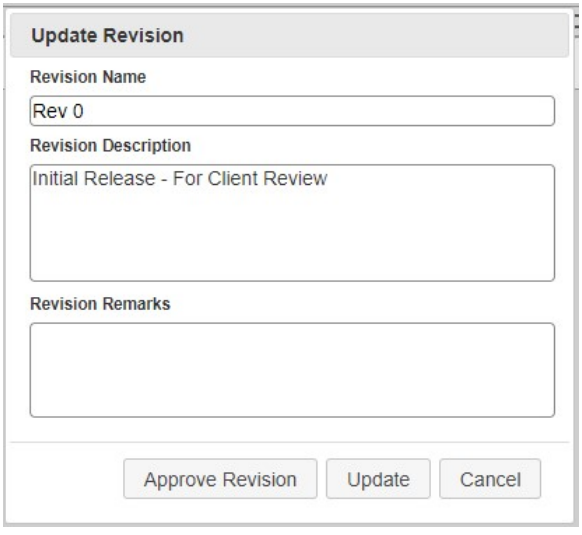
To stop viewing a previous revision and return to the working revision of the current study return to the revision manager and click on the view working draft button shown below.

 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.



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.

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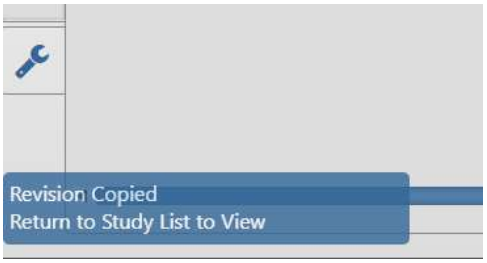
5.5.4 Copying and Deleting Revisions

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

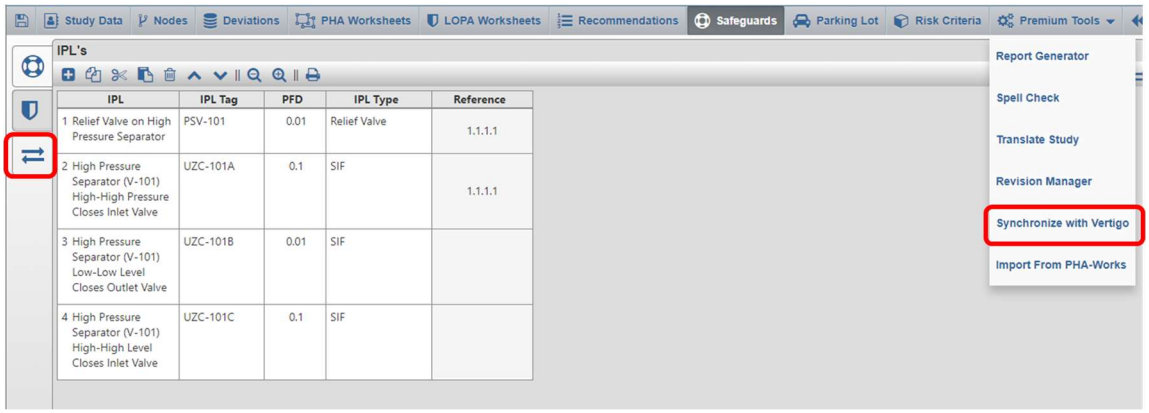
Clicking the delete icon will prompt you to delete the selected revision.

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.



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.



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

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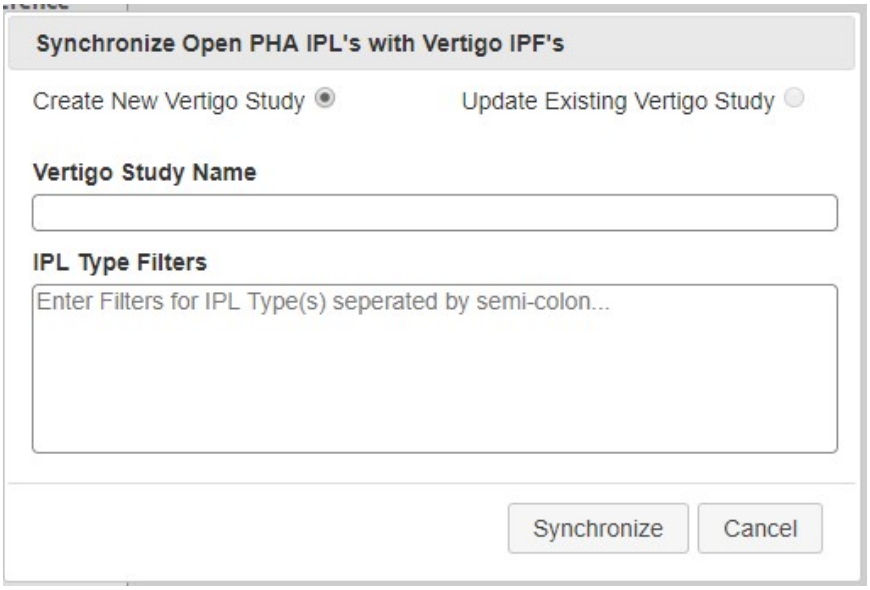


The first time you synchronize Open PHA with a Vertigo study you will need to create a new Vertigo Study as part of the synchronization. Once you Open PHA study is synchronized with an existing Vertigo study you will have the option to update that synchronized study with the current data in Open PHA.

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.

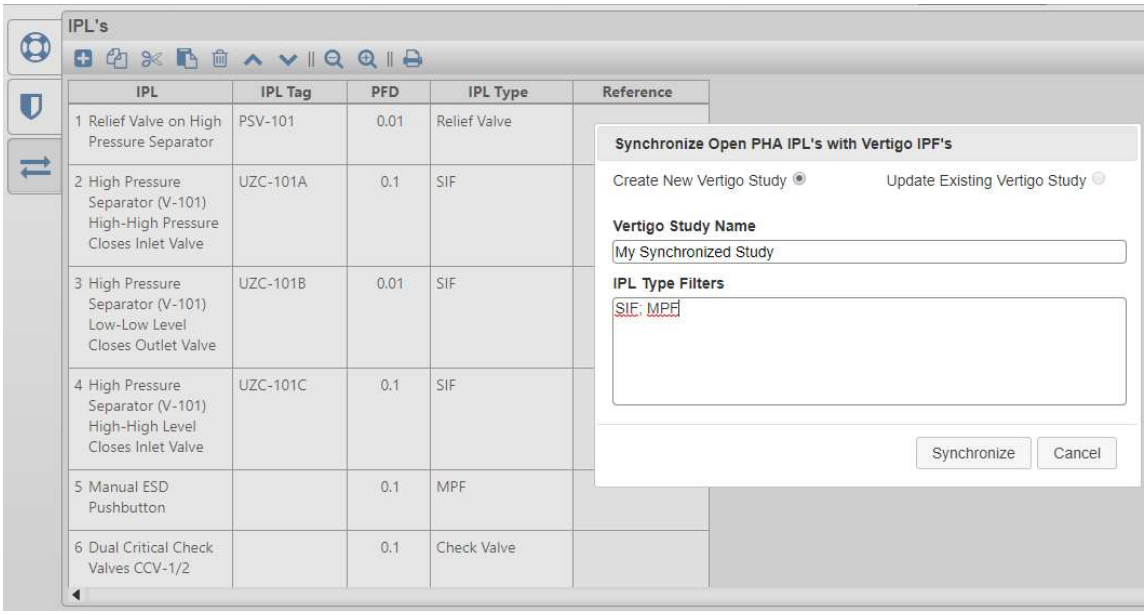
Unless IPL type filtering is applied, the new Vertigo study will contain one Independent Protective Function (IPF) for each Independent Protection Layer (IPL) in your Open PHA study. This is usually not the desired outcome as not all IPL's in LOPA are IPF's in SIS Lifecycle Management. Therefore, it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

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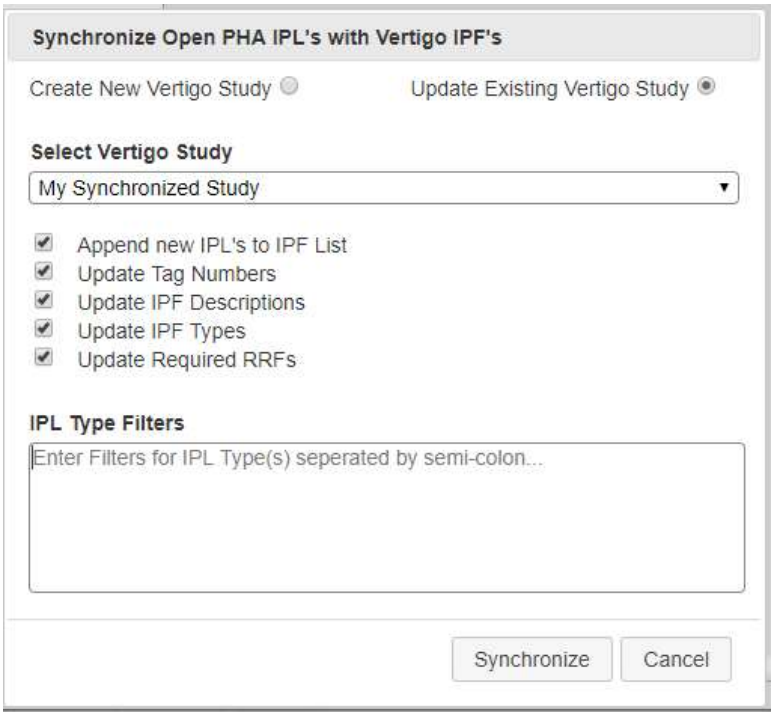


When updating an existing synchronized Vertigo study you will have the option to select what fields you would like to synchronize. These options are provided to allow you to maintain changes to your Vertigo study which were made after the initial synchronization with Open PHA.

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".

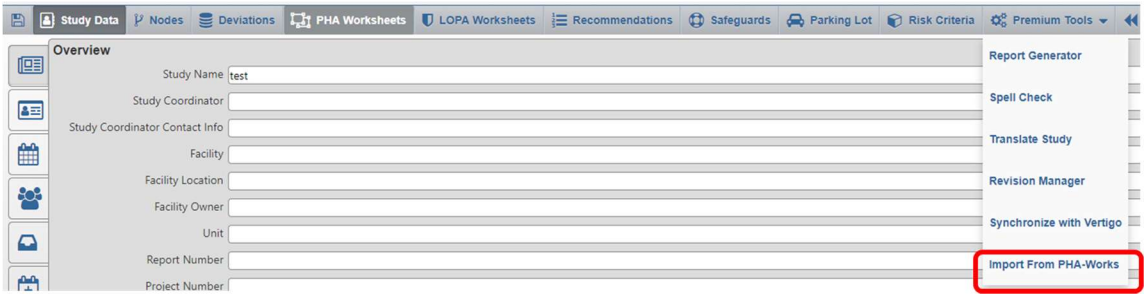
Update Required RRFs

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 from PHA-Works

The Open PHA PHA-Works import tool allows you to import PHA study data from PHA-Works files. To access the PHA-Works import tool select the "Import PHA-Works" option from the Premium tool's menu.



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.

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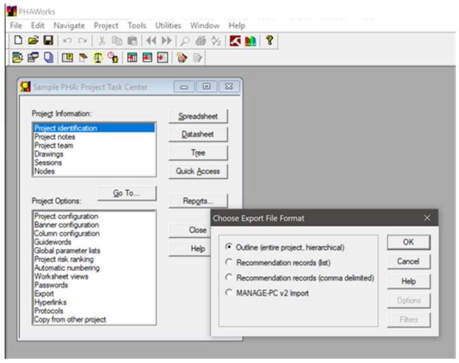
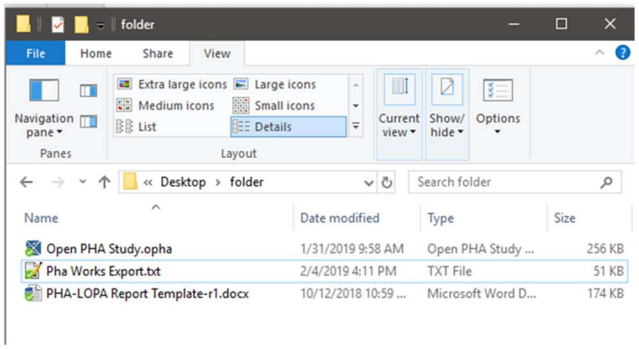
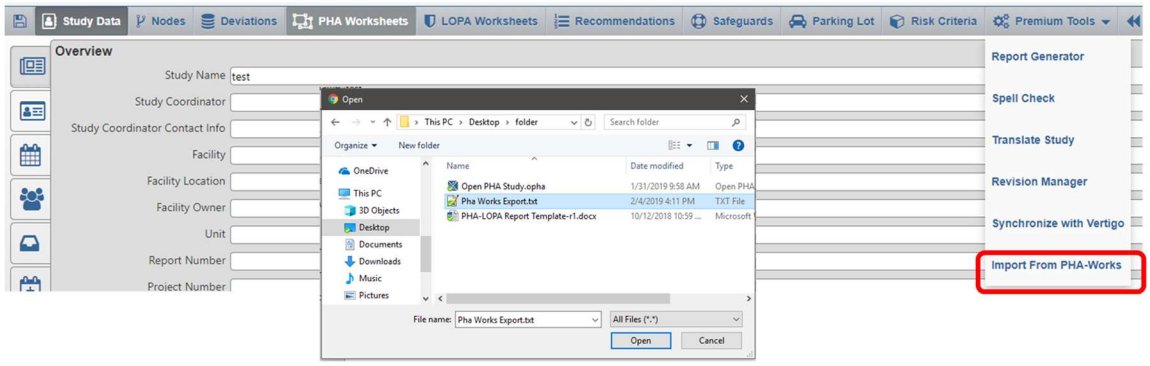




Next, from Open PHA Premium, in a new Open PHA Study click on the Import PHA-Works option in the Premium Tools menu and select the file that was exported.



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 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

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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 a Open PHA Premium Facility Dashboard.