Kenexis® Open-PHA®

PHA, HAZOP & LOPA Software

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1 Introduction

1.1 About Kenexis Open-PHA

Kenexis Open-PHA is the process hazard analysis module of the Kenexis Integrated Safety Suite (KISS). It is a browser-based, multi-user application for facilitating, documenting, and maintaining Process Hazard Analyses (PHA), Hazard and Operability studies (HAZOP), and Layer of Protection Analyses (LOPA). An Kenexis Open-PHA study organizes the analysis into nodes, deviations, and cause–consequence scenarios; ranks each scenario against a fully configurable risk matrix; and, where a scenario warrants it, carries the analysis into LOPA to quantify the required risk reduction and recommend a Safety Integrity Level (SIL).

Kenexis Open-PHA Cloud-Premium pairs the structured worksheets with a set of premium productivity tools: report generation from your own Word templates, study search, translation and spell-checking, revision management, previous-version recovery, reusable template libraries, bowtie diagram visualization, synchronization with Kenexis SIS SIS Lifecycle Management studies, and facility-level dashboards that aggregate PHA results across studies.

1.2 Editions

Kenexis Open-PHA is available in two editions that work together:

- **Kenexis Open-PHA Cloud-Premium** — the KISS module documented in this manual. It runs in your browser, stores studies centrally, supports multi-user access, and includes the premium tools described in Chapter 13.
- **Kenexis Open-PHA Desktop** — a free standalone desktop application for Windows, macOS, and Linux, available from the Kenexis website. The two editions share one file format (".opha"), so a study can move freely between the desktop and the cloud (sections 2.5 and 13.6).

1.3 Key Terms

Table 1-1. PHA and LOPA terminology.

Term	Definition
Process Hazard Analysis (PHA)	A qualitative study performed to identify process hazards that can adversely affect people, property, and the environment.
Layer of Protection Analysis (LOPA)	A semi-quantitative study used to identify required risk reduction and recommend layers of protection where needed.
Node	A section of the process with a defined design intention, analyzed as a unit. Each node carries its own deviations and worksheets.
Deviation	A departure from the design intention (guide word plus parameter, such as More Pressure) analyzed on the PHA worksheet.
Safeguard	A device, system, or action that prevents a scenario from occurring or reduces its impact. Safeguards are shared study-wide from a single master list.

Term	Definition
Independent Protection Layer (IPL)	A safeguard that is specifically designed to prevent the identified hazard, is independent of the initiating event and other IPLs, provides at least one order of magnitude of risk reduction, and is auditable.
Target Mitigated Event Likelihood (TMEL)	The maximum tolerable frequency for a consequence, set by the selected consequence severity. Also known as the target frequency.
Mitigated Event Likelihood (MEL)	The frequency of the harmful event considering the risk reduction provided by enabling events, conditional modifiers, and IPLs.
Risk Reduction Factor (RRF)	The amount of additional risk reduction required to mitigate risk to a tolerable level (the reciprocal of a probability of failure on demand).
Conditional Modifier (CM)	A probability factor for a condition necessary for the harmful outcome, such as occupancy or probability of ignition.
Enabling Event	A probability factor at the cause level that must be present for the initiating event to lead to the consequence.
Recommendation	A tracked improvement action arising from the study, with priority, responsible party, status, and due date.

1.4 About Kenexis

Kenexis is an independent engineering consulting and software development 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 specifications of instrumented safeguards such as safety instrumented systems, alarm systems, and fire and gas systems.

2 Getting Started

2.1 Signing In and the KISS Project Manager

Kenexis Open-PHA Cloud-Premium runs inside KISS and requires a KISS account. Point your browser at the KISS sign-in page and log in with your account credentials. If you have misplaced your password, the Forgot Password link on the sign-in page restores it.

After signing in you land on the KISS Project Manager. Facilities are listed on the left; selecting a facility shows its studies on the right, with each study's type and last-modified date. Kenexis Open-PHA studies open with a click on the study name.

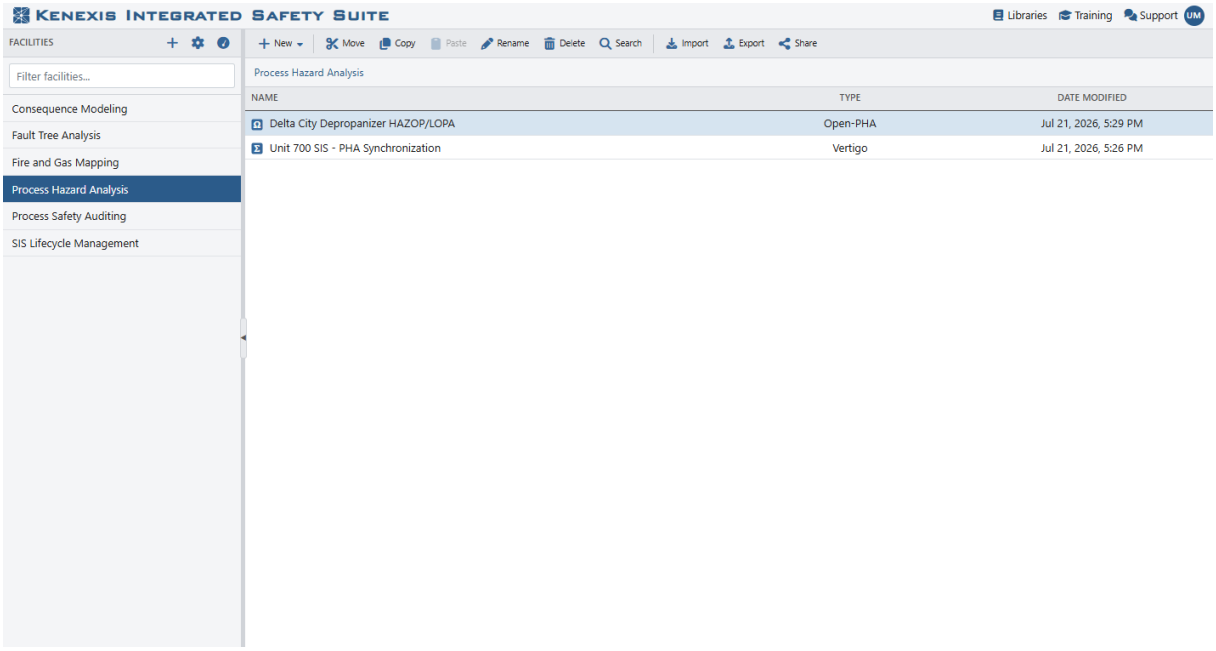


Figure 2-1. The KISS Project Manager: facilities on the left, the selected facility's studies on the right.

The KISS Project Manager toolbar acts on the selected study row (click any cell other than the name to select it). New creates a study, and Move, Copy, Rename, Delete, Import, Export, and Share perform the corresponding study-level operations. The Facility Dashboard button above the facility list opens the aggregated dashboard described in Chapter 14.

2.2 Creating a New Study

To create a study, select the facility that should hold it, click New in the toolbar, and choose Open-PHA. The new study opens immediately and a short series of dialogs configures its data structure.

The first dialog offers a choice between starting from a library template and creating an empty study. Starting from a template copies a complete study structure — including its risk criteria and worksheets — from a KISS library (section 13.7).

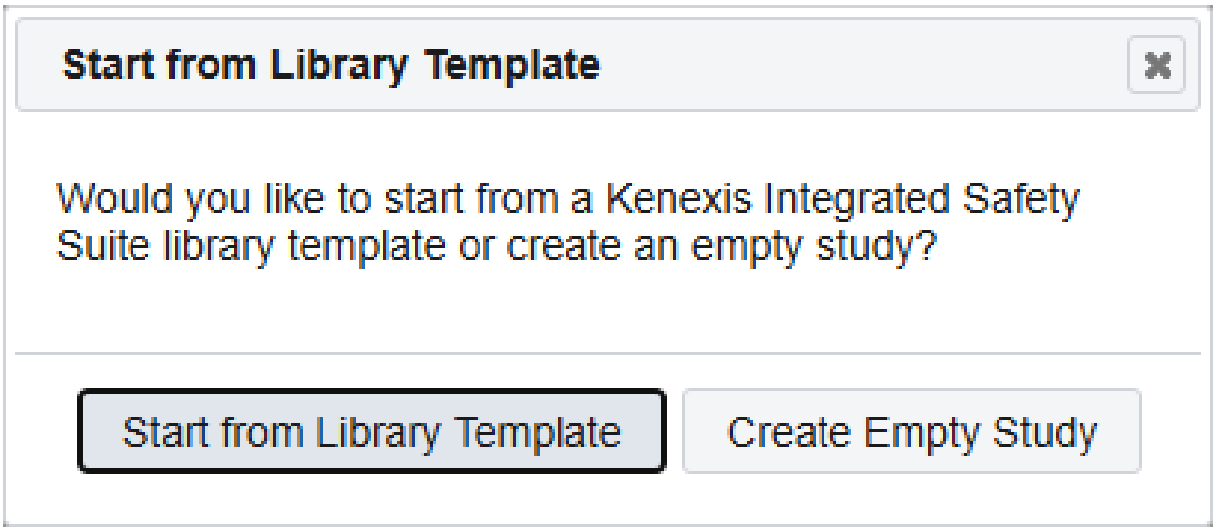


Figure 2-2. Start from a library template or create an empty study.

For an empty study, the next dialog selects the data structure. Kenexis Open-PHA supports numerous PHA methodologies, and the indexing choice tailors the worksheets to the methodology:

- **Option A — Standard (Cause-Indexed)**: each cause has one or more consequences. Well suited to HAZOP, What-If, and checklist PHAs.
- **Option B — Consequence-Indexed**: each consequence has one or more causes. Best for SIL selection and LOPA because it aggregates the risk of all causes onto each consequence, allowing a single SIL requirement per safety function.

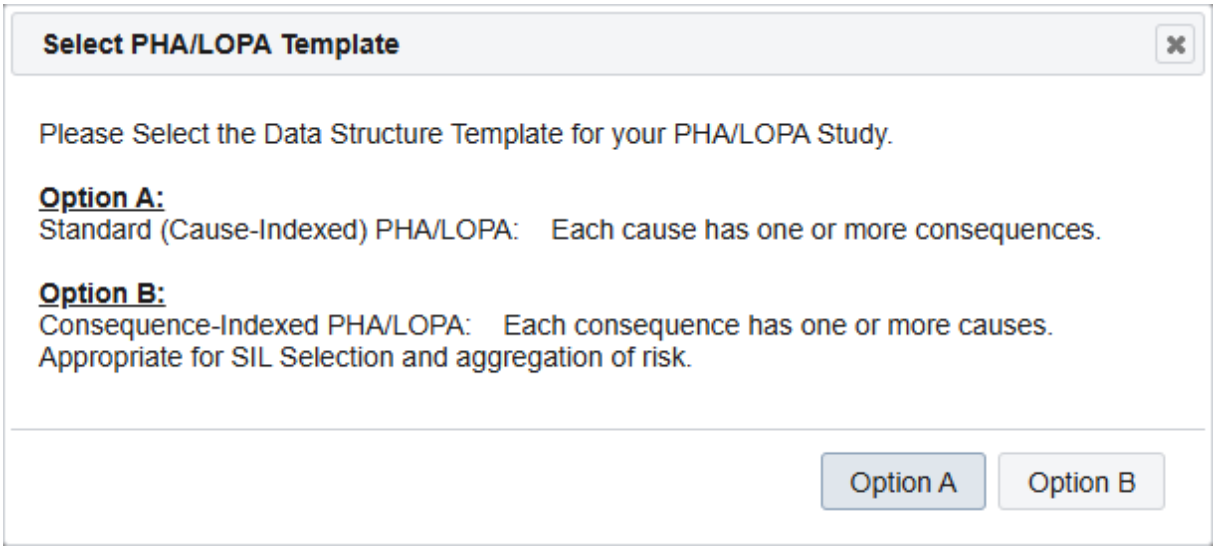


Figure 2-3. Selecting the study data structure.

The data structure is a foundational property of the study, chosen once at creation.

The next dialog selects the LOPA style:

- **Option A — Explicit**: uses TMEL targets, initiating event frequencies, and probabilities of failure on demand. This is the most widely used LOPA methodology in industry.

- **Option B — Implicit**: uses risk ranking targets, likelihood categories, and LOPA credits (section 9.4).

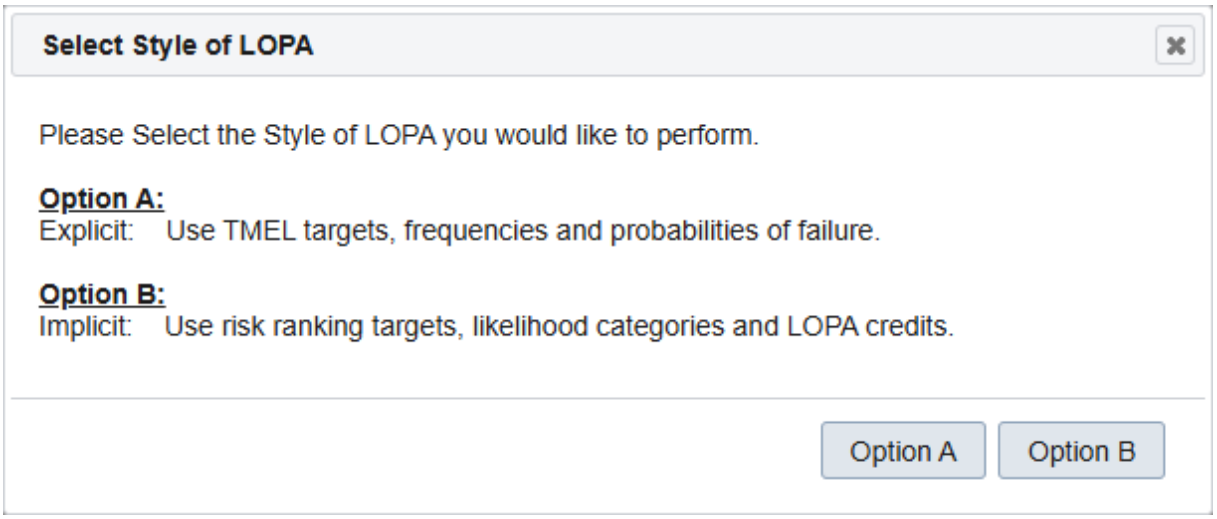


Figure 2-4. Selecting the LOPA style.

The LOPA style can be changed later from the Study Settings dialog (section 4.8), which also offers to convert the values already entered.

Next, the study's risk criteria can be imported from a KISS library or initialized with the Kenexis Open-PHA defaults. The default criteria provide a complete five-by-five matrix with five likelihood categories, five severity categories per consequence type, and five risk rankings — all fully editable afterward (Chapter 5).

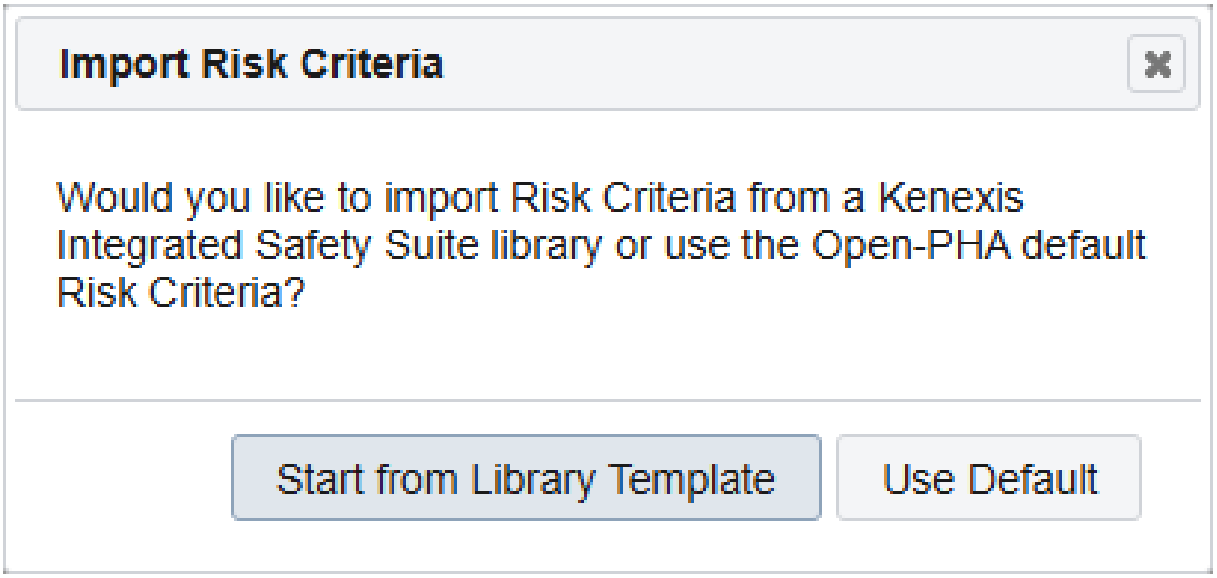


Figure 2-5. Choosing the study's starting risk criteria.

Finally, enter the study name and facility name. Clicking Create Study completes the setup and opens the Study Data tab, ready for work.

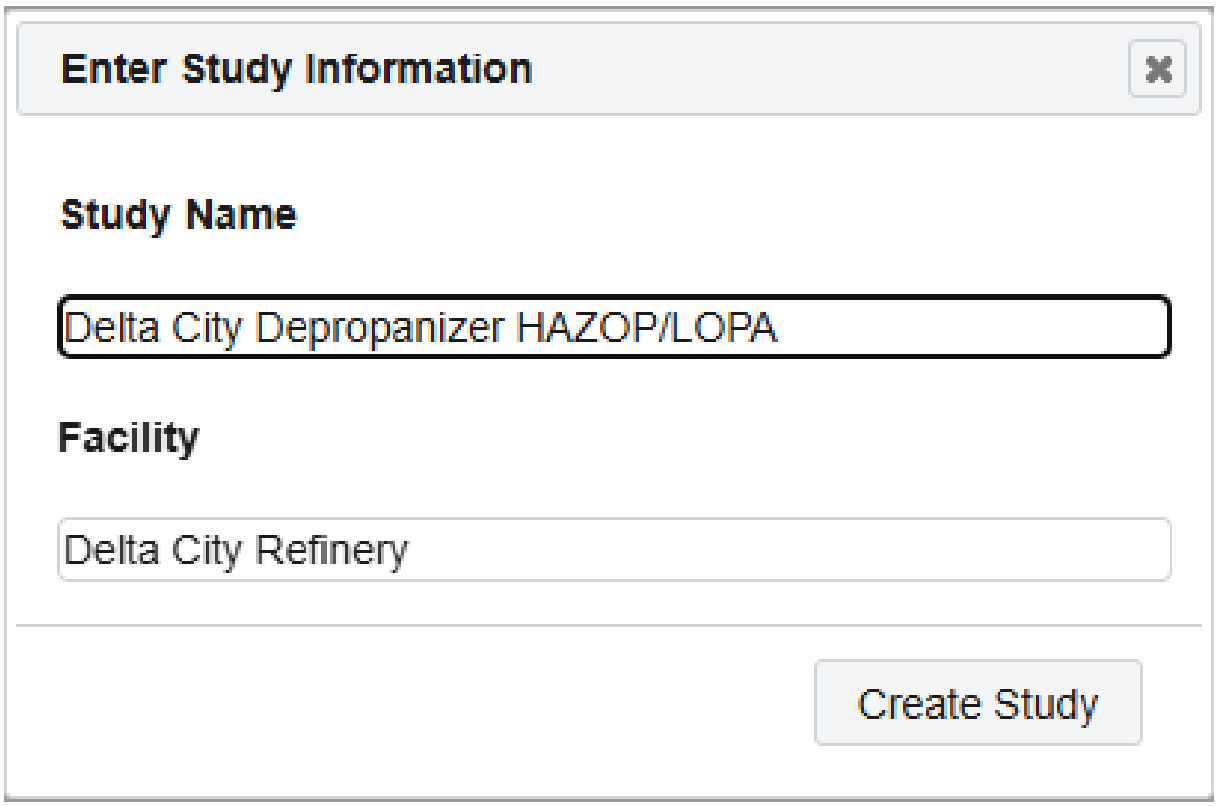


Figure 2-6. Entering the study information.

2.3 Opening, Renaming, and Deleting Studies

Clicking a study name in the KISS Project Manager opens it. Rename updates the study name everywhere, and Delete moves the study to the organization's recycle bin, from which an administrator can restore it. Copy and Paste duplicate a study, and Move relocates it to another facility or folder.

2.4 Concurrent Access

Kenexis Open-PHA Cloud-Premium is multi-user. The first user editing a study holds the editing session; anyone else opening the same study views it read-only, with a Read-Only badge in the header, until the editor closes the study.

Your organization’s Kenexis Open-PHA license sets how many people can edit at the same time. When every license seat is in use, a user with editing rights opens the study read-only, with a notice below the header naming the colleagues holding the seats. Reopen the study once a seat is free to edit it.

Kenexis Open-PHA also keeps one editing copy of a study per browser. Opening a study you are already editing in a second tab of the same browser opens that tab read-only, with a banner explaining that the study is already open in another tab. Close the second tab and continue in the first, or close the first tab and reload the second to make it the editing tab.

Every save is checked against the version of the study the page loaded. When another window or device of yours has saved the study since — a tab left open on another computer, for example — the newer

save is kept and the older page is told so: within about a minute a banner asks you to reload before editing, and a Save from that page opens the Study Not Saved dialog, which names the time and author of the newer save. Reload the page to continue from the latest version.

Whenever a save cannot be completed — the connection dropped, the server reported an error, a colleague holds the study's edit lock, a newer save exists, or your sign-in has expired — Kenexis Open-PHA immediately downloads a recovery copy of the study to your browser's Downloads folder, named after the study with RECOVERY and the date and time (for example "Unit 100 HAZOP RECOVERY 2026-10-14 1532.opha"), and keeps the study marked as unsaved. The Study Not Saved dialog explains why the save was declined, names the file, and offers Download Again, in case the browser blocked the automatic download, and Reload where loading the latest version is the way forward. After a dropped connection, keep the page open and press Save again once you are back online; a timed auto-save that fails switches auto-save off until you turn it on again in Settings (section 4.8). To restore work from a recovery copy, open the study and use Import As Working Revision › From Kenexis Open-PHA Desktop (section 13.6).

One editing tab per study

Keeping a study open in a single tab, on the computer you are working from, keeps every save flowing. When you move between computers, save and close the study on the first before opening it on the second.

2.5 Importing and Exporting Studies

The Import and Export buttons in the KISS Project Manager move complete studies between KISS and ".opha" files on your computer. Export downloads the selected study as an .opha file — the same format the desktop edition reads and writes. Import creates a new study in the selected facility from an .opha file and opens it immediately. Together they let you facilitate offline with Kenexis Open-PHA Desktop and continue in the cloud, where the premium tools are available.

Import creates a new study

Importing a file always produces a new study alongside the existing ones. To bring desktop edits back into an existing cloud study — preserving its revisions and Kenexis SIS links — use Import As Working Revision (section 13.6) instead.

3 The Kenexis Open-PHA Workspace

3.1 Navigation

The workspace header carries the study name, the Save button, and the Premium Tools menu. Below it, the navigation tab strip is the primary means of moving through the study: Study Data, Nodes, Deviations, PHA Worksheets, LOPA Worksheets, Check Lists, Recommendations, Safeguards, Parking Lot, and Risk Criteria. Studies that enable the optional worksheets (Chapter 12) also show ALARP Analysis, SCAI, and MOCs / Incidents tabs. Several tabs carry a secondary rail of pages on the left edge of the workspace.

Save (or Ctrl+S) writes the study to the cloud after confirming the page still holds the latest version of the study (section 2.4). The Settings page can additionally enable timed auto-save (section 4.8). Function keys F1 through F10 jump between the main tabs, and Ctrl+F1 through Ctrl+F10 select rail pages — the full hotkey set is in Appendix A.

3.2 Worksheet Tables

The table is the staple of the Kenexis Open-PHA interface: every tab edits its data in place, in a consistent grid. Click a cell to select it (dark blue highlight); click again or start typing to make it active for editing. Ctrl+click and Shift+click extend the selection across rows, and the arrow keys move between cells. Dropdown cells — likelihoods, severities, statuses — open their pick list on click, and computed cells such as risk ranks display their value read-only.

Every worksheet action can be reversed: cell edits, linking an item, adding, deleting, cutting, pasting, moving, disabling and enabling rows, and Replace All. Press Ctrl+Z, or click Undo in the header, to reverse the last action; Open-PHA returns to the worksheet the change was made on and selects the cell. Ctrl+Y, or Redo, replays it. The history holds the last hundred actions of the current session and survives a save, so you can undo past a save and save again. Operations that are not worksheet actions — Study Settings, Column Settings, Risk Criteria, imports, library synchronisation, revision and Previous Versions operations — cannot be undone and clear the history, as does reloading the page. Inside a cell you are typing in, Ctrl+Z is the browser's own undo for that text.

3.3 The Workspace Toolbar

The toolbar above each worksheet provides, from left to right:

- Add New Row — inserts a row below the selection (also Ctrl+Enter).
- Copy, Cut, and Paste Row(s) — duplicate or move the selected rows (also Ctrl+C, Ctrl+X, Ctrl+V).
- Delete Row(s) — removes the selected rows (also the Delete key).
- Move Row Up / Move Row Down — reorders the selected row (also Ctrl+Up and Ctrl+Down).
- Zoom Out / Zoom In — scales the worksheet in ten-percent steps; the zoom level persists per browser.
- Export To Excel — downloads the current worksheet as a spreadsheet.

- Filter — applies typed column filters (contains, equals, and similar operators) to narrow large worksheets.
- Disable / Enable Row — sets rows aside: a disabled row is struck through and shaded and stays in the record. Select rows by their description cell (for example the cause text); both actions apply to every selected row, so a Ctrl+click or Shift+click selection is disabled in one step, and a selection that mixes enabled and disabled rows offers both. Disabling an enabling event, conditional modifier, IPL or LOPA recommendation also removes its contribution from the LOPA calculations.
- Search and Replace — finds text in the worksheet, steps through the hits, and optionally replaces all of them.

On the Nodes, Deviations, and PHA worksheets the copy functions perform a deep copy: copying a node brings its deviations and worksheet scenarios along, so similar process sections can be analyzed by copying a completed node and editing the differences.

3.4 Numbering and References

Rows carry hierarchical outline numbers (for example 1.2.3 for the third consequence of the second deviation of node one) that appear throughout the worksheets, the Recommendations and Safeguards registers, and the generated reports. Registers that reference worksheet rows — recommendations, safeguards, and comments — show the referencing locations as links that navigate straight to the scenario.

4 Study Data

The Study Data tab collects the study's bookkeeping: general information, the team, the sessions and attendance record, the drawing list, and the study's revision and revalidation history. Its rail also hosts the column settings and the study settings.

4.1 Overview

The Overview page documents high-level information about the study: the study name and coordinator, the PHA type (Preliminary, Project, MOC, Unit, or Decommissioning), the study status, the revalidation due date, the facility and owner, and free-text fields for the project description and general notes. Several additional identification fields (company, site, plant, and unit groupings) can be switched on from Column Settings when an organization tracks them.



Figure 4-1. The Study Data Overview page.

4.2 Team Members

The Team Members page records the participants: name, company, title, department, expertise, experience, and contact details. Team members entered here populate the facilitator and scribe selections on the Sessions page and the attendance grid.

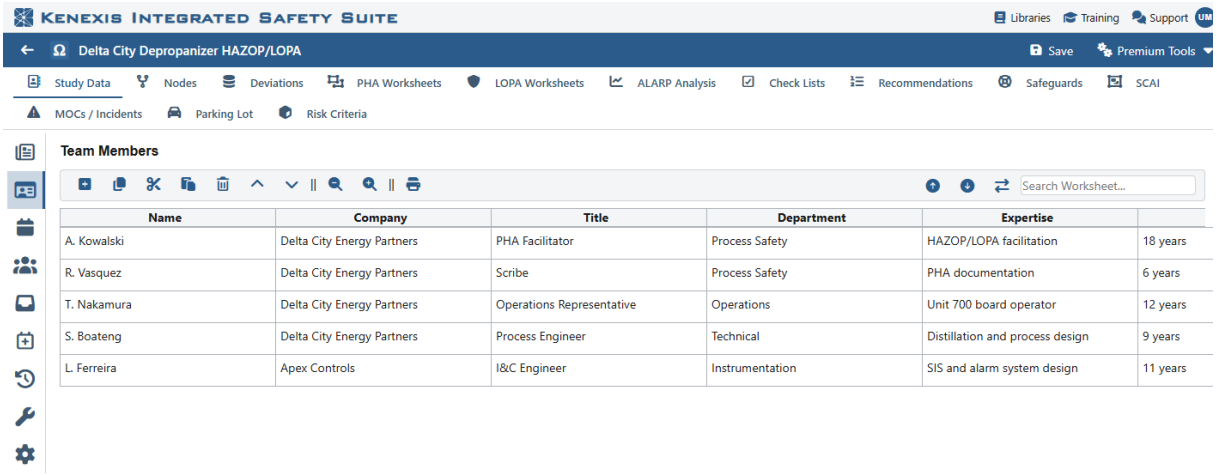


Figure 4-2. The Team Members page.

4.3 Sessions

The Sessions page documents each meeting: date, duration, a description of the topics or nodes covered, and the facilitator and scribe chosen from the team member list.

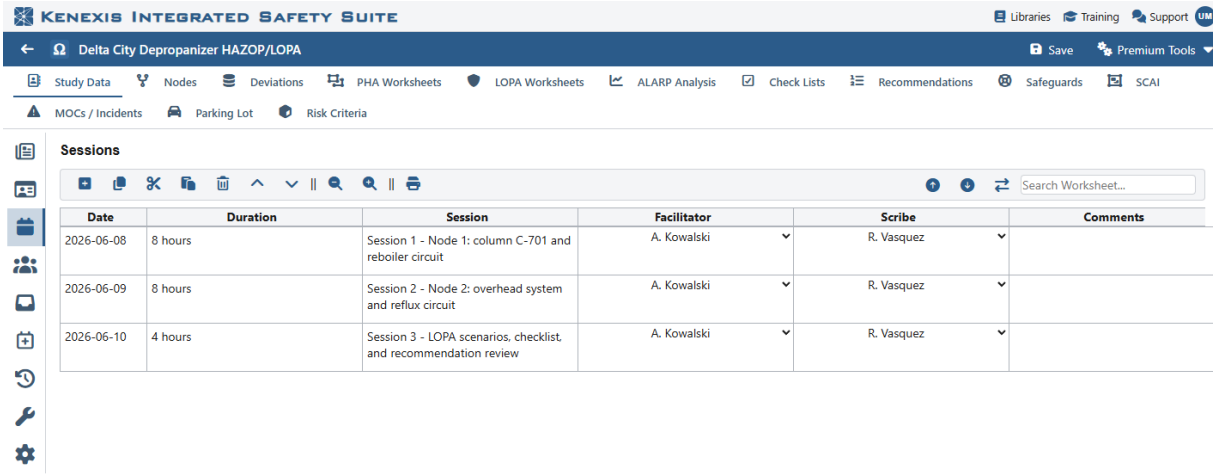


Figure 4-3. The Sessions page.

4.4 Attendance

The Attendance page is a grid of team members against sessions. Each intersection records that member's participation in that session as Present, Partial, Virtual, or Absent.

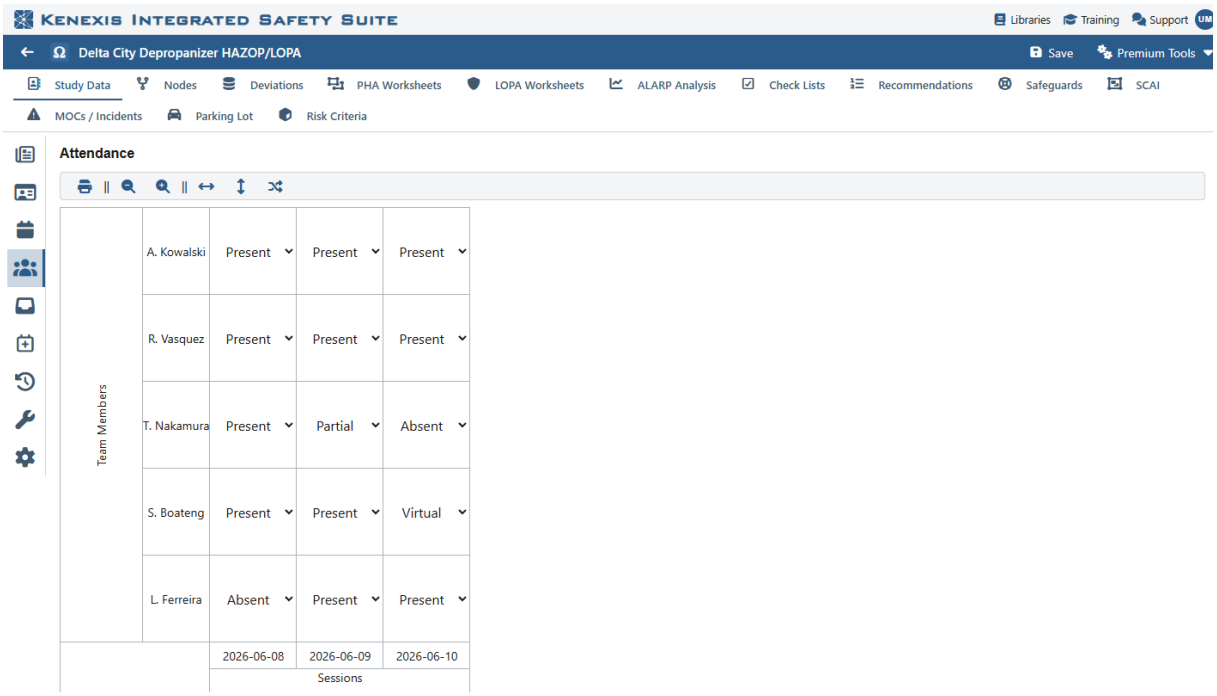


Figure 4-4. The Attendance grid.

4.5 Documents

The Documents page lists the drawings and documents available to the team: number, revision, document type, description, and an optional hyperlink. Documents recorded here populate the drawing links on the Nodes page. A CSV import on the toolbar appends document lists prepared outside Kenexis Open-PHA.

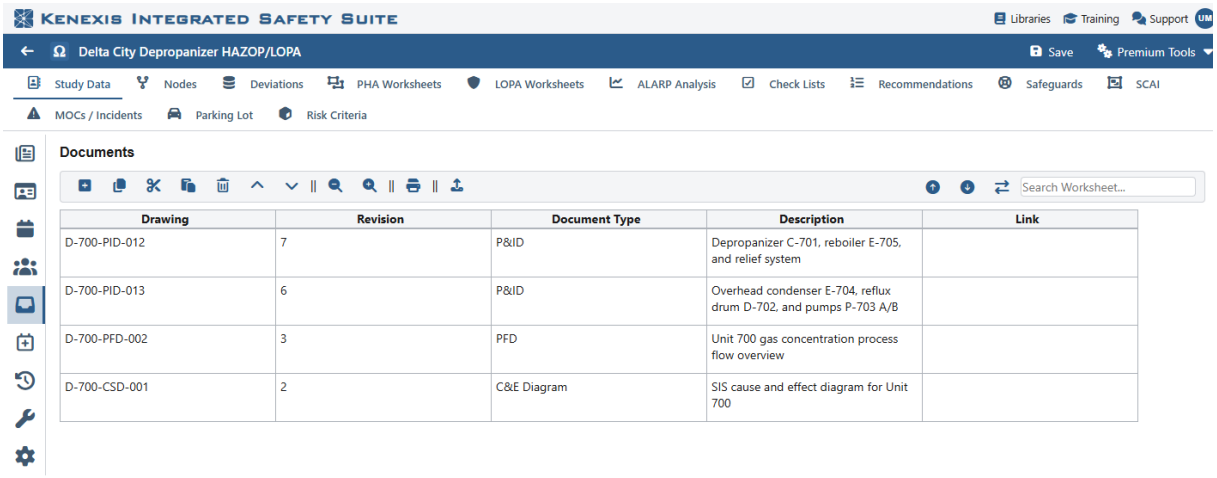


Figure 4-5. The Documents page.

4.6 Revalidation History and Revision History

The Revalidation History page tracks the study's periodic revalidations with start and end dates and comments. The Revision History page is the study's formal revision record, managed by the Revision Manager described in section 13.5.

4.7 Column Settings

The Column Settings page controls which columns appear on every page and worksheet in the study, organized as a tree of toggles. A blue slider shows a visible column; clicking the slider or its label toggles it. The pencil icon beside a column renames its header study-wide, so worksheets can carry your organization's terminology. Core structural columns — the ones every worksheet is built on, such as Deviation, Cause, Consequence and the likelihood and severity selections — remain visible at all times; they are listed with the pencil alone, so their headers can still be renamed.

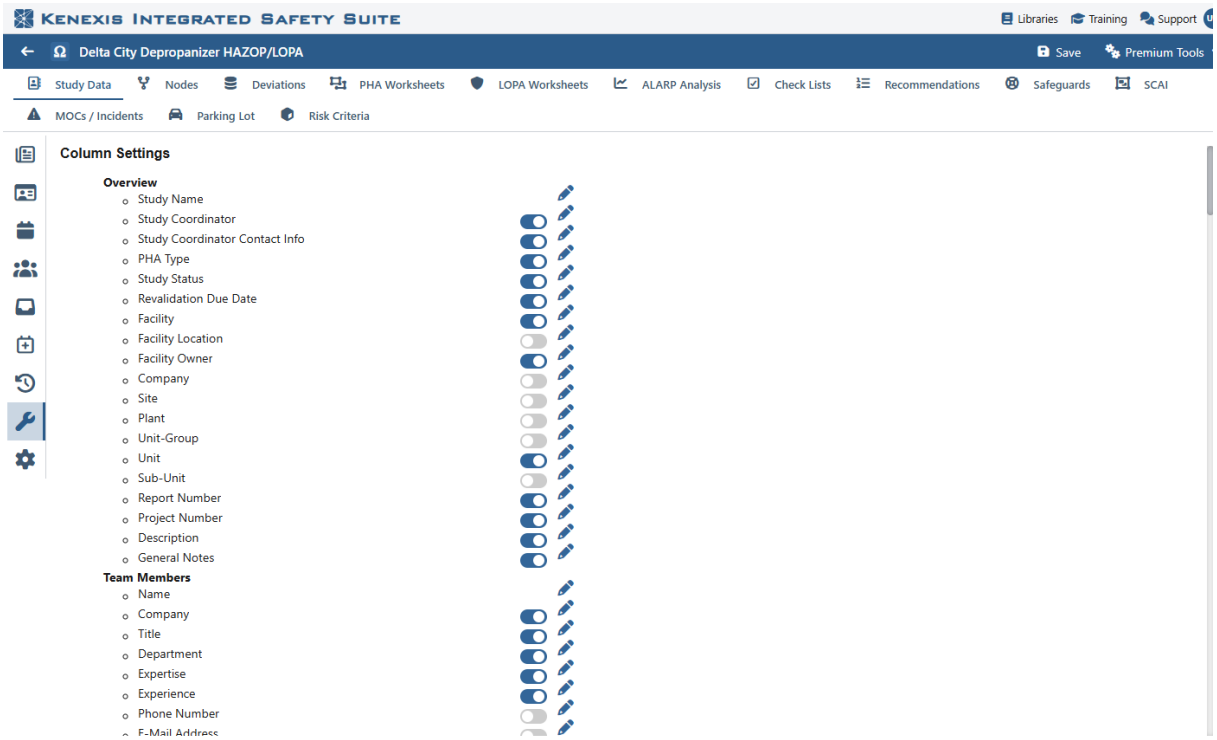


Figure 4-6. Column Settings: per-column visibility and renaming.

Column visibility participates in the calculations

An enabling event, conditional modifier, IPL or LOPA recommendation counts in the LOPA calculation only while its column and its credit, probability or PFD column are both visible on the LOPA worksheet, and the risk ranking uses the visible severity and likelihood columns. Showing or hiding these columns updates the calculated results accordingly (Chapter 9).

4.8 Settings

The Settings page opens the Study Settings dialog. General Settings provides auto-save (with a selectable interval), Presenter Mode (larger, bolder worksheet text for meeting projection), the Scenario Context Bar switch (section 7.1), the Visible Tabs switches that enable the optional worksheets (Chapter 12), and item numbering controls per register. The Consequence Categories tab renames the five consequence categories, sets their single-letter codes, and assigns each a color used across the worksheets and reports.

The LOPA Methodology selection switches the study between Explicit and Implicit LOPA at any time. Every record holds both styles' values, so the switch changes which columns the LOPA worksheet shows and calculates (Chapter 9) and keeps whatever was entered in the other style. A confirmation dialog offers to convert the existing values as well: IPL and LOPA recommendation PFDs become whole IPL credits and credits become PFDs; enabling event and conditional modifier probabilities become credits kept to a tenth, and back; and each cause frequency becomes the likelihood nearest to it on a logarithmic scale, and back. Clear either box to switch the style and leave the values as they are.

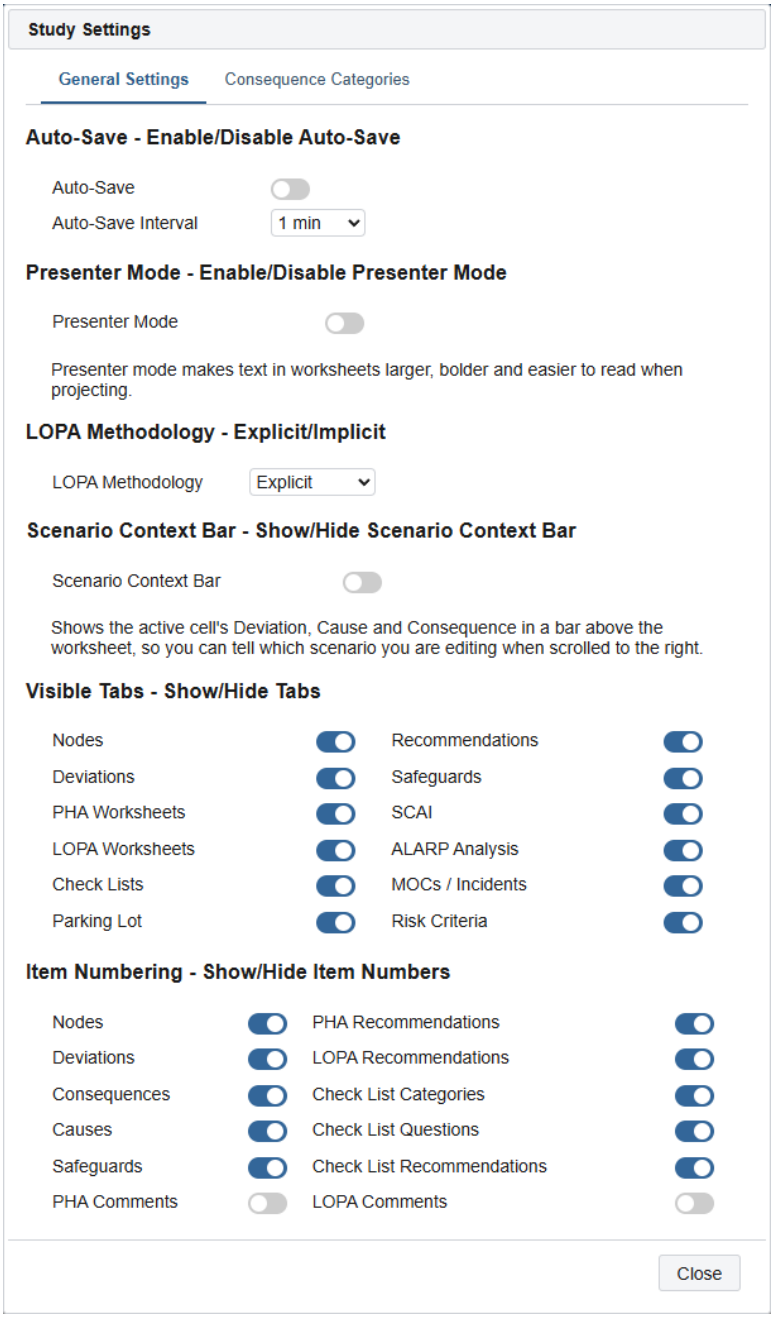


Figure 4-7. The Study Settings dialog.

5 Risk Criteria

The Risk Criteria tab defines the study's risk model: the likelihood categories, the consequence severity categories, the risk rankings, and the risk matrix that maps severity and likelihood to a ranking. The criteria are per-study, and complete criteria sets can be exported to a library or file and imported into new studies (section 5.5).

5.1 Likelihood Categories

Each likelihood category has a code, a description, and a frequency. The codes populate the likelihood dropdowns on the PHA worksheet. In explicit LOPA studies the frequencies also bin the calculated mitigated event likelihood back onto the matrix (section 9.3); the default ladder spans five orders of magnitude.

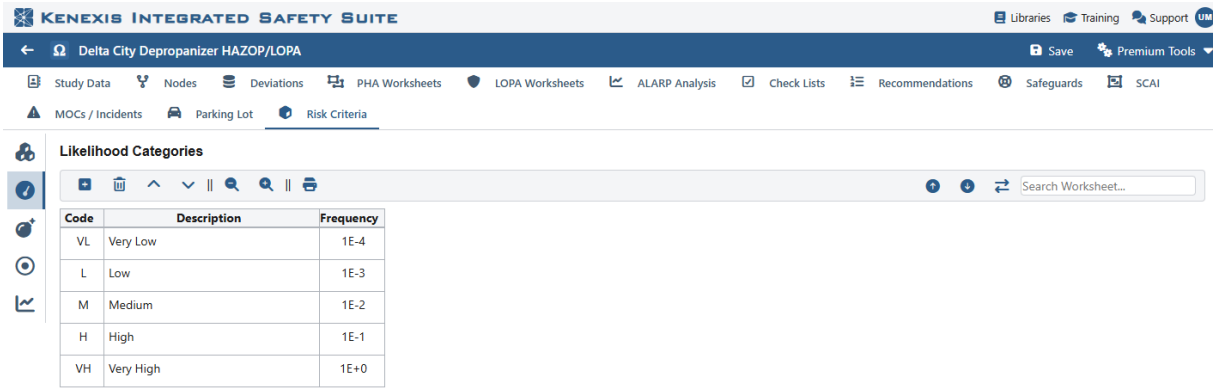


Figure 5-1. The Likelihood Categories page.

5.2 Consequence Categories

The Consequence Categories page defines the severity levels used in the risk matrix. A severity table exists for each consequence category — Safety, Environment, Asset, Community, and Reputation by default — selected from the dropdown at the top of the page. Each severity has a code, a description, and, in explicit LOPA studies, the TMEL that becomes the LOPA target frequency whenever that severity is selected on a worksheet.

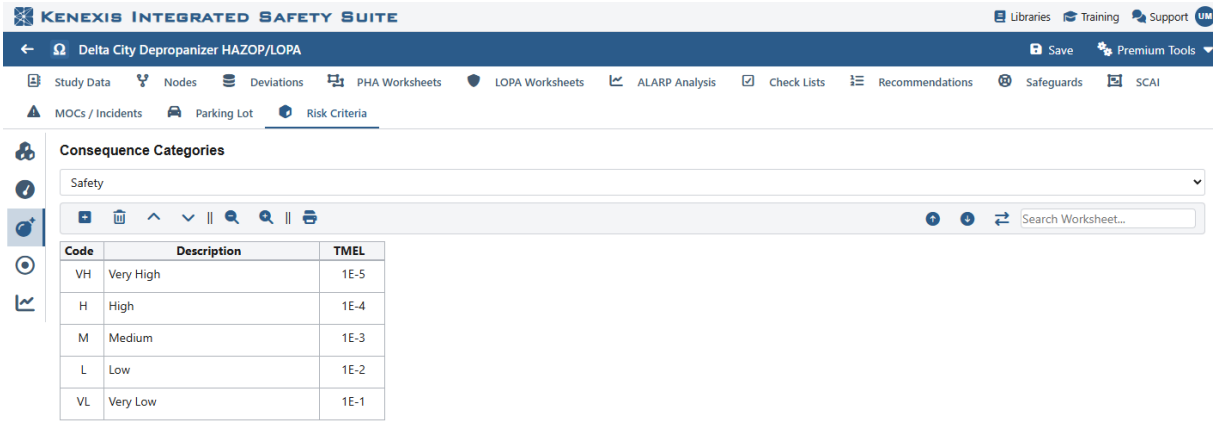


Figure 5-2. The Consequence Categories page.

5.3 Risk Rankings

The Risk Rankings page names the ranking levels, assigns each a code, a color, and a priority, and — in implicit LOPA studies — the number of LOPA credits required to mitigate risk of that rank to a tolerable level. Clicking a color cell opens the color picker; the chosen color paints the matrix cells and every computed rank cell in the study.

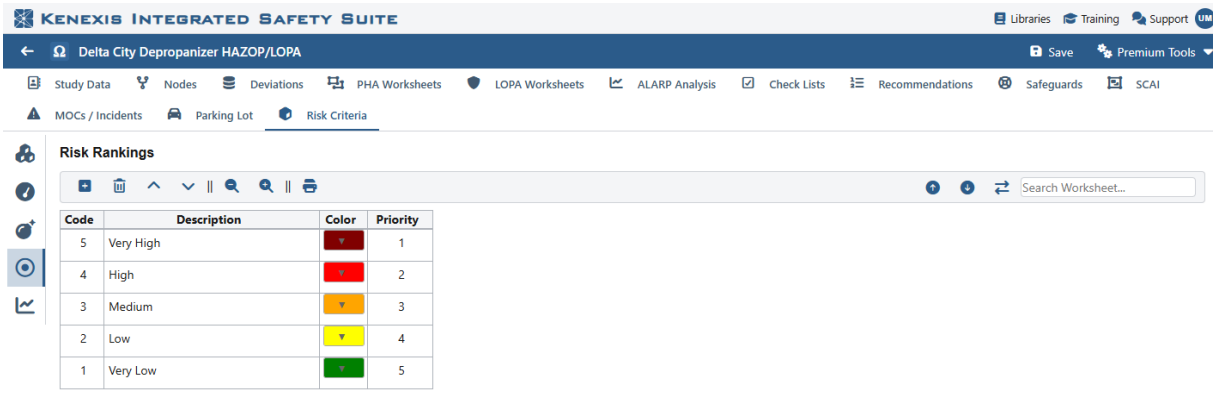


Figure 5-3. The Risk Rankings page.

5.4 The Risk Matrix

The Risk Matrix page builds the matrix automatically from the likelihood and severity categories, one matrix per consequence category. Clicking a cell assigns it a risk ranking from the dropdown; the cell takes the ranking's color. The toolbar swaps the axes, moves the header rows and columns to the opposite sides, exports the matrix to Excel, and imports or exports the complete risk criteria set.

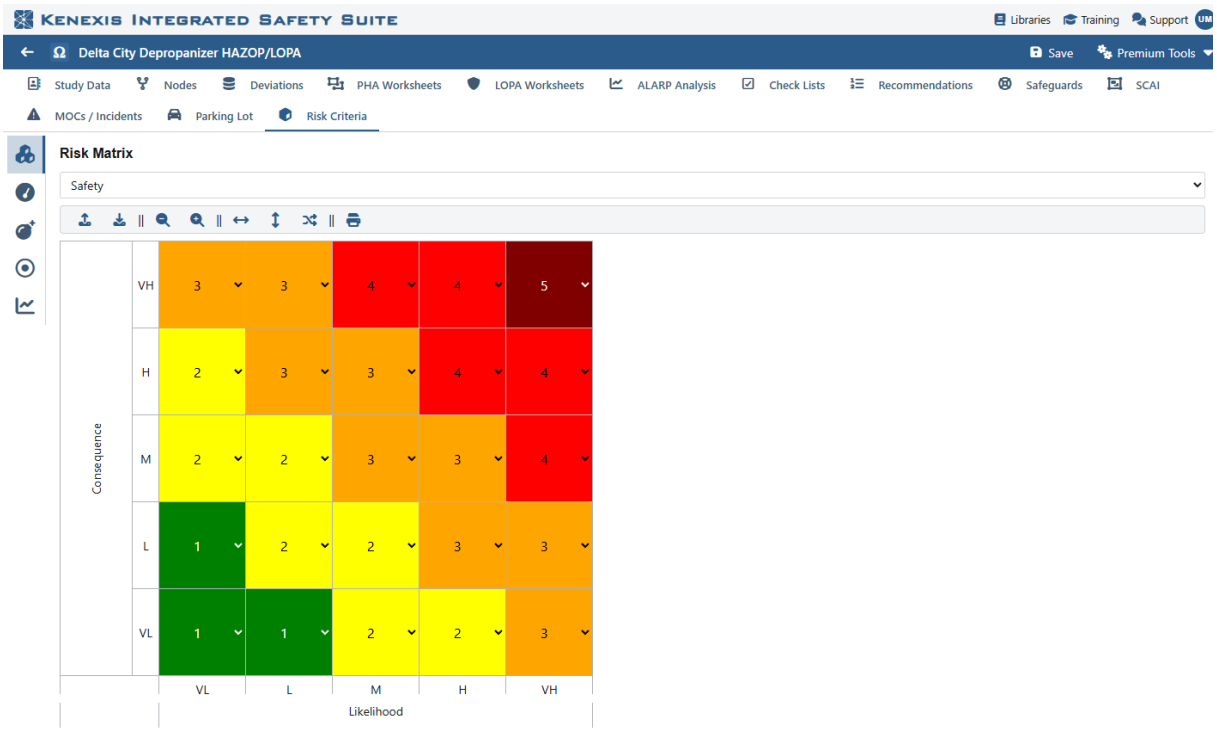


Figure 5-4. The Risk Matrix page.

Deleting a likelihood or severity category removes its column or row from the matrix, and deleting a risk ranking leaves every cell that used it unranked; the scenarios in those cells lose their risk rank and the LOPA results built on it. When a delete would empty ranked matrix cells, Open-PHA says so before it deletes: the Confirm Delete dialog names each affected category or ranking, how many ranked cells it holds, and the consequence categories they are in. Choose Yes to delete anyway, or Cancel to keep it.

5.5 Sharing Risk Criteria

Complete risk criteria — categories, rankings, and the matrix — travel three ways: to and from KISS libraries (Export Risk Criteria under Premium Tools, and the library option offered when a study is created), and to and from a local file via the matrix toolbar's import and export buttons. Standardizing criteria in a library keeps every study in a program consistent.

6 Nodes and Deviations

6.1 Nodes

The Nodes table lays the foundation of the analysis: one row per process section, with its description, design intention, boundary, design and operating conditions, and a highlight color. Optional columns record hazardous materials, equipment tags, and location. Each node links to the sessions in which it was analyzed and the drawings that cover it, chosen from the Sessions and Documents pages. A PHA worksheet is created for every node in this table.

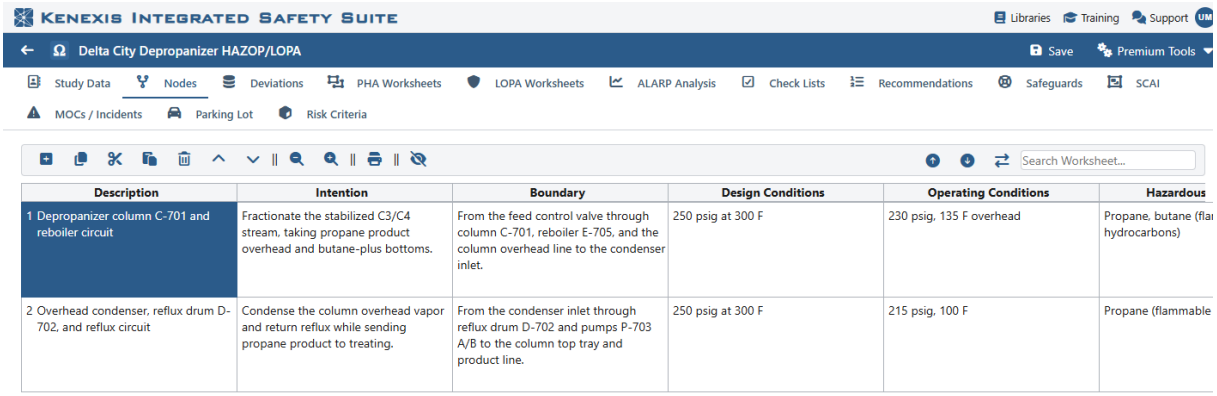


Figure 6-1. The Nodes table.

Copying a node performs a deep copy — the node's deviations and PHA worksheet come along — which makes quick work of processes with repeated equipment trains.

6.2 Deviations

The Deviations page records the deviations analyzed for the selected node (chosen from the dropdown above the table). The Deviation column carries over to the PHA worksheet, and each deviation can be broken down into its guide word and parameter, with a design intent statement for context. Deviations entered directly on the PHA worksheet appear here as well — the two views edit the same data.

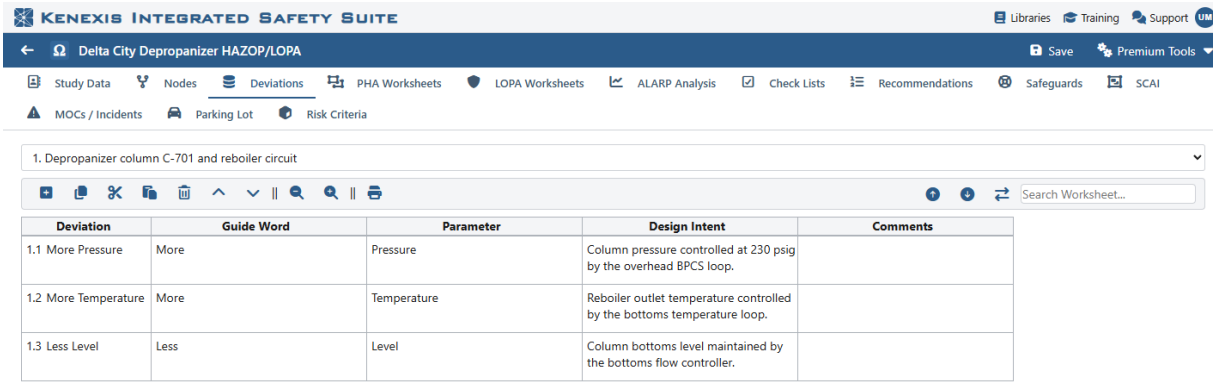
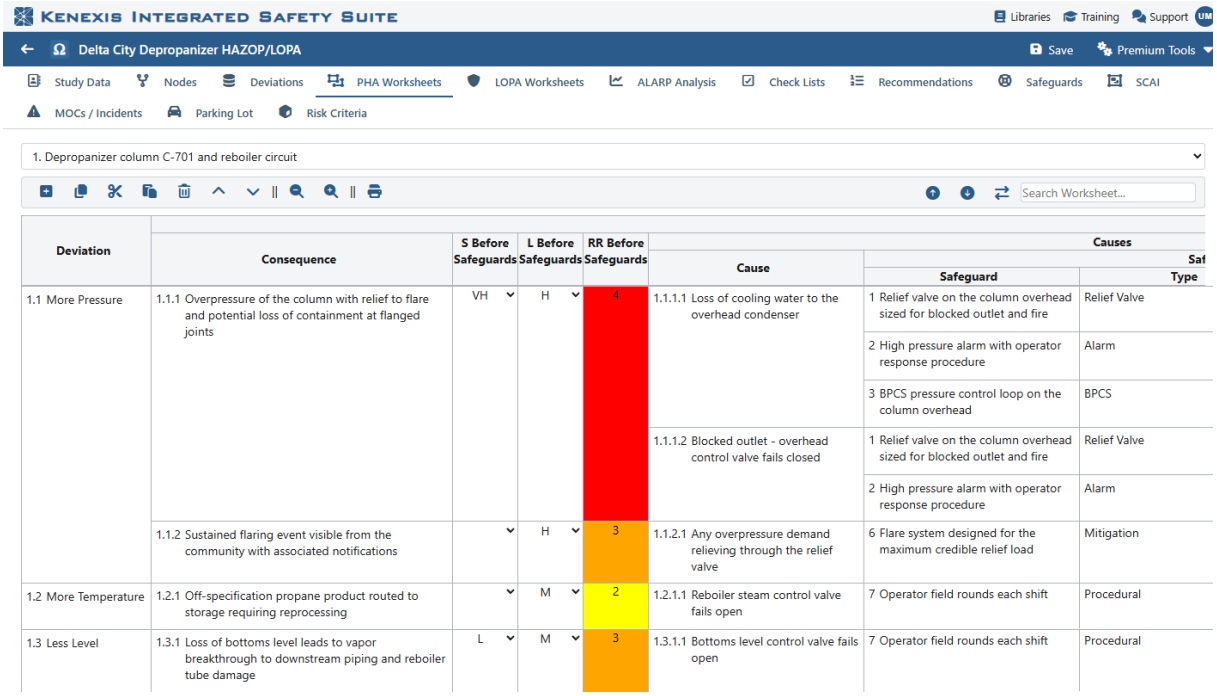


Figure 6-2. The Deviations page for the selected node.

7 PHA Worksheets

7.1 The Worksheet

The PHA Worksheets tab is the primary workspace for building scenarios. The dropdown above the worksheet selects the node, and the worksheet shows that node's deviations with their scenarios nested beneath: in a consequence-indexed study each consequence lists its causes, and in a cause-indexed study each cause lists its consequences. Safeguards attach to each scenario from the shared safeguard list (Chapter 11).



Deviation	Consequence	S Before Safeguards	L Before Safeguards	RR Before Safeguards	Causes		
					Cause	Safeguard	Saf Type
1.1 More Pressure	1.1.1 Overpressure of the column with relief to flare and potential loss of containment at flanged joints	VH	H	4	1.1.1.1 Loss of cooling water to the overhead condenser	1 Relief valve on the column overhead sized for blocked outlet and fire	Relief Valve
						2 High pressure alarm with operator response procedure	Alarm
						3 BPCS pressure control loop on the column overhead	BPCS
					1.1.1.2 Blocked outlet - overhead control valve fails closed	1 Relief valve on the column overhead sized for blocked outlet and fire	Relief Valve
						2 High pressure alarm with operator response procedure	Alarm
	1.1.2 Sustained flaring event visible from the community with associated notifications		H	3	1.1.2.1 Any overpressure demand relieving through the relief valve	6 Flare system designed for the maximum credible relief load	Mitigation
1.2 More Temperature	1.2.1 Off-specification propane product routed to storage requiring reprocessing		M	2	1.2.1.1 Reboiler steam control valve fails open	7 Operator field rounds each shift	Procedural
1.3 Less Level	1.3.1 Loss of bottoms level leads to vapor breakthrough to downstream piping and reboiler tube damage	L	M	3	1.3.1.1 Bottoms level control valve fails open	7 Operator field rounds each shift	Procedural

Figure 7-1. A consequence-indexed PHA worksheet: deviations, consequences, ranked risk, and causes with safeguards.

To build a scenario, click a cell and type. Text typed into the Safeguards column opens a filtered pick list of the study's existing safeguards — selecting one links it, and new text creates a new safeguard in the master list. Severity and likelihood cells are dropdowns fed by the risk criteria, and the risk rank cells compute and color themselves from the matrix as soon as a severity and likelihood are chosen.

The Scenario Context Bar keeps the current scenario's identity in view while you work in the right-hand columns. When enabled, a thin bar above the worksheet shows the deviation, cause, and consequence of the cell being edited and updates as the selection moves, so the scenario a safeguard or risk rank belongs to stays clear even when the cause and consequence columns have scrolled off to the left. It is switched on per study from the Study Settings dialog (section 4.8) and is off by default.

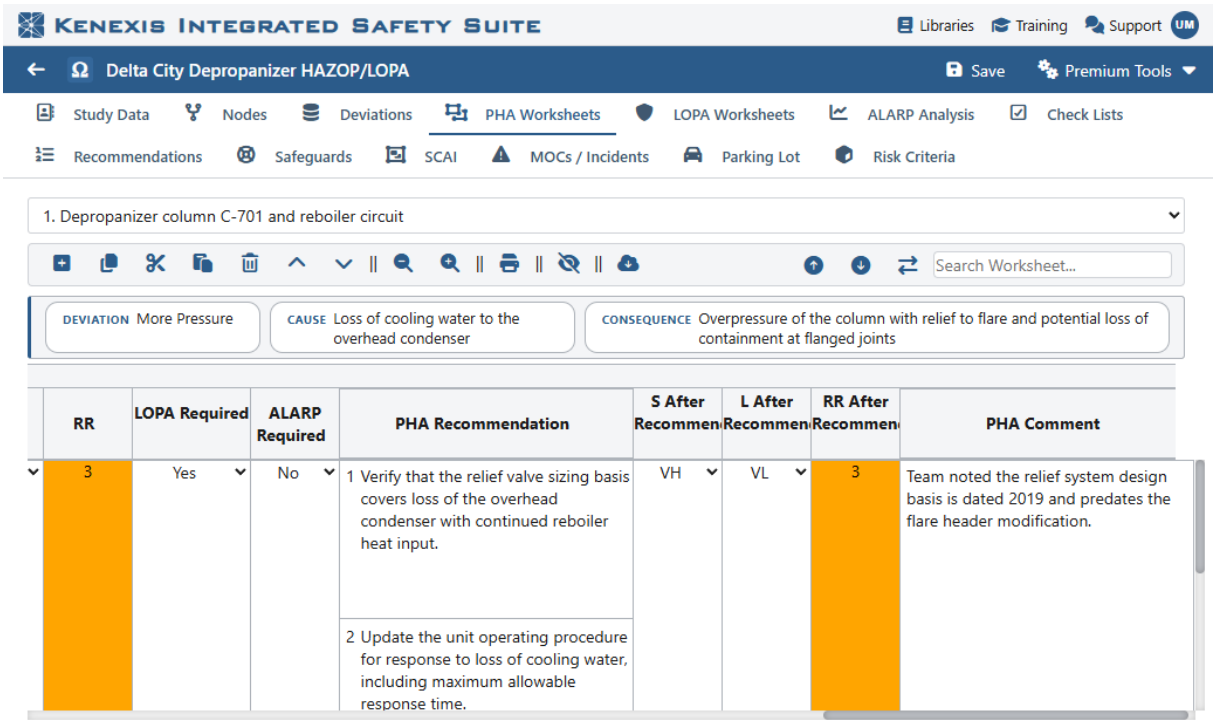


Figure 7-2. The Scenario Context Bar shows the active cell's deviation, cause, and consequence above the worksheet.

7.2 Risk Ranking Phases

Each scenario ranks in up to three phases, reading left to right across the worksheet:

- **Before Safeguards** — the unmitigated ranking, with no credit for safeguards.
- **Mitigated** — the ranking considering the safeguards in place today. These are the columns titled with the bare category codes.
- **After Recommendations** — the projected ranking once the scenario's recommendations are implemented.

In a consequence-indexed study each phase ranks per consequence category — a column per visible category code — and the scenario's overall rank is the most severe of them (Chapter 9).

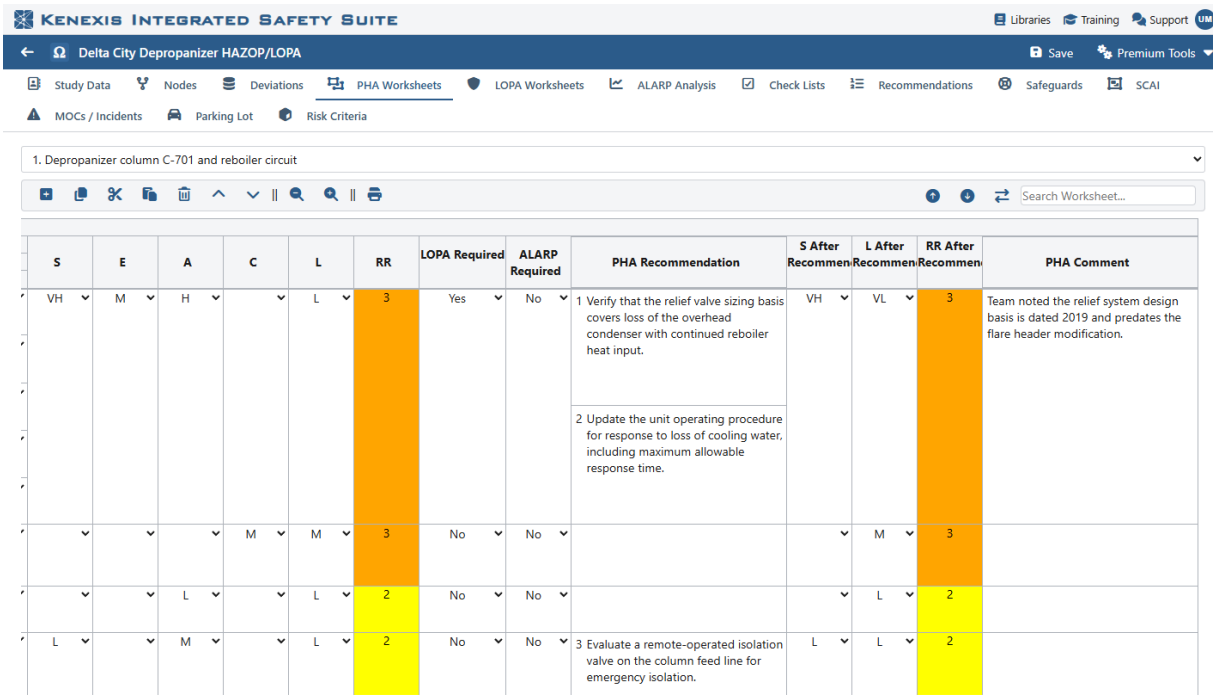


Figure 7-3. The right-hand worksheet columns: mitigated per-category severities, LOPA Required, recommendations, and the after-recommendations phase.

7.3 Flagging Scenarios for LOPA

Setting a scenario's LOPA Required field to Yes carries it onto the LOPA worksheet (Chapter 8), where the same cause and consequence data continue seamlessly into the quantitative analysis. Scenarios can also flag ALARP Required to appear on the ALARP worksheet when that optional tab is enabled (section 12.1).

Comments and recommendations link to each scenario from their cells on the worksheet; the full registers are described in Chapter 11.

8 LOPA Worksheets

8.1 The Worksheet

The LOPA worksheet continues the PHA scenarios that were flagged LOPA Required. Where the data is shared — deviations, causes, consequences, severities — the PHA and LOPA worksheets edit the same records, and a scenario created directly on the LOPA worksheet creates its PHA counterpart with LOPA Required set to Yes.

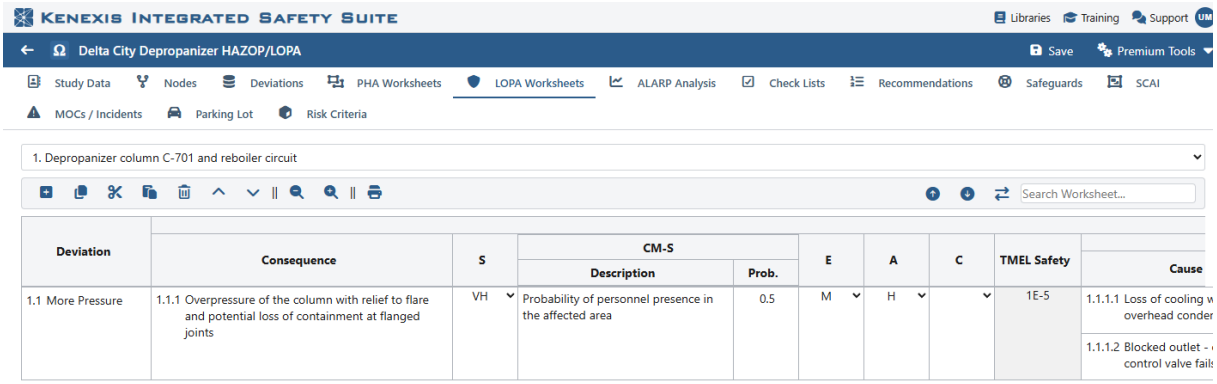


Figure 8-1. The LOPA worksheet: consequence, conditional modifiers, TMEL, causes with frequencies, enabling events, and IPLs.

The LOPA columns add the quantitative model. Each cause carries its initiating event frequency and any enabling events (probability factors that must be present for the cause to progress). Each consequence carries its conditional modifiers (probability factors on the outcome, such as occupancy) and its TMEL, populated automatically from the selected severity's TMEL. The IPLs column lists the attached safeguards; safeguards flagged as IPLs display their independence attributes and PFD, and they alone credit the calculation (section 11.2).

8.2 Results

The right-hand columns present the computed results — the LOPA risk rank, the mitigated event likelihood, the LOPA ratio, the required risk reduction factor, and the recommended SIL — with values that exceed their target shown in red. LOPA recommendations and comments link to each scenario from the final columns. Chapter 9 defines every calculation.

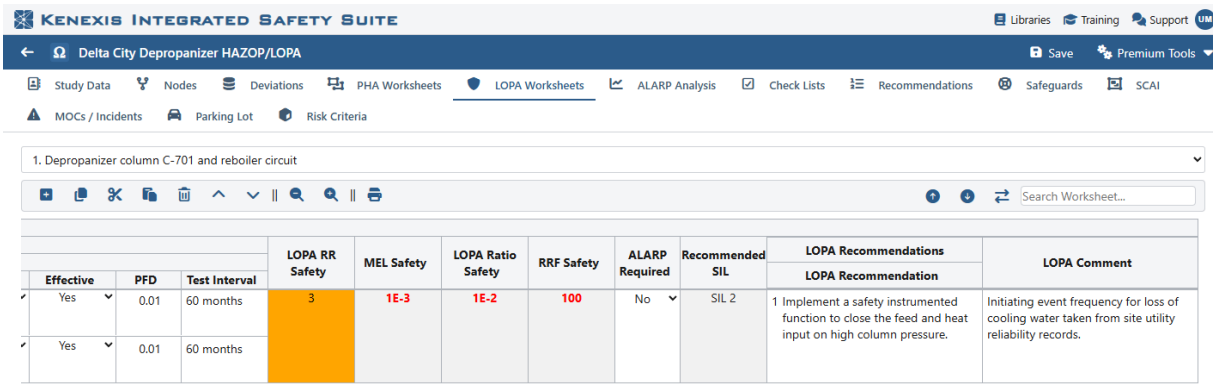


Figure 8-2. LOPA results: risk rank, MEL, LOPA ratio, RRF, and the recommended SIL, with a linked recommendation.

9 Risk Ranking and LOPA Calculations

Every computed value in Kenexis Open-PHA updates live in the browser as the team works, and the results are stored with the study when it is saved. This chapter defines the calculations. The worked examples use round illustrative numbers.

9.1 PHA Risk Ranking

A scenario's risk rank in each phase comes from the risk matrix: the selected severity and likelihood identify a matrix cell, and the cell's risk ranking becomes the scenario's rank, painted with the ranking's color. In a consequence-indexed study the lookup runs once per visible consequence category, and the scenario's overall rank is the highest-priority (most severe) of the per-category ranks. The Before Safeguards and After Recommendations phases repeat the lookup with their own likelihood selections.

9.2 Explicit LOPA

In an explicit LOPA study each cause carries an initiating event frequency. The cause's contribution to the mitigated event likelihood is its frequency reduced by its enabling events and by the probability of failure on demand of each IPL credited on that cause:

$$\mathrm{MEL}_{\mathrm{cause}} = F_{\mathrm{IE}} \cdot \prod_{\mathrm{EE}} P_{\mathrm{EE}} \cdot \prod_{\mathrm{IPL}} \mathrm{PFD}_{\mathrm{IPL}}$$

The consequence's mitigated event likelihood sums the cause contributions and applies the conditional modifiers. In a consequence-indexed study the calculation runs per consequence category, using that category's conditional modifiers:

$$\mathrm{MEL} = \left(\sum_{\mathrm{causes}} \mathrm{MEL}_{\mathrm{cause}} \right) \cdot \prod_{\mathrm{CM}} P_{\mathrm{CM}}$$

The target is the TMEL of the selected consequence severity (section 5.2). Two ratios compare the result to the target:

$$\mathrm{LOPA\ Ratio} = \frac{\mathrm{TMEL}}{\mathrm{MEL}}$$

$$\mathrm{RRF} = \frac{\mathrm{MEL}}{\mathrm{TMEL}}$$

A LOPA ratio of one or greater — equivalently an RRF at or below one — indicates the scenario meets its target with the credited layers. An RRF above one is the additional risk reduction still required, and it drives the recommended SIL:

Table 9-1. Recommended SIL by required risk reduction factor.

Required RRF	Recommended SIL
Below 10	No SIL
10 to below 100	SIL 1

Required RRF	Recommended SIL
100 to below 1,000	SIL 2
1,000 to below 10,000	SIL 3
10,000 to 100,000	SIL 4
Above 100,000	Greater than SIL 4

In a consequence-indexed study the recommended SIL uses the largest RRF across the consequence categories, so one SIL requirement covers the scenario's worst case. Values that exceed their target — an MEL above the TMEL, or an RRF above one — display in red on the worksheet.

9.3 The LOPA Risk Rank

The explicit LOPA worksheet also expresses the computed MEL as a matrix rank: the MEL is matched to the smallest likelihood category whose frequency is at or above it, and that likelihood, with the selected severity, looks up the matrix exactly as in the PHA. This presents the quantitative result in the same language as the qualitative ranking.

9.4 Implicit LOPA

In an implicit LOPA study the team works in LOPA credits rather than frequencies. The risk rank at the intersection of the cause likelihood and the consequence severity sets the required credits (from the Risk Rankings page, section 5.3), and each enabling event, conditional modifier, and IPL contributes its credit value:

$$\text{LOPA Gap} = \max\left(0, C_{\text{required}} - \sum C_{\text{EE}} - \sum C_{\text{CM}} - \sum C_{\text{IPL}}\right)$$

Each full credit corresponds to one order of magnitude of risk reduction — a credit of 1 corresponds to a PFD of 0.1, and a credit of 2 to a PFD of 0.01. The goal of an implicit LOPA is a gap of zero, which implies tolerability of risk; a remaining gap drives the recommended SIL directly (a gap of one recommends SIL 1, and so on). A fractional gap rounds down, because part of a credit does not reach the next SIL: a gap of 2.5 recommends SIL 2, and a gap below one recommends no SIL.

In a consequence-indexed study the calculation runs for each cause in each consequence category. The consequence's conditional modifiers for that category apply to every cause beneath it, so each cause row shows its own gap and LOPA risk rank. The consequence takes the gap and LOPA risk rank of its worst cause — the one still needing the most credits — and shows no LOPA risk rank when that number of credits matches no risk ranking's Required LOPA Credits.

9.5 A Worked Explicit Example

Consider a scenario with one cause: an initiating event frequency of 0.5 per year, an enabling condition with probability 0.4, and one credited IPL with a PFD of 0.01. The cause contribution is:

$$\text{MEL}_{\text{cause}} = 0.5 \cdot 0.4 \cdot 0.01 = 2 \cdot 10^{-3}$$

With a single conditional modifier of 0.25 on the consequence, the mitigated event likelihood becomes:

$$\text{MEL} = 2 \cdot 10^{-3} \cdot 0.25 = 5 \cdot 10^{-4}$$

Against a selected severity whose TMEL is 1E-5, the required risk reduction is:

$$\text{RRF} = \frac{5 \cdot 10^{-4}}{1 \cdot 10^{-5}} = 50$$

An RRF of 50 falls in the 10-to-100 band, so the worksheet recommends SIL 1. Implementing a LOPA recommendation that carries a PFD (for example a new safety instrumented function) multiplies into the after-recommendations result, and the worksheet shows the scenario meeting its target once the credited PFD closes the gap.

9.6 Scope of the Calculated Values

The calculations use the worksheet as configured. An enabling event, conditional modifier, IPL or LOPA recommendation counts only while its column and its credit, probability or PFD column are both visible on the LOPA worksheet; hiding either column leaves that factor out of the worksheet and out of the values saved with the study. Visible severity columns participate in the risk ranking, disabled enabling events, conditional modifiers, IPLs and LOPA recommendations drop out of the calculation, and safeguards credit a PFD only when flagged as IPLs with a numeric PFD. Saved studies carry their computed values with them, so reports and dashboards present exactly what the worksheets showed when the study was saved.

10 Check Lists

10.1 Check List Categories

The Check Lists tab manages the checklists incorporated in the study. The Check List Categories page lists every checklist with its total question count, the number completed, and the percent complete — a live progress summary across the checklist portion of the PHA.

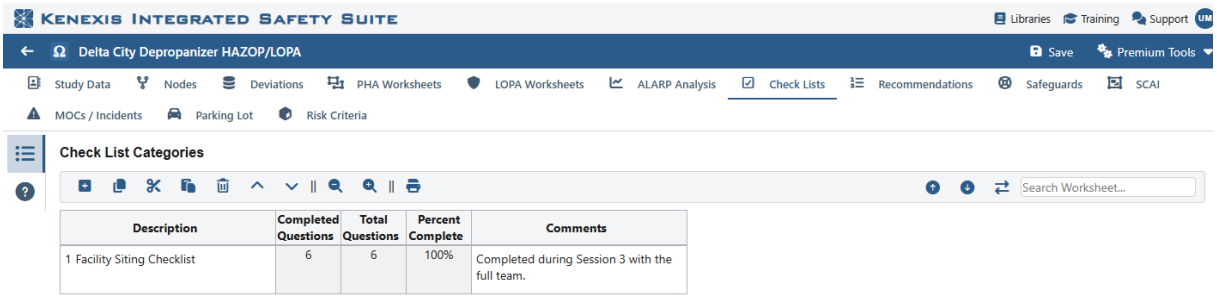


Figure 10-1. The Check List Categories page.

10.2 Check List Worksheets

The Check List Worksheets page hosts the questions of the checklist selected in the dropdown above the table. Each question takes an answer of Yes, No, or N/A, a justification, links to relevant safeguards, and — where the team acts on a question — a checklist recommendation, tracked in the Recommendations register like every other recommendation type. Checklist content can be typed directly, imported from a library template (section 13.7), or appended from a CSV file.

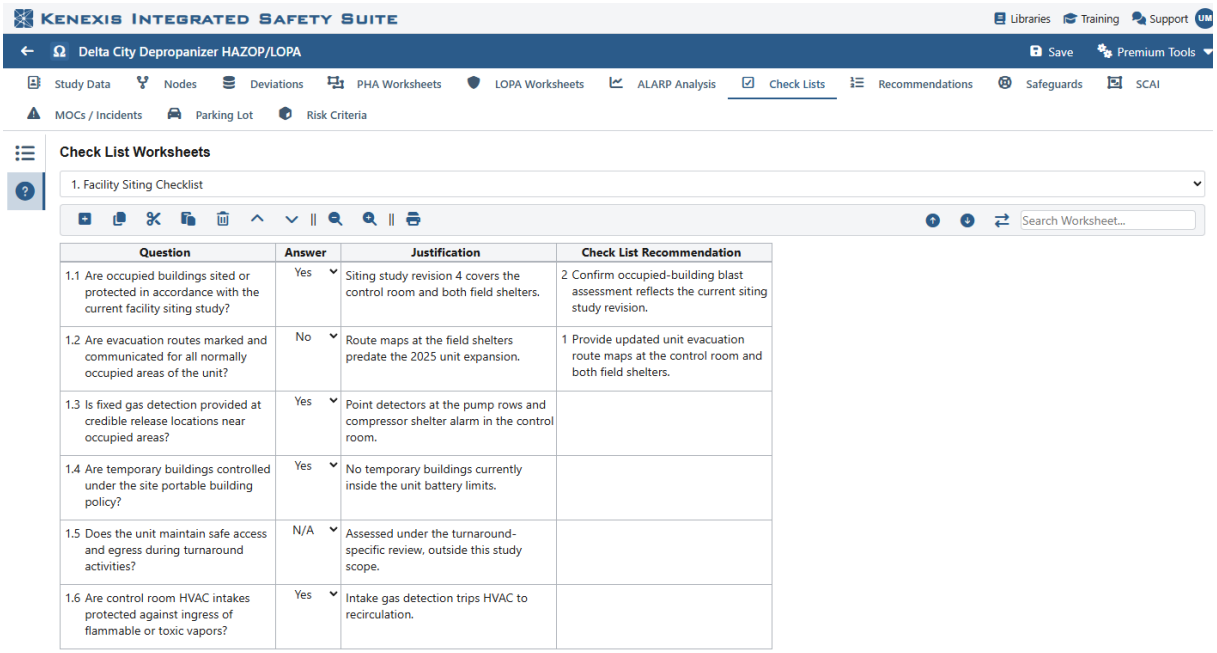
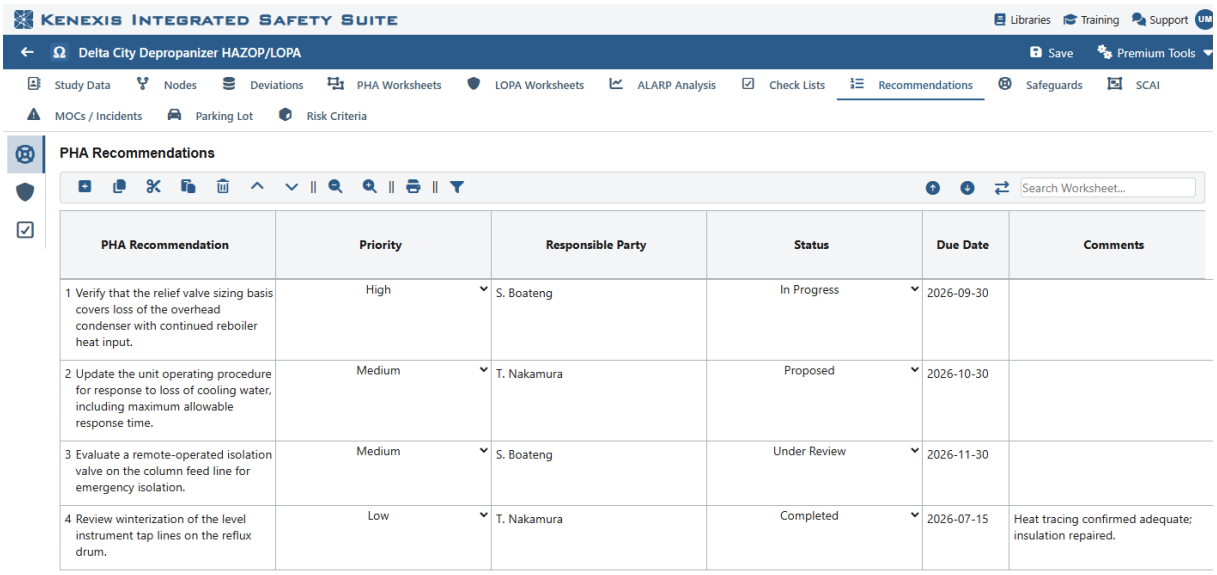


Figure 10-2. A checklist worksheet with answers, justifications, and a linked recommendation.

11 Recommendations, Safeguards, and the Parking Lot

11.1 Recommendations

The Recommendations tab consolidates every recommendation made during the study, grouped by origin on its rail: PHA Recommendations, LOPA Recommendations, and Check List Recommendations. Each record carries the recommendation text, a priority (High, Medium, or Low), the responsible party, a status spanning the recommendation lifecycle (Proposed through Implemented, Closed, and beyond), a due date, and comments. The Referenced Locations column links each recommendation back to every scenario that raised it. LOPA recommendations additionally carry the PFD (explicit studies) or IPL credit (implicit studies) that the after-recommendations calculation applies.



PHA Recommendation	Priority	Responsible Party	Status	Due Date	Comments
1 Verify that the relief valve sizing basis covers loss of the overhead condenser with continued reboiler heat input.	High	S. Boateng	In Progress	2026-09-30	
2 Update the unit operating procedure for response to loss of cooling water, including maximum allowable response time.	Medium	T. Nakamura	Proposed	2026-10-30	
3 Evaluate a remote-operated isolation valve on the column feed line for emergency isolation.	Medium	S. Boateng	Under Review	2026-11-30	
4 Review winterization of the level instrument tap lines on the reflux drum.	Low	T. Nakamura	Completed	2026-07-15	Heat tracing confirmed adequate; insulation repaired.

Figure 11-1. The PHA Recommendations register.

11.2 Safeguards and IPLs

Safeguards live in one master list shared by the whole study: entering a safeguard on any worksheet creates it here, and linking an existing safeguard reuses the same record — so editing it once updates every scenario that references it. The Safeguards tab manages the list. Each safeguard carries its type, tag, and category; the Is Safeguard and Is IPL flags that control where it appears (PHA worksheet, LOPA worksheet, or both); the IPL qualification attributes — Independent, Auditable, Effective — and the PFD (or IPL credit) that the LOPA calculation credits; and maintenance data such as safety-critical designation, response time, and test interval. Referenced Locations links each safeguard to every scenario that uses it — the essential view for safeguard and IPL rationalization.

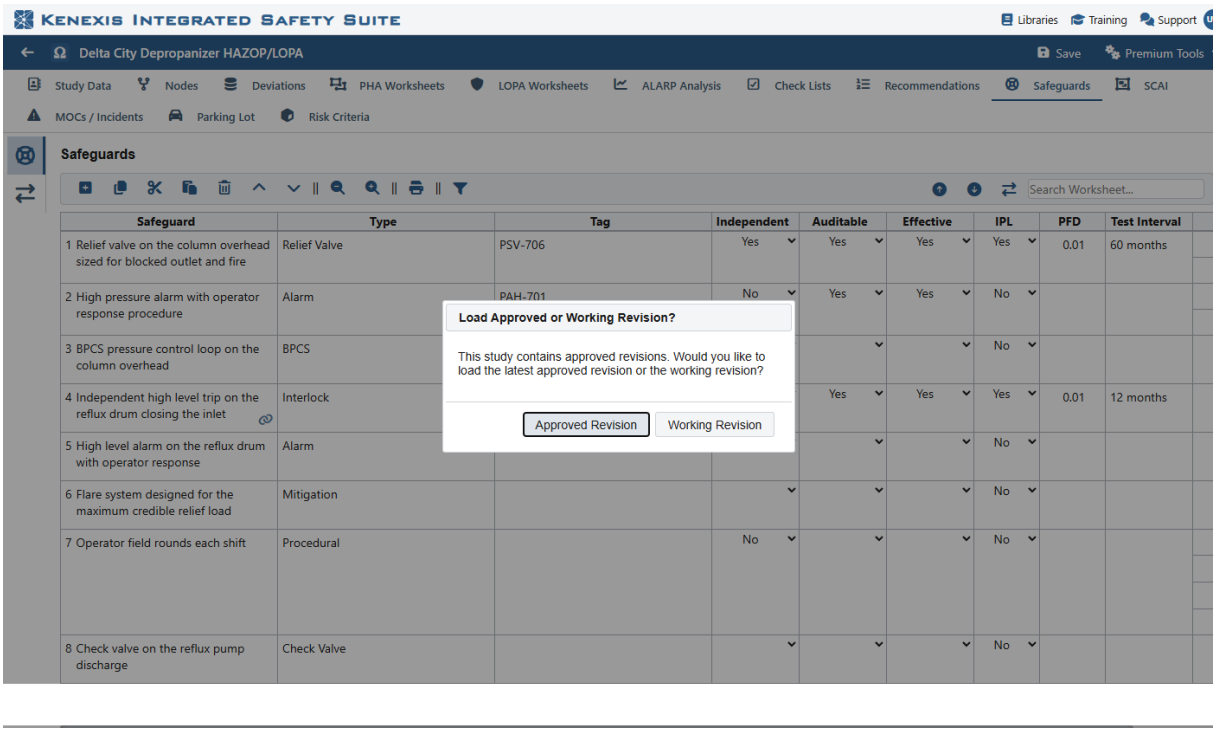


Figure 11-2. The Safeguards register, with a Kenexis SIS link icon on a synchronized IPL.

The rail's second page, Synchronize IPLs with Kenexis SIS, opens the Kenexis SIS synchronization described in section 13.8.

11.3 Parking Lot and Comments

The Parking Lot tracks items that warrant follow-up without rising to the level of a recommendation — a drawing to verify, a document to update — each with a response, a responsible party, and start and end dates. Its rail also carries the PHA Comments and LOPA Comments pages: every comment made on the worksheets, with links back to the scenarios where it was made.

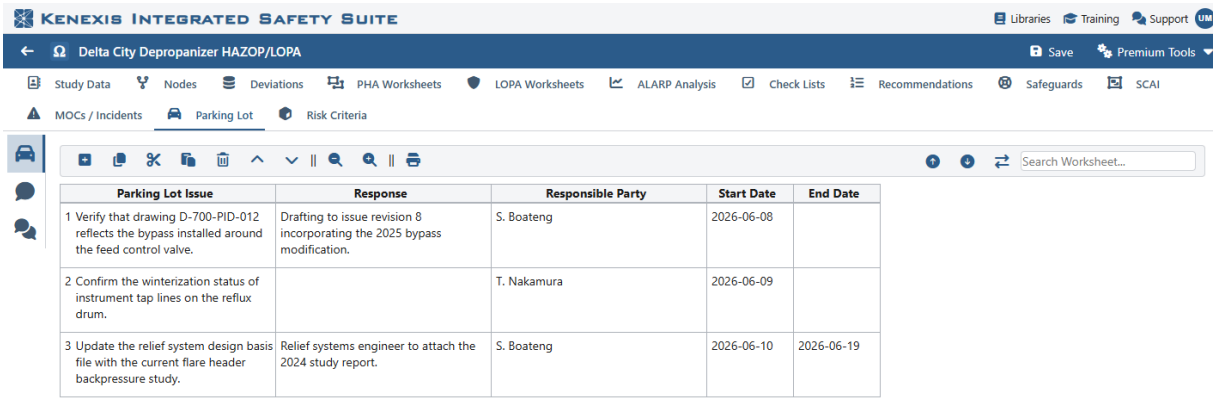


Figure 11-3. The Parking Lot.

12 Optional Worksheets

Three additional tabs switch on per study from Study Settings (section 4.8), extending the study record for organizations that manage these programs within the PHA.

12.1 ALARP Analysis

The ALARP Analysis worksheet demonstrates that risk is As Low As Reasonably Practicable for the scenarios flagged ALARP Required on the PHA worksheet. Each scenario lists the risk-reduction options the team considered — categorized using the ALARP categories defined on the Risk Criteria rail — with a description, whether the option is practicable, and the justification. Options judged practicable typically become recommendations; options rejected as grossly disproportionate document the ALARP case.

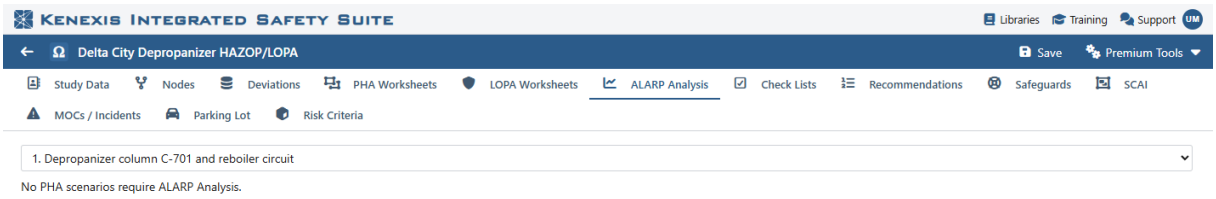


Figure 12-1. The ALARP Analysis worksheet.

12.2 SCAI

The SCAI tab registers Safety Controls, Alarms, and Interlocks: each record carries its type, tag, safety-critical designation, selected SIL, required response time, and test interval, and links to the safeguards it implements. The register gives operations a single handover list of the instrumented safeguards the PHA relies on.

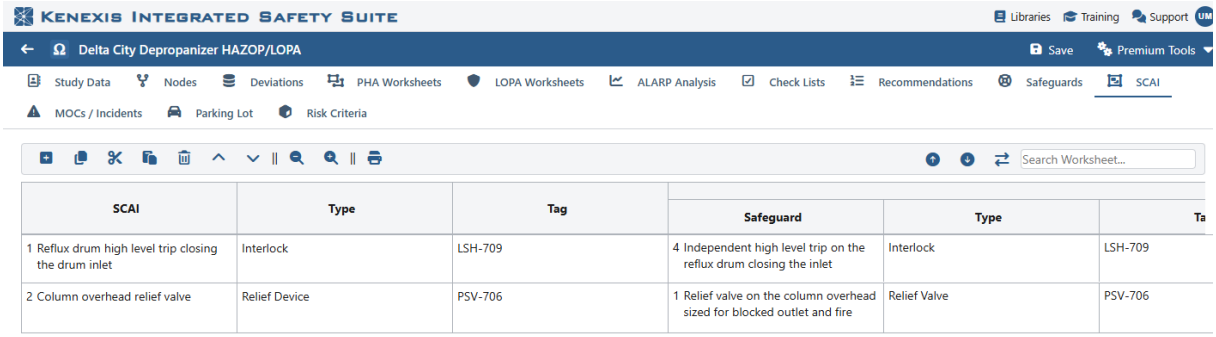


Figure 12-2. The SCAI register.

12.3 MOCs and Incidents

The MOCs / Incidents tab records the change and incident history the team reviewed. Its rail carries three pages: MOCs (management of change records with number, description, status, and duration), Previous Incidents (the site's own incidents, with reference, date, level, status, and the team's

discussion), and Industry Incidents (relevant external events and how the study addresses them). Each page supports CSV append-import for lists prepared outside Kenexis Open-PHA.

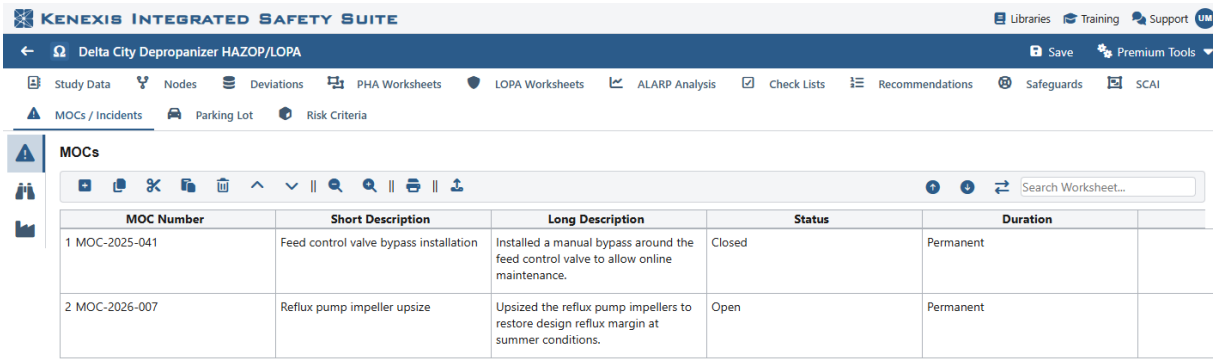


Figure 12-3. The MOCs / Incidents tab.

13 Premium Tools

13.1 The Premium Tools Menu

The Premium Tools menu in the workspace header gathers the productivity features of Kenexis Open-PHA Cloud-Premium: the report generator, study search, spell check and translation, the revision manager and previous versions, the import tools, the template libraries and library synchronization, Kenexis SIS synchronization, and the bowtie diagram visualizer.

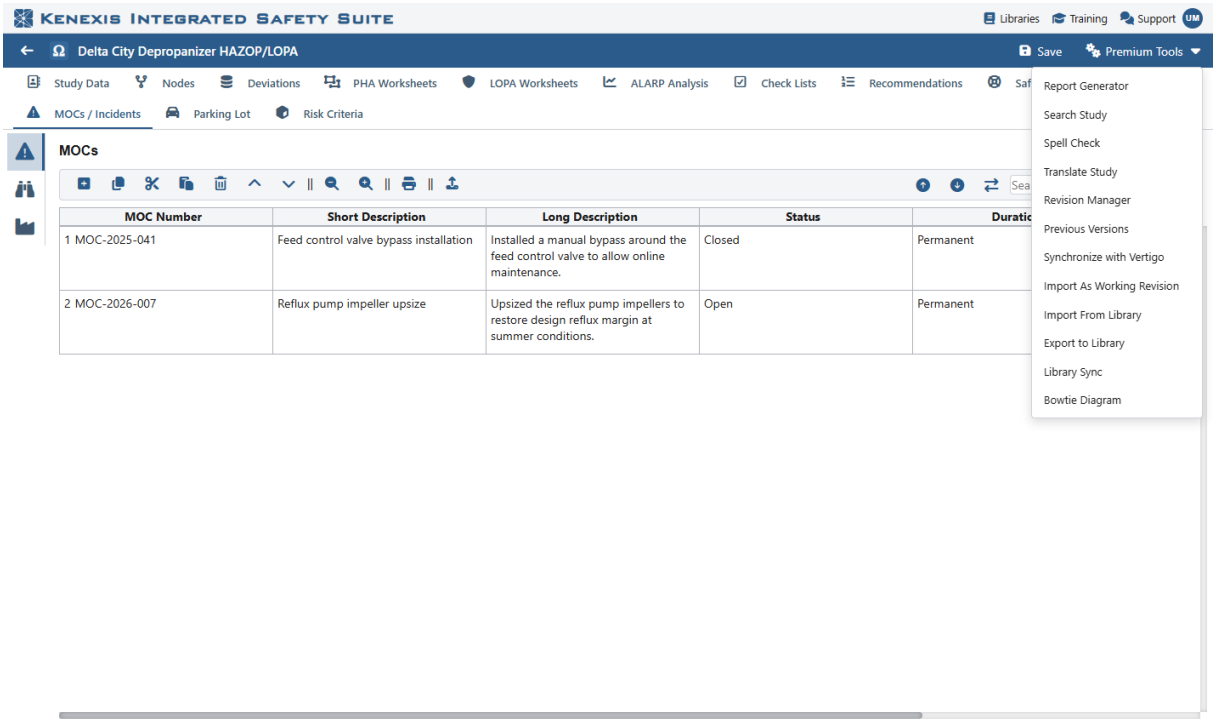


Figure 13-1. The Premium Tools menu.

13.2 Report Generation

Report Generator builds complete study reports server-side. Basic reporting selects any combination of study sections — the study data pages, risk criteria, nodes, the PHA and LOPA worksheets, recommendations, checklists, the optional worksheets, and more — and produces a Word document (with selectable page size and orientation) or an Excel workbook. Toggles include the referenced-locations columns and hide disabled items from the output.

The Excel workbook carries the presentation of its Word counterpart: risk-rank and consequence-category cells keep their colors, long entries wrap within a top-aligned cell, every cell is ruled, column widths follow their contents, and header rows are shaded. Merge Repeated Cells (Excel only) additionally merges each node, deviation and cause down the rows it governs, reproducing the worksheet hierarchy of the Word report. The toggle is on by default and becomes available once Excel is

the selected format. Clearing it keeps every cell independent, with each identifier on the first row of its group — the form to choose when the workbook is destined for sorting, filtering, or a pivot table.

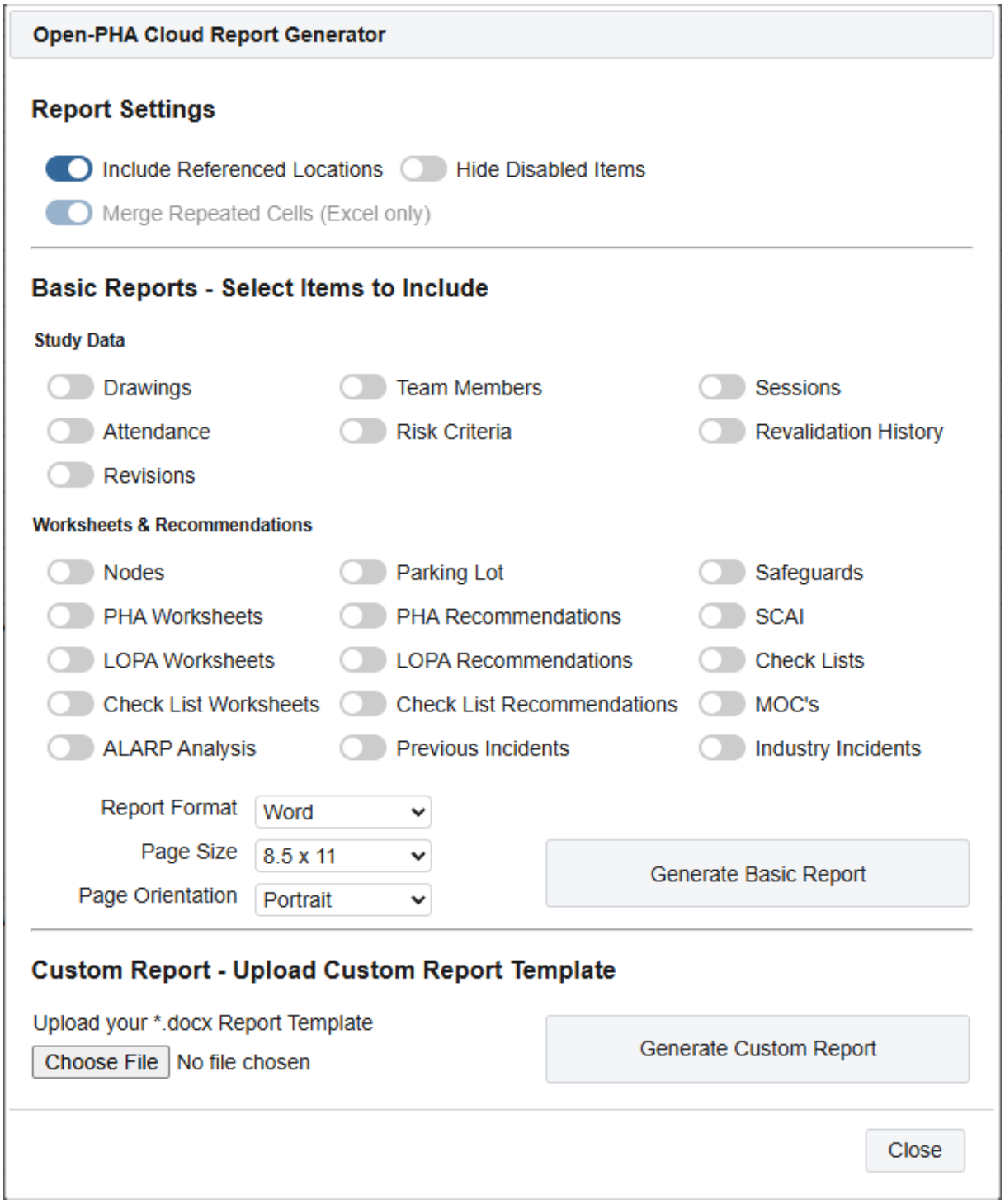


Figure 13-2. The Report Generator.

Custom reporting populates your own Word template: upload a .docx containing text patterns of the form <%Pattern%>, and Kenexis Open-PHA replaces each pattern with the corresponding study data —

single fields (for example <%Facility%>) or entire tables (for example <%Pha_Worksheets%>). Building the patterns into your organization's report template produces a finished, branded PHA report in one step. The recognized patterns are listed on the Kenexis support website.

13.3 Search Study

Search Study finds text anywhere in the study. Find Next steps through the hits; Find All lists every match with its location, and clicking a result navigates to the scenario and selects the cell. Case-sensitive and whole-word options refine the search, and the worksheet toolbar's search box adds per-worksheet find and replace-all.

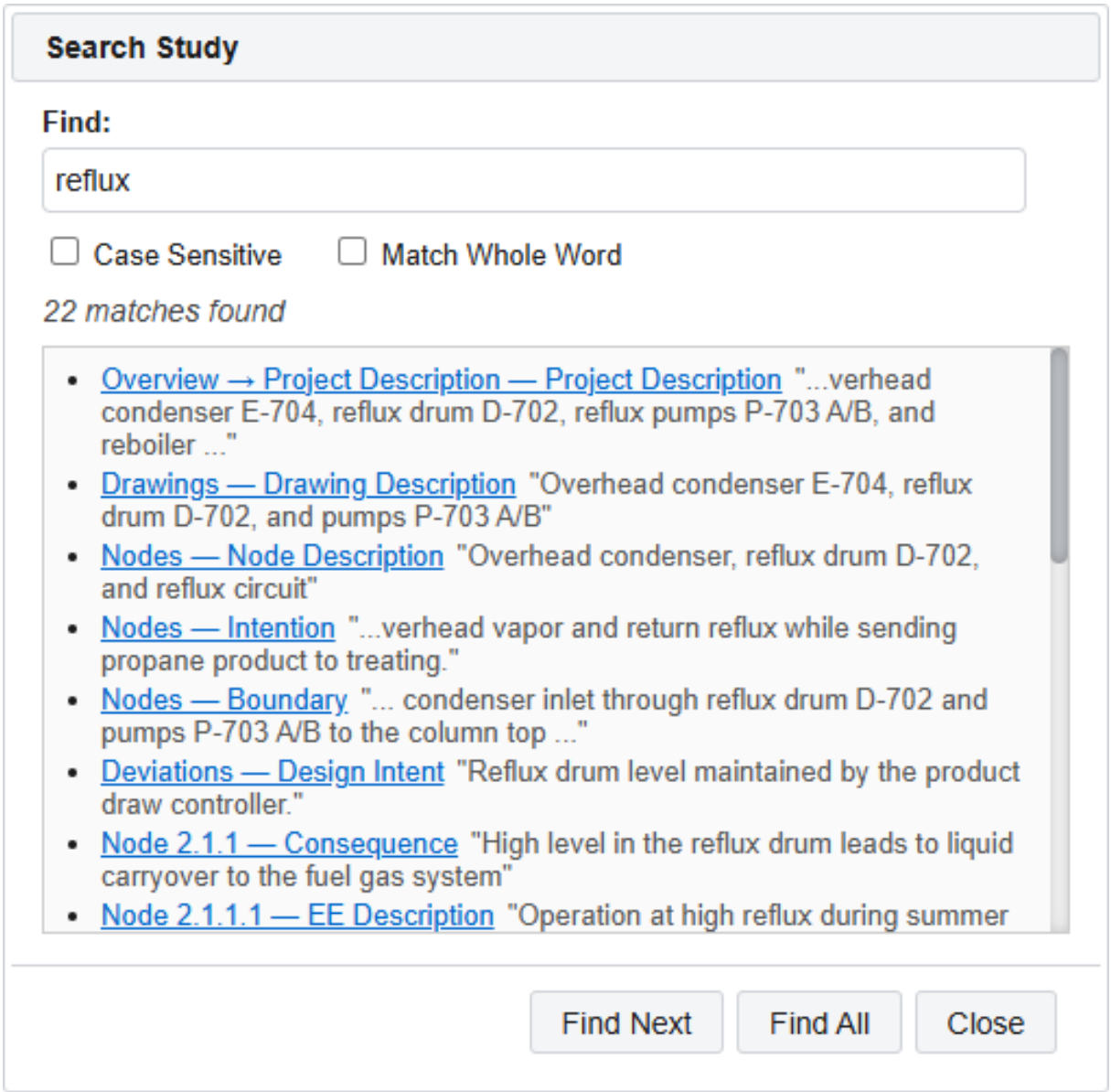


Figure 13-3. Search Study with results across the study.

13.4 Spell Check and Translation

Spell Check reviews the entire study — every worksheet, visible or not — against a dictionary in your language, offering Replace, Replace All, Ignore, Ignore All, and Add To Dictionary for each finding. Words added to the dictionary persist for future sessions.

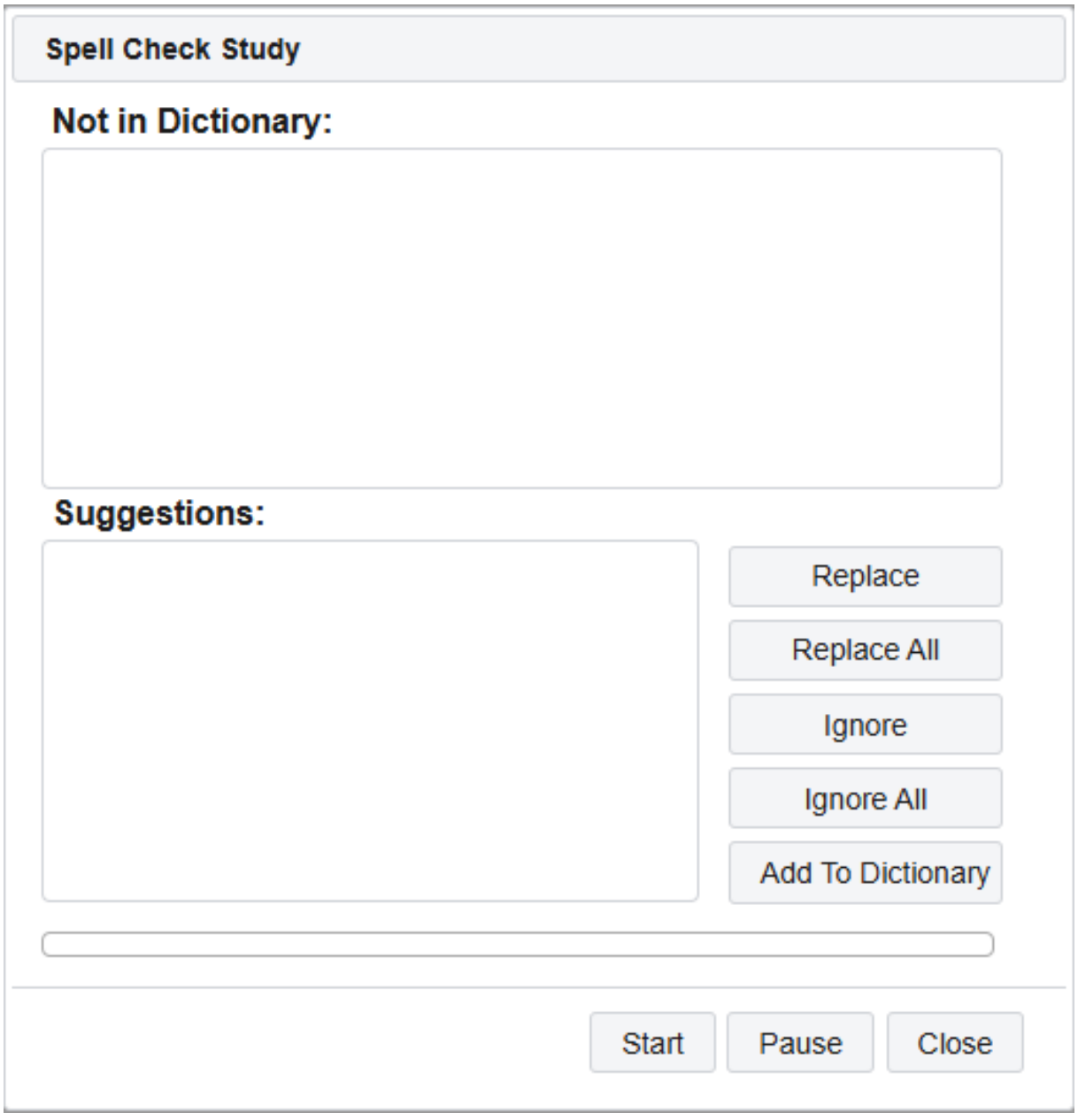


Figure 13-4. Spell Check Study.

Translate Study translates the study's text content into a selected language using a cloud translation engine. Translation runs in the background on the server, and an email notifies you at the address on your KISS account when the translated study is ready.

13.5 Revision Management

The Revision Manager — reached from Premium Tools or the Study Data rail — maintains the study's formal revision history. Add Revision snapshots the current study under a revision name, with a description and remarks; the creator and creation date are recorded automatically.

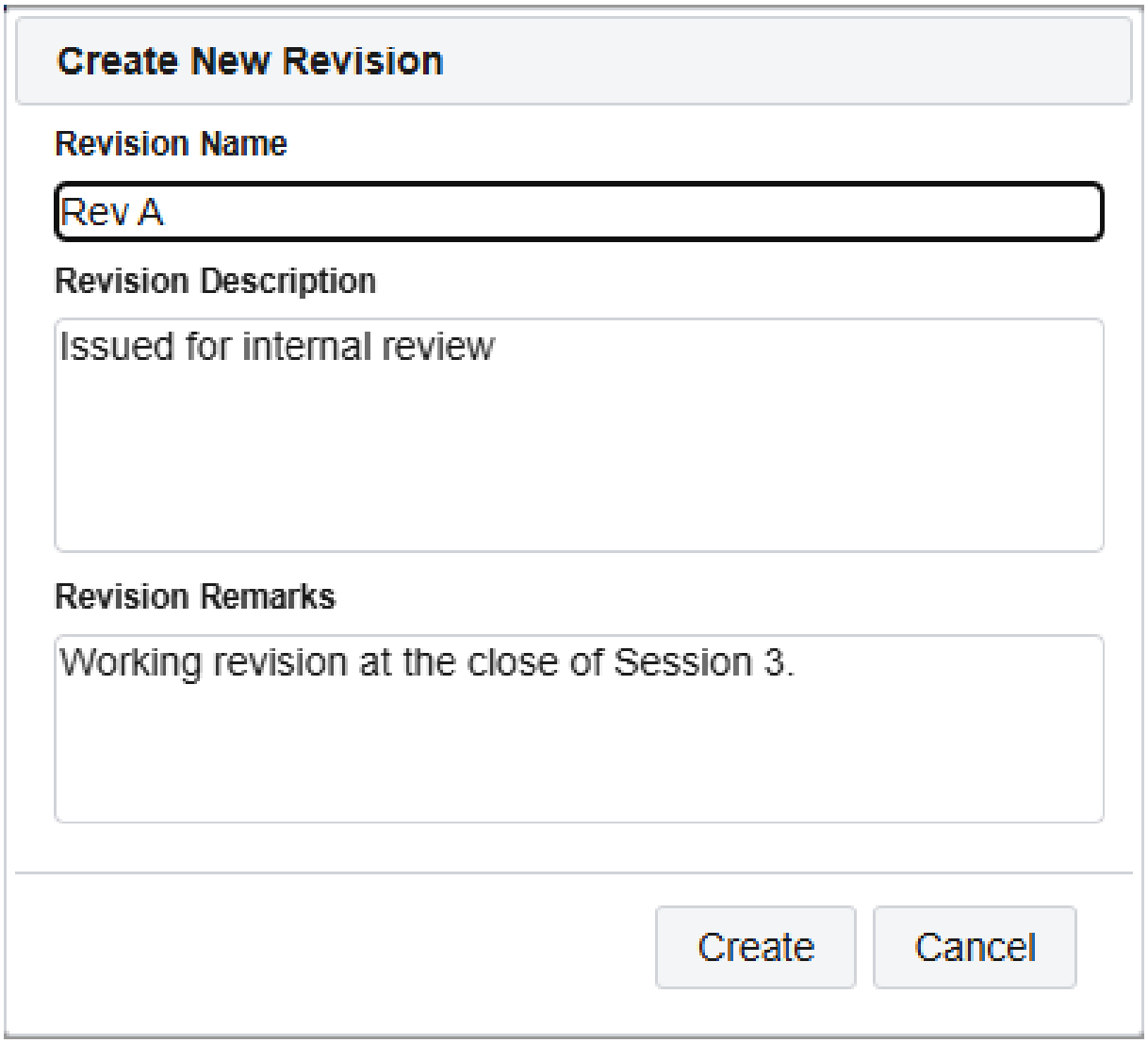


Figure 13-5. Creating a revision.

Edit Revision updates a revision's properties and carries the Approve Revision action: approval stamps the approver and approval date onto the revision record.

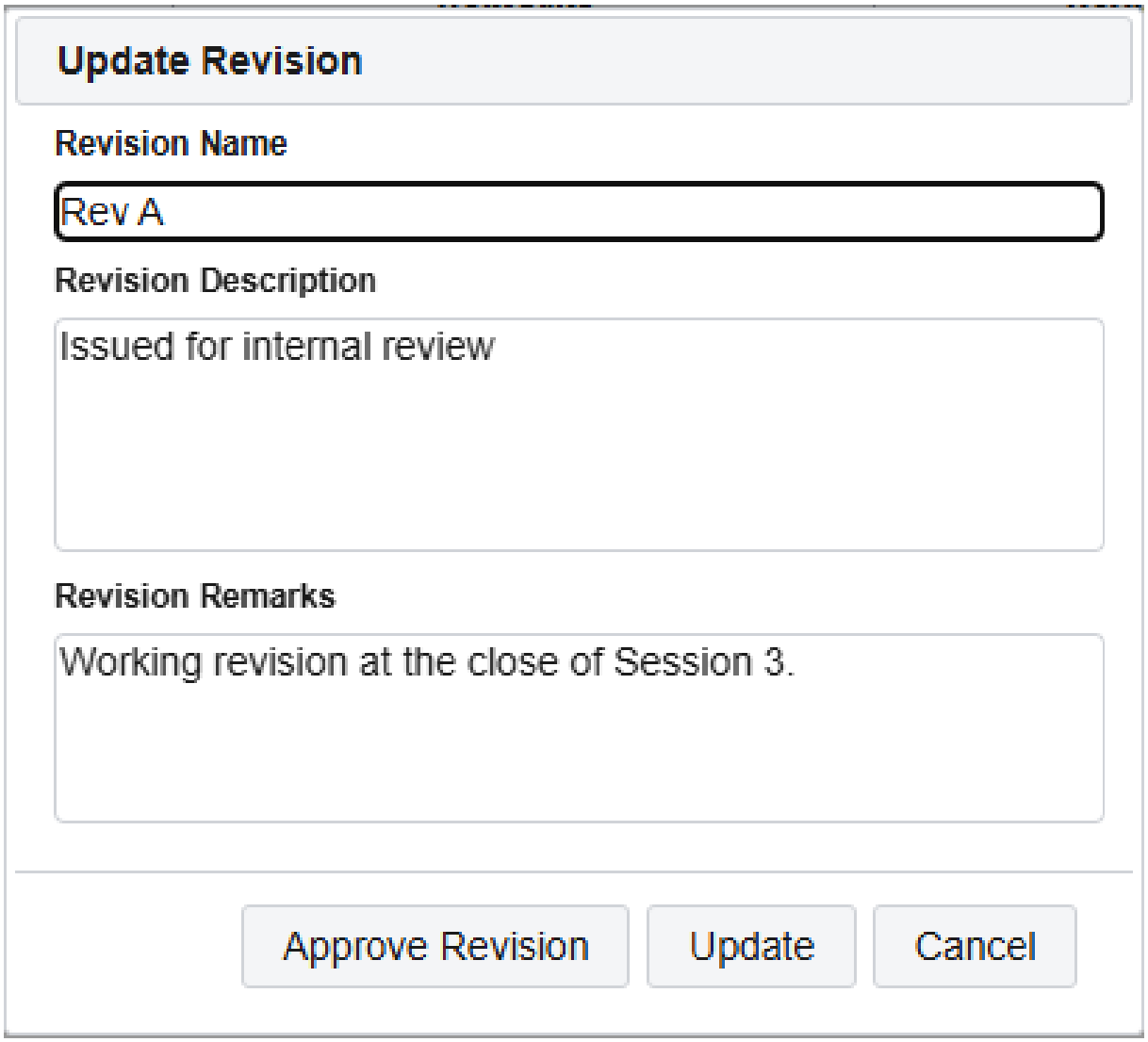


Figure 13-6. Updating and approving a revision.

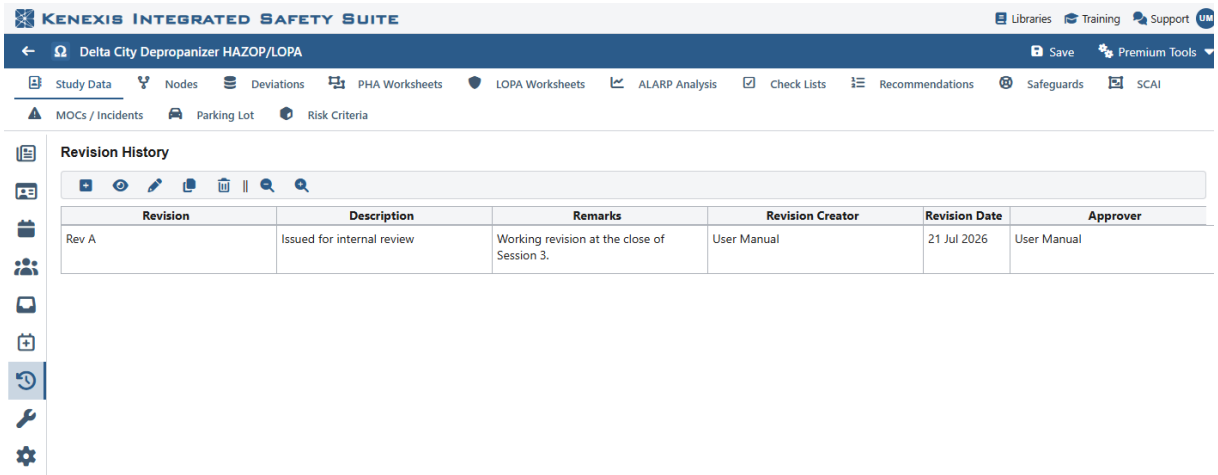


Figure 13-7. The Revision History page with an approved revision.

View Revision loads the selected snapshot read-only, so the study can be seen exactly as it stood at that revision; the View Working Revision button returns to the editable working copy. Copy Revision creates a new study from the snapshot, and Delete removes a revision from the history.

When a study with approved revisions opens, Kenexis Open-PHA offers the choice of loading the latest approved revision (read-only) or the working revision:

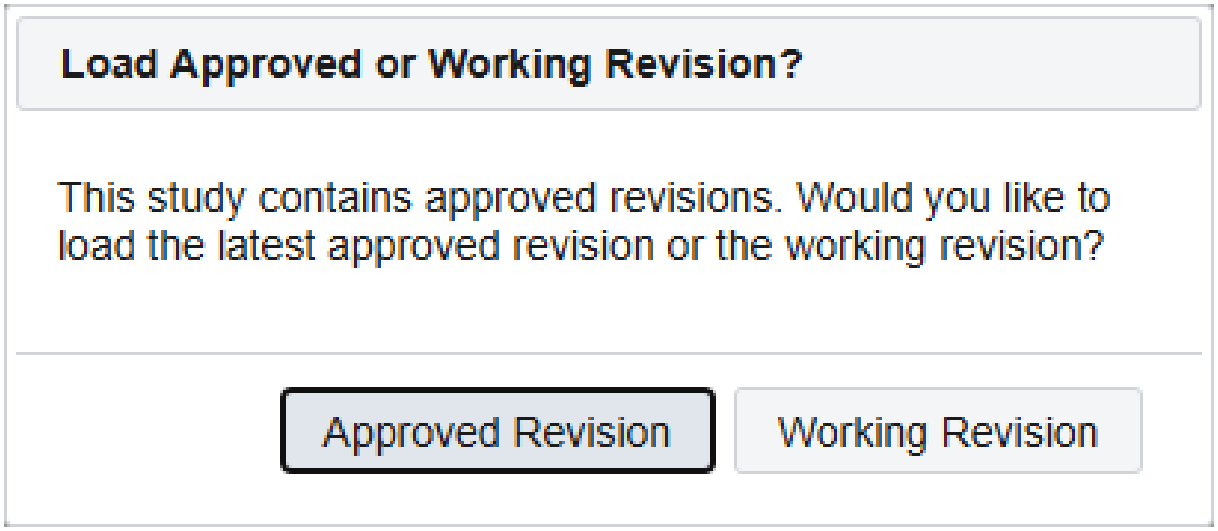


Figure 13-8. Opening a study that has approved revisions.

13.6 Previous Versions and Working-Revision Imports

Previous Versions lists the ten most recent saves of the study — each entry with its date, author, and size — so a recent change can be reviewed or undone. Any version can be viewed read-only, downloaded as an .opha file, restored as the current study, or deleted. With auto-save enabled the list turns over quickly, so use Revision Management (section 13.5) to keep milestones for the long term.

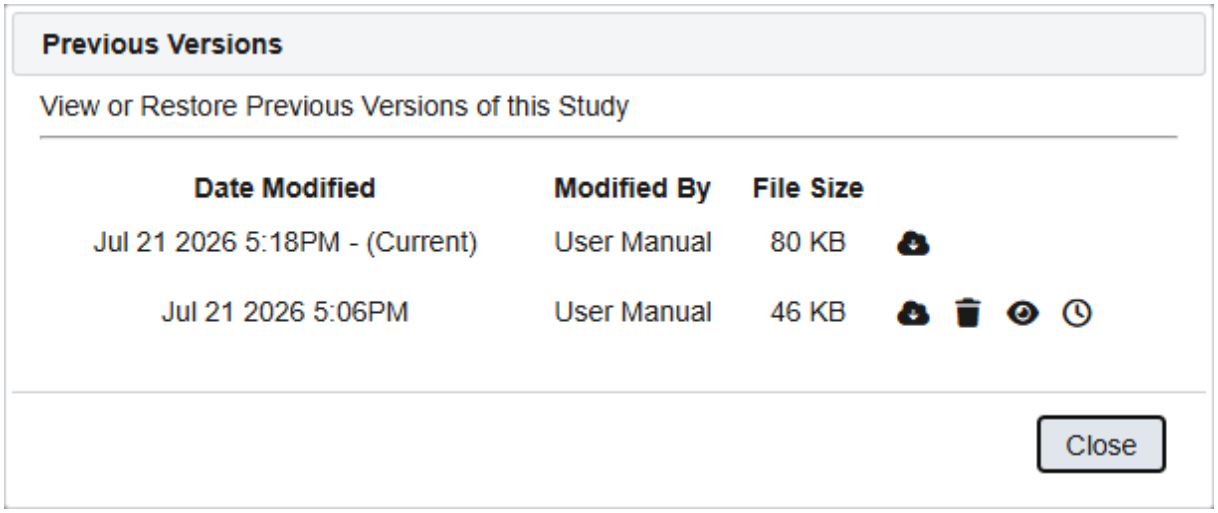


Figure 13-9. The Previous Versions dialog.

Import As Working Revision brings external data into the current study, replacing the working data after confirmation while preserving the study's identity — its revisions, links, and place in KISS:

- **From Kenexis Open-PHA Desktop** — re-uploads an .opha file edited offline. Together with Export, this supports a round trip: create a revision, export, facilitate offline, and import the result as the new working revision.
- **From PHAWorks** — imports a PHAWorks study exported in its Outline (entire project, hierarchical) format.
- **From CSV** — a mapping workspace that imports worksheet data from CSV files, with append and overwrite modes and reusable mapping configurations.

13.7 Template Libraries

KISS libraries hold reusable Kenexis Open-PHA content: whole study templates, node templates, checklist templates, risk criteria sets, and study settings. Export to Library publishes content from the open study — for example Export Node captures a complete node, with its deviations and scenarios, as a named template:

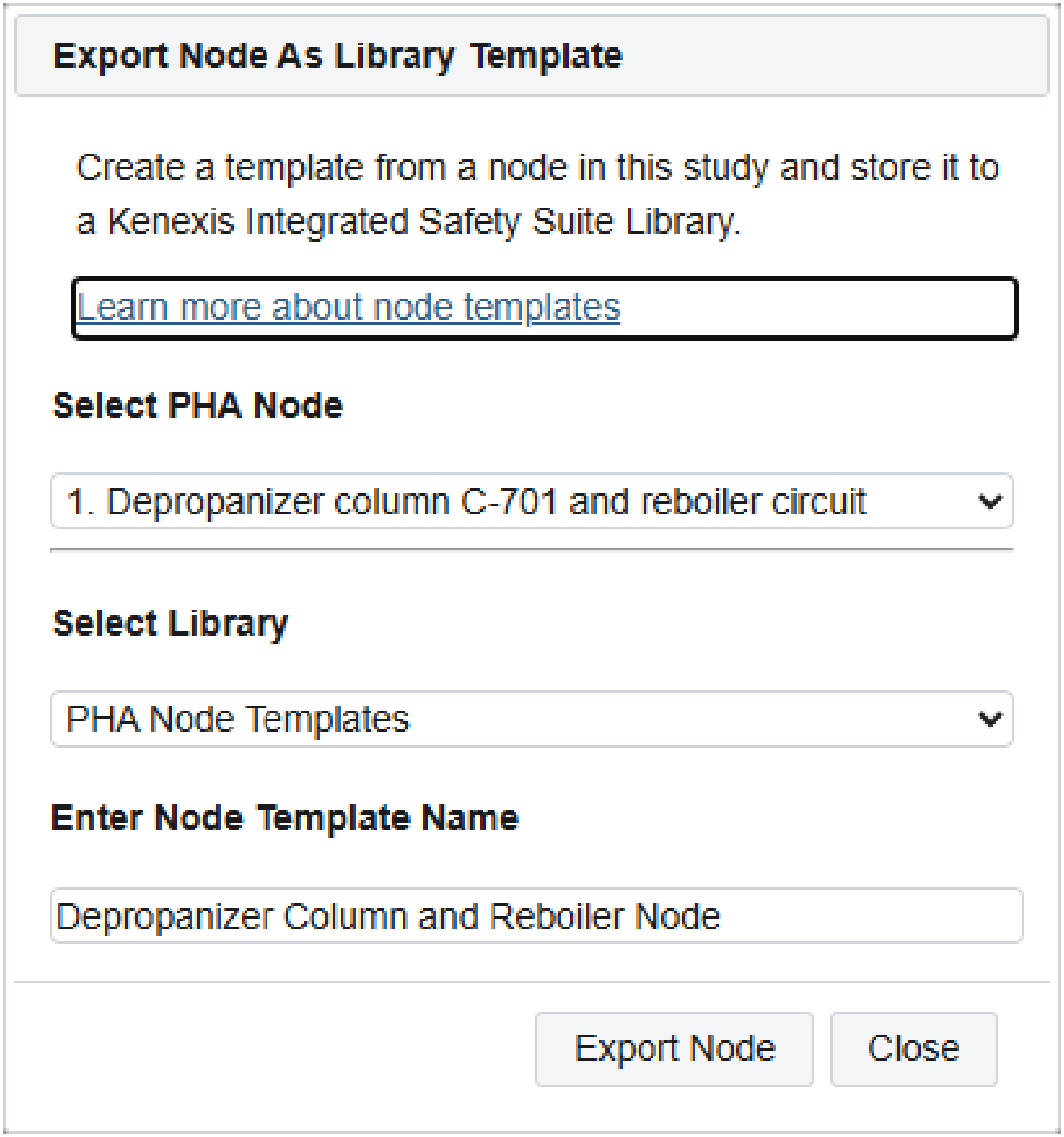


Figure 13-10. Exporting a node as a library template.

Import from Library brings templates into the study. Importing a node creates it with its full worksheet content, with merge options for the shared registers (safeguards and recommendations) to avoid duplicates:

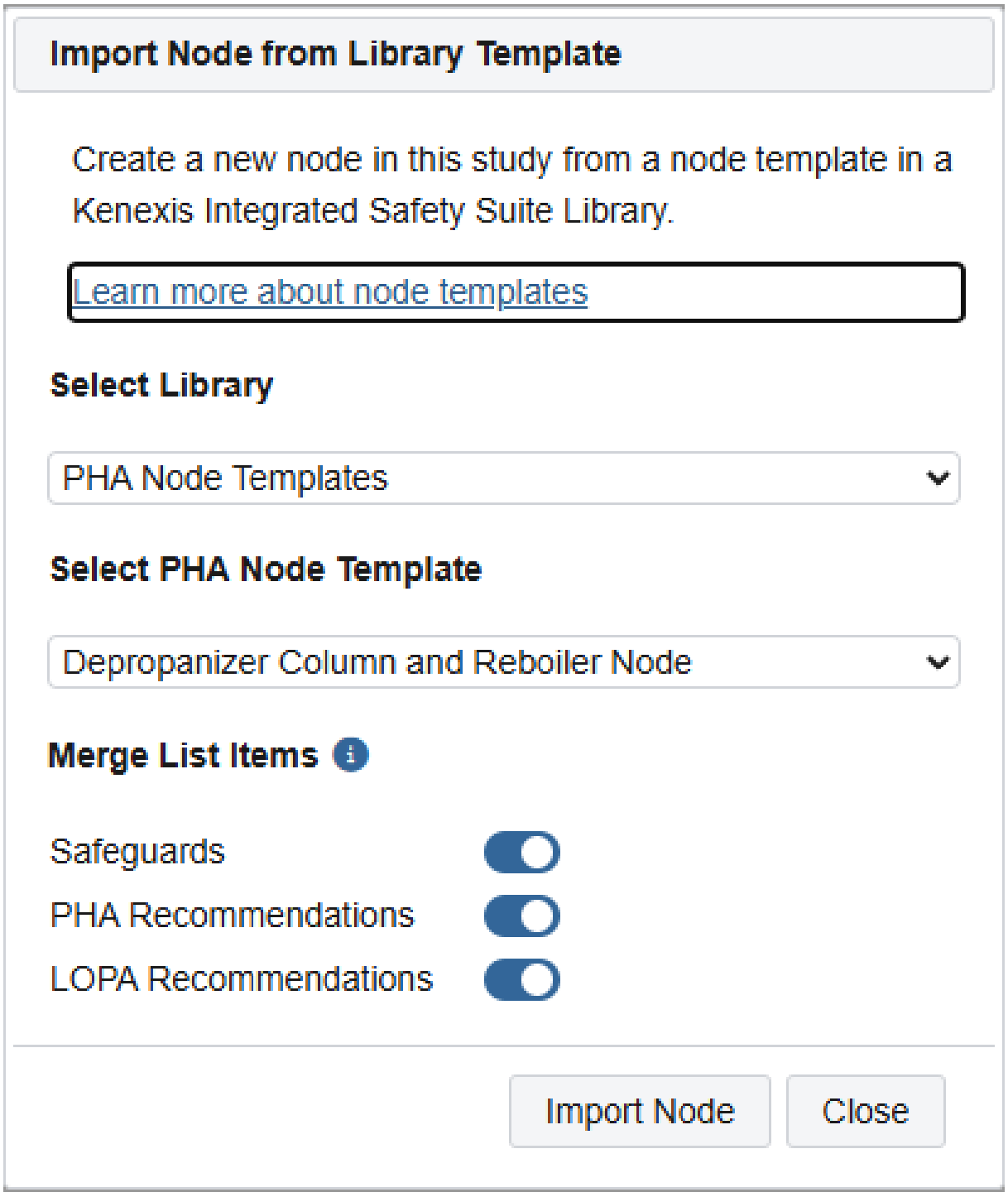


Figure 13-11. Importing a node template from a library.

Library Sync connects individual study records — safeguards, causes, enabling events, and conditional modifiers — to their source library rows, compares them, and applies selected updates from the library to the study, keeping standardized data aligned across a program.

13.8 Synchronize with Kenexis SIS

Kenexis Open-PHA studies synchronize with Kenexis SIS SIS Lifecycle Management studies, carrying the LOPA's IPL list into the SIS engineering workflow. Synchronize with Kenexis SIS creates a new Kenexis SIS study — in the same facility, with one Instrumented Protective Function per synchronized IPL — or updates a previously synchronized study, with checkboxes selecting which fields to update (tags, descriptions, types, and required RRFs, derived from each IPL's PFD) and whether to append newly added IPLs.

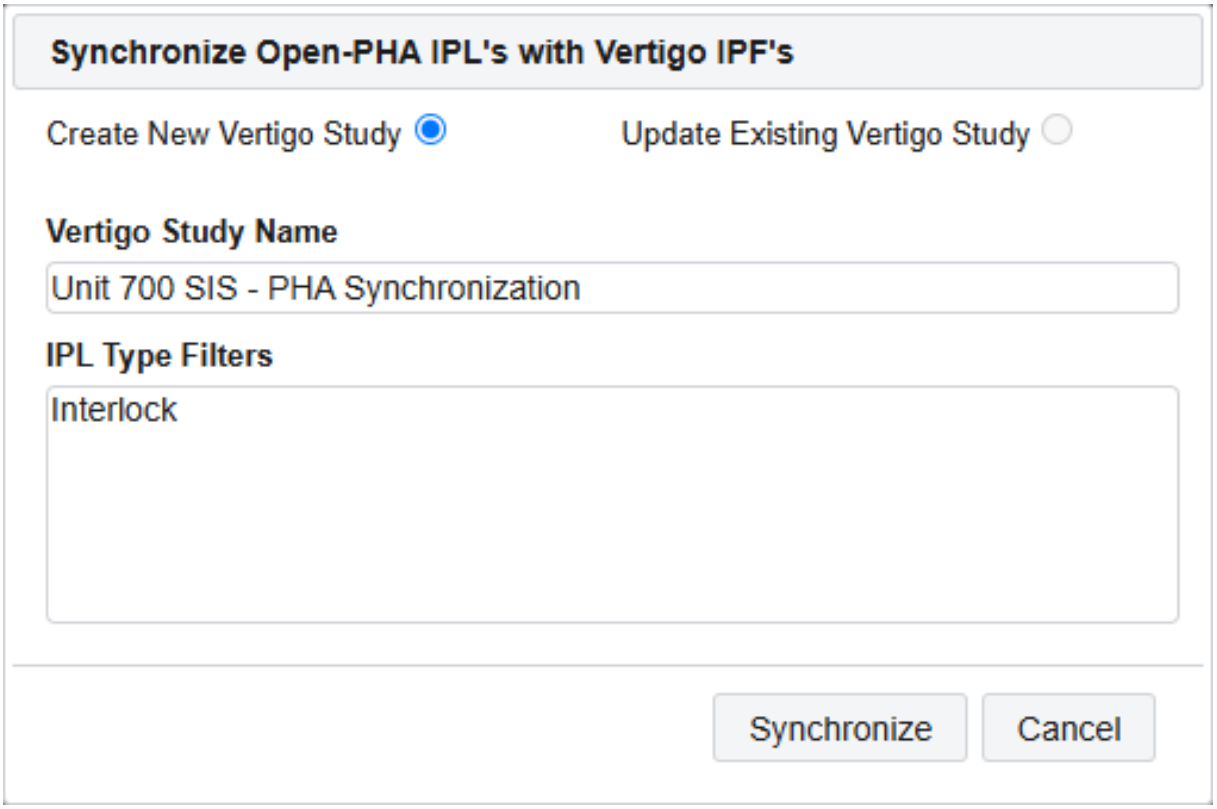


Figure 13-12. The Kenexis SIS synchronization dialog.

The IPL Type Filters box limits synchronization to selected IPL types, entered semicolon-separated — filtering on the safeguard type field so that, for example, only instrumented interlocks become Kenexis SIS IPFs. Synchronization flows from Kenexis Open-PHA to Kenexis SIS; updating a synchronized study applies the current Kenexis Open-PHA data to it.

Individual safeguards also link directly to Kenexis SIS IPFs: select an IPL safeguard and use Link Safeguard to Kenexis SIS IPF on the toolbar, then pick the facility, Kenexis SIS study, and IPF:

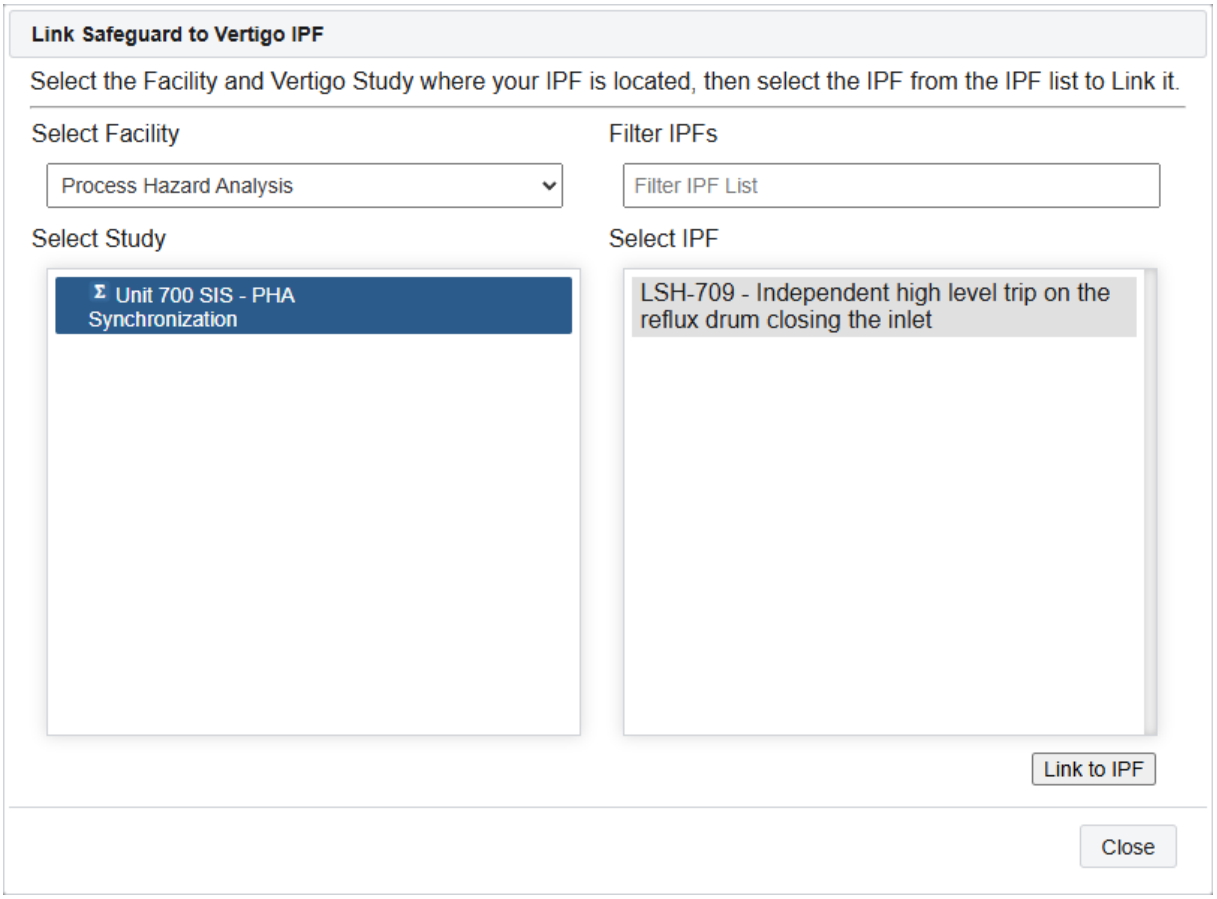


Figure 13-13. Linking a safeguard to a Kenexis SIS IPF.

A linked safeguard shows a link icon in the Safeguards register; clicking it lists the linked IPFs with their selected and achieved SILs live from Kenexis SIS, and navigates into the Kenexis SIS study on demand.

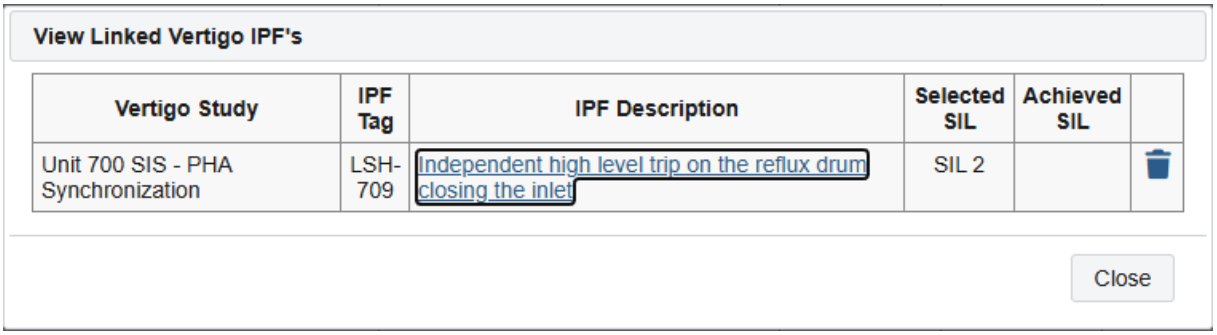


Figure 13-14. Viewing a safeguard's linked Kenexis SIS IPFs.

13.9 Bowtie Diagrams

A completed LOPA scenario visualizes as a bowtie diagram: causes and their protection layers on the left, the event at the center, and the conditional modifiers and per-category consequences on the right. Select one or more scenarios on the LOPA worksheet and choose Bowtie Diagram from Premium Tools. The viewer zooms in and out and downloads the diagram as an image for reports and presentations.

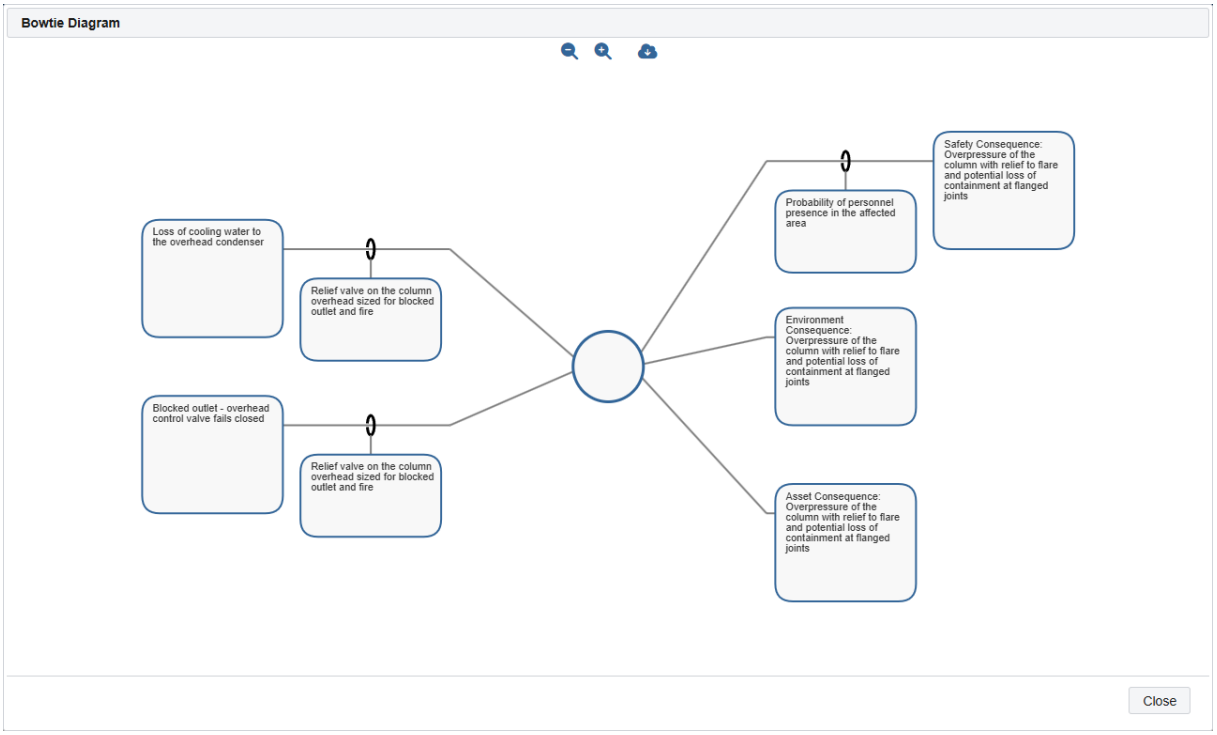


Figure 13-15. A LOPA scenario as a bowtie diagram.

14 The Facility Dashboard

The Facility Dashboard aggregates results across every study in a facility. Open it from the Facility Dashboard button above the facility list in the KISS Project Manager. The Kenexis Open-PHA section displays:

- PHA studies by the age of their current revision — a live view of revalidation currency.
- PHA and LOPA recommendations by implementation status.
- Risk-ranked scenarios by risk ranking.
- Scenario counts by consequence category and severity.

Facilities that also hold synchronized Kenexis SIS studies show the Kenexis SIS dashboard sections alongside — SIF counts by SIL, verification status, and testing history — a combined view of the path from PHA findings to implemented safety functions.

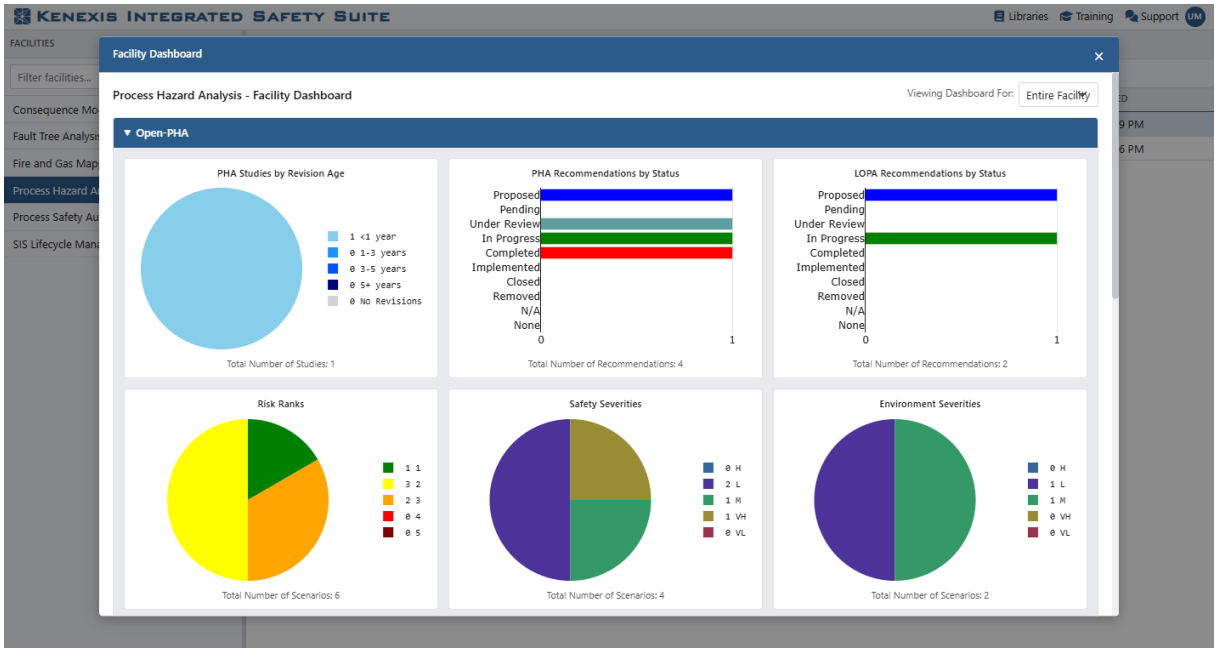
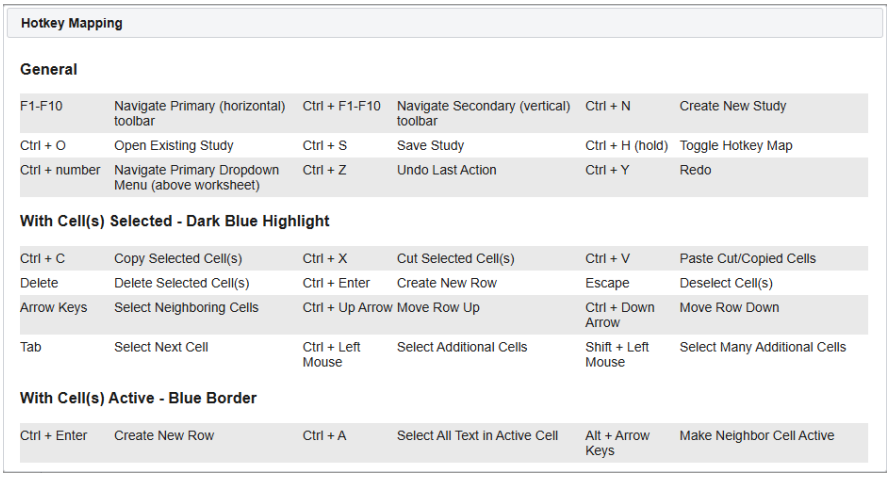


Figure 14-1. The facility dashboard for a facility holding PHA and Kenexis SIS studies.

Appendix A Hotkeys

Holding Ctrl+H displays the hotkey map at any time.



Hotkey Mapping

General

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 (hold)	Toggle Hotkey Map
Ctrl + number	Navigate Primary Dropdown Menu (above worksheet)	Ctrl + Z	Undo Last Action	Ctrl + Y	Redo

With Cell(s) Selected - Dark Blue Highlight

Ctrl + C	Copy Selected Cell(s)	Ctrl + X	Cut Selected Cell(s)	Ctrl + V	Paste Cut/Copied Cells
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

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

Figure A-1. The hotkey map (Ctrl+H).

Table A-1. Navigation hotkeys.

Hotkey	Action
Ctrl + H (hold)	Display the hotkey map
F1 – F10	Navigate the main tab strip
Ctrl + F1 – F10	Navigate the rail pages of the current tab
Ctrl + S	Save the study
Ctrl + Z	Undo the last worksheet action
Ctrl + Y	Redo
Ctrl + Number	Open the numbered entry of the worksheet dropdown

Working in a worksheet, with cells selected (dark blue highlight) or a cell active for editing (blue border):

Table A-2. Worksheet hotkeys by selection context.

Context	Hotkey	Action
Cells selected	Ctrl + C / X / V	Copy, cut, or paste the selected cells or rows
Cells selected	Delete	Delete the selected cells or rows
Cells selected	Ctrl + Enter	Create a new row
Cells selected	Escape	Deselect
Cells selected	Arrow keys	Move the selection
Cells selected	Ctrl + Up / Down	Move the selected row up or down
Cells selected	Tab	Move to the next cell and open it for editing
Cells selected	Ctrl + Click	Add a cell to the selection
Cells selected	Shift + Click	Extend the selection
Cell active	Ctrl + Enter	Create a new row

Context	Hotkey	Action
Cell active	Ctrl + A	Select all text in the active cell
Cell active	Alt + Arrow key	Activate the neighboring cell

Appendix B Calculation Summary

The quantities computed by Kenexis Open-PHA, as defined in Chapter 9:

Table B-1. Calculated quantities and their definitions.

Quantity	Definition
PHA Risk Rank	Matrix lookup of the selected severity and likelihood, per phase; the most severe rank across the visible consequence categories.
Cause MEL (explicit)	Initiating event frequency multiplied by the enabling event probabilities and the PFDs of the IPLs credited on the cause.
MEL (explicit)	Sum of the cause MELs, multiplied by the conditional modifier probabilities of the consequence category.
TMEL	The target frequency of the selected consequence severity (Risk Criteria).
LOPA Ratio	TMEL divided by MEL; one or greater meets the target.
RRF	MEL divided by TMEL; the additional risk reduction required.
Recommended SIL (explicit)	From the largest per-category RRF: SIL 1 at RRF 10, SIL 2 at 100, SIL 3 at 1,000, SIL 4 at 10,000.
LOPA RR (explicit)	The matrix rank of the MEL, binned to the smallest likelihood category at or above it.
Required credits (implicit)	The Required LOPA Credits of the risk rank at the cause likelihood and consequence severity.
LOPA Gap (implicit)	Required credits minus the enabling event, conditional modifier, and IPL credits, floored at zero. Consequence-indexed: per cause, with the consequence taking its worst cause.
Recommended SIL (implicit)	From the remaining gap: a gap of one recommends SIL 1, two SIL 2, and so on; a fractional gap rounds down.
After-recommendations values	The same calculations with the PFDs or credits of the scenario's LOPA recommendations applied.