Kenexis® Fire & Gas Mapping

(formerly Effigy®)

Revision 10.1 • July 2026

Table of Contents

1 Introduction

1.1 About Kenexis Fire & Gas Mapping

Kenexis Fire & Gas Mapping is the fire and gas system (FGS) mapping module of the Kenexis Integrated Safety Suite (KISS). It is a browser-based, multi-user application for placing fire and gas detectors in a three-dimensional model of a process area and quantifying how well that detector layout performs. Kenexis Fire & Gas Mapping answers the two questions at the heart of performance-based FGS design (as described in ISA TR84.00.07): how much of the area can the detectors see, and how much of the hazard frequency do they mitigate.

Kenexis Fire & Gas Mapping produces two complementary families of results:

- **Geographic coverage** — a map-based measure of the fraction of the monitored zone that is visible to one detector, to two or more detectors, or to none, evaluated at an analysis elevation. Fire and gas detection are assessed separately.
- **Scenario coverage (risk)** — a frequency-based measure built from specific release scenarios. Each scenario carries a frequency (per year); Kenexis Fire & Gas Mapping determines how much of that frequency is detected (mitigated) and how much is not (residual), overall and by area grade.

The two views work together: geographic coverage shows where the layout is strong or weak, and scenario coverage turns the layout into risk numbers that can be compared against performance targets.

1.2 Key Concepts

- **Zone** — the rectangular volume being analyzed, defined by its X, Y, and Z dimensions in the study's display units.
- **Analysis elevation** — the horizontal plane at which coverage maps are evaluated, typically about one metre above grade.
- **Equipment items** — three-dimensional shapes representing vessels, compressors, racks, and structures. An equipment item can block detector sight lines (an obstruction), define a graded area, and act as the source of fire and gas scenarios.
- **Area grades** — up to three coverage classes (for example A, B, C), each with its own coverage target. Grades let you demand more coverage where the hazard is higher.
- **Voting** — the alarm philosophy: 1ooN means one detector in alarm is sufficient for action; 2ooN requires confirmation by a second detector.

1.3 About Kenexis

Kenexis is an independent engineering consulting firm specializing in the integrity of instrumented safeguards and industrial networks. Kenexis applies skills in risk analysis, reliability engineering, and process engineering to help establish the design and maintenance specifications of instrumented safeguards such as safety instrumented systems (SIS), alarm systems, and fire and gas systems. The Kenexis Integrated Safety Suite is the software platform that supports this work.

2 Getting Started

2.1 Signing In

Kenexis Fire & Gas Mapping runs inside KISS and requires a KISS account. Point your browser at your organization's KISS address and sign in with your username and password, or with a configured single sign-on provider (Azure AD or Okta). Every Kenexis Fire & Gas Mapping page requires authentication; if your session expires you will be returned to the sign-in screen.

2.2 The KISS Manager — Facilities and Studies

After signing in you land on the KISS Manager. Facilities are listed on the left; selecting a facility loads its studies (and any folders) on the right. Kenexis Fire & Gas Mapping studies are marked with the Kenexis Fire & Gas Mapping flame icon and the type “Effigy”. Use the toolbar above the study list to create, organize, and move studies.

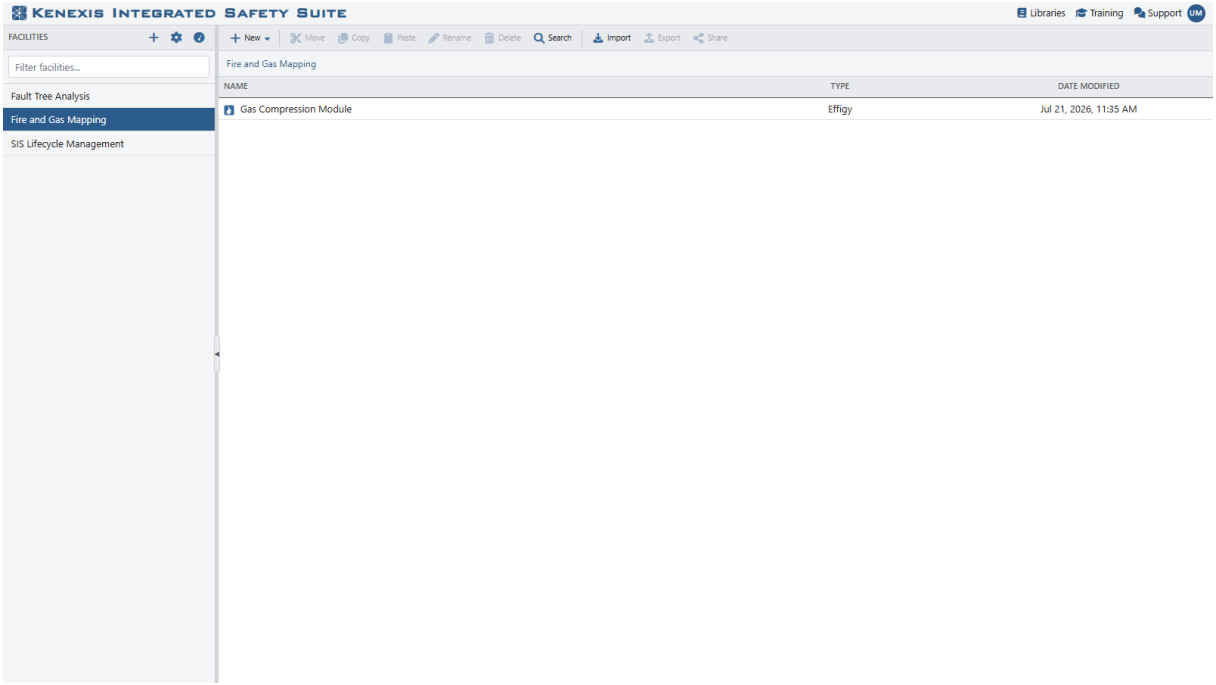


Figure 2-1. The KISS Manager. Selecting a facility lists its studies; the toolbar provides New, Move, Copy, Paste, Rename, Delete, Search, Import, Export, and Share.

2.3 Creating a Kenexis Fire & Gas Mapping Study

With a facility (or folder within it) selected, choose New › Effigy. The New Effigy Study dialog collects the study name plus the geometry Kenexis Fire & Gas Mapping needs before it can draw anything:

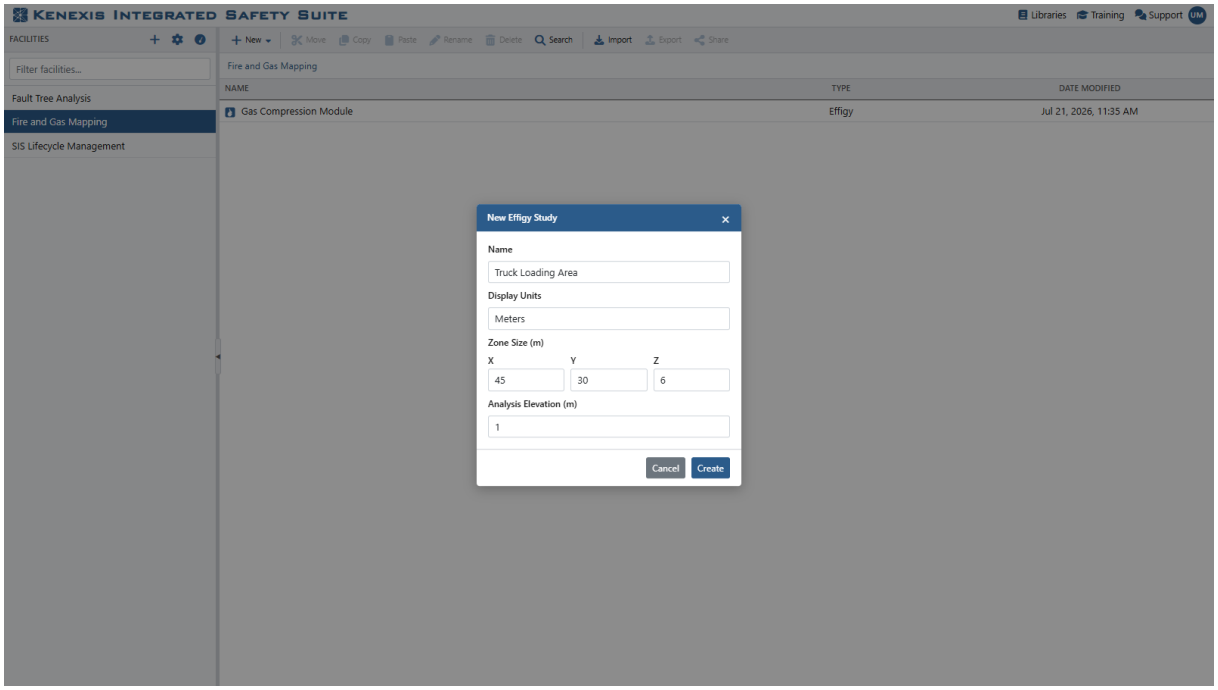


Figure 2-2. The New Effigy Study dialog: Name, Display Units, the Zone Size in X, Y, and Z, and the Analysis Elevation.

Table 2-1. Fields in the New Effigy Study dialog.

Field	Purpose
Name	The study name (required).
Display Units	The unit of length for everything you type and read: Feet, Inches, Meters, Millimeters, Centimeters, or Yard.
Zone Size X / Y / Z	The dimensions of the rectangular volume to analyze, in display units.
Analysis Elevation	The height of the horizontal plane at which coverage maps are evaluated.

Create opens the new study immediately. All of these values can be revised later on the Settings dialog's Study tab.

2.4 Managing Studies

The KISS Manager toolbar acts on the selected study. Buttons are enabled only when the action is permitted for your role and the facility's settings.

- **Copy / Paste / Move / Rename / Delete** — duplicate, relocate, or remove studies. Deleting is a soft delete: the study moves to the organization Recycle Bin.
- **Export** — downloads the study as “Effigy Study.zip”: a workbook of every study object plus the overlay image and any uploaded 3D models. The zip is a portable snapshot for backup or transfer between servers.
- **Import** — uploads an exported zip into the selected facility or folder. Import always creates a new study, so an import can never overwrite existing work. The file is fully validated before anything is written.

- **Share** — produces an external link that opens the study directly.

2.5 The Kenexis Fire & Gas Mapping Workspace

Opening a study shows the Kenexis Fire & Gas Mapping workspace. The header carries the study name on the left and, on the right, four calculation-status badges, the Calculate button, the Reports menu, and the Settings dialog. The badges — FG, GG, FS, and GS — track Fire Geographic Coverage, Gas Geographic Coverage, Fire Scenario Risk, and Gas Scenario Risk. Each badge is green when its results are current, amber when an edit has made them out of date, and gray when the calculation has not yet been run. If you open a study with view-only access, a Read Only badge appears and the editing controls are hidden.

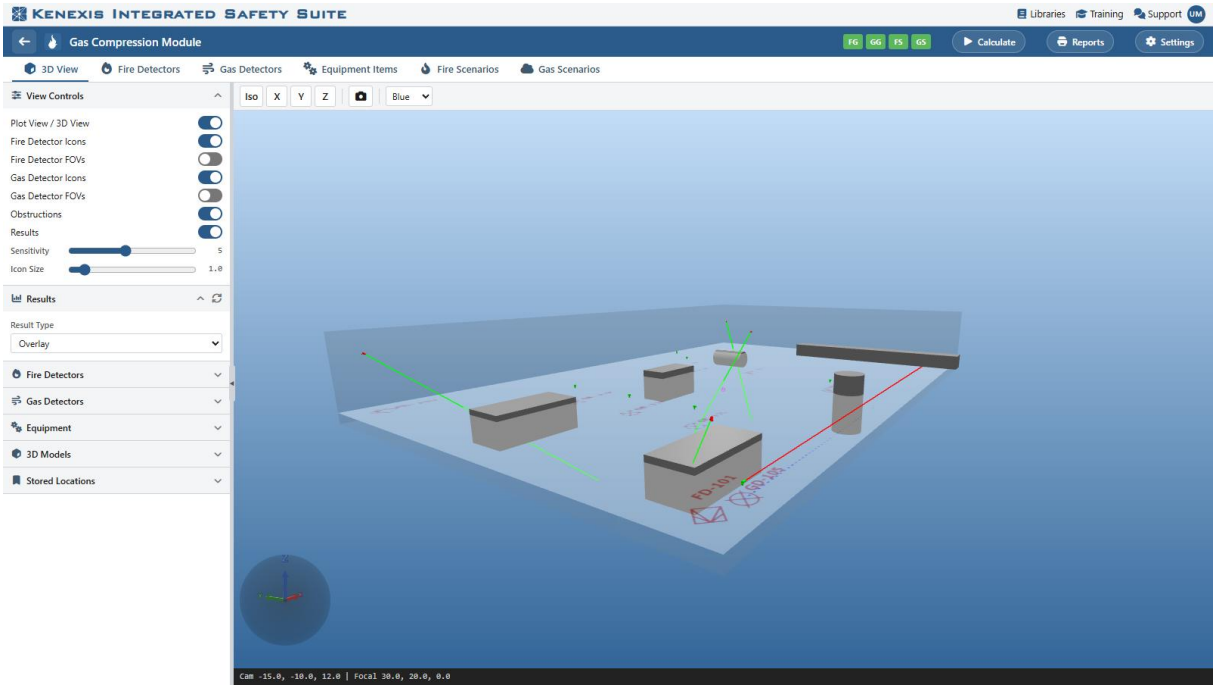


Figure 2-3. The Kenexis Fire & Gas Mapping workspace. The header shows the four calculation badges with Calculate, Reports, and Settings; the tab bar selects the working surface; the 3D View tab is the default.

Immediately below the header is the tab bar with the six workspace tabs:

Table 2-2. The six Kenexis Fire & Gas Mapping workspace tabs.

Tab	What it shows
3D View	The interactive 3D scene and the 2D plot view, with view controls and the results panel (Chapters 3, 4, and 11).
Fire Detectors	A sortable table of every fire detector (Chapter 5).
Gas Detectors	A sortable table of every gas detector (Chapter 6).
Equipment Items	A table of every equipment item and its roles (Chapter 7).
Fire Scenarios	Every fire scenario in the study, across all equipment (Chapter 8).
Gas Scenarios	Every gas scenario in the study, across all equipment (Chapter 8).

3 The 3D View

3.1 The Scene

The 3D View tab is the default working surface: a live three-dimensional model of the zone showing the zone boundary, every equipment item, every detector (drawn with its orientation line), and — once calculations have run — the selected result image draped on the analysis plane. The scene and the 2D plot view (Chapter 4) share one sidebar; the Plot View / 3D View toggle at the top of the View Controls panel switches between them.

3.2 View Controls

The View Controls panel toggles each layer of the scene:

Table 3-1. View Controls panel options.

Control	Effect
Plot View / 3D View	Switches between the 3D scene and the 2D plot view.
Fire Detector Icons	Shows or hides the fire-detector glyphs and name labels.
Fire Detector FOVs	Draws each fire detector's three-dimensional field of view.
Gas Detector Icons	Shows or hides the gas-detector glyphs.
Gas Detector FOVs	Draws gas-detector coverage volumes.
Obstructions	Shows or hides the equipment items.
Results	Shows or hides the result image on the analysis plane.
Sensitivity	Scales how far each mouse or keyboard movement travels (1–10).
Icon Size	Scales the detector glyphs (0.1–10.0).

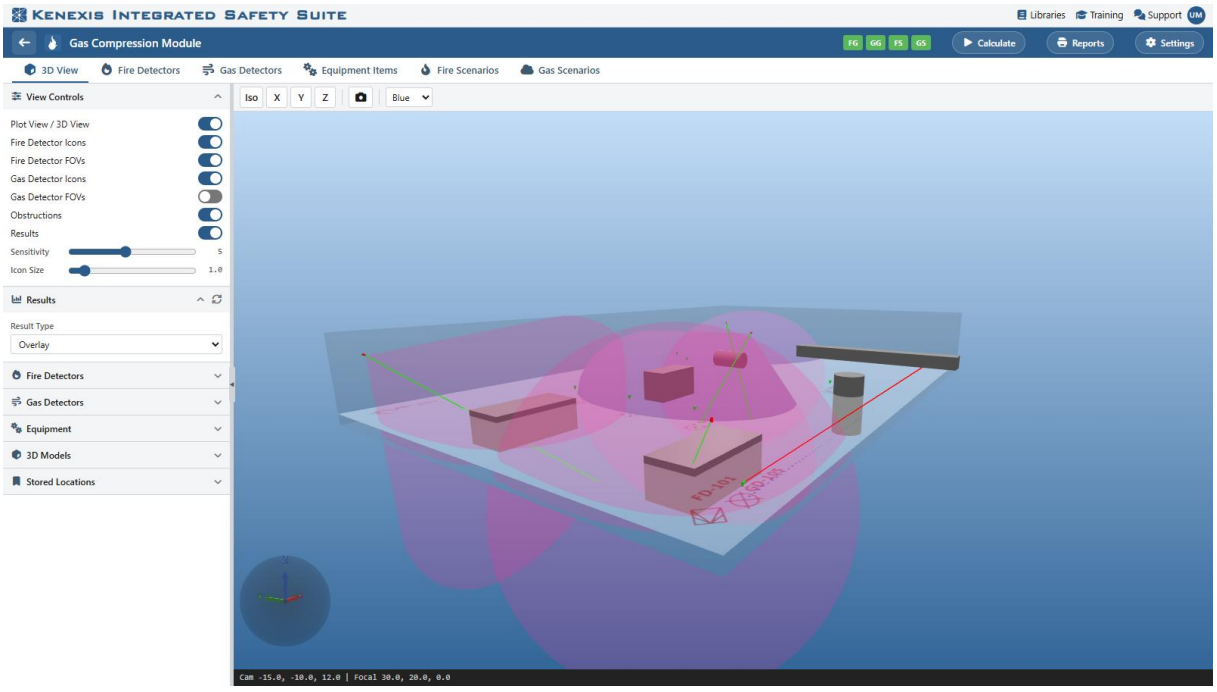


Figure 3-1. Fire-detector fields of view drawn in the 3D scene. Each FOV is the detector type's real sensitivity envelope, oriented by the detector's rotation and declination and scaled to its detection range.

3.3 Navigating the Scene

The camera is driven with the mouse, the keyboard, or both. The view preset buttons above the canvas — Iso, X, Y, and Z — jump to standard orientations; the status bar underneath reports the camera and focal point coordinates; and the background color selector chooses Black, White, or Blue. The Take Screen Shot button downloads the current scene as a PNG named after the study. Appendix A lists every mouse and keyboard control.

3.4 The Right-Click Menu

Right-clicking any object in the scene — an equipment item, a detector, a wall, or the zone boundary — opens a context menu for that object. It is the fastest way to work in 3D:

- **Open Details Form / Focus** — edit the picked object, or fly the camera to it.
- **Move Focal Point Here / Save as Stored Location** — set the orbit center, or bookmark the camera position.
- **Move / Orient** — relocate a detector to your camera position, the focal point, or a stored location; fire detectors can also be aimed at any of those targets.
- **Add** — place a new fire detector on the picked surface (aimed at the focal point, your location, or a stored location), a point gas detector at the surface, or an open-path gas detector whose receiver lands at your chosen target.
- **Delete** — remove the picked object, after confirmation.

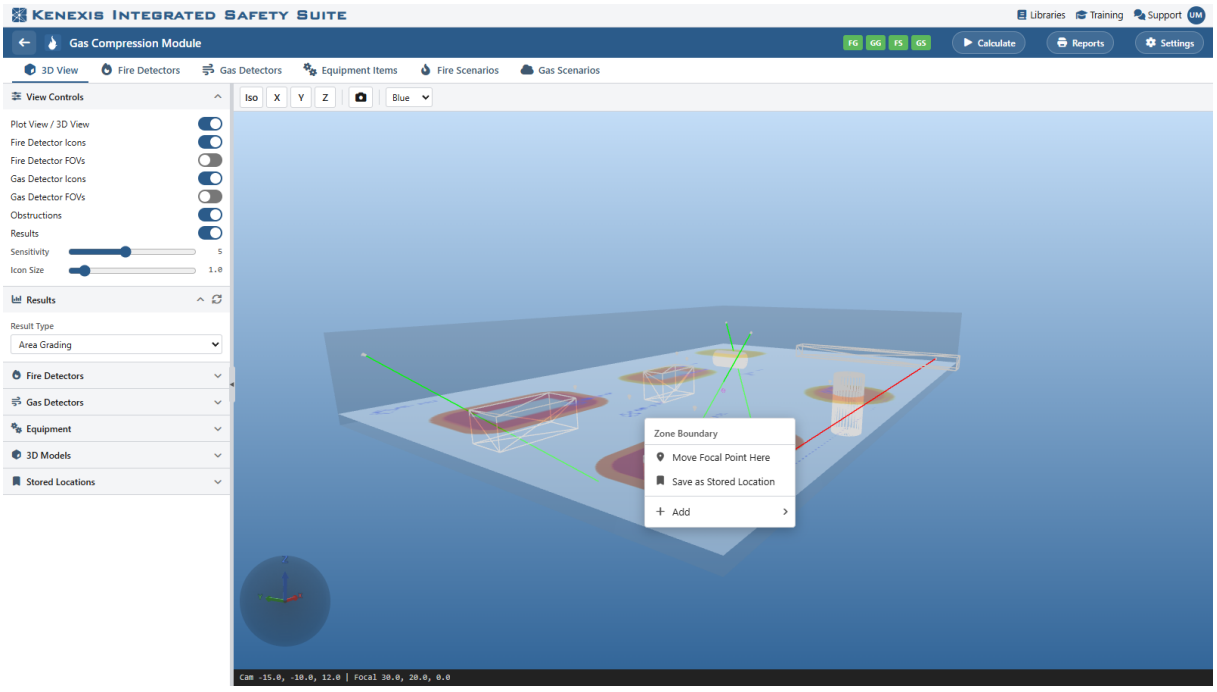


Figure 3-2. The 3D right-click menu, here opened on the zone boundary with the Area Grading result draped on the analysis plane. Picking an equipment item or detector adds object-specific actions such as Open Details Form, Focus, Move, and Orient.

3.5 Stored Locations

The Stored Locations panel bookmarks camera positions. Save captures the current viewpoint under a name; each entry has Go-to and Remove buttons. Stored locations also serve as placement targets in the right-click Move, Orient, and Add menus, which makes a well-chosen set of bookmarks a practical placement toolkit. Locations are remembered per browser.

3.6 Imported 3D Models

The 3D Models panel uploads plant models in binary STL format (up to 200 MB per file). An uploaded model appears in the scene and participates in the calculations as an obstruction, so a laser-scanned or CAD-exported structure can shadow detectors exactly as the real structure would. Each model has an Enabled toggle and a Delete button. For very large models, the Model Quality setting (Chapter 13) trades rendering detail for memory.

4 The Plot View

The plot view is the two-dimensional counterpart of the 3D scene: a plan drawing of the zone at the analysis elevation, with the same layers — detectors, equipment, graded-area outlines, and the selected result image. Toggle Plot View / 3D View in the View Controls panel to switch. Because it is a true-scale plan, the plot view is the natural surface for laying out a study from a plot plan and for reading coverage maps.

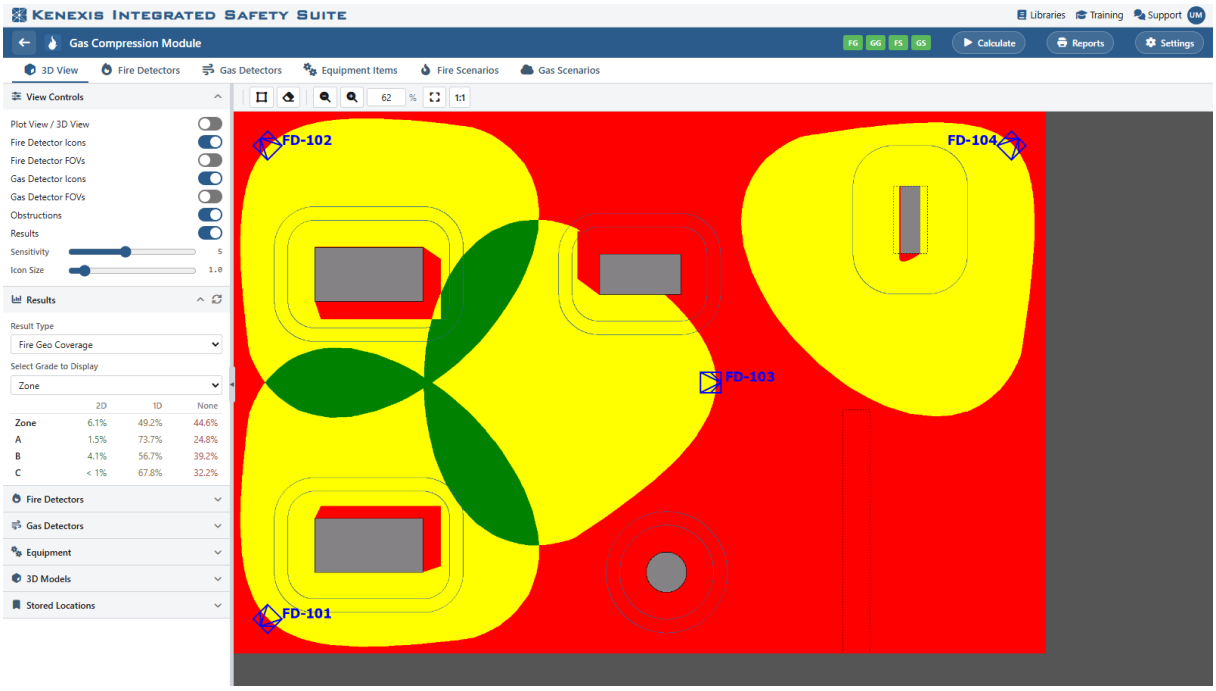


Figure 4-1. The plot view showing a fire geographic coverage result. Detector icons and name labels are drawn over the coverage map; the thin outlines around equipment are the graded-area boundaries; the toolbar provides area drawing, erase, zoom, Fit to View, and Actual Size.

4.1 The Plot Toolbar

Table 4-1. Plot view toolbar tools.

Tool	Purpose
Draw Area	Arms the rectangle-drawing tool used to place equipment and graded areas.
Erase	Clears the drawn rectangle.
Zoom Out / Zoom In / %	Steps the zoom, or type an exact percentage (5–300%).
Fit to View	Scales the plot to fill the pane.
Actual Size (1:1)	Returns to one screen pixel per image pixel.

4.2 Building the Layout by Drawing

The plot view's right-click menu turns a drawn rectangle into study objects. With an area drawn, right-click offers Add Equipment Item (as a Cube, Sphere, horizontal or vertical Cylinder, or horizontal or vertical Pressure Vessel) and Add Graded Area (Cube or Cylinder); the equipment dialog opens pre-filled with the rectangle's position and size, and after saving, the draw tool re-arms so you can digitize the next item immediately. Without a drawn area, the right-click menu places a new fire detector or gas detector at the clicked coordinates.

Together with an overlay image (Chapter 13), this is the fastest route from a plot plan to a working model: upload the drawing, then trace the equipment on top of it.

5 Fire Detectors

5.1 The Fire Detectors Tab

The Fire Detectors tab lists every fire detector with its type, location, orientation, and threshold RHO. The filter box narrows the list by name; the count label reports how many detectors are shown; every column header sorts. The Enabled checkbox on each row takes a detector in or out of the analysis without deleting it — ideal for comparing layout alternatives.

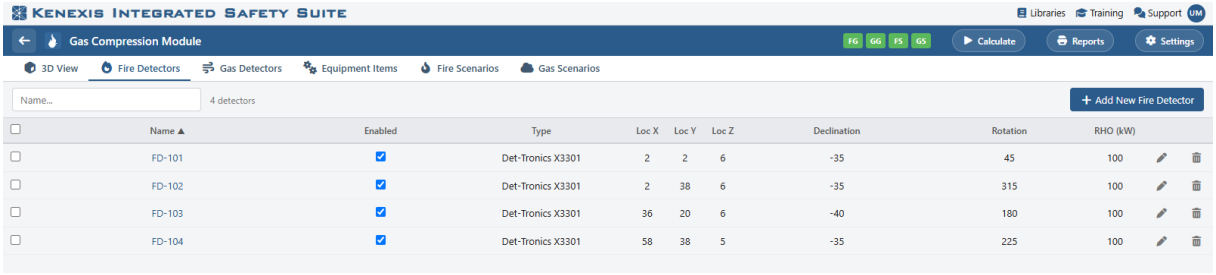


Figure 5-1. The Fire Detectors tab: name, enabled state, type, location, declination, rotation, and RHO, with edit and delete actions on each row.

Selecting one or more rows reveals the bulk actions: Enable, Disable, Duplicate, and Delete. Duplicate opens a dialog that makes a chosen number of copies, each offset from the last by an X/Y/Z step — a quick way to lay out a row of detectors at even spacing.

5.2 The Fire Detector Dialog

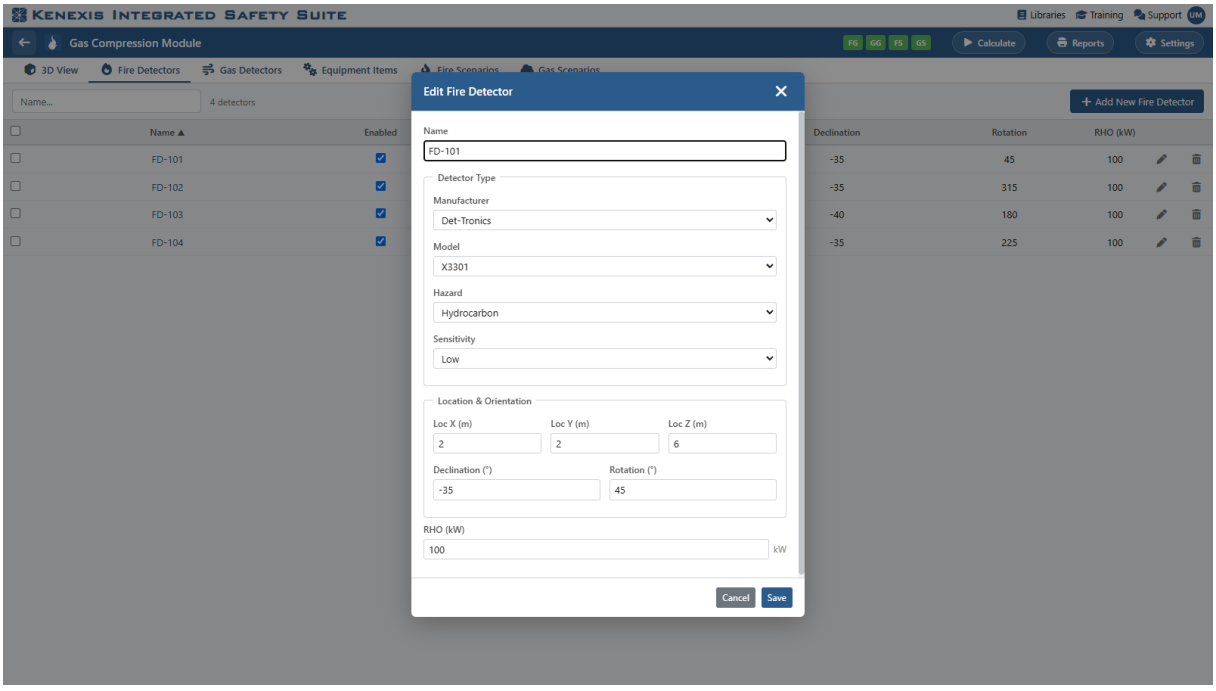


Figure 5-2. The Fire Detector dialog. The detector type is chosen from the library by manufacturer, model, hazard, and sensitivity; location and orientation place it; the RHO field sets the design-basis fire it must detect.

- **Name** — the detector tag (required).
- **Detector Type** — four cascading selections — Manufacturer, Model, Hazard, and Sensitivity — drawn from the Kenexis detector library. The chosen entry supplies the detector's field-of-view profile and sensitivity coefficient (Chapter 14).
- **Loc X / Loc Y / Loc Z** — the mounting position in display units.
- **Declination / Rotation** — the aiming angles in degrees. Rotation turns the detector in plan (0° points along +X, angles increase counter-clockwise); declination tilts the line of sight out of the horizontal plane — enter a negative declination to aim the detector down toward the analysis plane.
- **RHO (kW)** — the threshold radiant heat output: the size of the design-basis fire the detector must be able to detect. A larger RHO means a larger fire and therefore a longer detection range (section 14.2).

For detector types classified as visual (cameras), the RHO field is replaced by a Max Detection Distance in display units.

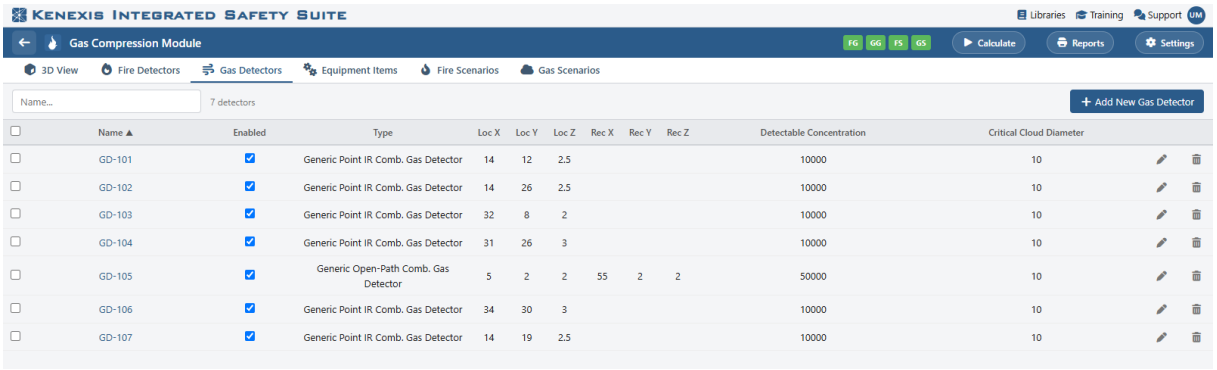
Detector defaults

New detectors are pre-filled with the type and RHO chosen on the Settings dialog's Detector Defaults tab (Chapter 13). Set the defaults once and each Add starts ready to place.

6 Gas Detectors

6.1 The Gas Detectors Tab

The Gas Detectors tab mirrors the fire-detector grid: filter, live count, sortable columns, per-row Enabled toggles, and the same bulk Enable / Disable / Duplicate / Delete actions. Open-path detectors additionally show their receiver coordinates alongside the transmitter location.



	Name ▲	Enabled	Type	Loc X	Loc Y	Loc Z	Rec X	Rec Y	Rec Z	Detectable Concentration	Critical Cloud Diameter
☐	GD-101	☑	Generic Point IR Comb. Gas Detector	14	12	2.5				10000	10
☐	GD-102	☑	Generic Point IR Comb. Gas Detector	14	26	2.5				10000	10
☐	GD-103	☑	Generic Point IR Comb. Gas Detector	32	8	2				10000	10
☐	GD-104	☑	Generic Point IR Comb. Gas Detector	31	26	3				10000	10
☐	GD-105	☑	Generic Open-Path Comb. Gas Detector	5	2	2	55	2	2	50000	10
☐	GD-106	☑	Generic Point IR Comb. Gas Detector	34	30	3				10000	10
☐	GD-107	☑	Generic Point IR Comb. Gas Detector	14	19	2.5				10000	10

Figure 6-1. The Gas Detectors tab. Point detectors show a single location; the open-path row also carries receiver coordinates. The Detectable Concentration and Critical Cloud Diameter columns hold each detector's detection parameters.

6.2 The Gas Detector Dialog

The dialog adapts to the detector technology chosen in the Detector Type list, which is drawn from the Kenexis gas-detector library:

- **Point detectors** — a single location plus two detection parameters: the Detectable Concentration (ppm) the cell must see to alarm, and the Critical Cloud Diameter — the size of gas cloud the layout is required to catch (section 14.5).
- **Open-path detectors** — a Transmitter Location and a Receiver Location define the beam; the detectable concentration is a path-integrated value in ppm-m.
- **Acoustic and visual detectors** — leak-noise and camera devices, placed with a location, rotation, declination, and a maximum detection distance.

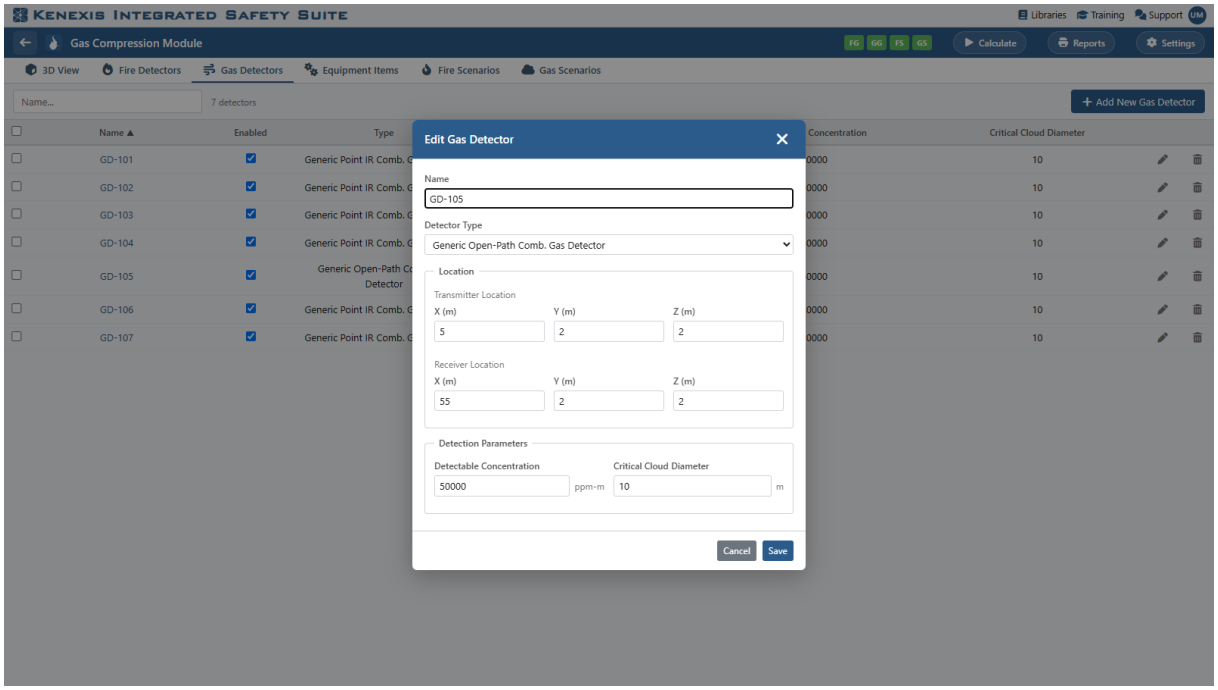


Figure 6-2. The Gas Detector dialog for an open-path type: transmitter and receiver locations define the beam, and the detection setpoint is expressed in ppm-m.

7 Equipment Items

7.1 One Object, Four Roles

Equipment items are the three-dimensional building blocks of the model. One item can play up to four roles at once, and the Equipment Items tab shows the roles as four checkmark columns:

- **Obstruction** — the item's shape blocks detector sight lines and is excluded from coverage statistics.
- **Graded Area** — the item's footprint (inflated by the grade's inclusion distance) defines a region held to a coverage target (Chapter 9).
- **Fire Scenario / Gas Scenario** — the item owns release scenarios used by the risk calculations (Chapter 8).

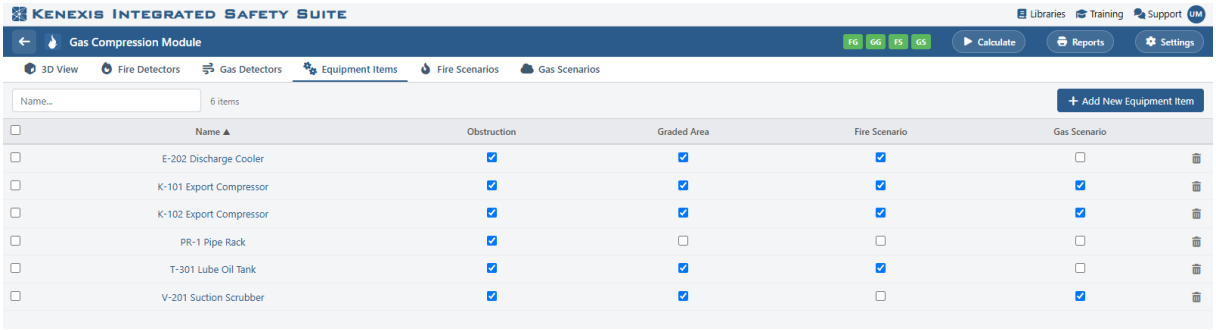


Figure 7-1. The Equipment Items tab. The four checkmark columns show each item's roles: obstruction, graded area, fire scenario source, and gas scenario source.

7.2 The Equipment Item Dialog

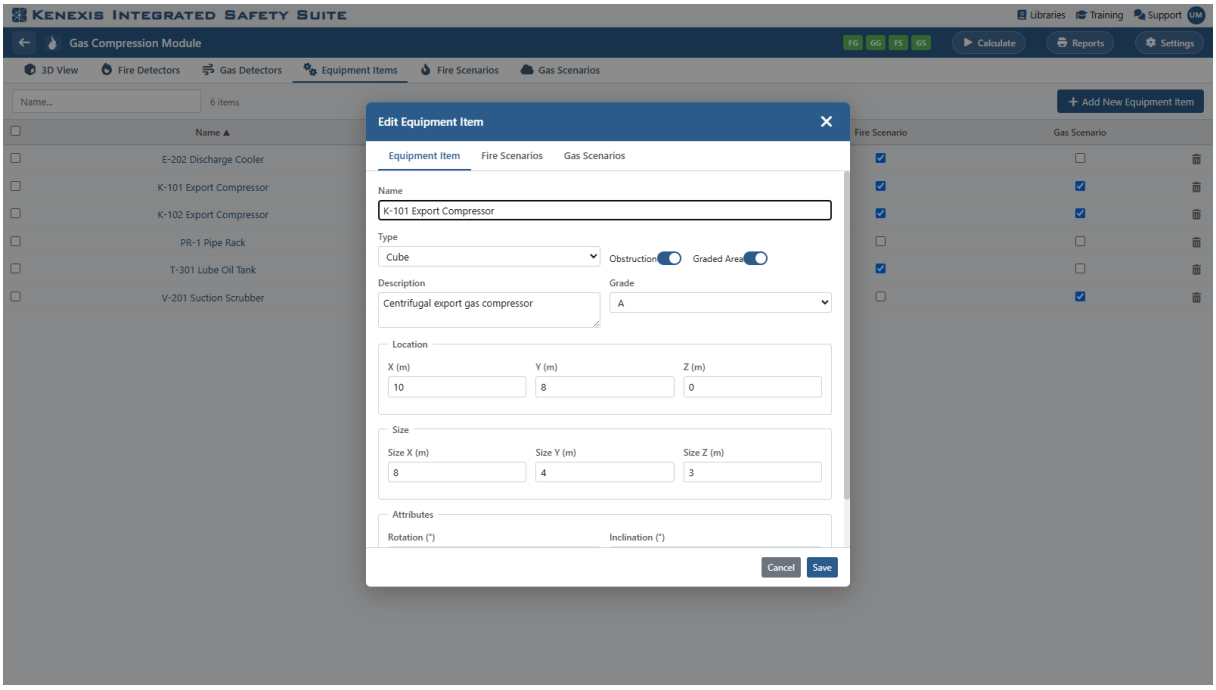


Figure 7-2. The Equipment Item dialog. The shape type drives which size fields appear; the Obstruction and Graded Area checkboxes set the item's roles; the Grade list assigns its coverage class.

- **Type** — Cube, Sphere, Cylinder (H), Cylinder (V), Pressure Vessel (H), or Pressure Vessel (V). The size fields follow the shape: a cube takes X/Y/Z dimensions, cylinders take a radius plus a length (horizontal) or height (vertical).
- **Location** — the item's position in display units.
- **Rotation / Inclination** — plan rotation and tilt for shapes where orientation matters.
- **Description / Grade** — free text, and the coverage grade applied when Graded Area is checked.

The dialog has three tabs. The Equipment Item tab holds the geometry; the Fire Scenarios and Gas Scenarios tabs manage the item's release scenarios and unlock once the item has been saved.

7.3 Scenarios on an Equipment Item

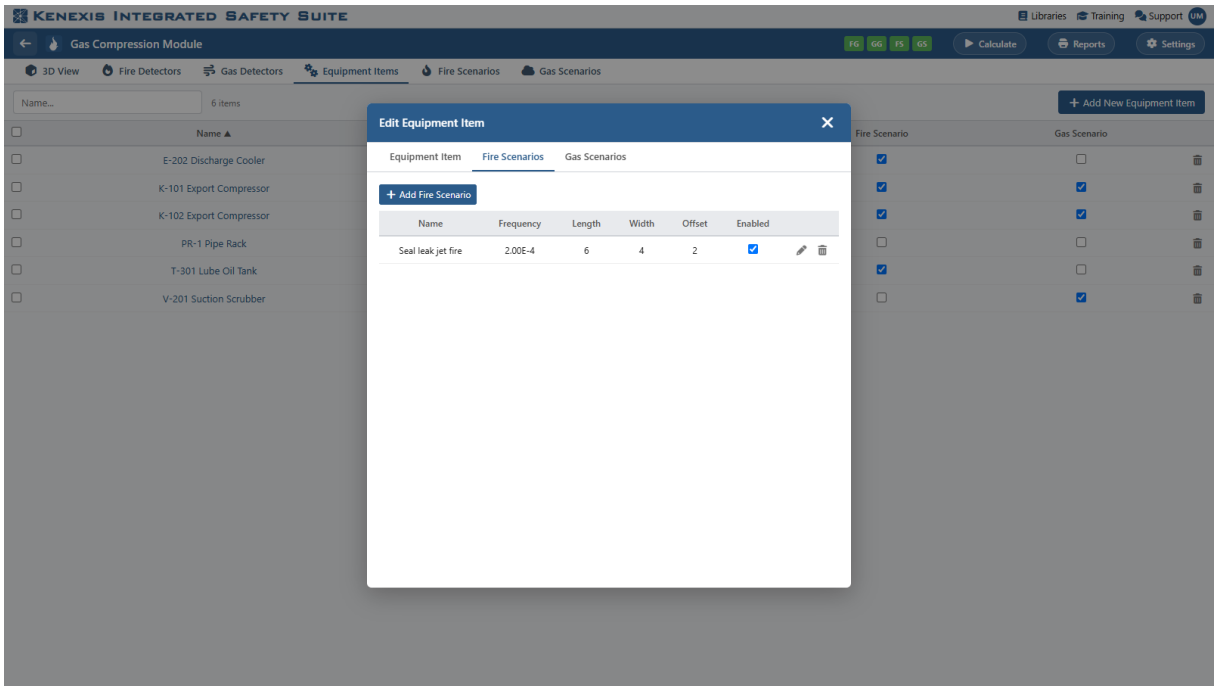


Figure 7-3. The Fire Scenarios tab of the Equipment Item dialog. Add opens an inline form; each saved scenario lists its frequency, footprint dimensions, offset, and enabled state.

Add Fire Scenario (or Add Gas Scenario) opens an inline form on the dialog: Name, the release location X/Y/Z, the footprint Length and Width, the Frequency in events per year (entered in scientific notation), and the Offset. Gas scenarios add the cloud Concentration in ppm. Chapter 8 explains how these numbers define the hazard footprint; validation keeps every entry physical (positive dimensions, width no greater than length, frequency greater than zero).

8 Fire and Gas Scenarios

8.1 What a Scenario Represents

A scenario is one credible release from one equipment item: a seal leak that becomes a jet fire, a flange leak that forms a flammable cloud. Each scenario carries the frequency of that event (per year) and a footprint — the area the fire or cloud occupies, described by a length, a width, and an offset. During the risk calculations Kenexis Fire & Gas Mapping sweeps the footprint through the full circle of possible release directions and asks, direction by direction, whether the detector layout would see it (sections 14.7–14.9).

8.2 The Study-Wide Scenario Tabs

The Fire Scenarios and Gas Scenarios tabs collect every scenario in the study into one sortable, filterable table — the place to review the scenario set as a whole. Each row shows the owning equipment item, the release location, frequency, footprint dimensions, and enabled state; gas rows add the cloud concentration. Clicking a scenario name opens the owning equipment item's dialog at that scenario, and the delete action removes a scenario after confirmation.

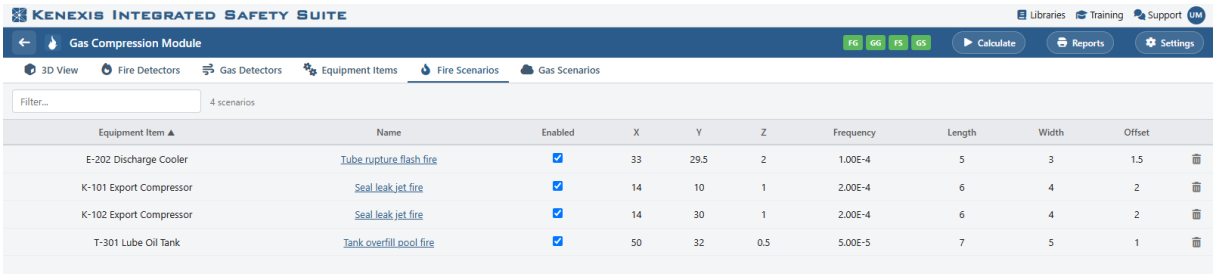


Figure 8-1. The Fire Scenarios tab: every fire scenario in the study, with its owning equipment item, location, frequency, footprint, and offset.

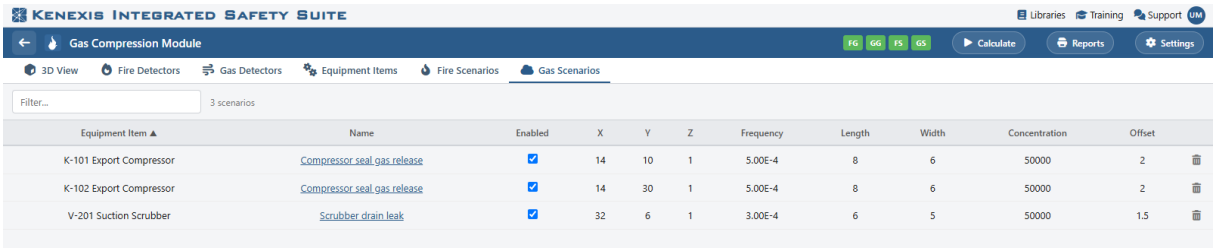


Figure 8-2. The Gas Scenarios tab adds the cloud concentration used by point and open-path detection.

8.3 The Offset

The offset slides the footprint along the release direction: the footprint's tapered tip sits at the release point when the offset is zero, moves upwind of it for a positive offset, and downwind for a negative one. This one number lets simple footprints describe realistic releases:

- **Pool fires** — set length, width, and offset all equal to the pool diameter and every rotation converges on a circular fire centered at the scenario location.
- **Releases around a vertical vessel** — a negative offset equal to the vessel radius starts each footprint at the vessel wall rather than its centerline.
- **Jet fires with flame lift-off** — a negative offset reproduces the stand-off distance between the leak point and the flame.
- **Impinged or congested releases** — a positive offset accounts for the upwind dispersion that occurs when a jet strikes nearby structure.

9 Area Grading

9.1 Grade Definitions

Grades express that not all parts of a zone deserve the same coverage. The Settings dialog's Grading tab defines up to three grades, each with a code, a coverage target, and inclusion distances:

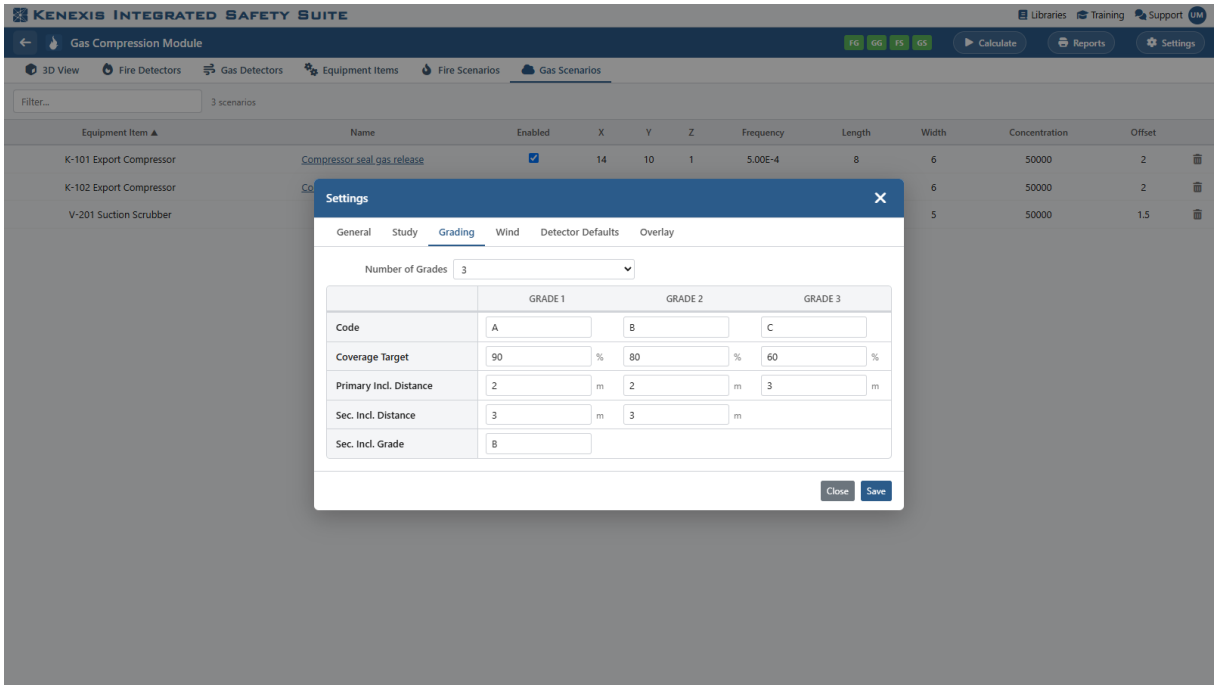


Figure 9-1. The Grading tab. Each grade column defines a code, a coverage target, and the primary and secondary inclusion distances that inflate a graded item's footprint.

Table 9-1. Settings on the Grading tab.

Setting	Meaning
Number of Grades	How many grades the study uses (0–3).
Code	The label shown in grids, results, and reports (for example A, B, C).
Coverage Target	The percentage of the graded region expected to be covered; results and reports show achieved coverage against this target.
Primary Incl. Distance	How far beyond the equipment footprint the grade's own region extends.
Sec. Incl. Distance / Sec. Incl. Grade	A second, larger ring assigned to a lower grade — the buffer around a high-hazard item is still graded, at reduced stringency.

9.2 Assigning Graded Areas

A graded area is created by checking Graded Area on an equipment item and choosing its grade (Chapter 7), or by drawing one directly in the plot view (Chapter 4). The graded region is the item's

footprint inflated by the grade's inclusion distances, so the grade covers the equipment and the working space around it. Where regions overlap, the more stringent grade wins.

9.3 The Area Grading Map

Selecting Area Grading in the results panel draws the graded regions over the zone, in both the plot view and the 3D scene — the quickest check that the grading you intended is the grading the model contains. Geographic coverage results are then reported per grade (Chapter 11), and every scenario inherits the grade of its equipment item so risk results split by grade as well.

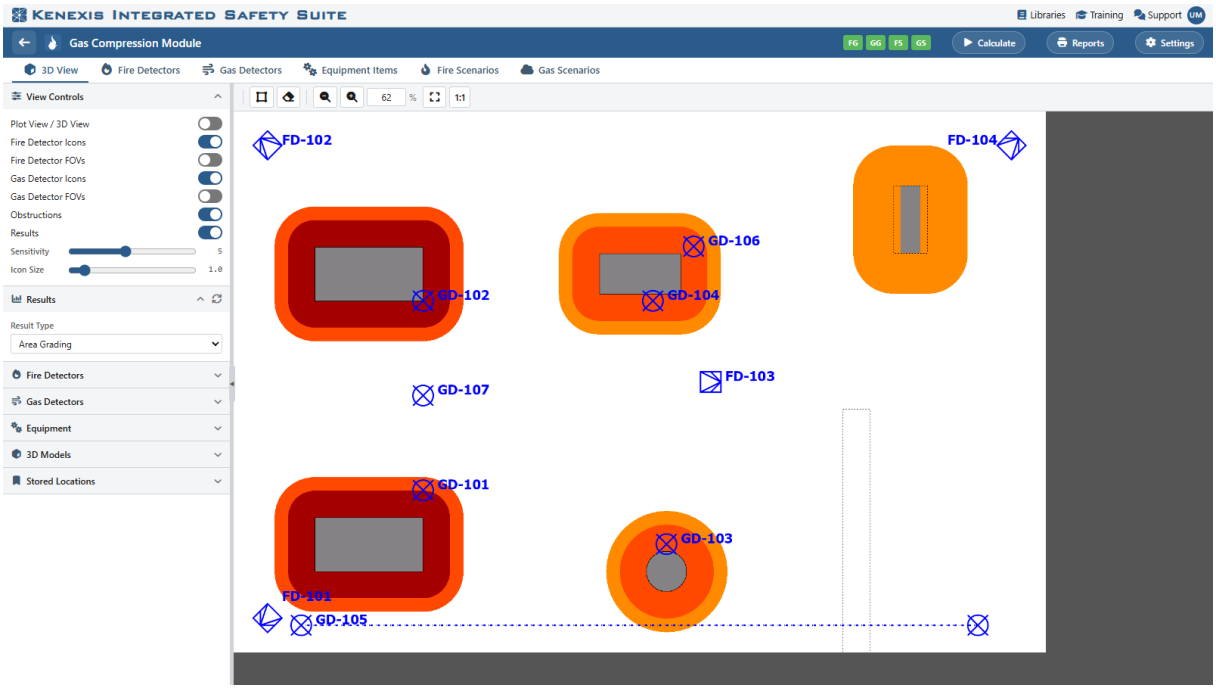


Figure 9-2. The Area Grading result in the plot view: each graded region is drawn around its equipment item, inflated by the grade's inclusion distances.

10 Running Calculations

10.1 The Run Calculate Dialog

The Calculate button in the header opens the Run Calculate dialog, which lists the four calculations with their current status — Current, Out of Date, or No Results. Check the ones to run and click Run.

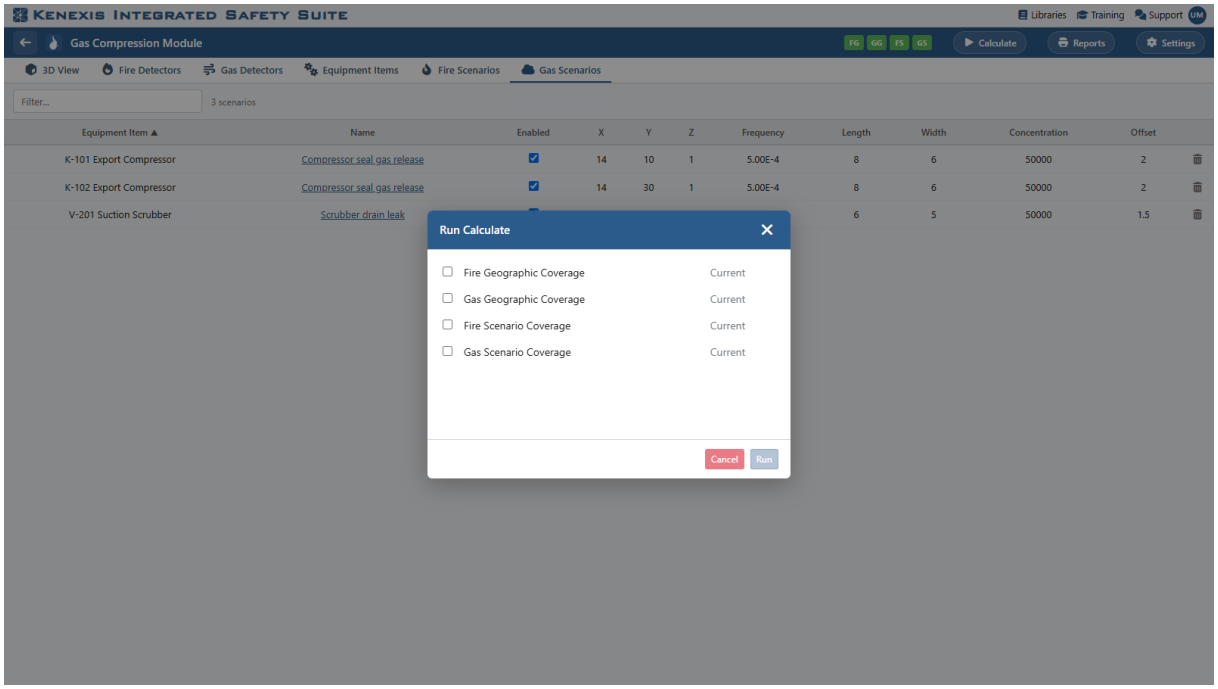


Figure 10-1. The Run Calculate dialog. Each calculation row shows its status; checked rows run when you click Run, with live progress bars.

Table 10-1. The four calculations and their outputs.

Calculation	Produces
Fire Geographic Coverage	The fire coverage map and per-grade coverage fractions.
Gas Geographic Coverage	The gas coverage map and per-grade coverage fractions.
Fire Scenario Coverage	Fire risk: mitigated and residual frequencies plus the unmitigated and residual risk maps.
Gas Scenario Coverage	Gas risk: the same set, weighted by the wind rose.

Calculations run in the Kenexis cloud: each request is queued and processed by the Kenexis Fire & Gas Mapping calculation engine, with progress reported back to the dialog every few seconds. Fire Scenario Coverage builds on the fire geographic map, so checking it automatically includes Fire Geographic Coverage whenever that map is not current. The Cancel button stops in-flight calculations after a confirmation. Every completed run is stamped with the analyst's name, Kenexis Fire & Gas Mapping certificate number, and the date, and those appear on the printed report.

10.2 Result Status Tracking

Kenexis Fire & Gas Mapping tracks which edits affect which results, so the badges and the Run Calculate dialog always tell you what needs to be re-run. The table summarizes the relationships:

Table 10-2. Which edits mark which calculations out of date.

Change	Fire Geo	Gas Geo	Fire Scenario	Gas Scenario
Fire detector add / edit / enable / disable	●		●	
Gas detector add / edit / enable / disable		●		●
Equipment item add / edit / enable / disable	●	●	●	●
3D model upload	●	●	●	
Graded area enable / disable			●	●
Fire scenario changes			●	
Gas scenario changes				●
Analysis elevation	●	●	●	●
Fire calculation method / plume size	●		●	
Gas calculation method		●		●
Scenario rotation count			●	●

Grading definitions and wind data

Edits to the grade definitions and the wind rose take effect the next time you run the affected calculations — re-run geographic coverage after re-grading, and gas scenario coverage after revising the wind rose.

11 Reviewing Results

11.1 The Results Panel

The Results panel on the 3D View tab selects which result is displayed on the plot view and the 3D floor. The Result Type list offers the two geographic coverage maps, the four risk maps (unmitigated and residual, fire and gas), the Area Grading map, and Overlay (the plain layout). For the geographic maps, a second list restricts the display to one grade, the ungraded zone, or everything; a Results Out of Date banner appears whenever the displayed result no longer matches the model, and the refresh button reloads the images after a calculation completes.

11.2 Geographic Coverage Maps

The geographic coverage maps color every point of the analysis plane by how many detectors can see it:

Table 11-1. Geographic coverage map colors.

Color	Meaning
Green	Visible to two or more detectors — sufficient for 2ooN voting.
Yellow	Visible to exactly one detector.
Red	Visible to no detector.
Gray	Inside an equipment item — excluded from the statistics.

The results table beside the map reports the same information numerically: for the zone and for each grade, the fraction covered by two or more detectors (2D), by exactly one (1D), and by none. Read the 2D column against the grade's coverage target when the voting philosophy is 2ooN; add the 1D column when a single detector is enough. Percentages below one and above ninety-nine display as “< 1%” and “> 99%”.

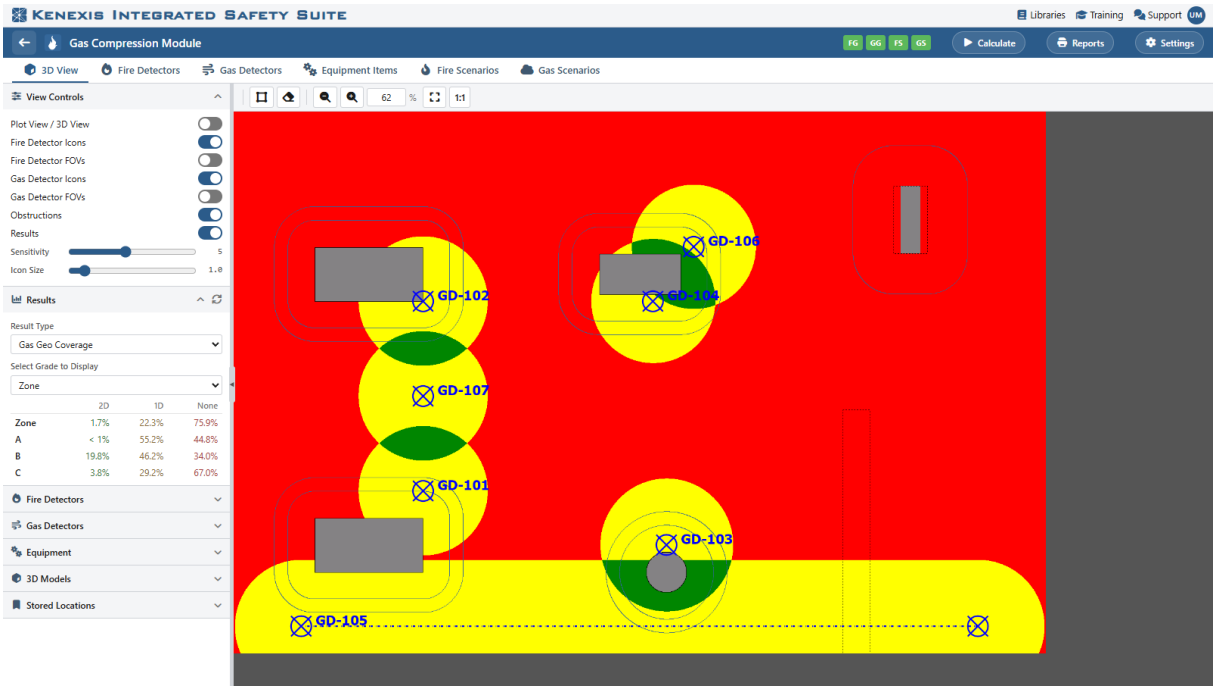


Figure 11-1. A gas geographic coverage map. Point detectors cover discs sized by the critical cloud diameter; the open-path beam covers the band between transmitter and receiver; green marks the overlap of two detectors.

11.3 Scenario Risk Results

Selecting a risk result switches the panel to the frequency summary: the Hazard Frequency (the total of every enabled scenario), the Mitigated Frequency (detected), the Residual Frequency (undetected), and the Scenario Coverage factor — mitigated divided by total. The same four numbers repeat for each grade, so a lightly covered grade stands out immediately. Frequencies are shown in scientific notation.

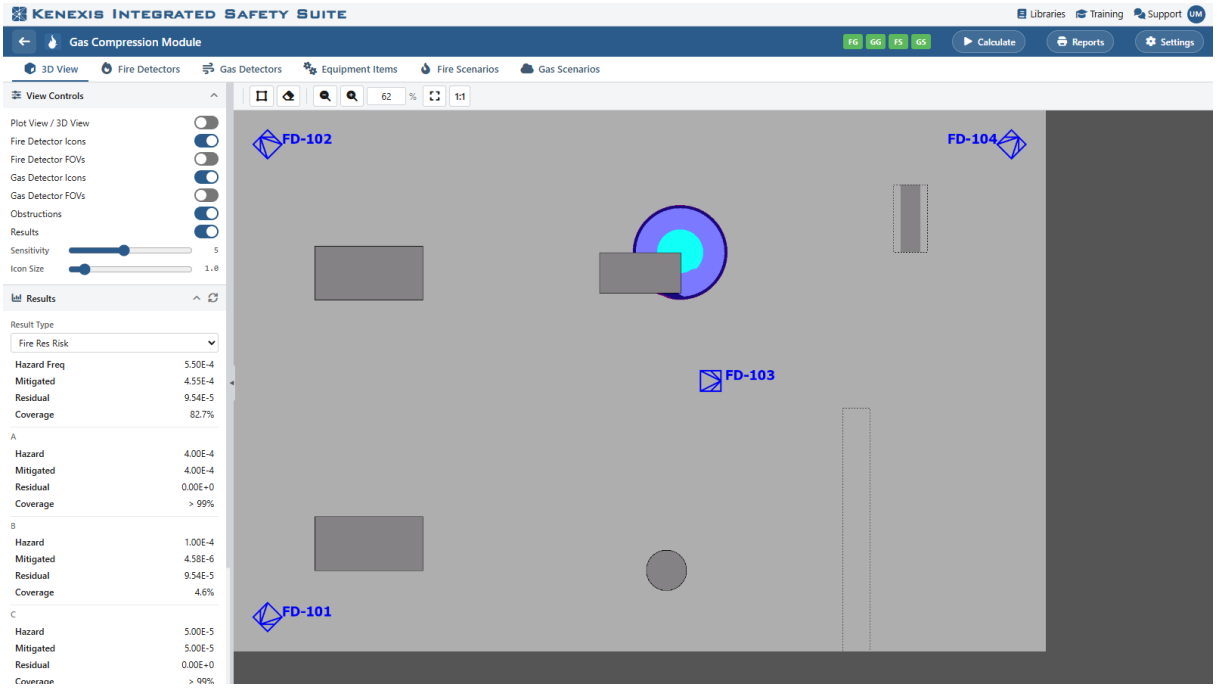


Figure 11-2. A fire residual risk map. Most of the zone shows no residual frequency; the colored region marks the one scenario the layout does not detect, and the panel reports hazard, mitigated, and residual frequencies with the scenario coverage factor, overall and per grade.

The two map styles answer different questions. The unmitigated (geographic risk) map shows where hazard frequency lives in the zone before credit for detection; the residual risk map shows what remains after the detectors do their work. Both use a logarithmic color scale spanning half-decade bands from 10^{-1} per year down to about 3×10^{-7} per year, so a change of one color step is a factor of about three in frequency.

12 Reports

The Reports button in the header opens the Report Options dialog, which assembles a Word document ("Effigy Report.docx") from the pages you select:

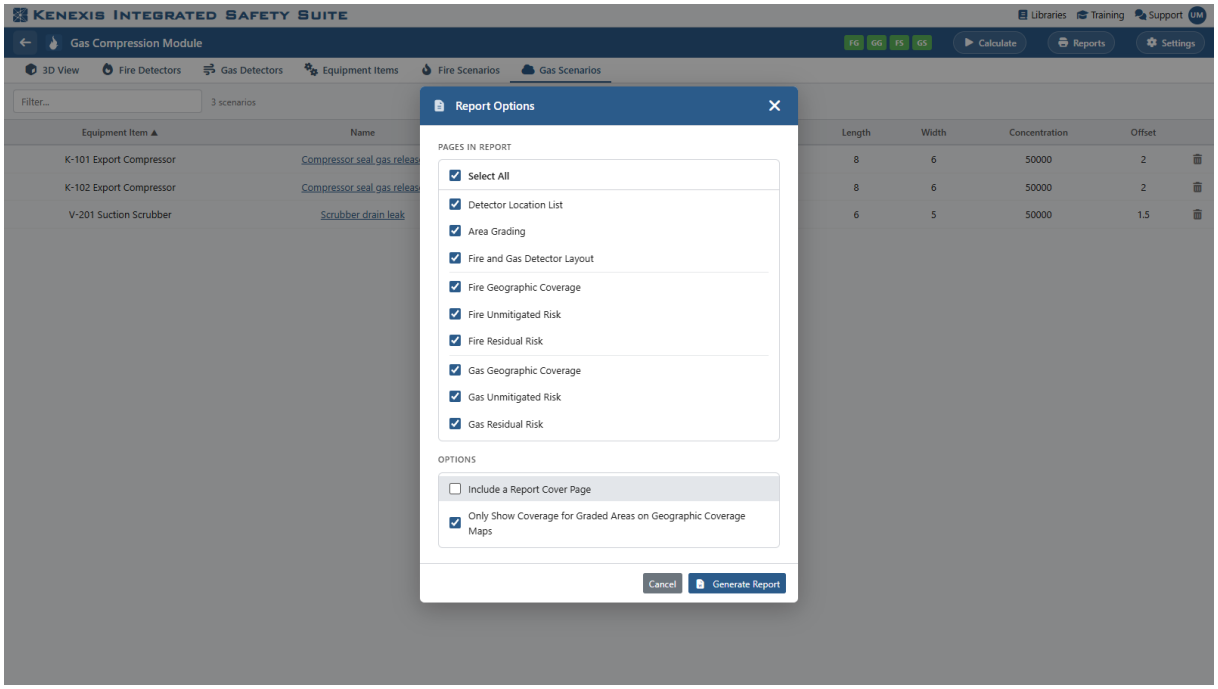


Figure 12-1. The Report Options dialog: pick the report pages, optionally add a cover page, and generate a Word document.

- **Detector Location List** — tabulated fire and gas detector coordinates and parameters.
- **Area Grading / Fire and Gas Detector Layout** — the grading map and the plain layout drawing.
- **Coverage and risk pages** — Fire and Gas Geographic Coverage, Unmitigated Risk, and Residual Risk, each with its map, its numeric results, the grade coverage targets alongside achieved coverage, and the analyst signature block (name, certificate number, and date). These pages become selectable once their calculations are current.

Two options tune the output: Include a Report Cover Page, and Only Show Coverage for Graded Areas on Geographic Coverage Maps — the latter blanks ungraded space so the maps concentrate on the regions with targets. Generate Report builds the document and downloads it.

13 Study Settings

The gear button in the header opens the Settings dialog: six tabs covering presentation, study identity and geometry, grading, wind, detector defaults, and the overlay image. Save writes every tab at once; geometry changes rebuild the 3D scene immediately.

13.1 General

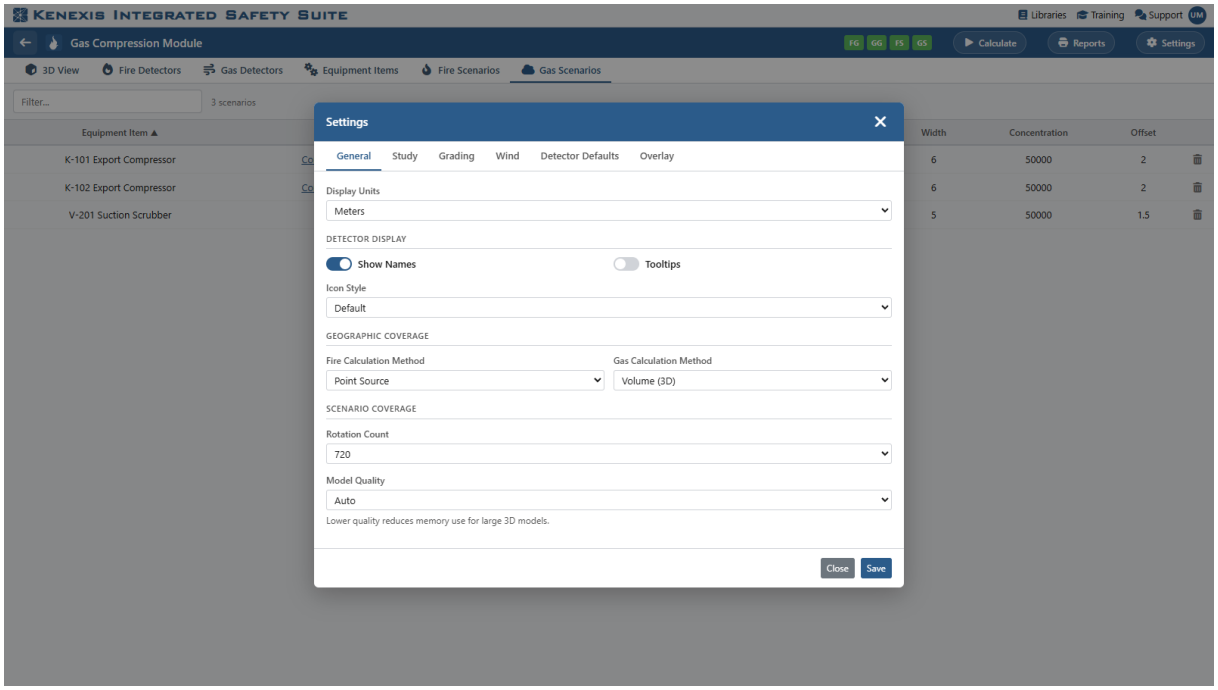


Figure 13-1. The General tab: display units, detector display options, the geographic calculation methods, the scenario rotation count, and the 3D model quality.

Table 13-1. Settings on the General tab.

Setting	Purpose
Display Units	The unit of length for the whole study; existing values are converted on save.
Show Names / Tooltips	Draw detector name labels in the views, and hover details.
Icon Style	Default Kenexis Fire & Gas Mapping glyphs or NFPA 170 symbols.
Fire Calculation Method	Point Source (conservative point fire) or Plume (a fire volume; adds Plume Width and Plume Height) — section 14.4.
Gas Calculation Method	Volume (3D) evaluates slices through the zone height; Area (2D) evaluates the analysis plane only — section 14.5.
Rotation Count	How many release directions each scenario is swept through: 720, 128, or 32 (section 14.7).
Model Quality	Rendering detail for imported 3D models: Auto, Fast, Normal, or Full. Lower quality reduces memory use for large models.

13.2 Study

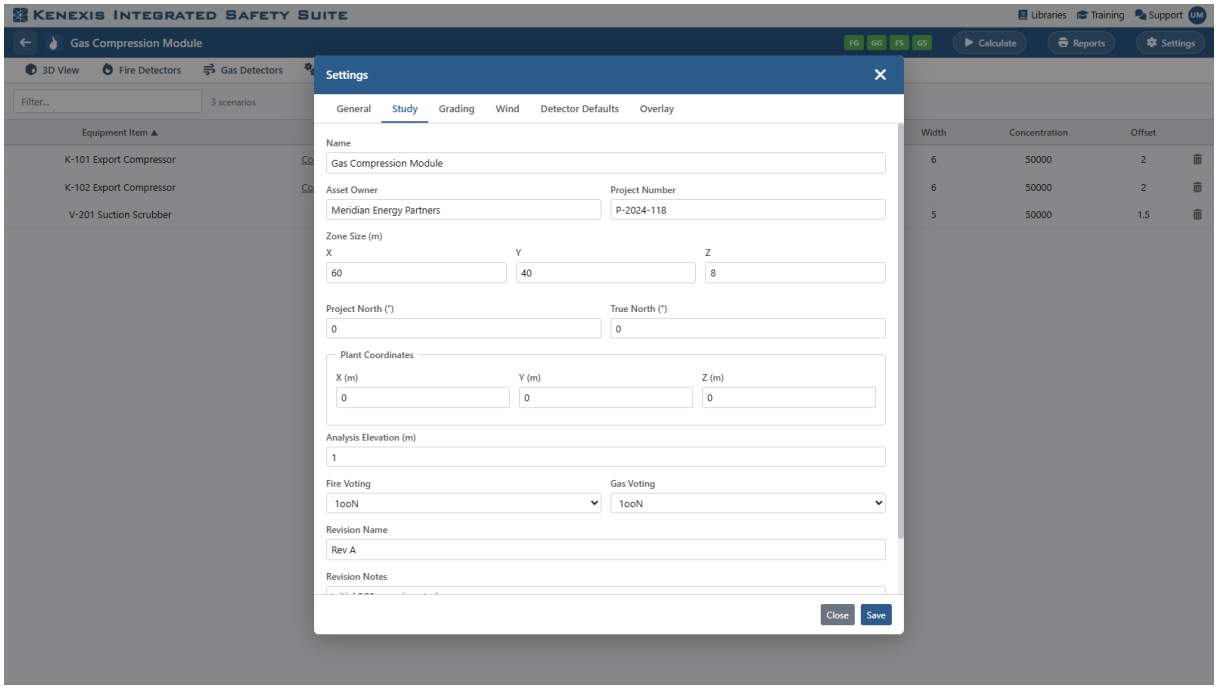


Figure 13-2. The Study tab: identity fields, zone size, north references, plant coordinates, analysis elevation, voting, and revision notes.

Table 13-2. Settings on the Study tab.

Setting	Purpose
Name / Asset Owner / Project Number	Study identity, shown in reports.
Zone Size X / Y / Z	The analyzed volume, in display units.
Project North / True North	The angles that relate the model's axes to plant north and true north; the wind rose and report compasses honor them.
Plant Coordinates	The plant-survey coordinates of the model origin. Set once, every location in the study is entered and displayed in plant space.
Analysis Elevation	The height of the coverage evaluation plane.
Fire Voting / Gas Voting	1ooN or 2ooN — the alarm philosophy used by the scenario risk calculations (section 14.8).
Revision Name / Notes	Free-text revision tracking for the study.

13.3 Grading

The Grading tab defines the study's coverage grades; Chapter 9 covers it in full.

13.4 Wind

The Wind tab holds the wind rose used by the gas scenario risk calculation: a relative weight for each of the sixteen compass directions, drawn live as a rose diagram. Enter values from any wind data you have — percentages, hours, or counts — and Kenexis Fire & Gas Mapping normalizes them into direction probabilities. The rose rotates with the study's True North so it always reads as a compass.

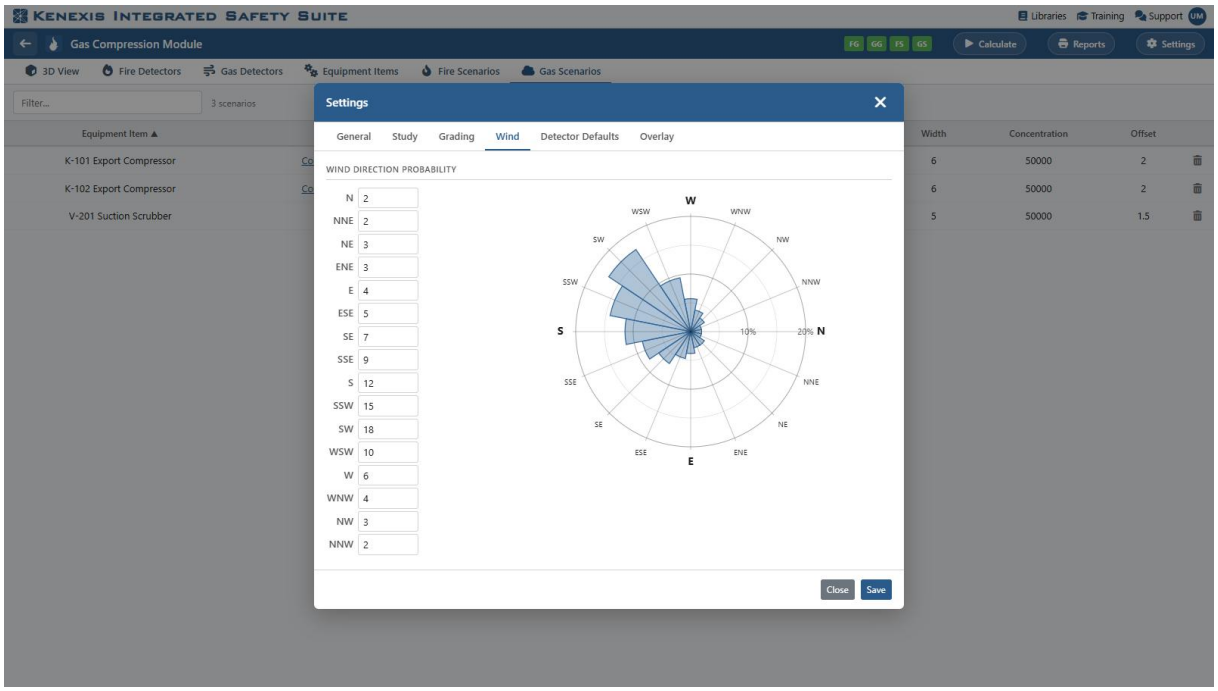


Figure 13-3. The Wind tab. Sixteen direction weights define the wind rose; the diagram updates as you type and reflects the study's north reference.

13.5 Detector Defaults

The Detector Defaults tab sets what a newly added detector starts as: the fire-detector library type (manufacturer, model, hazard, sensitivity) and default RHO, and the gas-detector type with its critical cloud diameter and point and open-path concentrations. Defaults make bulk placement fast — every Add and every right-click placement in the 3D view begins from these values.

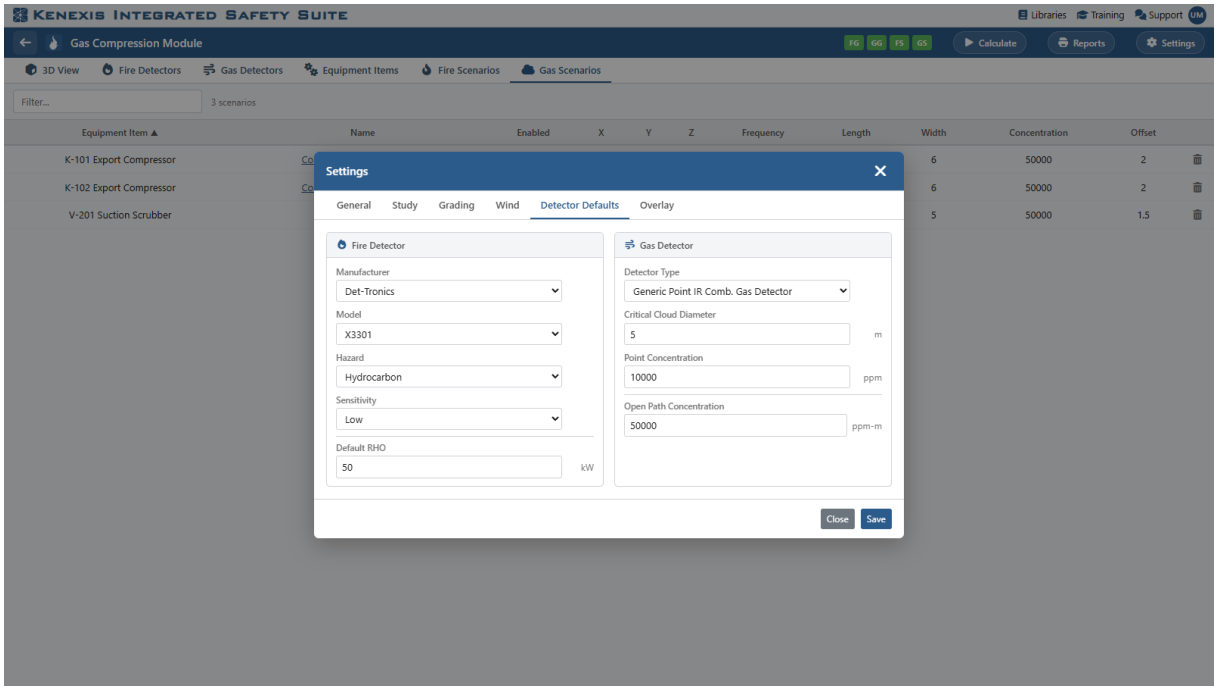


Figure 13-4. The Detector Defaults tab: the starting type and parameters for new fire and gas detectors.

13.6 Overlay

The Overlay tab attaches a plot plan or satellite image to the study. Drop a GIF, JPG, BMP, or PNG (up to 4 MB) on the upload zone and the image is stretched across the zone floor in the plot view and the 3D scene — the reference layer for tracing equipment (Chapter 4). Near-white areas of the image render transparent so the drawing reads as line work over the results. Clear Overlay removes it.

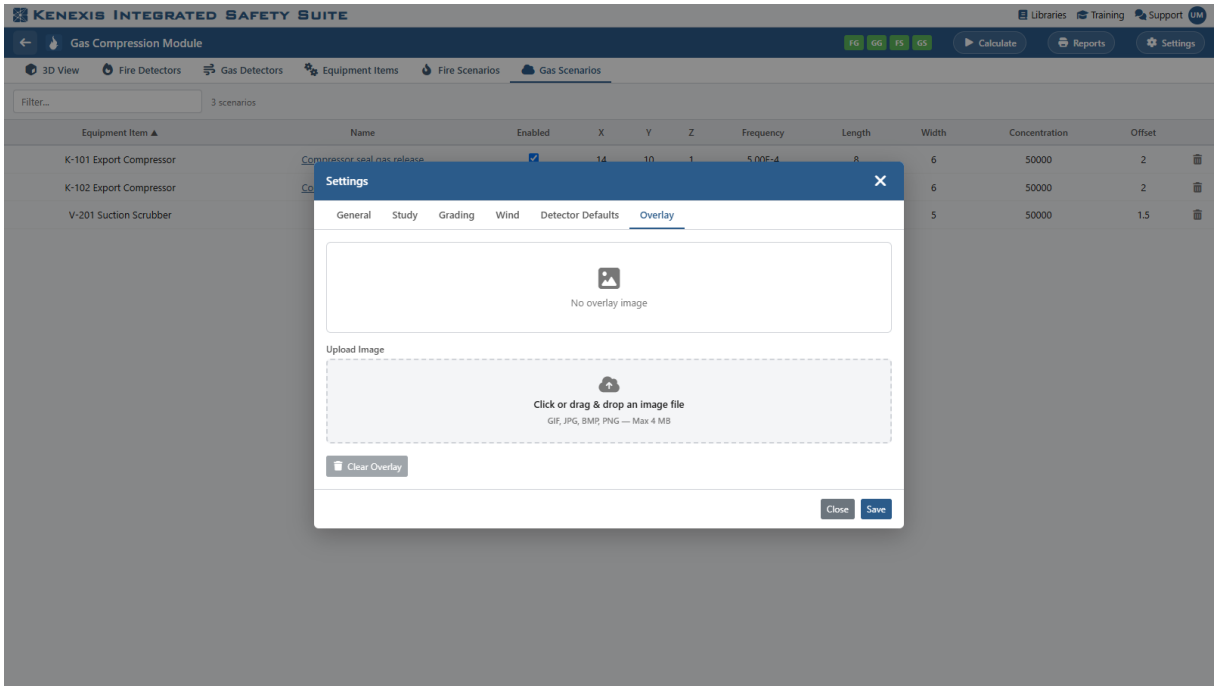


Figure 13-5. The Overlay tab: upload a plot-plan image to trace the layout against, or clear the current one.

14 The Calculations Behind Kenexis Fire & Gas Mapping

This chapter documents how Kenexis Fire & Gas Mapping turns a model into numbers. The relationships below are the ones the calculation engine uses; worked examples use round illustrative values.

14.1 The Analysis Raster and Units

Every calculation runs on a raster image of the zone in which one pixel represents one square inch at plant scale. A zone ten feet square therefore becomes a 120 × 120 pixel map. For very large zones the raster is scaled down just enough to stay within the engine's two-megapixel budget, keeping run times predictable. All lengths are stored in a single internal base and converted to the study's display units at the edges, so changing display units re-labels the study without disturbing the geometry.

14.2 Fire Detector Detection Range

A fire detector's reach depends on the fire it must see and on the detector's own sensitivity. Each library entry carries a sensitivity coefficient C calibrated from manufacturer performance data; together with the detector's threshold radiant heat output (RHO, in kW) it sets the maximum detection distance:

$$d = \left(\frac{82.83 \cdot \mathrm{RHO}}{1000 \cdot C}\right)^{0.478}$$

d = maximum detection distance in metres; RHO = threshold radiant heat output (kW); C = the library sensitivity coefficient; 82.83 and 0.478 are engine calibration constants.

Worked example

An optical flame detector with a sensitivity coefficient of 0.012, required to detect a 100 kW design-basis fire, reaches d = $(82.83 \times 100 / 12)^{0.478}$ ≈ 23 m. Halving the design-basis fire to 50 kW shortens the range to about 16 m — coverage is always relative to the fire you size it for.

Visual (camera) types use their entered maximum detection distance directly.

14.3 Fields of View and Obstruction Shadows

The detection range scales the detector type's three-dimensional sensitivity envelope — a solid of revolution built from the manufacturer's off-axis response profile — which is then oriented by the detector's rotation and declination. The engine intersects this solid with the analysis plane to get the detector's footprint, and then removes shadows: every triangle of every enabled obstruction (including imported STL models) is projected from the detector's position onto the plane, and the shadowed region is subtracted. What remains is the area that detector truly sees. Detector footprints are then combined per pixel: seen by one detector, by two or more, or by none — the yellow, green, and red of the coverage map. Pixels inside equipment are excluded from the statistics entirely.

14.4 Point Source and Plume Fire Models

The default point-source model treats a fire as a single point at the analysis elevation: a pixel is covered only if a detector has an unobstructed line to that exact point. This is deliberately conservative — real fires have volume, so a sight line blocked by a small pipe rarely hides a whole fire. The plume model accounts for that volume: the fire becomes a vertical column with the width and height you set, the engine evaluates visibility at several elevations through the column, and a location counts as covered when at least a quarter of the plume is visible to the detector. With large imported 3D models, the plume model avoids the pessimism that many small obstructions would otherwise accumulate.

14.5 Gas Geographic Coverage

Gas geographic coverage asks, for every point of the zone: if a gas cloud of the critical size were centered here, would a detector register it? A point detector therefore covers a disc — the intersection of the critical-cloud sphere, centered at the evaluation point, with the detector's position. At an elevation z the disc radius around a detector mounted at z_e is:

$$r(z) = \sqrt{\left(\frac{D}{2}\right)^2 - (z_e - z)^2}$$

D = the critical cloud diameter; z_e = the detector elevation. The disc exists only where the square root is real — a detector mounted higher than half the cloud diameter above the plane contributes nothing at that plane.

An open-path detector covers the same discs at its transmitter and receiver plus the band between them, the beam's cylinder of radius D/2. Acoustic detectors cover their manufacturer-profiled listening volume, and visual gas detectors are treated like flame detectors, shadows included. In the Volume (3D) method the engine evaluates slices through the full zone height and the zone row of the results aggregates all slices, while the per-grade rows are evaluated at the analysis elevation; the Area (2D) method evaluates the analysis plane only.

14.6 Coverage Fractions and the Grading Mask

The per-grade numbers come from a mask built from every enabled graded area: each region is the equipment footprint inflated by its grade's inclusion distances (rounded corners included), with secondary rings assigned to their designated lower grade and higher grades winning overlaps. Laying the mask over the coverage map and counting pixels gives, for the zone and for each grade, the fractions covered by two or more detectors, by exactly one, and by none. Equipment interiors are excluded from both numerator and denominator, so coverage percentages describe the space people and hazards actually occupy.

14.7 Scenario Footprints

A scenario's footprint is a teardrop: the release-side half of an ellipse capped by a half-circle at the far end. Its overall length along the release direction is the scenario Length and its maximum width is the scenario Width:

$$b = \frac{W}{2},\ a = L - b,\ c = \sqrt{a^2 - b^2}$$

$$x_c = x_r + (a - \text{Offset}) \cdot \cos\theta$$

$$y_c = y_r + (a - \text{Offset}) \cdot \sin\theta$$

L, W = scenario length and width; (x_r, y_r) = the release point; ϑ = the release direction; (x_c, y_c) = the footprint center; a, b = the ellipse semi-axes; c = the focal distance. The offset slides the tapered tip upwind (positive) or downwind (negative) of the release point.

The risk calculations sweep θ through the full circle in equal steps — the Rotation Count setting (720, 128, or 32). More rotations resolve the directionality more finely; fewer run faster.

14.8 Fire Scenario Risk

Fire direction carries no wind preference, so each rotation of a fire scenario carries an equal share of its frequency:

$$f_{\text{slice}} = \frac{f_{\text{scenario}}}{N_{\text{rot}}}$$

N_rot = the rotation count.

For each rotation the engine lays the footprint on the fire coverage map and tests whether enough of it is seen: about one square foot of the footprint must be covered at the multiplicity the fire voting demands — green pixels for 2ooN, green or yellow for 1ooN. Detected rotations add their frequency to the mitigated total; undetected rotations add to the residual total and paint their footprint onto the residual risk map. Every rotation also paints the unmitigated (geographic risk) map, which is why that map shows the hazard distribution before any detection credit. Totals accumulate overall and per grade, each scenario inheriting its equipment item's grade.

14.9 Gas Scenario Risk

Gas travels with the wind, so each rotation of a gas scenario is weighted by the wind rose: the sixteen direction weights are normalized to probabilities and interpolated across the rotation count, and a release direction's share is its scenario frequency times its wind probability. Detection is then evaluated per rotation, in order of detector capability:

- **Visual** — the same footprint-area test as fire, on the visual gas coverage map.
- **Acoustic** — detected if the release point itself lies inside the detector's listening volume; leak noise does not depend on wind direction, so a hit detects every rotation of that scenario.
- **Point** — detected if the detector sits inside the footprint and the scenario's cloud concentration meets the detector's setpoint.
- **Open path** — detected if the beam's chord through the footprint, times the cloud concentration, exceeds the path-integrated setpoint:

$$L_{\text{chord}} \cdot C_{\text{cloud}} > C_{\text{setpoint}}$$

L_chord = the beam length inside the footprint (m); C_cloud = the scenario concentration (ppm); C_setpoint = the open-path setpoint (ppm·m).

Gas voting applies across all technologies: 1ooN detects on the first hit, 2ooN requires two independent detectors. Mitigated and residual totals, per-grade splits, and the two risk maps are produced exactly as for fire.

Worked example

A release scenario of frequency 1×10^{-3} per year is swept through the rotation count. If the layout detects rotations carrying 75% of the wind-weighted frequency, the mitigated frequency is 7.5×10^{-4}, the residual frequency is 2.5×10^{-4}, and the scenario coverage factor is 0.75.

14.10 Scenario Coverage Factor

The headline risk number is the fraction of hazard frequency the layout detects:

$$\text{Scenario Coverage} = \frac{F_{\text{mit}}}{F_{\text{mit}} + F_{\text{res}}}$$

F_mit, F_res = the mitigated and residual frequency totals. The factor is reported overall and per grade.

14.11 Number Formatting

Displayed results are formatted for readability while stored at full precision. Coverage percentages show one decimal place, with values below one shown as “< 1%” and above ninety-nine as “> 99%”. Frequencies display in scientific notation; report pages clamp the extremes as “$< 1\times10^{-8}$” and “$> 5\times10^{-1}$” per year. Risk maps use the half-decade logarithmic color scale described in Chapter 11.

Appendix A 3D Navigation Reference

Keyboard controls apply when the 3D view is visible and no dialog or text field has focus.

Table A-1. 3D view keyboard and mouse controls.

Control	Action
`W / S`	Walk forward / backward
`A / D`	Pan left / right
`Q / E`	Pan down / up
`Arrow keys`	Look around
`Esc`	Dismiss the context menu and selection highlight
`Mouse wheel`	Zoom
`Ctrl + wheel`	Walk forward / backward
`Shift + wheel`	Move the focal point nearer / farther
`Drag`	Look around
`Shift + drag`	Orbit the focal point
`Ctrl + drag`	Pan
`Alt + drag`	Zoom
`Ctrl + Alt + drag`	Walk
`Shift + Alt + drag`	Move the focal point
`Right-click`	Pick an object and open its context menu

Appendix B Formula Quick Reference

Table B-1. Formula quick reference.

Quantity	Formula
Fire detection range	$d = \left(\frac{82.83 \cdot \mathrm{RHO}}{1000 \cdot C}\right)^{0.478}$
Point gas coverage radius	$r(z) = \sqrt{\left(\frac{D}{2}\right)^2 - (z_e - z)^2}$
Open-path detection	$L_{\mathrm{chord}} \cdot C_{\mathrm{cloud}} > C_{\mathrm{setpoint}}$
Footprint geometry	$b = \frac{W}{2}, \quad a = L - b, \quad c = \sqrt{a^2 - b^2}$
Fire slice frequency	$f_{\mathrm{slice}} = \frac{f_{\mathrm{scenario}}}{N_{\mathrm{rot}}}$
Gas slice frequency	$f_{\mathrm{slice}} = f_{\mathrm{scenario}} \cdot p_{\mathrm{wind}(\theta)}$
Scenario coverage factor	$\mathrm{SC} = \frac{F_{\mathrm{mit}}}{F_{\mathrm{mit}} + F_{\mathrm{res}}}$

End of manual.