KRYPTOS

3D Fire & Gas Detection

3D Fire Mapping Validation Report

App Version

1.0.0

Date

19-11-2026

1 Introduction

Kryptos is an advanced three-dimensional Fire and Gas Mapping software developed by Xalvic Advisors Private Limited for the engineering design, assessment and optimisation of fire and gas detection systems in industrial facilities. The software evaluates detector coverage within a three-dimensional representation of a facility, accounting for fire and gas characteristics, detector characteristics, detection ranges, fields of view, orientation, obstructions and the spatial distribution of the areas requiring protection.

The reliability and accuracy of the coverage calculations are fundamental to the engineering application of Kryptos. This document presents the validation of Kryptos' fire detection coverage calculations by comparing with independently derived analytical results for a series of representative test cases.

The validation cases have been deliberately selected to cover a range of geometric arrangements and fire detector configurations for which the expected coverage can be established analytically. These include variations in risk grade types, detector field of view, detection range, orientation and position relative to the protected areas, as well as different coverage voting requirements. Both low-alarm set point and high-alarm set point configurations are considered.

For each test case, the analytical coverage is determined independently and compared against the corresponding coverage calculated by Kryptos. The results are presented quantitatively, with the deviation between the two values reported in percentage points. This provides a direct measure of the agreement between the software calculations and the analytical reference results.

3D visualisations of the test configurations along with the coverage plots obtained in Kryptos are also included. These illustrate the spatial relationship between the fire detectors and the protected volumes, and provide a visual representation of the regions meeting the respective detection voting requirements. They complement the numerical comparisons by allowing the geometry, detector arrangement and resulting coverage distribution to be examined alongside the reported results.

The validation comprises 51 test cases and 139 individual coverage comparisons, encompassing the different risk grades, alarm-range and voting configurations considered. Across the results presented in this report, the mean and maximum

deviation between the analytical and software-calculated coverage is 0.03 and 0.29 percentage points respectively.

This document is specifically concerned with the validation of fire detection coverage calculations in Kryptos. The validation of gas detection coverage calculations, which involves a separate set of calculation methodologies and analytical test cases, is addressed in a separate document.

2 Validation Scope

The test cases are grouped according to the Risk Grades included in each arrangement. Each group is evaluated under two alarm-range configurations: (i) a single detection range for each Risk Grade; and (ii) separate Low Alarm and High Alarm ranges for each Risk Grade.

Test Group	Validation Scope	Single Alarm-Range Cases	Low- and High-Alarm-Range Cases
Single Risk Grade	One Risk Grade (cube or cylinder) with one to four fire detectors placed inside it or on its edge.	15	14
Two Risk Grades of the Same Type	Two Risk Grades of the same type (cubes or cylinders) side by side, each with its own detectors.	6	0
Two Risk Grades of Different Types	Two adjacent cubical Risk Grades of different types, with one detector positioned along their shared edge.	2	2
Four Risk Grades of Different Types	Four Risk Grades of different types, covered by one to four detectors, with and without a solid plank blocking the view.	6	6

Across the test cases, the parameters varied include the number of detectors, horizontal and vertical fields of view, detection ranges, detector locations (completely within a Risk Grade, on the boundary, or partially outside the Risk Grade), voting level, and the presence of solid obstructions that may block the detector's view.

3 Coverage Plot Legend

Each test case is illustrated using 3D views of the Risk Grades and fire detectors. The colours indicate the number of detectors that can detect each location within a Risk Grade.

Colour	Meaning
	Region is within the Risk Grade but not detected by any detector (0ooN)
	Detected by at least one detector (1ooN)
	Detected by at least two detectors (2ooN)
	Detected by at least three detectors (3ooN)
	Detected by at least four detectors (4ooN)
	Fire detector, identified by its number

The orientation cube in the upper-right corner of each view indicates the directions of the X, Y and Z axes. Where a slice plot is used, it shows a planar section through the Risk Grades. The slice plane and its position are identified in the caption below the corresponding figure.

4 Abbreviations and Terms

Term	Meaning
FOV (Field of View)	The angular extent of a fire detector's field of view, expressed in degrees. The horizontal FOV defines the lateral opening; the vertical FOV defines the vertical opening.
Curvature	A parameter describing how the detection range reduces towards the edge of the detector's field of view. A curvature value of 0 indicates that the range remains constant throughout the field of view without any reduction.
Range	The maximum distance at which a fire detector can detect a fire, expressed in metres (m). For cases with two alarm levels, each Risk Grade has separate Low Alarm and High Alarm ranges.
Vertical Tilt / Horizontal Tilt	The detector's angular orientation, expressed in degrees. Vertical tilt defines its upward or downward orientation; horizontal tilt defines its leftward or rightward orientation.

Term	Meaning
Risk Grade	A defined volume of a plant area for which fire detection coverage is assessed. In the cases presented here, a Risk Grade is represented by a cube or a cylinder. Each Risk Grade is assigned a Risk Grade Type.
Risk Grade Type	The classification assigned to a Risk Grade (for example, Fire Grade A). Each Risk Grade Type has an associated detector range.
Analytical Coverage (%)	The percentage of the Risk Grade volume calculated analytically that is detected (or covered) by the fire detector by being within the detector's range.
Software Coverage (%)	The percentage of the Risk Grade volume reported by Kryptos that is detected (or covered) by the fire detector.
Deviation	The difference between the analytical coverage and the software-calculated coverage, expressed in percentage points.
Voting Logic (1ooN, 2ooN, 3ooN, 4ooN)	Voting levels. For example, 2ooN means that a location is considered covered only if it is detected by at least two detectors. N denotes the total number of detectors considered in the configuration.
L and H (Low and High Alarm)	Low and High Alarm ranges. Each Risk Grade has a Low Alarm range (L) and a High Alarm range (H). A code such as LH indicates that one detector is evaluated using its Low Alarm range and another using its High Alarm range.

5 Geographical Coverage Calculation with a Single Alarm Range

5.1 Single Risk Grade

5.1.1 One detector completely inside a cubical Risk Grade - Field of View: 90°, Range: 10 m

Risk Grades

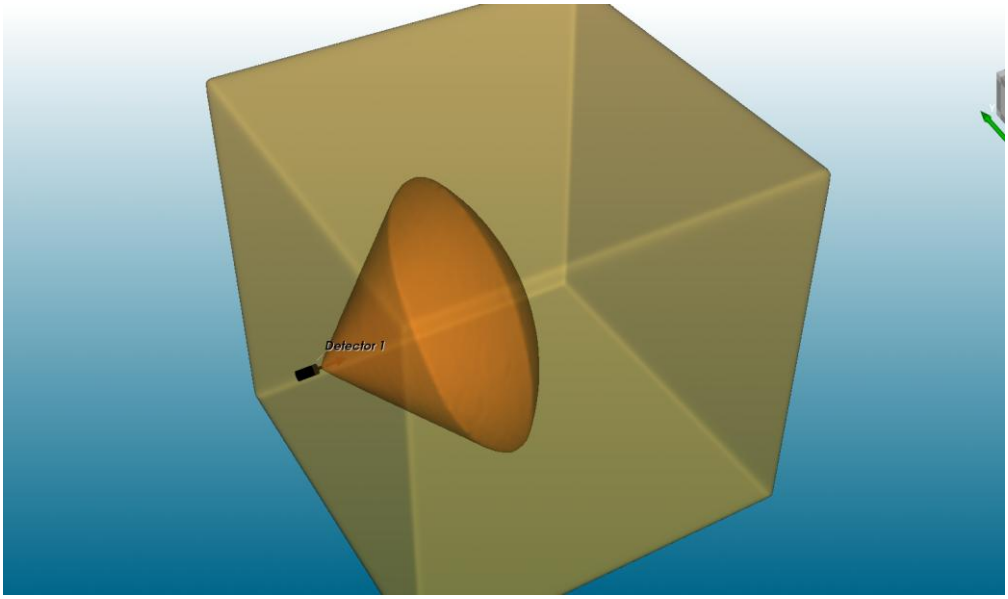
Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade B

Fire Detectors

Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
90°	90°	0	Risk Grade B - 10 m	0°	0°

Coverage Results

Risk Grade	Voting Logic	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade B	1ooN	7.67	7.69	0.02



View 1

5.1.2 One detector completely inside a cubical Risk Grade - Field of View: 60°, Range: 10 m

Risk Grades

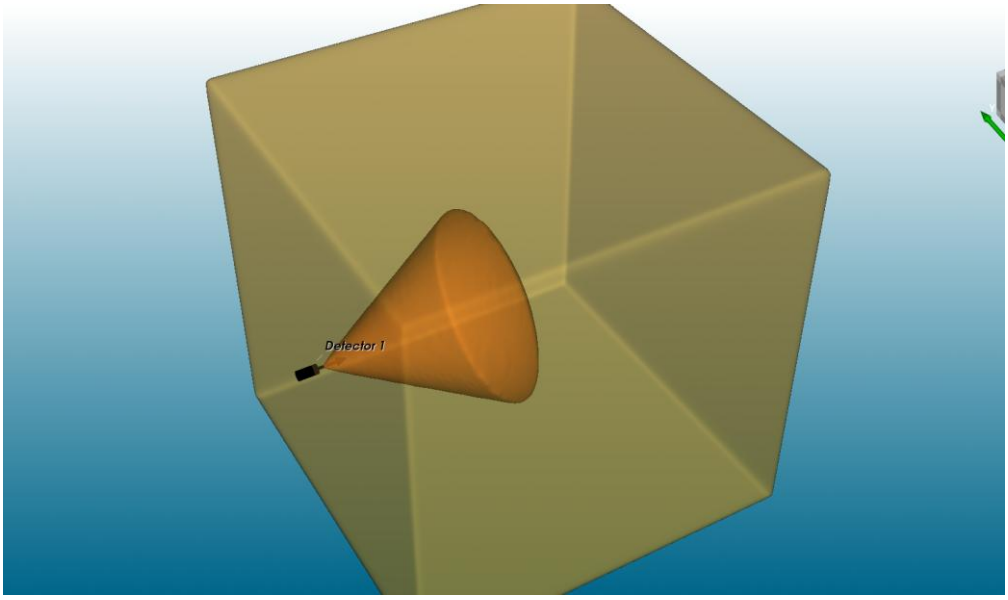
Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade A

Fire Detectors

Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
60°	60°	0	Risk Grade A - 10 m	0°	0°

Coverage Results

Risk Grade	Voting Logic	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade A	1ooN	3.51	3.57	0.06



View 1

5.1.3 One detector completely inside a cubical Risk Grade - Field of View: 120°, Range: 15 m

Risk Grades

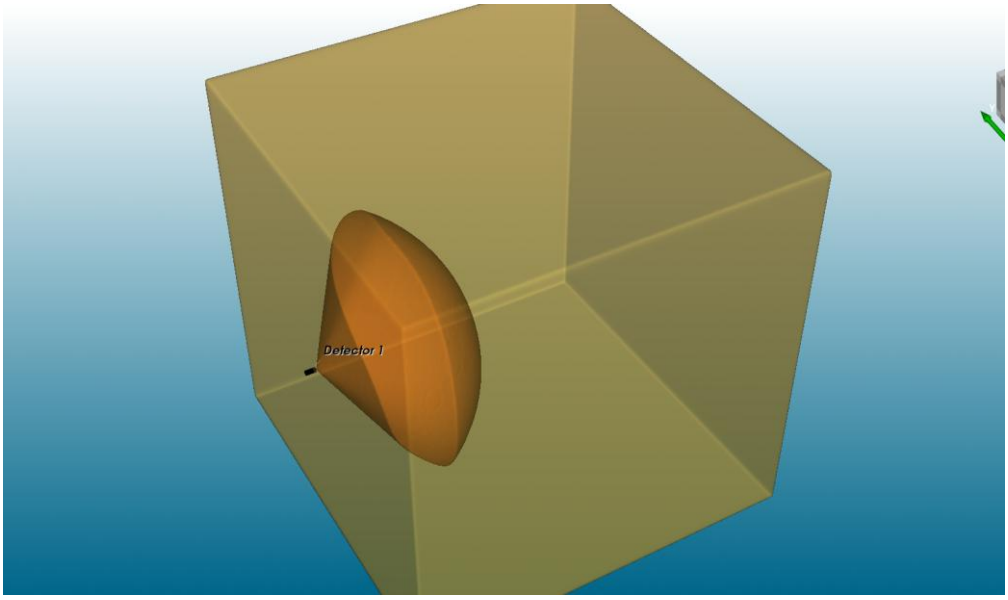
Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 40 m, Width 40 m, Height 40 m	Risk Grade D

Fire Detectors

Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
120°	120°	0	Risk Grade D - 15 m	0°	0°

Coverage Results

Risk Grade	Voting Logic	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade D	1ooN	5.52	5.37	0.15



View 1

5.1.4 One detector completely inside a cubical Risk Grade - Field of View: 90°, Range: 25 m

Risk Grades

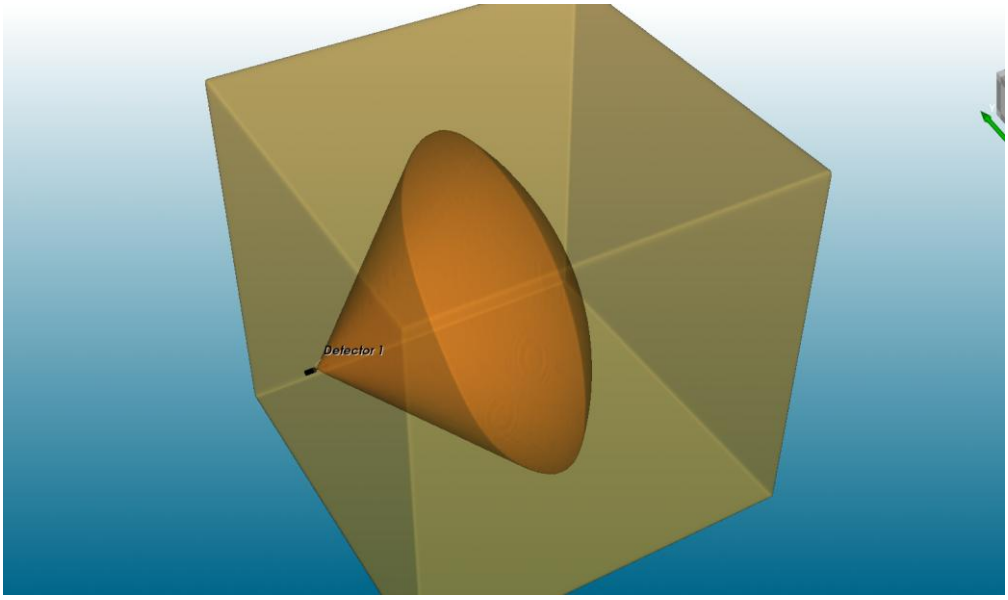
Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 40 m, Width 40 m, Height 40 m	Risk Grade D

Fire Detectors

Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
90°	90°	0	Risk Grade D - 25 m	0°	0°

Coverage Results

Risk Grade	Voting Logic	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade D	1ooN	14.98	14.76	0.22



View 1

5.1.5 Two detectors completely inside a cubical Risk Grade, with their coverage areas not touching each other - Field of View: 90°, Range: 10 m

Risk Grades

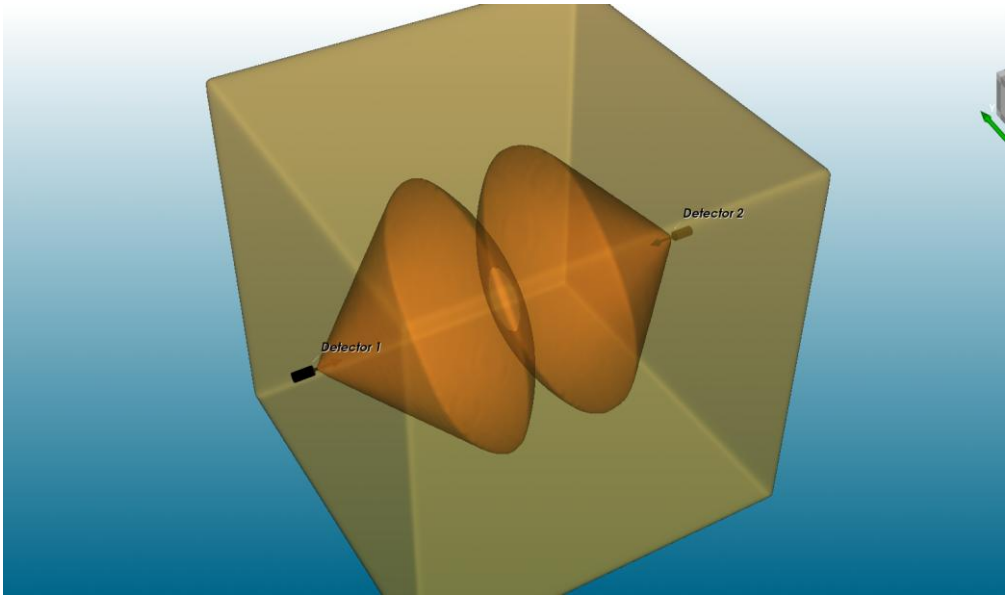
Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade A

Fire Detectors

Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
90°	90°	0	Risk Grade A - 10 m	0°	0°
90°	90°	0	Risk Grade A - 10 m	180°	0°

Coverage Results

Risk Grade	Voting Logic	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade A	1ooN	15.34	15.37	0.03



View 1

5.1.6 Two detectors completely inside a cubical Risk Grade, with their coverage areas not touching each other - Field of View: 60°, Range: 10 m

Risk Grades

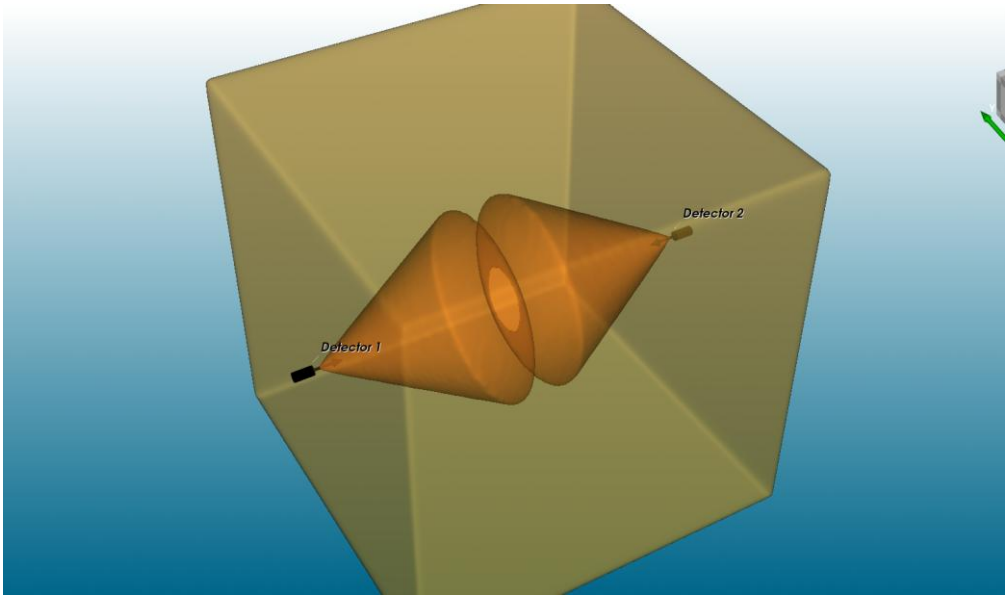
Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade B

Fire Detectors

Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
60°	60°	0	Risk Grade B - 10 m	0°	0°
60°	60°	0	Risk Grade B - 10 m	180°	0°

Coverage Results

Risk Grade	Voting Logic	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade B	1ooN	7.01	7.13	0.12



View 1

5.1.7 One detector half inside a cubical Risk Grade, with the other half of its view outside - Field of View: 90°, Range: 10 m

Risk Grades

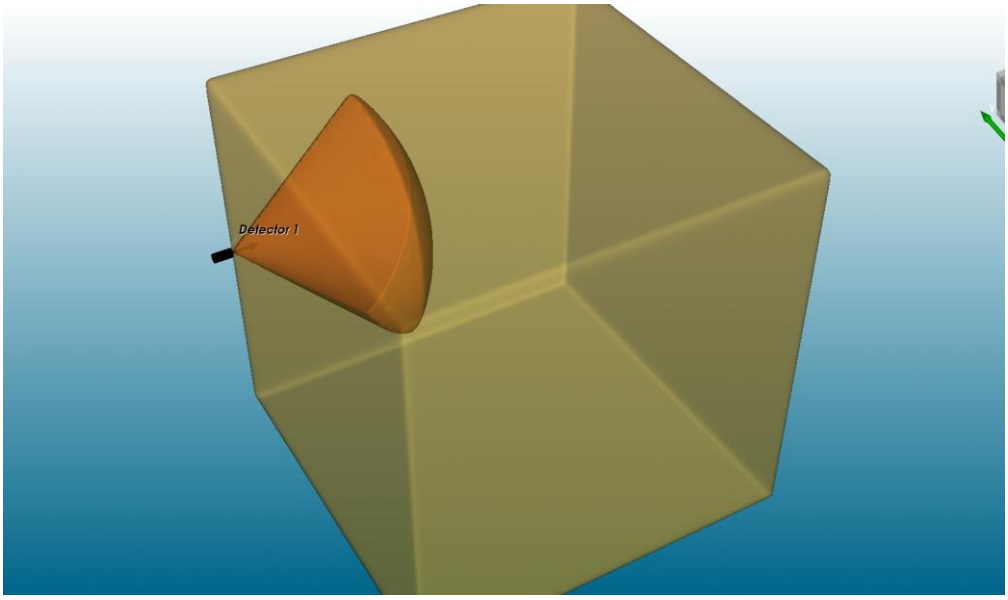
Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade D

Fire Detectors

Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
90°	90°	0	Risk Grade D - 10 m	0°	0°

Coverage Results

Risk Grade	Voting Logic	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade D	1ooN	3.83	3.84	0.01



View 1

5.1.8 One detector half inside a cubical Risk Grade, with the other half of its view outside - Field of View: 60°, Range: 12 m

Risk Grades

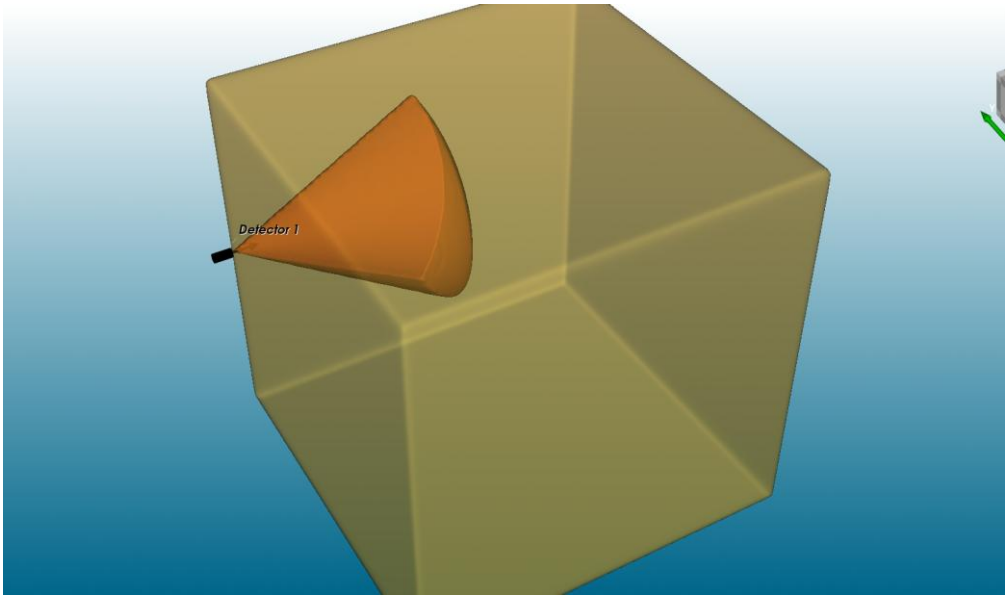
Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade C

Fire Detectors

Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
60°	60°	0	Risk Grade C - 12 m	0°	0°

Coverage Results

Risk Grade	Voting Logic	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade C	1ooN	3.03	3.07	0.04



View 1

5.1.9 Three detectors completely inside a cubical Risk Grade, with their coverage areas not touching each other - Field of View: 90°, Range: 10 m

Risk Grades

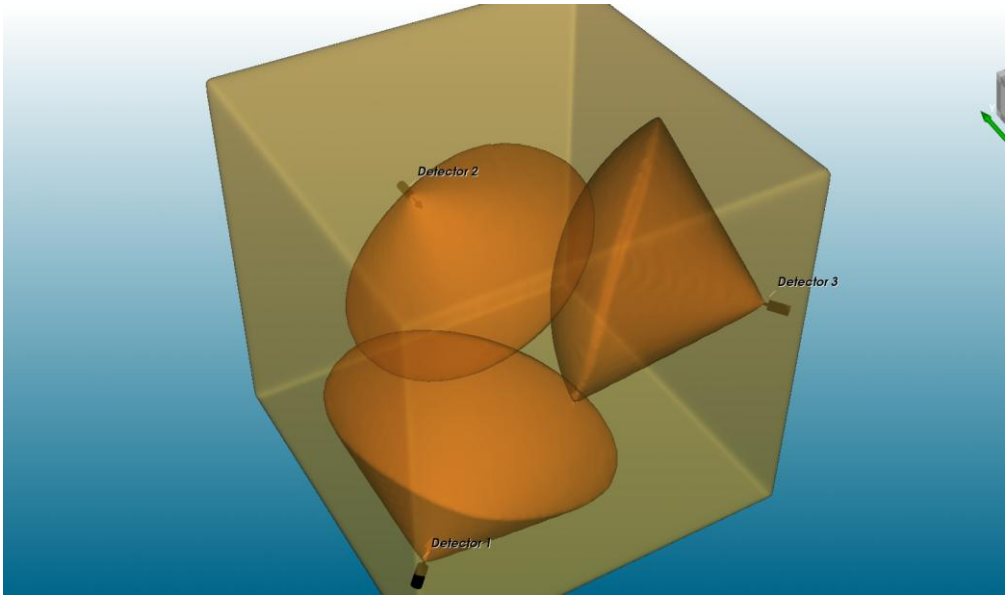
Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade B

Fire Detectors

Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
90°	90°	0	Risk Grade B - 10 m	9°	45°
90°	90°	0	Risk Grade B - 10 m	180°	90°
90°	90°	0	Risk Grade B - 10 m	9°	135°

Coverage Results

Risk Grade	Voting Logic	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade B	1ooN	23	23.07	0.07



View 1

5.1.10 Two detectors completely inside a cubical Risk Grade, placed at the same spot so their coverage fully overlaps (seen by at least two detectors) - Field of View: 60°, Range: 10 m

Risk Grades

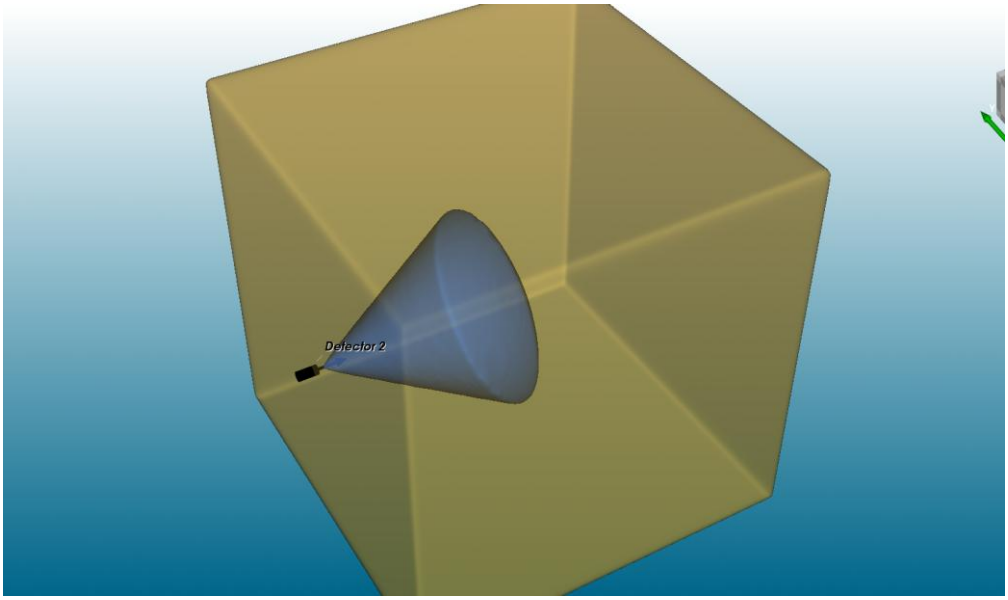
Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade D

Fire Detectors

Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
60°	60°	0	Risk Grade D - 10 m	0°	0°
60°	60°	0	Risk Grade D - 10 m	0°	0°

Coverage Results

Risk Grade	Voting Logic	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade D	2ooN	3.51	3.57	0.06



View 1

5.1.11 Three detectors completely inside a cubical Risk Grade, placed at the same spot so their coverage fully overlaps (seen by at least three detectors) - Field of View: 60°, Range: 10 m

Risk Grades

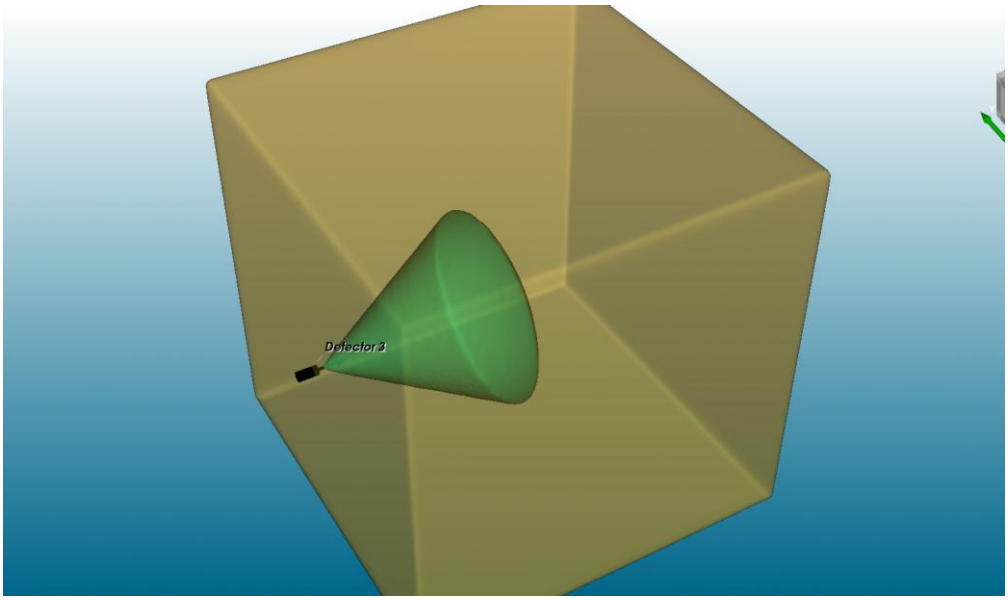
Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade A

Fire Detectors

Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
60°	60°	0	Risk Grade A - 10 m	0°	0°
60°	60°	0	Risk Grade A - 10 m	0°	0°
60°	60°	0	Risk Grade A - 10 m	0°	0°

Coverage Results

Risk Grade	Voting Logic	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade A	3ooN	3.51	3.57	0.06



View 1

5.1.12 Four detectors completely inside a cubical Risk Grade, placed at the same spot so their coverage fully overlaps (seen by at least four detectors) - Field of View: 90°, Range: 10 m

Risk Grades

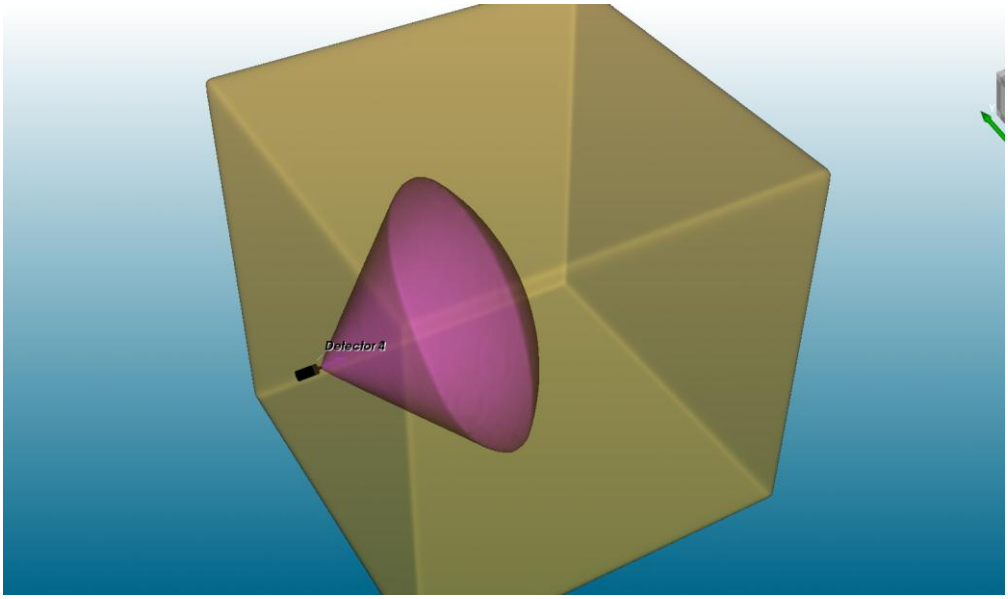
Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade D

Fire Detectors

Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
90°	90°	0	Risk Grade D - 10 m	0°	0°
90°	90°	0	Risk Grade D - 10 m	0°	0°
90°	90°	0	Risk Grade D - 10 m	0°	0°
90°	90°	0	Risk Grade D - 10 m	0°	0°

Coverage Results

Risk Grade	Voting Logic	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade D	4ooN	7.67	7.69	0.02



View 1

5.1.13 One detector completely inside a cylindrical Risk Grade - Field of View: 60°, Range: 10 m

Risk Grades

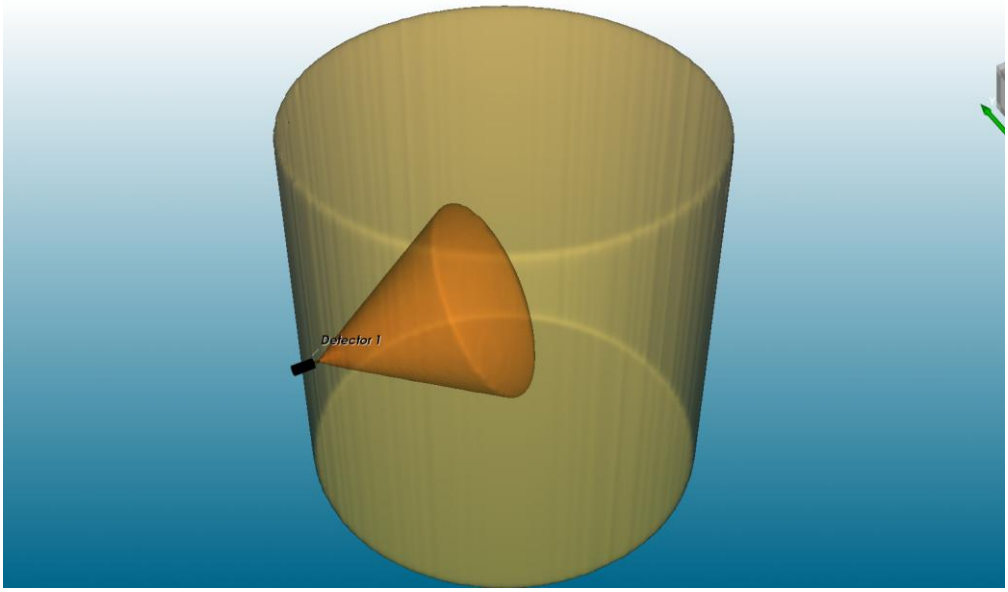
Risk Grade Geometry	Dimensions	Risk Grade Type
Cylinder	Radius 10 m, Height 20 m	Risk Grade B

Fire Detectors

Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
60°	60°	0	Risk Grade B - 10 m	0°	0°

Coverage Results

Risk Grade	Voting Logic	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade B	1ooN	4.47	4.55	0.08



View 1

5.1.14 One detector completely inside a cylindrical Risk Grade - Field of View: 120°, Range: 10 m

Risk Grades

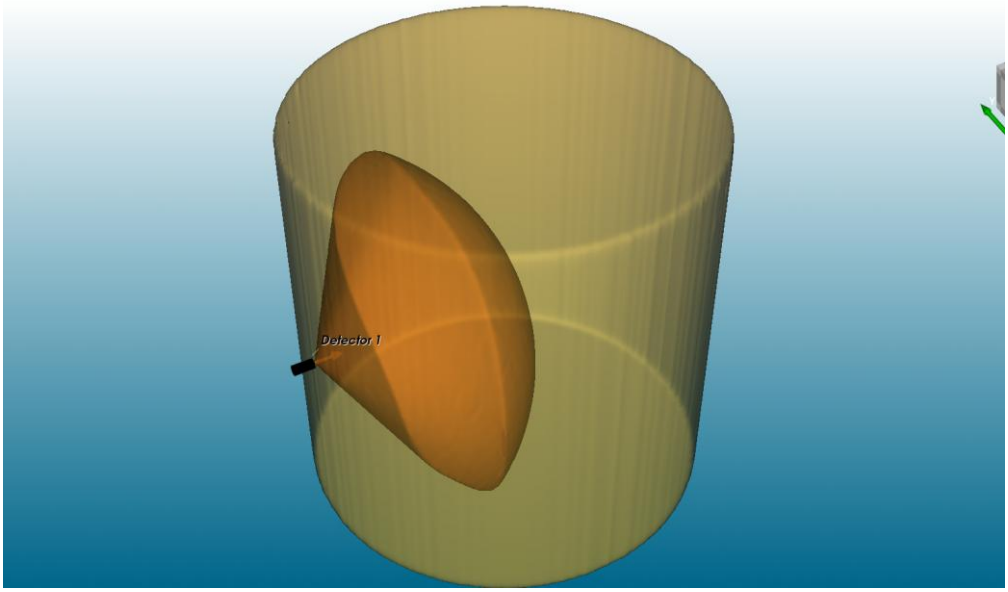
Risk Grade Geometry	Dimensions	Risk Grade Type
Cylinder	Radius 10 m, Height 20 m	Risk Grade D

Fire Detectors

Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
120°	120°	0	Risk Grade D - 10 m	0°	0°

Coverage Results

Risk Grade	Voting Logic	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade D	1ooN	16.67	16.38	0.29



View 1

5.1.15 Two detectors completely inside a cylindrical Risk Grade, with their coverage areas not touching each other - Field of View: 60°, Range: 10 m

Risk Grades

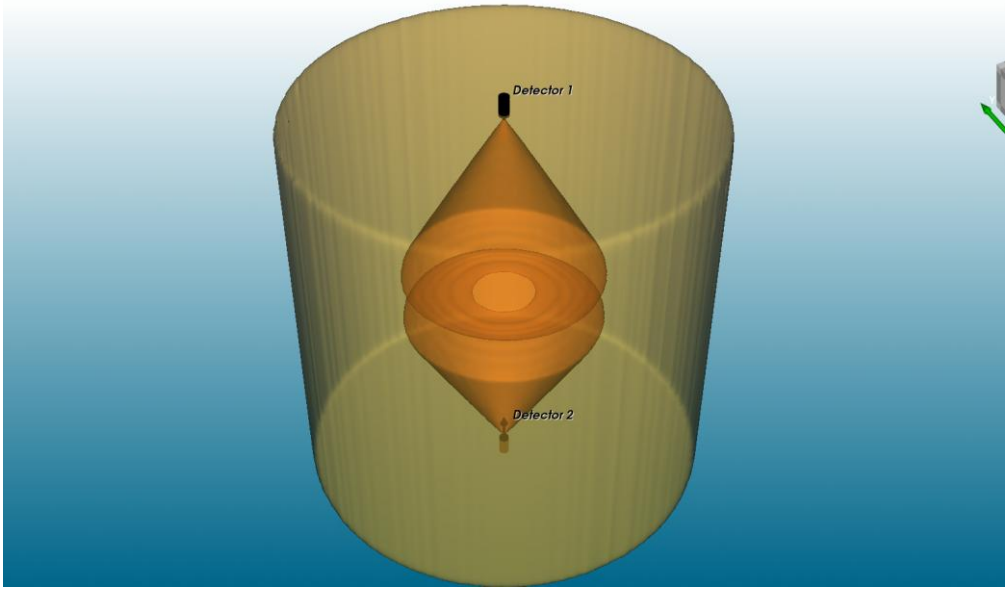
Risk Grade Geometry	Dimensions	Risk Grade Type
Cylinder	Radius 10 m, Height 20 m	Risk Grade D

Fire Detectors

Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
60°	60°	0	Risk Grade D - 10 m	270°	0°
60°	60°	0	Risk Grade D - 10 m	90°	0°

Coverage Results

Risk Grade	Voting Logic	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade D	1ooN	8.93	9.1	0.17



View 1

5.2 Two Risk Grades of the Same Type

5.2.1 One detector in each of two cubical Risk Grades of the same type that touch along one edge, each detector completely inside its Risk Grade - Field of View: 90°, Range: 10 m

Risk Grades

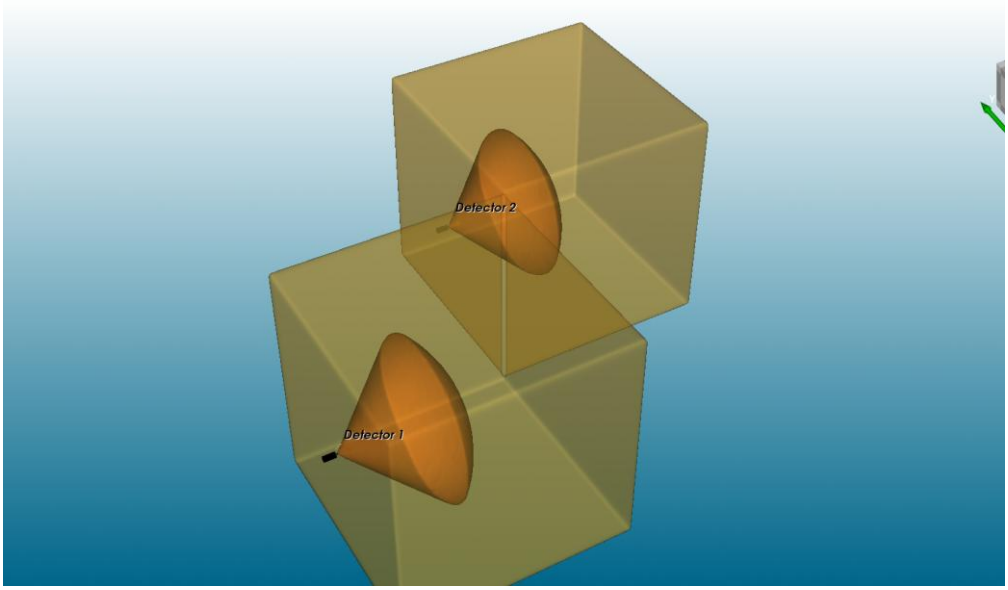
Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade D
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade D

Fire Detectors

Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
90°	90°	0	Risk Grade D - 10 m	0°	0°
90°	90°	0	Risk Grade D - 10 m	0°	0°

Coverage Results

Risk Grade	Voting Logic	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade D	1ooN	7.67	7.69	0.02



View 1

5.2.2 Two detectors in each of two cubical Risk Grades of the same type that touch along one edge, with their coverage areas not touching each other - Field of View: 90°, Range: 10 m

Risk Grades

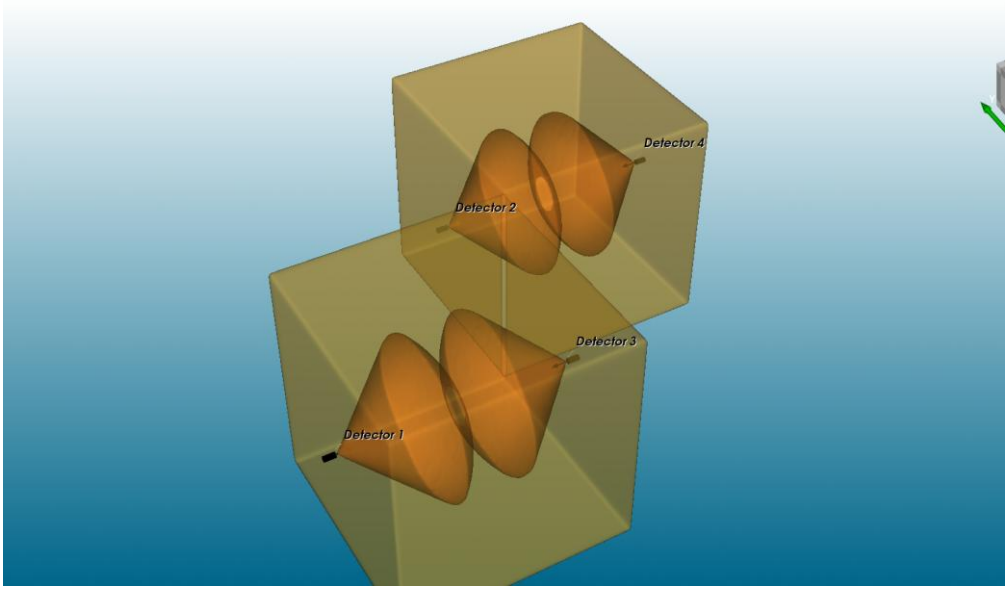
Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade D
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade D

Fire Detectors

Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
90°	90°	0	Risk Grade D - 10 m	0°	0°
90°	90°	0	Risk Grade D - 10 m	0°	0°
90°	90°	0	Risk Grade D - 10 m	180°	0°
90°	90°	0	Risk Grade D - 10 m	180°	0°

Coverage Results

Risk Grade	Voting Logic	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade D	1ooN	15.34	15.37	0.03



View 1

5.2.3 Two detectors in each of two cubical Risk Grades of the same type that touch along one edge, with their coverage areas not touching each other - Field of View: 60°, Range: 10 m

Risk Grades

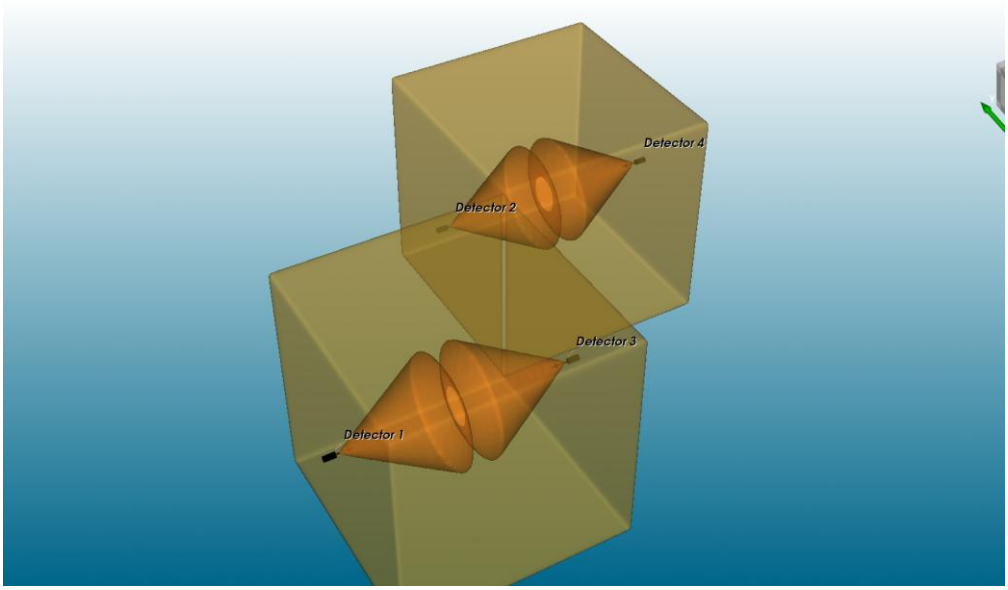
Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade C
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade C

Fire Detectors

Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
60°	60°	0	Risk Grade C - 10 m	0°	0°
60°	60°	0	Risk Grade C - 10 m	0°	0°
60°	60°	0	Risk Grade C - 10 m	180°	0°
60°	60°	0	Risk Grade C - 10 m	180°	0°

Coverage Results

Risk Grade	Voting Logic	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade C	1ooN	7.01	7.13	0.12



View 1

5.2.4 Two detectors at the same spot in each of two cubical Risk Grades of the same type that touch along one edge (seen by at least two detectors) - Field of View: 90°, Range: 10 m

Risk Grades

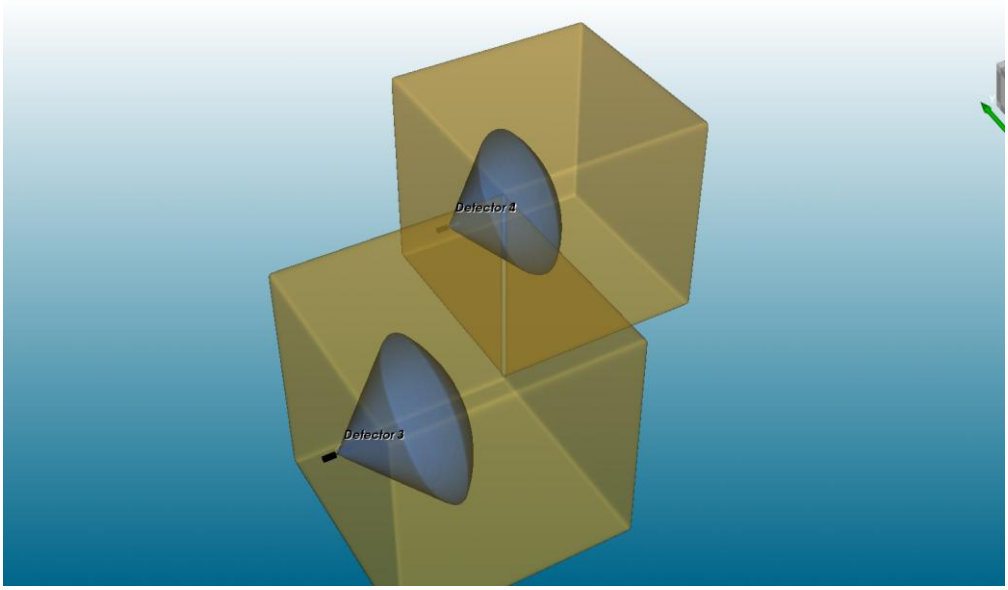
Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade A
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade A

Fire Detectors

Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
90°	90°	0	Risk Grade A - 10 m	0°	0°
90°	90°	0	Risk Grade A - 10 m	0°	0°
90°	90°	0	Risk Grade A - 10 m	0°	0°
90°	90°	0	Risk Grade A - 10 m	0°	0°

Coverage Results

Risk Grade	Voting Logic	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade A	2ooN	7.67	7.69	0.02



View 1

5.2.5 One detector placed on the top edge shared by two side-by-side cubical Risk Grades of the same type - Field of View: 90°, Range: 10 m

Risk Grades

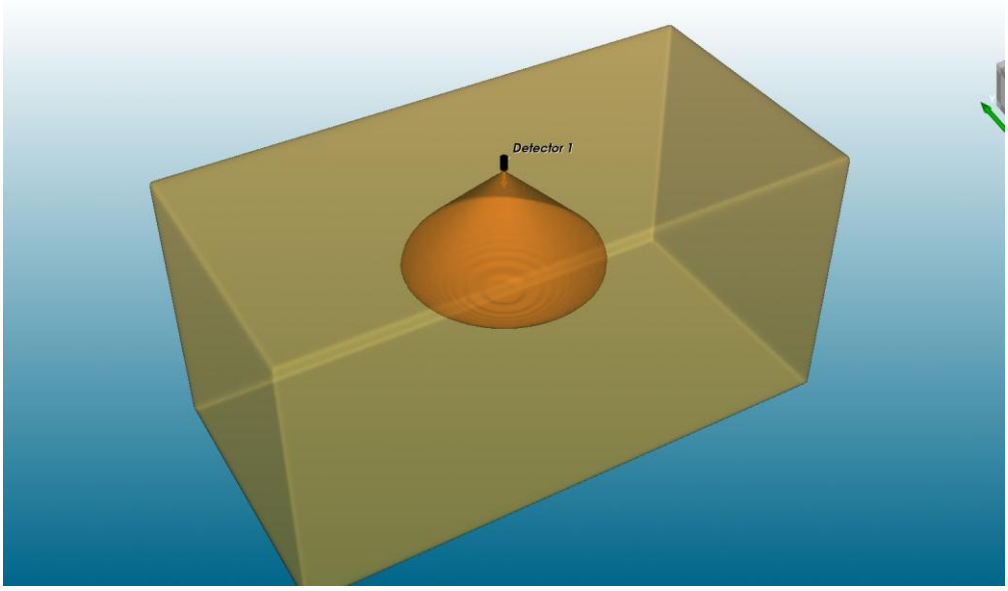
Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade C
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade C

Fire Detectors

Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
90°	90°	0	Risk Grade C - 10 m	270°	0°

Coverage Results

Risk Grade	Voting Logic	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade C	1ooN	3.83	3.85	0.02



View 1

5.2.6 One detector in each of two cylindrical Risk Grades of the same type that touch each other - Field of View: 90°, Range: 10 m

Risk Grades

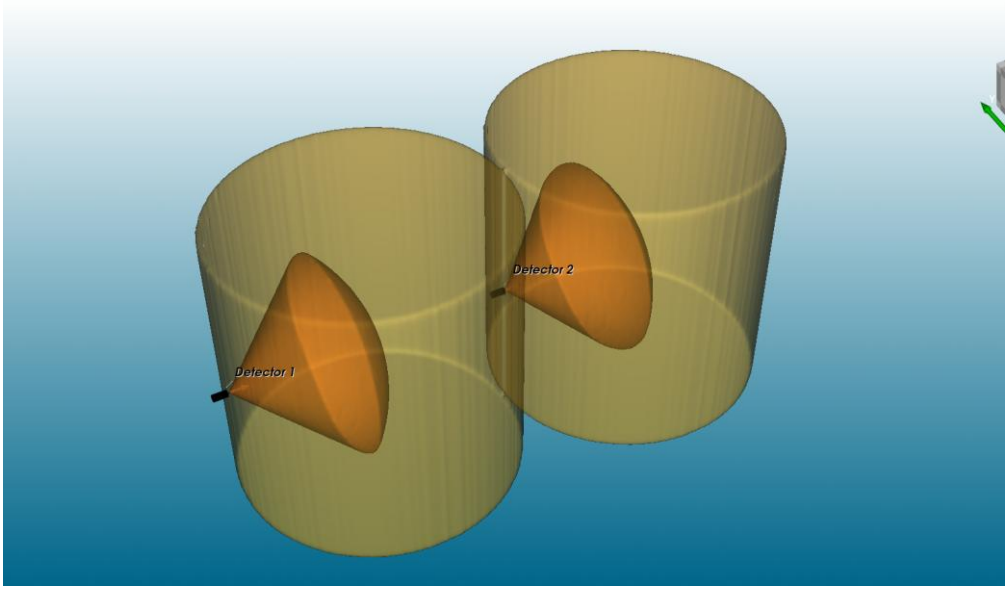
Risk Grade Geometry	Dimensions	Risk Grade Type
Cylinder	Radius 10 m, Height 20 m	Risk Grade B
Cylinder	Radius 10 m, Height 20 m	Risk Grade B

Fire Detectors

Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
90°	90°	0	Risk Grade B - 10 m	0°	0°
90°	90°	0	Risk Grade B - 10 m	0°	0°

Coverage Results

Risk Grade	Voting Logic	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade B	1ooN	9.76	9.8	0.04



View 1

5.3 Two Risk Grades of Different Types

5.3.1 One detector placed on the top edge shared by two side-by-side cubical Risk Grades of different types - Field of View: 90°, Range: Risk Grade A 10 m; Risk Grade C 14 m

Risk Grades

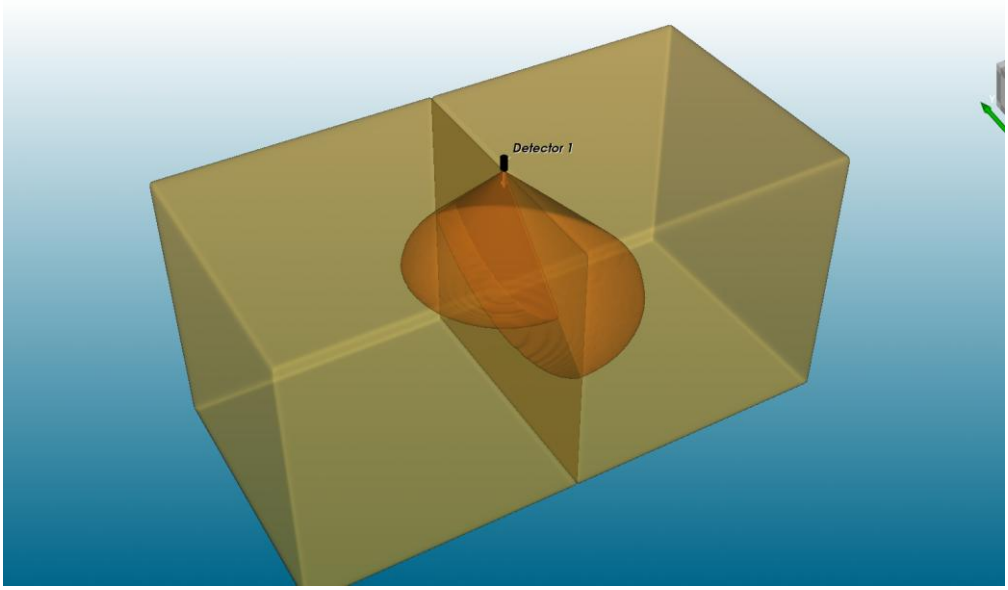
Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade A
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade C

Fire Detectors

Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
90°	90°	0	Risk Grade A - 10 m Risk Grade C - 14 m	270°	0°

Coverage Results

Risk Grade	Voting Logic	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade A	1ooN	3.83	3.85	0.02
Risk Grade C	1ooN	10.52	10.46	0.06



View 1

5.3.2 One detector placed on the top edge shared by two side-by-side cubical Risk Grades of different types - Field of View: 60°, Range: Risk Grade C 14 m; Risk Grade A 18 m

Risk Grades

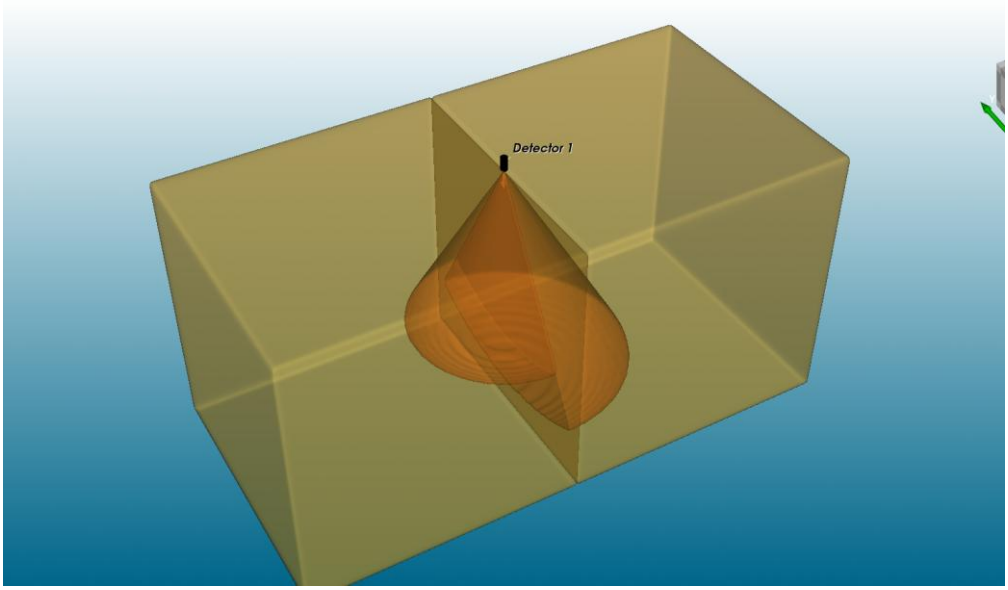
Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade C
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade A

Fire Detectors

Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
60°	60°	0	Risk Grade C - 14 m Risk Grade A - 18 m	270°	0°

Coverage Results

Risk Grade	Voting Logic	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade C	1ooN	4.81	4.86	0.05
Risk Grade A	1ooN	10.22	10.28	0.06



View 1

5.4 Four Risk Grades of Different Types

5.4.1 One detector covering four small cubical Risk Grades of different types placed in a row - Field of View: 120°, Range: 50 m

Risk Grades

Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 1 m, Width 1 m, Height 1 m	Risk Grade B
Cube	Length 1 m, Width 1 m, Height 1 m	Risk Grade D
Cube	Length 1 m, Width 1 m, Height 1 m	Risk Grade A
Cube	Length 1 m, Width 1 m, Height 1 m	Risk Grade C

Fire Detectors

Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
120°	120°	0	Risk Grade B - 50 m Risk Grade D - 50 m Risk Grade A - 50 m Risk Grade C - 50 m	0°	0°

Coverage Results

Risk Grade	Voting Logic	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade B	1ooN	100	100	0.00
Risk Grade D	1ooN	100	100	0.00
Risk Grade A	1ooN	100	100	0.00
Risk Grade C	1ooN	100	100	0.00



Slice Plot - XY @ 1

5.4.2 Four detectors covering four small cubical Risk Grades of different types placed in a row, with coverage checked for one, two, three and four detectors seeing the same point - Field of View: 120°, Range: 50 m

Risk Grades

Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 1 m, Width 1 m, Height 1 m	Risk Grade A
Cube	Length 1 m, Width 1 m, Height 1 m	Risk Grade C
Cube	Length 1 m, Width 1 m, Height 1 m	Risk Grade D
Cube	Length 1 m, Width 1 m, Height 1 m	Risk Grade B

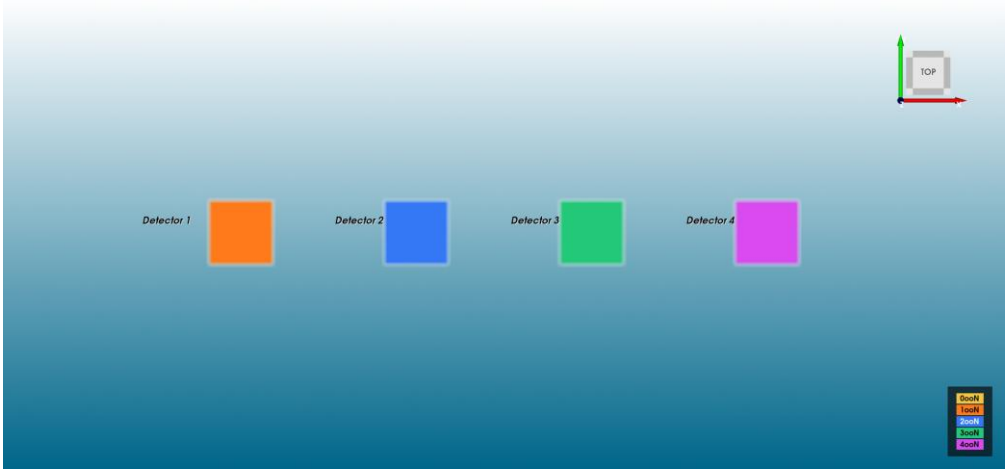
Fire Detectors

Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
120°	120°	0	Risk Grade A - 50 m Risk Grade C - 50 m Risk Grade D - 50 m Risk Grade B - 50 m	0°	0°
120°	120°	0	Risk Grade A - 50 m Risk Grade C - 50 m Risk Grade D - 50 m Risk Grade B - 50 m	0°	0°
120°	120°	0	Risk Grade A - 50 m Risk Grade C - 50 m Risk Grade D - 50 m Risk Grade B - 50 m	0°	0°
120°	120°	0	Risk Grade A - 50 m Risk Grade C - 50 m Risk Grade D - 50 m Risk Grade B - 50 m	0°	0°

Coverage Results

Risk Grade	Voting Logic	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade A	1ooN	100	100	0.00

Risk Grade	Voting Logic	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade C	2ooN	100	100	0.00
Risk Grade D	3ooN	100	100	0.00
Risk Grade B	4ooN	100	100	0.00



Slice Plot - XY @ 1

5.4.3 Four detectors covering four small cubical Risk Grades in a row, with a solid plank blocking the view of the first detector between the first and second Risk Grade (coverage checked for one, two and three detectors) - Field of View: 120°, Range: 50 m

Risk Grades

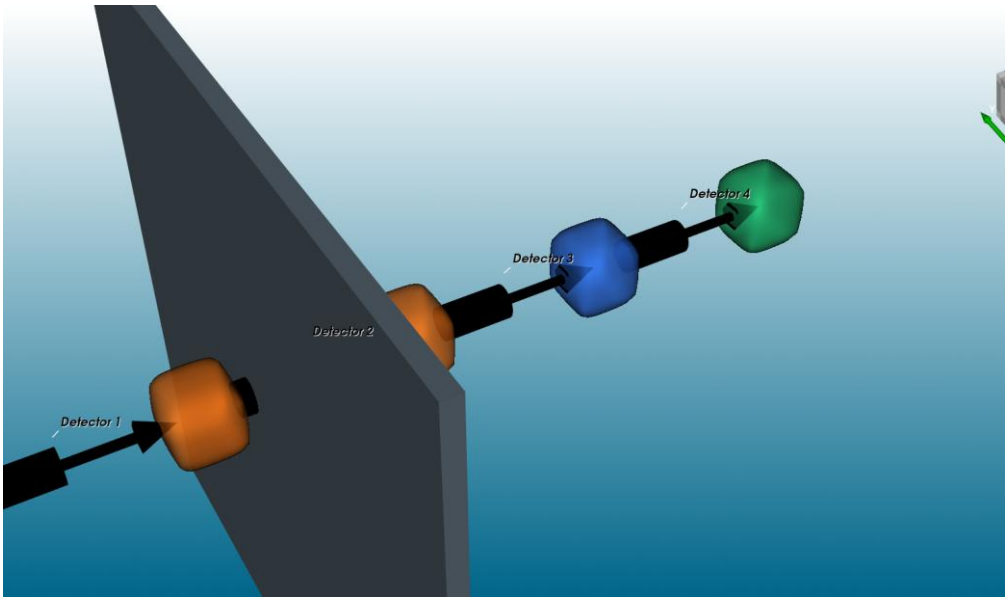
Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 1 m, Width 1 m, Height 1 m	Risk Grade B
Cube	Length 1 m, Width 1 m, Height 1 m	Risk Grade A
Cube	Length 1 m, Width 1 m, Height 1 m	Risk Grade D
Cube	Length 1 m, Width 1 m, Height 1 m	Risk Grade C

Fire Detectors

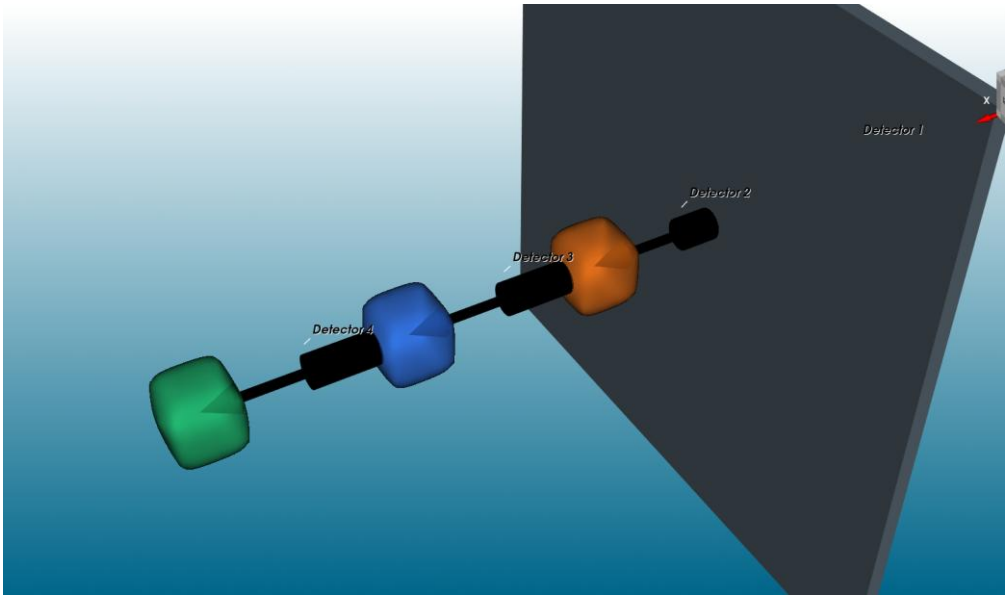
Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
120°	120°	0	Risk Grade B - 50 m Risk Grade A - 50 m Risk Grade D - 50 m Risk Grade C - 50 m	0°	0°
120°	120°	0	Risk Grade B - 50 m Risk Grade A - 50 m Risk Grade D - 50 m Risk Grade C - 50 m	0°	0°
120°	120°	0	Risk Grade B - 50 m Risk Grade A - 50 m Risk Grade D - 50 m Risk Grade C - 50 m	0°	0°
120°	120°	0	Risk Grade B - 50 m Risk Grade A - 50 m Risk Grade D - 50 m Risk Grade C - 50 m	0°	0°

Coverage Results

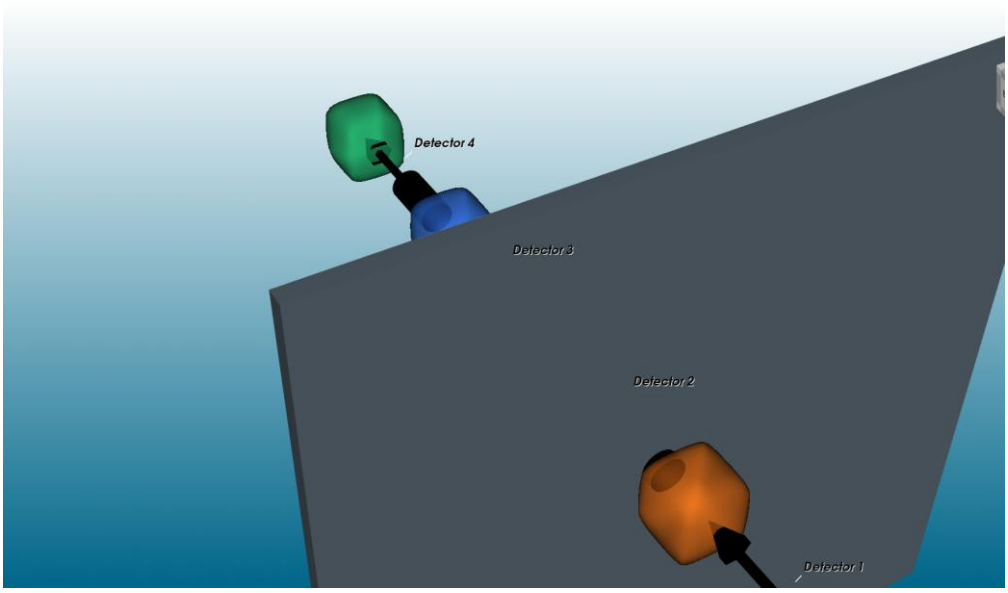
Risk Grade	Voting Logic	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade B	1ooN	100	100	0.00
Risk Grade A	1ooN	100	100	0.00
Risk Grade D	2ooN	100	100	0.00
Risk Grade C	3ooN	100	100	0.00



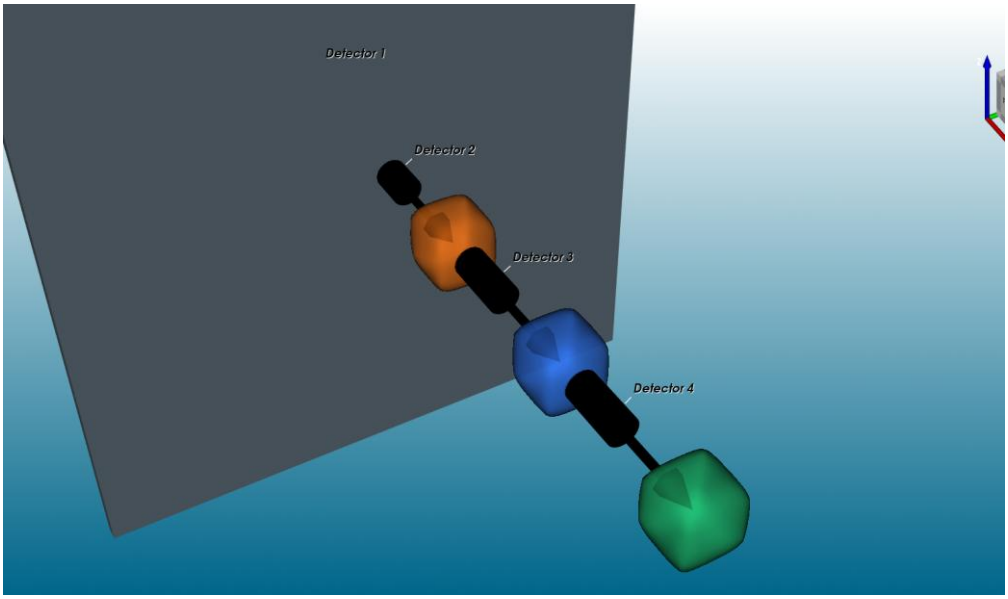
View 1


Detector 1
Detector 2
Detector 3
Detector 4

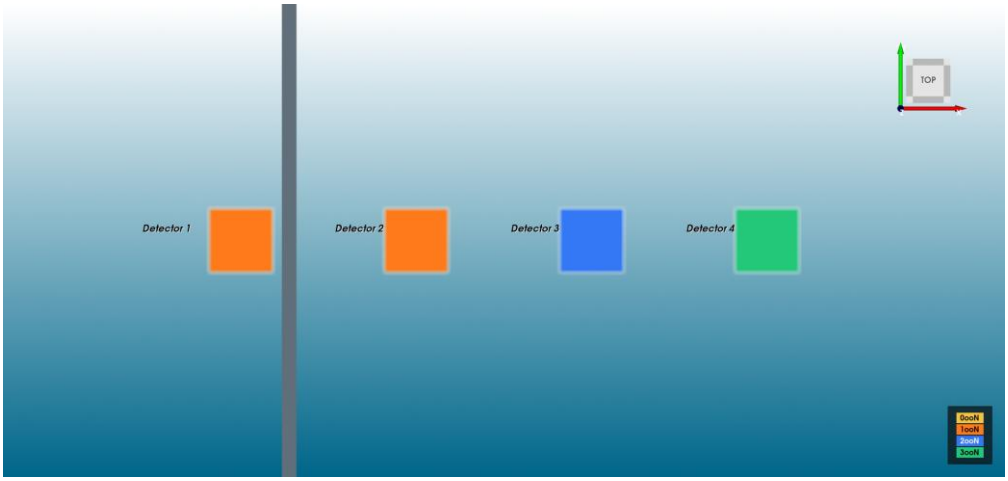
View 2


Detector 4
Detector 3
Detector 2
Detector 1

View 3



View 4



Slice Plot - XY @ 1

5.4.4 Four detectors covering four small cubical Risk Grades in a row, with a solid plank blocking the view of the second detector between the second and third Risk Grade (coverage checked for one and two detectors) - Field of View: 120°, Range: 50 m

Risk Grades

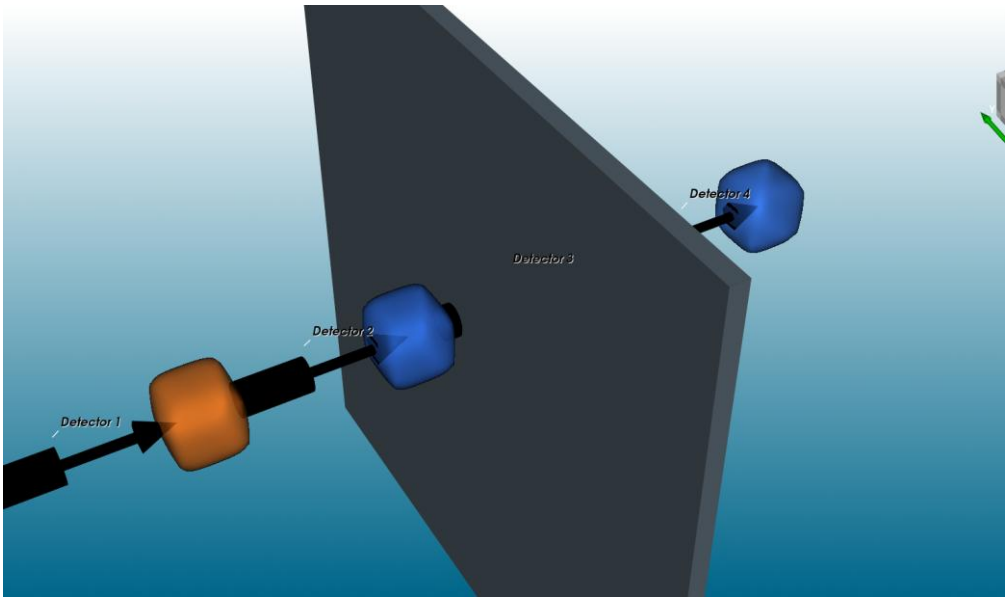
Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 1 m, Width 1 m, Height 1 m	Risk Grade C
Cube	Length 1 m, Width 1 m, Height 1 m	Risk Grade D
Cube	Length 1 m, Width 1 m, Height 1 m	Risk Grade A
Cube	Length 1 m, Width 1 m, Height 1 m	Risk Grade B

Fire Detectors

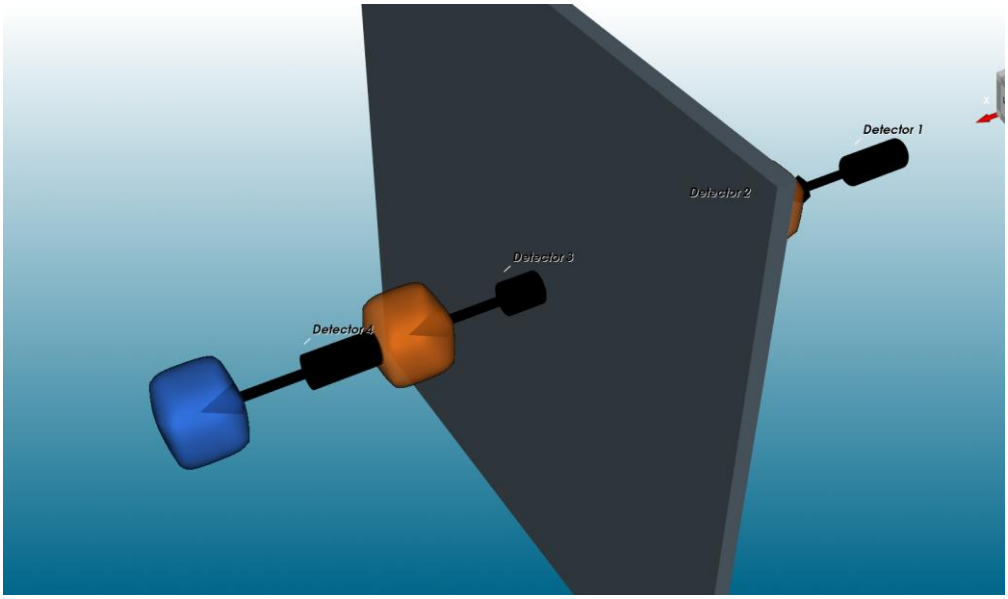
Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
120°	120°	0	Risk Grade C - 50 m Risk Grade D - 50 m Risk Grade A - 50 m Risk Grade B - 50 m	0°	0°
120°	120°	0	Risk Grade C - 50 m Risk Grade D - 50 m Risk Grade A - 50 m Risk Grade B - 50 m	0°	0°
120°	120°	0	Risk Grade C - 50 m Risk Grade D - 50 m Risk Grade A - 50 m Risk Grade B - 50 m	0°	0°
120°	120°	0	Risk Grade C - 50 m Risk Grade D - 50 m Risk Grade A - 50 m Risk Grade B - 50 m	0°	0°

Coverage Results

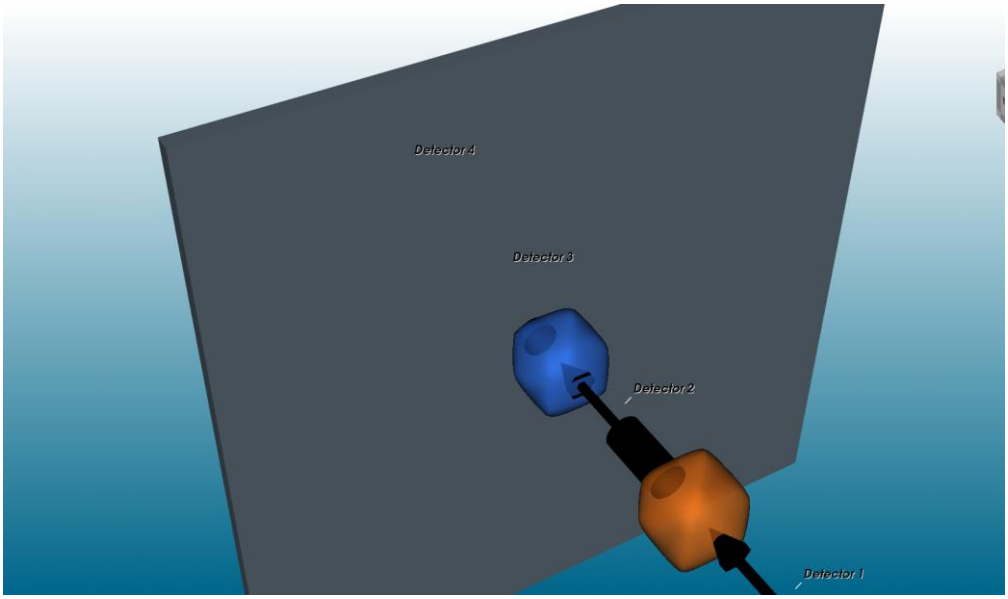
Risk Grade	Voting Logic	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade C	1ooN	100	100	0.00
Risk Grade D	2ooN	100	100	0.00
Risk Grade A	1ooN	100	100	0.00
Risk Grade B	2ooN	100	100	0.00



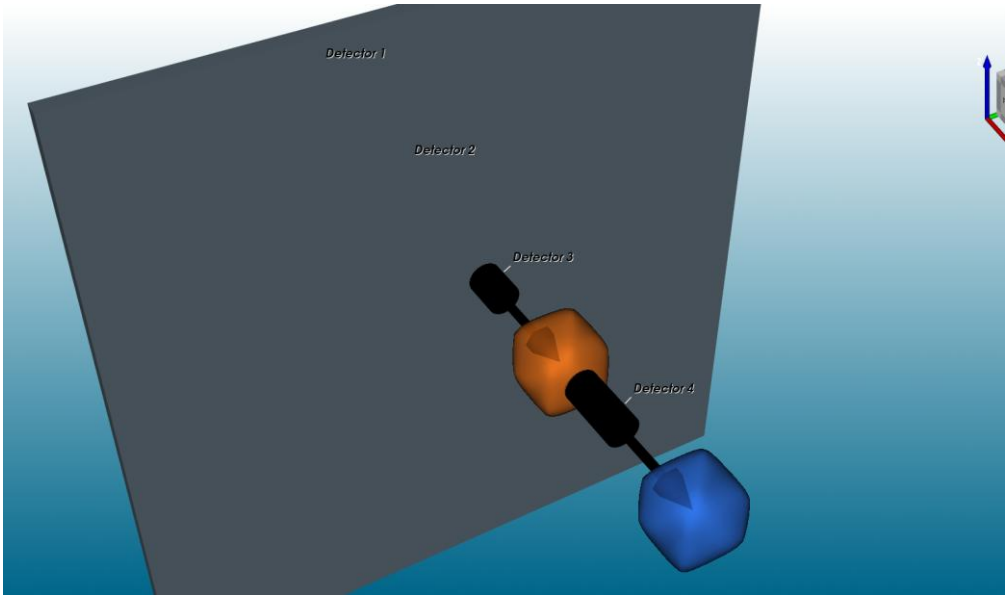
View 1


Detector 1
Detector 2
Detector 3
Detector 4

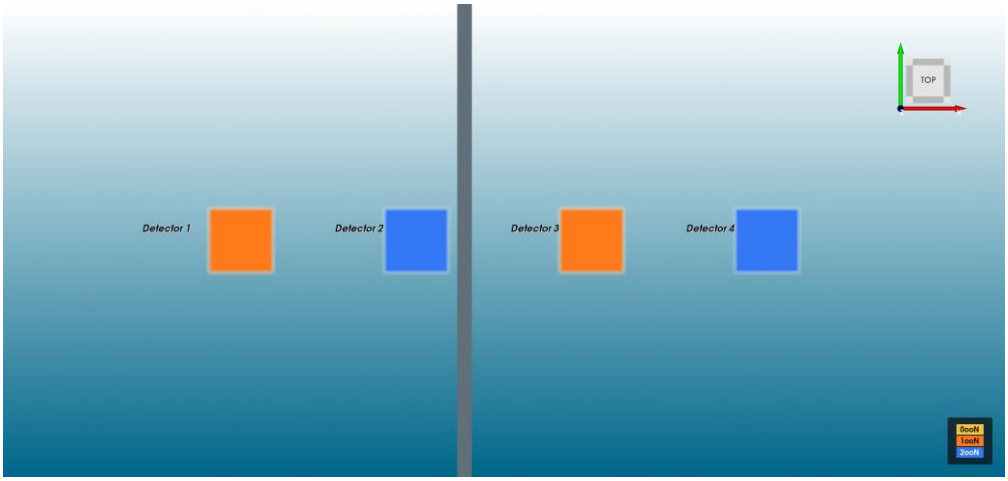
View 2


Detector 4
Detector 3
Detector 2
Detector 1

View 3



View 4



Slice Plot - XY @ 1

5.4.5 Four detectors covering four small cubical Risk Grades in a row, with a solid plank blocking the view of the third detector between the third and fourth Risk Grade (coverage checked for one, two and three detectors) - Field of View: 120°, Range: 50 m

Risk Grades

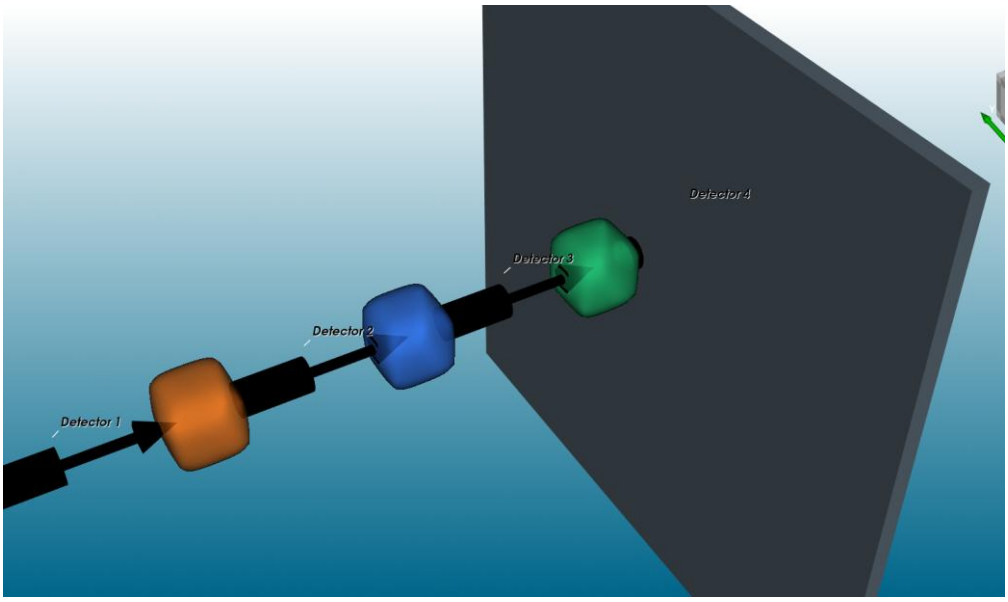
Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 1 m, Width 1 m, Height 1 m	Risk Grade A
Cube	Length 1 m, Width 1 m, Height 1 m	Risk Grade C
Cube	Length 1 m, Width 1 m, Height 1 m	Risk Grade D
Cube	Length 1 m, Width 1 m, Height 1 m	Risk Grade B

Fire Detectors

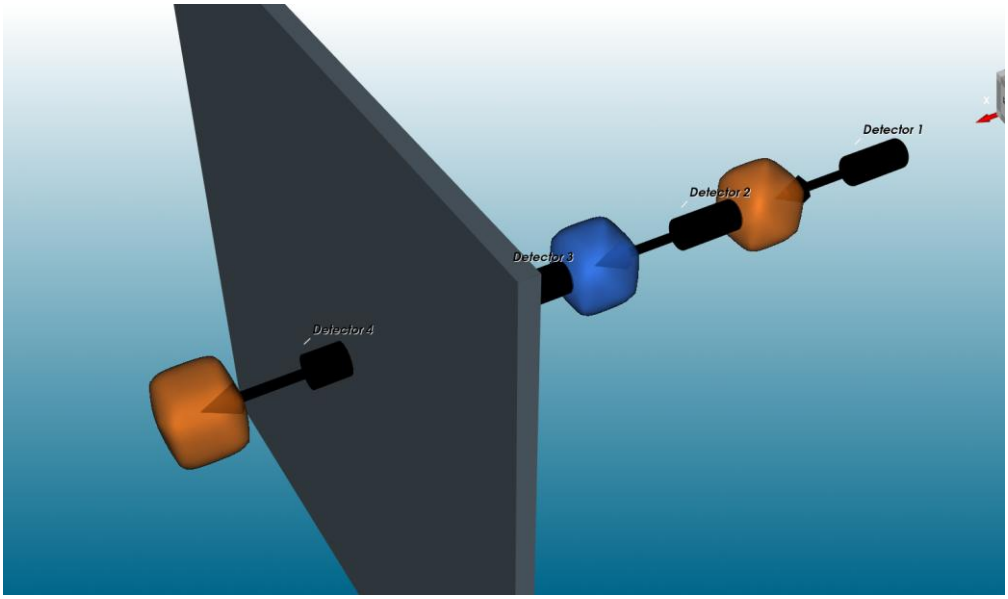
Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
120°	120°	0	Risk Grade A - 50 m Risk Grade C - 50 m Risk Grade D - 50 m Risk Grade B - 50 m	0°	0°
120°	120°	0	Risk Grade A - 50 m Risk Grade C - 50 m Risk Grade D - 50 m Risk Grade B - 50 m	0°	0°
120°	120°	0	Risk Grade A - 50 m Risk Grade C - 50 m Risk Grade D - 50 m Risk Grade B - 50 m	0°	0°
120°	120°	0	Risk Grade A - 50 m Risk Grade C - 50 m Risk Grade D - 50 m Risk Grade B - 50 m	0°	0°

Coverage Results

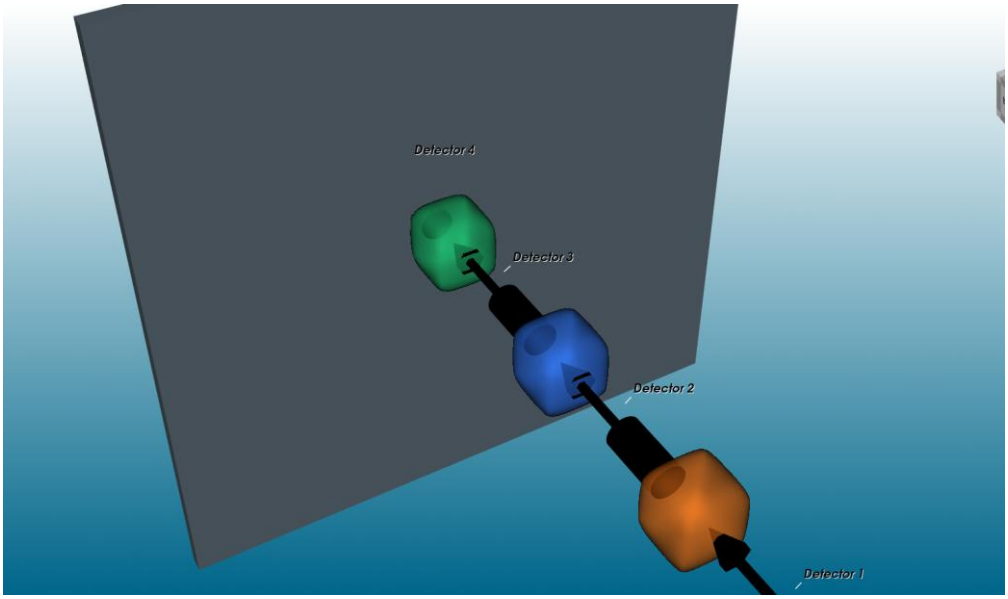
Risk Grade	Voting Logic	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade A	1ooN	100	100	0.00
Risk Grade C	2ooN	100	100	0.00
Risk Grade D	3ooN	100	100	0.00
Risk Grade B	1ooN	100	100	0.00



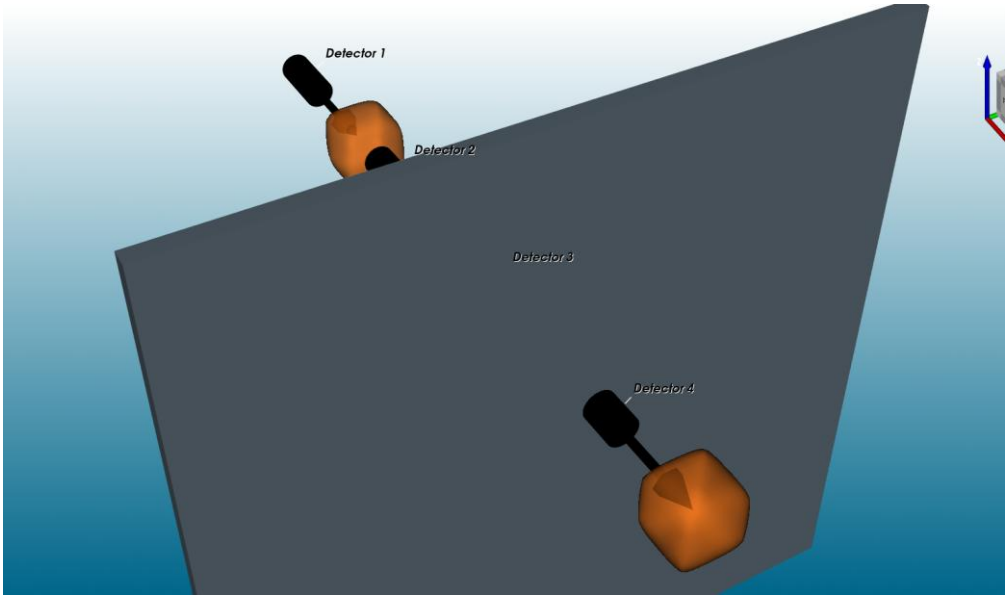
View 1


Detector 1
Detector 2
Detector 3
Detector 4

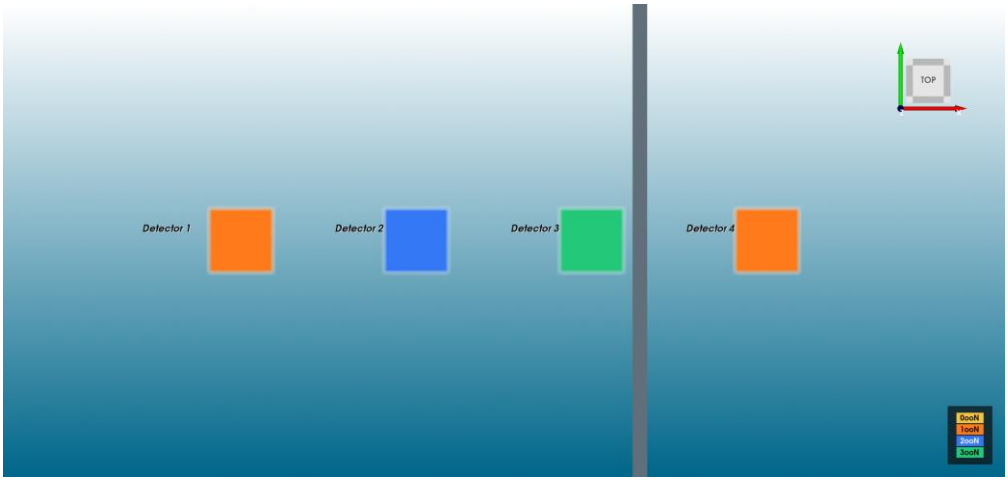
View 2


Detector 4
Detector 3
Detector 2
Detector 1

View 3



View 4



Slice Plot - XY @ 1

5.4.6 One detector placed above the center of four cubical Risk Grades of different types arranged in a square - Field of View: 90°, Range: Risk Grade A 8 m; Risk Grade C 12 m; Risk Grade D 16 m; Risk Grade B 20 m

Risk Grades

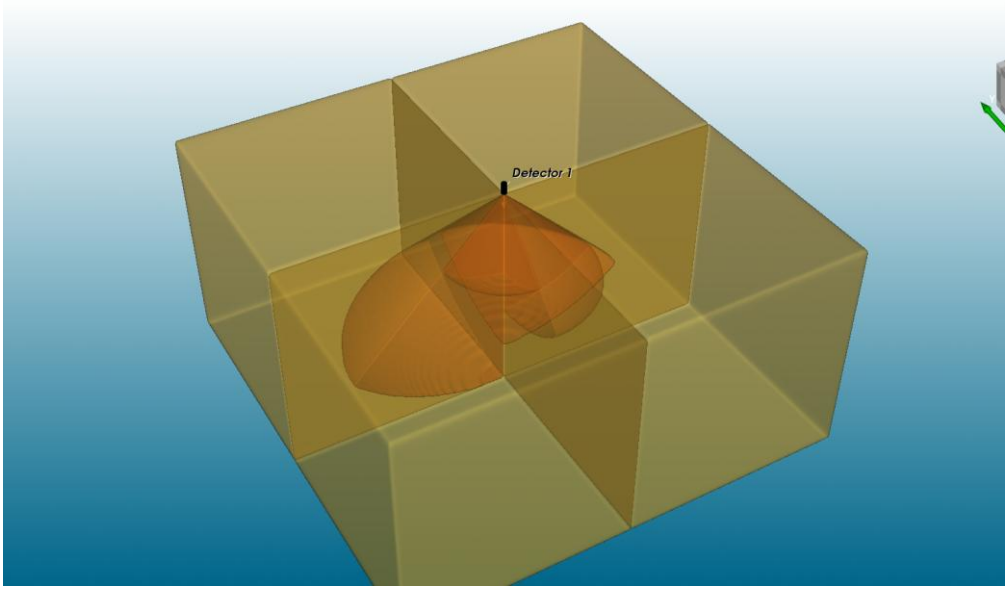
Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade A
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade C
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade D
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade B

Fire Detectors

Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
90°	90°	0	Risk Grade A - 8 m Risk Grade C - 12 m Risk Grade D - 16 m Risk Grade B - 20 m	270°	0°

Coverage Results

Risk Grade	Voting Logic	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade A	1ooN	0.98	0.99	0.01
Risk Grade C	1ooN	3.31	3.31	0.00
Risk Grade D	1ooN	7.85	7.79	0.06
Risk Grade B	1ooN	15.33	15.15	0.18



View 1

1 Geographical Coverage Calculation with Low and High Alarm Ranges

1.1 Single Risk Grade

1.1.1 One detector completely inside a cubical Risk Grade - Field of View: 90°, Range: Low 10 m / High 9 m

Risk Grades

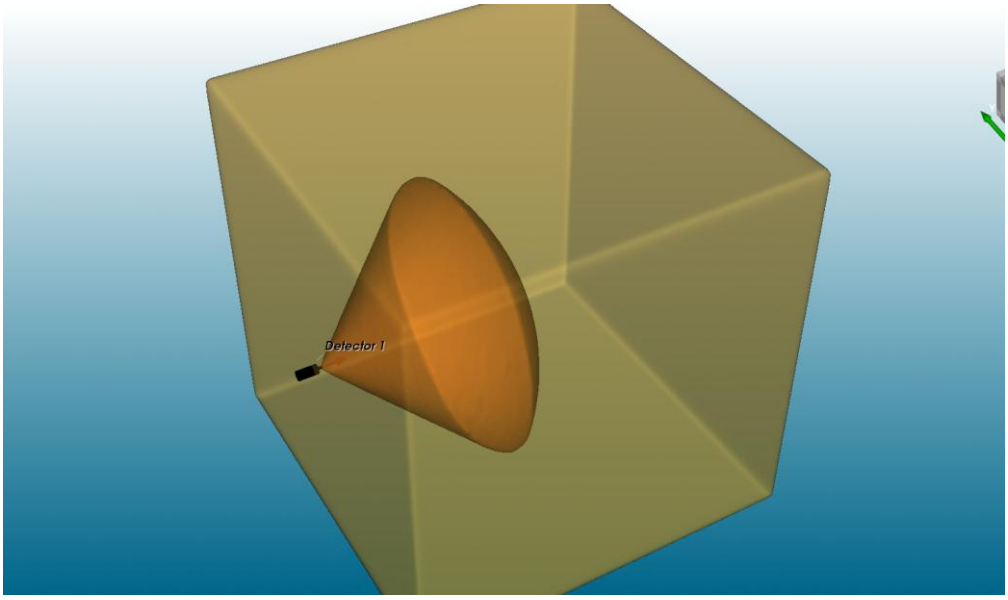
Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade C

Fire Detectors

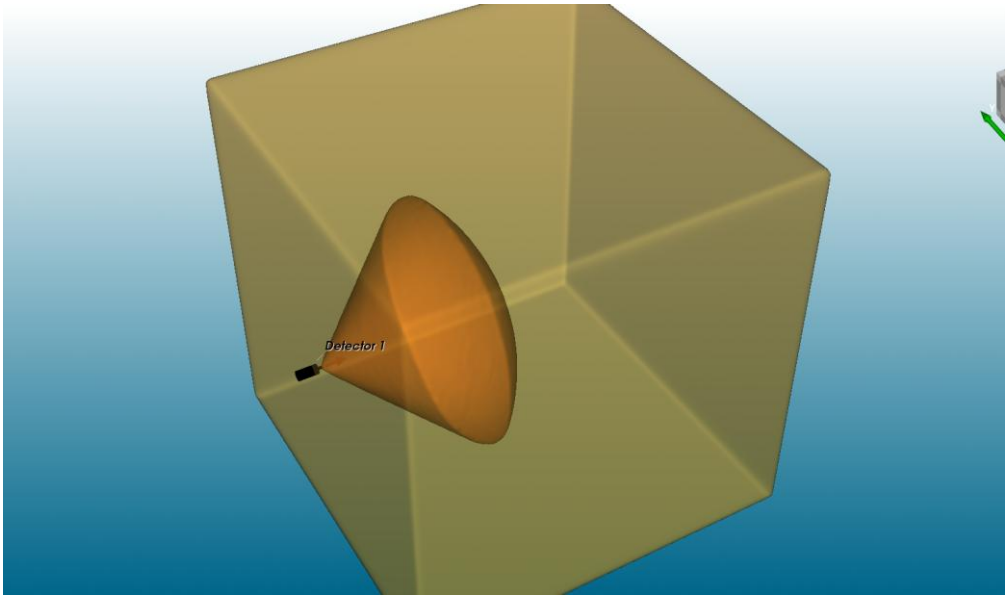
Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
90°	90°	0	Risk Grade C - Low 10 m / High 9 m	0°	0°

Coverage Results

Risk Grade	Voting Logic	Alarm Setting (Low / High)	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade C	1ooN	L	7.67	7.69	0.02
Risk Grade C	1ooN	H	5.59	5.62	0.03



View 1 - L



View 1 - H

1.1.2 One detector completely inside a cubical Risk Grade - Field of View: 60°, Range: Low 10 m / High 8 m

Risk Grades

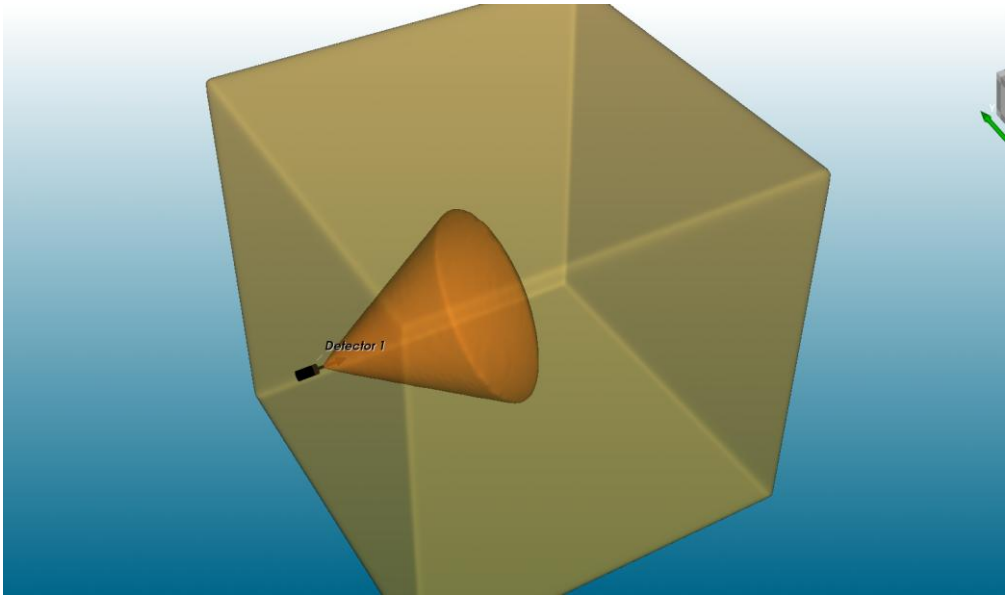
Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade A

Fire Detectors

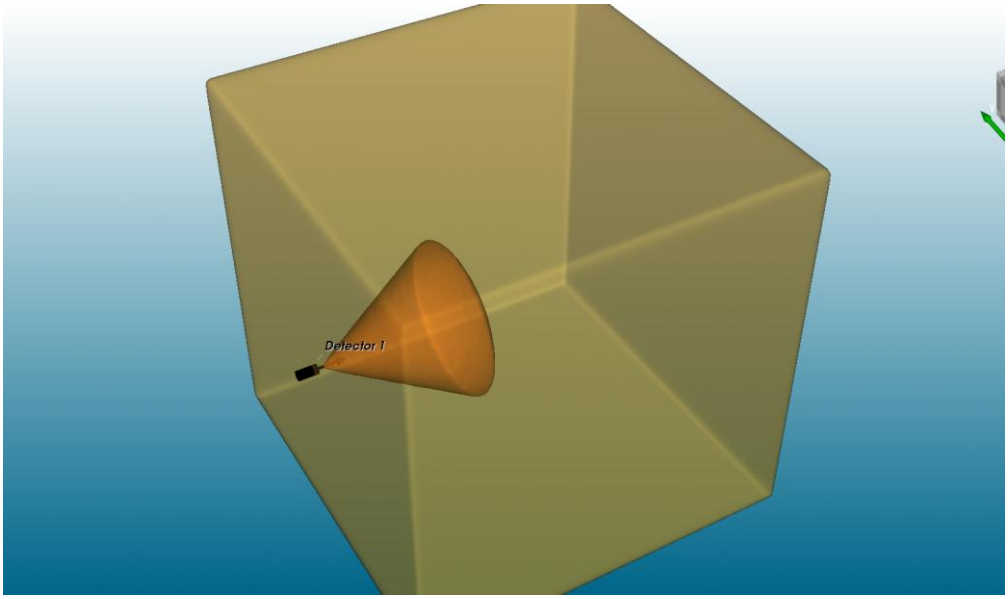
Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
60°	60°	0	Risk Grade A - Low 10 m / High 8 m	0°	0°

Coverage Results

Risk Grade	Voting Logic	Alarm Setting (Low / High)	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade A	1ooN	L	3.51	3.57	0.06
Risk Grade A	1ooN	H	1.8	1.84	0.04



View 1 - L



View 1 - H

1.1.3 One detector completely inside a cubical Risk Grade - Field of View: 45°, Range: Low 24 m / High 20 m

Risk Grades

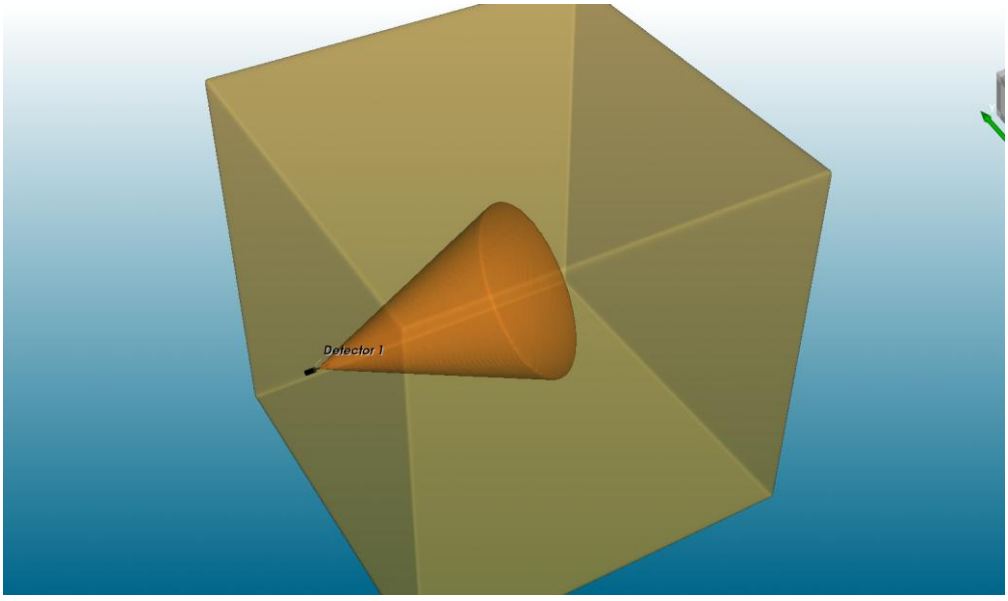
Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 40 m, Width 40 m, Height 40 m	Risk Grade D

Fire Detectors

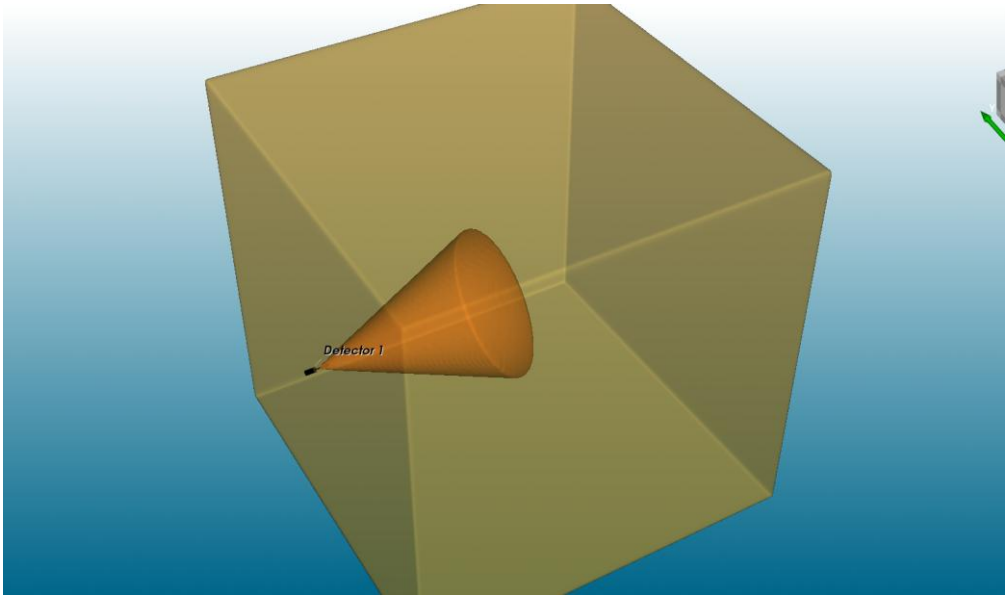
Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
45°	45°	0	Risk Grade D - Low 24 m / High 20 m	0°	0°

Coverage Results

Risk Grade	Voting Logic	Alarm Setting (Low / High)	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade D	1ooN	L	3.44	3.46	0.02
Risk Grade D	1ooN	H	1.99	2.01	0.02



View 1 - L



View 1 - H

1.1.4 Two detectors completely inside a cubical Risk Grade, with their coverage areas not touching each other - Field of View: 90°, Range: Low 10 m / High 9 m

Risk Grades

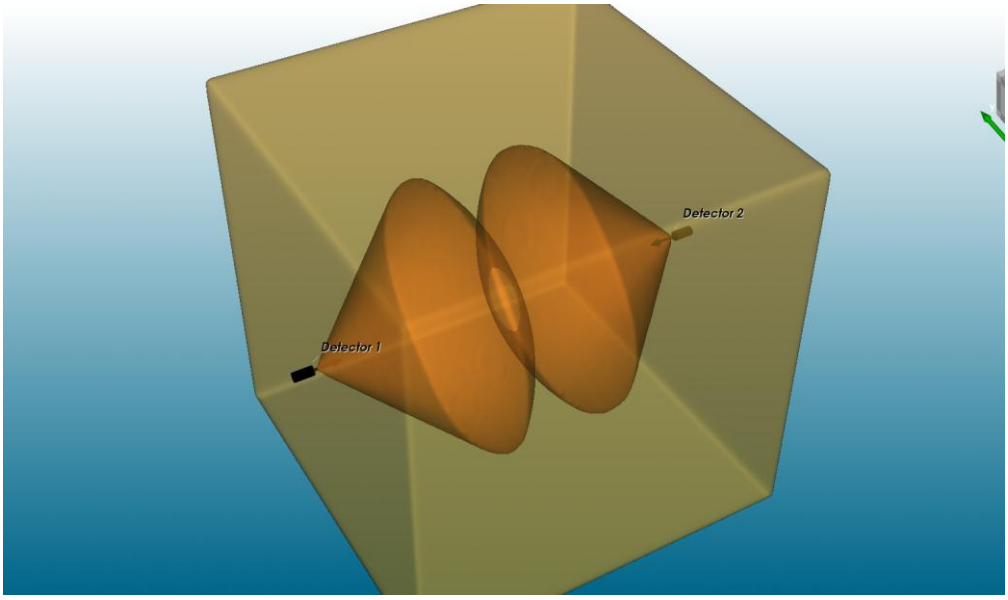
Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade D

Fire Detectors

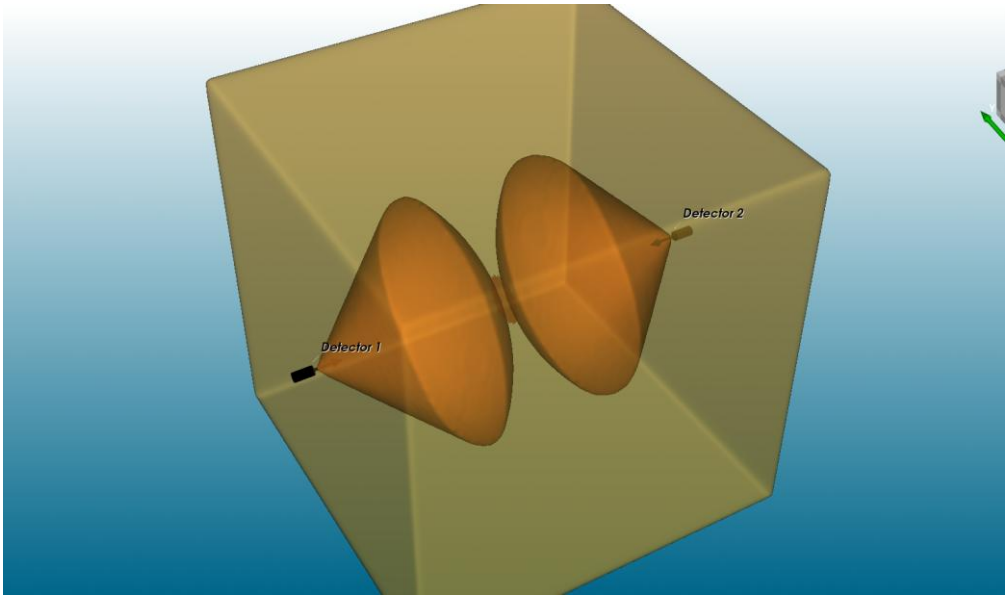
Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
90°	90°	0	Risk Grade D - Low 10 m / High 9 m	0°	0°
90°	90°	0	Risk Grade D - Low 10 m / High 9 m	180°	0°

Coverage Results

Risk Grade	Voting Logic	Alarm Setting (Low / High)	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade D	1ooN	L	15.34	15.37	0.03
Risk Grade D	1ooN	H	11.18	11.24	0.06



View 1 - L



View 1 - H

1.1.5 Two detectors completely inside a cubical Risk Grade, with their coverage areas not touching each other - Field of View: 60°, Range: Low 10 m / High 9 m

Risk Grades

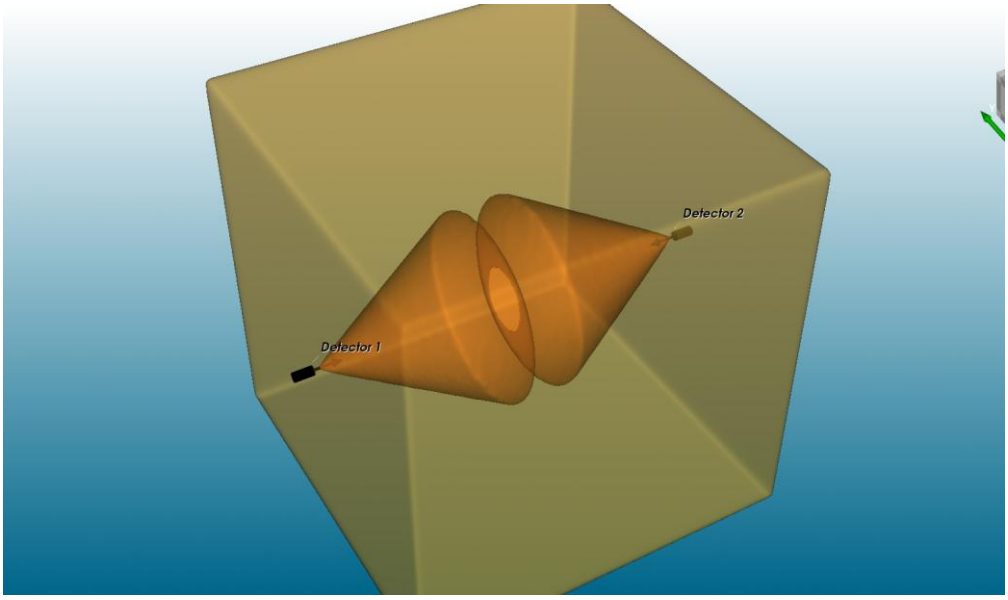
Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade C

Fire Detectors

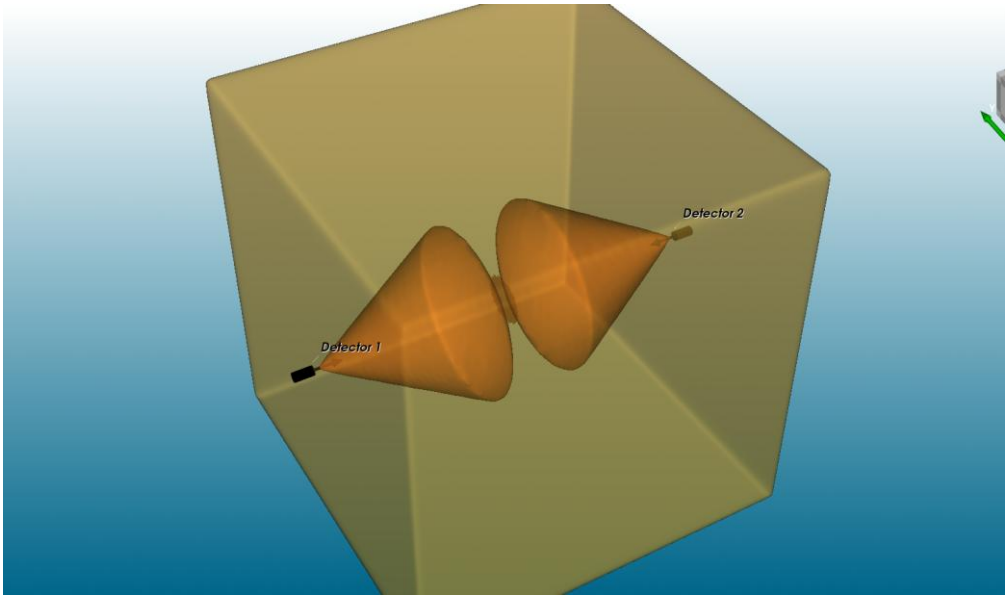
Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
60°	60°	0	Risk Grade C - Low 10 m / High 9 m	0°	0°
60°	60°	0	Risk Grade C - Low 10 m / High 9 m	180°	0°

Coverage Results

Risk Grade	Voting Logic	Alarm Setting (Low / High)	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade C	1ooN	L	7.01	7.13	0.12
Risk Grade C	1ooN	H	5.11	5.22	0.11



View 1 - L



View 1 - H

1.1.6 One detector half inside a cubical Risk Grade, with the other half of its view outside - Field of View: 90°, Range: Low 12 m / High 10 m

Risk Grades

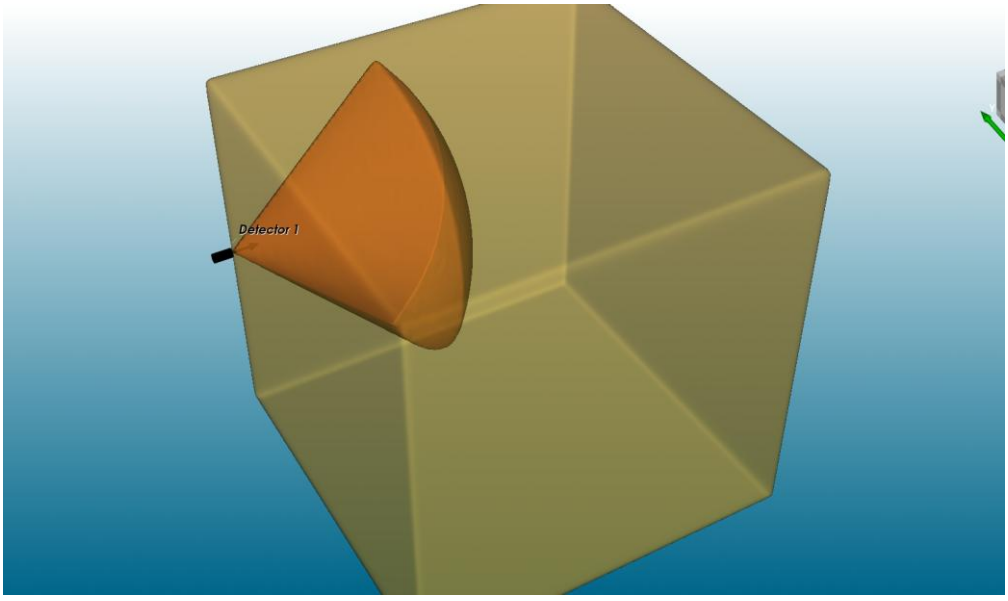
Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade D

Fire Detectors

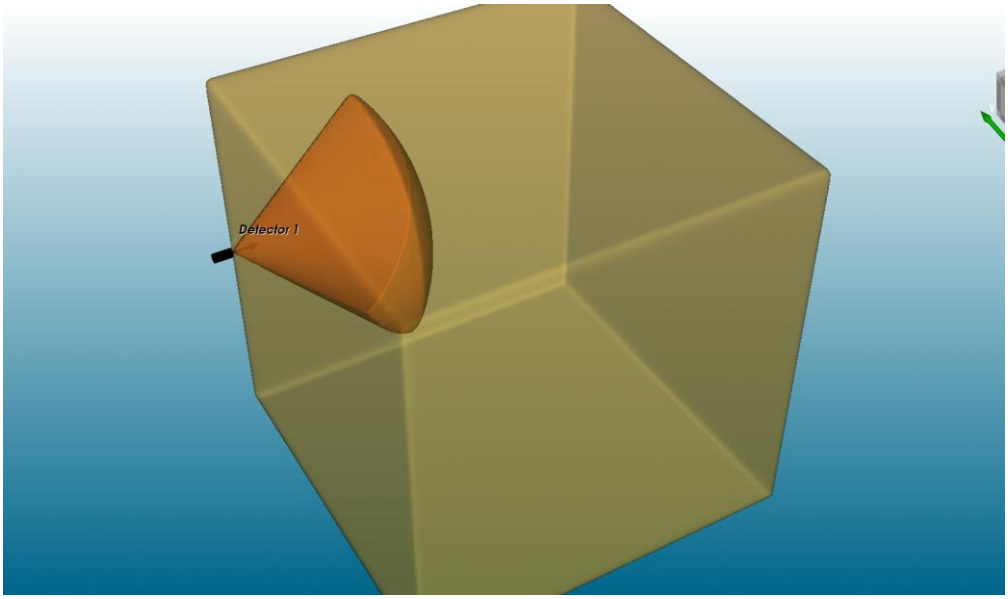
Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
90°	90°	0	Risk Grade D - Low 12 m / High 10 m	0°	0°

Coverage Results

Risk Grade	Voting Logic	Alarm Setting (Low / High)	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade D	1ooN	L	6.63	6.61	0.02
Risk Grade D	1ooN	H	3.83	3.84	0.01



View 1 - L



View 1 - H

1.1.7 One detector half inside a cubical Risk Grade, with the other half of its view outside - Field of View: 60°, Range: Low 14 m / High 12 m

Risk Grades

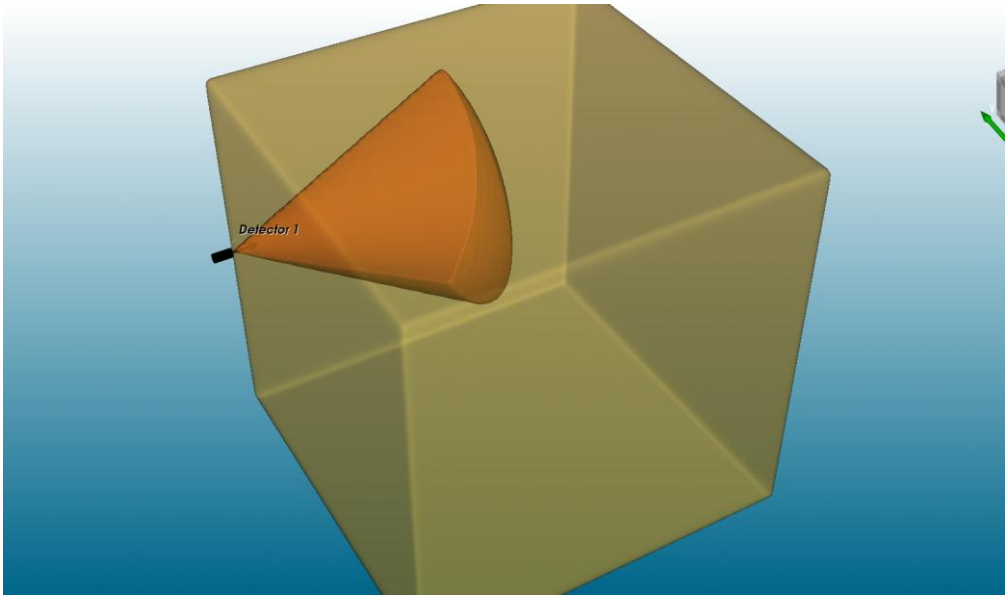
Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade A

Fire Detectors

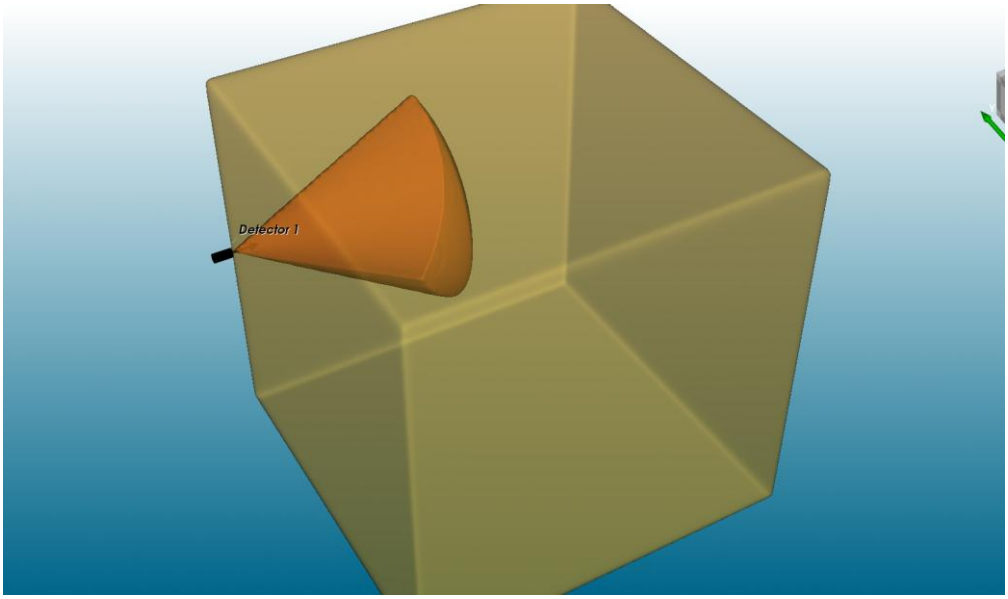
Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
60°	60°	0	Risk Grade A - Low 14 m / High 12 m	0°	0°

Coverage Results

Risk Grade	Voting Logic	Alarm Setting (Low / High)	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade A	1ooN	L	4.81	4.86	0.05
Risk Grade A	1ooN	H	3.03	3.07	0.04



View 1 - L



View 1 - H

1.1.8 Three detectors completely inside a cubical Risk Grade, with their coverage areas not touching each other - Field of View: 90°, Range: Low 10 m / High 9 m

Risk Grades

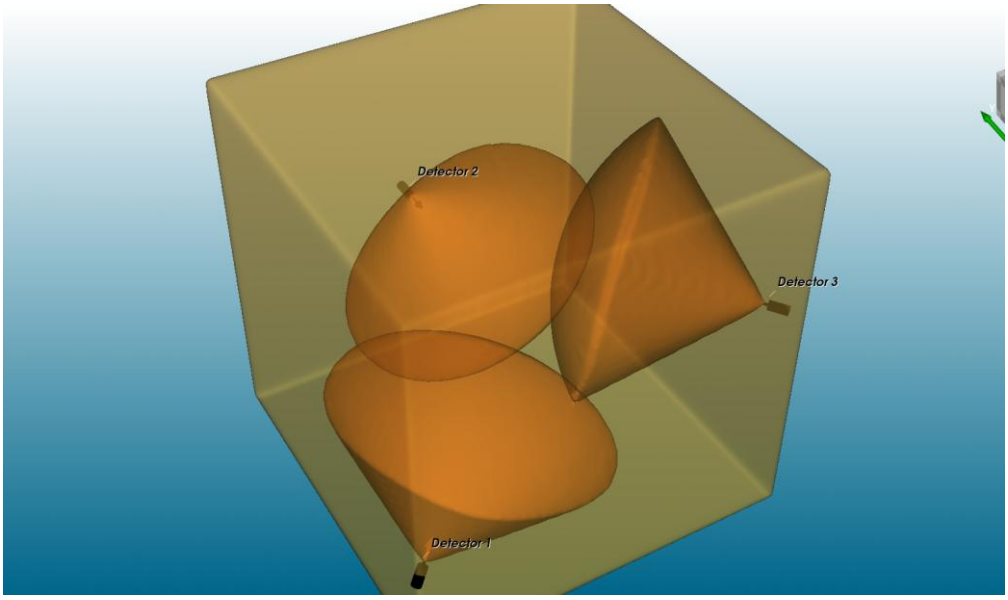
Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade D

Fire Detectors

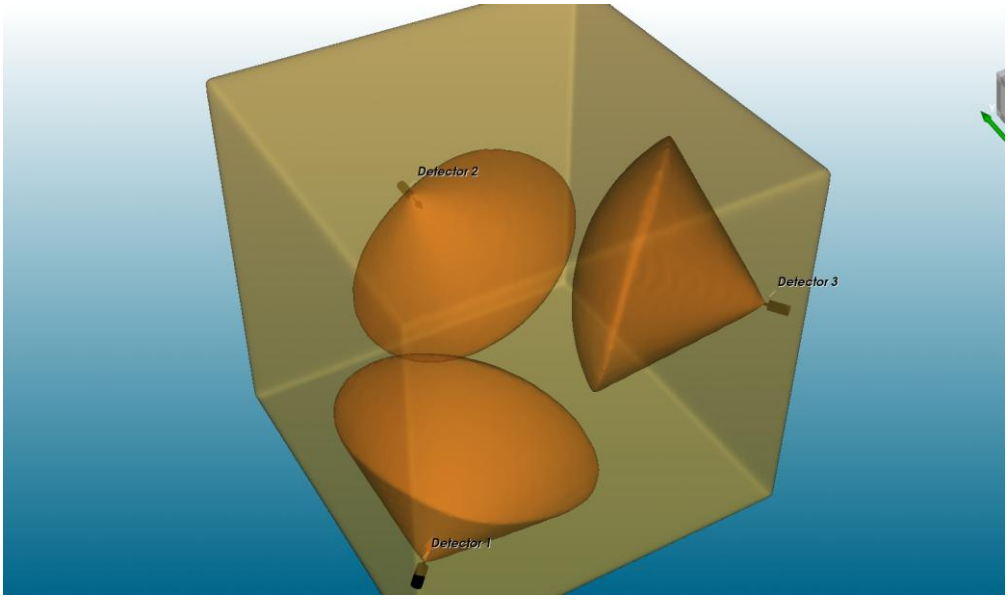
Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
90°	90°	0	Risk Grade D - Low 10 m / High 9 m	9°	45°
90°	90°	0	Risk Grade D - Low 10 m / High 9 m	180°	90°
90°	90°	0	Risk Grade D - Low 10 m / High 9 m	9°	135°

Coverage Results

Risk Grade	Voting Logic	Alarm Setting (Low / High)	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade D	1ooN	L	23	23.07	0.07
Risk Grade D	1ooN	H	16.77	16.87	0.10



View 1 - L



View 1 - H

1.1.9 Two detectors completely inside a cubical Risk Grade, placed at the same spot so their coverage fully overlaps (seen by at least two detectors) - Field of View: 60°, Range: Low 10 m / High 8 m

Risk Grades

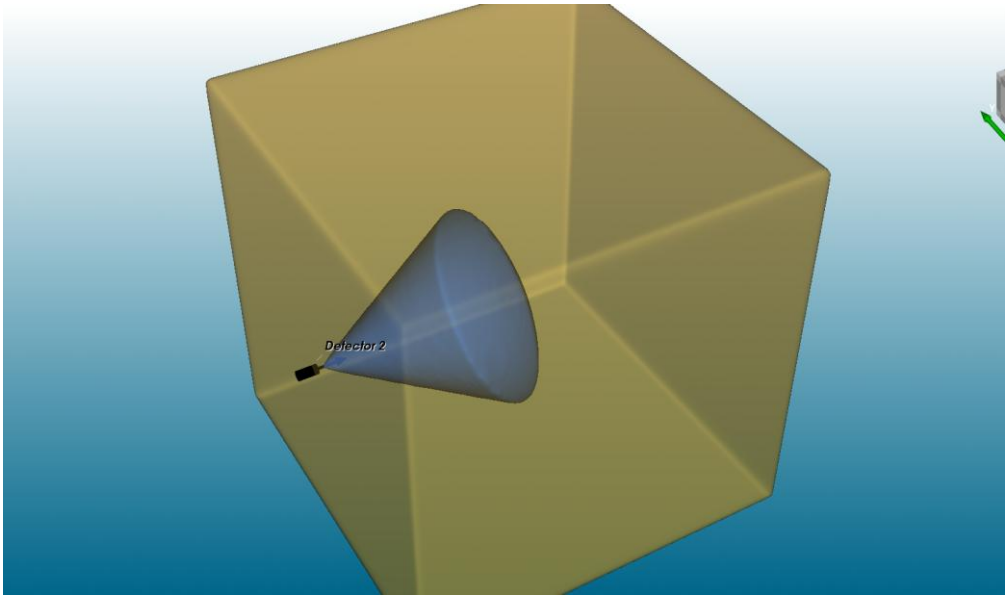
Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade B

Fire Detectors

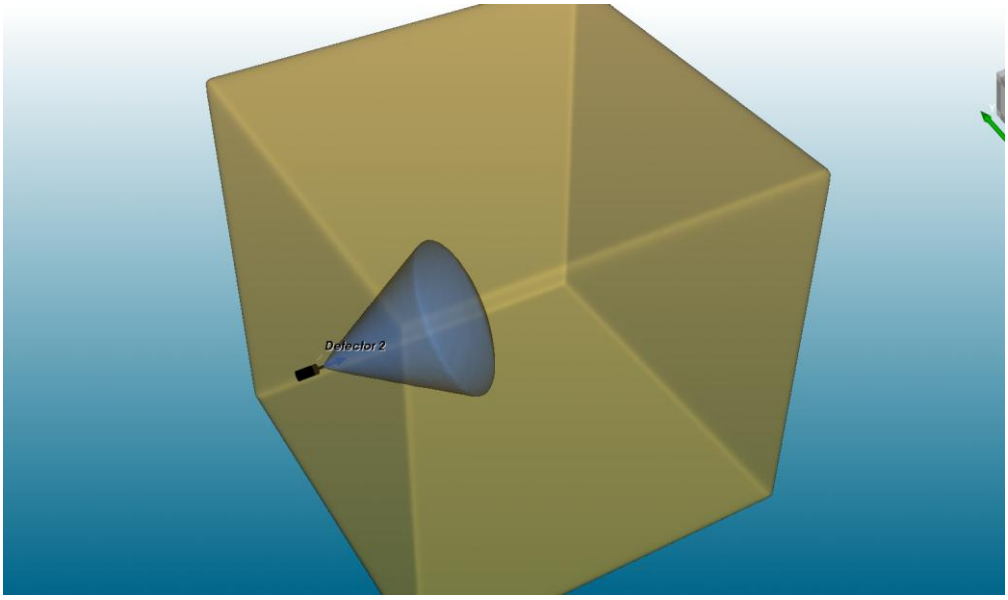
Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
60°	60°	0	Risk Grade B - Low 10 m / High 8 m	0°	0°
60°	60°	0	Risk Grade B - Low 10 m / High 8 m	0°	0°

Coverage Results

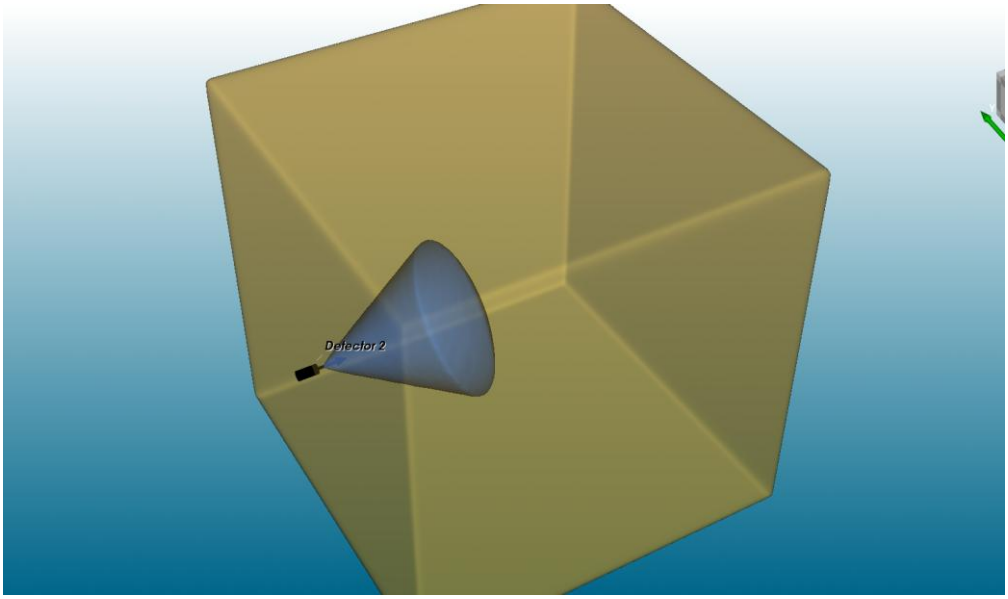
Risk Grade	Voting Logic	Alarm Setting (Low / High)	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade B	2ooN	LL	3.51	3.57	0.06
Risk Grade B	2ooN	LH	1.8	1.84	0.04
Risk Grade B	2ooN	HH	1.8	1.84	0.04



View 1 - LL



View 1 - LH



View 1 - HH

1.1.10 Three detectors completely inside a cubical Risk Grade, placed at the same spot so their coverage fully overlaps (seen by at least three detectors) - Field of View: 60°, Range: Low 10 m / High 8 m

Risk Grades

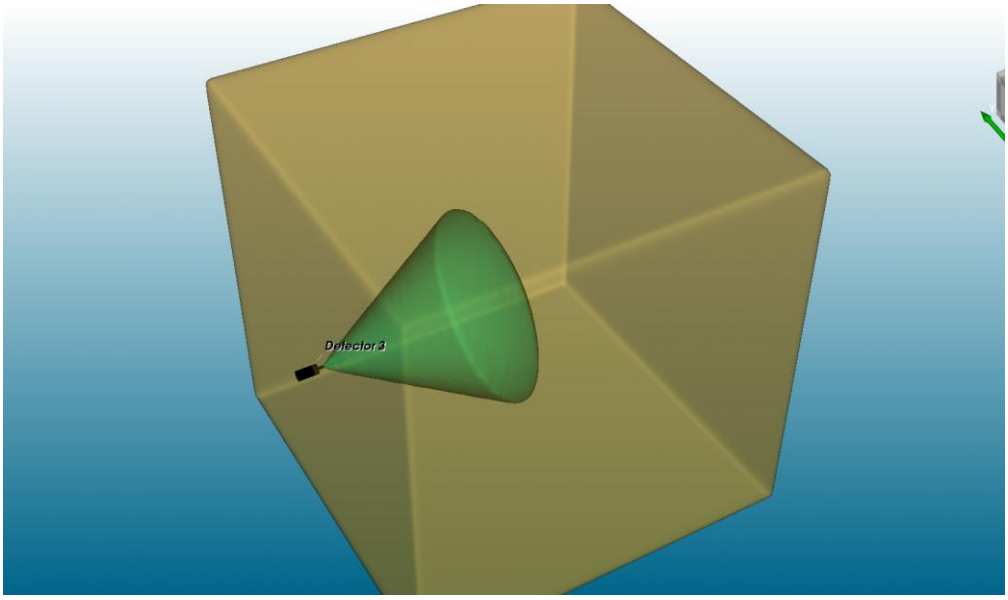
Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade D

Fire Detectors

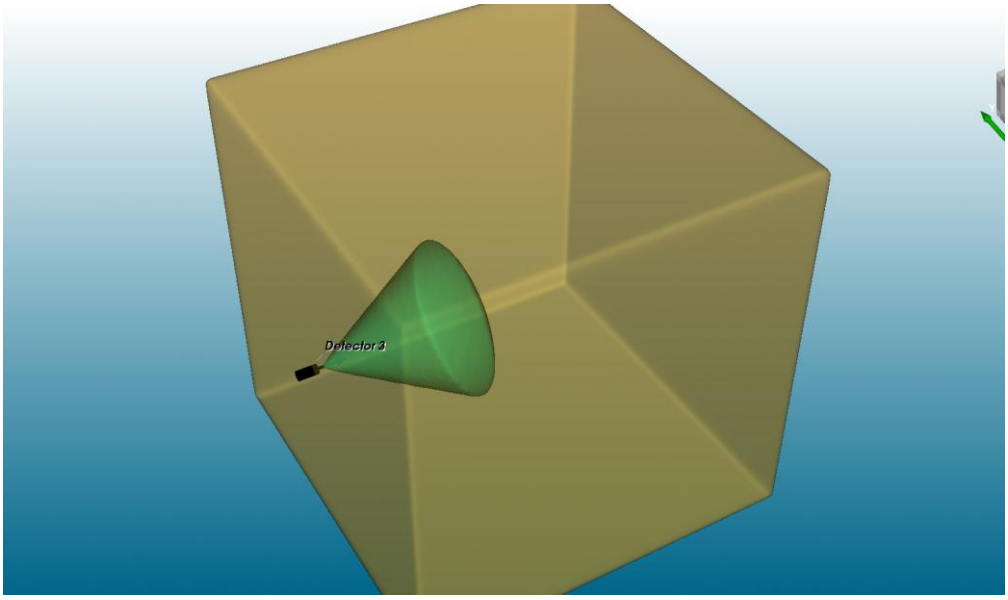
Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
60°	60°	0	Risk Grade D - Low 10 m / High 8 m	0°	0°
60°	60°	0	Risk Grade D - Low 10 m / High 8 m	0°	0°
60°	60°	0	Risk Grade D - Low 10 m / High 8 m	0°	0°

Coverage Results

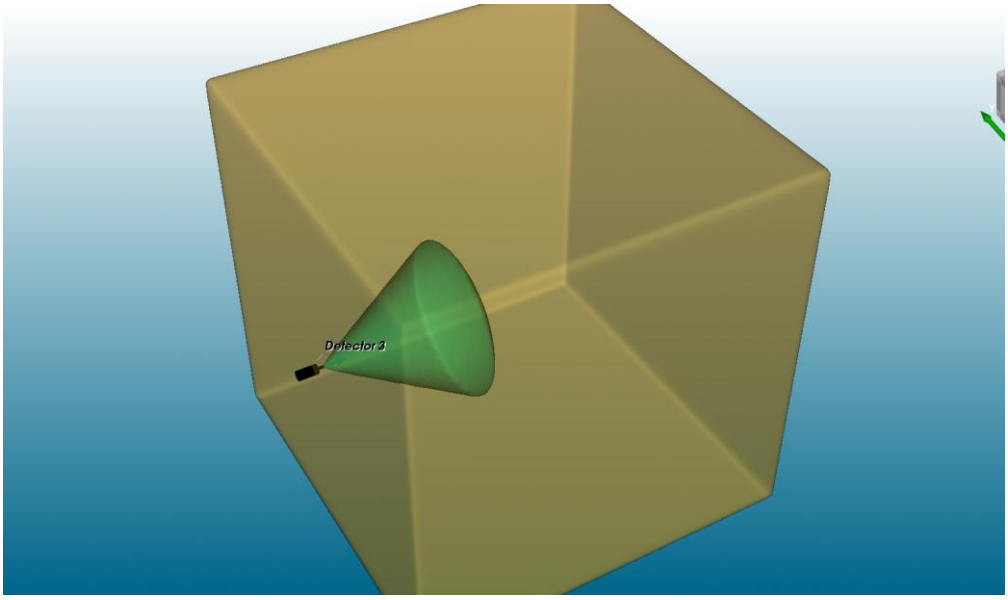
Risk Grade	Voting Logic	Alarm Setting (Low / High)	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade D	3ooN	LLL	3.51	3.57	0.06
Risk Grade D	3ooN	LLH	1.8	1.84	0.04
Risk Grade D	3ooN	LHH	1.8	1.84	0.04
Risk Grade D	3ooN	HHH	1.8	1.84	0.04



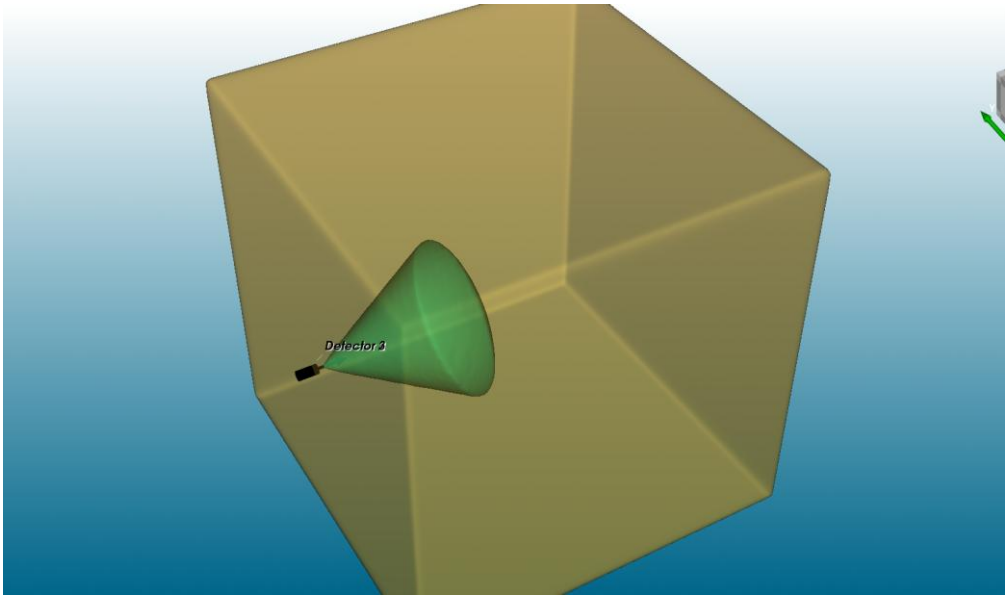
View 1 - LLL



View 1 - LLH



View 1 - LHH



View 1 - HHH

1.1.11 Four detectors completely inside a cubical Risk Grade, placed at the same spot so their coverage fully overlaps (seen by at least four detectors) - Field of View: 90°, Range: Low 10 m / High 8 m

Risk Grades

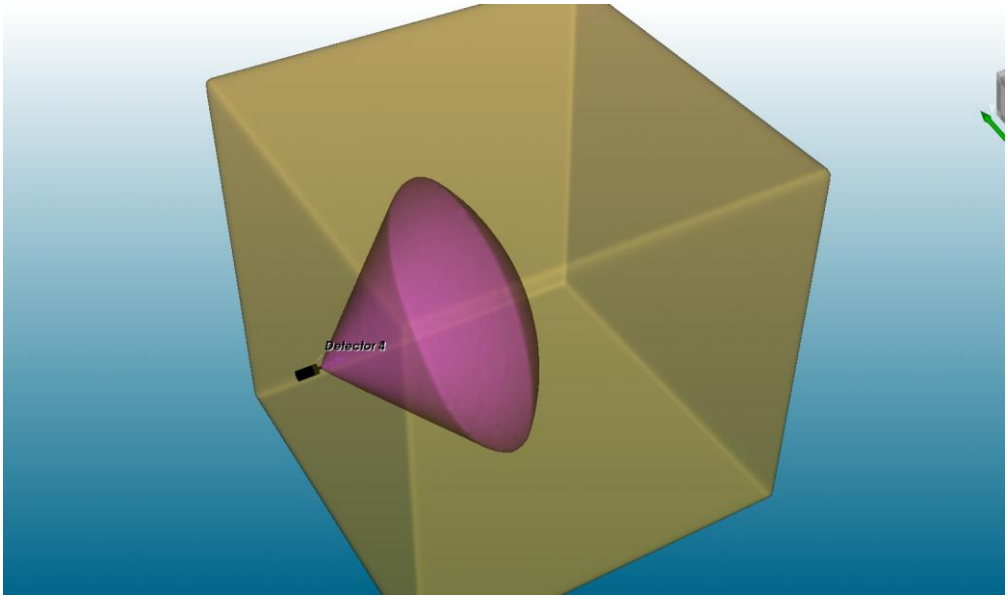
Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade B

Fire Detectors

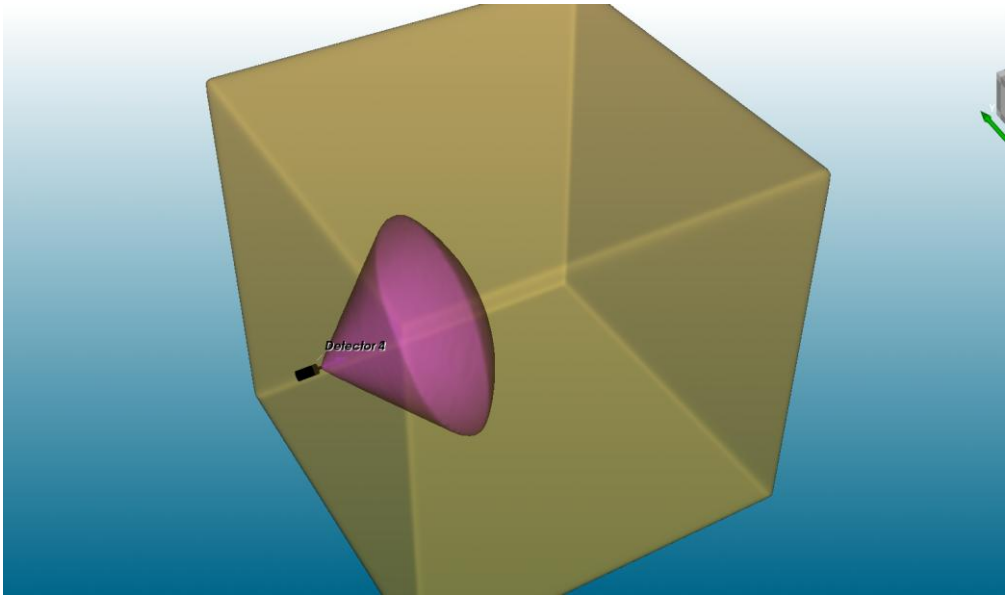
Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
90°	90°	0	Risk Grade B - Low 10 m / High 8 m	0°	0°
90°	90°	0	Risk Grade B - Low 10 m / High 8 m	0°	0°
90°	90°	0	Risk Grade B - Low 10 m / High 8 m	0°	0°
90°	90°	0	Risk Grade B - Low 10 m / High 8 m	0°	0°

Coverage Results

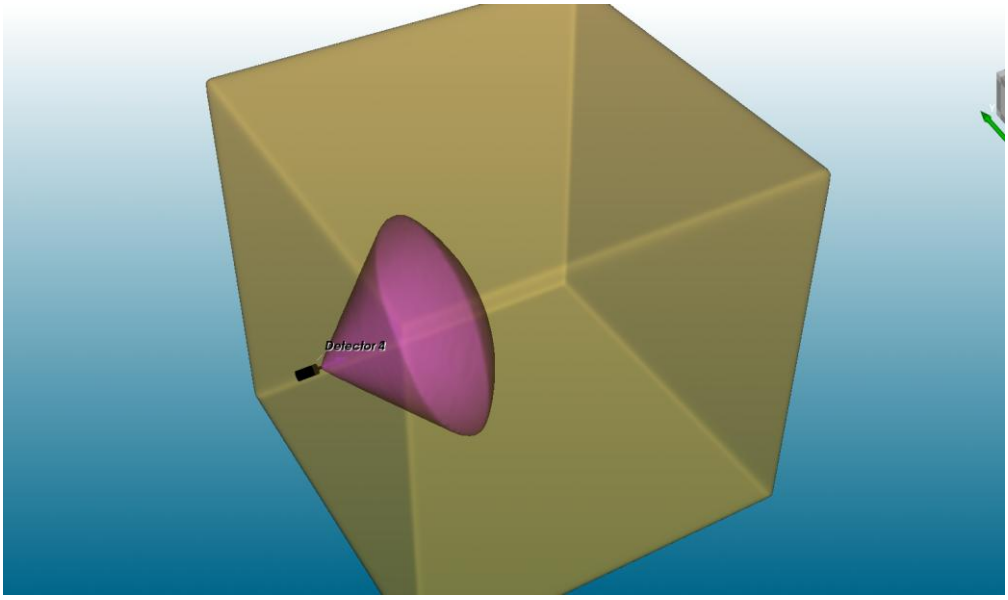
Risk Grade	Voting Logic	Alarm Setting (Low / High)	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade B	4ooN	LLLL	7.67	7.69	0.02
Risk Grade B	4ooN	LLLH	3.9	3.96	0.06
Risk Grade B	4ooN	LLHH	3.9	3.96	0.06
Risk Grade B	4ooN	LHHH	3.9	3.96	0.06
Risk Grade B	4ooN	HHHH	3.9	3.96	0.06



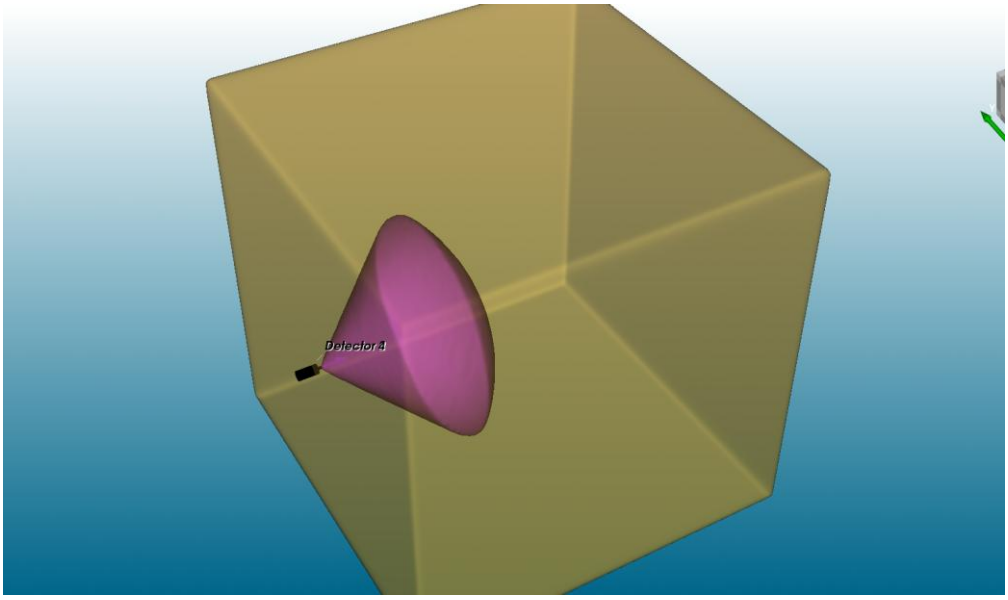
View 1 - LLLL



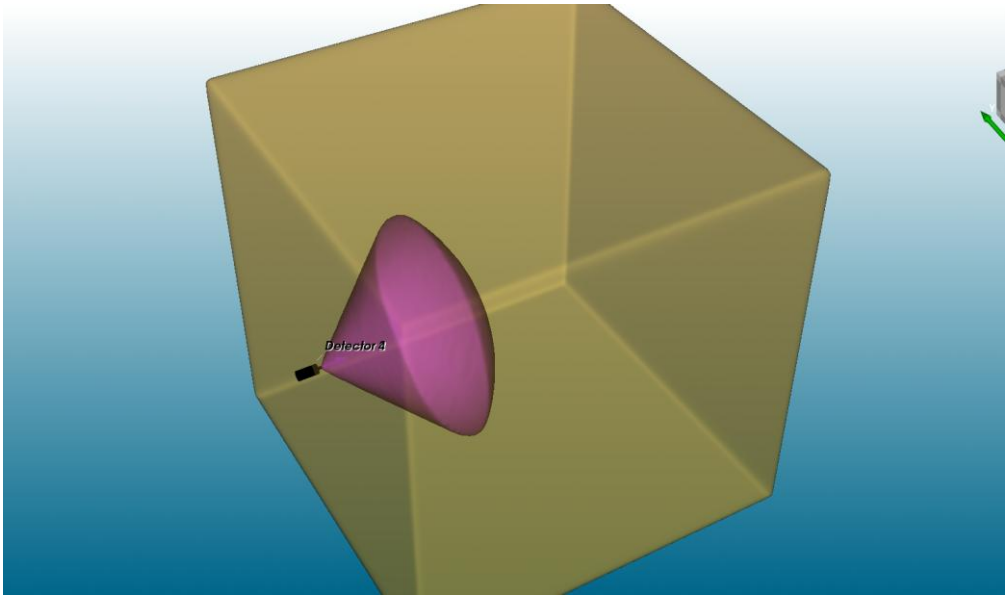
View 1 - LLLH



View 1 - LLHH



View 1 - LHHH



View 1 - HHHH

1.1.12 One detector completely inside a cylindrical Risk Grade - Field of View: 60°, Range: Low 10 m / High 8 m

Risk Grades

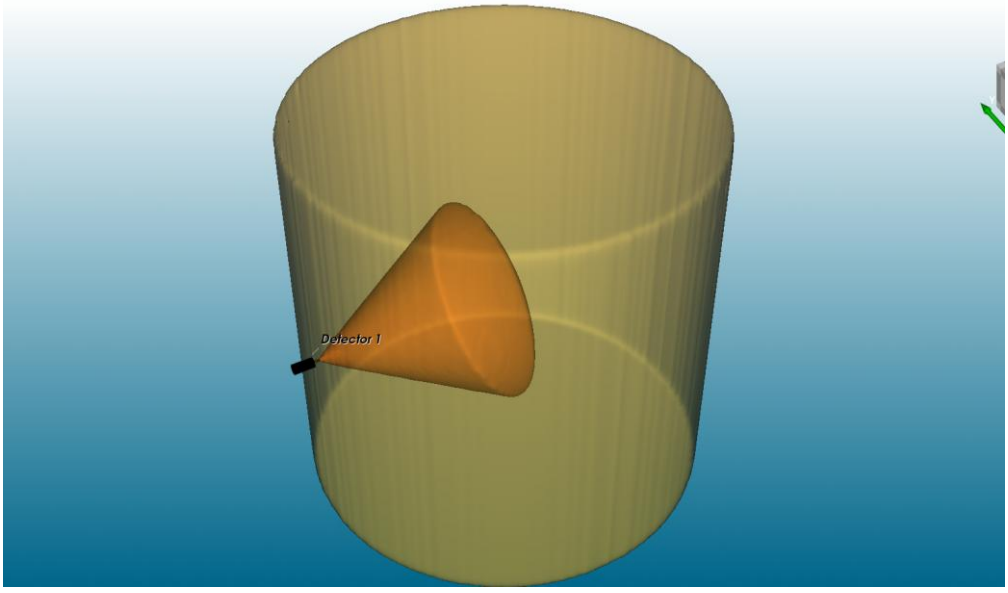
Risk Grade Geometry	Dimensions	Risk Grade Type
Cylinder	Radius 10 m, Height 20 m	Risk Grade D

Fire Detectors

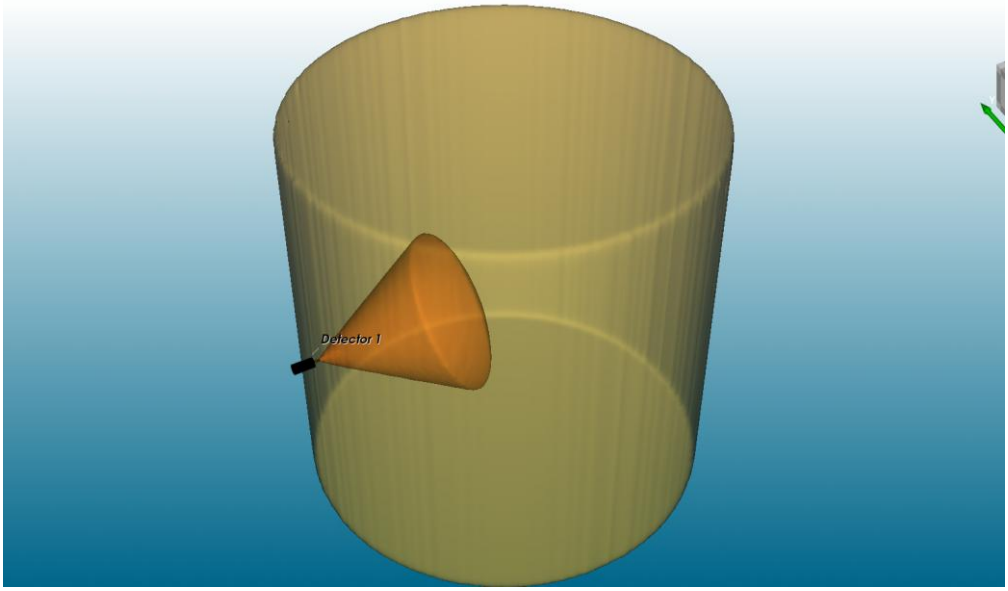
Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
60°	60°	0	Risk Grade D - Low 10 m / High 8 m	0°	0°

Coverage Results

Risk Grade	Voting Logic	Alarm Setting (Low / High)	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade D	1ooN	L	4.47	4.55	0.08
Risk Grade D	1ooN	H	2.29	2.35	0.06



View 1 - L



View 1 - H

1.1.13 One detector completely inside a cylindrical Risk Grade - Field of View: 90°, Range: Low 10 m / High 8 m

Risk Grades

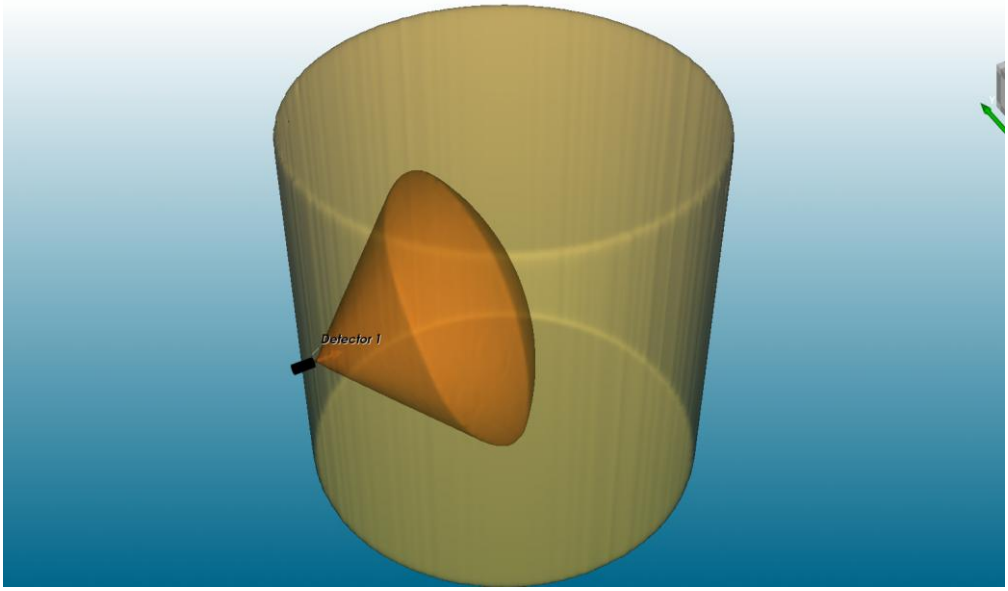
Risk Grade Geometry	Dimensions	Risk Grade Type
Cylinder	Radius 10 m, Height 20 m	Risk Grade C

Fire Detectors

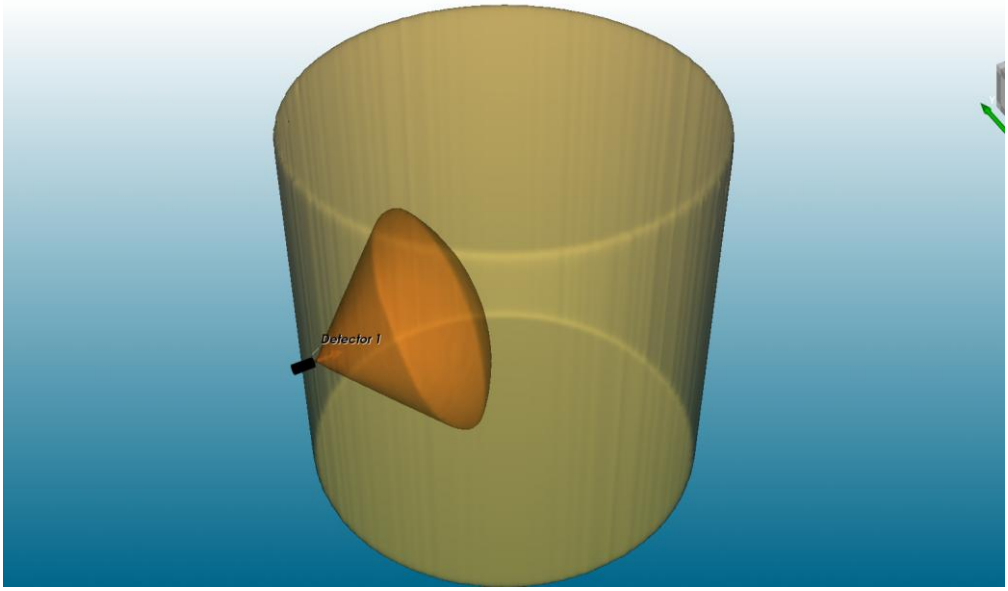
Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
90°	90°	0	Risk Grade C - Low 10 m / High 8 m	0°	0°

Coverage Results

Risk Grade	Voting Logic	Alarm Setting (Low / High)	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade C	1ooN	L	9.77	9.8	0.03
Risk Grade C	1ooN	H	5	5.05	0.05



View 1 - L



View 1 - H

1.1.14 Two detectors completely inside a cylindrical Risk Grade, with their coverage areas not touching each other - Field of View: 60°, Range: Low 10 m / High 8 m

Risk Grades

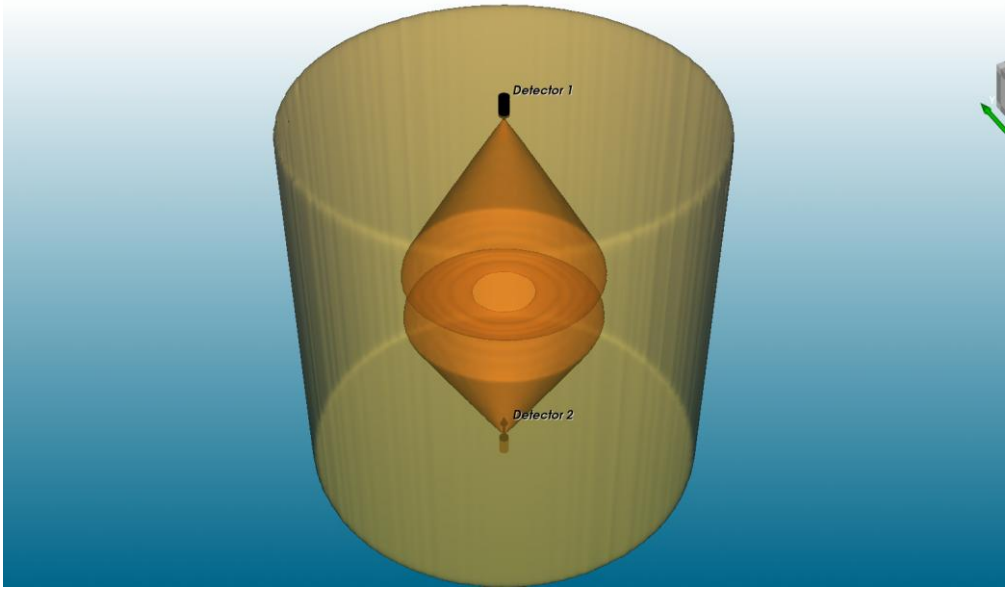
Risk Grade Geometry	Dimensions	Risk Grade Type
Cylinder	Radius 10 m, Height 20 m	Risk Grade A

Fire Detectors

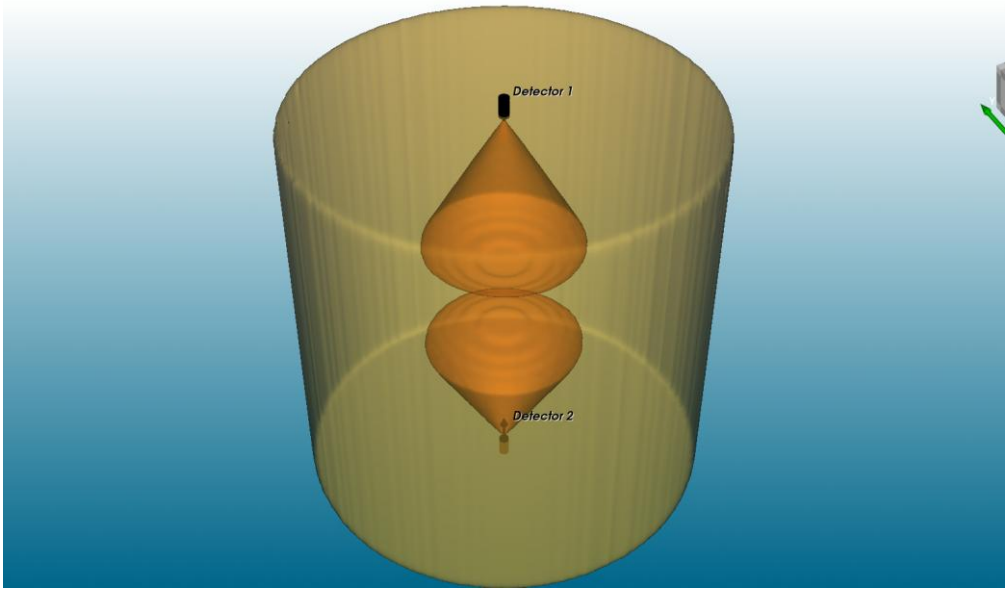
Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
60°	60°	0	Risk Grade A - Low 10 m / High 8 m	270°	0°
60°	60°	0	Risk Grade A - Low 10 m / High 8 m	90°	0°

Coverage Results

Risk Grade	Voting Logic	Alarm Setting (Low / High)	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade A	1ooN	L	8.93	9.1	0.17
Risk Grade A	1ooN	H	4.57	4.71	0.14



View 1 - L



View 1 - H

1.2 Two Risk Grades of Different Types

1.2.1 One detector placed on the top edge shared by two side-by-side cubical Risk Grades of different types - Field of View: 90°, Range: Risk Grade C Low 10 m / High 9 m; Risk Grade D Low 14 m / High 13 m

Risk Grades

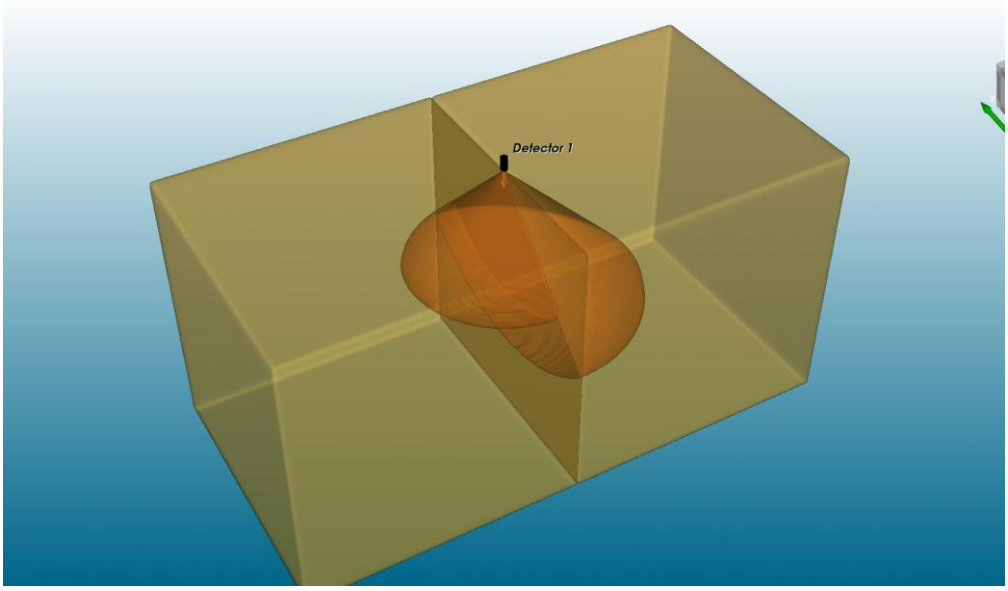
Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade C
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade D

Fire Detectors

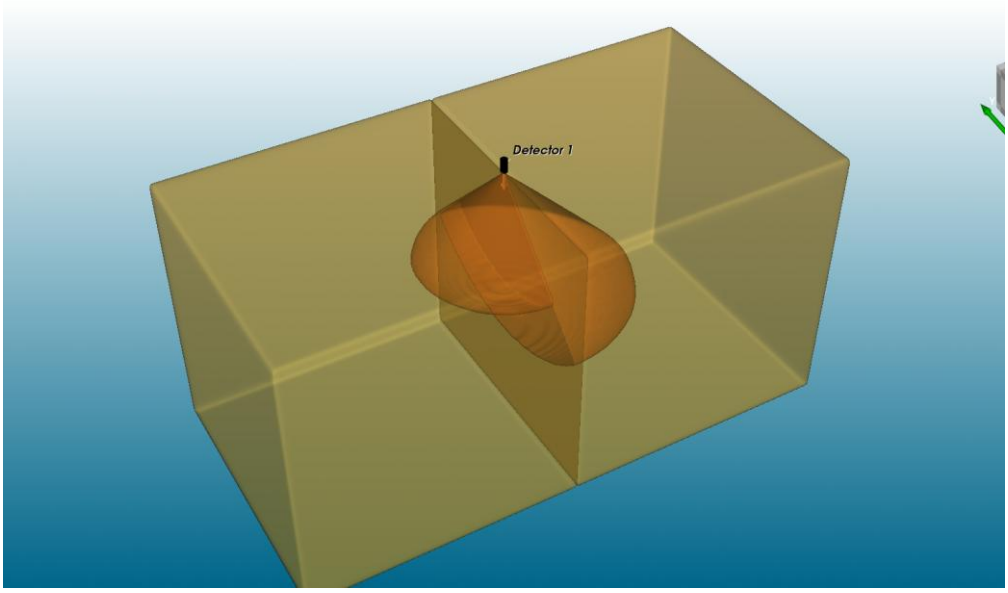
Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
90°	90°	0	Risk Grade C - Low 10 m / High 9 m Risk Grade D - Low 14 m / High 13 m	270°	0°

Coverage Results

Risk Grade	Voting Logic	Alarm Setting (Low / High)	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade C	1ooN	L	3.83	3.85	0.02
Risk Grade D	1ooN	L	10.52	10.46	0.06
Risk Grade C	1ooN	H	2.79	2.81	0.02
Risk Grade D	1ooN	H	8.42	8.39	0.03



View 1 - L



View 1 - H

1.2.2 One detector placed on the top edge shared by two side-by-side cubical Risk Grades of different types - Field of View: 60°, Range: Risk Grade A Low 14 m / High 12 m; Risk Grade C Low 18 m / High 15 m

Risk Grades

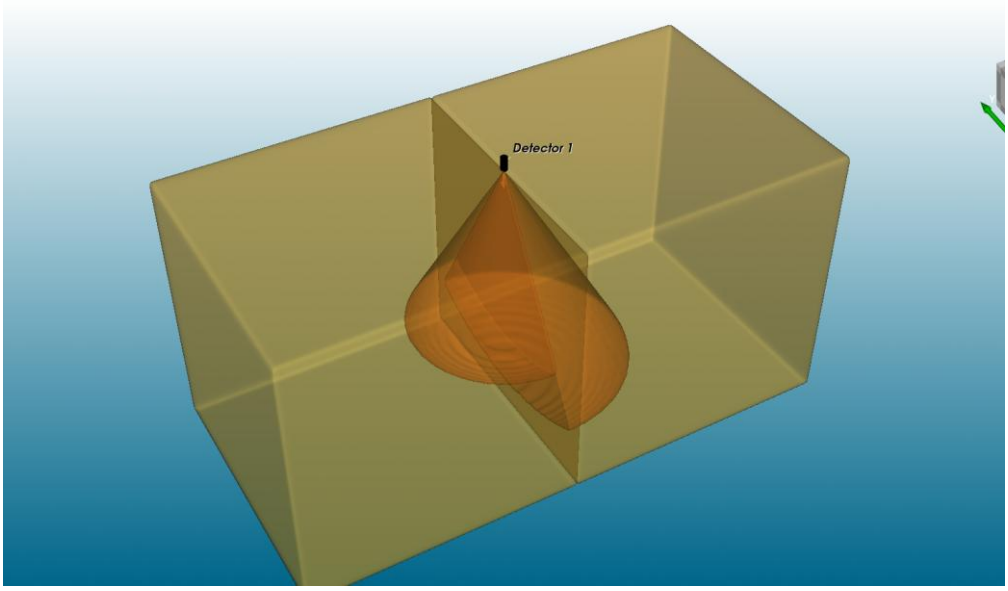
Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade A
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade C

Fire Detectors

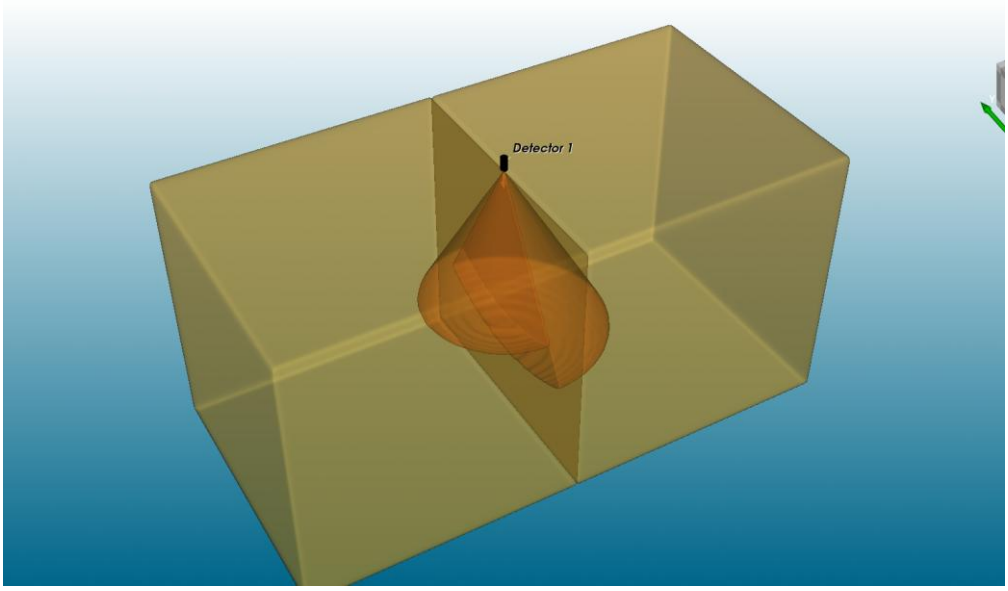
Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
60°	60°	0	Risk Grade A - Low 14 m / High 12 m Risk Grade C - Low 18 m / High 15 m	270°	0°

Coverage Results

Risk Grade	Voting Logic	Alarm Setting (Low / High)	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade A	1ooN	L	4.81	4.86	0.05
Risk Grade C	1ooN	L	10.23	10.28	0.05
Risk Grade A	1ooN	H	3.03	3.08	0.05
Risk Grade C	1ooN	H	5.92	5.97	0.05



View 1 - L



View 1 - H

1.3 Four Risk Grades of Different Types

1.3.1 One detector covering four small cubical Risk Grades of different types placed in a row - Field of View: 120°, Range: Low 50 m / High 45 m

Risk Grades

Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 1 m, Width 1 m, Height 1 m	Risk Grade B
Cube	Length 1 m, Width 1 m, Height 1 m	Risk Grade C
Cube	Length 1 m, Width 1 m, Height 1 m	Risk Grade A
Cube	Length 1 m, Width 1 m, Height 1 m	Risk Grade D

Fire Detectors

Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
120°	120°	0	Risk Grade B - Low 50 m / High 45 m Risk Grade C - Low 50 m / High 45 m Risk Grade A - Low 50 m / High 45 m Risk Grade D - Low 50 m / High 45 m	0°	0°

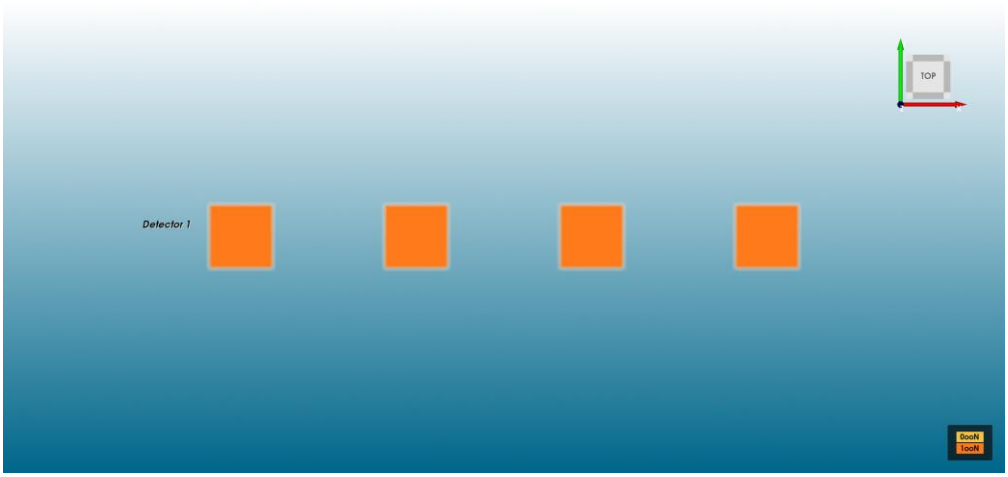
Coverage Results

Risk Grade	Voting Logic	Alarm Setting (Low / High)	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade B	1ooN	L	100	100	0.00
Risk Grade C	1ooN	L	100	100	0.00
Risk Grade A	1ooN	L	100	100	0.00
Risk Grade D	1ooN	L	100	100	0.00
Risk Grade B	1ooN	H	100	100	0.00
Risk Grade C	1ooN	H	100	100	0.00

Risk Grade	Voting Logic	Alarm Setting (Low / High)	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade A	1ooN	H	100	100	0.00
Risk Grade D	1ooN	H	100	100	0.00



Slice Plot - XY @ 1



Slice Plot - XY @ 1

1.3.2 Four detectors covering four small cubical Risk Grades of different types placed in a row, with coverage checked for one, two, three and four detectors seeing the same point - Field of View: 120°, Range: Low 50 m / High 45 m

Risk Grades

Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 1 m, Width 1 m, Height 1 m	Risk Grade A
Cube	Length 1 m, Width 1 m, Height 1 m	Risk Grade D
Cube	Length 1 m, Width 1 m, Height 1 m	Risk Grade B
Cube	Length 1 m, Width 1 m, Height 1 m	Risk Grade C

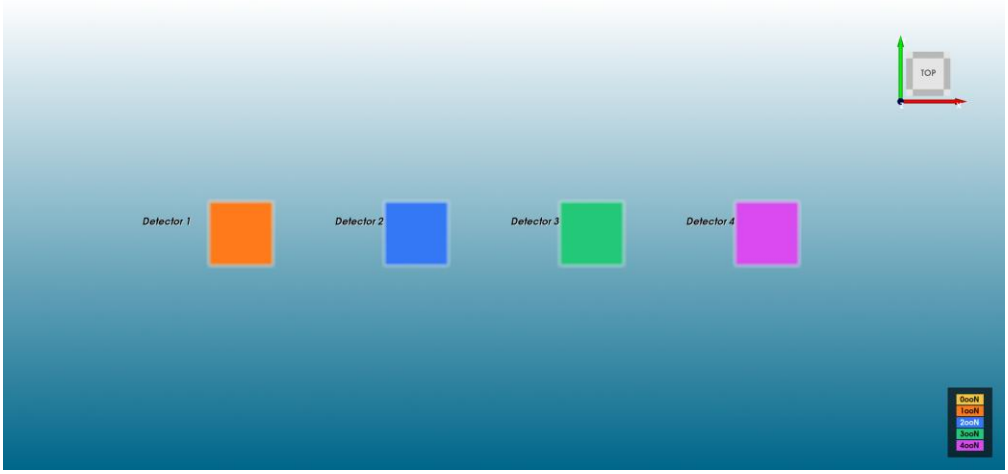
Fire Detectors

Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
120°	120°	0	Risk Grade A - Low 50 m / High 45 m Risk Grade D - Low 50 m / High 45 m Risk Grade B - Low 50 m / High 45 m Risk Grade C - Low 50 m / High 45 m	0°	0°
120°	120°	0	Risk Grade A - Low 50 m / High 45 m Risk Grade D - Low 50 m / High 45 m Risk Grade B - Low 50 m / High 45 m Risk Grade C - Low 50 m / High 45 m	0°	0°
120°	120°	0	Risk Grade A - Low 50 m / High 45 m Risk Grade D - Low 50 m / High 45 m Risk Grade B - Low 50 m / High 45 m Risk Grade C - Low 50 m / High 45 m	0°	0°

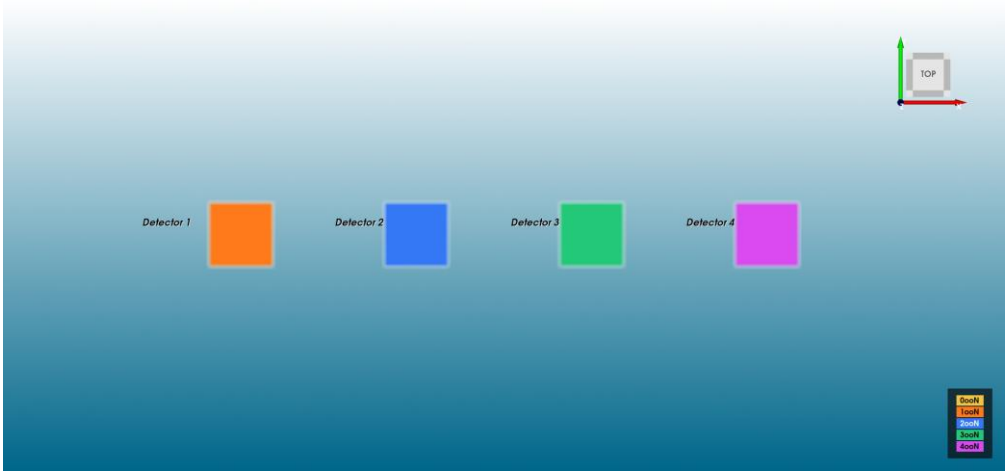
Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
120°	120°	0	Risk Grade A - Low 50 m / High 45 m Risk Grade D - Low 50 m / High 45 m Risk Grade B - Low 50 m / High 45 m Risk Grade C - Low 50 m / High 45 m	0°	0°

Coverage Results

Risk Grade	Voting Logic	Alarm Setting (Low / High)	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade A	1ooN	L	100	100	0.00
Risk Grade D	2ooN	L	100	100	0.00
Risk Grade B	3ooN	L	100	100	0.00
Risk Grade C	4ooN	L	100	100	0.00
Risk Grade A	1ooN	H	100	100	0.00
Risk Grade D	2ooN	H	100	100	0.00
Risk Grade B	3ooN	H	100	100	0.00
Risk Grade C	4ooN	H	100	100	0.00



Slice Plot - XY @ 1



Slice Plot - XY @ 1

1.3.3 Four detectors covering four small cubical Risk Grades in a row, with a solid plank blocking the view of the first detector between the first and second Risk Grade (coverage checked for one, two and three detectors) - Field of View: 120°, Range: Low 50 m / High 45 m

Risk Grades

Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 1 m, Width 1 m, Height 1 m	Risk Grade B
Cube	Length 1 m, Width 1 m, Height 1 m	Risk Grade C
Cube	Length 1 m, Width 1 m, Height 1 m	Risk Grade A
Cube	Length 1 m, Width 1 m, Height 1 m	Risk Grade D

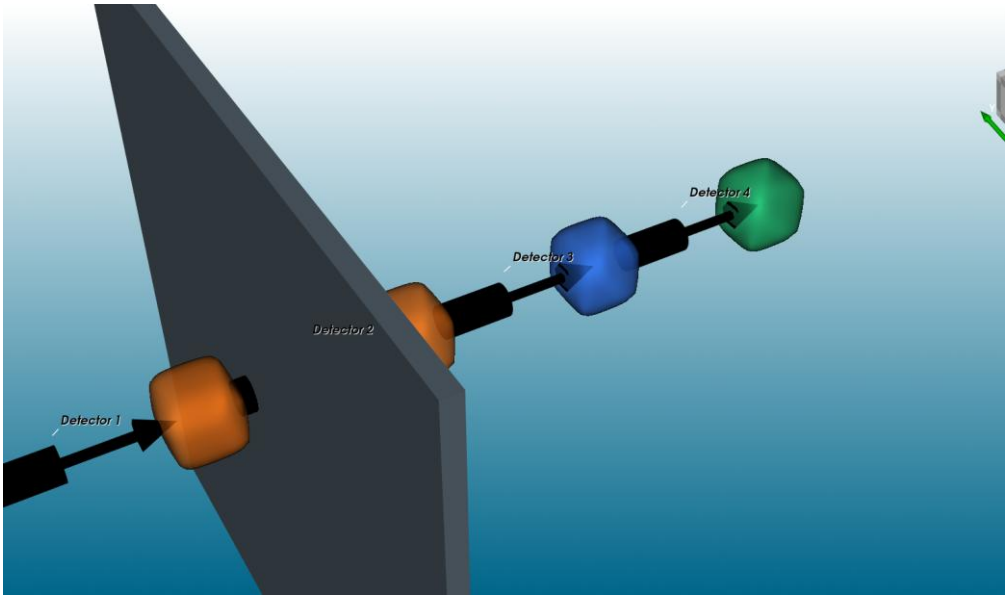
Fire Detectors

Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
120°	120°	0	Risk Grade B - Low 50 m / High 45 m Risk Grade C - Low 50 m / High 45 m Risk Grade A - Low 50 m / High 45 m Risk Grade D - Low 50 m / High 45 m	0°	0°
120°	120°	0	Risk Grade B - Low 50 m / High 45 m Risk Grade C - Low 50 m / High 45 m Risk Grade A - Low 50 m / High 45 m Risk Grade D - Low 50 m / High 45 m	0°	0°

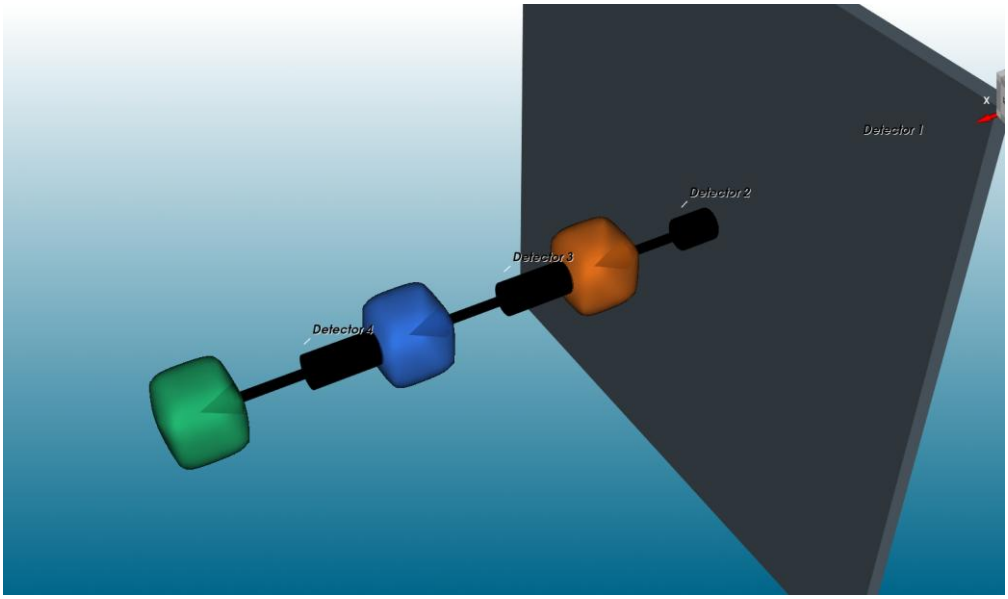
Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
120°	120°	0	Risk Grade B - Low 50 m / High 45 m Risk Grade C - Low 50 m / High 45 m Risk Grade A - Low 50 m / High 45 m Risk Grade D - Low 50 m / High 45 m	0°	0°
120°	120°	0	Risk Grade B - Low 50 m / High 45 m Risk Grade C - Low 50 m / High 45 m Risk Grade A - Low 50 m / High 45 m Risk Grade D - Low 50 m / High 45 m	0°	0°

Coverage Results

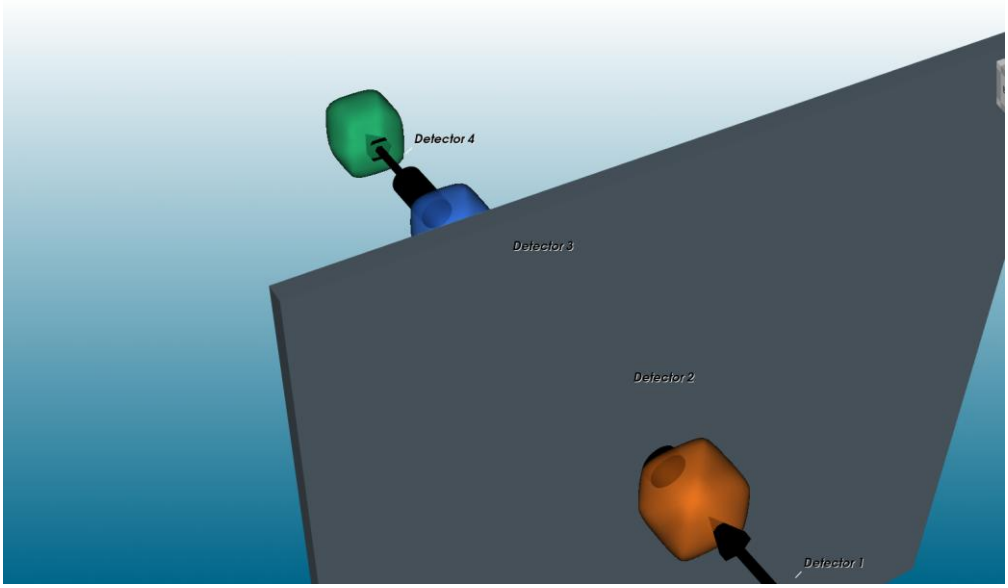
Risk Grade	Voting Logic	Alarm Setting (Low / High)	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade B	1ooN	L	100	100	0.00
Risk Grade C	1ooN	L	100	100	0.00
Risk Grade A	2ooN	L	100	100	0.00
Risk Grade D	3ooN	L	100	100	0.00
Risk Grade B	1ooN	H	100	100	0.00
Risk Grade C	1ooN	H	100	100	0.00
Risk Grade A	2ooN	H	100	100	0.00
Risk Grade D	3ooN	H	100	100	0.00



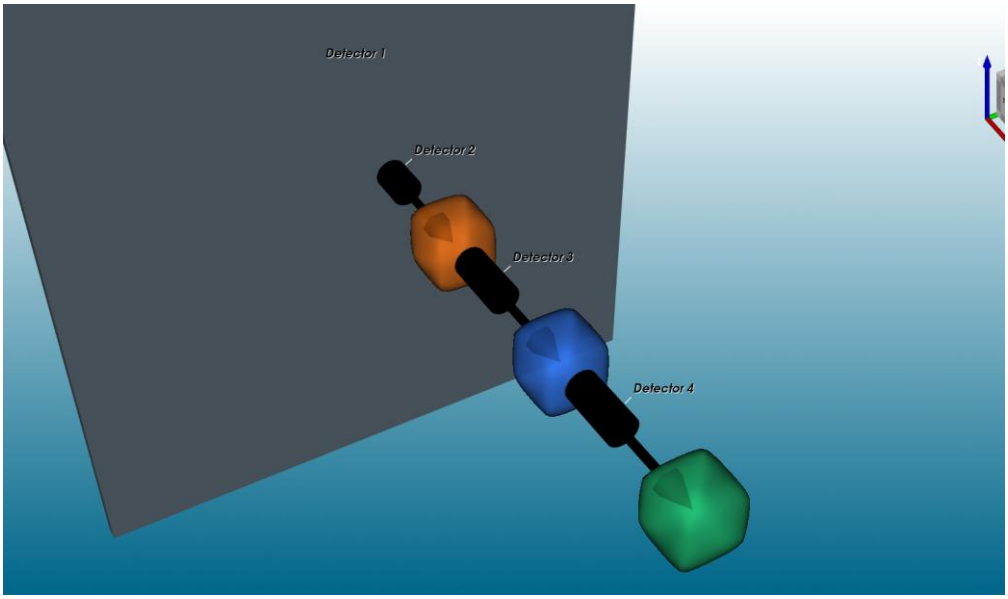
View 1 - L



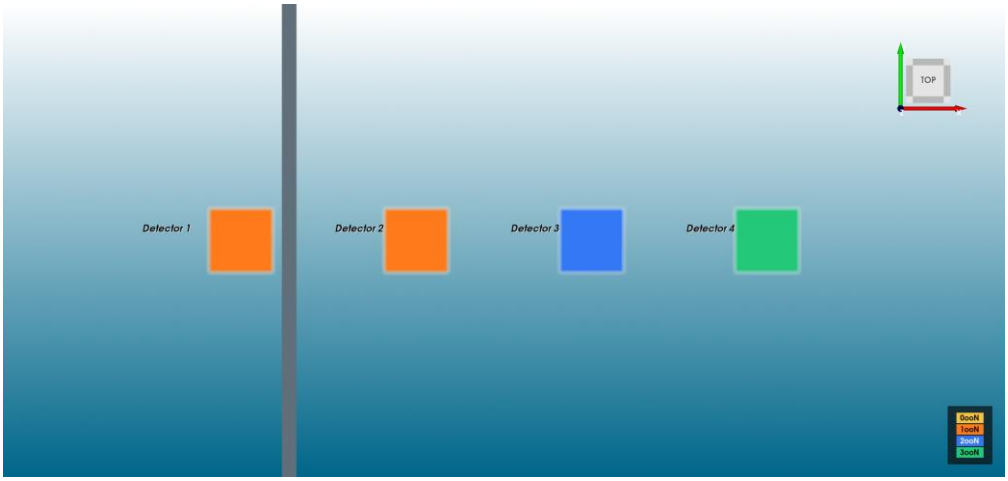
View 2 - L



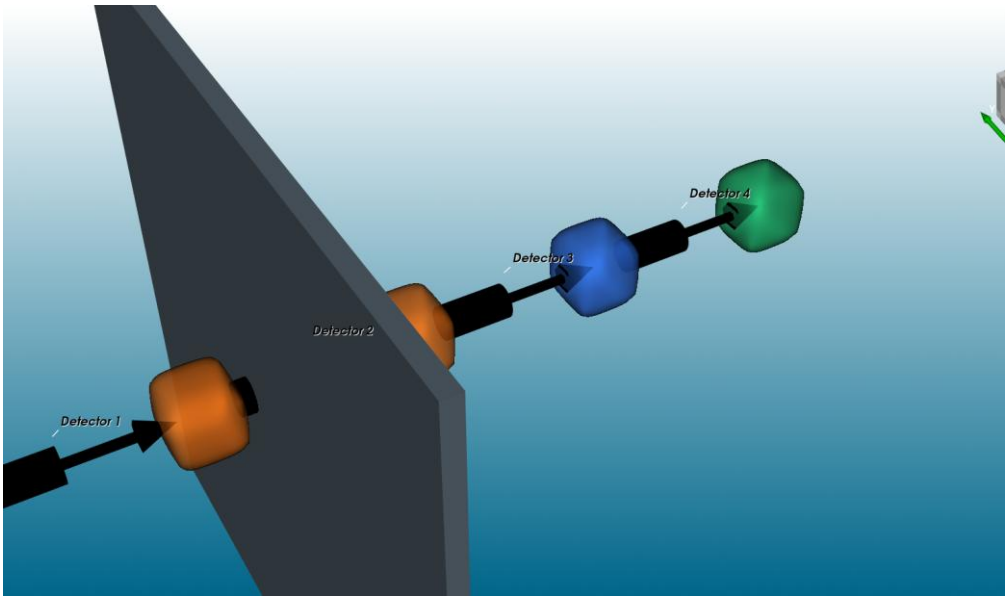
View 3 - L



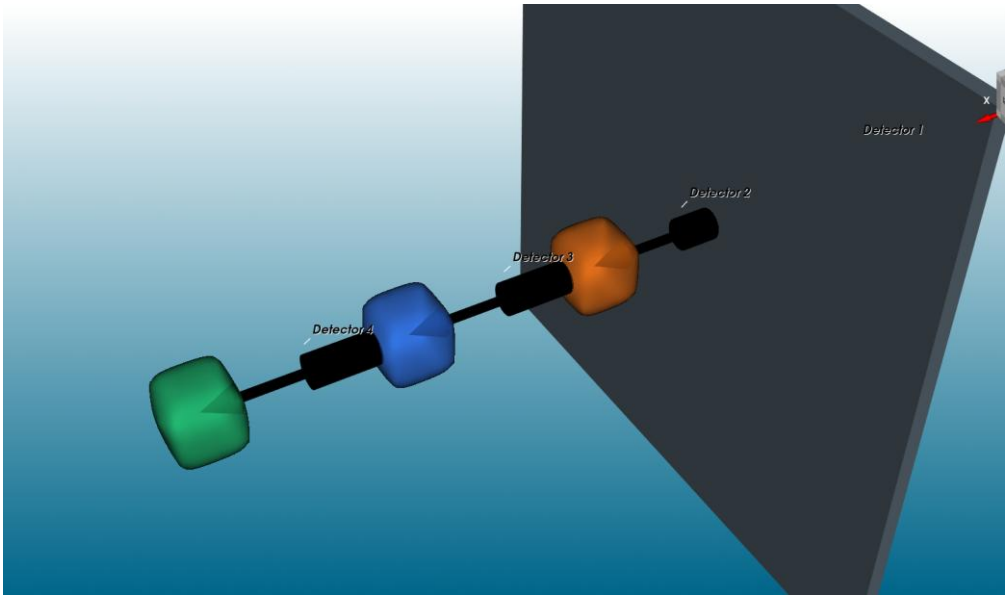
View 4 - L



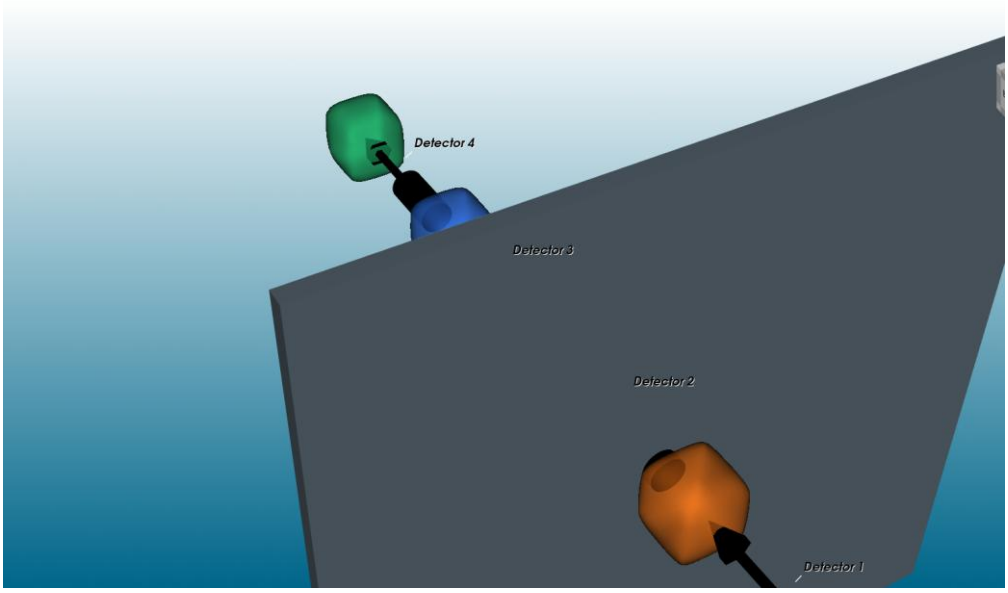
Slice Plot - XY @ 1



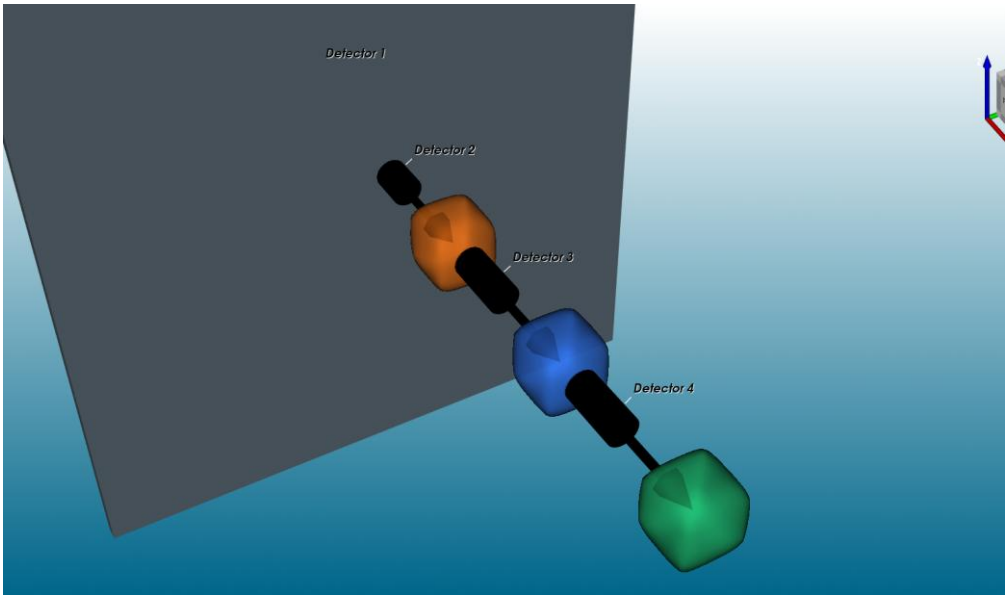
View 1 - H



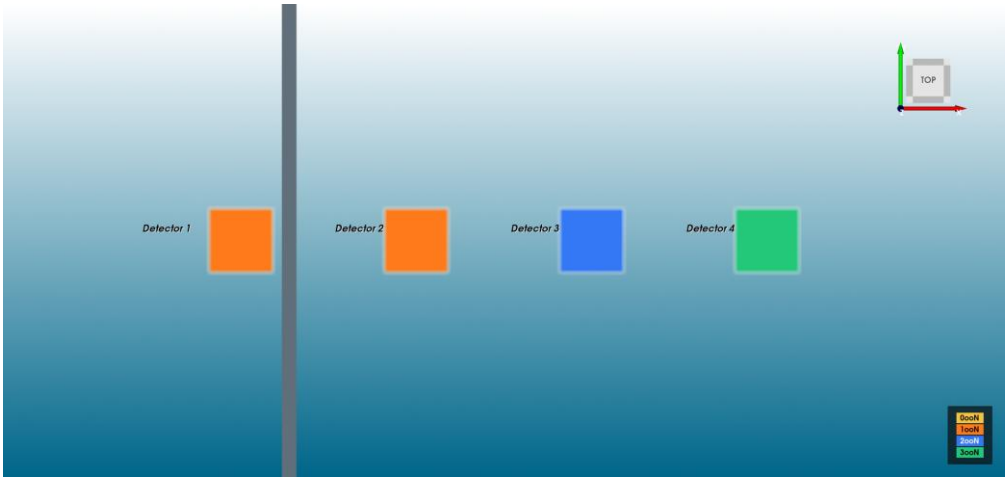
View 2 - H



View 3 - H



View 4 - H



Slice Plot - XY @ 1

1.3.4 Four detectors covering four small cubical Risk Grades in a row, with a solid plank blocking the view of the second detector between the second and third Risk Grade (coverage checked for one and two detectors) - Field of View: 120°, Range: Low 50 m / High 45 m

Risk Grades

Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 1 m, Width 1 m, Height 1 m	Risk Grade A
Cube	Length 1 m, Width 1 m, Height 1 m	Risk Grade B
Cube	Length 1 m, Width 1 m, Height 1 m	Risk Grade D
Cube	Length 1 m, Width 1 m, Height 1 m	Risk Grade C

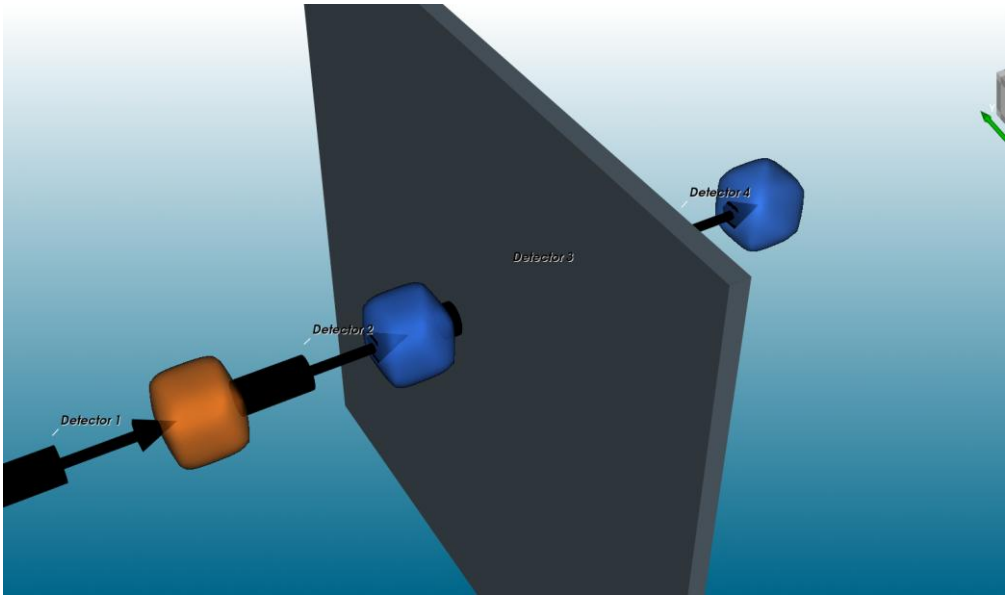
Fire Detectors

Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
120°	120°	0	Risk Grade A - Low 50 m / High 45 m Risk Grade B - Low 50 m / High 45 m Risk Grade D - Low 50 m / High 45 m Risk Grade C - Low 50 m / High 45 m	0°	0°
120°	120°	0	Risk Grade A - Low 50 m / High 45 m Risk Grade B - Low 50 m / High 45 m Risk Grade D - Low 50 m / High 45 m Risk Grade C - Low 50 m / High 45 m	0°	0°

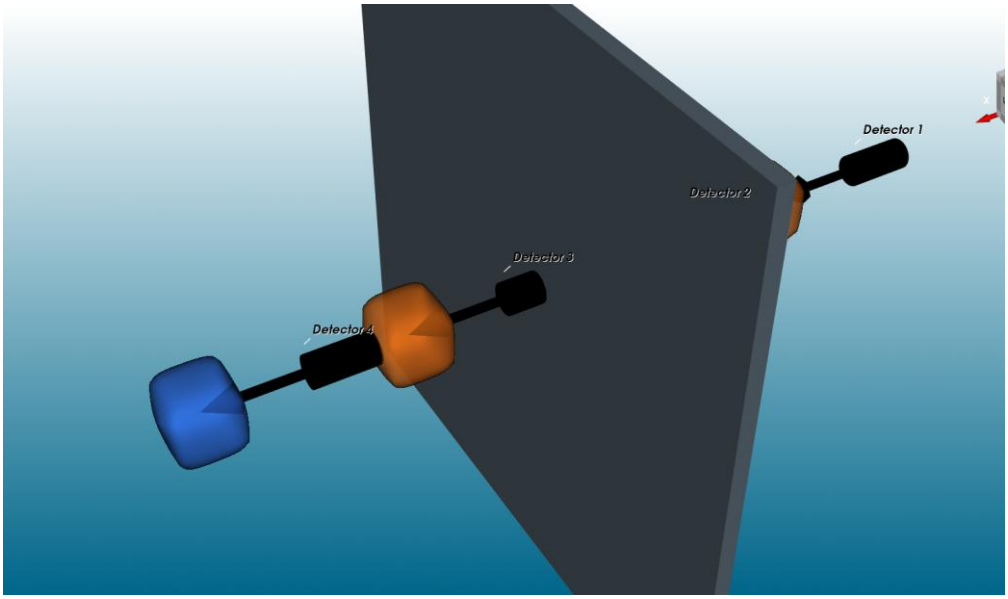
Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
120°	120°	0	Risk Grade A - Low 50 m / High 45 m Risk Grade B - Low 50 m / High 45 m Risk Grade D - Low 50 m / High 45 m Risk Grade C - Low 50 m / High 45 m	0°	0°
120°	120°	0	Risk Grade A - Low 50 m / High 45 m Risk Grade B - Low 50 m / High 45 m Risk Grade D - Low 50 m / High 45 m Risk Grade C - Low 50 m / High 45 m	0°	0°

Coverage Results

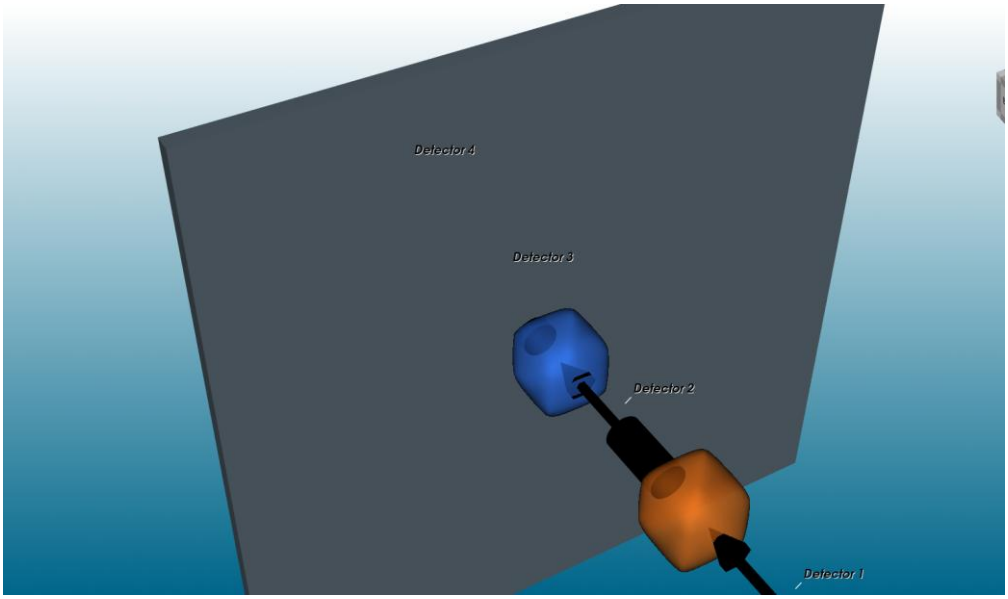
Risk Grade	Voting Logic	Alarm Setting (Low / High)	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade A	1ooN	L	100	100	0.00
Risk Grade B	2ooN	L	100	100	0.00
Risk Grade D	1ooN	L	100	100	0.00
Risk Grade C	2ooN	L	100	100	0.00
Risk Grade A	1ooN	H	100	100	0.00
Risk Grade B	2ooN	H	100	100	0.00
Risk Grade D	1ooN	H	100	100	0.00
Risk Grade C	2ooN	H	100	100	0.00



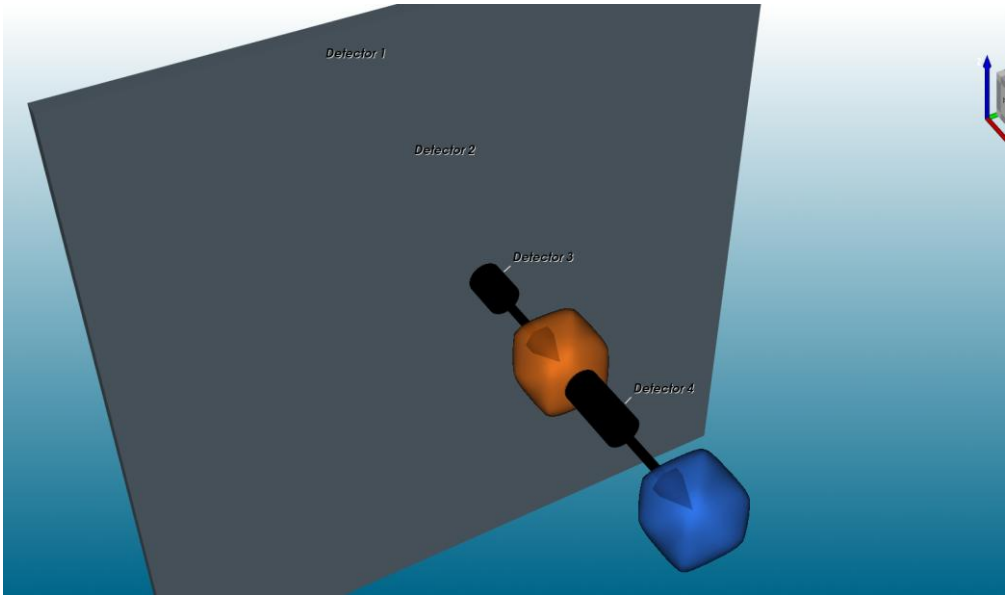
View 1 - L



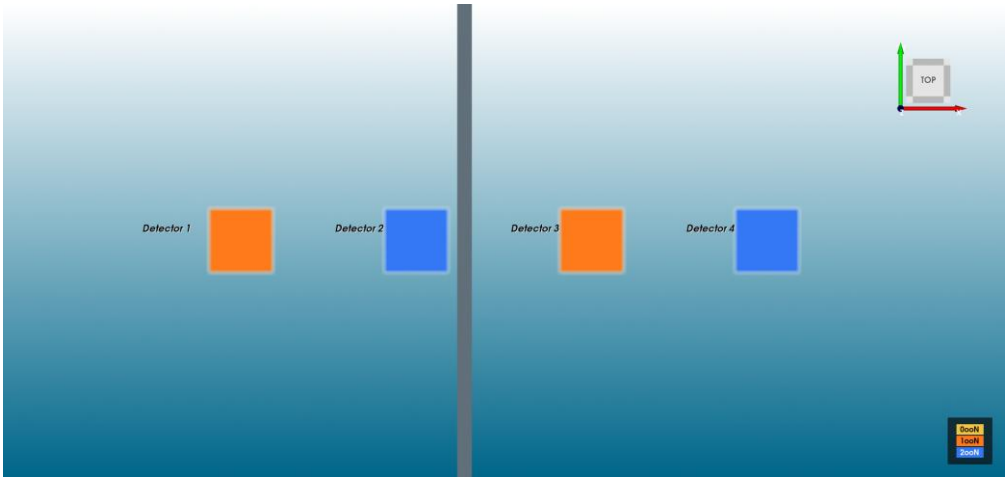
View 2 - L



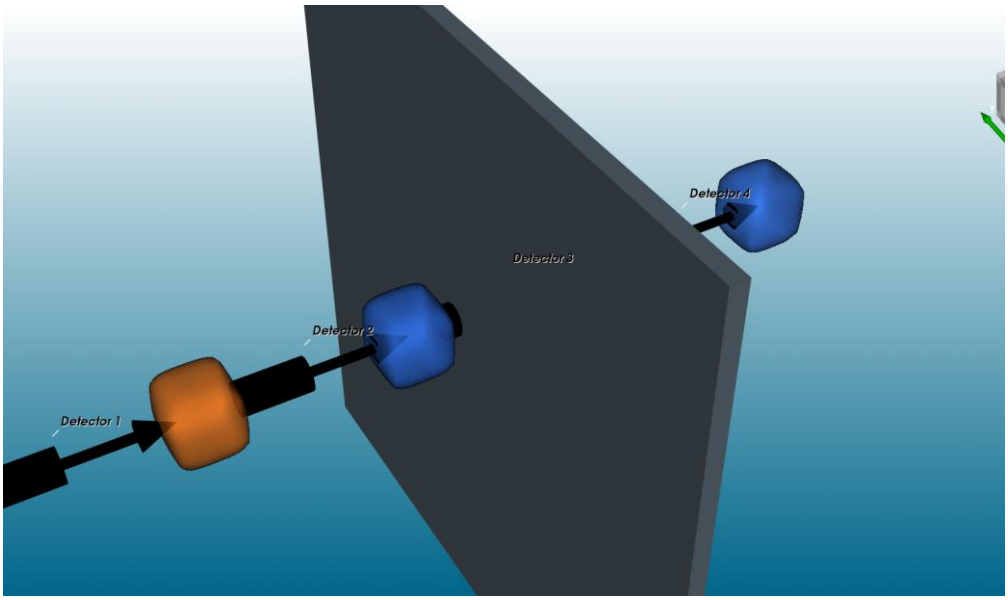
View 3 - L



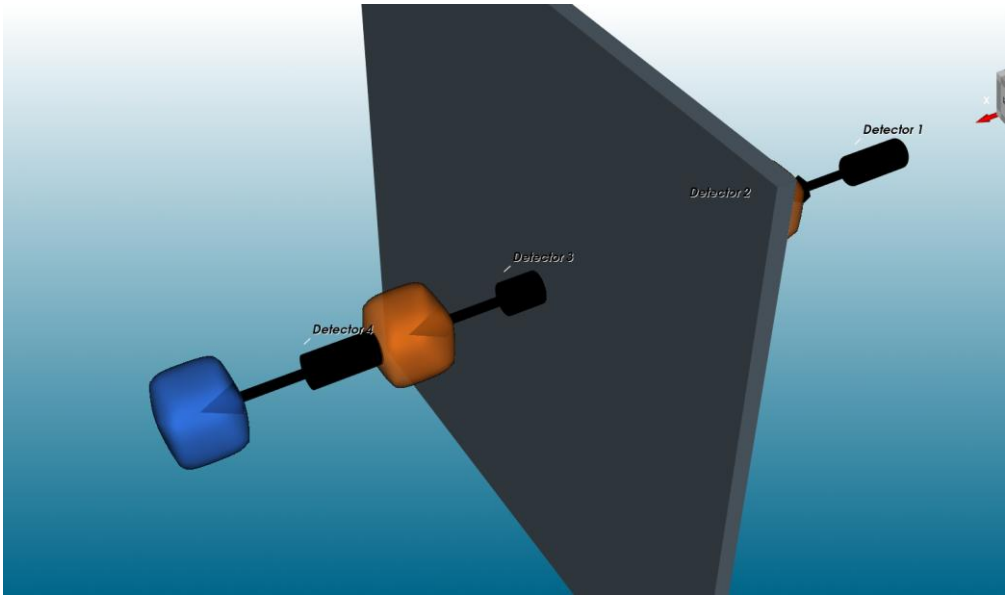
View 4 - L



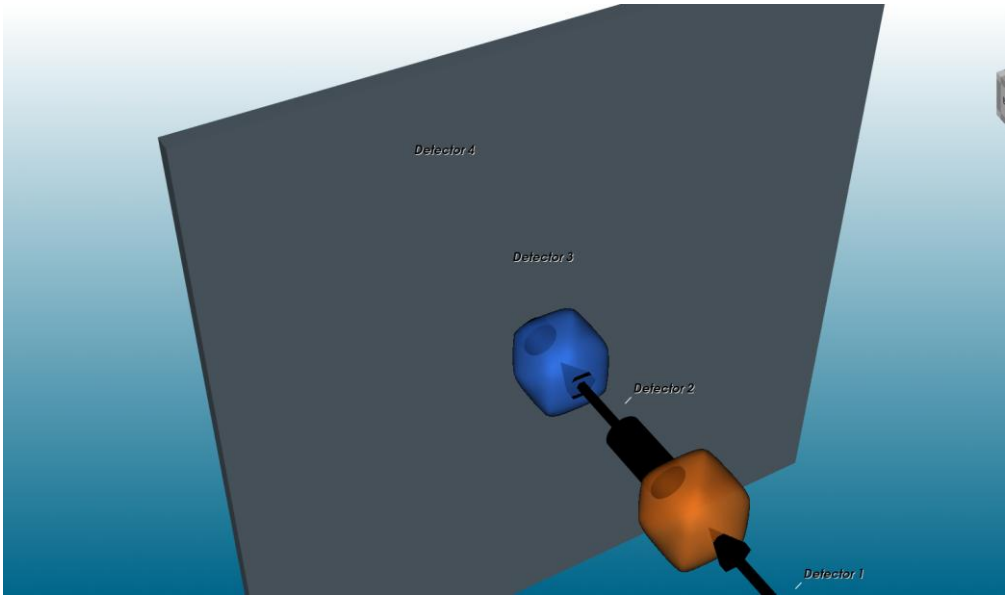
Slice Plot - XY @ 1



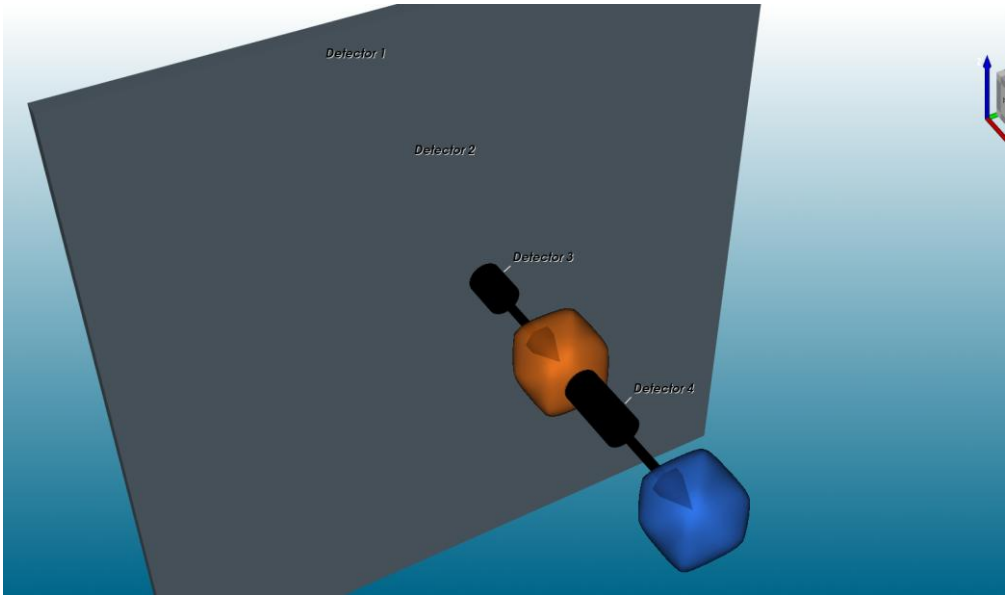
View 1 - H



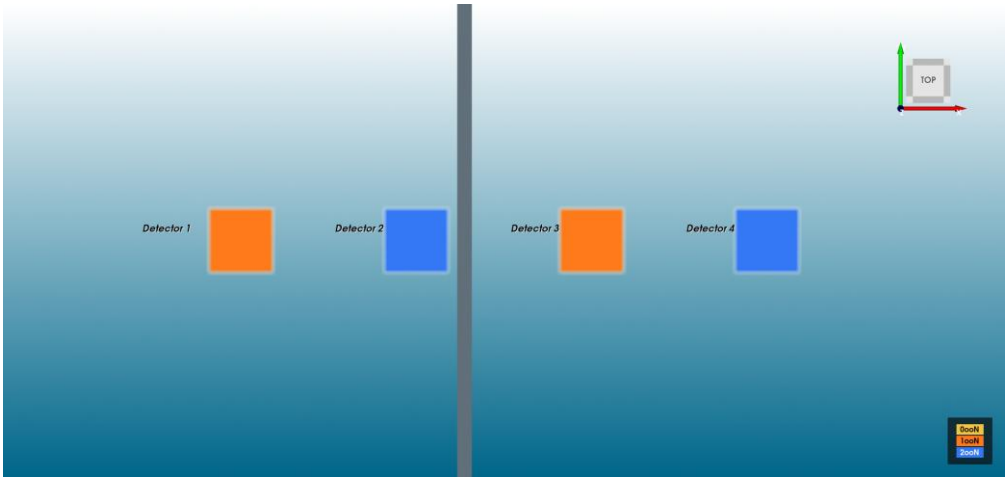
View 2 - H



View 3 - H



View 4 - H



Slice Plot - XY @ 1

1.3.5 Four detectors covering four small cubical Risk Grades in a row, with a solid plank blocking the view of the third detector between the third and fourth Risk Grade (coverage checked for one, two and three detectors) - Field of View: 120°, Range: Low 50 m / High 45 m

Risk Grades

Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 1 m, Width 1 m, Height 1 m	Risk Grade C
Cube	Length 1 m, Width 1 m, Height 1 m	Risk Grade D
Cube	Length 1 m, Width 1 m, Height 1 m	Risk Grade A
Cube	Length 1 m, Width 1 m, Height 1 m	Risk Grade B

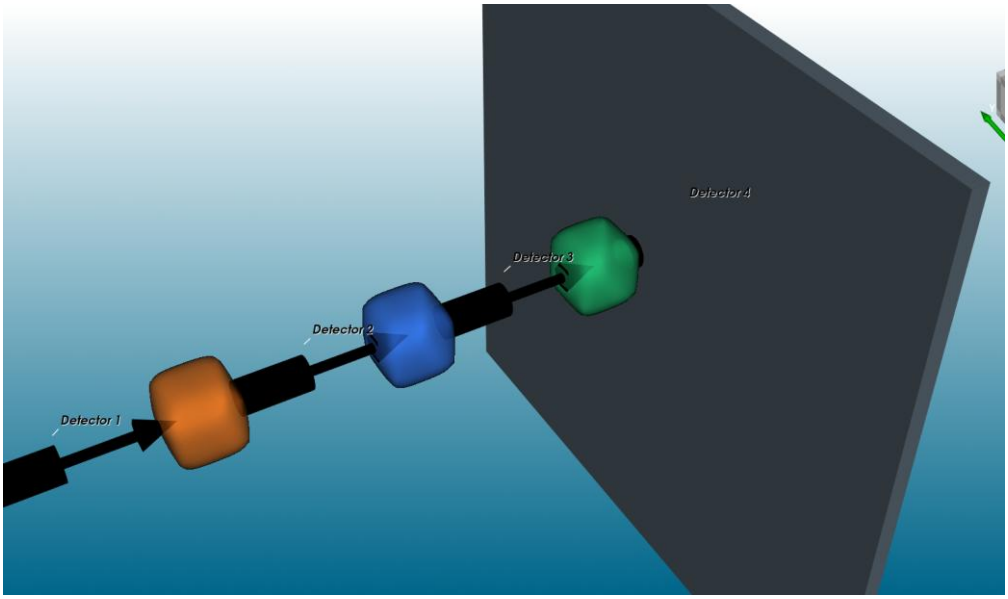
Fire Detectors

Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
120°	120°	0	Risk Grade C - Low 50 m / High 45 m Risk Grade D - Low 50 m / High 45 m Risk Grade A - Low 50 m / High 45 m Risk Grade B - Low 50 m / High 45 m	0°	0°
120°	120°	0	Risk Grade C - Low 50 m / High 45 m Risk Grade D - Low 50 m / High 45 m Risk Grade A - Low 50 m / High 45 m Risk Grade B - Low 50 m / High 45 m	0°	0°

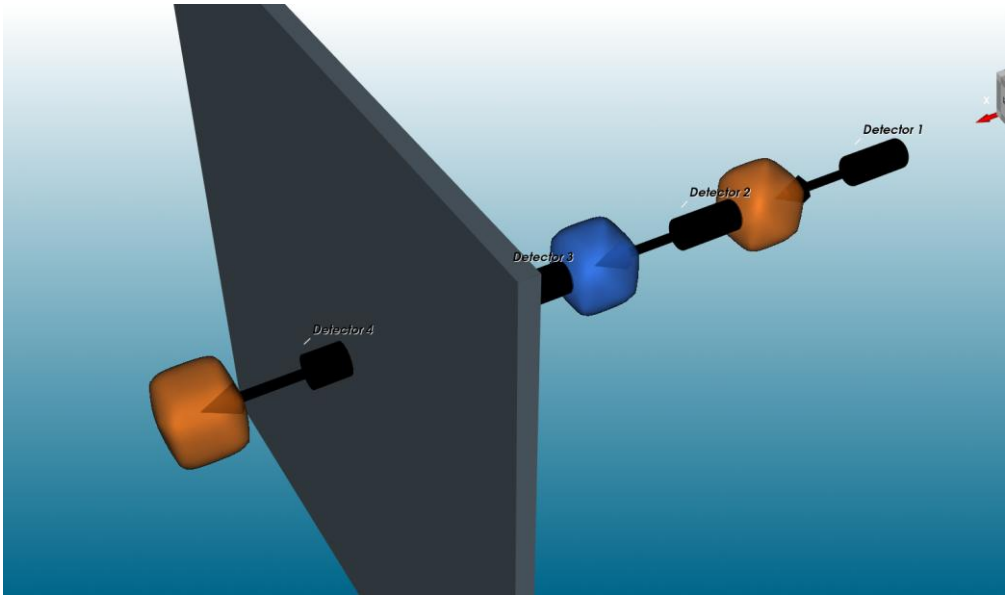
Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
120°	120°	0	Risk Grade C - Low 50 m / High 45 m Risk Grade D - Low 50 m / High 45 m Risk Grade A - Low 50 m / High 45 m Risk Grade B - Low 50 m / High 45 m	0°	0°
120°	120°	0	Risk Grade C - Low 50 m / High 45 m Risk Grade D - Low 50 m / High 45 m Risk Grade A - Low 50 m / High 45 m Risk Grade B - Low 50 m / High 45 m	0°	0°

Coverage Results

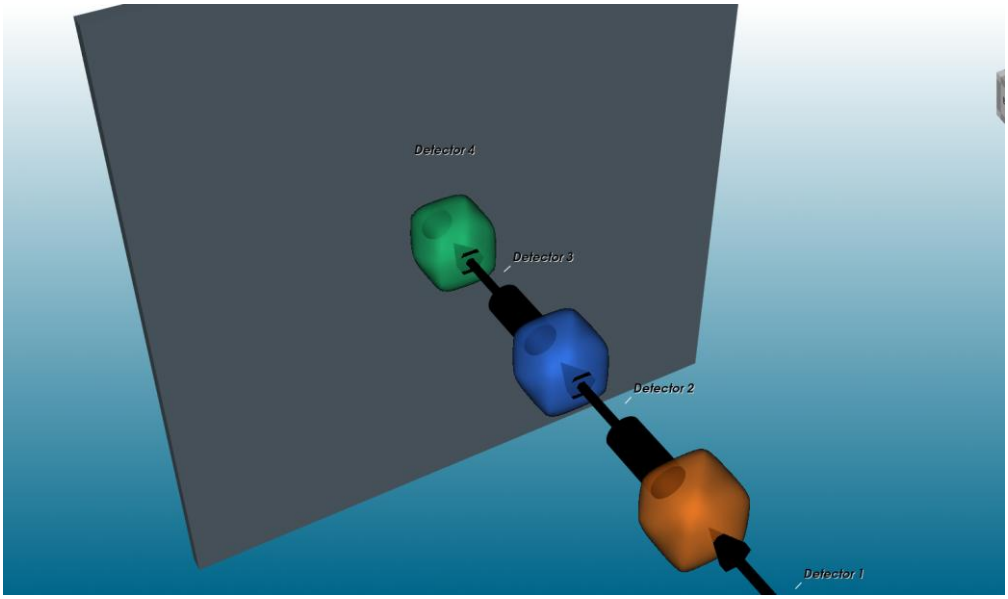
Risk Grade	Voting Logic	Alarm Setting (Low / High)	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade C	1ooN	L	100	100	0.00
Risk Grade D	2ooN	L	100	100	0.00
Risk Grade A	3ooN	L	100	100	0.00
Risk Grade B	1ooN	L	100	100	0.00
Risk Grade C	1ooN	H	100	100	0.00
Risk Grade D	2ooN	H	100	100	0.00
Risk Grade A	3ooN	H	100	100	0.00
Risk Grade B	1ooN	H	100	100	0.00



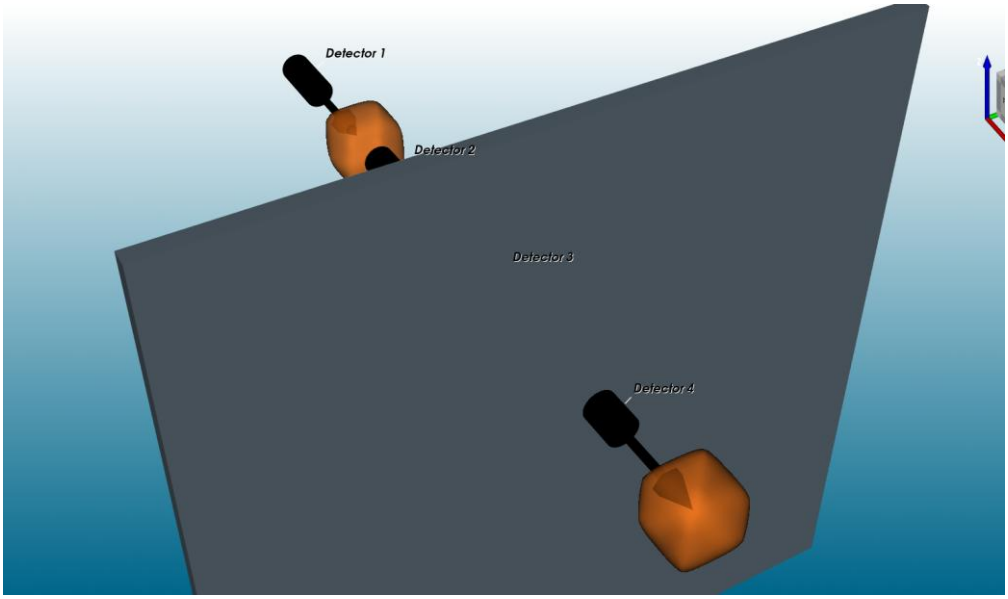
View 1 - L



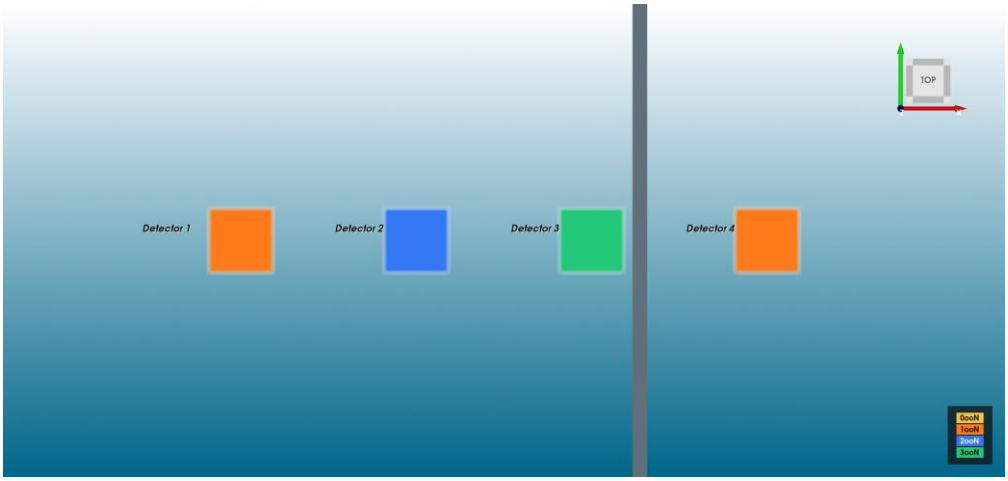
View 2 - L



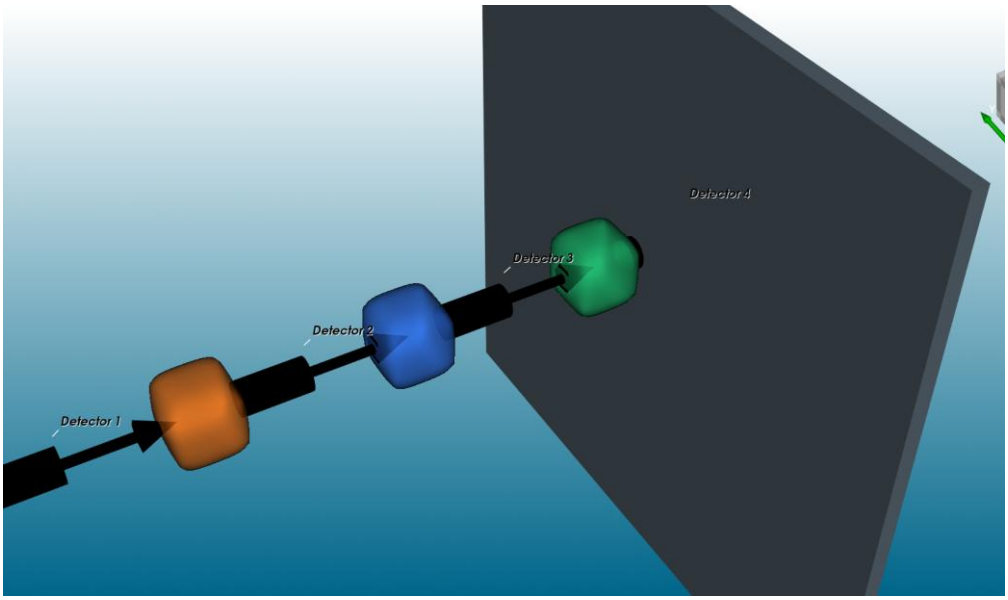
View 3 - L



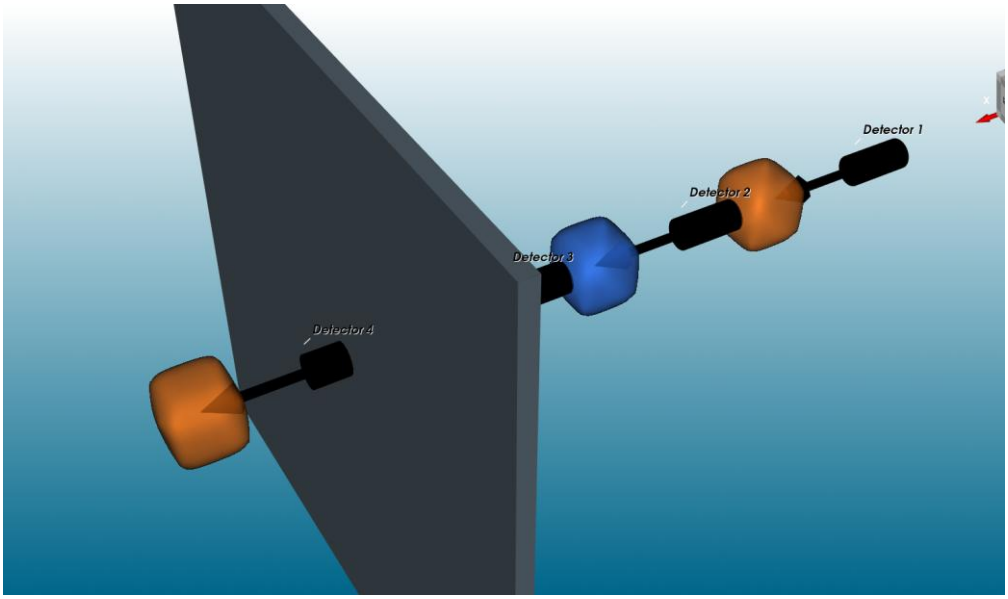
View 4 - L



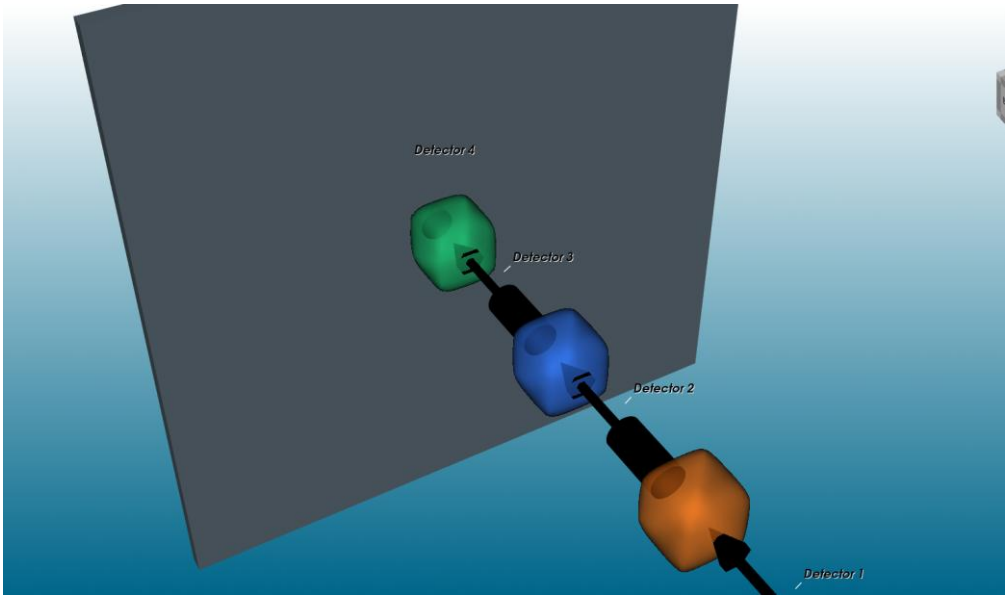
Slice Plot - XY @ 1



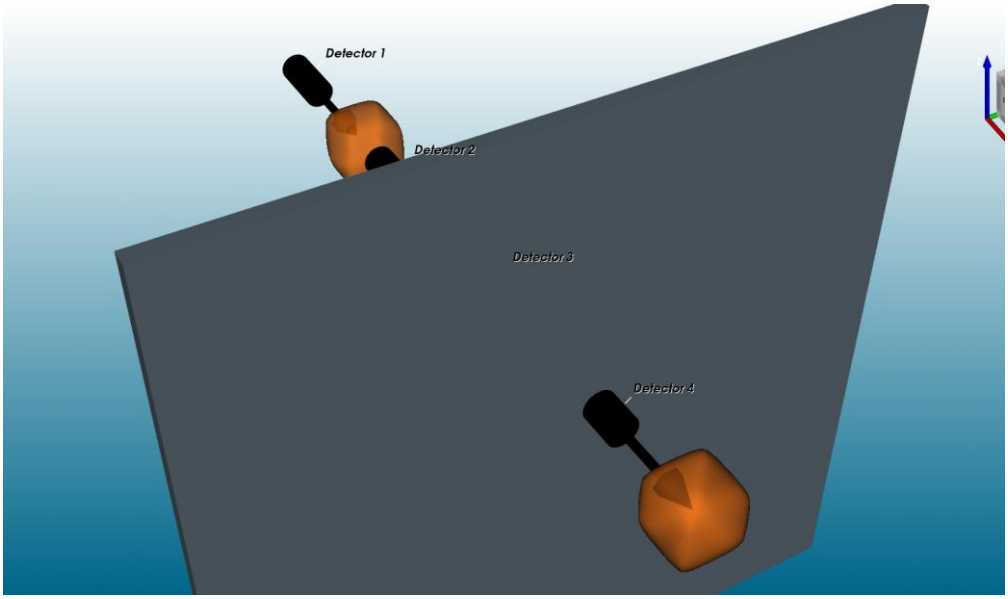
View 1 - H



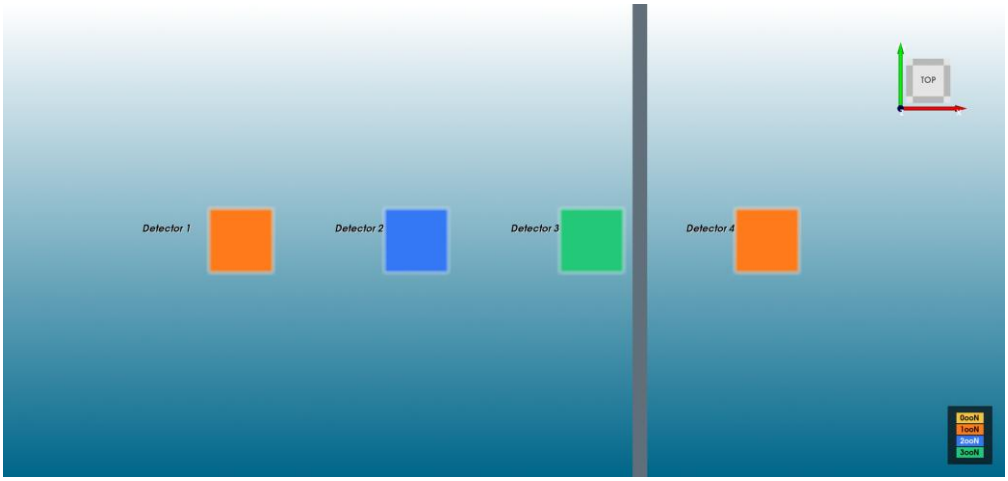
View 2 - H



View 3 - H



View 4 - H



Slice Plot - XY @ 1

1.3.6 One detector placed above the center of four cubical Risk Grades of different types arranged in a square - Field of View: 90°, Range: Risk Grade D Low 8 m / High 6 m; Risk Grade C Low 12 m / High 10 m; Risk Grade A Low 16 m / High 13 m; Risk Grade B Low 20 m / High 17 m

Risk Grades

Risk Grade Geometry	Dimensions	Risk Grade Type
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade D
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade C
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade A
Cube	Length 20 m, Width 20 m, Height 20 m	Risk Grade B

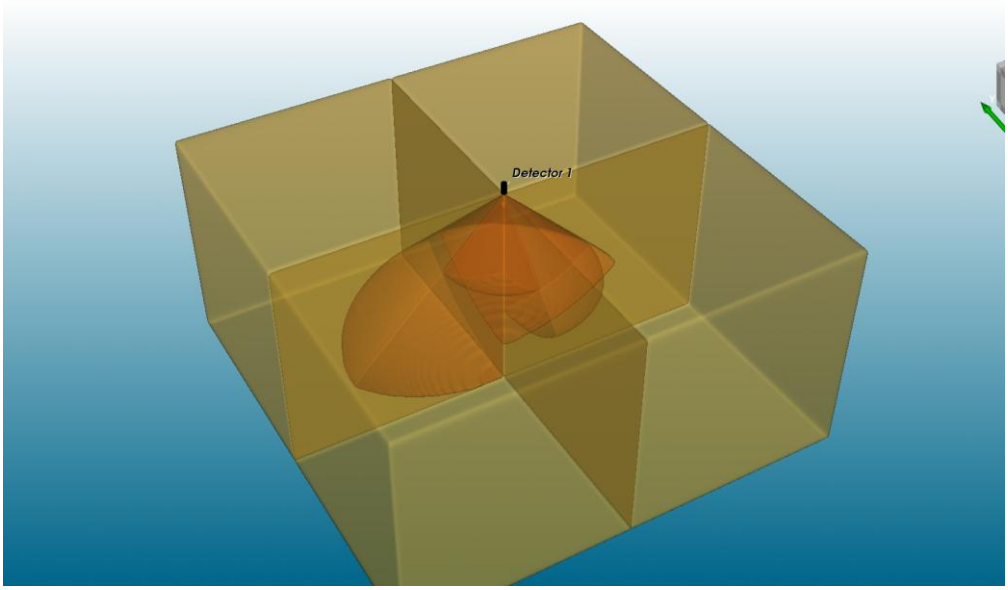
Fire Detectors

Horizontal Field of View (FOV)	Vertical Field of View	Curvature	Range	Vertical Tilt	Horizontal Tilt
90°	90°	0	Risk Grade D - Low 8 m / High 6 m Risk Grade C - Low 12 m / High 10 m Risk Grade A - Low 16 m / High 13 m Risk Grade B - Low 20 m / High 17 m	270°	0°

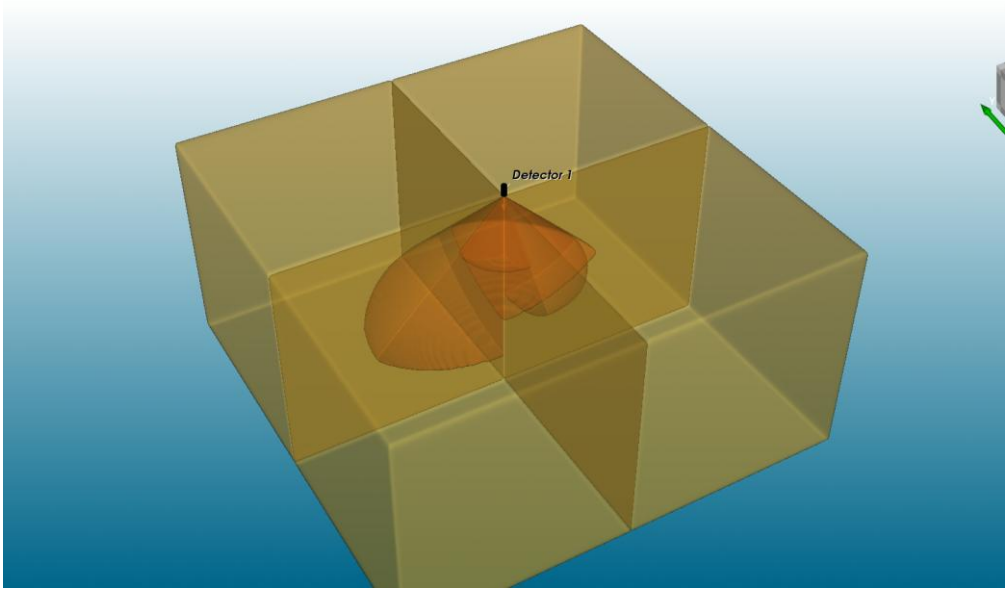
Coverage Results

Risk Grade	Voting Logic	Alarm Setting (Low / High)	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade D	1ooN	L	0.98	0.99	0.01
Risk Grade C	1ooN	L	3.31	3.31	0.00
Risk Grade A	1ooN	L	7.85	7.79	0.06
Risk Grade B	1ooN	L	15.33	15.15	0.18
Risk Grade D	1ooN	H	0.41	0.42	0.01
Risk Grade C	1ooN	H	1.92	1.92	0.00

Risk Grade	Voting Logic	Alarm Setting (Low / High)	Analytical Coverage (%)	Software Coverage (%)	Deviation (percentage points)
Risk Grade A	1ooN	H	4.21	4.2	0.01
Risk Grade B	1ooN	H	9.42	9.33	0.09



View 1 - L



View 1 - H