MICROPACK FIRE & GAS
A Consilium Group Company

BS60080:2020 HAZARD DETECTION ASSESSMENT

HAZARD ASSESSMENT TYPE:

FLAME DETECTION

WASTE RECYCLING FACILITY

Client Information

CLIENT:	Name
SITE NAME:	Site
CLIENT CONTACT:	+000000 000000
EMAIL ADDRESS:	name@micropack.co.uk
TELEPHONE NUMBER:	+000000 000000

Report Information

REPORT AUTHOR:	Name
REPORT REFERENCE:	Reference
REVISION:	Revision Number
ECN:	Number
DATE:	05/05/2020

Micropack Consultant Signature

Signature Here

If there are any questions relating to this review, please contact a member of the team using the contact details below.

MICROPACK (Engineering) Ltd
Fire Training Centre, Schoolhill, Portlethen, Aberdeen AB12 4RR
T: +44(0)1224 784055 **E:** info@micropack.co.uk
www.micropackfireandgas.com

Visual Flame Detection
Multi Spectrum Flame Detection
Fire & Gas Consultancy
3D Fire and Gas mapping software

Registered in Scotland No. SC170022

Table of Contents

Area Description / Hazard Analysis

The waste disposal site receives and sorts waste before sending it on for recycling or landfill.

The principal fire hazard(s) in the building considered during the detector selection and layout design process is/are:

1. Spontaneous ignition of the unsorted or sorted trash pile resulting from the inclusion of inappropriate materials / hazardous waste (i.e., batteries)
2. Mechanical / Electrical Fires (i.e., the trommel, and the conveyor system.)

Special risk fuels and fires that cannot be detected by certain types of detectors (i.e., highly pure methanol, MEG, TEG, and hydrogen) are not expected to be present or to occur on this site.

The hazard analysis and mapping methodology used is in line with **BS60080:2020/ISA TR 84.00.07 guidance**. See **Appendix B** for more information.

Summary of Flame Detector Coverage Recommendations

Layout	Detector Count	Full Alarm (1ooN*) Coverage	Delayed Alarm (1ooN) Coverage	No Coverage
Option 1 (FDS300)	5	97%	-	3%

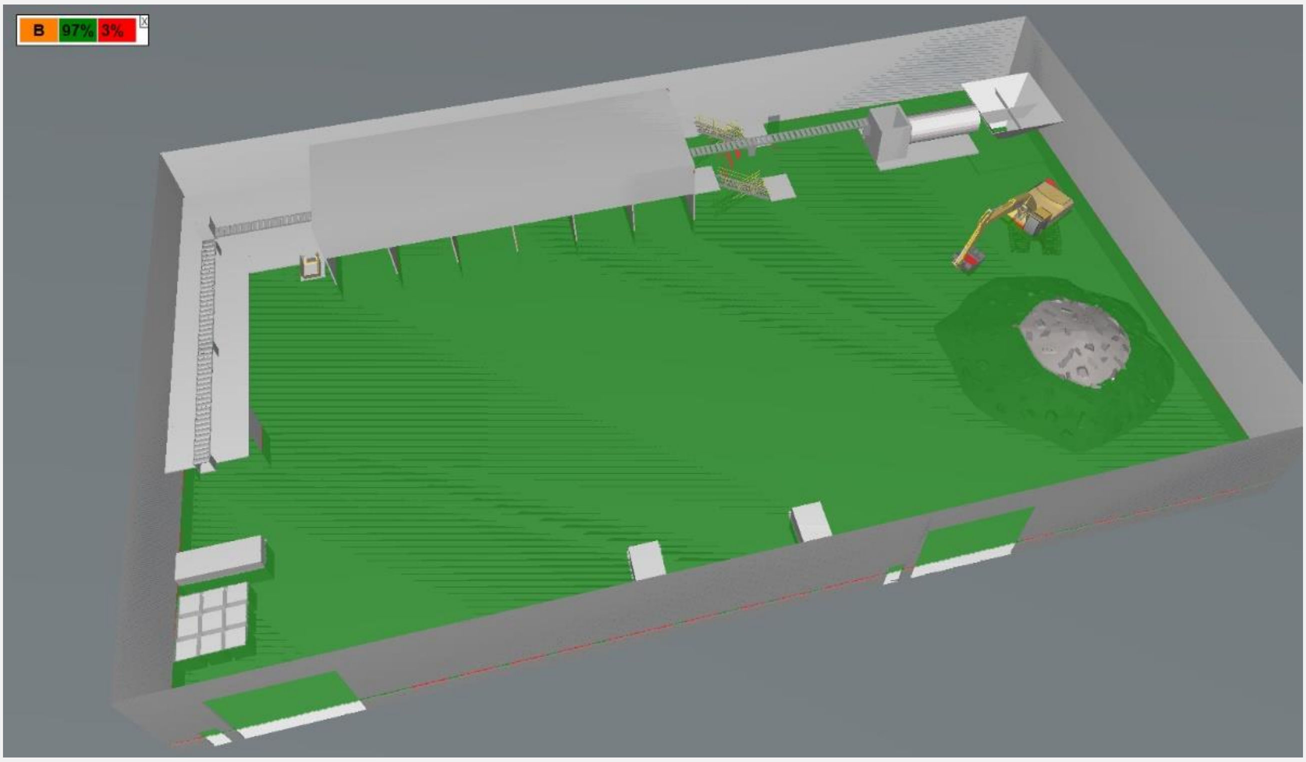
*1ooN: One out of the total number of detectors (N) is required to detect the fire – as opposed to other voting strategies that require multiple concurrent alarm signals.

Recommended Flame Detector Layout Details

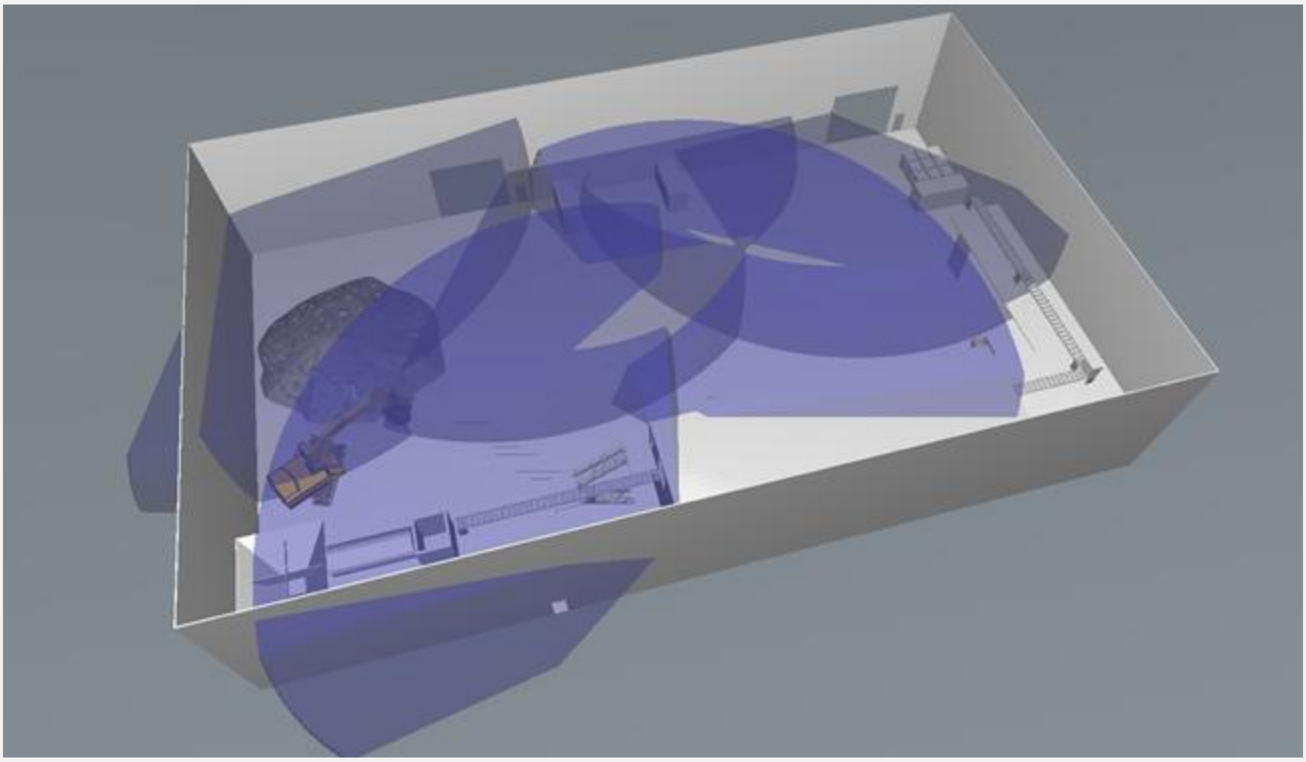
Tag No	Detector	Technology	Co-ordinates (m)			Pan	Tilt
			X	Y	Z		
De01	Micropack FDS300	iVFD	90.995	41.254	4.00	-170	25
De02	Micropack FDS300	iVFD	75.253	65.869	4.00	-120	25
De03	Micropack FDS300	iVFD	63.268	84.438	5.00	-105	25
De04	Micropack FDS300	iVFD	54.228	46.408	2.00	-15	25
De05	Micropack FDS300	iVFD	47.428	42.135	2.50	75	25

MICROPACK (Engineering) Ltd
Fire Training Centre, Schoolhill, Portlethen, Aberdeen AB12 4RR
T: +44(0)1224 784055 **E:** info@micropack.co.uk
www.micropackfireandgas.com

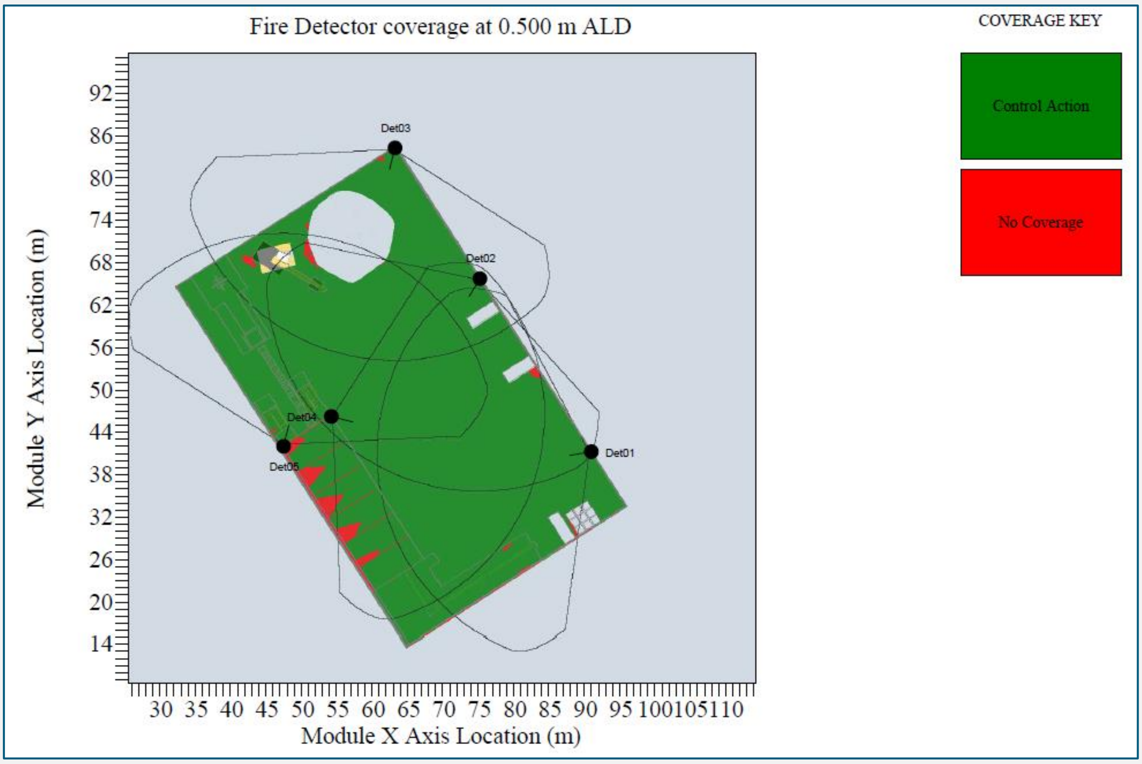
Flame Detection Coverage – **HazMap3D** Assessment



Flame Detection Layout – **HazMap3D** Layout



Recommended Flame Detection Layout – 2D Plot Plan



Assessment Colours Guide

Assessment Colors for Flame Detection		Assessment Colors for Gas Detection	
Green	Area where coverage fully meets the graded alarm and control action requirements.	**Green**	Area where the graded alarm and control action requirements are fully met. In methodologies which test only detector spacing this indicates that the point is close enough to a detector to satisfy the spacing requirement.
Yellow	Area with sufficient coverage for control action but alarms will be late/delayed while the fire escalates.		
Orange	Area with alarm coverage from at least 1 detector, but does not have the coverage necessary for control action.	**Orange**	Area which have alarm coverage from at least one detector, but the voting target for control action is not achieved. Cannot occur with methodologies in which spacing is the only assessment criterion.
Brown	Area wherein the target fire size cannot be seen by any detector, but larger fires can be seen by one device.		
Red	Area with no coverage (based on selected methodology).	**Red**	Area with no coverage (based on selected methodology).

Consultant Notes

Adding **1 additional flame detector** can increase the alarm coverage by X%. A new layout and assessment can be created if desired.

MICROPACK FIRE & GAS
A Consilium Group Company

Appendix A: Flame Detector Effective Viewing Distance

The following method is applied to calculate the effective viewing distance of a flame detector (D).

D is the effective viewing distance calculated from parameters X, F1, F2, and F3, as follows:

$$D = X \times F1 \times F2 \times F3$$

1. X = Specified detection distance for a 1 ft² (0.1 m²) n-heptane pool fire (approximately 40 KW RHO) under ideal FM 3260 conditions at the chosen sensitivity setting, if applicable, and to give the required response time. This distance can be obtained from the detector specification, manual, or FM 3260 (Ref 25) test report.
2. F1 = Factor representing a reduction in sensitivity to genuine flame in the presence of unwanted stimuli. From the detector manual or, otherwise, from the detector manufacturer, obtain the detection distances at the chosen sensitivity setting for the **FM 3260 tests for a 1 ft² (0.1 m²)** n-heptane pool fire in the presence of the following false alarm sources:

    - **A:** Sunlight (direct, modulated, reflected). ***(Triple Weighted)***
    - **B:** Arc Welding
    - **C:** 6 kW heater, modulated at 24.4m (80 ft) at 3 m (10 ft).
    - **D:** 300 W incandescent lamp, modulated at 0.9 m (3 ft).
    - **E:** 500 W shielded quartz halogen lamp, modulated at 2.4 m (8 ft).
    - **F:** 500 W unshielded quartz halogen lamp, modulated at 2.4 m (8 ft).
    - **G:** 250 W vapor lamp modulated.
    - **H:** Two 34 W fluorescent lamps modulated.

Note: For most of the variables the radiation source is expected to be modulated / "chopped." For sunlight, the value can be modulated OR unmodulated. Modulated sunlight often has a far more severe impact on detector performance than Unmodulated sunlight. In the case of some MSIR detector, unmodulated sunlight degrades performance by 70% (30% effective), while modulated sunlight degrades performance by 85% (15% effective)

3. Take the average detection distance (Dav) from these eight tests with a weighted factor of 3 for the sunlight test. This means adding the 8 distances plus twice the sunlight test distance and dividing by ten.

$$D_{av} = \frac{3 * A + B + C + D + E + F + G + H}{10}$$

$$F1 = \frac{(X + D_{av})}{2}$$

Note: There are different approaches in the industry for dealing with missing/unavailable data when performing this calculation. Some operators will remove that false alarm source/variable from the equation when the number is unavailable. Some will substitute a value of 0 for the missing variable - penalizing the detector/manufacturer for not making the information available or not performing the test. If this more punitive approach is used, and no data is available, then Dav will go to zero and F1 will go to 0.5 - which is the minimum value F1 can assume. Some will substitute values from similar detectors for which data is available.

4. F2 = Factor representing a reduction in sensitivity due to dirty optics. Determine from the detector specification or instruction manual the fraction of maximum detection distance at which the dirty optics fault alarm occurs. F2 is the midpoint between this fraction and 1. Thus, if the dirty optics alarm is initiated at 60% of the maximum distance, F2 will be 0.8.

5. F3 = Factor representing a reduction in sensitivity across the claimed field of view from the maximum at the centreline. A default value of 1.0 should be used unless a different value is justified from analysis of the detector field of view diagrams for horizontal and vertical planes.

Micropack FDS300 intelligent Visual Flame Detector

X	60 m
F1	0.95[1]
F2	0.95[2]
F3	1.0[3]
D	60 *0.95*0.95*1.0
D	**54.15 m**
Sensitivity	**90.25%[4]**

Note:

1. Internal and independent testing has shown that the false alarm sources considered in the calculation of F1 do not degrade the performance of the FDS300. It still detects 1 ft by 1 ft n-heptane test fires at 60 m when exposed to these false alarm sources / desensitizing stimuli. However, Micropack still derates the detector by 5% in assessments to be conservative.

2. Micropack has demonstrated internally and in independent tests that things like salt build-up on the front optics (in offshore applications) and things like dirt, grime, and grit build-up have minimal, if any, impact on the performance of the FDS300 unless that build-up becomes extremely heavy/severe. However, Micropack still derates the detector by 5% in assessments to be conservative.

3. HazMap3D automatically accounts for F3 by showing the 3D FOV cone and thereby accounting for off-axis sensitivity losses.

4. HazMap3D requests that sensitivity is specified as a whole number percentage, so 90% is used.

Appendix B: Flame Detection Assessment Methodology

Applying Grades

Where a fire risk has been identified, we apply a grade to the area, which defines the size of the fire to be covered by the recommended flame detectors.

Viewing Distances & Coverage Factors

Graded areas shall employ the maximum detector viewing distances as detailed below. Performance specification for each of these gradings defines the maximum viewing distances (expressed as D or multiples of D) for flame detectors placed to cover these hazards/ graded areas. D is the effective viewing distance calculated from specified detection distance to 1 ft^2 n-heptane pool fire incorporating reduction in sensitivity to genuine flame in the presence of desensitizing factors (Refer to Appendix A)

Table 1: Flame detection maximum viewing distances.

Grade	Maximum Viewing Distance for Alarm Coverage	Maximum Viewing Distance for Delayed Alarm Coverage
Fire Grade	1.5D	3.0D

Target Fire Sizes

Alarm: 1.5D (~100 kW RHO or approximately twice the size of the standard 1 square foot heptane test fire)

Delayed Alarm: 3.0D (~400 kW RHO or approximately 8 times the size of the standard 1 square foot heptane test fire)

See **Appendix A** for calculation of detector effective viewing distance for the FM3260 test fire, D.

The percentage coverage required is based on engineering judgment of the area hazards and the benefit of detection. This is the coverage the flame detector provides of the graded areas and includes the loss of view from obstructions and lack of coverage for any other reasons. Additional detection should be considered if the coverage is not deemed adequate.

Application within Software

For this project, Micropack's own 3D mapping software HazMap3D has been utilized. The 3D model used has been supplied by the client/created by Micropack.

The flame detectors are represented as three-dimensional cones depicting each detector's field of view, with any obstructions reducing this correspondingly Figure 1. This 'footprint', as this file is called, is then represented based upon the detector manufacturer's information, and equated to the required detection distance for each grade.

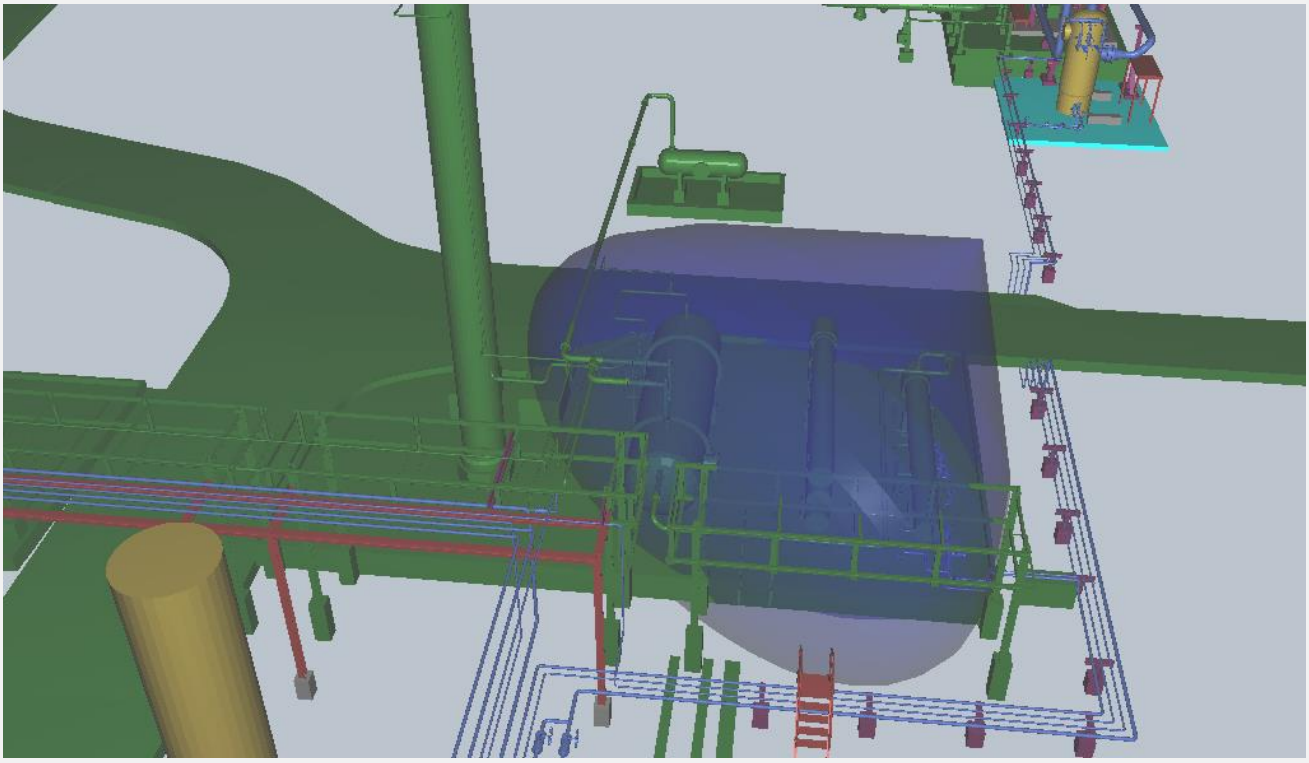


Figure 1: Flame detector footprint.

The transparent purple cone is the field of view of a detector 1.0D, which is calculated in Appendix A in response to a 40kW n-heptane pool fire. Surrounding this core are other cones that correspond to the required detection distance and fire size (kW); however, these are invisible within the model UI to decrease the processing time and produce a manageable amount of information on the screen for the user. For voted control action coverage to be achieved, two or more flame detectors need to have overlapped transparent cones of the appropriate size.

Note: The FOV cones visible are a depiction of a reference detection range to which the detection distance is calculated, typically 1.0D. The field of view visible on the assessments should therefore not be assumed to be the total range of the detector.

As determined using the performance target specification procedure, each area has been graded according to its local hazards and escalation risks. This information is stored in a 'Grade map' file. This Grade map is essentially the area that requires to be seen by the flame detector, Figure 2. A custom software system then 'overlays' each relevant detector's footprint onto the Grade map and, using a truth table, constructs a graphical image of the coverage afforded by the area's detectors.

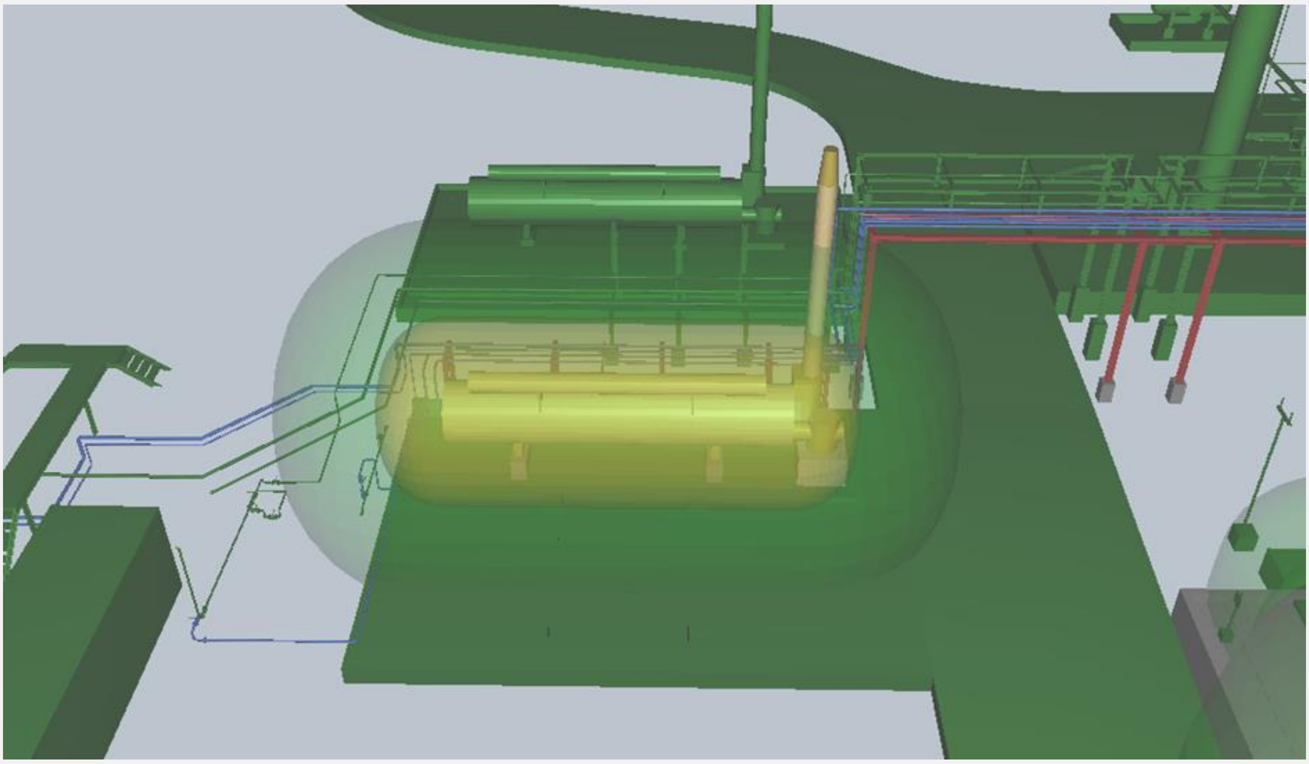


Figure 2: Picture depicting the fire grade map within the software.

The finished graphical file is known as the 'assessment' file (this is presented in the report) and provides an objective estimate of that area's flame detection coverage. If the coverage is adequate no additional detection is required and optimization/ removal of detectors is explored. If they are not met, then the addition of and/or the relocation of devices is explored. Note, however, that adequacy (or otherwise) of an area's detection still requires engineering judgment. The results of the mapping assessment must be interpreted in the light of the surveyor's knowledge of the area to arrive at an assessment of adequacy.

Voting Configuration

Different voting strategies are used on different sites depending on risk level, likelihood of spurious alarm, and desired executive actions.

1ooN: One out of the total number of detectors (N) is required to detect the fire – as opposed to other voting strategies that require multiple concurrent alarm signals.

2ooN: At least Two out of the total number of detectors (N) are required to detect the fire simultaneously.