Bacton Review

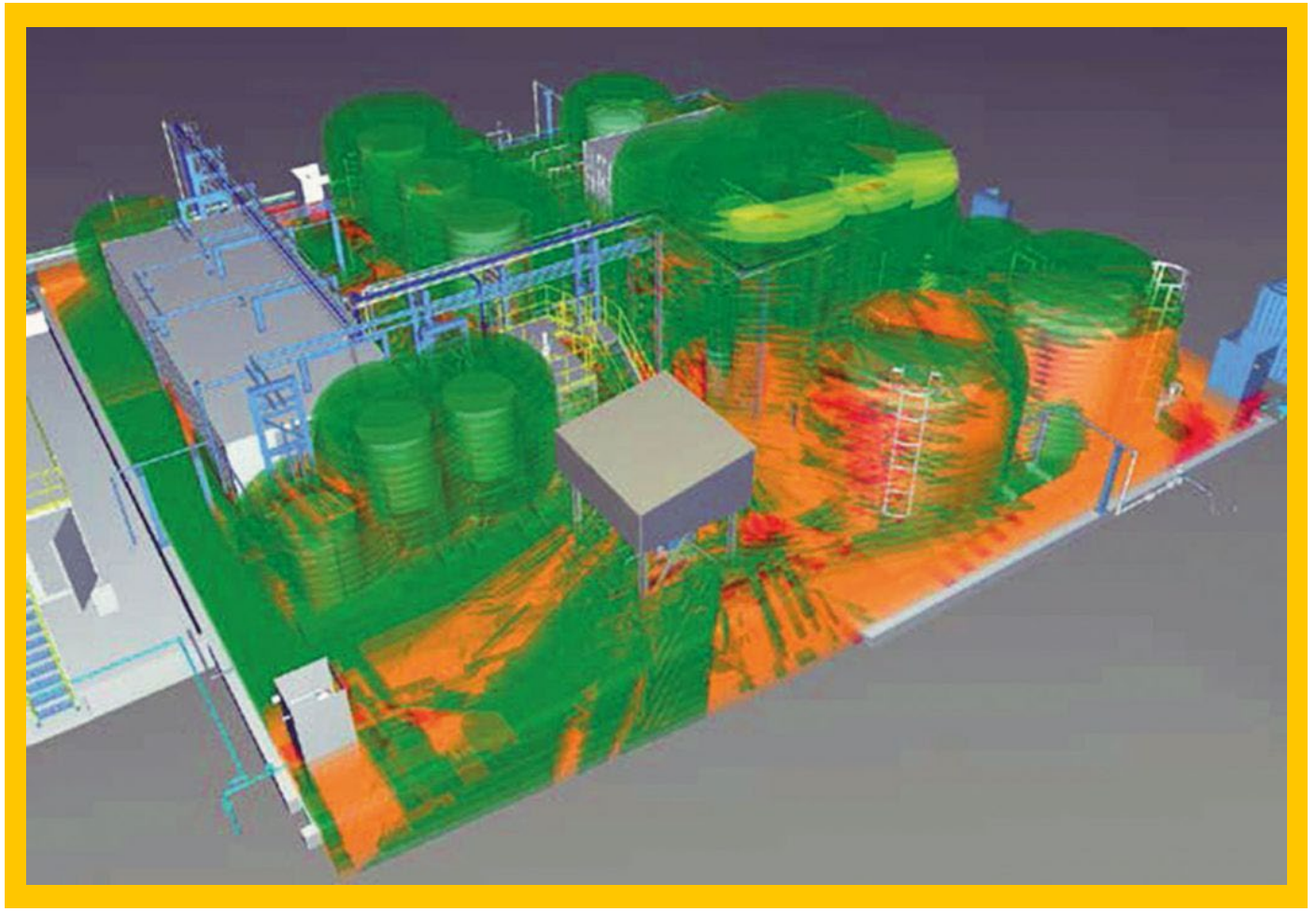
Fire & Gas Mapping Optimisation Project

Charlie Bradshaw
Internship
Odgen Trust

EEEGR
EAST OF ENGLAND ENERGY GROUP

Contents

- Introduction
- Fire Detectors
- Gas Detectors
- Maintenance
- False Alarms
- Health & Safety Regulations
- BBL Site
- Coverages & Adjustments
- My project Recommendations
- Conclusion



Introduction

This presentation is a review of my project studies into fire and gas detector coverage at the Shells site in Bacton. It will go into depth about current detector systems that the site currently use along with potential future investments into new devices.

This presentation shows my recommendations for where I feel there are oppitunites to enhance the detection functions.

https://tse2.mm.bing.net/th/id/OIP.8yHCRHv6IDbIO -99jEu1kQHaEL?r=0&rs=1&pid=ImgDetMain&o=7&rm=3

Gathering Information

- To gather information about fire and gas mapping, I went on many site visits and tours showing how the overall process works at Bacton and offshore sites.

- I experienced work at Bacton, through watching certain process happen and being able to experience employees' complete tasks on site involving maintenance. Furthermore, I experienced a vessel tour through how staff live on the vessel (Kroonborg), how they travel to offshore platforms along with how equipment and goods was delivered across to the platforms.

- Finally, I met many different Engineers who told me there own experienced and what job role they were working in. This allowed me to gather many different aspects and views of the gas industry showing me all the other sectors within this industry.

Fire Detectors Research

UV Flame Detector

- This device works through a flame emitting ultraviolet (UV) light. The UV flame detector will contain a UV sensor that is sensitive to UV radiation. This radiation will be emitted by a fire allowing the device to detect it. This enables a fast and quick response sent back to the control room.

- In most situations the UV sensor will filter out any other light sources (natural or artificial light), but potential other light sources may trigger a false alarm.

https://th.bing.com/th/id/R.1eed82a7a4403dd80f28a8b932e288d5?rik=RkVFKNLtUGcQdA&pid=ImgRaw&r=0

Single Frequency IR Flame Detector

- Commonly used for facilities that process hydrocarbon gas or liquids, fires or other fuels, such as hydrogen or methanol. (Which may be impossible for the sensor to see or very poorly detected).

- The device works through the pyro-electric detector responding to changes in IR radiation and will be sensitive between 2 to 20 meters.

https://th.bing.com/th/id/R.8f8917b85750b2b13e20921ce27e677f?nik=xT8poVC4Nvs4XQ&riu=http%3a%2f%2fproduct.autronicafire.com%2fileshare%2fcache%2f0_0_False_False_1_85__fileshare_flarkivroot_produkt_bilder_AutroFlame_X33AF_SS_jpg.jpg&ehk=GALYQ%2bkDRUr8C32vBEgldPpeVISEmfkJy5R2k9OCy8%3d&risl=&pid=ImgRaw&r=0

Multi Frequency IR Flame Detector

- These devices will use multiple IR sensors to help reduce false alarm activations. This is through a large number of variants available for different sensitivities of fuels types (such as hydrogen).

- To determine a fire, the device will look for relationships between signals of each sensors. If mostly all the relationships are similar and are signalling, there is a possible fire. A signal will be sent to the control room allowing for procedures to be carried out.

- However, water can unbalance the relationships causing false alarms or making the devices unable to detect incidents.

https://www.nexinstrument.com/assets/images/X3301A4N14T2 -01.jpg

Visual Imaging Flame Detector

- This device will process live video images to detect for hydrocarbon flames. It will utilise digital signal processing and flame detection algorithms.

- Once they detect the hydrocarbons it will transmit a signal back to control room allowing them to carry on with protocol to prevent the fire from becoming more dangerous.

- However visual flame doesn't respond to or detect flare reflections. (Flare reflections is an image that occurs when light scatters of flares within a lens system.)

https://apfmag.com/wp -content/uploads/2021/01/APF76_Jan21_Detection_GD_2 - 770x864.png

My Research Assessment Judgement

	Response Speed	False Alarm Immunity	Outdoor Suitability	Detection Range	Maintenance Requirements	Relative Cost	Total
UV Flame Detector	Very Fast	Low to Moderate	Fair	Short to Medium	Low	Low	14
Single Frequency IR Flame Detector	Fast	Moderate	Good	Medium	Low	Low to Medium	15
Multi Frequency IR Flame Detector	Fast	Very High	Excellent	Long	Low to Moderate	High	17
Visual Flame Detector	Moderate to Fast	High	Good	Long	Moderate to High	High	13

Rating	Colour	Score
Excellent		4
Good		3
Decent		2
Poor		1

- There are multiple flame detectors at Bacton, but the main one is visual flame detectors in the BBL site.

Gas Detectors Research

Catalytic Bead Gas Detector

- Mainly used in older installations and is no longer approved by the HSE.

https://www.lavastica.com/wp -content/uploads/2024/04/Det -TronicsCGS-430x430.jpg

- This device will burn gas and measure the temperature rise in a sensor. Beads are electrically heated platinum wire coil. Gas diffuses through a sintered disk and a combustible mixture passes over the hot catalyst surface. Combustion then occurs, heat involved increases the temperature of the bead. Resistance is measured using the coil as the temperature thermometer standard bridge circuit.

- They are used to detect non-hydrocarbon gasses, for example hydrogen. However, the sensor may drift resulting in required regular calibration. The catalyst also may become poisoned as well, leading to failed response to gas.

Laser Open Path Gas Detector

- This device uses the addition of laser sensors to perform its function. This is conducted when physical contact between the laser and gas happen, which triggers the alarm to send a signal to the control room that a leak has occurred.

- This device has a very fast response times, they are very precise targeted detection immune to most contaminants, capable of ppm level detection and the laser diode is not affected by the sun.

- Having said that, these devices are extremely expensive and may have a limitation to path length.

https://tse3.mm.bing.net/th/id/OIP.Dpjf8DL1mAA5NynYsGMHewHaE8?r=0&w=600&h=400&rs=1&pid=ImgDetMain&o=7&rm=3

Point IR Gas Detector

- Infrared gas detection is based on the unique IR absorption pattern associated with hydrocarbon gas and vapour. These devices emit infrared radiation through a gas sample, the amount of light absorbed at specific wavelengths indicates the concentration of gas present.

- These devices typically have two beams, an active beam that passes through any gasses and a reference beam that does not interact with the gas.

- Space or congestion prohibits the use off open path detectors so point IR gas detectors can be supplemented in . It will also need the detection of spot flammability at a particular location which is required.

https://tqplc.com/wp -content/uploads/2023/02/gd133 -right.jpg

Ultrasonic Gas Detector (Modern Alternatives)

- This device detects gas leaks through sounds. This is due to when gas leaks it will emit an ultrasonic energy. This will be detected by the acoustic device and will notify the control room that it has detected a gas leak.

- This device does not require a line of site and can still function even if the release is dispersed.

- In spite of that, the device is heavily influenced by background noise , it cannot differentiate between air and hazardous gas and will depend on the gas flow rates to detect that sound.

Distran Ultra Pro - Protex Systems

My Research Assessment Judgement

	Response Speed	False Alarm Immunity	Outdoor Suitability	Detection Range	Maintenance Requirements	Relative Cost	Total
Cataylitic Bead Detector	Good	Moderate	Good	Localised	High	Low	14
Point IR Detector	Good	High	Excellent	Localised	Low	Moderate	17
Laser Open Path Detector	Good	Very High	Excellent	Tens to Hundreds of Meters	Low to Moderate	High	17
Ultrasonic Gas Detector (Acoustic)	Excellent	High	Excellent	Medium to Long Acoustic Coverage	Low	High	17

Rating	Colour	Score
Excellent		4
Good		3
Decent		2
Poor		1

- The main gas detection located on the BBL site are laser open path detectors (line of sight) and point IR gas detectors. There are some acoustic devices but are not as common as the others.

Investigation into Maintenance

Maintenance

- Maintenance is crucial to make sure all detection devices are performing their functions correctly.

- Each detection device will have its own specific maintenance routine.

- Firstly, maintenance with fire detectors.
  This table shows what maintenance is performed for specific types of fire detectors:

https://www.mengsolutions.com.au/wp -content/uploads/2023/10/blog -images-main-article10.webp

Detector Type	Maintenance Issue
UV/IR Flame Detectors	Function Testings
Line of Sight	Cleaning optics
High Sensitivity(All Detectors)	System testings

Maintenance

- Moving onto the maintenance of gas detectors, this is also a crucial step to ensuring safety to the site.

- Firstly, laser open path maintenance is fairly light as it does not need calibration, only a function checking. It isn't normally practical to use gas to test the open path detectors as it is difficult with optimal alignment and the volume of gas required may cause a hazard. So, a clear plastic film will absorb IR and is a convenient function test.

- Secondly, point IR gas detectors. Maintenance for these devices involve using test gas where air movements are slow or for areas like HVAC, special glass filters with an absorption that matches gas sufficiently well for a function test.

Understanding False Alarms

False Alarm stimuli

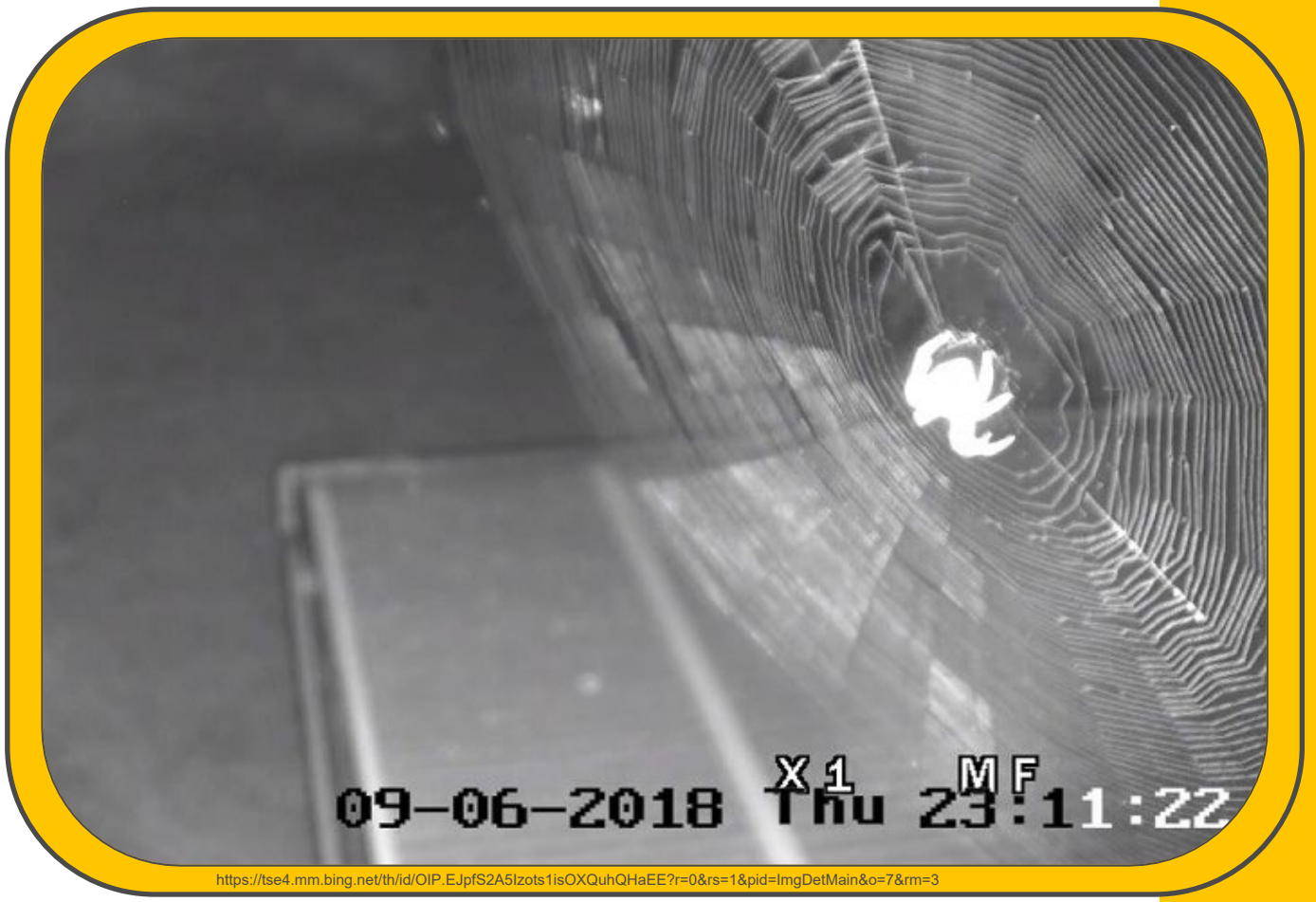
Firstly, **dust**. This stimuli is caused by the wind blowing dust particles onto the sensor lens not allowing a device to fully detect the coverage they are meant to.

This can lead to late alarms or no leaks detected causing a great danger to everyone in that environment. This can occur through the dry summer months, especially when Bacton is surrounded by fields which can produce crops through harvest.

False Alarm stimuli

Moving onto, **animals**. Animals such as spiders and birds may nest in these cameras.

Spiders are attracted to the heat the sensor gives off and will nest inside them cause false alarms to occur due to the movement and heat from the spiders. This has happened multiple times at Bacton.



https://tse4.mm.bing.net/th/id/OIP.EJpfS2A5Izots1isOXQuhQHaEE?r=0&rs=1&pid=ImgDetMain&o=7&rm=3

False Alarm stimuli

Furthermore, **sun glare** is another false alarm stimuli.

Sun glare is caused by the glare/reflection of oceans that direct the sunlight towards detectors.

https://as2.ftcdn.net/v2/jpg/04/39/68/33/1000_F_439683353_PdxfG6i16CVBGFJUp5qEblaWOJRkOW2e.jpg

This can cause devices to pick up false readings on gas detectors. This has a chance to also occur at Bacton due to its location near the sea.

False Alarm stimuli

Finally, **rain**. This stimuli is caused through rain coming into contact with the cameras and getting onto the screen.

This causes the sensor not to be able to pick up all the coverage posing a risk of the detector missing a potential fire or gas leak. Rain can also cause faults for the electronics as rain can damage this system causing the camera to malfunction.

Rain may also alter the sensors as the density of the rain can change the sensors reading.

Reducing False Alarms

There are only a handful of methods that can help control or reduce false alarm methods in fire and gas detection devices.

Firstly, correct maintenance. Ensuring all devices are frequently and correctly serviced to ensure that they do not malfunction and produce false alarms. This is a simple but effective method.

Secondly, installation of the correct technology. Ensuring the right device for that area is installed that fits the criteria met in the location it is given.

Finally, regular testing and monitoring. This method ensures the devices are monitored for any faults and are frequently tested to guarantee there are not faults that could detect false alarms.

Health & Safety Regulations Studied

BS EN 60079-29---Detection of Flammable Gases and Oxygen:

This regulation specifies in requirements, test methods and acceptance criteria for flammable, oxygen and toxic gas detection.

This will include all vapour and gas detectors, along with the alarms and signals it will process and give in detection of a gas or vapour.

https://i.pinimg.com/originals/95/76/68/957668a192a5c2f51fa0760538bbaed2.jpg

BS EN 45544 ---Detection of toxic gases and vapours:

This regulation is apart of a four -part multi -series standard that gives guidance on selection, installation, use of maintenance and electrical apparatus used for direct detection and direct concentration measurement of toxic gasses and vapours in the workplace atmosphere.

https://images - global.nhst.tech/image/VVJ4a1hENmpyYlJZb0c3Um90anA0VFFrUHhLQmlXTDJNWUdSM1diQXc3RT0=/nhst/binary/c6c7d9f2022e84a9ed5dba301fd6ba54

This regulation is applied to any devices that sounds indications or alarms to warn the presence of toxic gas in the area or that indicates protective protocols.

BS 5839---Fire detection and fire alarm systems:

This legislation is a fire safety standard that provides recommendations for the design, installation, commissioning and maintenance of fire detection and fire alarm systems in a non-domestic premises.

It serves as a code of practice rather than a requirement to install fire detection systems in any specific building.

Health & Safety

These regulations are all followed at Bacton allowing for safe operations to be carried out. They keep employees safe whilst at work and decreases the chances of dangerous events from occurring.

The health and safety regulations are not only put in for the safety of others but, also protect the plant allowing it to continue to generate money.

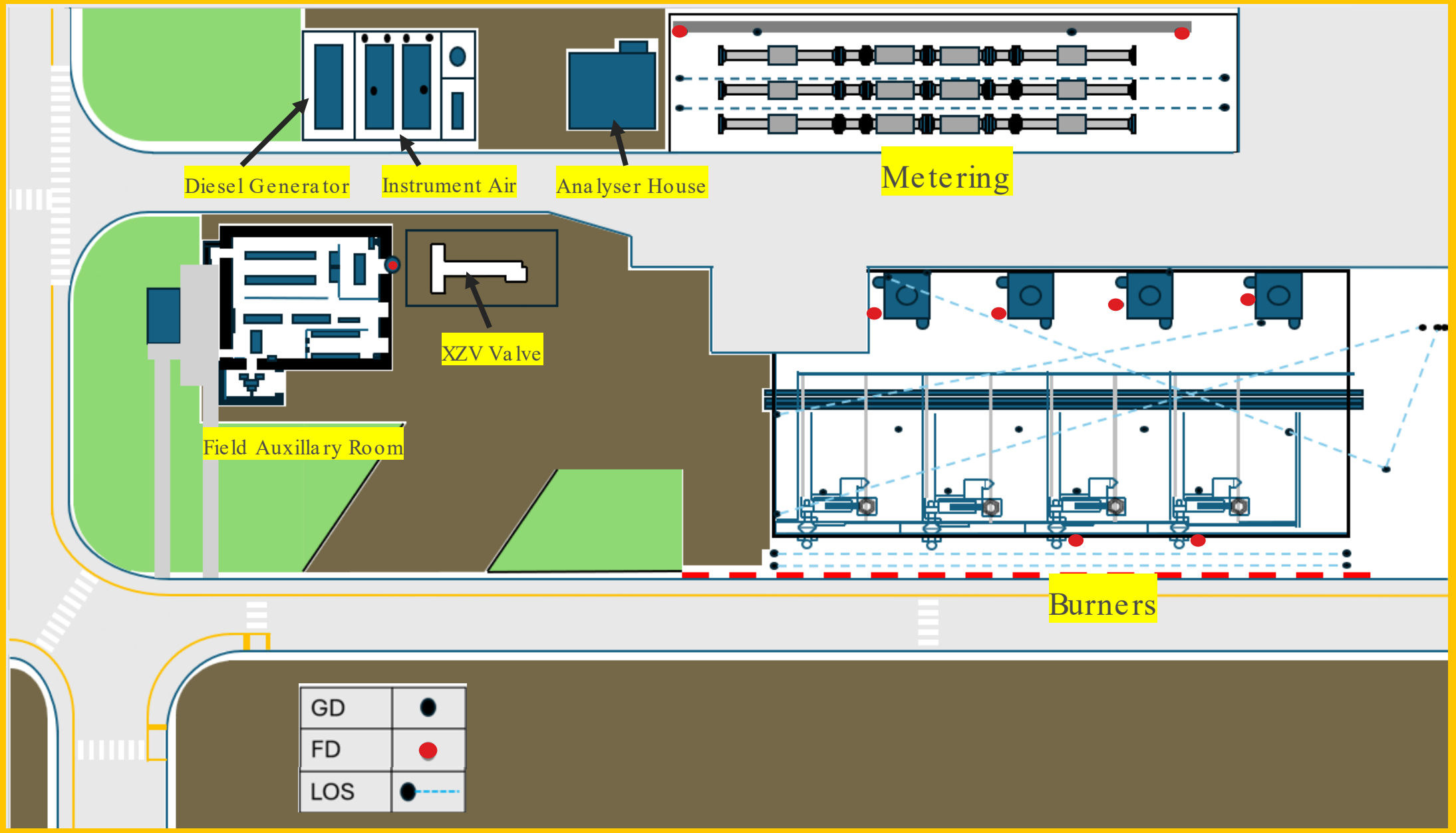
BBL Site Investigation

Locations

- There are multiple areas on the BBL site that need to be monitored for fire and gas leaks. All the areas on the BBL site are the burners, metering area, analyser house, diesel generator and instrument air units, auxillary room and the gas/ pig receiver.

https://static.vecteezy.com/system/resources/previews/068/705/286/non_2x/folded-map-with-red-location-pin-navigation-symbol-free-png.png

- These areas helps to transport gas to and from a site in Holland. It will process the gas and transport it over to national grid to distribute across the country. Gas can also be sent to Holland through this site.

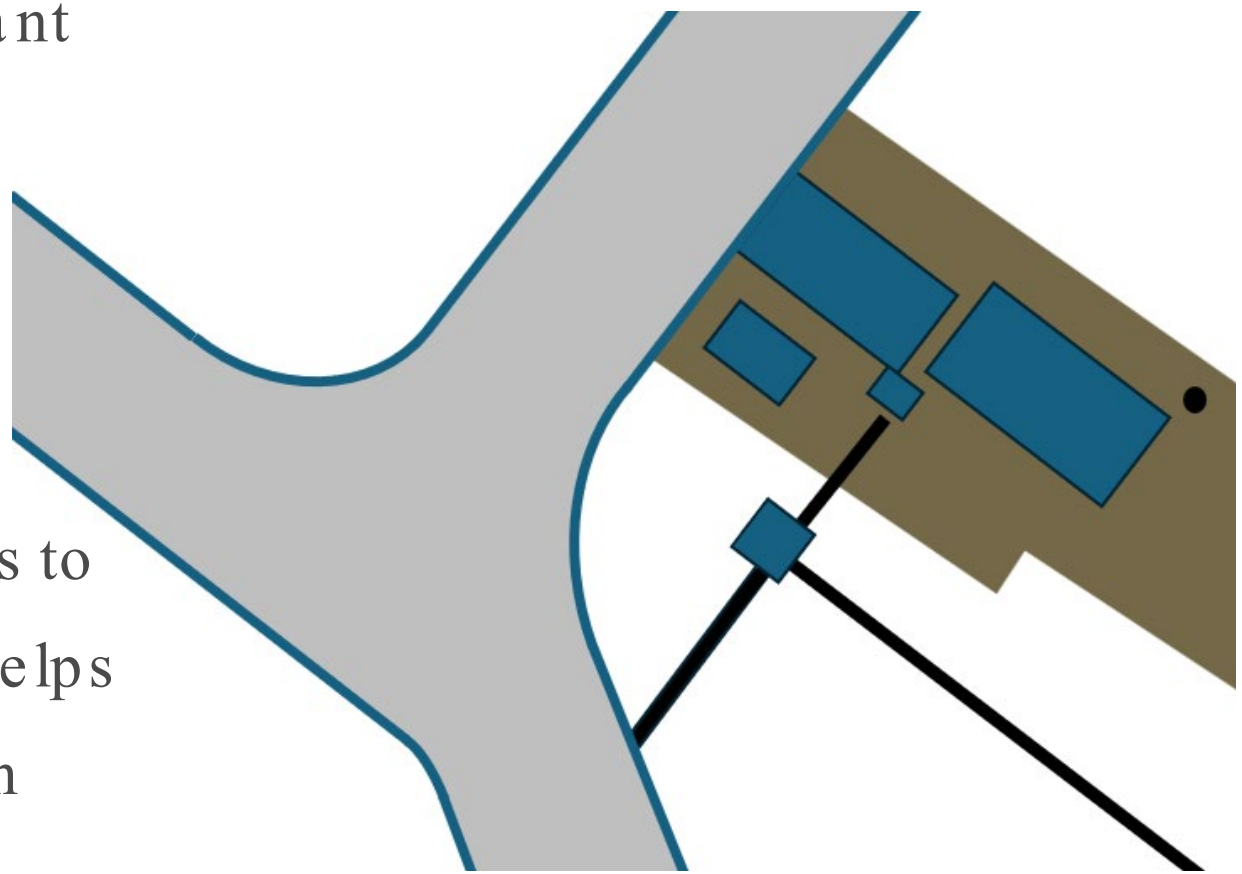


Existing Detector locations

GD	●
FD	●
LOS	●----

- Gas/ Pig Receiver

This is the first connection to the Bacton plant from the under-water piping from holland and it is not located near the rest of the BBL location.



This area is only used once every five years to help clean the pipes. The acoustic device helps to detect any leaks that could happen even when the area is not in use

My Fire and Gas Mapping Research

Current Coverage (Flame) ---Metering Room

Results

1ooN	89.2%
2ooN	25.9%
>2ooN	0.0%

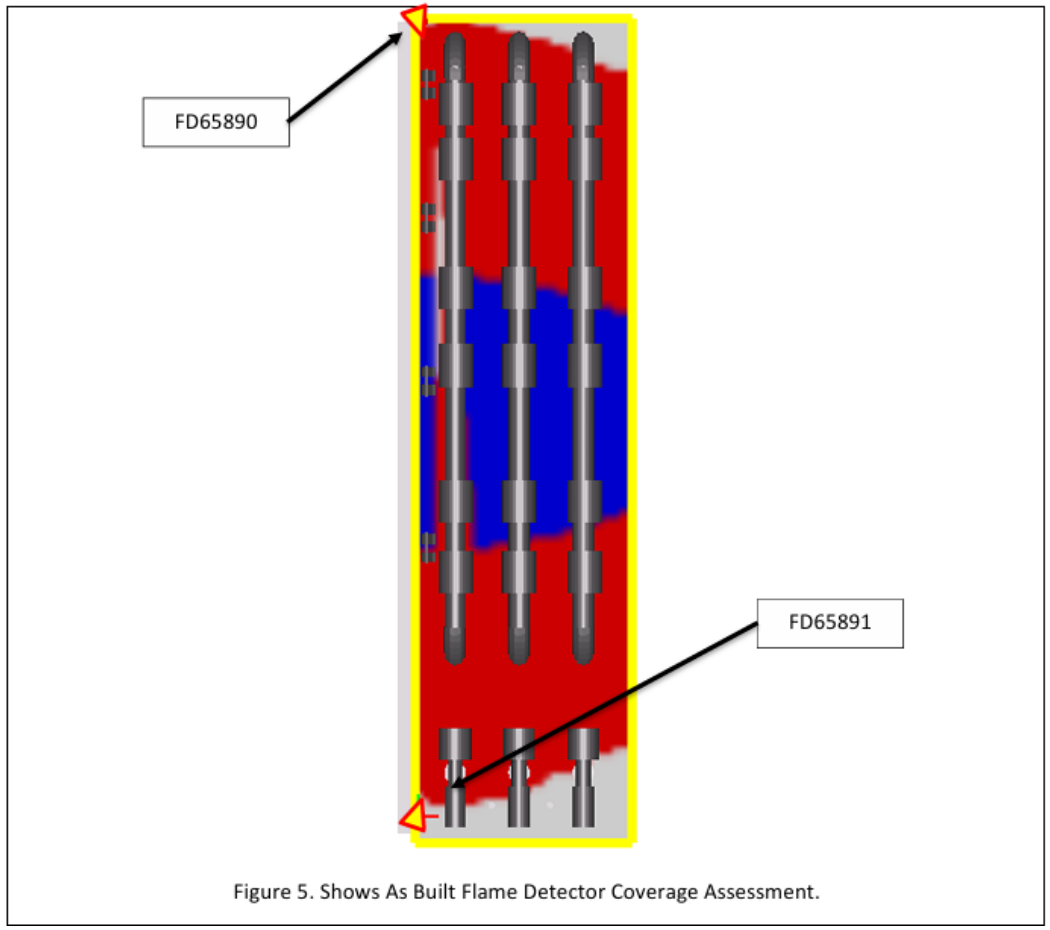


Figure 5. Shows As Built Flame Detector Coverage Assessment.

This image shows the current coverage of flame detector coverage in the BBL site in the metering area. Currently the flame detectors are not reaching the full coverage requirement and that can pose strong risks to fire and gas leaks.

These were conducted through a site visit and survey finding out where current detectors are.

Current Coverage (Gas) ---Metering Room

1ooN	100.0%
2ooN	100.0%
>2ooN	0.0%

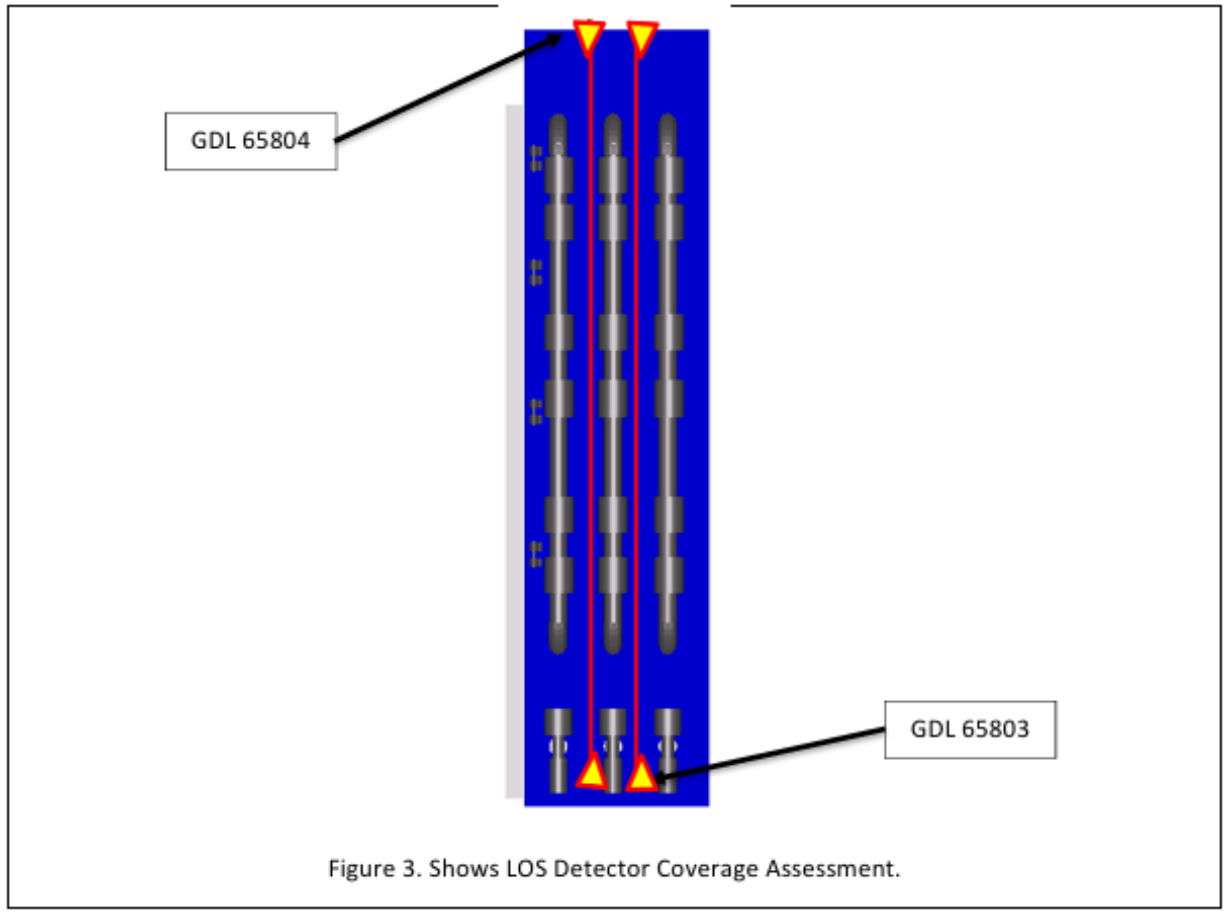
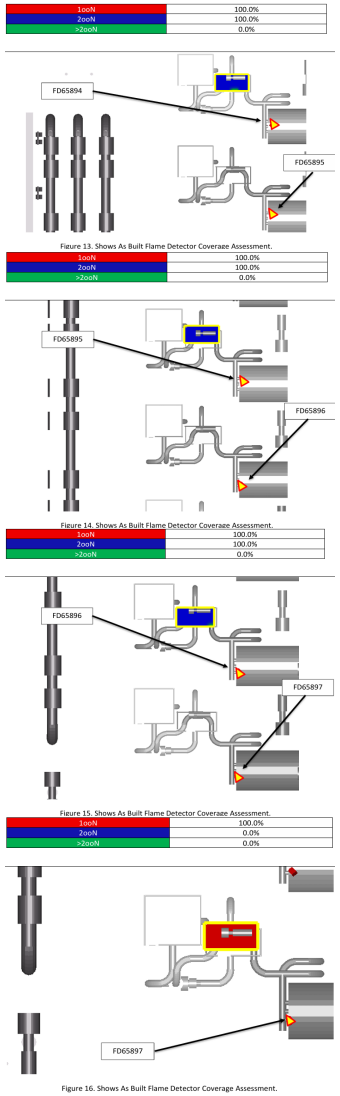


Figure 3. Shows LOS Detector Coverage Assessment.

However, for the gas coverage for the metering area, it is fully covered by the two line of sight detectors. No adjustments will need to be made in this area to do with gas but, flame detectors will need an upgrading for the coverage.

Current Coverage (Flame) ---Burners



1ooN	100.0%
2ooN	100.0%
>2ooN	0.0%

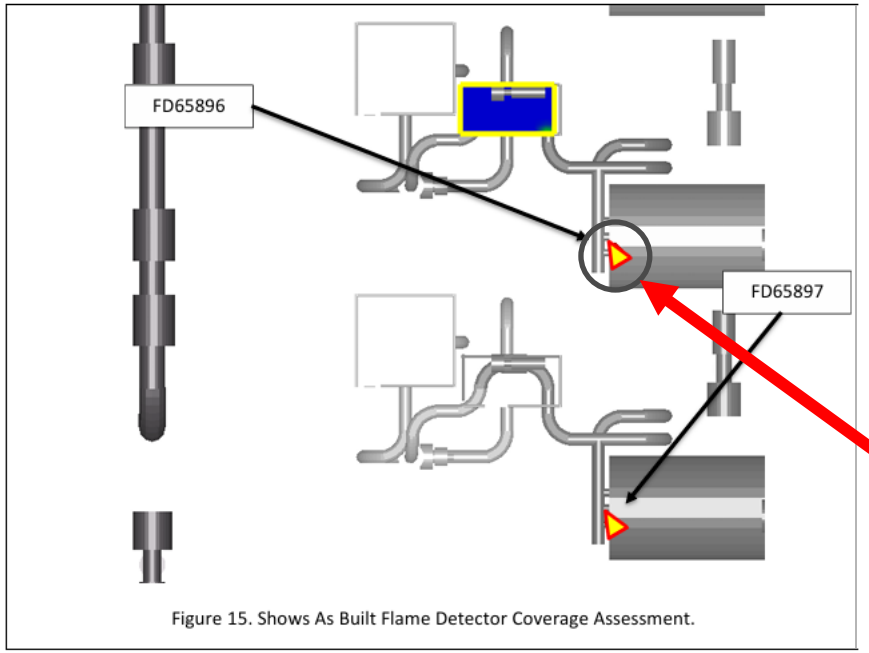


Figure 15. Shows As Built Flame Detector Coverage Assessment.

These images show the burners on the BBL site in Bacton. All detectors meet the required target for 1ooN. But the fourth platform does not contain two detectors, so the 2ooN target is not met for the last burner. Another flame detector would have to be installed in the circle location matching the other three burners.

Current Coverage (Flame) ---Burners

Furthermore, another concern is the back areas of the burners. Only two out of the four burners contain flame detectors at the back. They may not need flame detectors in these areas but there but it should be question why not if two other burners already contain detector coverage in these locations.

Burner 1 Results

1ooN	100.0%
2ooN	0.0%
>2ooN	0.0%

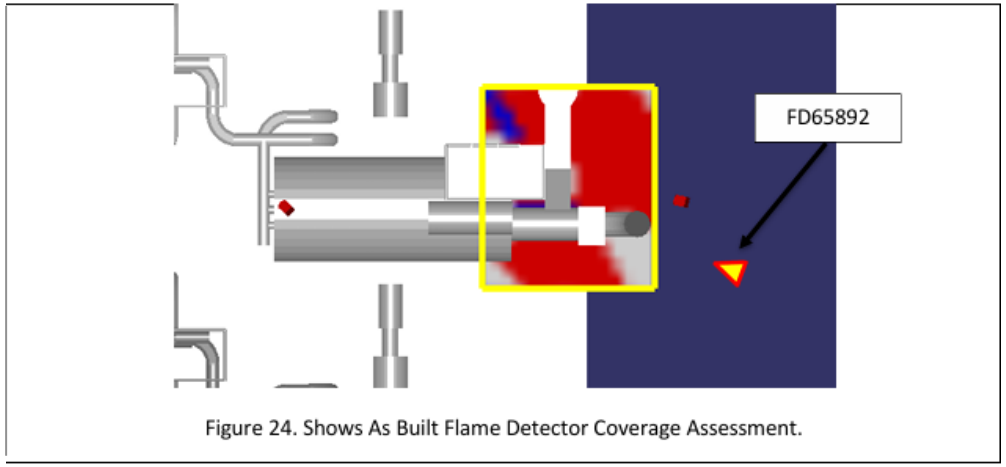


Figure 24. Shows As Built Flame Detector Coverage Assessment.

Burner 2 Results

1ooN	47.9%
2ooN	0.0%
>2ooN	0.0%

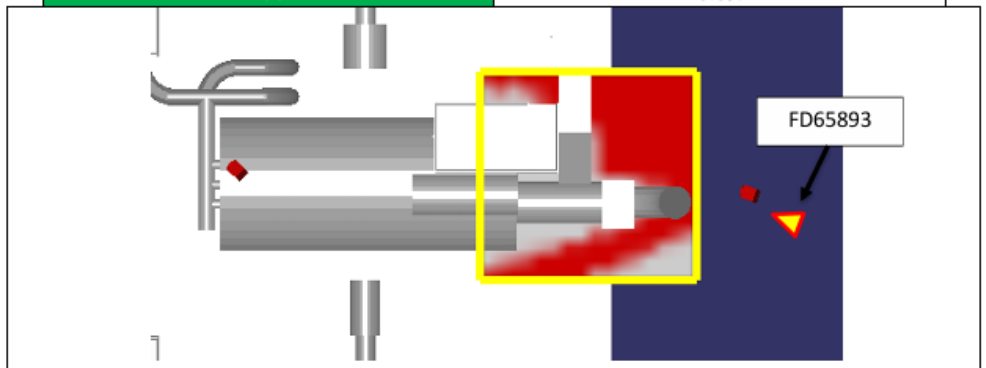


Figure 25. Shows As Built Flame Detector Coverage Assessment.

Current Coverage (Gas) ---Burners

Results

1ooN	99.3%
2ooN	93.4%
>2ooN	65.0%

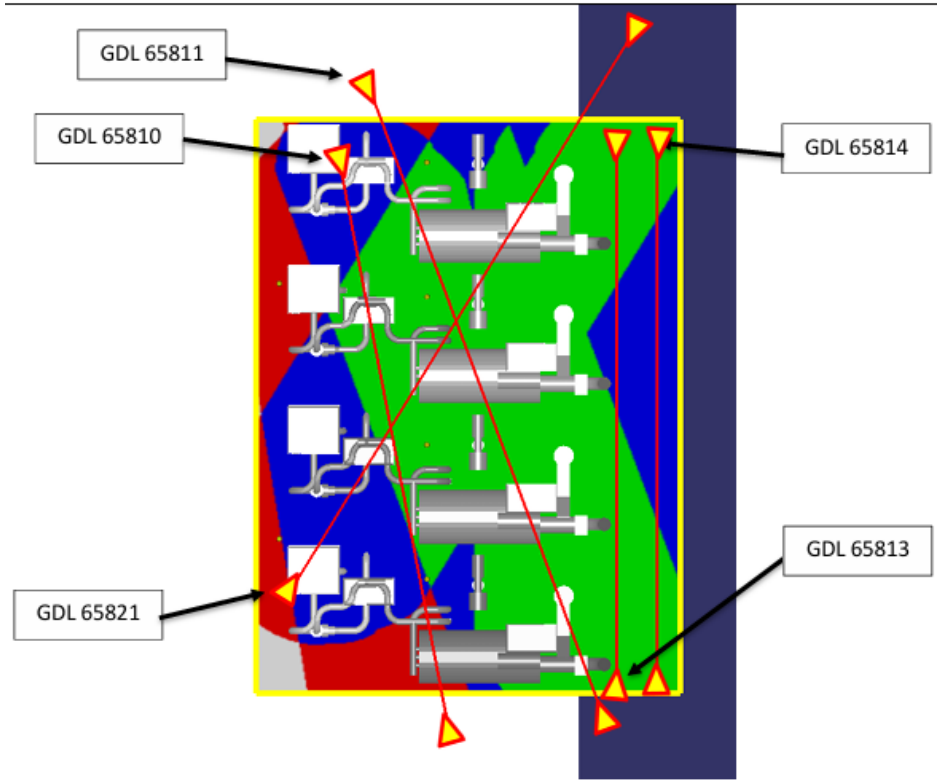


Figure 11. Shows As Built LOS Detector Coverage Assessment.

This area shows the burner/processing area of the BBL site. This area meets the gas detection percentage meaning this area will not need to be changed as it meets current requirements of 90% + for 1ooN and 85% + for 2ooN.

Current Coverage (Gas) ---BBL Inlet

Results

1ooN	n/a
2ooN	n/a
>2ooN	n/a

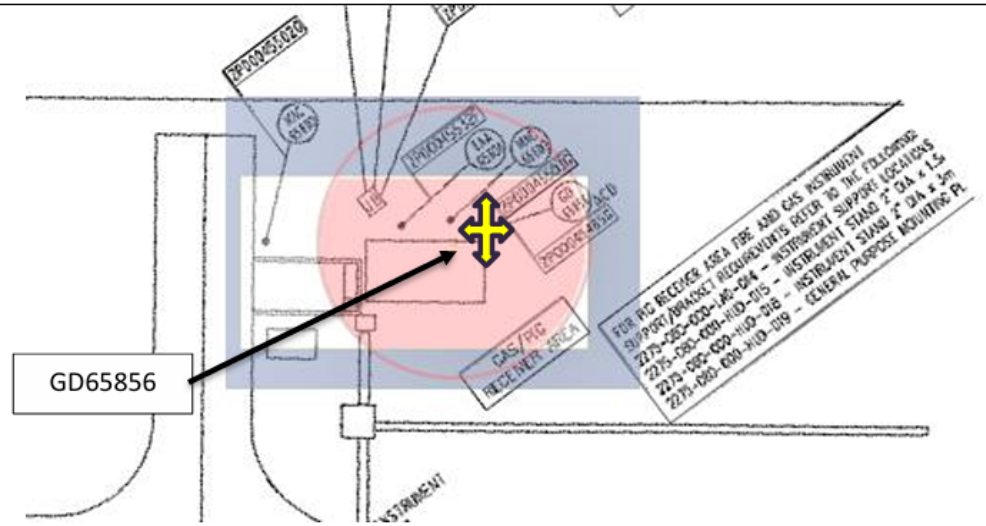


Figure 26. Shows Acoustic Coverage Assessment 8m Radius.

This image shows the BBL inlet area which is not located near the BBL site it is positioned on the top right hand of the shells Bacton site. There is no coverage here apart from an acoustic device. On site it was communicated that this was enough detection and no flame detection was needed in this area, meaning no new installations needed.

Current Coverage (Gas) ---Instrument Air/Diesel Generator

The instrument air/ diesel generators have no existing mapping technology. There is gas detectors which are located on the external air intake unit encase there is a gas leak on site, and it can be detected if the air intake is intaking gas rather than air. Each housing unit contains two gas detectors.

However, the diesel generator does not have any gas detectors located in its area. The question was asked if there was any needed for this location and no clear response was given to why it would be needed.

There are no flame detectors in this locations.

Current Coverage (Flame) ---XZV Valve ---Auxillary Room & Analyser House

Currently there is a single acoustic device located on the side on the auxillary building for the XZV valve. Some of the detection coverage is lost due to the position it has been placed in not allowing full use of the 360 -degree coverage. This detector also has been installed incorrectly as the detector display is facing towards the building, resulting in anyone who wants to see the live reading or the status of the detector can't.

There is a singular flame detector mounted above the acoustic device. This means it cannot meet the requirements of 2ooN as there is not enough coverage.

It was communicated that a single gas detector is present in this building but is not mapped. That is the only detector in the analyser building as recorded.

My Project Personal Recommendations

New Coverage (Flame) ---Metering Room

1ooN	96.1%
2ooN	85.7%
>2ooN	29.2%

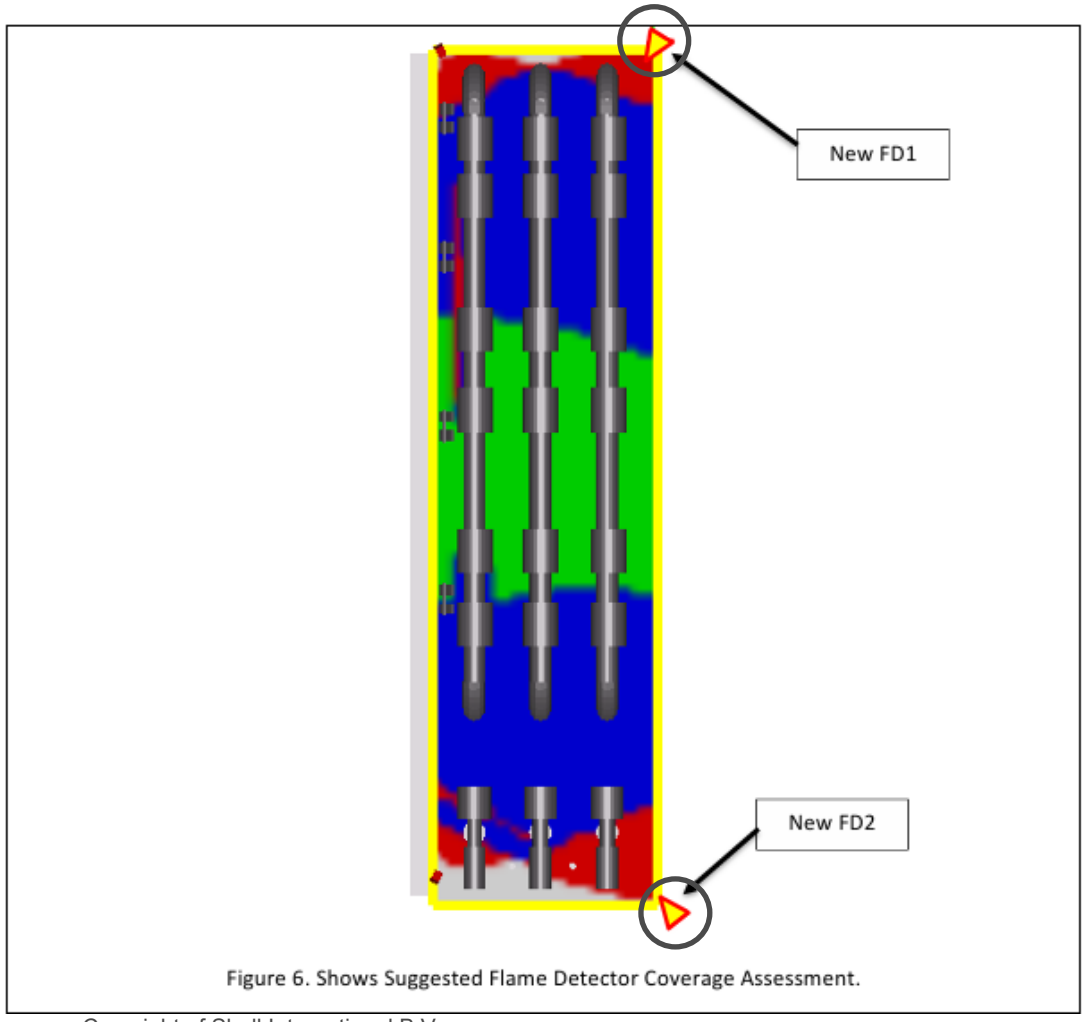


Figure 6. Shows Suggested Flame Detector Coverage Assessment.

New flame detectors would be installed on the two corners opposite to the other flame detectors. This allows for a larger coverage from the detectors along with a larger area covered, meeting the target of percentage covered by the detectors.

This was gathered through a company called Protex Systems using their software called HAZDET.

Current Coverage (Flame) ---Burners

1ooN	100.0%
2ooN	100.0%
>2ooN	0.0%

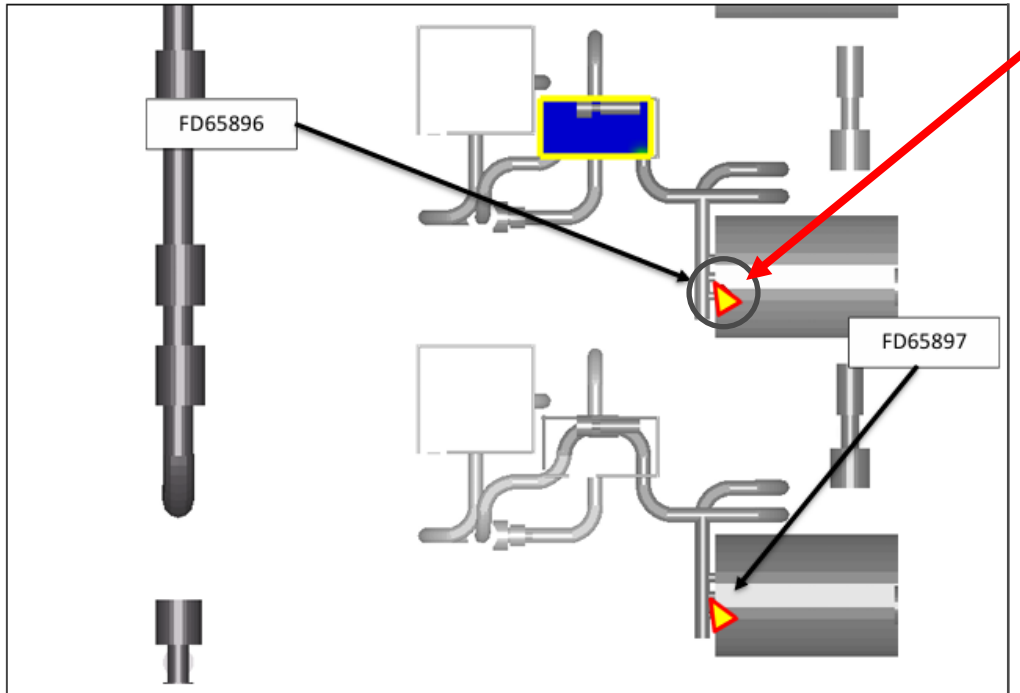


Figure 15. Shows As Built Flame Detector Coverage Assessment.

Another flame detector would have to be installed in the circle location so, the fourth burner meets the percentage coverage requirements.

Furthermore, another two flame detectors would need to be added on the back of the two burners that are missing detectors for extra safety.

Benefits

To continue, some gas detectors should be installed on the diesel generator for safety purposes ensuring the generator is safe and has an alarm system if malfunctioning occurs along with some flame detectors encase of a fire.

Finally, the acoustic device mounted on the auxillary house should be installed correctly and repositioned to allow full 360 -degree usage of the device along with an added flame detector to increase the coverage to reach the target.

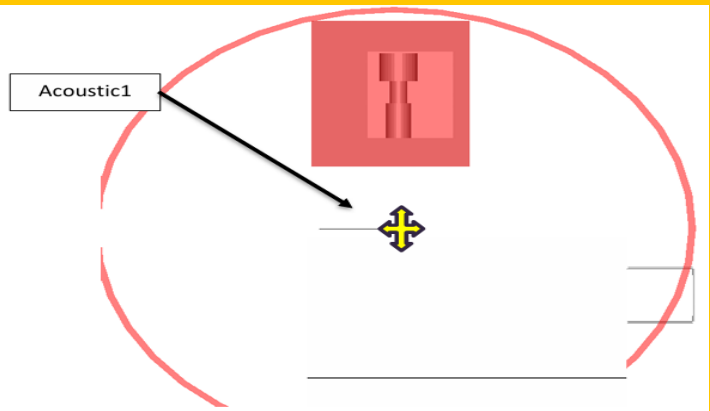


Figure 29. Shows AGLD Detector Coverage Assessment.

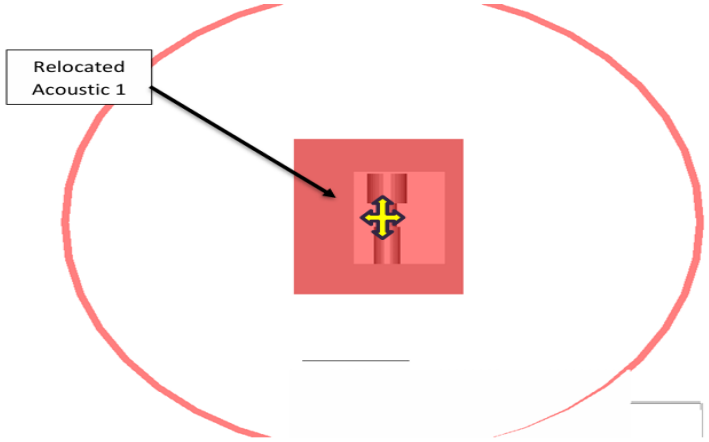


Figure 30. Shows AGLD Suggested Detector Coverage Assessment.

Benefits

By installing these new detectors in these specific locations will provide a more safe, reliable and efficient system.

The BBL site will become a much safer place as employees are protected more by detectors allowing them to be confident in an emergency and not unsure encase of a false alarm due to the increase in detector coverage and voting system.

Furthermore, increasing the coverage makes the detector system more reliable as they can be trusted in an alarm situation and not considered if it is a false alarm. Finally, the system will become more efficient as there will be less false alarms allowing work to continue. This overall will save more money by less work being disrupted and potential infrastructure being saved as detectors are able to detect a leakage more quickly.

Conclusion

Summary

To summarise, This presentation is my work placement study about the fire and gas mapping at Bacton. It goes into depth about the different types of detectors that can be used, health and safety regulations, false alarm stimuli and the BBLs as found infrastructure.

To finalise this report, I show my recommendations that could be changed to the fire and gas mapping, showing where new detectors can go to increase safety and coverage of the BBL site in Bacton.

Thank You for Listening & Supporting.

Any Questions?