MAPPING OF FLAME GAS DETECTOR USING DETECT3D & STUDY OF PRE-INCIDENT PLANNING ASSESSMENT BY CONSIDERING SCENARIO OF PIN HOLE LEAK AND FIRE IN DOWNSTREAM HP LINE OF VESSEL

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Abstract: **Detectors is used in Process Industry to Detect Fire or gas release and automatically Initiate audible and visual alarm in the respective designated Emergency response area, Control room. They are designed to operate continuously expect for periods of maintenance or fault repair. By early Detection of a potential hazardous event and carrying out predetermined actions to mitigate the effects, Detector helps to ensure 1. Protection of personnel, protection of environment, protection of plant, In the absence of useful Flame detection, Process Industry is vulnerable to a potentially significant and disproportional increase of Main hazards: (1) Fires can basis of injury to people and have the probable to raise the hazard to adjacent vessels, piping or equipment. This paper explained how to set up optimization simulation and How to interpret the Coverage, Fitness for Flame gas Detector by Using Detect3D software. Also Study of pre-incident planning assessment by considering the scenario of Pin hole leak & Fire in downstream HP line of vessel.**

Index Terms **- Fire, PIPA (Pre-incident Planning assessment), Detect3D**

1.0INTRODUCTION

Fire causes huge loss of lives and properties in India. Maintaining a high level of process and plant safety is a critical concern. Detectors contain the equipment required to warn personnel of the existence of emergency condition to mitigate the circumstances. Detectors provide complete status indication and control for fire detection and protection system. Optimization modeling technique preferred to meet the performance requirement with an efficient and effective detector layout. To optimize the layout each detector shall be consider individually and as part of group detectors. in each zone, the number and location of the detector shall be set such that the combined coverage of all the detector in the zone meets the requirement for detecting the Fire or gas hazardous events that has been considered.

Detect3D is a design and breakdown software package for fire and gas detector layouts and mapping. It is mainly well fitting for congested process areas with important fire risks.

A pre-incident plan is one of the most precious tools available for aiding responding people in effectively controlling an emergency. Although there are many types of incidents that require emergency response, fires generally represent the most frequent challenge to emergency responders. Many of the recommendations in this document that relate to fires and fire Protection features can be equally applicable to other types of incidents.

1.1 OBJECTIVE

To minimize detectors for target coverage requirement.

To maximize coverage for a given number of detectors

To study of pre-incident planning assessment by considering the scenario-pin hole leak and fire in downstream hp line of vessel.

2.0 RESEARCH METHODOLOGY

2.1 Flame Detector Mapping:-

The purpose of Detect3D is to minimize the risk of undetected fires by calculating the realistic detector coverage layouts using fast and ray casting technique developed by Insight Numeric. Providing a three-dimensional environment for viewing coverage of fire zones and identifying blind spots (regions of zero coverage). Allowing users too quickly and easily allowing users to modify a detector layout based on the results.

Alternative methods for detector positioning use simple 2D overlays which do not accurately account for obstructions and may not highlight areas where fires could occur and not be detected. Detect3D accounts for all obstructions in a 3D environment with high accuracy.

It is important to reduce the risk of fires in facilities, and having accurate detection of fires and gas leaks is a major component for reducing that risk. Detect3D calculates the effectiveness of detector layouts identifies regions of concern and provides the tools

necessary to improve the detector placement and orientation, thus reducing the risk of non-detection. By placing flame and gas detectors more effectively, the risk will be reduced and the cost may even be lowered as in some instances fewer detectors are required to provide the same level of coverage.

Steps for Flame gas Detector mapping are given below:-

Step-01 Importing the Geometry

Multiple CAD file types can be imported into Detect3D like.PDS, DGN, DGS etc.

3D Vessel Geometry added For Flame Detector Optimization.

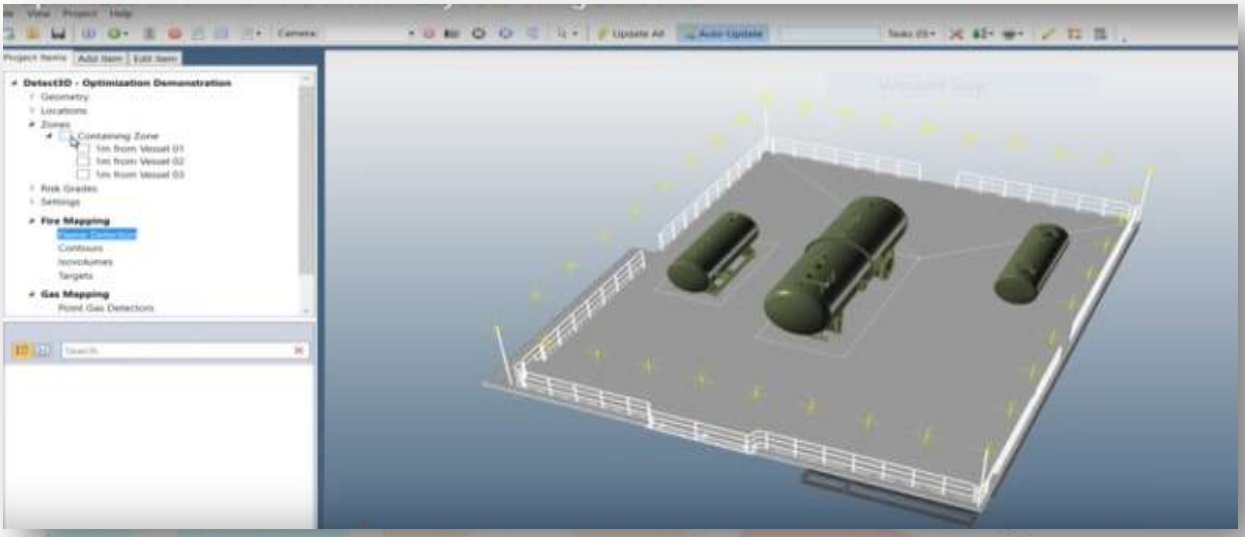

Fig-01 (3D Vessel Geometry)

Step-2 Define a Fire Zone

A fire zone marks out a defined volume in which to consider the fire risk.

Defined Zone for Geometry is 1m From Vessel

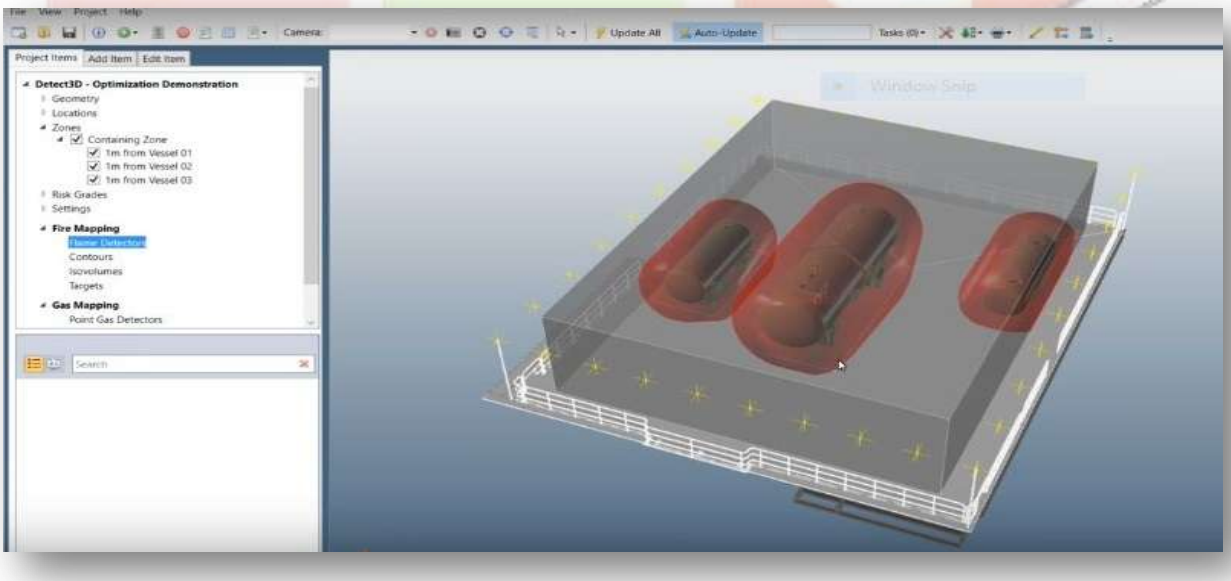

Fig-02 (Fire Zone)

Step-03 setting up an Optimization Simulation

It is being targeted coverage for Zone 01 to 70% 1ooN and 20% 2ooN by expanding the Coverage Property under the Required Coverage heading. No further changes to the setup are required, default values for the optimization have been chosen for ease of use and so that a simulation can be set up quickly.

Defined Coverage Target-1OON-70% & 2OON -25%

Defined Coverage Target-1OON-70% & 2OON -25%

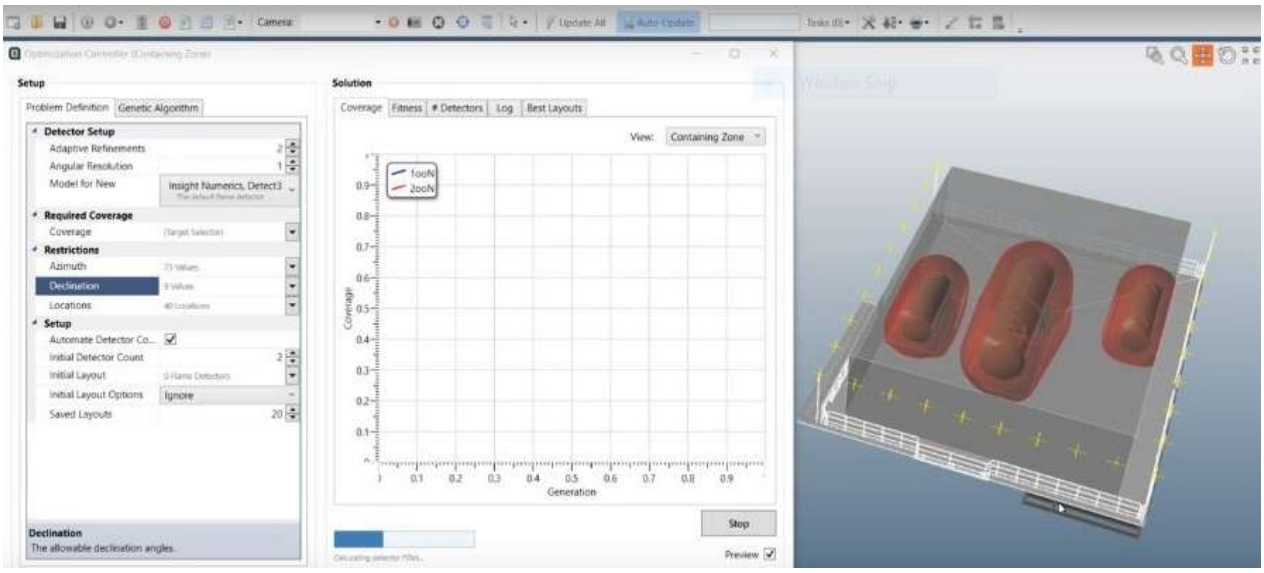

Fig-03 (Optimization Simulation)

STEP-04 Running an Optimization Simulation.

- Run at the bottom right of the Optimization Controller Window.

-Optimization Controller shows the coverage of the currently calculated best layout plotted against the generations of the optimization. The blue line indicates 1ooN coverage and the red line indicates 2ooN.

- Click on the Best Layouts tab. This shows all the layouts found by the Genetic Algorithm that have fitness greater than the target coverage, and have the same number of the detectors as the best layout.

- Choose the layout that is most suitable,

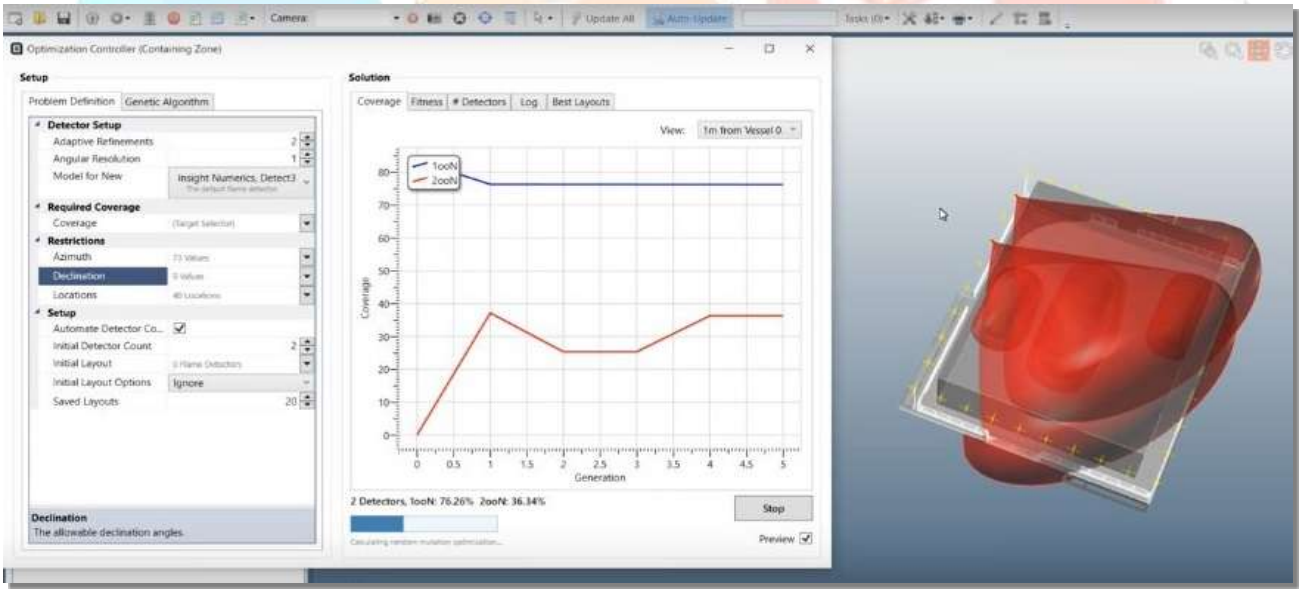

Fig-04 (Simulation result)

2.2 A **Study for Pre-Incident Planning Assessment**

2.2.01 Scenario:-

- Pin hole leak & Fire in downstream HP line of vessel. Vessel contain VGO (Vacuum gas Oil).

2.2.02 Detection of Incident:-

- DFI & DGT

2.2.03 Approach Road:-

- Always From Upwind /cross wind direction

2.2.04 Fire Protection Facilities:-

- Hydrant & Monitor is provided in the plant area.

2.2.05 Fuel Supply Reduction Measure

- Reduce the extent of leak the HP Loop is immediately by pressing switch.
- Reduce system Pressure below 5 bar and interties the HP loop by introducing N2

2.2.06 Consequence Analysis:-
Consequence analysis done by using PHAST Software

Sr. No.	Details of Jet Fire	
1	Frustrum length	16.3 m
2	Flame angle from Vertical	11.81 degree
3	Cone width End	5.2 m
4	Flame lift off	2.1 m

Table-01 (Details of Jet Fire)

Table-2 (Release Summary)

2.2.07 Safe Working area for Firefighting/Dispersion:-
- Heat Flux of 2.5 KW/m2 Up to 35 M in Upwind

Sr. No.	Release Summary	
1	Mass Flow rate	4.37 Kg/s
2	Duration of Release	20 min
3	Release height	1.4 m

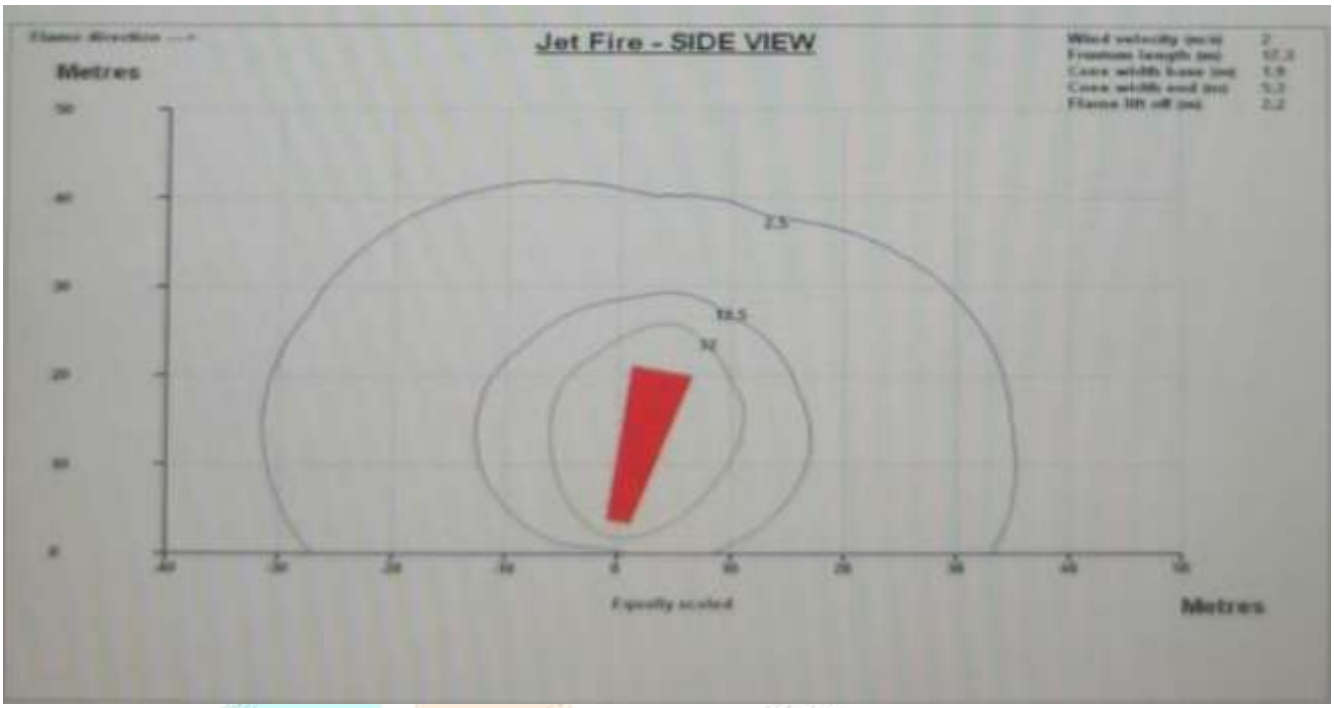

Fig-5(Jet Fire Side View)

2.2.08 Prioritizing the Protection Measure:-

- Prioritizing of the Protection Measures shall be carried out depending on the radiation Level at various location
- Immediate evacuate of all Personnel From Upwind & nearby area.
- Start cooling of nearby all affected area.
- Start cooling of using Fixed Monitor.
- Continuous cooling of Vessel till the remaining hold Up.
- Provide water curtain in down wind direction to prevent radiation effect on surrounding equipment.
- Apply DCP Fire Extinguisher to cut off the Flame up on Process Isolation.
- Continue the Cooling of equipment for 10 Min. after the Fire is Extinguisher.

2.2.09 Firefighting Equipment:-

Equipment	Area to be protected	Rate (LPM)	Duration (Min.)	Water Requirement
Fixed Monitor	**Water Jet Spray to cool exposed equipment**	**2700**	**45**	**121500**
Mayra Curtain -1 nos.	**Water spray for cooling of exposed equipment**	**450**	**45**	**20250**

Portable Monitor-1 nos.	**Water spray for cooling of exposed equipment**	**1000**	**45**	**45000**

Table-3 (Fire Fighting Equipment)

3.0RESULT:-

3.01 Optimization for flame gas detector done. Their results are given below:-

There are minimum 2 nos. of Flame gas Detector required for target coverage for Zone 01 to 70% 1ooN and 25% 2ooN.

3.02 Study of Pre-incident Planning assessment done by considering the scenario-Pin hole leak and fire in downstream HP line of vessel and required resources details are given below:-

Sr. No.	Resources	Quantity
1	Water requirement	146250 L
2	Portable Monitor	1
3	Mayura Curtain	1
4	Storm water channel capacity	4000 M3/Hr
5	DCP Fire Extinguisher	1

Table -4 (Resources)

4.0 References:-

[1] (2016), *insightnumarics*, retrieved from www.insightnumerics.com

[2] Li, J.H., Zou, X.H. and Lu, W. (2012) The Design and Implementation of Fire Smoke Detection System Based on FPGA. Proceedings of the 24th