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REPORT

PTT LPG Recovery Unit Probabilistic Explosion Study

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Document Info

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Classification

Confidential (F)

Title

PTT LPG Recovery Unit Probabilistic Explosion Study

Extract

Gexcon has been requested by PTT Public Company Limited to perform a probabilistic explosion study for the new LPG Recovery Unit area developed in PTT Gas Separation Plant, Map Ta Phut, Rayong, Thailand. The study involves comparison of three proposed different elevations of LPG Recovery Unit and their explosion risks are compared to find which elevation provides overall most modest explosion risk.

Project Info

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PTT LPG Recovery Unit Probabilistic Explosion Study

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Abbreviation

ACH	Air Changes per Hour
ACM	Anticipated Congestion Method
CCB	Central Control Building
CFD	Computational Fluid Dynamics
DWG	Drawing binary file format for AutoCAD applications
ESP	Ethane Separation Plant
ESD	Emergency Shut Down
ESDV	Emergency Shut Down Valve
FLACS	Flame Acceleration Simulator
HCR	Hydrocarbon Releases Database
HMB	Heat and Mass Balance
JIP	Joint Industry Project
LPG	Liquefied Petroleum Gas
MAWP	Maximum Allowable Working Pressure
MP	Monitor Points
NGL	Natural Gas Liquids
NORSOK	Norwegian Petroleum Industry Standards
OGP	International Association of Oil & Gas Producers
PDMS	Plant Design Management System (3D CAD Design Software)
PID	Piping & Instrumentation Diagram
PP	Pressure Panels
PTT	Petroleum Authority of Thailand
TDIM	Time Dependent Ignition Model
UOP	Universal Oil Products (Honeywell Company)
WOAD	World Offshore Accident Database

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1 Introduction

Gexcon has been involved by Arthit E&C Co., Ltd (herefore called as COMPANY) who is requested by Petroleum Authority of Thailand Plc (or PTT Plc herefore called as CLIENT) to perform a probabilistic explosion study for a new Liquefied Petroleum Gas (LPG) Recovery Unit located in PTT Gas Separation Plant, Map Ta Phut, Rayong Thailand. Scope of the study covers ventilation, dispersion and explosion simulations. Based on the simulations and required input, the resulting explosion risk for the installation was calculated. The objectives are to determine ventilation conditions, potential gas cloud build-up for various release scenarios, explosion loads and explosion risk in the area of concern.

The LPG Recovery Unit is a new proposed LPG Recovery installation located adjacent to the existing Ethane Separation Plant (ESP) plant as depicted in Figure 1-1. Analysis was performed for three cases based on the elevation level:

- Base Case: Present elevation level which is 6 m higher than ESP Plant
- Case 1: Lower elevation level which is 3 m higher than ESP Plant
- Case 2: Same level (0 m higher) as the adjacent ESP Plant

The three elevation level are studied as a sensitivity test.

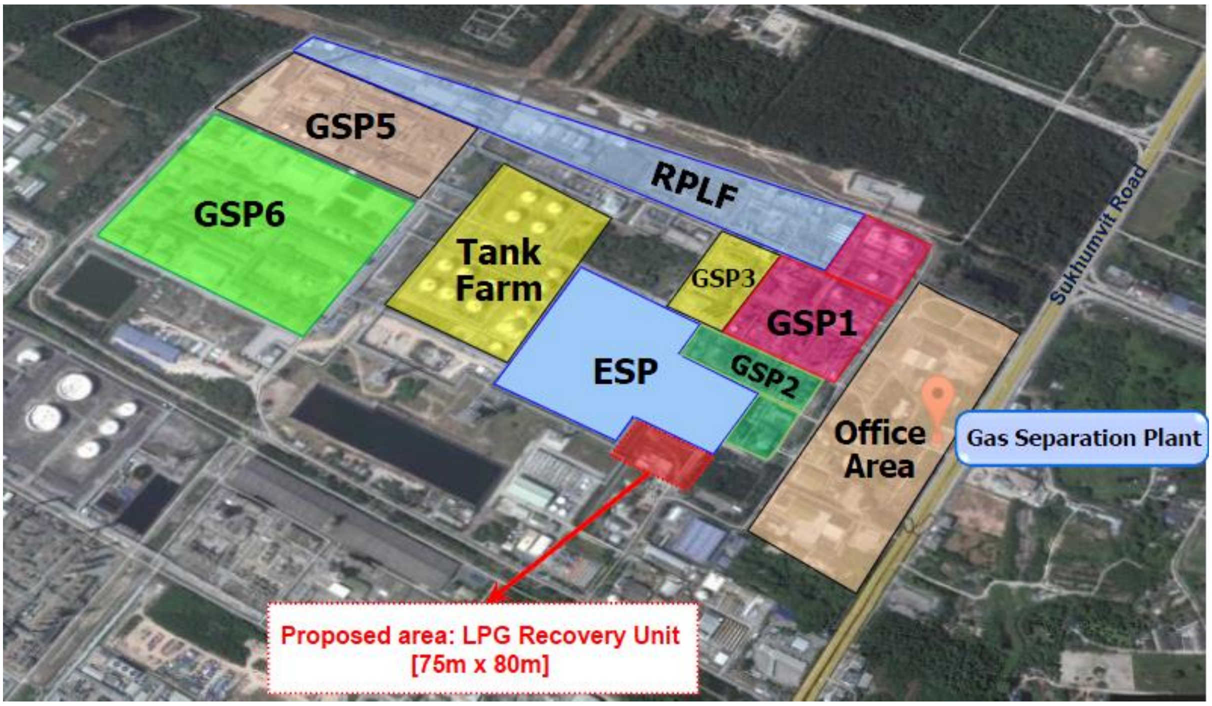


Figure 1-1 Proposed LPG Recovery Unit area

The explosion analysis has comprised the following main tasks:

1. Establish a 3D geometrical model in FLACS of the PTT Gas Separation plant. The geometrical model of the existing facility was transferred from the PTT PDMS model of the area and converted to FLACS. The new LPG Recovery Unit area was imported from DWG prepared by Arthit E&C Co., Ltd. Additional congestion blocks were added to the LPG Recovery Unit area using Anticipated Congestion Method (ACM) that has been discussed and agreed by COMPANY and CLIENT. ACM method involves the import of incomplete model, identification of missing congestion, and implementation of congestion to the LPG Recovery Unit area.
2. Perform ventilation simulations for 12 different wind directions. One wind speed was selected to determine the Air Changes per Hour (ACH) in the area.
3. Perform dispersion simulations by varying leak parameters (release location, direction, rates, gas composition, wind speed and direction) to assess the potential gas cloud build-up from an accidental release.
4. Perform explosion simulations by varying gas cloud sizes, gas cloud locations and ignition locations to calculate the potential explosion loads in the area.
5. Calculate the explosion risk in the area and established dimensioning explosion loads for the surrounding buildings.

The simulations were performed with the latest version of the 3D CFD FLACS tool (version 10.5). FLACS is a well-known and thoroughly validated CFD tool developed for ventilation, dispersion and explosion simulations in complex geometries. FLACS is developed and maintained by GexCon AS in Norway.

This report is organised in the following way:

Section 2 summarises the main inputs and assumptions considered in the analysis. Section 3 contains a brief description of the geometrical model used in the analysis. Sections 4, 5 and 6 describe the investigated scenarios and the main results from the ventilation analysis, the dispersion analysis and the explosion analysis respectively. Section 7 summarises the explosion risk in the LPG Recovery Unit area. Section 8 briefly discusses the risk exposure at other areas adjacent to the LPG Recovery Unit area. Section 9 contains a conclusion of the study.

2 Input and assumptions in the analysis

The input data used in the analysis was provided by COMPANY and CLIENT or based on discussions between COMPANY, CLIENT, and GexCon. Assumptions and evaluations that were made during the explosion analysis were based on GexCon's best judgement on how to perform such analysis.

2.1 Statistical weather data

The raw wind data is provided by the CLIENT as a function of direction and wind speed in a 5 minutes interval between year 2013 and 2015 [1]. It has been processed into a wind rose by Gexcon considering a year worth of data (from September 2014 to August 2015) to take into account the whole variations of wind condition during different seasons. The wind statistics are classified into 12 wind directions relative to the true north direction as indicated by Figure 2-1 and Table 2-1 below. There is approximately 30º difference between the true north and the plant north where plant north is +30º clockwise of the true north direction. This has been taken account in the wind statistic / probability calculations.

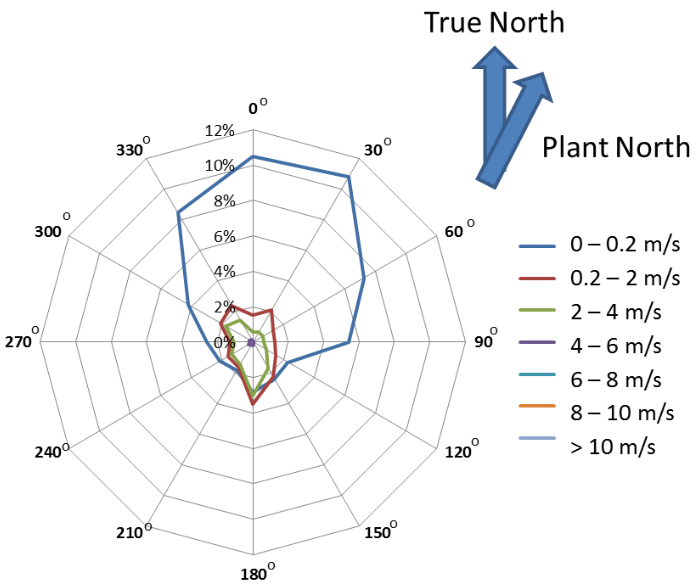


Figure 2-1 Wind rose for LPG Recovery Unit

Table 2-1 Annual wind percentage frequency of mean wind speed

		Wind Direction (º) True North												
Wind Speed (m/s)	**Wind Speed Range**	**0**	**30**	**60**	**90**	**120**	**150**	**180**	**210**	**240**	**270**	**300**	**330**	**SUM**
	0 - 0.2	10%	11%	7%	5%	2%	2%	3%	2%	2%	3%	4%	8%	61%
	0.2 - 2	2%	2%	1%	1%	1%	2%	3%	2%	2%	1%	2%	2%	22%
	2 - 4	1%	1%	1%	1%	1%	2%	3%	1%	1%	1%	2%	1%	15%
	4 - 6	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	2%
	6 - 8	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	8 - 10	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	>10	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
SUM		13%	14%	9%	7%	5%	7%	10%	5%	5%	5%	8%	12%	100%

The safety study considers an ambient temperature of 40 ºC and ambient pressure of 1.021 bar.

The wind statistics shows that the wind speed range of 0-4 m/s has total frequency of 98% (dominant wind speed). Therefore representative wind speed selection is focused into the first 3 wind speed categories as detailed in Table 2-1 above.

The 2 m/s wind speed was selected to be the representative wind speed in the ventilation simulations as it corresponds to the middle of the wind speed categories range. Extrapolation calculations were then performed to determine the flow regimes for the higher (2-6 m/s) and lower (0-2 m/s) wind speed categories.

2.2 Leak frequency and leak modelling

Based on the UOP Technical Proposal Appendix 8 (UR-1301-07-TP-Rev 0) [2], 3 cases (normal, lean, and rich) for the new LPG Recovery Unit. Each case has 11 major streams. However, only the rich case was used as representative for the facility. All release scenarios were modelled as 100% gas release for conservatism.

2.2.1 Leak size and leak frequencies

Leak frequencies for the facility are obtained from the parts count method multiplied by the OGP's failure rate database [3] based on the UOP's PIDs [4] and classified into each stream as tabulated in Table 2-2.

Table 2-2 Release frequencies (/year) in the LPG Recovery Unit

Stream	Small (1 to 10 mm)	Medium (10 to 50 mm)	Large (50 to 150 mm)	Very Large (>150 mm)	Total
1	9.73E-02	9.78E-03	1.52E-03	8.24E-04	**1.09E-01**
2	3.28E-02	3.72E-03	1.07E-03	3.64E-04	**3.80E-02**
3	2.31E-03	2.91E-04	6.66E-05	4.90E-05	**2.72E-03**
4	3.05E-02	2.58E-03	3.71E-04	1.14E-04	**3.36E-02**
9	1.00E-03	7.74E-05	2.94E-05	-	**1.11E-03**
10	1.38E-03	1.05E-04	4.62E-05	-	**1.53E-03**
11	8.10E-02	8.98E-03	1.58E-03	8.72E-04	**9.24E-02**
12	1.71E-02	1.64E-03	2.06E-04	3.30E-05	**1.90E-02**
13	2.12E-02	1.74E-03	1.97E-04	2.65E-05	**2.32E-02**
14	1.34E-03	9.97E-05	4.00E-05	-	**1.48E-03**
15	1.51E-03	1.60E-04	-	-	**1.67E-03**
Total	**2.87E-01**	**2.92E-02**	**5.13E-03**	**2.28E-03**	**3.24E-01**

As the result of the interpolation, the leak frequencies are distributed following NORSOK leak rates [5], and presented in Table 2-3.

Table 2-3 Release frequencies (/year) in the LPG Recovery Unit distributed following NORSOK leak rates

Stream	Release frequencies (/year)									
	0.75 kg/s	**1.5 kg/s**	**3 kg/s**	**6 kg/s**	**12 kg/s**	**24 kg/s**	**48 kg/s**	**96 kg/s**	**192 kg/s and over**	**Total**
1	9.73E-02	2.40E-03	2.08E-03	2.17E-03	2.14E-03	1.22E-03	4.89E-04	4.84E-04	1.14E-03	**1.09E-01**
2	3.42E-02	8.35E-04	8.17E-04	6.91E-04	3.64E-04	3.33E-04	3.35E-04	1.85E-04	1.79E-04	**3.80E-02**
3	2.40E-03	6.20E-05	6.43E-05	6.25E-05	2.95E-05	2.07E-05	2.15E-05	2.32E-05	3.37E-05	**2.72E-03**
4	3.05E-02	6.32E-04	5.91E-04	5.73E-04	5.64E-04	2.86E-04	1.19E-04	1.20E-04	1.79E-04	**3.36E-02**
9	1.01E-03	1.85E-05	1.75E-05	1.71E-05	1.66E-05	1.03E-05	9.13E-06	9.50E-06	2.91E-06	**1.11E-03**
10	1.41E-03	2.23E-05	2.25E-05	2.30E-05	1.86E-05	1.43E-05	1.47E-05	1.01E-05	-	**1.53E-03**
11	8.29E-02	2.07E-03	2.00E-03	1.97E-03	1.26E-03	5.09E-04	5.04E-04	4.87E-04	7.52E-04	**9.24E-02**
12	1.73E-02	3.86E-04	3.50E-04	3.61E-04	3.43E-04	6.68E-05	6.59E-05	6.54E-05	4.08E-05	**1.90E-02**
13	2.15E-02	4.40E-04	3.72E-04	3.73E-04	2.81E-04	6.07E-05	6.43E-05	5.43E-05	2.49E-05	**2.32E-02**
14	1.36E-03	2.30E-05	2.22E-05	2.14E-05	1.73E-05	1.29E-05	1.28E-05	9.30E-06	1.97E-19	**1.48E-03**
15	1.53E-03	3.77E-05	3.60E-05	3.52E-05	3.16E-05	-	-	-	-	**1.67E-03**
Total	**2.91E-01**	**6.92E-03**	**6.37E-03**	**6.30E-03**	**5.07E-03**	**2.54E-03**	**1.64E-03**	**1.45E-03**	**2.35E-03**	**3.24E-01**

2.2.2 Isolatable inventories sections

The isolatable inventories have been provided by CLIENT based on the Block Flow Diagram Heat and Material Balance (Doc. No. UR1301-07.HMB.01) [2], refer to Figure 2-2. The isolatable inventories/segments were used to calculate leak profiles and implicitly the released mass, and duration of gas exposure. Table 2-4 highlights the inventory characteristics in LPG Recovery Unit for the Rich Case that was used in the study.

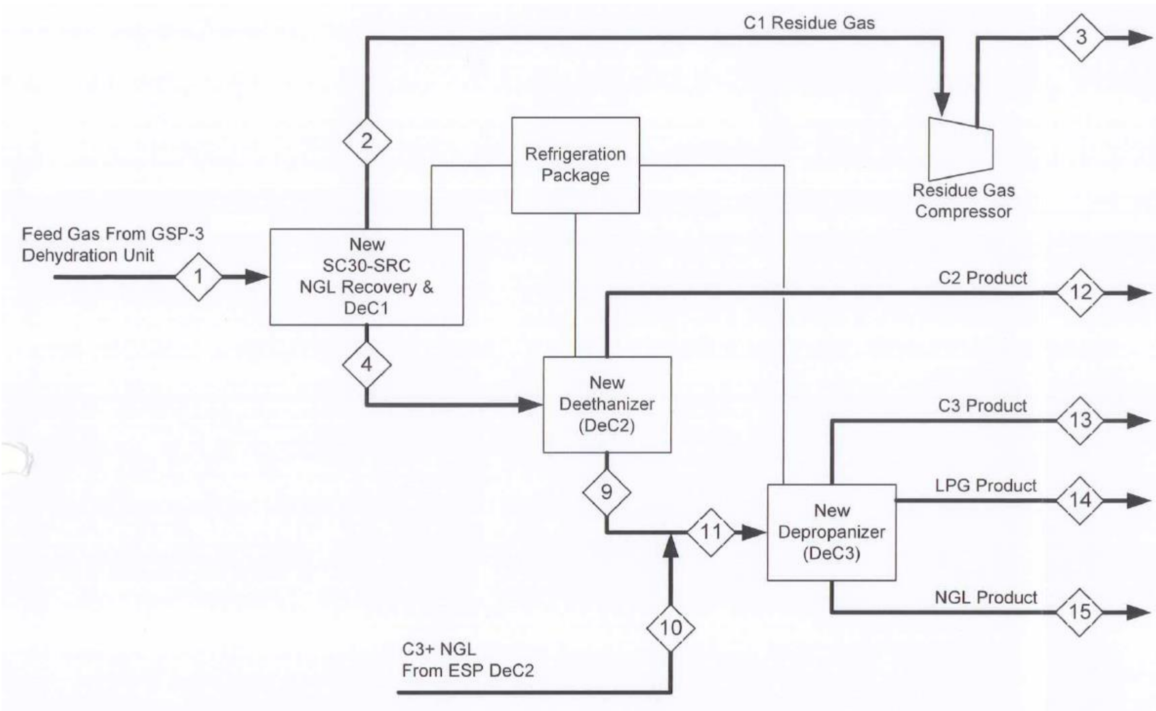


Figure 2-2 Process flow diagram of the LPG Recovery Unit [2]

Table 2-4 Inventory characteristics in the LPG Recovery Unit (Rich Case) [2]

Stream Name	Description	Inventory Characteristics							
		Pressure (barg)	Temp. (C)	Mass Flow rate (kg/h)	Estimated Volume (m^3)	Estimated Mass (kg)	Vapour Fraction	Density (kg/m^3)	MW (g/mol)
1	Feed Gas From GSP-3 Dehydration Unit	52.3	52.2	310,713	81.57	3858.26	1.0	47.3	20.8
2	C1 Residue Gas	18.0	52.0	199,478	19.48	231.81	1.0	11.9	16.4
3	-	24.0	51.7	199,478	139.79	2208.68	1.0	15.8	16.4
4	-	34.5	36.7	111,235	111.45	48603.35	0.0	436.1	39.9
9	-	28.1	95.0	67,031	5.95	2390.12	0.0	401.7	50.5
10	C3+NGL From ESP DeC2	17.8	55.7	14,602	61.86	7249.99	0.304	117.2	44.7
11	-	17.8	69.9	81,633	208	24440.00	0.318	117.5	49.3
12	C2 Product	27.6	7.1	44,203	29.75	1743.35	1.0	58.6	30.2
13	C3 Product	19.3	25.0	21,083	38.84	19291.83	0.0	496.7	44.1
14	LPG Product	16.7	25.0	53,664	349.48	183826.48	0.0	526.0	49.3
15	NGL Product	16.9	25.0	6,886	22.53	14419.20	0.0	640.0	78.9

2.2.3 Leak modelling

The initial release rate for each hole size was calculated based on the isolatable inventory condition i.e. pressure, temperature, etc. When ESD is initiated, the inventory becomes finite and the release rate decrease. Gas detection time, ESDV closing time and inventory properties were used to calculate realistic leak profiles and the transient growth and decay of the resulting gas cloud.

Gas detection times, shutdown procedures and inventory characteristics determine the duration of the leak, and thereby the mass of released hydrocarbon. Inputs specified in the subsequent sub-chapter were used to make assessments regarding leak representation, gas composition and the accurate modelling of leak profiles. The flammable gas cloud formed from dispersion simulations were then adjusted in calculation of the explosion frequency taking into account of the ESD closing, gas detection system response time and the depletion of released isolatable inventory. This task is part of post-processing work which was conducted after FLACS simulations.

Although gas releases are considered the most important aspect towards explosion risk, releases of NGL may also contribute to cloud build up. Flashing and evaporation may all contribute to formation of explosive atmosphere. For this analysis, all liquid inventories were treated as gas. This is considered to be a conservative approach.

2.2.4 Gas or fluid composition

Stream 1 and Stream 13 in the rich case [2] were chosen as the representative gas compositions in the simulations as tabulated in Table 2-5.

Stream 1 is the feed gas with a molecular weight of 20.8 g/mol, which is representative of the low buoyant streams. Stream 1 has also the largest inventory among the low buoyant streams, Stream 2 and 3.

Stream 13 is selected as the other representative gas and represents the heavier gases exiting the separation process. Stream 13 has a molecular weight of 44.1 g/mol. From a safety point of view, propane is considered a conservative representation of the heavier components (C_5, C_6 …) in all streams.

Table 2-5 Fluid compositions by representative inventory in mole percentage (%) [2]

Representative stream	Stream 1	Stream 13
C_1	79.16	0
C_2	9.8	0.16
C_3	5.8	99.83
C_4	2.5	0.01
C_5	0.46	0
C_6	0.08	0
C_7	0.1	0
C_8	0.0	0
H_2O	0.0	0
CO_2	0.3	0
N_2	1.8	0

2.2.5 Gas detection

Gas detection influences explosion risk in a number of ways; including time to shutdown, which again affects leak duration. In this study, Gexcon used a detection time of 10 seconds for large rates (>15 kg/s), 20 seconds for intermediate rates (2-15 kg/s), and 30 seconds for small rates (<2 kg/s).

2.2.6 Shutdown and blow-down

Emergency depressurizing philosophy has been provided by CLIENT [7].

The blow-down rates were calculated by Gexcon using the proposed values listed below:

- Time to ESD valves fully closed: 60 seconds after high alarm.
- Automatic blow down initiated immediately after complete shutdown.
- The blow down rate is defined so that the segment pressure in the processing equipment is reduced to 7 barg or 50 % of MAWP (Maximum Allowable Working Pressure) (the strictest being applied) in 15 minutes.

2.3 Ignition probability modelling

The Time Dependent Ignition Model (TDIM) was applied in this probabilistic explosion study. TDIM is based on a joint industry project where the aim was to establish ignition probabilities for use for gas leaks in offshore modules. The basis for the model was a number of recorded leaks, where most of the leaks were small and with a mean duration estimated to five minutes. The data were established in order to be relevant for the period before ignition isolation.

The main elements in the model are that it provides scenario specific ignition probabilities based on the gas cloud size development, and that the model is capable of reflecting effects of measures like shutdown, depressurization and isolation. Adjustment factors relative to the age of the installation, the levels of maintenance and manning, and the type of technology used are also described. The main ignition sources in the model are the continuous sources that with a given probability cause ignition at first exposure of flammable gas, and the discrete ignition source that gives a spark with a given probability per second while exposed to flammable gas. The model is different from models usually used in QRAs, in the sense that it is more complex and more realistic, but also less conservative. As in all ignition models, there are large uncertainties in the results due to the lack of historical data and the difficulty to analyze such accidents. Gexcon's point of view is that the model is more trustworthy than empirical models, which are too conservative.

The ignition intensities for the various elements in the model such as pumps, compressors, electrical equipment, etc. have been established based on evaluations of events reported in WOAD, the HCR database, and the Blowout database. Based on the first ignition intensities developed, a benchmarking study was undertaken and the results from the benchmarking study formed the basis for the latest guidelines for the use of the model. The ignition intensities used by Gexcon for the present study are in accordance with the latest guidelines.

Ignition intensities are separated into two classes, continuous and discrete ignition sources:

- Continuous ignition sources will ignite the flammable gas cloud as soon as it reaches the source. Continuous ignition sources are therefore only associated with new volumes of flammable gas. Once the flammable gas cloud is in a steady state situation, or decreasing in size due to the leak being shut down, continuous ignition sources do not contribute anymore.
- Discrete ignition sources can ignite a combustible gas cloud at any moment. Discrete ignition sources are associated with the total flammable volume of gas and contribute as long as the flammable gas is present.

Ignition intensities are grouped by type of source (hot work, pumps, compressors, generators, electrical equipment, other equipment, other and personnel). For hot work, the relevant parameter is the number of hours per year. For pumps, compressors and generators, the number of active sources is taken into account. For the rest, the exposed ground area and deck area are used.

Adjustment factors for age of the installation, maintenance, manning and technology are also introduced in the model:

- adjustment factor for age (<u>new, < 15 years</u>)
- adjustment factor for maintenance (<u>normal</u>)
- adjustment factor for manning (<u>average for new facility</u>)

- adjustment factor for technology (after 1980)

Adjustments are made according to TDIIM guidelines DNV Report No. 99-3193, “Technical Report: JIP Guidelines for use of JIP Ignition Model” [6], (**Table 2-6** through **Table 2-9).**

Table 2-6 Recommended adjustment factors for age

Ignition Source	Old (> 15 years)	New (< 15 years)
Electrical equipment	1.2	0.9
Rotating machinery	1.2	0.9
Other equipment	1.2	0.9
Other	1.0	1.0
Presence of personnel	1.0	1.0

Table 2-7 Recommended adjustment factors for maintenance

Ignition Source	Normal	Infrequent	Frequent
Electrical equipment	1.0	1.2	0.90
Rotating machinery	1.0	1.3	0.85
Other equipment	1.0	1.2	0.90
Other	1.0	1.0	1.0
Presence of personnel	1.0	1.1	0.95

Table 2-8: Recommended adjustment factors for manning level

Ignition Source	Average for old facility	Unmanned	Average for new facility	Excessive
Presence of Personnel	1.3	0.2	0.6	2.0

Table 2-9: Recommended adjustment factors for technology

Ignition Source	Before 1980	After 1980
Electrical equipment	1.5	0.6
Rotating machinery	1.5	0.6
Other equipment	1.5	0.6
Other	1.0	1.0
Presence of personnel	1.0	1.0

The ignition intensities which were used for the LPG Recovery Unit area are shown in Table 2-10 and Table 2-11.

Table 2-10 Continuous ignition sources

	Gas		Adjustment factors for ignition source categories				
			Age	**Maintenance**	**Manning**	**Technology**	**Overall**
Hot work							
Pumps	9.60E-05	Rotating machinery	0.9	1	1	0.6	0.54
Compressors	2.30E-03	Rotating machinery	0.9	1	1	0.6	0.54
Generators	3.5E-03	Rotating machinery	0.9	1	1	0.6	0.54
Electrical equip.*	2.60E-06	Electrical eq.	0.9	1	1	0.6	0.54
Other equip.*	2.60E-06	Other eq.	0.9	1	1	0.6	0.54
Other*	1.30E-06	Other	1	1	1	1	1
Personnel*	3.00E-06	Personnel	1	1	0.6	1	0.6

* per m^2 of ground exposed to gas

Table 2-11 Discrete or intermittent ignition sources

	Gas		Adjustment factors for ignition source categories				
			Age	**Maintenance**	**Manning**	**Technology**	**Overall**
Pumps	2.10E-07	Rotating machinery	0.9	1	1	0.6	0.54
Compressors	5.10E-06	Rotating machinery	0.9	1	1	0.6	0.54
Generators	6.2E-06	Rotating machinery	0.9	1	1	0.6	0.54
Electrical equip.*	2.70E-08	Electrical eq.	0.9	1	1	0.6	0.54
Other equip*	2.10E-09	Other eq.	0.9	1	1	0.6	0.54
Other*	1.70E-08	Other	1	1	1	1	1
Personnel*	4.00E-08	Personnel	1	1	0.6	1	0.6

* per m^2 of ground exposed to gas

Input to the number of active ignition sources (preferably split by area) and exposed ground area for the various areas of concern were provided by CLIENT and listed in Table 2-12. Normally, ignition probability is only calculated for the areas where gas might appear.

Table 2-12 Input to the ignition model

	Area
	New LPG Area
# hours of hot work per year*	40
# of pumps	9**
# of compressors	4**
# of generators	13***
Other (1 ground level area – m^2)	7052
Exposed ground area (all level ground + deck area - m^2)**	7052

* Assumed by GexCon
** Taken from EL-10-XXXX.XX-3200-001 [8]
*** Calculated assuming each of pumps and compressors have a generator

2.3.1 Reduction of ignition intensities

It is assumed that ignition control measures are effectuated at gas alarm. Ignition intensities are reduced or shut down according to the facility philosophy for disconnection of different equipment upon gas detection. The group "Other" represents ignition sources that are "unknown", and can therefore not be reduced.

The following information based on the latest guidelines, DNV Report No. 99-3193 "Technical Report: JIP Guidelines for use of JIP Ignition Model" [6] are used:

For continuous ignition intensities:

- Intensities for pumps and compressor are reduced by 50 % every 15 seconds after high gas alarm.
- Intensities for electrical equipment, other equipment and personnel are reduced by 50 % every five seconds after high level gas alarm.
- Intensities for hot work are reduced by 50 % every 10 seconds after low alarm.

The example of typical reduction model for continuous ignition intensities is illustrated in Figure 2-3

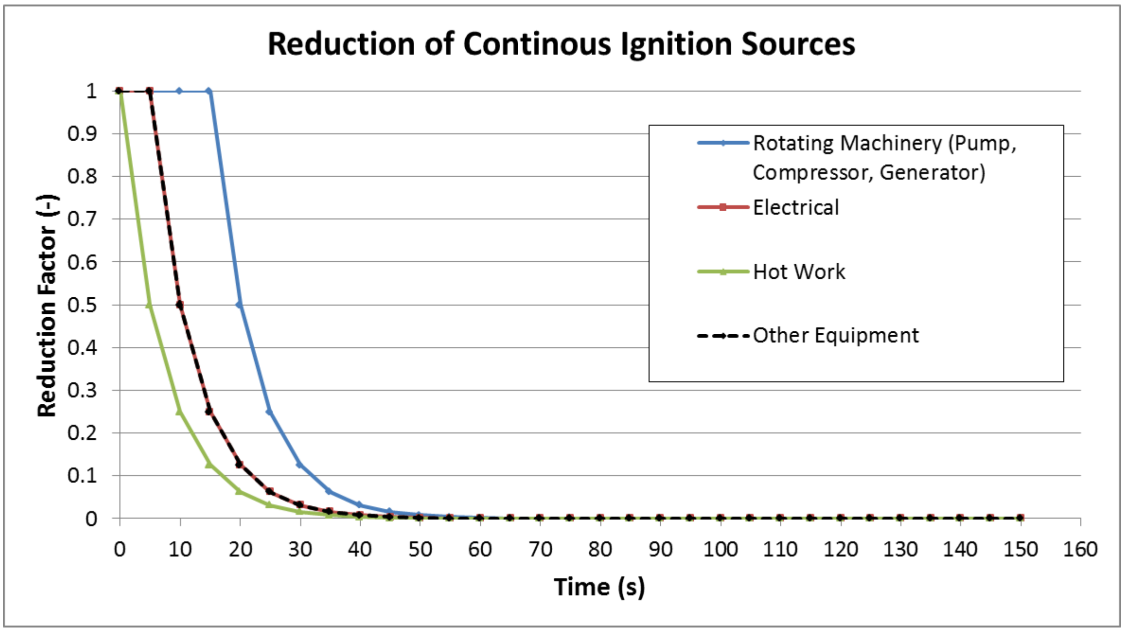


Figure 2-3 Reduction of continuous ignition intensities, t=0 → leak start. Low gas alarm= 15s. High gas alarm=30s

For discrete ignition intensities:

- Intensities for pumps and other equipment are reduced by 75 % after high gas alarm.

- Intensities for electrical equipment are reduced by 20 % after low gas alarm, and 50 % after high gas alarm.
- Intensities for personnel are reduced to 0 after 1 minute following low gas alarm, i.e. it is assumed that personnel have left the area.

The example of typical reduction model for discrete ignition intensities is illustrated in Figure 2-4.

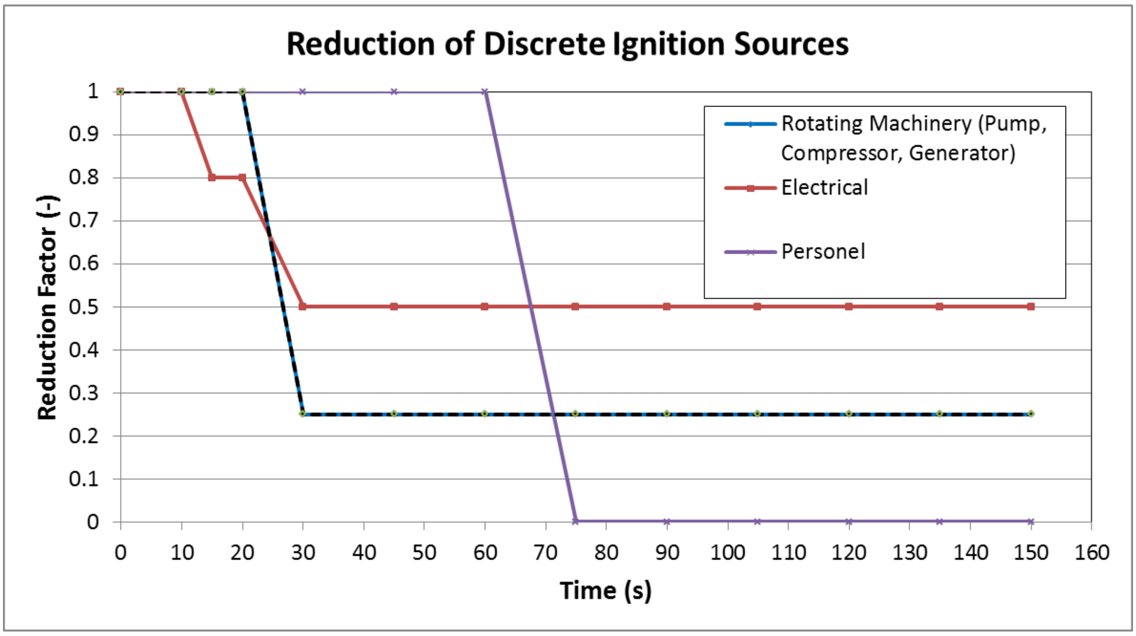


Figure 2-4 Reduction of discrete ignition intensities t=0 → leak start. Low gas alarm= 15s. High gas alarm=30s

2.4 Structure and equipment

Solid structure and solid equipment are modeled with zero porosity – thus they are closed. In this study, openings in buildings were considered closed and buildings were assumed as solid blocks.

Equipment that is too small to be resolved on the computational grid was represented with a decreased porosity in the computational cell (i.e. the area/volume is not completely open). Equipment (including equipment too small to be resolved on the computational grid) was taken into account in the turbulence and flame propagation models.

Structures and equipment were assumed to be solid and unyielding during the entire explosion, i.e. they remained in place even for the largest explosion loads.

3 Geometrical model

The new LPG Recovery Unit is located around PTT ESP Plan, Pond Area, and Stock and Waste Yard Area in PTT Gas Separation Plant, Map Ta Phut, Rayong, Thailand. The existing facility model of ESP plant was transferred from PTT PDMS model of the area and converted to FLACS. For the LPG Recovery Unit, a DWG was prepared by Arthit E&C Co., Ltd. and then converted in FLACS format. The 3D FLACS model of LPG Recovery Unit is illustrated in Figure 3-1.

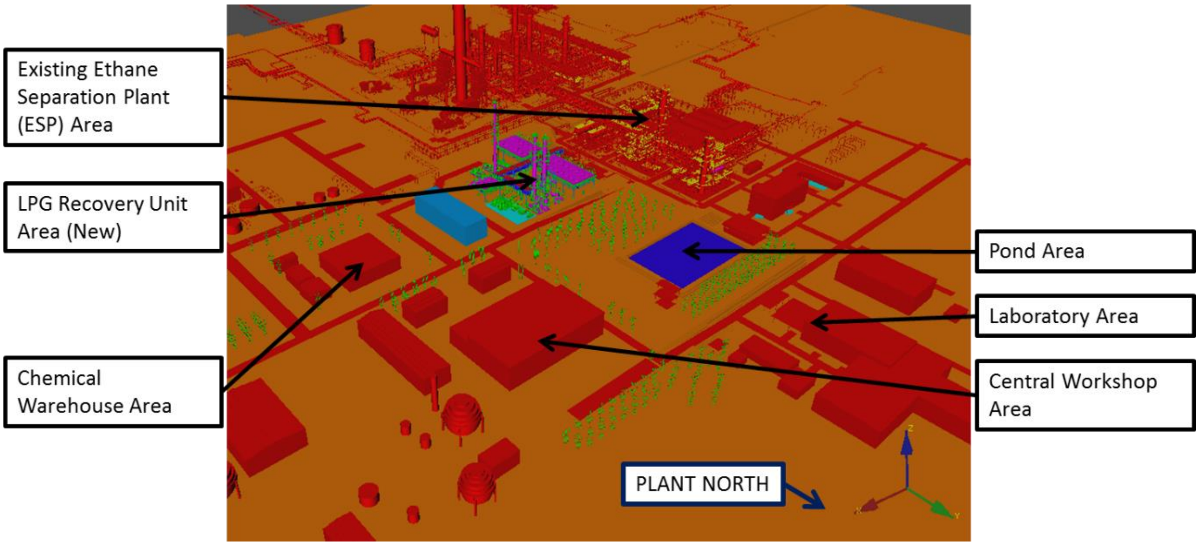


Figure 3-1 FLACS 3D model of LPG Recovery Unit and the existing adjacent areas, view from north east

As part of the scope of work, three geometry variations were prepared, which are listed in Table 3-1 below.

Table 3-1 Geometry Variation Cases

Geometry Option	Description
Base Case	LPG Recovery Unit is 6m above ESP Area
Case 1	LPG Recovery Unit is 3m above ESP Area
Case 2	LPG Recovery unit is 0m / same elevation as ESP Area

Those three variations are depicted in Figure 3-2 to Figure 3-4.

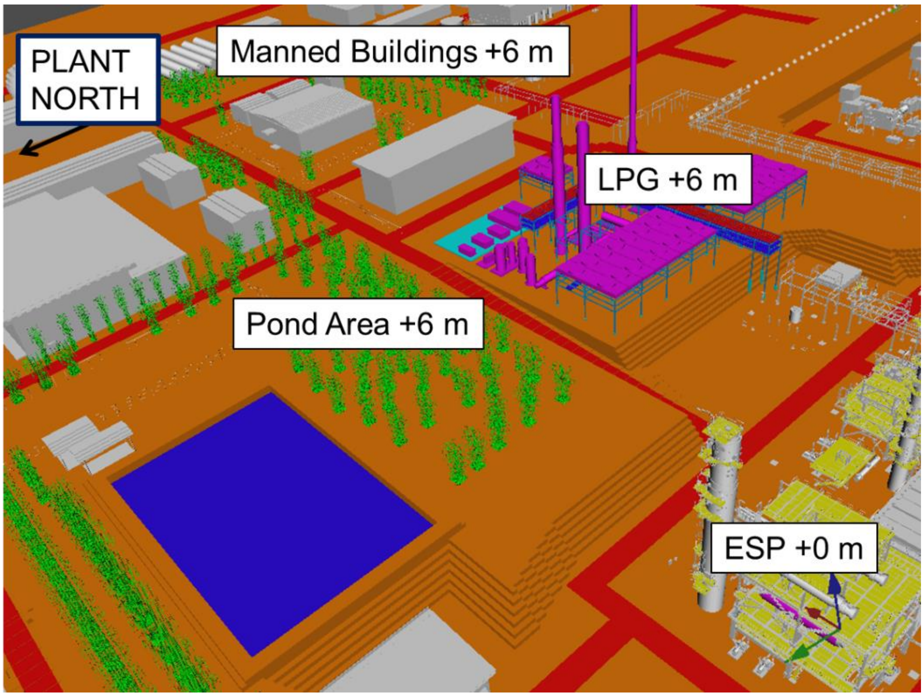


Figure 3-2 North west view of Base Case geometry, LPG Unit is 6 m above ESP

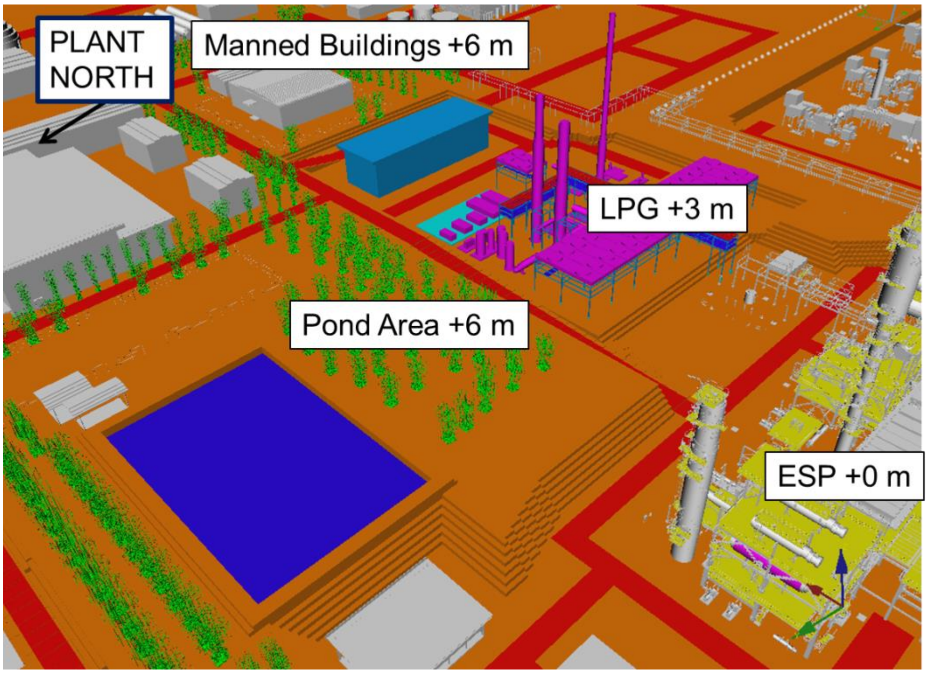


Figure 3-3 North west view of Case 1 geometry, LPG Unit is 3 m above ESP

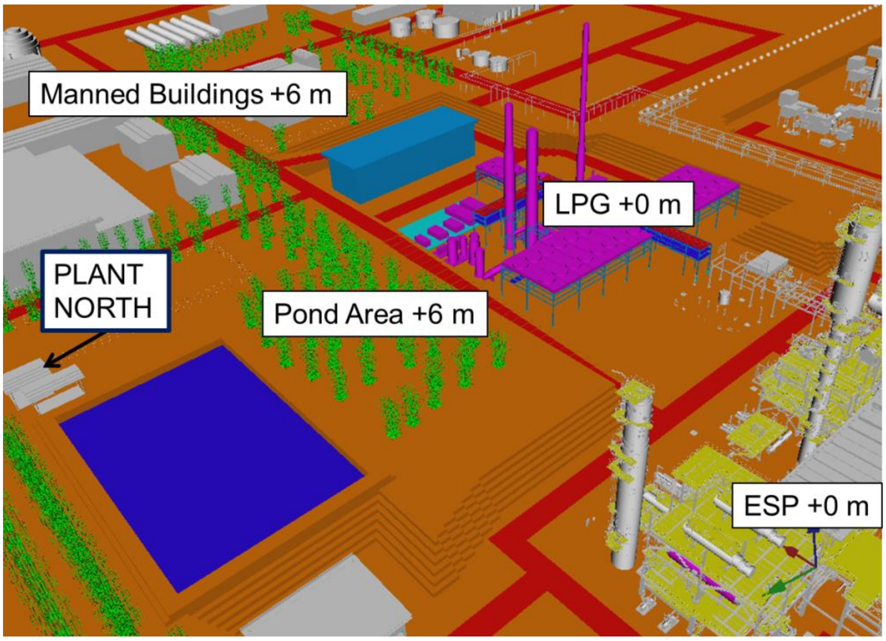


Figure 3-4 North west view of Case 2 geometry, LPG Unit is 0 m above ESP (same elevation)

For explosion simulations, additional congestion blocks were added into the LPG Recovery Unit area using the Anticipated Congestion Method (ACM) and based on discussions with COMPANY and CLIENT. Incomplete CAD model typically missing skids, tertiary steel, mid and small size piping, cable racks, pipe support, etc. Goal of ACM is to identify missing congestion and implement approximate representation. ACM method involves the import of incomplete model, identification of missing congestion, and implementation of congestion to the LPG Recovery Unit area.

The 3D FLACS model with added ACM is shown in Figure 3-5. Note that the green colored objects are the additional congestion blocks (AC-blocks) added by Gexcon. Snapshots of the LPG Recovery Unit area from different directions that show the complete overview of the added AC-blocks are provided in Appendix A.

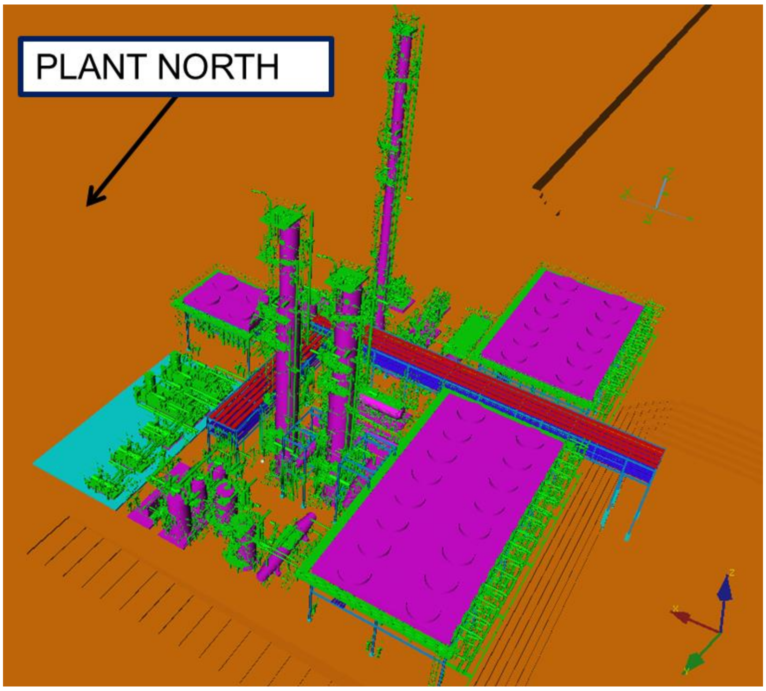


Figure 3-5 FLACS 3D model of LPG Recovery Unit with added Anticipated Congestion Modeling (ACM), view from north west

The ACM implementation in the LPG Recovery Unit area was performed by comparing the congestion parameters with the existing ESP West area. The comparison of pipe count and packing density as congestion parameters before and after the implementation of ACM are tabulated in Table 3-2 and Table 3-3.

Table 3-2 Pipe count before and after implementation of ACM

Pipe Size	Pipe Length (m)		
	LPG Recovery Unit		ESP West
	Before ACM	After ACM	
0” – 2”	0.4	**15943.8**	19796.6
3” – 4”	0	**8926.8**	5059
6” – 8”	1	**3580.5**	3356.3
10” – 14”	2495.4	**3694.9**	2073.6
16” – 30”	18	**368.9**	1972.9
< 30”	285.4	**327.0**	503.5
Total	2800.2	**32841.9**	32762.2

Table 3-3 Packing Density before and after implementation of ACM

Type	Packing Density (m/m^3)		
	LPG Recovery Unit		ESP West
	Before ACM	After ACM	
Piping (L/V)	0.008	**0.088**	0.088
Box (L/V)	0.021	**0.074**	0.209

4 Ventilation analysis

Ventilation analysis has been performed as part of the probabilistic explosion study. The purpose of the analysis is to determine the ventilation conditions of the LPG Recovery Unit area. Ventilation conditions are determined in terms of Air Changes per Hour (ACH).

4.1 Investigated scenarios

A total of 12 ventilation simulations (12 wind directions, 1 wind speed) were performed. The 12 wind directions include winds from **0°, 30°, 60°, 90°, 120°, 150°, 180°, 210°, 240°, 270°, 300°**& **330°**. Plant North direction is set at 0°.

Ventilation simulations were performed with a wind speed of 2 m/s. From 2 m/s wind speed simulations, result for all wind classes were estimated based on the assumption that there is a linear correlation between external wind speed and internal flow.

4.2 Results of the ventilation analysis

The Air Changes per Hour for all 12 wind directions are presented in Figure 4-1 for 2 m/s wind speed. Results are also illustrated in Table 4-1 to Table 4-3 for all combinations of wind speed and wind direction for the three geometry cases.

The flow pattern at the LPG Recovery Unit area with different geometry variations are provided in Appendix B.

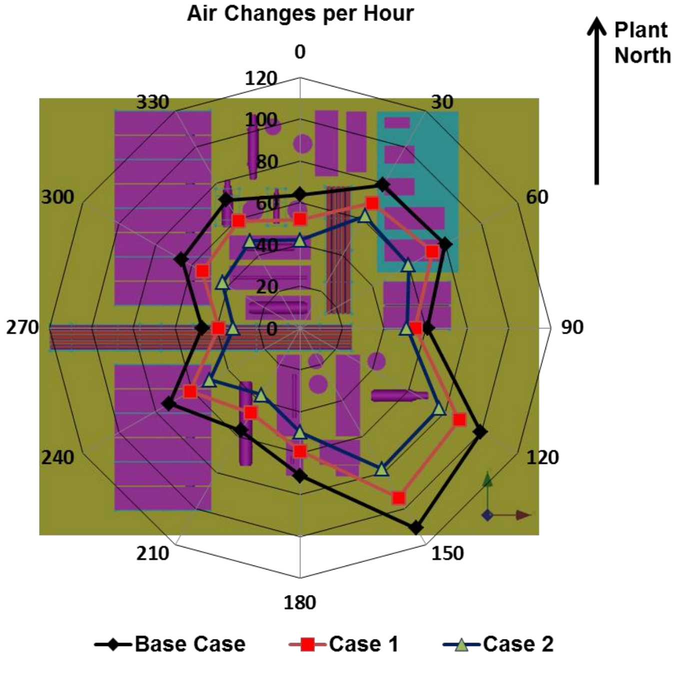


Figure 4-1 Air Changes per Hour (ACH) for 2 m/s external wind speed in LPG Recovery Unit area for Base Case, Case 1 and Case 2 geometry variations

Table 4-1 ACH in LPG Recovery Unit Area – Base Case geometry variation for combination of wind speed and wind direction

Wind Speed (m/s)	Wind Directions (°)											
	0	**30**	**60**	**90**	**120**	**150**	**180**	**210**	**240**	**270**	**300**	**330**
0.1	3	4	4	3	5	6	4	3	4	2	3	4
1.1	35	43	44	33	55	61	39	31	40	26	36	39
3	96	118	120	91	150	166	106	85	109	70	98	106
5	159	197	200	152	250	277	177	142	181	117	164	176
7	223	276	280	213	349	388	248	199	254	164	229	247

Table 4-2 ACH in LPG Recovery Unit Area – Case 1 geometry variation for combination of wind speed and wind direction

Wind Speed (m/s)	Wind Directions (°)											
	0	**30**	**60**	**90**	**120**	**150**	**180**	**210**	**240**	**270**	**300**	**330**
0.1	3	3	4	3	4	5	3	2	3	2	3	3
1.1	30	37	39	31	47	52	32	26	34	22	30	33
3	81	101	105	84	128	141	87	72	93	60	83	90
5	135	168	175	140	213	235	145	120	155	100	138	150
7	189	235	245	196	298	329	203	168	217	140	193	210

Table 4-3 ACH in LPG Recovery Unit Area – Case 2 geometry variation for combination of wind speed and wind direction

Wind Speed (m/s)	Wind Directions (°)											
	0	**30**	**60**	**90**	**120**	**150**	**180**	**210**	**240**	**270**	**300**	**330**
0.1	2	3	3	3	3	4	2	2	3	2	2	3
1.1	24	31	32	29	38	41	26	21	29	19	24	28
3	65	84	87	78	104	111	71	59	78	53	66	75
5	108	140	145	130	173	185	118	98	130	88	110	125
7	151	196	203	182	242	259	165	137	182	123	154	175

The frequencies of ACH have been calculated based on the wind statistics on Table 2-1. The ACH exceedance curves for all three geometry variations are given in Figure 4-2. ACH values at 95% of occurrence are below 12 ACH which indicates that the area is not well ventilated according to IP 15 standard [10] and NORSOK S-001 standard [9]. Low ventilation condition increases concern over smaller gas releases.

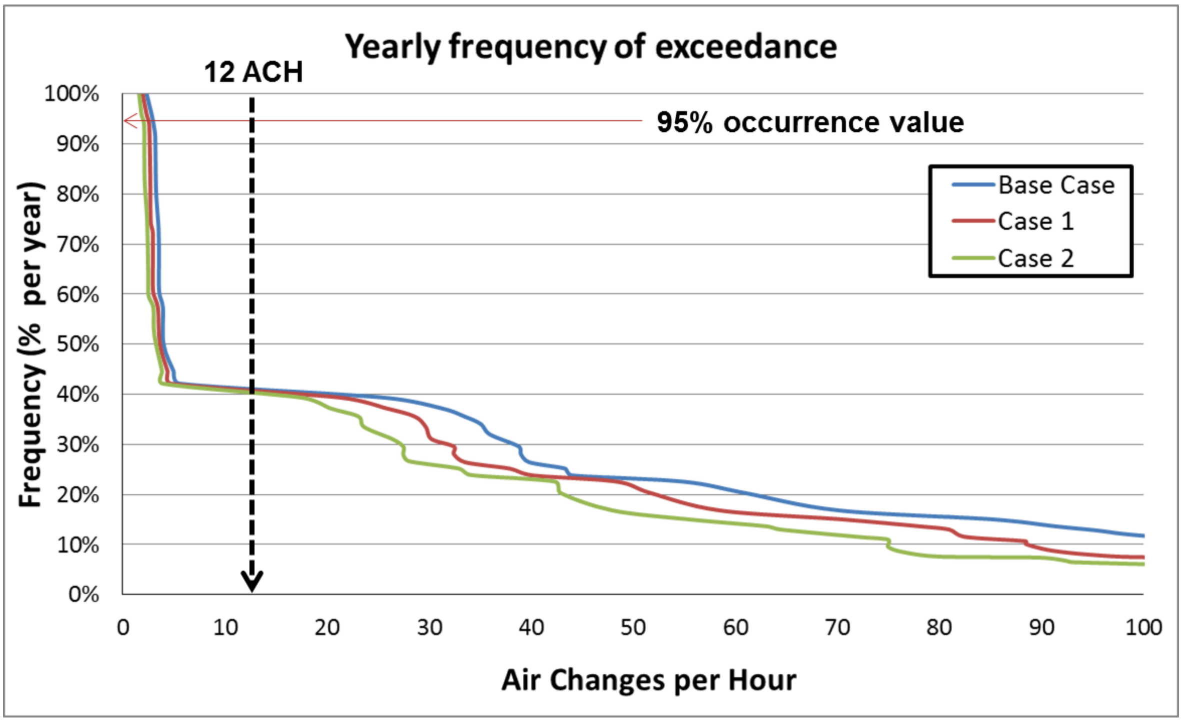


Figure 4-2 ACH exceedance curve for all three geometry cases in LPG Recovery Unit area

From the comparison of the exceedance curve, Base Case (El. +6 m) has the best ventilation conditions compared to Case 1 (El. +3 m) and Case 2 (El. 0 m). When the LPG Recovery Unit is placed on the elevation of 6 m, the air flow can move more freely due to less congestion and confinement at the surroundings. It is expressed by the relatively high number of ACH for the Base Case compared to the other two cases. When the elevation of the LPG Recovery Unit is lowered, it becomes heavily congested by the surroundings. Thus the air flow becomes more restricted, resulting in poorer ventilation. This is shown as a lower ACH for Case 2 (El. 0 m).

It is worth noting that low calculated ACH is due to the large portion (61%) of low wind (0 - 0.2 m/s) at the entire PTT Separation Plant and not subjected to the design features of the LPG Recovery Unit area.

5 Dispersion analysis

Dispersion simulations were performed in order to establish representative gas clouds likely to be generated for various wind and release conditions. Results from dispersion analysis were used as a basis for the probabilistic explosion study and to calculate explosion frequencies.

5.1 Investigated scenarios

A total of 1,152 dispersion simulations were performed in order to establish representative gas clouds likely to be generated for various wind and release conditions. Using the frozen cloud assumption, a total of 3,456 scenarios were used in the analysis.

Frozen cloud approximation is used to limit the number of simulations. This means that not all leak rates and wind classes were simulated. Typically, several wind classes and leak rates are simulated, and the remaining conditions are estimated based on the frozen cloud approximation. The frozen cloud approximation is based on interpolation of cloud size data from the dispersion simulations. Note that this is not simply an interpolation of cloud sizes, but is derived by interpolating gas concentration in each and every control volume at every second. (Typical simulation domains have several hundred thousand or millions of control volumes). The frozen cloud approximation yields a detailed scenario description, including a representation of how cloud build-up develops over time.

For the explosion risk analysis, 9 leak rates were used: 0.75, 1.5, 3, 6, 12, 24, 48, 96, and 192 kg/s. However, not all leak rates were simulated. The 0.75, 3, 12, 48, 96 and 192 kg/s leak rates were simulated, and the remaining rates were estimated based on the frozen cloud assumption.

Wind conditions include 4 wind directions (west, east, south and north) and 4 wind speeds. 2 wind speeds for each direction were simulated, and the remaining wind speeds were estimated based on the frozen cloud assumption. The wind directions and wind speeds used in this study are tabulated in Table 5-1.

Table 5-1 Wind directions and wind speed used in the dispersion study

Wind Direction Relative to Plant North	Wind Speed (m/s)[c]			
	1	2	3	4
West to East	0.1[a]	0.7[b]	1.5[a]	3.1[b]
East to West	0.1[a]	1.1[b]	1.9[a]	4.9[b]
South to North	0.1[a]	0.6[b]	2.2[a]	4.9[b]
North to South	0.1[a]	1.2[b]	1.7[a]	3.9[b]

Note:
[a]Simulated wind speeds
[b]Wind speed estimated by frozen cloud
[c]These wind speeds will be used to represent Base Case, Case 1 and Case 2.

Two gas composition streams were studied: Stream 1 representing lighter, buoyant gas streams and Stream 13 representing heavier, non-buoyant gas streams.

For each wind direction, 4 release locations were used. The location of the equipment in LPG Recovery Unit area is illustrated in Figure 5-1s. The representative release locations and direction are depicted in Figure 5-2 to Figure 5-5 below.

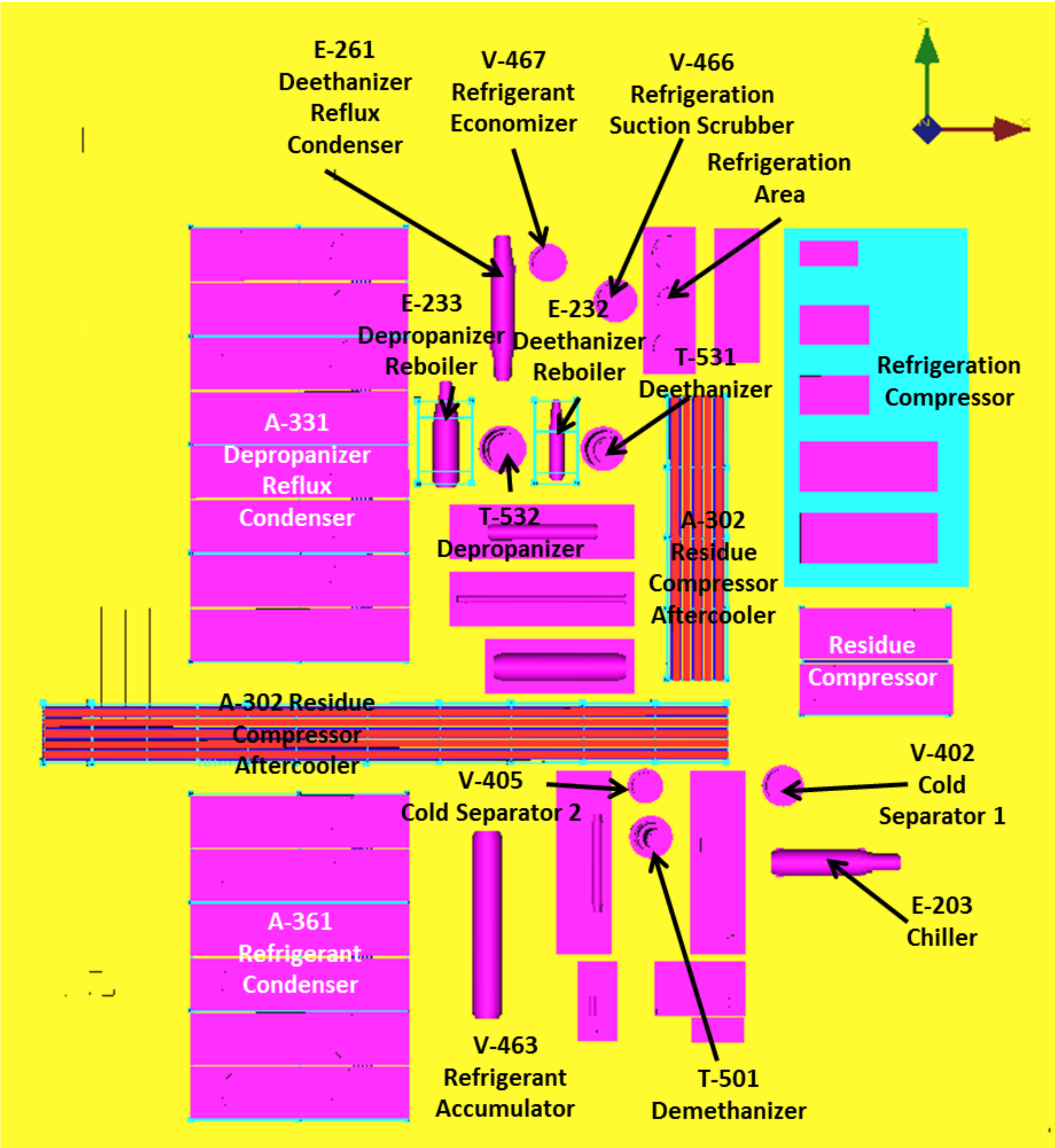


Figure 5-1 LPG Recovery Unit plan and equipment layout

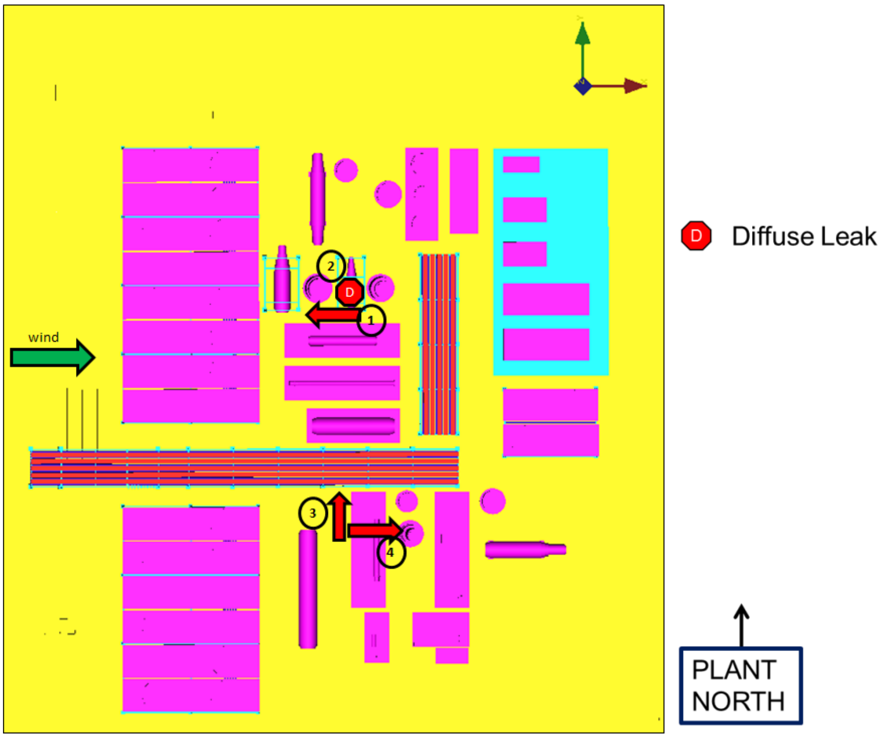


Figure 5-2 Dispersion scenarios in the LPG Recovery Unit area for wind from west to east; view from above

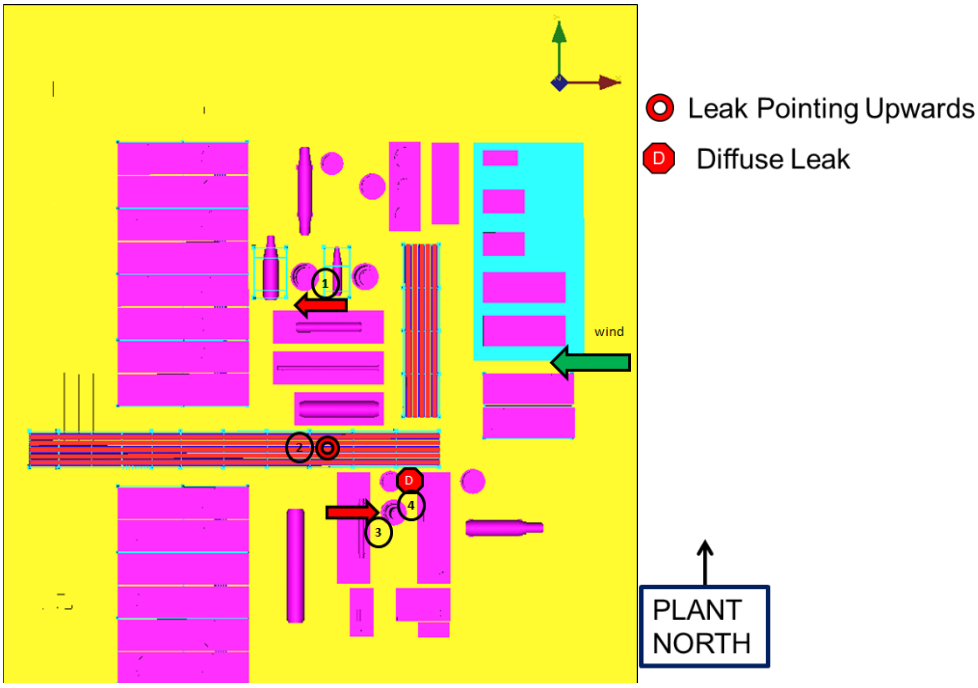


Figure 5-3 Dispersion scenarios in the LPG Recovery Unit area for wind from east to west; view from above

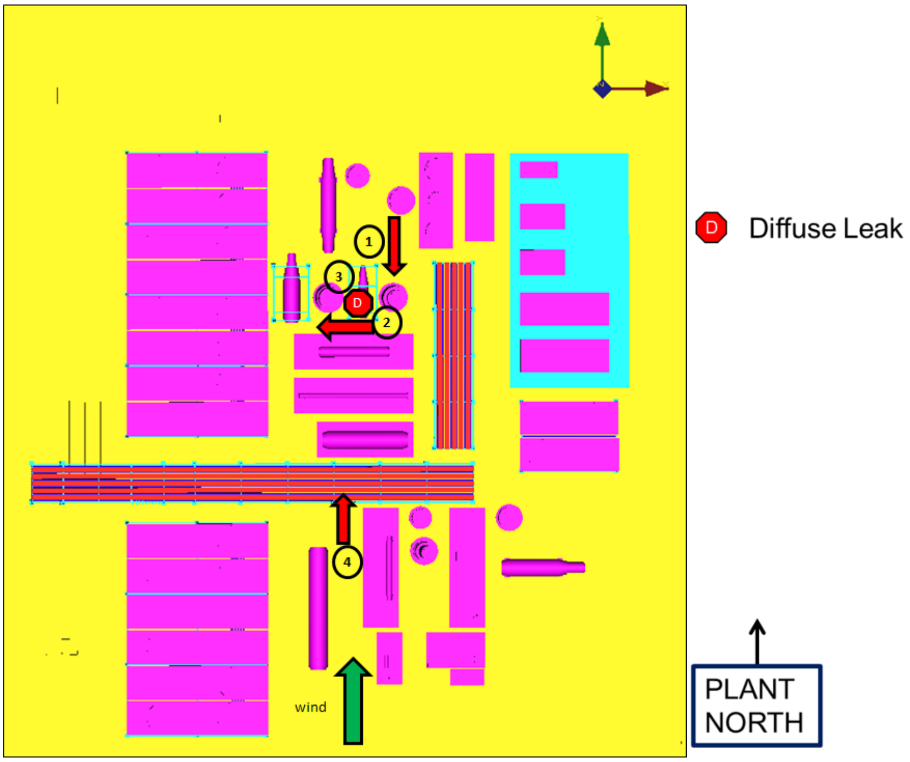


Figure 5-4 Dispersion scenarios in the LPG Recovery Unit area for wind from south to north; view from above

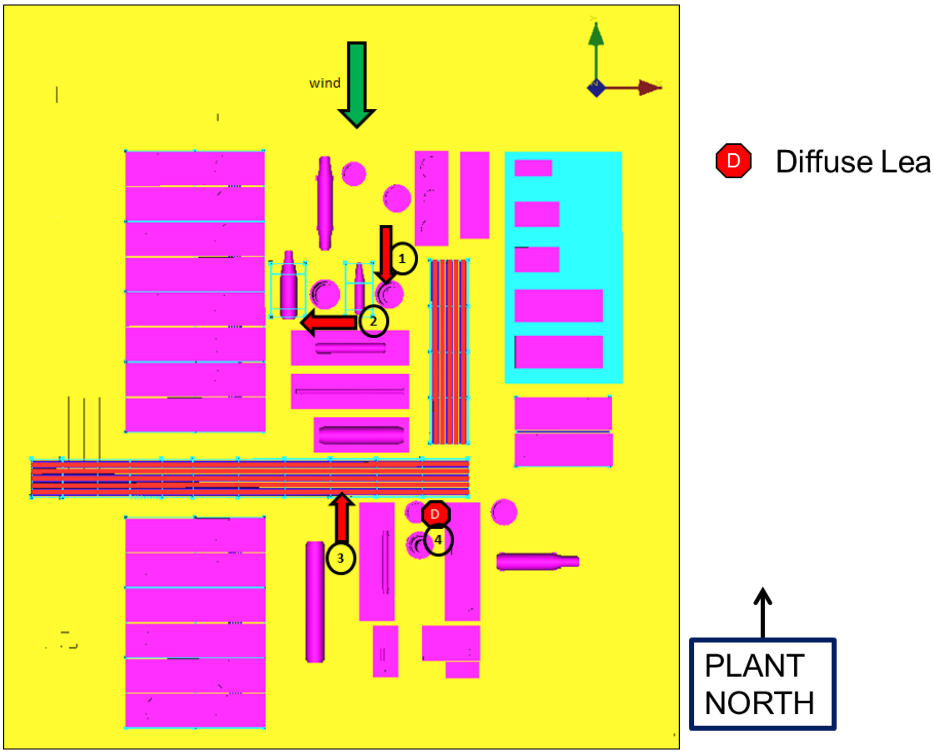


Figure 5-5 Dispersion scenarios in the LPG Recovery Unit area for wind from north to south; view from above

5.2 Measurements

From the dispersion simulations, the Equivalent Stoichiometric Cloud (ESC), the flammable volume, and the new volumes of flammable gas (new volume of flammable gas = new volume of flammable gas that appears at each second of the dispersion simulation) are monitored. Those 3 volumes are used to calculate the frequency of ignited gas cloud using the time dependent ignition model.

The ESC is a measure of the flammable part of an inhomogeneous gas cloud, which can lead to build up of explosion overpressure when the cloud is ignited (i.e. the part with concentration close to stoichiometric). The inhomogeneous gas cloud from the dispersion simulation is transformed into a homogeneous gas cloud with stoichiometric fuel air ratio by scaling the dispersed gas cloud with both a normalized laminar burning velocity (S) and a normalized expansion ration (E). For fuel concentrations outside the flammability limits, S = 0 which gives zero contribution. As an example, for a case with an inhomogeneous gas cloud with partial volume V_f of fixed concentration where E*S = ½, the volumetric contribution to the equivalent stoichiometric volume is equal to ½ *V_f.

$$\text{Equivalent stoichiometric volume} = \int_{Vol} E \cdot S \cdot dv \quad ; E, S \in [0,1]$$

Flammable and equivalent stoichiometric volumes of gas were monitored in the LPG Recovery Unit area and the adjacent areas. The LPG Recovery Unit monitor region extends 20m above the ground. Illustration of the monitoring region used in this study is provided in Figure 5-6.

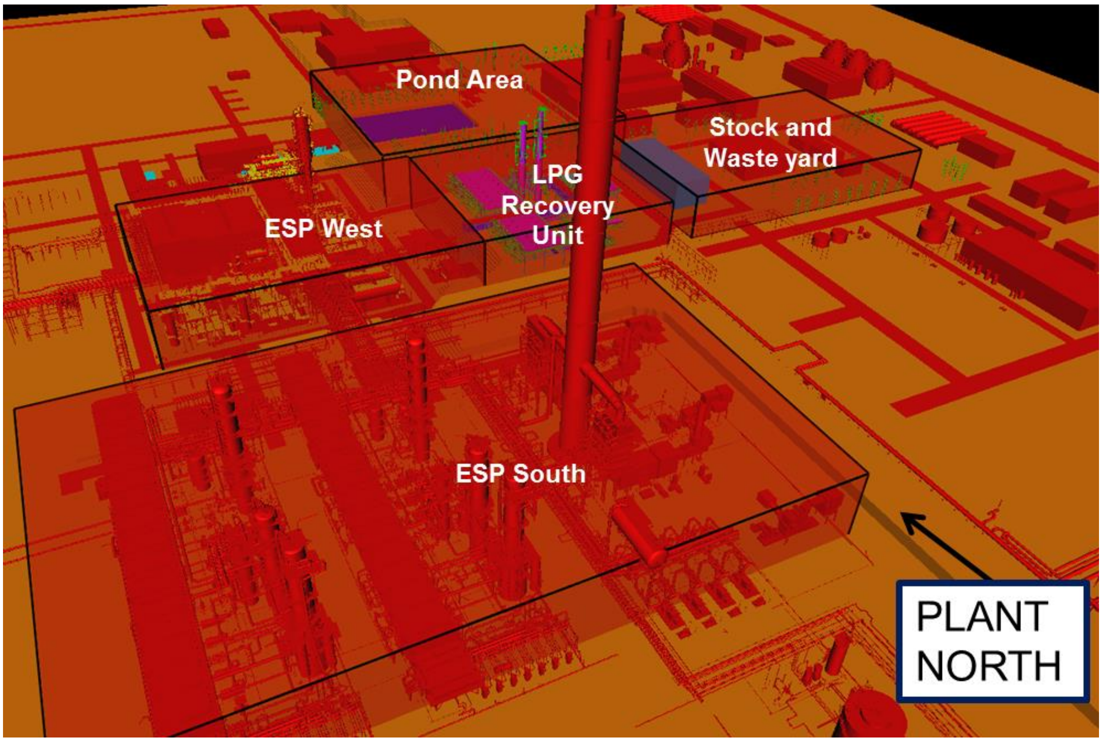


Figure 5-6 Illustration of monitoring region for LPG Recovery Unit area and adjacent units

For visualisation purposes, flammable gas dispersion depiction is set within its Lower Flammability Limit (LFL) and Upper Flammability Limit (UFL). Its values are tabulated in Table 5-2.

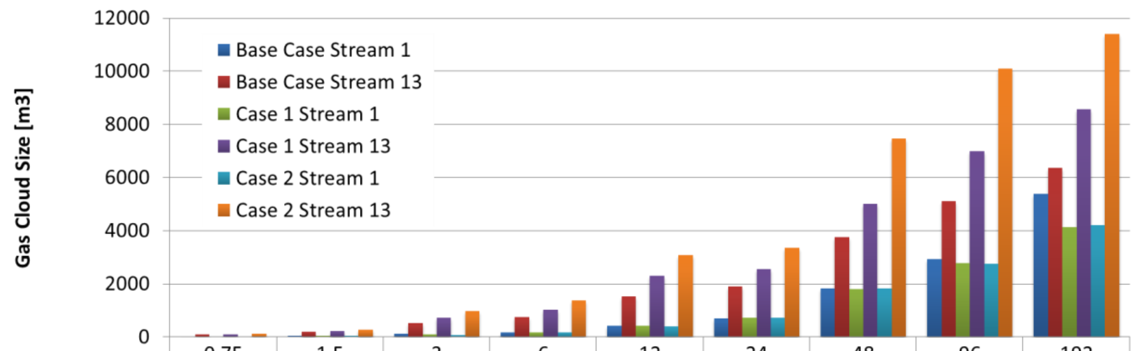
Table 5-2 LFL and UFL for visualising dispersion scenarios

Parameter	Stream 1	Stream 13
LFL	4.3 %	2.1 %
UFL	14.3 %	9.4 %

5.3 Results of the dispersion analysis

Figure 5-7 to Figure 5-8 illustrate the average and the maximum size of the ESC for the different release rates, gas composition, and geometry cases monitored in the LPG Recovery Unit area. The maximum gas cloud generated in the LPG Recovery Unit area is generated from Case 2 geometry variation (LPG Recovery Unit area is level with ESP area). It has an equivalent stoichiometric volume of 31,724 m^3 and is generated from a 96 kg/s leak pointing plant north with a wind condition of 0.1 m/s flowing from south to north. This gas cloud is illustrated in Figure 5-9.

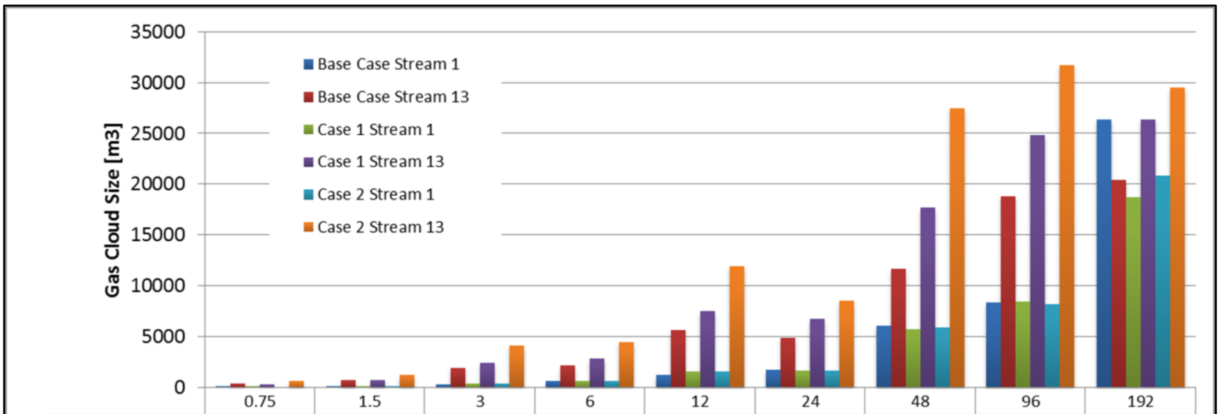
ESC volumes as a function of leak rate at other monitored areas are provided in Appendix C.



	0.75	1.5	3	6	12	24	48	96	192
Base Case Stream 1	25	39	104	169	416	691	1809	2928	5371
Base Case Stream 13	93	199	523	745	1507	1905	3751	5094	6342
Case 1 Stream 1	16	30	77	156	404	706	1804	2759	4127
Case 1 Stream 13	86	217	710	1022	2303	2551	4989	6975	8567
Case 2 Stream 1	16	29	75	155	395	706	1821	2757	4196
Case 2 Stream 13	108	266	963	1354	3061	3356	7446	10083	11388

Leak Rates [kg/s]

Figure 5-7 Average Equivalent Stoichiometric Clouds for different geometry cases and gas compositions in LPG Recovery Unit area



	0.75	1.5	3	6	12	24	48	96	192
Base Case Stream 1	92	131	297	611	1268	1725	6090	8385	26388
Base Case Stream 13	381	723	1913	2178	5639	4872	11719	18781	20405
Case 1 Stream 1	92	132	343	632	1594	1647	5721	8450	18756
Case 1 Stream 13	300	748	2410	2844	7558	6715	17696	24861	26408
Case 2 Stream 1	82	128	349	668	1596	1684	5884	8175	20896
Case 2 Stream 13	634	1268	4149	4443	11937	8502	27514	31724	29503

Figure 5-8 Maximum Equivalent Stoichiometric Clouds for different geometry cases and gas compositions in LPG Recovery Unit area

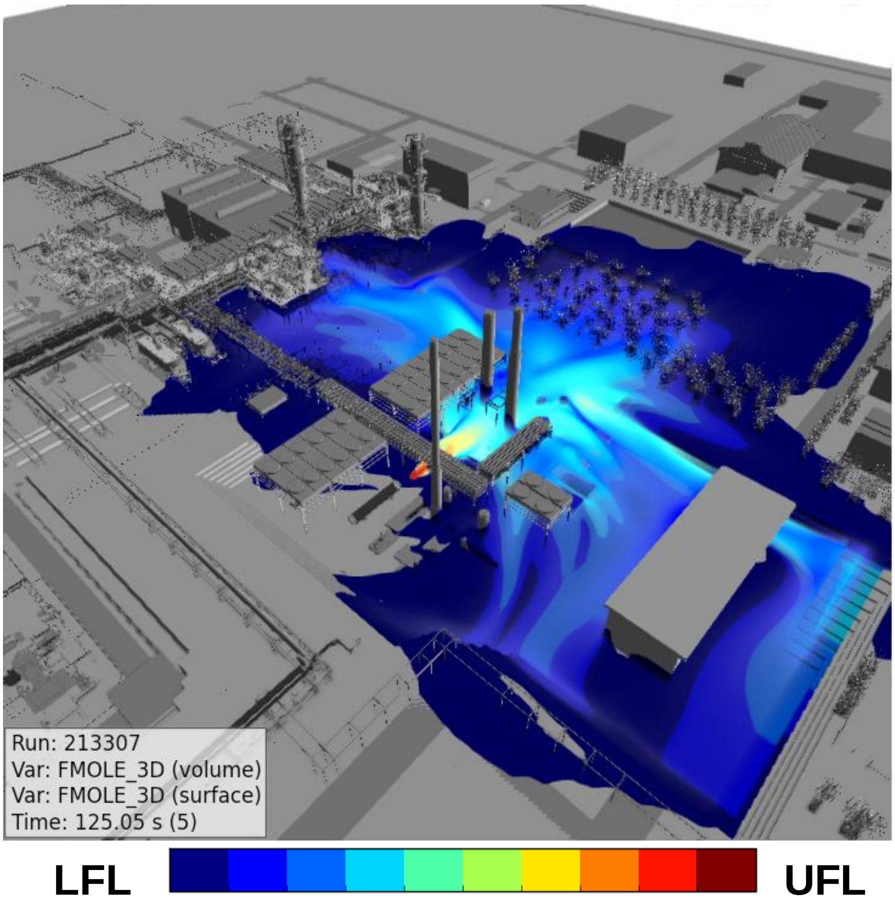


Figure 5-9 Visualisation of worst case gas cloud formation in Case 2 geometry variation, view from south-east of LPG Recovery Unit area. Red colored region indicates area with a gas concentration close to UFL (dark red) while blue region indicates area with gas concentration close to LFL (dark blue).

The trend of increasing ESC volume as the elevation of the LPG Recovery Unit lowers is obviously shown for all simulated scenarios using Stream 13 as the gas is less buoyant. When the LPG Recovery Unit is lower, the ventilation gets poorer due to the higher degree of confinement. Therefore, when there is an accidental gas release, it gets much more difficult to be diluted by the wind resulting in a flammable gas cloud build-up.

In general, as the Base Case geometry variation is well-ventilated compared to Case 1 and Case 2 geometry variations, flammable gas tends to be carried away out of the facility. On Case 1 and especially Case 2, flammable gas tends to gather around the facility, increasing average volume of ESC formed in LPG Recovery Unit area and its adjacent areas.

Figure 5-10 illustrates the comparison of different geometry variation for LPG Recovery Unit in regards of a same leak and wind conditions. The leak is a 96 kg/s Stream 13 leak pointing east toward a vessel (impinging jet) and wind flowing from east to west with 1.9 m/s speed. As the elevation of LPG Recovery goes down, ESC volume recorded in LPG Recovery Unit area and its adjacent area increases from 3,685 m3 (Base Case) to 10,877 m^3 (Case 1) and 21,572 m^3 (Case 2). Three-dimensional visualisation of the scenarios is also provided in Figure 5-11 to provide better illustration on the effect on the geometry to flammable gas cloud build-up.

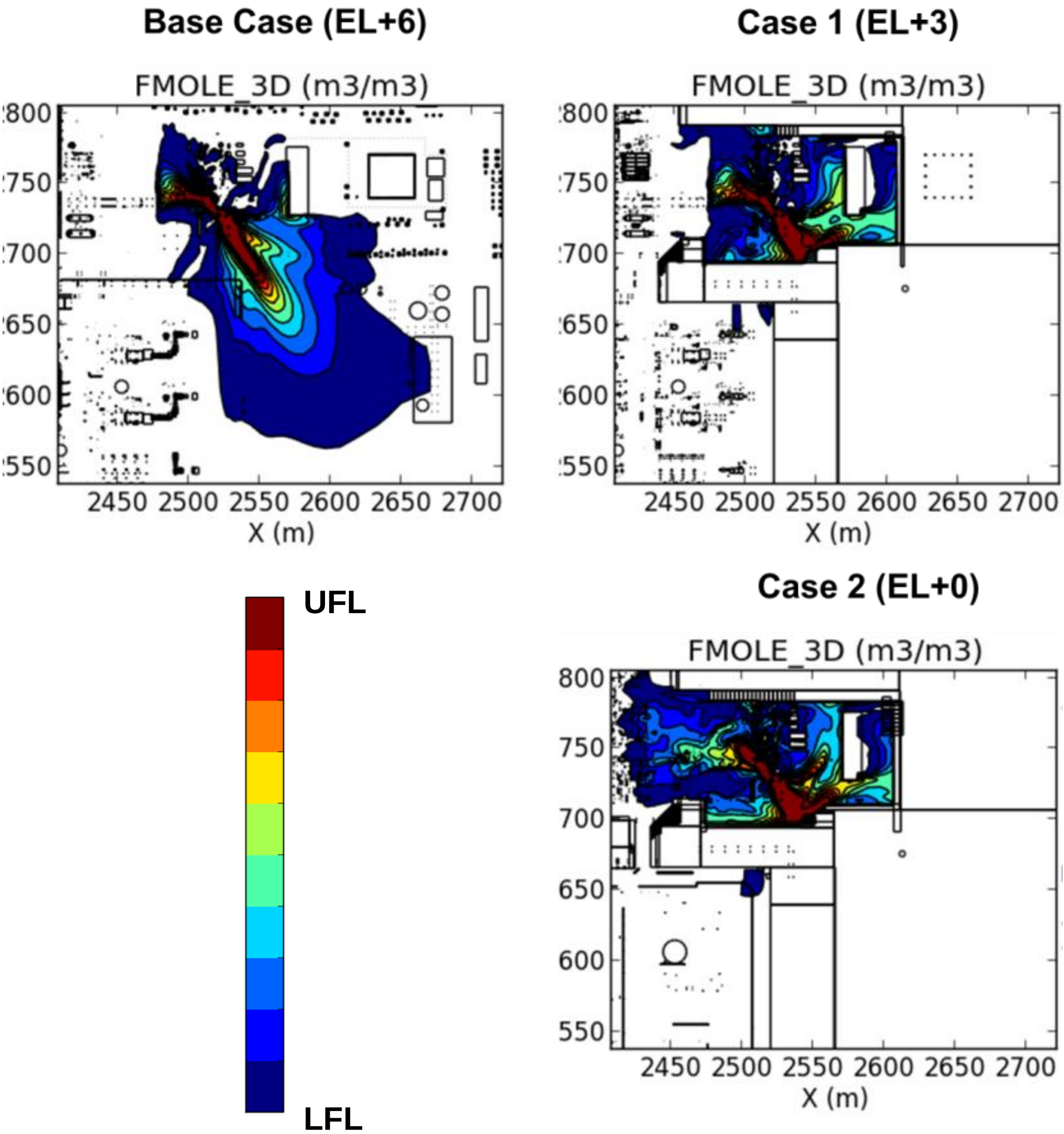


Figure 5-10 Two dimensional illustration of gas dispersion with different geometry variation with same leak and wind conditions, plan view. Red colored region indicates area with a gas concentration close to UFL (dark red) while blue region indicates area with gas concentration close to LFL (dark blue).

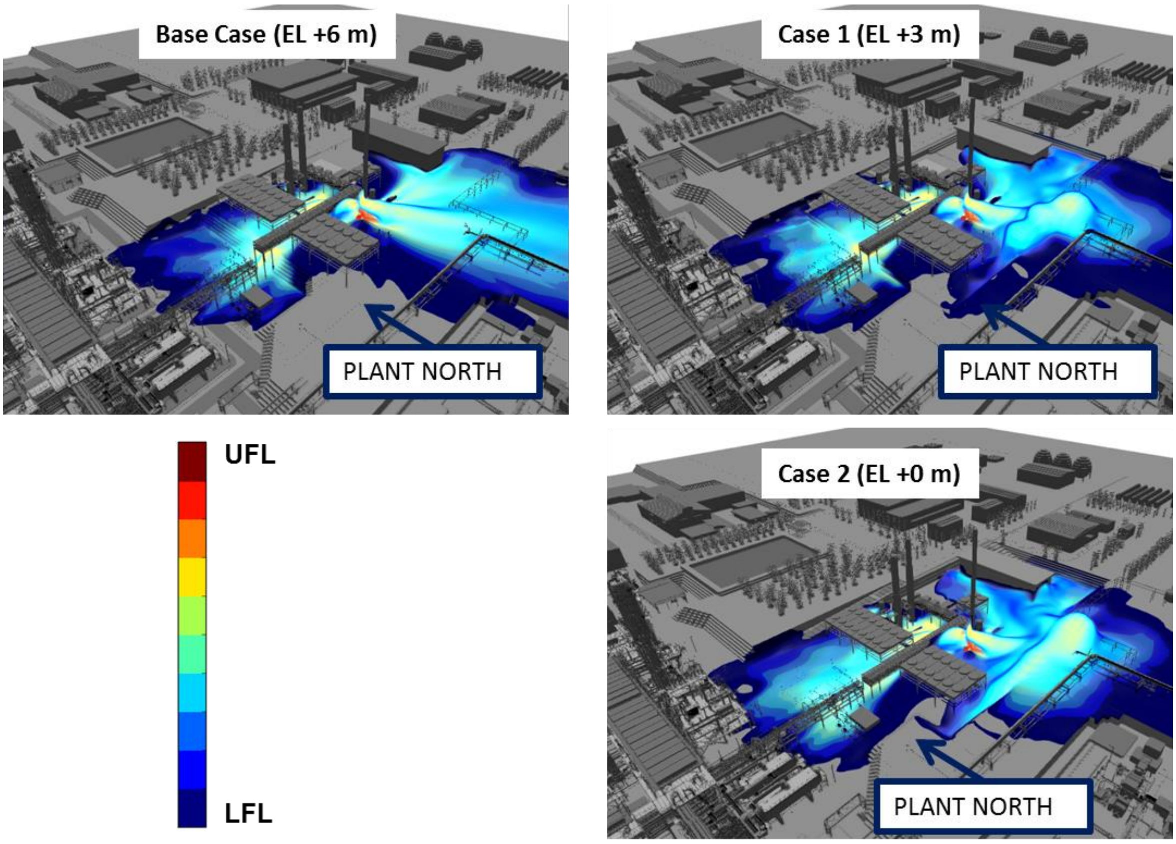


Figure 5-11 Three dimensional illustration of gas dispersion with different geometry variation with same leak and wind conditions, view from south west direction. Red colored region indicates area with a gas concentration close to UFL (dark red) while blue region indicates area with gas concentration close to LFL (dark blue).

6 Explosion analysis

The purpose of the explosion analysis is to identify potential loads in the LPG Recovery Unit area and its surrounding areas. Explosion simulations were performed by varying parameters such as gas cloud size and location, ignition location and gas composition.

6.1 Investigated scenarios

A total of 720 explosion simulations have been performed in the LPG Recovery Unit area as part of the explosion risk analysis. The explosion simulations have been performed for various geometry options (Base Case, Case 1 and Case 2), gas cloud sizes, gas cloud locations and ignition locations. The gas clouds are set at a homogeneous stoichiometric concentration. The investigated gas cloud sizes are summarized in Table 6-1.

Table 6-1 Representative explosion gas cloud volumes in the LPG Recovery Unit area

Gas Cloud Class	Representative Gas Cloud Volume (m^3)
1	500
2	720
3	1,125
4	1,620
5	2,904
6	5,832
7	8,192
8	15,129
9	26,411

The clouds in the five smallest classes (Class 1 – 5) were ignited in the centre and in one corner. The clouds of the four largest classes (Class 6 – 9) were ignited in the centre and in four different corners / sides. Figure 6-1 shows an example of gas clouds and ignition locations.

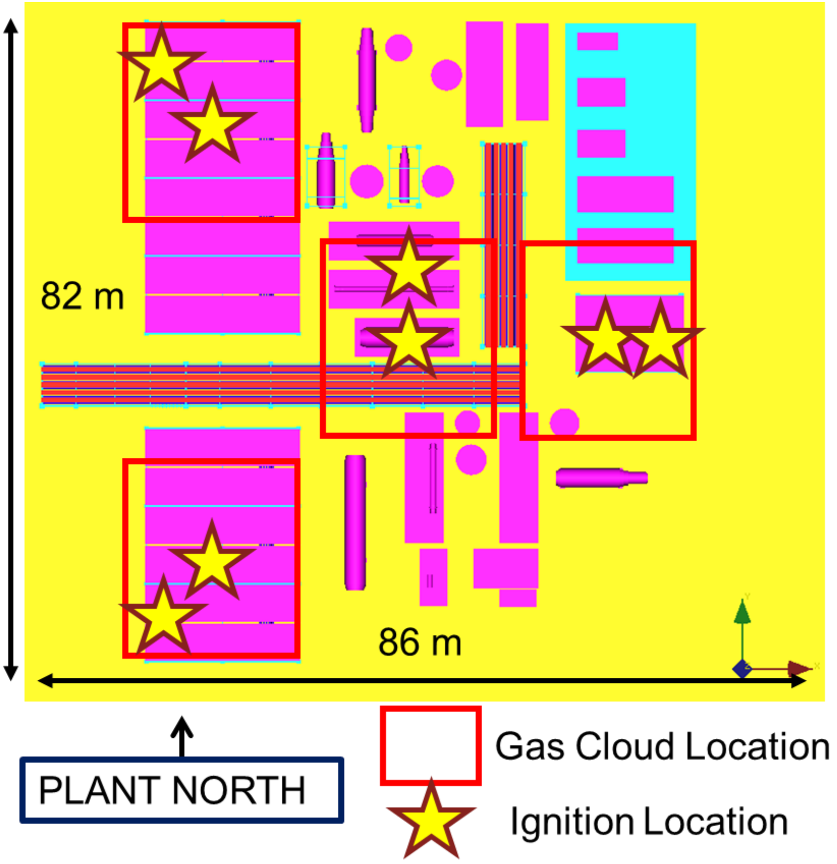


Figure 6-1 Example of explosion scenario setup – gas cloud and ignition locations in the LPG Recovery Unit area

6.2 Measurements and targets of interest

Explosion overpressures for specific targets of interest are provided in Figure 6-2 and Table 6-2. The values have been recorded by placing pressure panels on surfaces / walls and / or monitor points in the vicinity of the target locations. Pressures on walls and plated decks were measured as inactive pressure panels on the surface of the walls. Object with cross sectional area less than 2 m were measured by drag load on monitor points placed on the adjacent grid cell to the target. Differential pressure was estimated by calculating the difference in time-pressure curves at two points on different sides of the object.

The overpressure used to characterize a single scenario is the single highest overpressure value observed within the group of panels prescribed for that target. There are two sizes of pressure panel that are used in the explosion simulations, which are 3 x 3 m (Local panel) and 10 x 10 m (Global panel). Loading onto the global panels are generally lower and correspond to the loading exerted to supporting structure. Local panel refer to peak loading in a smaller area and local strength requirement such as the thickness of steel plates.

For LPG Recovery Unit area and ESP area, pressure was monitored as the pressure readings in the monitor points arranged in grid in each respective area. For a more complete details, monitor points setup is depicted in Figure 6-3 and Figure 6-4. Pressure panels setup is depicted in Figure 6-5 to Figure 6-8

Table 6-2 Targets for explosion load determination

Target	Variable
LPG Recovery Unit Area	Pressure on Monitor Points
ESP West Area	Pressure on Monitor Points
LPG Recovery Unit Substation + Control Room	Pressure on Pressure Panel
Central Workshop Area	Pressure on Pressure Panel
Stock Yard and Waste Yard Area	Pressure on Pressure Panel
Laboratory Area	Pressure on Pressure Panel
ESP Control Room	Pressure on Pressure Panel

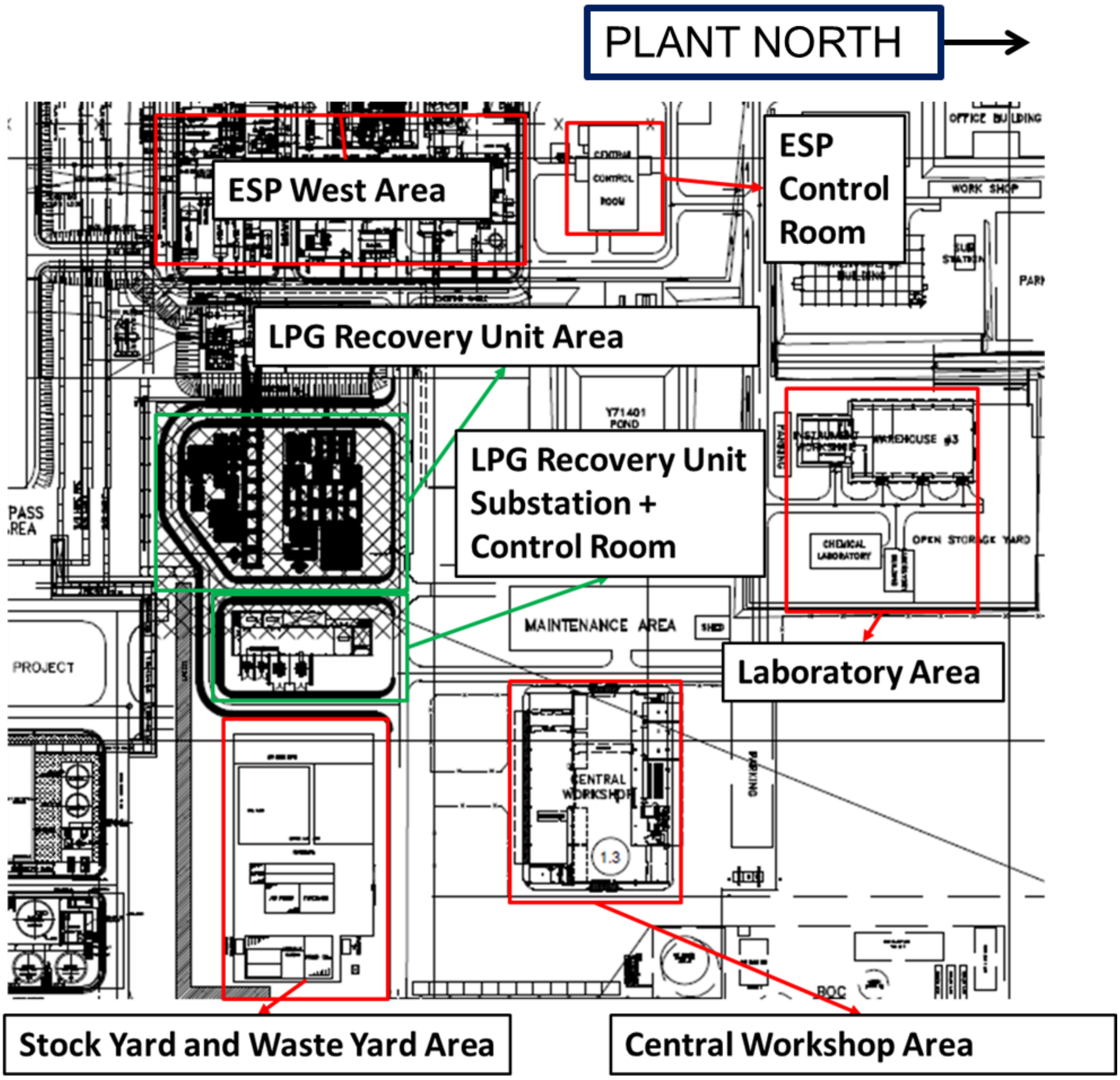


Figure 6-2 Explosion target locations relative to the LPG Recovery Unit area

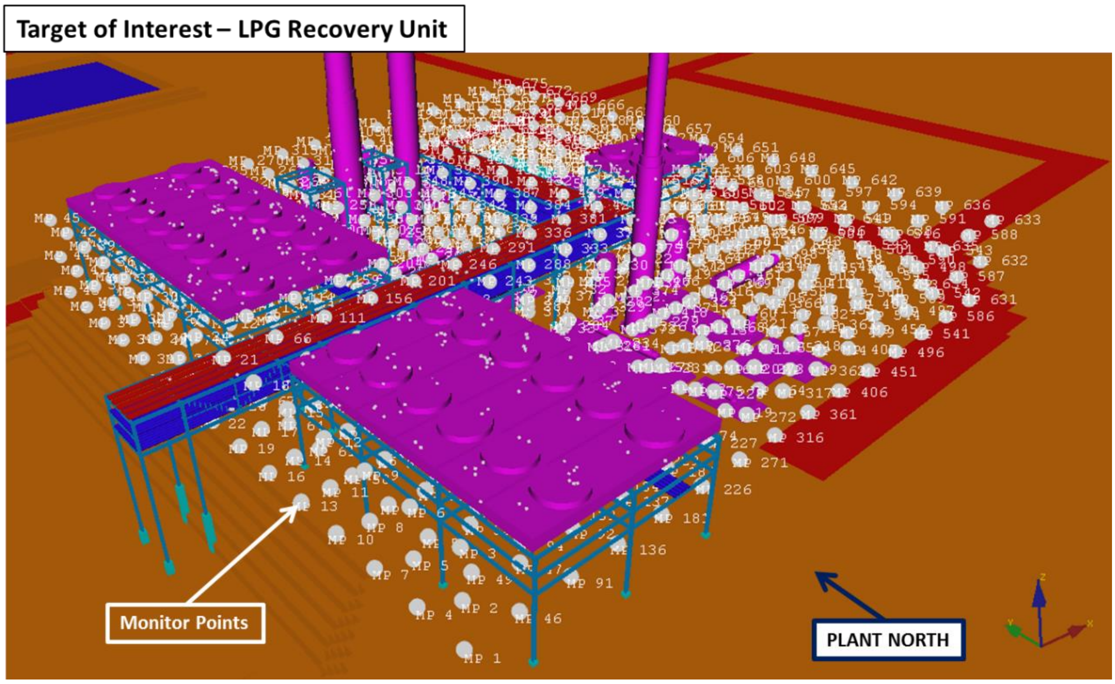


Figure 6-3 Monitor point (MP) setup at LPG Recovery Unit area

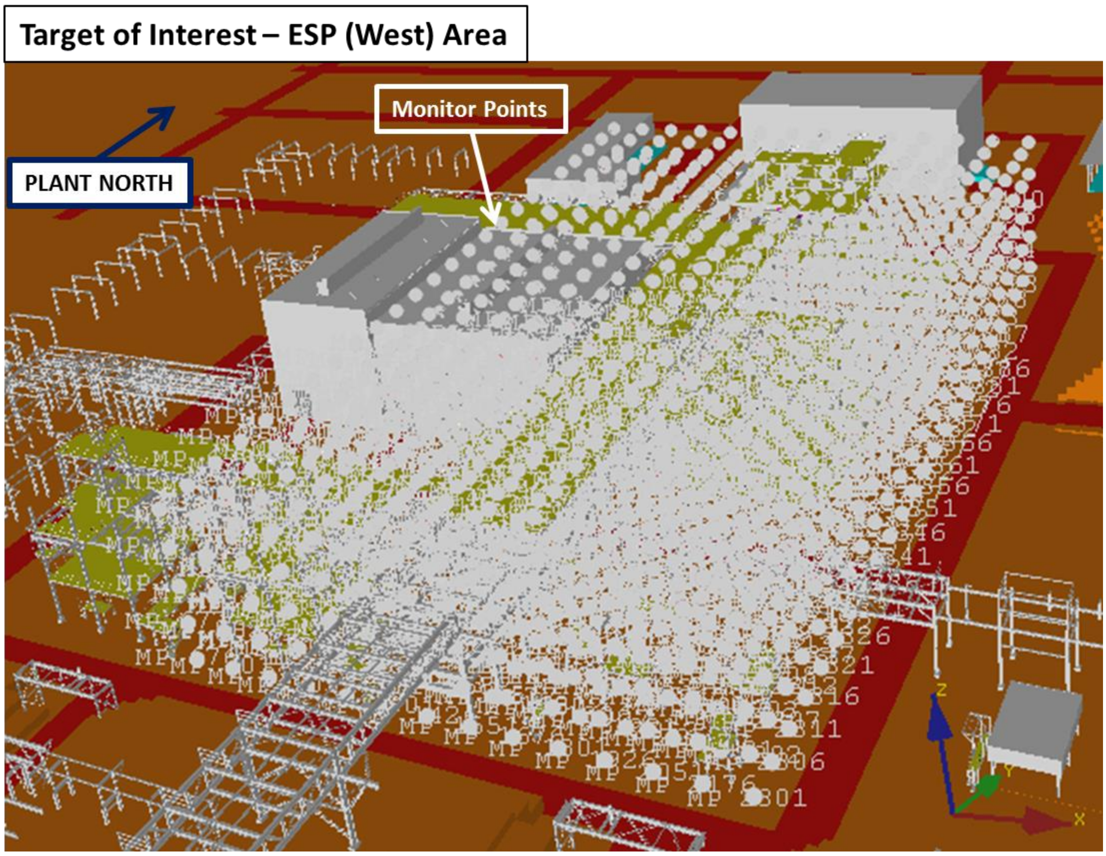


Figure 6-4 Monitor point (MP) setup at ESP West area

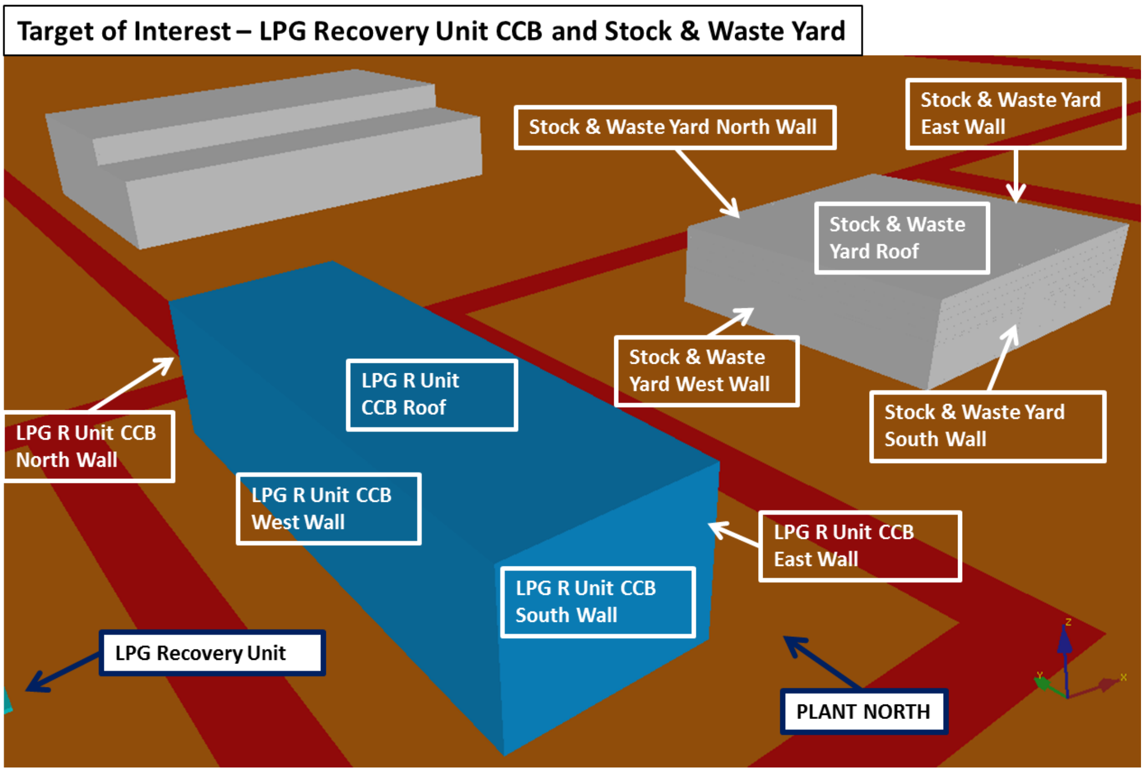


Figure 6-5 Pressure panel (PP) setup at LPG Recovery Unit CCB and Stock & Waste Yard Area

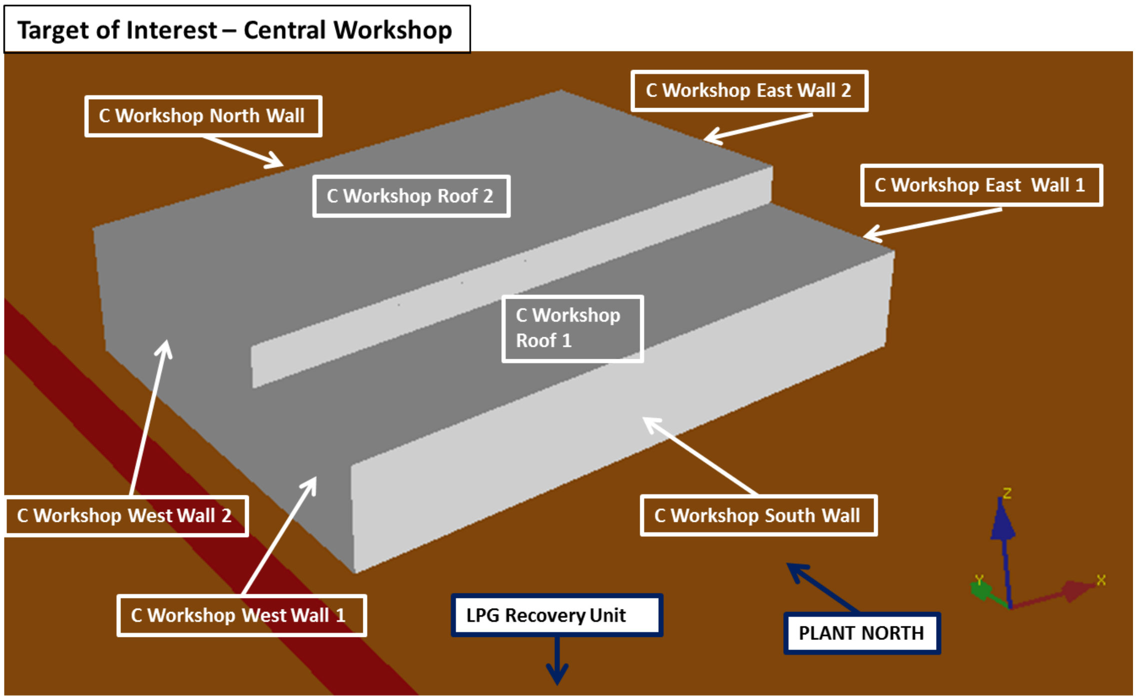


Figure 6-6 Pressure panel (PP) setup at Central Workshop

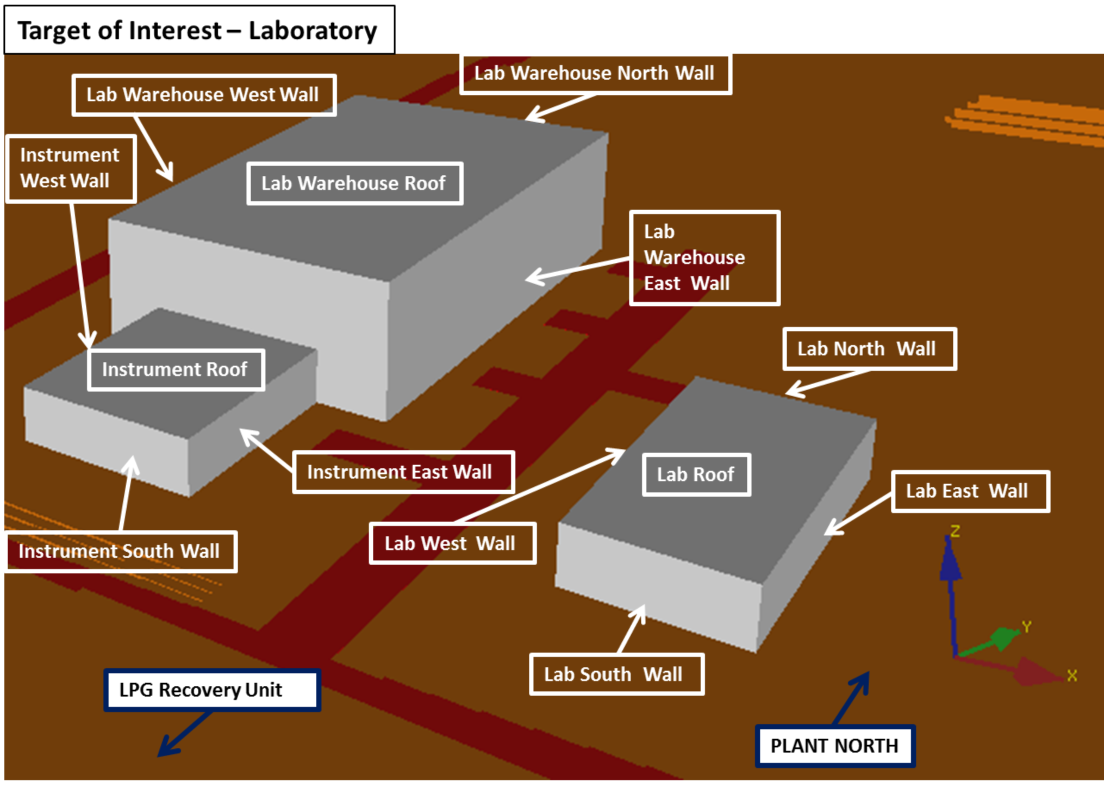


Figure 6-7 Pressure panel (PP) setup at Laboratory area

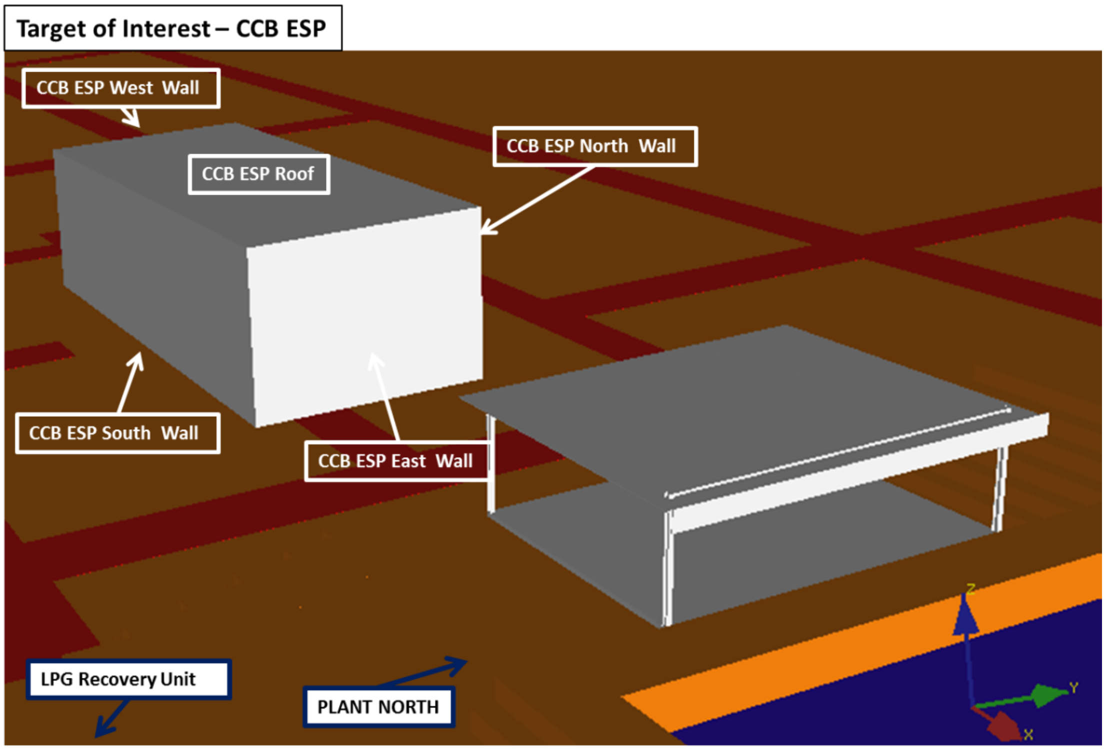


Figure 6-8 Pressure panel (PP) setup at CCB ESP

6.3 Results of the explosion analysis

Maximum and average overpressures for each flammable gas cloud class of Stream 1 in LPG Recovery Unit area is presented in Figure 6-9. For Stream 13, the overpressures are provided in Figure 6-10. The maximum overpressure for both streams exceeds 10 barg for the largest flammable gas cloud volume (26,411 m^3).

The complete overpressure magnitude values measured on all targets of interest are tabulated in Appendix D. Based on further comments, overpressures are also extracted for each of walls and roofs of target of interest and provided in Appendix G.

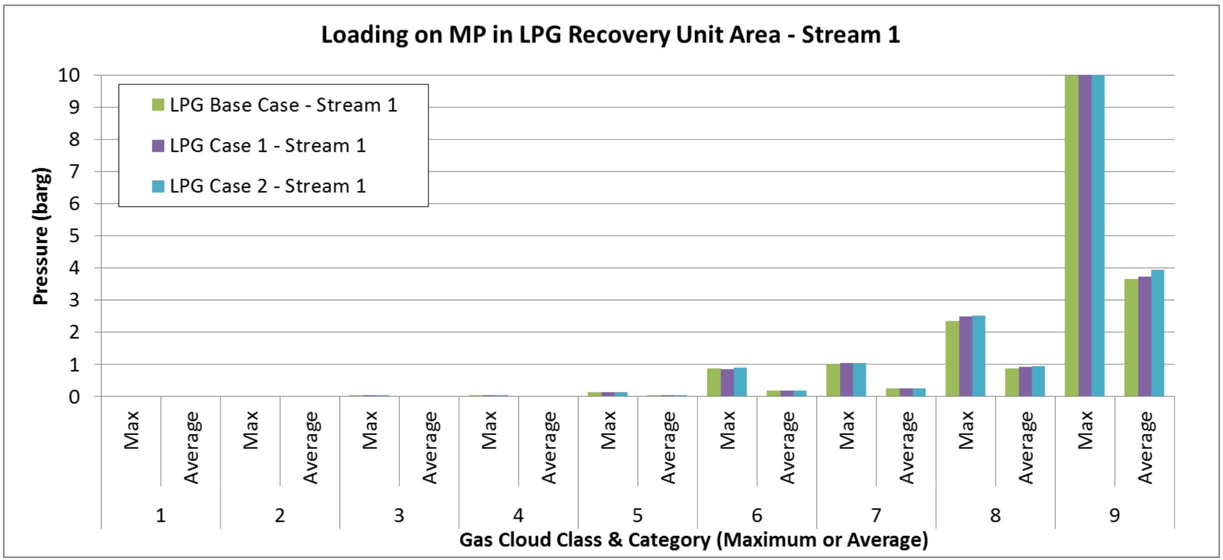


Figure 6-9 Overpressure measured by monitor points on LPG Recovery Unit area for Stream 1

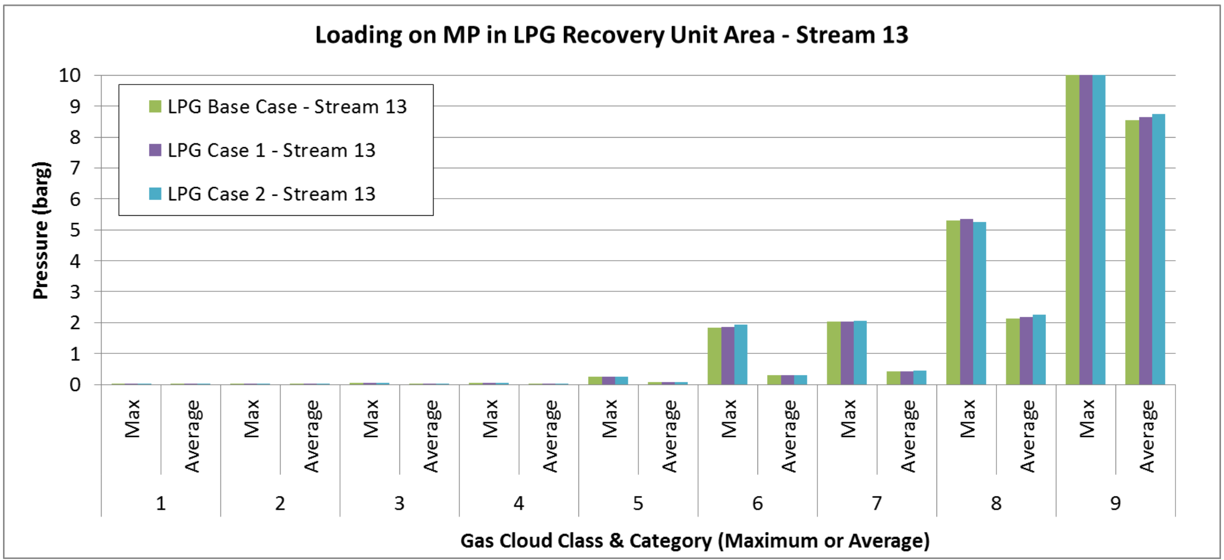


Figure 6-10 Overpressure measured by monitor points on LPG Recovery Unit area for Stream 13

Explosion overpressures are also measured by monitor points in the adjacent area of LPG Recovery Unit. Figure 6-11 and Figure 6-12 show the overpressure in ESP area on the west of LPG Recovery Unit for Stream 1 and Stream 13, respectively. From the two figures it can be seen that the overpressures at adjacent areas are relatively lower compared to overpressure in LPG Recovery Unit area due to large distance from LPG Recovery Unit area.

An example of overpressure 3D contour in the LPG Recovery Unit area which illustrates different geometry variation (Base Case, Case 1 and Case 2) is presented in Figure 6-13.

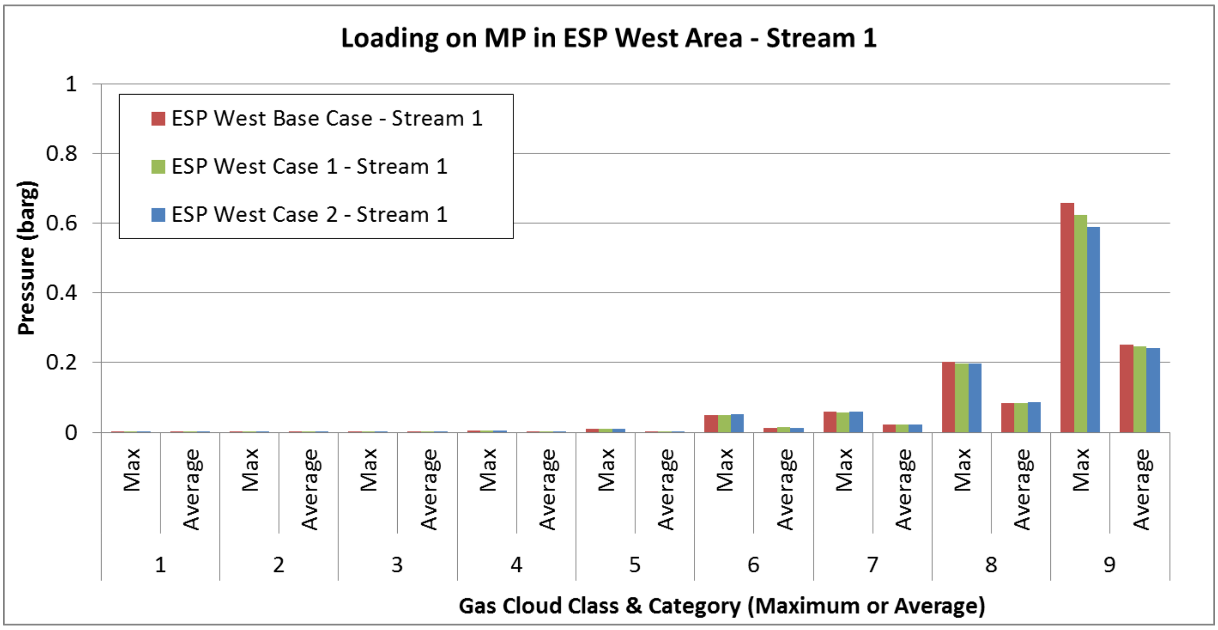


Figure 6-11 Overpressure in ESP area on the west of LPG Recovery Unit for Stream 1

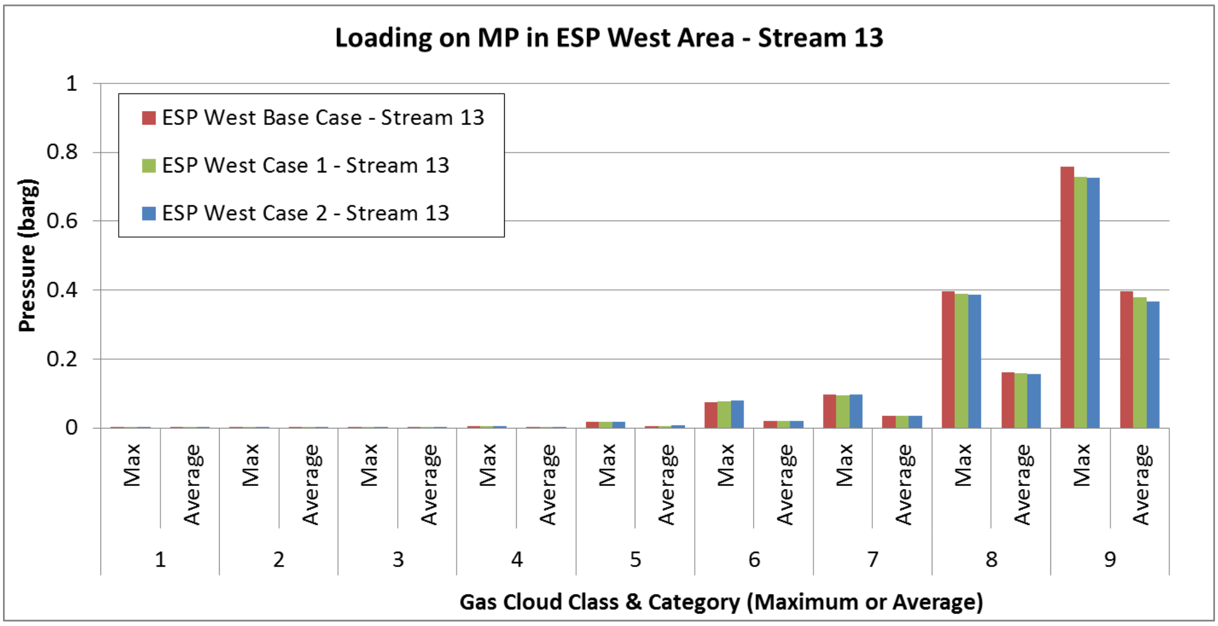


Figure 6-12 Overpressure in ESP area on the west of LPG Recovery Unit for Stream 13

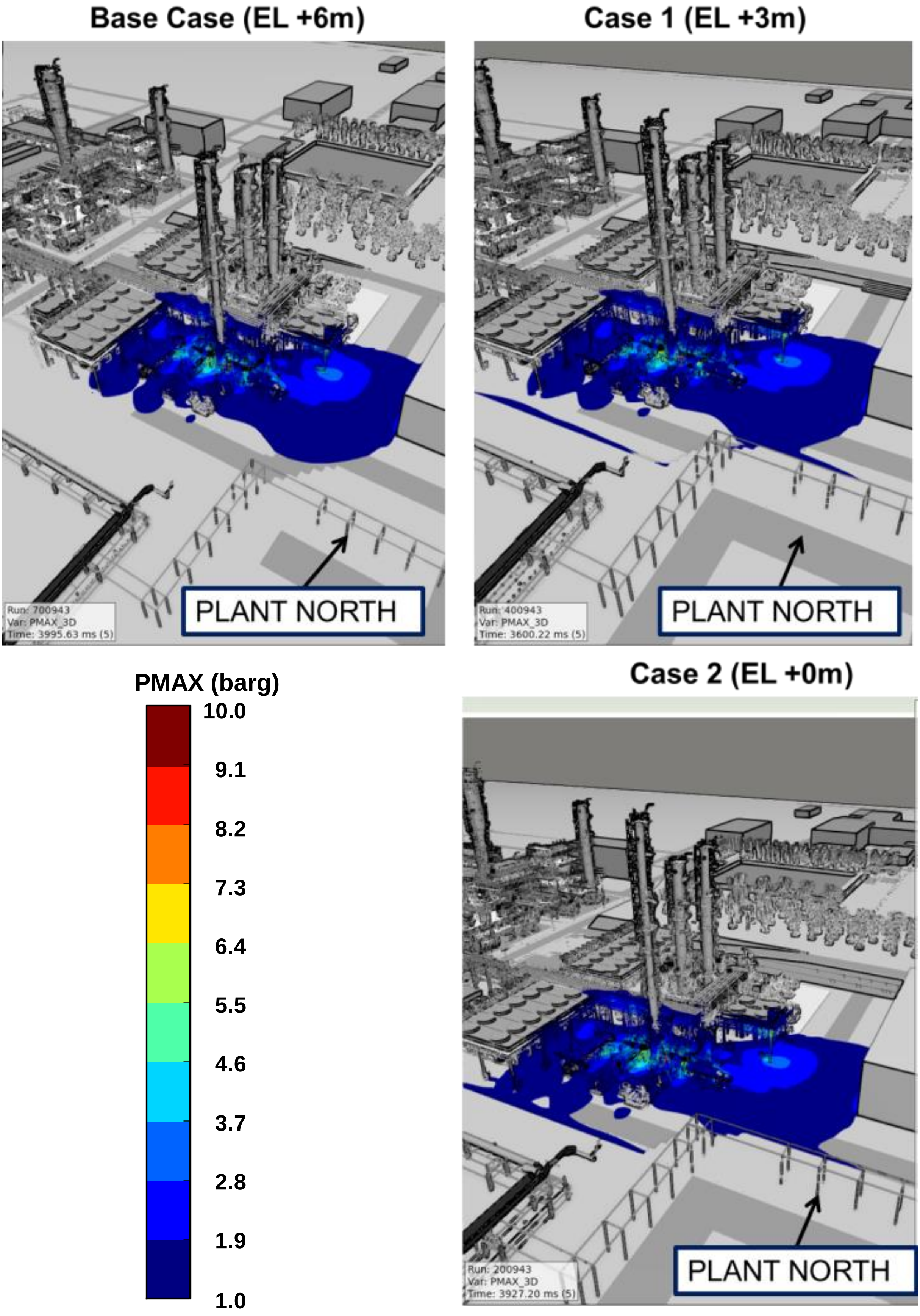


Figure 6-13 Example of overpressure contour in LPG Recovery Unit for each elevation cases

The explosion results show that both maximum and average loads on all targets of interest will increase as the gas cloud volume gets larger. The study also shows that heavier gas creates larger overpressure for all geometry variation cases and targets. It also reveals that as the LPG Recovery Unit area is lower in the elevation, it becomes slightly more confined due to higher adjacent areas and results in the slight increase of overpressure. The lowest maximum overpressures in the LPG Recovery Unit area are recorded for Base Case (6 m elevation). However, for targets in the adjacent areas of LPG Recovery Unit, Case 2 (0 m elevation) creates the lowest explosion overpressure due to centralized pressure build-up in the LPG Recovery Unit area.

7 Explosion risk analysis

The explosion risk was calculated by combining the consequences, as determined by dispersion and explosion simulations, with leak frequencies, weather statistics and ignition probabilities. A conceptual illustration of the work flow in this task is depicted in Figure 7-1.

Explosion frequency was determined by coupling leak frequency, weather data and ignition probability with the dispersion simulation results. Explosion risk analysis results in an exceedance curve that shows the overpressures and the likelihood of occurrence. From the curves, explosion overpressure at 10^{-4}/year and 10^{-5}/year are tabulated.

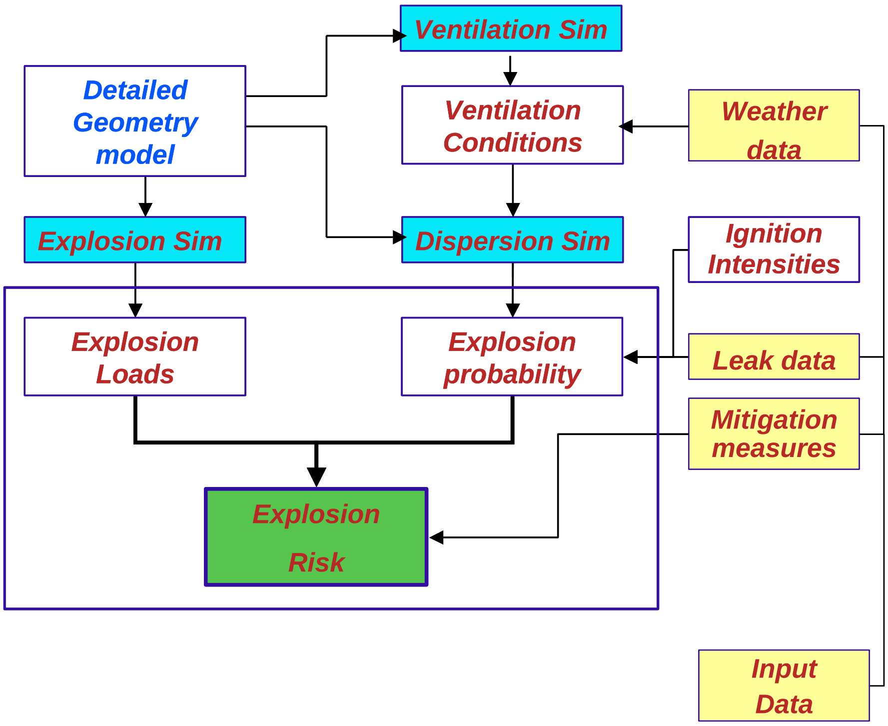


Figure 7-1 Overview of the methodology for defining explosion risk

7.1 Explosion frequency

Total leak frequency, explosion frequency, and ignition probability values in LPG Recovery Unit for Base Case, Case 1 and Case 2 are provided in Table 7-1, Table 7-2 and Table 7-3 . Ignition probability is determined by dividing explosion frequency by leak frequency.

The total explosion frequency in the LPG Recovery Unit is 3.20E-04/year, 3.34E-04/year and 3.48E-04/year for Base Case, Case 1 and Case 2, respectively. The calculated explosion frequency for all geometry variations is still in the same order of magnitude. The difference is not significant as they all utilized the same process equipment, ignition sources and wind conditions. The only distinctive parameter is the gas cloud size from the dispersion simulation results. From the values it can be seen that the Base Case has the least explosion frequency and probability compared to Case 1 and Case 2 geometry respectively.

Table 7-1 Leak frequency, explosion frequency and delayed ignition probability for Base Case

Leak Rate (kg/s)	Total Leak Frequency in Facility (/year)	Explosion Frequency (/year)	Ignition Probability
0.75	2.91E-01	1.89E-04	6.50E-04
1.5	6.92E-03	7.50E-06	1.08E-03
3	6.37E-03	1.14E-05	1.79E-03
6	6.30E-03	1.94E-05	3.08E-03
12	5.07E-03	2.32E-05	4.57E-03
24	2.54E-03	1.35E-05	5.30E-03
48	1.64E-03	1.32E-05	8.07E-03
96	1.45E-03	1.46E-05	1.01E-02
192	2.35E-03	2.78E-05	1.18E-02
TOTAL	3.24E-01	3.20E-04	9.88E-04

Table 7-2 Leak frequency, explosion frequency and delayed ignition probability for Case 1

Leak Rate (kg/s)	Total Leak Frequency in Facility (/year)	Explosion Frequency (/year)	Ignition Probability
0.75	2.91E-01	1.89E-04	6.49E-04
1.5	6.92E-03	7.45E-06	1.08E-03
3	6.37E-03	1.18E-05	1.86E-03
6	6.30E-03	2.22E-05	3.53E-03
12	5.07E-03	2.80E-05	5.53E-03
24	2.54E-03	1.63E-05	6.43E-03
48	1.64E-03	1.55E-05	9.46E-03
96	1.45E-03	1.60E-05	1.11E-02
192	2.35E-03	2.78E-05	1.18E-02
TOTAL	3.24E-01	3.34E-04	1.03E-03

Table 7-3 Leak frequency, explosion frequency and delayed ignition probability for Case 2

Leak Rate (kg/s)	Total Leak Frequency in Facility (/year)	Explosion Frequency (/year)	Ignition Probability
0.75	2.91E-01	1.86E-04	6.37E-04
1.5	6.92E-03	8.54E-06	1.23E-03
3	6.37E-03	1.33E-05	2.08E-03
6	6.30E-03	2.49E-05	3.95E-03
12	5.07E-03	3.16E-05	6.23E-03
24	2.54E-03	1.84E-05	7.23E-03
48	1.64E-03	1.73E-05	1.06E-02
96	1.45E-03	1.83E-05	1.26E-02
192	2.35E-03	3.01E-05	1.28E-02
TOTAL	3.24E-01	3.48E-04	1.07E-03

7.2 Explosion risk and frequency of exceedance

Explosion overpressure exceedance curve for the LPG Recovery Unit area is presented in Figure 7-2. The 10-5/year overpressure is presented as the Ductile Level Blast (DLB) overpressure as recommended by UKOAA fire and Explosion Guidance Issue 1 [11]. Meanwhile 10^{-4}/year explosion frequency overpressure is identified as the Strength Level Blast (SLB) overpressure. From the figure, it shows that the Case 2 returns the largest overpressure at 10^{-4}/year and 10^{-5}/year occurrence compared to other two cases (Base Case and Case 1).

The overpressures of all targets at 10^{-4}/year and 10^{-5}/year occurrence are tabulated in Table 7-4 as a summary. From the table it can be observed that 10^{-4}/year overpressure is relatively low, below 0.02 barg while 10^{-5}/year overpressure may reach up to 2.42 barg for Case 2 geometry in the LPG Recovery Unit area. The rest of the targets are relatively lower due to larger distance to the LPG Recovery Area.

The 10^{-4}/year and 10^{-5}/year overpressure values can then be compared to several document and standards such as OGP 434-15 [12] or API RP752 [13] where those contained tables for overpressure loads and its impact towards building / targets. As there are no impairment criteria provided by PTT, it is proposed to use the OGP 434-15 impairment criteria of 15.8 kPa / 0.158 barg which indicates the lower limit of serious structural damage. Out of all targets, the largest damage will be sustained by the LPG Recovery Unit Area which has exceeds the 0.158 barg threshold at 10^{-5}/year frequency of occurrence (Base Case). For Case 1, overall explosion loads increases and therefore the LPG Recovery Unit Area also exceeded the 0.158 barg threshold. Meanwhile Case 2 has the worst explosion loads where LPG Recovery Unit Area and the CCB building of the LPG Recovery Unit area experience loads above the 0.158 barg threshold. It is recommended to reinforce these targets which has exceeded the threshold.

When the overpressures are compared between the cases, it can be seen that the Base Case provides the lowest explosion overpressures in all targets for both 10^{-4}/year and 10^{-5}/year frequency and therefore poses the least explosion risk compared to the rest two geometry options.

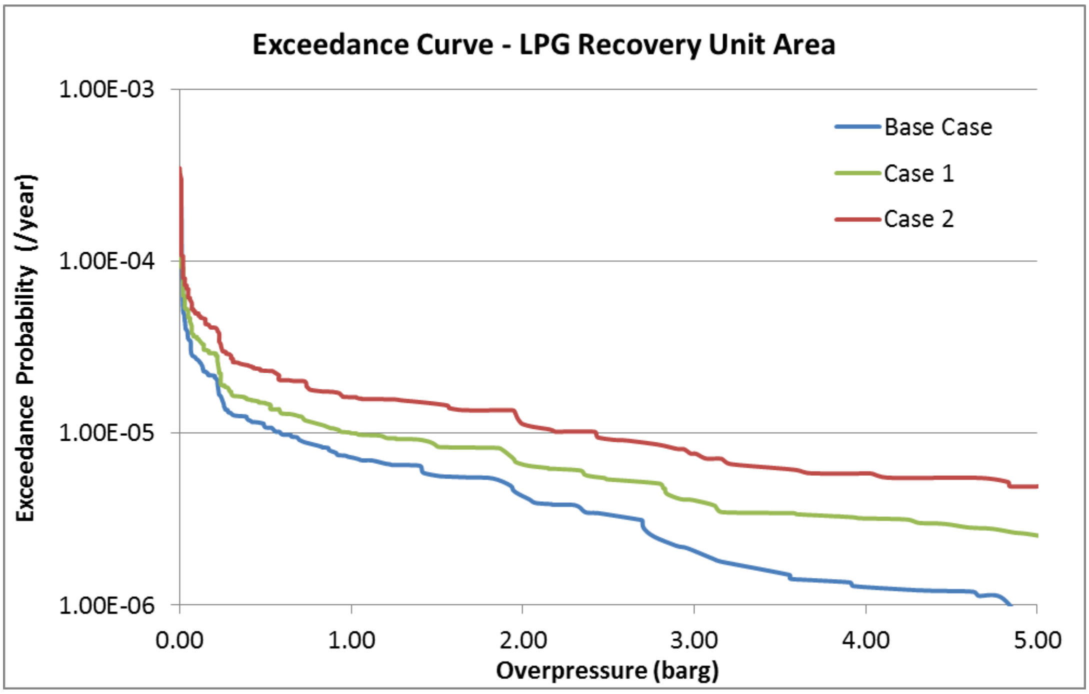


Figure 7-2 Overpressure exceedance curve in LPG Recovery Unit area for all cases

The explosion overpressure exceedance curves for all targets of interest are illustrated in Appendix E. Based on further comments, exceedance curves are also extracted for each of walls and roofs of target of interest and provided in Appendix H.

Table 7-4 Explosion overpressures on all targets at 10^{-4}/year and 10^{-5}/year occurrence

Target of Interest	Base Case		Case 1		Case 2	
	10^{-4} / year (barg) Overpressure	10^{-5} / year (barg) Overpressure	10^{-4} / year (barg) Overpressure	10^{-5} / year (barg) Overpressure	10^{-4} / year (barg) Overpressure	10^{-5} / year (barg) Overpressure
MP LPG Rec Area	0.01	0.59	0.01	1.02	0.02	2.42
MP ESP West	<0.01	0.04	<0.01	0.07	<0.01	0.13
PP LPG CCB Global	<0.01	0.10	<0.01	0.14	<0.01	0.27
PP SW Yard Global	<0.01	0.03	<0.01	0.05	<0.01	0.10
PP Workshop Global	<0.01	0.03	<0.01	0.04	<0.01	0.08
PP Lab Global	<0.01	0.02	<0.01	0.03	<0.01	0.05
PP ESP CCB Global	<0.01	0.04	<0.01	0.04	<0.01	0.07
PP LPG CCB Local	<0.01	0.10	<0.01	0.15	<0.01	0.29
PP SW Yard Local	<0.01	0.03	<0.01	0.05	<0.01	0.11
PP Workshop Local	<0.01	0.03	<0.01	0.05	<0.01	0.08
PP Lab Local	<0.01	0.02	<0.01	0.03	<0.01	0.05
PP ESP CCB Local	<0.01	0.04	<0.01	0.04	<0.01	0.07

8 Flammable gas exposure to adjacent area

Gas exposure towards adjacent areas of LPG Recovery Unit has been monitored for all the simulated releases. The possibility of process releases from LPG Recovery Unit generating gas clouds and explosion in other areas have been assessed in a semi quantitative manner. The presence of non-buoyant gas and large probability of calm weather conditions would result in buoyancy driven dispersion into neighboring areas. The non-buoyant gas composition tends to travel lower than its buoyant counterpart, and the low wind speed conditions tends to gather flammable gas cloud concentration compared to higher wind speed conditions. Given the alternative option for elevation of the LPG plant the potential hazard to adjacent areas are considered. The areas that have been monitored are tabulated below in Table 8-1:

Table 8-1 Adjacent area studied

Name	Location Relative to LPG Recovery Unit Area
ESP West	West of LPG Recovery Unit Area
ESP South	South of LPG Recovery Unit Area
Pond Area	North of LPG Recovery Unit Area
Stock Yard and Waste Yard Area	East of LPG Recovery Unit Area

Dispersion simulations shows that releases in the LPG Recovery Unit could generate substantial clouds in several of the adjacent area. The probability for these types of events is seen to be very low. Cloud build-up at the four adjacent areas was monitored in all dispersion simulations and it appears that several scenarios produce ESC volume exceeding 500 m^3.

- For ESP West, when release rates exceed 3 kg/s, notable gas exposure (500 m^3) of adjacent areas is occasionally observed. The probability of all release rates causing exposure is in the order of 1.1 - 1.75% of every leak occurring in LPG Recovery Unit Area. For large leaks (>15 kg/s), exposure of gas to ESP West area occur in 0.98 - 1.17 % of the time.
- For ESP South, when release rates exceed 48 kg/s, notable gas exposure (500 m^3) of adjacent areas is observed. The probability of all release rates causing exposure is in the order of 0.16 – 0.24% of every leak occurring in LPG Recovery Unit Area. For large leaks (>15 kg/s), exposure of gas to ESP West area occur in 0.16 - 0.24 % of the time.
- For Pond Area, when release rates exceed 12 kg/s, notable gas exposure (500 m^3) of adjacent areas is observed. The probability of all release rates causing exposure is in the order of 0.46 – 0.8% of every leak occurring in LPG Recovery Unit Area. For large leaks (>15 kg/s), exposure of gas to Pond Area occur in 0.45 – 0.65 % of the time.
- For Stock Yard and Waste Yard Area, when release rates exceed 6 kg/s, notable gas exposure (500 m^3) of adjacent areas is observed. The probability of all release rates causing exposure is in the order of 0.46 – 1.10% of every leak occurring in LPG Recovery Unit Area. For large leaks (>15 kg/s), exposure of gas to this area occur in 0.56 – 0.82 % of the time.

From the findings above it can be observed that the risk exposure in ESP West is the highest compared to other areas in terms of the release rates required to produce significant gas clouds as well as probability of the exposure when there is a leak in LPG Recovery Unit area. Other areas have lower exposure risk compared to ESP West area and need larger release rates to produce substantial ESC volume. Gas exposure to adjacent areas indicates greater uncertainty with respect to ignition control measures but generally ignition probability is presumed to be large. Although the likelihood of a gas exposure from LPG Recovery Unit area is small (2 out of 100 leaks), gas cloud in adjacent areas may reach significant sizes (Table 8-2). The low probability of the gas exposure may potentially be counterweighted by a high ignition probability. In the event that these types of clouds ignite, large explosion would occur. The presence of potent ignition sources in these areas should be considered as a point of concern. Selected plot of large scale gas exposure is included in Appendix F.

Table 8-2 Worst case gas exposure of adjacent areas

Maximum ESC (m^3)	ESP West	ESP South	Pond Area	Stock Yard & Waste Yard Area
Base Case	94,277	28,476	59,516	14,146
Case 1	73,864	53,014	81,637	20,231
Case 2	69,156	60,909	57,655	28,956

It should be noted that in general, as the Base Case is more ventilated, flammable gas tends to be carried away out of the facility while on Case 1 and especially Case 2 it tends to gather around the facility, increasing average volume of ESC on the areas of interest (ESP South, LPG Recovery Unit, Pond Area, and Stock and Waste Yard Area).

Figure 8-1 illustrates a 192 kg/s leak towards ESP West with a Stream 13 (non-buoyant gas) composition. There is a 1.5 m/s wind flowing from east (left) to west (right). As the geometry become less ventilated (Case 1 and 2), flammable gas cloud tends to gather in the facility, and for leaks pointing ESP West it results in more region with concentration above UFL.

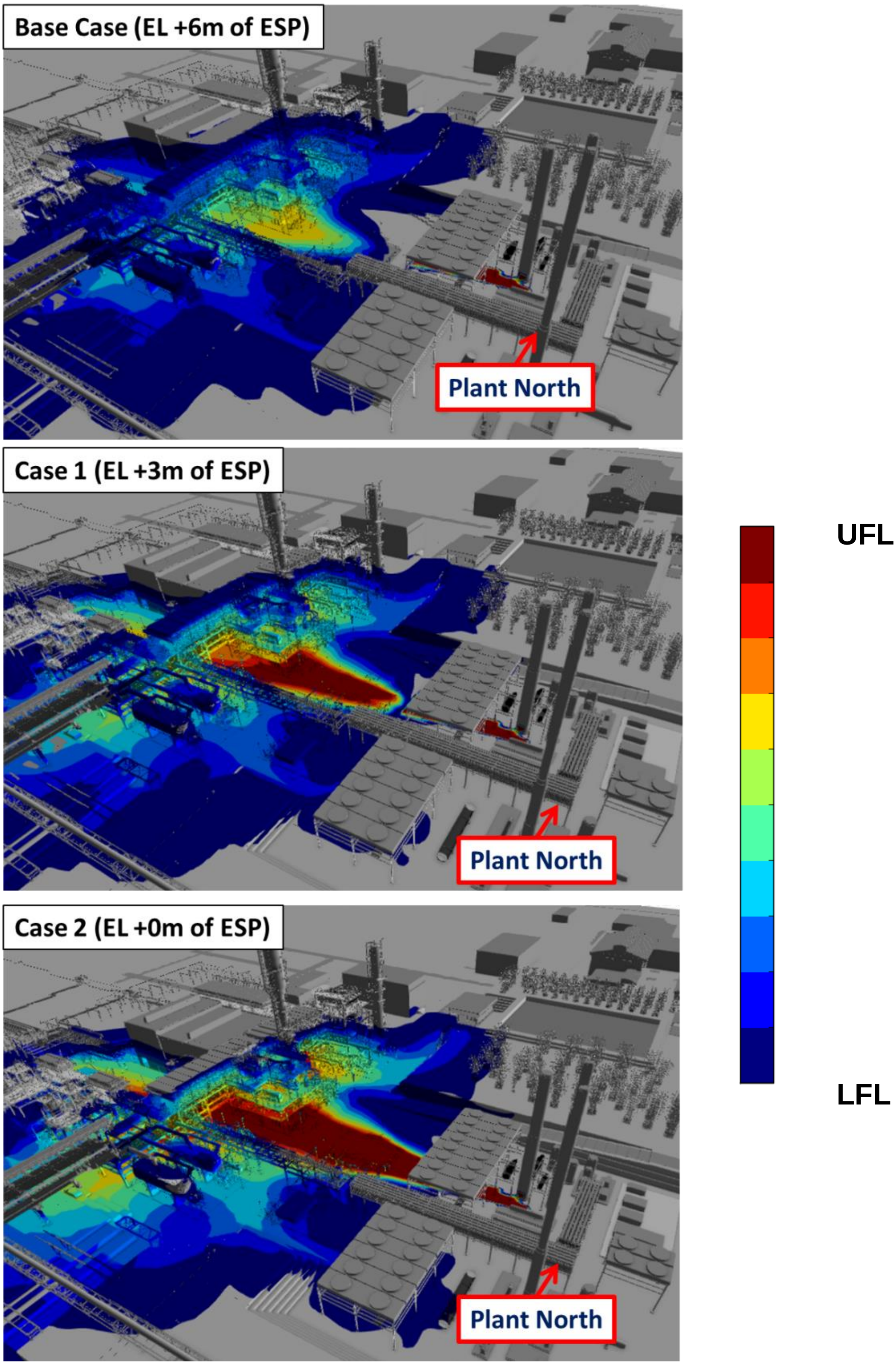


Figure 8-1 Illustration of a leak toward ESP West from LPG Recovery area given different geometry variations (view from south-east). Plot is taken at t=90 seconds after leak start. Red area indicates gas concentration close to the UFL

9 Conclusion and recommendation

A full probabilistic explosion study has been carried out for the LPG Recovery Unit area in PTT Gas Separation Plant, Map Ta Phut, Rayong, Thailand. The study has involved ventilation, dispersion, explosion simulations and post-processing steps to combine the simulation results with weather data, leak frequencies, and ignition probabilities. Three geometry variation cases with various elevations (Base Case of EL +6m above ESP Area, Case 1 and 2 of EL +3m and EL +0m respectively) of LPG Recovery Unit area have been studied and compared to find out which geometry case has the least explosion risk.

The ventilation analysis for the LPG Recovery Unit area shows that all geometry variations are less ventilated. This is mainly due to the large portion (61%) of low wind speed condition (0 - 0.2 m/s) and not the design features of the LPG Recovery Unit area. The ACH value for 95% occurrence is below 12 for all of the three geometry cases. Stagnant areas in the LPG Recovery Unit area have been observed but there is no particular area that stands out as particularly poorly ventilated. Base Case is the most well ventilated option compared to Case 1 and Case 2 options. On this basis there are no practicable recommendations on how to improve ventilation condition.

Dispersion simulations have been performed with variations in leak location, leak rate, leak orientation, wind direction and wind speed. In the dispersion simulations, the Equivalent Stoichiometric Cloud (ESC) volume was monitored in the LPG Recovery Unit area and its adjacent areas. The results show that as the Base Case geometry variation is more ventilated compared to Case 1 and Case 2 geometry variations, flammable gas tends to be carried away out of facility. On Case 1 and especially Case 2, flammable gas tends to gather around the facility, increasing average volume of ESC formed in LPG Recovery Unit area and its adjacent areas.

Explosion simulations have been performed with varied gas cloud sizes and locations, as well as multiple cloud and ignition locations. Explosion overpressures in LPG Recovery Unit exceeded 10 barg for the maximum flammable gas cloud volume. Results also show that the increase of gas cloud size increases both maximum and average loads on all targets of interest. Heavier gas composition is observed to generate larger overpressures for all geometry variation cases and targets. It also reveals that as the LPG Recovery Unit area is lower in the elevation, it becomes slightly more confined due to higher adjacent areas and results in the slight increase of overpressure. The lowest overpressures in the LPG Recovery Unit area are recorded for Base Case (6 m elevation). However, for targets in the adjacent areas of LPG Recovery Unit, Case 2 (0 m elevation) creates the lowest explosion overpressure due to centralized pressure build-up in the LPG Recovery Unit area. It should be noted that the trend above is negligible towards the overall increase of explosion risk on the target of interest as observed in the 10^{-4} and 10^{-5}/year overpressure values.

Results from the dispersion and explosion simulations were combined with leak frequencies and ignition probabilities from the TDIM model to calculate the explosion risk and exceedance curves. Total explosion frequency is 3.20E-04/year, 3.34E-04/year and 3.48E-04/year for Base Case, Case 1 and Case 2, respectively. The 10^{-5}/year overpressure is presented as the Ductile Level Blast (DLB) overpressure as recommended by UKOAA fire and Explosion Guidance Issue 1 [11]. Meanwhile 10^{-4}/year explosion frequency overpressure is identified as the Strength Level Blast (SLB) overpressure. The 10^{-4}/year and 10^{-5}/year overpressure values can then be compared to several document and standards such as OGP 434-15 [12] or API RP752 [13] where those contained tables for overpressure loads and its impact towards building / targets. As there are no impairment criteria provided by PTT, it is proposed to use the OGP 434-15 impairment criteria of 15.8 kPa / 0.158 barg which indicates the lower limit of serious structural damage. Out of all targets in Base Case variation, the largest damage is sustained by the LPG Recovery Unit Area which exceeds 0.158 barg threshold at 10^{-5}/year frequency of occurrence. For Case 1, overall explosion loads increases and the LPG Recovery Unit

Area also exceeded the 0.158 barg threshold. Meanwhile Case 2 has the worst explosion loads where LPG Recovery Unit Area and the CCB building of the LPG Recovery Unit area experience loads above the 0.158 barg threshold. It is recommended to reinforce these targets which has exceeded the threshold.

Semi-quantitative gas exposure risk assessment for the areas adjacent to LPG Recovery Unit area concluded that ESP West has the largest exposure risk where a leak of 3 kg/s from the LPG Recovery Unit could create a significant ESC volume of 500 m^3. In general there is less than 2% (2 out of 100) of leaks from LPG Recovery Unit area that can generate this size of ESC volume in the adjacent area. However, gas clouds may reach relatively large size and on the end produce large explosion. The presence of potent ignition sources in these areas should be considered as a point of concern.

Out of the three geometry cases studied, Base Case provides the lowest explosion risk following the findings summarised below:

1. From the ventilation study, it is found out that Base Case is more ventilated than the other geometry options (Case 1 and Case 2) as illustrated by Figure 4-2. When the geometry is more ventilated, gas clouds tends to be diluted and carried away out of the facility
2. Dispersion study results supports the ventilation study result where Base Case relatively have the smallest average and maximum Equivalent Stoichiometric Cloud (ESC) volume formed in the LPG Recovery Unit area compared to the other two geometry options (Figure 5-7).
3. It is found from the explosion simulation results that explosions modelled in the Base Case produce slightly lower loads compared to other two geometry options (Figure 6-9 and Figure 6-10).
4. Explosion frequency of Base Case is lower compared to other two geometry options (Section 7.1)
5. Explosion risk which is indicated by the 10^{-4}/year and 10^{-5}/year overpressure loads shows that Base Case has the lowest overpressure loads at the two frequencies and therefore has lowest explosion risk compared to the other two geometry options (Table 7-4).

Based on the findings above, the following recommendations are made:

1. Base Case elevation is recommended to be selected as it shows the lowest explosion risk for both the LPG Recovery Unit and buildings in the surrounding area. The results show that the Base Case has the highest ventilation rate compared to other configurations (Figure 4-2). This leads to comparatively smaller flammable gas cloud volume formed in the LPG Recovery Unit area (Figure 5-7). With the less confined nature of Base Case, the explosion overpressure generated in this area is accordingly lower and these all combination results in the lowest explosion risk (Table 7-4).
2. Uncontrolled ignition sources need to be considered in the effort to enhance safety level and measures as potential of gas migrating from LPG Recovery Unit towards other areas has been observed (Figure 8-1).
3. As the current study was based on early stage, the Anticipated Congestion Method (ACM) has been introduced to represent the future possible congestion level. Therefore, it is recommended to revalidate the study using a higher degree of geometry detail and accuracy in the later design stage i.e. 100% FEED or detailed design.

10 References

[1] Wind data received from Arthit, Received 29th January 2016.

[2] UOP Technical Proposal for LPG Recovery Project Appendix 8 Design Documents, 12 October 2015. (Received 22nd March 2016)

[3] "OGP Risk Assessment Data Directory: Process Release Frequencies", Report No. 434-1 March 2010

[4] UOP Technical Proposal for LPG Recovery Project 14 Instrument Function Symbols, 12 October 2015. (Received 22nd March 2016)

[5] "NORSOK Standard Z-013, Risk and emergency preparedness assessment" 3rd Edition, October 2010, Annex F.

[6] "JIP, Guidelines for the use of JIP ignition model", DNV report no. 99-3193/ Scandpower report no 27.29.03

[7] PTT Engineering Standard – Emergency Depressuring Philosophy PH-10-06, August 2005.

[8] Document No. "EL-10-XXXX.XX-3200-001 – Preliminary Equipment List for New Area (WP-007)" Rev D1, Received 22nd March 2016

[9] NORSOK Standard S-001 Technical Safety

[10] IP 15 Area Classification code for installations handling flammable fluids

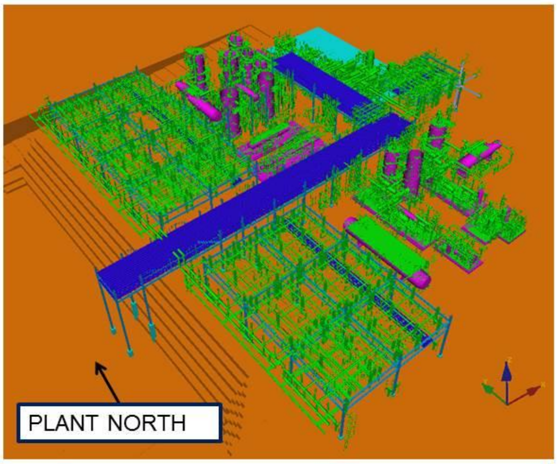
[11] UKOAA Fire and Explosion Guidance Issue 1, October 2013.

[12] "OGP Risk Assessment Data Directory: Vulnerability of plant / structure", Report No. 434-15 March 2010

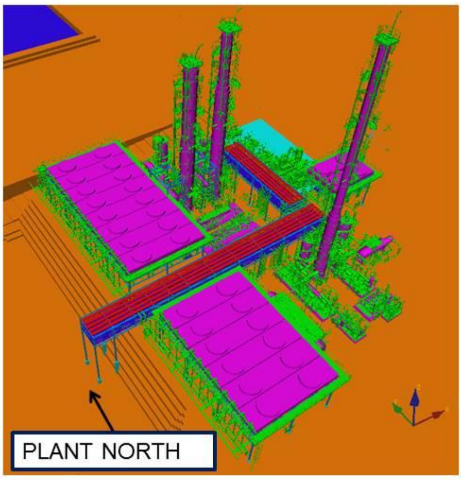
[13] API RP2FB: 1st Edition – Design of Offshore Facilities Against Fire and Blast Loading, January 2005

Appendix A LPG Recovery Unit ACM overview

ACM - Geometry Overview (1)



Cut-plane at elevation 8.75 m from ground level

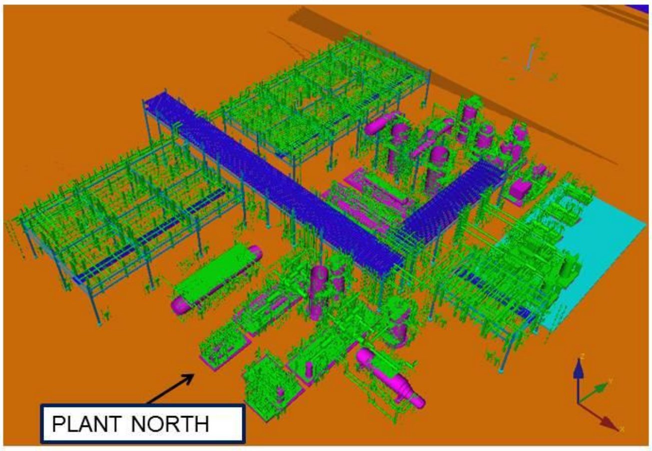


Overview

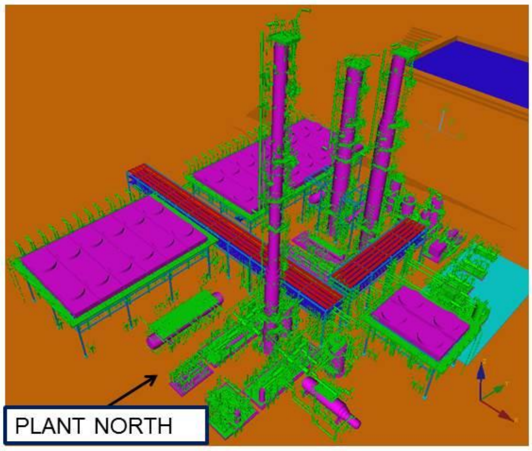
Green objects denotes ACM blocks added towards the model.

2

ACM - Geometry Overview (2)



Cut-plane at elevation 8.75 m from ground level



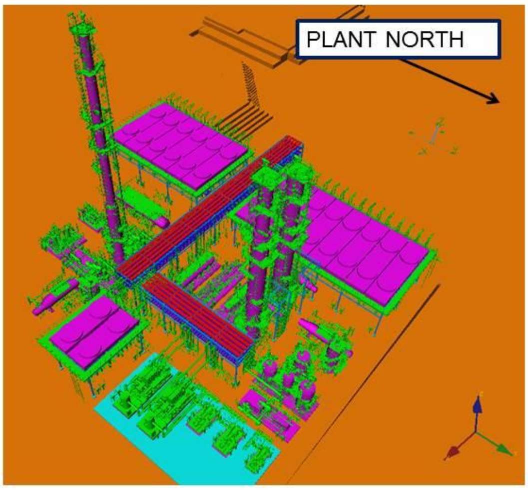
Overview

Green objects denotes ACM blocks added towards the model.

3

ACM - Geometry Overview (3)

Cut-plane at elevation 8.75 m from ground level



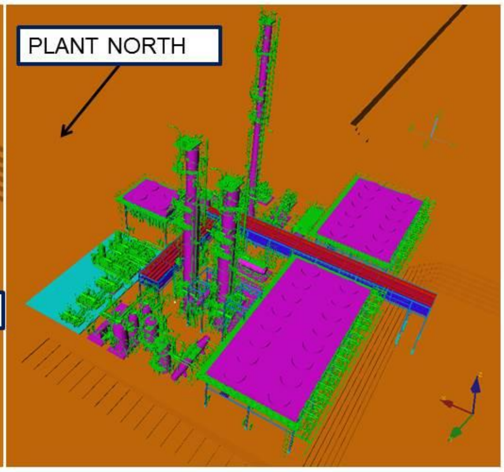
Overview

Green objects denotes ACM blocks added towards the model.

4

ACM - Geometry Overview (4)

Cut-plane at elevation 8.75 m from ground level

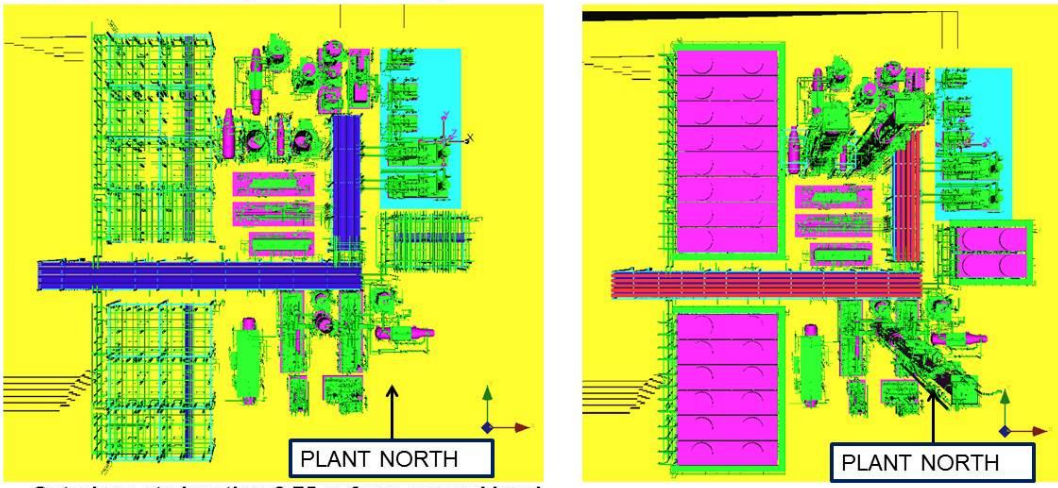


Overview

Green objects denotes ACM blocks added towards the model.

5

ACM - Geometry Overview (5)



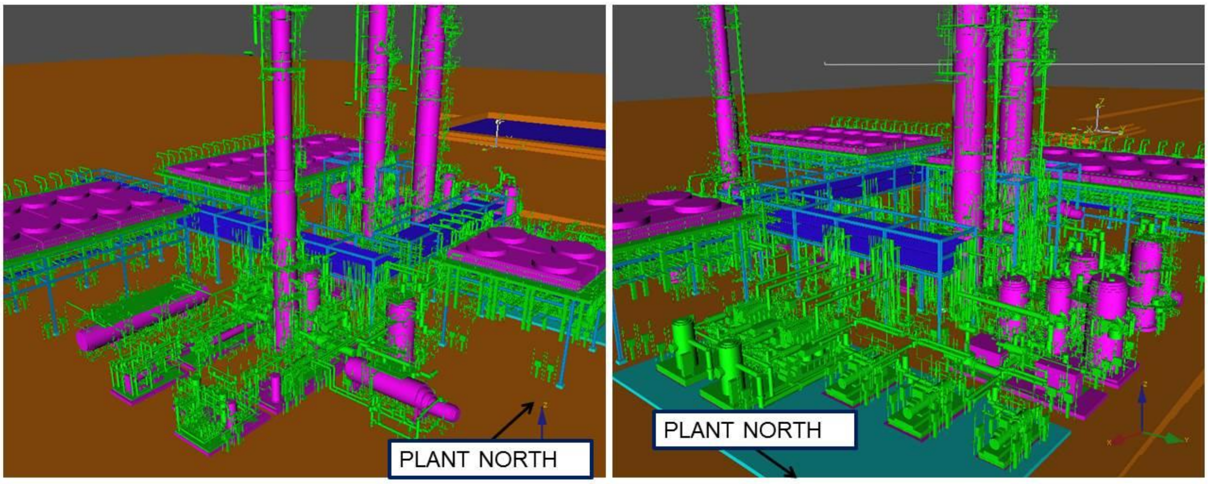
Cut-plane at elevation 8.75 m from ground level

Overview

Green objects denotes ACM blocks added towards the model.

6

ACM - Geometry Close Up (1) from different directions

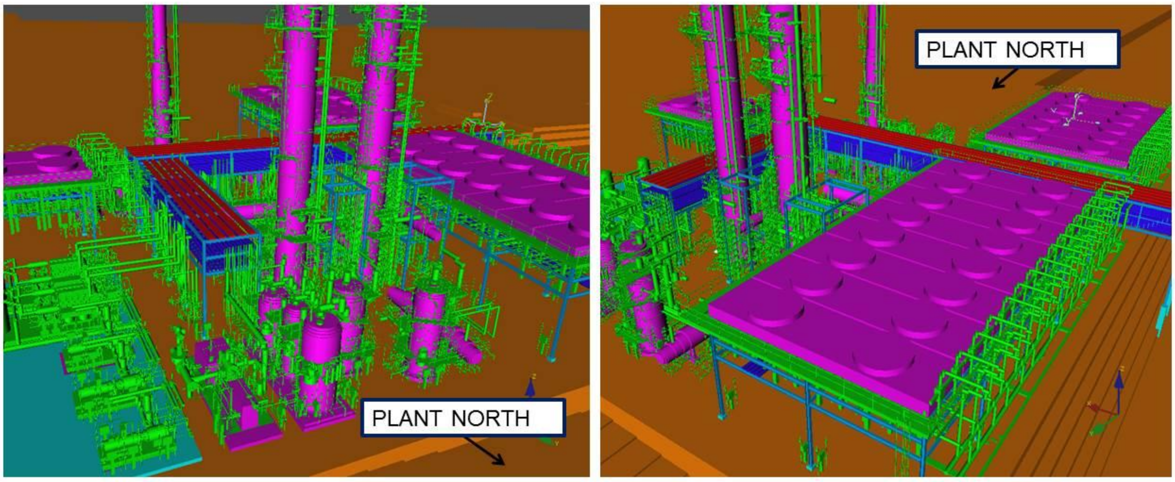


Green objects denotes ACM blocks added towards the model.

7

GEXCON

ACM - Geometry Close Up (2) from different directions

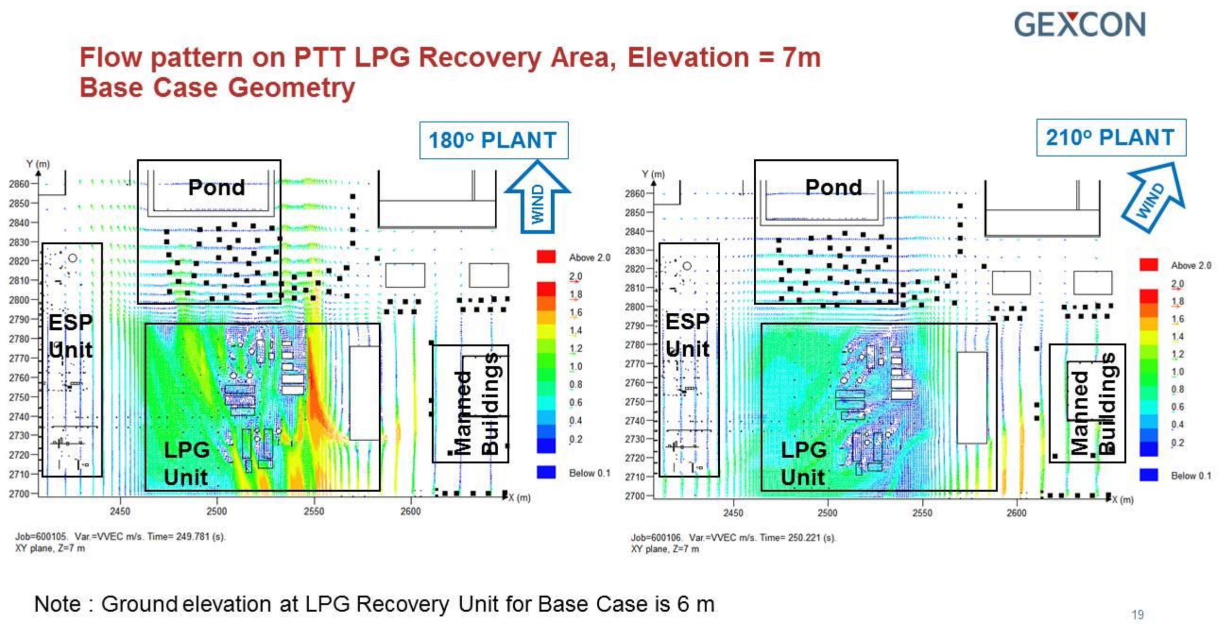


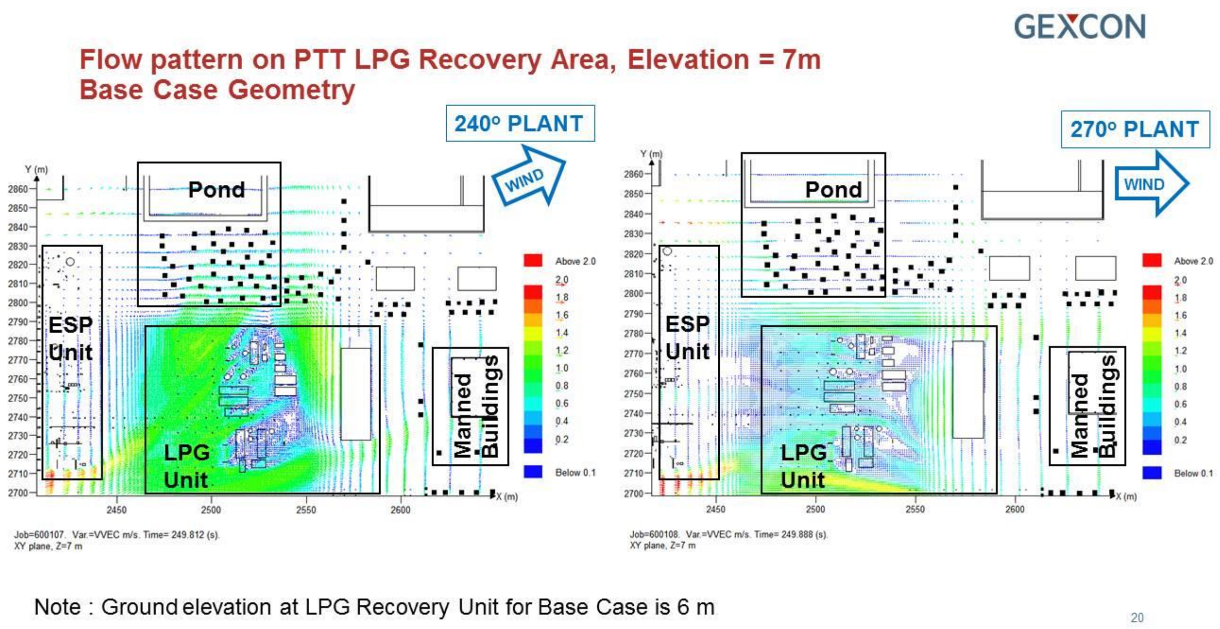
Green objects denotes ACM blocks added towards the model.

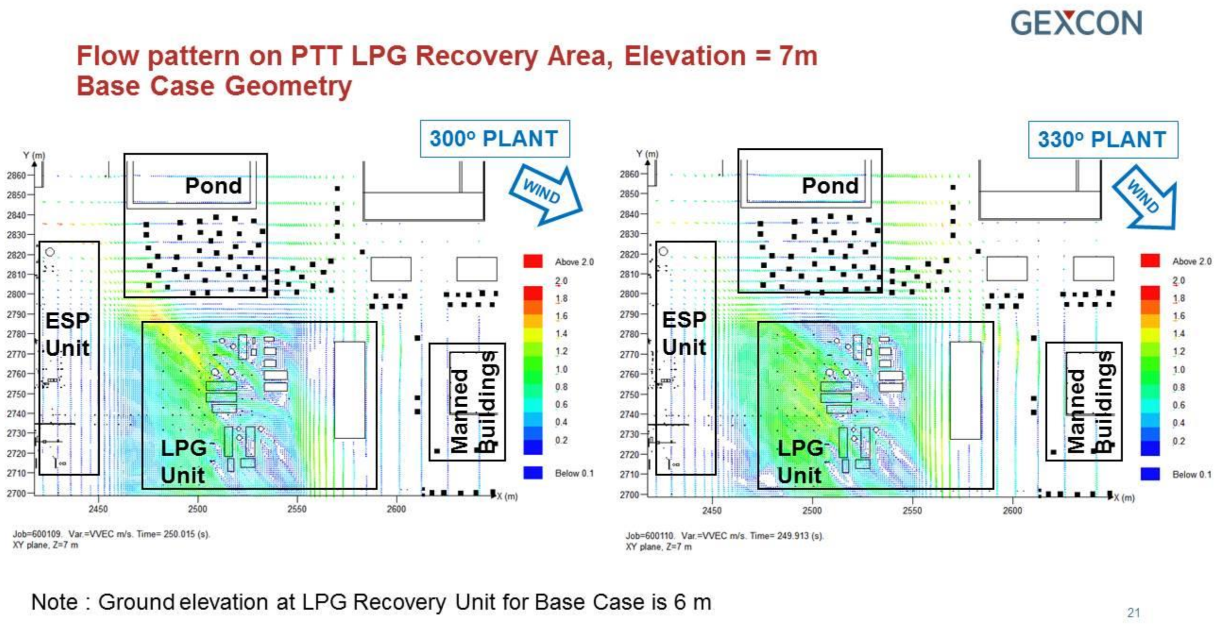
8

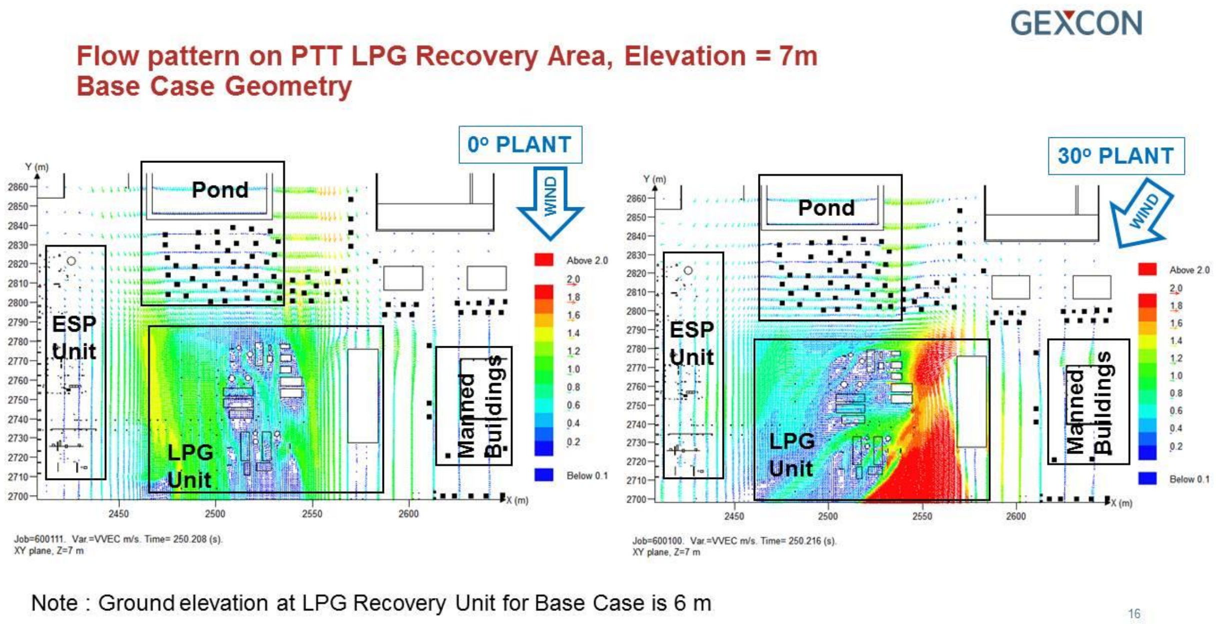
Appendix B Ventilation flow pattern of LPG Recovery Unit area

Base Case Geometry

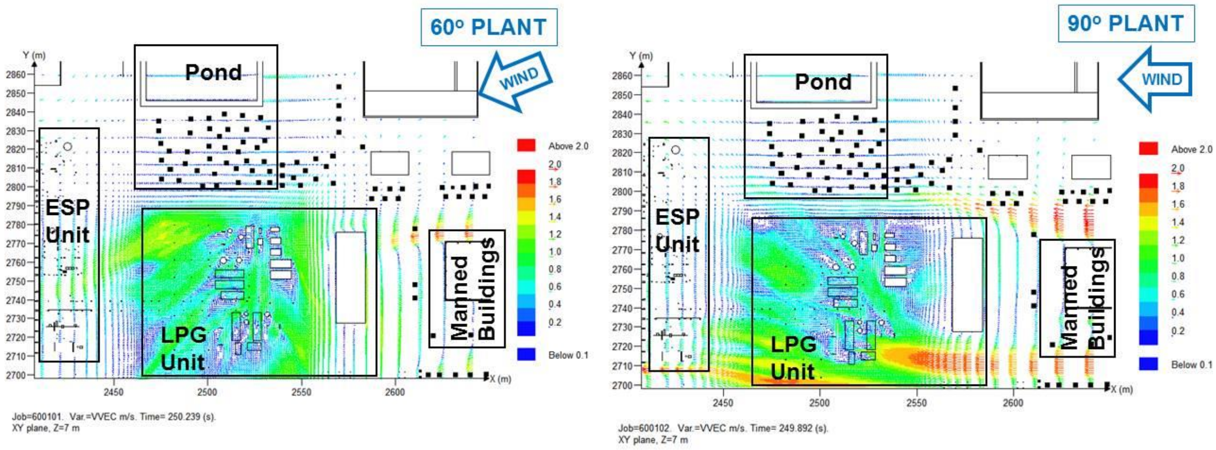





GEXCON
Flow pattern on PTT LPG Recovery Area, Elevation = 7m
Base Case Geometry
300º PLANT
330º PLANT
WIND
Pond
ESP Unit
LPG Unit
Manned Buildings
Above 2.0
Below 0.1
Job=600109. Var.=VVEC m/s. Time= 250.015 (s).
XY plane, Z=7 m
Job=600110. Var.=VVEC m/s. Time= 249.913 (s).
XY plane, Z=7 m
Note : Ground elevation at LPG Recovery Unit for Base Case is 6 m
21


GEXCON
Flow pattern on PTT LPG Recovery Area, Elevation = 7m
Base Case Geometry
0º PLANT
30º PLANT
WIND
Pond
ESP Unit
LPG Unit
Manned Buildings
Above 2.0
Below 0.1
Job=600111. Var.=VVEC m/s. Time= 250.208 (s).
XY plane, Z=7 m
Job=600100. Var.=VVEC m/s. Time= 250.216 (s).
XY plane, Z=7 m
Note : Ground elevation at LPG Recovery Unit for Base Case is 6 m
16

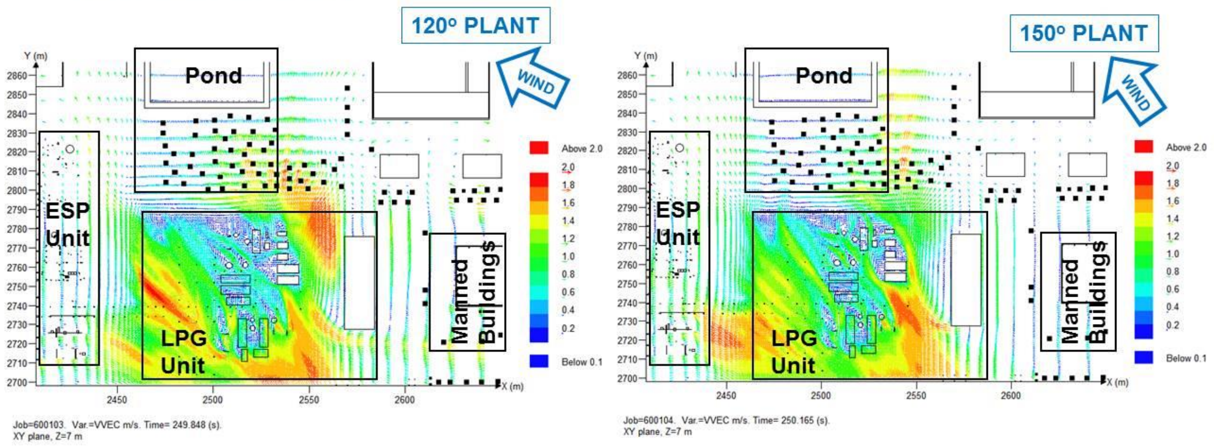
Flow pattern on PTT LPG Recovery Area, Elevation = 7m
Base Case Geometry



Note : Ground elevation at LPG Recovery Unit for Base Case is 6 m

17

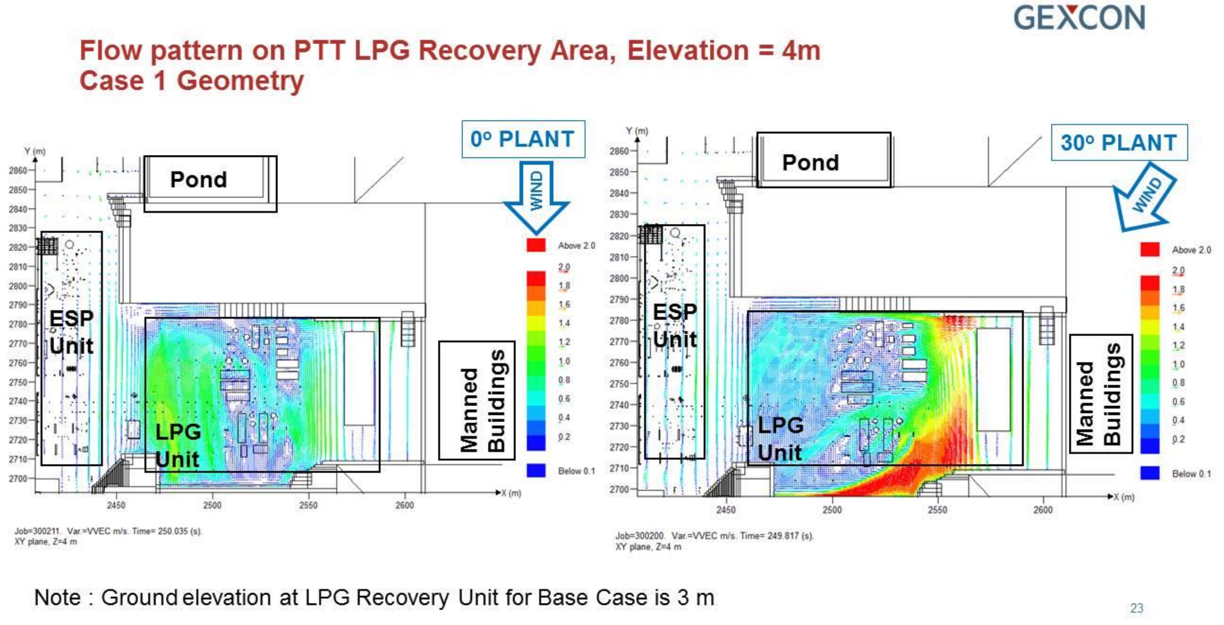
Flow pattern on PTT LPG Recovery Area, Elevation = 7m
Base Case Geometry

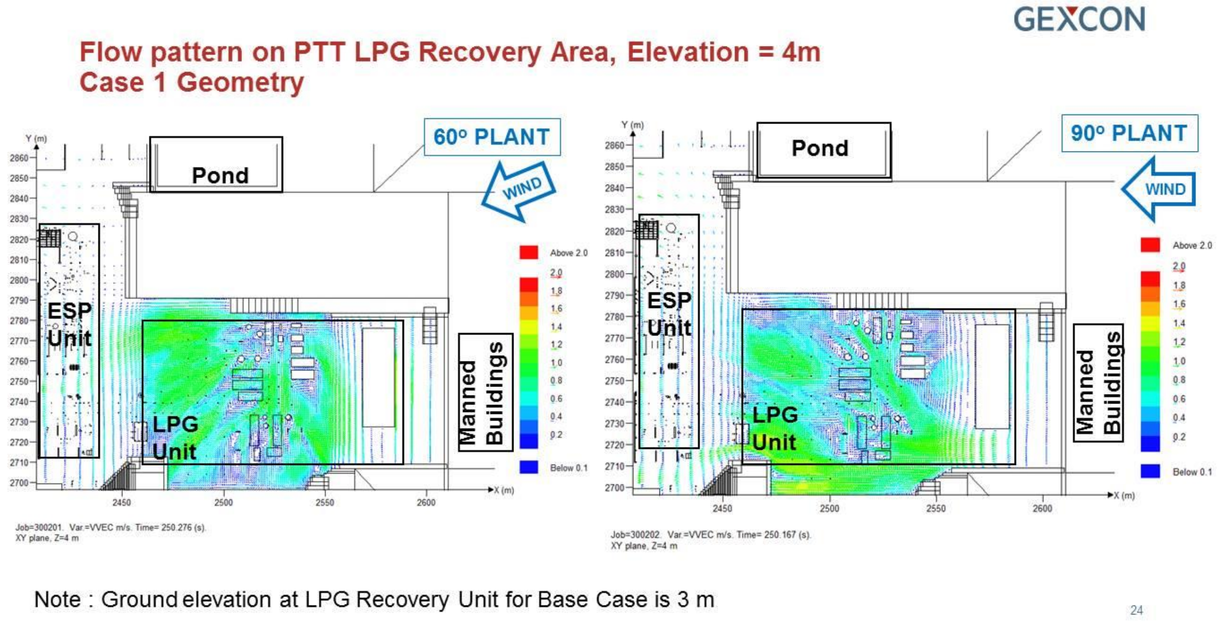


Note : Ground elevation at LPG Recovery Unit for Base Case is 6 m

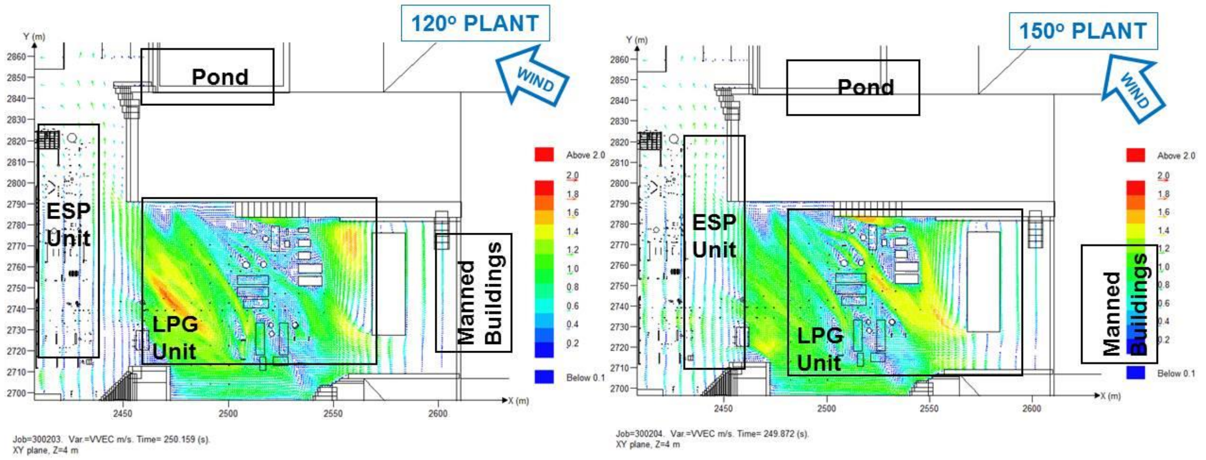
18

Case 1 Geometry





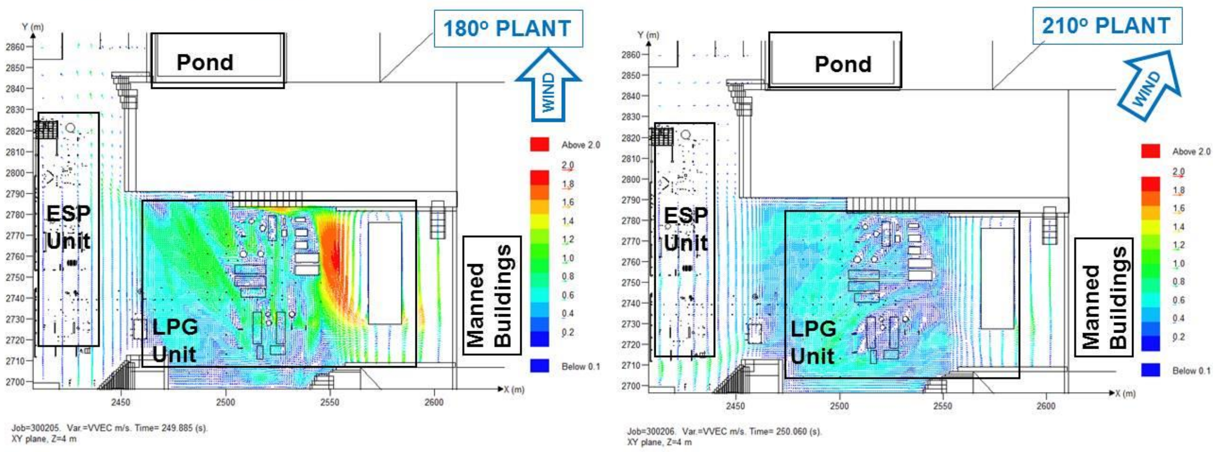
Flow pattern on PTT LPG Recovery Area, Elevation = 4m
Case 1 Geometry



Note : Ground elevation at LPG Recovery Unit for Base Case is 3 m

25

Flow pattern on PTT LPG Recovery Area, Elevation = 4m
Case 1 Geometry

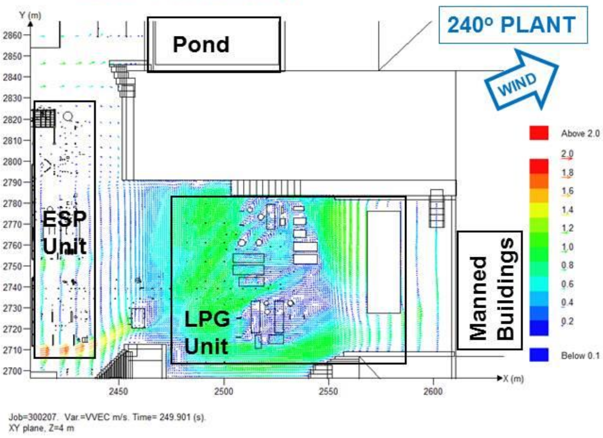


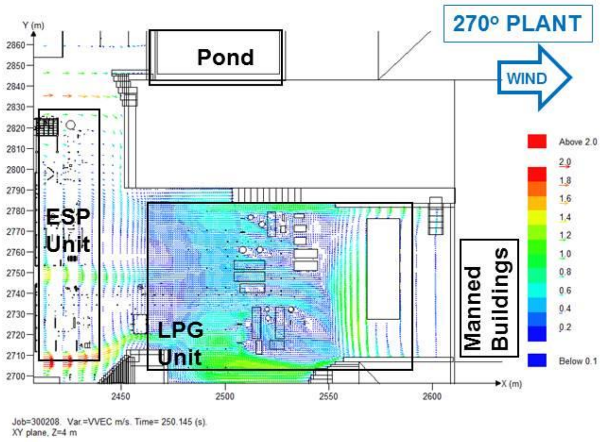
Note : Ground elevation at LPG Recovery Unit for Base Case is 3 m

26

GEXCON

Flow pattern on PTT LPG Recovery Area, Elevation = 4m
Case 1 Geometry



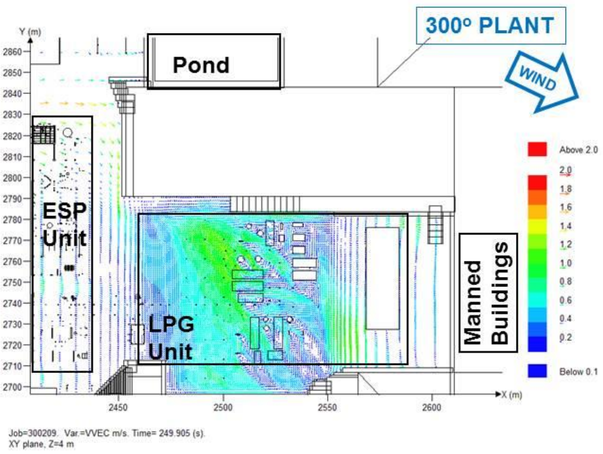


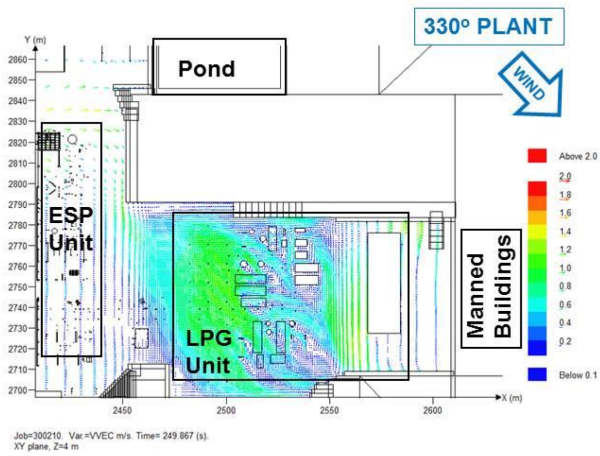
Note : Ground elevation at LPG Recovery Unit for Base Case is 3 m

27

GEXCON

Flow pattern on PTT LPG Recovery Area, Elevation = 4m
Case 1 Geometry



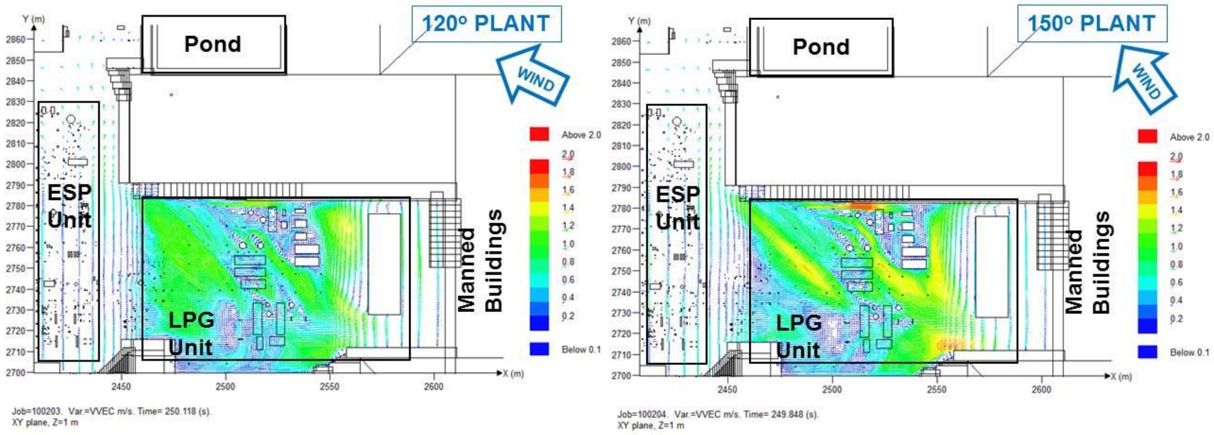


Note : Ground elevation at LPG Recovery Unit for Base Case is 3 m

28

Case 2 Geometry

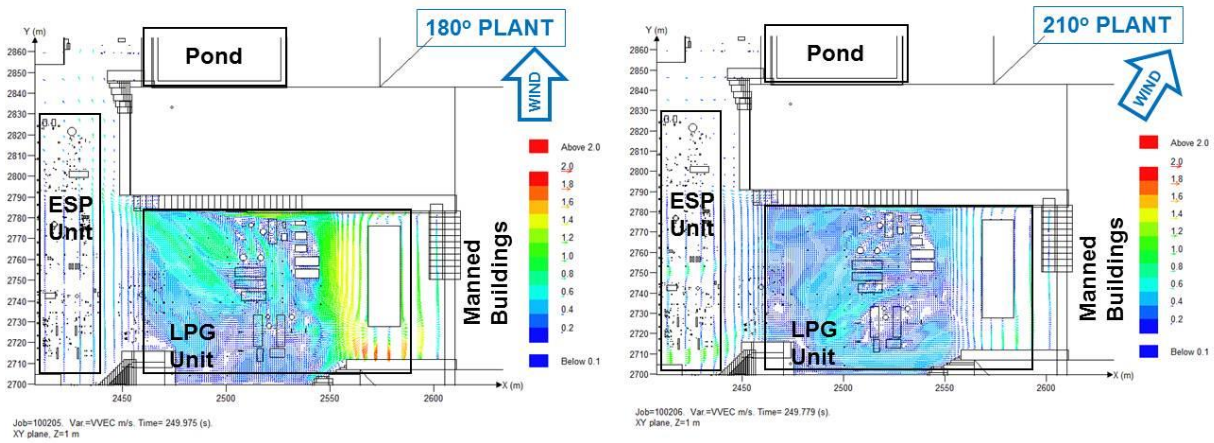
Flow pattern on PTT LPG Recovery Area, Elevation = 1 m
Case 2 Geometry



Note : Ground elevation at LPG Recovery Unit for Base Case is 0 m

32

Flow pattern on PTT LPG Recovery Area, Elevation = 1 m
Case 2 Geometry

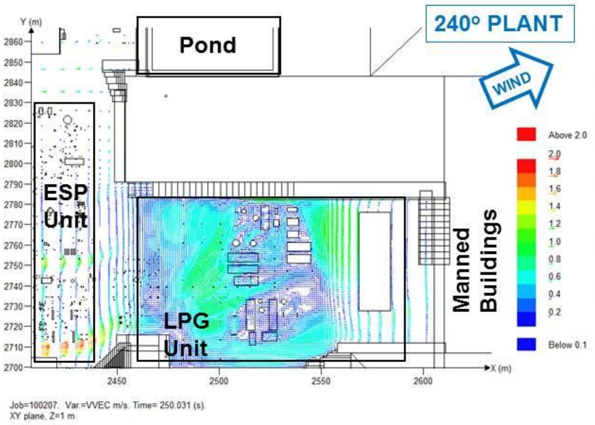


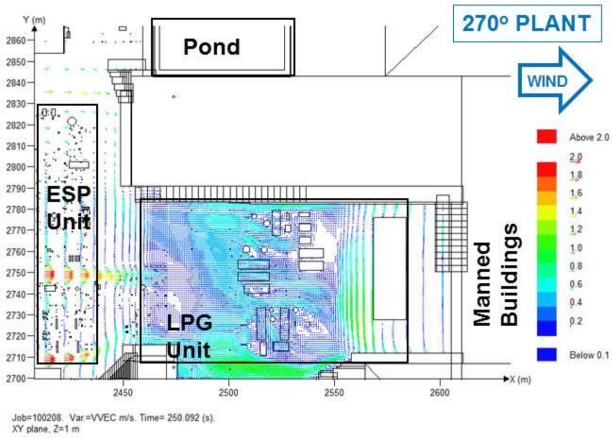
Note : Ground elevation at LPG Recovery Unit for Base Case is 0 m

33

GEXCON

Flow pattern on PTT LPG Recovery Area, Elevation = 1 m
Case 2 Geometry



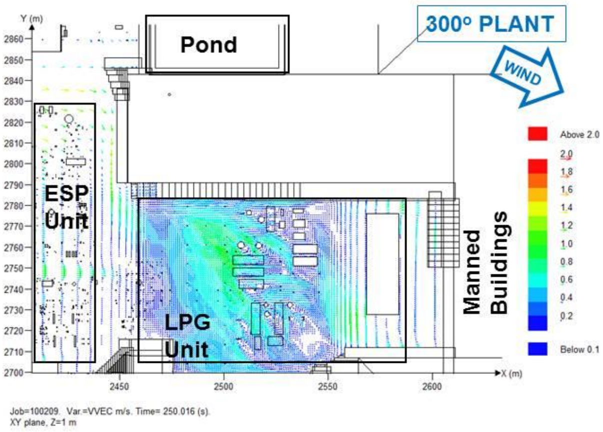


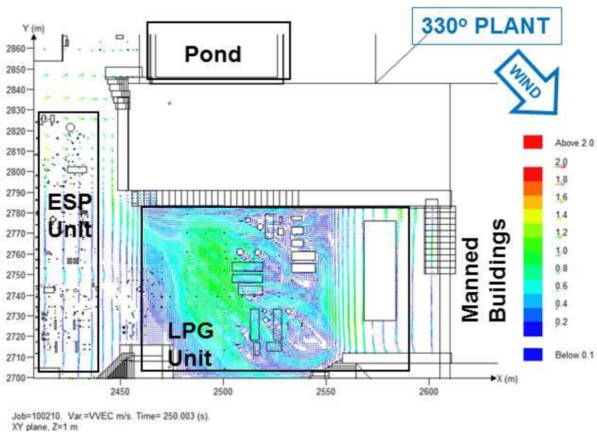
Note : Ground elevation at LPG Recovery Unit for Base Case is 0 m

34

GEXCON

Flow pattern on PTT LPG Recovery Area, Elevation = 1 m
Case 2 Geometry



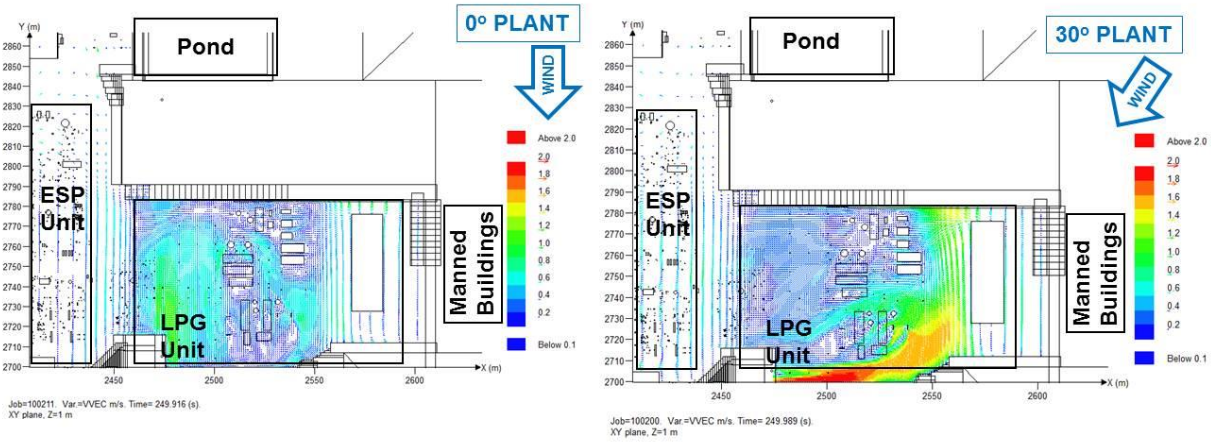


Note : Ground elevation at LPG Recovery Unit for Base Case is 0 m

35

GEXCON

Flow pattern on PTT LPG Recovery Area, Elevation = 1 m
Case 2 Geometry

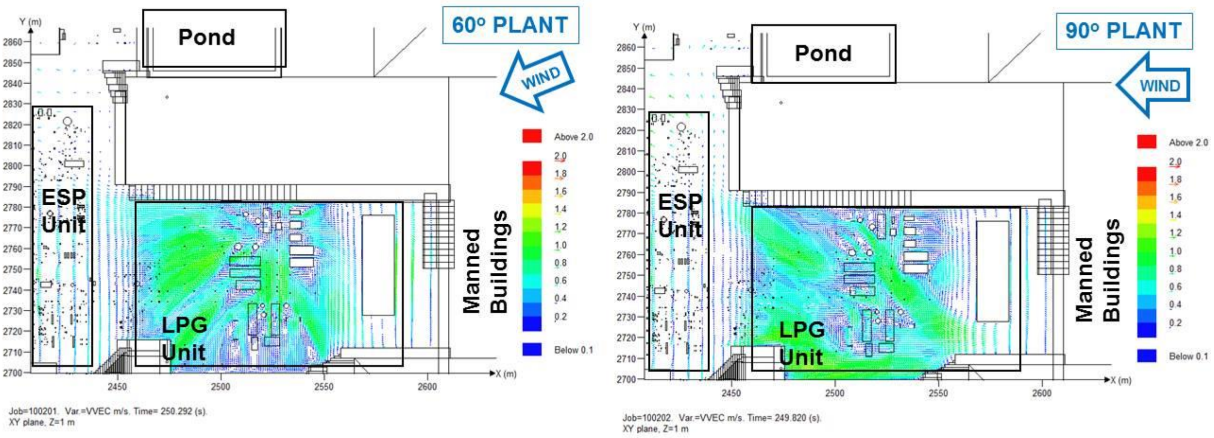


Note : Ground elevation at LPG Recovery Unit for Base Case is 0 m

30

GEXCON

Flow pattern on PTT LPG Recovery Area, Elevation = 1 m
Case 2 Geometry

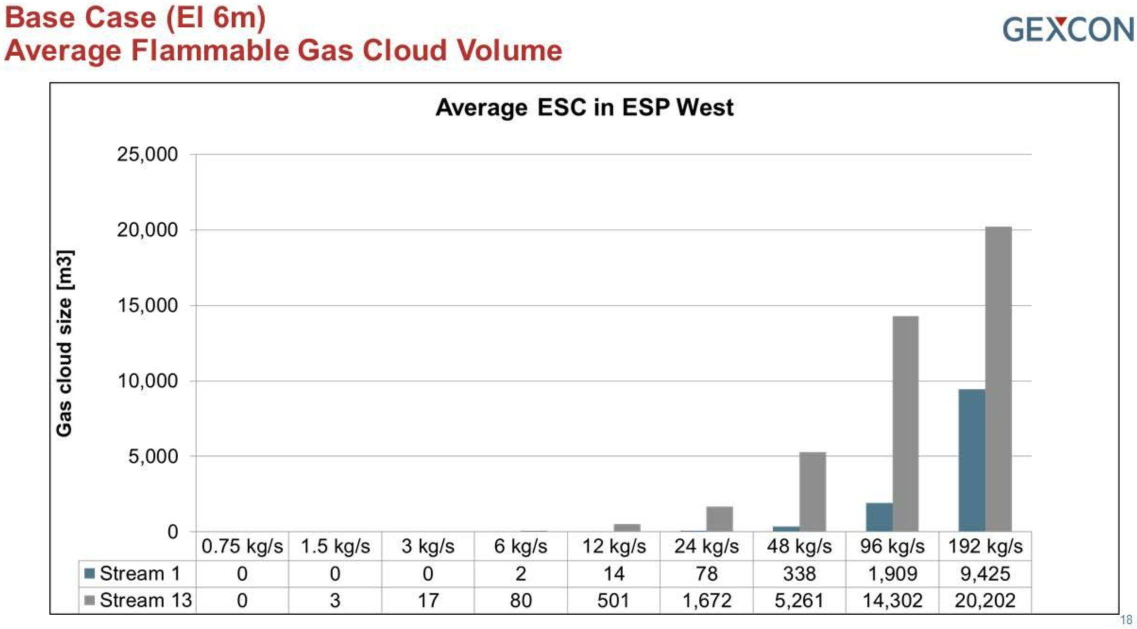


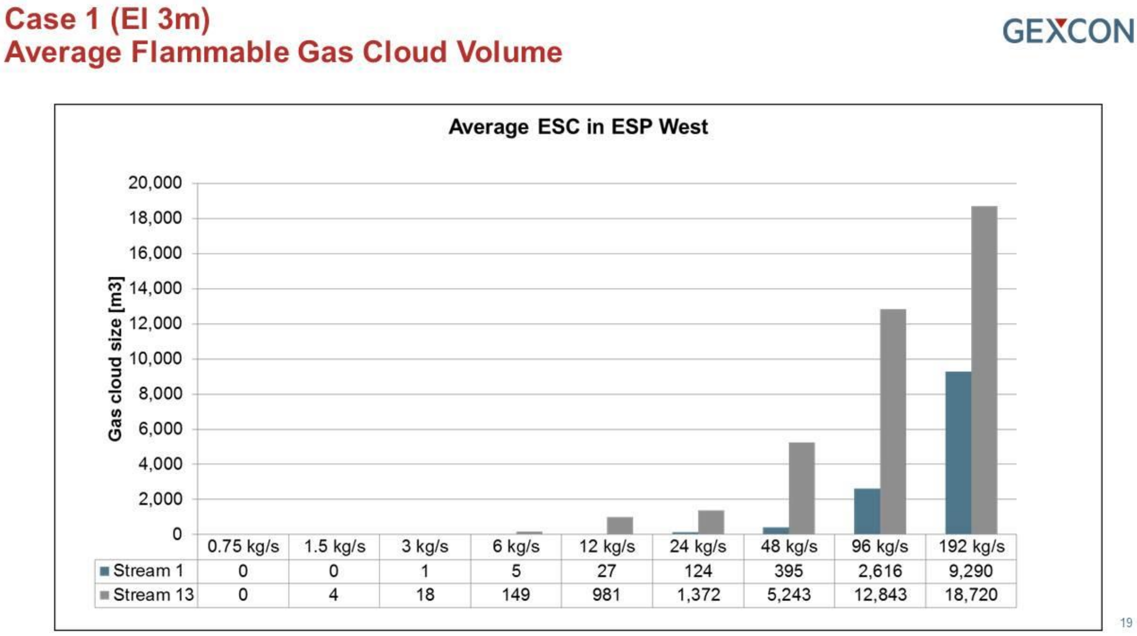
Note : Ground elevation at LPG Recovery Unit for Base Case is 0 m

31

Appendix C Maximum and Average ESC in LPG Recovery Unit area and its adjacent area

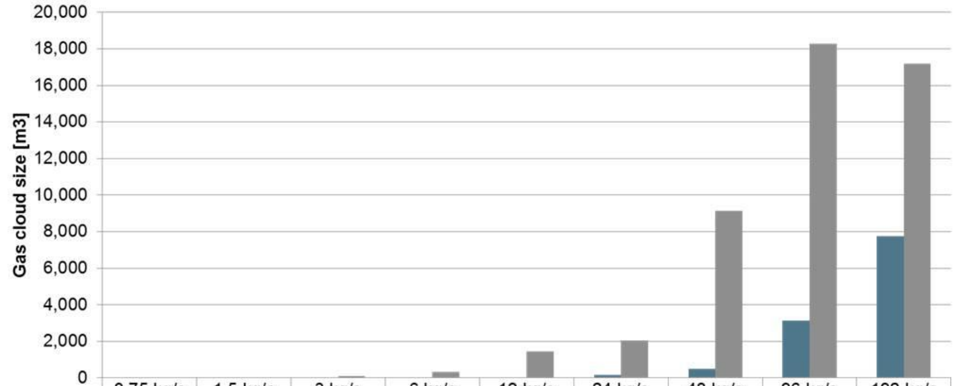
ESP West Area





Case 2 (El 0m)
Average Flammable Gas Cloud Volume

GEXCON

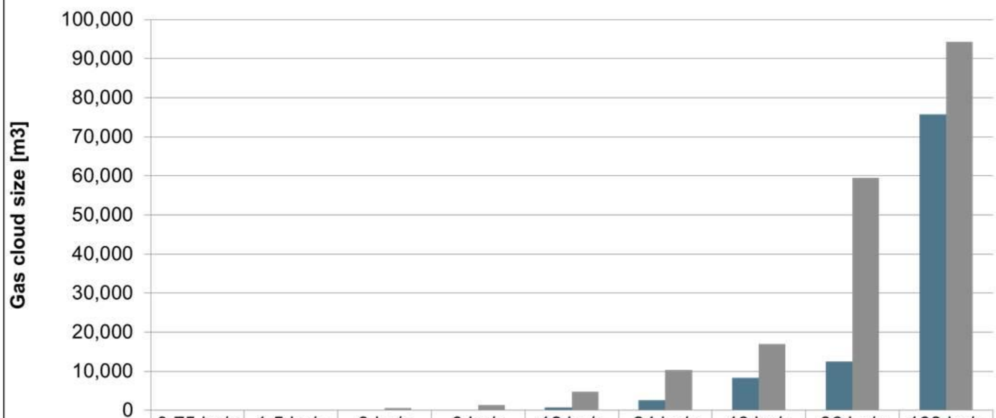


	0.75 kg/s	1.5 kg/s	3 kg/s	6 kg/s	12 kg/s	24 kg/s	48 kg/s	96 kg/s	192 kg/s
Stream 1	0	0	2	8	42	163	500	3,150	7,764
Stream 13	3	14	100	332	1,453	2,047	9,148	18,289	17,203

20

Base Case (El 6m)
Maximum Flammable Gas Cloud Volume

GEXCON

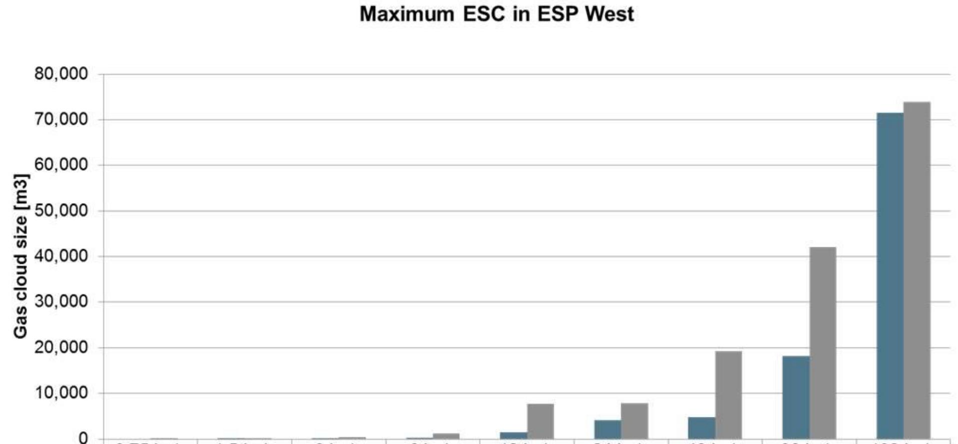


	0.75 kg/s	1.5 kg/s	3 kg/s	6 kg/s	12 kg/s	24 kg/s	48 kg/s	96 kg/s	192 kg/s
Stream 1	0	0	27	137	706	2,539	8,278	12,526	75,715
Stream 13	8	164	573	1,426	4,704	10,343	17,000	59,527	94,277

21

Case 1 (El 3m)
Maximum Flammable Gas Cloud Volume

GEXCON

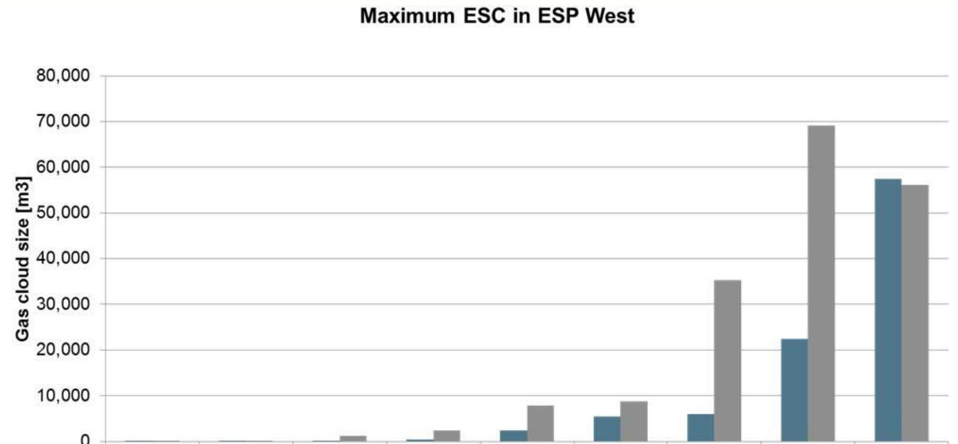


	0.75 kg/s	1.5 kg/s	3 kg/s	6 kg/s	12 kg/s	24 kg/s	48 kg/s	96 kg/s	192 kg/s
Stream 1	0	7	57	277	1,497	4,096	4,836	18,162	71,464
Stream 13	0	190	351	1,205	7,683	7,898	19,287	42,123	73,864

22

Case 2 (El 0m)
Maximum Flammable Gas Cloud Volume

GEXCON



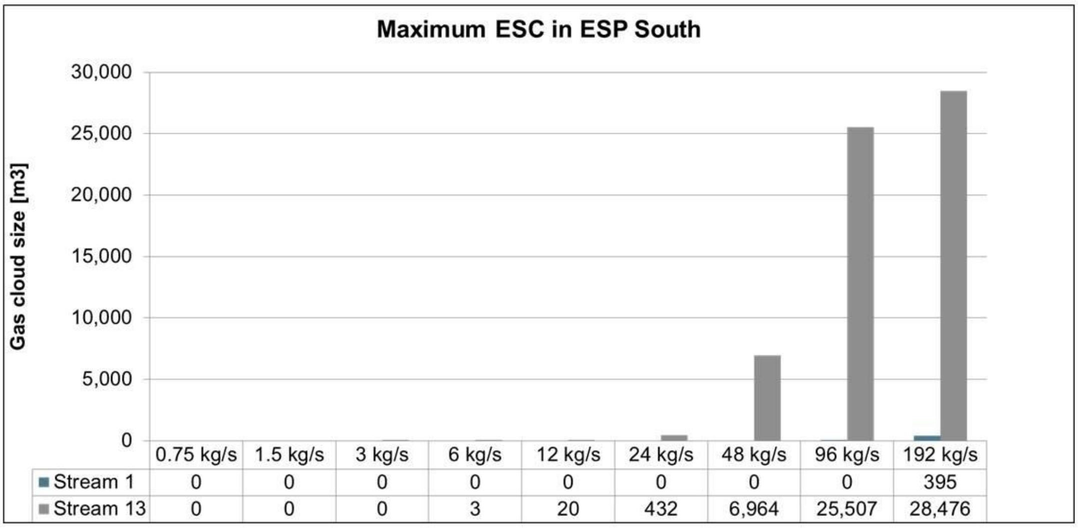
	0.75 kg/s	1.5 kg/s	3 kg/s	6 kg/s	12 kg/s	24 kg/s	48 kg/s	96 kg/s	192 kg/s
Stream 1	1	25	97	438	2,383	5,465	6,008	22,460	57,510
Stream 13	92	170	1,172	2,376	7,885	8,769	35,268	69,156	56,106

23

ESP South Area

Base Case (El 6m)
Maximum Flammable Gas Cloud Volume

GEXCON

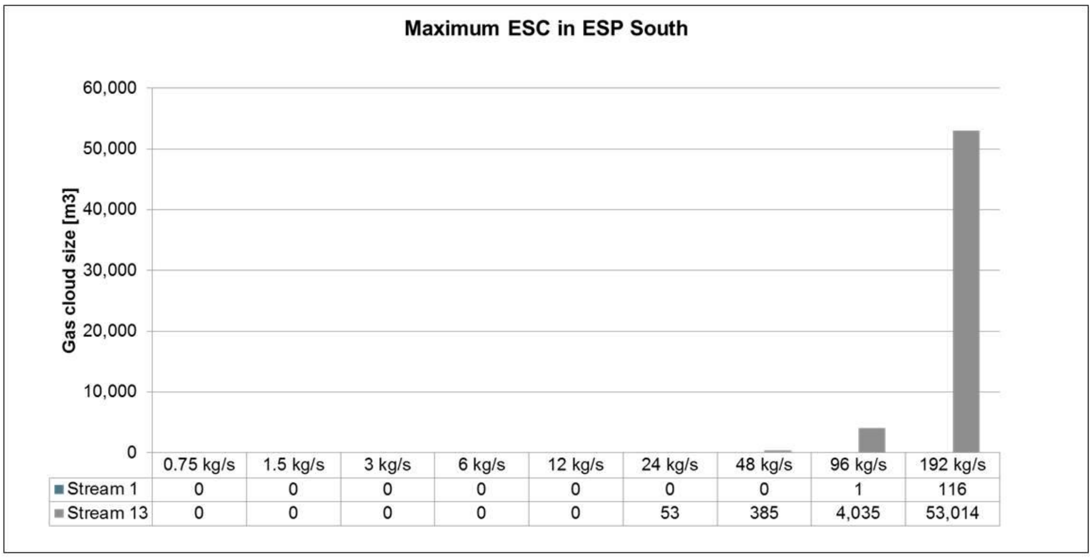


	0.75 kg/s	1.5 kg/s	3 kg/s	6 kg/s	12 kg/s	24 kg/s	48 kg/s	96 kg/s	192 kg/s
Stream 1	0	0	0	0	0	0	0	0	395
Stream 13	0	0	0	3	20	432	6,964	25,507	28,476

27

Case 1 (El 3m)
Maximum Flammable Gas Cloud Volume

GEXCON



	0.75 kg/s	1.5 kg/s	3 kg/s	6 kg/s	12 kg/s	24 kg/s	48 kg/s	96 kg/s	192 kg/s
Stream 1	0	0	0	0	0	0	0	1	116
Stream 13	0	0	0	0	0	53	385	4,035	53,014

28

Case 2 (El 0m)
Maximum Flammable Gas Cloud Volume

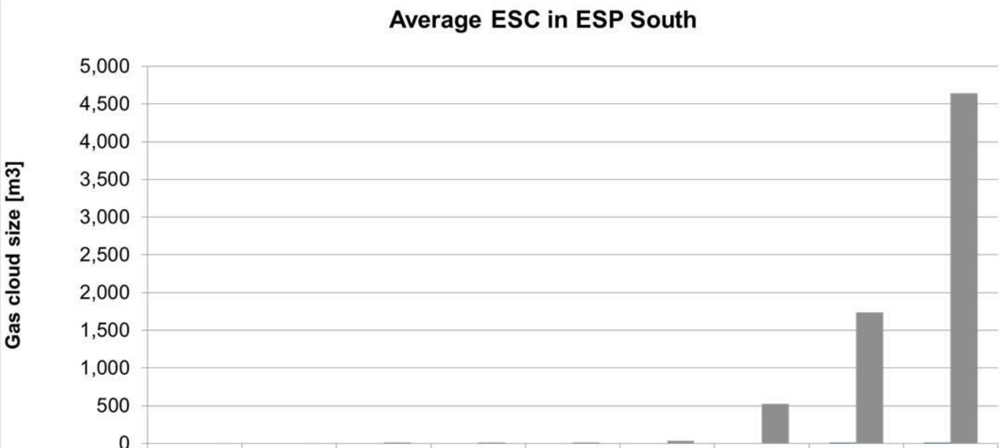
GEXCON

	0.75 kg/s	1.5 kg/s	3 kg/s	6 kg/s	12 kg/s	24 kg/s	48 kg/s	96 kg/s	192 kg/s
Stream 1	0	0	0	0	0	0	0	1	25
Stream 13	0	0	0	0	32	54	629	5,910	60,909

29

Base Case (El 6m)
Average Flammable Gas Cloud Volume

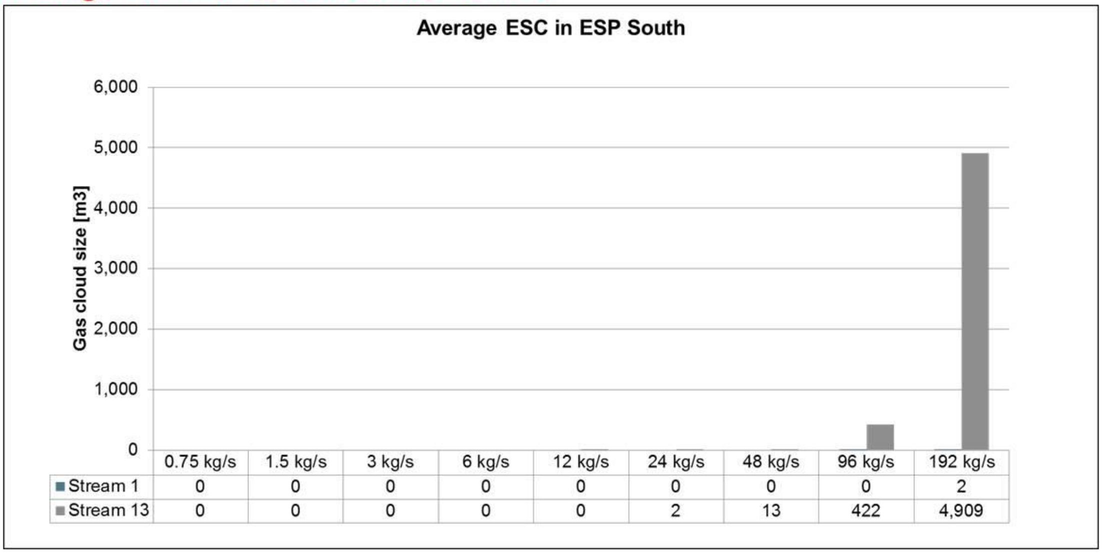
GEXCON



	0.75 kg/s	1.5 kg/s	3 kg/s	6 kg/s	12 kg/s	24 kg/s	48 kg/s	96 kg/s	192 kg/s
Stream 1	0	0	0	0	0	0	0	0	9
Stream 13	0	0	0	0	3	37	524	1,736	4,645

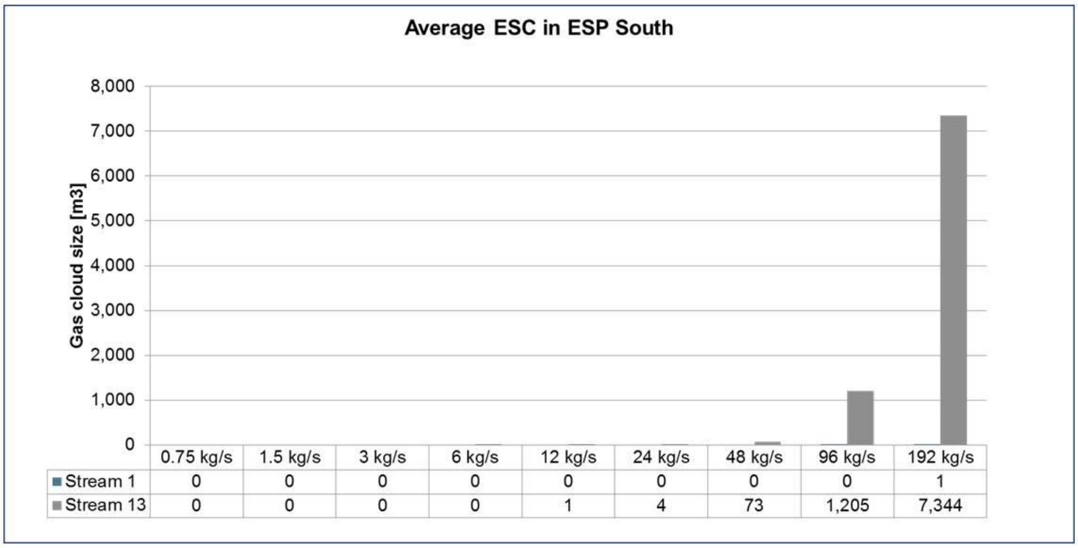
24

Case 1 (El 3m)
Average Flammable Gas Cloud Volume



25

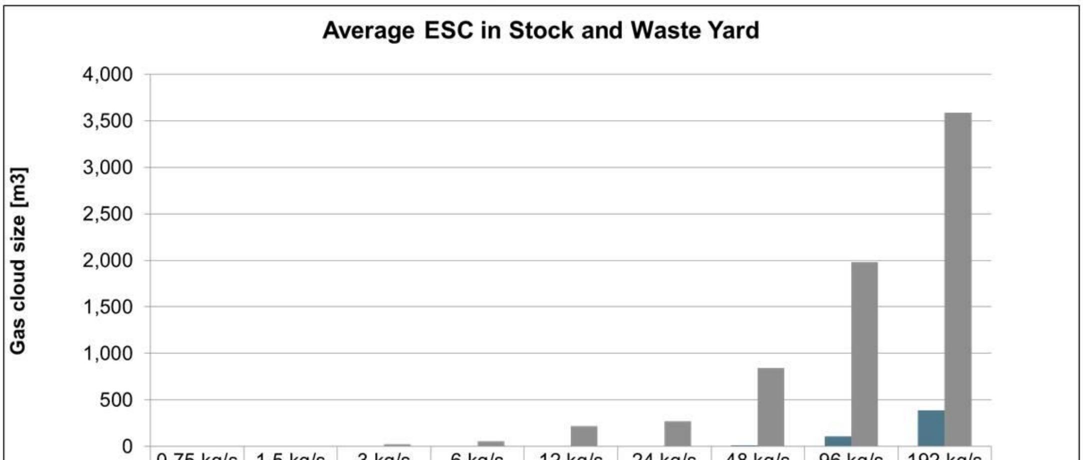
Case 2 (El 0m)
Average Flammable Gas Cloud Volume



26

Stock and Waste Yard Area

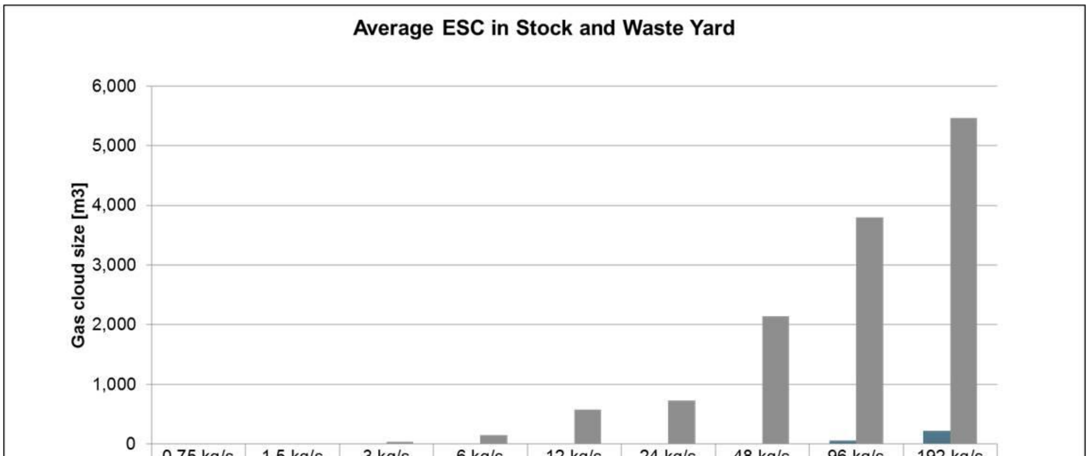
Base Case (El 6m)
Average Flammable Gas Cloud Volume



	0.75 kg/s	1.5 kg/s	3 kg/s	6 kg/s	12 kg/s	24 kg/s	48 kg/s	96 kg/s	192 kg/s
Stream 1	0	0	0	0	0	4	10	109	385
Stream 13	0	2	26	58	217	270	845	1,984	3,585

30

Case 1 (El 3m)
Average Flammable Gas Cloud Volume

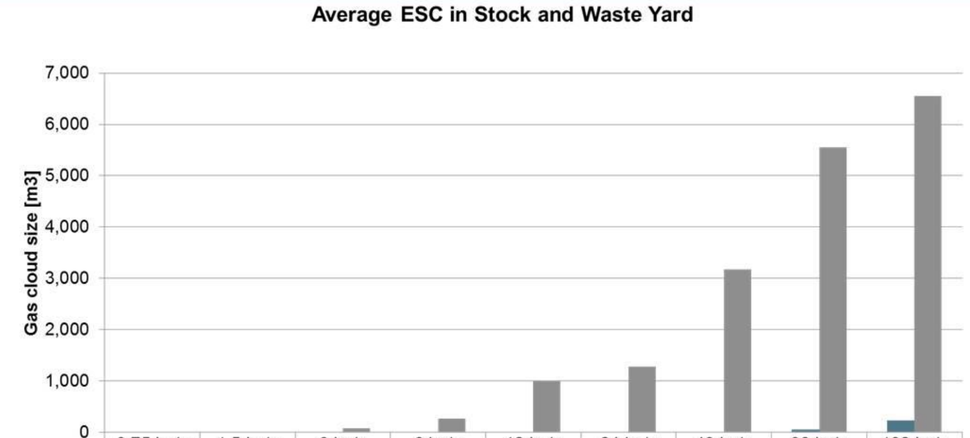


	0.75 kg/s	1.5 kg/s	3 kg/s	6 kg/s	12 kg/s	24 kg/s	48 kg/s	96 kg/s	192 kg/s
Stream 1	0	0	0	0	0	0	2	56	216
Stream 13	0	2	42	155	573	727	2,138	3,796	5,466

31

Case 2 (El 0m)
Average Flammable Gas Cloud Volume

GEXCON



	0.75 kg/s	1.5 kg/s	3 kg/s	6 kg/s	12 kg/s	24 kg/s	48 kg/s	96 kg/s	192 kg/s
Stream 1	0	0	0	0	0	0	2	53	227
Stream 13	1	5	80	263	1,002	1,279	3,179	5,550	6,553

32

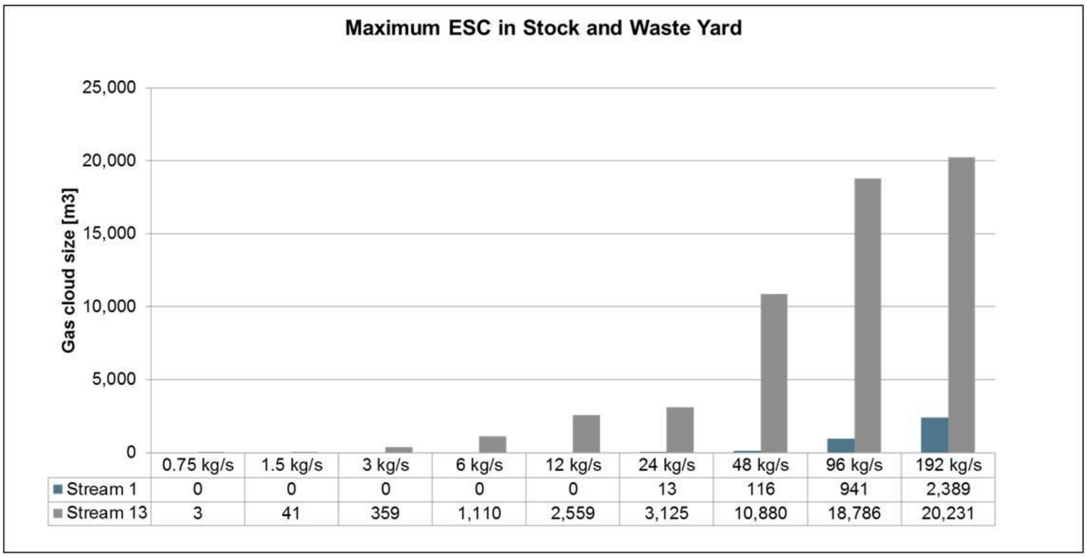
Base Case (El 6m)
Maximum Flammable Gas Cloud Volume

GEXCON

	0.75 kg/s	1.5 kg/s	3 kg/s	6 kg/s	12 kg/s	24 kg/s	48 kg/s	96 kg/s	192 kg/s
Stream 1	0	0	0	0	0	100	243	1,514	5,282
Stream 13	6	53	306	437	1,217	1,064	3,435	9,296	14,146

33

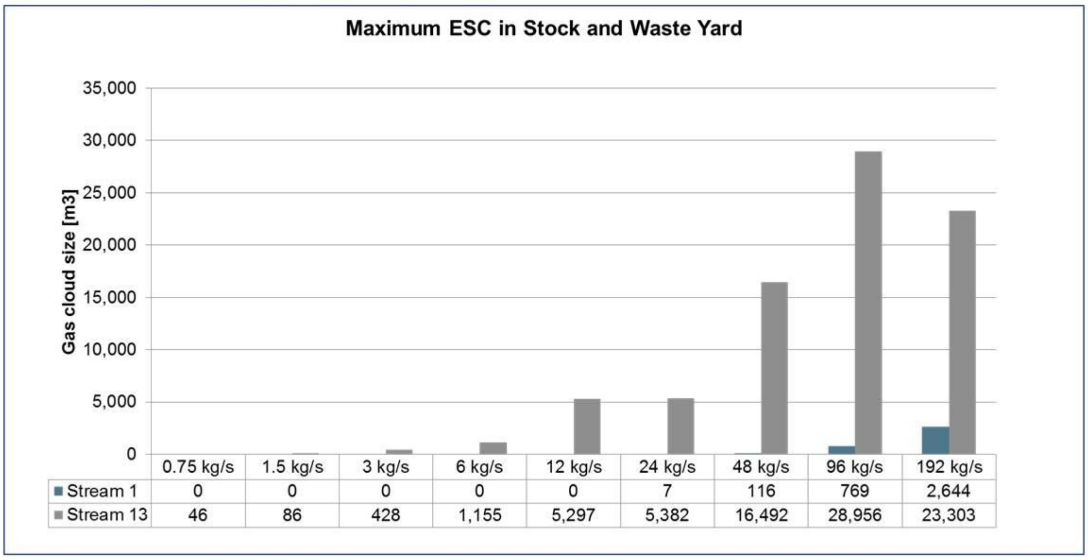
Case 1 (El 3m)
Maximum Flammable Gas Cloud Volume



	0.75 kg/s	1.5 kg/s	3 kg/s	6 kg/s	12 kg/s	24 kg/s	48 kg/s	96 kg/s	192 kg/s
Stream 1	0	0	0	0	0	13	116	941	2,389
Stream 13	3	41	359	1,110	2,559	3,125	10,880	18,786	20,231

34

Case 2 (El 0m)
Maximum Flammable Gas Cloud Volume



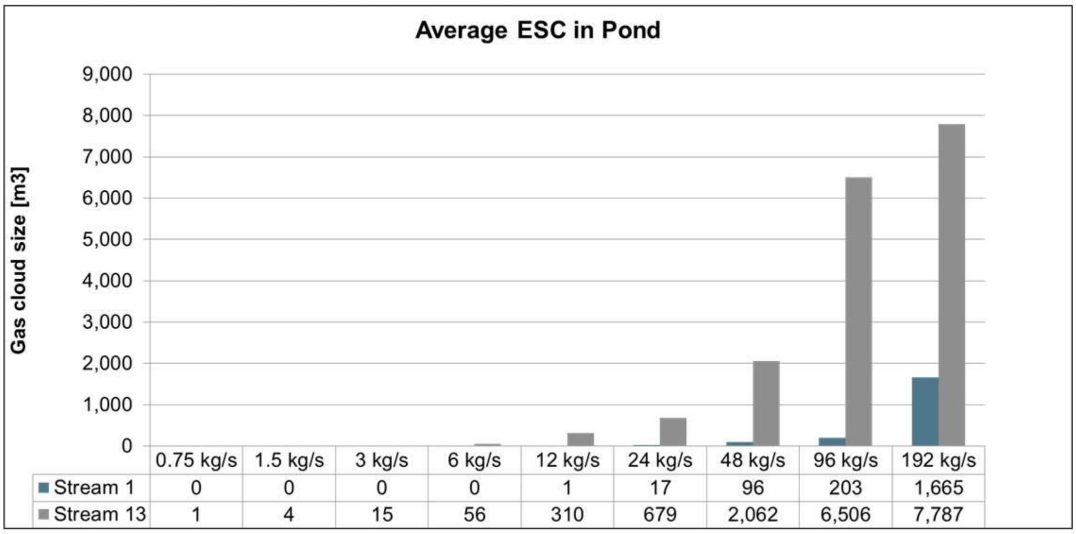
	0.75 kg/s	1.5 kg/s	3 kg/s	6 kg/s	12 kg/s	24 kg/s	48 kg/s	96 kg/s	192 kg/s
Stream 1	0	0	0	0	0	7	116	769	2,644
Stream 13	46	86	428	1,155	5,297	5,382	16,492	28,956	23,303

35

Pond Area

Base Case (El 6m)
Average Flammable Gas Cloud Volume

GEXCON

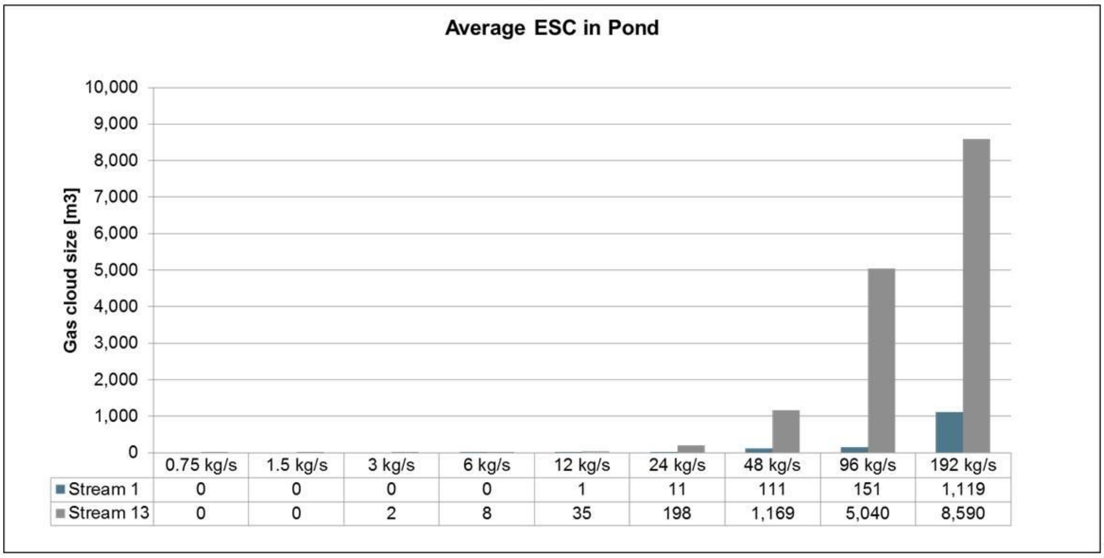


	0.75 kg/s	1.5 kg/s	3 kg/s	6 kg/s	12 kg/s	24 kg/s	48 kg/s	96 kg/s	192 kg/s
Stream 1	0	0	0	0	1	17	96	203	1,665
Stream 13	1	4	15	56	310	679	2,062	6,506	7,787

36

Case 1 (El 3m)
Average Flammable Gas Cloud Volume

GEXCON

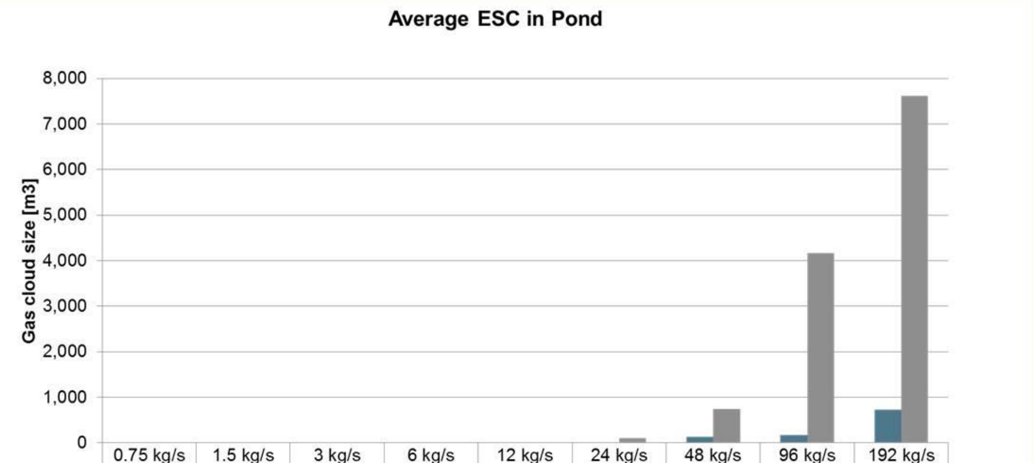


	0.75 kg/s	1.5 kg/s	3 kg/s	6 kg/s	12 kg/s	24 kg/s	48 kg/s	96 kg/s	192 kg/s
Stream 1	0	0	0	0	1	11	111	151	1,119
Stream 13	0	0	2	8	35	198	1,169	5,040	8,590

37

Case 1 (El 3m)
Average Flammable Gas Cloud Volume

GEXCON



	0.75 kg/s	1.5 kg/s	3 kg/s	6 kg/s	12 kg/s	24 kg/s	48 kg/s	96 kg/s	192 kg/s
Stream 1	0	0	0	0	2	14	125	164	734
Stream 13	0	0	0	3	15	106	742	4,166	7,615

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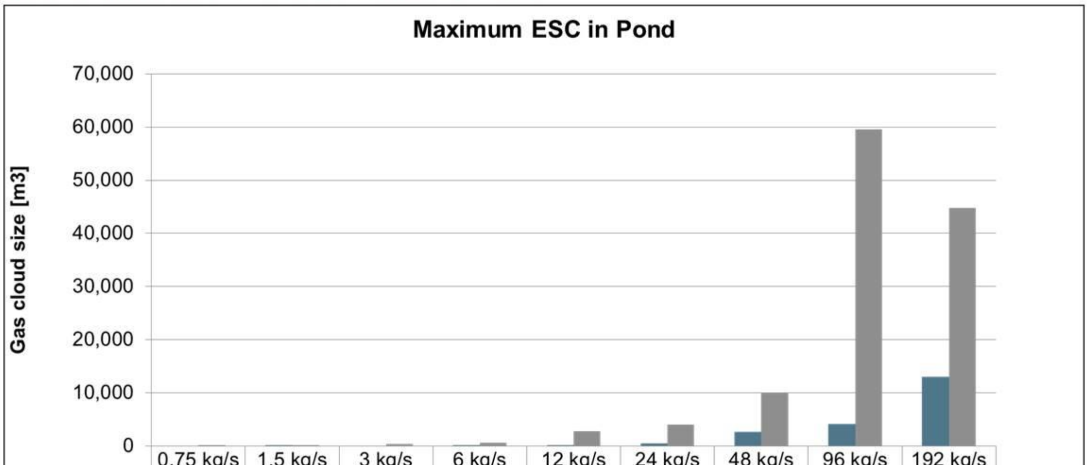
Base Case (El 6m)
Maximum Flammable Gas Cloud Volume

GEXCON



	0.75 kg/s	1.5 kg/s	3 kg/s	6 kg/s	12 kg/s	24 kg/s	48 kg/s	96 kg/s	192 kg/s
Stream 1	0	0	0	1	70	466	2,708	4,140	12,960
Stream 13	42	129	324	620	2,822	4,041	9,913	59,516	44,777

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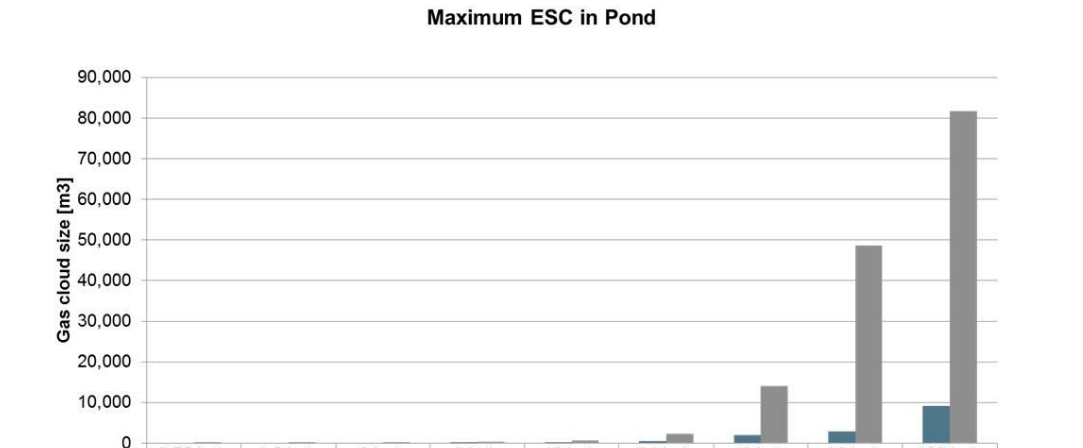
Case 1 (El 3m)
Maximum Flammable Gas Cloud Volume

GEXCON

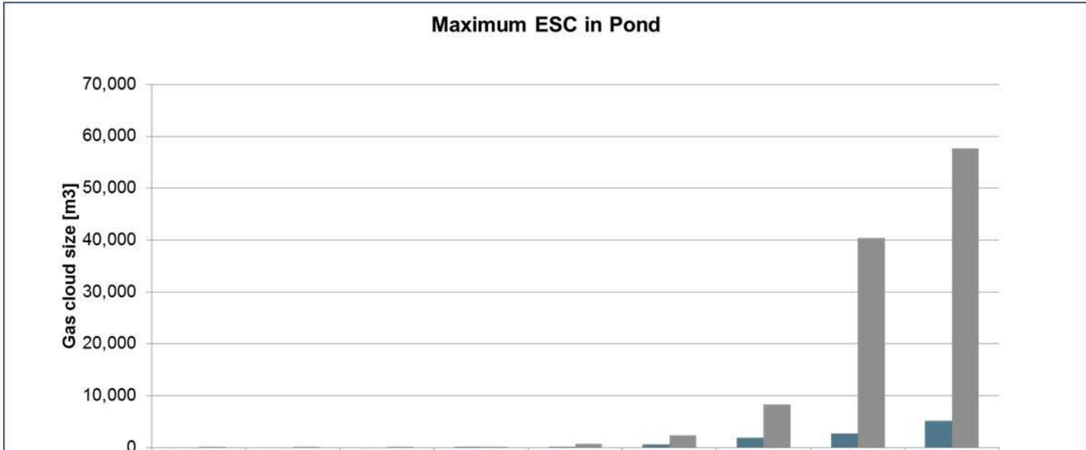


	0.75 kg/s	1.5 kg/s	3 kg/s	6 kg/s	12 kg/s	24 kg/s	48 kg/s	96 kg/s	192 kg/s
Stream 1	0	0	0	2	85	499	2,010	2,926	9,132
Stream 13	2	3	15	416	665	2,285	14,104	48,602	81,637

40

Case 2 (El 0m)
Maximum Flammable Gas Cloud Volume

GEXCON



	0.75 kg/s	1.5 kg/s	3 kg/s	6 kg/s	12 kg/s	24 kg/s	48 kg/s	96 kg/s	192 kg/s
Stream 1	0	0	0	4	123	577	1,921	2,709	5,179
Stream 13	0	0	3	176	689	2,372	8,310	40,441	57,655

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Appendix D Overpressures load table at targets of interest

Target / Gas Cloud Class		LPG Base Case - Stream 1	LPG Case 1 - Stream 1	LPG Case 2 - Stream 1	LPG Base Case - Stream 13	LPG Case 1 - Stream 13	LPG Case 2 - Stream 13	ESP West Base Case - Stream 1	ESP West Case 1 - Stream 1	ESP West Case 2 - Stream 1	ESP West Base Case - Stream 13	ESP West Case 1 - Stream 13	ESP West Case 2 - Stream 13
1	Max	0.01	0.01	0.01	0.02	0.02	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	0.01	0.01	0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
2	Max	0.01	0.01	0.01	0.03	0.03	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	0.01	0.01	0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
3	Max	0.03	0.03	0.03	0.05	0.05	0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	0.01	0.01	0.01	0.02	0.02	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
4	Max	0.05	0.05	0.05	0.06	0.06	0.06	<0.01	<0.01	<0.01	0.01	0.01	0.01
	Average	0.01	0.01	0.01	0.02	0.02	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
5	Max	0.14	0.14	0.14	0.24	0.24	0.24	0.01	0.01	0.01	0.02	0.02	0.02
	Average	0.05	0.05	0.05	0.09	0.09	0.09	<0.01	<0.01	<0.01	0.01	0.01	0.01
6	Max	0.87	0.85	0.89	1.83	1.87	1.95	0.05	0.05	0.05	0.07	0.08	0.08
	Average	0.18	0.18	0.18	0.29	0.30	0.30	0.01	0.01	0.01	0.02	0.02	0.02
7	Max	1.01	1.03	1.03	2.04	2.03	2.06	0.06	0.06	0.06	0.10	0.09	0.10
	Average	0.25	0.26	0.25	0.43	0.43	0.44	0.02	0.02	0.02	0.03	0.03	0.04
8	Max	2.36	2.48	2.53	5.30	5.35	5.26	0.20	0.20	0.20	0.40	0.39	0.39
	Average	0.88	0.92	0.94	2.14	2.18	2.25	0.08	0.09	0.09	0.16	0.16	0.16
9	Max	9.98	>10	>10	>10	>10	>10	0.66	0.62	0.59	0.76	0.73	0.73
	Average	3.66	3.74	3.94	8.54	8.65	8.75	0.25	0.25	0.24	0.40	0.38	0.37

Table A- 1 Explosion overpressure measured by monitor points in LPG Recovery Unit and ESP West areas

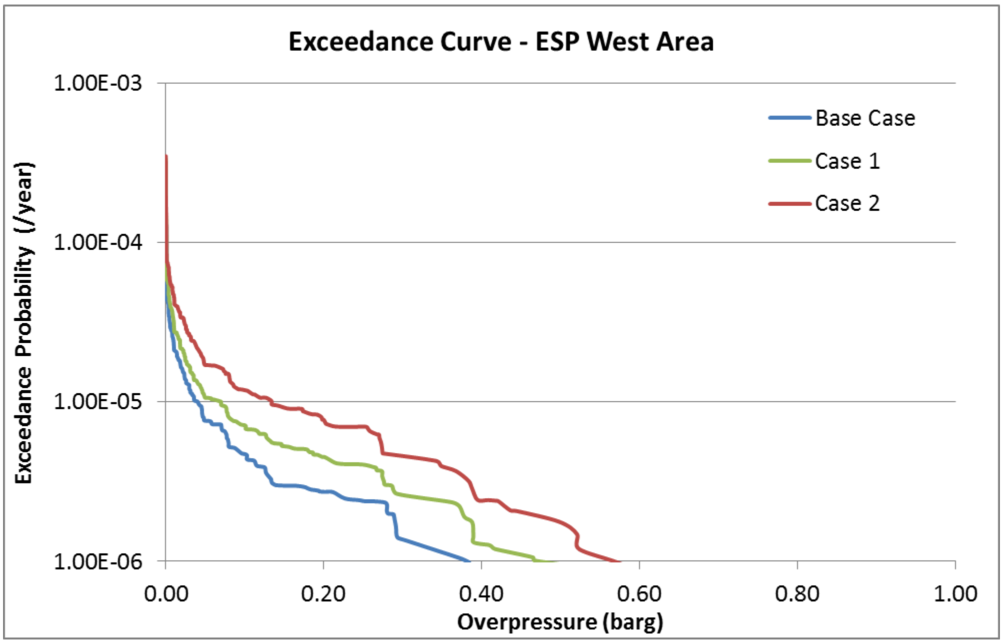
Target / Gas Cloud Class		LPG R Unit CCB Base Case Global - Stream 1	LPG R Unit CCB Case 1 Global - Stream 1	LPG R Unit CCB Case 2 Global - Stream 1	LPG R Unit CCB Base Case Global - Stream 13	LPG R Unit CCB Case 1 Global - Stream 13	LPG R Unit CCB Case 2 Global - Stream 13	Stock and Waste Yard Base Case Global - Stream 1	Stock and Waste Yard Case 1 Global - Stream 1	Stock and Waste Yard Case 2 Global - Stream 1	Stock and Waste Yard Base Case Global - Stream 13	Stock and Waste Yard Case 1 Global - Stream 13	Stock and Waste Yard Case 2 Global - Stream 13	C Workshop Base Case Global - Stream 1	C Workshop Case 1 Global - Stream 1	C Workshop Case 2 Global - Stream 1	C Workshop Base Case Global - Stream 13	C Workshop Case 1 Global - Stream 13	C Workshop Case 2 Global - Stream 13	Laboratory Base Case Global - Stream 1	Laboratory Case 1 Global - Stream 1	Laboratory Case 2 Global - Stream 1	Laboratory Base Case Global - Stream 13	Laboratory Case 1 Global - Stream 13	Laboratory Case 2 Global - Stream 13	CCB ESP Base Case Global - Stream 1	CCB ESP Case 1 Global - Stream 1	CCB ESP Case 2 Global - Stream 1	CCB ESP Base Case Global - Stream 13	CCB ESP Case 1 Global - Stream 13	CCB ESP Case 2 Global - Stream 13
1	Max	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
2	Max	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
3	Max	0.01	0.01	0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
4	Max	0.01	0.01	0.01	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
	Average	<0.01	<0.01	<0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
5	Max	0.04	0.03	0.03	0.06	0.06	0.06	0.01	0.01	0.01	0.02	0.02	0.02	0.01	0.01	0.01	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02
	Average	0.01	0.01	0.01	0.02	0.02	0.02	<0.01	<0.01	<0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.01	0.01
6	Max	0.10	0.10	0.10	0.14	0.14	0.14	0.03	0.03	0.03	0.04	0.04	0.05	0.03	0.03	0.02	0.04	0.04	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.04	0.04	0.04
	Average	0.03	0.03	0.03	0.04	0.05	0.05	0.01	0.01	0.01	0.02	0.02	0.02	0.01	0.01	0.01	0.02	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02
7	Max	0.15	0.17	0.14	0.20	0.20	0.20	0.05	0.05	0.05	0.07	0.07	0.07	0.04	0.04	0.04	0.05	0.05	0.05	0.03	0.02	0.02	0.04	0.03	0.03	0.04	0.04	0.04	0.06	0.06	0.05
	Average	0.05	0.05	0.05	0.07	0.08	0.08	0.02	0.02	0.02	0.03	0.03	0.03	0.02	0.02	0.02	0.03	0.03	0.02	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03
8	Max	0.31	0.31	0.32	0.75	0.77	0.76	0.09	0.10	0.10	0.15	0.16	0.16	0.09	0.09	0.09	0.16	0.16	0.15	0.05	0.05	0.05	0.07	0.07	0.06	0.09	0.08	0.08	0.15	0.15	0.15
	Average	0.16	0.17	0.18	0.33	0.34	0.35	0.05	0.06	0.06	0.09	0.09	0.10	0.05	0.05	0.05	0.08	0.08	0.08	0.03	0.03	0.03	0.05	0.04	0.04	0.05	0.05	0.05	0.07	0.07	0.07
9	Max	1.78	1.77	1.81	2.33	2.39	2.37	0.37	0.36	0.36	0.41	0.41	0.43	0.35	0.33	0.32	0.42	0.40	0.38	0.10	0.10	0.10	0.15	0.14	0.14	0.19	0.18	0.17	0.26	0.25	0.25
	Average	0.60	0.61	0.62	0.98	0.98	0.99	0.15	0.15	0.16	0.22	0.23	0.23	0.12	0.12	0.12	0.18	0.17	0.17	0.06	0.06	0.06	0.09	0.09	0.09	0.10	0.10	0.10	0.14	0.14	0.13

Table A- 2 Explosion overpressure measured by global panels on targets of interest

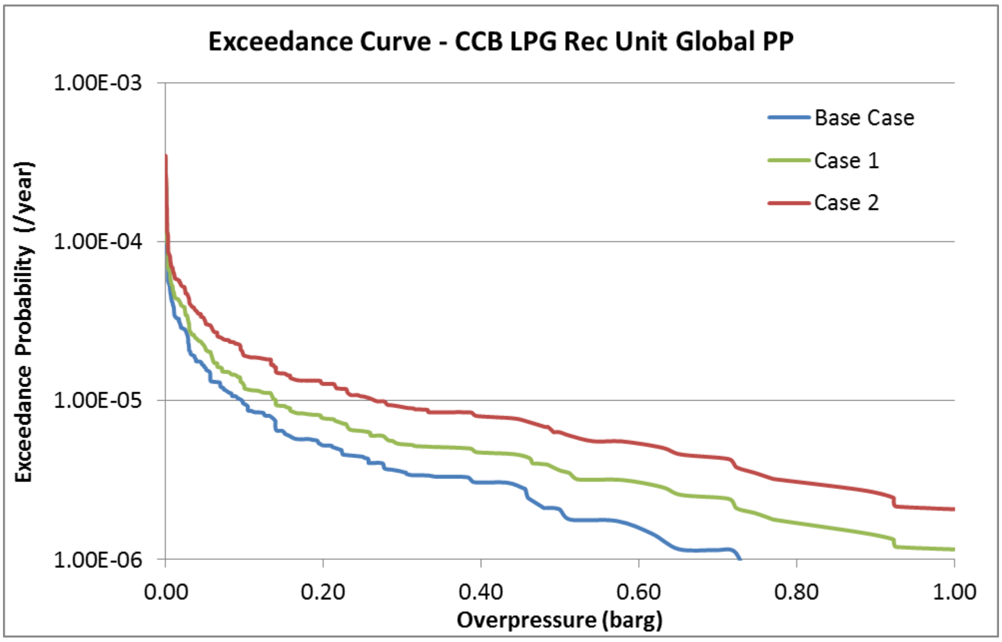
Gas Cloud Class	Target	LPG R Unit CCB Base Case Local - Stream 1	LPG R Unit CCB Case 1 Local - Stream 1	LPG R Unit CCB Case 2 Local - Stream 1	LPG R Unit CCB Base Case Local - Stream 13	LPG R Unit CCB Case 1 Local - Stream 13	LPG R Unit CCB Case 2 Local - Stream 13	Stock and Waste Yard Base Case Local - Stream 1	Stock and Waste Yard Case 1 Local - Stream 1	Stock and Waste Yard Case 2 Local - Stream 1	Stock and Waste Yard Base Case Local - Stream 13	Stock and Waste Yard Case 1 Local - Stream 13	Stock and Waste Yard Case 2 Local - Stream 13	C Workshop Base Case Local - Stream 1	C Workshop Case 1 Local - Stream 1	C Workshop Case 2 Local - Stream 1	C Workshop Base Case Local - Stream 13	C Workshop Case 1 Local - Stream 13	C Workshop Case 2 Local - Stream 13	Laboratory Base Case Local - Stream 1	Laboratory Case 1 Local - Stream 1	Laboratory Case 2 Local - Stream 1	Laboratory Base Case Local - Stream 13	Laboratory Case 1 Local - Stream 13	Laboratory Case 2 Local - Stream 13	CCB ESP Base Case Local - Stream 1	CCB ESP Case 1 Local - Stream 1	CCB ESP Case 2 Local - Stream 1	CCB ESP Base Case Local - Stream 13	CCB ESP Case 1 Local - Stream 13	CCB ESP Case 2 Local - Stream 13
1	Max	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
2	Max	<0.01	<0.01	<0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
3	Max	0.01	0.01	0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
4	Max	0.02	0.01	0.01	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.01	0.01
	Average	<0.01	<0.01	<0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
5	Max	0.04	0.04	0.04	0.06	0.06	0.06	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02
	Average	0.01	0.01	0.01	0.02	0.02	0.02	<0.01	<0.01	<0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.01	0.01
6	Max	0.11	0.11	0.11	0.15	0.15	0.15	0.04	0.04	0.04	0.05	0.05	0.05	0.03	0.03	0.03	0.04	0.04	0.04	0.02	0.02	0.02	0.03	0.03	0.02	0.03	0.03	0.03	0.04	0.04	0.04
	Average	0.03	0.04	0.03	0.05	0.05	0.05	0.01	0.01	0.01	0.02	0.02	0.02	0.01	0.01	0.01	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02
7	Max	0.16	0.18	0.15	0.21	0.21	0.21	0.05	0.06	0.06	0.07	0.08	0.08	0.04	0.04	0.04	0.06	0.05	0.05	0.03	0.03	0.02	0.04	0.04	0.03	0.04	0.04	0.04	0.06	0.06	0.06
	Average	0.05	0.05	0.05	0.08	0.08	0.08	0.02	0.02	0.02	0.03	0.03	0.03	0.02	0.02	0.02	0.03	0.03	0.03	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03
8	Max	0.33	0.34	0.35	0.84	0.83	0.84	0.10	0.12	0.11	0.18	0.18	0.18	0.09	0.09	0.09	0.18	0.17	0.17	0.05	0.05	0.05	0.08	0.08	0.07	0.09	0.09	0.09	0.16	0.16	0.15
	Average	0.18	0.18	0.19	0.36	0.37	0.38	0.06	0.06	0.06	0.10	0.10	0.11	0.05	0.05	0.05	0.08	0.08	0.08	0.03	0.03	0.03	0.05	0.05	0.05	0.05	0.05	0.05	0.08	0.08	0.07
9	Max	1.88	1.87	1.93	2.49	2.55	2.53	0.44	0.43	0.42	0.50	0.49	0.50	0.40	0.39	0.37	0.48	0.46	0.44	0.11	0.11	0.11	0.17	0.17	0.16	0.20	0.19	0.18	0.27	0.26	0.26
	Average	0.65	0.66	0.68	1.08	1.08	1.10	0.17	0.17	0.18	0.25	0.26	0.26	0.13	0.13	0.13	0.19	0.19	0.19	0.07	0.07	0.07	0.11	0.10	0.10	0.11	0.10	0.10	0.15	0.14	0.14

Table A- 3 Explosion overpressure measured by local panels on targets of interest

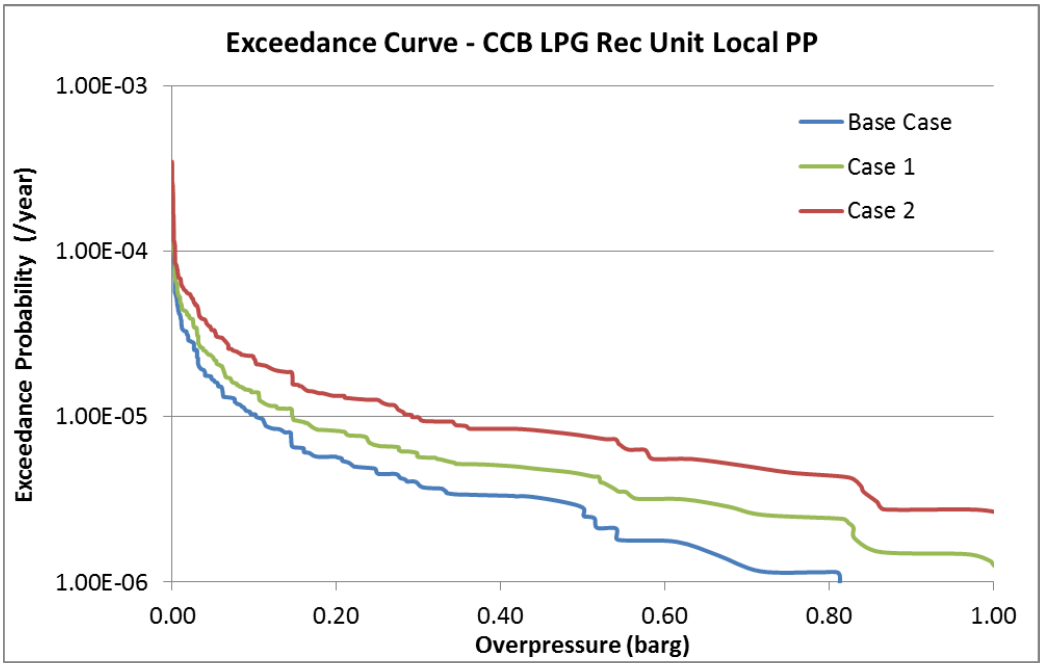
Appendix E Exceedance curve on target of interest



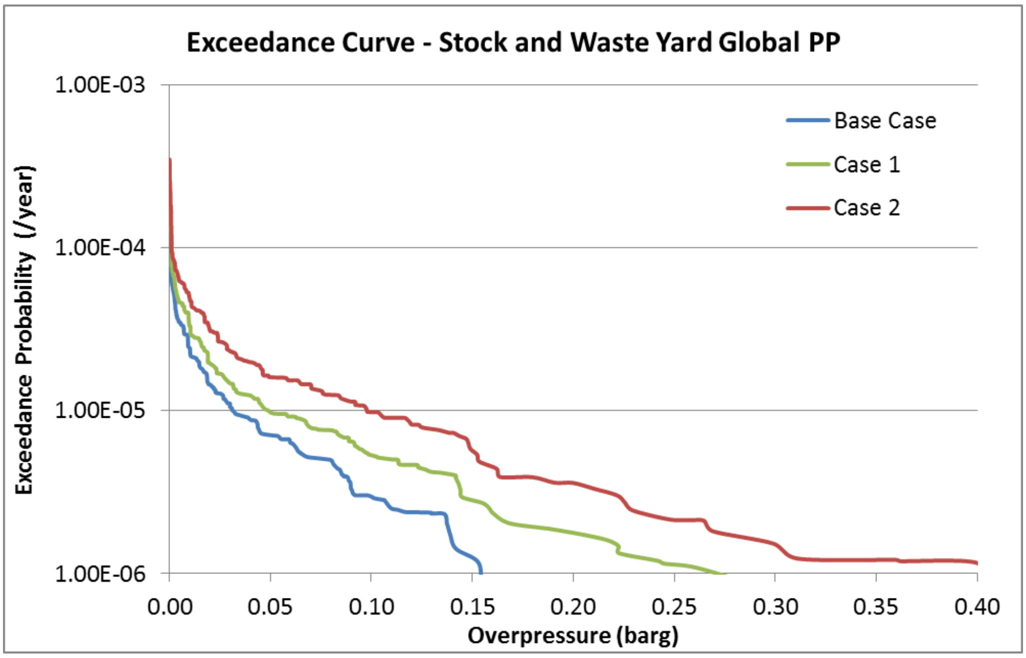
Appendix B- 1 Exceedance curve – ESP West Area



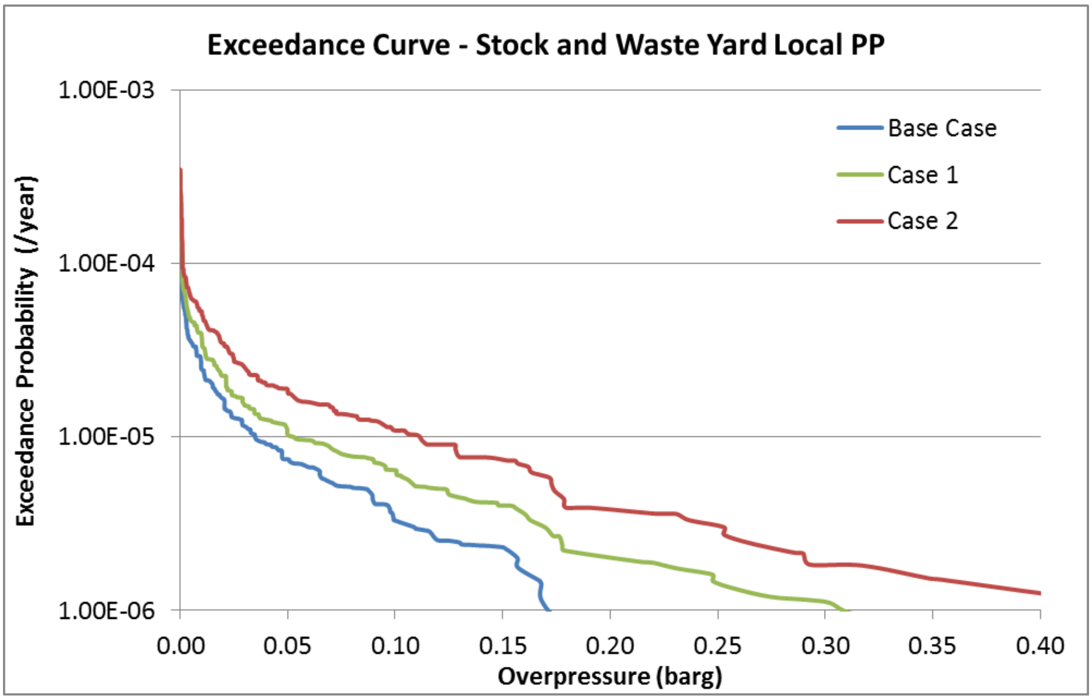
Appendix B- 2 Exceedance curve – CCB LPG Recovery Unit Local Panels



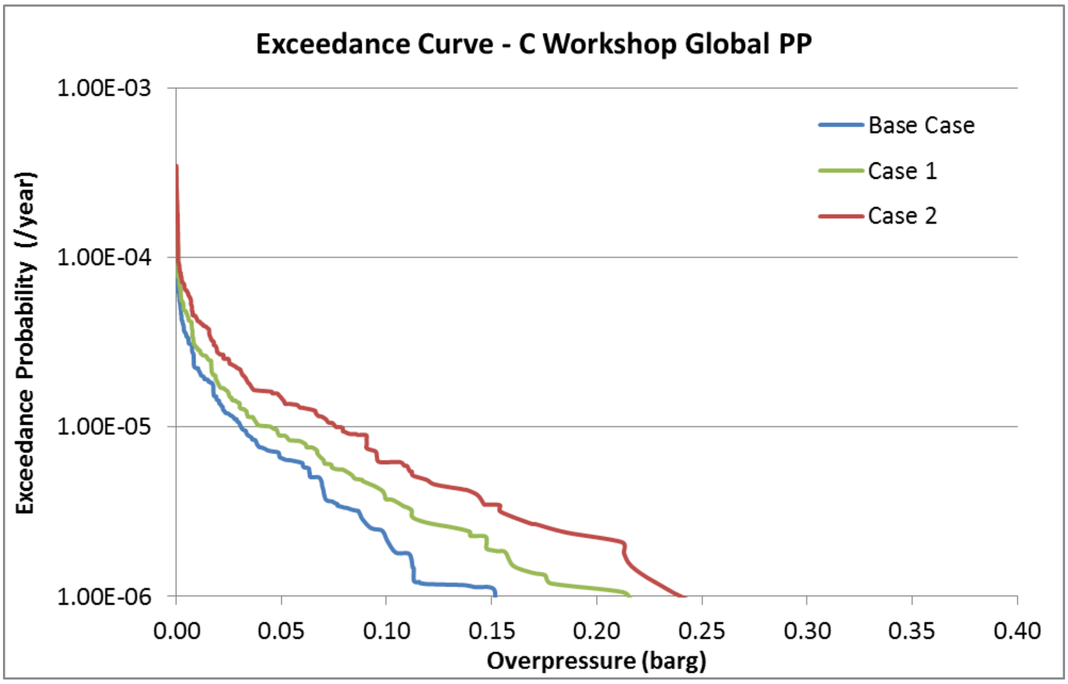
Appendix B- 3 Exceedance curve – CCB LPG Recovery Unit Local Panels



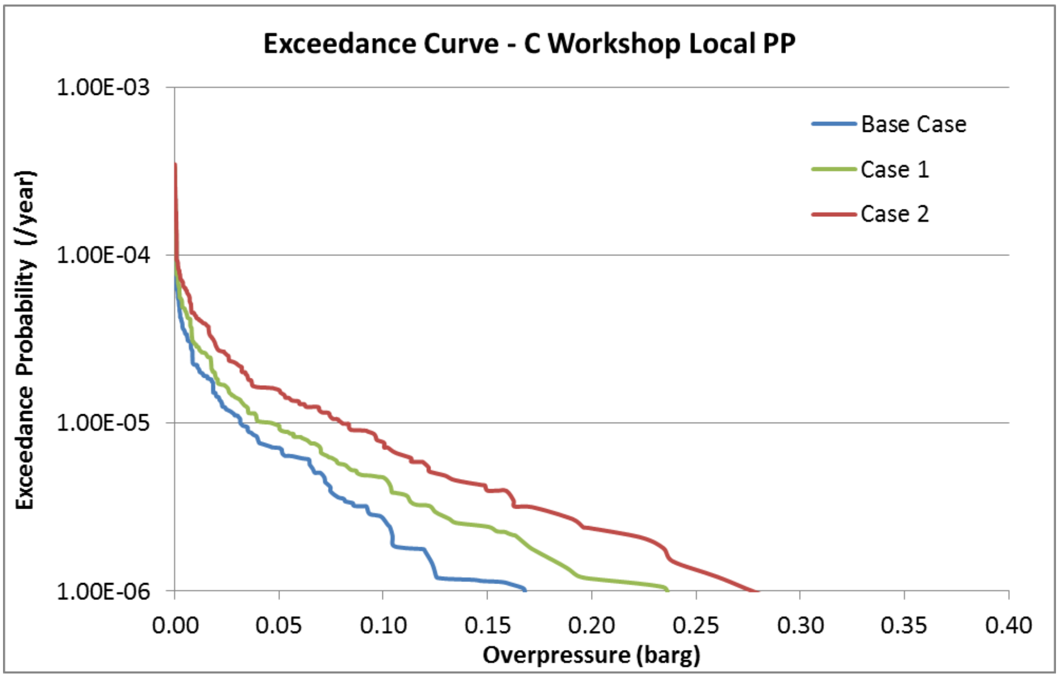
Appendix B- 4 Exceedance curve – Stock and Waste Yard Global Panels



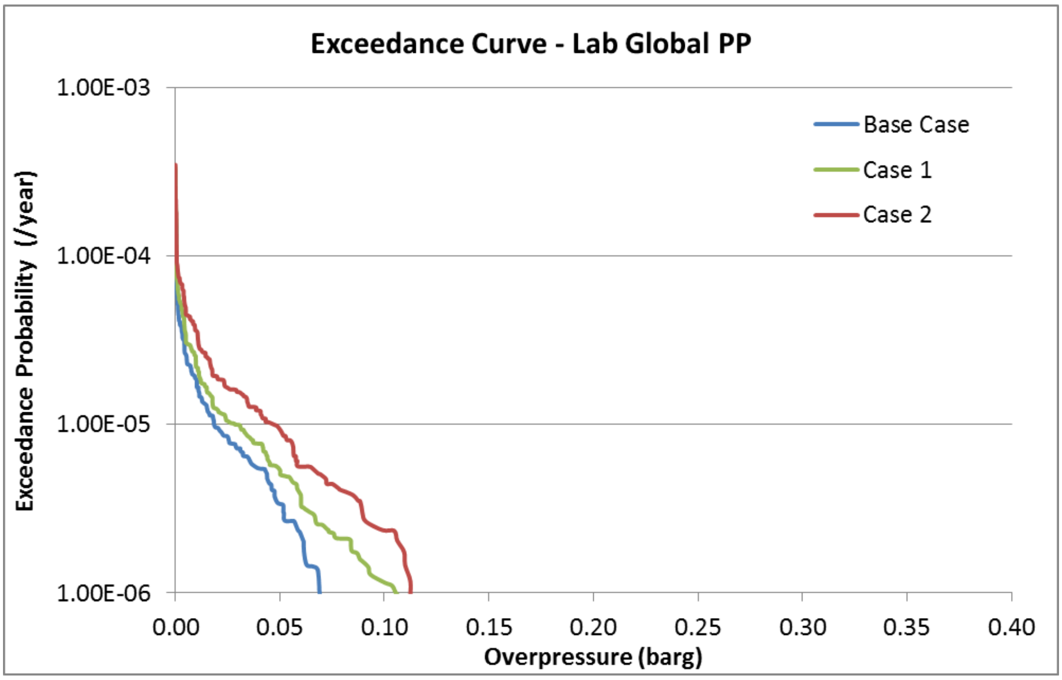
Appendix B- 5 Exceedance curve – Stock and Waste Yard Local Panels



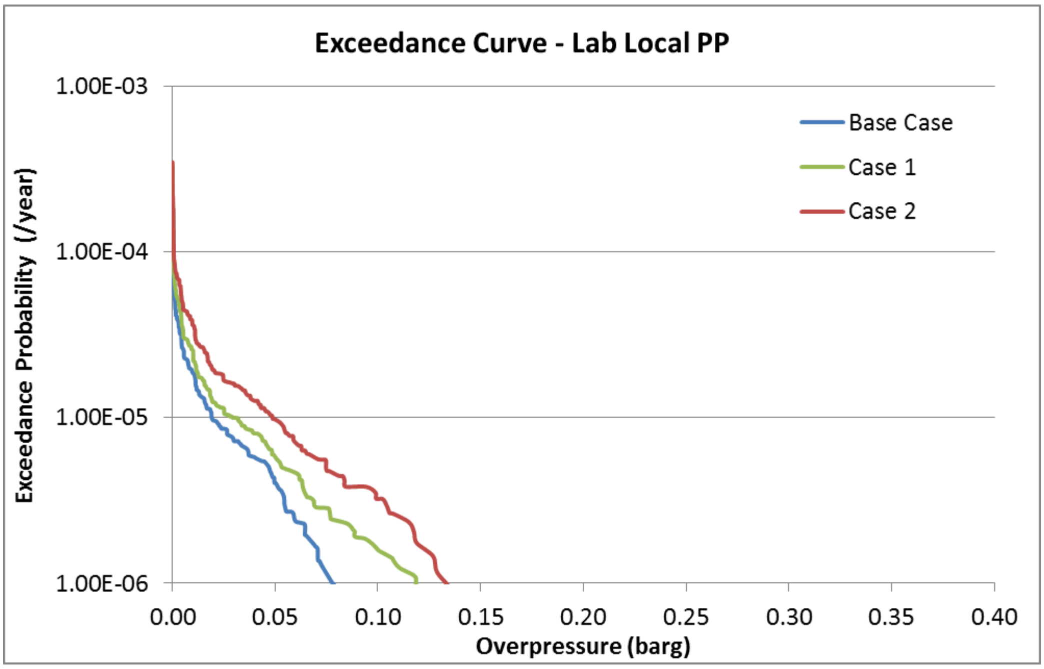
Appendix B- 6 Exceedance curve – Workshop Global Panels



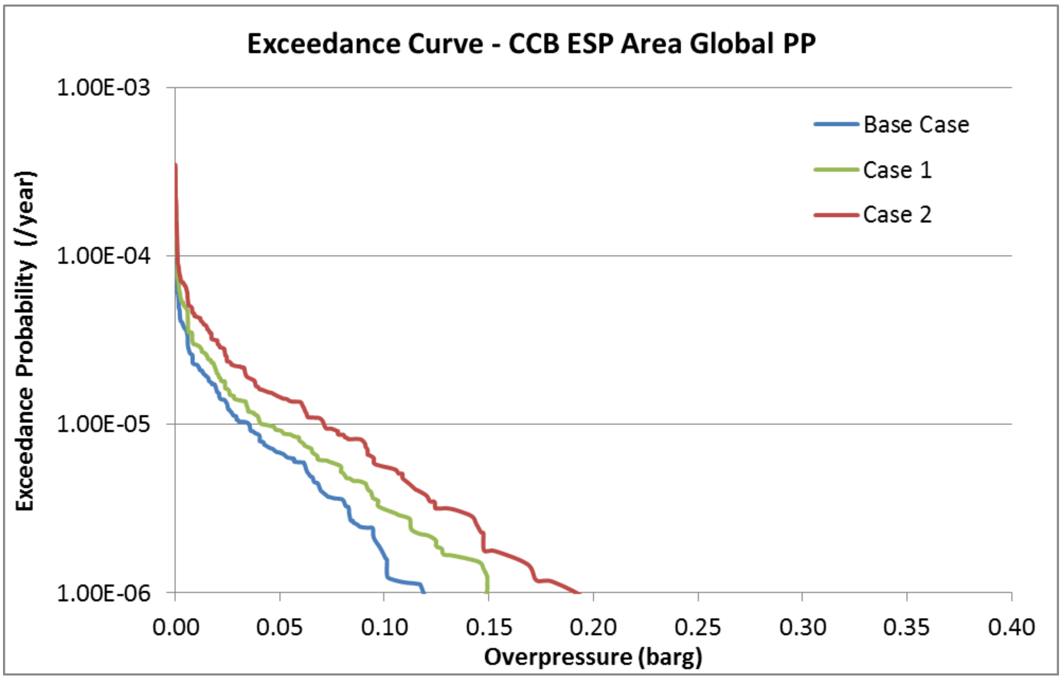
Appendix B- 7 Exceedance curve – Workshop Local Panels



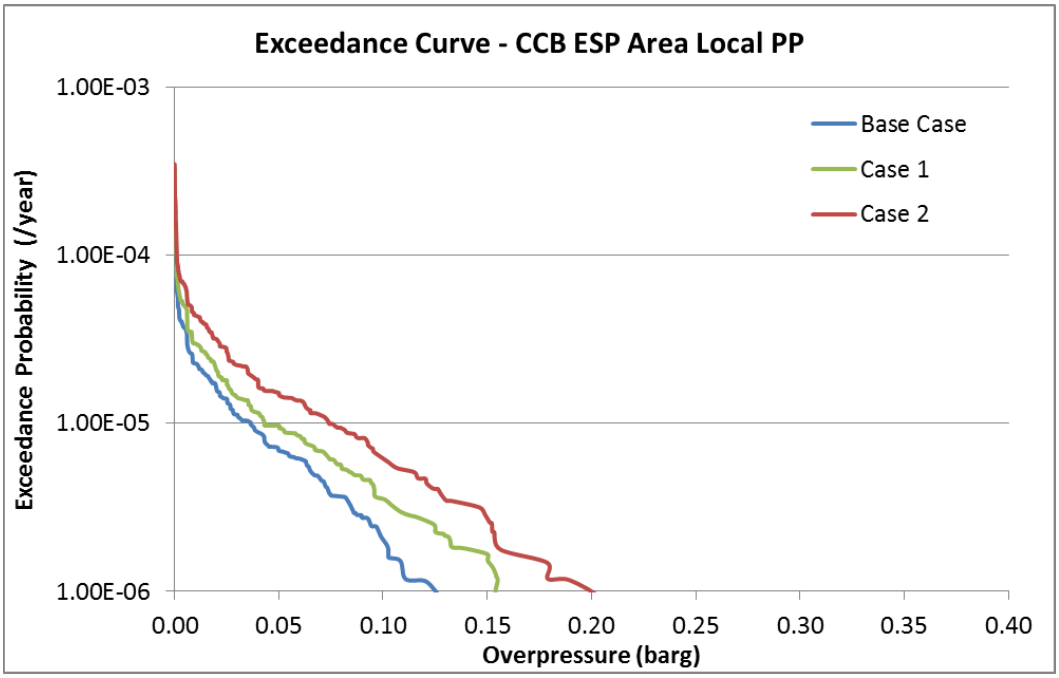
Appendix B- 8 Exceedance curve – Laboratory Global Panels



Appendix B- 9 Exceedance curve – Laboratory Local Panels

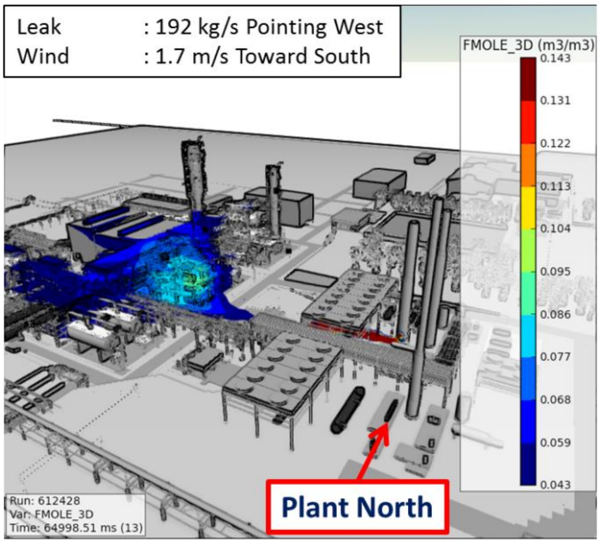


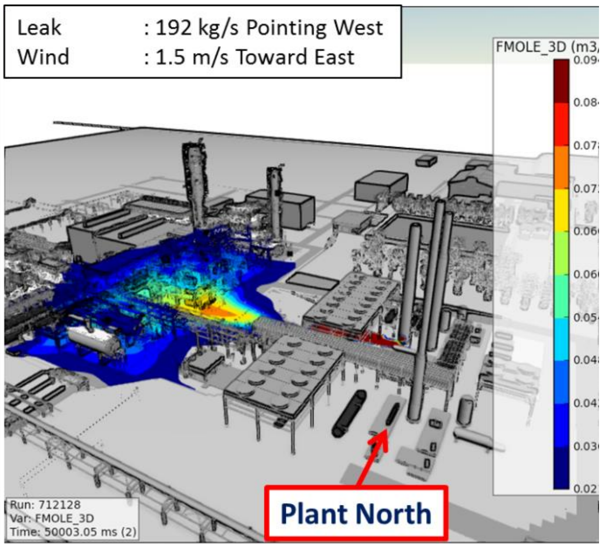
Appendix B- 10 Exceedance curve – CCB ESP Global Panels



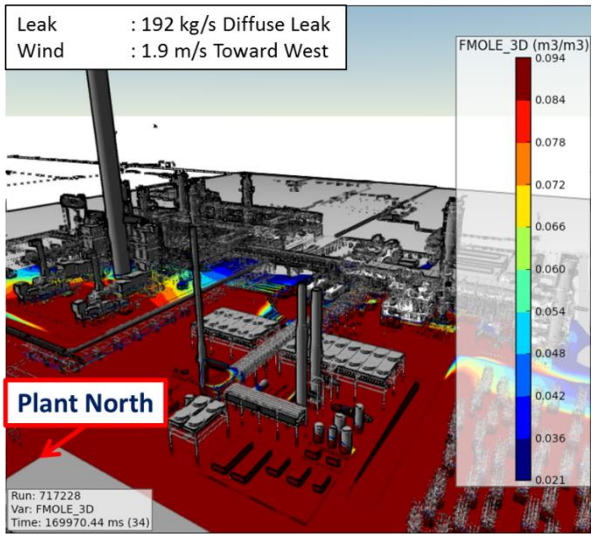
Appendix B- 11 Exceedance curve – CCB ESP Local Panels

Appendix F Plots of gas exposure to areas adjacent of LPG Recovery Unit area

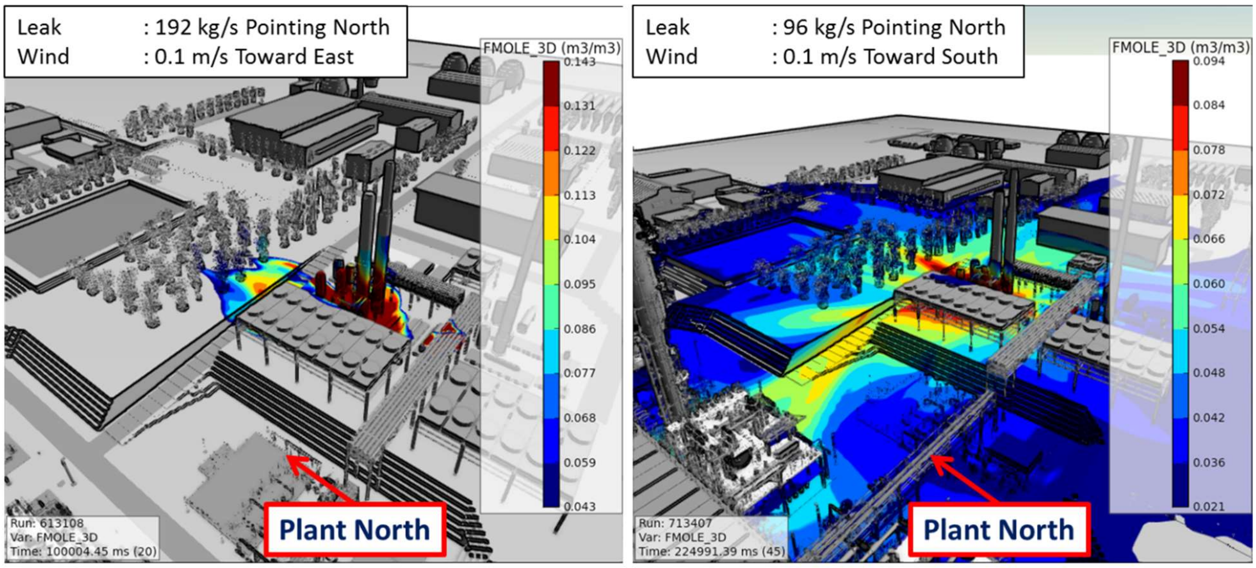




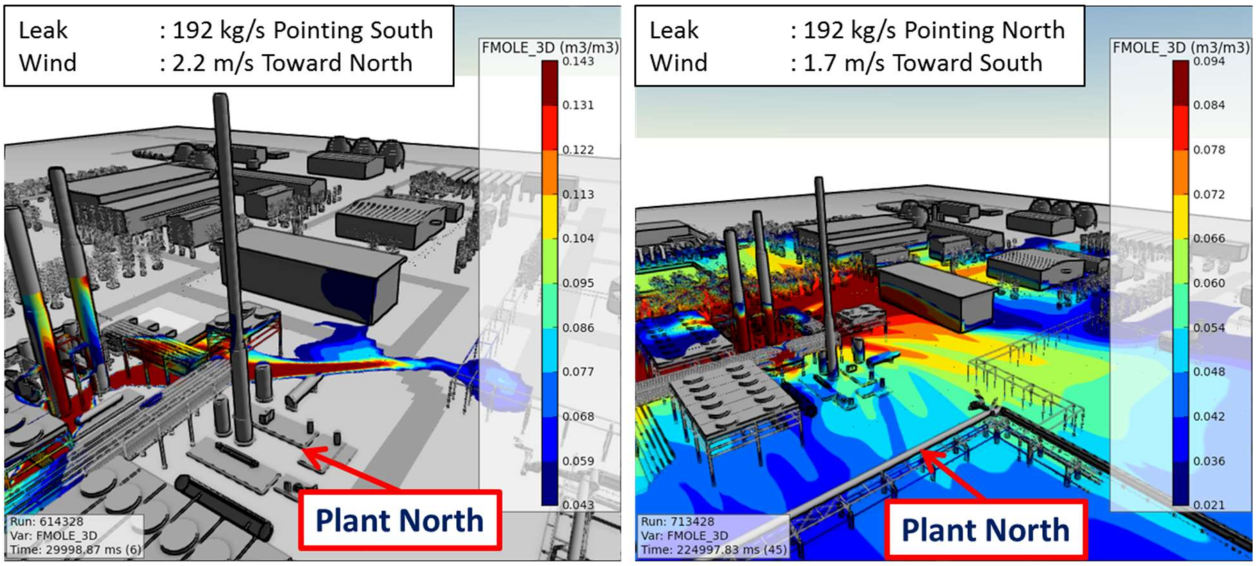
ESC Exposure to West (ESP West)



ESC Exposure to South (ESP South)



ESC Exposure to North (Pond Area)



ESC Exposure to East (CCB and Waste & Stock Yard)

Appendix G Overpressures load table at targets of interest (walls and roofs)

(In a separate document)

Appendix G **Overpressures load table at targets of interest (walls and roofs of target buildings)**

Note: This appendix complements Appendix D which also provides overpressure load at targets of interest. However, in this section the overpressures are divided into each walls and roofs.

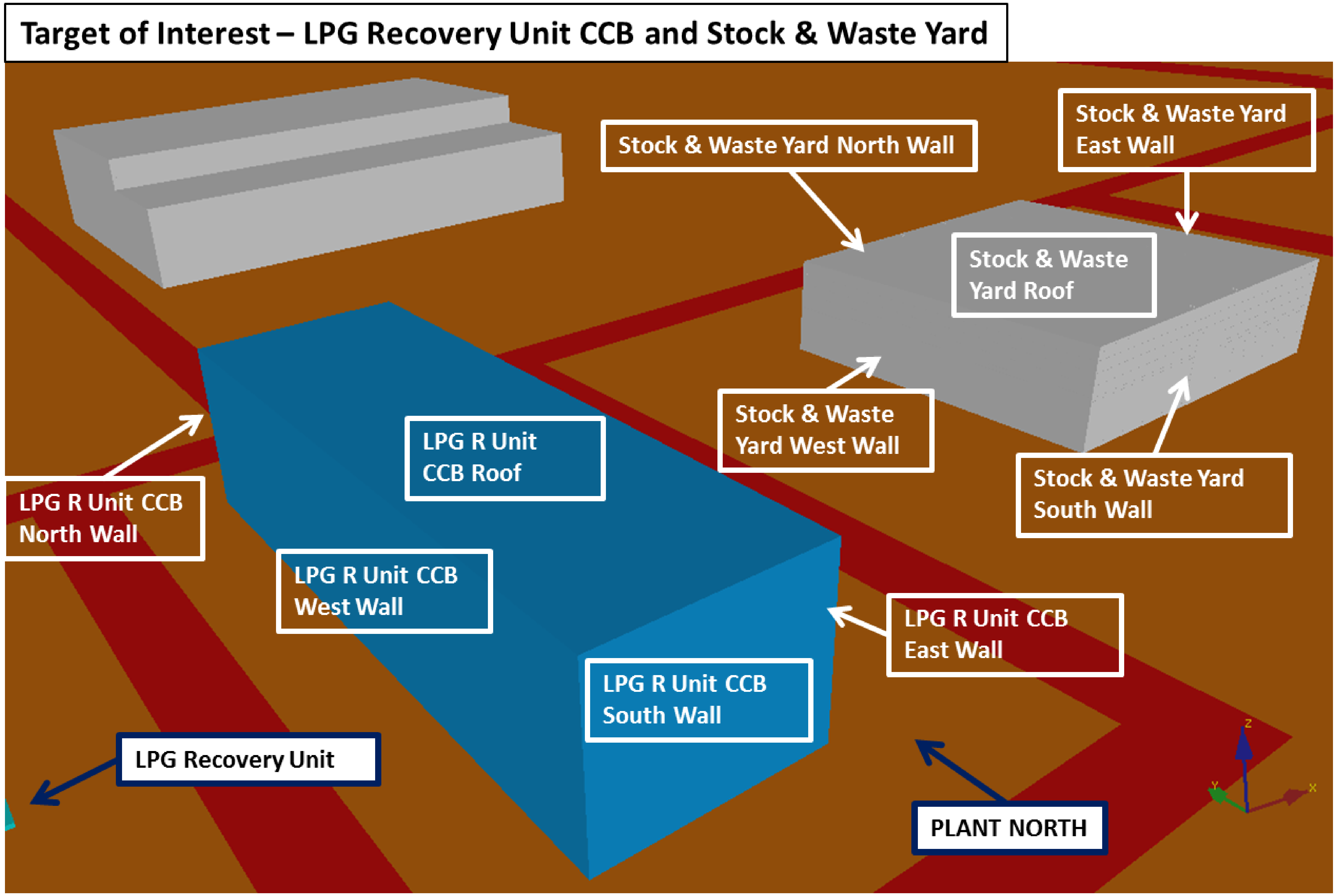


Figure G-1 Pressure Panel on LPG Recovery Unit CCB and Stock & Waste Yard

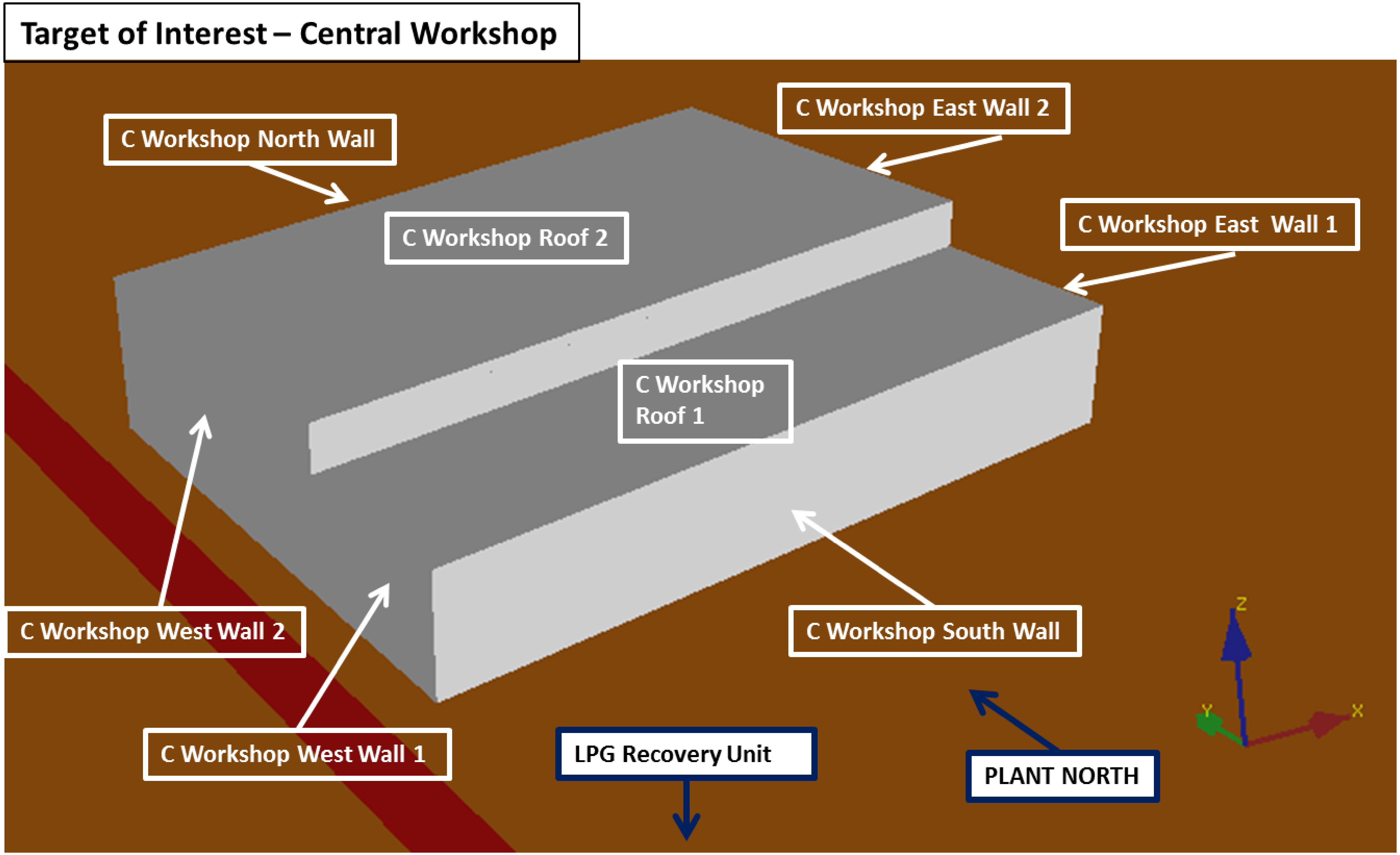


Figure G-2 Pressure Panel on Central Workshop

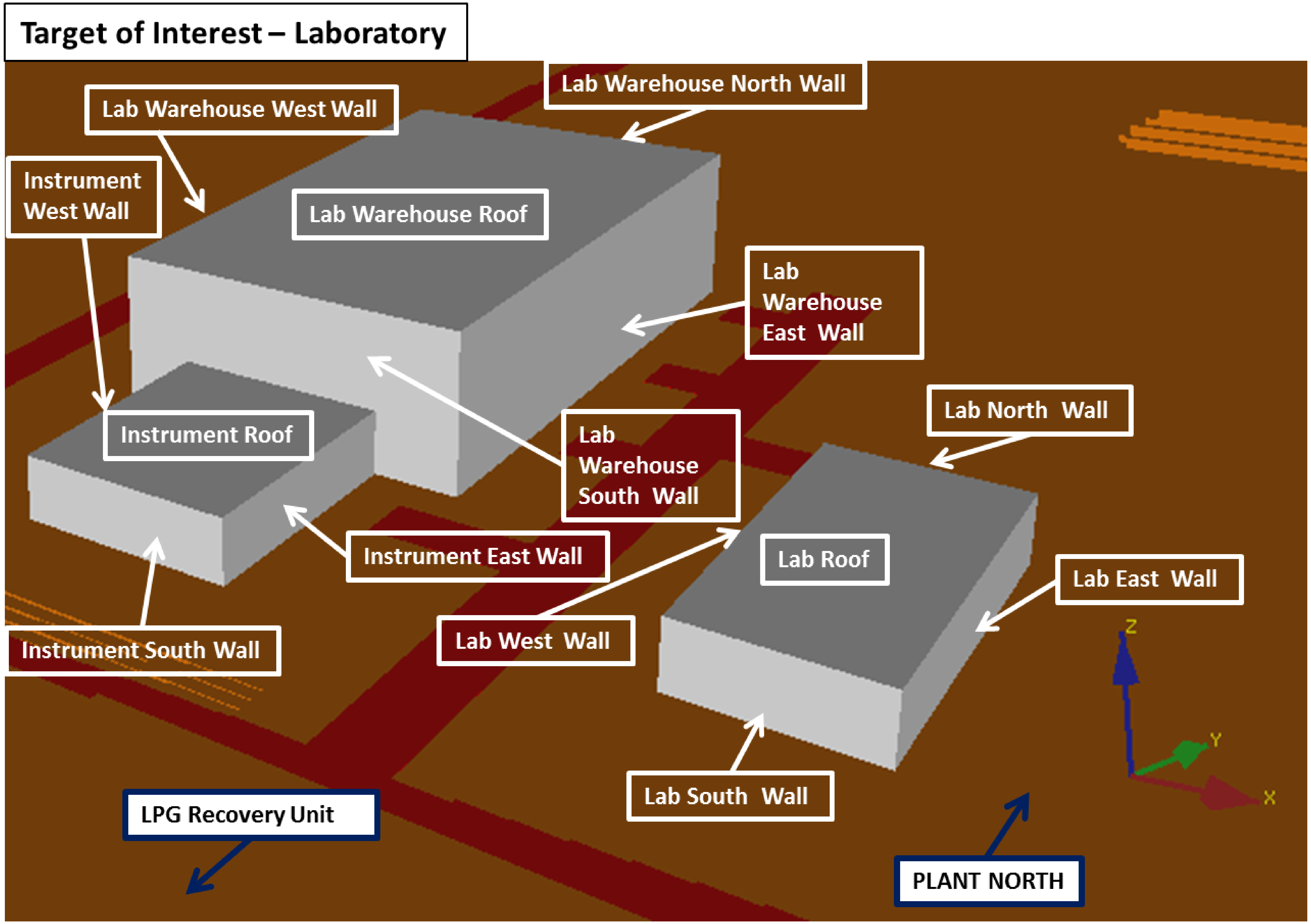


Figure G-3 Pressure Panel on Laboratory Area

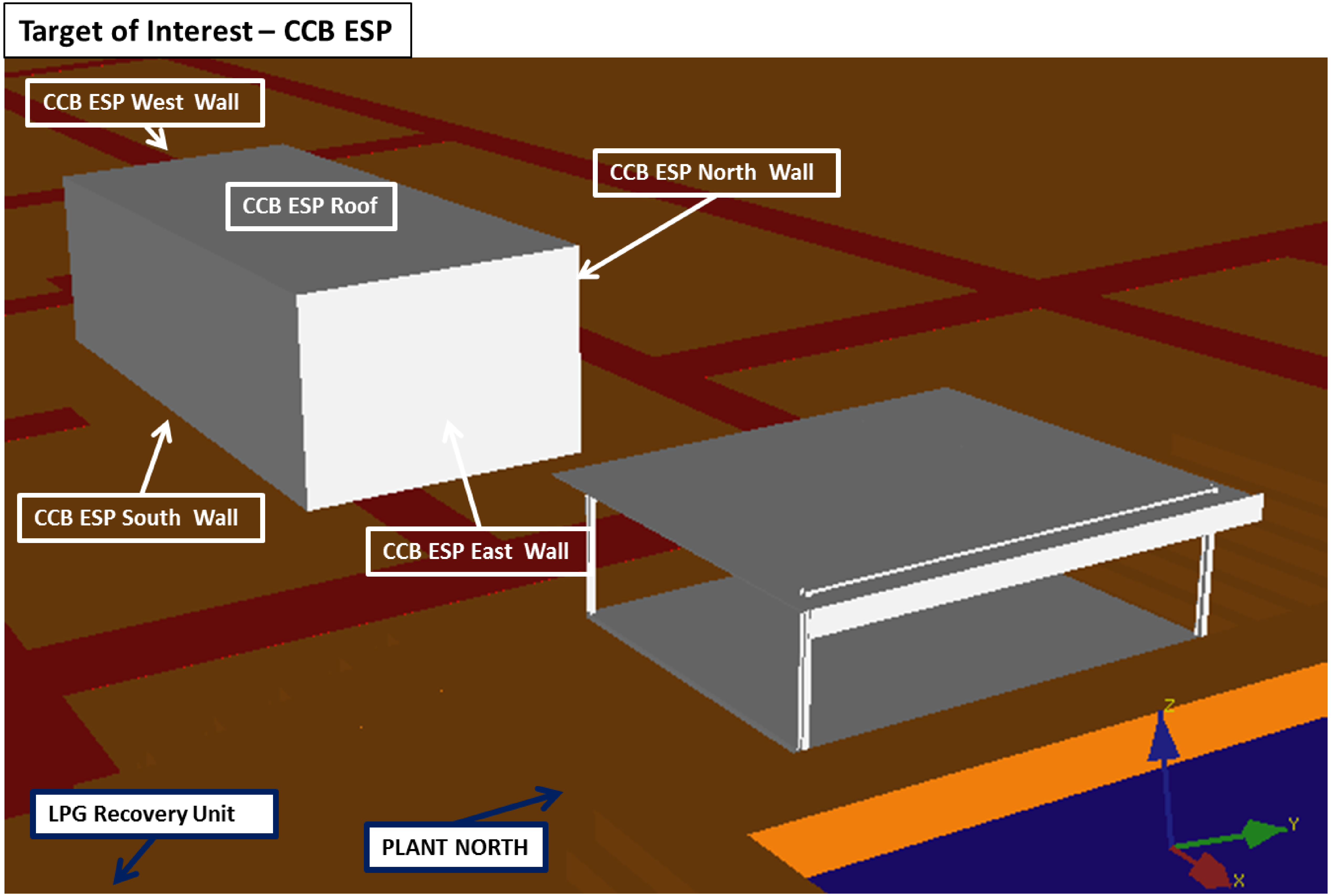


Figure G-4 Pressure Panel on CCB ESP Area

Table 1 Overpressure Loads at Global Pressure Panels of Base Case Geometry – Stream 1 Gas Composition

Gas Cloud Class	Target	LPG R Unit CCB Base Case Global - Stream 1-SouthWall	LPG R Unit CCB Base Case Global - Stream 1-EastWall	LPG R Unit CCB Base Case Global - Stream 1-NorthWall	LPG R Unit CCB Base Case Global - Stream 1-WestWall	LPG R Unit CCB Base Case Global - Stream 1-Roof	Stock and WasteYard Base Case Global - Stream 1-SouthWall	Stock and WasteYard Base Case Global - Stream 1-EastWall	Stock and WasteYard Base Case Global - Stream 1-NorthWall	Stock and WasteYard Base Case Global - Stream 1-WestWall	Stock and WasteYard Base Case Global - Stream 1-Roof	C Workshop Base Case Global - Stream 1-SouthWall	C Workshop Base Case Global - Stream 1-EastWall 1	C Workshop Base Case Global - Stream 1-EastWall 2	C Workshop Base Case Global - Stream 1-NorthWall	C Workshop Base Case Global - Stream 1-WestWall 1	C Workshop Base Case Global - Stream 1-WestWall 2	C Workshop Base Case Global - Stream 1-Roof 1	C Workshop Base Case Global - Stream 1-Roof 2	Lab Base Case Global - Stream 1-SouthWall	Lab Base Case Global - Stream 1-EastWall	Lab Base Case Global - Stream 1-NorthWall	Lab Base Case Global - Stream 1-WestWall	Lab Base Case Global - Stream 1-Roof	Instrument Base Case Global - Stream 1-SouthWall	Instrument Base Case Global - Stream 1-EastWall	Instrument Base Case Global - Stream 1-WestWall	Instrument Base Case Global - Stream 1-Roof	Lab Warehouse Base Case Global - Stream 1-SouthWall	Lab Warehouse Base Case Global - Stream 1-EastWall	Lab Warehouse Base Case Global - Stream 1-NorthWall	Lab Warehouse Base Case Global - Stream 1-WestWall	Lab Warehouse Base Case Global - Stream 1-Roof	CCB ESP Base Case Global - Stream 1-SouthWall	CCB ESP Base Case Global - Stream 1-EastWall	CCB ESP Base Case Global - Stream 1-NorthWall	CCB ESP Base Case Global - Stream 1-WestWall	CCB ESP Base Case Global - Stream 1-Roof
1	Max	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
2	Max	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
3	Max	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
4	Max	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
5	Max	0.02	0.01	0.02	0.04	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	<0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
6	Max	0.05	0.03	0.05	0.10	0.05	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.03	0.03	0.02	0.02	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.02	<0.01	0.01	0.02	0.03	0.02	0.02	0.01	0.02
	Average	0.02	0.01	0.02	0.03	0.02	0.01	<0.01	<0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01
7	Max	0.07	0.05	0.05	0.15	0.06	0.04	0.04	0.04	0.05	0.04	0.04	0.04	0.03	0.02	0.03	0.04	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	<0.01	0.02	0.02	0.04	0.03	0.02	0.02	0.03
	Average	0.02	0.02	0.02	0.05	0.03	0.02	0.01	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.02	0.02	0.02	0.01	0.01	<0.01	0.01	0.01	<0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	<0.01	0.01	0.02	0.01	0.01	<0.01	0.01
8	Max	0.13	0.08	0.10	0.31	0.12	0.06	0.07	0.06	0.09	0.07	0.08	0.07	0.07	0.05	0.09	0.09	0.07	0.06	0.04	0.04	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.05	<0.01	0.04	0.04	0.09	0.07	0.05	0.04	0.06
	Average	0.07	0.05	0.06	0.16	0.07	0.04	0.04	0.04	0.05	0.04	0.05	0.04	0.04	0.03	0.05	0.05	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.03	<0.01	0.03	0.03	0.05	0.04	0.03	0.03	0.04
9	Max	0.35	0.18	0.35	1.78	0.36	0.20	0.12	0.17	0.37	0.18	0.32	0.11	0.12	0.11	0.35	0.34	0.24	0.20	0.10	0.10	0.08	0.09	0.09	0.09	0.08	0.07	0.09	0.08	0.09	0.01	0.07	0.07	0.19	0.16	0.08	0.08	0.11
	Average	0.17	0.11	0.14	0.60	0.18	0.09	0.08	0.09	0.15	0.09	0.11	0.07	0.06	0.06	0.12	0.12	0.09	0.08	0.06	0.05	0.06	0.05	0.05	0.06	0.05	0.05	0.06	0.05	0.06	<0.01	0.05	0.05	0.10	0.08	0.06	0.05	0.07

Table 2 Overpressure Loads at Local Pressure Panels of Base Case Geometry – Stream 1 Gas Composition

Target / Gas Cloud Class		LPG R Unit CCB Base Case Local - Stream 1-SouthWall	LPG R Unit CCB Base Case Local - Stream 1-EastWall	LPG R Unit CCB Base Case Local - Stream 1-NorthWall	LPG R Unit CCB Base Case Local - Stream 1-WestWall	LPG R Unit CCB Base Case Local - Stream 1-Roof	Stock and WasteYard Base Case Local - Stream 1-SouthWall	Stock and WasteYard Base Case Local - Stream 1-EastWall	Stock and WasteYard Base Case Local - Stream 1-NorthWall	Stock and WasteYard Base Case Local - Stream 1-WestWall	Stock and WasteYard Base Case Local - Stream 1-Roof	C Workshop Base Case Local - Stream 1-SouthWall	C Workshop Base Case Local - Stream 1-EastWall 1	C Workshop Base Case Local - Stream 1-EastWall 2	C Workshop Base Case Local - Stream 1-NorthWall	C Workshop Base Case Local - Stream 1-WestWall 1	C Workshop Base Case Local - Stream 1-WestWall 2	C Workshop Base Case Local - Stream 1-Roof 1	C Workshop Base Case Local - Stream 1-Roof 2	Lab Base Case Local - Stream 1-SouthWall	Lab Base Case Local - Stream 1-EastWall	Lab Base Case Local - Stream 1-NorthWall	Lab Base Case Local - Stream 1-WestWall	Lab Base Case Local - Stream 1-Roof	Instrument Base Case Local - Stream 1-SouthWall	Instrument Base Case Local - Stream 1-EastWall	Instrument Base Case Local - Stream 1-WestWall	Instrument Base Case Local - Stream 1-Roof	Lab Warehouse Base Case Local - Stream 1-SouthWall	Lab Warehouse Base Case Local - Stream 1-EastWall	Lab Warehouse Base Case Local - Stream 1-NorthWall	Lab Warehouse Base Case Local - Stream 1-WestWall	Lab Warehouse Base Case Local - Stream 1-Roof	CCB ESP Base Case Local - Stream 1-SouthWall	CCB ESP Base Case Local - Stream 1-EastWall	CCB ESP Base Case Local - Stream 1-NorthWall	CCB ESP Base Case Local - Stream 1-WestWall	CCB ESP Base Case Local - Stream 1-Roof
1	Max	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
2	Max	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
3	Max	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
4	Max	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
5	Max	0.02	0.01	0.02	0.04	0.03	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	<0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.01
	Average	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
6	Max	0.05	0.03	0.06	0.11	0.06	0.03	0.03	0.03	0.04	0.03	0.03	0.03	0.02	0.02	0.03	0.03	0.03	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	<0.01	0.02	0.02	0.03	0.02	0.02	0.02	0.02
	Average	0.02	0.01	0.02	0.03	0.02	0.01	<0.01	0.01	0.01	0.01	0.01	0.01	<0.01	<0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01
7	Max	0.08	0.05	0.06	0.16	0.08	0.04	0.04	0.04	0.05	0.04	0.04	0.04	0.03	0.02	0.03	0.04	0.04	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.01	0.02	0.02	0.04	0.03	0.02	0.02	0.03
	Average	0.03	0.02	0.03	0.05	0.03	0.02	0.01	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.02	0.02	0.02	0.01	0.01	<0.01	0.01	0.01	0.01	0.01	0.01	<0.01	0.01	0.01	0.01	<0.01	<0.01	0.01	0.02	0.02	0.01	0.01	0.02
8	Max	0.15	0.09	0.12	0.33	0.15	0.07	0.07	0.07	0.10	0.08	0.09	0.08	0.07	0.05	0.09	0.09	0.08	0.07	0.04	0.04	0.05	0.04	0.04	0.05	0.05	0.04	0.05	0.05	0.05	0.02	0.04	0.05	0.09	0.08	0.05	0.04	0.06
	Average	0.08	0.05	0.07	0.18	0.09	0.04	0.04	0.04	0.06	0.04	0.05	0.04	0.04	0.03	0.05	0.05	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.01	0.03	0.03	0.05	0.04	0.03	0.03	0.04
9	Max	0.58	0.28	0.52	1.88	0.56	0.24	0.18	0.21	0.44	0.20	0.35	0.13	0.12	0.13	0.35	0.40	0.29	0.21	0.11	0.10	0.09	0.09	0.09	0.09	0.11	0.09	0.10	0.10	0.10	0.04	0.07	0.08	0.20	0.18	0.09	0.09	0.12
	Average	0.22	0.14	0.19	0.65	0.24	0.10	0.09	0.10	0.17	0.10	0.12	0.08	0.07	0.06	0.12	0.13	0.11	0.09	0.06	0.05	0.06	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.07	0.03	0.05	0.05	0.11	0.09	0.06	0.05	0.07

Table 3 Overpressure Loads at Global Pressure Panels of Case 1 Geometry – Stream 1 Gas Composition

Target / Gas Cloud Class		LPG R Unit CCB Case 1 Global - Stream 1-SouthWall	LPG R Unit CCB Case 1 Global - Stream 1-EastWall	LPG R Unit CCB Case 1 Global - Stream 1-NorthWall	LPG R Unit CCB Case 1 Global - Stream 1-WestWall	LPG R Unit CCB Case 1 Global - Stream 1-Roof	Stock and WasteYard Case 1 Global - Stream 1-SouthWall	Stock and WasteYard Case 1 Global - Stream 1-EastWall	Stock and WasteYard Case 1 Global - Stream 1-NorthWall	Stock and WasteYard Case 1 Global - Stream 1-WestWall	Stock and WasteYard Case 1 Global - Stream 1-Roof	C Workshop Case 1 Global - Stream 1-SouthWall	C Workshop Case 1 Global - Stream 1-EastWall 1	C Workshop Case 1 Global - Stream 1-EastWall 2	C Workshop Case 1 Global - Stream 1-NorthWall	C Workshop Case 1 Global - Stream 1-WestWall 1	C Workshop Case 1 Global - Stream 1-WestWall 2	C Workshop Case 1 Global - Stream 1-Roof 1	C Workshop Case 1 Global - Stream 1-Roof 2	Lab Case 1 Global - Stream 1-SouthWall	Lab Case 1 Global - Stream 1-EastWall	Lab Case 1 Global - Stream 1-NorthWall	Lab Case 1 Global - Stream 1-WestWall	Lab Case 1 Global - Stream 1-Roof	Instrument Case 1 Global - Stream 1-SouthWall	Instrument Case 1 Global - Stream 1-EastWall	Instrument Case 1 Global - Stream 1-WestWall	Instrument Case 1 Global - Stream 1-Roof	Lab Warehouse Case 1 Global - Stream 1-SouthWall	Lab Warehouse Case 1 Global - Stream 1-EastWall	Lab Warehouse Case 1 Global - Stream 1-NorthWall	Lab Warehouse Case 1 Global - Stream 1-WestWall	Lab Warehouse Case 1 Global - Stream 1-Roof	CCB ESP Case 1 Global - Stream 1-SouthWall	CCB ESP Case 1 Global - Stream 1-EastWall	CCB ESP Case 1 Global - Stream 1-NorthWall	CCB ESP Case 1 Global - Stream 1-WestWall	CCB ESP Case 1 Global - Stream 1-Roof
1	Max	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
2	Max	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
3	Max	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
4	Max	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
5	Max	0.02	0.02	0.01	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	<0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
6	Max	0.05	0.03	0.05	0.10	0.05	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	<0.01	0.01	0.02	0.03	0.02	0.02	0.01	0.02
	Average	0.02	0.01	0.02	0.03	0.02	0.01	<0.01	0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01
7	Max	0.07	0.05	0.07	0.17	0.06	0.04	0.04	0.04	0.05	0.04	0.04	0.03	0.03	0.02	0.04	0.04	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	<0.01	0.02	0.02	0.04	0.03	0.02	0.02	0.03
	Average	0.03	0.02	0.02	0.05	0.03	0.02	0.01	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.02	0.02	0.02	0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	<0.01	0.01	0.02	0.01	0.01	<0.01	0.01
8	Max	0.13	0.08	0.12	0.31	0.12	0.07	0.07	0.06	0.10	0.07	0.08	0.07	0.07	0.05	0.09	0.09	0.07	0.06	0.04	0.04	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.05	<0.01	0.04	0.05	0.08	0.07	0.05	0.04	0.06
	Average	0.07	0.05	0.06	0.17	0.07	0.04	0.04	0.04	0.06	0.04	0.05	0.04	0.04	0.03	0.05	0.05	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.03	<0.01	0.03	0.03	0.05	0.04	0.03	0.02	0.04
9	Max	0.35	0.19	0.42	1.77	0.36	0.20	0.12	0.17	0.36	0.18	0.31	0.11	0.12	0.11	0.33	0.33	0.24	0.20	0.10	0.09	0.08	0.09	0.08	0.09	0.08	0.07	0.09	0.08	0.09	0.01	0.07	0.08	0.18	0.15	0.08	0.07	0.11
	Average	0.17	0.12	0.16	0.61	0.18	0.10	0.08	0.09	0.15	0.10	0.11	0.07	0.06	0.05	0.11	0.12	0.09	0.08	0.06	0.05	0.05	0.05	0.05	0.06	0.05	0.05	0.06	0.05	0.06	<0.01	0.05	0.05	0.10	0.08	0.06	0.05	0.07

Table 4 Overpressure Loads at Local Pressure Panels of Case 1 Geometry – Stream 1 Gas Composition

Gas Cloud Class	Target	LPG R Unit CCB Case 1 Local - Stream 1-SouthWall	LPG R Unit CCB Case 1 Local - Stream 1-EastWall	LPG R Unit CCB Case 1 Local - Stream 1-NorthWall	LPG R Unit CCB Case 1 Local - Stream 1-WestWall	LPG R Unit CCB Case 1 Local - Stream 1-Roof	Stock and WasteYard Case 1 Local - Stream 1-SouthWall	Stock and WasteYard Case 1 Local - Stream 1-EastWall	Stock and WasteYard Case 1 Local - Stream 1-NorthWall	Stock and WasteYard Case 1 Local - Stream 1-WestWall	Stock and WasteYard Case 1 Local - Stream 1-Roof	C Workshop Case 1 Local - Stream 1-SouthWall	C Workshop Case 1 Local - Stream 1-EastWall 1	C Workshop Case 1 Local - Stream 1-EastWall 2	C Workshop Case 1 Local - Stream 1-NorthWall	C Workshop Case 1 Local - Stream 1-WestWall 1	C Workshop Case 1 Local - Stream 1-WestWall 2	C Workshop Case 1 Local - Stream 1-Roof 1	C Workshop Case 1 Local - Stream 1-Roof 2	Lab Case 1 Local - Stream 1-SouthWall	Lab Case 1 Local - Stream 1-EastWall	Lab Case 1 Local - Stream 1-NorthWall	Lab Case 1 Local - Stream 1-WestWall	Lab Case 1 Local - Stream 1-Roof	Instrument Case 1 Local - Stream 1-SouthWall	Instrument Case 1 Local - Stream 1-EastWall	Instrument Case 1 Local - Stream 1-WestWall	Instrument Case 1 Local - Stream 1-Roof	Lab Warehouse Case 1 Local - Stream 1-SouthWall	Lab Warehouse Case 1 Local - Stream 1-EastWall	Lab Warehouse Case 1 Local - Stream 1-NorthWall	Lab Warehouse Case 1 Local - Stream 1-WestWall	Lab Warehouse Case 1 Local - Stream 1-Roof	CCB ESP Case 1 Local - Stream 1-SouthWall	CCB ESP Case 1 Local - Stream 1-EastWall	CCB ESP Case 1 Local - Stream 1-NorthWall	CCB ESP Case 1 Local - Stream 1-WestWall	CCB ESP Case 1 Local - Stream 1-Roof
1	Max	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
2	Max	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
3	Max	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
4	Max	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
5	Max	0.02	0.02	0.02	0.04	0.02	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	<0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
6	Max	0.05	0.03	0.06	0.11	0.06	0.03	0.03	0.03	0.04	0.03	0.03	0.03	0.02	0.02	0.02	0.03	0.02	0.02	0.01	0.01	0.02	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.02	<0.01	0.01	0.02	0.03	0.02	0.02	0.01	0.02
	Average	0.02	0.01	0.02	0.04	0.02	0.01	<0.01	0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01
7	Max	0.07	0.06	0.07	0.18	0.08	0.04	0.04	0.04	0.06	0.04	0.04	0.04	0.03	0.02	0.04	0.04	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.01	0.02	0.02	0.04	0.03	0.02	0.02	0.03
	Average	0.03	0.02	0.03	0.05	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.02	0.02	0.02	0.01	0.01	<0.01	0.01	0.01	0.01	0.01	0.01	<0.01	0.01	0.01	0.01	<0.01	<0.01	0.01	0.02	0.02	0.01	<0.01	0.02
8	Max	0.16	0.09	0.14	0.34	0.15	0.07	0.07	0.07	0.12	0.08	0.09	0.08	0.07	0.05	0.09	0.09	0.08	0.07	0.04	0.04	0.05	0.04	0.04	0.04	0.05	0.04	0.05	0.05	0.05	0.02	0.04	0.05	0.09	0.08	0.05	0.04	0.06
	Average	0.09	0.06	0.08	0.18	0.09	0.05	0.04	0.04	0.06	0.05	0.05	0.04	0.04	0.03	0.05	0.05	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.01	0.03	0.03	0.05	0.04	0.03	0.03	0.04
9	Max	0.58	0.28	0.66	1.87	0.56	0.24	0.18	0.21	0.43	0.20	0.35	0.13	0.12	0.13	0.34	0.39	0.29	0.20	0.11	0.09	0.09	0.09	0.09	0.09	0.11	0.09	0.09	0.10	0.10	0.04	0.07	0.08	0.19	0.17	0.08	0.08	0.11
	Average	0.23	0.14	0.21	0.66	0.25	0.11	0.10	0.10	0.17	0.11	0.12	0.07	0.06	0.06	0.11	0.13	0.11	0.08	0.06	0.05	0.06	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.03	0.05	0.05	0.10	0.09	0.06	0.05	0.07

Table 5 Overpressure Loads at Global Pressure Panels of Case 2 Geometry – Stream 1 Gas Composition

Target		LPG R Unit CCB Case 2 Global - Stream 1-SouthWall	LPG R Unit CCB Case 2 Global - Stream 1-EastWall	LPG R Unit CCB Case 2 Global - Stream 1-NorthWall	LPG R Unit CCB Case 2 Global - Stream 1-WestWall	LPG R Unit CCB Case 2 Global - Stream 1-Roof	Stock and WasteYard Case 2 Global - Stream 1-SouthWall	Stock and WasteYard Case 2 Global - Stream 1-EastWall	Stock and WasteYard Case 2 Global - Stream 1-NorthWall	Stock and WasteYard Case 2 Global - Stream 1-WestWall	Stock and WasteYard Case 2 Global - Stream 1-Roof	C Workshop Case 2 Global - Stream 1-SouthWall	C Workshop Case 2 Global - Stream 1-EastWall 1	C Workshop Case 2 Global - Stream 1-EastWall 2	C Workshop Case 2 Global - Stream 1-NorthWall	C Workshop Case 2 Global - Stream 1-WestWall 1	C Workshop Case 2 Global - Stream 1-WestWall 2	C Workshop Case 2 Global - Stream 1-Roof 1	C Workshop Case 2 Global - Stream 1-Roof 2	Lab Case 2 Global - Stream 1-SouthWall	Lab Case 2 Global - Stream 1-EastWall	Lab Case 2 Global - Stream 1-NorthWall	Lab Case 2 Global - Stream 1-WestWall	Lab Case 2 Global - Stream 1-Roof	Instrument Case 2 Global - Stream 1-SouthWall	Instrument Case 2 Global - Stream 1-EastWall	Instrument Case 2 Global - Stream 1-WestWall	Instrument Case 2 Global - Stream 1-Roof	Lab Warehouse Case 2 Global - Stream 1-SouthWall	Lab Warehouse Case 2 Global - Stream 1-EastWall	Lab Warehouse Case 2 Global - Stream 1-NorthWall	Lab Warehouse Case 2 Global - Stream 1-WestWall	Lab Warehouse Case 2 Global - Stream 1-Roof	CCB ESP Case 2 Global - Stream 1-SouthWall	CCB ESP Case 2 Global - Stream 1-EastWall	CCB ESP Case 2 Global - Stream 1-NorthWall	CCB ESP Case 2 Global - Stream 1-WestWall	CCB ESP Case 2 Global - Stream 1-Roof
Gas Cloud Class																																						
1	Max	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
2	Max	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
3	Max	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
4	Max	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
5	Max	0.02	0.02	0.02	0.03	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	<0.01	<0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
6	Max	0.04	0.04	0.05	0.10	0.06	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	<0.01	0.01	0.01	0.03	0.02	0.02	0.01	<0.01
	Average	0.02	0.01	0.02	0.03	0.02	0.01	<0.01	0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01
7	Max	0.07	0.06	0.07	0.14	0.09	0.04	0.04	0.04	0.05	0.04	0.04	0.03	0.03	0.02	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	<0.01	0.02	0.02	0.04	0.03	0.02	0.02	0.03
	Average	0.03	0.02	0.03	0.05	0.04	0.02	0.01	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.02	0.02	0.02	0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	0.01	0.02	0.01	0.01	<0.01	<0.01
8	Max	0.13	0.10	0.15	0.32	0.20	0.07	0.07	0.06	0.10	0.07	0.08	0.07	0.07	0.05	0.09	0.09	0.07	0.06	0.05	0.04	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.05	<0.01	0.04	0.04	0.08	0.07	0.05	0.04	0.06
	Average	0.08	0.06	0.07	0.18	0.12	0.04	0.04	0.04	0.06	0.04	0.05	0.04	0.03	0.03	0.05	0.05	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.03	<0.01	0.03	0.03	0.05	0.04	0.03	0.02	0.04
9	Max	0.36	0.21	0.60	1.81	0.42	0.20	0.13	0.17	0.36	0.18	0.30	0.11	0.11	0.10	0.32	0.32	0.23	0.19	0.10	0.09	0.08	0.08	0.08	0.08	0.08	0.07	0.09	0.08	0.09	0.01	0.06	0.07	0.17	0.15	0.08	0.07	0.10
	Average	0.18	0.13	0.20	0.62	0.25	0.10	0.08	0.09	0.16	0.10	0.11	0.07	0.06	0.05	0.11	0.11	0.09	0.08	0.06	0.05	0.05	0.05	0.05	0.06	0.05	0.05	0.06	0.05	0.06	<0.01	0.05	0.05	0.10	0.08	0.05	0.04	0.06

Table 6 Overpressure Loads at Local Pressure Panels of Case 2 Geometry – Stream 1 Gas Composition

Gas Cloud Class	Target	LPG R Unit CCB Case 2 Local - Stream 1-SouthWall	LPG R Unit CCB Case 2 Local - Stream 1-EastWall	LPG R Unit CCB Case 2 Local - Stream 1-NorthWall	LPG R Unit CCB Case 2 Local - Stream 1-WestWall	LPG R Unit CCB Case 2 Local - Stream 1-Roof	Stock and WasteYard Case 2 Local - Stream 1-SouthWall	Stock and WasteYard Case 2 Local - Stream 1-EastWall	Stock and WasteYard Case 2 Local - Stream 1-NorthWall	Stock and WasteYard Case 2 Local - Stream 1-WestWall	Stock and WasteYard Case 2 Local - Stream 1-Roof	C Workshop Case 2 Local - Stream 1-SouthWall	C Workshop Case 2 Local - Stream 1-EastWall 1	C Workshop Case 2 Local - Stream 1-EastWall 2	C Workshop Case 2 Local - Stream 1-NorthWall	C Workshop Case 2 Local - Stream 1-WestWall 1	C Workshop Case 2 Local - Stream 1-WestWall 2	C Workshop Case 2 Local - Stream 1-Roof 1	C Workshop Case 2 Local - Stream 1-Roof 2	Lab Case 2 Local - Stream 1-SouthWall	Lab Case 2 Local - Stream 1-EastWall	Lab Case 2 Local - Stream 1-NorthWall	Lab Case 2 Local - Stream 1-WestWall	Lab Case 2 Local - Stream 1-Roof	Instrument Case 2 Local - Stream 1-SouthWall	Instrument Case 2 Local - Stream 1-EastWall	Instrument Case 2 Local - Stream 1-WestWall	Instrument Case 2 Local - Stream 1-Roof	Lab Warehouse Case 2 Local - Stream 1-SouthWall	Lab Warehouse Case 2 Local - Stream 1-EastWall	Lab Warehouse Case 2 Local - Stream 1-NorthWall	Lab Warehouse Case 2 Local - Stream 1-WestWall	Lab Warehouse Case 2 Local - Stream 1-Roof	CCB ESP Case 2 Local - Stream 1-SouthWall	CCB ESP Case 2 Local - Stream 1-EastWall	CCB ESP Case 2 Local - Stream 1-NorthWall	CCB ESP Case 2 Local - Stream 1-WestWall	CCB ESP Case 2 Local - Stream 1-Roof
1	Max	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
2	Max	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
3	Max	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
4	Max	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
5	Max	0.02	0.02	0.02	0.04	0.02	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	<0.01	<0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
6	Max	0.05	0.04	0.07	0.11	0.05	0.03	0.03	0.03	0.04	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	<0.01	0.01	0.02	0.03	0.02	0.02	0.01	0.02
	Average	0.02	0.01	0.02	0.03	0.02	0.01	<0.01	0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01
7	Max	0.08	0.06	0.08	0.15	0.06	0.04	0.04	0.04	0.06	0.04	0.04	0.03	0.03	0.02	0.03	0.04	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.02	0.04	0.03	0.02	0.02	0.03
	Average	0.03	0.02	0.03	0.05	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.02	0.02	0.02	0.01	<0.01	<0.01	0.01	0.01	<0.01	0.01	0.01	<0.01	0.01	0.01	0.01	<0.01	<0.01	0.01	0.02	0.01	0.01	<0.01	0.01
8	Max	0.16	0.10	0.18	0.35	0.12	0.07	0.07	0.07	0.11	0.08	0.09	0.08	0.07	0.05	0.09	0.09	0.08	0.06	0.05	0.04	0.05	0.04	0.04	0.04	0.05	0.04	0.04	0.05	0.05	0.02	0.04	0.04	0.09	0.08	0.05	0.04	0.06
	Average	0.09	0.07	0.09	0.19	0.08	0.05	0.04	0.04	0.06	0.05	0.05	0.04	0.03	0.03	0.05	0.05	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.01	0.03	0.03	0.05	0.04	0.03	0.03	0.04
9	Max	0.59	0.31	0.92	1.93	0.38	0.24	0.19	0.22	0.42	0.20	0.34	0.13	0.12	0.13	0.33	0.37	0.28	0.20	0.11	0.09	0.09	0.08	0.09	0.09	0.11	0.09	0.09	0.10	0.10	0.03	0.07	0.07	0.18	0.16	0.08	0.08	0.11
	Average	0.23	0.16	0.27	0.68	0.19	0.11	0.10	0.10	0.18	0.11	0.12	0.07	0.06	0.06	0.11	0.12	0.10	0.08	0.06	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.03	0.05	0.05	0.10	0.09	0.06	0.05	0.07

Table 7 Overpressure Loads at Global Pressure Panels of Base Case Geometry – Stream 13 Gas Composition

Gas Cloud Class	Target	LPG R Unit CCB Base Case Global - Stream 13-SouthWall	LPG R Unit CCB Base Case Global - Stream 13-EastWall	LPG R Unit CCB Base Case Global - Stream 13-NorthWall	LPG R Unit CCB Base Case Global - Stream 13-WestWall	LPG R Unit CCB Base Case Global - Stream 13-Roof	Stock and WasteYard Base Case Global - Stream 13-SouthWall	Stock and WasteYard Base Case Global - Stream 13-EastWall	Stock and WasteYard Base Case Global - Stream 13-NorthWall	Stock and WasteYard Base Case Global - Stream 13-WestWall	Stock and WasteYard Base Case Global - Stream 13-Roof	C Workshop Base Case Global - Stream 13-SouthWall	C Workshop Base Case Global - Stream 13-EastWall 1	C Workshop Base Case Global - Stream 13-EastWall 2	C Workshop Base Case Global - Stream 13-NorthWall	C Workshop Base Case Global - Stream 13-WestWall 1	C Workshop Base Case Global - Stream 13-WestWall 2	C Workshop Base Case Global - Stream 13-Roof 1	C Workshop Base Case Global - Stream 13-Roof 2	Lab Base Case Global - Stream 13-SouthWall	Lab Base Case Global - Stream 13-EastWall	Lab Base Case Global - Stream 13-NorthWall	Lab Base Case Global - Stream 13-WestWall	Lab Base Case Global - Stream 13-Roof	Instrument Base Case Global - Stream 13-SouthWall	Instrument Base Case Global - Stream 13-EastWall	Instrument Base Case Global - Stream 13-WestWall	Instrument Base Case Global - Stream 13-Roof	Lab Warehouse Base Case Global - Stream 13-SouthWall	Lab Warehouse Base Case Global - Stream 13-EastWall	Lab Warehouse Base Case Global - Stream 13-NorthWall	Lab Warehouse Base Case Global - Stream 13-WestWall	Lab Warehouse Base Case Global - Stream 13-Roof	CCB ESP Base Case Global - Stream 13-SouthWall	CCB ESP Base Case Global - Stream 13-EastWall	CCB ESP Base Case Global - Stream 13-NorthWall	CCB ESP Base Case Global - Stream 13-WestWall	CCB ESP Base Case Global - Stream 13-Roof
1	Max	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
2	Max	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
3	Max	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
4	Max	0.01	<0.01	<0.01	0.02	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
5	Max	0.03	0.02	0.02	0.06	0.03	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.02	0.01	0.01	<0.01	0.01
	Average	<0.01	<0.01	<0.01	0.02	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
6	Max	0.06	0.04	0.05	0.14	0.06	0.03	0.04	0.03	0.04	0.03	0.04	0.04	0.03	0.02	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	<0.01	0.02	0.02	0.04	0.03	0.02	0.02	0.03
	Average	0.02	0.02	0.02	0.04	0.02	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	<0.01	0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.01	0.01	<0.01	0.01
7	Max	0.10	0.06	0.07	0.20	0.09	0.05	0.05	0.04	0.07	0.05	0.05	0.05	0.04	0.03	0.05	0.05	0.05	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.04	<0.01	0.03	0.03	0.06	0.04	0.03	0.03	0.04
	Average	0.04	0.03	0.03	0.07	0.04	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	<0.01	0.01	0.01	0.03	0.02	0.02	0.01	0.02
8	Max	0.23	0.13	0.19	0.75	0.19	0.10	0.08	0.10	0.15	0.10	0.16	0.09	0.08	0.06	0.16	0.16	0.12	0.11	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.05	0.06	0.06	0.07	<0.01	0.05	0.06	0.15	0.13	0.07	0.07	0.09
	Average	0.11	0.08	0.09	0.33	0.12	0.06	0.05	0.06	0.09	0.06	0.08	0.06	0.05	0.04	0.08	0.08	0.06	0.06	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.04	<0.01	0.04	0.04	0.07	0.06	0.04	0.04	0.05
9	Max	0.44	0.21	0.36	2.33	0.41	0.22	0.14	0.20	0.41	0.19	0.36	0.12	0.13	0.12	0.42	0.40	0.27	0.23	0.15	0.13	0.12	0.12	0.12	0.13	0.12	0.10	0.14	0.12	0.12	0.01	0.09	0.10	0.26	0.22	0.12	0.10	0.15
	Average	0.23	0.14	0.19	0.98	0.24	0.12	0.10	0.12	0.22	0.13	0.16	0.09	0.08	0.07	0.17	0.17	0.13	0.12	0.09	0.08	0.08	0.08	0.07	0.09	0.08	0.07	0.09	0.08	0.08	0.01	0.07	0.07	0.14	0.12	0.08	0.06	0.09

Table 8 Overpressure Loads at Local Pressure Panels of Base Case Geometry – Stream 13 Gas Composition

Target / Gas Cloud Class		LPG R Unit CCB Base Case Local - Stream 13-SouthWall	LPG R Unit CCB Base Case Local - Stream 13-EastWall	LPG R Unit CCB Base Case Local - Stream 13-NorthWall	LPG R Unit CCB Base Case Local - Stream 13-WestWall	LPG R Unit CCB Base Case Local - Stream 13-Roof	Stock and WasteYard Base Case Local - Stream 13-SouthWall	Stock and WasteYard Base Case Local - Stream 13-EastWall	Stock and WasteYard Base Case Local - Stream 13-NorthWall	Stock and WasteYard Base Case Local - Stream 13-WestWall	Stock and WasteYard Base Case Local - Stream 13-Roof	C Workshop Base Case Local - Stream 13-SouthWall	C Workshop Base Case Local - Stream 13-EastWall 1	C Workshop Base Case Local - Stream 13-EastWall 2	C Workshop Base Case Local - Stream 13-NorthWall	C Workshop Base Case Local - Stream 13-WestWall 1	C Workshop Base Case Local - Stream 13-WestWall 2	C Workshop Base Case Local - Stream 13-Roof 1	C Workshop Base Case Local - Stream 13-Roof 2	Lab Base Case Local - Stream 13-SouthWall	Lab Base Case Local - Stream 13-EastWall	Lab Base Case Local - Stream 13-NorthWall	Lab Base Case Local - Stream 13-WestWall	Lab Base Case Local - Stream 13-Roof	Instrument Base Case Local - Stream 13-SouthWall	Instrument Base Case Local - Stream 13-EastWall	Instrument Base Case Local - Stream 13-WestWall	Instrument Base Case Local - Stream 13-Roof	Lab Warehouse Base Case Local - Stream 13-SouthWall	Lab Warehouse Base Case Local - Stream 13-EastWall	Lab Warehouse Base Case Local - Stream 13-NorthWall	Lab Warehouse Base Case Local - Stream 13-WestWall	Lab Warehouse Base Case Local - Stream 13-Roof	CCB ESP Base Case Local - Stream 13-SouthWall	CCB ESP Base Case Local - Stream 13-EastWall	CCB ESP Base Case Local - Stream 13-NorthWall	CCB ESP Base Case Local - Stream 13-WestWall	CCB ESP Base Case Local - Stream 13-Roof
1	Max	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
2	Max	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
3	Max	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
4	Max	0.01	<0.01	<0.01	0.02	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
5	Max	0.03	0.02	0.02	0.06	0.03	0.02	0.02	0.01	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.02	0.02	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.02	0.01	0.01	0.01	0.01
	Average	0.01	<0.01	<0.01	0.02	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
6	Max	0.07	0.05	0.06	0.15	0.07	0.04	0.04	0.04	0.05	0.04	0.04	0.04	0.03	0.02	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.01	0.02	0.02	0.04	0.03	0.02	0.02	0.03
	Average	0.03	0.02	0.02	0.05	0.03	0.01	0.01	0.01	0.02	0.01	0.02	0.01	0.01	<0.01	0.01	0.02	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.01	0.01	<0.01	0.01
7	Max	0.12	0.07	0.08	0.21	0.11	0.05	0.05	0.05	0.07	0.05	0.06	0.05	0.04	0.03	0.05	0.05	0.05	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.02	0.03	0.03	0.06	0.04	0.03	0.03	0.04
	Average	0.04	0.03	0.04	0.08	0.04	0.02	0.02	0.02	0.03	0.02	0.03	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.02	<0.01	0.01	0.01	0.03	0.02	0.02	0.01	0.02
8	Max	0.34	0.15	0.24	0.84	0.28	0.12	0.09	0.11	0.18	0.11	0.17	0.09	0.08	0.07	0.16	0.18	0.14	0.11	0.07	0.06	0.06	0.06	0.06	0.07	0.08	0.06	0.07	0.07	0.07	0.03	0.05	0.06	0.16	0.14	0.08	0.08	0.10
	Average	0.15	0.09	0.11	0.36	0.15	0.07	0.06	0.06	0.10	0.07	0.08	0.06	0.05	0.04	0.08	0.08	0.07	0.06	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.04	0.04	0.04	0.05	0.02	0.04	0.04	0.08	0.06	0.04	0.04	0.06
9	Max	0.74	0.31	0.60	2.49	0.67	0.28	0.20	0.24	0.50	0.22	0.40	0.15	0.14	0.16	0.43	0.48	0.34	0.24	0.16	0.13	0.13	0.12	0.12	0.14	0.17	0.13	0.15	0.16	0.15	0.05	0.09	0.11	0.27	0.24	0.12	0.11	0.16
	Average	0.32	0.18	0.26	1.08	0.35	0.14	0.13	0.13	0.25	0.14	0.18	0.10	0.09	0.08	0.18	0.19	0.16	0.12	0.09	0.08	0.08	0.08	0.08	0.09	0.11	0.09	0.10	0.10	0.10	0.03	0.07	0.08	0.15	0.13	0.08	0.07	0.10

Table 9 Overpressure Loads at Global Pressure Panels of Case 1 Geometry – Stream 13 Gas Composition

Target / Gas Cloud Class		LPG R Unit CCB Case 1 Global - Stream 13-SouthWall	LPG R Unit CCB Case 1 Global - Stream 13-EastWall	LPG R Unit CCB Case 1 Global - Stream 13-NorthWall	LPG R Unit CCB Case 1 Global - Stream 13-WestWall	LPG R Unit CCB Case 1 Global - Stream 13-Roof	Stock and WasteYard Case 1 Global - Stream 13-SouthWall	Stock and WasteYard Case 1 Global - Stream 13-EastWall	Stock and WasteYard Case 1 Global - Stream 13-NorthWall	Stock and WasteYard Case 1 Global - Stream 13-WestWall	Stock and WasteYard Case 1 Global - Stream 13-Roof	C Workshop Case 1 Global - Stream 13-SouthWall	C Workshop Case 1 Global - Stream 13-EastWall 1	C Workshop Case 1 Global - Stream 13-EastWall 2	C Workshop Case 1 Global - Stream 13-NorthWall	C Workshop Case 1 Global - Stream 13-WestWall 1	C Workshop Case 1 Global - Stream 13-WestWall 2	C Workshop Case 1 Global - Stream 13-Roof 1	C Workshop Case 1 Global - Stream 13-Roof 2	Lab Case 1 Global - Stream 13-SouthWall	Lab Case 1 Global - Stream 13-EastWall	Lab Case 1 Global - Stream 13-NorthWall	Lab Case 1 Global - Stream 13-WestWall	Lab Case 1 Global - Stream 13-Roof	Instrument Case 1 Global - Stream 13-SouthWall	Instrument Case 1 Global - Stream 13-EastWall	Instrument Case 1 Global - Stream 13-WestWall	Instrument Case 1 Global - Stream 13-Roof	Lab Warehouse Case 1 Global - Stream 13-SouthWall	Lab Warehouse Case 1 Global - Stream 13-EastWall	Lab Warehouse Case 1 Global - Stream 13-NorthWall	Lab Warehouse Case 1 Global - Stream 13-WestWall	Lab Warehouse Case 1 Global - Stream 13-Roof	CCB ESP Case 1 Global - Stream 13-SouthWall	CCB ESP Case 1 Global - Stream 13-EastWall	CCB ESP Case 1 Global - Stream 13-NorthWall	CCB ESP Case 1 Global - Stream 13-WestWall	CCB ESP Case 1 Global - Stream 13-Roof
1	Max	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
2	Max	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
3	Max	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
4	Max	0.01	<0.01	<0.01	0.02	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
5	Max	0.03	0.02	0.02	0.06	0.03	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.01	0.01	<0.01	0.01
	Average	0.01	<0.01	<0.01	0.02	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
6	Max	0.07	0.05	0.06	0.14	0.06	0.04	0.03	0.03	0.04	0.04	0.04	0.04	0.03	0.02	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	<0.01	0.02	0.02	0.04	0.03	0.02	0.02	0.03
	Average	0.02	0.02	0.02	0.04	0.02	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	<0.01	0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.01	0.01	<0.01	0.01
7	Max	0.11	0.07	0.08	0.20	0.09	0.05	0.05	0.04	0.07	0.05	0.05	0.05	0.04	0.03	0.05	0.05	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.03	0.02	0.03	<0.01	0.03	0.03	0.06	0.04	0.03	0.03	0.04
	Average	0.04	0.03	0.03	0.07	0.04	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	<0.01	0.01	0.01	0.03	0.02	0.02	0.01	0.02
8	Max	0.23	0.13	0.23	0.77	0.20	0.11	0.08	0.10	0.16	0.10	0.16	0.09	0.08	0.06	0.16	0.16	0.12	0.11	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.05	0.06	0.05	0.06	<0.01	0.05	0.05	0.15	0.13	0.07	0.07	0.09
	Average	0.12	0.08	0.10	0.34	0.12	0.06	0.05	0.06	0.09	0.06	0.07	0.05	0.05	0.04	0.07	0.07	0.06	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.04	<0.01	0.03	0.04	0.07	0.06	0.04	0.04	0.05
9	Max	0.45	0.21	0.47	2.39	0.41	0.22	0.14	0.20	0.41	0.19	0.35	0.12	0.13	0.12	0.40	0.39	0.26	0.22	0.14	0.13	0.11	0.12	0.11	0.13	0.11	0.10	0.13	0.12	0.12	0.01	0.09	0.10	0.25	0.21	0.11	0.10	0.14
	Average	0.23	0.15	0.22	0.98	0.25	0.13	0.11	0.12	0.22	0.13	0.16	0.09	0.08	0.07	0.17	0.17	0.13	0.11	0.09	0.08	0.08	0.08	0.07	0.09	0.08	0.07	0.09	0.08	0.08	0.01	0.07	0.07	0.14	0.12	0.07	0.06	0.09

Table 10 Overpressure Loads at Local Pressure Panels of Case 1 Geometry – Stream 13 Gas Composition

Target / Gas Cloud Class		LPG R Unit CCB Case 1 Local - Stream 13-SouthWall	LPG R Unit CCB Case 1 Local - Stream 13-EastWall	LPG R Unit CCB Case 1 Local - Stream 13-NorthWall	LPG R Unit CCB Case 1 Local - Stream 13-WestWall	LPG R Unit CCB Case 1 Local - Stream 13-Roof	Stock and WasteYard Case 1 Local - Stream 13-SouthWall	Stock and WasteYard Case 1 Local - Stream 13-EastWall	Stock and WasteYard Case 1 Local - Stream 13-NorthWall	Stock and WasteYard Case 1 Local - Stream 13-WestWall	Stock and WasteYard Case 1 Local - Stream 13-Roof	C Workshop Case 1 Local - Stream 13-SouthWall	C Workshop Case 1 Local - Stream 13-EastWall 1	C Workshop Case 1 Local - Stream 13-EastWall 2	C Workshop Case 1 Local - Stream 13-NorthWall	C Workshop Case 1 Local - Stream 13-WestWall 1	C Workshop Case 1 Local - Stream 13-WestWall 2	C Workshop Case 1 Local - Stream 13-Roof 1	C Workshop Case 1 Local - Stream 13-Roof 2	Lab Case 1 Local - Stream 13-SouthWall	Lab Case 1 Local - Stream 13-EastWall	Lab Case 1 Local - Stream 13-NorthWall	Lab Case 1 Local - Stream 13-WestWall	Lab Case 1 Local - Stream 13-Roof	Instrument Case 1 Local - Stream 13-SouthWall	Instrument Case 1 Local - Stream 13-EastWall	Instrument Case 1 Local - Stream 13-WestWall	Instrument Case 1 Local - Stream 13-Roof	Lab Warehouse Case 1 Local - Stream 13-SouthWall	Lab Warehouse Case 1 Local - Stream 13-EastWall	Lab Warehouse Case 1 Local - Stream 13-NorthWall	Lab Warehouse Case 1 Local - Stream 13-WestWall	Lab Warehouse Case 1 Local - Stream 13-Roof	CCB ESP Case 1 Local - Stream 13-SouthWall	CCB ESP Case 1 Local - Stream 13-EastWall	CCB ESP Case 1 Local - Stream 13-NorthWall	CCB ESP Case 1 Local - Stream 13-WestWall	CCB ESP Case 1 Local - Stream 13-Roof
1	Max	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
2	Max	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
3	Max	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
4	Max	0.01	<0.01	<0.01	0.02	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
5	Max	0.03	0.02	0.03	0.06	0.03	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.02	0.01	0.01	<0.01	0.01
	Average	0.01	<0.01	<0.01	0.02	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
6	Max	0.08	0.05	0.07	0.15	0.07	0.04	0.04	0.04	0.05	0.04	0.04	0.04	0.03	0.02	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.01	0.02	0.02	0.04	0.03	0.02	0.02	0.03
	Average	0.03	0.02	0.03	0.05	0.03	0.01	0.01	0.01	0.02	0.01	0.02	0.01	0.01	<0.01	0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.01	0.01	<0.01	0.01
7	Max	0.12	0.08	0.09	0.21	0.11	0.06	0.05	0.05	0.08	0.05	0.05	0.05	0.04	0.03	0.05	0.05	0.05	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.02	0.03	0.03	0.06	0.04	0.03	0.03	0.04
	Average	0.04	0.03	0.04	0.08	0.04	0.02	0.02	0.02	0.03	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	<0.01	0.01	0.01	0.03	0.02	0.02	0.01	0.02
8	Max	0.35	0.16	0.30	0.83	0.28	0.12	0.10	0.11	0.18	0.11	0.17	0.09	0.08	0.07	0.16	0.17	0.14	0.11	0.07	0.06	0.06	0.06	0.06	0.07	0.08	0.06	0.07	0.07	0.07	0.03	0.05	0.06	0.16	0.14	0.07	0.07	0.10
	Average	0.15	0.09	0.13	0.37	0.15	0.07	0.06	0.06	0.10	0.07	0.08	0.06	0.05	0.04	0.07	0.08	0.07	0.06	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.02	0.03	0.04	0.08	0.06	0.04	0.04	0.05
9	Max	0.75	0.32	0.73	2.55	0.67	0.28	0.20	0.24	0.49	0.22	0.39	0.15	0.13	0.15	0.41	0.46	0.33	0.23	0.15	0.13	0.13	0.12	0.12	0.14	0.17	0.13	0.15	0.15	0.14	0.05	0.09	0.10	0.26	0.23	0.12	0.11	0.15
	Average	0.33	0.19	0.30	1.08	0.35	0.15	0.13	0.14	0.26	0.14	0.18	0.10	0.09	0.08	0.17	0.19	0.15	0.12	0.09	0.08	0.08	0.08	0.08	0.09	0.10	0.09	0.10	0.10	0.09	0.03	0.07	0.07	0.14	0.12	0.08	0.07	0.09

Table 11 Overpressure Loads at Global Pressure Panels of Case 2 Geometry – Stream 13 Gas Composition

Target / Gas Cloud Class		LPG R Unit CCB Case 2 Global - Stream 13-SouthWall	LPG R Unit CCB Case 2 Global - Stream 13-EastWall	LPG R Unit CCB Case 2 Global - Stream 13-NorthWall	LPG R Unit CCB Case 2 Global - Stream 13-WestWall	LPG R Unit CCB Case 2 Global - Stream 13-Roof	Stock and WasteYard Case 2 Global - Stream 13-SouthWall	Stock and WasteYard Case 2 Global - Stream 13-EastWall	Stock and WasteYard Case 2 Global - Stream 13-NorthWall	Stock and WasteYard Case 2 Global - Stream 13-WestWall	Stock and WasteYard Case 2 Global - Stream 13-Roof	C Workshop Case 2 Global - Stream 13-SouthWall	C Workshop Case 2 Global - Stream 13-EastWall 1	C Workshop Case 2 Global - Stream 13-EastWall 2	C Workshop Case 2 Global - Stream 13-NorthWall	C Workshop Case 2 Global - Stream 13-WestWall 1	C Workshop Case 2 Global - Stream 13-WestWall 2	C Workshop Case 2 Global - Stream 13-Roof 1	C Workshop Case 2 Global - Stream 13-Roof 2	Lab Case 2 Global - Stream 13-SouthWall	Lab Case 2 Global - Stream 13-EastWall	Lab Case 2 Global - Stream 13-NorthWall	Lab Case 2 Global - Stream 13-WestWall	Lab Case 2 Global - Stream 13-Roof	Instrument Case 2 Global - Stream 13-SouthWall	Instrument Case 2 Global - Stream 13-EastWall	Instrument Case 2 Global - Stream 13-WestWall	Instrument Case 2 Global - Stream 13-Roof	Lab Warehouse Case 2 Global - Stream 13-SouthWall	Lab Warehouse Case 2 Global - Stream 13-EastWall	Lab Warehouse Case 2 Global - Stream 13-NorthWall	Lab Warehouse Case 2 Global - Stream 13-WestWall	Lab Warehouse Case 2 Global - Stream 13-Roof	CCB ESP Case 2 Global - Stream 13-SouthWall	CCB ESP Case 2 Global - Stream 13-EastWall	CCB ESP Case 2 Global - Stream 13-NorthWall	CCB ESP Case 2 Global - Stream 13-WestWall	CCB ESP Case 2 Global - Stream 13-Roof
1	Max	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
2	Max	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
3	Max	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
4	Max	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
5	Max	0.03	0.02	0.03	0.06	0.03	0.02	0.01	0.01	0.02	0.02	0.01	0.02	0.01	<0.01	0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.01	0.01	<0.01	0.01
	Average	0.01	<0.01	<0.01	0.02	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
6	Max	0.07	0.05	0.07	0.14	0.06	0.04	0.03	0.03	0.05	0.04	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.02	<0.01	0.02	0.02	0.04	0.03	0.02	0.02	0.03
	Average	0.02	0.02	0.02	0.05	0.02	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	<0.01	0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.01	0.01	<0.01	0.01
7	Max	0.11	0.08	0.10	0.20	0.09	0.05	0.05	0.04	0.07	0.05	0.05	0.05	0.04	0.03	0.05	0.05	0.04	0.04	0.03	0.02	0.03	0.03	0.02	0.02	0.03	0.02	0.03	0.02	0.03	<0.01	0.03	0.03	0.05	0.04	0.03	0.03	0.04
	Average	0.04	0.03	0.04	0.08	0.04	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	<0.01	0.01	0.01	0.03	0.02	0.02	0.01	0.02
8	Max	0.23	0.15	0.33	0.76	0.20	0.11	0.08	0.10	0.16	0.10	0.15	0.09	0.08	0.06	0.15	0.15	0.12	0.10	0.06	0.06	0.05	0.06	0.05	0.06	0.06	0.05	0.06	0.05	0.06	<0.01	0.04	0.05	0.15	0.12	0.07	0.06	0.09
	Average	0.12	0.09	0.12	0.35	0.12	0.07	0.05	0.06	0.10	0.07	0.07	0.05	0.05	0.04	0.07	0.07	0.06	0.05	0.04	0.03	0.04	0.04	0.03	0.04	0.04	0.03	0.04	0.03	0.04	<0.01	0.03	0.04	0.07	0.05	0.04	0.03	0.05
9	Max	0.45	0.23	0.70	2.37	0.42	0.23	0.14	0.20	0.43	0.19	0.33	0.12	0.13	0.12	0.38	0.37	0.25	0.21	0.14	0.12	0.11	0.12	0.11	0.12	0.11	0.09	0.13	0.11	0.12	0.01	0.08	0.10	0.25	0.20	0.11	0.10	0.14
	Average	0.24	0.17	0.28	0.99	0.25	0.14	0.11	0.12	0.23	0.13	0.16	0.09	0.08	0.07	0.17	0.16	0.13	0.11	0.09	0.08	0.07	0.08	0.07	0.08	0.08	0.07	0.09	0.07	0.08	<0.01	0.06	0.07	0.13	0.11	0.07	0.06	0.09

Table 12 Overpressure Loads at Local Pressure Panels of Case 2 Geometry – Stream 13 Gas Composition

Target / Gas Cloud Class		LPG R Unit CCB Case 2 Local - Stream 13-SouthWall	LPG R Unit CCB Case 2 Local - Stream 13-EastWall	LPG R Unit CCB Case 2 Local - Stream 13-NorthWall	LPG R Unit CCB Case 2 Local - Stream 13-WestWall	LPG R Unit CCB Case 2 Local - Stream 13-Roof	Stock and WasteYard Case 2 Local - Stream 13-SouthWall	Stock and WasteYard Case 2 Local - Stream 13-EastWall	Stock and WasteYard Case 2 Local - Stream 13-NorthWall	Stock and WasteYard Case 2 Local - Stream 13-WestWall	Stock and WasteYard Case 2 Local - Stream 13-Roof	C Workshop Case 2 Local - Stream 13-SouthWall	C Workshop Case 2 Local - Stream 13-EastWall 1	C Workshop Case 2 Local - Stream 13-EastWall 2	C Workshop Case 2 Local - Stream 13-NorthWall	C Workshop Case 2 Local - Stream 13-WestWall 1	C Workshop Case 2 Local - Stream 13-WestWall 2	C Workshop Case 2 Local - Stream 13-Roof 1	C Workshop Case 2 Local - Stream 13-Roof 2	Lab Case 2 Local - Stream 13-SouthWall	Lab Case 2 Local - Stream 13-EastWall	Lab Case 2 Local - Stream 13-NorthWall	Lab Case 2 Local - Stream 13-WestWall	Lab Case 2 Local - Stream 13-Roof	Instrument Case 2 Local - Stream 13-SouthWall	Instrument Case 2 Local - Stream 13-EastWall	Instrument Case 2 Local - Stream 13-WestWall	Instrument Case 2 Local - Stream 13-Roof	Lab Warehouse Case 2 Local - Stream 13-SouthWall	Lab Warehouse Case 2 Local - Stream 13-EastWall	Lab Warehouse Case 2 Local - Stream 13-NorthWall	Lab Warehouse Case 2 Local - Stream 13-WestWall	Lab Warehouse Case 2 Local - Stream 13-Roof	CCB ESP Case 2 Local - Stream 13-SouthWall	CCB ESP Case 2 Local - Stream 13-EastWall	CCB ESP Case 2 Local - Stream 13-NorthWall	CCB ESP Case 2 Local - Stream 13-WestWall	CCB ESP Case 2 Local - Stream 13-Roof
1	Max	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
2	Max	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
3	Max	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
4	Max	0.01	<0.01	<0.01	0.02	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
5	Max	0.04	0.03	0.03	0.06	0.03	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.01	0.01	<0.01	0.01
	Average	0.01	<0.01	0.01	0.02	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
6	Max	0.08	0.06	0.08	0.15	0.07	0.04	0.04	0.04	0.05	0.04	0.04	0.04	0.03	0.02	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.02	0.04	0.03	0.02	0.02	0.03
	Average	0.03	0.02	0.03	0.05	0.03	0.02	0.01	0.01	0.02	0.02	0.02	0.01	0.01	<0.01	0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.01	0.01	<0.01	0.01
7	Max	0.13	0.09	0.11	0.21	0.11	0.06	0.05	0.05	0.08	0.05	0.05	0.05	0.04	0.03	0.05	0.05	0.04	0.04	0.03	0.02	0.03	0.03	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.02	0.03	0.03	0.06	0.04	0.03	0.03	0.04
	Average	0.04	0.03	0.04	0.08	0.04	0.02	0.02	0.02	0.03	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	<0.01	0.01	0.01	0.03	0.02	0.02	0.01	0.02
8	Max	0.35	0.18	0.41	0.84	0.28	0.12	0.10	0.11	0.18	0.11	0.17	0.09	0.08	0.07	0.15	0.17	0.14	0.11	0.07	0.06	0.06	0.06	0.06	0.07	0.07	0.06	0.07	0.07	0.07	0.03	0.05	0.05	0.15	0.13	0.07	0.07	0.10
	Average	0.16	0.10	0.15	0.38	0.15	0.07	0.06	0.07	0.11	0.07	0.08	0.06	0.05	0.04	0.07	0.08	0.07	0.06	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.02	0.03	0.04	0.07	0.06	0.04	0.04	0.05
9	Max	0.74	0.35	1.09	2.53	0.67	0.28	0.20	0.24	0.50	0.22	0.37	0.14	0.13	0.14	0.39	0.44	0.32	0.22	0.15	0.12	0.12	0.12	0.11	0.13	0.16	0.12	0.14	0.15	0.14	0.05	0.09	0.10	0.26	0.22	0.11	0.11	0.15
	Average	0.33	0.21	0.39	1.10	0.36	0.16	0.14	0.14	0.26	0.15	0.18	0.10	0.09	0.08	0.17	0.18	0.15	0.12	0.09	0.08	0.08	0.08	0.08	0.09	0.10	0.09	0.09	0.10	0.09	0.03	0.07	0.07	0.14	0.12	0.08	0.07	0.09

Appendix H **Exceedance curve on target of interest (walls and roofs)**

(In a separate document)

Appendix H Exceedance curve on target of interest (walls and roofs of target buildings)

Note: This appendix complements Appendix E which also provides exceedance curve of the targets of interest. However, in this section the exceedance curves are divided into each walls and roofs.

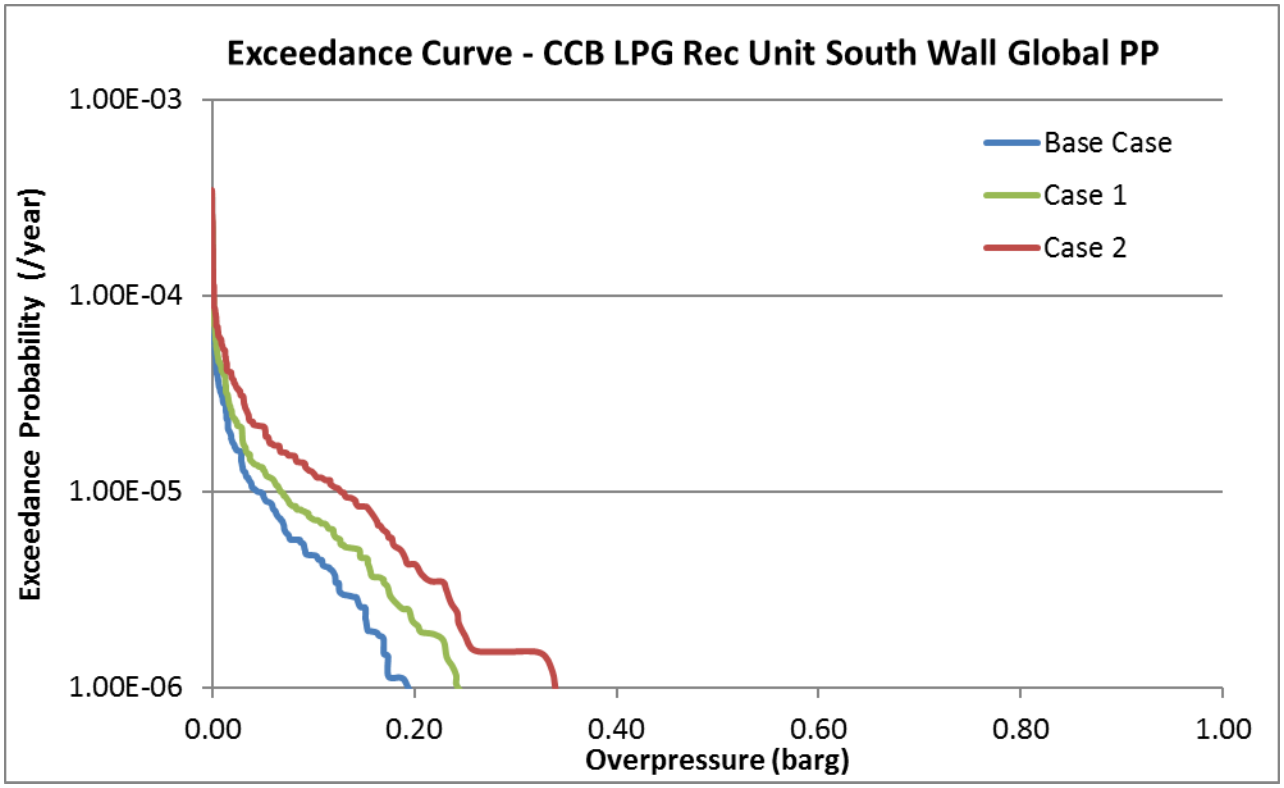
Summary of 10-4 / year and 10-5 / year frequency explosion loads (walls and roofs of target buildings)

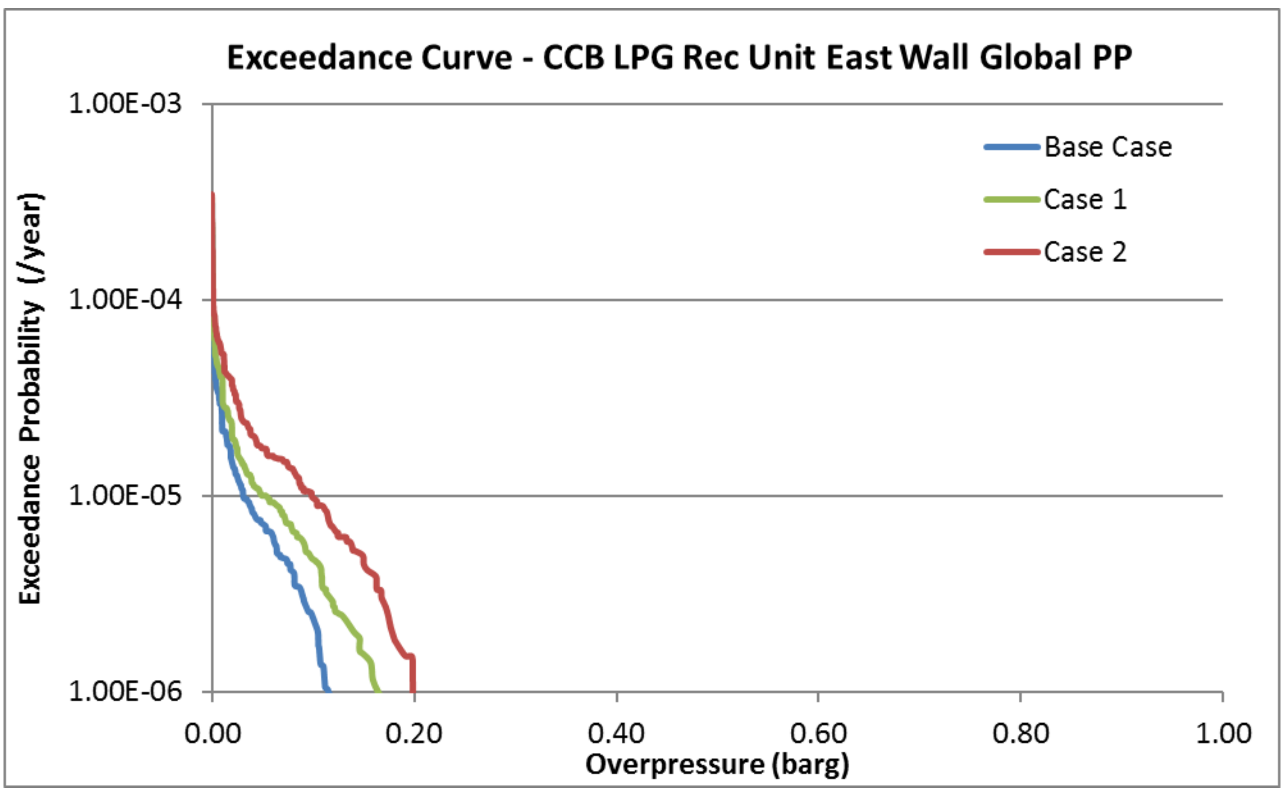
Target of Interest	Base Case		Case 1		Case 2	
	10^{-4} / year (barg) Overpressure	10^{-5} / year (barg) Overpressure	10^{-4} / year (barg) Overpressure	10^{-5} / year (barg) Overpressure	10^{-4} / year (barg) Overpressure	10^{-5} / year (barg) Overpressure
LPG Recovery Unit Area	0.01	0.59	0.01	1.02	0.02	2.42
ESP West Area	<0.01	0.04	<0.01	0.07	<0.01	0.13
LPG R Unit CCB Global - SouthWall	<0.01	0.04	<0.01	0.07	<0.01	0.13
LPG R Unit CCB Global - EastWall	<0.01	0.03	<0.01	0.05	<0.01	0.10
LPG R Unit CCB Global - NorthWall	<0.01	0.04	<0.01	0.06	<0.01	0.12
LPG R Unit CCB Global - WestWall	<0.01	0.10	<0.01	0.14	<0.01	0.27
LPG R Unit CCB Global - Roof	<0.01	0.05	<0.01	0.07	<0.01	0.13
Stock and WasteYard Global - SouthWall	<0.01	0.03	<0.01	0.04	<0.01	0.08
Stock and WasteYard Global - EastWall	<0.01	0.02	<0.01	0.04	<0.01	0.06
Stock and WasteYard Global - NorthWall	<0.01	0.03	<0.01	0.04	<0.01	0.06
Stock and WasteYard Global - WestWall	<0.01	0.03	<0.01	0.05	<0.01	0.10
Stock and WasteYard Global - Roof	<0.01	0.03	<0.01	0.04	<0.01	0.07
C Workshop Global - SouthWall	<0.01	0.03	<0.01	0.04	<0.01	0.08
C Workshop Global - EastWall1	<0.01	0.03	<0.01	0.04	<0.01	0.06
C Workshop Global - EastWall2	<0.01	0.02	<0.01	0.03	<0.01	0.05
C Workshop Global - NorthWall	<0.01	0.02	<0.01	0.03	<0.01	0.04
C Workshop Global - WestWall	<0.01	0.03	<0.01	0.04	<0.01	0.07
C Workshop Global - WestWall2	<0.01	0.03	<0.01	0.04	<0.01	0.07

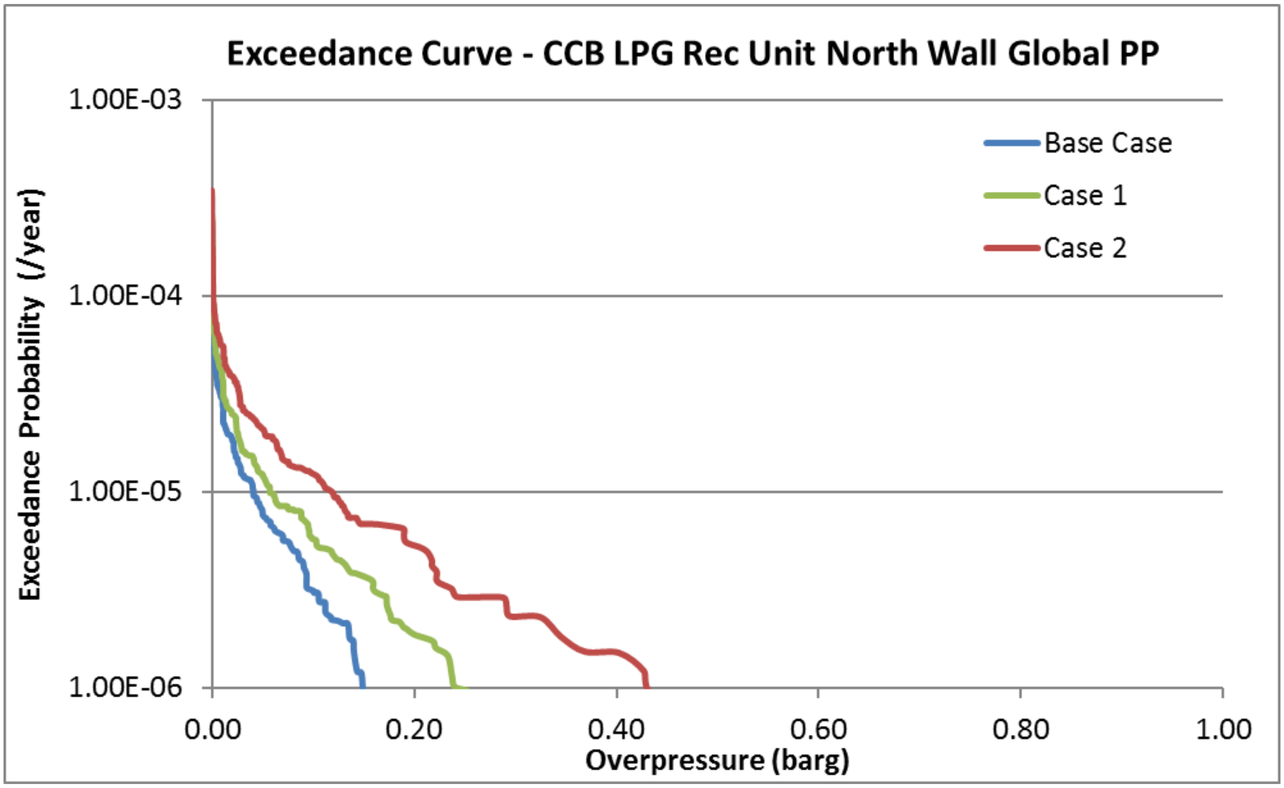
C Workshop Global - Roof1	<0.01	0.03	<0.01	0.04	<0.01	0.06
C Workshop Global - Roof2	<0.01	0.02	<0.01	0.04	<0.01	0.06
Lab Warehouse Global – South Wall	<0.01	0.02	<0.01	0.02	<0.01	0.04
Lab Warehouse Global – East Wall	<0.01	0.02	<0.01	0.02	<0.01	0.04
Lab Warehouse Global – North Wall	<0.01	0.02	<0.01	0.03	<0.01	0.04
Lab Warehouse Global – West Wall	<0.01	0.02	<0.01	0.02	<0.01	0.04
Lab Global - Roof	<0.01	0.02	<0.01	0.02	<0.01	0.04
Instrument Global - SouthWall	<0.01	0.02	<0.01	0.02	<0.01	0.04
Instrument Global - EastWall	<0.01	0.02	<0.01	0.02	<0.01	0.04
Instrument Global - WestWall	<0.01	0.02	<0.01	0.02	<0.01	0.04
Instrument Global - Roof	<0.01	0.02	<0.01	0.02	<0.01	0.04
Lab Warehouse Global - SouthWall	<0.01	0.01	<0.01	0.02	<0.01	0.03
Lab Warehouse Global - SouthWall	<0.01	0.02	<0.01	0.03	<0.01	0.04
Lab Warehouse Global - EastWall	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lab Warehouse Global - NorthWall	<0.01	0.02	<0.01	0.02	<0.01	0.04
Lab Warehouse Global - Roof	<0.01	0.02	<0.01	0.02	<0.01	0.04
CCB ESP Global - SouthWall	<0.01	0.04	<0.01	0.04	<0.01	0.07
CCB ESP Global - EastWall	<0.01	0.02	<0.01	0.03	<0.01	0.06
CCB ESP Global - NorthWall	<0.01	0.02	<0.01	0.03	<0.01	0.04
CCB ESP Global - WestWall	<0.01	0.02	<0.01	0.02	<0.01	0.04
CCB ESP Global - Roof	<0.01	0.02	<0.01	0.03	<0.01	0.05
LPG R Unit CCB Local - SouthWall	<0.01	0.05	<0.01	0.08	<0.01	0.17
LPG R Unit CCB Local - EastWall	<0.01	0.03	<0.01	0.05	<0.01	0.10
LPG R Unit CCB Local - NorthWall	<0.01	0.05	<0.01	0.07	<0.01	0.15
LPG R Unit CCB Local - WestWall	<0.01	0.10	<0.01	0.15	<0.01	0.29
LPG R Unit CCB Local - Roof	<0.01	0.06	<0.01	0.08	<0.01	0.16
Stock and WasteYard Local - SouthWall	<0.01	0.03	<0.01	0.04	<0.01	0.08
Stock and WasteYard Local - EastWall	<0.01	0.03	<0.01	0.04	<0.01	0.07
Stock and WasteYard Local - NorthWall	<0.01	0.03	<0.01	0.04	<0.01	0.07
Stock and WasteYard Local - WestWall	<0.01	0.03	<0.01	0.05	<0.01	0.11
Stock and WasteYard Local - Roof	<0.01	0.03	<0.01	0.04	<0.01	0.08

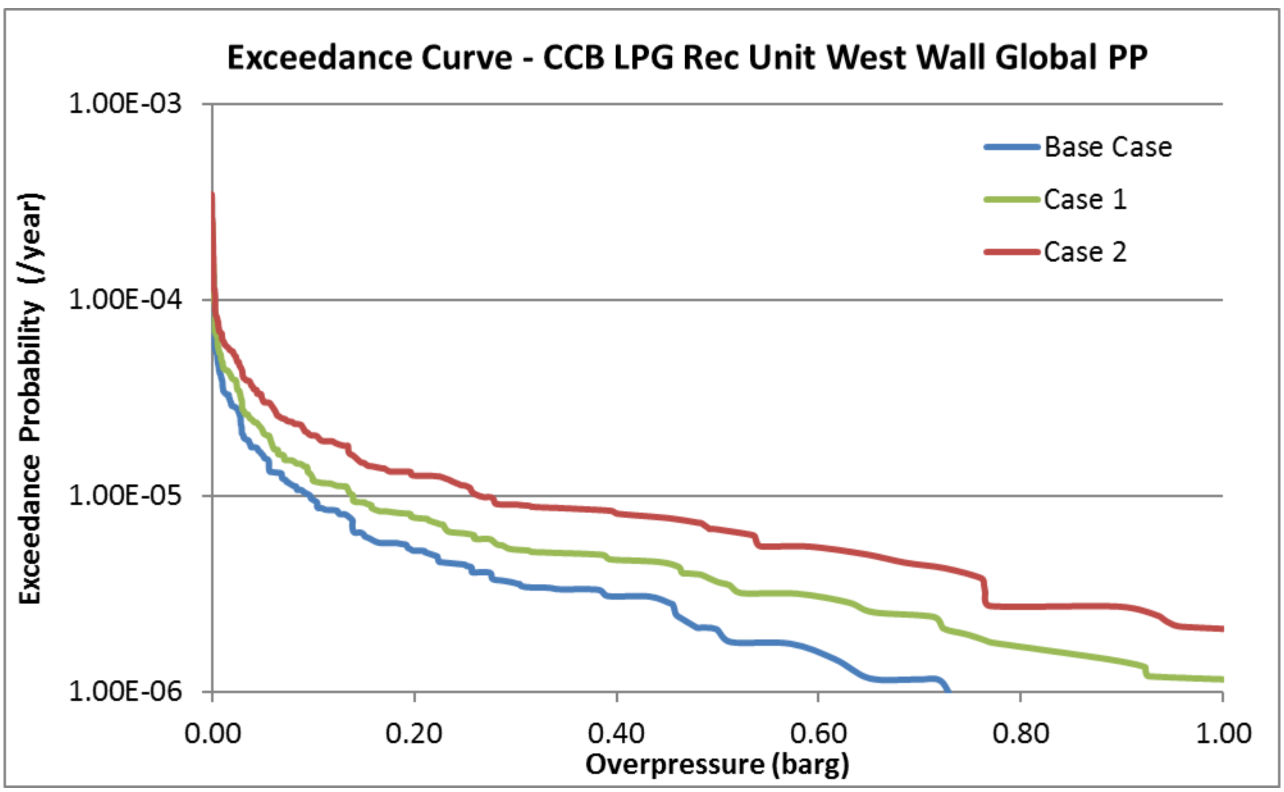
C Workshop Local - SouthWall	<0.01	0.03	<0.01	0.05	<0.01	0.08
C Workshop Local - EastWall1	<0.01	0.03	<0.01	0.04	<0.01	0.06
C Workshop Local - EastWall2	<0.01	0.02	<0.01	0.03	<0.01	0.05
C Workshop Local - NorthWall	<0.01	0.02	<0.01	0.03	<0.01	0.04
C Workshop Local - WestWall	<0.01	0.03	<0.01	0.04	<0.01	0.07
C Workshop Local - WestWall2	<0.01	0.03	<0.01	0.04	<0.01	0.08
C Workshop Local - Roof1	<0.01	0.03	<0.01	0.04	<0.01	0.07
C Workshop Local - Roof2	<0.01	0.02	<0.01	0.04	<0.01	0.06
Lab Local - SouthWall	<0.01	0.02	<0.01	0.03	<0.01	0.04
Lab Local - EastWall	<0.01	0.02	<0.01	0.02	<0.01	0.04
Lab Local - NorthWall	<0.01	0.02	<0.01	0.03	<0.01	0.04
Lab Local - WestWall	<0.01	0.02	<0.01	0.02	<0.01	0.04
Lab Local - Roof	<0.01	0.02	<0.01	0.02	<0.01	0.04
Instrument Local - SouthWall	<0.01	0.02	<0.01	0.02	<0.01	0.04
Instrument Local - EastWall	<0.01	0.02	<0.01	0.03	<0.01	0.05
Instrument Local - WestWall	<0.01	0.02	<0.01	0.02	<0.01	0.04
Instrument Local - Roof	<0.01	0.02	<0.01	0.02	<0.01	0.04
Lab Warehouse Local – South Wall	<0.01	0.02	<0.01	0.03	<0.01	0.04
Lab Warehouse Local – East Wall	<0.01	0.02	<0.01	0.03	<0.01	0.05
Lab Warehouse Local – North Wall	<0.01	<0.01	<0.01	0.01	<0.01	0.02
Lab Warehouse Local – West Wall	<0.01	0.02	<0.01	0.02	<0.01	0.04
Lab Warehouse Local - Roof	<0.01	0.02	<0.01	0.03	<0.01	0.04
CCB ESP Local - SouthWall	<0.01	0.04	<0.01	0.04	<0.01	0.07
CCB ESP Local - EastWall	<0.01	0.03	<0.01	0.04	<0.01	0.06
CCB ESP Local - NorthWall	<0.01	0.02	<0.01	0.03	<0.01	0.04
CCB ESP Local - WestWall	<0.01	0.02	<0.01	0.02	<0.01	0.04
CCB ESP Local - Roof	<0.01	0.03	<0.01	0.03	<0.01	0.05

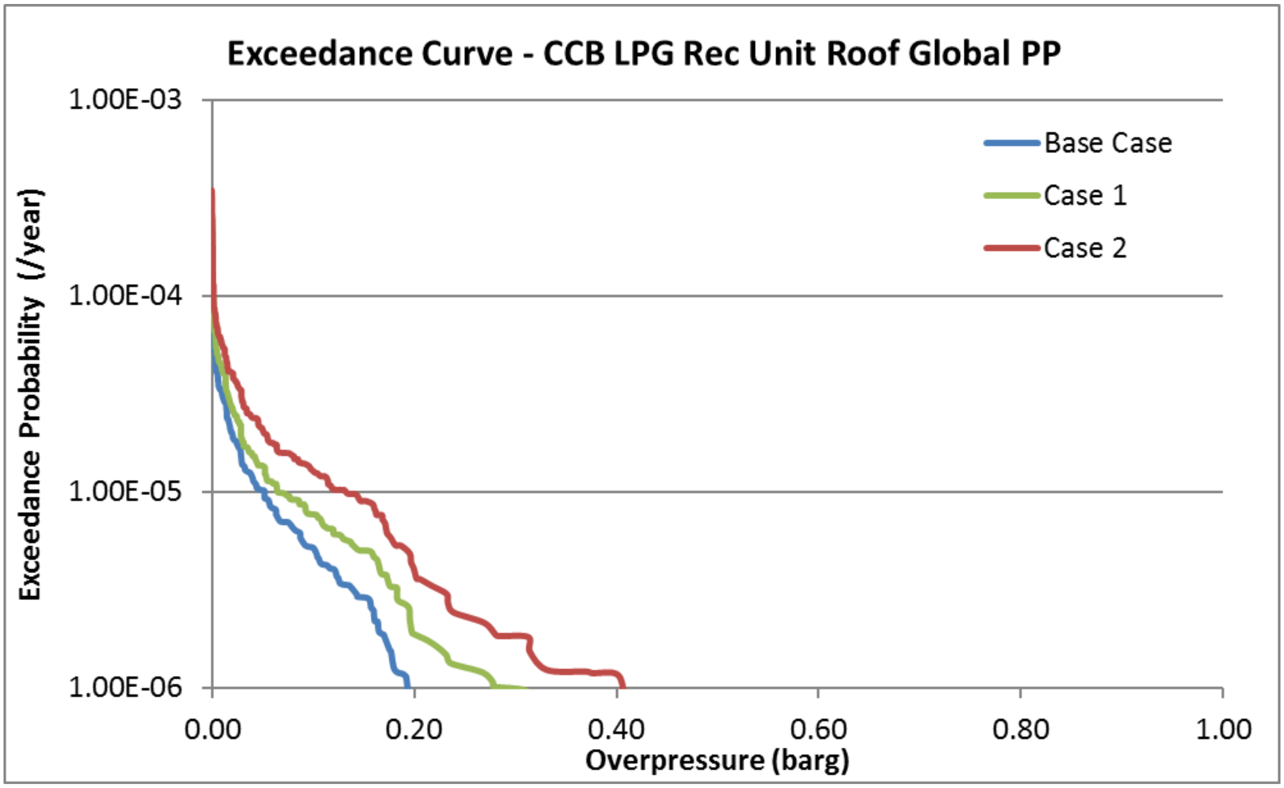
Global Pressure Panels

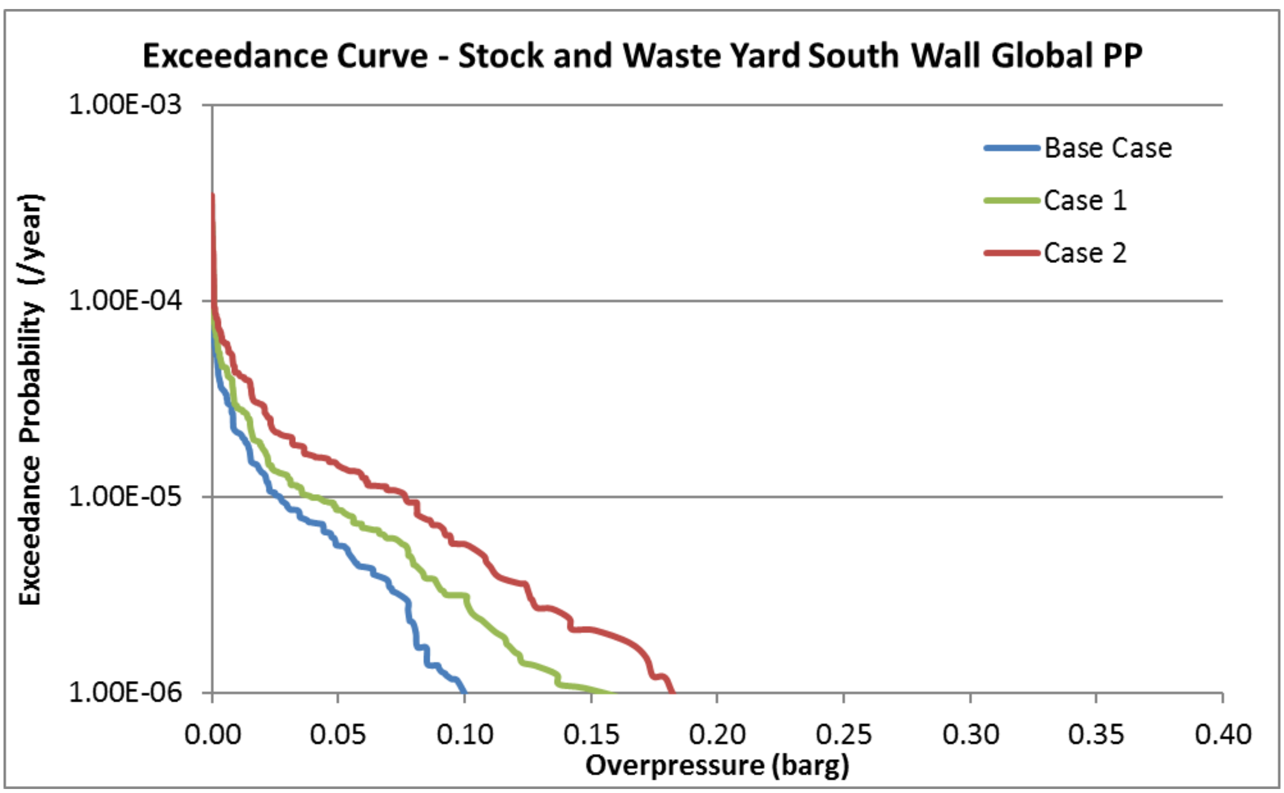


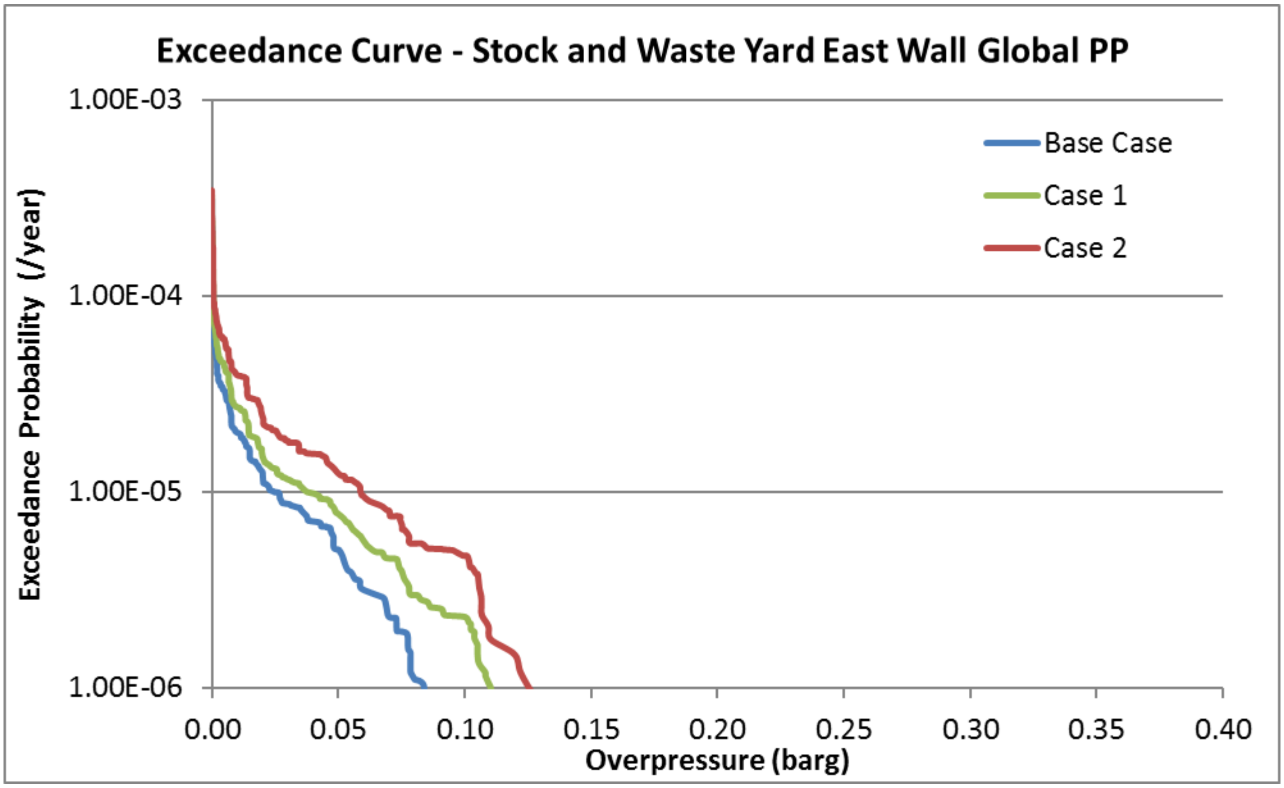


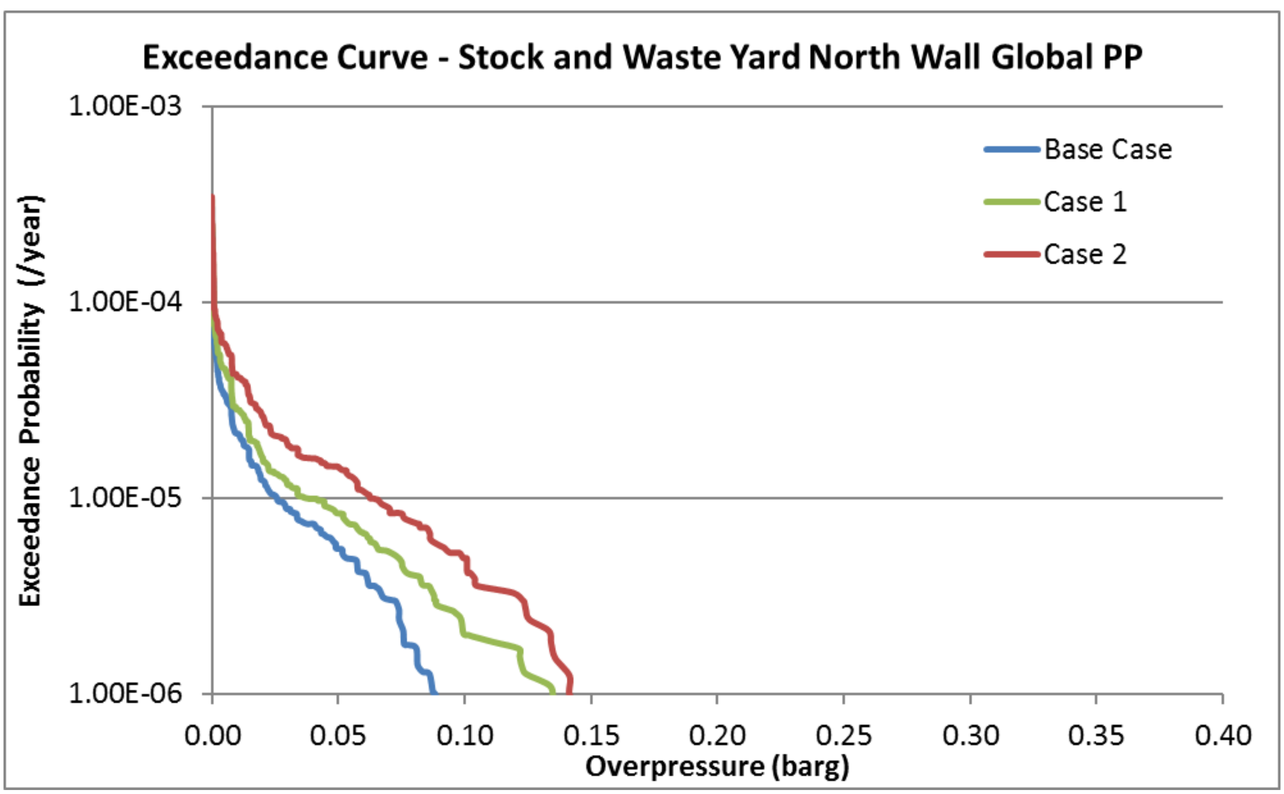

Exceedance Curve - CCB LPG Rec Unit North Wall Global PP
Exceedance Probability (/year)
1.00E-03
1.00E-04
1.00E-05
1.00E-06
0.00
0.20
0.40
0.60
0.80
1.00
Overpressure (barg)
Base Case
Case 1
Case 2

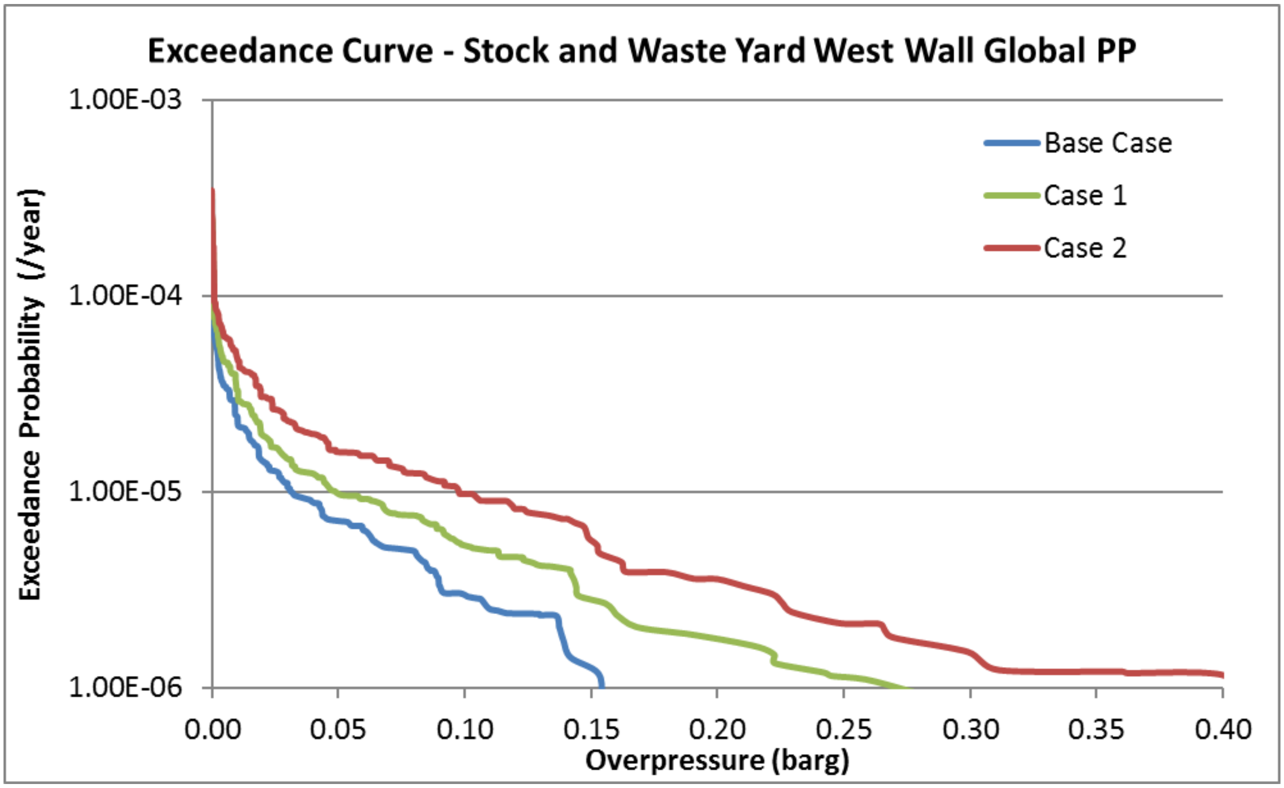

Exceedance Curve - CCB LPG Rec Unit West Wall Global PP
Exceedance Probability (/year)
1.00E-03
1.00E-04
1.00E-05
1.00E-06
0.00
0.20
0.40
0.60
0.80
1.00
Overpressure (barg)
Base Case
Case 1
Case 2

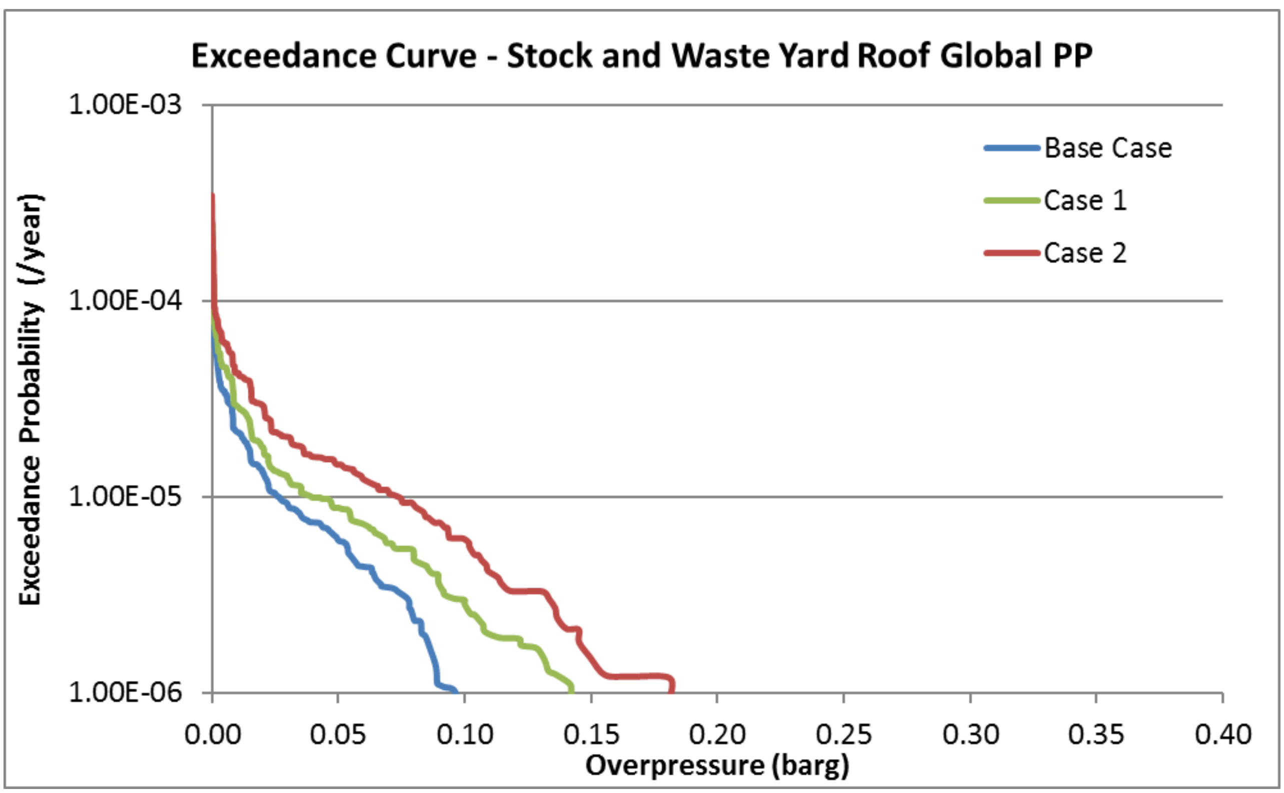

Exceedance Curve - CCB LPG Rec Unit Roof Global PP
Exceedance Probability (/year)
1.00E-03
1.00E-04
1.00E-05
1.00E-06
0.00
0.20
0.40
0.60
0.80
1.00
Overpressure (barg)
Base Case
Case 1
Case 2

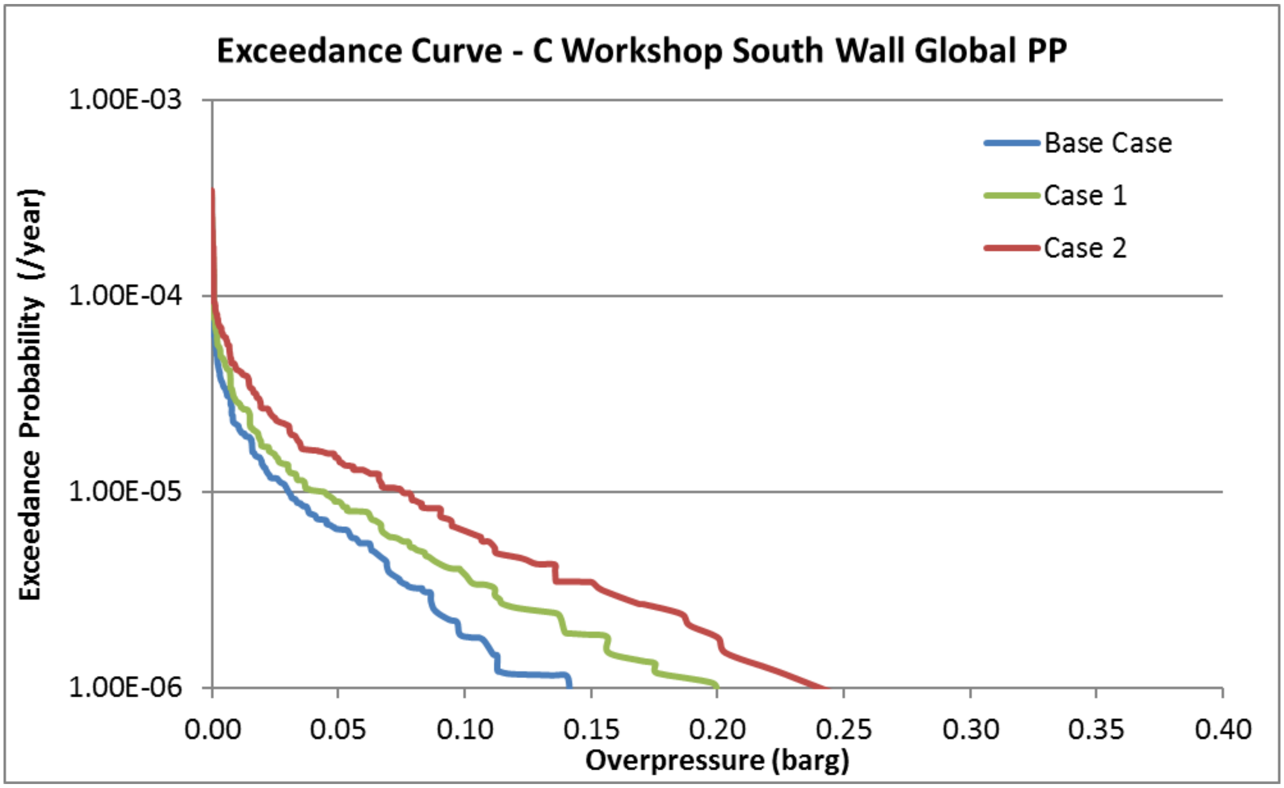

Exceedance Curve - Stock and Waste Yard South Wall Global PP
Exceedance Probability (/year)
1.00E-03
1.00E-04
1.00E-05
1.00E-06
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2

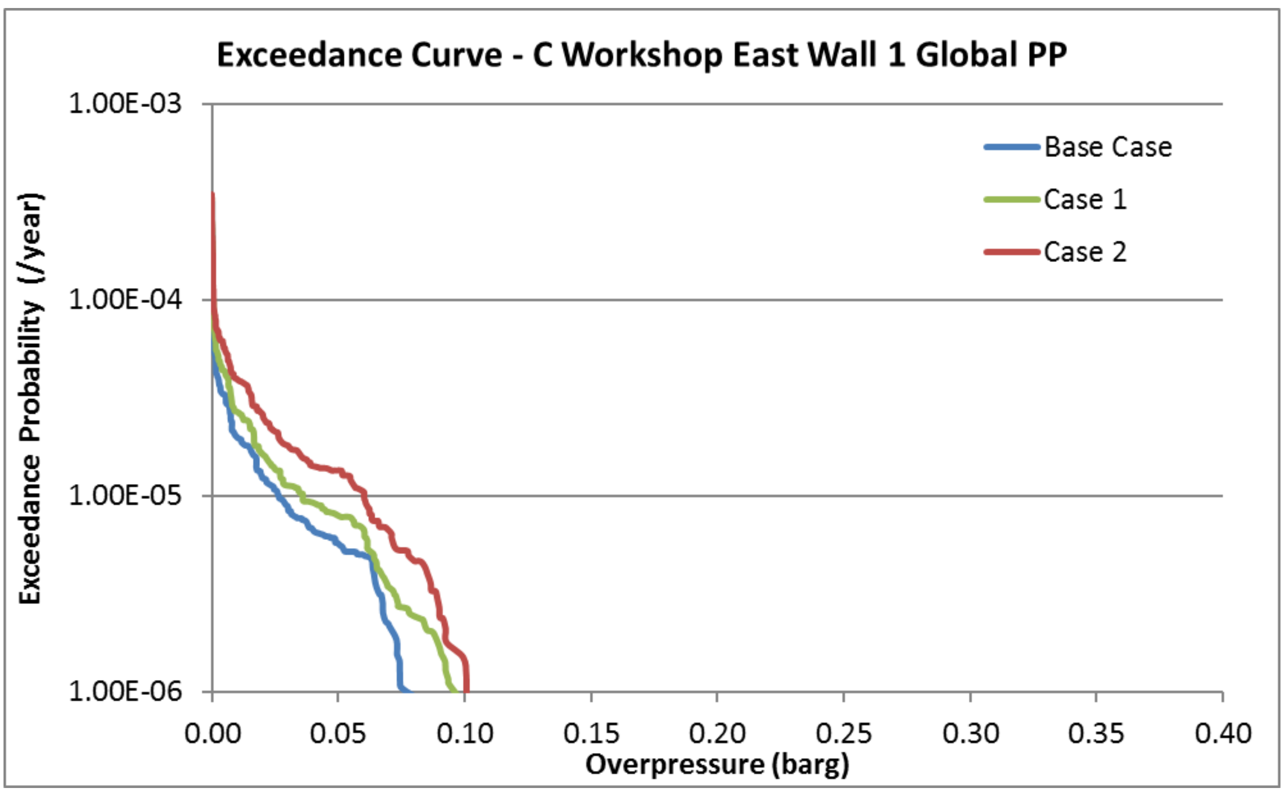

Exceedance Curve - Stock and Waste Yard East Wall Global PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2

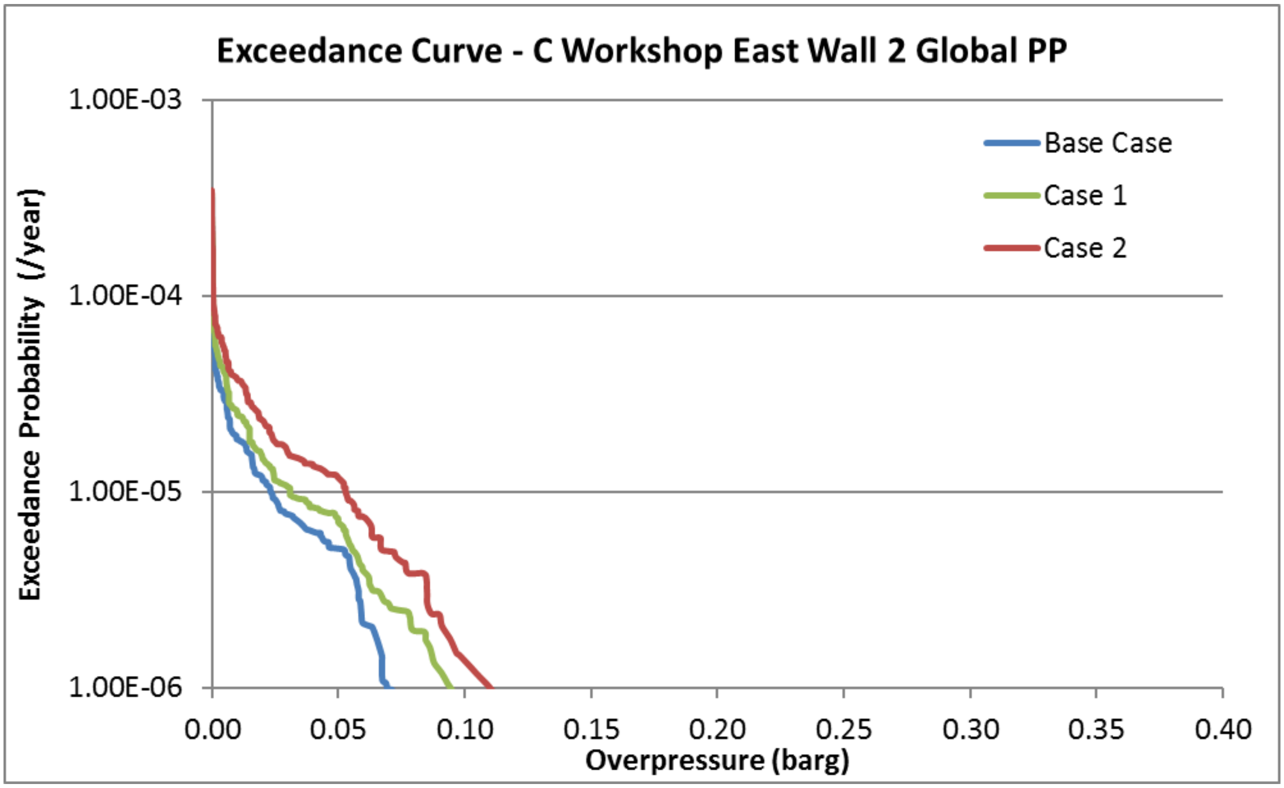

Exceedance Curve - Stock and Waste Yard North Wall Global PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2

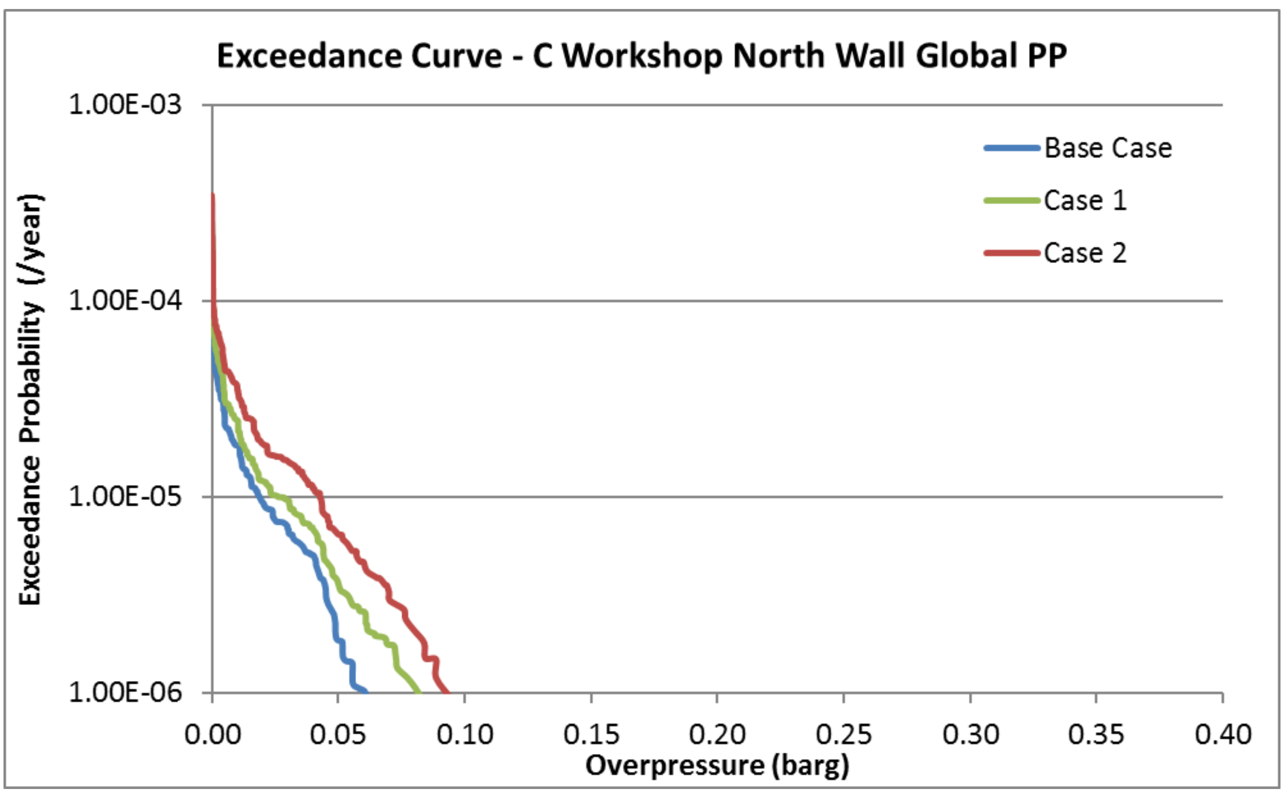

Exceedance Curve - Stock and Waste Yard West Wall Global PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2

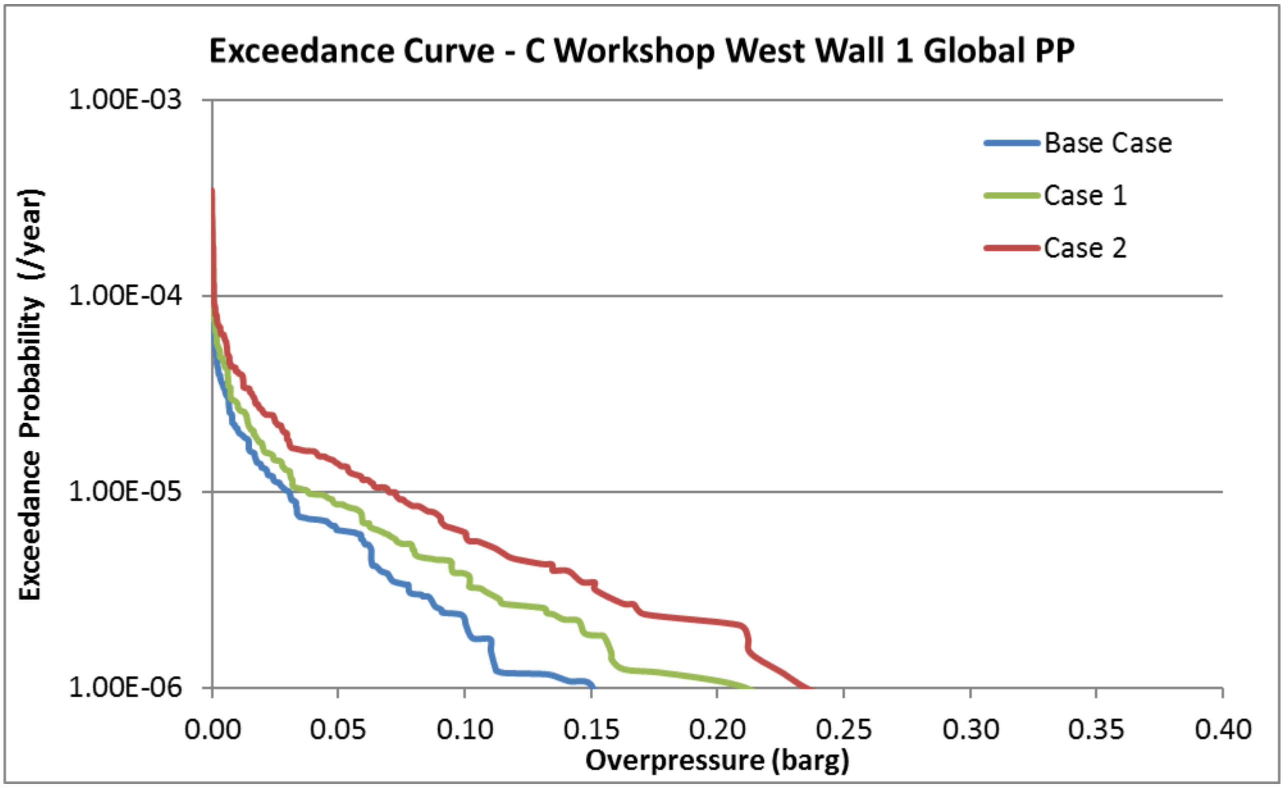

Exceedance Curve - Stock and Waste Yard Roof Global PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2

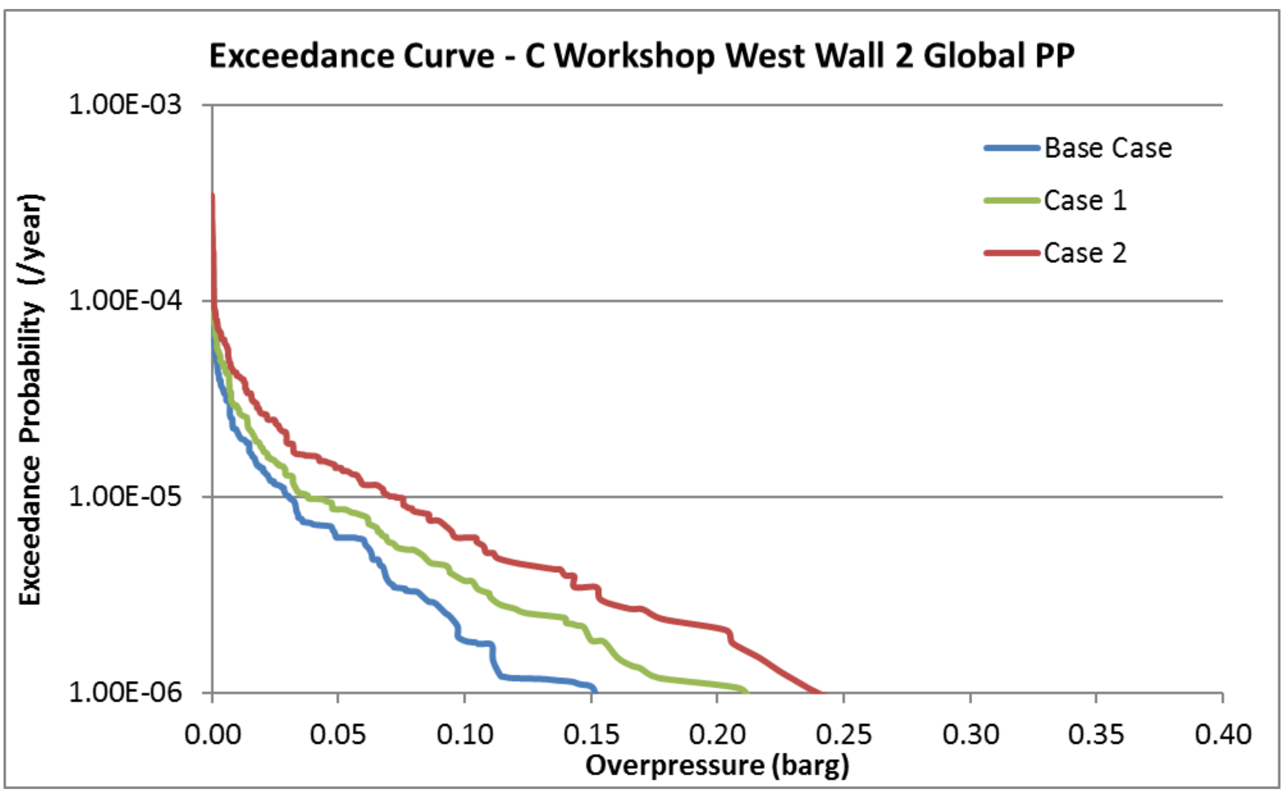

Exceedance Curve - C Workshop South Wall Global PP
Exceedance Probability (/year)
1.00E-03
1.00E-04
1.00E-05
1.00E-06
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2

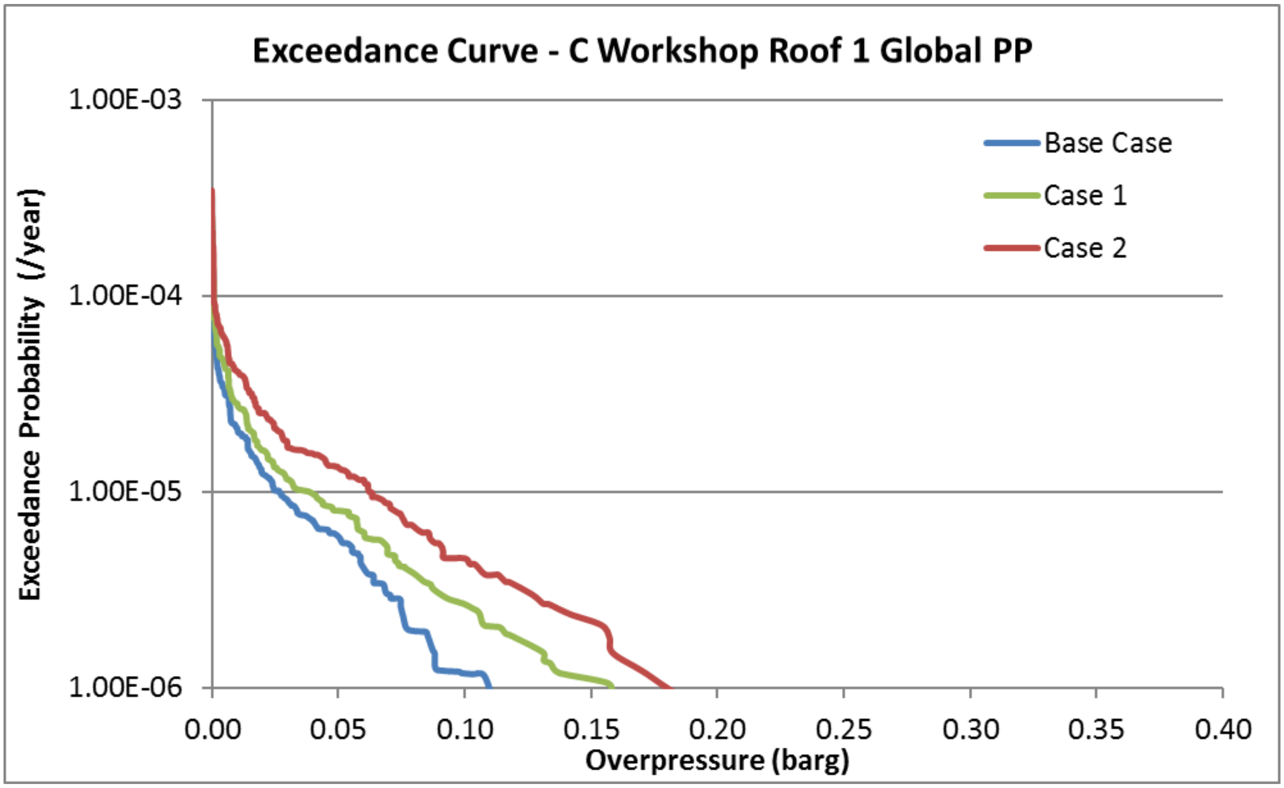

Exceedance Curve - C Workshop East Wall 1 Global PP
Exceedance Probability (/year)
1.00E-03
1.00E-04
1.00E-05
1.00E-06
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2

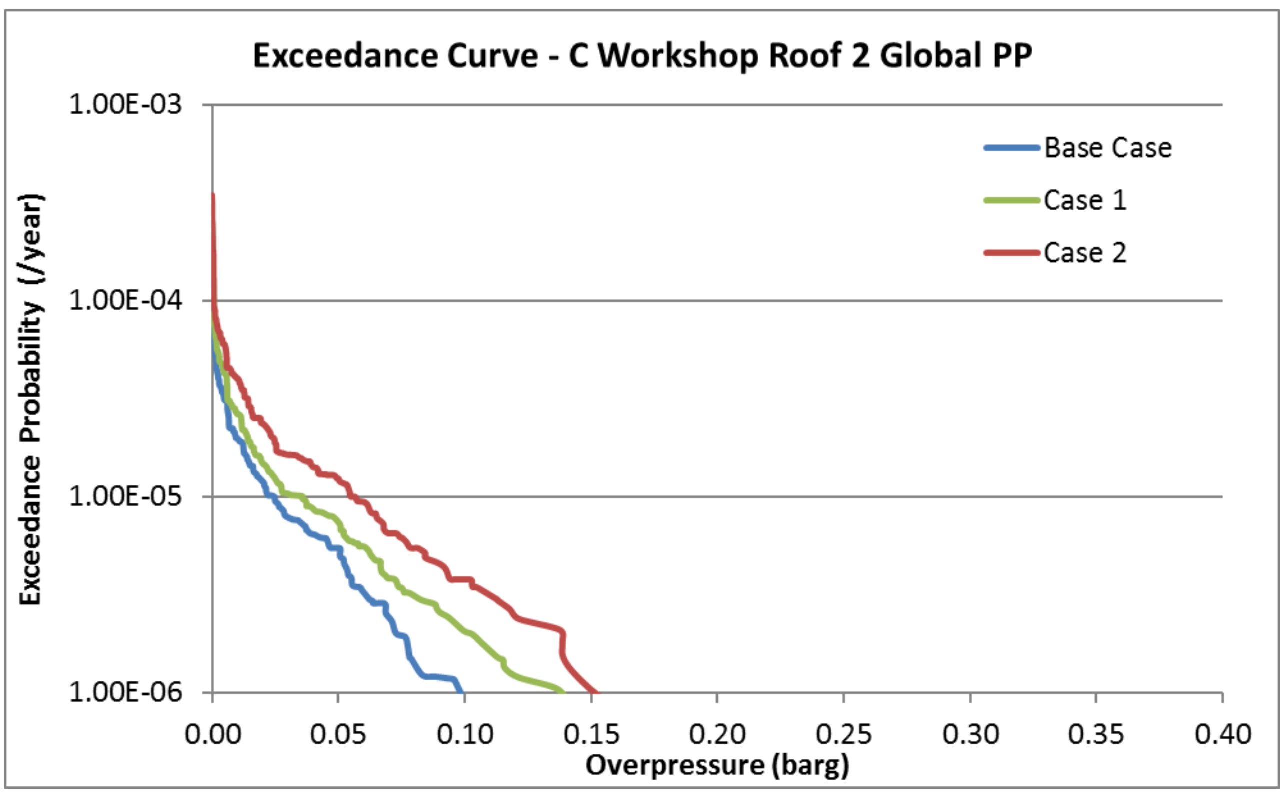

Exceedance Curve - C Workshop East Wall 2 Global PP
Exceedance Probability (/year)
1.00E-03
1.00E-04
1.00E-05
1.00E-06
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2

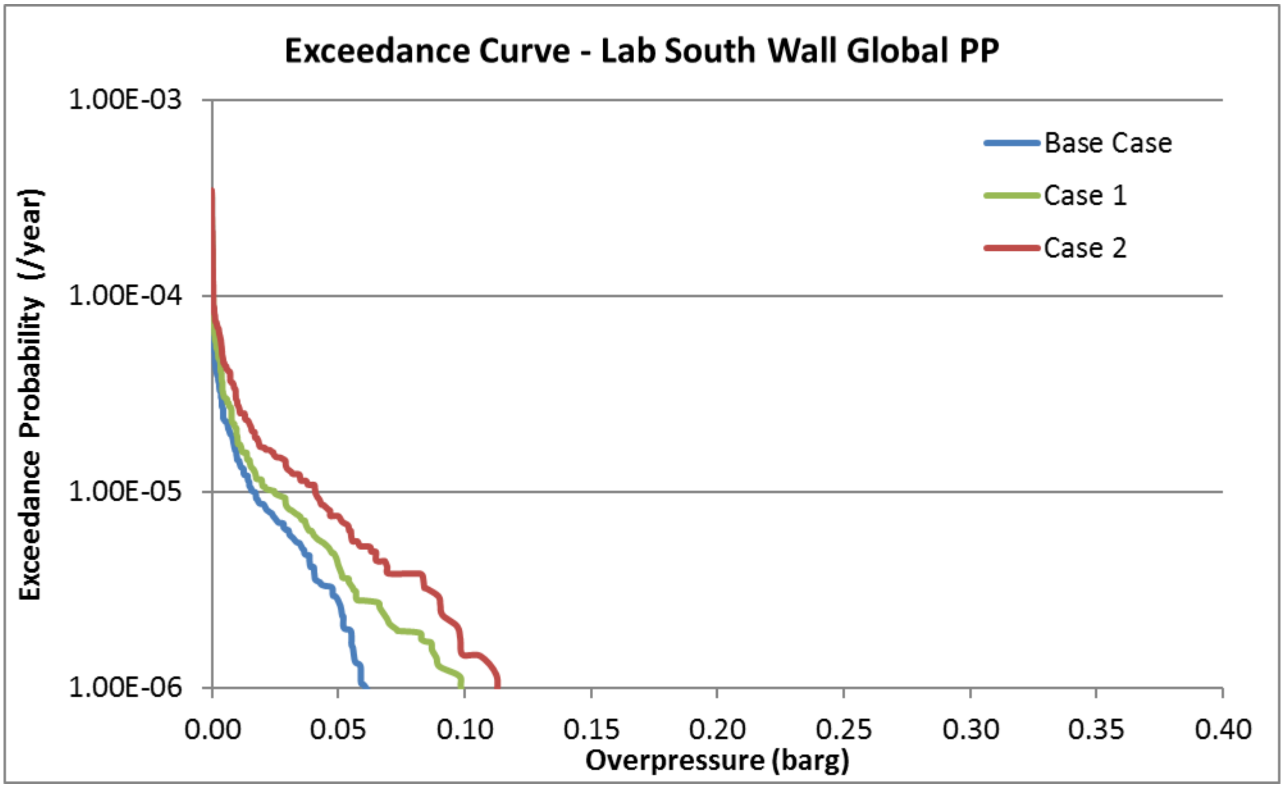

Exceedance Curve - C Workshop North Wall Global PP
Exceedance Probability (/year)
1.00E-03
1.00E-04
1.00E-05
1.00E-06
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2

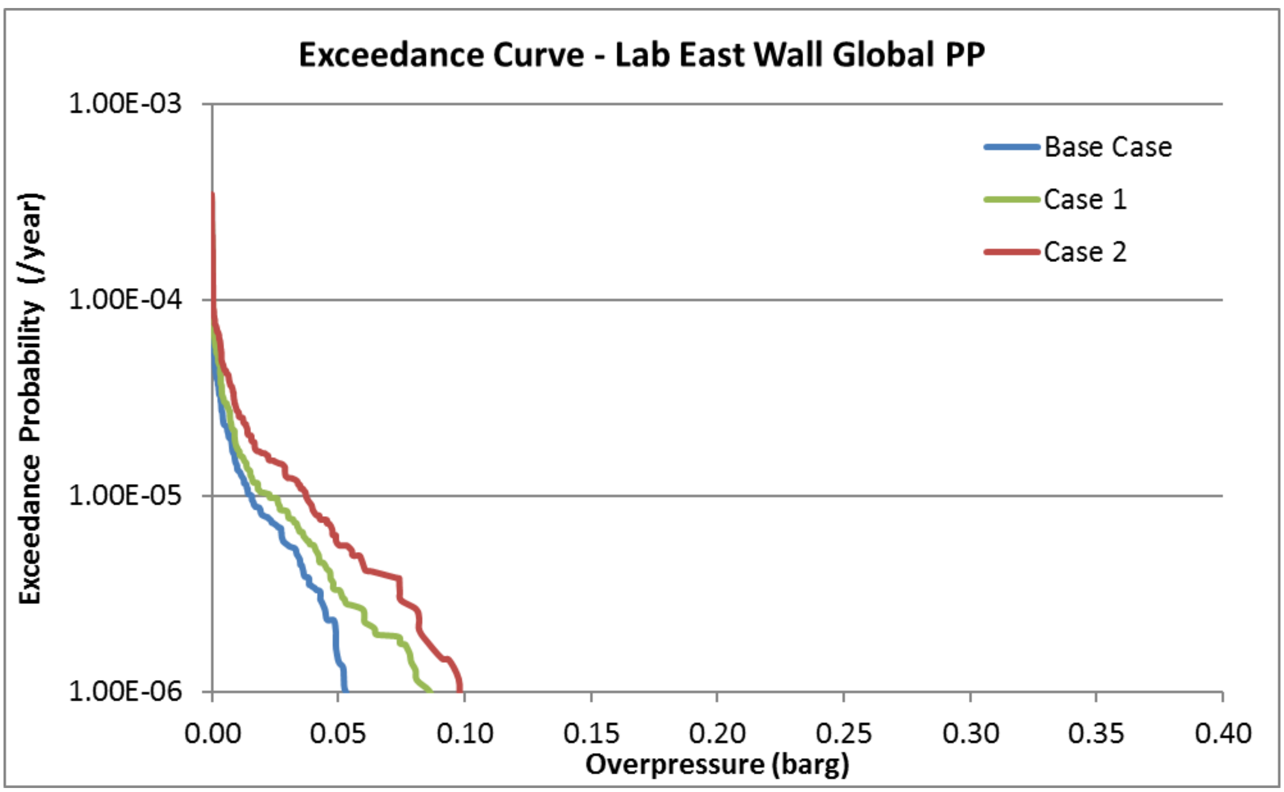

Exceedance Curve - C Workshop West Wall 1 Global PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2

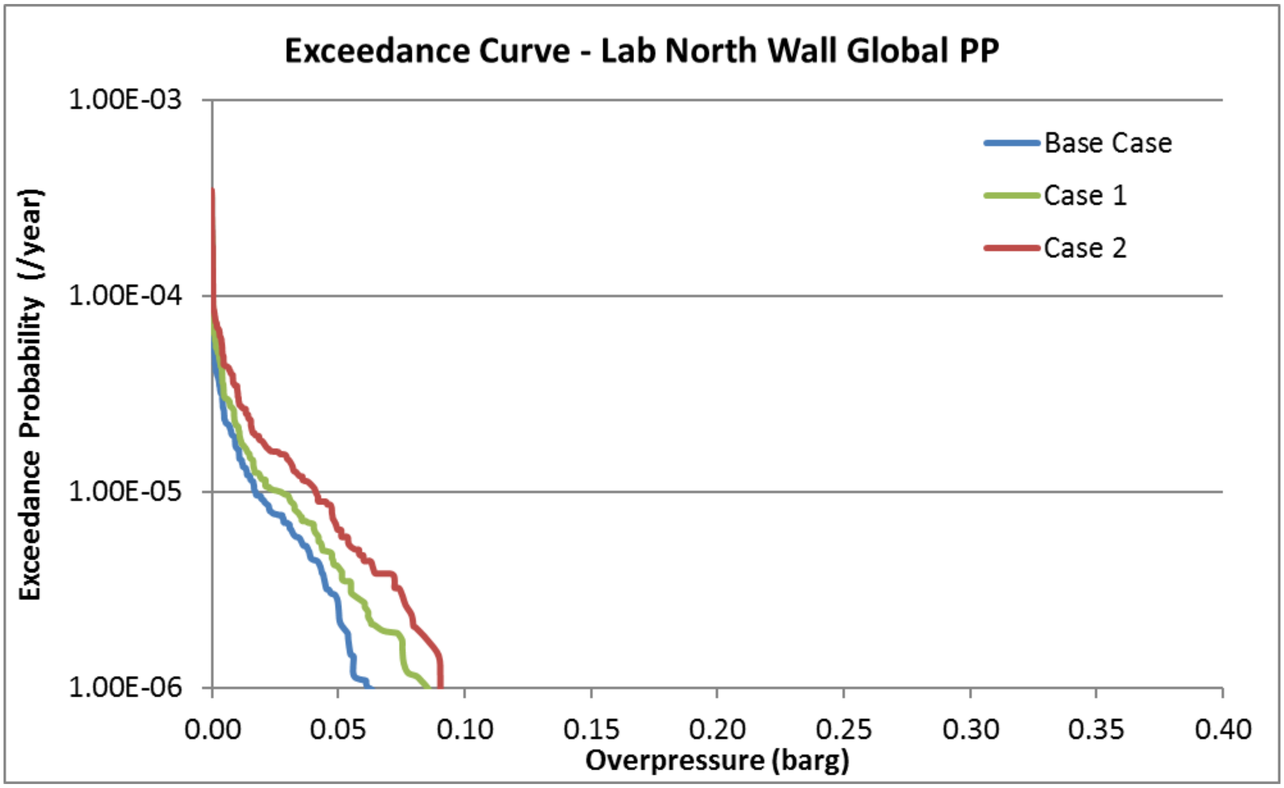

Exceedance Curve - C Workshop West Wall 2 Global PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2

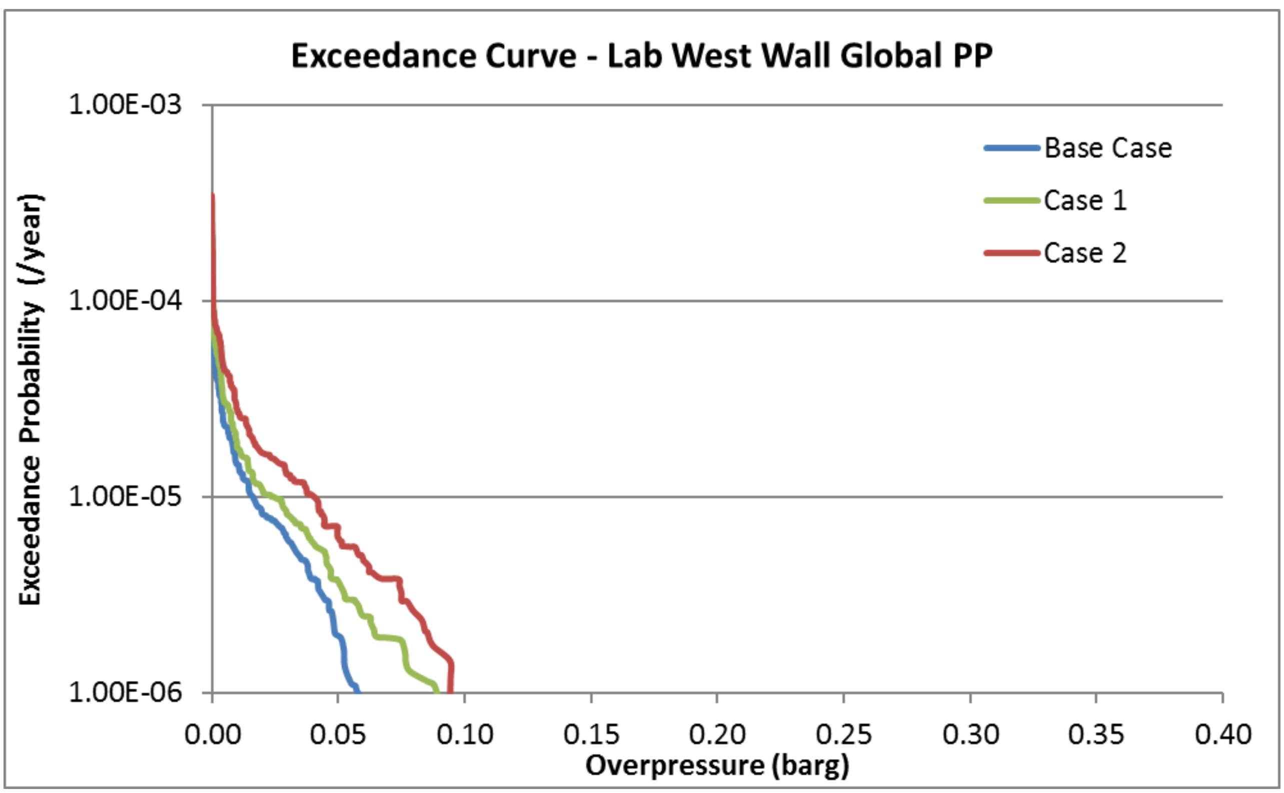

Exceedance Curve - C Workshop Roof 1 Global PP
Exceedance Probability (/year)
1.00E-03
1.00E-04
1.00E-05
1.00E-06
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2

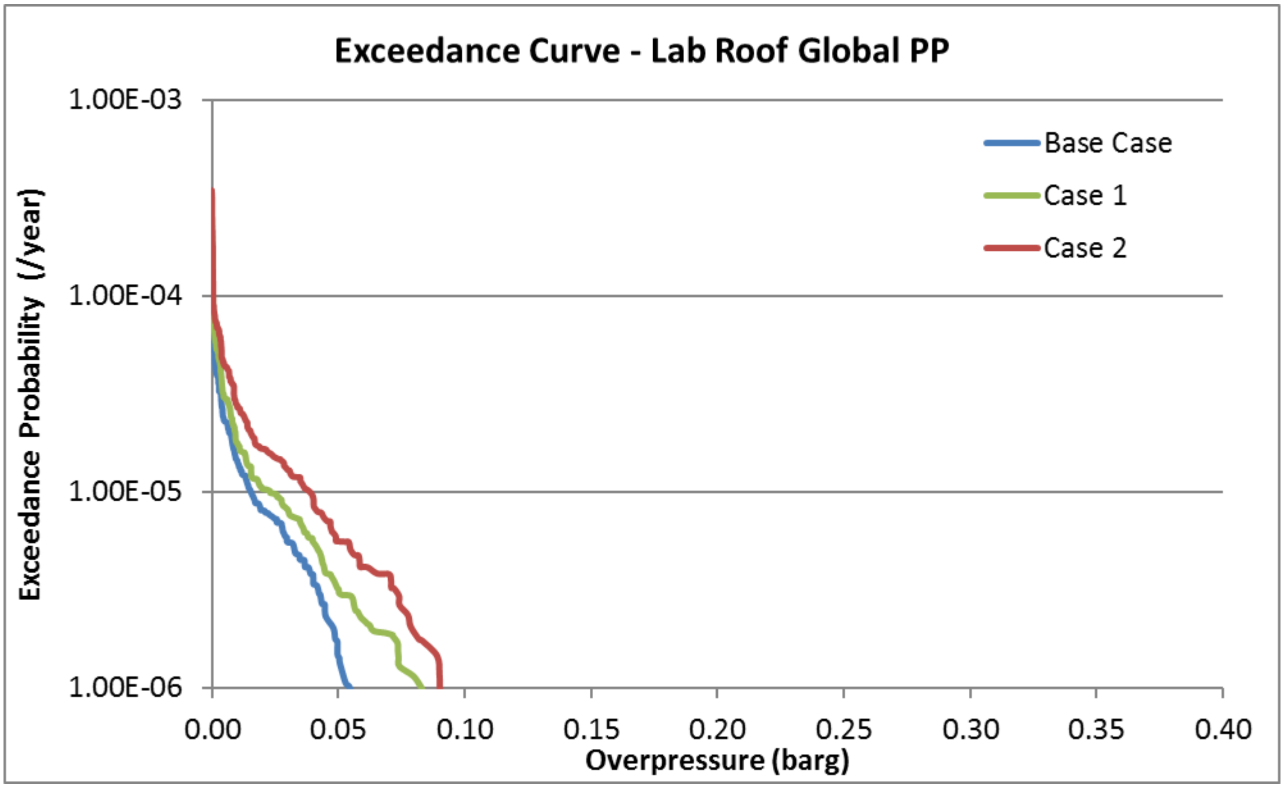

Exceedance Curve - C Workshop Roof 2 Global PP
Exceedance Probability (/year)
1.00E-03
1.00E-04
1.00E-05
1.00E-06
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2

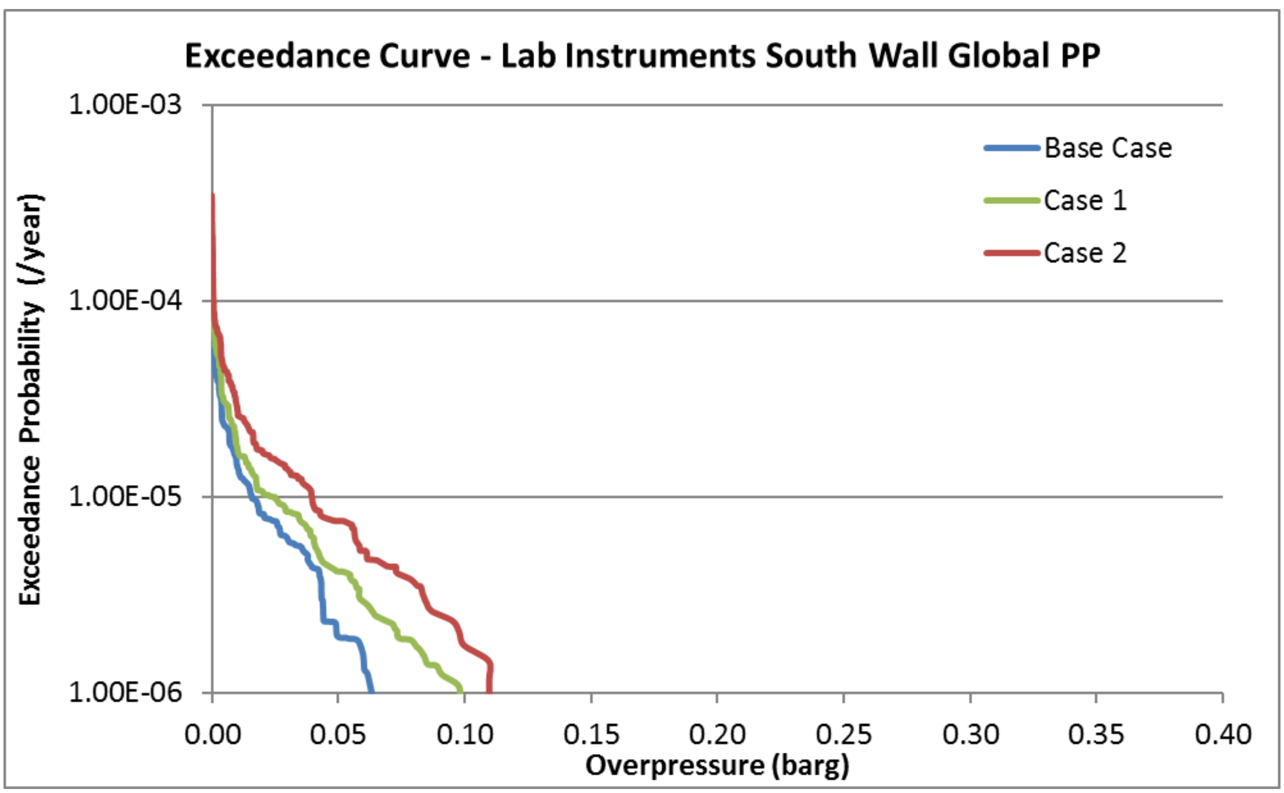

Exceedance Curve - Lab South Wall Global PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2

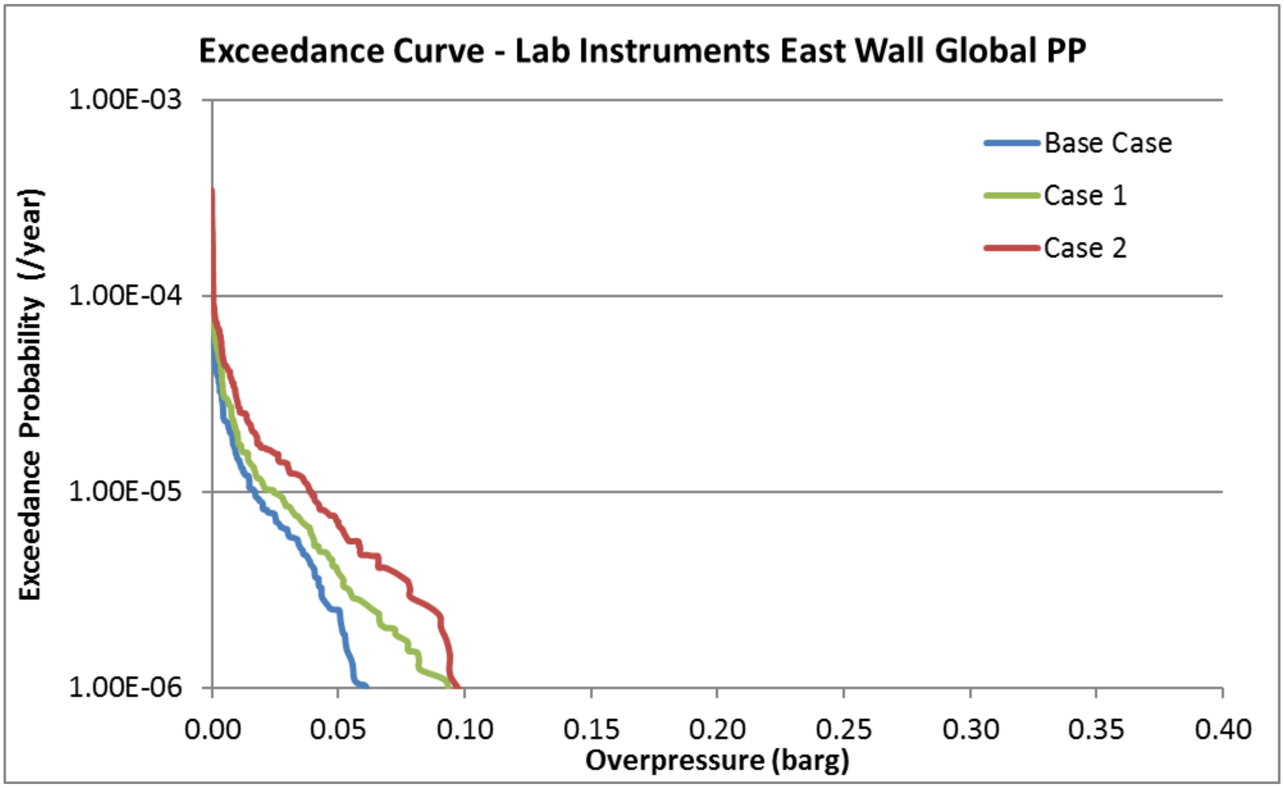

Exceedance Curve - Lab East Wall Global PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2


Exceedance Curve - Lab North Wall Global PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2

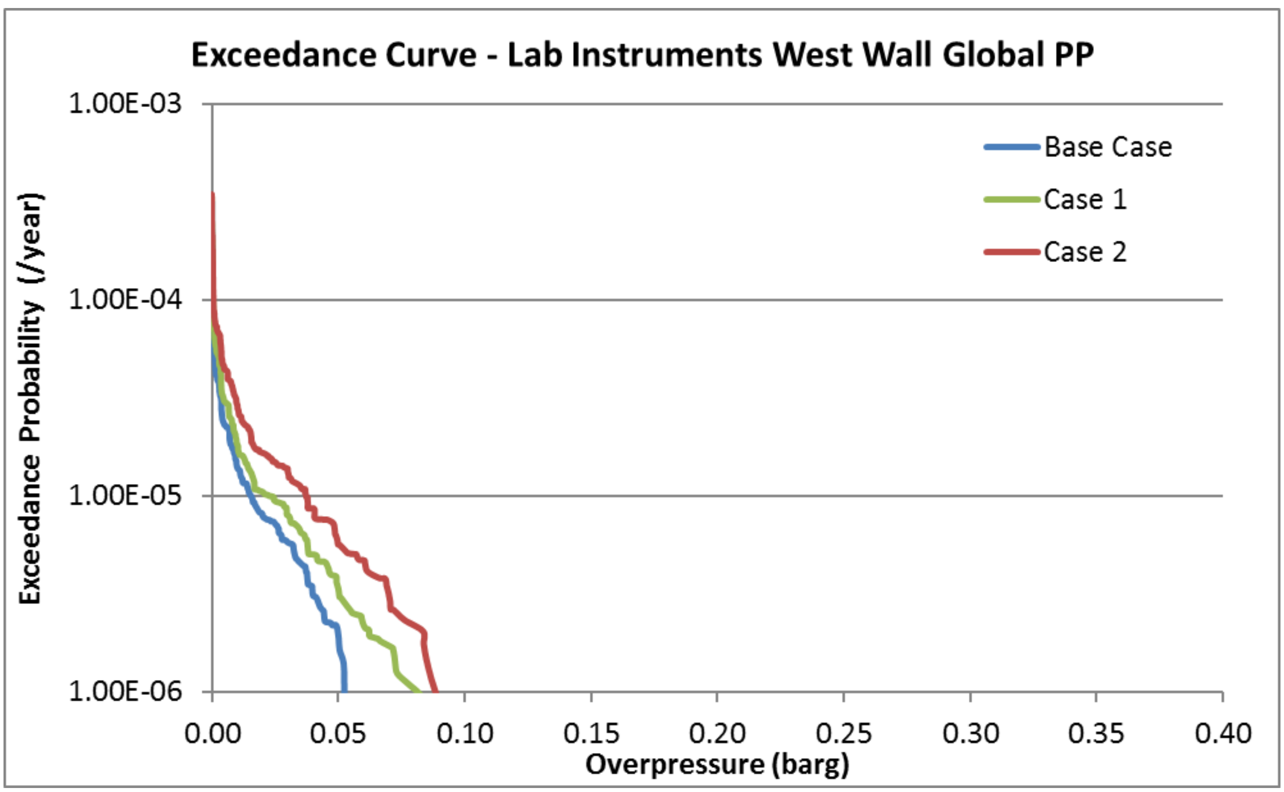

Exceedance Curve - Lab West Wall Global PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2


Exceedance Curve - Lab Roof Global PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2

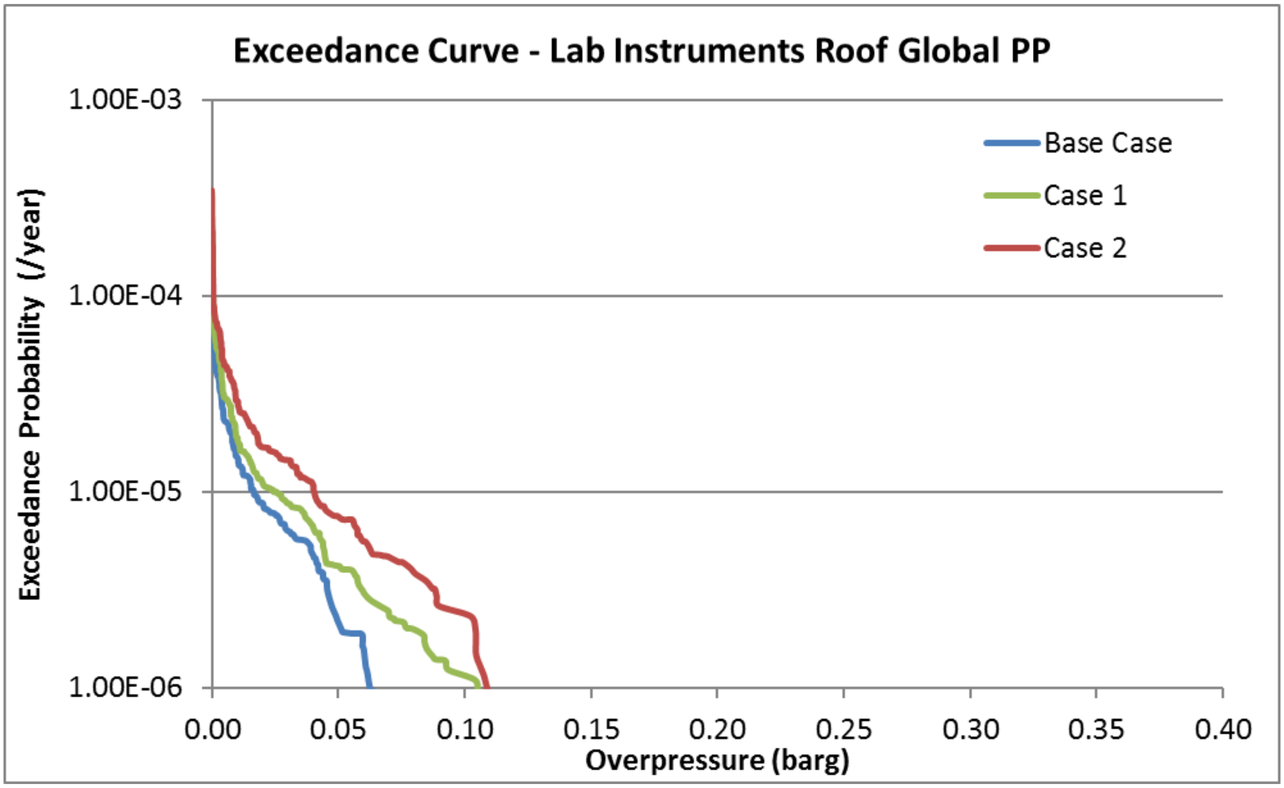

Exceedance Curve - Lab Instruments South Wall Global PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2

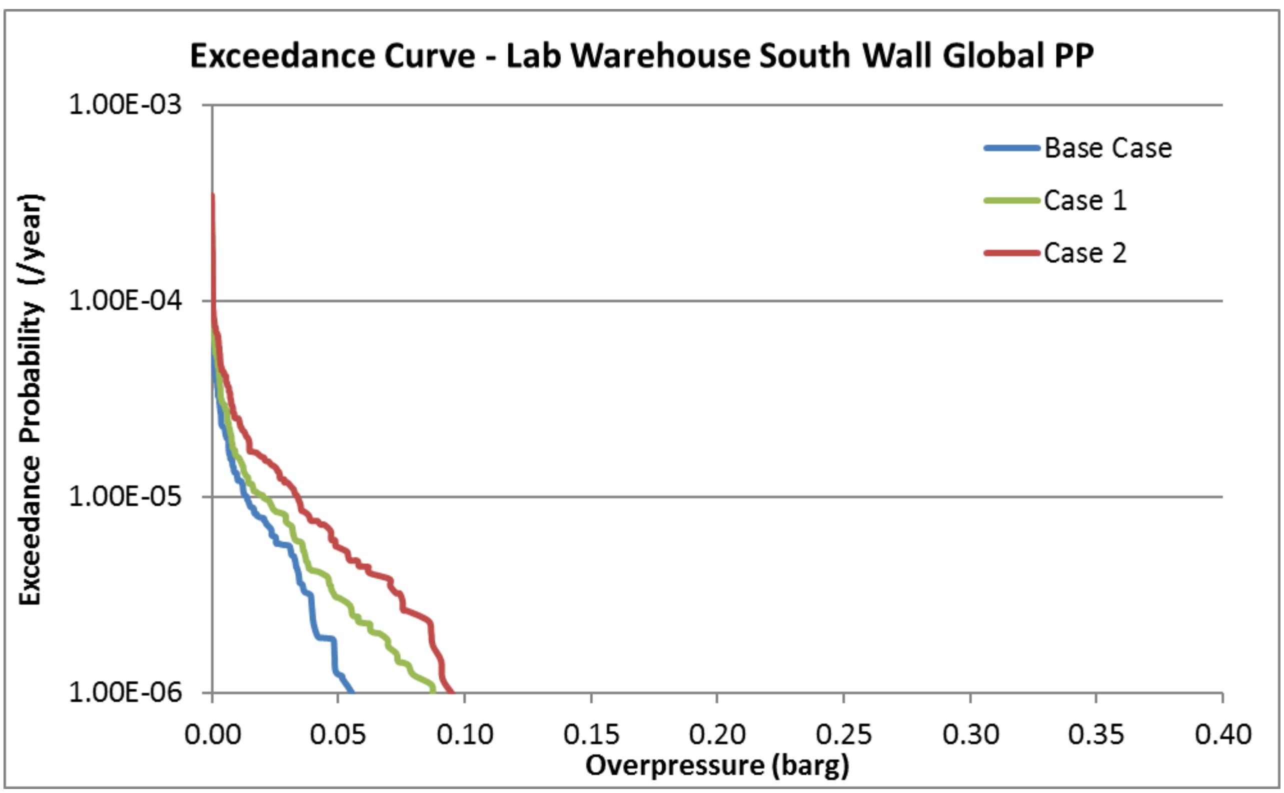


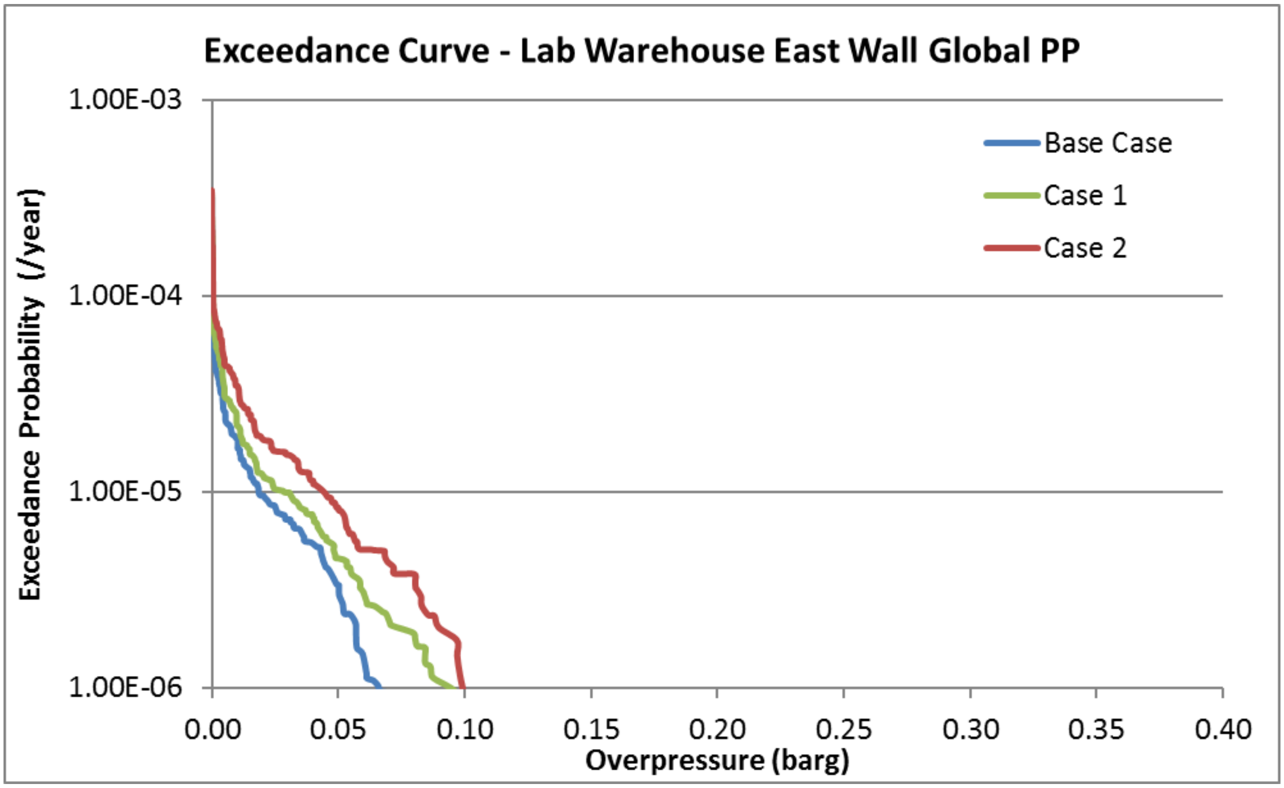
Exceedance Curve - Lab Instruments East Wall Global PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
Base Case
Case 1
Case 2
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)



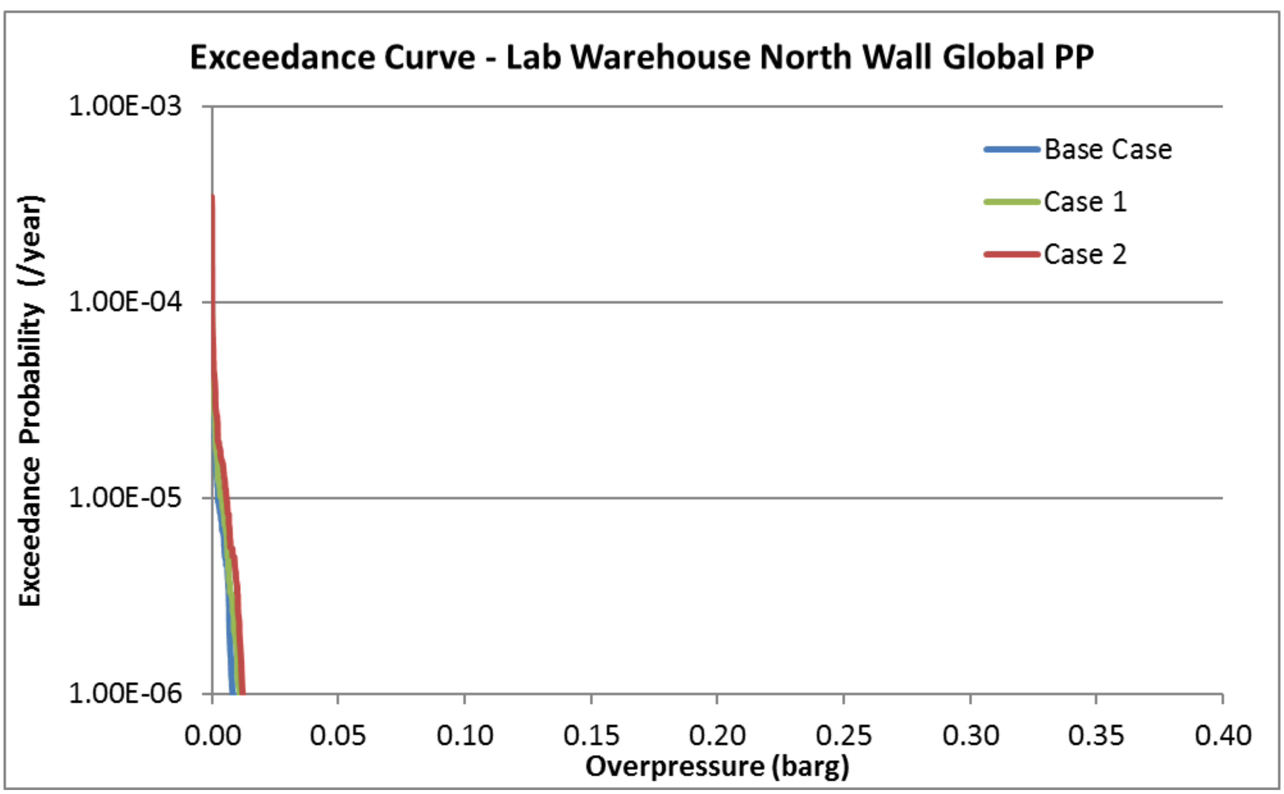
Exceedance Curve - Lab Instruments West Wall Global PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
Base Case
Case 1
Case 2
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)


Exceedance Curve - Lab Instruments Roof Global PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
Base Case
Case 1
Case 2
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)

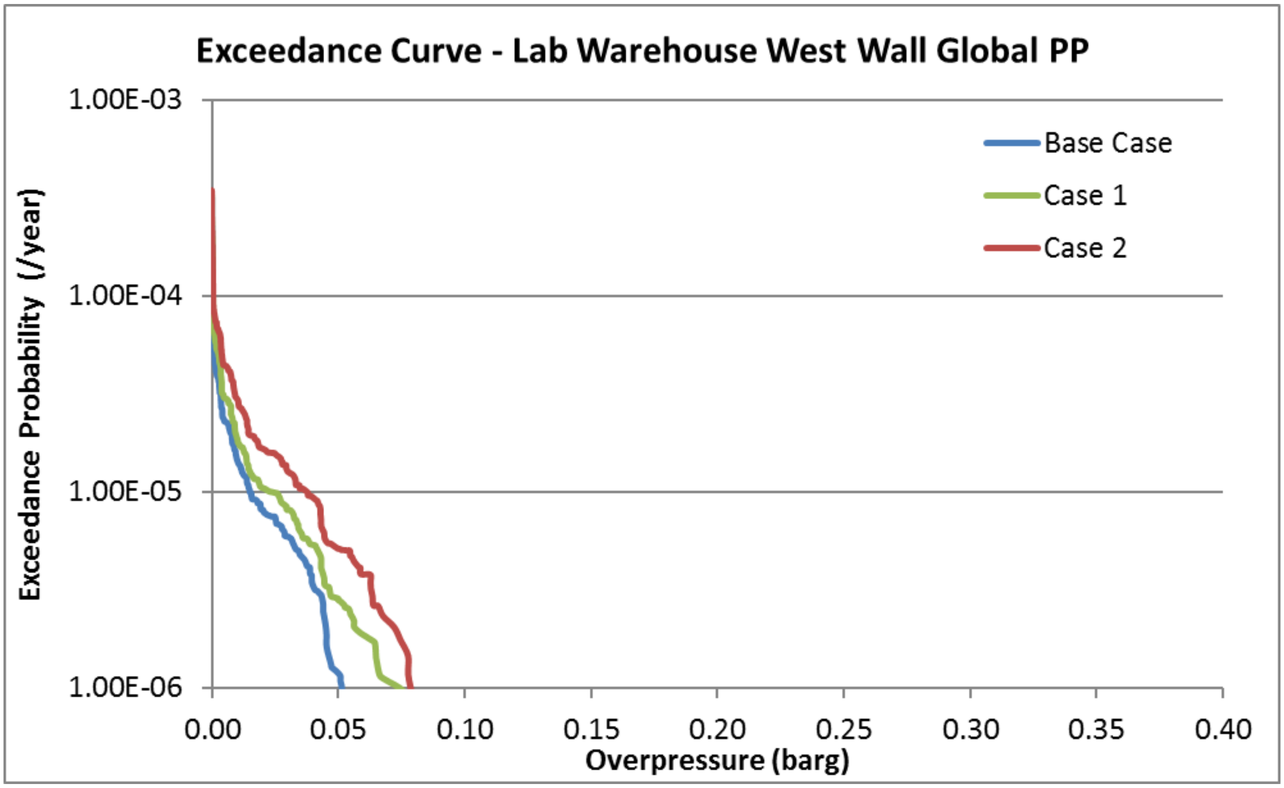

Exceedance Curve - Lab Warehouse South Wall Global PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
Base Case
Case 1
Case 2
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)

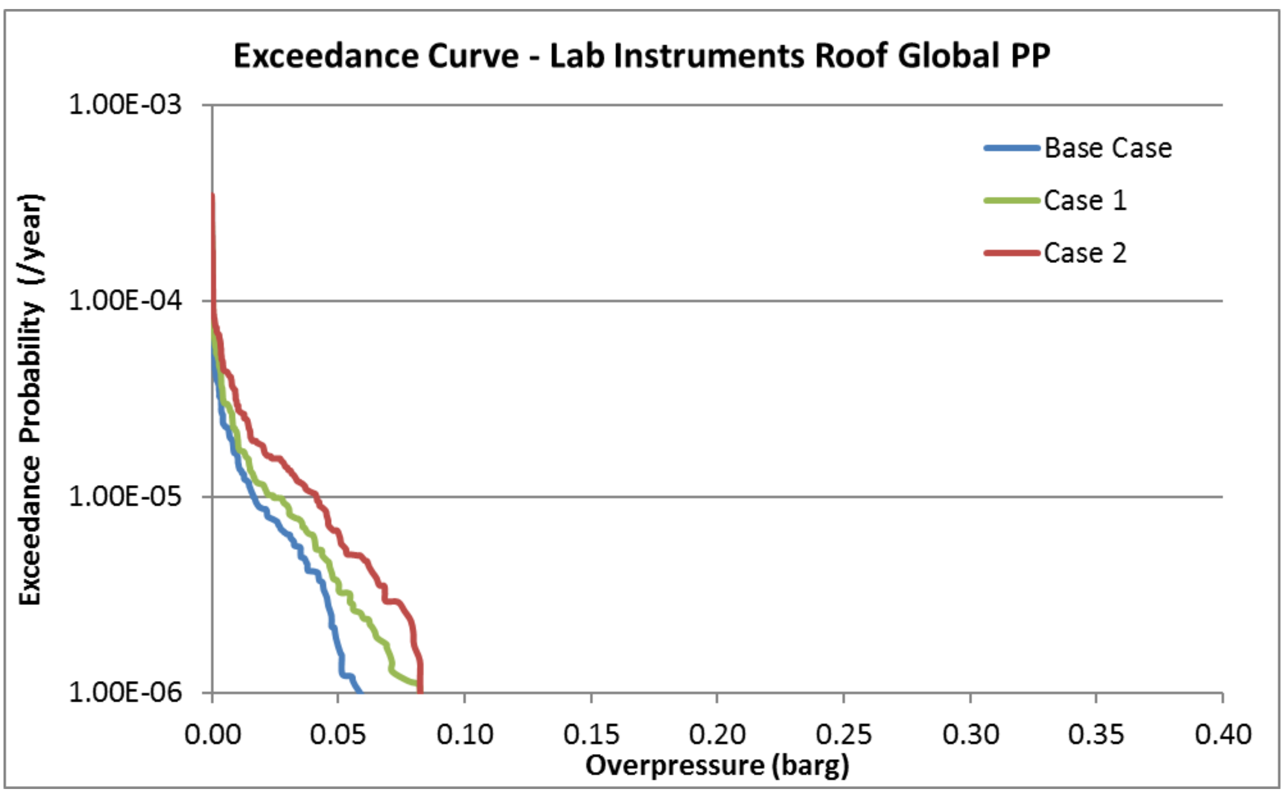


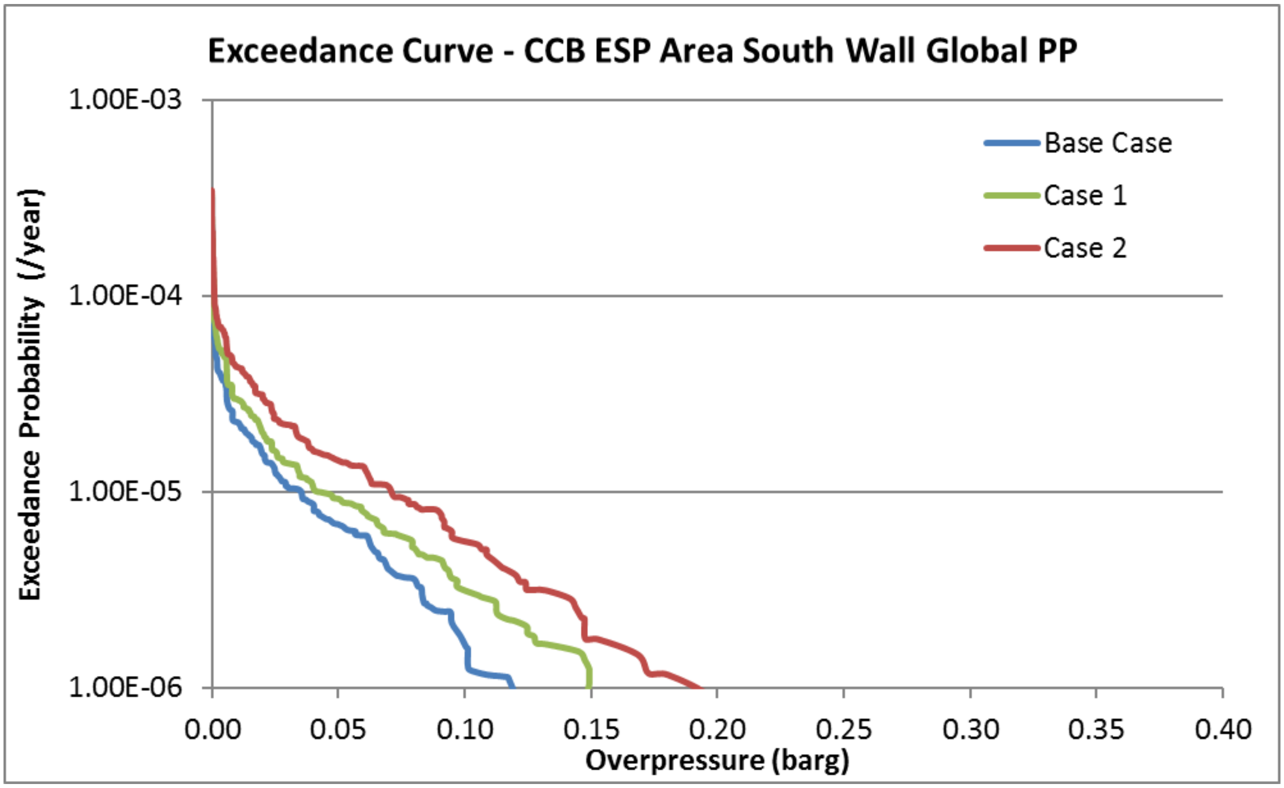
Exceedance Curve - Lab Warehouse East Wall Global PP
Exceedance Probability (/year)
1.00E-03
1.00E-04
1.00E-05
1.00E-06
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2

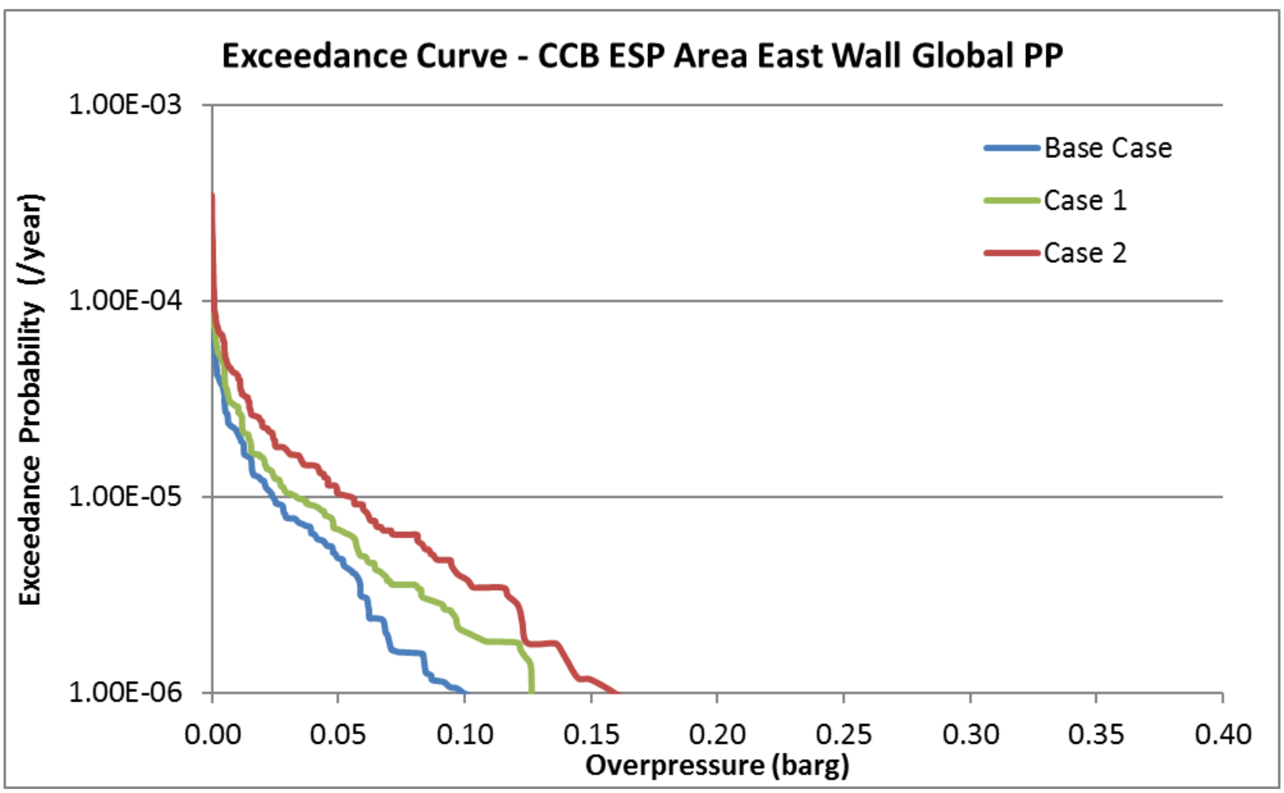


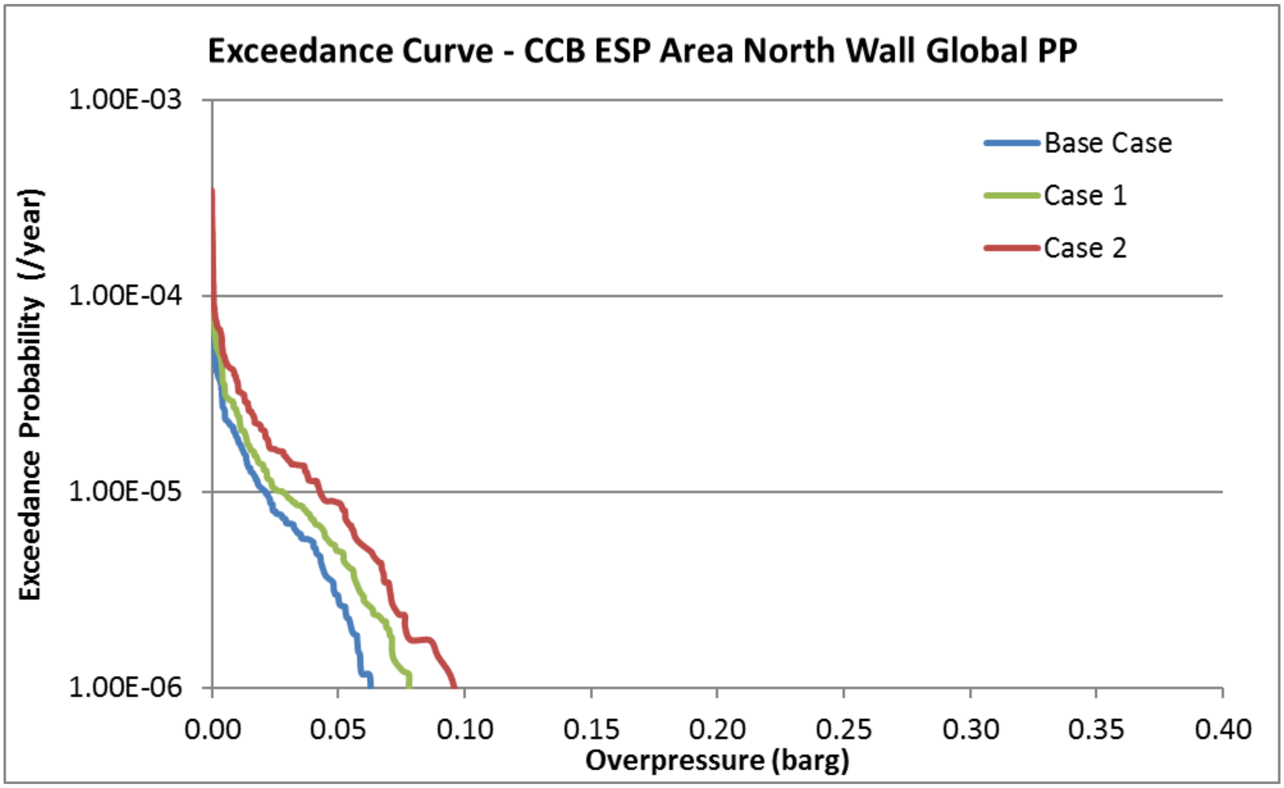
Exceedance Curve - Lab Warehouse North Wall Global PP
Exceedance Probability (/year)
1.00E-03
1.00E-04
1.00E-05
1.00E-06
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2


Exceedance Curve - Lab Warehouse West Wall Global PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2

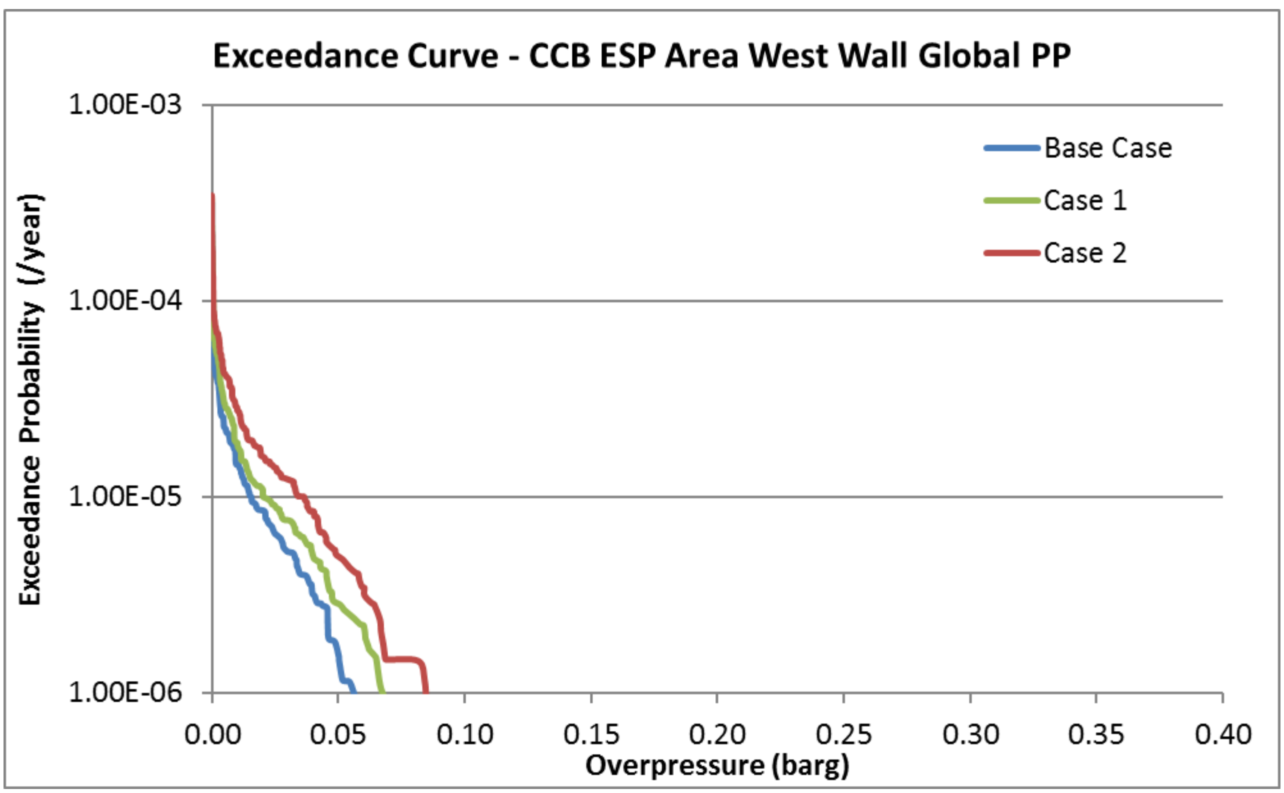

Exceedance Curve - Lab Instruments Roof Global PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2


Exceedance Curve - CCB ESP Area South Wall Global PP
Exceedance Probability (/year)
1.00E-03
1.00E-04
1.00E-05
1.00E-06
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2

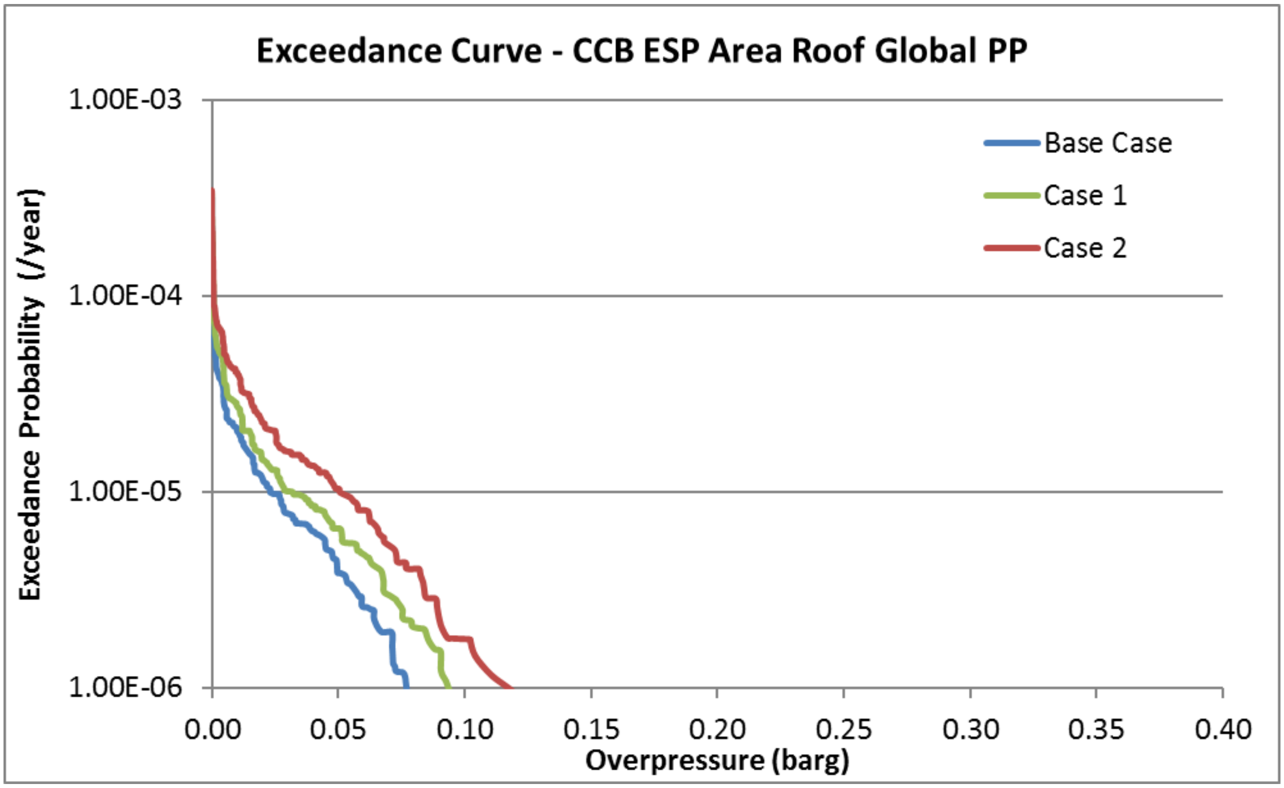

Exceedance Curve - CCB ESP Area East Wall Global PP
Exceedance Probability (/year)
1.00E-03
1.00E-04
1.00E-05
1.00E-06
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2



Exceedance Curve - CCB ESP Area North Wall Global PP
Exceedance Probability (/year)
1.00E-03
1.00E-04
1.00E-05
1.00E-06
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2

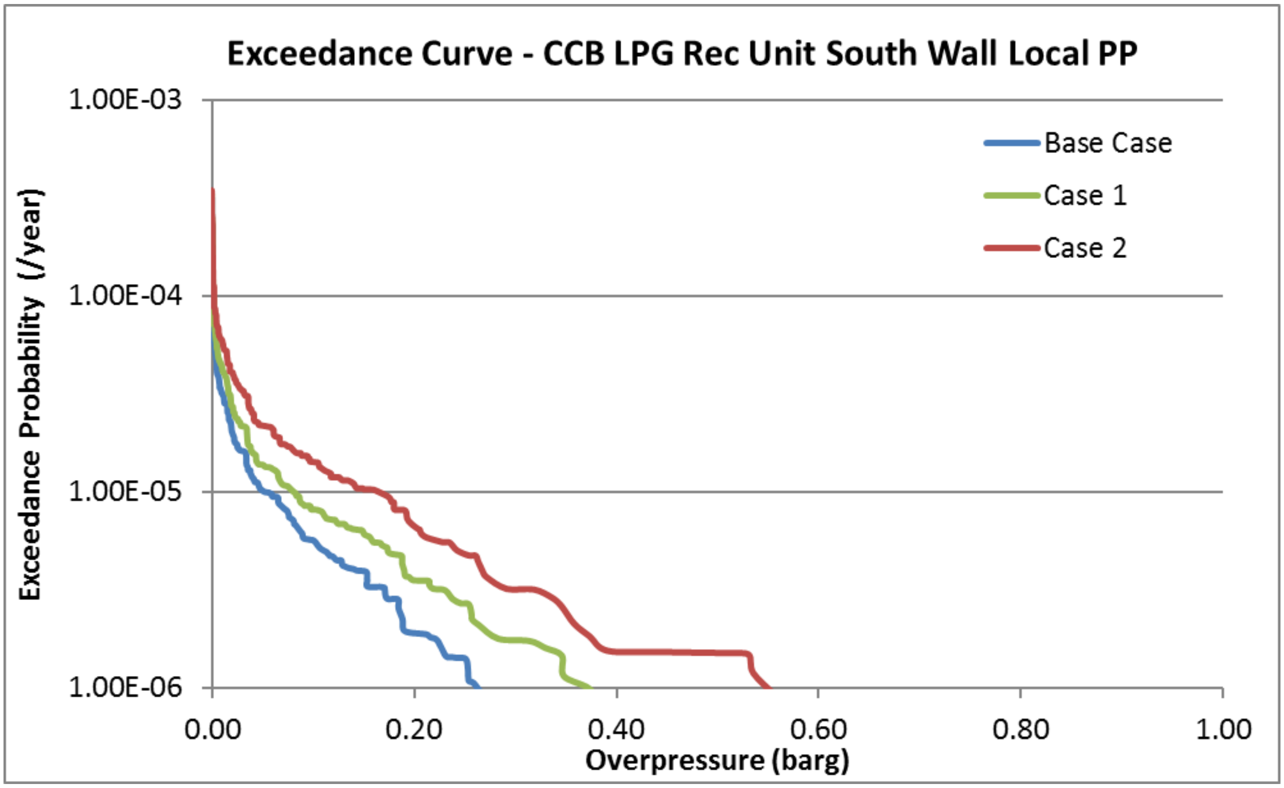


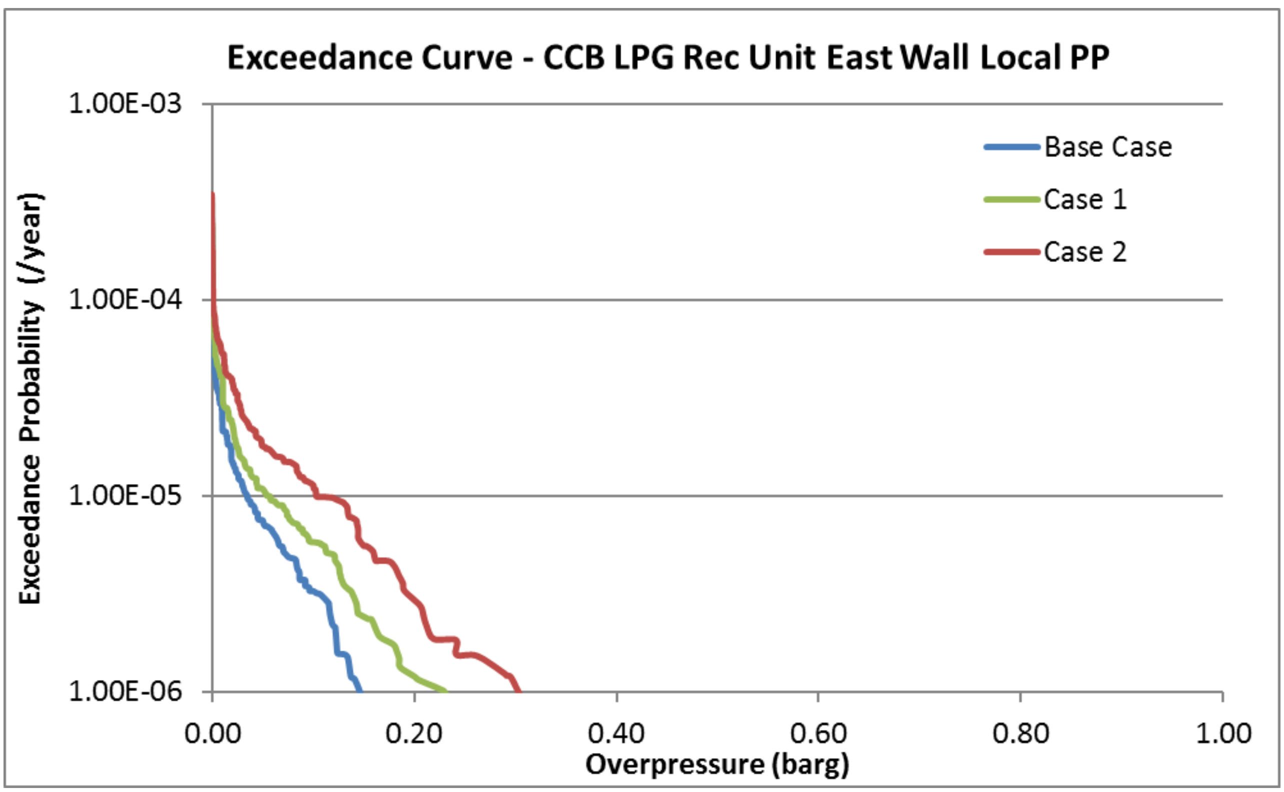
Exceedance Curve - CCB ESP Area West Wall Global PP
Exceedance Probability (/year)
1.00E-03
1.00E-04
1.00E-05
1.00E-06
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2

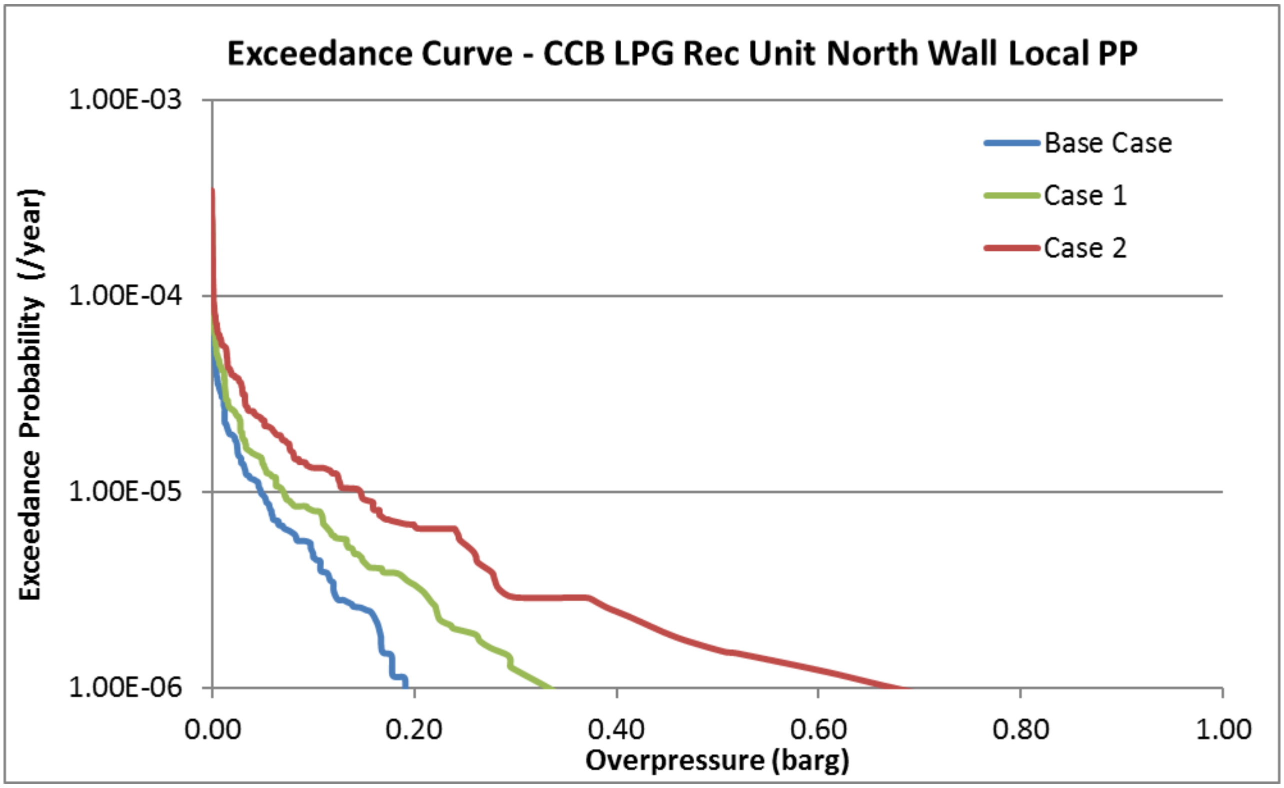


Exceedance Curve - CCB ESP Area Roof Global PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
Base Case
Case 1
Case 2
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)

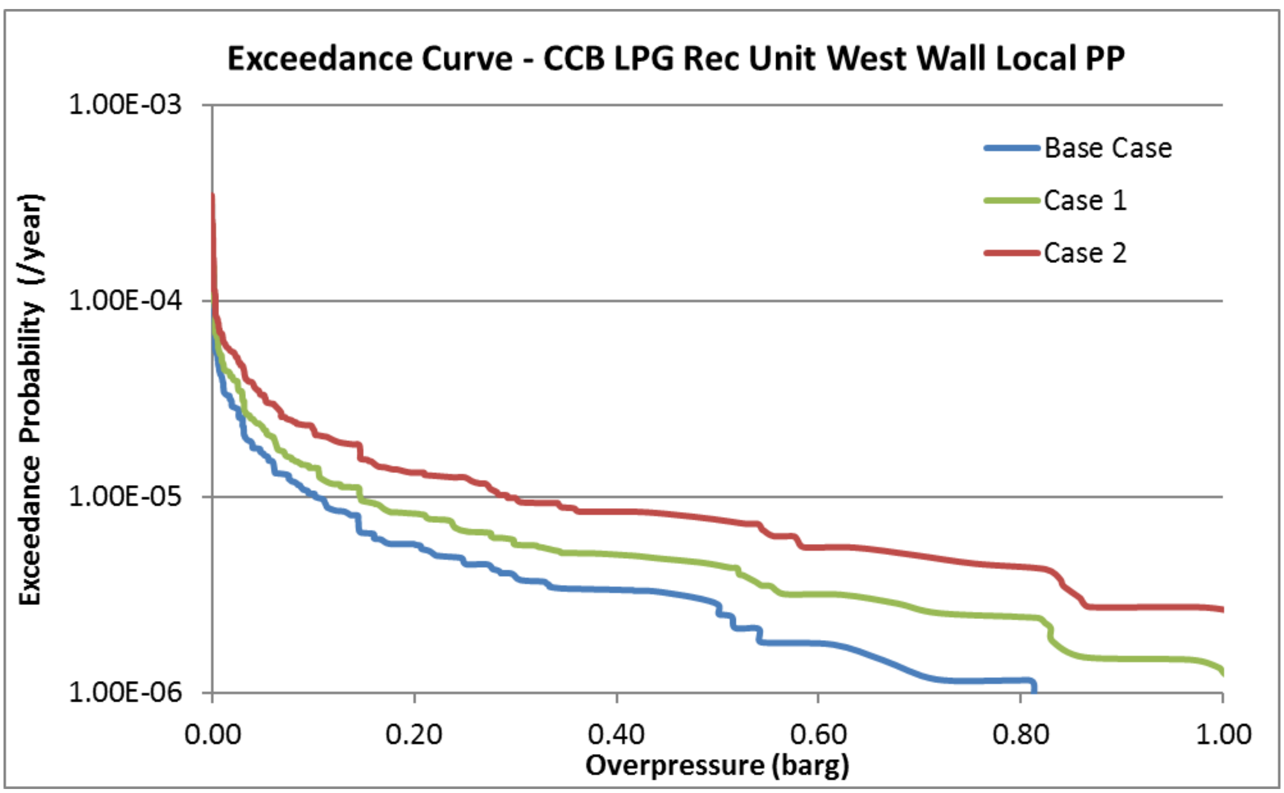
Local Pressure Panels



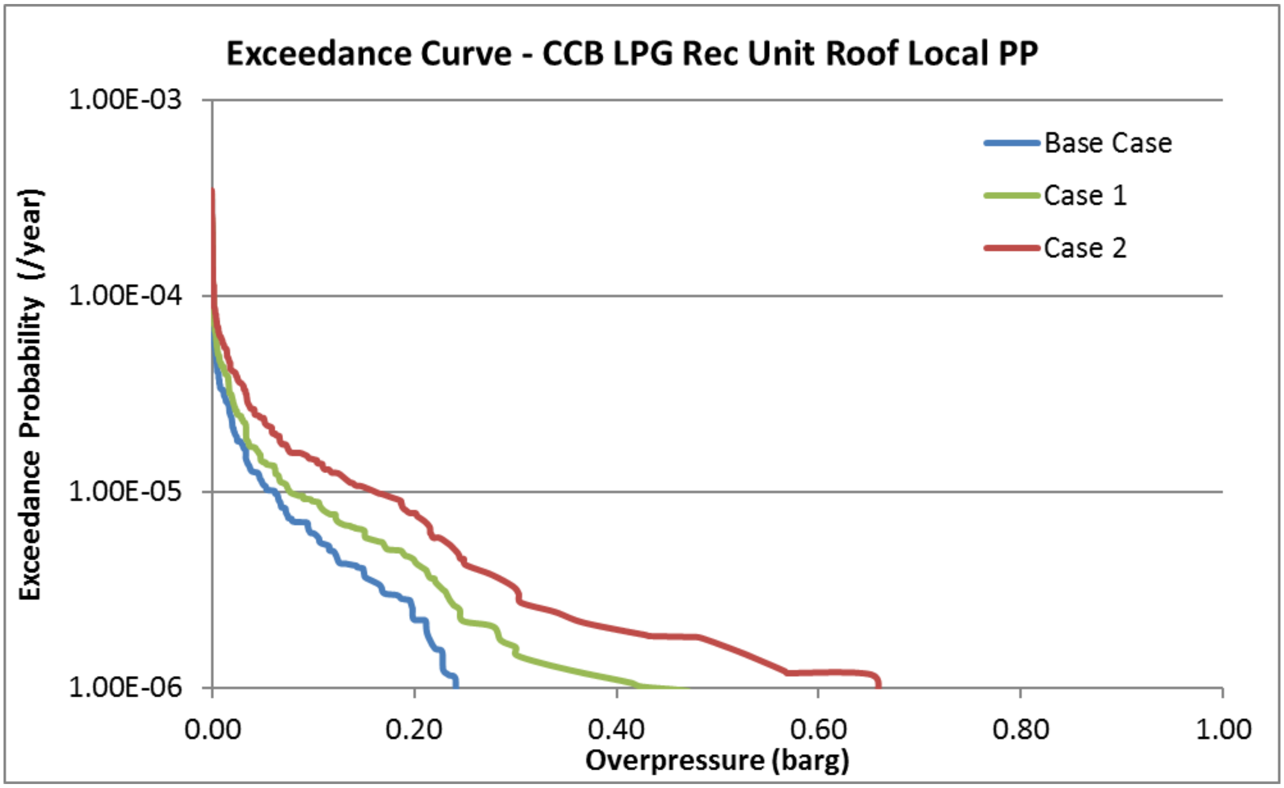


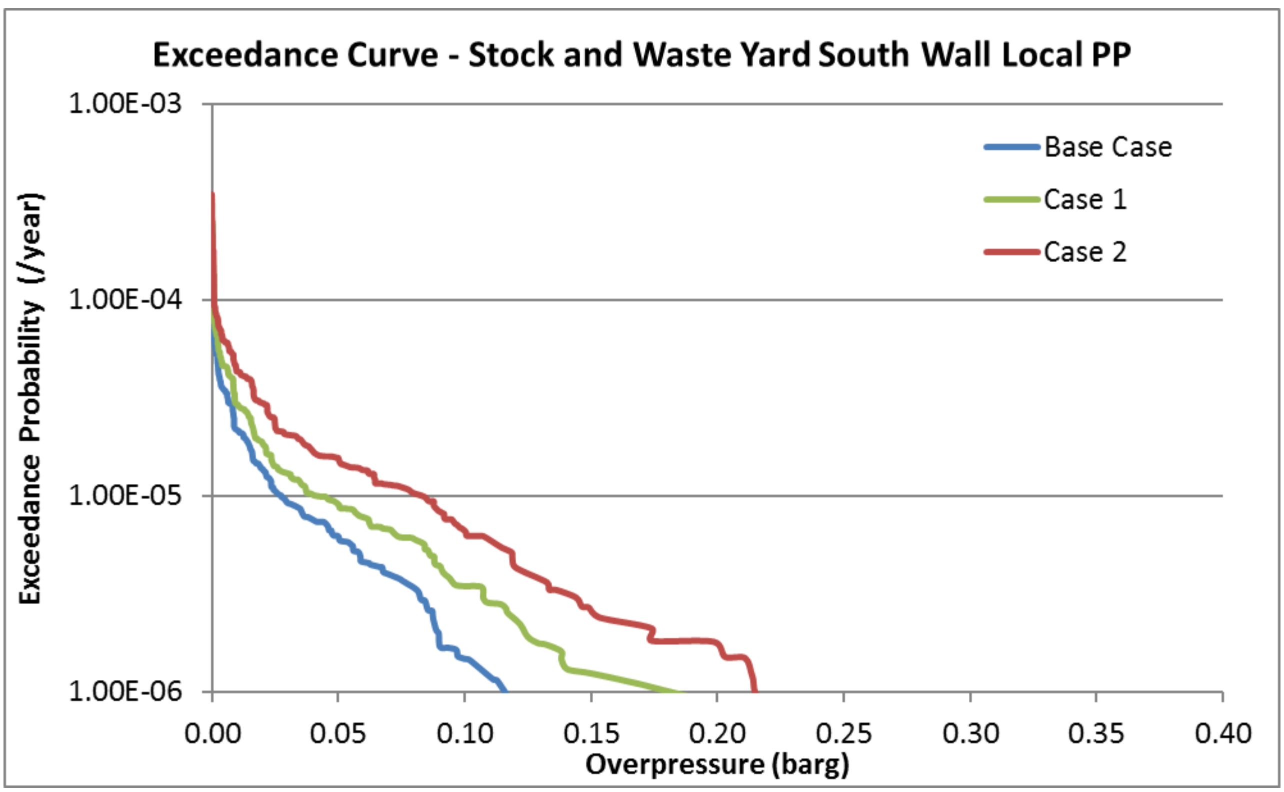


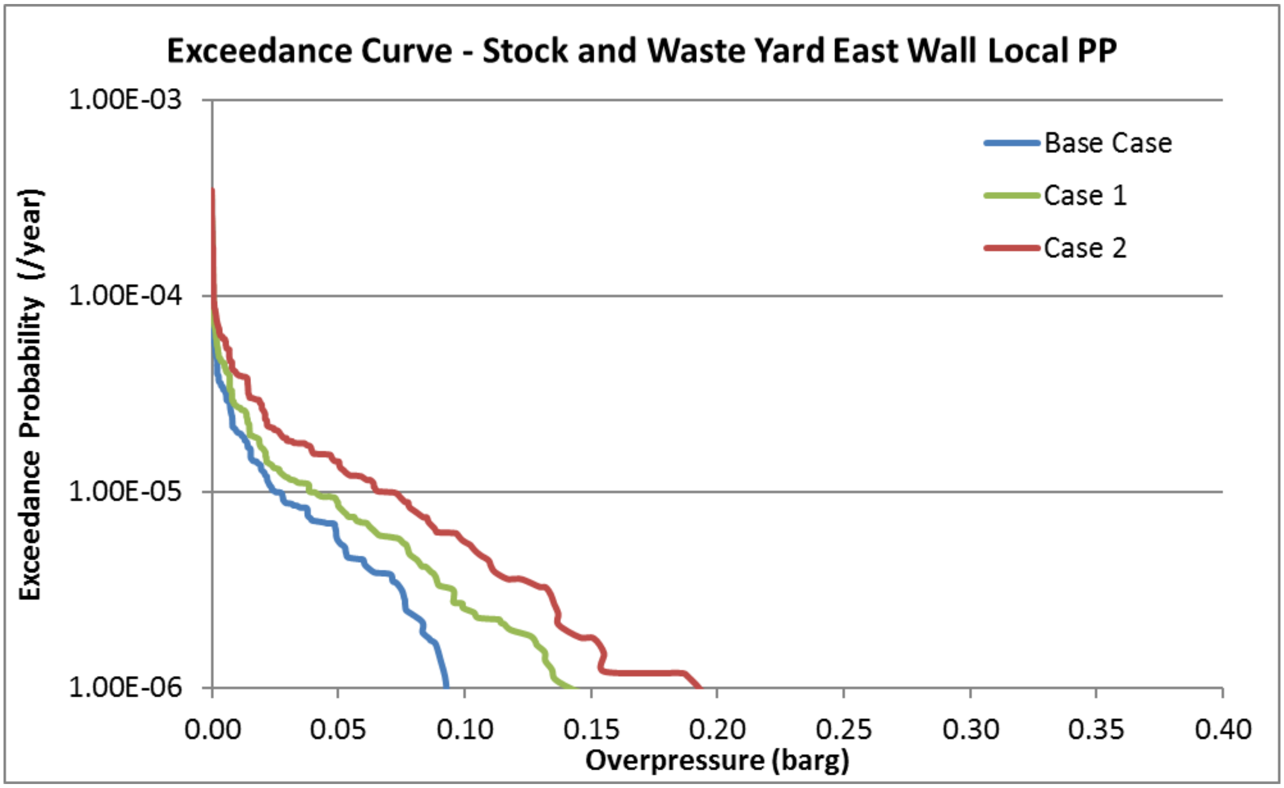
Exceedance Curve - CCB LPG Rec Unit North Wall Local PP
Base Case
Case 1
Case 2
Exceedance Probability (/year)
1.00E-03
1.00E-04
1.00E-05
1.00E-06
0.00
0.20
0.40
0.60
0.80
1.00
Overpressure (barg)

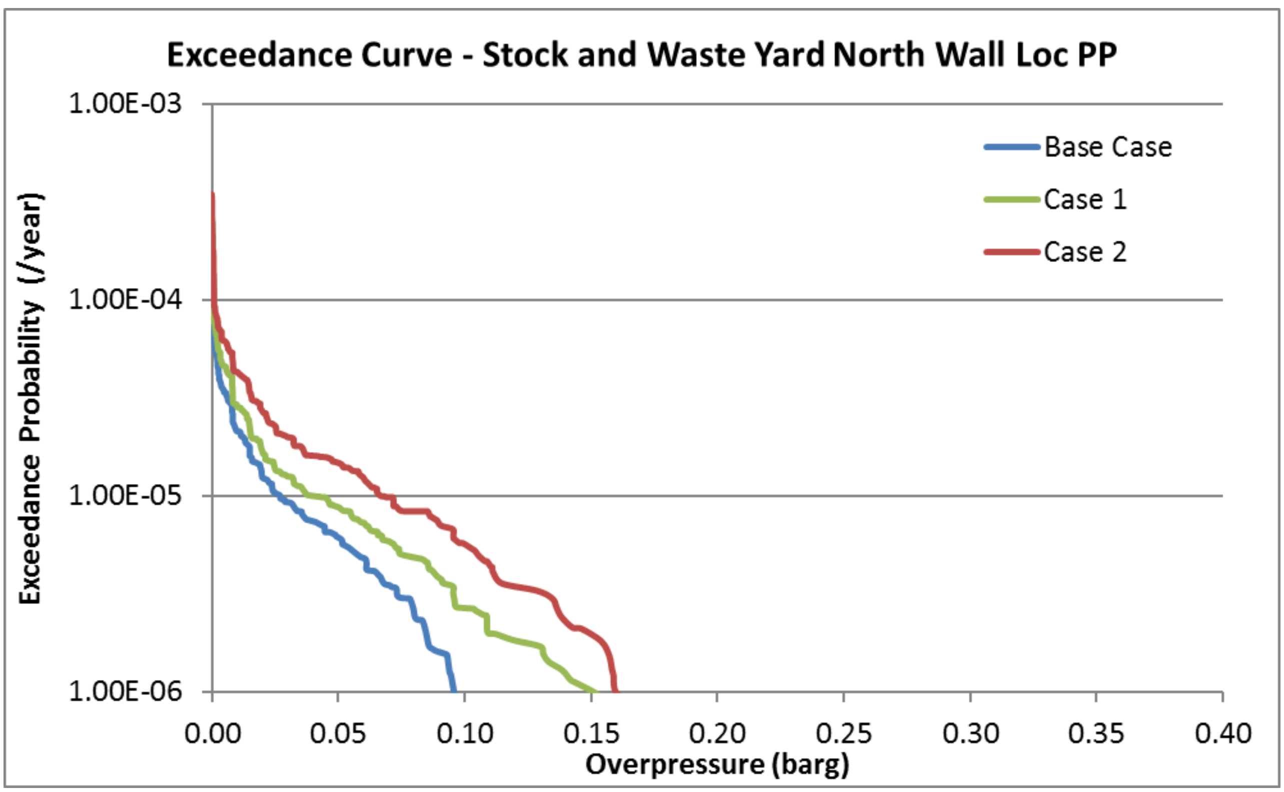


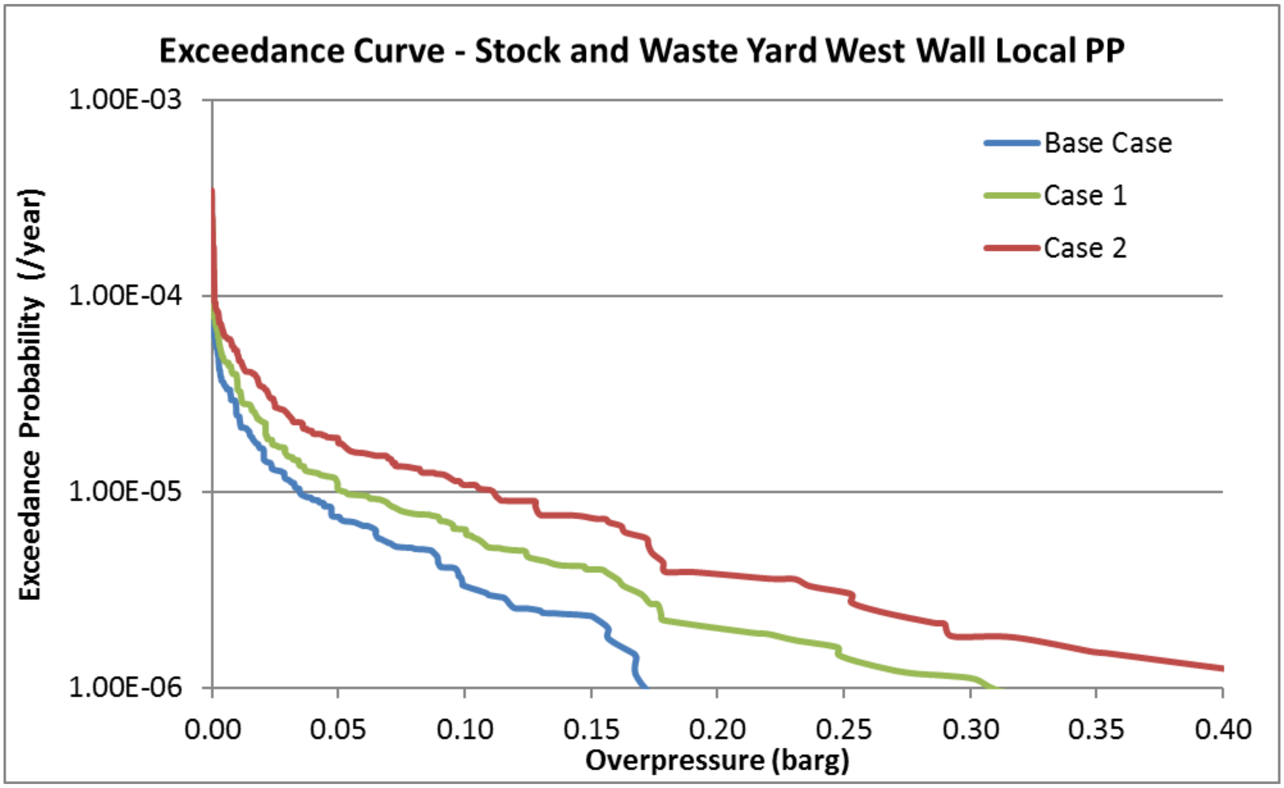
Exceedance Curve - CCB LPG Rec Unit West Wall Local PP
Base Case
Case 1
Case 2
Exceedance Probability (/year)
1.00E-03
1.00E-04
1.00E-05
1.00E-06
0.00
0.20
0.40
0.60
0.80
1.00
Overpressure (barg)

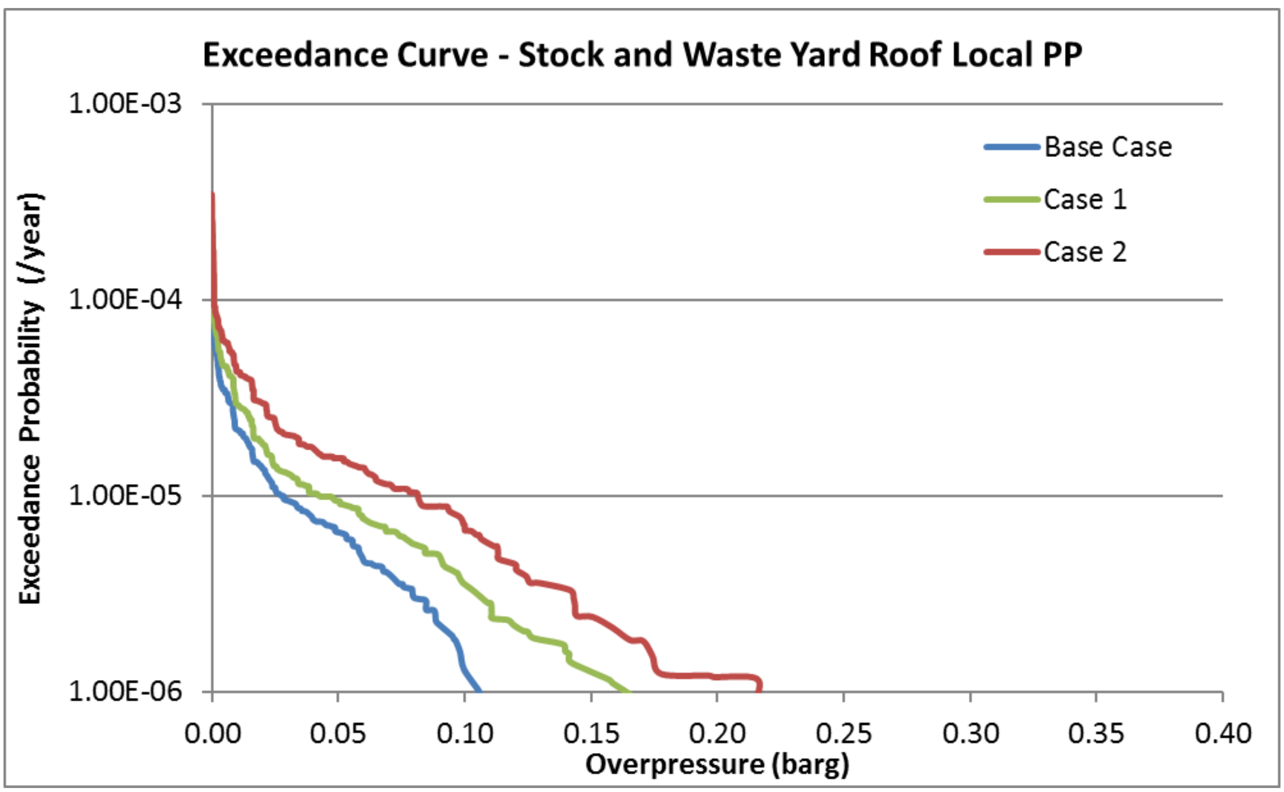

Exceedance Curve - CCB LPG Rec Unit Roof Local PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
0.00
0.20
0.40
0.60
0.80
1.00
Overpressure (barg)
Base Case
Case 1
Case 2

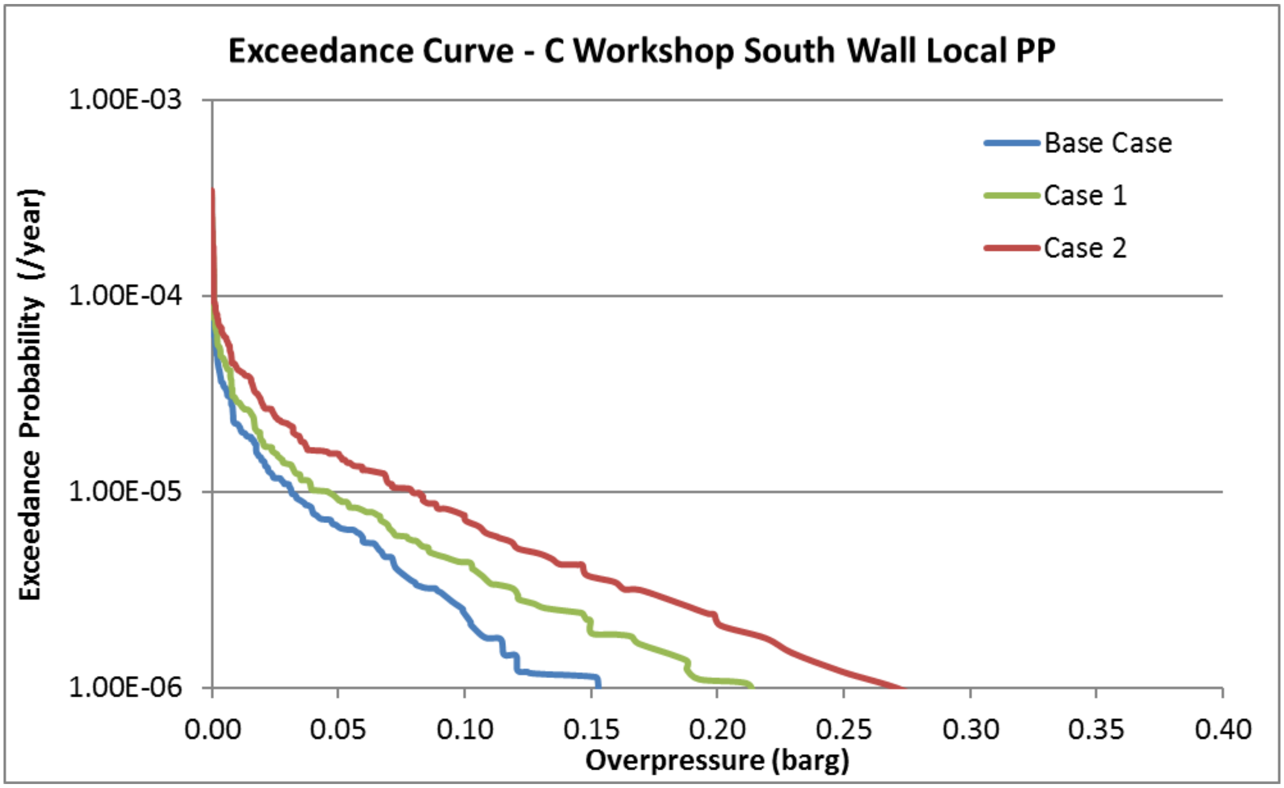

Exceedance Curve - Stock and Waste Yard South Wall Local PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2

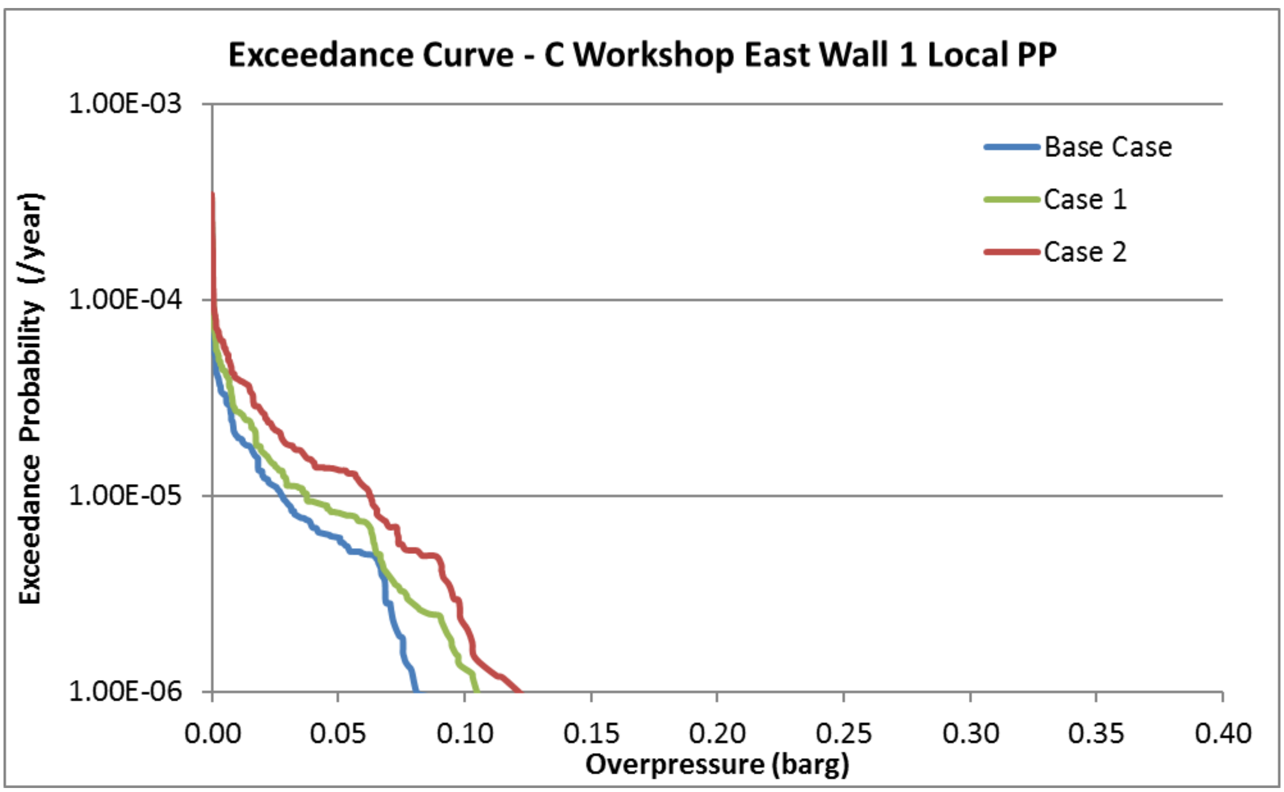

Exceedance Curve - Stock and Waste Yard East Wall Local PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2

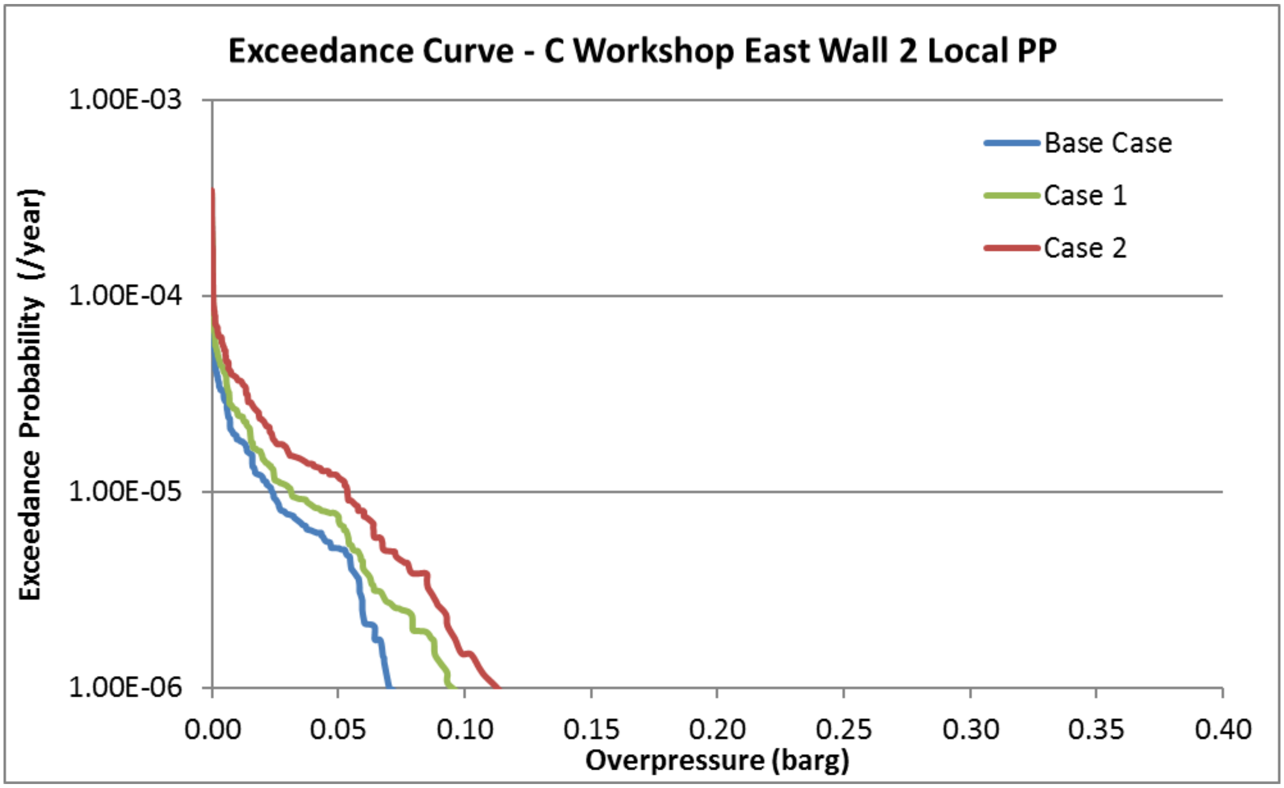

Exceedance Curve - Stock and Waste Yard North Wall Loc PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2


Exceedance Curve - Stock and Waste Yard West Wall Local PP
Exceedance Probability (/year)
1.00E-03
1.00E-04
1.00E-05
1.00E-06
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2

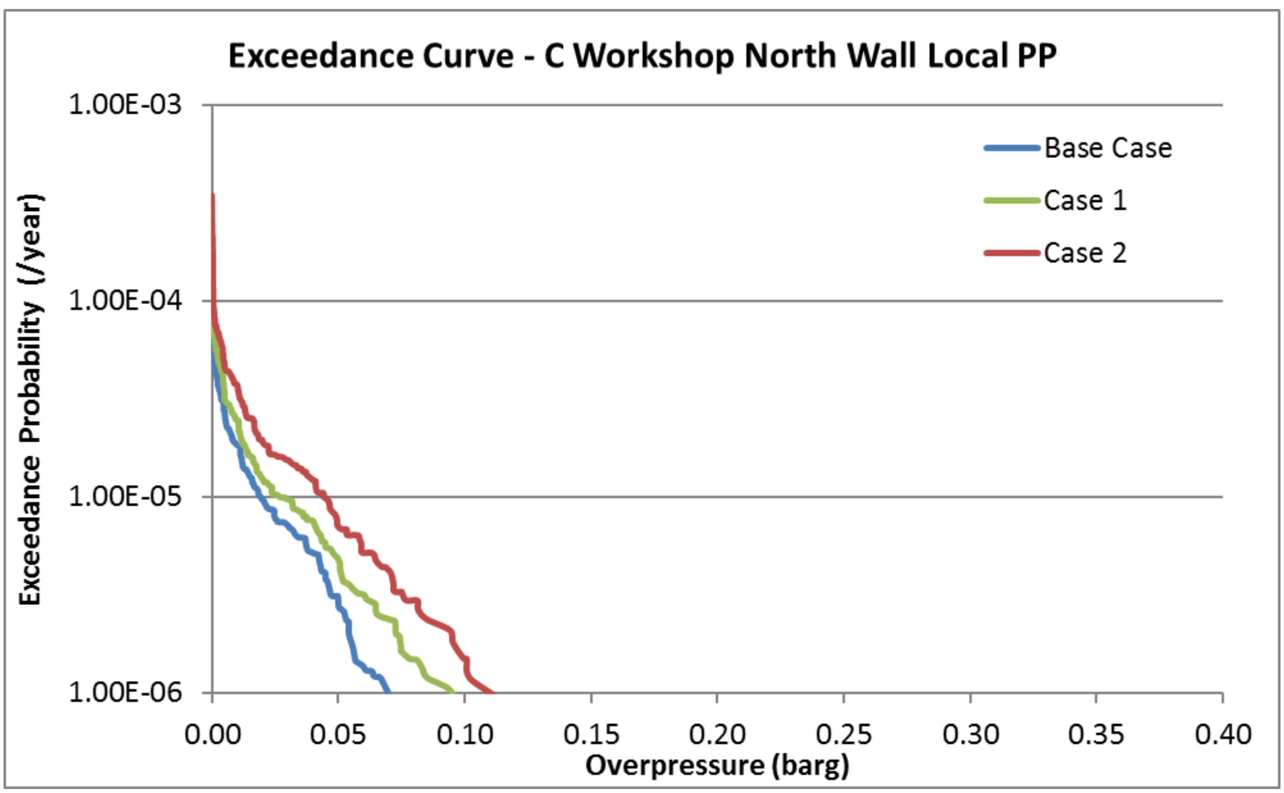

Exceedance Curve - Stock and Waste Yard Roof Local PP
Exceedance Probability (/year)
1.00E-03
1.00E-04
1.00E-05
1.00E-06
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2


Exceedance Curve - C Workshop South Wall Local PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
Base Case
Case 1
Case 2
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)

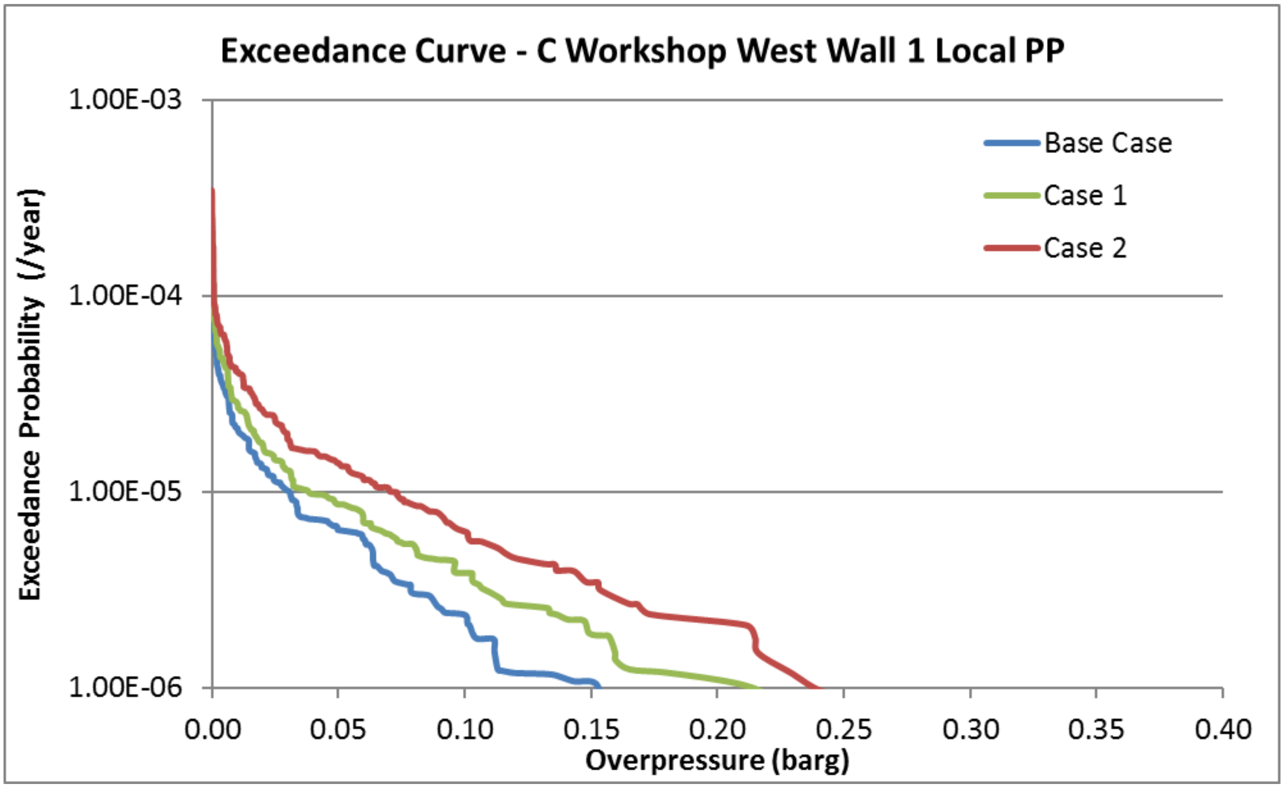

Exceedance Curve - C Workshop East Wall 1 Local PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
Base Case
Case 1
Case 2
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)



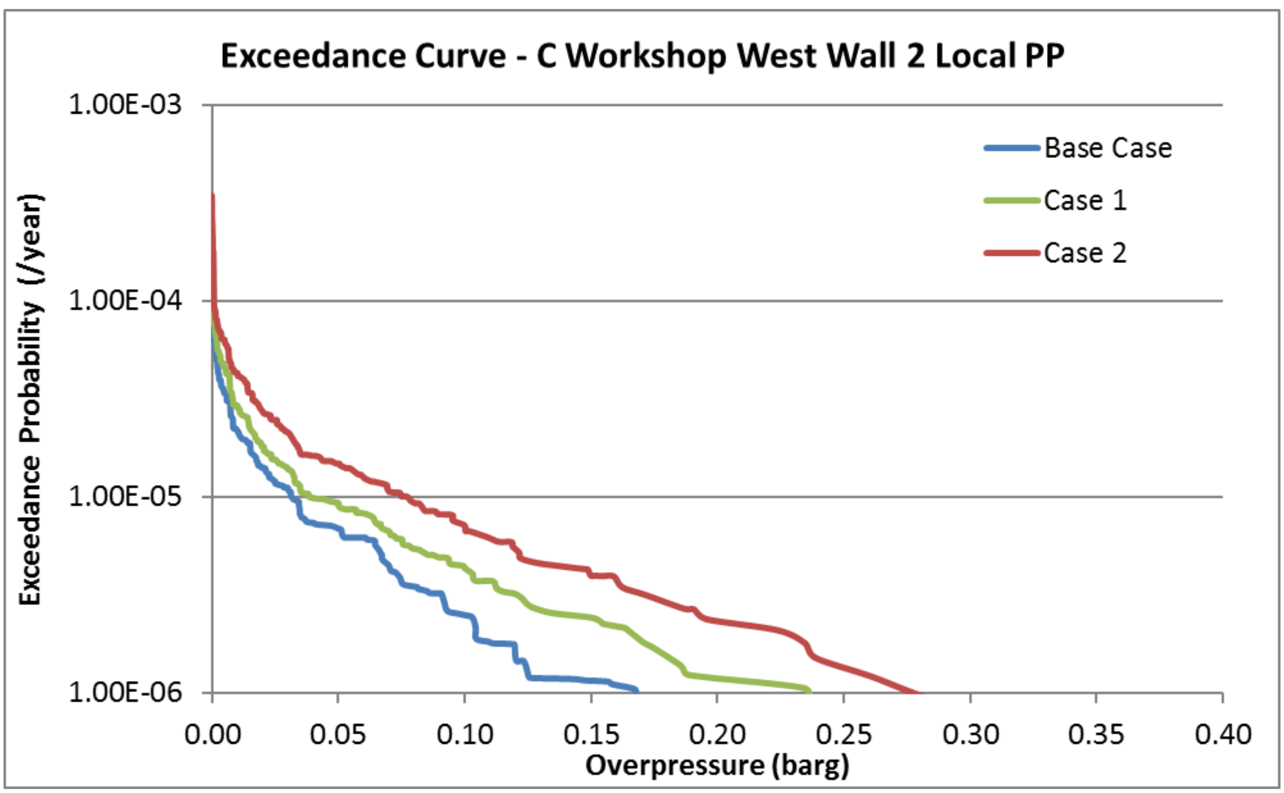
Exceedance Curve - C Workshop East Wall 2 Local PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
Base Case
Case 1
Case 2
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)



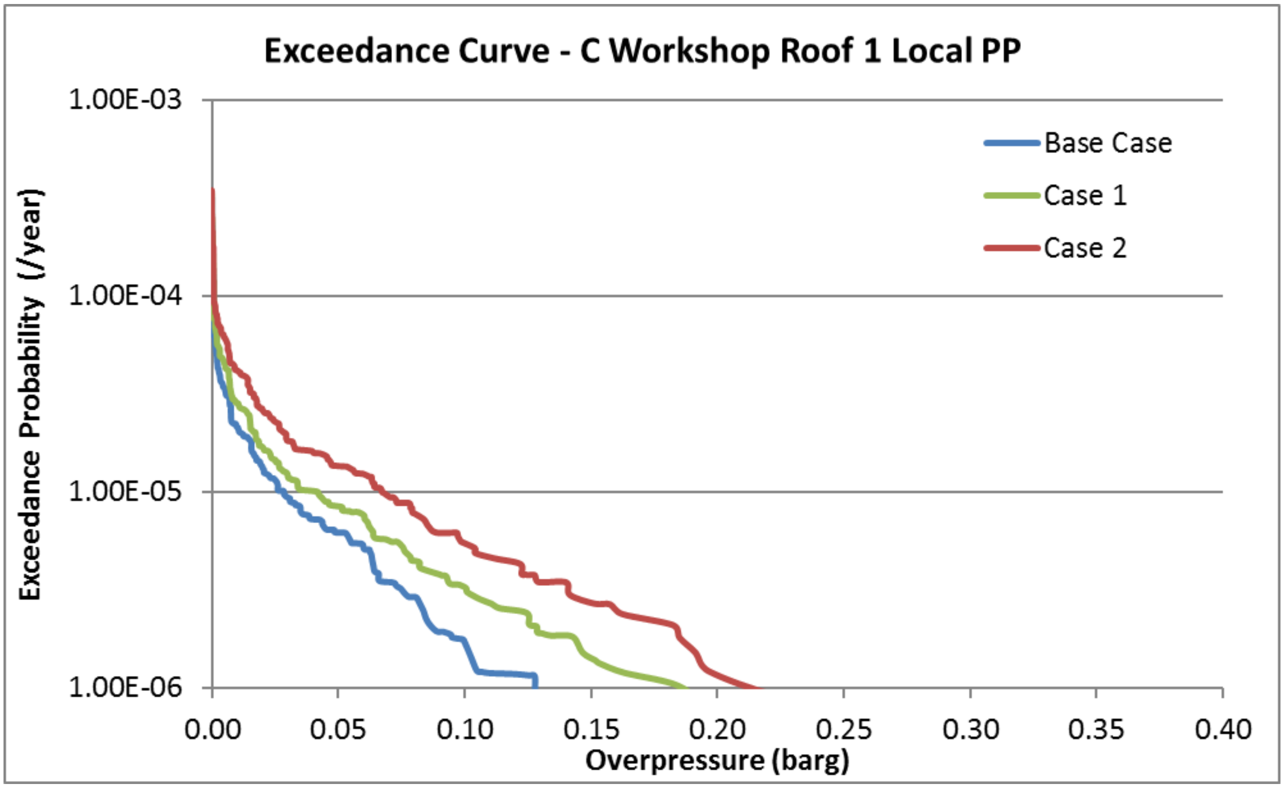
Exceedance Curve - C Workshop North Wall Local PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
Base Case
Case 1
Case 2
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)



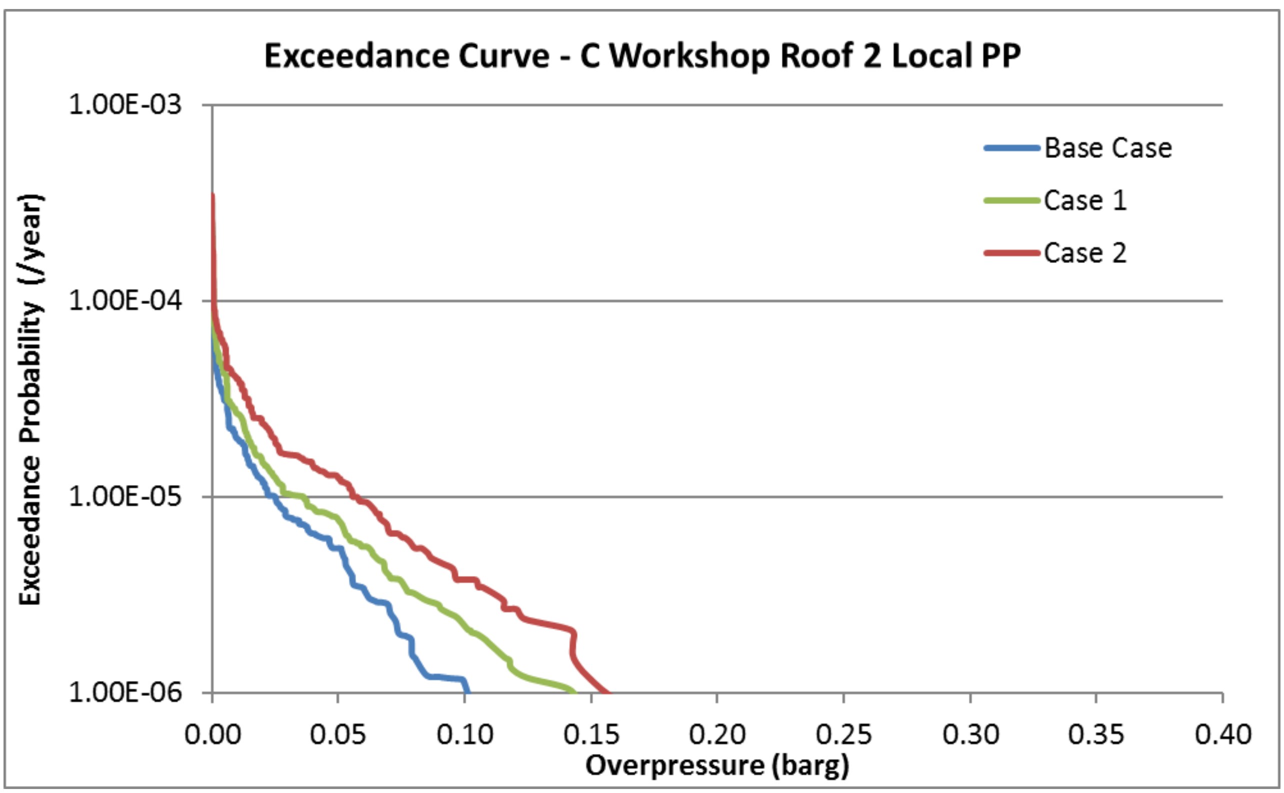
Exceedance Curve - C Workshop West Wall 1 Local PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
Base Case
Case 1
Case 2
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)



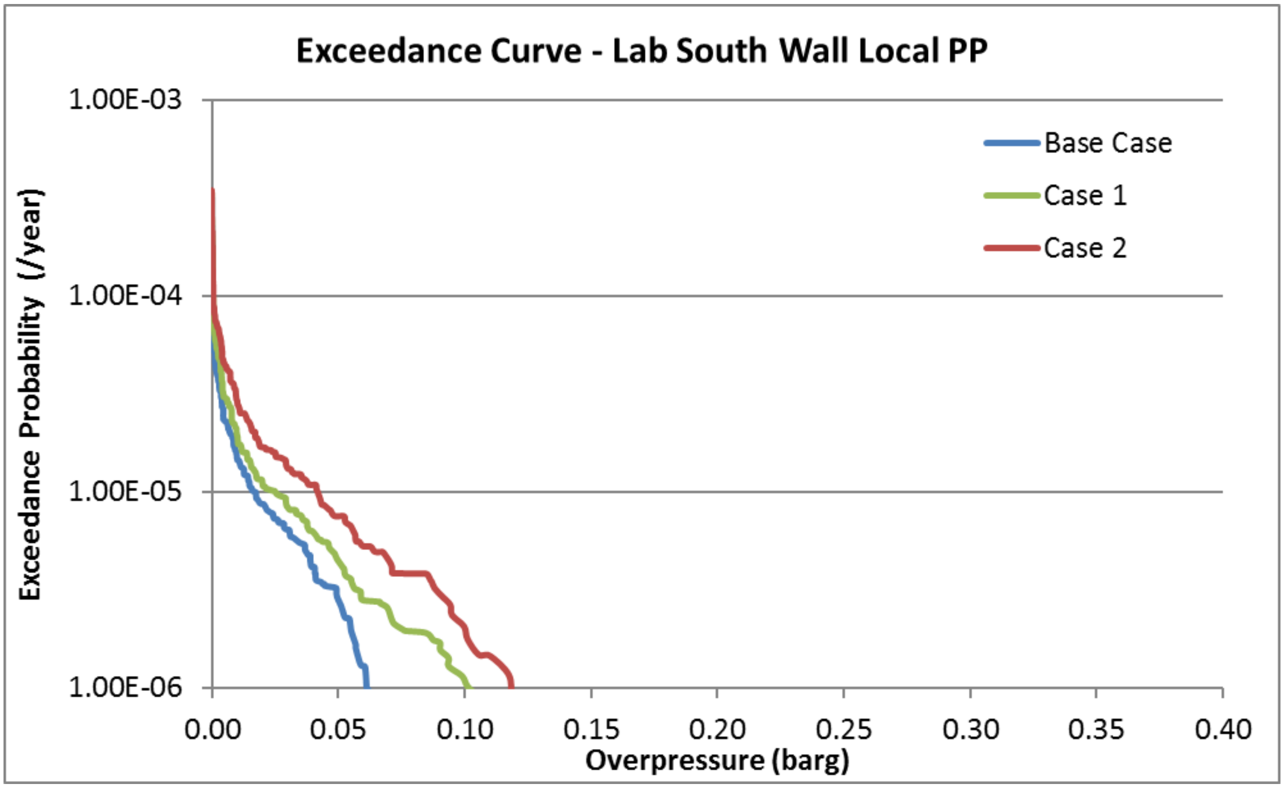
Exceedance Curve - C Workshop West Wall 2 Local PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
Base Case
Case 1
Case 2
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)



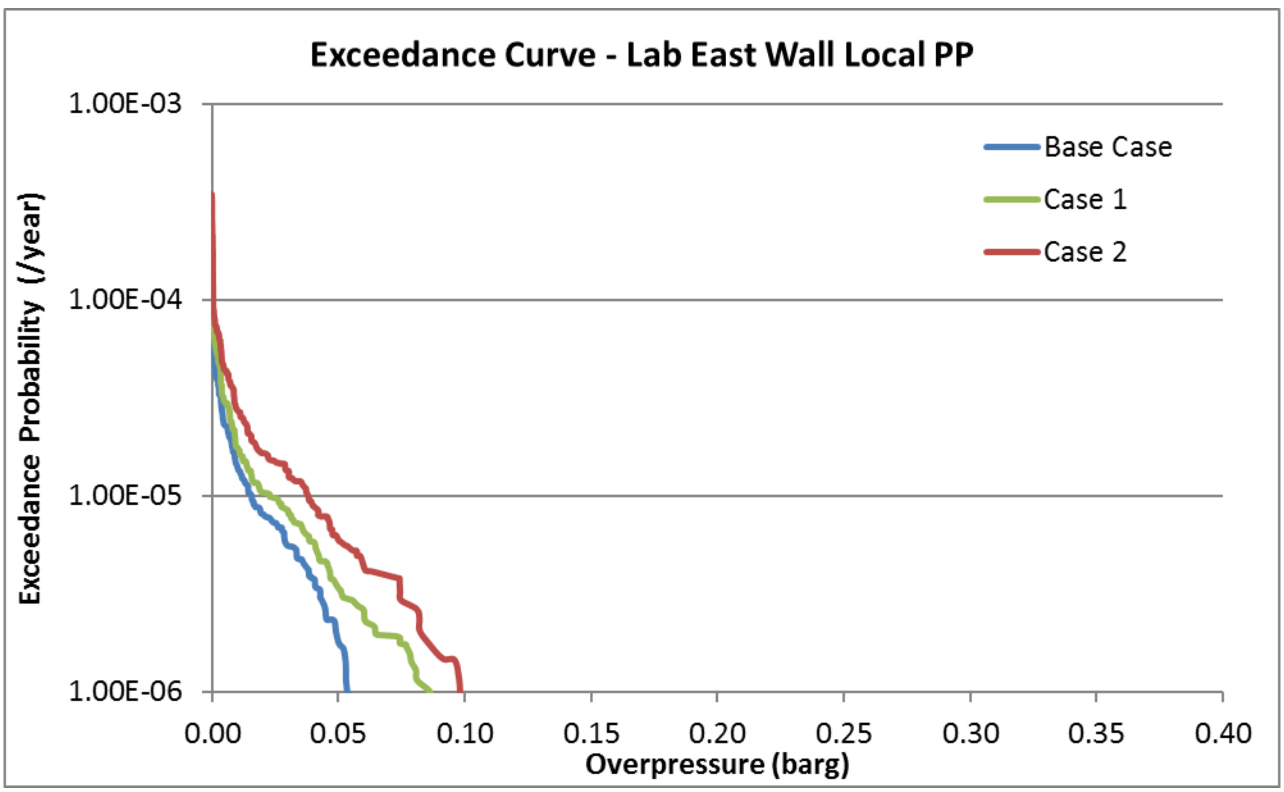
Exceedance Curve - C Workshop Roof 1 Local PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2



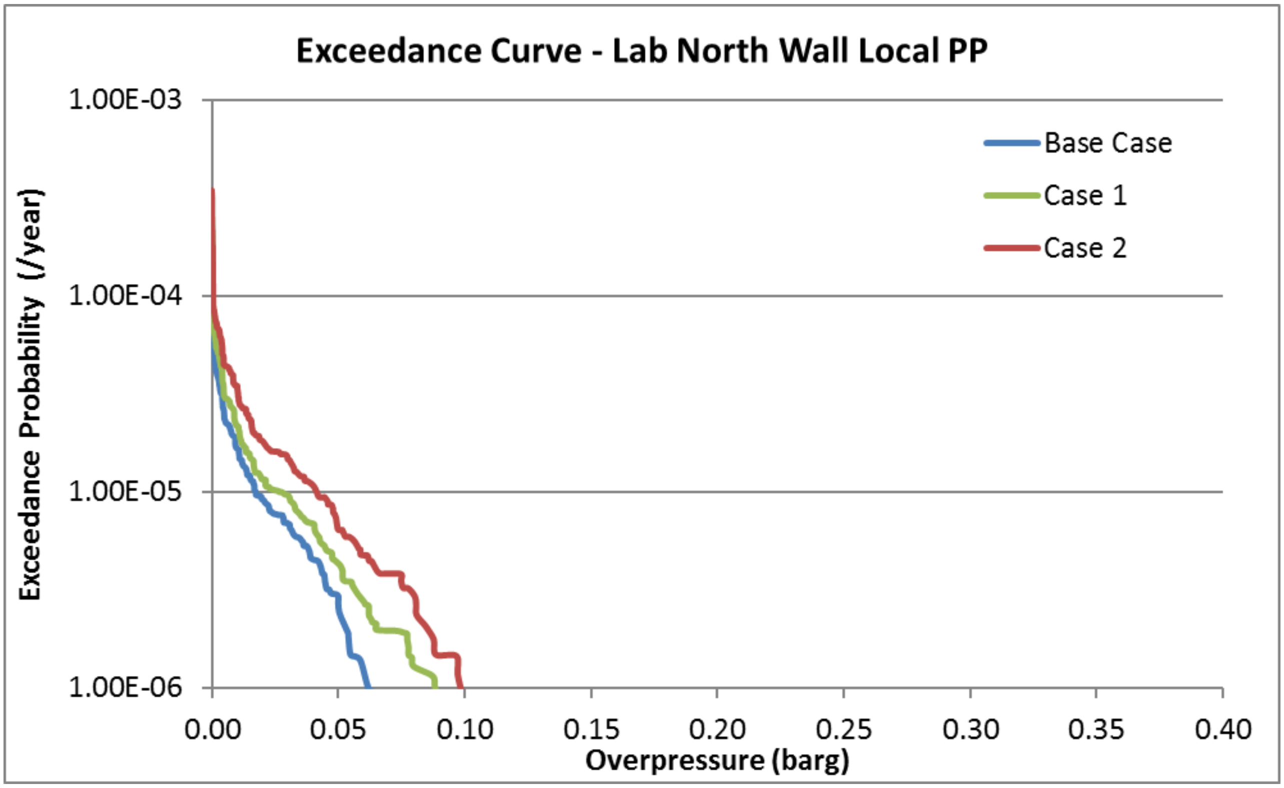
Exceedance Curve - C Workshop Roof 2 Local PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2



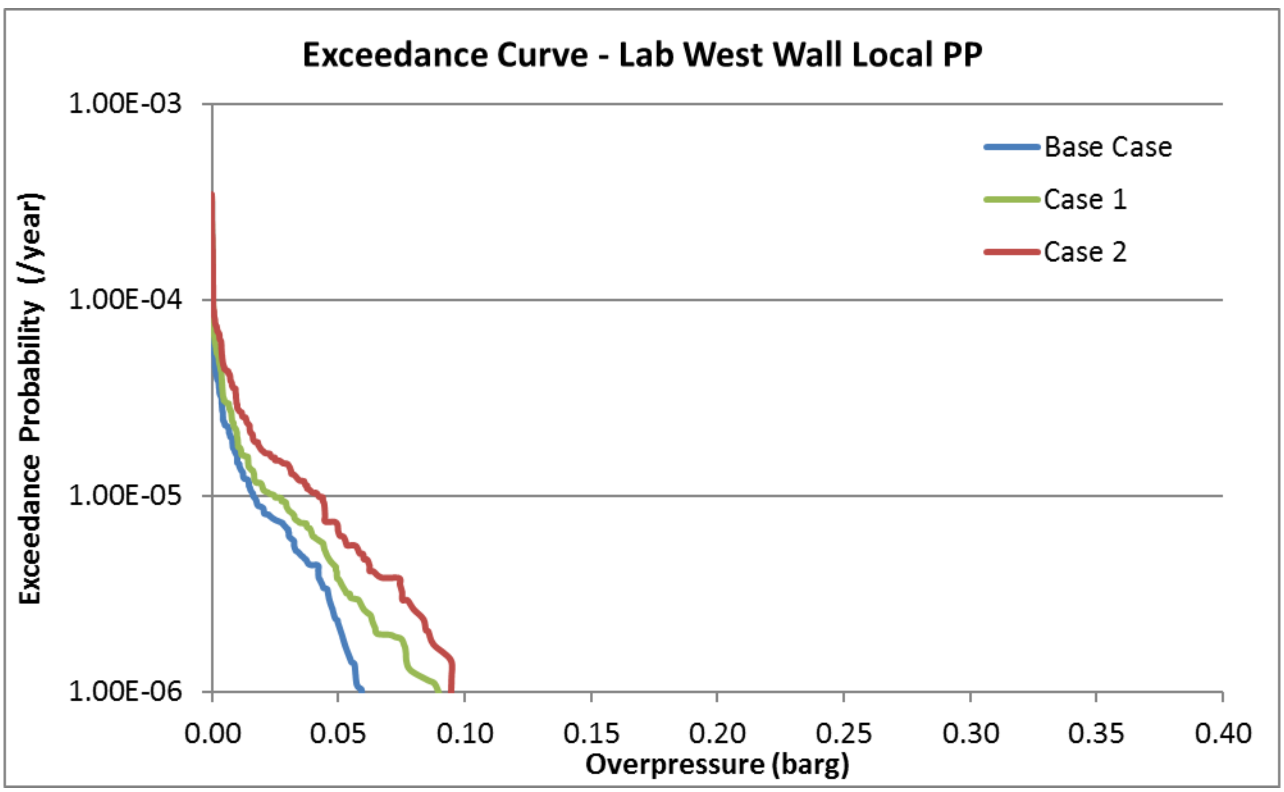
Exceedance Curve - Lab South Wall Local PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
Base Case
Case 1
Case 2
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)



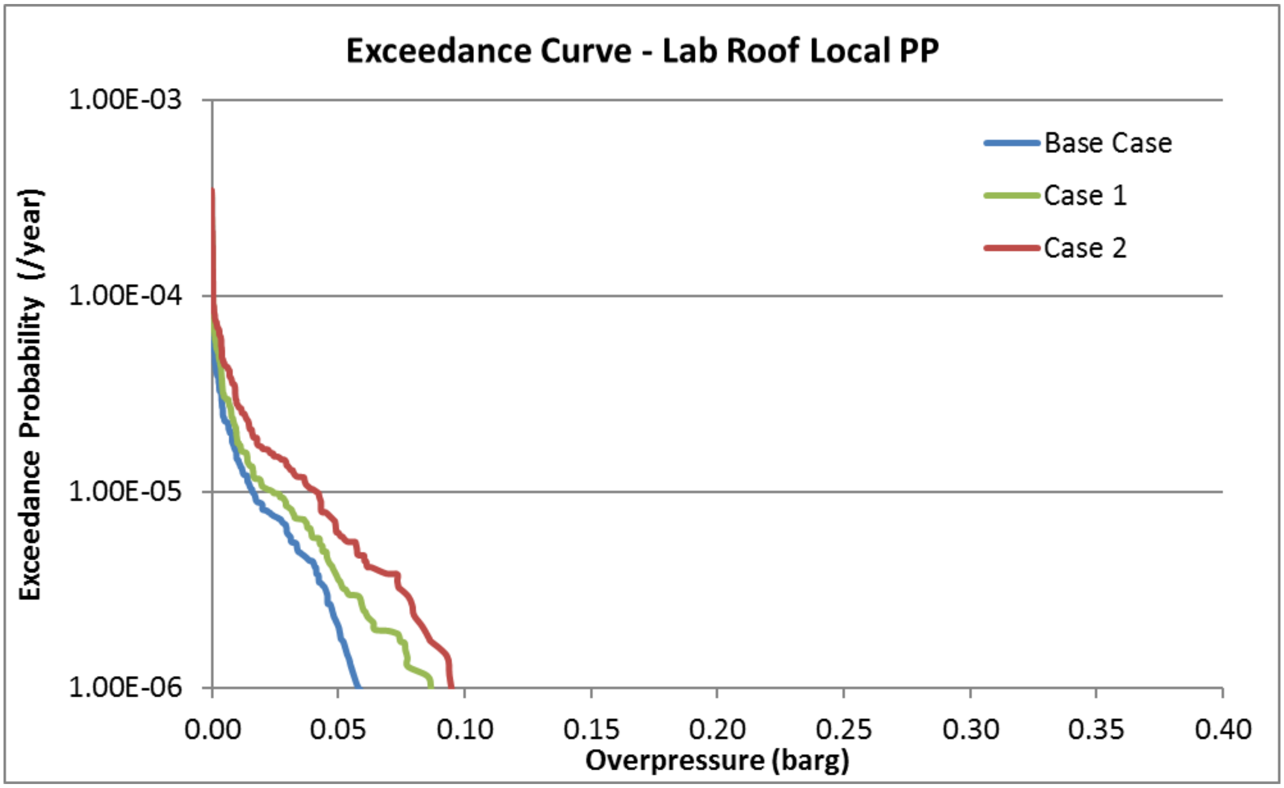
Exceedance Curve - Lab East Wall Local PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
Base Case
Case 1
Case 2
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)

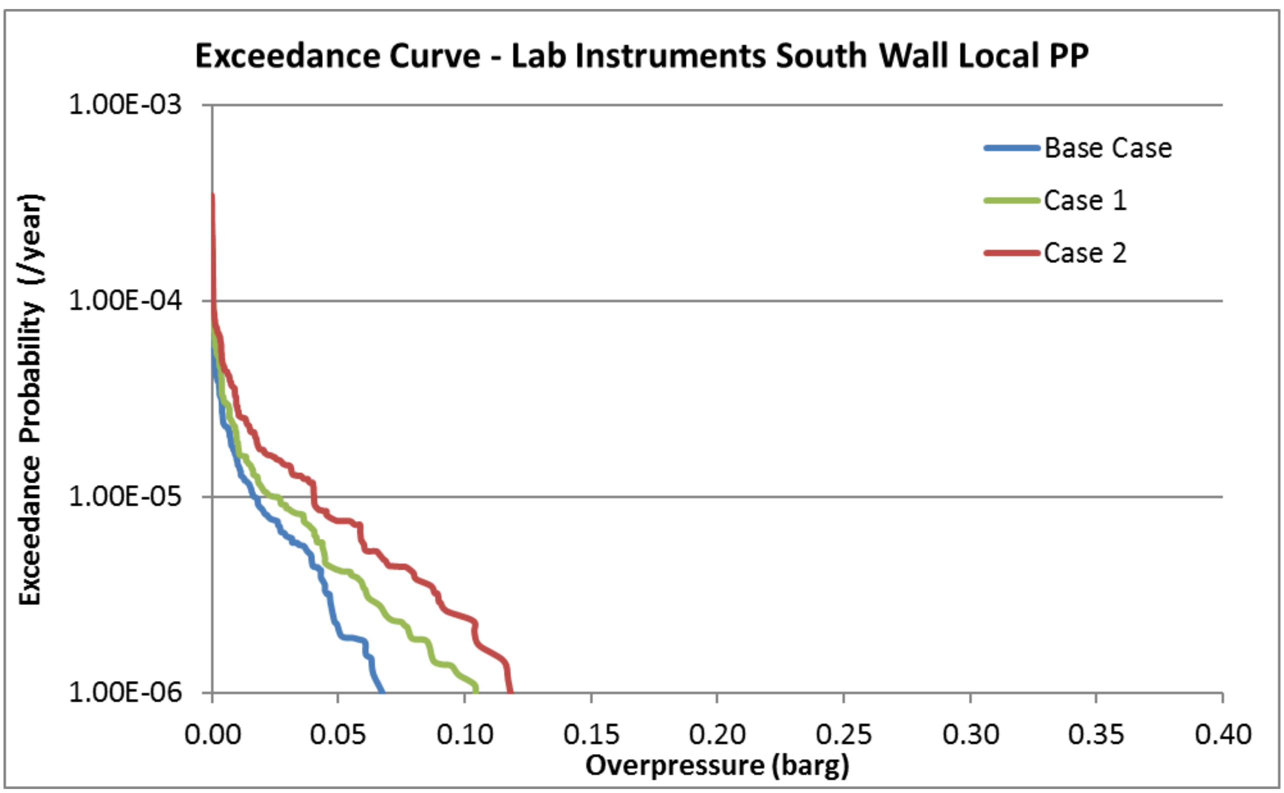


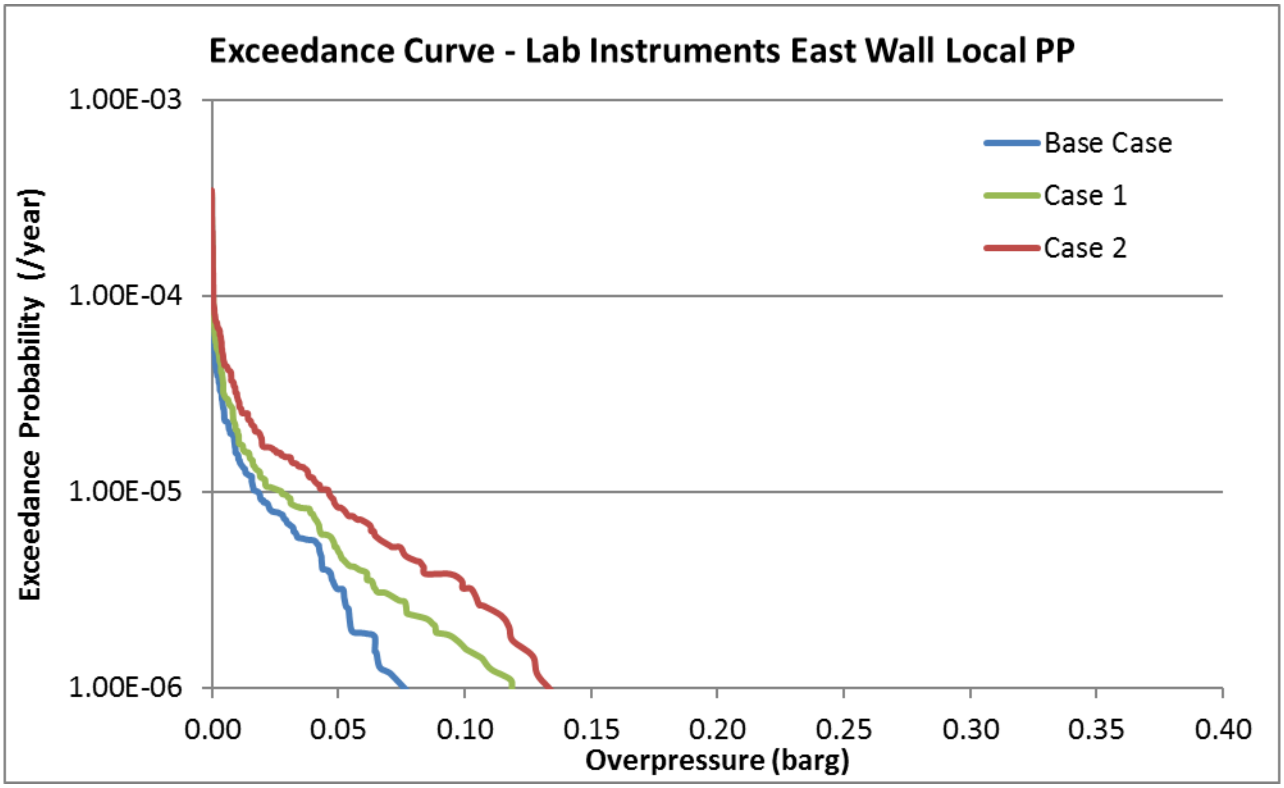
Exceedance Curve - Lab North Wall Local PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2

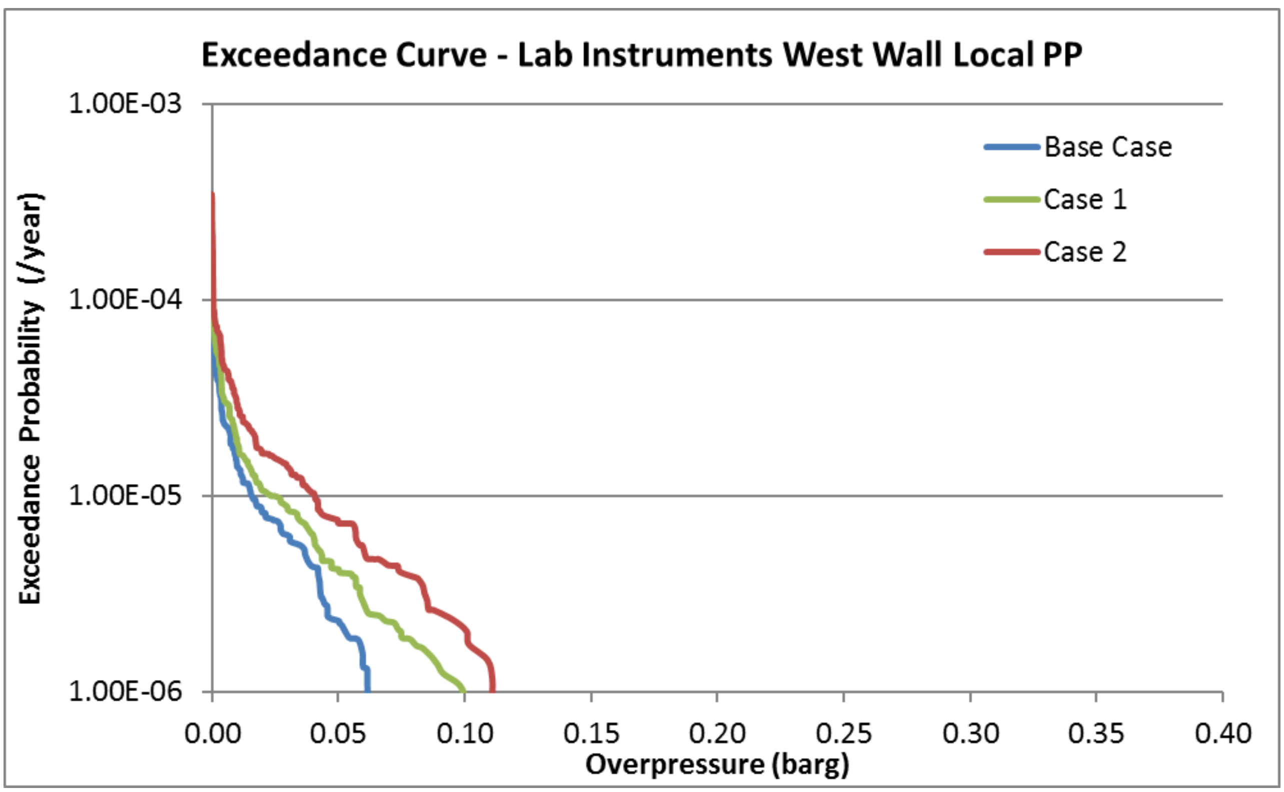


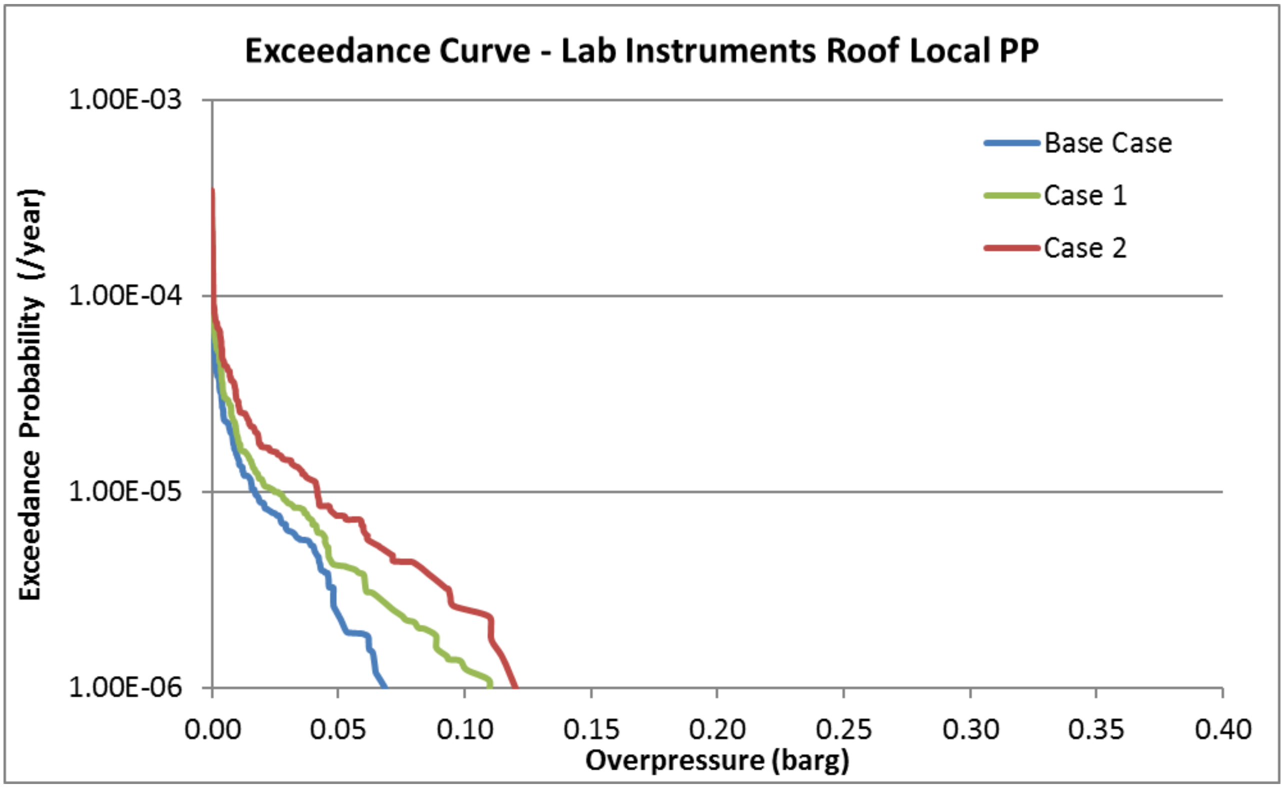
Exceedance Curve - Lab West Wall Local PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2


Exceedance Curve - Lab Roof Local PP
Exceedance Probability (/year)
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Base Case
Case 1
Case 2
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)

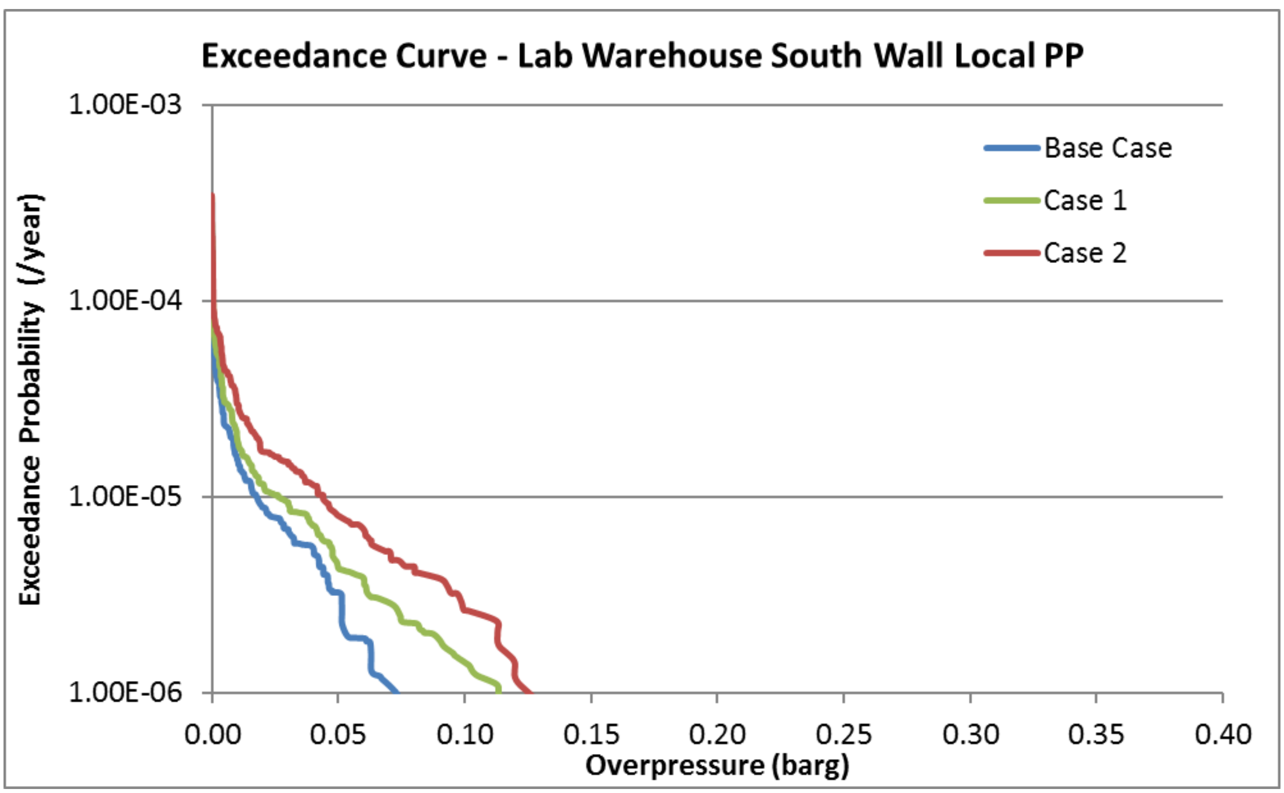

Exceedance Curve - Lab Instruments South Wall Local PP
Exceedance Probability (/year)
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Base Case
Case 1
Case 2
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)


Exceedance Curve - Lab Instruments East Wall Local PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2

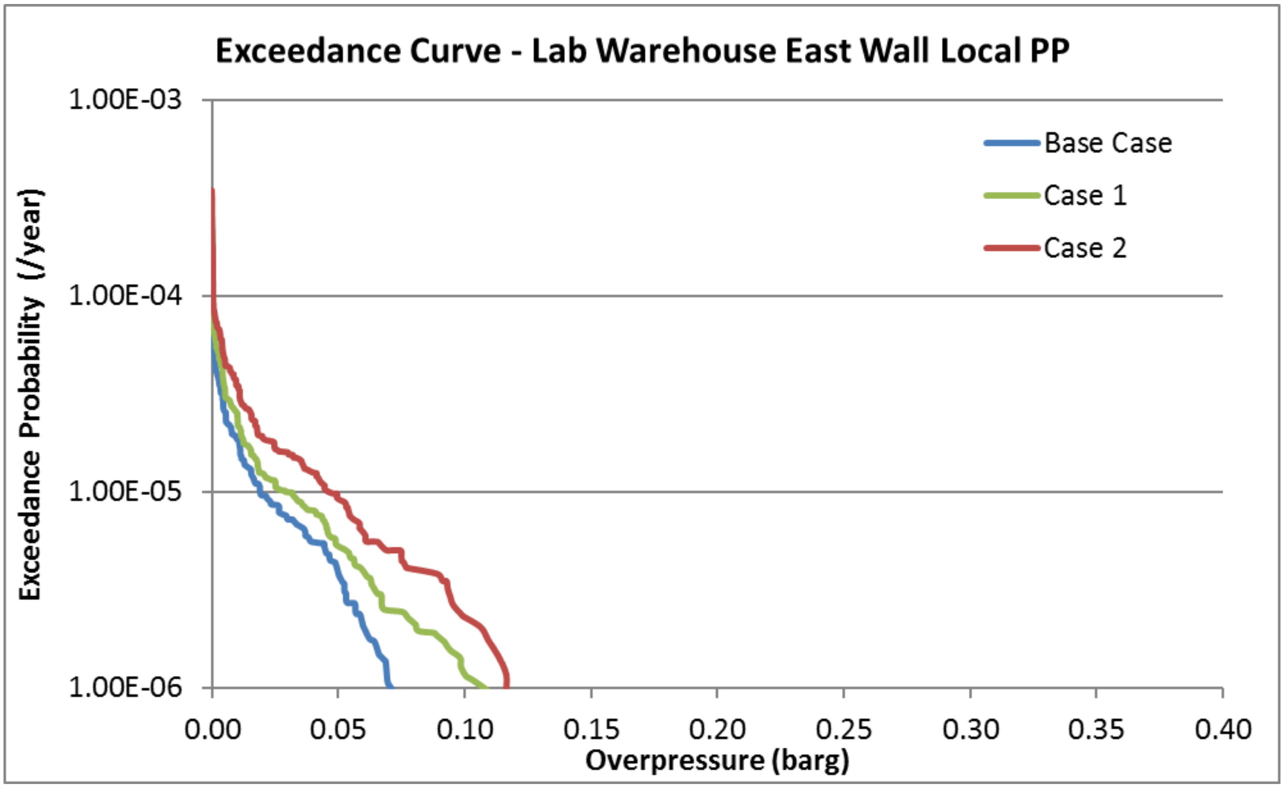

Exceedance Curve - Lab Instruments West Wall Local PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2

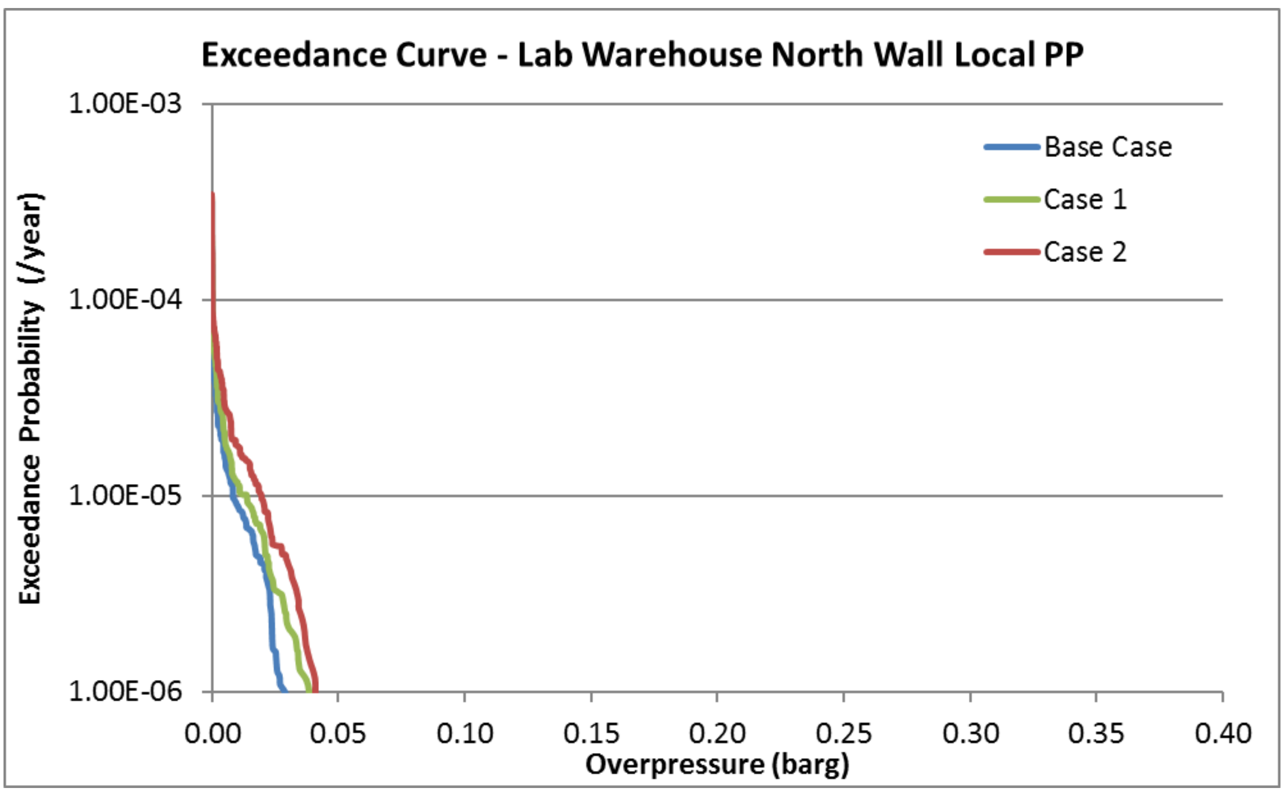


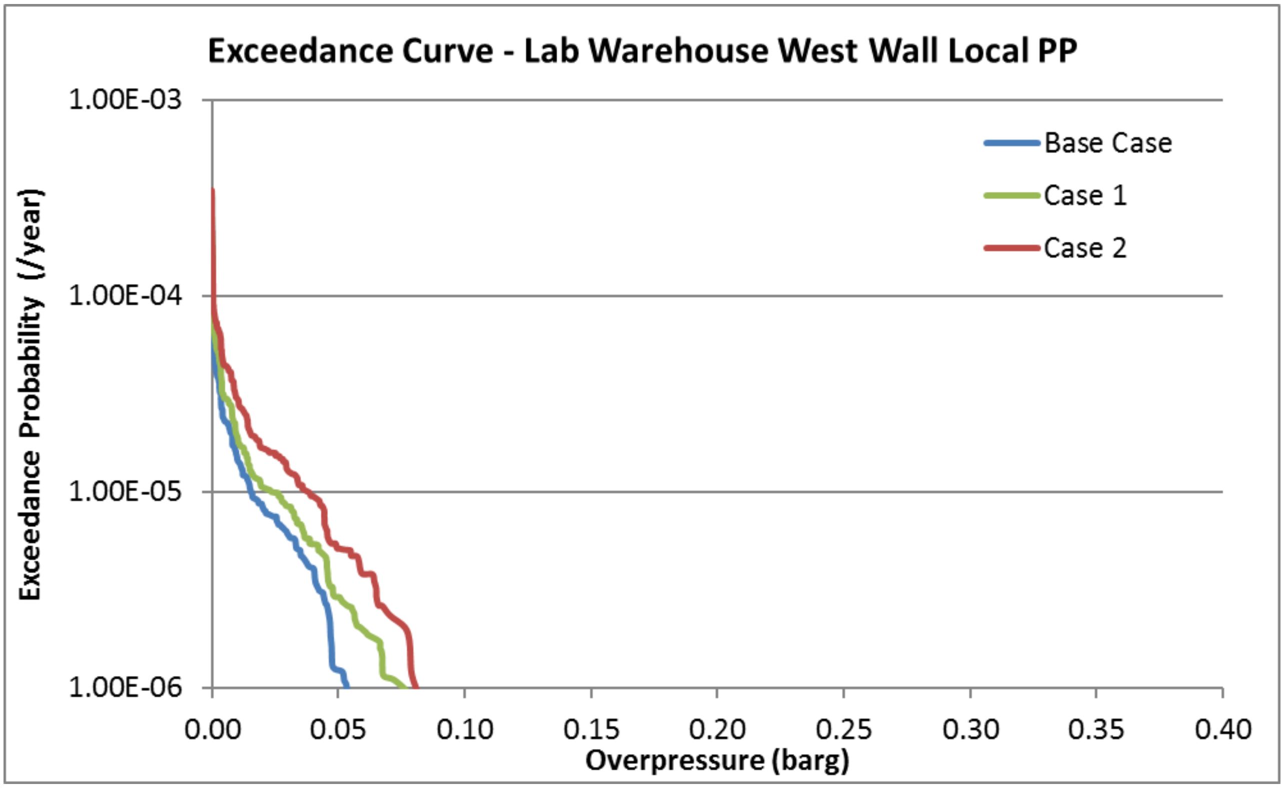
Exceedance Curve - Lab Instruments Roof Local PP
Base Case
Case 1
Case 2
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)



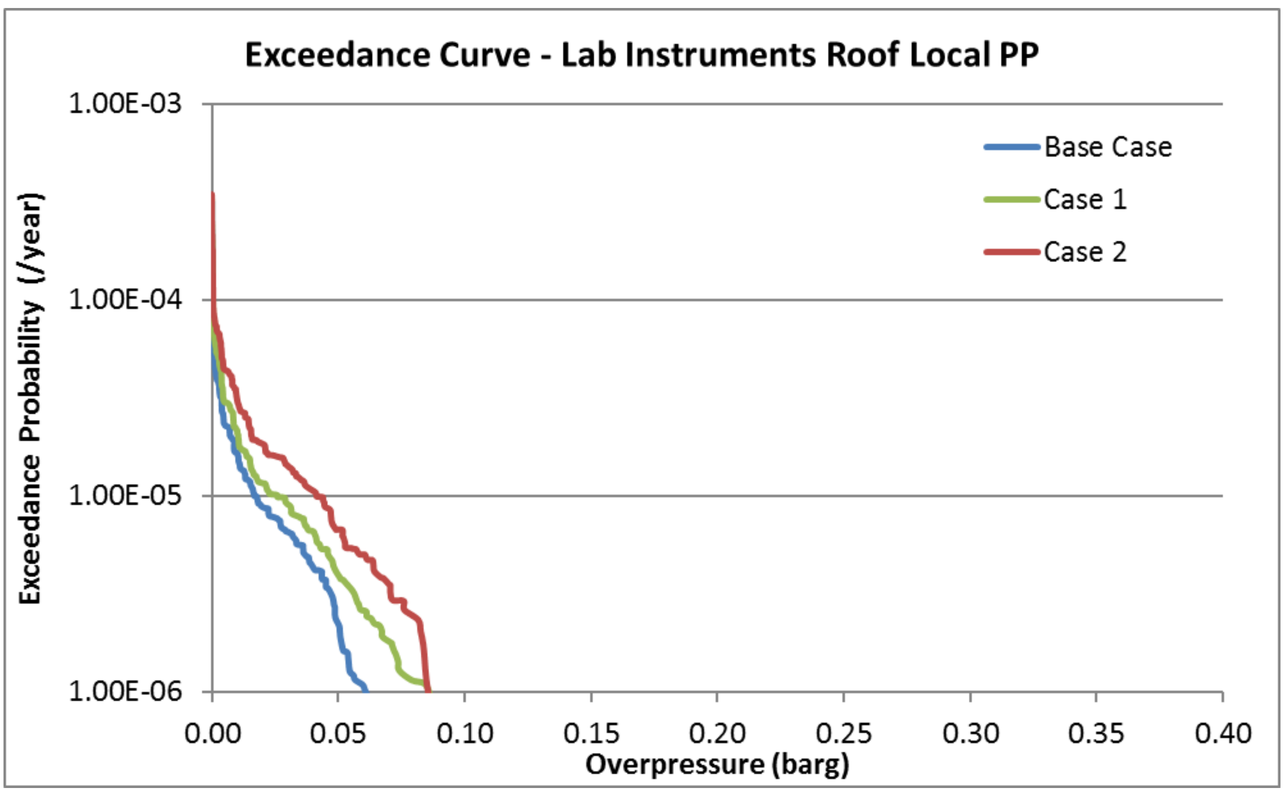
Exceedance Curve - Lab Warehouse South Wall Local PP
Base Case
Case 1
Case 2
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)


Exceedance Curve - Lab Warehouse East Wall Local PP
Exceedance Probability (/year)
1.00E-03
1.00E-04
1.00E-05
1.00E-06
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2

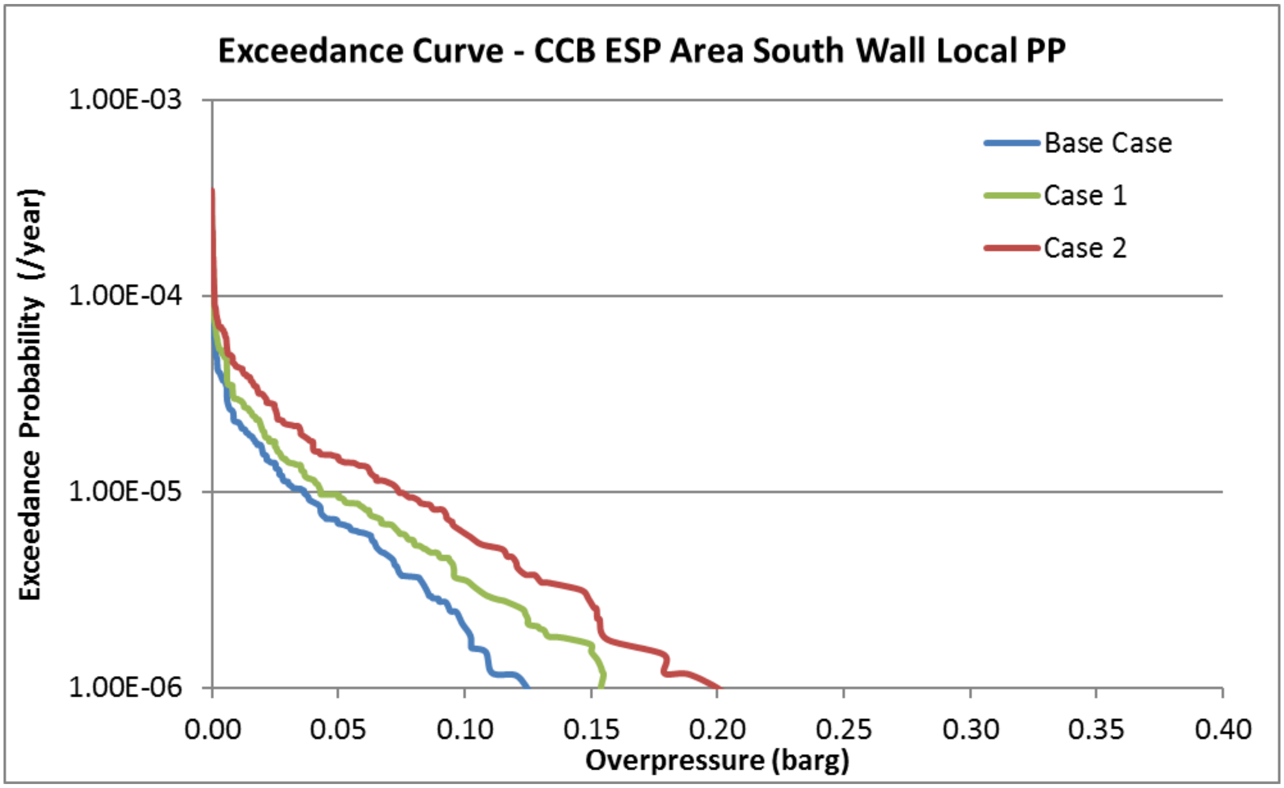

Exceedance Curve - Lab Warehouse North Wall Local PP
Exceedance Probability (/year)
1.00E-03
1.00E-04
1.00E-05
1.00E-06
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2

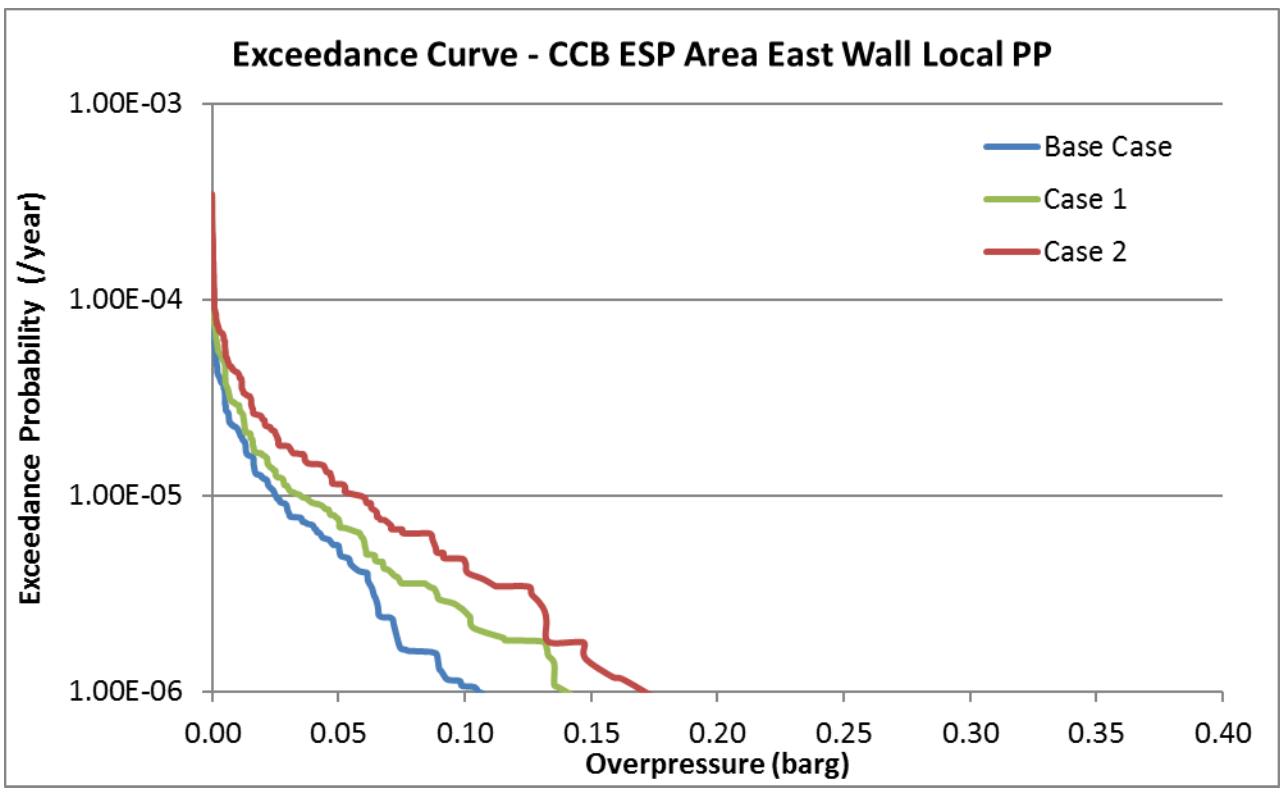


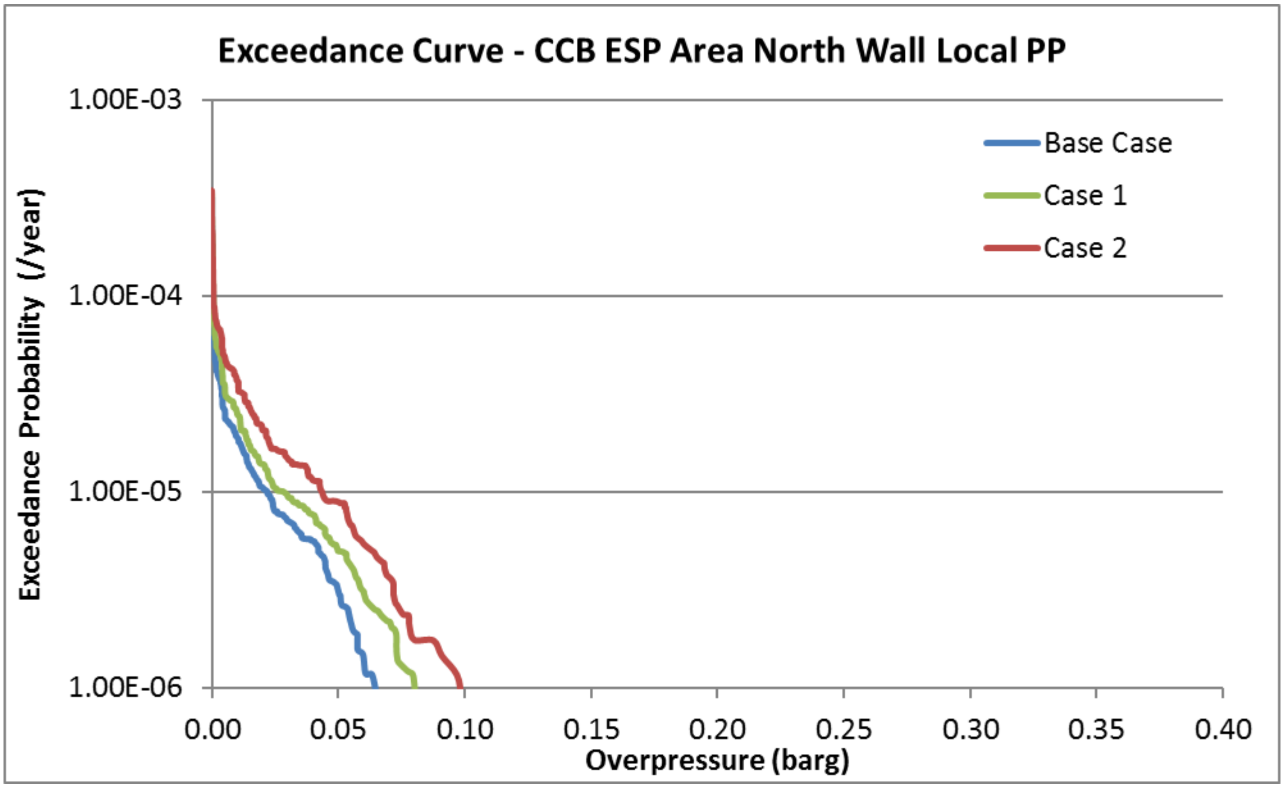
Exceedance Curve - Lab Warehouse West Wall Local PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2

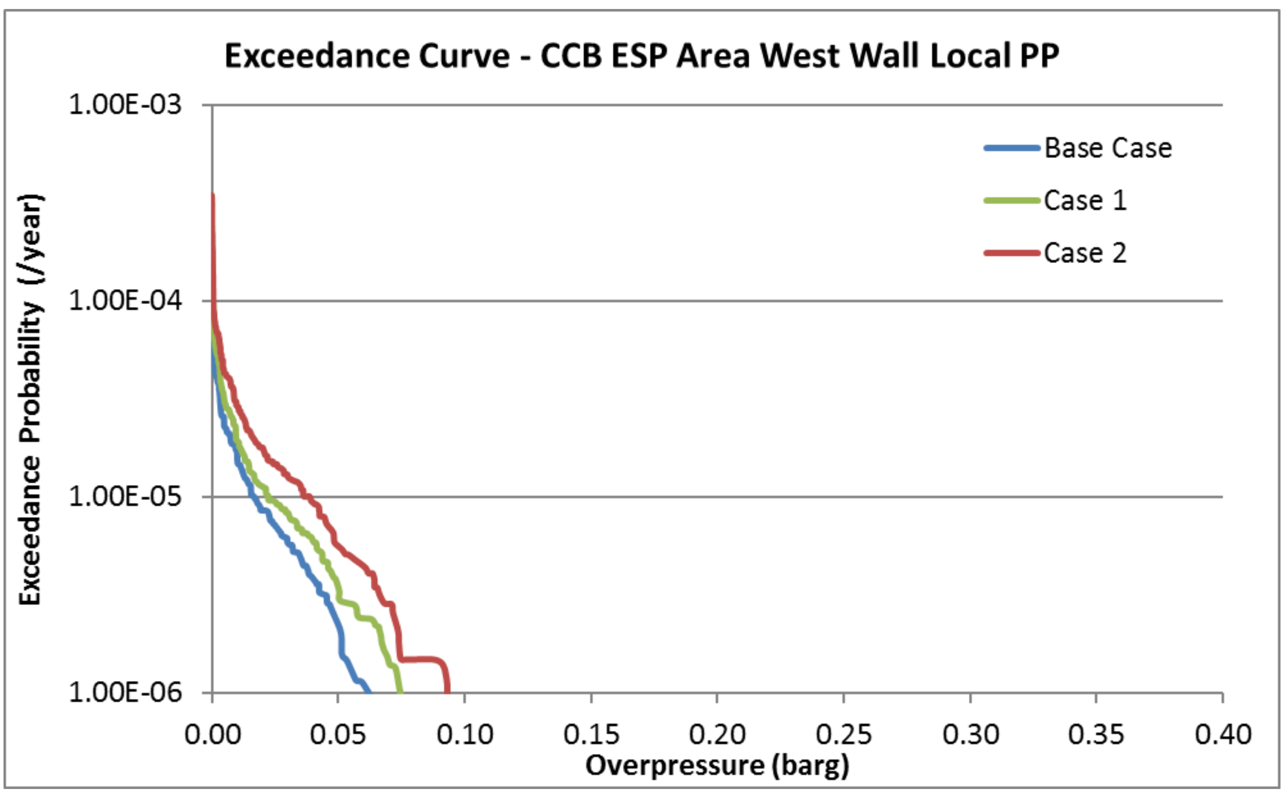


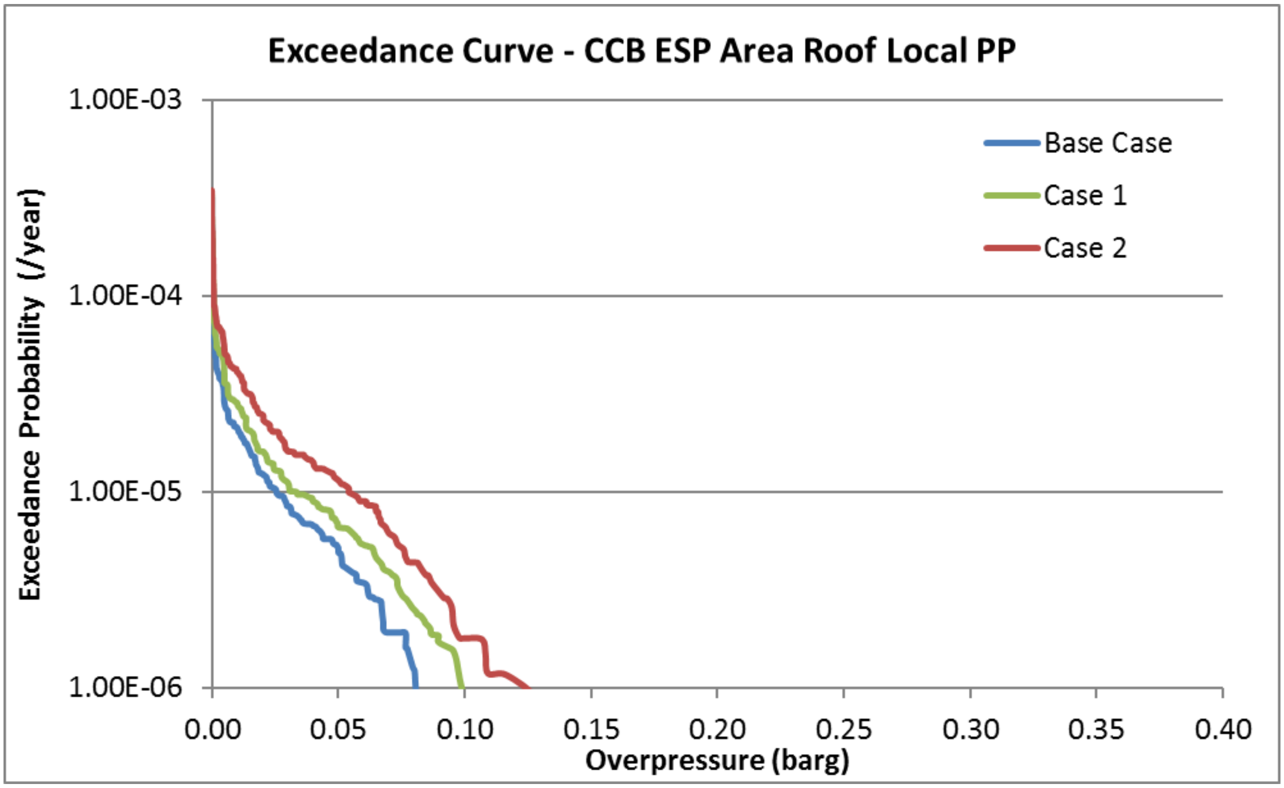
Exceedance Curve - Lab Instruments Roof Local PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2


Exceedance Curve - CCB ESP Area South Wall Local PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2


Exceedance Curve - CCB ESP Area East Wall Local PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2


Exceedance Curve - CCB ESP Area North Wall Local PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2


Exceedance Curve - CCB ESP Area West Wall Local PP
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Exceedance Probability (/year)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2



Exceedance Curve - CCB ESP Area Roof Local PP
Exceedance Probability (/year)
1.00E-03
1.00E-04
1.00E-05
1.00E-06
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Overpressure (barg)
Base Case
Case 1
Case 2

Appendix I Plan view LFL plots for selected worst case scenario

PTT LPG Recovery Unit Explosion Probabilistic Study

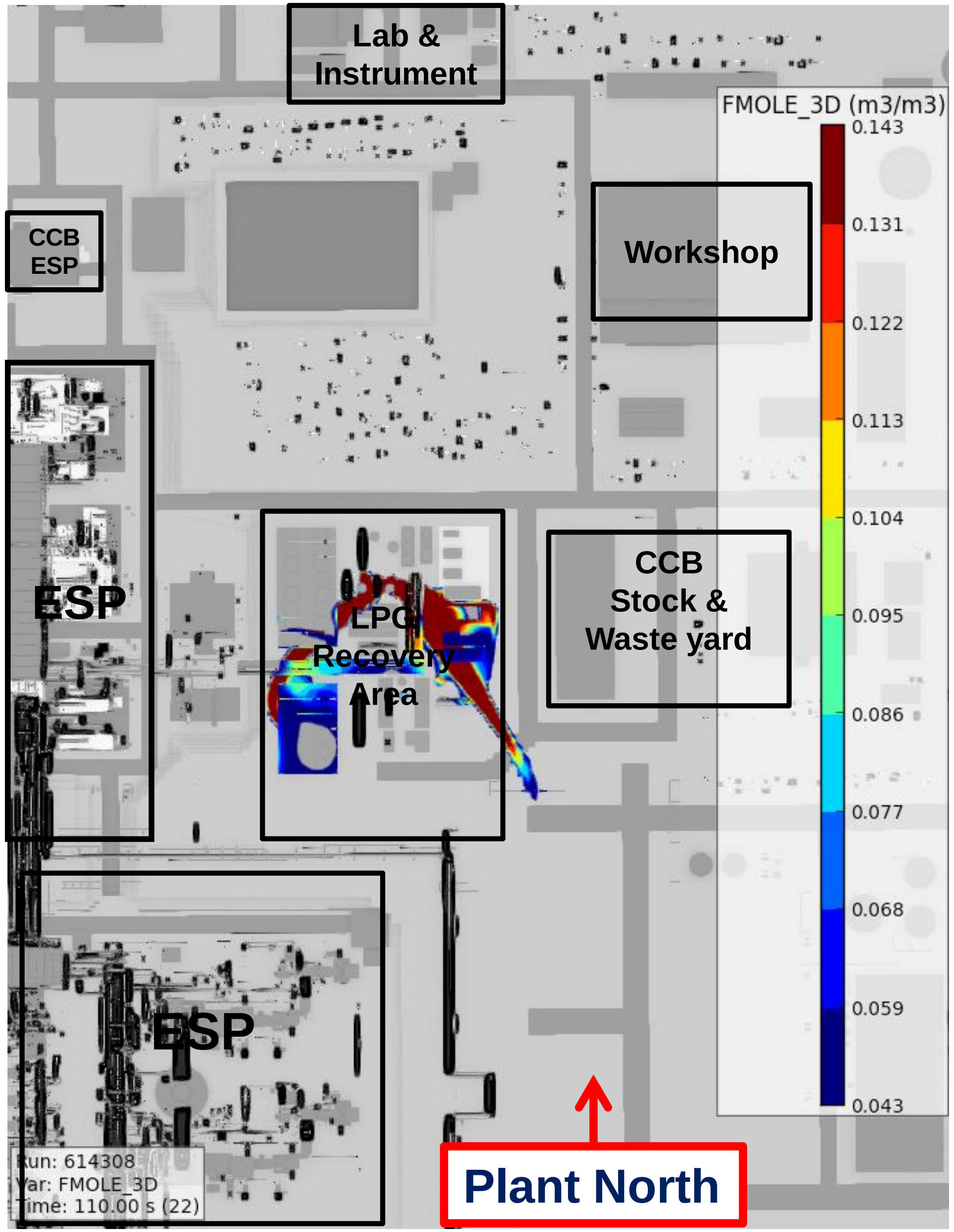
Appendix I – Plan View LFL Plots for Selected Worst Case Scenario

GEXCON

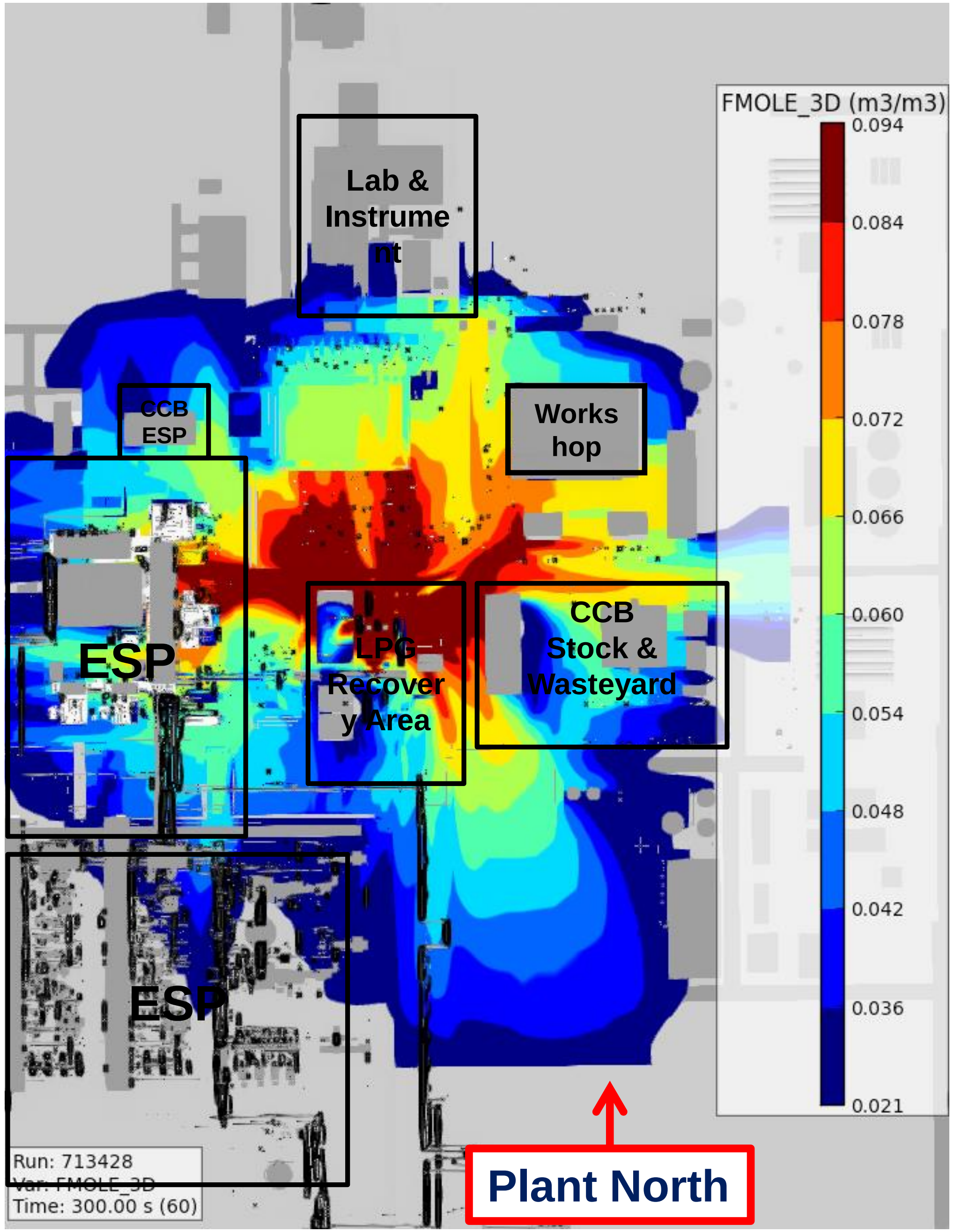
Note

- Five selected worst case dispersion plots of LFL – UFL region of flammable ESC volume has been generated to consider the migration of gas from LPG Recovery Unit towards other areas and the presence of uncontrolled ignition sources.
- These plots represents the three geometry variation cases – Base Case, Case 1 and Case 2.
- These plots are generated considering the safety measures such as gas detection, ESDV and BDV failed.
- Therefore dispersion simulations are able to reach more than typical time (1 – 2 minutes response time)

Geometry – Base Case

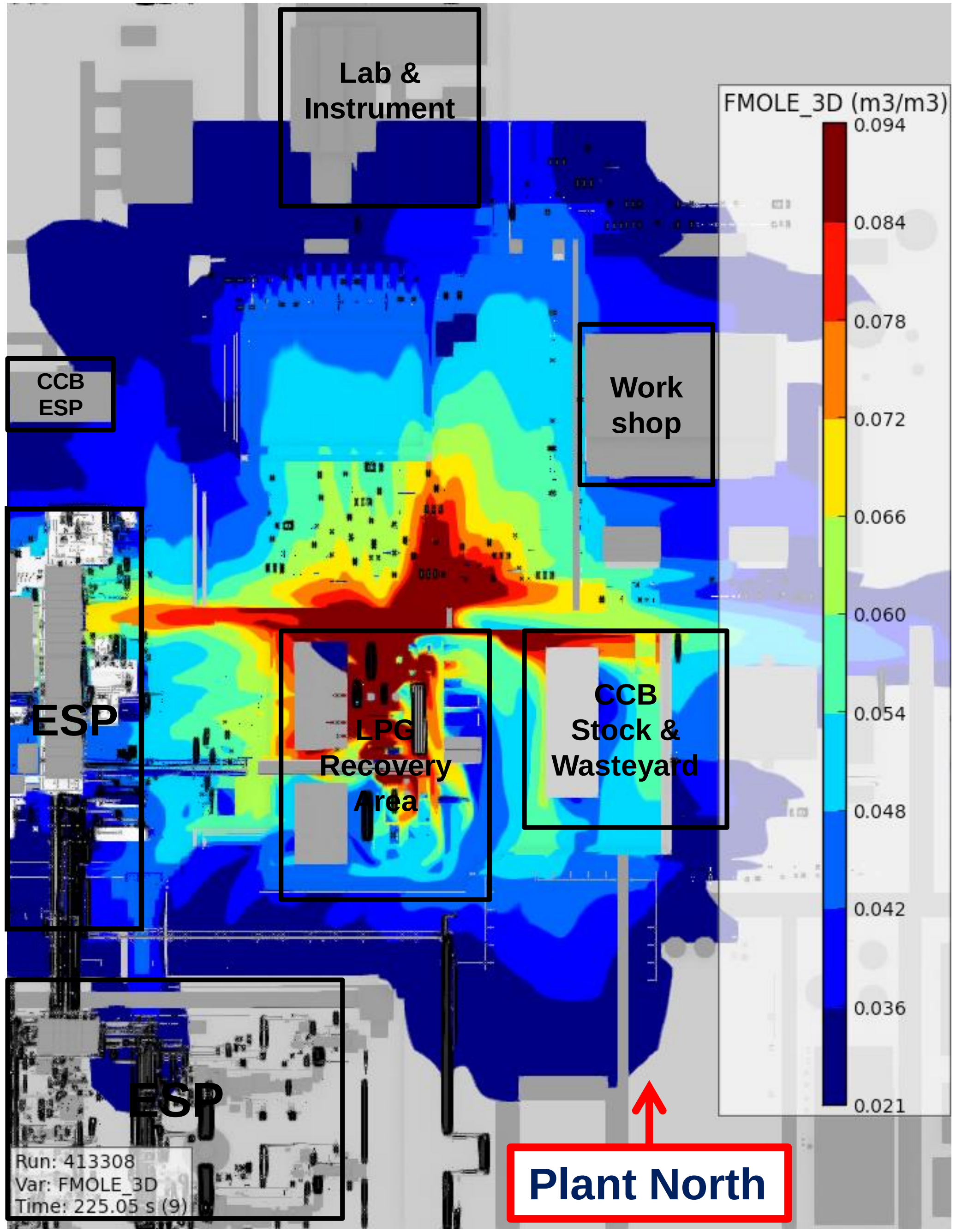


Geometry – Base Case

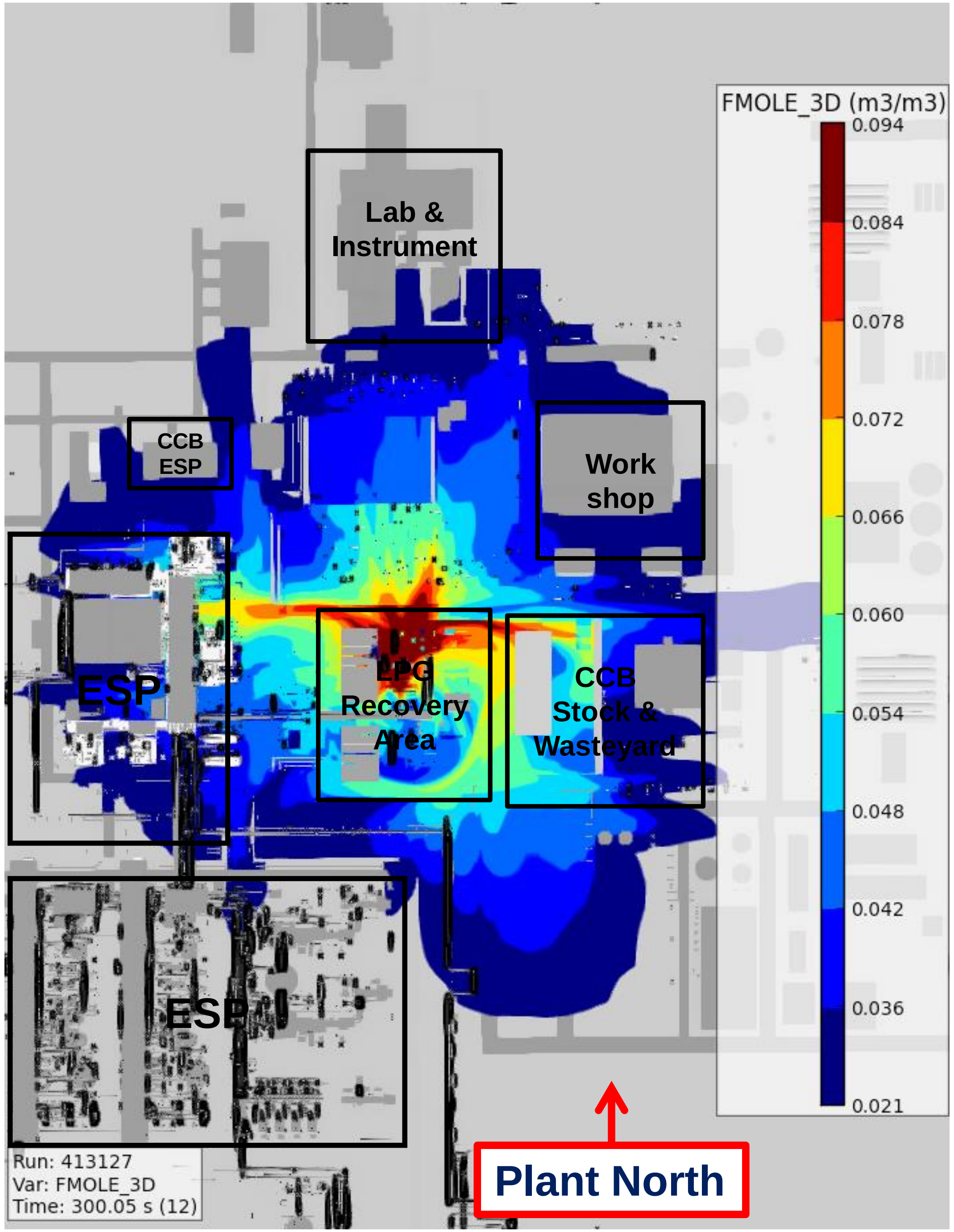


Geometry – Case 1

GEXCON

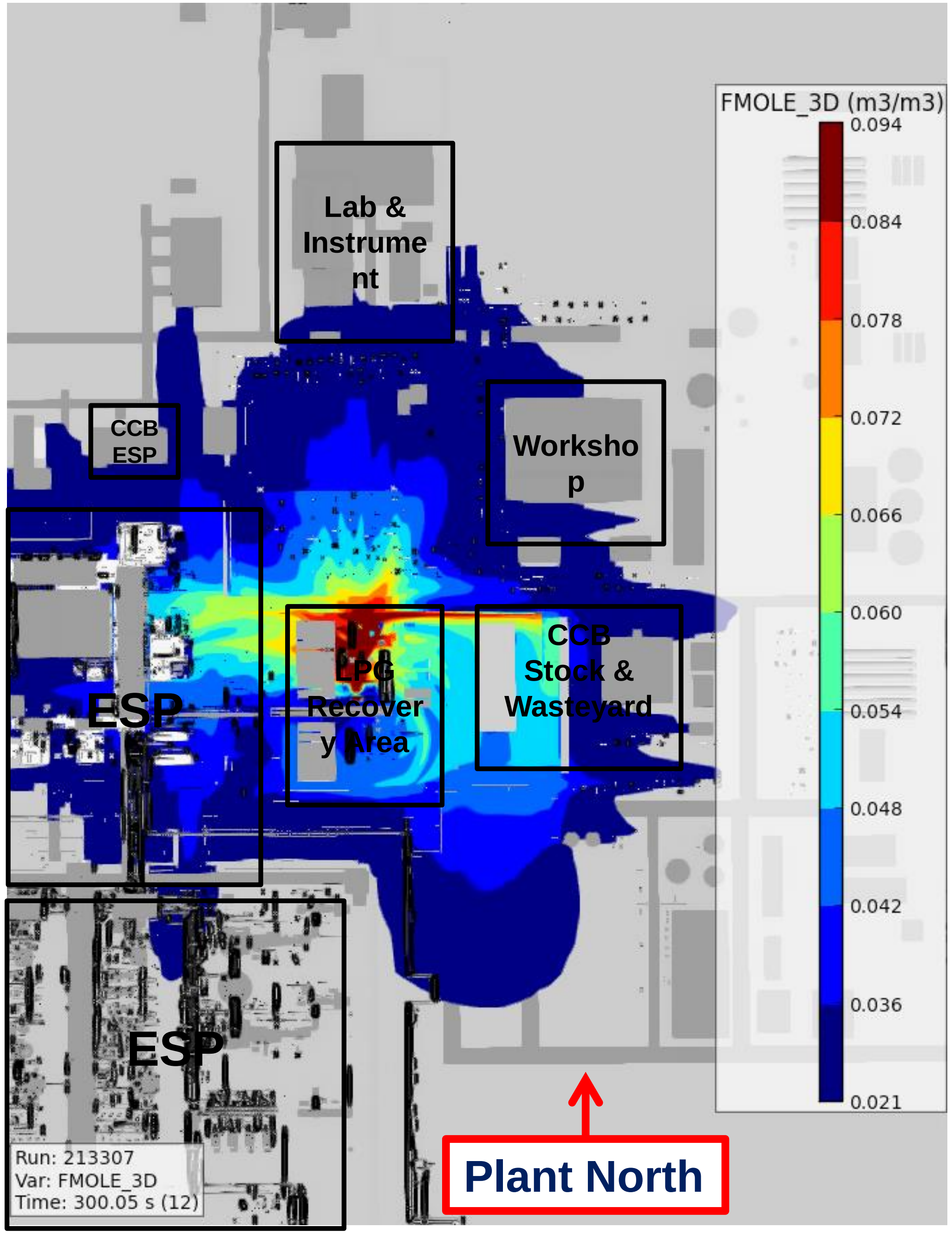


Geometry – Case 1



Geometry – Case 2

GEXCON



Thank You for your Attention

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