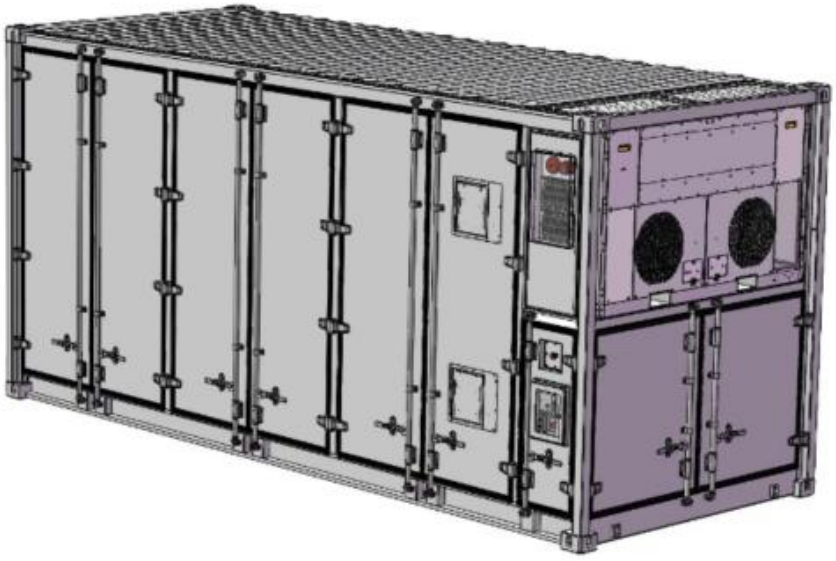
Community Risk Assessment

CT11 BESS

SolBank3.0
Granby, Connecticut

Report | Rev0 | December 3, 2024



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Date	Revision	Reason for Issue	Developed By	Checked By	Approved by
12/03/2024	Rev0	Initial Report	KS	MR	MR

EXECUTIVE SUMMARY

Fire & Risk Alliance, LLC (FRA) was retained by Key Capture Energy, LLC to conduct a Community Risk Assessment (CRA) for the CT11 lithium-ion Battery Energy Storage System (BESS) proposed to be installed in Granby, Connecticut. The CT11 BESS is anticipated to include eight (8) SolBank3.0 cabinets manufactured by Canadian Solar and will have an approximate capacity of 4.99 megawatts (MW). The purpose of this analysis was to evaluate the downwind dispersion distances, concentration profiles, and widths of flammable and toxic releases of battery vent gas during a thermal runaway event. Thermal runaway generates flammable and toxic gases that can be released into the environment during a BESS failure. This analysis provides valuable information regarding the extent of impact to adjacent areas from these gases.

The CRA (commonly referred to as a plume analysis) was performed via a consequence modeling and assessment approach that examines multiple battery vent gas release scenarios possible from a non-flaming propagating thermal runaway event at the CT11 BESS. The Process Hazard Analysis Software Tools (PHAST) Unified Dispersion Model (UDM) was utilized for this analysis. It was based on one SolBank3.0 container that houses 48 battery modules. Each battery module contains 104 cells. In total, one SolBank3.0 contains 4,992 cells. All battery vent gas components modeled in this analysis were based on the gases identified and quantified in the UL 9540A cell test data. These include, Carbon Monoxide (CO) and Carbon Dioxide (CO2) for toxic gas dispersion modeling and Hydrogen, Methane, Ethylene, Ethane, Propylene, Propane, C4 (butylene), and C5 (pentane) for flammable vent gas dispersion modeling.

This analysis evaluated the potential release scenario and consequence extents for a UL 9540A test report-based release, where 5-cells underwent thermal runaway. Results for the UL 9540A based release scenario (5-cells undergoing thermal runaway) showed that there are no significant flammable or toxic gas cloud hazards that extend significantly beyond the immediate release location.

This analysis also considered a potential worst-case upper bounding release scenario and consequence extents for a hypothetical scenario of a full container release (4,992 cells) in 79 minutes. The analysis indicated that concentrations above the Centers for Disease Control and Prevention's Immediately Dangerous to Life or Health (IDLH) value for CO (1200 ppm) were present at a maximum extent of 17.84 m (58.5 ft) from the SolBank3.0 container for the worst-case scenario of the entire SolBank3.0 venting 4,992 cells in 79 minutes. Flash fires were also modeled as a consequence for all scenarios. The flash fire envelope did not extend beyond 7.61 m (25 ft) for the worst case upper bounding scenario (full container release in 79 minutes). Overpressure and fireballs were also modeled as a consequence for all scenarios. Over pressure models indicate that none of the modeled failure scenarios result in a mass and density of flammable gas that is significant enough to cause any overpressure event. Results for the worst-case, full container release scenario demonstrate there are no off-site toxic gas (CO) concentrations above IDLH, thermal radiation (fireball or flash fire), or dangerous overpressure risks due to a vapor cloud explosion.

In summary, the CRA documented in this report utilizing the consequence-based modeling tool PHAST demonstrated that none of the modelled battery gas release scenarios from a SolBank3.0 resulted in flammable gas or toxic gas consequences which extend beyond the CT11 BESS property line.

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1 Introduction

Fire & Risk Alliance (FRA) was retained by Key Capture Energy, LLC (KCE) to conduct a Community Risk Assessment (CRA) for the CT11 lithium-ion Battery Energy Storage System (BESS) in Granby, Connecticut. The CT11 BESS is anticipated to include eight (8) SolBank3.0 cabinets manufactured by Canadian Solar, as shown in Figure 1. It will have an approximate capacity of 4.99 megawatts (MW). This plume analysis was performed via a consequence modeling and assessment approach and examines the battery vent gas release scenarios possible from a non-flaming propagating thermal runaway event affecting specified numbers of cells and modules. This analysis is based on one SolBank3.0 container that contains 48 battery modules. Each battery module contains 104 cells. In total, one SolBank3.0 contains 4,992 cells. The largest potential release scenario assessed in this analysis was for a 48-battery module (4,992 cells) container release as it was deemed the worst-case scenario for a non-flaming thermal runaway event.[1]

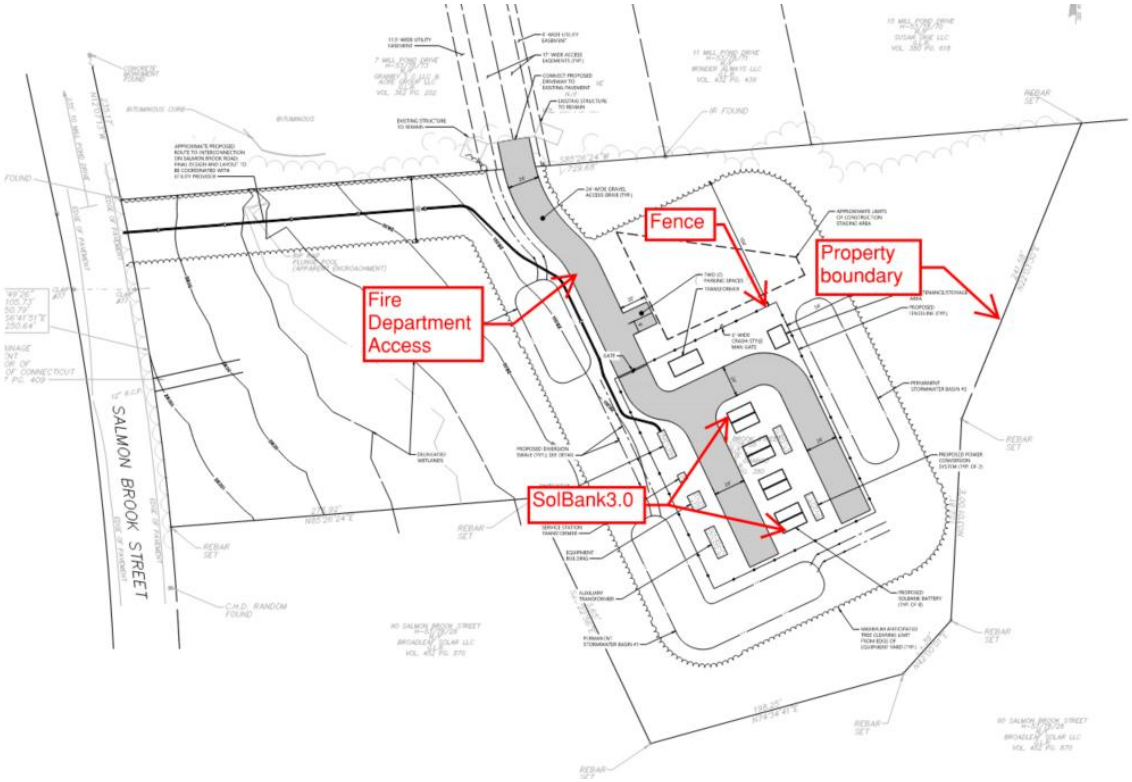

Figure 1 CT11 BESS Site Layout

1.1 Purpose and Scope

The purpose of this analysis is to evaluate the downwind dispersion distances, concentration profiles, and widths of flammable and toxic (CO IDLH) releases of battery vent gas during a thermal runaway event. Thermal runaway generates flammable and toxic gases that can be released into the environment during BESS failure. This analysis provided valuable information regarding the extent of impact to adjacent areas

[1] Non-flaming thermal runaway propagation primarily occurs due to conduction between cells in physical contact. Public research and internal FRA research have shown non-flaming thermal runaway propagation is typically limited to the initiating module as air gaps and physical barriers are sufficient to prevent or significantly delay thermal runaway propagation between the initiating module and adjacent unaffected modules. Thermal runaway propagation could occur simultaneously in multiple modules in extreme events (such as lighting strike or serious BMS level fault) where multiple modules are impacted and are effectively 'an initiating module'. For these reasons an entire container non-flaming gas release event is considered as the worst-case.

from these gases. This analysis is limited to evaluating the extent of gas plumes generated from a non-flaming thermal runaway event.

1.2 Thermal Runaway & Thermal Runaway Propagation Background

For the purpose of this analysis, it is important to understand thermal runaway and the dynamics of thermal runaway propagation as to the potential consequences of these phenomena, with and without the presence of an ignition source. Thermal runaway is a condition in which a self-heating chemical reaction occurs within a battery cell. This occurs when the battery cell generates heat faster than the battery cell is capable of dissipating heat. Thermal runaway can be initiated by physical damage (e.g., puncture, crushing, water damage), electrical malfunctions (e.g., overcharging, water damage), exposure to elevated ambient temperatures (e.g., adjacent cells in thermal runaway with elevated temperatures), manufacturing defects, and other internal conditions which may develop inside of aging battery cells (e.g. dendrites).

Thermal runaway typically results in an overpressure event within the battery cell, due to internal heat generation inside the casing, causing hot battery gases to be ejected from the cell via the pressure relief valve. Depending on the conditions, thermal runaway may be limited to the initiating cell(s) or thermal runaway may propagate to adjacent cells. Thermal runaway propagation typically occurs through conductive and convective heating, or by physical damage of adjacent cells due to swelling of the initiating cell. Conductive heating is the primary mode of heat transfer to adjacent cells for a non-flaming (battery gas release event in the absence of ignition source) event and convective heating is the primary mode of heat transfer to adjacent cells for a flaming event (battery gas release event in the presence of an ignition source). Non-flaming events are typically limited to the initiating module/s based upon a common initiating event. Flaming events typically involve module to module propagation due to pre-heating of cells via the convective heating occurring from combustion.

In conclusion, thermal runaway is a chemical reaction that occurs within a battery cell which results in uncontrolled self-heating. This process can occur from an initiating event without the presence of an ignition source (i.e., non-flaming thermal runaway) or in the presence of an ignition source (i.e., flaming thermal runaway). Thermal runaway can be limited to a single cell or may generate enough heat to propagate to adjacent cells and/or modules. The primary mode of heat transfer in a non-flaming thermal runaway event is conduction and the primary mode of heat transfer in a flaming thermal runaway event is via convection and radiation. Depending upon the specific external conditions existing during a thermal runaway event, a non-flaming or flaming event may occur.

2 SolBank3.0 Container Overview

A brief overview of the SolBank3.0 components is provided below. Additional details may be found in the corresponding UL 9540A reports.

2.1 BESS Cell

The SolBank3.0 utilizes a prismatic lithium iron phosphate (LFP) cell manufactured by Xiamen Hithium Energy Storage Technology, Ltd. as shown in Figure 2. It is model LFP71173207/314Ah and has a nominal capacity of 314-amp hours (Ah), a nominal voltage of 3.2 volts (V) and is hermetically sealed. The cell is equipped with an off-gas vent that is designed to release cell vent gases in the event of a fault. TÜV Rheinland performed UL 9540A cell level testing and issued a report.[2]

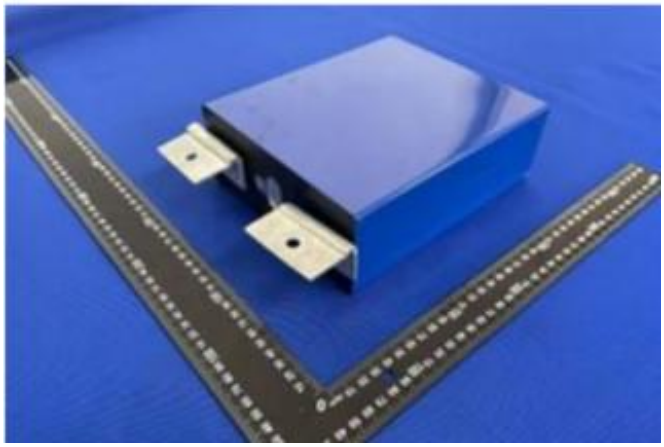

Figure 2 Battery Cell

UL 9540A testing determined that the gas volume released during the cell test measured 130 liters. The cell vent gas flammability properties are shown in Table 1 and the gas composition released during the test is shown in Table 2.

Table 1. Cell test vent gas flammability properties

Vent Gas Information and Flammability Properties	
Average cell surface temperature at gas venting	203.7°C
Average cell surface temperature at thermal runaway	295.7°C
Gas volume	130 L
LFL, % volume in air at the ambient temperature	6.5%
LFL, % volume in air at the venting temperature	8.1%

[2] TÜV Test Report # CN23F118 001, TÜV Rheinland, Issue Date: 2023-12-06

Table 2. Gas composition vented during thermal runaway of cell test

Gas Composition	Cell Gas Analysis	
	Liters	Concentration %
Carbon monoxide	21.1	16.202
Carbon dioxide	34.9	26.861
Hydrogen	64.8	49.875
Methane	4.8	3.671
Ethylene	1.8	1.389
Ethane	0.71	0.548
Propylene	0.97	0.745
Propane	0.23	0.18
C4 (butylene)	0.37	0.288
C5 (pentane)	0.93	0.718
Totals	**130**	**100%**

2.2 BESS Module

The module is the second smallest level of the BESS anatomy. Each module contains 104 model LFP71173207/314Ah cells connected in series, as shown in Figure 3. Each module is rated for 314 Ah, 332.8 V, and 104.5 kWh. TÜV Rheinland performed UL 9540A module level testing and issued a report.[3]

Figure 3 Battery Module

[3] TÜV Test Report # CN248UKE 001, TÜV Rheinland, Issue Date: 2024-06-28

2.3 BESS Unit

The battery unit is the third level of the SolBank3.0 battery anatomy. The SolBank3.0 unit consists of 4 battery modules connected in series, as shown in Figure 4. Two units separated by a Battery Management System (BMS) Box make-up a battery rack. In total, one SolBank3.0 contains 12 battery units (i.e. 6 battery racks) corresponding to 4,992 cells. TÜV Rheinland performed UL 9540A unit level testing and issued a report.[4]

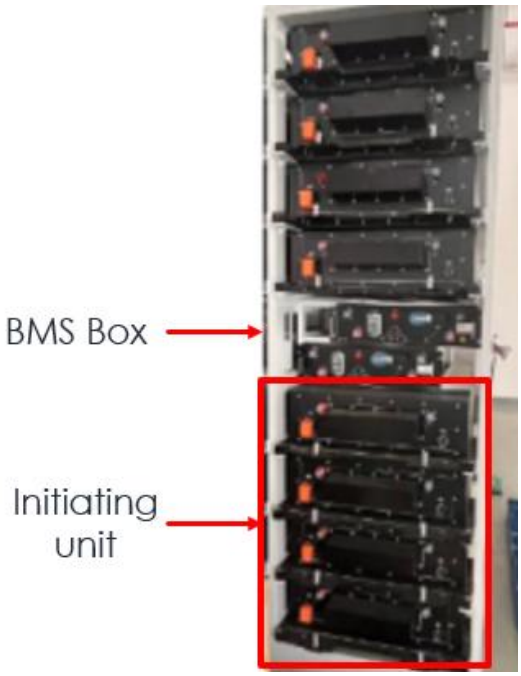

Figure 4. BESS Unit

[4] TÜV Test Report # CN24M32L 001 TÜV Rheinland, Issue Date: 2024-06-28

3 PHAST Consequence Modeling

The Process Hazard Analysis Software Tools (PHAST) Unified Dispersion Model (UDM) was used to calculate the downwind dispersion distances, concentration profiles, and widths of flammable and toxic (CO IDLH) releases of battery vent gas. Dispersion models require the use of an averaging time to calculate the maximum concentration and plume width for the duration of the release and subsequent time until the cloud concentration falls below threshold values for flammable and toxic levels. The averaging time for flammable dispersion models in PHAST is 18.75 seconds and 30 minutes for IDLH concentrations.

Battery vent gas release scenarios were modeled in PHAST to determine the maximum extent of the flammable cloud (4.05% 1/2 LFL, 8.1% LFL from UL 9540A reports), and of the CO IDLH (1200 ppm) component of the cloud. All release timing and mass flow rates for PHAST modeling were based on the conservative values obtained from UL 9540A cell/module test data, with a cell-based mass flow rate for total vent gas (TVG) of 0.000572 kg/s.

The following five (5) scenarios and associated sub-scenarios were modeled in PHAST:

- Scenario 1: UL 9540A Based Scenario (5-cells venting under thermal runaway)
  - 1.1: Propagation rate of 5-cells per 19 minutes from UL 9540A module test for all cells (34.2 lpm for 19 min)
  - 1.2: 10-minute release duration (bounding release duration)
- Scenario 2: 1-Module Release (104-cells)
  - 2.1: Propagation through a single module at a rate of 5-cells per 19 minutes from UL 9540A module test (171.14 lpm for 79 min)
  - 2.2: 10-minute release duration (conservative upper bounding release duration)
- Scenario 3: 1-Unit Release [4 modules] (416-cells)
  - 3.1: Propagation simultaneously through each module at a rate of 5-cells per 19 minutes from UL 9540A module test (684.56 lpm for 79 min)
- Scenario 4: 1-rack Release [8 modules] (832-cells)
  - 4.1: Propagation simultaneously through each module at a rate of 5-cells per 19 minutes from UL 9540A module test (1,369.11 lpm for 79 min)
- Scenario 5: 1-SolBank3.0 Container Release [6 racks] (4,992-cells)
  - 5.1: Propagation simultaneously through each module at a rate of 5-cells per 19 minutes from UL 9540A module test (8,214.68 lpm for 79 min)

The X.1 Scenarios represent a duration of release with cell-to-cell propagation occurring at the rate observed in the UL 9540A test data, scaled to the number of cells. The X.2 Scenarios condense the release volumes to an upper bounding theoretical worst-case release duration of 10 minutes for Scenario 1 and 2 (maximal extent). For all of the above scenarios, the flammable cloud was modeled as a mixture according to the component concentrations listed in the UL 9540A reports and gas properties, and CO was tracked as a component of the release to determine the maximum extent of IDLH concentrations (1200 ppm CO).

3.1 PHAST Model Parameters

Atmospheric stability and wind speed impact the consequence analysis results by increasing or reducing turbidity of the air flow, in turn maximizing or minimizing the dispersion of the vapor cloud. Pasquill stability classes are given in Table 3. Stability Class F was used as it is the most conservative approach (high stability/low turbulence) and maximizes the extent and concentration of the vapor cloud downwind from the release cation.

Table 3. Pasquill Stability Classes

Stability Class	Definition	Stability Class	Definition
A	Very Unstable	D	Neutral
B	Unstable	E	Slightly Stable
C	Slightly Unstable	F	Stable

Long term weather data is not available for the CT11 BESS location; therefore, wind speed data was estimated for the site based on publicly available long-term weather data from nearby areas, as shown in Table 4 and Table 5 below.[5]

Table 4. Weather Stations

Station ID	Station Name
KBDL	Bradley International Airport
KBAF	Barnes Municipal Airport

Table 5. Wind Speeds Utilized

Type	Speed (mph)
Average Low	2
Average	5
Average High	11

The average daily maximum, daily average, and daily minimum wind speeds (2 mph, 5 mph, 11 mph) were used in a sensitivity analysis to determine which wind conditions produced the furthest extent of the cloud (flammable and CO IDLH). As shown below in Figure 5 and Figure 6, the 2 mph wind speed produced the farthest extents for the flammable cloud and CO IDLH, and was used as the baseline for all PHAST modeling scenarios.

[5] It should be noted, the wind study in this section of the report shows the low wind conditions actually result in worst case exposure conditions for flammable and toxic gas exposure (i.e. largest radius). This is because higher winds allow for more mixing of the battery gases with air which dilute the mixture. As such, the higher wind conditions at the site would result in a lesser affected area. Therefore, the results presented in this analysis are conservative for areas with higher wind conditions.

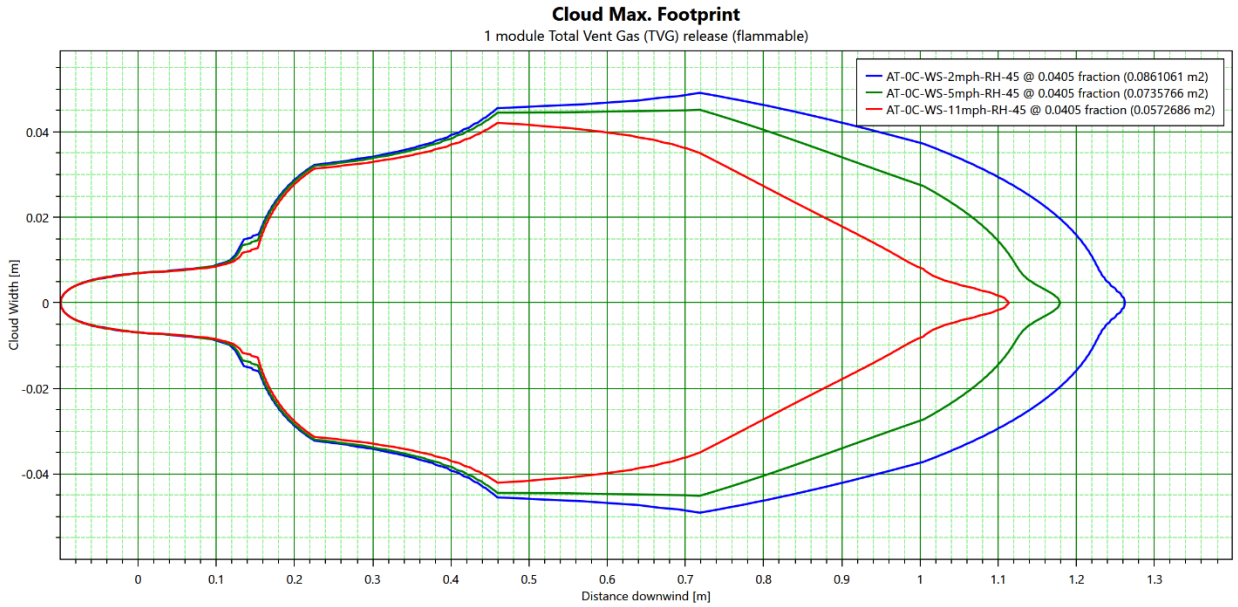

Figure 5 Wind Speed Comparison for TVG ½ LFL Extent (blue = 2 mph)

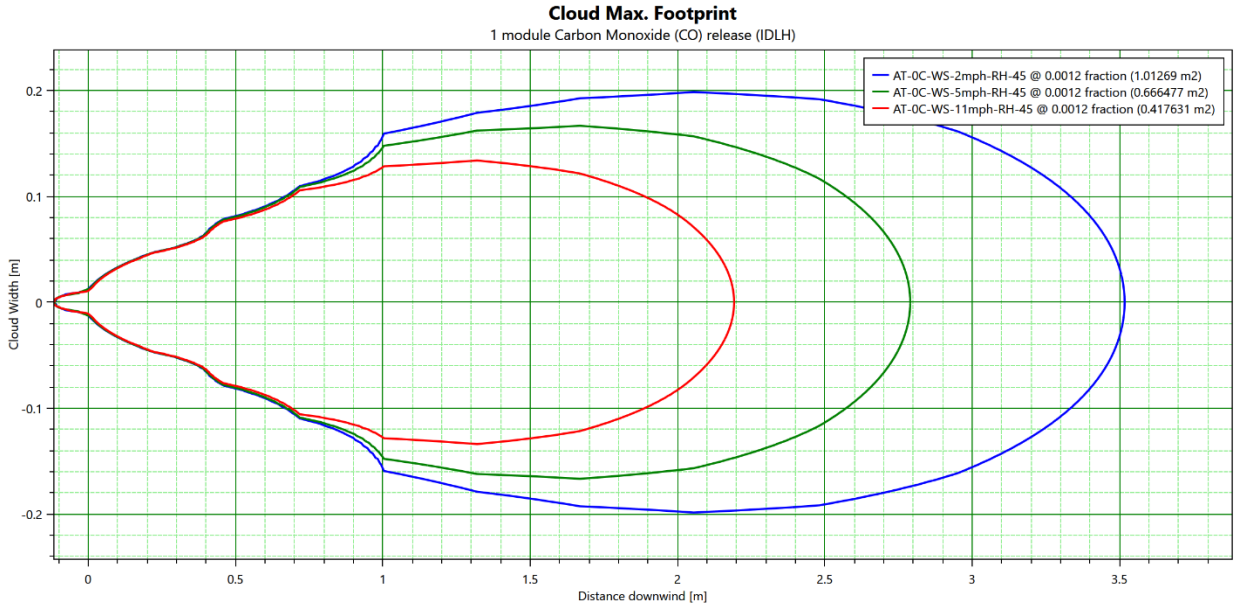

Figure 6 Wind Speed Comparison for CO IDLH Extent (blue = 2 mph)

The mean low temperature and associated relative humidity (RH) for this area were used in this analysis, as listed in Table 6. Utilizing the mean low temperature and associated RH and not a higher temperature consistent with a summer day for instance, produced the farthest extents for the flammable cloud and CO IDLH.

Table 6. Representative Weather Conditions

Component	Facility
Average minimum wind speed (mph)	2
Pasquill stability class	F
Ambient temperature (°F)	32
Relative humidity (%)	45

All other PHAST modeling parameters for release conditions were taken directly from the UL 9540A reports and from the conservative calculations of the battery vent gas release rate, release duration, and propagation rate for individual cells.

4 PHAST Results

Results of the PHAST consequence analysis for the five (5) main battery gas venting scenarios and associated sub-scenarios identified above in Section 3 are summarized below in Tables 7 and 8.

Plan view images are provided in Sections 4.1 through 4.7 below. These images show the horizontal extent of battery gas concentrations and the extent of associated consequences (i.e. flashfire and fireball). Additional images are provided in Appendix A showing the vertical extent of flammable battery gas concentrations and CO IDLH concentrations.

Table 7. Results Summary of Flammable and CO IDLH Extents

Scenario	Sub-Scenario	TVG 100% LFL [m (ft)]	TVG 50% LFL [m (ft)]	CO IDLH [m (ft)]	CO Exposure Duration (min)
1 (5-cell)	1.1 (19-min)	0.25 (0.8)	0.51 (1.6)	1.82 (5.9)	19
	1.2 (10-min)	0.35 (1.14)	0.68 (2.23)	2.33 (7.6)	10
2 (1-module [104 cells])	2.1 (79-min)	0.55 (1.8)	1.26 (4.1)	3.52 (11.5)	79
	2.2 (10-min)	1.55 (5.1)	2.7 (8.8)	8.4 (27.5)	10
3 (1-string [4 modules])	3.1 (79-min)	1.27 (4.1)	1.99 (6.5)	6.31 (20.7)	79
4 (1-rack [8 module])	4.1 (79-min)	1.57 (5.1)	2.72 (8.9)	8.54 (28)	79
5 (1-container [6-racks])	5.1 (79-min)	3.4 (11.1)	6.2 (20.3)	17.84 (58.5)	79

Table 8. Results Summary of Flash Fire, Fireball, and Deflagration Extents

Scenario	Sub-Scenario	Flash Fire Radii [m (ft)]	Fireball 4.7 kW/m^2 Radii (m)	Fireball 12 kW/m^2 Radii (m)	Deflagration (m)		
					0.0206 8 psi	0.13 79 psi	0.2068 psi
1 (5-cell)	1.1 (19-min)	0.64 (2)	-	-	-	-	-
	1.2 (10-min)	1.13 (3.7)	-	-	-	-	-
2 (1-module [104 cells])	2.1 (79-min)	1.46 (4.8)	-	-	-	-	-
	2.2 (10-min)	3.35 (11)	-	-	-	-	-
3 (1-unit [4 modules])	3.1 (79-min)	2.47 (8.1)	-	-	-	-	-
4 (1-rack [8 modules])	4.1 (79-min)	3.39 (11.1)	-	-	-	-	-
5 (1-container [6-racks])	5.1 (79-min)	7.61 (25)	-	-	-	-	-

4.1 Scenario 1 (5-cell release-UL 9540A Based): PHAST Modeling Results for 1.1 & 1.2

4.1.1 Battery Vent Gas ½ LFL & LFL Extents

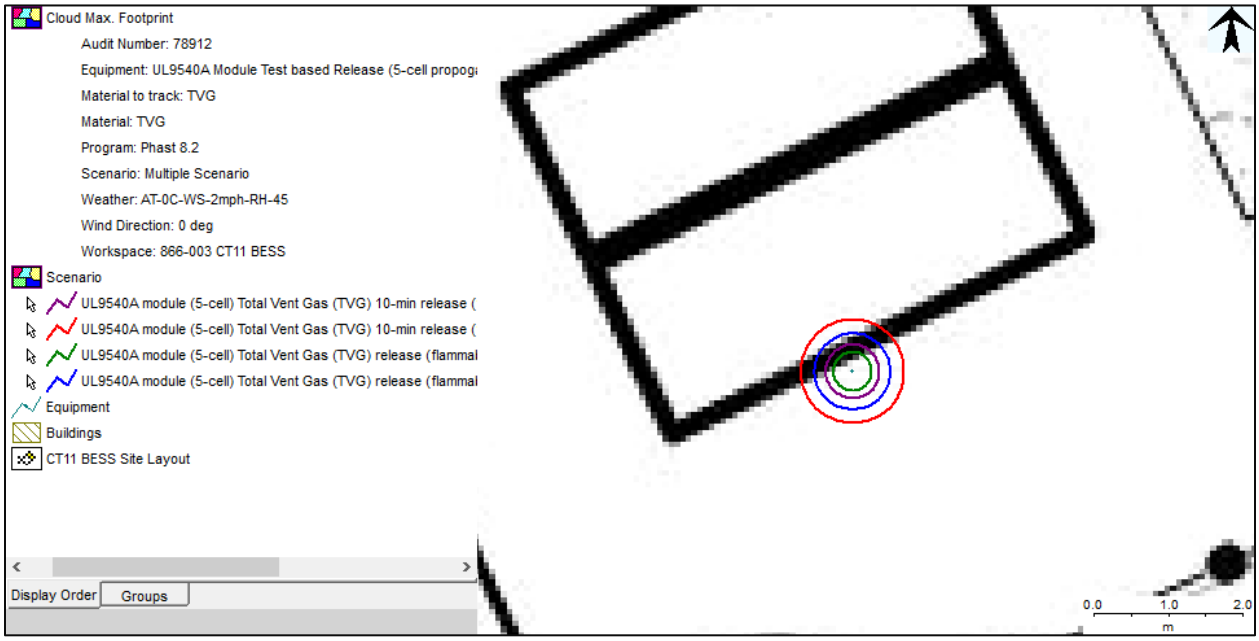

Figure 7 Map of horizontal extent of vapor cloud for LFL (8.1%) and ½ LFL (4.05%)

4.1.2 Carbon Monoxide (CO-1200 ppm) IDLH Extents

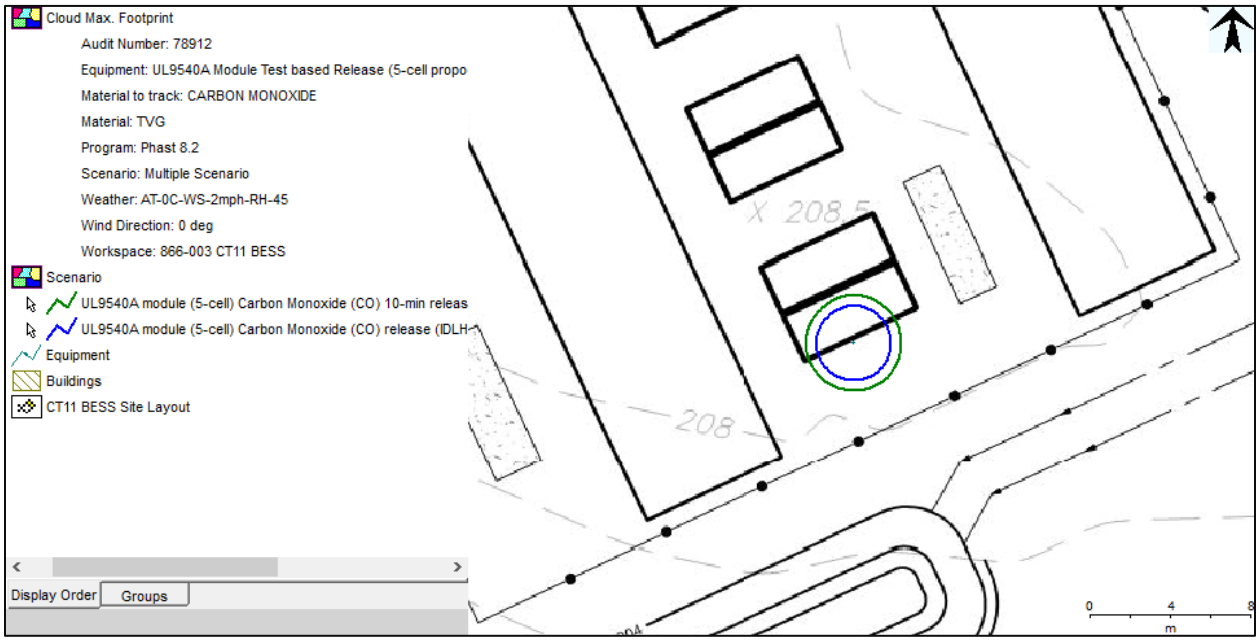

Figure 8 Map of horizontal extent of vapor cloud for CO IDLH (1200 ppm)

4.2 Scenario 2 (1-module [104 cells] release): PHAST Modeling Results for 2.1 & 2.2

4.2.1 Battery Vent Gas ½ LFL & LFL Extents

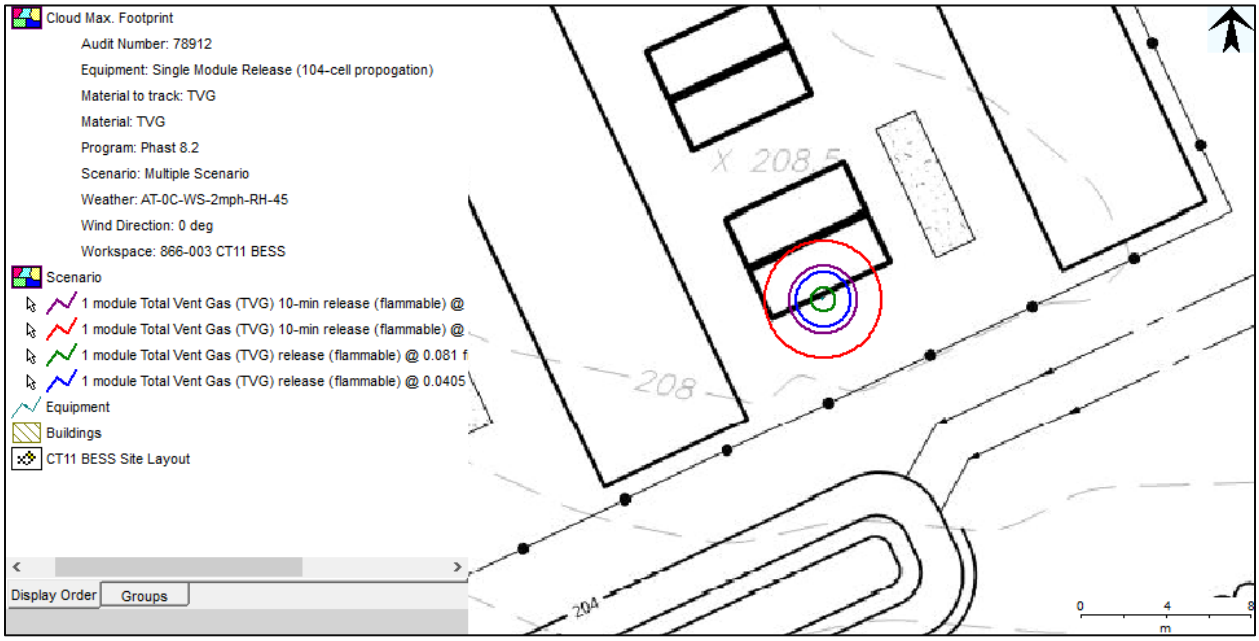

Figure 9 Map of horizontal extent of vapor cloud for LFL (8.1%) and ½ LFL (4.05%)

4.2.2 Carbon Monoxide (CO-1200 ppm) IDLH Extents

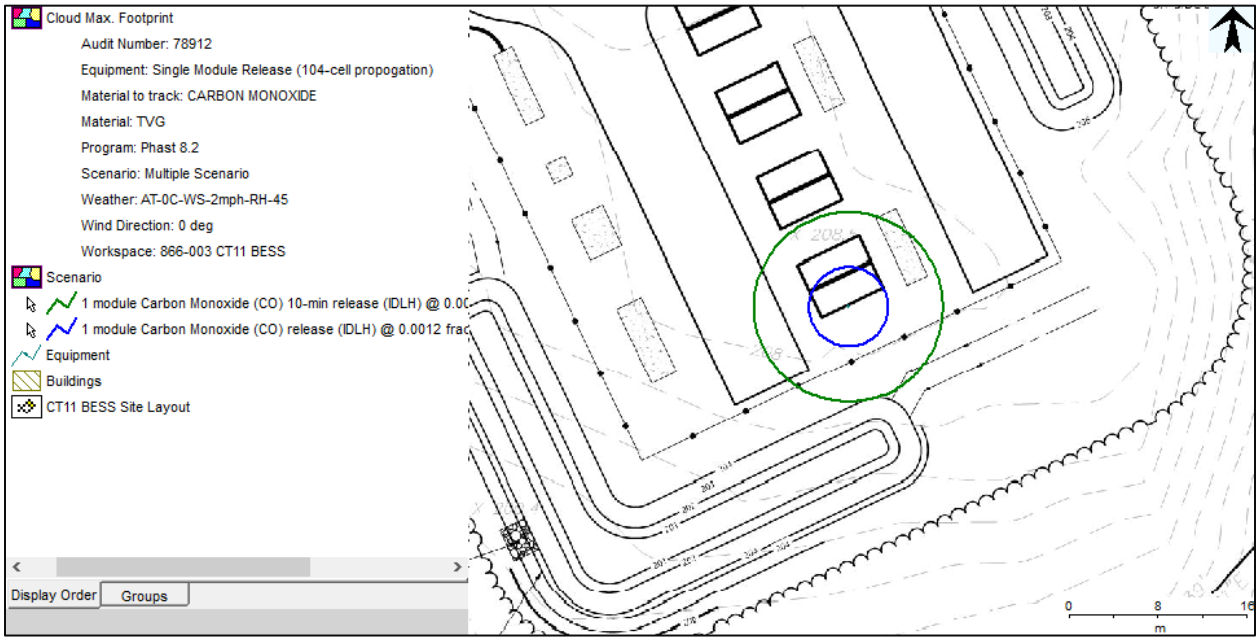

Figure 10 Map of horizontal extent of vapor cloud for CO IDLH (1200 ppm)

4.3 Scenario 3 (1-unit [4 module] release): PHAST Modeling Results for 3.1

4.3.1 Battery Vent Gas ½ LFL & LFL Extents

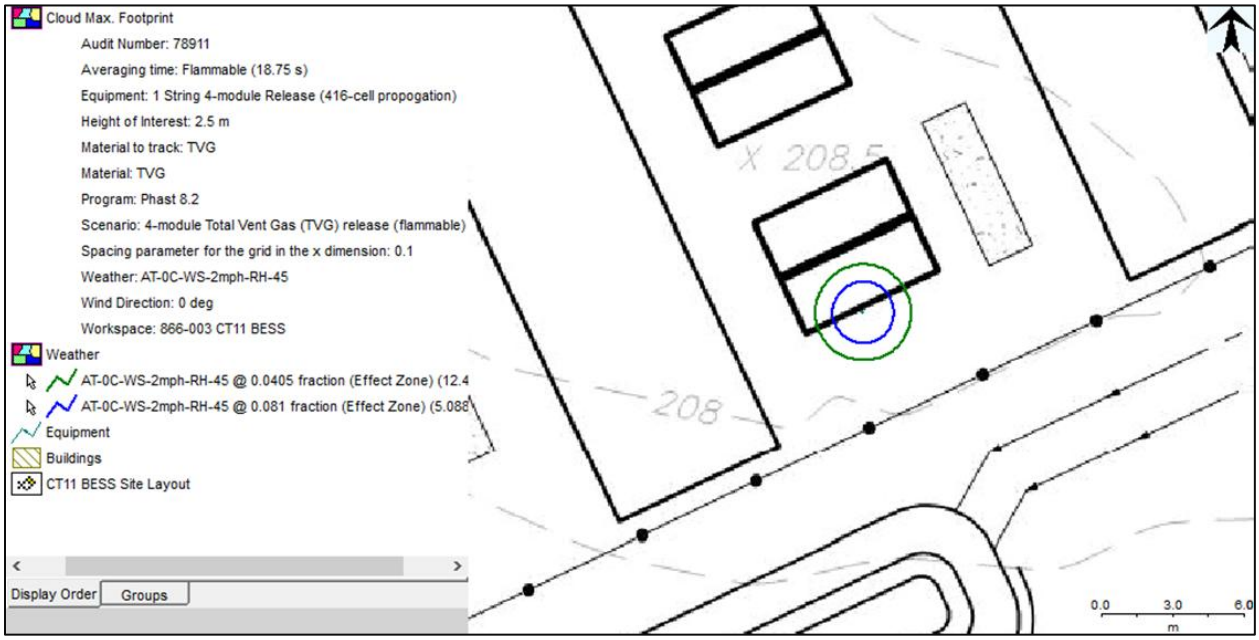

Figure 11 Map of horizontal extent of vapor cloud for LFL (8.1%) and ½ LFL (4.05%)

4.3.2 Carbon Monoxide (CO-1200 ppm) IDLH Extents

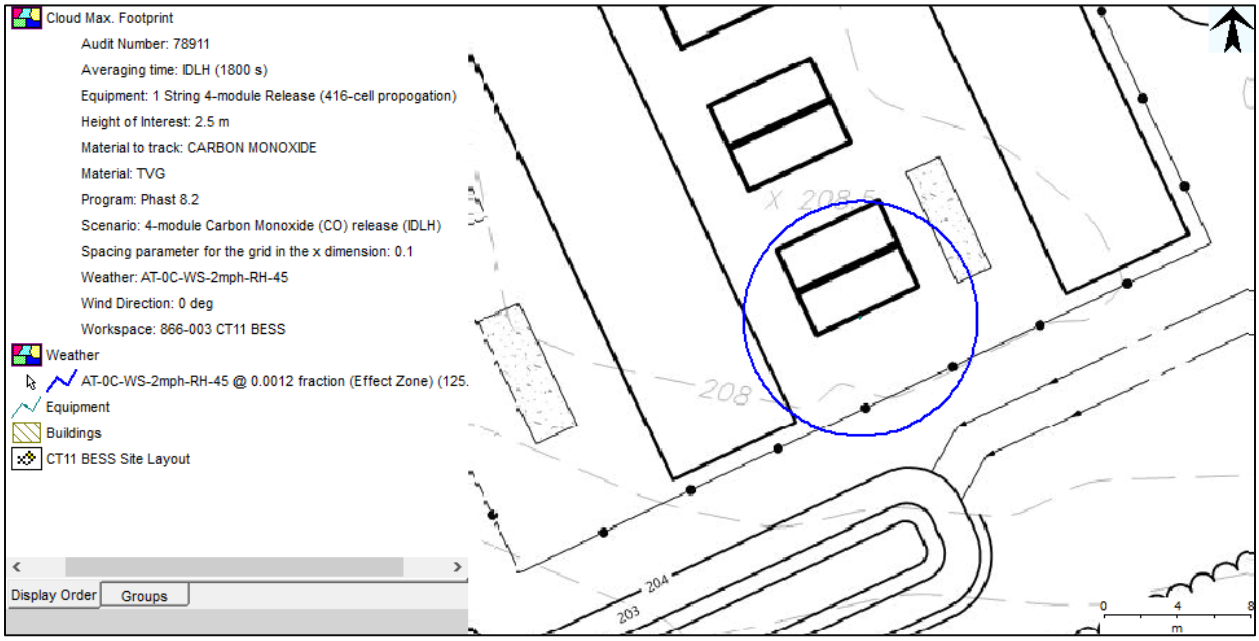

Figure 12 Map of horizontal extent of vapor cloud for CO IDLH (1200 ppm)

4.4 Scenario 4 (1-rack [8 module] release): PHAST Modeling Results for 4.1

4.4.1 Battery Vent Gas ½ LFL & LFL Extents

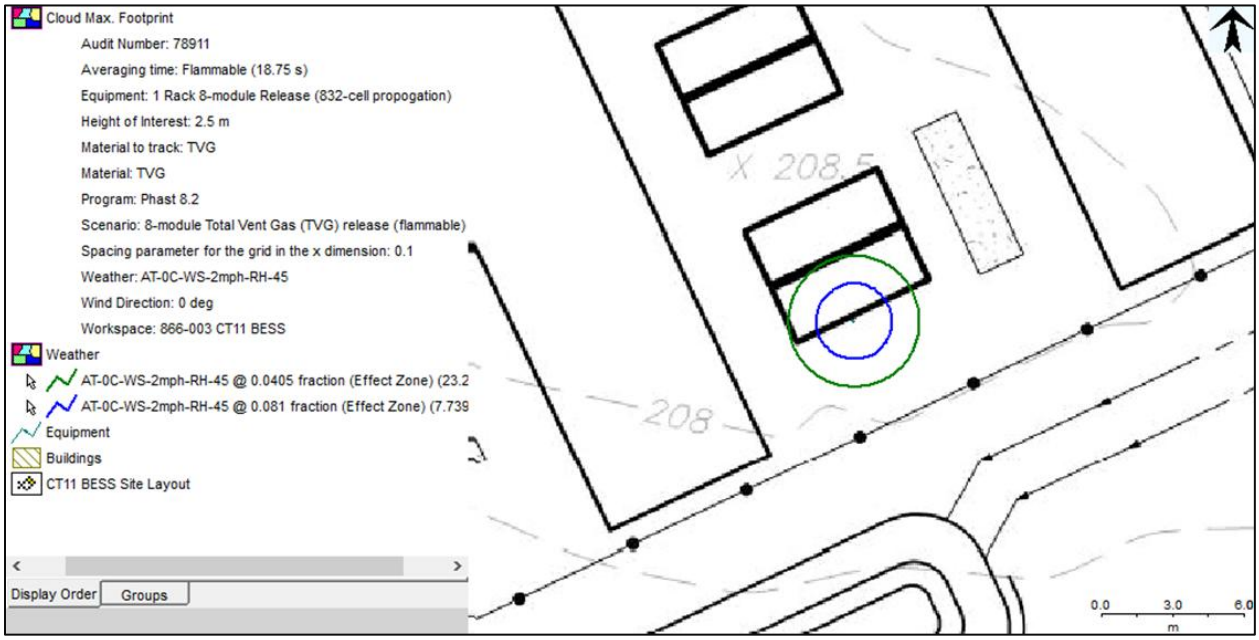

Figure 13 Map of horizontal extent of vapor cloud for LFL (8.1%) and ½ LFL (4.05%)

4.4.2 Carbon Monoxide (CO-1200 ppm) IDLH Extents

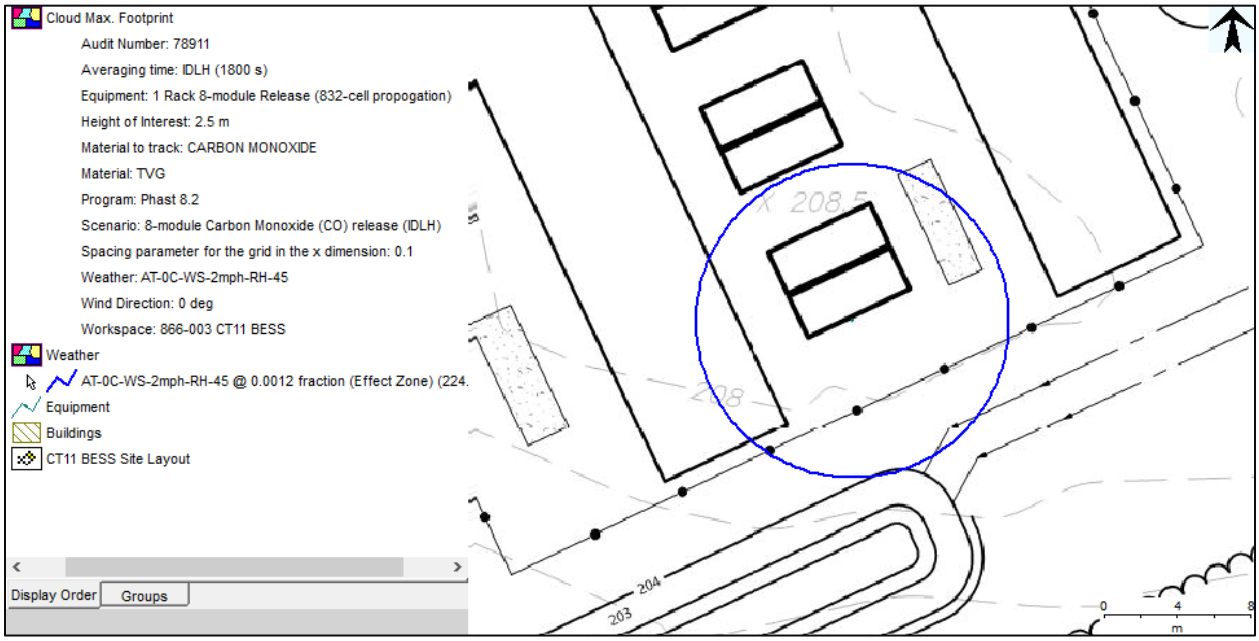

Figure 14 Map of horizontal extent of vapor cloud for CO IDLH (1200 ppm)

4.5 Scenario 5 (1-container [48 module] release): PHAST Modeling Results for 5.1

4.5.1 Battery Vent Gas ½ LFL & LFL Extents

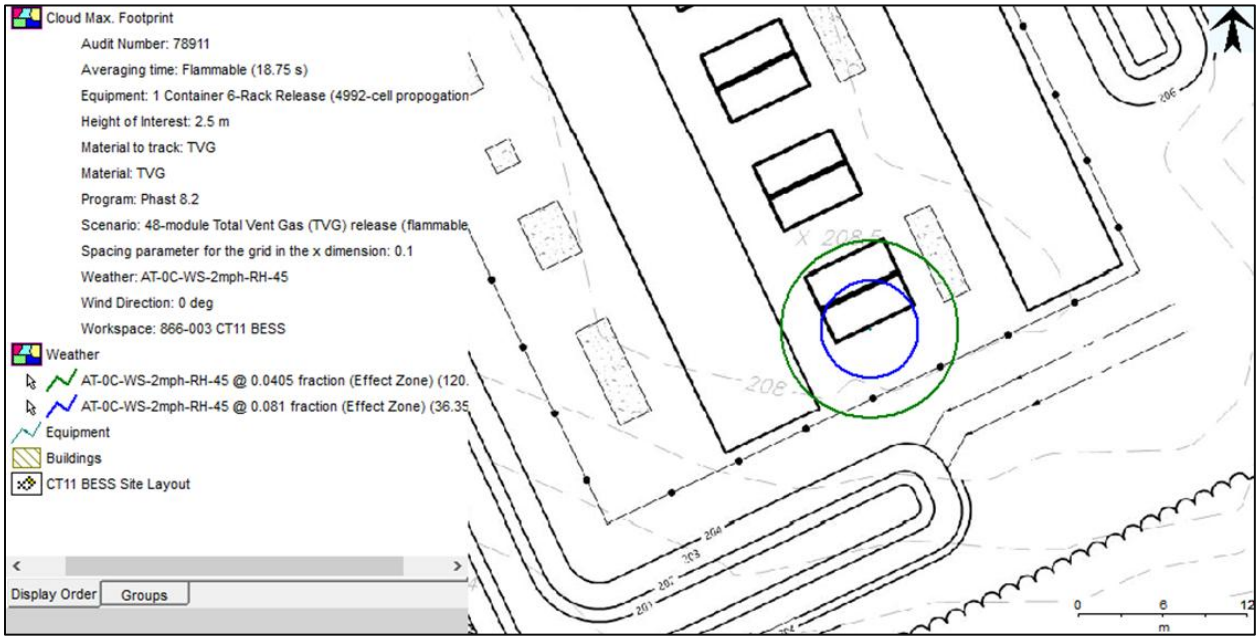

Figure 15 Map of horizontal extent of vapor cloud for LFL (8.1%) and ½ LFL (4.05%)

4.5.2 Carbon Monoxide (CO-1200 ppm) IDLH Extents

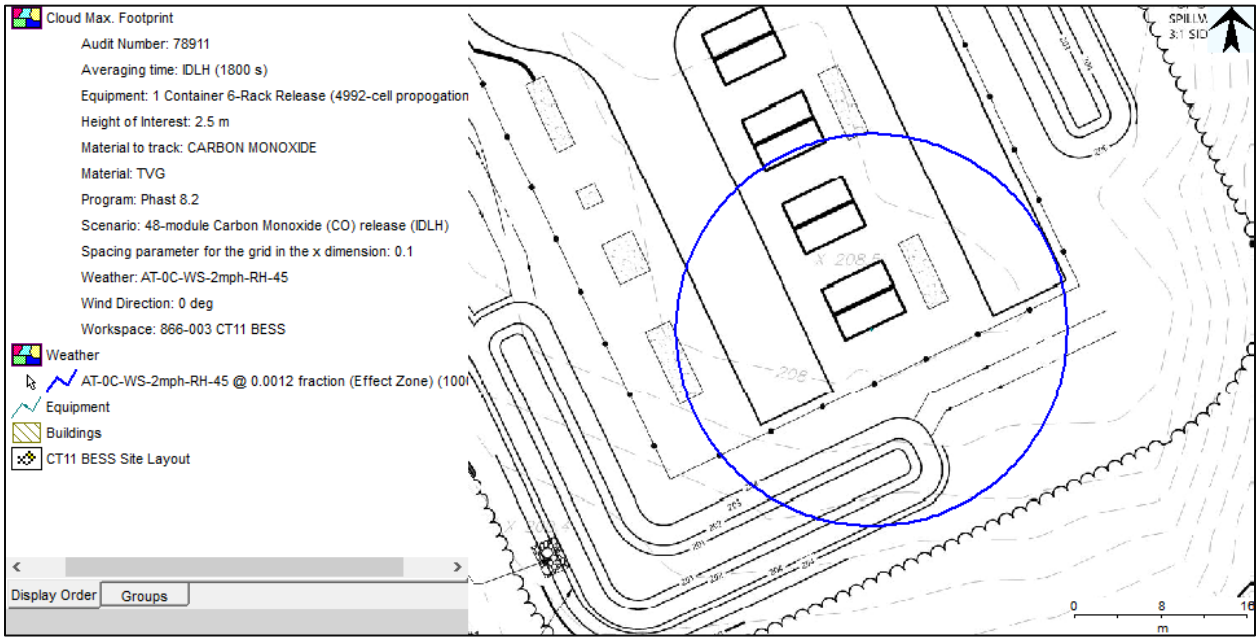

Figure 16 Map of horizontal extent of vapor cloud for CO IDLH (1200 ppm)

4.6 Scenarios 1-5: Flash-Fire Results

A flash fire occurs when the battery vent gas released is diffused in air such that all flammable fuel shall be consumed nearly instantaneously once ignited. In a flash fire the flame front accelerates rapidly from the ignition point to the limit of the flammable cloud, after which it immediately goes out. Thus, the duration of heat flux values equal to those sufficient to ignite flammable clothing or cause second-degree burns to exposed skin does not occur for more than 1-3 seconds (NFPA defines the upper limit of a flash fire to be 3 seconds) in any single location within the flash fire envelope.

4.6.1 Scenario 1 (5-cell release): Sub-Scenarios 1.1 & 1.2

Figure 17 Maximum Extent of Flash Fire Envelope (duration < 3 sec)

4.6.2 Scenario 2 (1-module [104 cells] release): Sub-Scenarios 2.1 & 2.2

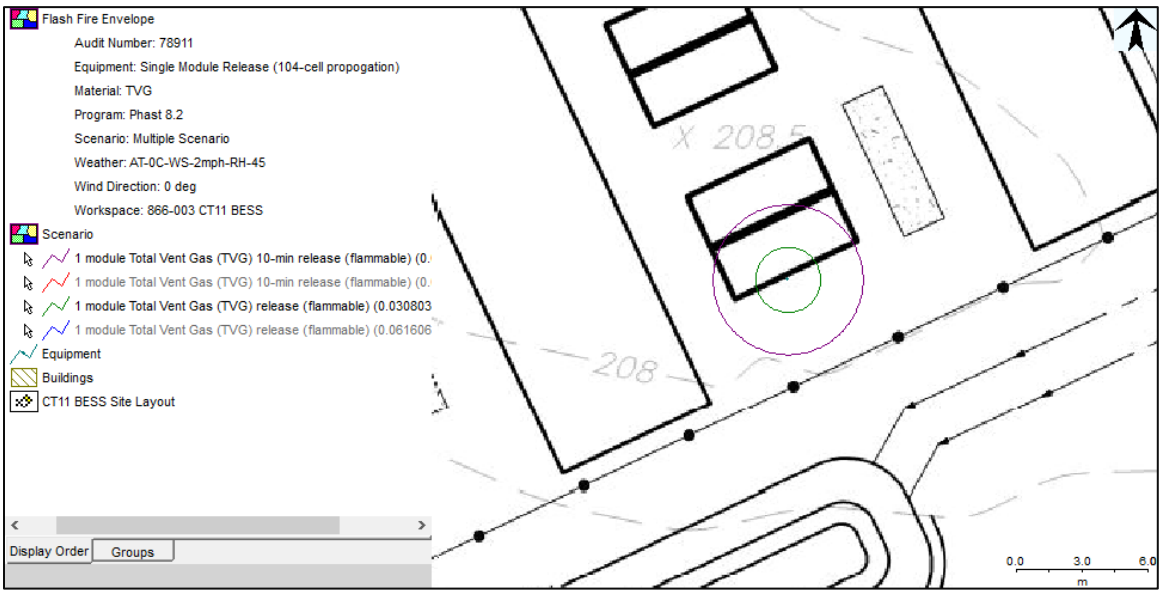

Figure 18 Maximum Extent of Flash Fire Envelope (duration < 3 sec)

4.6.3 Scenario 3 (1-unit [4 module] release): Sub-Scenario 3.1

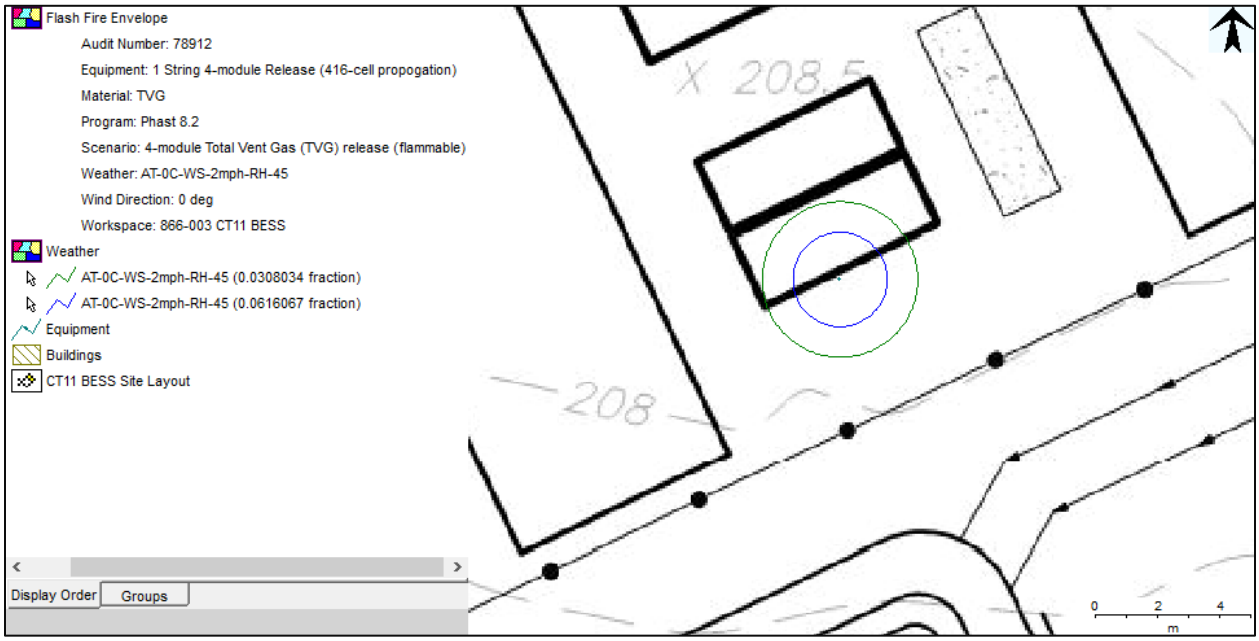

Figure 19 Maximum Extent of Flash Fire Envelope (duration < 3 sec)

4.6.4 Scenario 4 (1-rack [8 module] release): Sub-Scenario 4.1

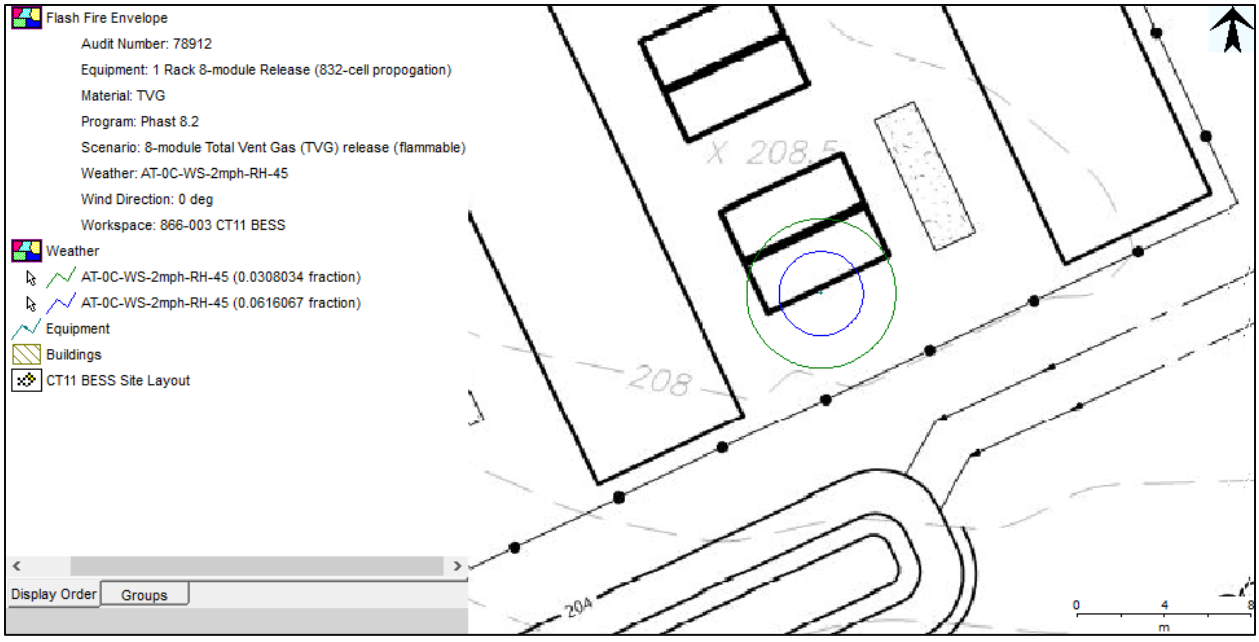

Figure 20 Maximum Extent of Flash Fire Envelope (duration < 3 sec)

4.6.5 Scenario 5 (1-container [48 module] release): Sub-Scenario 5.1

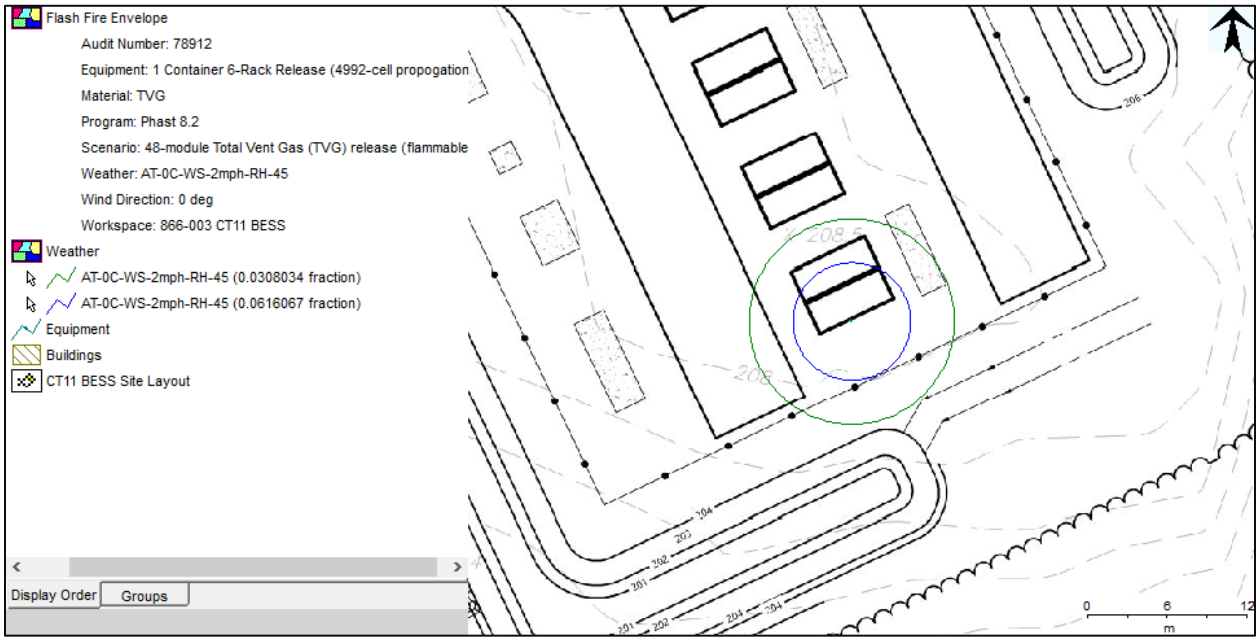

Figure 21 Maximum Extent of Flash Fire Envelope (duration < 3 sec)

4.7 Explosion & Fireball Results

None of the modeled battery vent gas release scenarios led to the consequence of an explosion or fireball based on the release rates and release volumes. Based on these results there is no thermal radiation risk identified from the release of battery gas to atmosphere leading to a fireball or flash fire, and there is no significant risk from dangerous overpressures due to a vapor cloud explosion.

5 Conclusions

The community risk assessment documented in this report utilizing the consequence-based modeling tool PHAST demonstrated that none of the modelled battery gas release scenarios from a SolBank3.0 result in flammable gas or toxic gas consequences which extend beyond the CT11 BESS property line. The maximum extent of impact from ½ LFL flammable vapor cloud was 6.2 m (20.3 ft) from a SolBank3.0 container and the maximum extent of carbon monoxide in concentrations exceeding the IDLH was 17.84 m (58.5 ft). Section 5.1 and 5.2 below provide visual comparisons of the consequence extents for all modeled gas release scenarios.

Additionally, it should be noted, although Scenario 5 (1-container, full unit release) was included in the analysis for understanding the conservative upper bounding scenario of a non-flaming gas release from all cells within all modules of the SolBank3.0, it is not a likely or even feasible scenario. The UL 9540A reports demonstrated that thermal runaway did not propagate from module-to-module. Additionally, there are no documented occurrences in BESS literature, in documented BESS failures, or even anecdotal case reports that support a mechanism of failure that would cause a non-flaming thermal runaway event to occur in all cells of a BESS container in this short duration (79 minutes). As such, there is no documented way for all 104-cells within a module or for 4,992 cells within a container, to undergo non-flaming thermal runaway from a single failure. Rather, propagation from cell to cell would remain a component of the release timing, conditions, and consequences for all potential single failures leading to thermal runaway and battery gas venting events.

5.1 Total Vent Gas LFL Extent

In conclusion, modeling results for all UL 9540A based Scenarios and sub-scenarios showed no significant impacts from flammable battery vent gas dispersion.

The maximum extent of impact, from the ½ LFL flammable vapor cloud (4.05%), was 6.2 m (20.3 ft) for a hypothetical full container release based on UL 9540A module level propagation data where the battery vent gas from all 48-modules (Scenario 5.1) is released to atmosphere within 79-minutes, as shown below in comparison to the other release scenarios.

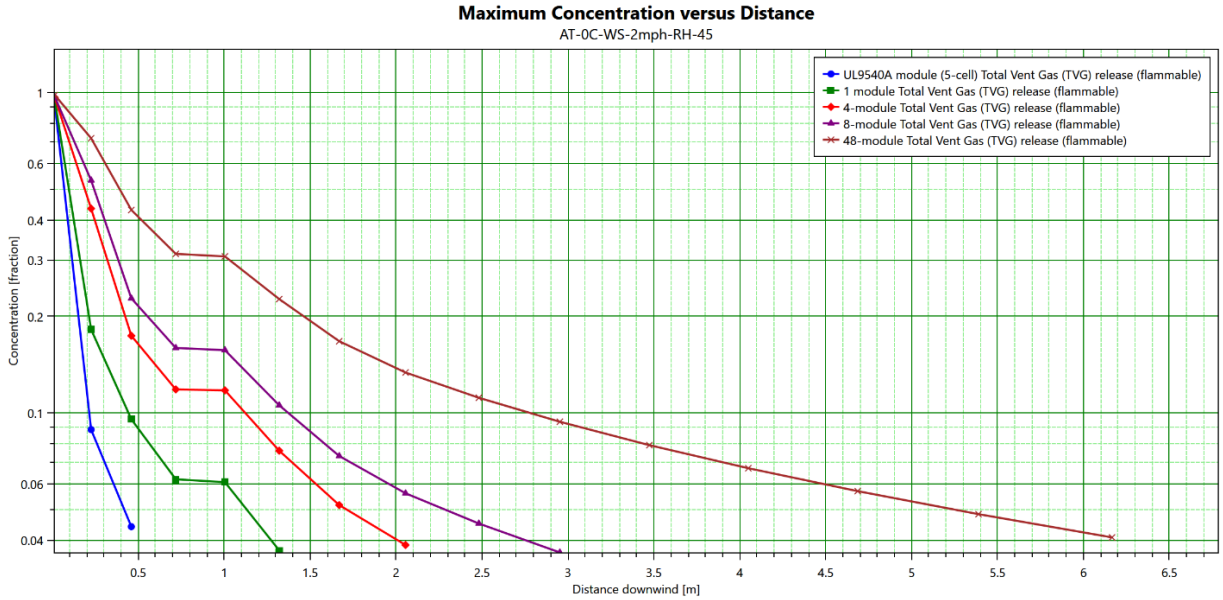

Figure 22 Concentration vs Distance for Sub-Scenarios X.1 (UL9450A cell-to-cell release duration)

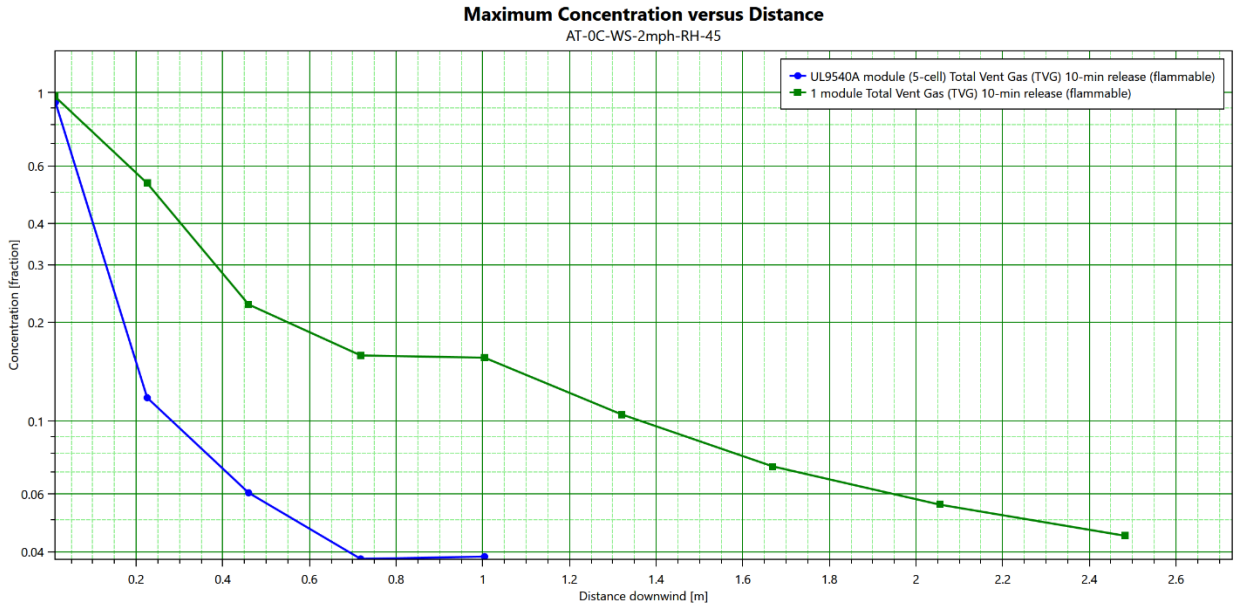

Figure 23 Concentration vs Distance for Sub-Scenarios X.2 (10-minute release duration)

5.1.1 Flash Fires

Flash fires were a modeled consequence for all scenarios. The flash fire envelope did not extend beyond the property boundaries for any scenarios. Even within the affected area onsite, the duration of heat flux values equal to those sufficient to ignite flammable clothing or cause second-degree burns to exposed skin does not occur for more than 1-3 seconds (NFPA defines the upper limit of a flash fire to be 3 seconds) in any single location within the flash fire envelope.

As such, there would be no significant risk to persons or property from either of the above-listed scenarios.

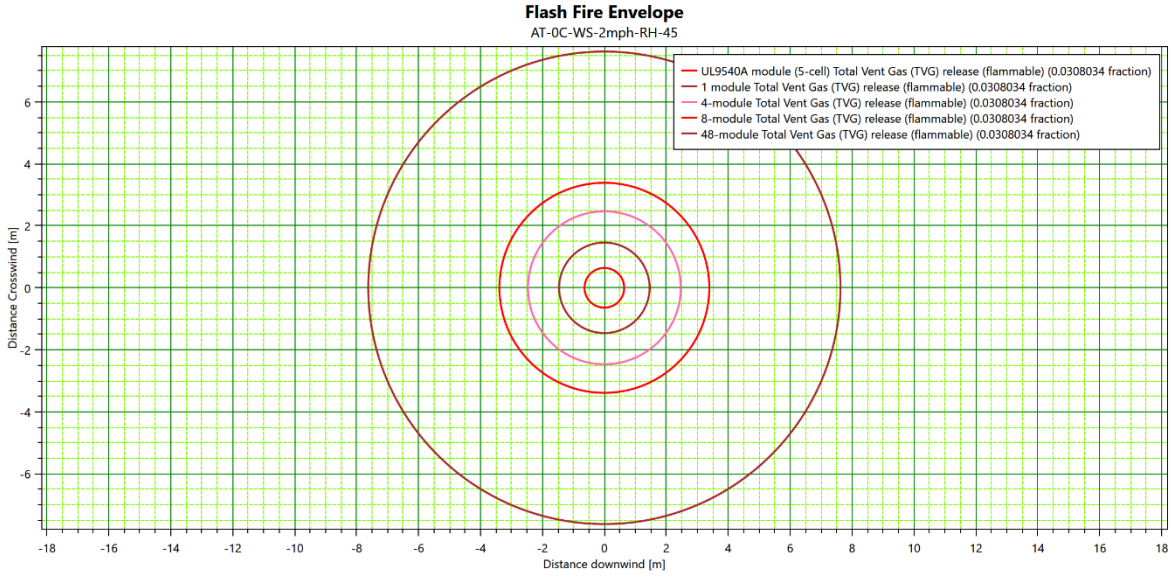

Figure 24 Flash Fire Envelope for Sub-Scenarios X.1 (UL9450A cell-to-cell propagation release duration)

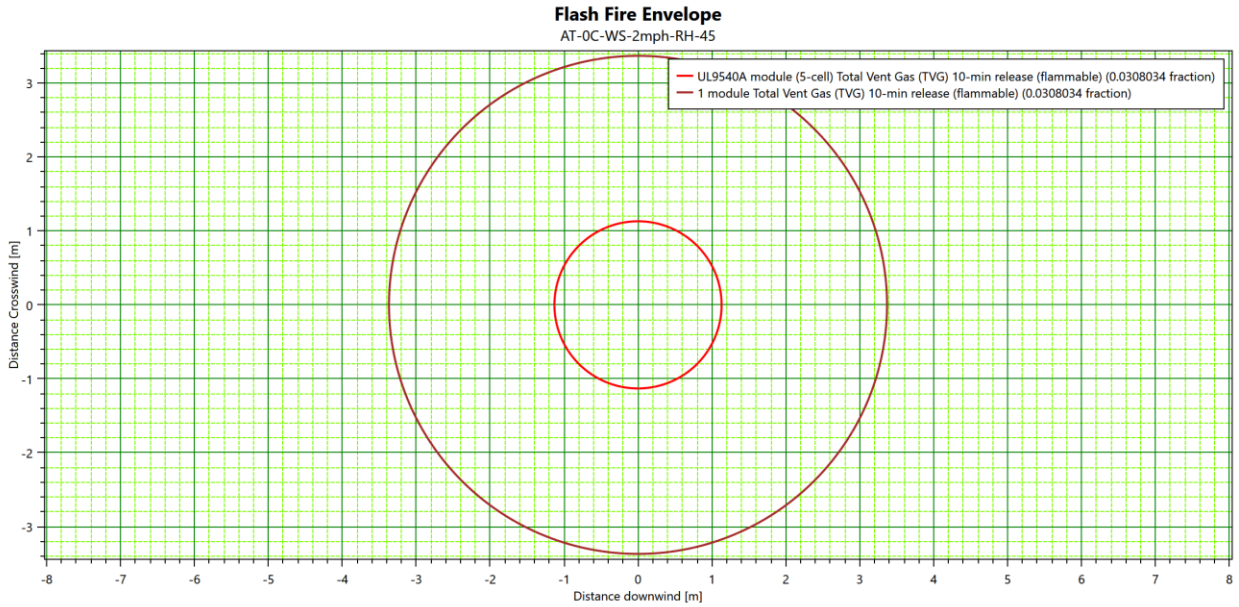

Figure 25 Flash Fire Envelope for Sub-Scenarios X.2 (10-minute release duration)

5.2 Carbon Monoxide IDLH Extent

The maximum extent of impact for carbon monoxide in battery vent gas dispersion in concentrations greater than or equal to the IDLH (1200 ppm) occurred during a hypothetical full container release based where the battery vent gas from all 48-modules (Scenario 5.1) is released to atmosphere within 79-minutes based on UL 9540A module level propagation rates. The maximum extent for Scenario 5.1 was 17.84 m (58.5 ft), as shown below in comparison to the other release scenarios. Additionally, it should be noted, the risk from CO exposure is a factor of concentration and exposure time, with a required minimum exposure time of 30-minutes at the IDLH concentration of 1200 ppm.

Based on the results, there is no significant risk from CO exposure from any modeled scenario off-site.

See the below quote from the CDC CO IDLH publication as reference.

> *"It has been stated that a 1-hour exposure to 1,000 to 1,200 ppm would cause unpleasant but no dangerous symptoms, but that 1,500 to 2,000 ppm might be a dangerous concentration after 1 hour [Henderson et al. 1921a, 1921b].* ***In general, a carboxyhemoglobin (COHb) level of 10-20% will only cause slight headaches [NIOSH 1972]*** *and a COHb of 11-13% will have no effect on hand and foot reaction time, hand steadiness, or coordination [Stewart and Peterson 1970]. At a COHb of 35%, manual dexterity is impaired [Stewart 1975]. At 40% COHb, mental confusion, added to increasing incoordination, precludes driving an automobile [Stewart 1975].* ***A 30-minute exposure to 1,200 ppm will produce a COHb of 10-13% [NIOSH 1972]***

6 Limitations

At the request of KCE, FRA performed a community risk assessment for Canadian Solar's SolBank3.0 lithium-ion BESS. The SolBank3.0 is a fully integrated BESS consisting of battery modules, power electronics, control systems, a battery management system, a thermal management system, and an explosion control system all pre-assembled within a single, non-occupiable cabinet. It is meant for outdoor installations, mounted to the ground, for commercial, industrial, and utility applications. This assessment evaluated the plume dynamics from a release of battery vent gas due to a propagating thermal runaway event from the SolBank3.0 at the CT11 BESS Site. The modeled battery vent gas release scenarios could be caused by a non-flaming propagating thermal runaway event affecting specified numbers of cells and modules. This analysis is based on one SolBank3.0 container that contains 48 modules, each with 104 cells, totaling 4,992 cells per container.

The scope of services performed during this analysis may not adequately address the needs of other users of this report, and any re-use of this report or its conclusions presented herein are at the sole risk of the user. The opinions and comments formulated during this assessment are based on observations and information available at the time of the analysis from the UL 9540A tests provided to FRA by KCE. Any engineering analysis that utilizes modeling and calculations, such as the one presented in this report, has inherent limitations. While the methodology and assumptions used are based on best practices and available data, there are inherent assumptions made in any analysis and there may be additional uncertainties and unknown factors that can affect the accuracy of the results. Additionally, the analysis is limited by the quality and quantity of the data available at the time of the study. Therefore, the results of this analysis should be interpreted with these limitations in mind and should not be considered as absolute or definitive. No guarantee or warranty as to future performance is expressed or implied.

Appendix A: Graphical Results (PHAST Analysis)

Appendix B: Consequence Summary Report

APPENDIX A: GRAPHICAL RESULTS (PHAST ANALYSIS)

1.0 SCENARIO 1: 5-CELL UL9540A THERMAL RUNAWAY (FROM UL9540A TEST DATA)

1.1 TVG Flammable Vapor Cloud Extent (19 min Release)

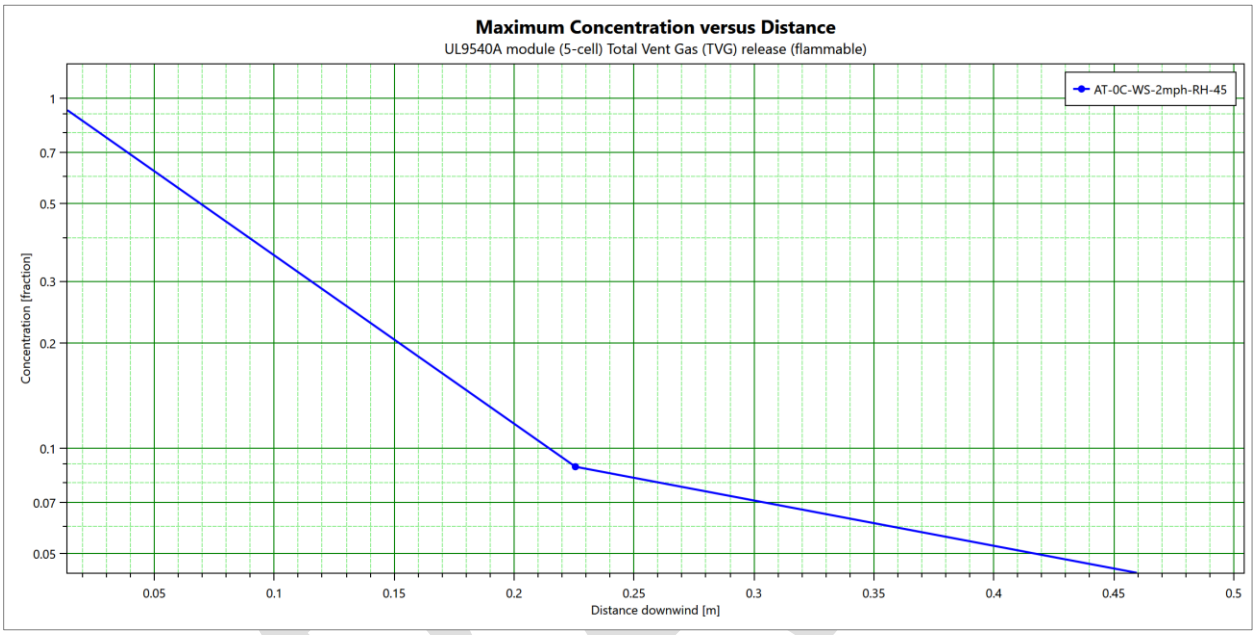

Figure 1 Maximum concentration vs distance for flammable vapor cloud

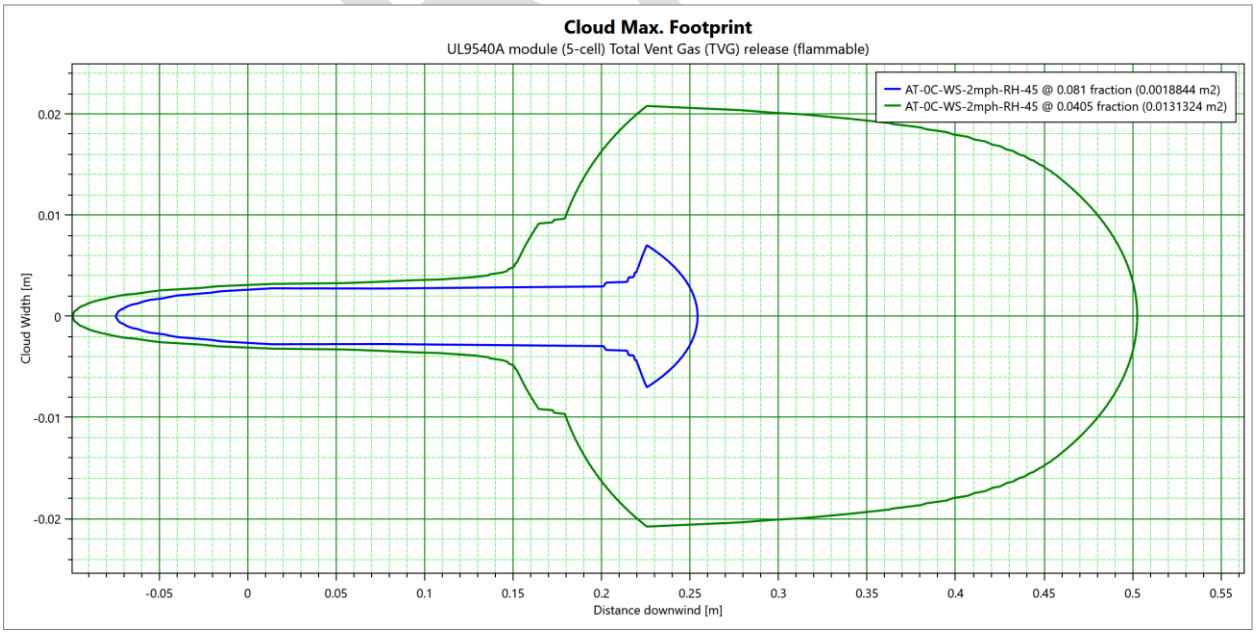

Figure 2 Maximum horizontal extent of vapor cloud for LFL (8.1%) and ½ LFL (4.05%)

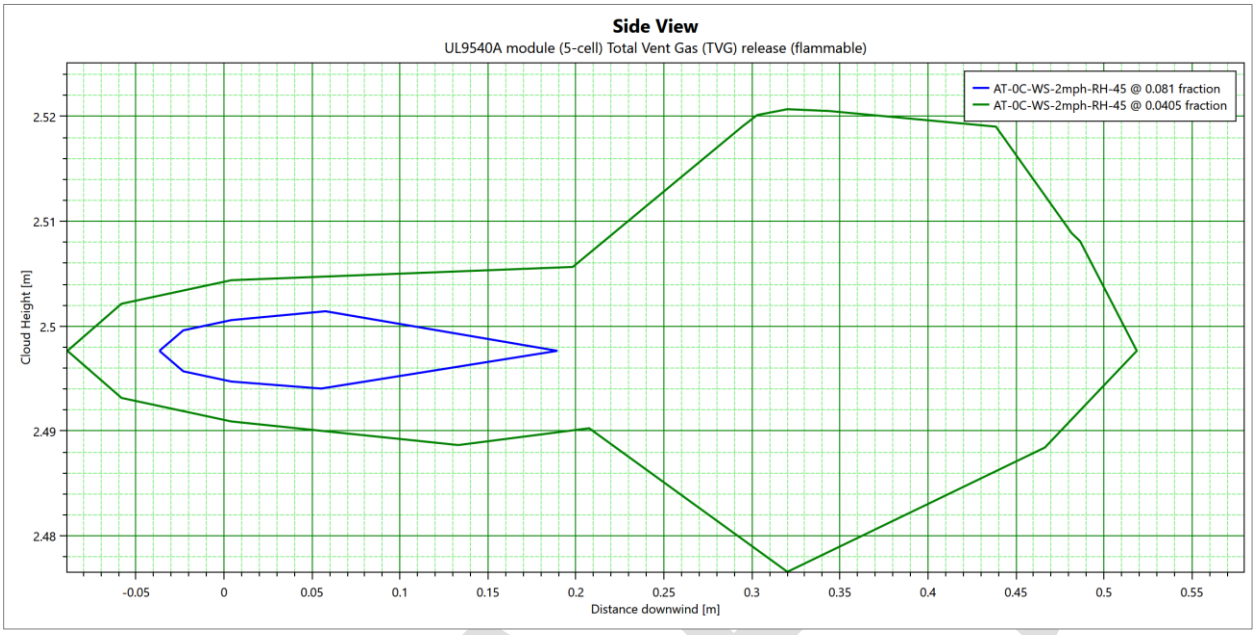

Figure 3 Maximum vertical extent of vapor cloud for LFL (8.1%) and ½ LFL (4.05%)

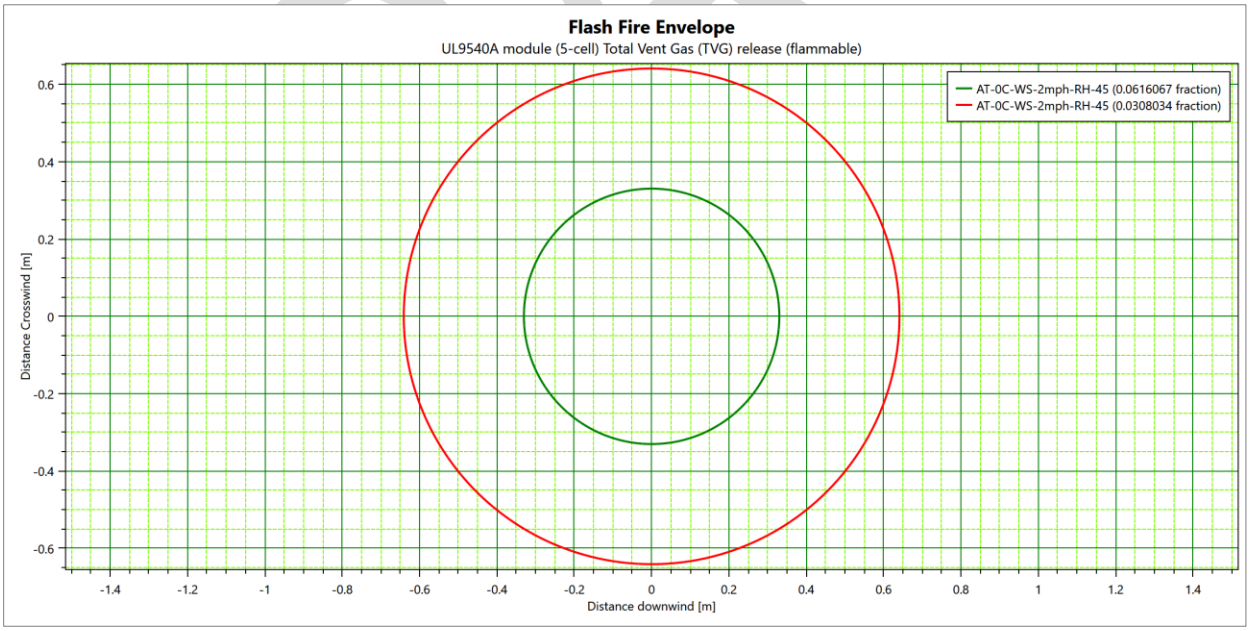

Figure 4 Flash Fire Envelope for LFL (8.1%) and ½ LFL (4.05%)

1.2 CO IDLH (1200 ppm) Component Extent (19 min Release)

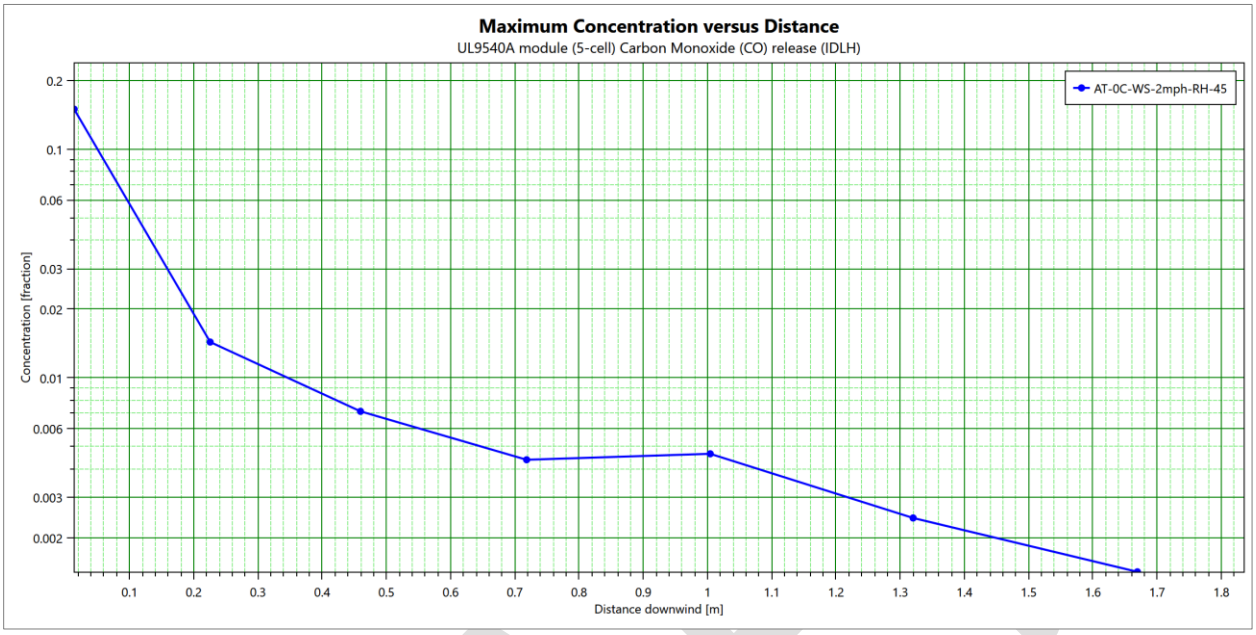

Figure 5 Maximum Concentration vs distance for CO gas component

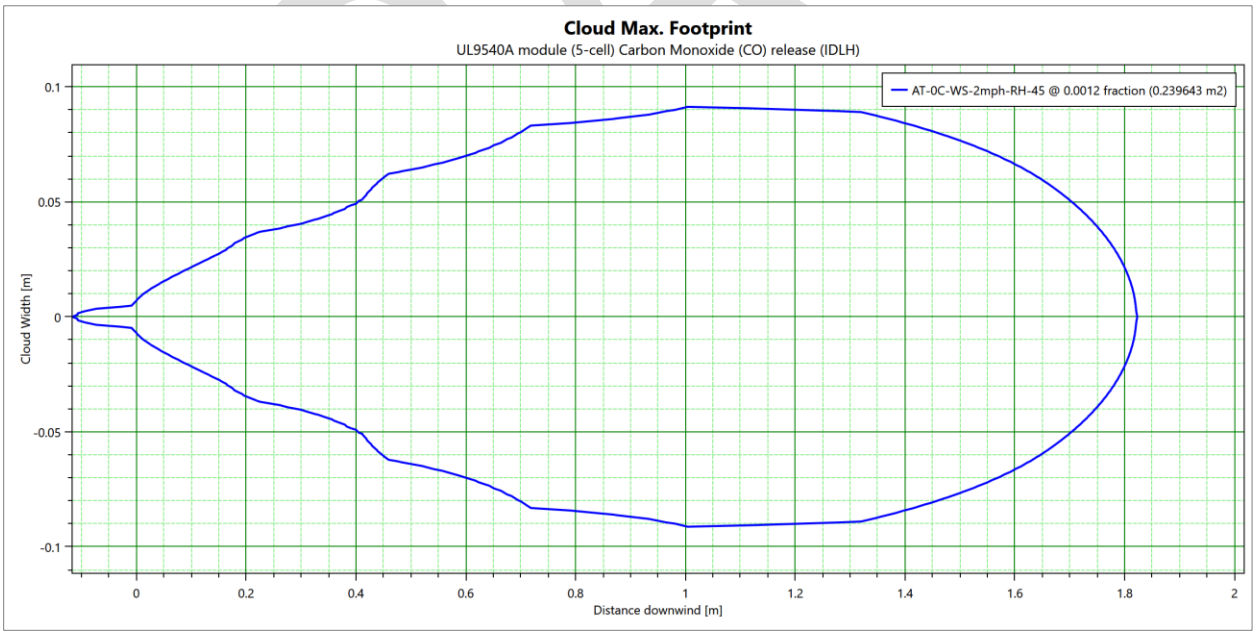

Figure 6 Maximum horizontal extent of vapor cloud for CO IDLH (1200 ppm)

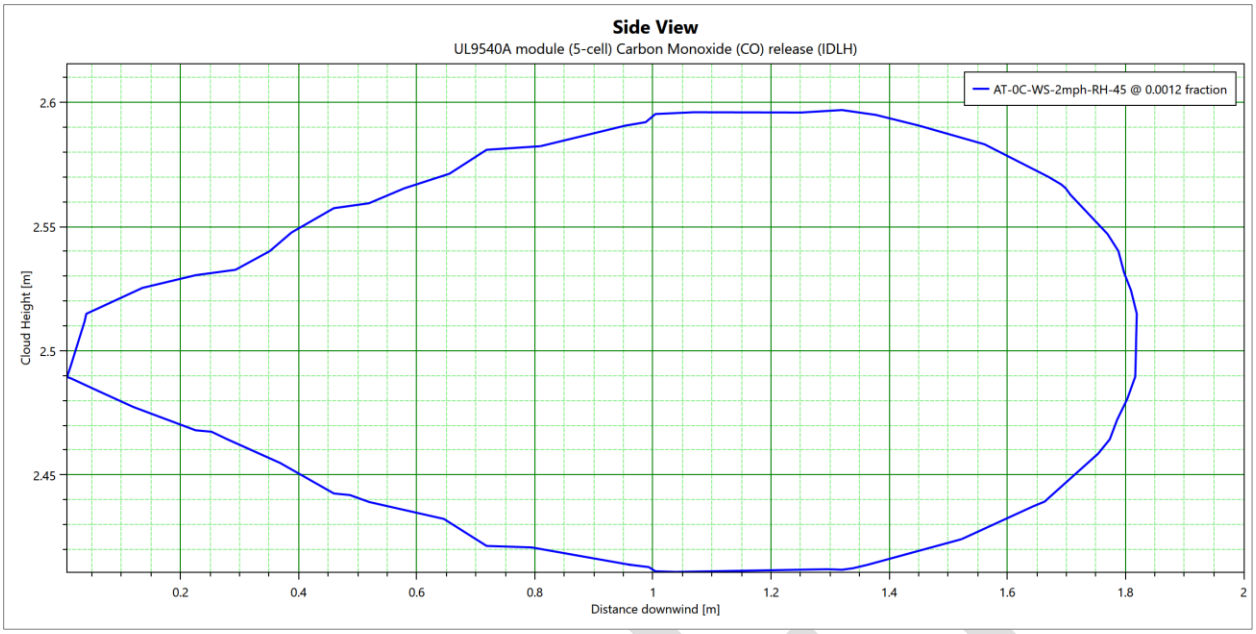

Figure 7 Maximum vertical extent of vapor cloud for CO IDLH (1200 ppm)

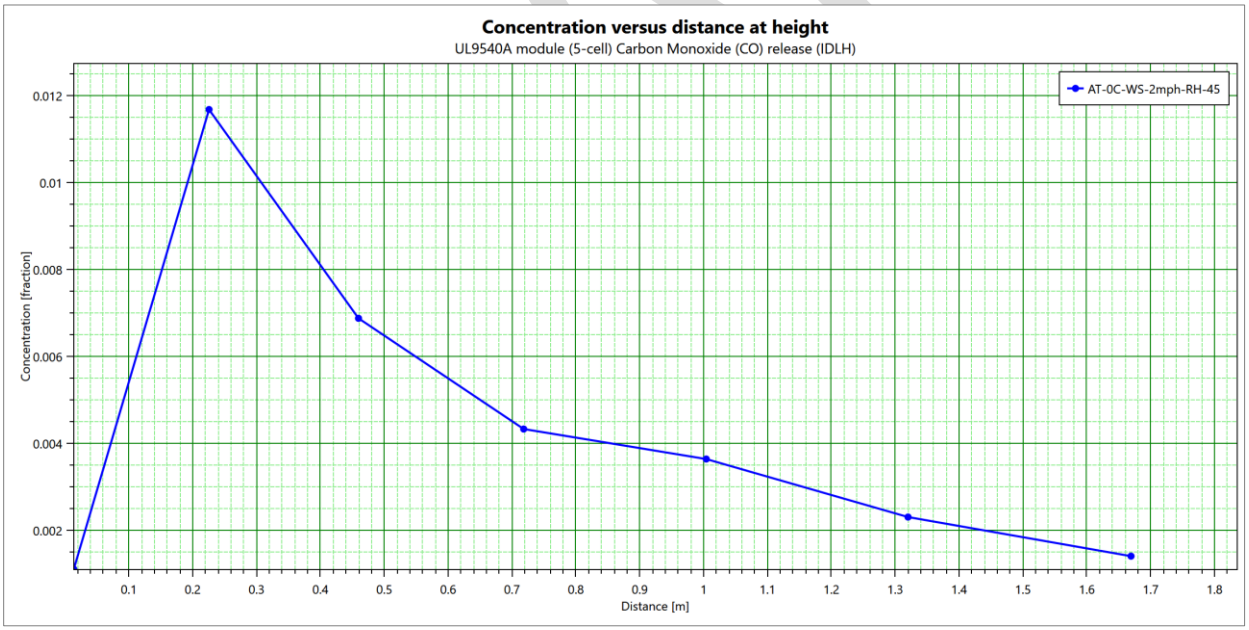

Figure 8 Concentration vs distance for CO IDLH (1200 ppm)

1.3 TVG Flammable Vapor Cloud Extent (10 min Release)

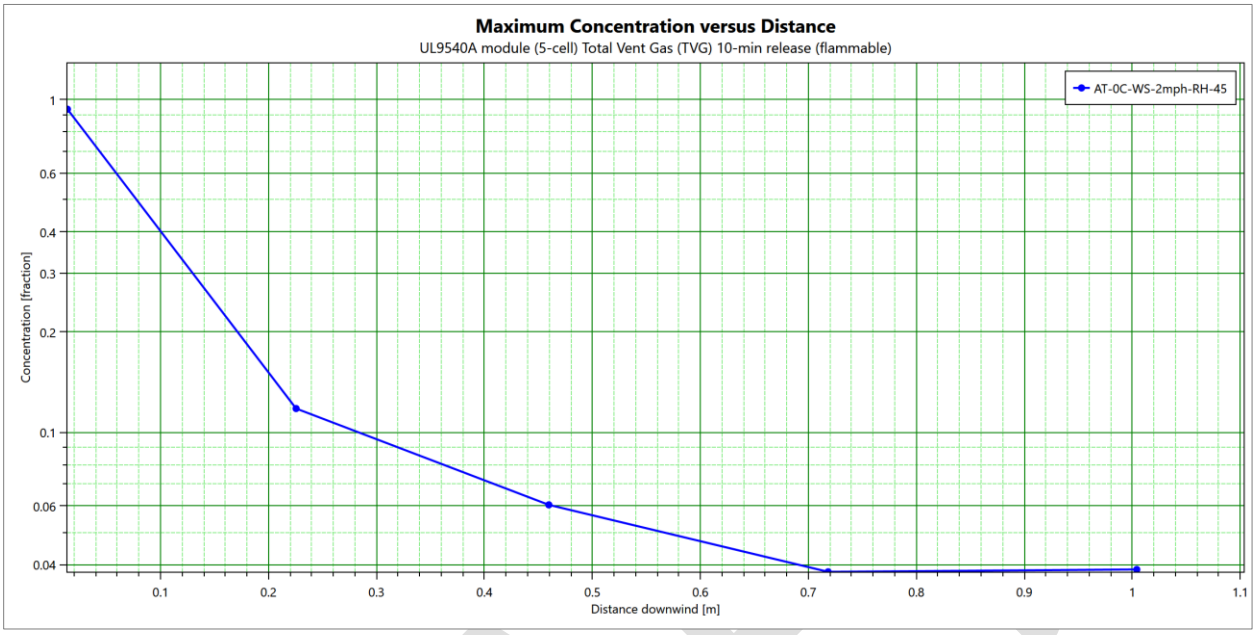

Figure 9 Maximum concentration vs distance for flammable vapor cloud

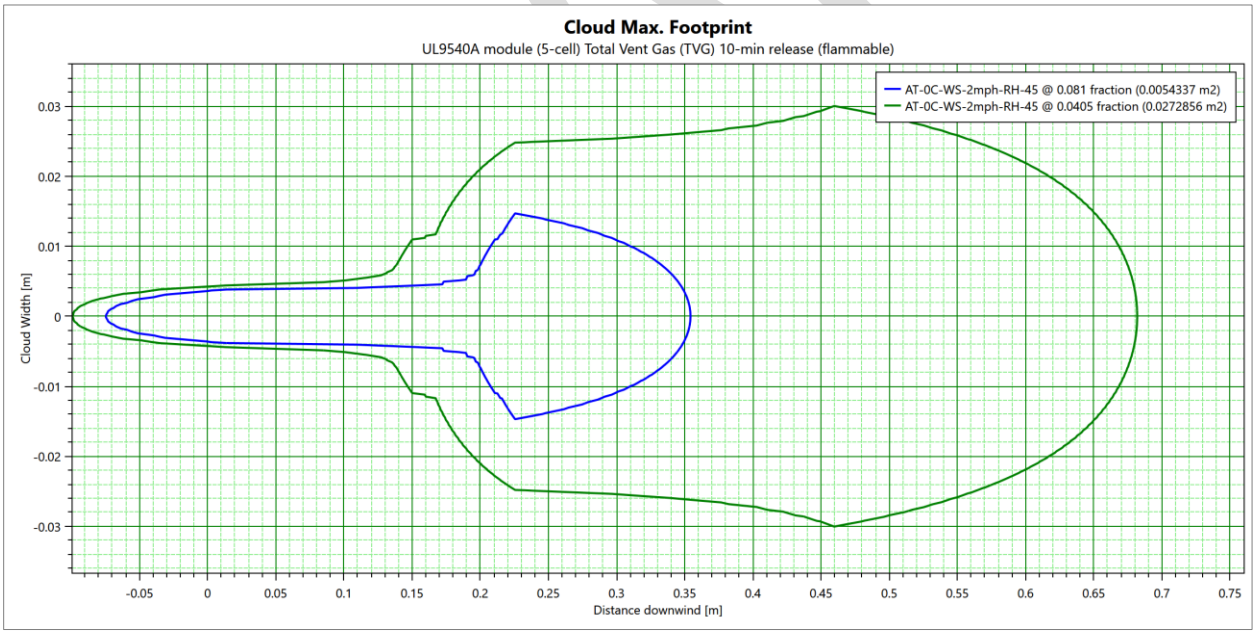

Figure 10 Maximum horizontal extent of vapor cloud for LFL (8.1%) and ½ LFL (4.05%)

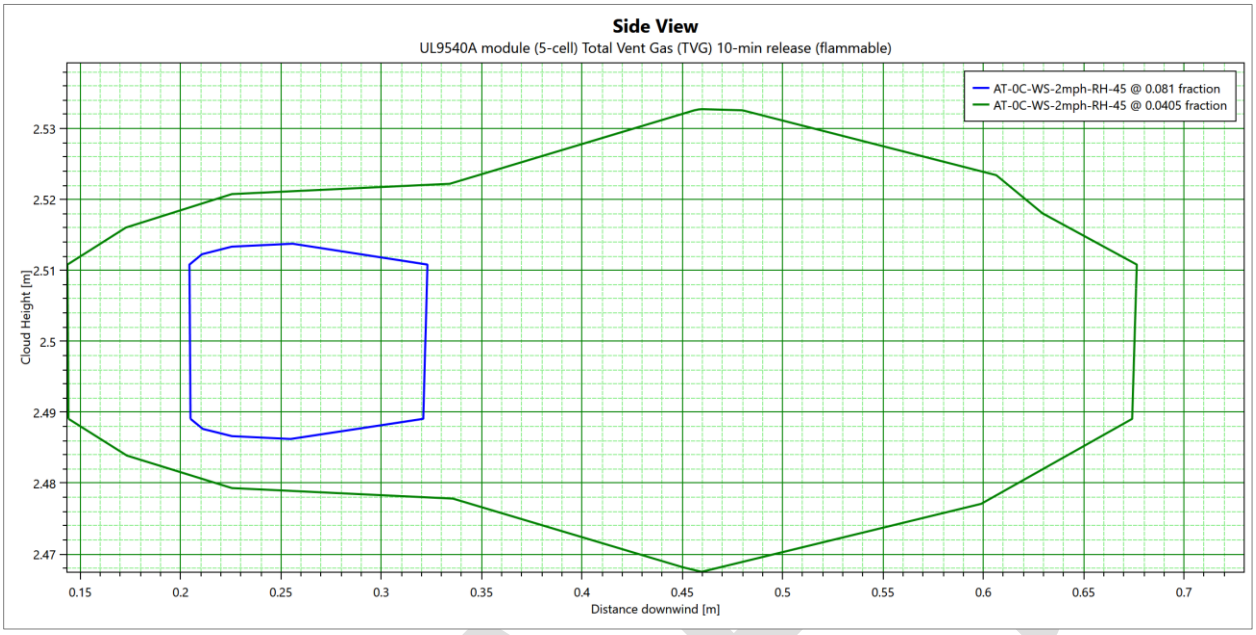

Figure 11 Maximum vertical extent of vapor cloud for LFL (8.1%) and ½ LFL (4.05%)

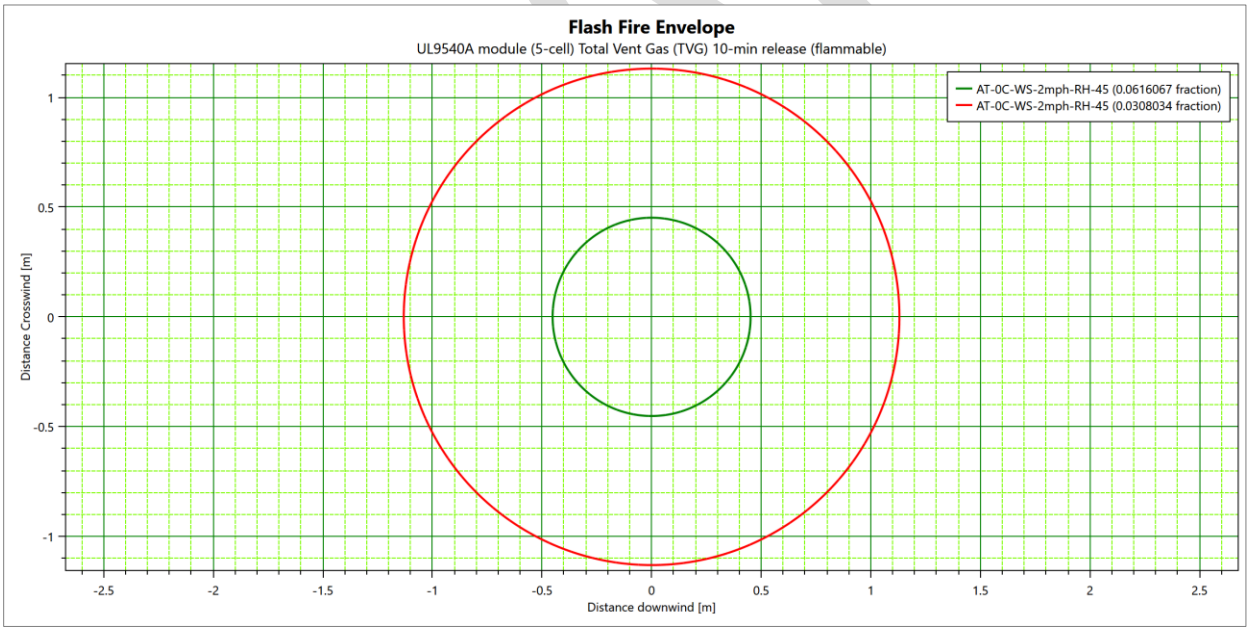

Figure 12 Flash Fire Envelope for LFL (8.1%) and ½ LFL (4.05%)

1.4 CO IDLH (1200 ppm) Component Extent (10 min Release)

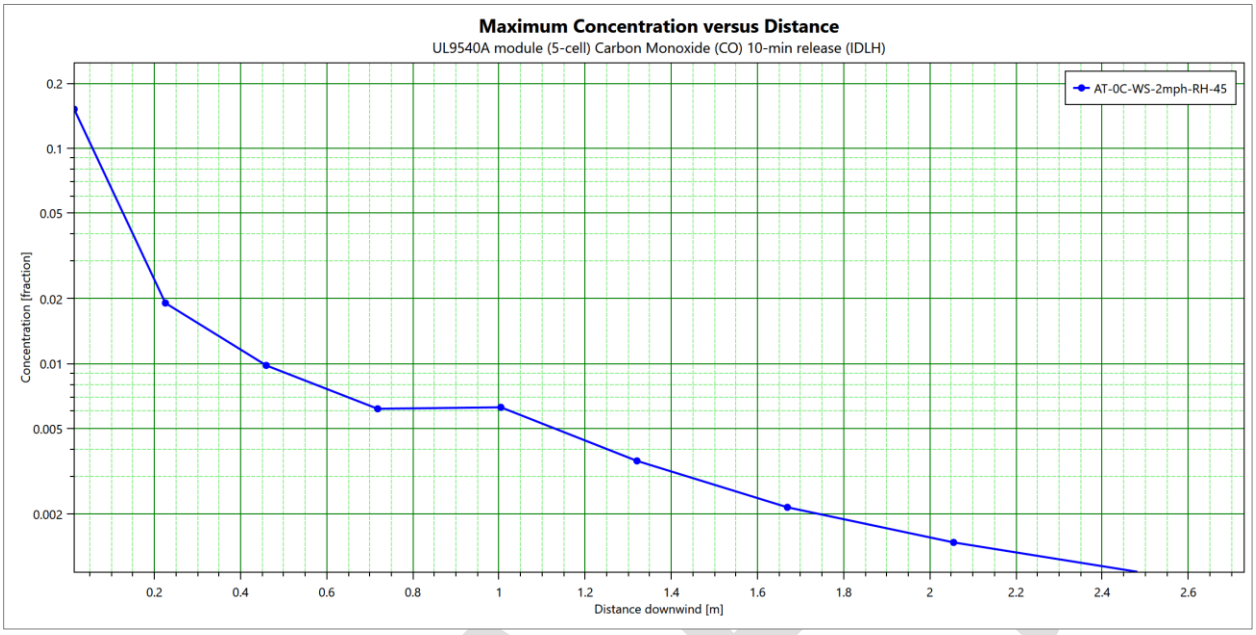

Figure 13 Maximum Concentration vs distance for CO gas component

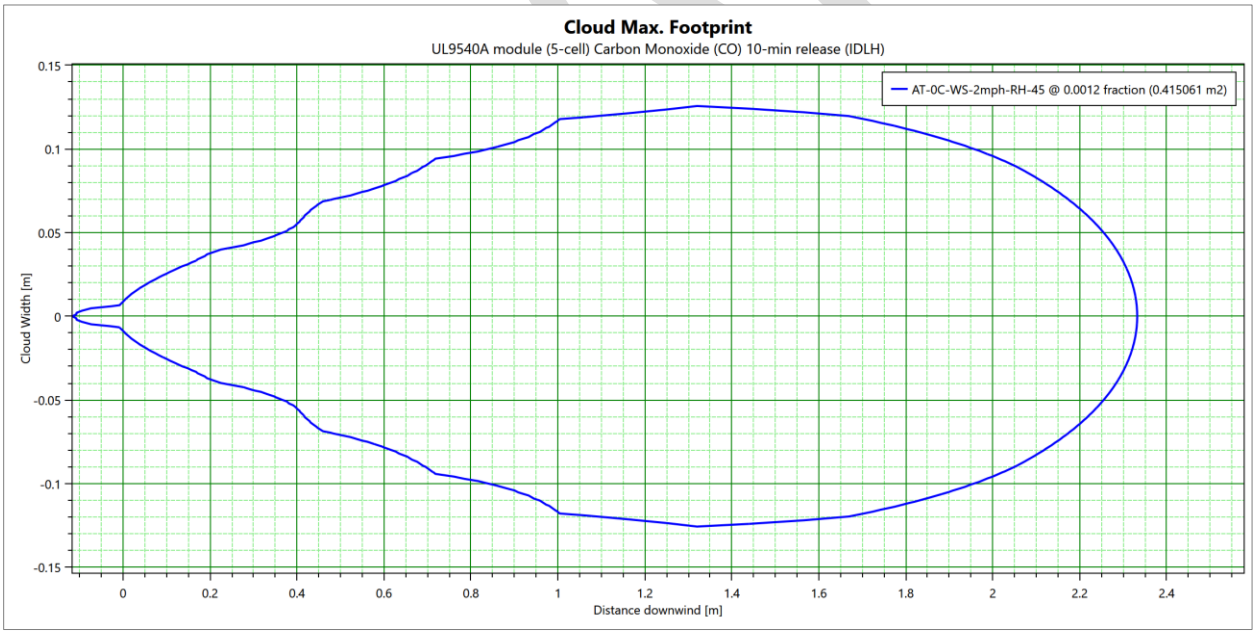

Figure 14 Maximum horizontal extent of vapor cloud for CO IDLH (1200 ppm)

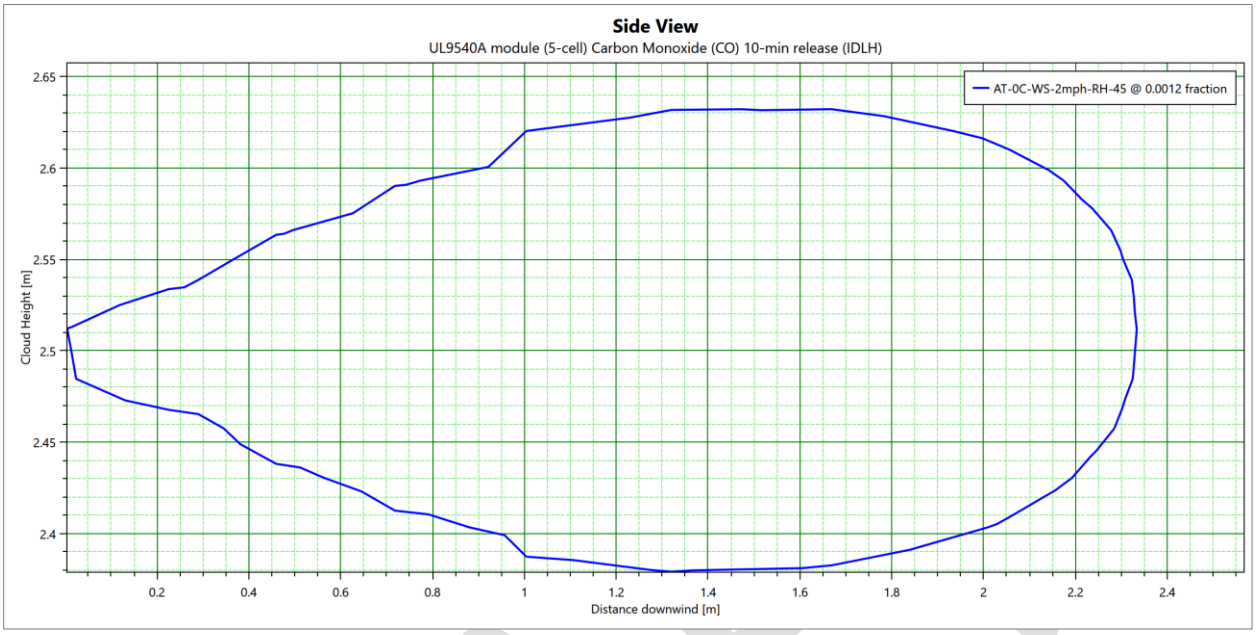

Figure 15 Maximum vertical extent of vapor cloud for CO IDLH (1200 ppm)

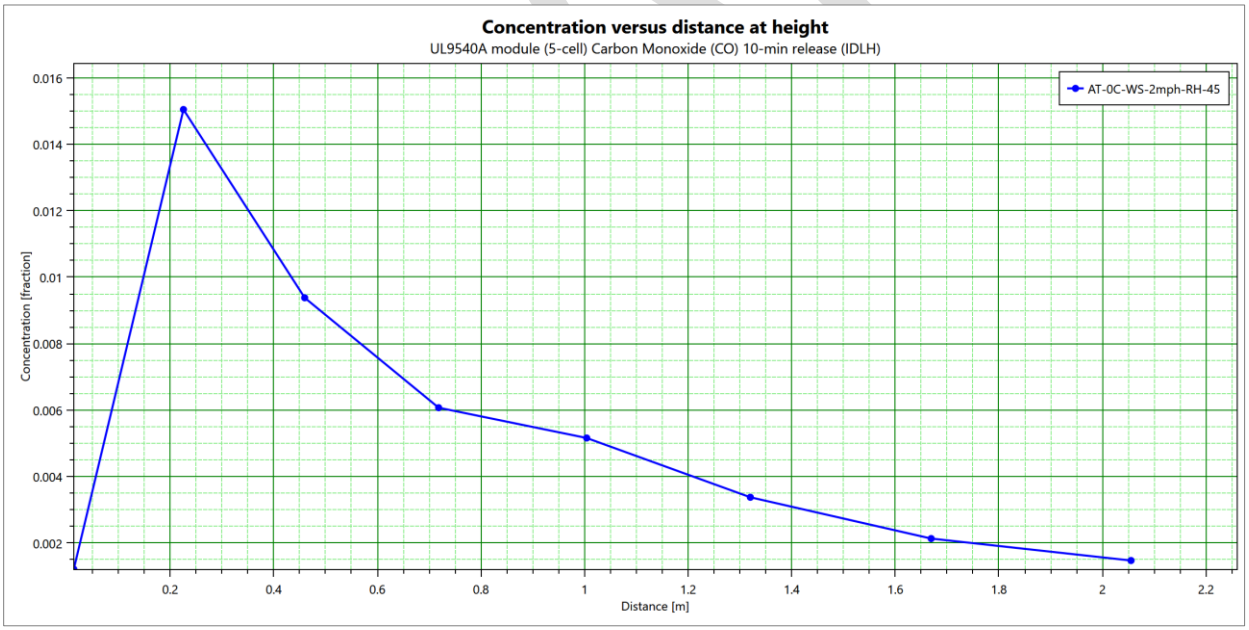

Figure 16 Concentration vs distance for CO IDLH (1200 ppm)

1.2 Scenario 2: 1-Module Release

2.1 TVG Flammable Vapor Cloud Extent (79 min Release)

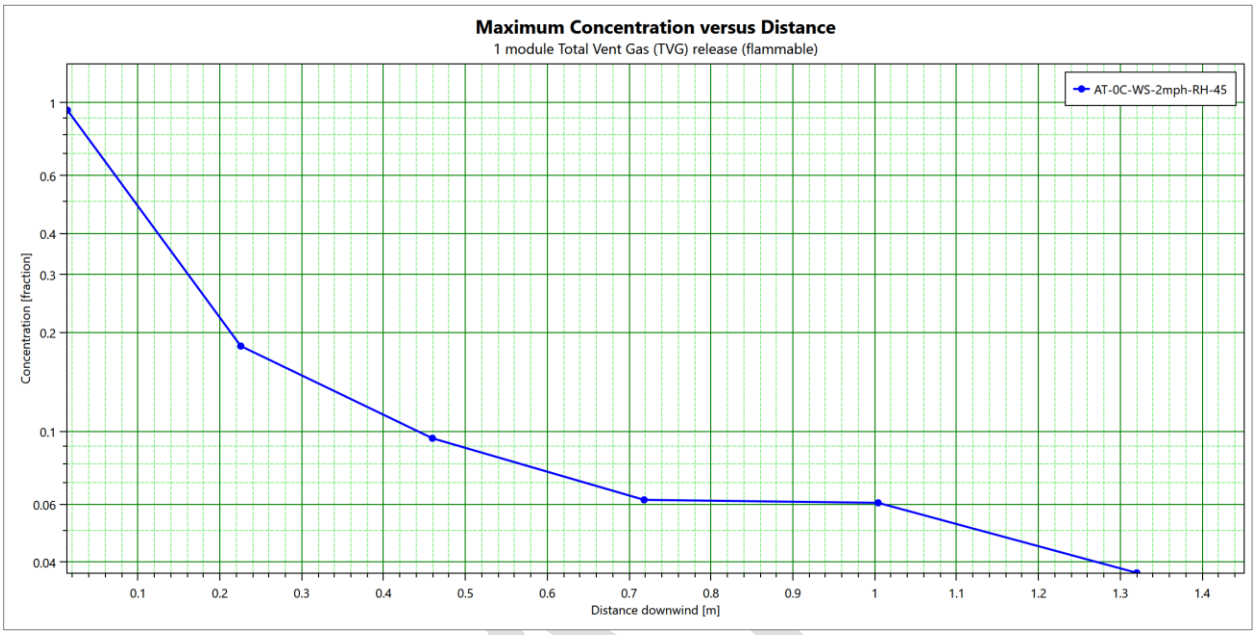

Figure 17 Maximum concentration vs distance for flammable vapor cloud

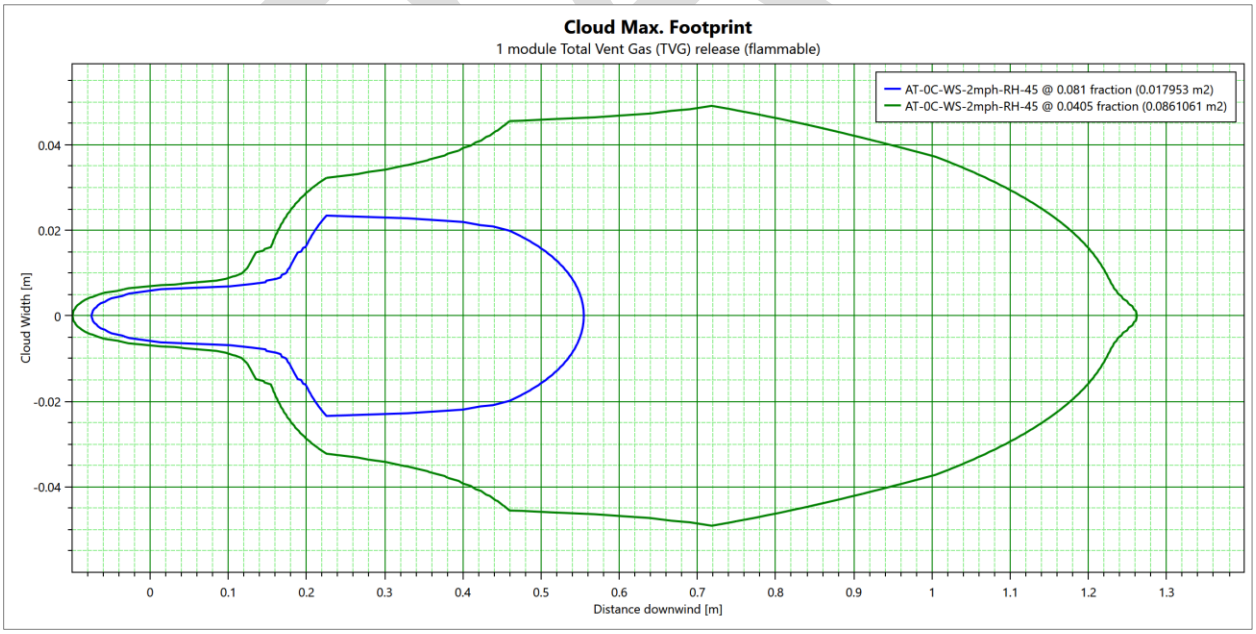

Figure 18 Maximum horizontal extent of vapor cloud for LFL (8.1%) and ½ LFL (4.05%)

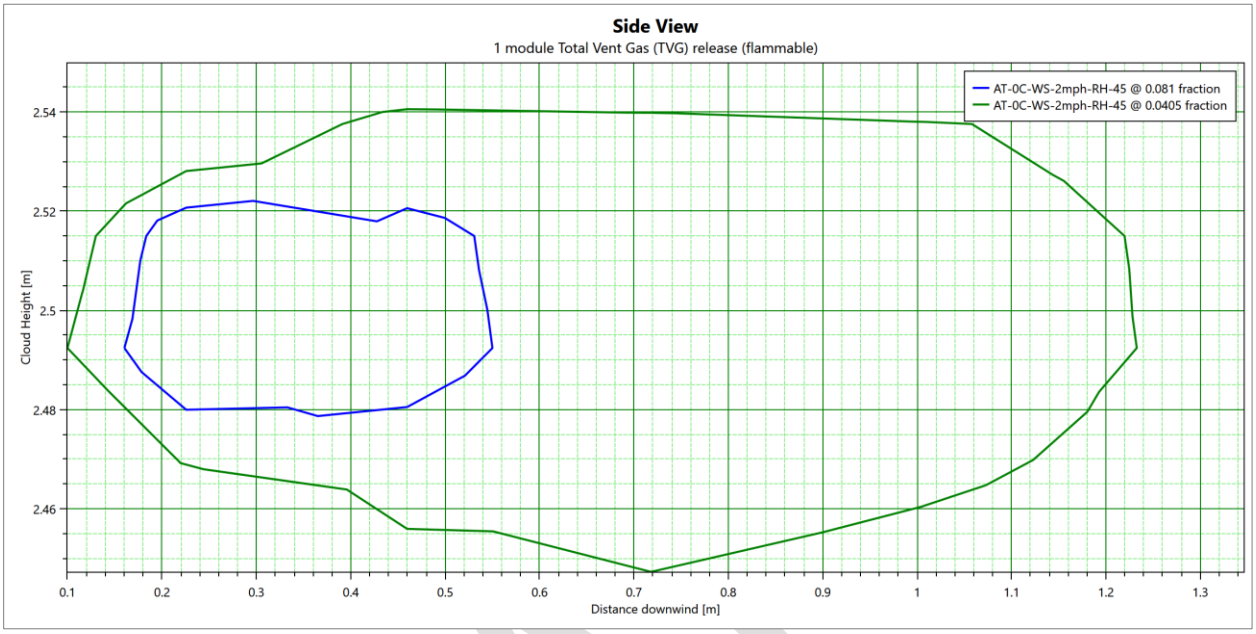

Figure 19 Maximum vertical extent of vapor cloud for LFL (8.1%) and ½ LFL (4.05%)

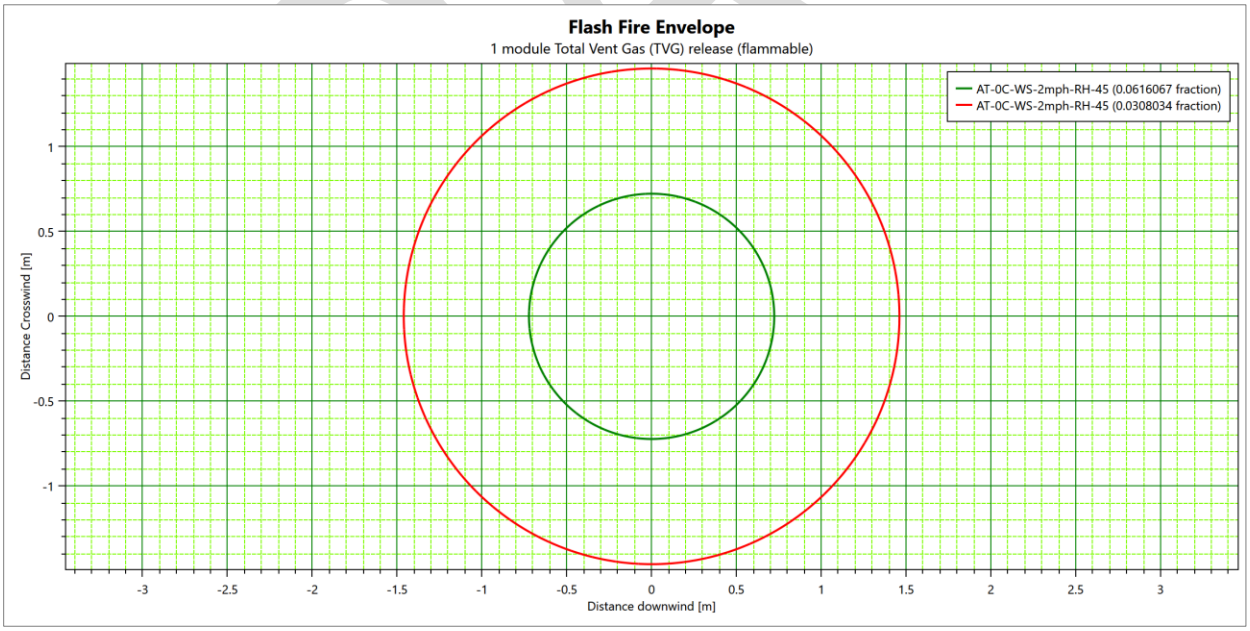

Figure 20 Flash Fire Envelope for LFL (8.1%) and ½ LFL (4.05%)

2.2 CO IDLH (1200 ppm) Component Extent (79 min Release)

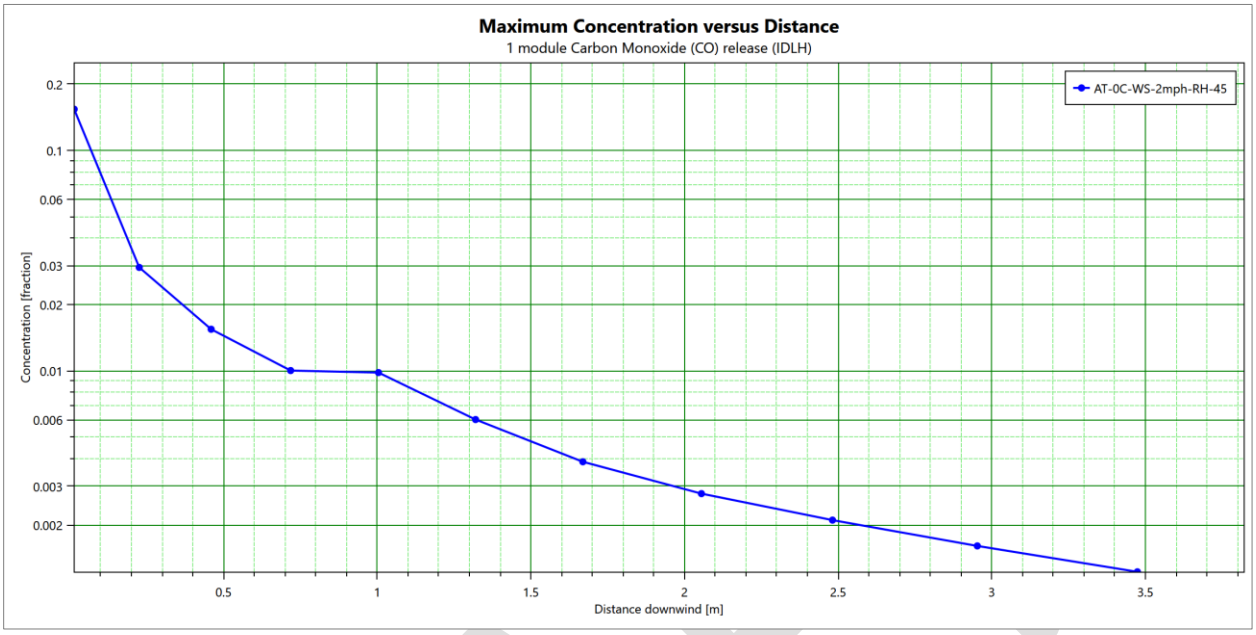

Figure 21 Maximum Concentration vs distance for CO gas component

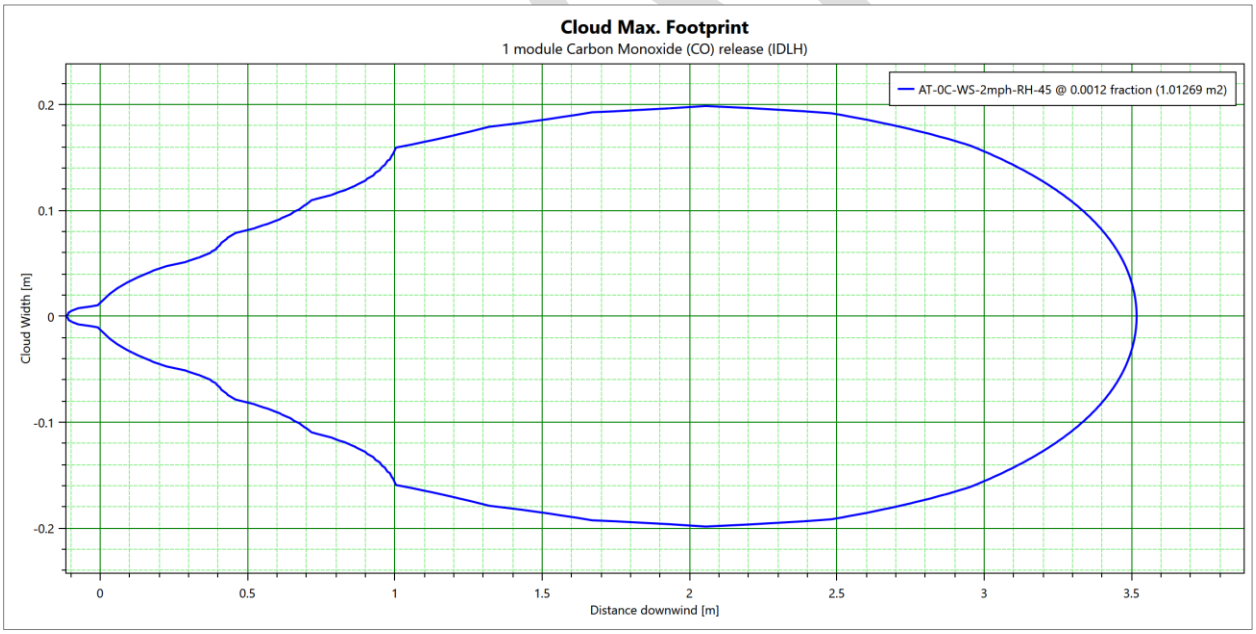

Figure 22 Maximum horizontal extent of vapor cloud for CO IDLH (1200 ppm)

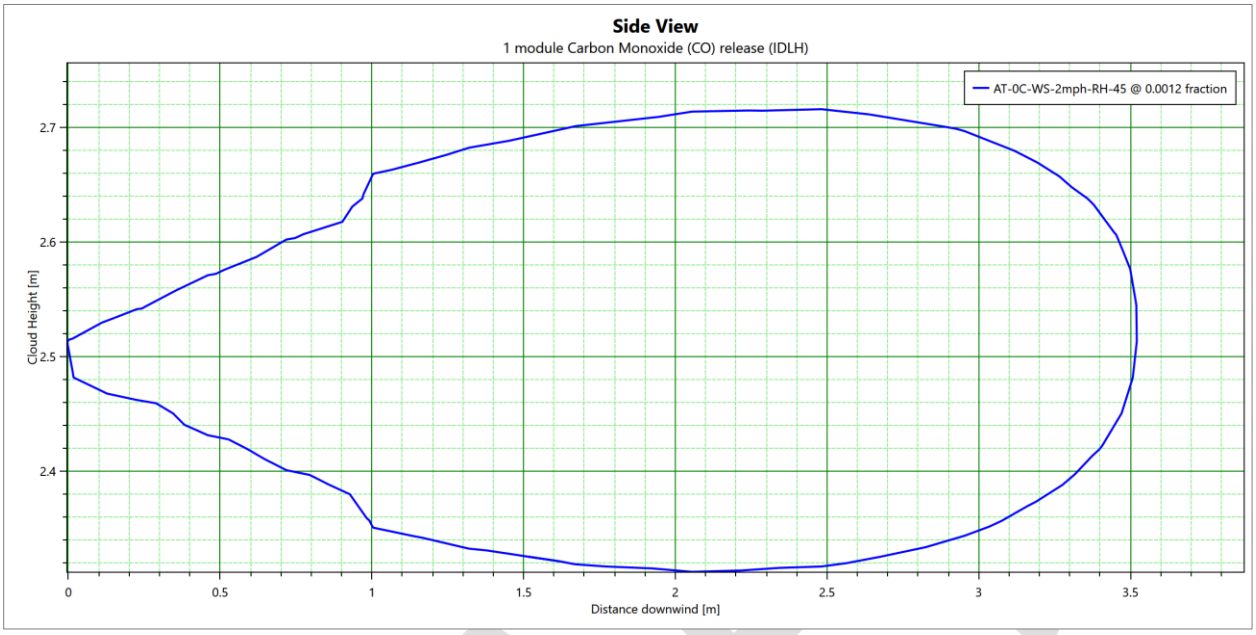

Figure 23 Maximum vertical extent of vapor cloud for CO IDLH (1200 ppm)

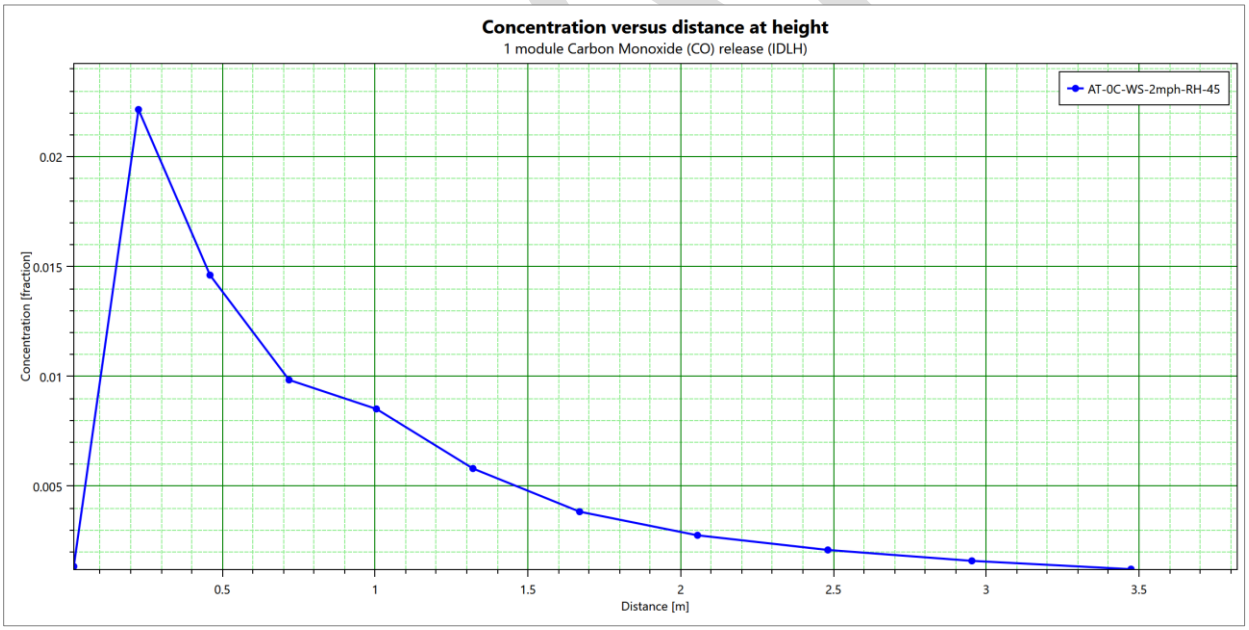

Figure 24 Concentration vs distance for CO IDLH (1200 ppm)

2.3 TVG Flammable Vapor Cloud Extent (10 min Release)

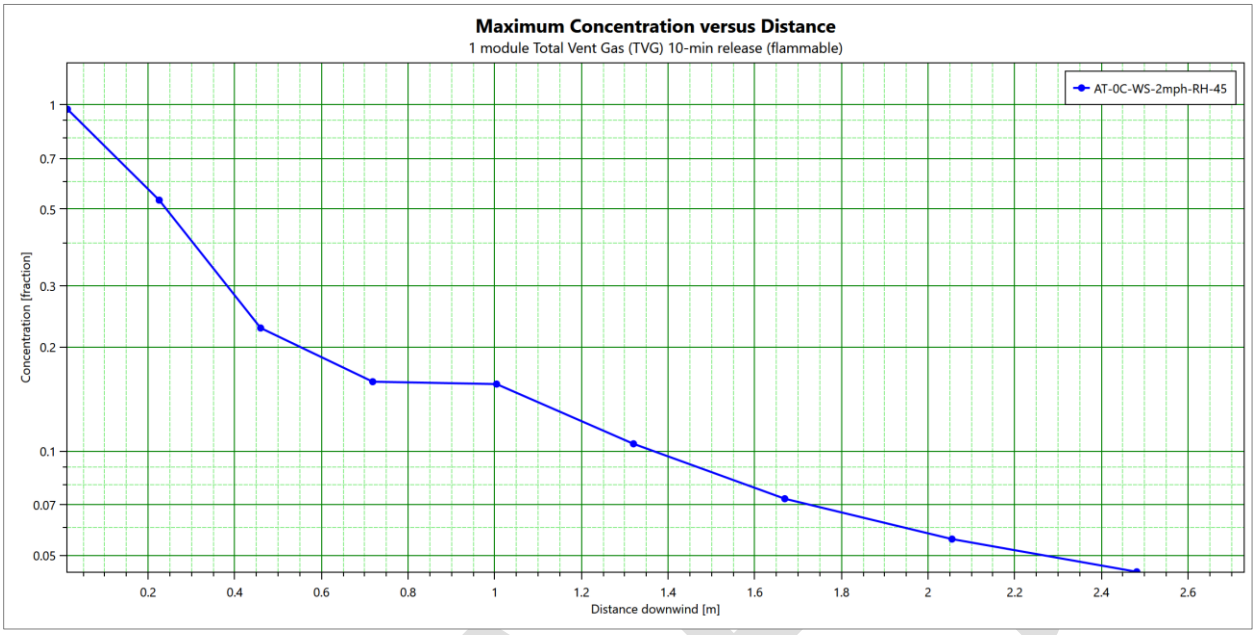

Figure 25 Maximum concentration vs distance for flammable vapor cloud

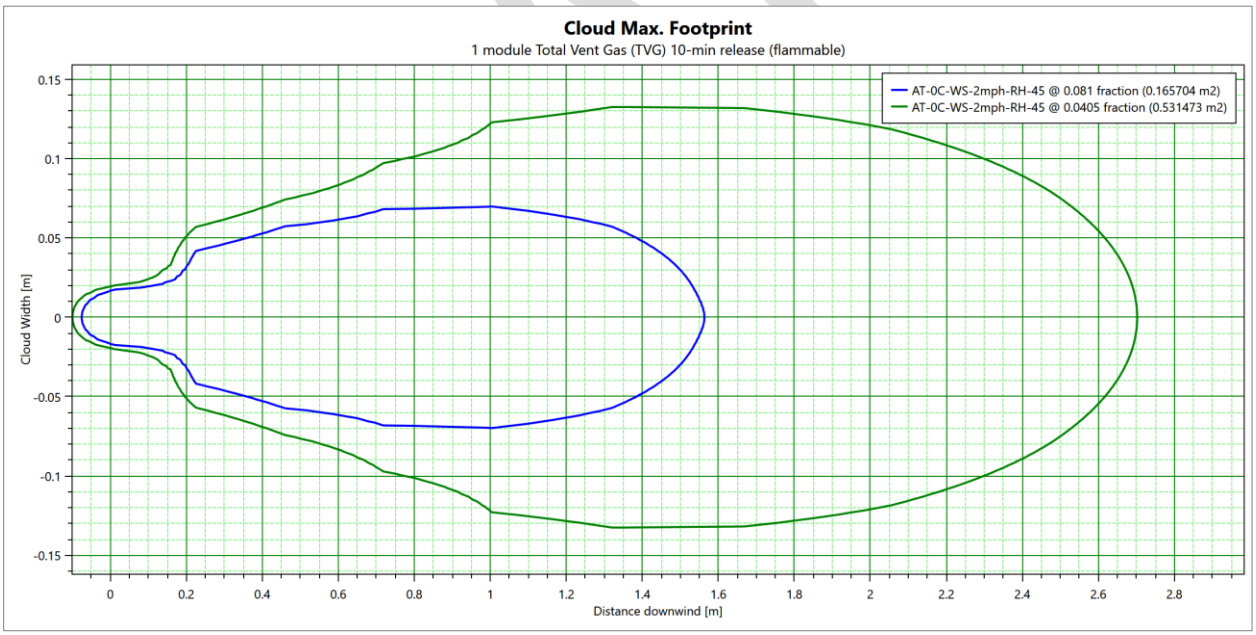

Figure 26 Maximum horizontal extent of vapor cloud for LFL (8.1%) and ½ LFL (4.05%)

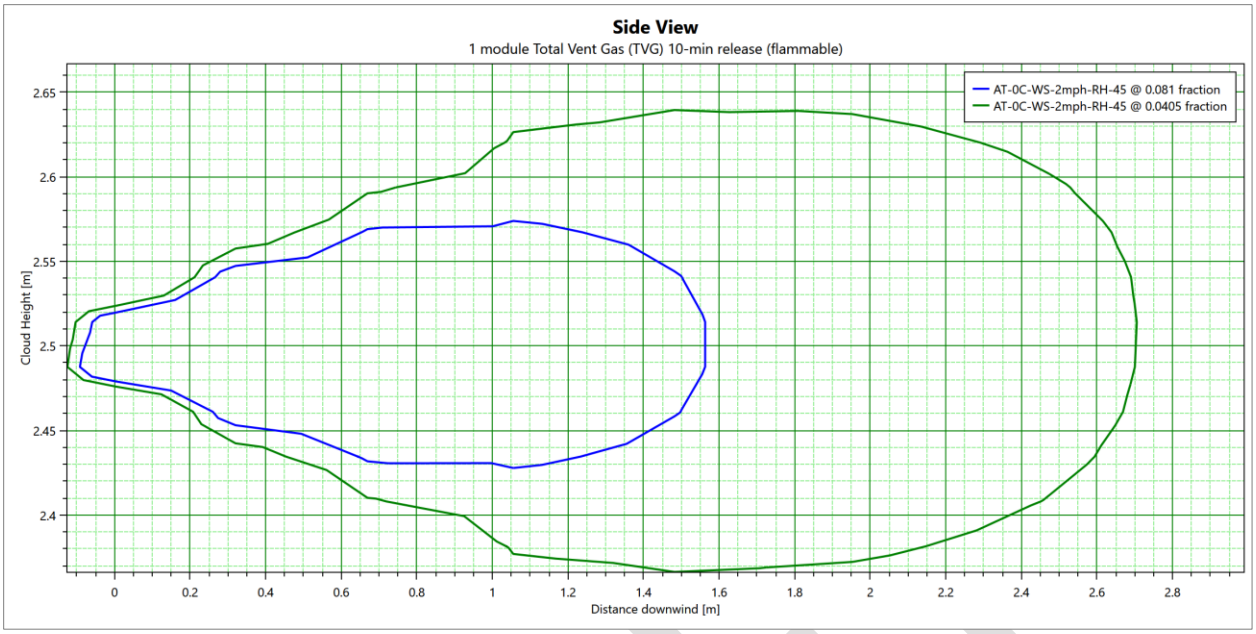

Figure 27 Maximum vertical extent of vapor cloud for LFL (8.1%) and ½ LFL (4.05%)

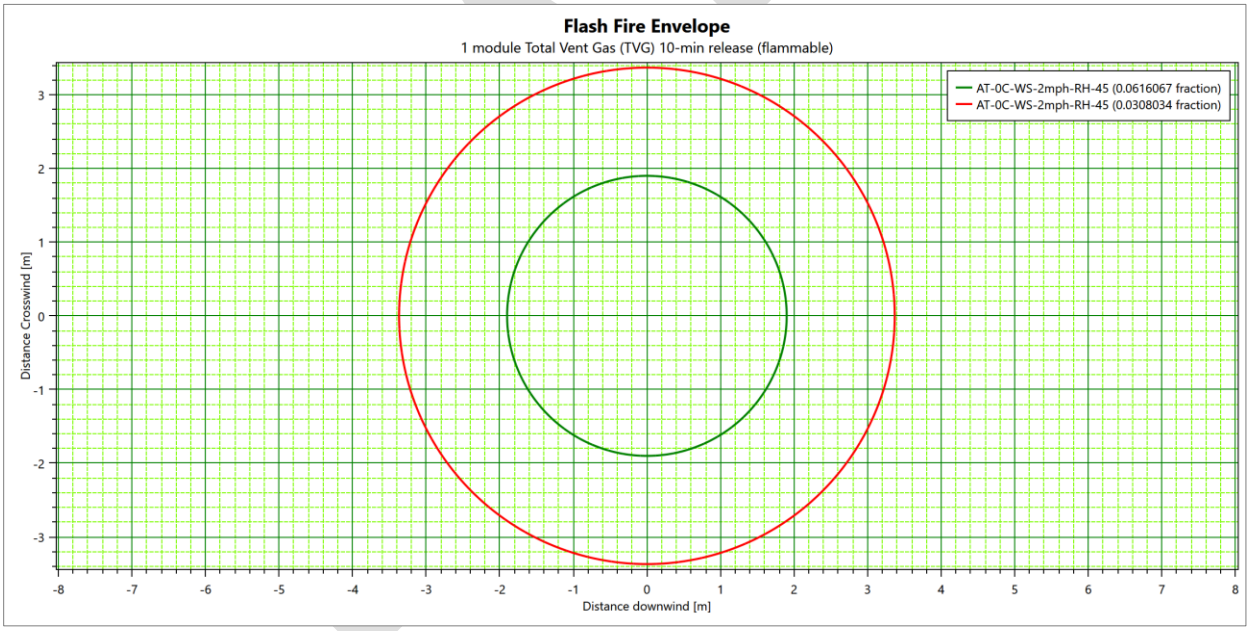

Figure 28 Flash Fire Envelope for LFL (8.1%) and ½ LFL (4.05%)

2.4 CO IDLH (1200 ppm) Component Extent (10 min Release)

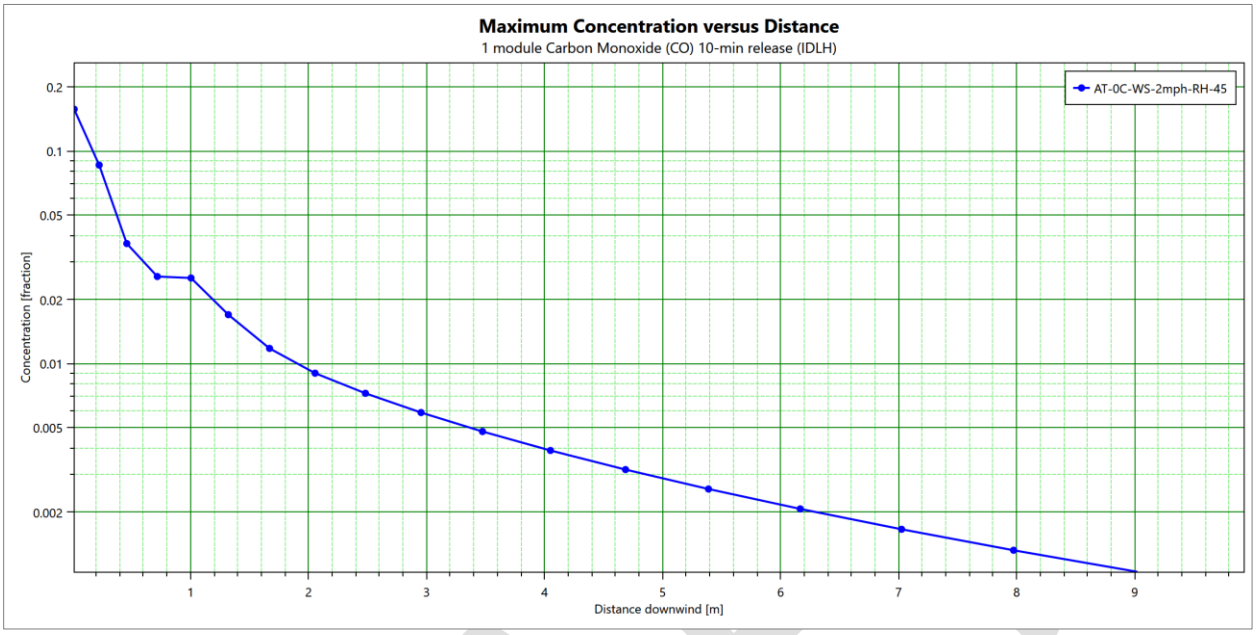

Figure 29 Maximum Concentration vs distance for CO gas component

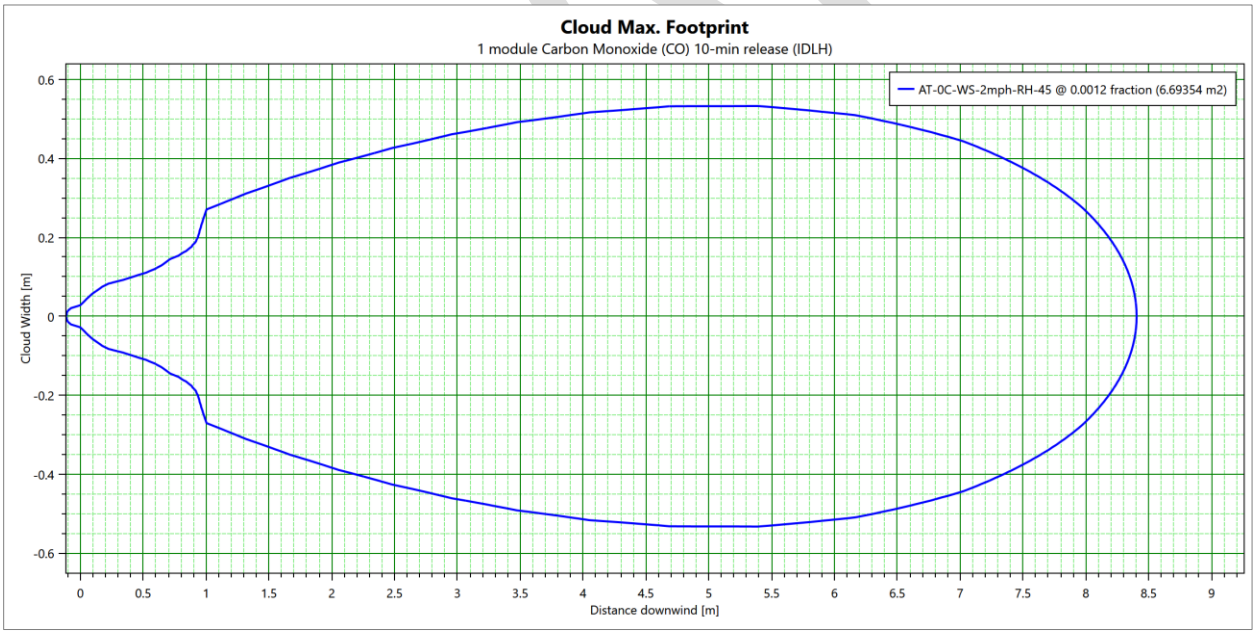

Figure 30 Maximum horizontal extent of vapor cloud for CO IDLH (1200 ppm)

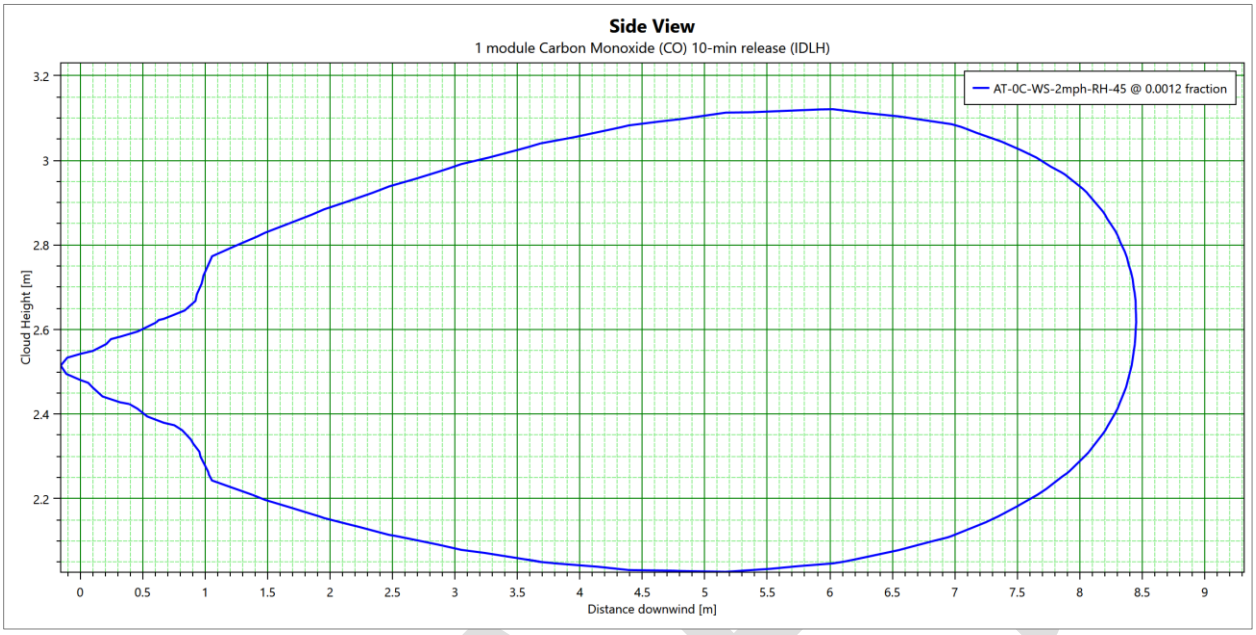

Figure 31 Maximum vertical extent of vapor cloud for CO IDLH (1200 ppm)

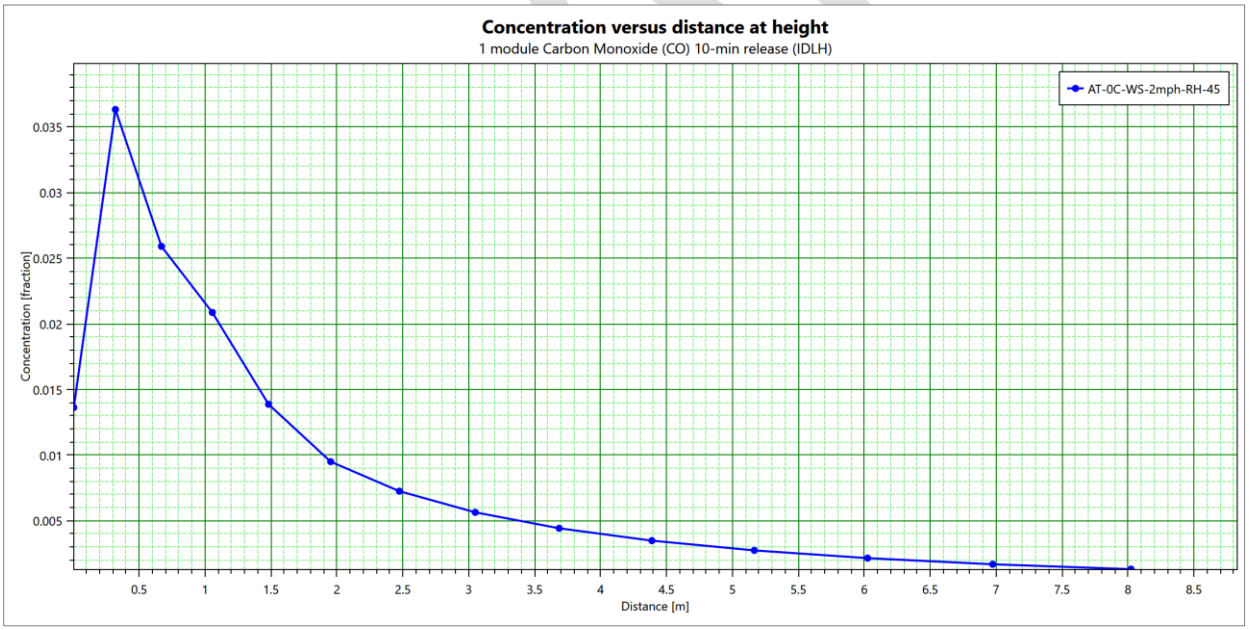

Figure 32 Concentration vs distance for CO IDLH (1200 ppm)

1.3 Scenario 3: 1-String Release

3.1 TVG Flammable Vapor Cloud Extent (79 min Release)

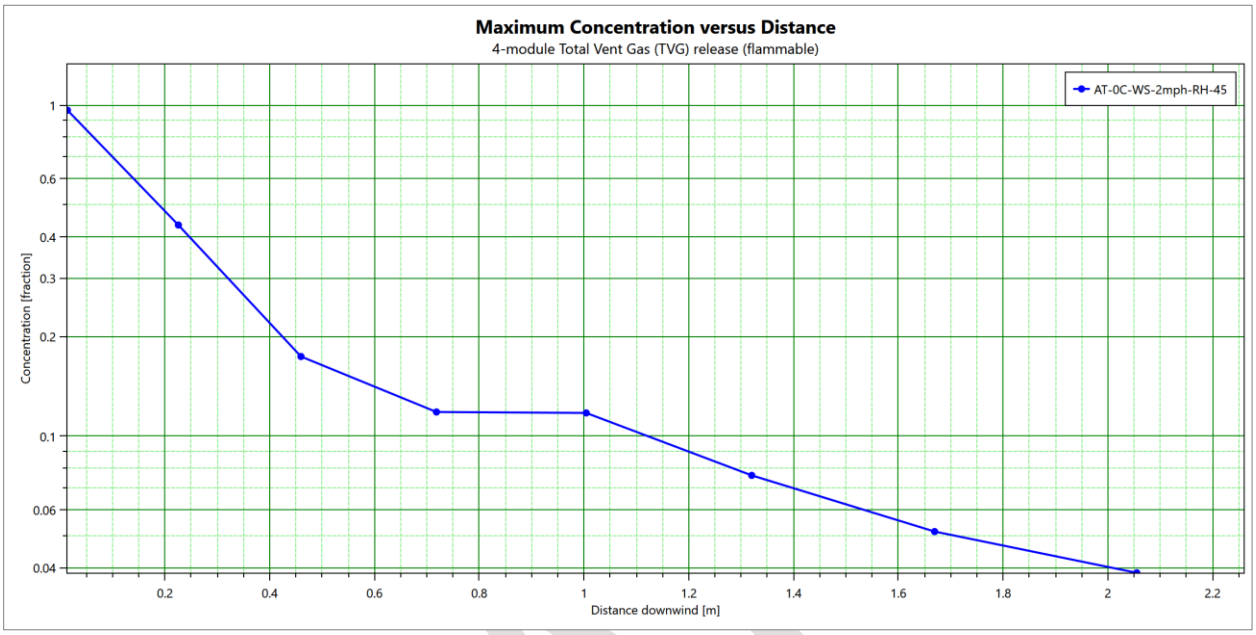

Figure 33 Maximum concentration vs distance for flammable vapor cloud

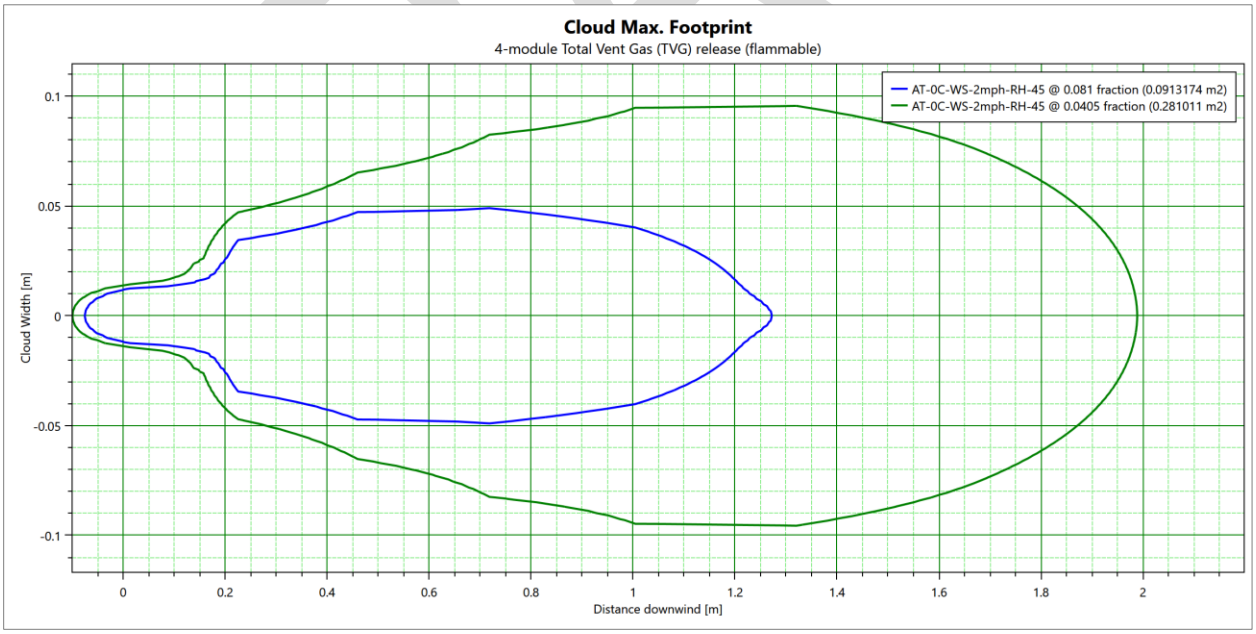

Figure 34 Maximum horizontal extent of vapor cloud for LFL (8.1%) and ½ LFL (4.05%)

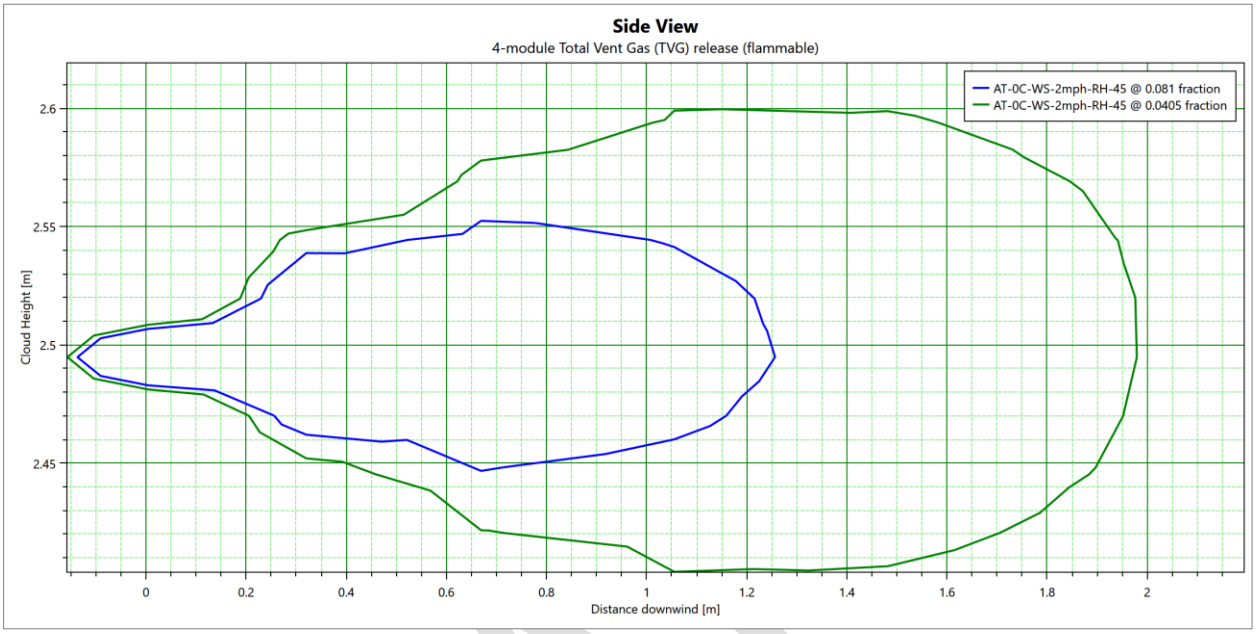

Figure 35 Maximum vertical extent of vapor cloud for LFL (8.1%) and ½ LFL (4.05%)

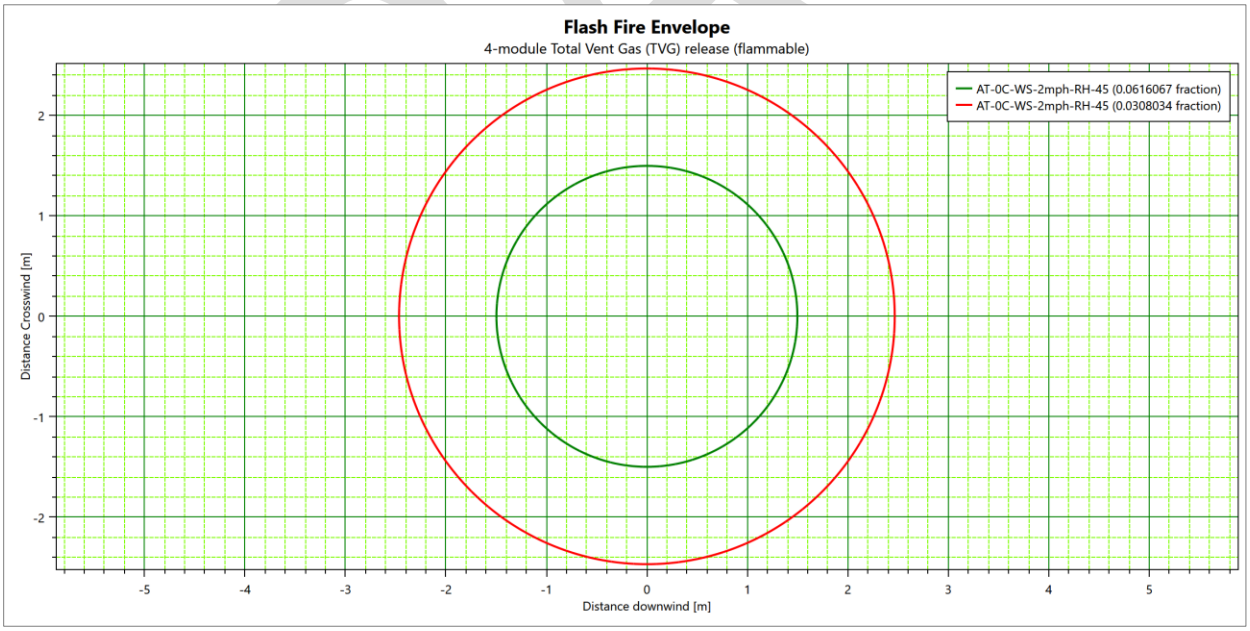

Figure 36 Flash Fire Envelope for LFL (8.1%) and ½ LFL (4.05%)

3.2 CO IDLH (1200 ppm) Component Extent (79 min Release)

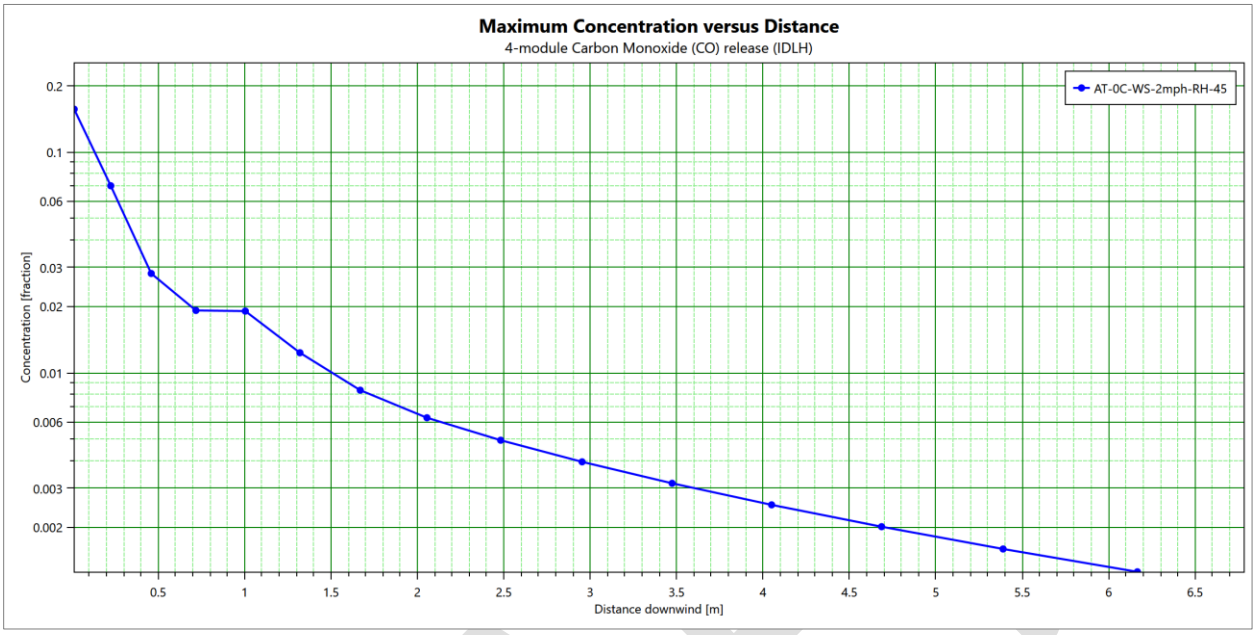

Figure 37 Maximum Concentration vs distance for CO gas component

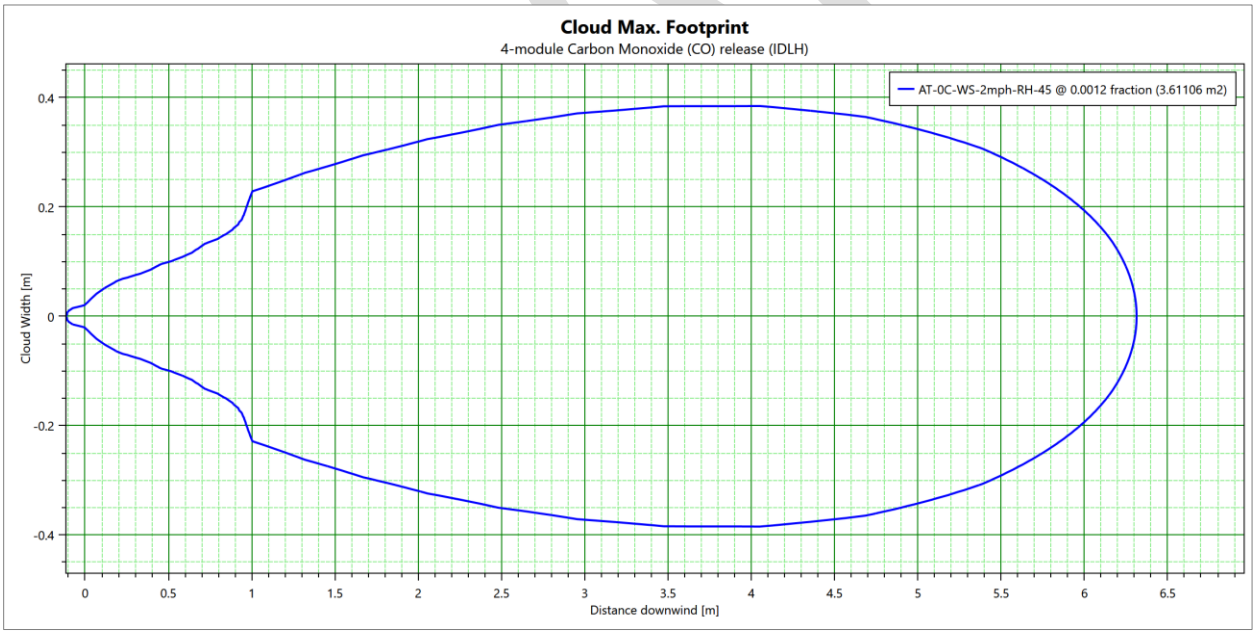

Figure 38 Maximum horizontal extent of vapor cloud for CO IDLH (1200 ppm)

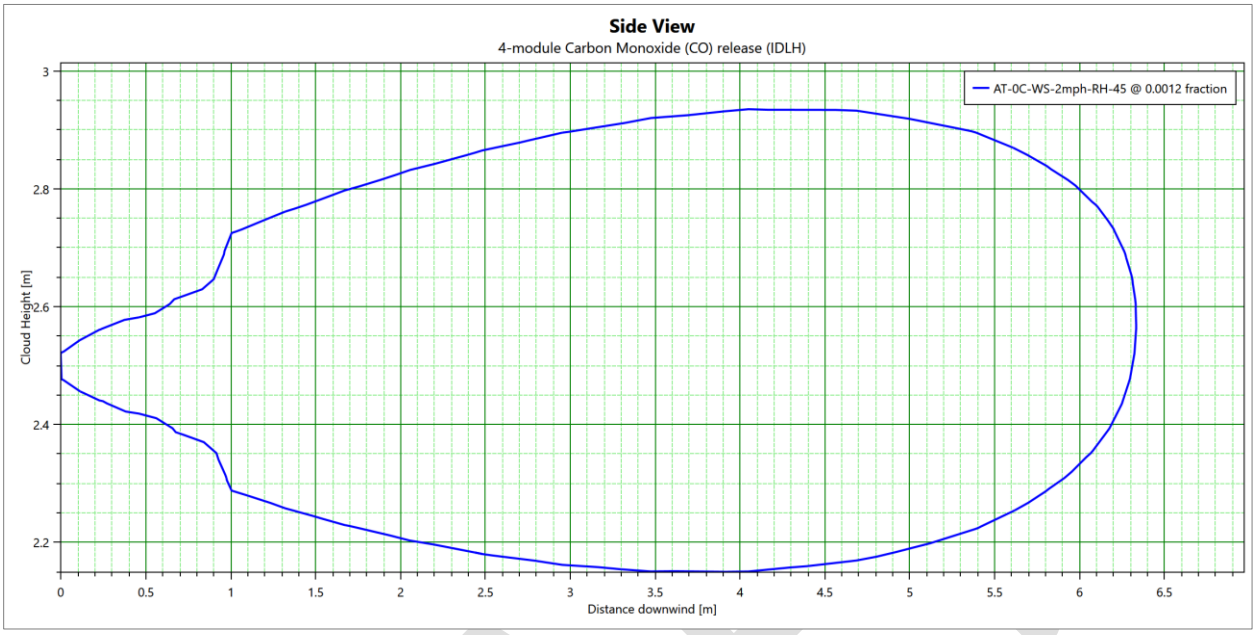

Figure 39 Maximum vertical extent of vapor cloud for CO IDLH (1200 ppm)

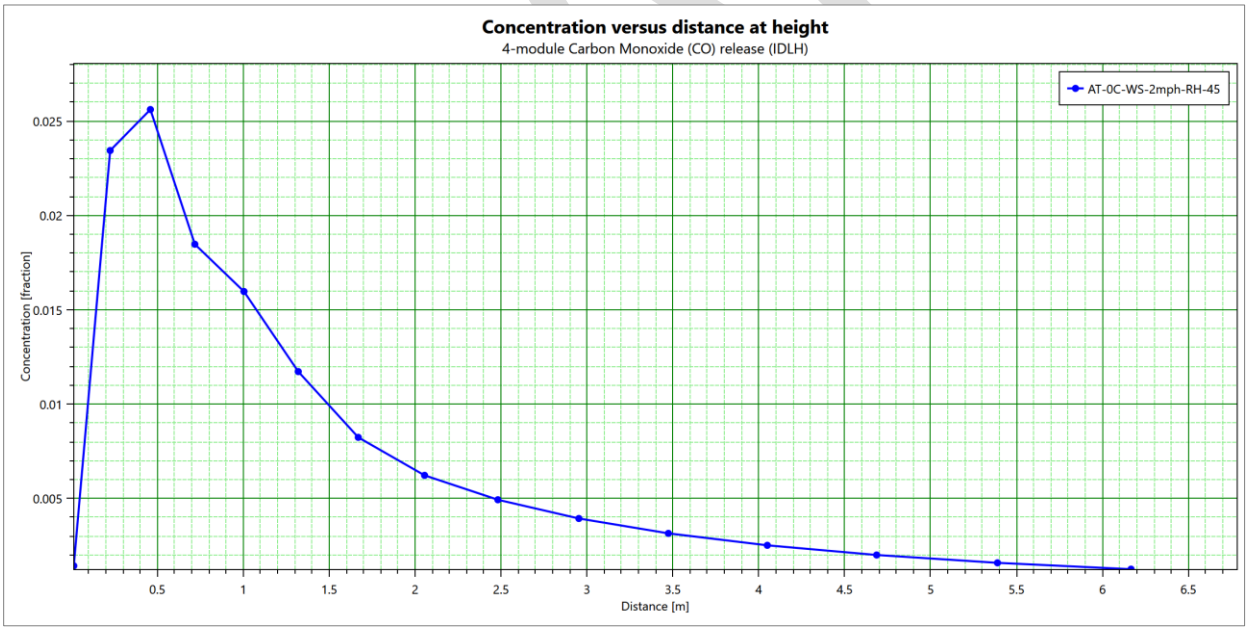

Figure 40 Concentration vs distance for CO IDLH (1200 ppm)

1.4 Scenario 4: 1-Rack Release [8 modules]

4.1 TVG Flammable Vapor Cloud Extent (79 min Release)

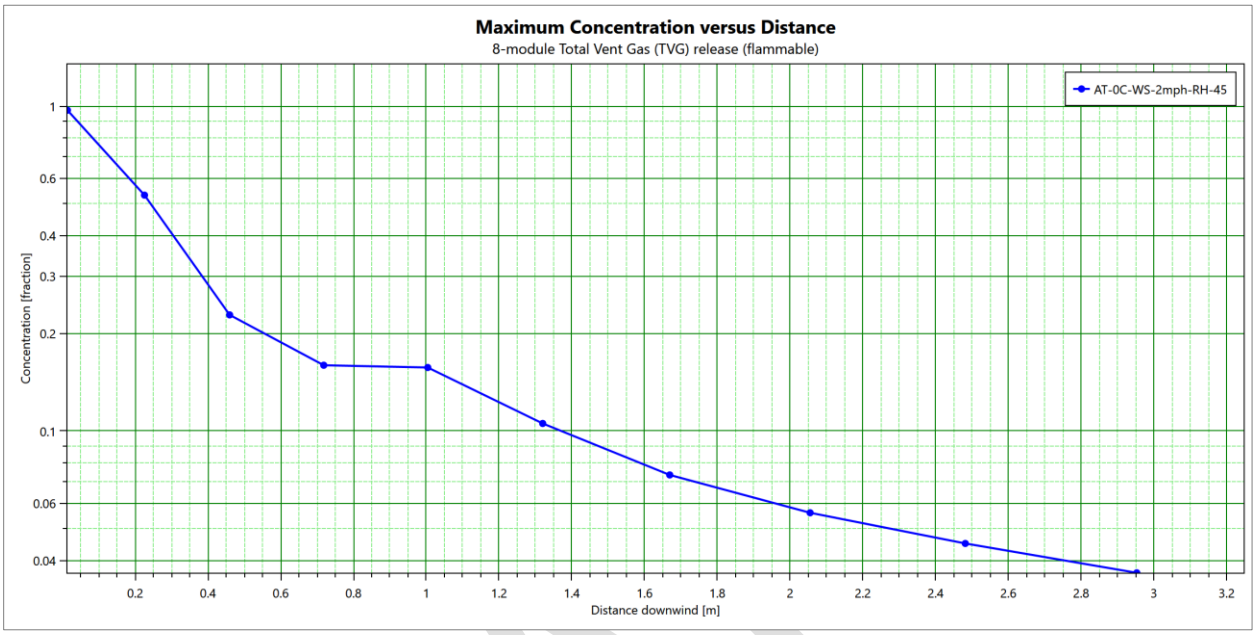

Figure 41 Maximum concentration vs distance for flammable vapor cloud

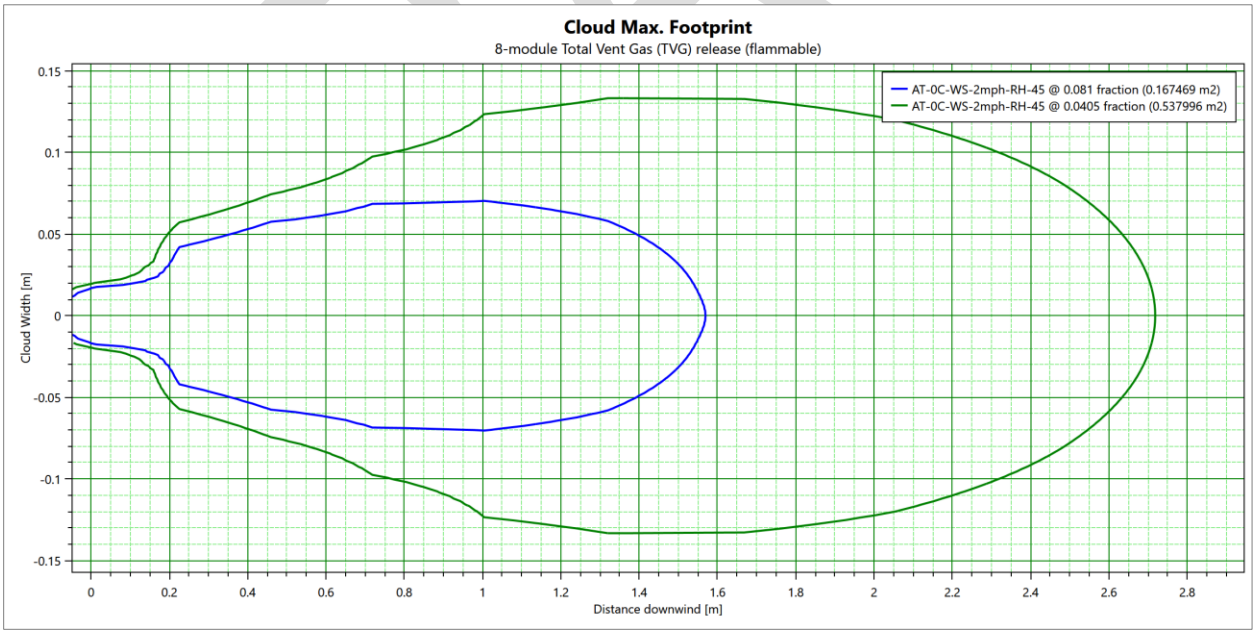

Figure 42 Maximum horizontal extent of vapor cloud for LFL (8.1%) and ½ LFL (4.05%)

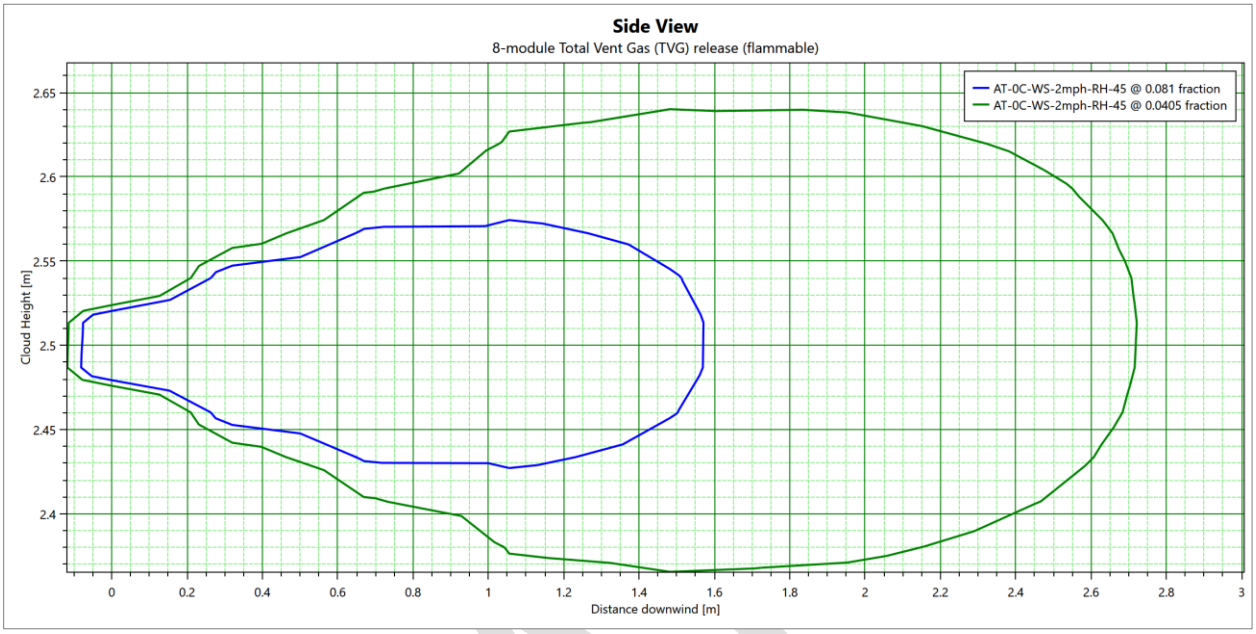

Figure 43 Maximum vertical extent of vapor cloud for LFL (8.1%) and ½ LFL (4.05%)

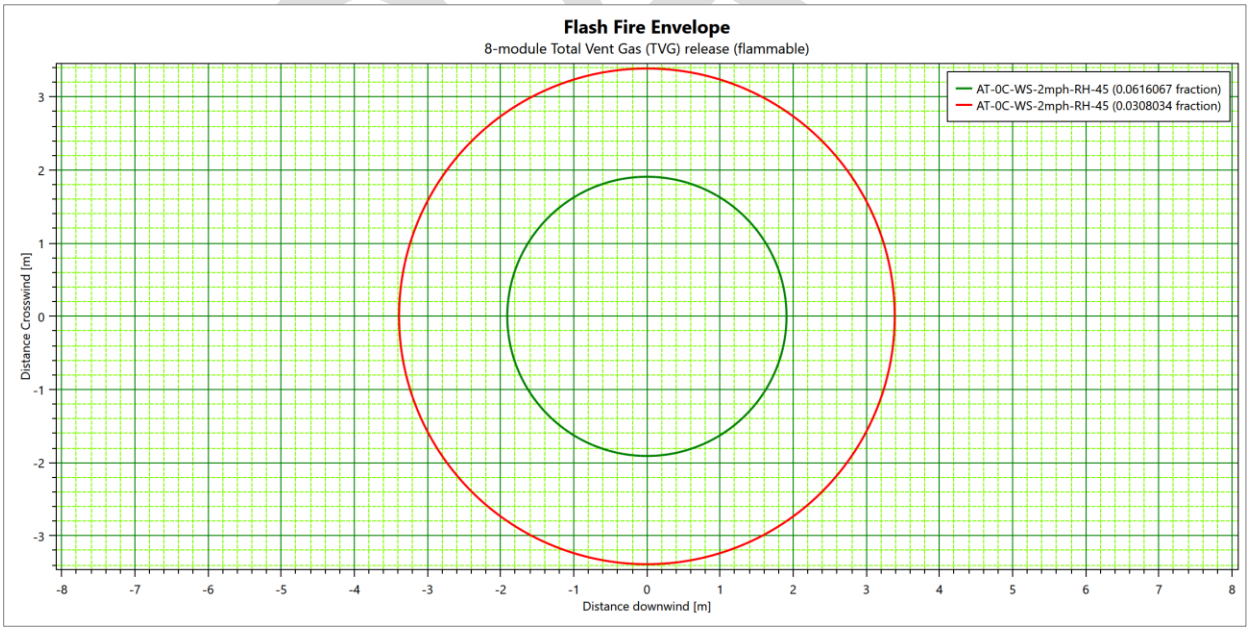

Figure 44 Flash Fire Envelope for LFL (8.1%) and ½ LFL (4.05%)

4.2 CO IDLH (1200 ppm) Component Extent (79 min Release)

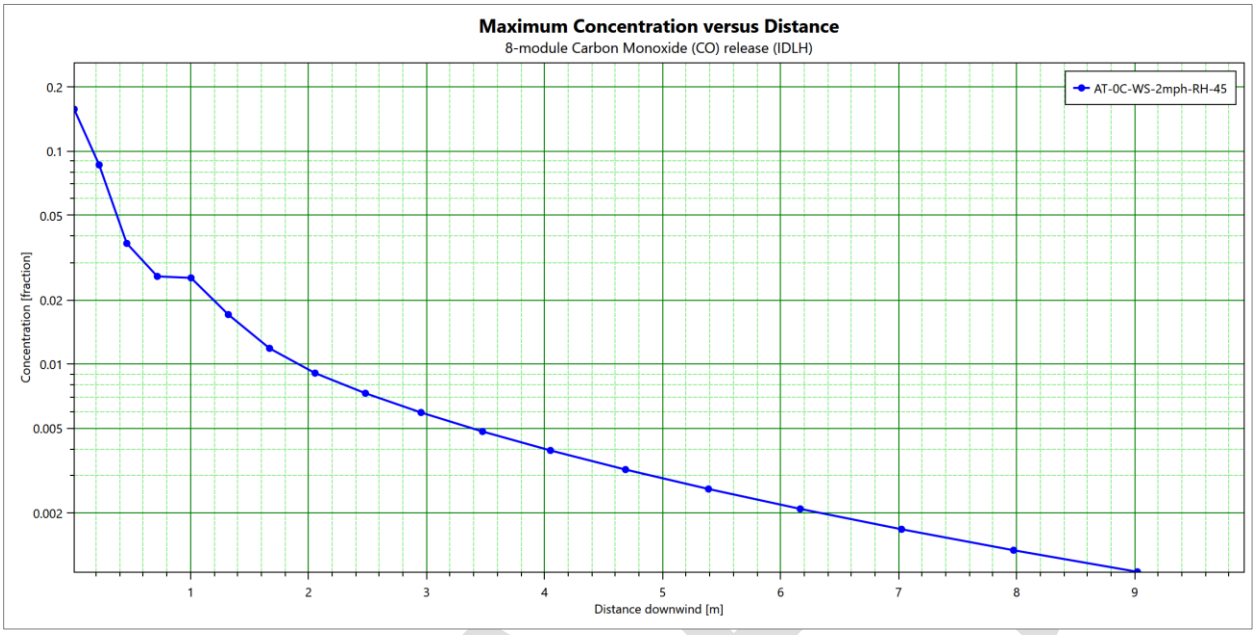

Figure 45 Maximum Concentration vs distance for CO gas component

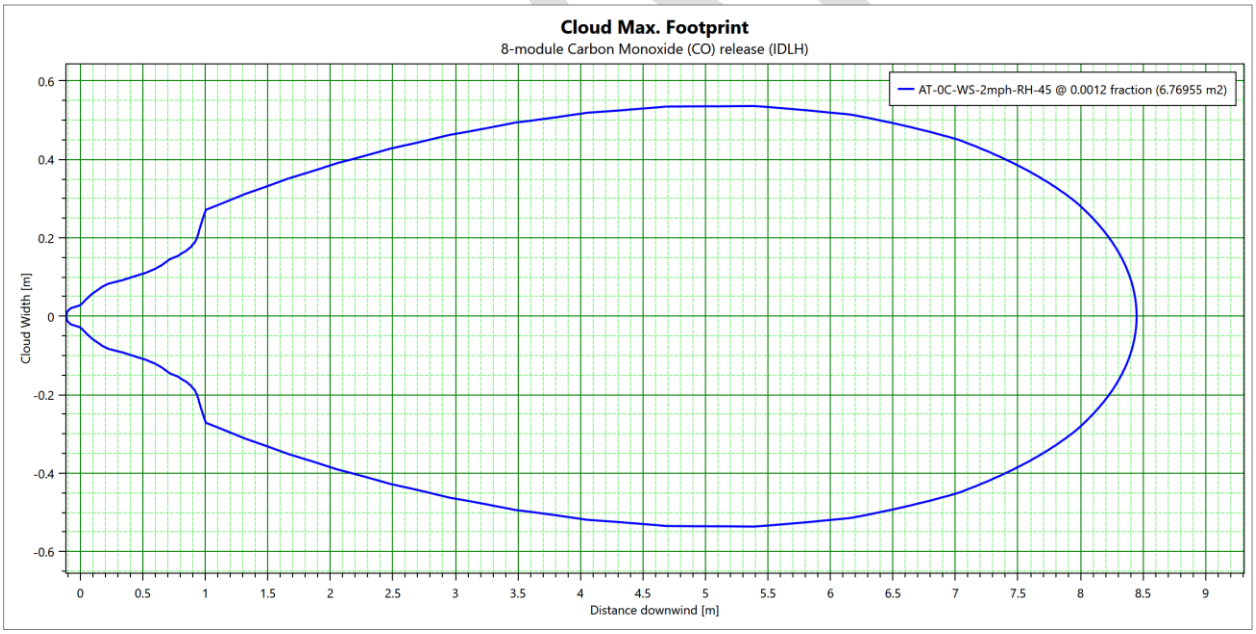

Figure 46 Maximum horizontal extent of vapor cloud for CO IDLH (1200 ppm)

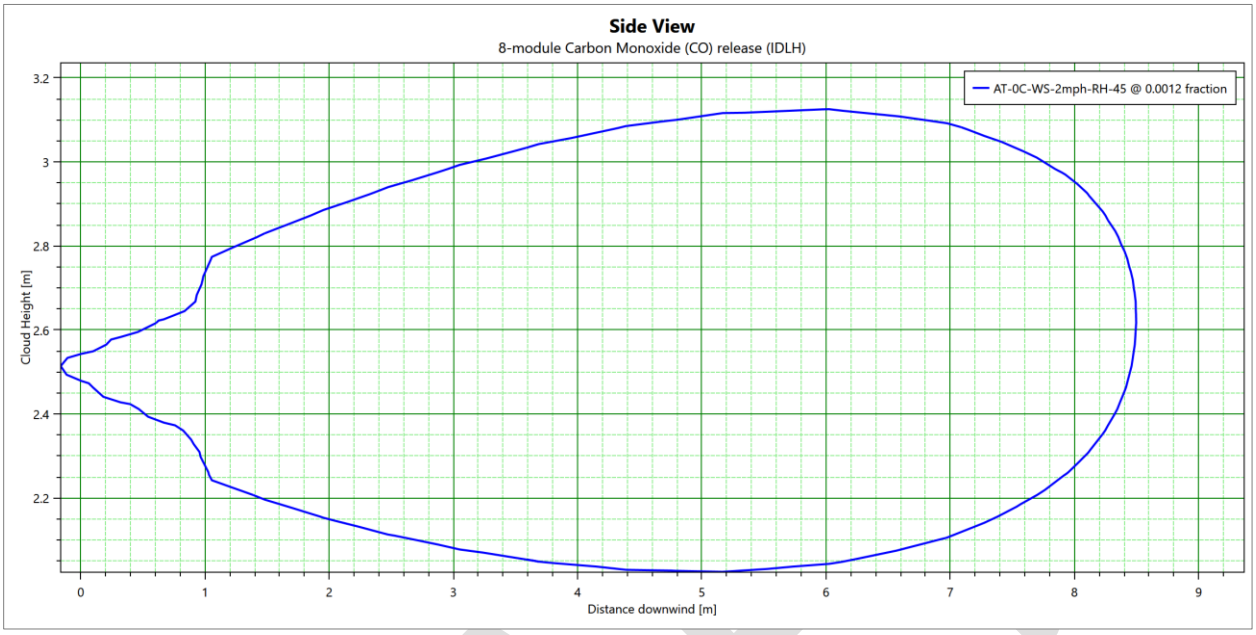

Figure 47 Maximum vertical extent of vapor cloud for CO IDLH (1200 ppm)

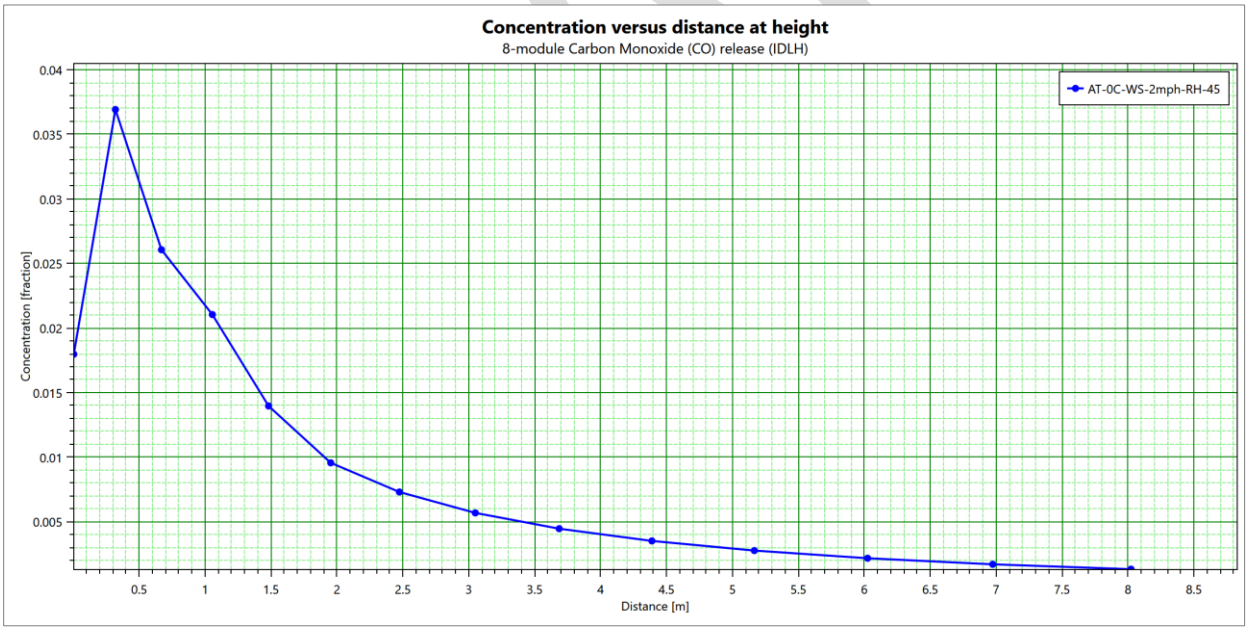

Figure 48 Concentration vs distance for CO IDLH (1200 ppm)

1.5 Scenario 5: 1-Container Release

5.1 TVG Flammable Vapor Cloud Extent (79 min Release)

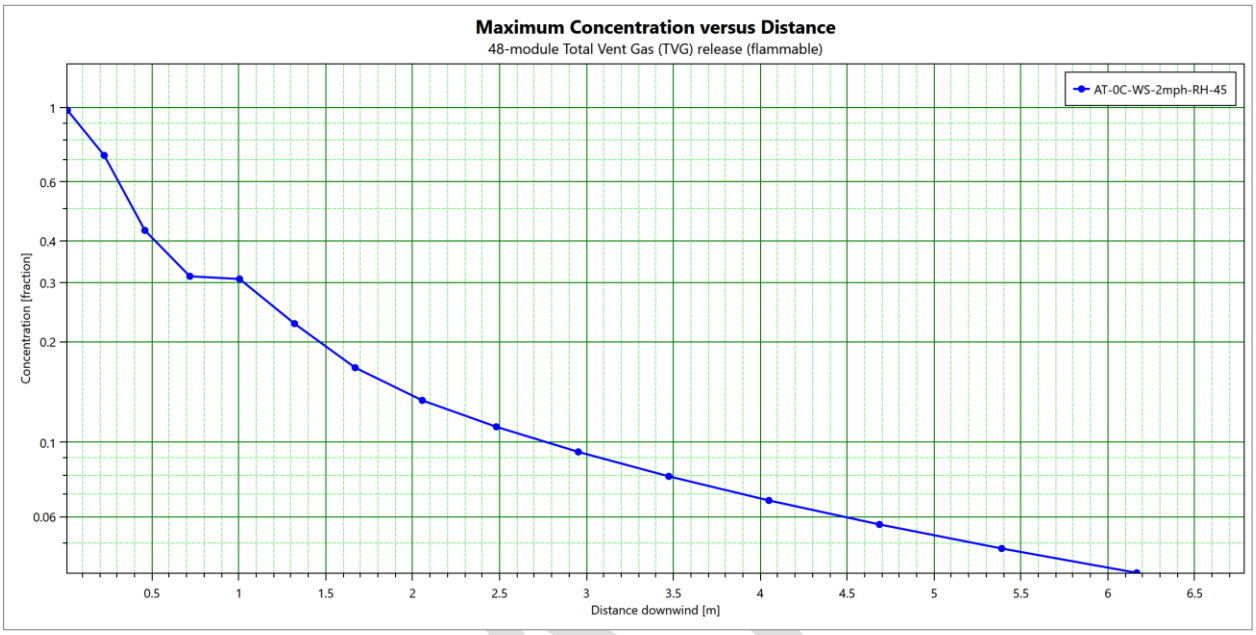

Figure 49 Maximum concentration vs distance for flammable vapor cloud

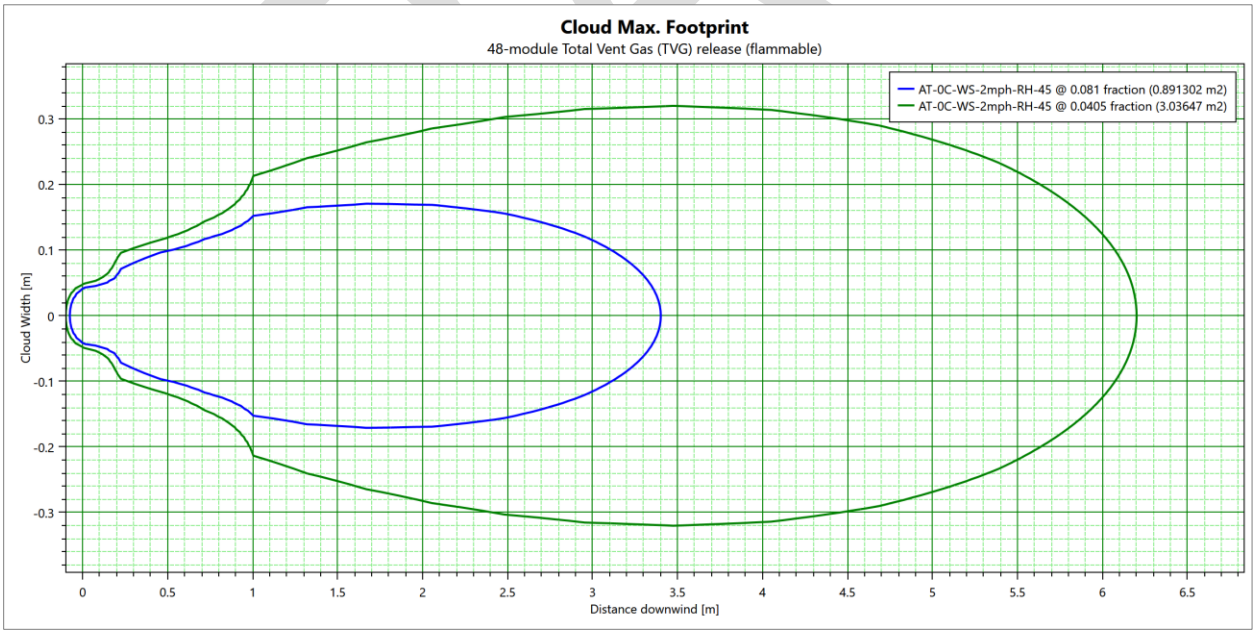

Figure 50 Maximum horizontal extent of vapor cloud for LFL (8.1%) and ½ LFL (4.05%)

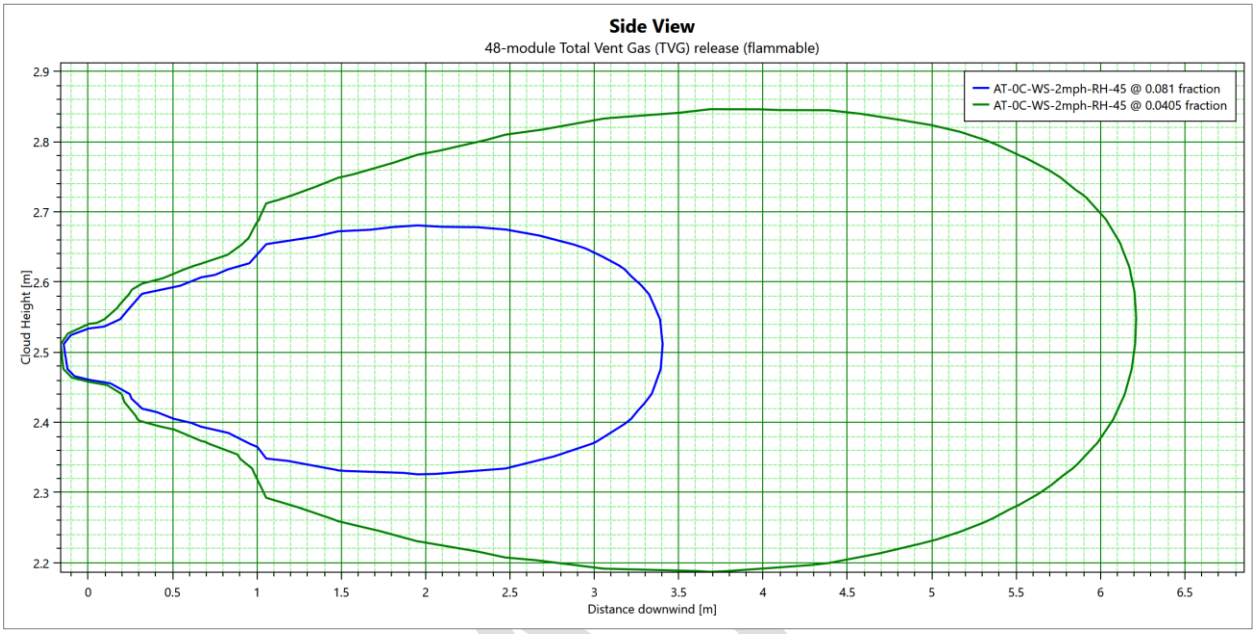

Figure 51 Maximum vertical extent of vapor cloud for LFL (8.1%) and ½ LFL (4.05%)

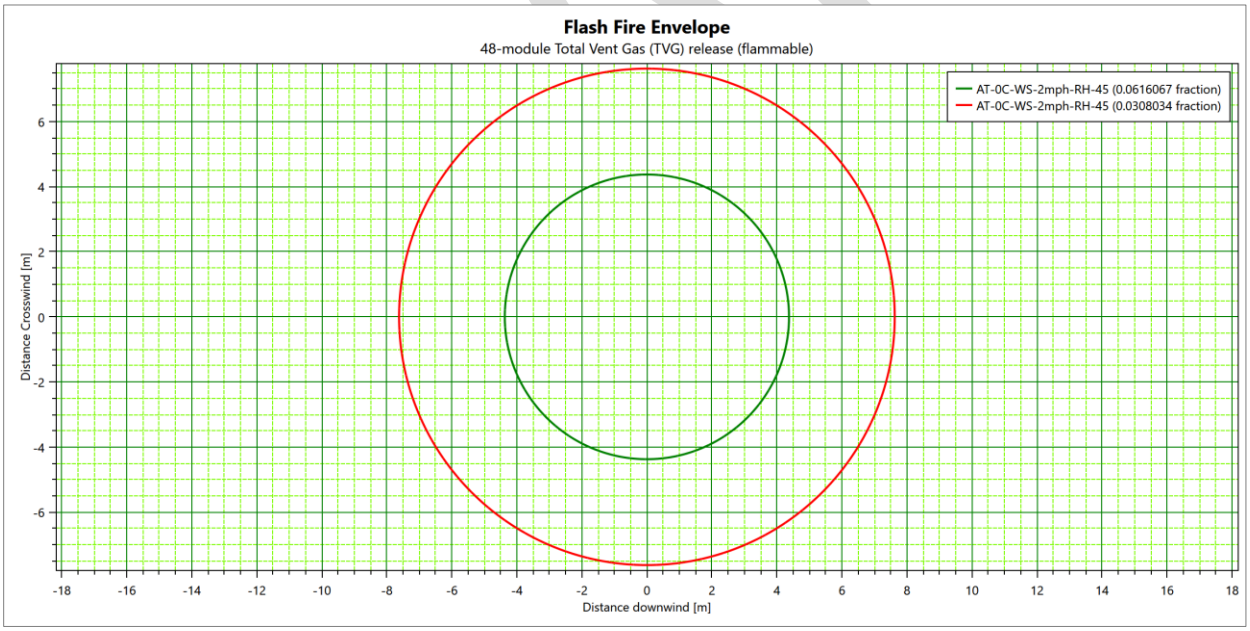

Figure 52 Flash Fire Envelope for LFL (8.1%) and ½ LFL (4.05%)

5.2 CO IDLH (1200 ppm) Component Extent (79 min Release)

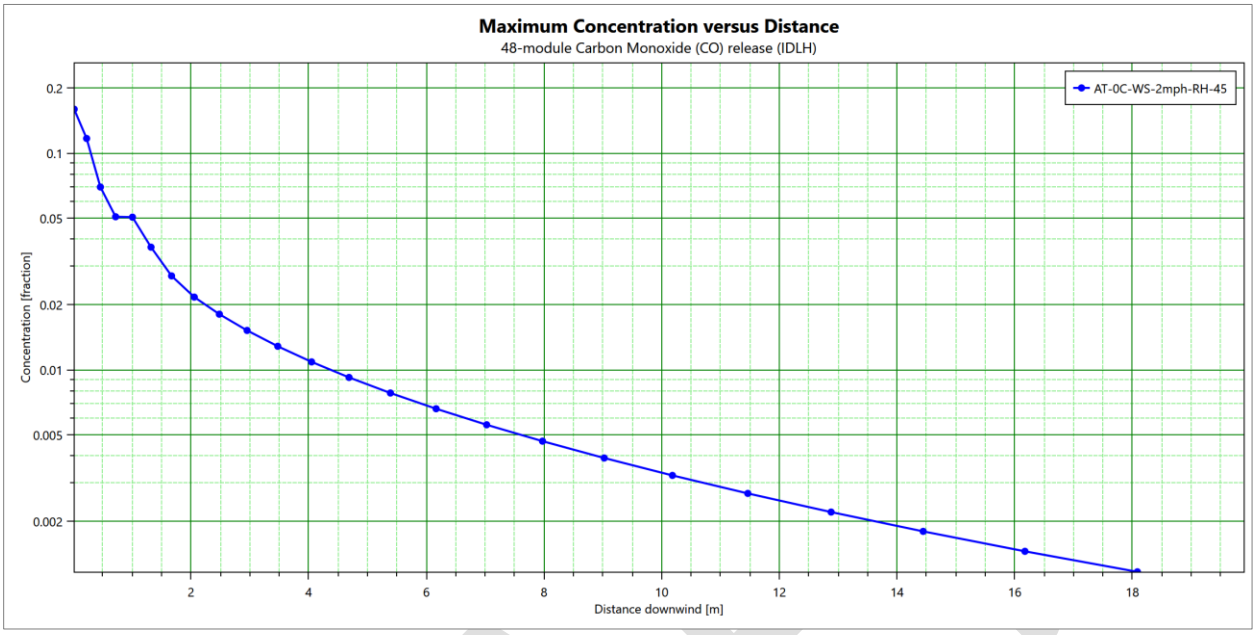

Figure 53 Maximum Concentration vs distance for CO gas component

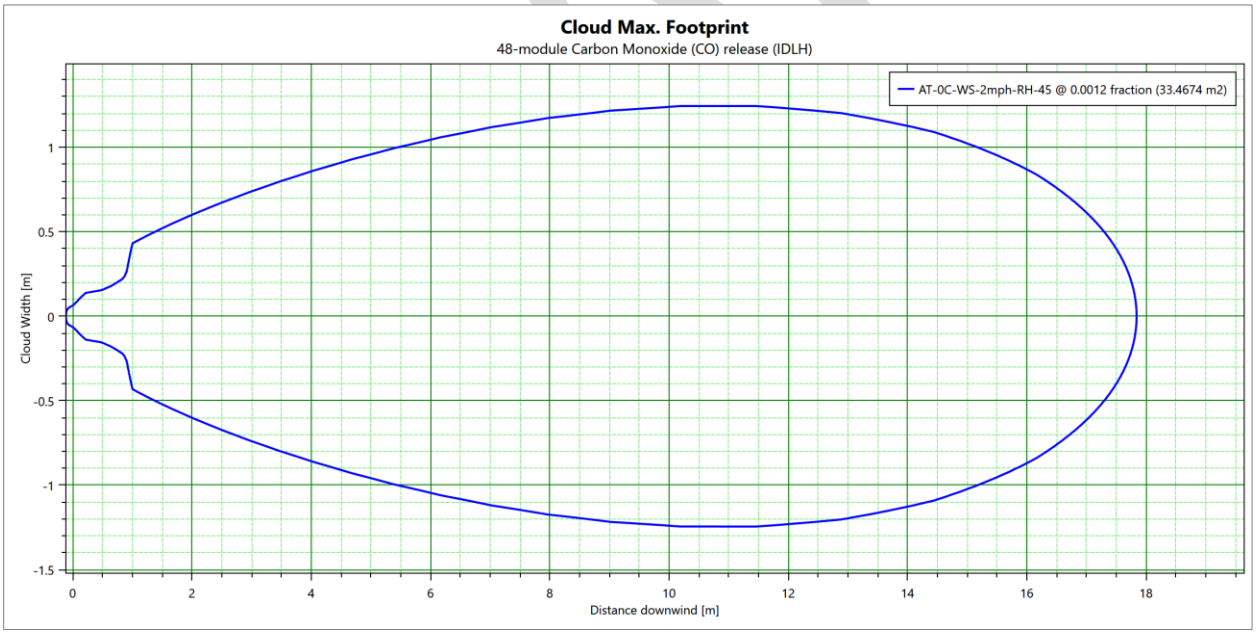

Figure 54 Maximum horizontal extent of vapor cloud for CO IDLH (1200 ppm)

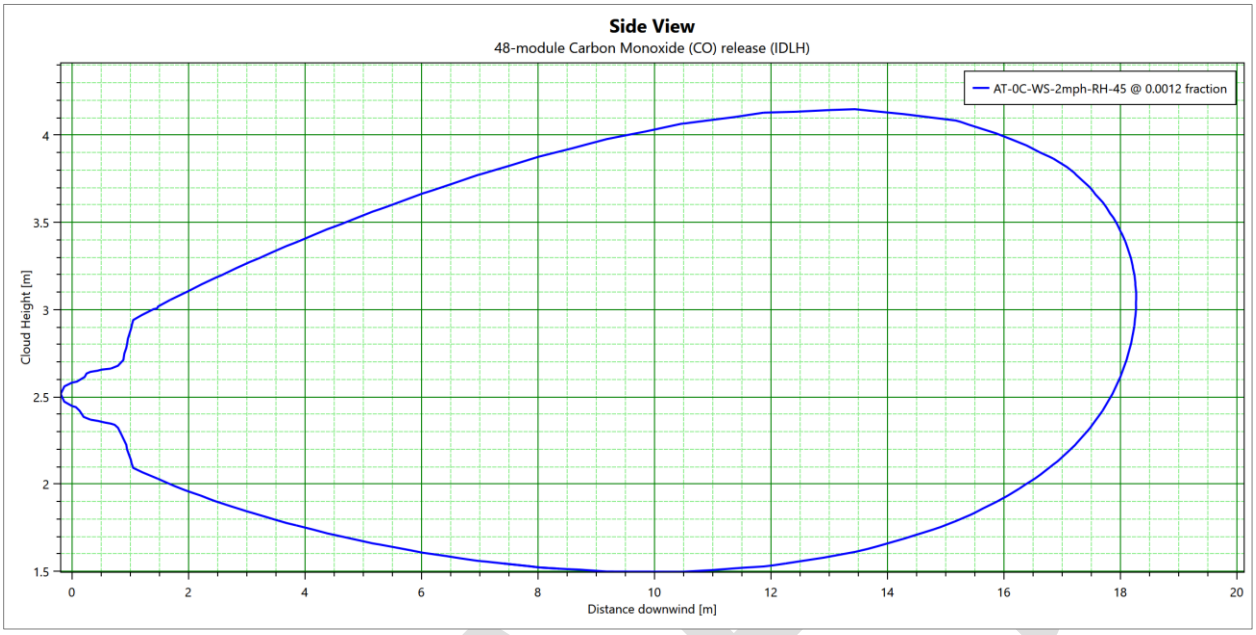

Figure 55 Maximum vertical extent of vapor cloud for CO IDLH (1200 ppm)

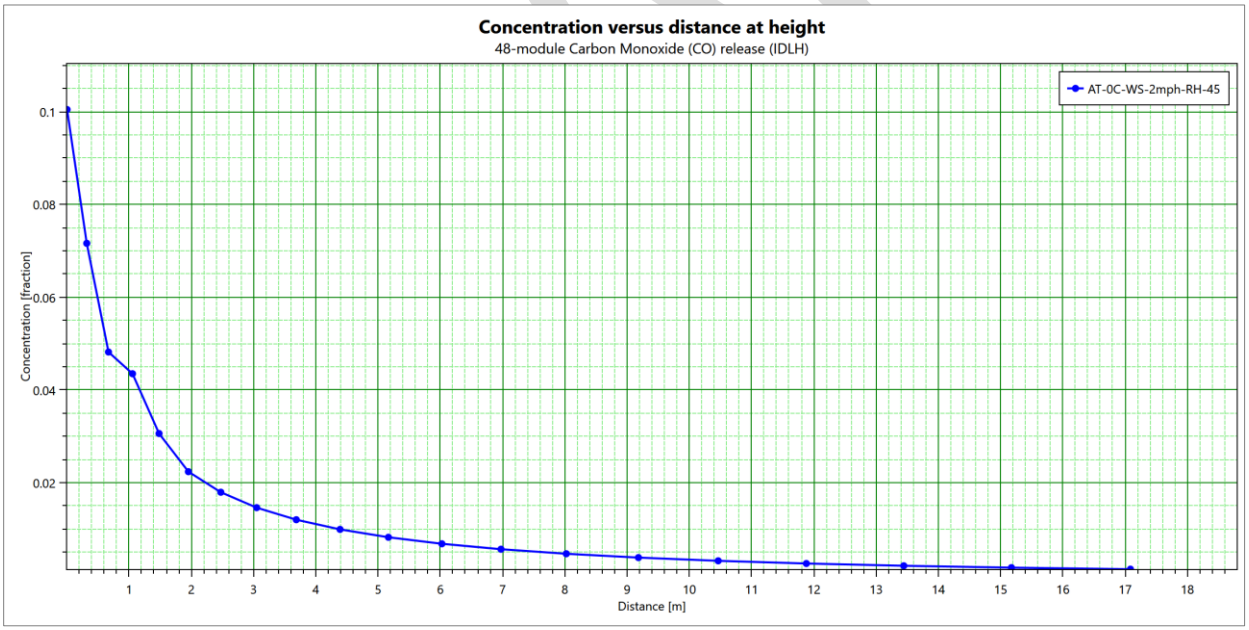

Figure 56 Concentration vs distance for CO IDLH (1200 ppm)

1.6 Summary Results for Vent Gas LFL Extent

6.1 Scenario 1: UL9540A Thermal Runaway (2-Cells)

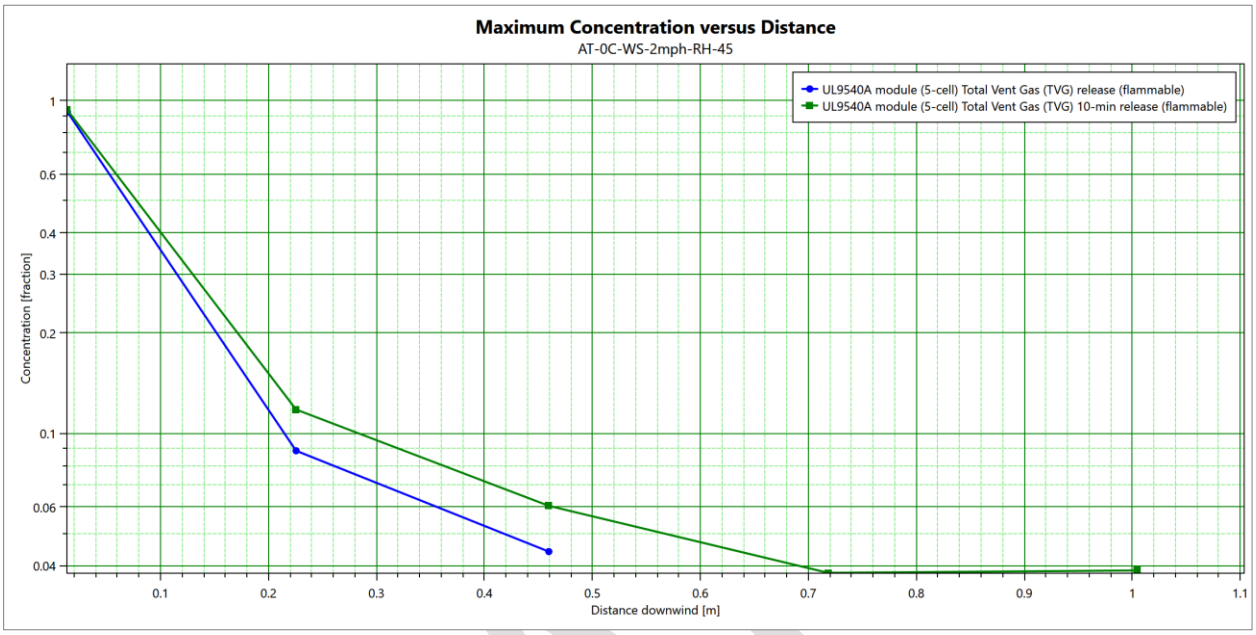

Figure 57 Maximum concentration vs distance for flammable vapor cloud for all sub-scenarios

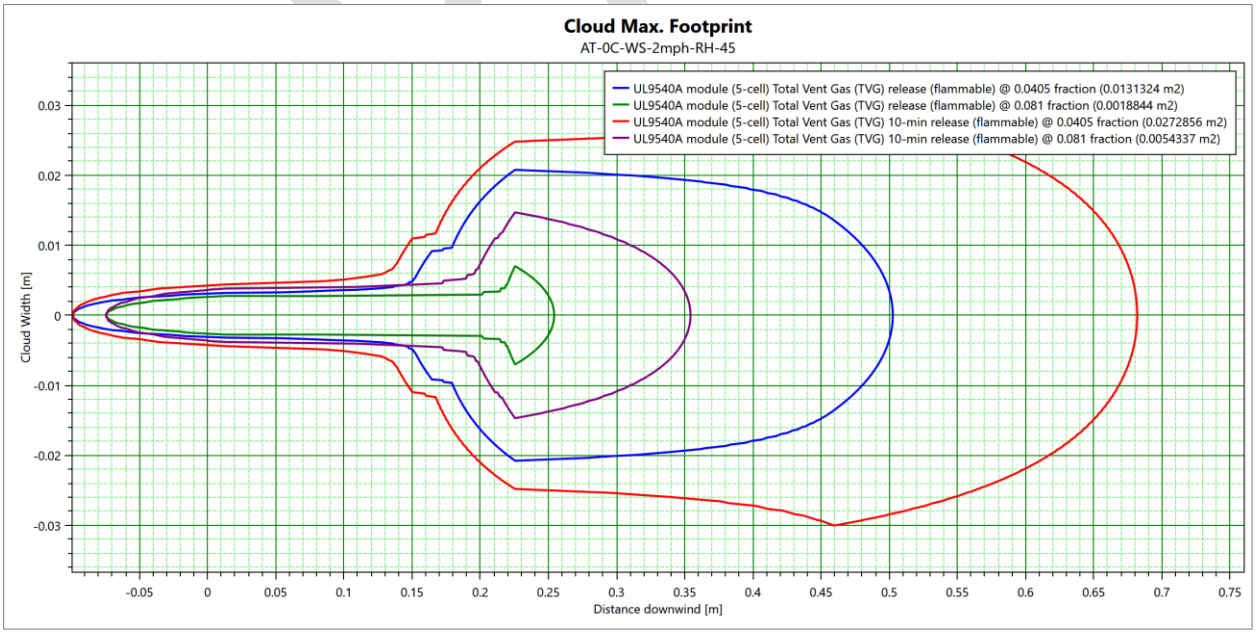

Figure 58 Maximum horizontal extent of vapor cloud for LFL (8.1%) for all sub-scenarios

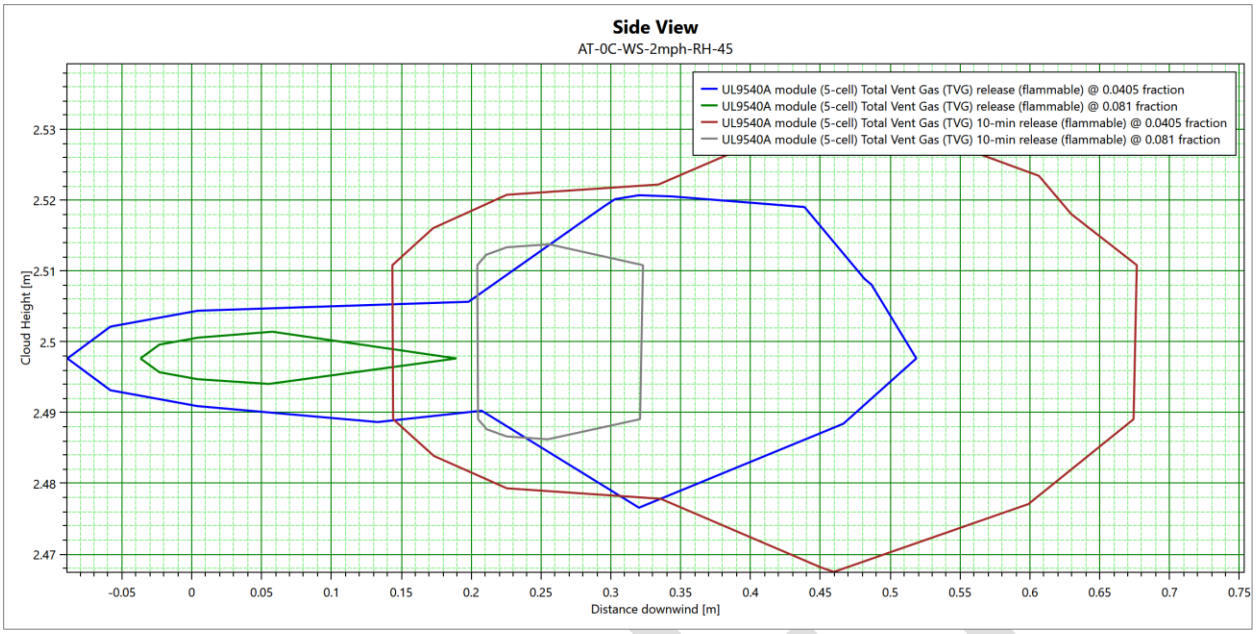

Figure 59 Maximum vertical extent of vapor cloud for LFL (8.1%) for all sub-scenarios

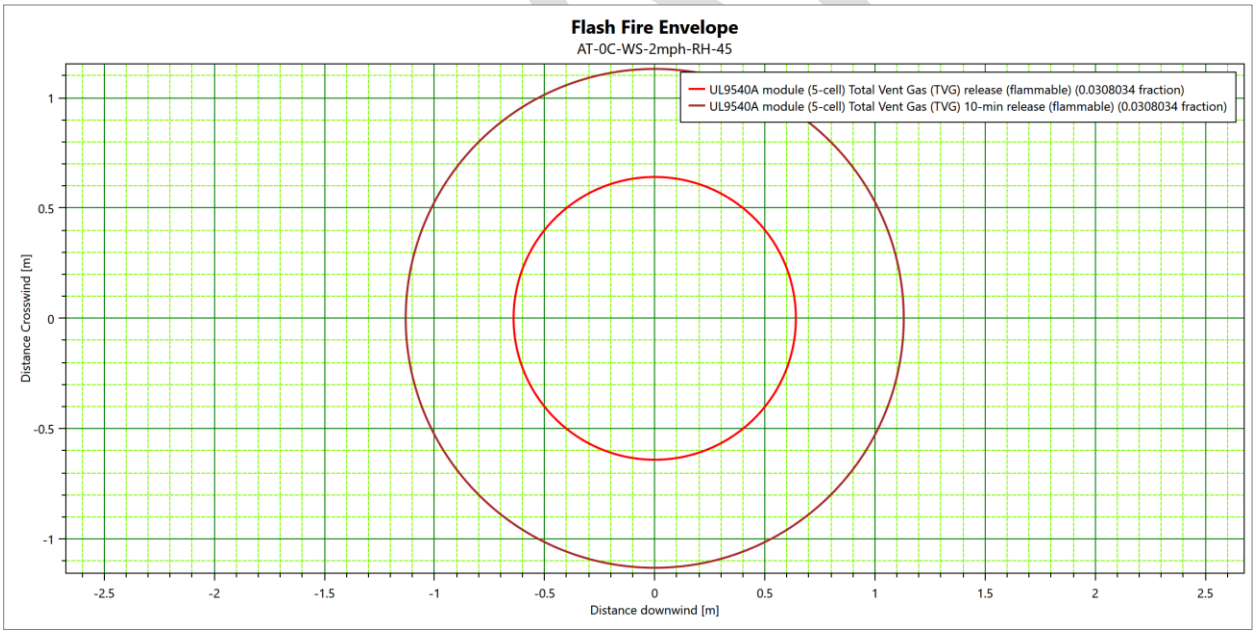

Figure 60 Flash Fire Envelope for ½ LFL (4.05%) for all sub-scenarios

6.2 Scenario 2: 1-Module Release

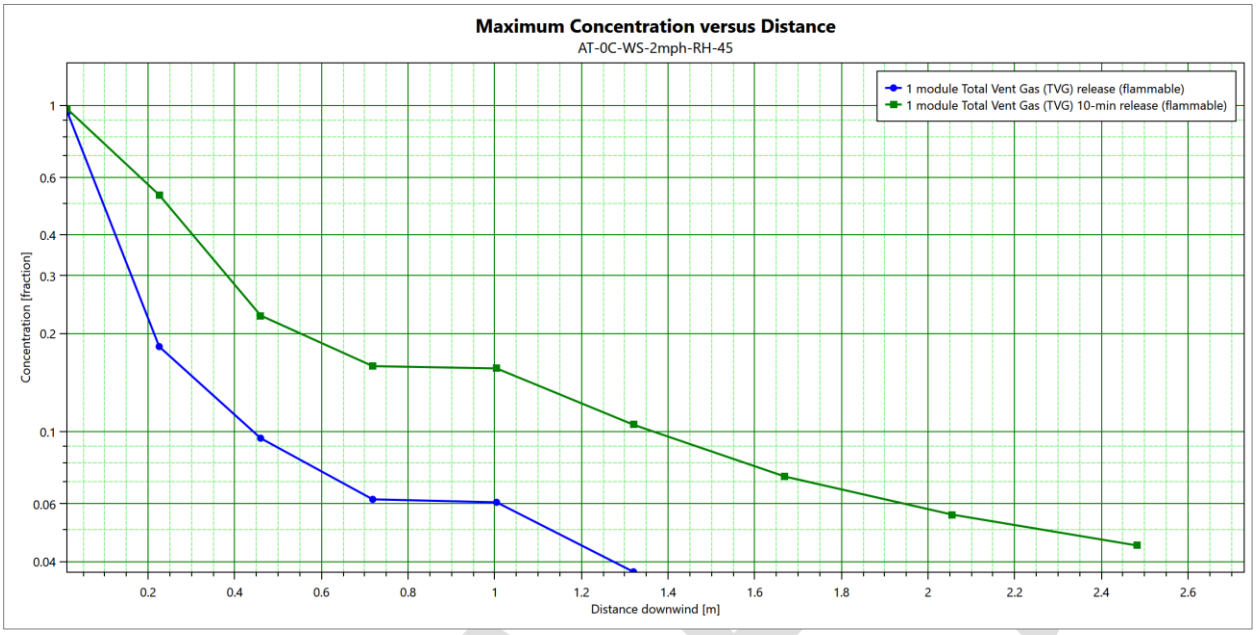

Figure 61 Maximum concentration vs distance for flammable vapor cloud for all sub-scenarios

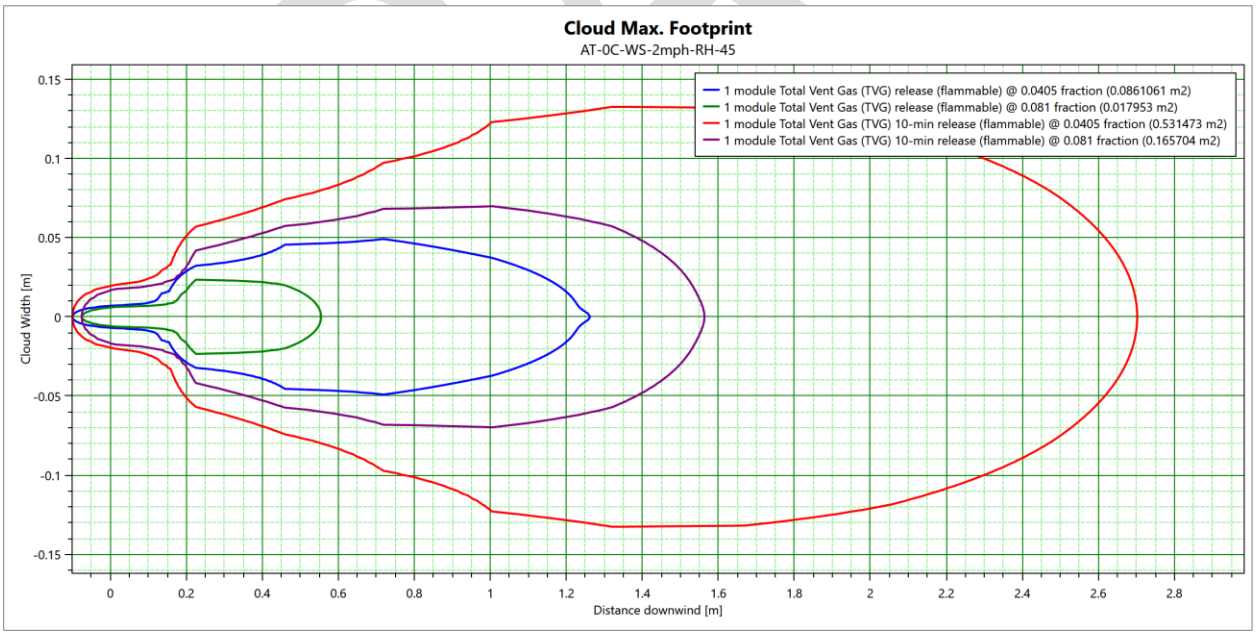

Figure 62 Maximum horizontal extent of vapor cloud for LFL (8.1%) for all sub-scenarios

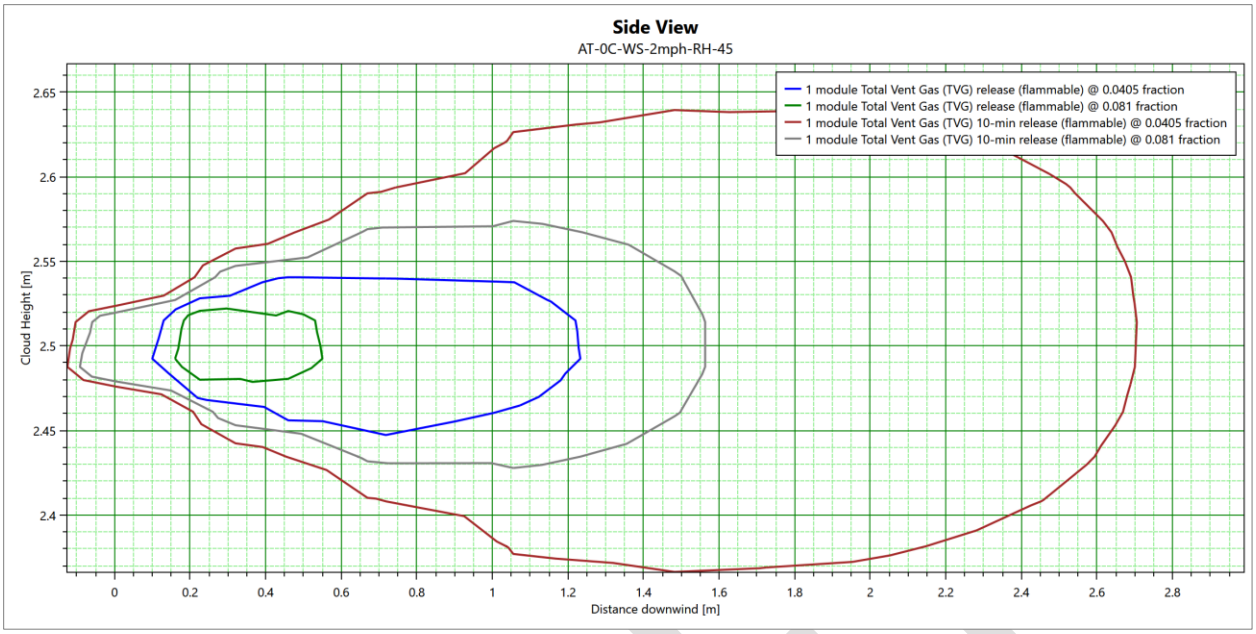

Figure 63 Maximum vertical extent of vapor cloud for LFL (8.1%) for all sub-scenarios

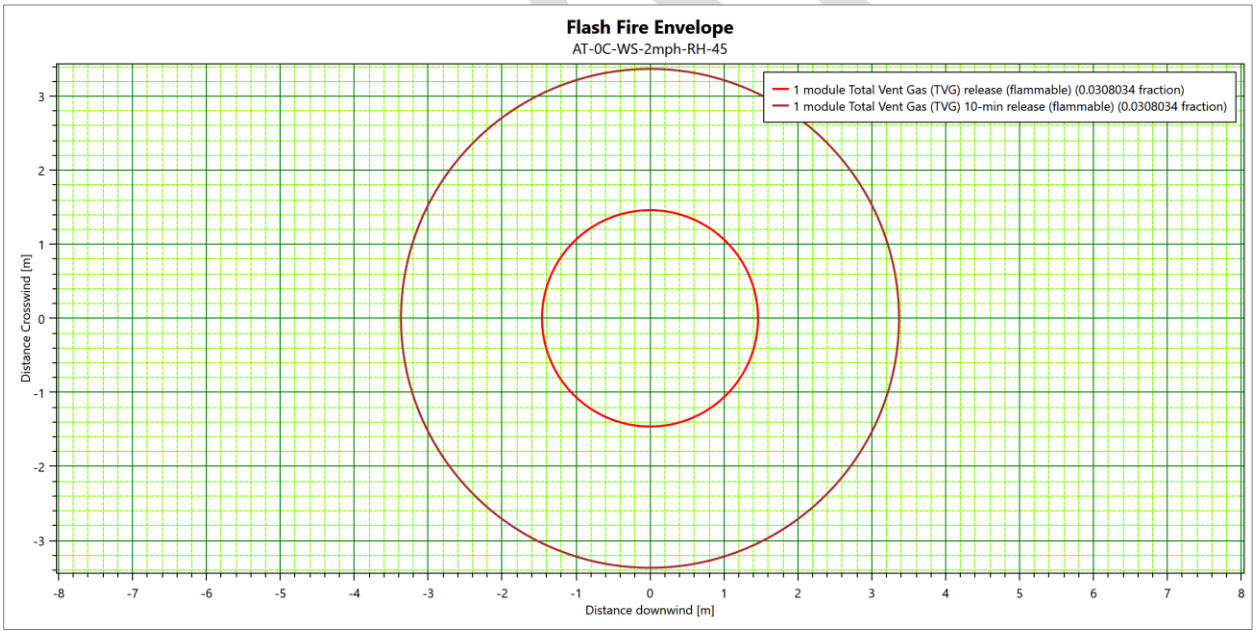

Figure 64 Flash Fire Envelope for ½ LFL (4.05%) for all sub-scenarios

1.7 Summary Results for Vent Gas CO IDLH (1200ppm) Extent

7.1 Scenario 1: UL9540A Thermal Runaway (2-Cells)

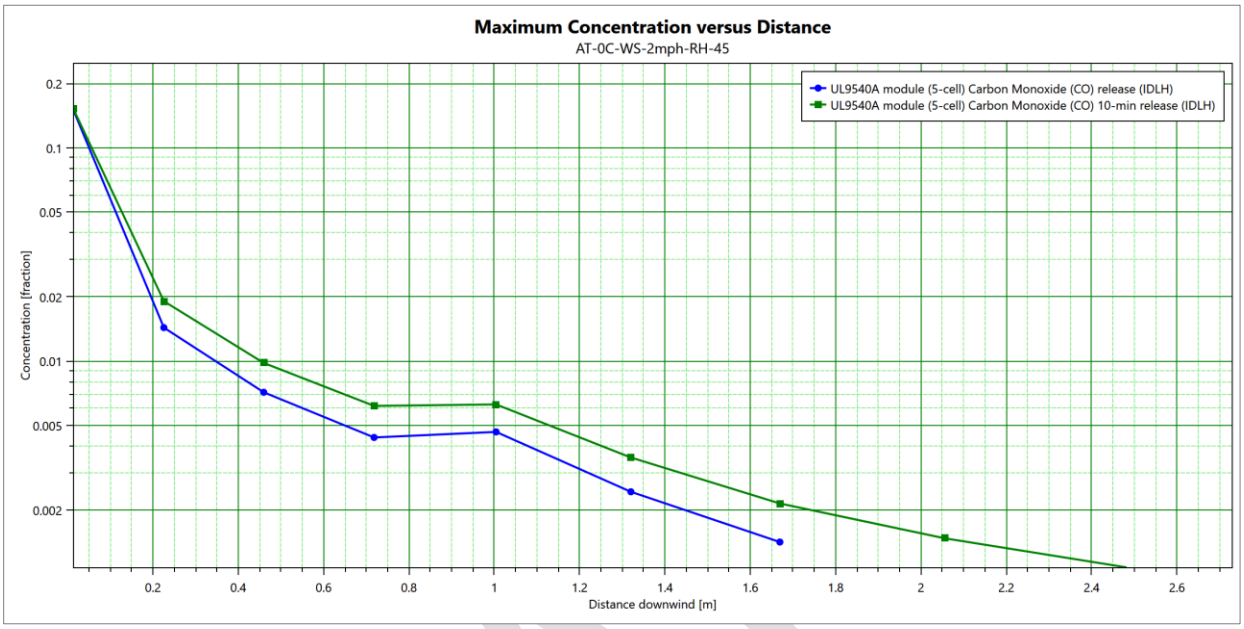

Figure 65 Maximum concentration vs distance at height (2.5m) for CO IDLH (1200ppm) for all sub-scenarios

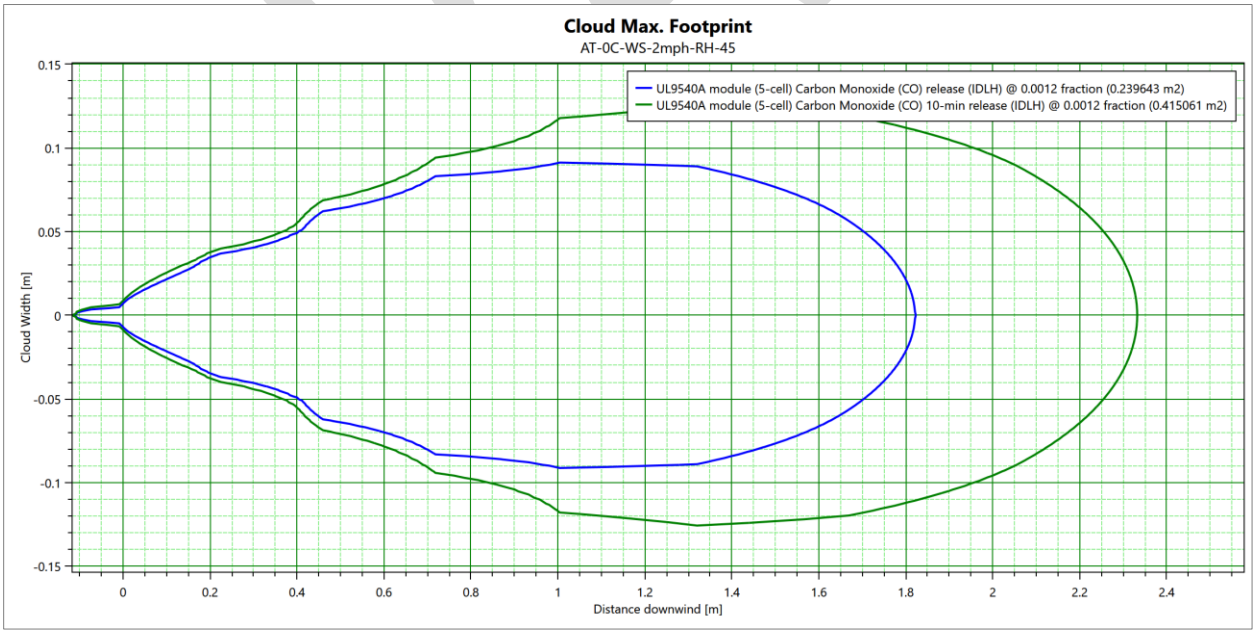

Figure 66 Maximum horizontal extent of vapor cloud for CO IDLH (1200 ppm) for all sub-scenarios

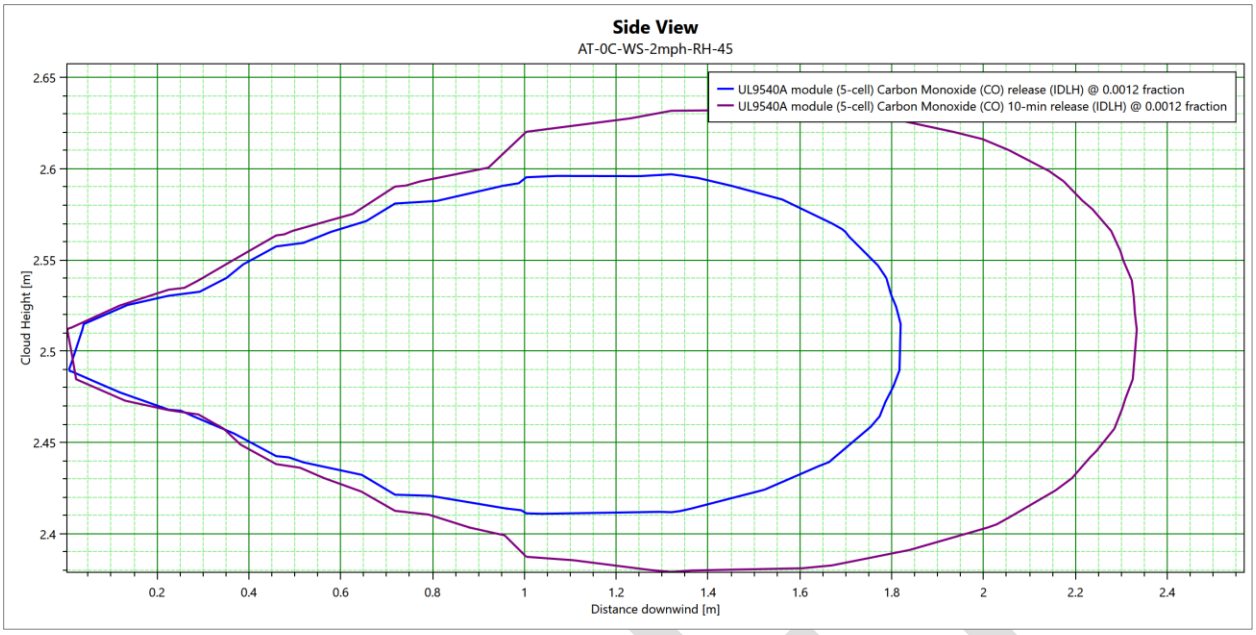

Figure 67 Maximum vertical extent of vapor cloud for CO IDLH (1200 ppm) for all sub-scenarios

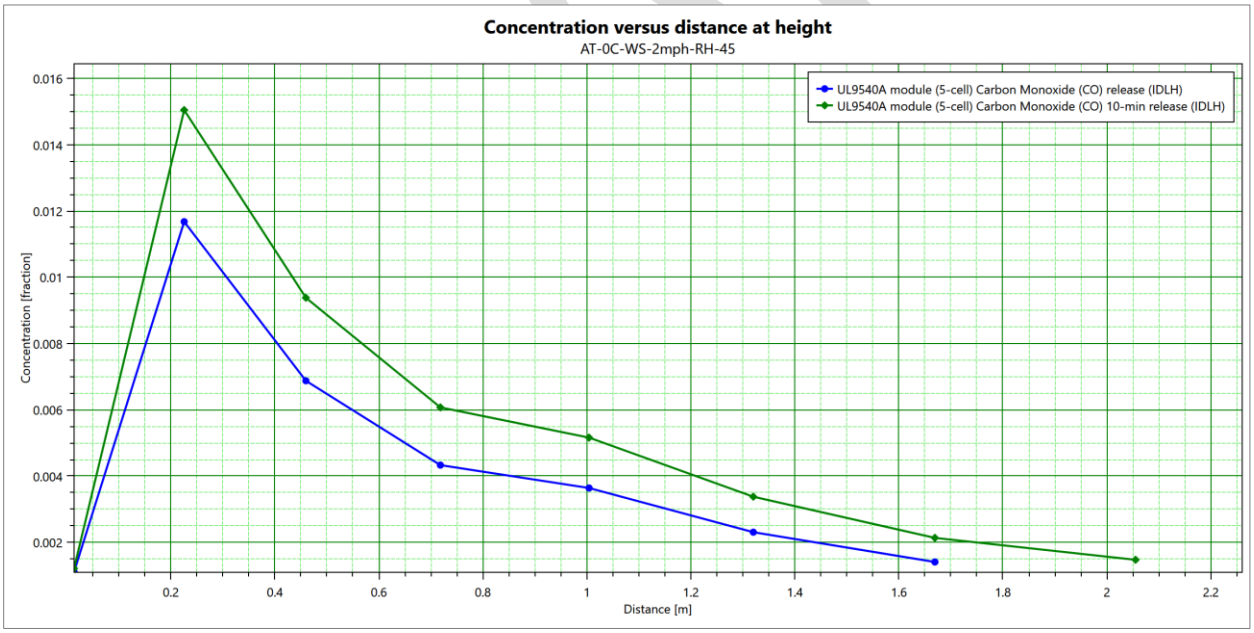

Figure 68 Concentration vs. distance for CO IDLH (1200 ppm) for all sub-scenarios

7.2 Scenario 2: 1-Module Release

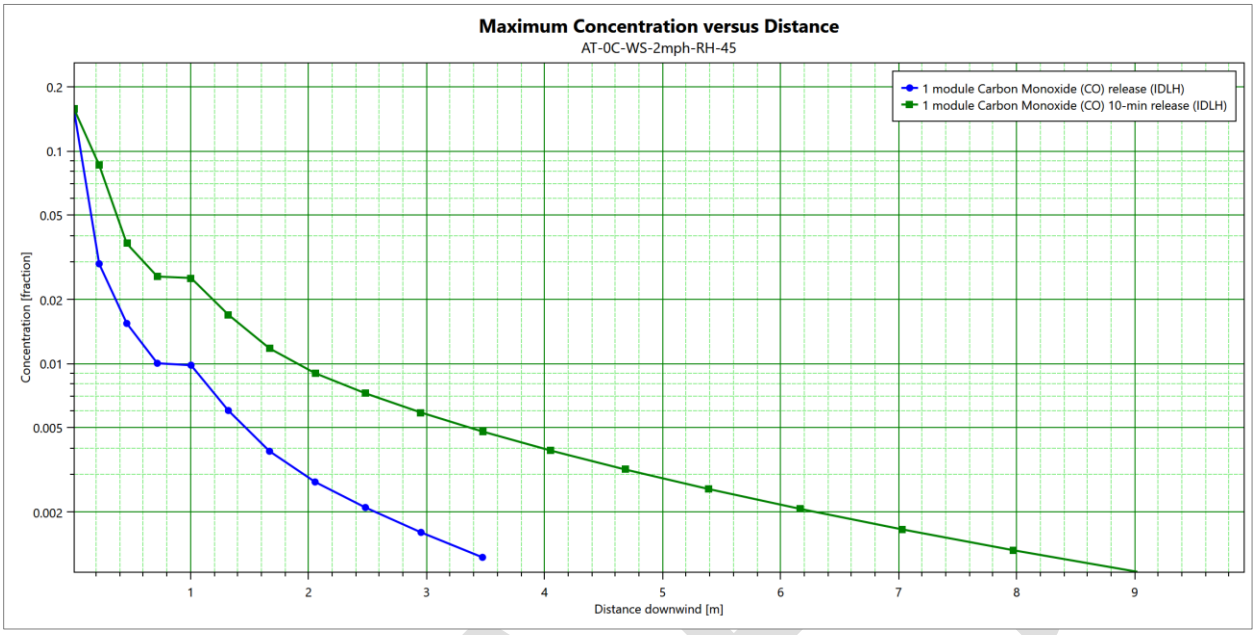

Figure 69 Maximum concentration vs distance at height (2.5m) for CO IDLH (1200ppm) for all sub-scenarios

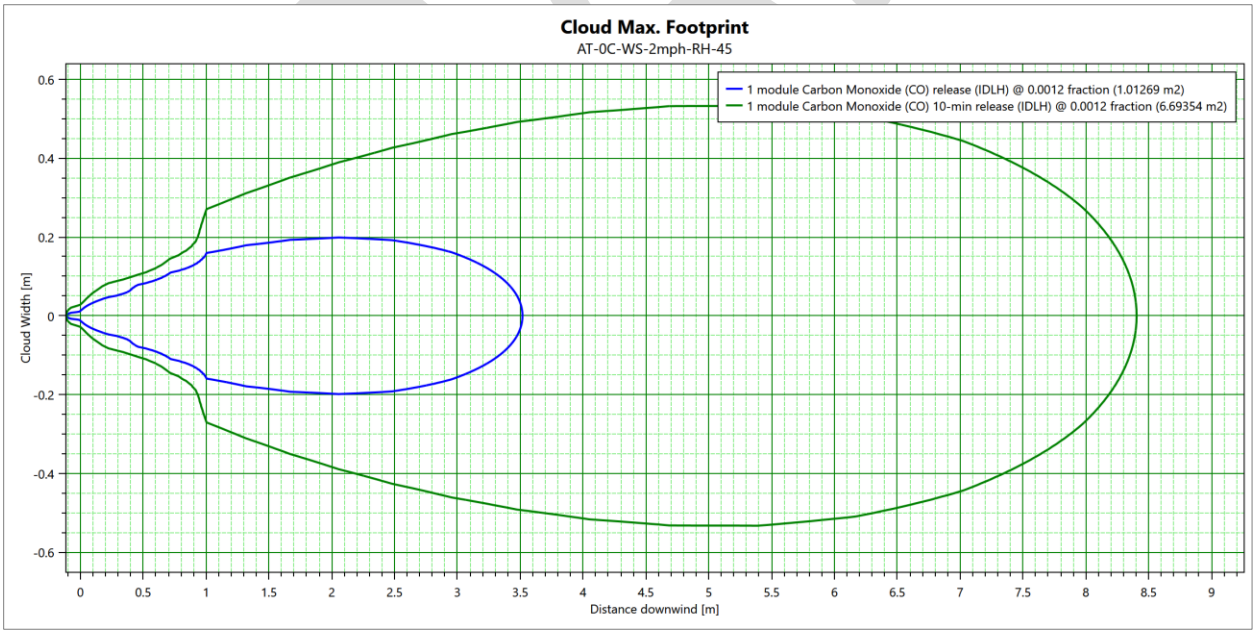

Figure 70 Maximum horizontal extent of vapor cloud for CO IDLH (1200 ppm) for all sub-scenarios

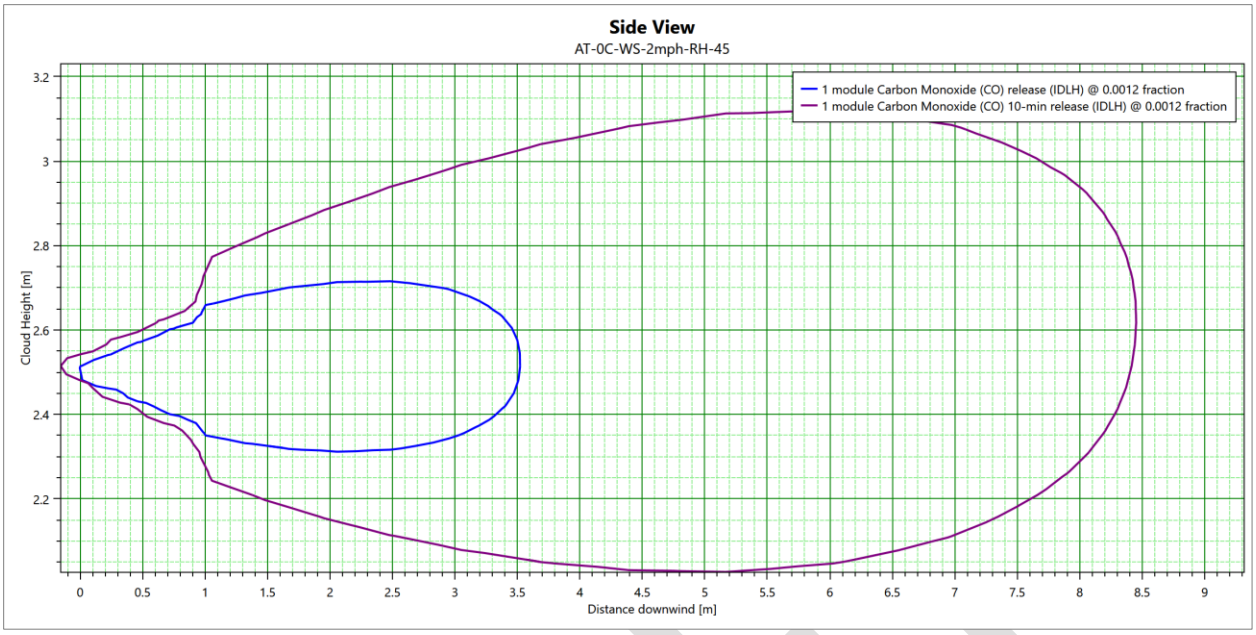

Figure 71 Maximum vertical extent of vapor cloud for CO IDLH (1200 ppm) for all sub-scenarios

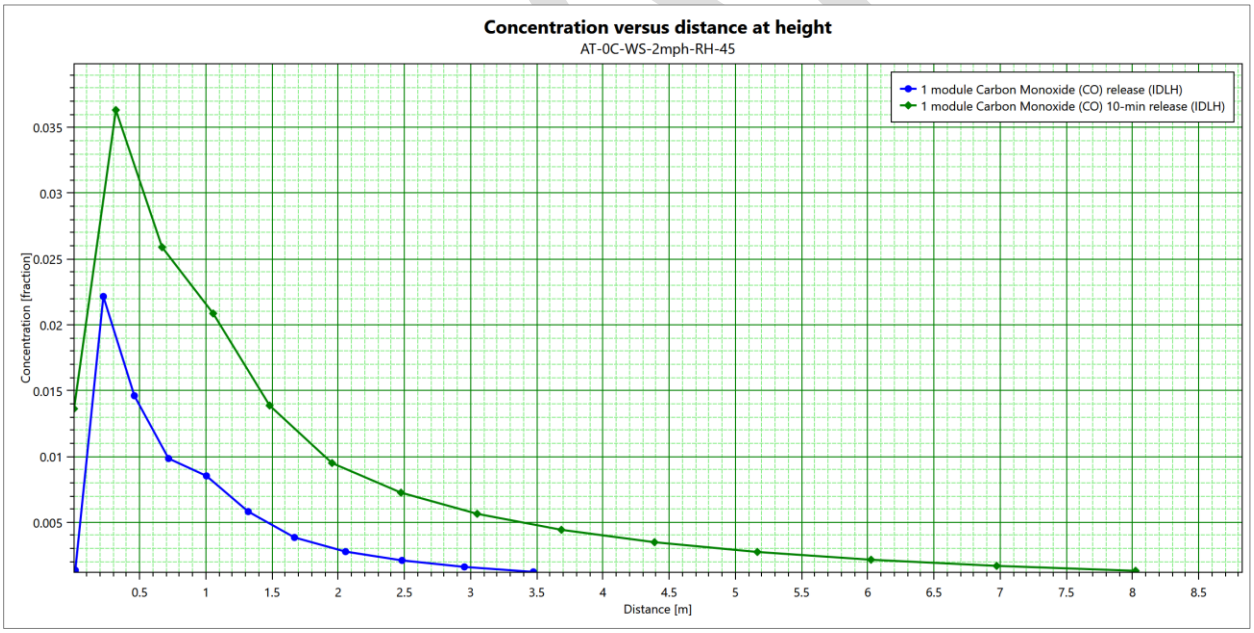

Figure 72 Concentration vs. distance for CO IDLH (1200 ppm) for all sub-scenarios

Consequence Summary Report

Workspace: 866-003 CT11 BESS

Study: Study

Summary Basis

These tables will only report global values set in the parameters. Values that are modified in the study tree will not be reported.

The report is context sensitive, and filters up to the study level. You willl need to generate multiple summary reports if you have multiple studies in your workspace.

Discharge Results (after atmospheric expansion)

Path	Scenario	Weather	Peak Flowrate [kg/s]	Temperature [degC]	Liquid mass fraction in material [fraction]	Droplet diameter [um]	Expanded diameter [m]	Velocity [m/s]	End time of release [s]
Study\Key Capture CT11 BESS Site \UL9540A Module Test based Release (5-cell propogation)	UL9540A module (5-cell) Total Vent Gas (TVG) release (flammable)	AT-0C-WS-2mph-RH-45	0.000897358	-24.4309	0	0	0.00173089	404.1	1140
		AT-0C-WS-5mph-RH-45	0.000897358	-24.4309	0	0	0.00173089	404.1	1140
		AT-0C-WS-11mph-RH-45	0.000897358	-24.4309	0	0	0.00173089	404.1	1140
	UL9540A module (5-cell) Carbon Monoxide (CO) release (IDLH)	AT-0C-WS-2mph-RH-45	0.000897358	-24.4309	0	0	0.00173089	404.1	1140
		AT-0C-WS-5mph-RH-45	0.000897358	-24.4309	0	0	0.00173089	404.1	1140

		AT-0C-WS-11mph-RH-45	0.00089735	-24.4309	0	0	0.00173089	404.1	1140
	UL9540A module (5-cell) Total Vent Gas (TVG) 10-min release (flammable)	AT-0C-WS-2mph-RH-45	0.00170498	-24.4309	0	0	0.00238587	404.1	600
		AT-0C-WS-5mph-RH-45	0.00170498	-24.4309	0	0	0.00238587	404.1	600
		AT-0C-WS-11mph-RH-45	0.00170498	-24.4309	0	0	0.00238587	404.1	600
	UL9540A module (5-cell) Carbon Monoxide (CO) 10-min release (IDLH)	AT-0C-WS-2mph-RH-45	0.00170498	-24.4309	0	0	0.00238587	404.1	600
		AT-0C-WS-5mph-RH-45	0.00170498	-24.4309	0	0	0.00238587	404.1	600
		AT-0C-WS-11mph-RH-45	0.00170498	-24.4309	0	0	0.00238587	404.1	600
Study\Key Capture CT11 BESS Site \Single Module Release (104-cell propogation)	1 module Total Vent Gas (TVG) release (flammable)	AT-0C-WS-2mph-RH-45	0.00448906	-24.4309	0	0	0.00387137	404.1	4740
		AT-0C-WS-5mph-RH-45	0.00448906	-24.4309	0	0	0.00387137	404.1	4740
		AT-0C-WS-11mph-RH-45	0.00448906	-24.4309	0	0	0.00387137	404.1	4740

	1 module Carbon Monoxide (CO) release (IDLH)	AT-0C-WS-2mph-RH-45	0.00448906	-24.4309	0	0	0.00387137	404.1	4740
		AT-0C-WS-5mph-RH-45	0.00448906	-24.4309	0	0	0.00387137	404.1	4740
		AT-0C-WS-11mph-RH-45	0.00448906	-24.4309	0	0	0.00387137	404.1	4740
	1 module Total Vent Gas (TVG) 10-min release (flammable)	AT-0C-WS-2mph-RH-45	0.0354636	-24.4309	0	0	0.0108812	404.1	600
		AT-0C-WS-5mph-RH-45	0.0354636	-24.4309	0	0	0.0108812	404.1	600
		AT-0C-WS-11mph-RH-45	0.0354636	-24.4309	0	0	0.0108812	404.1	600
	1 module Carbon Monoxide (CO) 10-min release (IDLH)	AT-0C-WS-2mph-RH-45	0.0354636	-24.4309	0	0	0.0108812	404.1	600
		AT-0C-WS-5mph-RH-45	0.0354636	-24.4309	0	0	0.0108812	404.1	600
		AT-0C-WS-11mph-RH-45	0.0354636	-24.4309	0	0	0.0108812	404.1	600
Study\Key Capture CT11 BESS Site\1 String 4-module Release (416-cell propogation)	4-module Total Vent Gas (TVG) release (flammable)	AT-0C-WS-2mph-RH-45	0.0179563	-24.4309	0	0	0.00774274	404.1	4740
		AT-0C-	0.017956	-24.4309	0	0	0.007742	404.1	4740

		WS-5mph-RH-45	3				74		
		AT-0C-WS-11mph-RH-45	0.0179563	-24.4309	0	0	0.00774274	404.1	4740
	4-module Carbon Monoxide (CO) release (IDLH)	AT-0C-WS-2mph-RH-45	0.0179563	-24.4309	0	0	0.00774274	404.1	4740
		AT-0C-WS-5mph-RH-45	0.0179563	-24.4309	0	0	0.00774274	404.1	4740
		AT-0C-WS-11mph-RH-45	0.0179563	-24.4309	0	0	0.00774274	404.1	4740
Study\Key Capture CT11 BESS Site\1 Rack 8-module Release (832-cell propogation)	8-module Total Vent Gas (TVG) release (flammable)	AT-0C-WS-2mph-RH-45	0.0359125	-24.4309	0	0	0.0109499	404.1	4740
		AT-0C-WS-5mph-RH-45	0.0359125	-24.4309	0	0	0.0109499	404.1	4740
		AT-0C-WS-11mph-RH-45	0.0359125	-24.4309	0	0	0.0109499	404.1	4740
	8-module Carbon Monoxide (CO) release (IDLH)	AT-0C-WS-2mph-RH-45	0.0359125	-24.4309	0	0	0.0109499	404.1	4740
		AT-0C-WS-5mph-RH-45	0.0359125	-24.4309	0	0	0.0109499	404.1	4740
		AT-0C-WS-11mph-RH-45	0.0359125	-24.4309	0	0	0.0109499	404.1	4740
Study\Key Capture CT11 BESS Site\1 Container 6-Rack Release (4992-cell	48-module Total Vent Gas	AT-0C-WS-2mph-RH-45	0.215475	-24.4309	0	0	0.0268216	404.1	4740

propogation)	(TVG) release (flammable)								
		AT-0C-WS-5mph-RH-45	0.215475	-24.4309	0	0	0.0268216	404.1	4740
		AT-0C-WS-11mph-RH-45	0.215475	-24.4309	0	0	0.0268216	404.1	4740
	48-module Carbon Monoxide (CO) release (IDLH)	AT-0C-WS-2mph-RH-45	0.215475	-24.4309	0	0	0.0268216	404.1	4740
		AT-0C-WS-5mph-RH-45	0.215475	-24.4309	0	0	0.0268216	404.1	4740
		AT-0C-WS-11mph-RH-45	0.215475	-24.4309	0	0	0.0268216	404.1	4740

Dispersion Results

Input dispersion parameters

Core averaging time	18.75	s
Flammable averaging time	18.75	s
Toxic averaging time	**60**	s
Height of interest	**2.5**	m

Distance downwind to defined concentrations

The reported concentration of interest is defined at the scenario

Path	Scenario	Weather	Material	Material to track	Concentration of interest [fraction]	Averaging time selected	Distance downwind to concentration of interest [m]
Study\Key Capture CT11 BESS Site\UL9540A Module Test based Release (5-cell propogation)	UL9540A module (5-cell) Total Vent Gas (TVG) release (flammable)	AT-0C-WS-2mph-RH-45	**TVG**	TVG	0.0405	Flammable	0.498107
		AT-0C-WS-5mph-RH-45	**TVG**	TVG	0.0405	Flammable	0.46176
		AT-0C-WS-11mph-RH-45	**TVG**	TVG	0.0405	Flammable	0.41221
	UL9540A module (5-cell) Carbon Monoxide (CO) release (IDLH)	AT-0C-WS-2mph-RH-45	**TVG**	**CARBON MONOXIDE**	0.0012	IDLH	1.81705
		AT-0C-WS-5mph-RH-45	**TVG**	**CARBON MONOXIDE**	0.0012	IDLH	1.56702
		AT-0C-WS-11mph-RH-45	**TVG**	**CARBON MONOXIDE**	0.0012	IDLH	1.38247
	UL9540A module (5-	AT-0C-WS-2mph-	**TVG**	TVG	0.0405	Flammable	0.67804

	cell) Total Vent Gas (TVG) 10-min release (flammable)	RH-45					
		AT-0C-WS-5mph-RH-45	**TVG**	TVG	0.0405	Flammable	0.622344
		AT-0C-WS-11mph-RH-45	**TVG**	TVG	0.0405	Flammable	0.548013
	UL9540A module (5-cell) Carbon Monoxide (CO) 10-min release (IDLH)	AT-0C-WS-2mph-RH-45	**TVG**	**CARBON MONOXIDE**	0.0012	IDLH	2.33133
		AT-0C-WS-5mph-RH-45	**TVG**	**CARBON MONOXIDE**	0.0012	IDLH	1.9064
		AT-0C-WS-11mph-RH-45	**TVG**	**CARBON MONOXIDE**	0.0012	IDLH	1.60583
Study\Key Capture CT11 BESS Site\Single Module Release (104-cell propogation)	1 module Total Vent Gas (TVG) release (flammable)	AT-0C-WS-2mph-RH-45	**TVG**	TVG	0.0405	Flammable	1.26791
		AT-0C-WS-5mph-RH-45	**TVG**	TVG	0.0405	Flammable	1.18775
		AT-0C-WS-11mph-RH-45	**TVG**	TVG	0.0405	Flammable	1.09578
	1 module Carbon Monoxide (CO) release (IDLH)	AT-0C-WS-2mph-RH-45	**TVG**	**CARBON MONOXIDE**	0.0012	IDLH	3.51848
		AT-0C-WS-5mph-RH-45	**TVG**	**CARBON MONOXIDE**	0.0012	IDLH	2.79029
		AT-0C-WS-11mph-RH-45	**TVG**	**CARBON MONOXIDE**	0.0012	IDLH	2.19198
	1 module Total Vent	AT-0C-WS-2mph-	**TVG**	TVG	0.0405	Flammable	2.70165

	Gas (TVG) 10-min release (flammable)	RH-45					
		AT-0C-WS-5mph-RH-45	**TVG**	TVG	0.0405	Flammable	2.34486
		AT-0C-WS-11mph-RH-45	**TVG**	TVG	0.0405	Flammable	1.96625
	1 module Carbon Monoxide (CO) 10-min release (IDLH)	AT-0C-WS-2mph-RH-45	**TVG**	**CARBON MONOXIDE**	0.0012	IDLH	8.40947
		AT-0C-WS-5mph-RH-45	**TVG**	**CARBON MONOXIDE**	0.0012	IDLH	6.50131
		AT-0C-WS-11mph-RH-45	**TVG**	**CARBON MONOXIDE**	0.0012	IDLH	4.91304
Study\Key Capture CT11 BESS Site\1 String 4-module Release (416-cell propogation)	4-module Total Vent Gas (TVG) release (flammable)	AT-0C-WS-2mph-RH-45	**TVG**	TVG	0.0405	Flammable	1.98679
		AT-0C-WS-5mph-RH-45	**TVG**	TVG	0.0405	Flammable	1.77834
		AT-0C-WS-11mph-RH-45	**TVG**	TVG	0.0405	Flammable	1.56684
	4-module Carbon Monoxide (CO) release (IDLH)	AT-0C-WS-2mph-RH-45	**TVG**	**CARBON MONOXIDE**	0.0012	IDLH	6.31435
		AT-0C-WS-5mph-RH-45	**TVG**	**CARBON MONOXIDE**	0.0012	IDLH	4.91967
		AT-0C-WS-11mph-RH-45	**TVG**	**CARBON MONOXIDE**	0.0012	IDLH	3.77118

Study\Key Capture CT11 BESS Site\1 Rack 8-module Release (832-cell propogation)	8-module Total Vent Gas (TVG) release (flammable)	AT-0C-WS-2mph-RH-45	**TVG**	TVG	0.0405	Flammable	2.71727
		AT-0C-WS-5mph-RH-45	**TVG**	TVG	0.0405	Flammable	2.35793
		AT-0C-WS-11mph-RH-45	**TVG**	TVG	0.0405	Flammable	1.97618
	8-module Carbon Monoxide (CO) release (IDLH)	AT-0C-WS-2mph-RH-45	**TVG**	**CARBON MONOXIDE**	0.0012	IDLH	8.45342
		AT-0C-WS-5mph-RH-45	**TVG**	**CARBON MONOXIDE**	0.0012	IDLH	6.53514
		AT-0C-WS-11mph-RH-45	**TVG**	**CARBON MONOXIDE**	0.0012	IDLH	4.93664
Study\Key Capture CT11 BESS Site\1 Container 6-Rack Release (4992-cell propogation)	48-module Total Vent Gas (TVG) release (flammable)	AT-0C-WS-2mph-RH-45	**TVG**	TVG	0.0405	Flammable	6.20265
		AT-0C-WS-5mph-RH-45	**TVG**	TVG	0.0405	Flammable	5.2446
		AT-0C-WS-11mph-RH-45	**TVG**	TVG	0.0405	Flammable	4.21347
	48-module Carbon Monoxide (CO) release (IDLH)	AT-0C-WS-2mph-RH-45	**TVG**	**CARBON MONOXIDE**	0.0012	IDLH	17.8507
		AT-0C-WS-5mph-RH-45	**TVG**	**CARBON MONOXIDE**	0.0012	IDLH	14.2152
		AT-0C-WS-11mph-RH-45	**TVG**	**CARBON MONOXIDE**	0.0012	IDLH	10.1958

Path	Scenario	Weather	Distance to	Distance to	Distance to

			UFL [m]	LFL [m]	LFL fraction [m]
Study\Key Capture CT11 BESS Site\UL9540A Module Test based Release (5-cell propogation)	UL9540A module (5-cell) Total Vent Gas (TVG) release (flammable)	AT-0C-WS-2mph-RH-45	0.0462694	0.330205	0.640843
		AT-0C-WS-5mph-RH-45	0.0468526	0.314963	1.06148
		AT-0C-WS-11mph-RH-45	0.0481796	0.290994	0.506036
	UL9540A module (5-cell) Carbon Monoxide (CO) release (IDLH)	AT-0C-WS-2mph-RH-45	0.0462694	0.330205	0.640843
		AT-0C-WS-5mph-RH-45	0.0468526	0.314963	1.06148
		AT-0C-WS-11mph-RH-45	0.0481796	0.290994	0.506036
	UL9540A module (5-cell) Total Vent Gas (TVG) 10-min release (flammable)	AT-0C-WS-2mph-RH-45	0.054541	0.451621	1.13067
		AT-0C-WS-5mph-RH-45	0.0550514	0.427546	1.0641
		AT-0C-WS-11mph-RH-45	0.0562207	0.39076	0.668809
	UL9540A module (5-cell) Carbon Monoxide (CO) 10-min release (IDLH)	AT-0C-WS-2mph-RH-45	0.054541	0.451621	1.13067
		AT-0C-WS-5mph-RH-45	0.0550514	0.427546	1.0641
		AT-0C-WS-11mph-RH-45	0.0562207	0.39076	0.668809

Study\Key Capture CT11 BESS Site\Single Module Release (104-cell propogation)	1 module Total Vent Gas (TVG) release (flammable)	AT-0C-WS-2mph-RH-45	0.0700197	0.722828	1.4608
		AT-0C-WS-5mph-RH-45	0.0703897	0.676063	1.34624
		AT-0C-WS-11mph-RH-45	0.0712581	0.60743	1.22377
	1 module Carbon Monoxide (CO) release (IDLH)	AT-0C-WS-2mph-RH-45	0.0700197	0.722828	1.4608
		AT-0C-WS-5mph-RH-45	0.0703897	0.676063	1.34624
		AT-0C-WS-11mph-RH-45	0.0712581	0.60743	1.22377
	1 module Total Vent Gas (TVG) 10-min release (flammable)	AT-0C-WS-2mph-RH-45	0.121995	1.90014	3.36881
		AT-0C-WS-5mph-RH-45	0.12194	1.74065	2.85571
		AT-0C-WS-11mph-RH-45	0.121759	1.55786	2.32526
	1 module Carbon Monoxide (CO) 10-min release (IDLH)	AT-0C-WS-2mph-RH-45	0.121995	1.90014	3.36881
		AT-0C-WS-5mph-RH-45	0.12194	1.74065	2.85571
		AT-0C-WS-11mph-RH-45	0.121759	1.55786	2.32526
Study\Key Capture CT11 BESS Site\1 String 4-module Release (416-cell propogation)	4-module Total Vent Gas (TVG) release (flammable)	AT-0C-WS-2mph-RH-45	0.101251	1.49755	2.46653
		AT-0C-WS-5mph-	0.10134	1.40334	2.12227

		RH-45			
		AT-0C-WS-11mph-RH-45	0.101612	1.28576	1.793
	4-module Carbon Monoxide (CO) release (IDLH)	AT-0C-WS-2mph-RH-45	0.101251	1.49755	2.46653
		AT-0C-WS-5mph-RH-45	0.10134	1.40334	2.12227
		AT-0C-WS-11mph-RH-45	0.101612	1.28576	1.793
Study\Key Capture CT11 BESS Site\1 Rack 8-module Release (832-cell propogation)	8-module Total Vent Gas (TVG) release (flammable)	AT-0C-WS-2mph-RH-45	0.122421	1.90855	3.388
		AT-0C-WS-5mph-RH-45	0.122362	1.74851	2.8718
		AT-0C-WS-11mph-RH-45	0.122173	1.56394	2.33757
	8-module Carbon Monoxide (CO) release (IDLH)	AT-0C-WS-2mph-RH-45	0.122421	1.90855	3.388
		AT-0C-WS-5mph-RH-45	0.122362	1.74851	2.8718
		AT-0C-WS-11mph-RH-45	0.122173	1.56394	2.33757
Study\Key Capture CT11 BESS Site\1 Container 6-Rack Release (4992-cell propogation)	48-module Total Vent Gas (TVG) release (flammable)	AT-0C-WS-2mph-RH-45	0.204742	4.37141	7.62296
		AT-0C-WS-5mph-RH-45	0.203828	3.82996	6.31364
		AT-0C-WS-11mph-RH-45	0.201996	3.18297	4.97586
	48-module Carbon Monoxide (CO)	AT-0C-WS-2mph-RH-45	0.204742	4.37141	7.62296

	release (IDLH)				
		AT-0C-WS-5mph-RH-45	0.203828	3.82996	6.31364
		AT-0C-WS-11mph-RH-45	0.201996	3.18297	4.97586

Outdoor Toxic Results

Distance downwind to defined concentrations

The reported concentrations are defined in the respective material properties

Path	Scenario	Weather	Distance downwind to ERPG1 (3600 s) [m]	Distance downwind to ERPG2 (3600 s) [m]	Distance downwind to ERPG3 (3600 s) [m]	Distance downwind to STEL (900 s) [m]	Distance downwind to IDLH (1800 s) [m]
Study\Key Capture CT11 BESS Site\UL9540A Module Test based Release (5-cell propogation)	UL9540A module (5-cell) Total Vent Gas (TVG) release (flammable)	AT-0C-WS-2mph-RH-45	n/a	n/a	n/a	n/a	n/a
		AT-0C-WS-5mph-RH-45	n/a	n/a	n/a	n/a	n/a
		AT-0C-WS-11mph-RH-45	n/a	n/a	n/a	n/a	n/a
	UL9540A module (5-cell) Carbon Monoxide (CO) release (IDLH)	AT-0C-WS-2mph-RH-45	n/a	n/a	n/a	n/a	n/a
		AT-0C-WS-5mph-RH-45	n/a	n/a	n/a	n/a	n/a
		AT-0C-WS-11mph-RH-45	n/a	n/a	n/a	n/a	n/a
	UL9540A module (5-cell) Total Vent Gas (TVG) 10-min release (flammable)	AT-0C-WS-2mph-RH-45	n/a	n/a	n/a	n/a	n/a
		AT-0C-WS-5mph-RH-45	n/a	n/a	n/a	n/a	n/a

		AT-0C-WS-11mph-RH-45	n/a	n/a	n/a	n/a	n/a
	UL9540A module (5-cell) Carbon Monoxide (CO) 10-min release (IDLH)	AT-0C-WS-2mph-RH-45	n/a	n/a	n/a	n/a	n/a
		AT-0C-WS-5mph-RH-45	n/a	n/a	n/a	n/a	n/a
		AT-0C-WS-11mph-RH-45	n/a	n/a	n/a	n/a	n/a
Study\Key Capture CT11 BESS Site\Single Module Release (104-cell propogation)	1 module Total Vent Gas (TVG) release (flammable)	AT-0C-WS-2mph-RH-45	n/a	n/a	n/a	n/a	n/a
		AT-0C-WS-5mph-RH-45	n/a	n/a	n/a	n/a	n/a
		AT-0C-WS-11mph-RH-45	n/a	n/a	n/a	n/a	n/a
	1 module Carbon Monoxide (CO) release (IDLH)	AT-0C-WS-2mph-RH-45	n/a	n/a	n/a	n/a	n/a
		AT-0C-WS-5mph-RH-45	n/a	n/a	n/a	n/a	n/a
		AT-0C-WS-11mph-RH-45	n/a	n/a	n/a	n/a	n/a
	1 module Total Vent Gas (TVG) 10-min release (flammable)	AT-0C-WS-2mph-RH-45	n/a	n/a	n/a	n/a	n/a
		AT-0C-WS-5mph-RH-45	n/a	n/a	n/a	n/a	n/a

		AT-0C-WS-11mph-RH-45	n/a	n/a	n/a	n/a	n/a
	1 module Carbon Monoxide (CO) 10-min release (IDLH)	AT-0C-WS-2mph-RH-45	n/a	n/a	n/a	n/a	n/a
		AT-0C-WS-5mph-RH-45	n/a	n/a	n/a	n/a	n/a
		AT-0C-WS-11mph-RH-45	n/a	n/a	n/a	n/a	n/a
Study\Key Capture CT11 BESS Site\1 String 4-module Release (416-cell propogation)	4-module Total Vent Gas (TVG) release (flammable)	AT-0C-WS-2mph-RH-45	n/a	n/a	n/a	n/a	n/a
		AT-0C-WS-5mph-RH-45	n/a	n/a	n/a	n/a	n/a
		AT-0C-WS-11mph-RH-45	n/a	n/a	n/a	n/a	n/a
	4-module Carbon Monoxide (CO) release (IDLH)	AT-0C-WS-2mph-RH-45	n/a	n/a	n/a	n/a	n/a
		AT-0C-WS-5mph-RH-45	n/a	n/a	n/a	n/a	n/a
		AT-0C-WS-11mph-RH-45	n/a	n/a	n/a	n/a	n/a
Study\Key Capture CT11 BESS Site\1 Rack 8-module Release (832-cell propogation)	8-module Total Vent Gas (TVG) release (flammable)	AT-0C-WS-2mph-RH-45	n/a	n/a	n/a	n/a	n/a
		AT-0C-WS-5mph-RH-45	n/a	n/a	n/a	n/a	n/a
		AT-0C-WS-11mph-	n/a	n/a	n/a	n/a	n/a

		RH-45					
	8-module Carbon Monoxide (CO) release (IDLH)	AT-0C-WS-2mph-RH-45	n/a	n/a	n/a	n/a	n/a
		AT-0C-WS-5mph-RH-45	n/a	n/a	n/a	n/a	n/a
		AT-0C-WS-11mph-RH-45	n/a	n/a	n/a	n/a	n/a
Study\Key Capture CT11 BESS Site\1 Container 6-Rack Release (4992-cell propogation)	48-module Total Vent Gas (TVG) release (flammable)	AT-0C-WS-2mph-RH-45	n/a	n/a	n/a	n/a	n/a
		AT-0C-WS-5mph-RH-45	n/a	n/a	n/a	n/a	n/a
		AT-0C-WS-11mph-RH-45	n/a	n/a	n/a	n/a	n/a
	48-module Carbon Monoxide (CO) release (IDLH)	AT-0C-WS-2mph-RH-45	n/a	n/a	n/a	n/a	n/a
		AT-0C-WS-5mph-RH-45	n/a	n/a	n/a	n/a	n/a
		AT-0C-WS-11mph-RH-45	n/a	n/a	n/a	n/a	n/a

Distance downwind to defined dangerous doses

The reported dangerous doses are defined in the respective material properties

Exposure duration at defined dangerous doses

The reported dangerous doses are defined in the respective material properties

Jet Fire Results

Distance downwind to defined radiation levels

The reported radiations are defined in the parameters

Path	Scenario	Weather	Flame length [m]	Distance downwind to intensity level 1 (4.7 kW/m2) [m]	Distance downwind to intensity level 2 (12.5 kW/m2) [m]	Distance downwind to intensity level 3 (37.5 kW/m2) [m]
Study\Key Capture CT11 BESS Site\UL9540A Module Test based Release (5-cell propogation)	UL9540A module (5-cell) Total Vent Gas (TVG) release (flammable)	AT-0C-WS-2mph-RH-45	0.544256	n/a	n/a	n/a
		AT-0C-WS-5mph-RH-45	0.544239	n/a	n/a	n/a
		AT-0C-WS-11mph-RH-45	0.544205	n/a	n/a	n/a
	UL9540A module (5-cell) Carbon Monoxide (CO) release (IDLH)	AT-0C-WS-2mph-RH-45	0.544256	n/a	n/a	n/a
		AT-0C-WS-5mph-RH-45	0.544239	n/a	n/a	n/a
		AT-0C-WS-11mph-RH-45	0.544205	n/a	n/a	n/a
	UL9540A module (5-cell) Total Vent Gas (TVG) 10-min release (flammable)	AT-0C-WS-2mph-RH-45	0.726373	n/a	n/a	n/a
		AT-0C-WS-5mph-RH-45	0.726333	n/a	n/a	n/a
		AT-0C-WS-11mph-RH-45	0.726253	n/a	n/a	n/a

	UL9540A module (5-cell) Carbon Monoxide (CO) 10-min release (IDLH)	AT-0C-WS-2mph-RH-45	0.726373	n/a	n/a	n/a
		AT-0C-WS-5mph-RH-45	0.726333	n/a	n/a	n/a
		AT-0C-WS-11mph-RH-45	0.726253	n/a	n/a	n/a
Study\Key Capture CT11 BESS Site\Single Module Release (104-cell propogation)	1 module Total Vent Gas (TVG) release (flammable)	AT-0C-WS-2mph-RH-45	1.11815	n/a	n/a	n/a
		AT-0C-WS-5mph-RH-45	1.11801	n/a	n/a	n/a
		AT-0C-WS-11mph-RH-45	1.11774	n/a	n/a	n/a
	1 module Carbon Monoxide (CO) release (IDLH)	AT-0C-WS-2mph-RH-45	1.11815	n/a	n/a	n/a
		AT-0C-WS-5mph-RH-45	1.11801	n/a	n/a	n/a
		AT-0C-WS-11mph-RH-45	1.11774	n/a	n/a	n/a
	1 module Total Vent Gas (TVG) 10-min release (flammable)	AT-0C-WS-2mph-RH-45	2.77164	1.31362	n/a	n/a
		AT-0C-WS-5mph-RH-45	2.77016	1.3385	n/a	n/a
		AT-0C-WS-11mph-RH-45	2.7673	1.29878	n/a	n/a
	1 module	AT-0C-	2.77164	1.31362	n/a	n/a

	Carbon Monoxide (CO) 10-min release (IDLH)	WS-2mph-RH-45				
		AT-0C-WS-5mph-RH-45	2.77016	1.3385	n/a	n/a
		AT-0C-WS-11mph-RH-45	2.7673	1.29878	n/a	n/a
Study\Key Capture CT11 BESS Site\1 String 4-module Release (416-cell propogation)	4-module Total Vent Gas (TVG) release (flammable)	AT-0C-WS-2mph-RH-45	2.05914	1.26586	n/a	n/a
		AT-0C-WS-5mph-RH-45	2.05843	1.26173	n/a	n/a
		AT-0C-WS-11mph-RH-45	2.05707	1.25317	n/a	n/a
	4-module Carbon Monoxide (CO) release (IDLH)	AT-0C-WS-2mph-RH-45	2.05914	1.26586	n/a	n/a
		AT-0C-WS-5mph-RH-45	2.05843	1.26173	n/a	n/a
		AT-0C-WS-11mph-RH-45	2.05707	1.25317	n/a	n/a
Study\Key Capture CT11 BESS Site\1 Rack 8-module Release (832-cell propogation)	8-module Total Vent Gas (TVG) release (flammable)	AT-0C-WS-2mph-RH-45	2.78687	1.31887	n/a	n/a
		AT-0C-WS-5mph-RH-45	2.78536	1.3526	n/a	n/a
		AT-0C-WS-11mph-RH-45	2.78247	1.29971	n/a	n/a

	8-module Carbon Monoxide (CO) release (IDLH)	AT-0C-WS-2mph-RH-45	2.78687	1.31887	n/a	n/a
		AT-0C-WS-5mph-RH-45	2.78536	1.3526	n/a	n/a
		AT-0C-WS-11mph-RH-45	2.78247	1.29971	n/a	n/a
Study\Key Capture CT11 BESS Site\1 Container 6-Rack Release (4992-cell propogation)	48-module Total Vent Gas (TVG) release (flammable)	AT-0C-WS-2mph-RH-45	6.11973	2.8374	1.45051	n/a
		AT-0C-WS-5mph-RH-45	6.19282	2.87231	1.5149	n/a
		AT-0C-WS-11mph-RH-45	6.35479	2.94289	1.66385	n/a
	48-module Carbon Monoxide (CO) release (IDLH)	AT-0C-WS-2mph-RH-45	6.11973	2.8374	1.45051	n/a
		AT-0C-WS-5mph-RH-45	6.19282	2.87231	1.5149	n/a
		AT-0C-WS-11mph-RH-45	6.35479	2.94289	1.66385	n/a

Flash Fire Results

Distance downwind to defined concentrations

The reported LFL and LFL fraction are defined in the respective material property

Path	Scenario	Weather	Distance downwind to LFL [m]	Distance downwind to LFL Fraction [m]
Study\Key Capture CT11 BESS Site \UL9540A Module Test based Release (5-cell propogation)	UL9540A module (5-cell) Total Vent Gas (TVG) release (flammable)	AT-0C-WS-2mph-RH-45	0.330205	0.640843
		AT-0C-WS-5mph-RH-45	0.314963	1.06148
		AT-0C-WS-11mph-RH-45	0.290994	0.506036
	UL9540A module (5-cell) Carbon Monoxide (CO) release (IDLH)	AT-0C-WS-2mph-RH-45	0.330205	0.640843
		AT-0C-WS-5mph-RH-45	0.314963	1.06148
		AT-0C-WS-11mph-RH-45	0.290994	0.506036
	UL9540A module (5-cell) Total Vent Gas (TVG) 10-min release (flammable)	AT-0C-WS-2mph-RH-45	0.451621	1.13067
		AT-0C-WS-5mph-RH-45	0.427546	1.0641
		AT-0C-WS-11mph-RH-45	0.39076	0.668809
	UL9540A module (5-cell) Carbon Monoxide (CO) 10-min release (IDLH)	AT-0C-WS-2mph-RH-45	0.451621	1.13067
		AT-0C-WS-5mph-RH-45	0.427546	1.0641
		AT-0C-WS-11mph-RH-45	0.39076	0.668809
Study\Key Capture CT11 BESS Site \Single Module Release (104-cell propogation)	1 module Total Vent Gas (TVG) release (flammable)	AT-0C-WS-2mph-RH-45	0.722828	1.4608

		AT-0C-WS-5mph-RH-45	0.676063	1.34624
		AT-0C-WS-11mph-RH-45	0.60743	1.22377
	1 module Carbon Monoxide (CO) release (IDLH)	AT-0C-WS-2mph-RH-45	0.722828	1.4608
		AT-0C-WS-5mph-RH-45	0.676063	1.34624
		AT-0C-WS-11mph-RH-45	0.60743	1.22377
	1 module Total Vent Gas (TVG) 10-min release (flammable)	AT-0C-WS-2mph-RH-45	1.90014	3.36881
		AT-0C-WS-5mph-RH-45	1.74065	2.85571
		AT-0C-WS-11mph-RH-45	1.55786	2.32526
	1 module Carbon Monoxide (CO) 10-min release (IDLH)	AT-0C-WS-2mph-RH-45	1.90014	3.36881
		AT-0C-WS-5mph-RH-45	1.74065	2.85571
		AT-0C-WS-11mph-RH-45	1.55786	2.32526
Study\Key Capture CT11 BESS Site\1 String 4-module Release (416-cell propogation)	4-module Total Vent Gas (TVG) release (flammable)	AT-0C-WS-2mph-RH-45	1.49755	2.46653
		AT-0C-WS-5mph-RH-45	1.40334	2.12227
		AT-0C-WS-11mph-RH-45	1.28576	1.793
	4-module Carbon Monoxide (CO) release (IDLH)	AT-0C-WS-2mph-RH-45	1.49755	2.46653
		AT-0C-WS-5mph-RH-45	1.40334	2.12227
		AT-0C-WS-11mph-RH-45	1.28576	1.793

Study\Key Capture CT11 BESS Site\1 Rack 8-module Release (832-cell propogation)	8-module Total Vent Gas (TVG) release (flammable)	AT-0C-WS-2mph-RH-45	1.90855	3.388
		AT-0C-WS-5mph-RH-45	1.74851	2.8718
		AT-0C-WS-11mph-RH-45	1.56394	2.33757
	8-module Carbon Monoxide (CO) release (IDLH)	AT-0C-WS-2mph-RH-45	1.90855	3.388
		AT-0C-WS-5mph-RH-45	1.74851	2.8718
		AT-0C-WS-11mph-RH-45	1.56394	2.33757
Study\Key Capture CT11 BESS Site\1 Container 6-Rack Release (4992-cell propogation)	48-module Total Vent Gas (TVG) release (flammable)	AT-0C-WS-2mph-RH-45	4.37141	7.62296
		AT-0C-WS-5mph-RH-45	3.82996	6.31364
		AT-0C-WS-11mph-RH-45	3.18297	4.97586
	48-module Carbon Monoxide (CO) release (IDLH)	AT-0C-WS-2mph-RH-45	4.37141	7.62296
		AT-0C-WS-5mph-RH-45	3.82996	6.31364
		AT-0C-WS-11mph-RH-45	3.18297	4.97586

Maximum distance to LFL fraction at any height

Path	Scenario	Weather	Max flash fire distance [m]	Height of the max flash fire distance [m]	Time [s]
Study\Key Capture CT11 BESS Site\UL9540A Module Test based Release (5-cell propogation)	UL9540A module (5-cell) Total Vent Gas (TVG) release (flammable)	AT-0C-WS-2mph-RH-45	0.641277	2.49093	1.47633
		AT-0C-WS-5mph-RH-45	0.583585	2.49286	36.6041

		AT-0C-WS-11mph-RH-45	0.508384	2.49612	1.47633
	UL9540A module (5-cell) Carbon Monoxide (CO) release (IDLH)	AT-0C-WS-2mph-RH-45	0.641277	2.49093	1.47633
		AT-0C-WS-5mph-RH-45	0.583585	2.49286	36.6041
		AT-0C-WS-11mph-RH-45	0.508384	2.49612	1.47633
	UL9540A module (5-cell) Total Vent Gas (TVG) 10-min release (flammable)	AT-0C-WS-2mph-RH-45	1.09602	2.50209	591.54
		AT-0C-WS-5mph-RH-45	0.881154	2.50463	591.546
		AT-0C-WS-11mph-RH-45	0.668941	2.50874	1.25988
	UL9540A module (5-cell) Carbon Monoxide (CO) 10-min release (IDLH)	AT-0C-WS-2mph-RH-45	1.09602	2.50209	591.54
		AT-0C-WS-5mph-RH-45	0.881154	2.50463	591.546
		AT-0C-WS-11mph-RH-45	0.668941	2.50874	1.25988
Study\Key Capture CT11 BESS Site\Single Module Release (104-cell propogation)	1 module Total Vent Gas (TVG) release (flammable)	AT-0C-WS-2mph-RH-45	1.46138	2.50173	4672.38
		AT-0C-WS-5mph-RH-45	1.32331	2.50537	4672.36
		AT-0C-WS-11mph-RH-45	1.1641	2.51145	2708.61

	1 module Carbon Monoxide (CO) release (IDLH)	AT-0C-WS-2mph-RH-45	1.46138	2.50173	4672.38
		AT-0C-WS-5mph-RH-45	1.32331	2.50537	4672.36
		AT-0C-WS-11mph-RH-45	1.1641	2.51145	2708.61
	1 module Total Vent Gas (TVG) 10-min release (flammable)	AT-0C-WS-2mph-RH-45	3.37206	2.51323	591.675
		AT-0C-WS-5mph-RH-45	2.85631	2.519	300.095
		AT-0C-WS-11mph-RH-45	2.32918	2.50389	132.217
	1 module Carbon Monoxide (CO) 10-min release (IDLH)	AT-0C-WS-2mph-RH-45	3.37206	2.51323	591.675
		AT-0C-WS-5mph-RH-45	2.85631	2.519	300.095
		AT-0C-WS-11mph-RH-45	2.32918	2.50389	132.217
Study\Key Capture CT11 BESS Site\1 String 4-module Release (416-cell propogation)	4-module Total Vent Gas (TVG) release (flammable)	AT-0C-WS-2mph-RH-45	2.46645	2.49678	4672.47
		AT-0C-WS-5mph-RH-45	2.12536	2.50237	256.439
		AT-0C-WS-11mph-RH-45	1.80219	2.51255	4672.37
	4-module Carbon Monoxide (CO) release (IDLH)	AT-0C-WS-2mph-RH-45	2.46645	2.49678	4672.47
		AT-0C-WS-5mph-	2.12536	2.50237	256.439

		RH-45			
		AT-0C-WS-11mph-RH-45	1.80219	2.51255	4672.37
Study\Key Capture CT11 BESS Site\1 Rack 8-module Release (832-cell propogation)	8-module Total Vent Gas (TVG) release (flammable)	AT-0C-WS-2mph-RH-45	3.39155	2.51246	4672.53
		AT-0C-WS-5mph-RH-45	2.87222	2.51826	256.441
		AT-0C-WS-11mph-RH-45	2.34115	2.50318	256.438
	8-module Carbon Monoxide (CO) release (IDLH)	AT-0C-WS-2mph-RH-45	3.39155	2.51246	4672.53
		AT-0C-WS-5mph-RH-45	2.87222	2.51826	256.441
		AT-0C-WS-11mph-RH-45	2.34115	2.50318	256.438
Study\Key Capture CT11 BESS Site\1 Container 6-Rack Release (4992-cell propogation)	48-module Total Vent Gas (TVG) release (flammable)	AT-0C-WS-2mph-RH-45	7.64217	2.58901	4672.82
		AT-0C-WS-5mph-RH-45	6.31402	2.54494	4672.68
		AT-0C-WS-11mph-RH-45	4.97372	2.51957	256.443
	48-module Carbon Monoxide (CO) release (IDLH)	AT-0C-WS-2mph-RH-45	7.64217	2.58901	4672.82
		AT-0C-WS-5mph-RH-45	6.31402	2.54494	4672.68
		AT-0C-WS-11mph-RH-45	4.97372	2.51957	256.443