
Appendix C

Hazards

Report and Modeling

Supporting Information

Appendix C – Hazards Report and Modeling Supporting Information

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** The Applicant claimed confidential information on most CANARY modeling details, so only selected scenarios representing the potentially larger (Propane release BLEVE) and H2S scenarios, are included.*

WORST-CASE CONSEQUENCE ANALYSIS FOR THE ALTAIR RENEWABLE FUELS PROJECT FINAL REPORT

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1.0 INTRODUCTION

Quest Consultants Inc.[®] was retained by Environmental Audit, Inc. and World Energy to perform a worst-case consequence analysis on the revised AltAir renewable fuels project. The primary author of this report is David W. Johnson. His resume is listed in Appendix A. The objective of the study was to compute the potential increase or decrease in hazards to the public due to the revised changes to the facility.

The study was divided into several tasks.

Task 1. Evaluate the maximum credible potential releases, and their consequences, for the modifications to the facility which have been revised by the project.

Task 2. Evaluate the maximum credible potential releases, and their consequences, for existing process units, transfer systems, and storage areas.

Task 3. Evaluate whether the consequences associated with the revised modifications generate potential hazards that are larger or smaller than the potential hazards which currently exist.

Potential hazards from the existing and revised equipment are associated with accidental releases of toxic and flammable materials. Hazardous events associated with these types of releases include toxic vapor clouds, flash fires, torch fires, pool fires, boiling liquid expanding vapor explosions (BLEVEs) and vapor cloud explosions.

For each type of hazard identified (toxic, radiant, overpressure), maximum distances to potentially injurious levels (vulnerability/hazard zones) are determined. The hazard levels used are those that have been developed by the U.S. Environmental Protection Agency (EPA) and American Industrial Hygiene Association (AIHA) for risk management purposes.

2.0 OVERVIEW OF ALTAIR FACILITY

2.1 Facility Location

The AltAir facility is located at 14700 Downey Avenue, Paramount, California. The facility is bounded by Lakewood Boulevard, Somerset Boulevard, Downey Avenue, and Contreras Street. The current layout of the facility and the major roads bounding the facility are shown in Figure 2-1.

2.2 Summary of Revised Changes to Facility

The following discussion summarizes the revised changes to the major units. The areas of change are shown in Figure 2-2.

2.2.1 Unit A Renewable Fuels Unit (Capacity Increase)

Renewable fuels Unit A will be upgraded to increase capacity to 5,000 Barrels per Day (BPD) by adding a pretreatment reactor, a second isomerization reactor, and additional supporting equipment (separator, surge drum, compressor, flash drums, etc.).

2.2.2 Unit B Renewable Fuels Unit (New)

A new renewable fuels Unit B with a capacity of 20,000 BPD will be installed to produce additional renewable diesel, jet, and gasoline. The new Unit B will reuse existing equipment available onsite (heaters, reboilers, compressors, reactors, distillation columns, vessels and drums), supplemented with new equipment (pretreatment reactors, deoxygenation reactors, isomerization reactor, distillation columns, amine absorber, separators, piping, etc.). Some existing heaters will be demolished and new heaters will be added as needed for this Unit.

2.2.3 Pretreatment Unit (New)

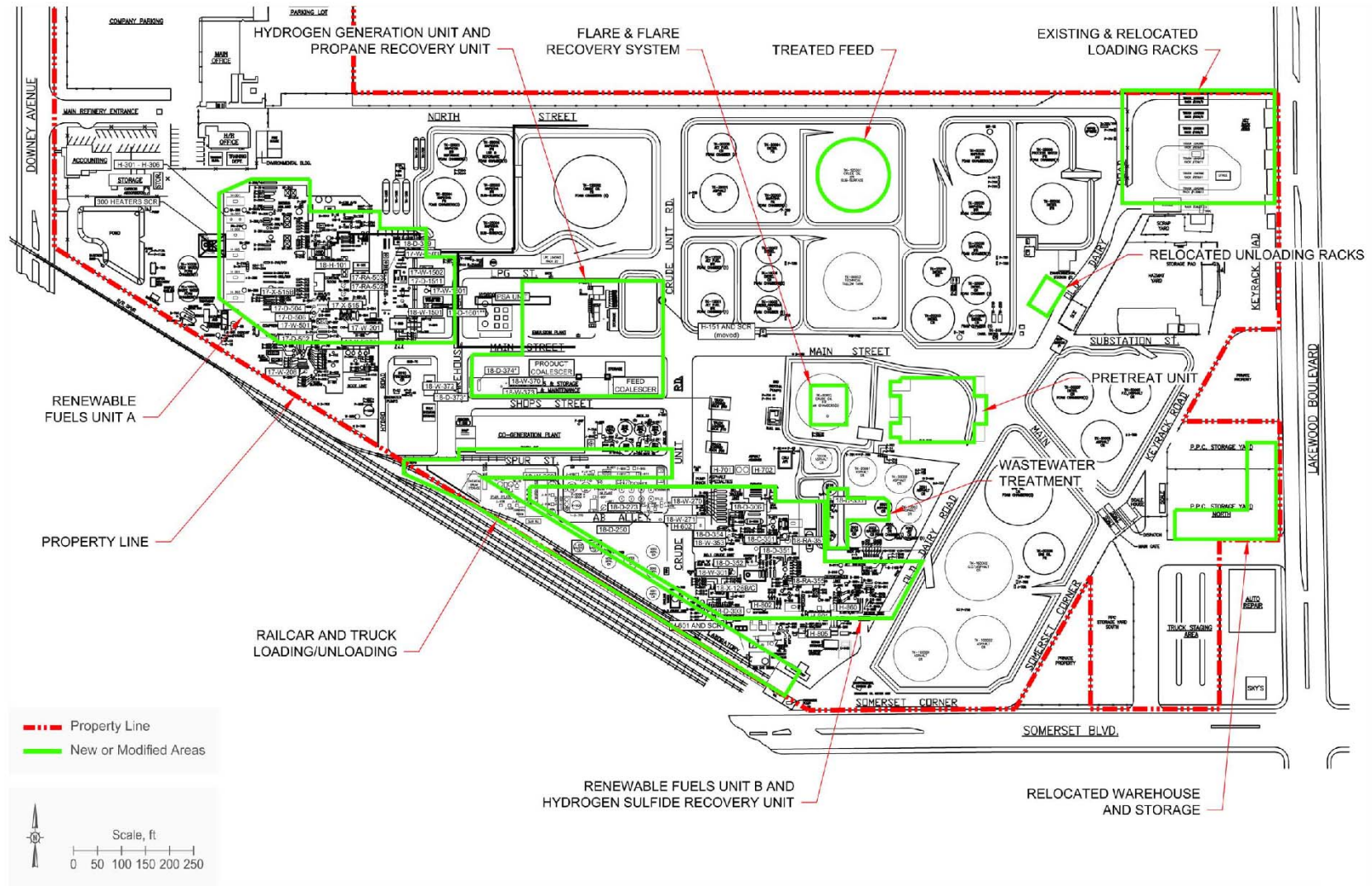
A new pretreatment unit will be installed to treat raw feedstocks such as grease, vegetable oils, fats, beef tallow, etc. The new Pretreat Unit is a commercial process developed specifically for the animal fat and vegetable oil industry. The overall process consists of a feed acid or enzymatic degumming section followed by continuous bleaching and filtration to yield a treated oil stream that is suitable feedstock for the Renewable Fuels Units. This unit will be configured in two series of equipment to treat up to the capacity of the processing units.

2.2.4 Naphtha Stabilization / Propane Recovery Unit (New/Modifications)

The existing unit will be modified to add new propane recovery capability to the naphtha stabilization unit. This will allow recovery of propane and butane from the gas streams generated in Units A and B to use in product blending or for fuel.

2.2.5 Hydrogen Generation Unit (New)

A new Hydrogen Generation Unit using steam/methane reforming (SMR) technology with hydrogen production capacity of 75 million standard cubic feet per day (mmscfd) will be installed.



2.2.6 Hydrogen Sulfide Recovery Unit (New)

A new unit to remove hydrogen sulfide from acid gas and return it to the renewable fuels process units will be installed. The unit includes multiple contactors and regenerators using an amine solution that absorbs H₂S, but allows CO₂ to pass through. CO₂ rich gas is sent to incinerator/caustic scrubber, while H₂S rich gas is recycled to Units A and B. Recycling of the hydrogen sulfide will reduce truck trips of new sulfide agent as well as reduce off-gas that must be treated.

2.2.7 Flares (New/Existing)

A new flare and flare vapor recovery system will be added to service existing units, the Hydrogen Generation Unit and new processing units. A manifold system will be installed to hydraulically balance the existing flare and the new flare.

2.2.8 Sour Water Stripper (New)

The Sour Water Stripper Unit will be replaced with advanced facilities known as the Sour Water Plus Unit to treat an increased amount of sour water generated by the process.

2.2.9 Wastewater Treatment Facilities (Modifications)

The existing wastewater treatment system will be upgraded to handle increased process wastewater generated from the new Pre-Treatment Unit.

2.2.10 Air Pollution Control Devices (New and Repurposed)

Air pollution control devices using selective catalytic reduction (SCR) will be added to new and existing boilers. The SCR units will use 19% aqueous ammonia as the reduction agent.

2.3 Summary to Revised Changes to Storage and Logistics Equipment

The following discussion summarizes the revised changes to storage and logistics. The areas of change are shown in Figure 2-2.

2.3.1 Storage Tanks (Change of Contents, Modification)

Existing storage tanks will be re-permitted as needed for renewable fuels operation (change material stored in existing tanks). Storage tank TK-125001 will be modified by adding a new upper section (increasing height by 12 feet) and change in material stored.

2.3.2 Truck Loading/Unloading Racks (Modification/Relocation)

Existing truck loading/unloading facilities (previously used for asphalt) will be modified and relocated for renewable fuels. Vapor recovery will be modified as required.

2.3.3 Railcar Loading/Unloading (Modifications/New Rail Spur)

Existing railcar loading/unloading facilities will be modified to receive raw materials and ship products. A new rail track (on Spur St.) will be installed internal to the facility.

2.3.4 Vapor Recovery – Truck Racks

See 2.3.2 for truck rack vapor recovery.

2.3.5 Vapor Recovery – Rail Racks

Vapor recovery will be added for loading at rail spur 3.

2.4 Summary of Changes to Pipelines Associated with Changes to Utilities

The following discussion summarizes the change to pipelines associated with revised changes to the utilities.

2.4.1 Hydrogen Pipeline

The revised Renewables Fuel Project includes the continued use of an existing pipeline. The pipeline is currently being repurposed to supply hydrogen for Unit A as approved in a separate CEQA document (City of Carson, 2020). The existing pipeline was in crude oil service prior to the original Renewable Fuels Project and operated at pressures up to 550 psig. The repurposed crude oil pipeline was approved to supply hydrogen to the facility as part of the separate project (City of Carson, 2020) and the conversion modifications have been completed and the pipeline is currently operating. The incoming pressure of the hydrogen pipeline will remain at 160 psig and a temperature of 65°F. The prior pipeline CEQA document analyzed the incoming hydrogen at an operating pressure up to 160 psig. Therefore, there is no change in maximum operating pressure of the pipeline that would require hazard zone calculations for the portion of the pipeline outside of the facility. Nonetheless, the hazard impact zones have been provided. Figure 2-3 shows the route for the repurposed existing crude oil pipeline, which will be used for hydrogen, and the natural gas pipeline route (discussed in Section 2.4.2).

2.4.2 Natural Gas Pipeline (New)

The Refinery has existing natural gas service from two pipeline connections from the Southern California Gas distribution pipeline located in Somerset Boulevard. A new natural gas pipeline will be installed to provide natural gas from the Southern California Gas transmission pipeline system to the hydrogen generation unit. The natural gas pipeline will be routed underground from the source connection to a location inside the facility boundaries, then above ground to the hydrogen generation unit.

The new natural gas pipeline is expected to use the route shown in Figure 2-3. The route is expected to run from near the intersection of Del Amo Blvd. and Lakewood Blvd. north along Lakewood Blvd. to Somerset Blvd. and then west to the facility connection.

The selected natural gas pipeline route will be provided with a blowdown station to depressurize the pipeline. Location of the blowdown station has not been determined.

2.4.3 Product Pipeline Maintenance

The existing active product pipelines that service the facility will have maintenance activities performed to comply with California State Fire Marshall (CSFM) code. Maintenance may include the replacement of manual valves with motorized valves, the addition of pressure sensors, and minor repairs to pipelines. The product pipelines previously transported vacuum gas oil (VGO), gasoline, naphtha, diesel, and jet. Following completion of the revised project, the product pipelines will transport renewable diesel and renewable jet. Figure 2-4 shows the product pipeline routes identified by CSFM numbers.

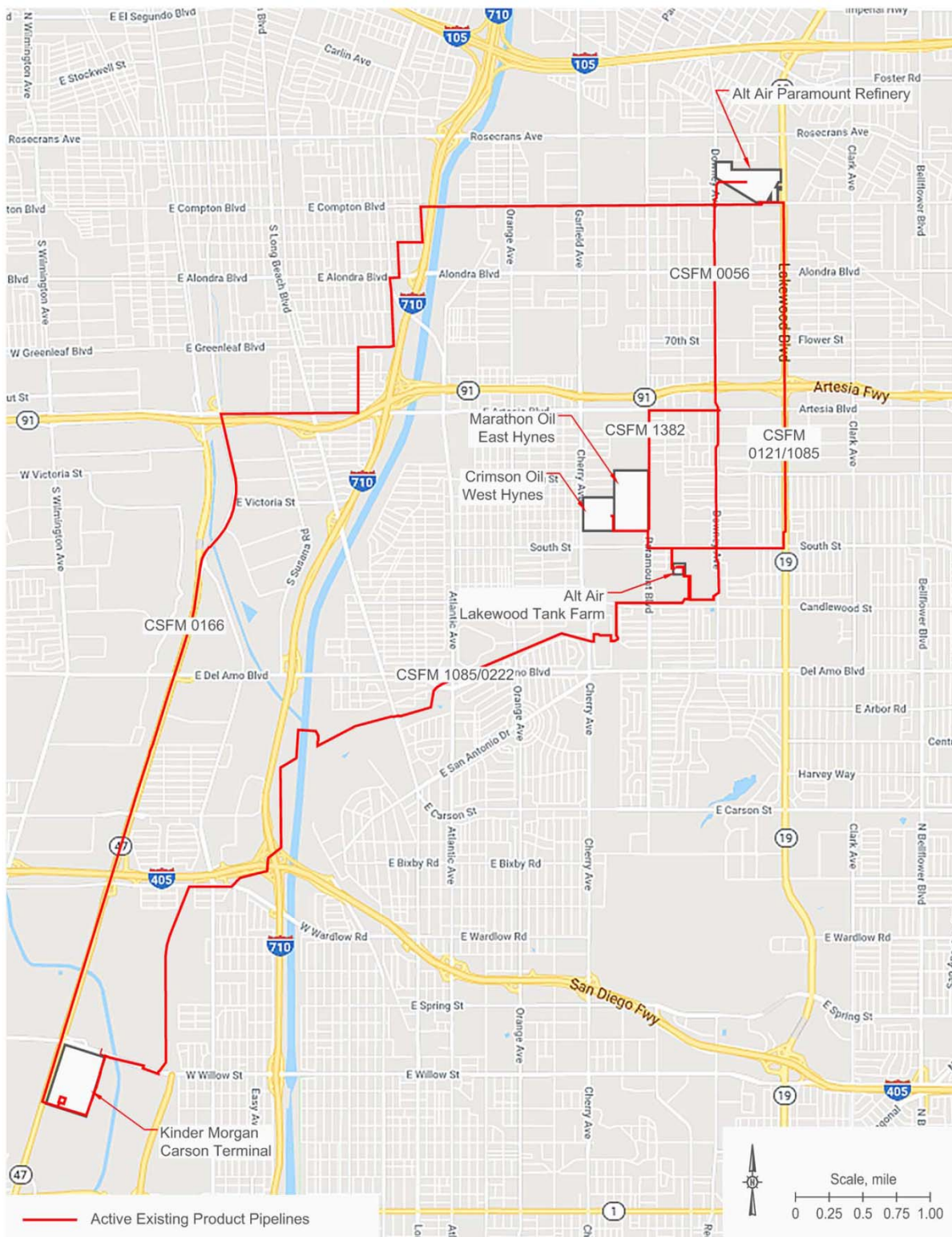


Figure 2-4
Product Pipeline Routes

3.0 MODELING METHODOLOGY

For any one of the hazards that are inherent to the revised process systems at the World Energy AltAir facility to impact an area, a loss of containment (LOC) must occur. If the hydrocarbons normally contained within the piping or equipment at the site are released, the resulting flash fire, vapor cloud explosion (VCE), torch fire, pool fire, or toxic vapor cloud has specific consequences that can be described by modeling.

To describe the hazards at any facility handling or storing hazardous materials, release scenarios are developed to simulate the potential LOC events. This first requires calculations of material release rates and the properties of the material following release. Following these calculations, hazard models are applied to describe the extent of a toxic or flammable vapor cloud (flash fire), torch fire radiation, pool fire radiation, Boiling Liquid Expanding Vapor Explosion (BLEVE) or overpressure from a vapor cloud explosion. With the results of these calculations, the extent of the potential impacts can be determined.

In the current study, the facility was divided up into multiple areas that generally correspond to the units or processing groups in the facility. The areas and the potential changes to them are described in Section 2. The areas within the facility requiring evaluation are listed in Tables 4-1 and 4-2. As described above, the hazards associated with the release of flammable and/or toxic fluids are well known. However, the extent or size of a particular hazard following an accidental release is a function of the fluid's composition, temperature, pressure, inventory, pipe size, normal flowrate, release orientation, etc. Not all of these parameters will change within a portion of a unit, but many will change as a fluid passes through a unit. In Quest's accident selection methodology, many potential releases and hazard zone calculations are made, but only the largest (worst case) results are presented in Section 4.

3.1 CANARY Consequence Analysis Models

When performing site-specific consequence analysis studies, the ability to accurately model the release, dilution, and dispersion of gases and aerosols is important if an accurate assessment of potential exposure is to be attained. For this reason, Quest uses a modeling package, CANARY by Quest[®], that contains a set of complex models that calculate release conditions, initial dilution of the vapor (dependent upon the release characteristics), and the subsequent dispersion of the vapor introduced into the atmosphere. The models contain algorithms that account for thermodynamics, mixture behavior, transient release rates, gas cloud density relative to air, initial velocity of the released gas, and heat transfer effects from the surrounding atmosphere and the substrate. The release and dispersion models contained in the QuestFOCUS package (the predecessor to CANARY by Quest[®]) were reviewed in a United States Environmental Protection Agency (EPA) sponsored study [TRC, 1991] and an American Petroleum Institute (API) study [Hanna, Strimaitis, and Chang, 1991]. In both studies, the QuestFOCUS software was evaluated on technical merit (appropriateness of models for specific applications) and on model predictions for specific releases. One conclusion drawn by both studies was that the dispersion software tended to over predict the extent of the gas cloud travel, thus resulting in too large a cloud when compared to the test data (i.e., a conservative approach).

A study prepared for the Minerals Management Service (MMS) [Chang, et al., 1998] reviewed models for use in modeling routine and accidental releases of flammable and toxic gases. The MMS recommends CANARY for use when evaluating toxic and flammable gas releases. The specific models (e.g., SLAB) contained in the CANARY software package have also been extensively reviewed.

CANARY also contains models for pool fire, torch fire, and boiling liquid expanding vapor explosion (BLEVE) radiation. These models account for impoundment configuration, material composition, target height relative to the flame, target distance from the flame, atmospheric attenuation (includes humidity), wind speed, and atmospheric temperature. Both are based on information in the public domain (published literature) and have been validated with experimental data.

3.2 The QMEFS Model for Vapor Cloud Explosions

For vapor cloud explosion (VCE) calculations, Quest uses a model that is a variation of the Baker-Strehlow-Tang (BST) method. The Quest Model for Estimation of Flame Speeds (QMEFS) [Marx & Ishii, 2017] is based on experimental data involving vapor cloud explosions, and is related to the amount of confinement and/or obstruction present in the volume occupied by the vapor cloud.

Quest's QMEFS model is based on the premise that the strength of the blast wave generated by a VCE is dependent on the reactivity of the flammable gas involved, the presence (or absence) of structures such as walls or ceilings that partially confine the vapor cloud, the spatial density of obstructions within the flammable cloud [Baker, et al., 1994, 1998], the average size of those obstacles, and the overall size of the confined or congested space [Mercx & van den Berg, 1997, Mercx, et al., 2000]. This model reflects the results of several international research programs on vapor cloud explosions, which show that the strength of the blast wave generated by a VCE increases as the degree of confinement and/or obstruction of the cloud increases. The following quotations illustrate this point.

“On the evidence of the trials performed at Maplin Sands, the deflagration [explosion] of truly unconfined flat clouds of natural gas or propane does not constitute a blast hazard.” [Hirst and Eyre, 1982] (Tests conducted by Shell Research Ltd., in the United Kingdom.)

“Both in two- and three-dimensional geometries, a continuous accelerating flame was observed in the presence of repeated obstacles. A positive feedback mechanism between the flame front and a disturbed flow field generated by the flame is responsible for this. The disturbances in the flow field mainly concern flow velocity gradients. Without repeated obstacles, the flame front velocities reached are low both in two-dimensional and three-dimensional geometry.” [van Wingerden and Zeeuwen, 1983] (Tests conducted by TNO in the Netherlands.)

“The current understanding of vapor cloud explosions involving natural gas is that combustion only of that part of the cloud which engulfs a severely congested region, formed by repeated obstacles, will contribute to the generation of pressure.” [Johnson, Sutton, and Wickens, 1991] (Tests conducted by British Gas in the United Kingdom.)

Researchers who have studied case histories of accidental vapor cloud explosions have reached similar conclusions.

“It is a necessary condition that obstacles or other forms of semi-confinement are present within the explosive region at the moment of ignition in order to generate an explosion.” [Wiekema, 1984]

“A common feature of vapor cloud explosions is that they have all involved ignition of vapor clouds, at least part of which have engulfed regions of repeated obstacles.” [Harris and Wickens, 1989]

The strength of the blast wave predicted by the QMEFS VCE model is directly related to the size of the obstructed or partially confined volume that is filled with a flammable mixture of gas and air, and fuel reactivity.

3.3 Hazards Identification and Modeling Endpoints

The potential hazards associated with this facility are common to most hydrocarbon processing facilities worldwide, and are a function of the materials being processed, processing systems, procedures used for operating and maintaining the facility, and hazard detection and mitigation systems. The hazards that are likely to exist are identified by the physical and chemical properties of the materials being handled and the process conditions. For hydrocarbon facilities, the common hazards are:

- toxic gas clouds (e.g., gas with hydrogen sulfide or other toxics such as ammonia)
- flash fires
- torch fires
- pool fires
- boiling liquid expanding vapor explosions (BLEVEs)
- vapor cloud explosions (VCEs)

When comparing a toxic hazard to a flammable or explosive hazard, the magnitude of the hazard's impact must be identically defined. For instance, it would not be meaningful to compare human exposure to nonlethal overpressures (low overpressures which may break windows) to human exposure to lethal fire radiation (34,500 Btu/(hr•ft²) for five seconds). Thus, in order to compare the hazards of toxic gases, fires, and explosions on humans, equivalent levels of hazard must be defined.

The endpoint hazard criterion defined in this study corresponds to a hazard level which might cause an injury. With this definition, the injury level must be defined for each type of hazard (toxic, radiant heat, or overpressure exposure). Fortunately, data exist which approximate an equivalent injury level for each of the hazards listed. Table 3-1 presents the endpoint hazard criteria used by federal agencies and national associations for this type of analysis.

3.4 Weather Conditions

The weather conditions at the time of an accidental release (a LOC event) can influence the extents of the resulting hazards. For the purposes of a consequence-based study, a set of weather conditions – consisting of atmospheric stability and wind speed – must be assigned for each calculation. Atmospheric stability is classified by the letters A through F. In general, the most unstable atmosphere is characterized by stability class A. Stability A would correspond to an atmospheric condition where there is strong solar radiation and moderate winds. This combination of radiation and wind allows for rapid fluctuations in the air and thus greater mixing of the released gas with time. Stability D is characterized by fully overcast or partial cloud cover during both daytime and nighttime. The atmospheric turbulence is not as great during D conditions as during A conditions; thus, the gas will not mix as quickly with the surrounding atmosphere. Stability F corresponds to the most “stable” atmospheric conditions. Stability F generally occurs during the early morning hours before sunrise (thus, no solar radiation) and under low wind. The combination of low wind and lack of solar heating allows for an atmosphere which appears calm or still and thus restricts the ability to actively mix with the released gas.

**Table 3-1
Consequence Analysis Hazard Levels
(Endpoint Criteria for Consequence Analysis)**

| Hazard Type | Injury Threshold | | |
|--------------------------------------|-------------------|--|-----------------------|
| | Exposure Duration | Hazard Level | Reference |
| Radiant heat exposure | 40 sec | 1,600 Btu/(hr•ft ²) * | 40 CFR 68 [EPA, 1996] |
| BLEVE exposure | Varies | 740,000 (Btu/hr•ft ²) ^{4/3} •sec* | [EPA, 1996] |
| Toxic gas exposure | Up to 60 minutes | 30 ppm (H ₂ S) | ERPG-2 [AIHA, 2011] |
| Explosion overpressure | Instantaneous | 1.0 psig † | 40 CFR 68 [EPA, 1996] |
| Flash fires (flammable vapor clouds) | Instantaneous | Lower Flammable Limit (LFL) | 40 CFR 68 [EPA, 1996] |

40 CFR 68. United States Environmental Protection Agency RMP endpoints.

* Corresponds to second-degree skin burns.

† An overpressure of 1 psi may cause partial demolition of houses, which can result in serious injuries to people, and shattering of glass windows, which may cause skin laceration from flying glass.

For vapor dispersion calculations, the typical worst-case weather assumption is a stable atmosphere with low wind, which tends to produce longer vapor dispersion distances. The conditions chosen for the dispersion analyses are:

Atmospheric Stability Class F (extremely stable)
Wind Speed 3.36 mph (1.5 m/s)

For pool and torch fire radiation, higher wind speeds generally result in longer impact distances due to flame bending. Torch fires are less affected by wind speed due to their high momentum. Atmospheric stability does not affect the size or characteristics of a flame. Thus, a worst-case wind speed for pool and torch fire radiation was chosen as:

Wind Speed 20 mph (8.9 m/s)

For all calculations, annual average air temperature and relative humidity values were taken as:

Air Temperature 65°F (18.3°C)
Relative Humidity 65%

4.0 IMPLEMENTATION OF WORST-CASE MODELING METHODOLOGY

The results of the worst-case consequence modeling calculations for the existing and revised processes are presented in this section. In addition, for several processes, the vulnerability zone which extends the greatest distance from the point of release is overlaid onto the local area in order to determine possible public exposure to the defined hazard levels.

4.1 Accident Selection

The inherent flammable hazards associated with hydrocarbon processing facilities are well known. A review of the World Energy AltAir process shows that there are multiple release scenarios that could result in fire, toxic, or overpressure hazards that could generate significant impacts. The hazards from the various release scenarios are identified in the following sections. The release scenarios selected for analysis are summarized in Tables 4-1 and 4-2.

4.2 Releases Resulting in the Largest Downwind Hazard Zones

When the hazard identification and consequence modeling calculations described in Section 3.0 are completed for the accidents selected in Section 4.1 for both the existing facility and the revised changes to the facility, the releases which generate the largest hazard zones can be defined for the facility and associated pipe ways. Tables B-1 and B-2 summarize the maximum hazard zones (worst case distance to endpoint) for Units A and B. Table B-3 summarizes the maximum hazard zones for the Units A/B common equipment and associated common areas. Table B-4 summarizes the maximum hazard zones for vapor cloud explosions from congested areas often referred to as Potential Explosion Sites (PESs).

4.3 Worst-Case Consequences

4.3.1 Flash Fires

Flash fires are the result of a release, formation of a flammable vapor cloud and ignition of the cloud. Flash fire hazard zones are defined by the maximum extent of the LFL portion of the vapor cloud. For example, a release from a condensed overheads line could result in a flash fire. In this release scenario, the flash fire is assumed to define the maximum vulnerability zone for this release and therefore is the maximum hazard.

An example hazard footprint and vulnerability zone associated with a “worst-case” event is illustrated in Figure 4-1. The vulnerability zone (the circle) depicts the potential area that could be affected due to a heavier than air release. This presentation is misleading since all locations within this zone cannot be simultaneously exposed to a potential flash fire hazard from any single accident. There are other possible hazard zones following this loss of containment that form smaller footprints. The scenario that creates the maximum hazard footprint is just one of the many possible outcomes found when considering variables such as hole size, orientation, wind speed, atmospheric stability, and wind direction. The hazard footprint in Figure 4-1 (the cross hatching) shows what would be expected if the pipe were to rupture, with low speed wind, and the atmosphere is stable, and the release is oriented horizontal, and the gas is ignited after reaching a maximum extent.

**Table 4-1
Summary of Units A and B Worst-Case Scenarios Evaluated**

| Equipment (Equipment Tag #) | Description/Comment |
|--|--|
| Unit A | |
| HDO Reactor (17-RA-502/503) | Treated and Heated Feed to Reactor |
| Recycle Gas Compressor (17-X-515/516) | Recycle Gas from Compressor Discharge |
| HDO Reactor (17-RA-502/503) | Effluent from HDO Reactor |
| Hot Separator (17-D-504) | Liquid from Hot Separator |
| Hot Separator (17-D-504) | Vapor from Hot Separator |
| Cold Separator (17-D-506, 17-W-201) | Cold Separator Vapor to HP Amine |
| Stripper Column (17-W-501) | Feed to Stripper Column |
| Stripper Column (17-W-501) | Stripper Column Overheads to Condenser |
| Stripper Column (17-W-501) | Stripper Column Bottoms to Surge Drum |
| Hot Isom Separator (17-D-502, 17-X-507B) | Hot Isomerization Separator Vapor |
| Fractionator (17-W-1601) | Feed to Fractionator |
| Fractionator (17-W-1601) | Fractionator Overheads |
| Fractionator (17-W-1601) | Feed to Jet Reboiler |
| Fractionator (17-W-1601) | Fractionator Condensed Overheads |
| Jet SC Stripper (17-W-1507) | Jet SC Stripper Bottoms to Storage |
| Unit B | |
| HDO Reactor (18-D-355) | Feed to HDO Reactor |
| Recycle Gas (18-D-354, 18-C-351) | Recycle Gas from Compressor Discharge |
| HDO Reactor (18-RA-351, 18-RA-355) | Combined Effluent from HDO Reactor |
| Hot Separator (18-D-351) | Liquid from Hot Separator |
| Hot Separator (18-D-351) | Vapor from Hot Separator |
| Cold Separator (18-D-352, 18-W-353) | Vapor from Cold Separator to HP Amine |
| Stripper Column (18-X-126B/C, 18-W-301) | Feed to Stripper |
| Stripper Column (18-W-301) | Stripper Overheads to Condenser |
| Stripper Column (18-D-303) | Stripper Bottoms to Surge Drum |
| Hot Isomerization Separator (18-D-306) | Hot Isomerization Separator Vapor |
| Fractionator (18-H-101, 18-W-1501) | Feed to Fractionator after Heater |

**Table 4-2
Summary of Units A and B Common Equipment Worst-Case Scenarios Evaluated**

| Equipment (Equipment Tag #) | Description/Comment |
|---|---|
| C3 Recovery, Naphtha Splitter | |
| Stripper (18-W-370) | Stripper Bottoms to Depropanizer |
| Debutanizer (18-W-372, 18-W-373) | Feed to Debutanizer |
| Depropanizer (18-D-373) | Depropanizer Condensed Overheads |
| Debutanizer (18-D-374) | Debutanizer Condensed Overheads |
| Naphtha Splitter (18-D-379) | Feed to Naphtha Splitter |
| Naphtha Splitter (17-D-1511) | Naphtha Splitter Condensed Overheads |
| Naphtha Splitter (17-W-1502) | Naphtha Splitter Bottoms |
| H₂S Recovery | |
| Amine Contactor 1 (unknown) | Combined Feed to H ₂ S Recovery |
| AGE 3 Regenerator (unknown) | Concentrated Acid Gas Leaving Unit after compression |
| Sour Water Stripper (SWS) | |
| SWS Water Overhead Accumulator (18-D-250) | Acid Gas from SWS Column |
| Amine Regeneration | |
| Feed from Amine Absorbers (17-W-208) | Combined Acid Gas to Amine Regen |
| Feed Pretreatment | |
| General Pretreatment Area | Units A/B Low Pressure Feed |
| Tankage | |
| Tallow Storage Tank (TK-125001) | Tank Top Fire after Height Increase and Contents Change |
| Crude Storage Tank (TK-125001) | Tank Top Fire for Existing Contents and Configuration |
| Pressurized Storage | |
| Pressurized LPG Storage (TK-1201) | LFL, Torch Fire, and BLEVE of TK-1201 |
| Flares | |
| Existing | Existing Flare at Design Case |
| Revised | Revised Flare at Design Case |
| Railcar Loading/Unloading | |
| Existing Rail Spur | Raw Material Release at Existing Rail Spur |
| Revised Rail Spur | Raw Material Release at Revised Rail Spur |

| Equipment (Equipment Tag #) | Description |
|--------------------------------|--|
| Truck Loading/Unloading | |
| Existing Truck Loading | Gasoline Release at Existing Location |
| Relocated Truck Loading | Naphtha Release at Relocated Location |
| Natural Gas Pipeline | |
| New Natural Gas Pipeline | Natural Gas Release from Exterior/Interior Pipeline |
| Hydrogen Pipeline | |
| Existing Hydrogen Pipeline | Hydrogen Release from Exterior/Interior Pipeline |
| Product Pipelines | |
| Existing Product Pipelines | Product Pipeline Transporting VGO, Gasoline, Naphtha, Jet, and Diesel Fuel |
| Revised Product Pipelines | Product Pipeline Transporting Renewable Jet and Renewable Diesel Fuel |

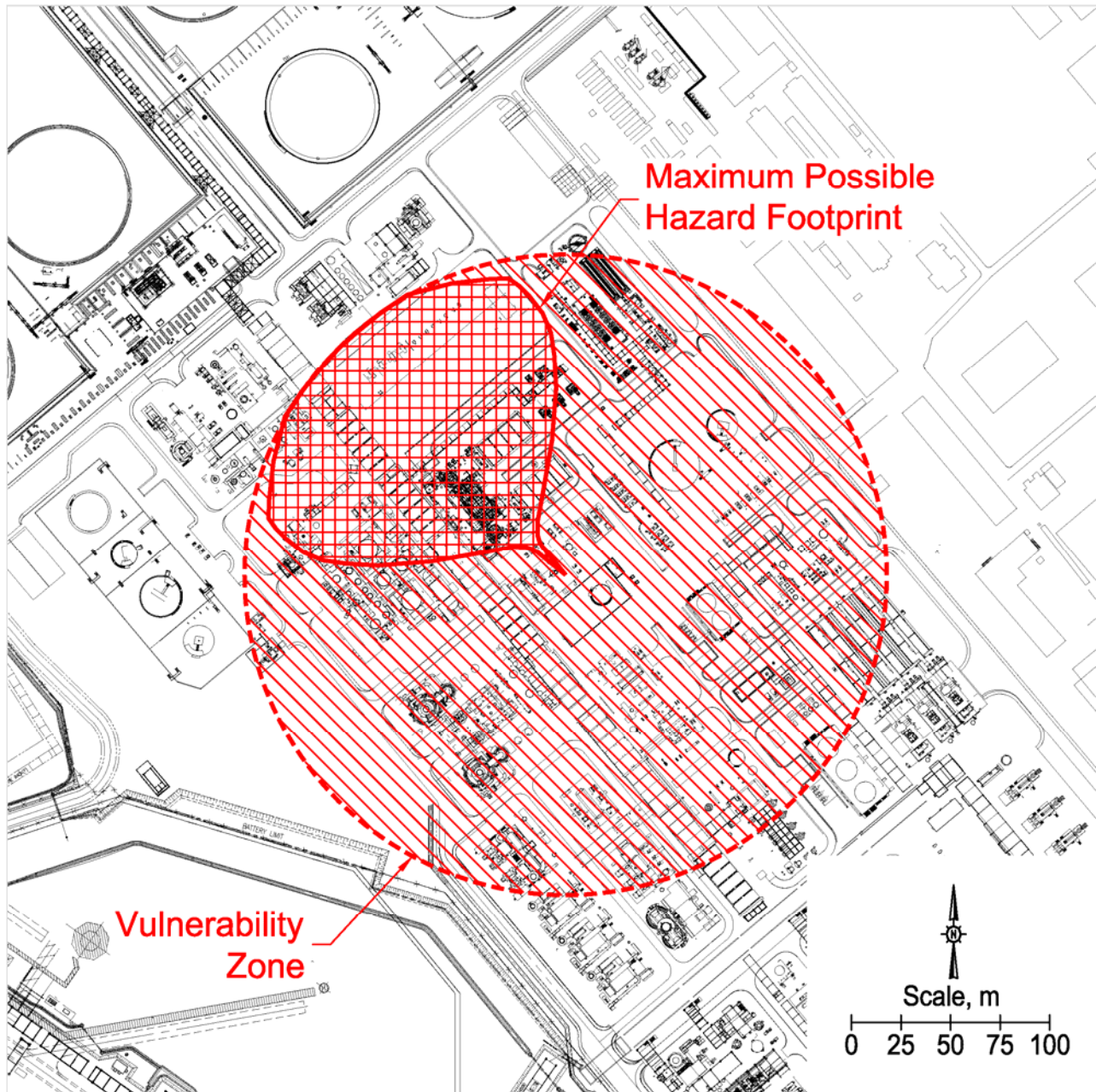


Figure 4-1
Example Vulnerability Zone

4.3.2 Fire Radiation

Fire radiation hazards for this facility are a result of flash fires (LFL), torch fires, pool fires, or BLEVEs. Consequence results for fire radiation are summarized in Tables B-1, B-2, and B-3 in Appendix B.

4.3.3 Toxic Vapor Clouds

Releases of material containing H₂S produce worst-case vulnerability zones in several areas (Units A and B, H₂S Recovery, Sour Water Stripper, and Amine Regeneration). The results from the toxic vapor cloud analysis are summarized in Tables B-1, B-2, and B-3 in Appendix B.

4.3.4 Vapor Cloud Explosions (VCE)

One of the possible results of a flammable fluid or gas release is the potential ignition of the vapor in a congested area (PES) which could then result in a VCE. The results for the thirty eight (38) VCE events are summarized in Table B-4 in Appendix B. Individual PESs are shown in Figure C-5 of Appendix C.

4.4 Summary of Maximum Vulnerability Zones for Existing and New/Modified Equipment

Figures showing the composite hazard vulnerability zone limits for the existing and new or modified equipment are presented in Appendix C, Figures C-1 through C-8. Each Figure in Appendix C shows the composite vulnerability zone for one type of hazard. Figures C-1, C-2, and C-3 show the flash fire (LFL), torch fire, and pool fire vulnerability zones. Figure C-4 shows the vulnerability zone for toxic releases while Figure C-5 shows the overpressure (1 psig) vulnerability zone. TK-1201 BLEVE vulnerability zones for are shown in Figure C-6. Vulnerability zones for the new natural gas pipeline and the existing hydrogen pipeline inside of the fence line are included within composite vulnerability zones of Figures C-1 and C-2 and in Figures C-7 and C-8 for pipeline segments outside of the facility boundaries.

The potential hazard zones from releases originating inside the facility are dominated by radiation (flash fire, torch fire, and BLEVE) and overpressure hazards from Units A and B and the Unit A/B common areas. One of the largest potential vulnerability zones from a process unit affecting an area outside the facility is a release from the Unit B hot separator liquid outlet line. The torch fire vulnerability zone for this release extends a distance of 591 ft. from the release point. The largest vulnerability zone is from a BLEVE of TK-1201. The vulnerability zone for this scenario extends 1,397 feet from the tank.

4.5 Worst Case Vulnerability Zone Comparisons

Based on the information found in Tables B-1, B-2 and B-3, releases from Unit A, Unit B and the common equipment and utility areas were selected to compare vulnerability zone for new/modified equipment with vulnerability zones from existing equipment. Table 4-3 lists the new/modified and corresponding existing scenarios selected for comparison in each area of the facility areas (Units A, B, common equipment, and utilities). Table 4-4 summarizes vulnerability zones distances for each scenario where a comparison is available. Figures 4-2 through 4-5 show the results for these scenarios plotted on an overview of the facility. Figure 4-6 shows a comparison of the outer vulnerability zone limits of the new/modified equipment and the outer vulnerability zone limits of the existing equipment. The Figure 4-6 existing equipment vulnerability zone limit includes the hazard vulnerability zone for the TK-1201 BLEVE (assumed to contain propane and filled to the “safe fill level.” This vulnerability zone has a radius of 1,397 ft.

**Table 4-3
Identification of Facility Worst Case Scenario Comparisons**

| New/Modified Scenario | Existing Comparison Scenarios |
|--|--|
| Unit A: Feed to Fractionator | Feed to Jet Reboiler |
| Unit A: Fractionator Overheads | Fractionator Overheads |
| Unit B: Combined Effluent from HDO Reactors | Light Naphtha Stabilizer Overheads |
| Unit B: Liquid from Hot Separator | Naphtha Splitter Overheads |
| Propane Recovery: Debutanizer Overheads | Reformate Stabilizer |
| H2 Production: Hydrogen from PSA | Hydrogen Storage and Transfer |
| Flares: New Flare at Design Case | Tank Top Fire – TK-80002 |
| Tankage: Tank Top Fire – TK-125001 | Tank Top Fire – TK-125001 |
| Pressurized Storage: BLEVE of TK-1201 | BLEVE of TK-1201 |
| H₂S Recovery: Concentrated Acid Gas Leaving H ₂ S Recovery after compression – C-270A/B/C | SCOT amine regen gas to H-401 |
| Amine Regeneration: Combined Acid Gas to Regeneration | No (known) existing comparison scenario |
| Pretreatment: Feed Piping in Pretreatment Area | No (known) existing comparison scenario |
| Rail Car Loading/Unloading: Loading/Unloading at New Rail Spur | Rail Car Loading/Unloading at Existing Rail Spur |
| Truck Loading/Unloading: Loading/Unloading at New Location | Truck Loading/Unloading at Existing Location |
| Natural Gas Pipeline: Natural Gas Line to Hydrogen Production within Facility | Natural Gas Line to Cogen Unit |
| Natural Gas Pipeline: Natural Gas Pipeline exterior to Facility | No (known) existing comparison scenario |
| Hydrogen Pipeline: Hydrogen Line inside Facility | Hydrogen Line inside Facility |
| Hydrogen Pipeline: Hydrogen Pipeline | Hydrogen Pipeline |
| Product Pipeline: Product Pipeline transporting renewable diesel and jet fuel | Product Pipeline transporting VGO, gasoline, naphtha, diesel, and jet fuel |

**Table 4-4
Worst Case Vulnerable Zone Comparisons**

| Base Case | Release From | New/ Mod or Existing | Distance in Feet to | | | | | | Offsite Hazard? |
|-------------|---|----------------------------|---------------------|-----|--------------------------|-----------------------------|---|-------|-----------------|
| | | | Fence Line | LFL | Toxic (H ₂ S) | Torch Fire | Pool Fire | BLEVE | |
| | | | | | 30 ppm | 1600 Btu/hr-ft ² | 740,000 (Btu/hr-ft ²) ^{4/3} -sec | | |
| 14A | Feed to Fractionator | N/M | 327 | 309 | na | 273 | na | na | N |
| 16A | Fractionator to Jet Reboiler | E | 327 | 260 | na | 180 | 50 | na | N |
| 15A | Fractionator Overheads | N/M | 318 | 397 | na | 181 | 104 | na | Y |
| 15A | Fractionator Overheads | E | 318 | 215 | na | 140 | na | na | N |
| 05B | HDO Reactors Combined Stream | N/M | 189 | 292 | 132 | 601 | na | na | Y |
| LNSO | Light Naphtha Stabilizer | E | 220 | 523 | 295 | 282 | na | na | Y |
| 06B | Hot Separator Liquid | N/M | 189 | 439 | 314 | 591 | na | na | Y |
| NSO | Naphtha Splitter Ovhd. Accumulator | E | 190 | 699 | 471 | 371 | na | na | Y |
| PR04 | Debutanizer Condensed Ovhd. | N/M | 217 | 431 | na | 216 | na | na | Y |
| RSO | Reformate Stabilizer Ovhd Accumulator | E | 310 | 545 | na | 292 | na | na | Y |
| H2P02 | Hydrogen Production | N/M | 403 | 115 | na | 76 | na | na | N |
| ALONP-25 | Hydrogen Storage and Transfer | E | 350 | 196 | na | 90 | na | na | N |
| F06 | New Flare | N/M | 541 | na | na | <5 | na | na | N |
| TK-80002 | TK-80002 | E | 541 | na | na | na | 192 | na | N |
| TK-125001-A | TK-125001 (after modifications) | N/M | 170 | na | na | na | 214 | na | Y |
| TK-125001-B | TK-125001 (before modifications) | E | 170 | na | na | na | 232 | na | Y |
| H2S02a | Conc. Acid Gas Leaving H ₂ S Recov. Unit | N/M | 165 | <10 | 253 | 13 | na | na | Y |
| | No (known) existing comparison scenario | E | na | na | na | na | na | na | na |
| H2S01 | Combined Acid Gas to Regen | N/M | 53 | nf | 216 | nf | na | na | Y |
| SCOT01 | SCOT amine regen gas to H-401 | E | 95 | nf | 424 | nf | na | na | Y |

| Base Case | Release From | New/ Mod or Existing | Distance in Feet to | | | | | | Offsite Hazard? |
|-------------|---|----------------------|---------------------|-----|--------------------------|-----------------------------|-----------|---|-----------------|
| | | | Fence Line | LFL | Toxic (H ₂ S) | Torch Fire | Pool Fire | BLEVE | |
| | | | | | 30 ppm | 1600 Btu/hr-ft ² | | 740,000 (Btu/hr-ft ²) ^{4/3} -sec | |
| PT01 | Pretreatment Feed Piping | N/M | 462 | na | na | na | 127 | na | N |
| | <i>No (known) existing comparison scenario</i> | E | na | na | na | na | na | na | na |
| RCL / RCU02 | Rail Loading/Unloading Rack – New Spur | N/M | 98 | na | na | na | 127 | na | Y |
| RCL / RCU01 | Rail Loading/Unloading Rack | E | 8 | na | na | na | 127 | na | Y |
| TRL / TRU02 | Truck Loading/Unloading | N/M | 108 | na | na | na | 127 | na | Y |
| TRL / TRU01 | Truck Loading/Unloading | E | 29 | na | na | na | 180 | na | Y |
| NG01 | Natural Gas Line - interior | N/M | 0 | 96 | na | 159 | na | na | Y |
| NG2INT1k | Natural Gas to Cogen Unit | E | 0 | 45 | na | 65 | na | na | Y |
| NG03 | Natural Gas Pipeline - exterior | N/M | 0 | 96 | na | 183 | na | na | Y |
| | <i>NG Pipeline on Somerset exists, but is not co-located with the new pipeline. Assumed to not exist for comparison purposes.</i> | E | na | na | na | na | na | na | na |
| H201 | Hydrogen Line - interior | N/M | 129 | 100 | na | 74 | na | na | N |
| H201 | Hydrogen Line - interior | E | 129 | 100 | na | 74 | na | na | N |
| H203 | Hydrogen Pipeline – exterior | N/M | 0 | 95 | na | 75 | na | na | Y |
| H203 | Hydrogen Pipeline – exterior | E | 0 | 95 | na | 75 | na | na | Y |
| PL5-02N | Product Pipeline– transporting renewable jet fuel | N/M | 0 | na | na | na | 138 | na | Y |
| PL1-04E | Product Pipeline– transporting gasoline | E | 0 | na | na | na | 154 | na | Y |
| TK-1201 | Pressurized Storage – TK-1201 | N/M | 215 | 304 | na | 126 | na | 1,397 | Y |
| TK-1201 | Pressurized Storage – TK-1201 | E | 215 | 304 | na | 126 | na | 1,397 | Y |

na = no accident scenario; not applicable

nf = non-flammable

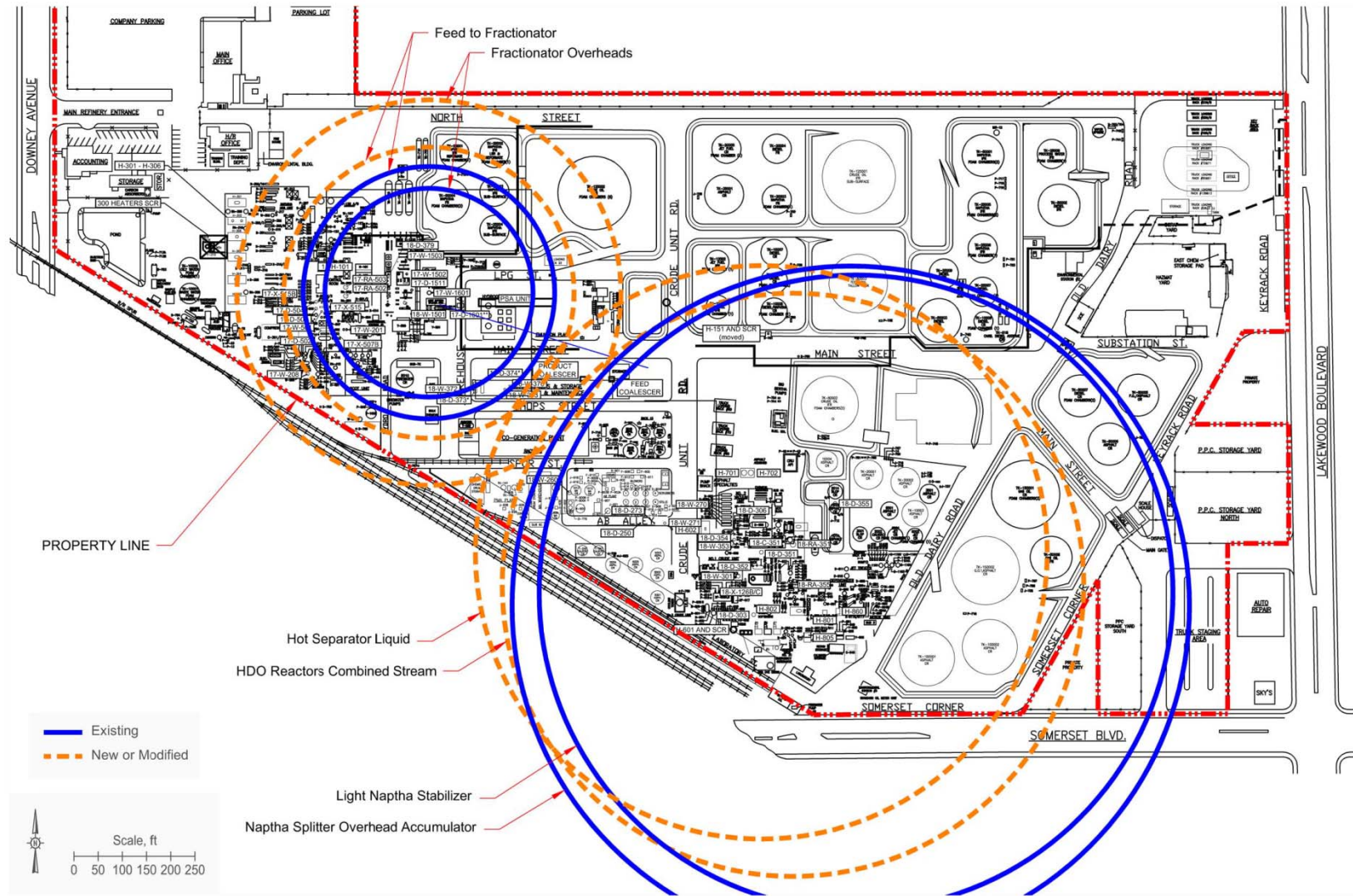


Figure 4-2
Unit A Unit B Worst Case Vulnerability Zone Comparison

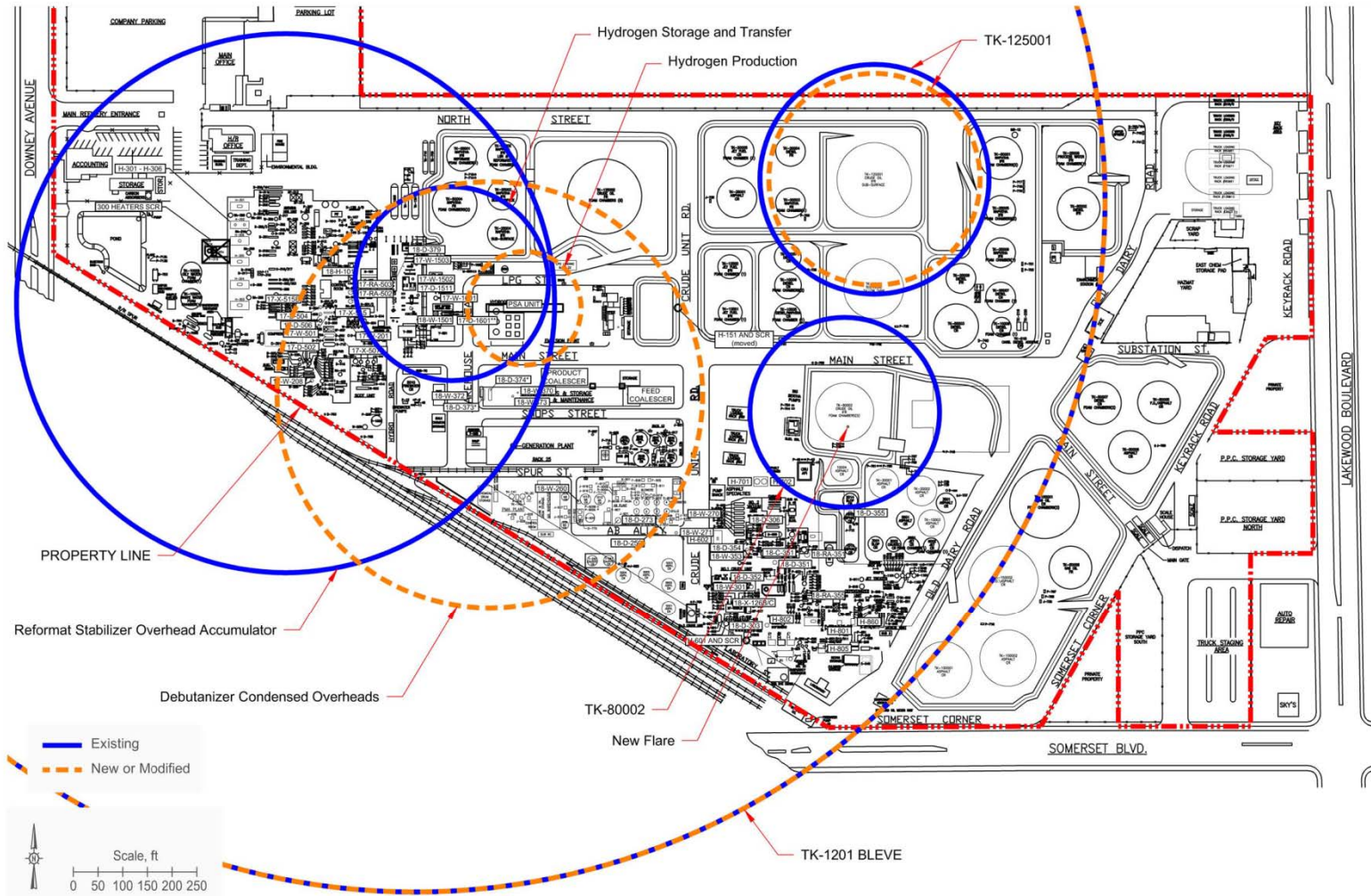


Figure 4-3
C₃ Recovery, H₂ Production, Flares, and Tankage Vulnerability Zone Comparison

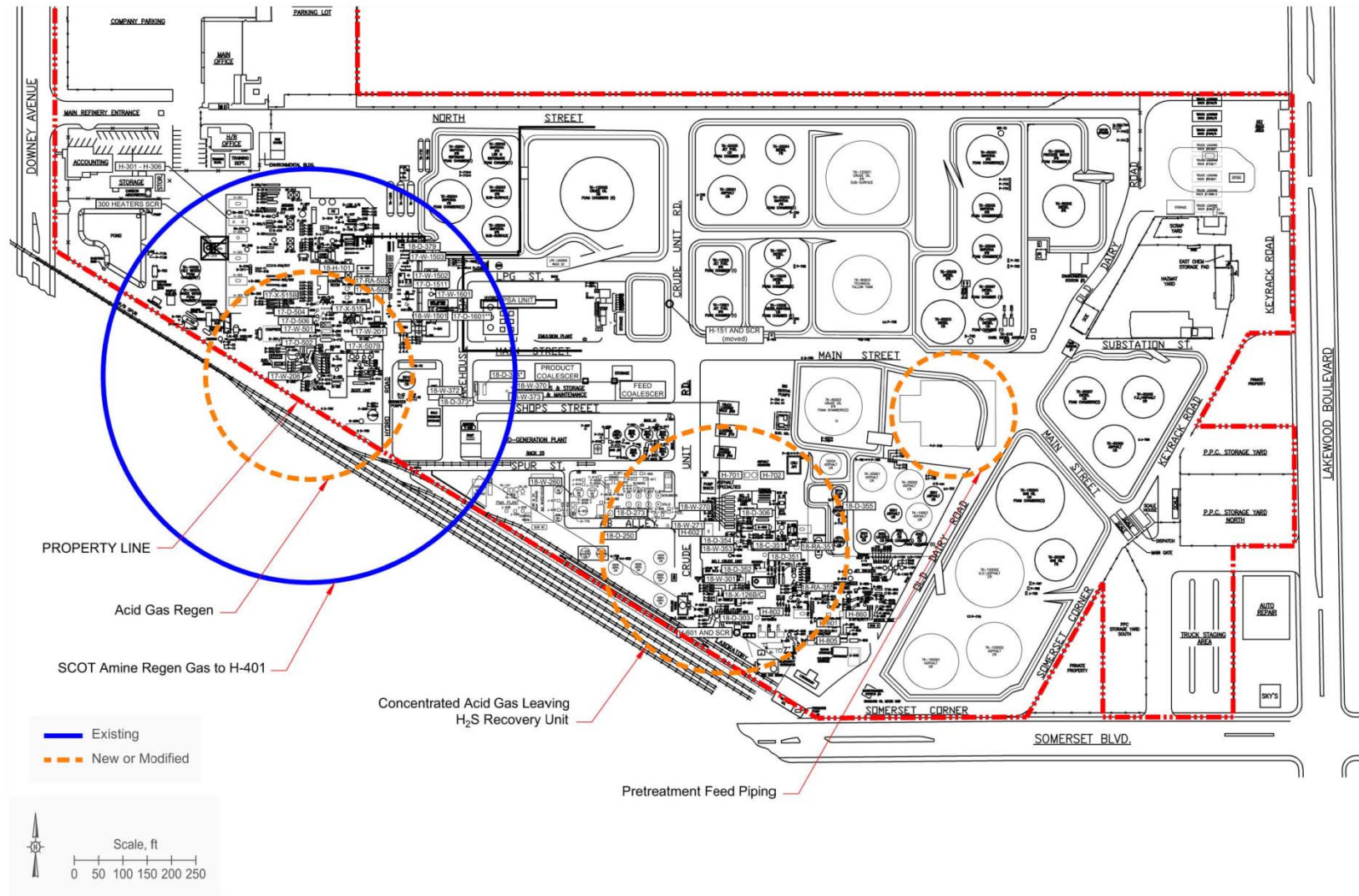


Figure 4-4
H₂S Recovery, Amine Regeneration, and Pretreatment Vulnerability Zone Comparisons

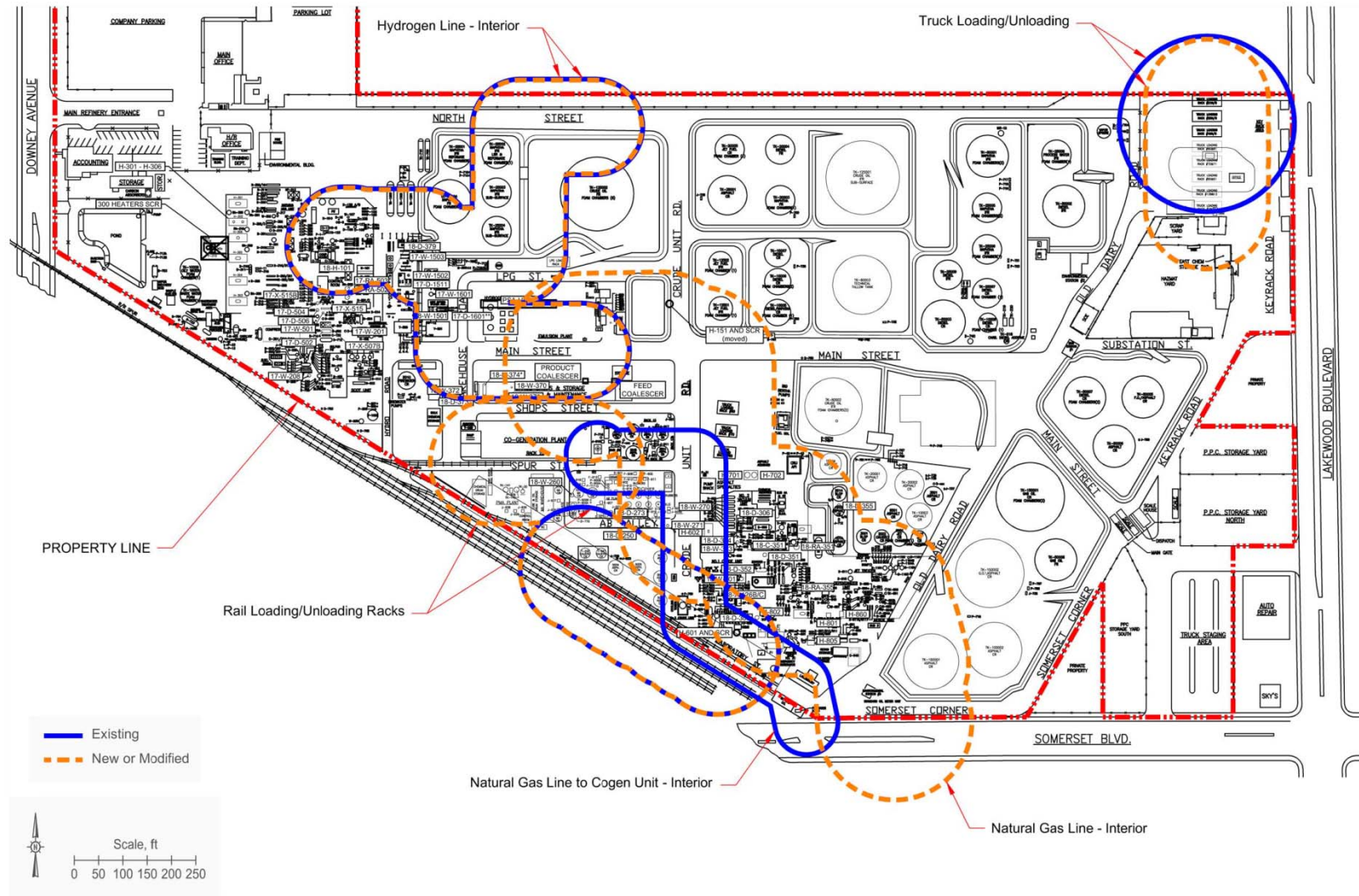


Figure 4-5
Railcar, Truck, Natural Gas and Hydrogen Interior Pipeline Vulnerability Zone Comparison

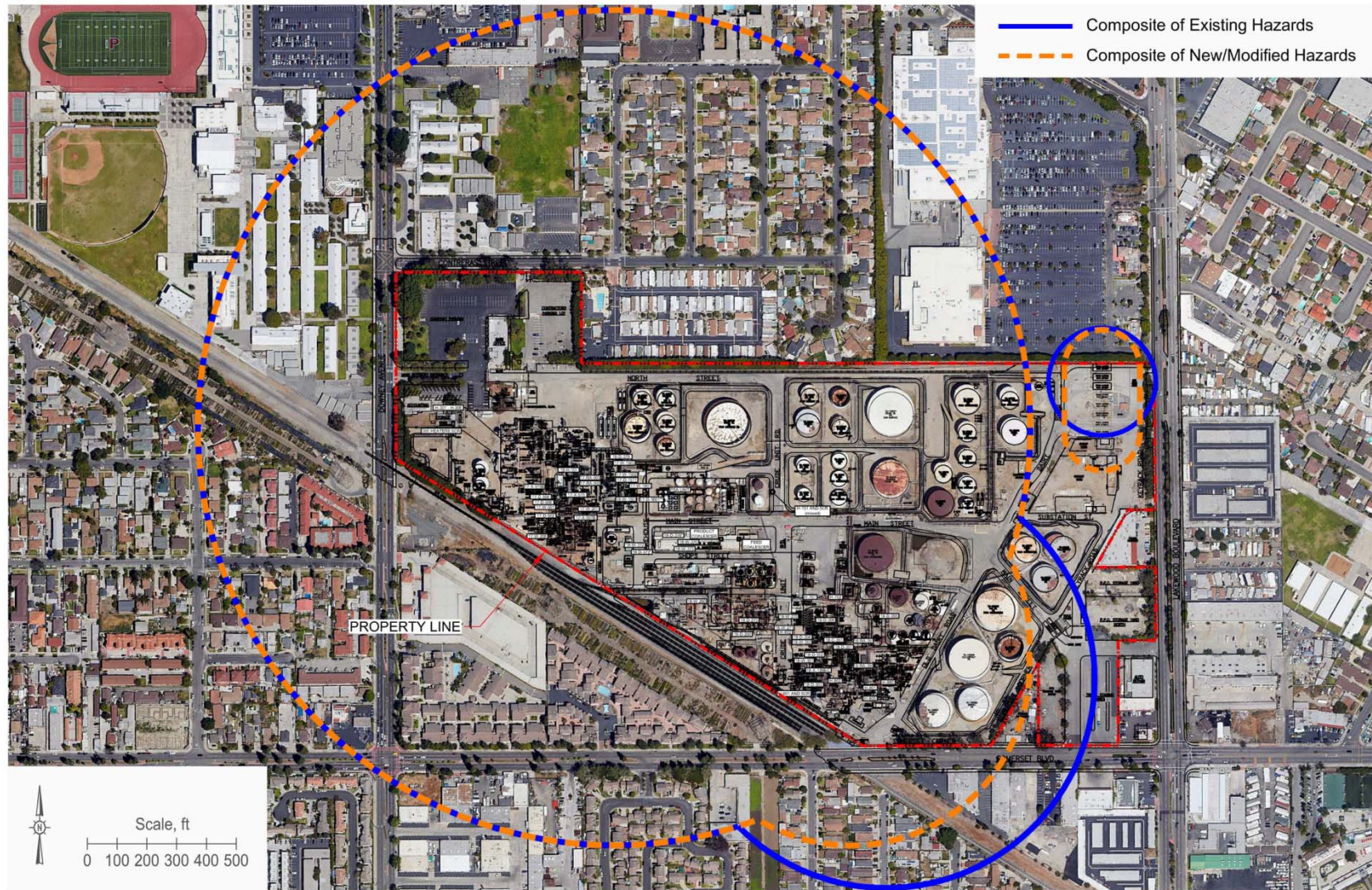


Figure 4-6
New/Modified and Existing Composite Hazard Vulnerability Zone Comparison

5.0 CONCLUSIONS

Fifty five (55) new/modified worst case release scenarios were identified and modeled during the hazard analysis. For each of these release scenarios, one to five hazard vulnerability zones were determined. The modeled hazard vulnerabilities included flash fire (LFL) hazards, toxic hazards (H₂S, ERPG-2), radiant heat hazards from torch and pool fires (second degree skin burns), and explosion overpressure (1.0 psig) hazards. These worst case release scenarios generated over 150 individual hazard vulnerability zones. The information obtained from the vulnerability zone calculations was used to generate result summary Tables B-1, B-2, B-3, and B-4 found in Appendix B. This information and the graphical representation of the table information found in Figure 4-6 provide the basis for the following conclusions.

The analysis showed that the combined hazard vulnerability zone generated by the modifications of existing equipment or by adding new equipment covered most of the facilities fenced in area and extended to areas outside of the fence line. While all of the individual (Flash Fire, Torch Fire, Pool Fire, Toxic, or Overpressure) hazard vulnerability zones extended beyond the facility boundary at one or more locations, the pool fire and toxic vulnerability zones extended the shortest distances beyond the facility boundary (Figures C-3 and C-4). Flash fire (LFL), torch fire, BLEVE, and overpressure hazard vulnerability zones extended the furthest beyond the facility boundary (Figures C-1, C-2, C-6 and C-5).

No area was found where 1) the composite new/modified hazard vulnerability zone extended outside of the facility boundary AND 2) the composite hazard vulnerability zone for new/modified equipment exceeded the composite hazard vulnerability zone for existing equipment.

As shown in Figure 4-6 and discussed in the above paragraphs, none of the revised changes to the facility affect areas offsite that are not impacted by existing operations. Given the complexity of the modeling process and the uncertainty in producing an “exact” answer, the results of this analysis should be viewed as providing a conservative upper limit of the potential hazard impacts studied under worst-case conditions. Focusing solely on the results under worst-case conditions does not provide a reasonable assessment of the potential risk that the refinery poses on the surrounding public. For instance, for the largest impact to occur, a hole equivalent to a full pipe rupture would have to be created, AND the hole would have to be in the liquid portion of the vessel or in associated equipment handling this liquid, AND the release would have to be oriented horizontally, AND the release stream does not impact nearby equipment, AND the winds would be low (1.5 m/s), AND the atmosphere would have to be stable (Pasquill F), AND the terrain would remain uniform over the cloud’s length of travel. It is clear that the probability of all these conditions existing at the same time is extremely low. Thus, the creation of any modeled hazard vulnerability zone should not be considered probable or likely.

On the other hand, all the calculations made in this report employed the similar set of worst-case conditions. This affords the comparison of new/modified scenarios to existing scenarios. In this manner an apples-to-apples comparison of the existing and revised facility configurations can be made. When this comparison is made, as Figure 4-6 shows, it is clear that no new areas of increased hazard zone vulnerability are created outside of the facility by changes made within the facility.

5.1 Vulnerability Zone for Exterior to Facility Hydrogen Pipeline

The repurposed hydrogen pipeline (Section 2.4.1 and Figure 2-3) will present new flash fire (LFL) and torch fire vulnerability zones that will likely encroach onto public residential areas along the pipeline route as analyzed in the EIR for the pipeline conversion (Carson, 2020). Table 4-4 summarizes the existing and modified vulnerability zones. Figure C-8 illustrates the modified vulnerability zone for the two hazards (LFL and torch fire) at a portion of the pipeline route along Downey Ave. The flash fire (LFL) vulnerability zones for the existing and modified use of the hydrogen pipeline are the same size. Thus, the modified hydrogen pipeline does not present an increased public vulnerability zone when compared to the existing pipeline.

5.2 Vulnerability Zone for Exterior to Facility Natural Gas Pipeline

Section 2.4.2 and Figure 2-3 describe the new natural gas pipeline routing.

The worst case calculations presented in the summary tables use the expected pipeline pressure, line size, and average distance to the line rupture point to give the exterior to facility hazard vulnerability zones.

Table B-3 (Appendix B) gives the hazard vulnerability zone for the route. Figure C-7 shows these vulnerability zones on a portion of the pipeline route along Lakewood St. As the table shows, the torch fires dominate the hazard vulnerability zones. Since the pipelines will be new with no existing vulnerability zones, the new natural gas pipelines will present an increase of vulnerability zone to the public.

Vulnerability zone calculations were also made for the pipeline blowdown station and are also presented in Table B-3. Both the flash fire (LFL) and torch fire vulnerability zones are smaller than those for the pipeline and do not increase the pipeline vulnerability zone to the public.

5.3 Vulnerability Zone for Product Pipelines

Section 2.4.3 describes the changes to the facility product pipeline usage.

The worst case calculations presented in the summary tables use the supplied pipeline pressure, line size, material molecular weight, and average flow rate to calculate the hazard vulnerability zones.

Both the current products transported, vacuum gas oil (VGO), gasoline, naphtha, diesel, and jet fuel and the proposed products to be transported, renewable diesel and renewable jet fuel, are being transported as liquids and will form liquid pools when released, resulting in pool fire hazards. Pool fire vulnerability zones for each renewable product are presented in Table B-3. The product pipeline pool fire comparison results presented in Table 4-4 show that a small, but noticeable decrease in maximum vulnerability zone occurs when comparing transport of existing product and new product.

6.0 REFERENCES

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APPENDIX A

RESUME

David W. Johnson
Quest Consultants Inc.®
Principal Consultant

EDUCATION

1969 Ph.D., Chemical Engineering
 University of Oklahoma, Norman, Oklahoma

1965 B.S., Chemical Engineering
 University of Texas, Austin, Texas

EXPERIENCE

1989 - Present Quest Consultants Inc., Norman, Oklahoma
 Principal Consultant

Facilitated HAZOP, SIL/LOPA, What If?, HAZID, and HEMP (bowtie) reviews for numerous projects, including:

- Chemical complex
- Oil and gas processing facilities
- Refinery units
- LNG baseload (export) facilities
- LNG import facilities
- Offshore oil and gas processing

Performed consequence modeling for siting and safety studies of several liquefied natural gas (LNG) facilities. Involved in numerous consequence analysis, risk analysis, and facility siting studies involving refineries, gas plants, pipelines, and petrochemical plants.

Responsible for Quest's testing and research programs, and for the development and implementation of analytical models for predicting accidental release rates, aerosol formation, pool spreading, heat transfer, and vaporization rates.

Directed all major aspects of several experimental programs involving releases of hazardous fluids.

- On-site tests conducted to determine if the flammable cloud produced by emergency venting of ullage gas from a crude oil pipeline surge tank could reach associated process areas.
- Two field-test programs conducted to evaluate the efficacy of additives designed to reduce the amount of aerosol formed during accidental releases from HF alkylation units.

David W. Johnson

- Release tests conducted for the Petroleum Environmental Research Foundation (PERF) to determine the potential for a hydrocarbon/sulfuric acid emulsion to form an aerosol upon its release.
- Aerosol release tests conducted for the CCPS at the DOE Nevada Test Site.

Assisted in development of RMPPs for several refinery units in California, including alkylation, hydrotreating, hydrocracking, catalytic cracking, delayed coking, and product storage. This work included a review of unit HAZOPs, selection of potential release scenarios, estimation of accident frequencies, and supervision of hazard modeling.

1983 - 1989 Energy Analysts, Inc., Norman, Oklahoma
Principal Engineer

Conducted HAZOP study for a proposed refinery expansion in the Philippines. Trained refinery personnel as HAZOP leaders for future HAZOP studies.

Responsible for the technical content of the final safety analysis report (FSAR) for the Big Hill Strategic Petroleum Reserve (SPR) site. Tasks completed included identification and analysis of hazards; review of site layout and design; and equipment, piping, and instrumentation evaluation. Made recommendations to improve site operations.

Developed risk models in the areas of fire and thermal radiation, rate of fluid release from containment, and Gaussian dispersion for EAHAP hazards analysis computer code.

Designed and participated in several large-scale outdoor fire and fluid release tests designed to determine the burning and release characteristics of hydrocarbon fluids.

1977 - 1983 Applied Technology Corporation, Norman, Oklahoma
Vice President

Developed mathematical models in the areas of fire radiation, vapor dispersion, and heat transfer. Applied these models to LNG facility safety studies.

Designed and conducted several large-scale outdoor tests involving fire and materials combustion. Tests included the burning and subsequent extinguishment of hexane, LPG, and carbon disulfide pool fires.

1970 - 1977 University Engineers, Inc., Norman, Oklahoma
Senior Engineer

Project manager of a semi-works seawater desalination project utilizing direct contact heat transfer and freezing to produce potable water.

Involved in several large-scale outdoor fire tests to study the flammability characteristics of thermal insulation products.

David W. Johnson

1965 Celanese Fibers Corporation, Rock Hill, South Carolina
Development Engineer

Adapted existing plant equipment for new and more productive uses, developed computer models describing machine operations, and assisted in plant start-up.

PROFESSIONAL MEMBERSHIPS

National Society of Professional Engineers
American Institute of Chemical Engineers
Oklahoma Society of Professional Engineers

PUBLICATIONS

Authored more than twenty-five papers in the areas of physical properties, kinetics, and process plant safety.

RELEVANT PROJECT EXPERIENCE

Process Hazards Analysis (PHA) of a Large LNG Liquefaction Facility: *Directed* the HAZOP and LOPA studies for a large scale grass roots LNG facility in Texas. Studies for both the FEED and EPC were performed as well as Management of Change (MOC) reviews. *Client: Sabine Pass LNG.*

Process Hazards Analysis (PHA) of a Large LNG Liquefaction Facility: *Directed* the HAZOP and LOPA studies for a large scale grass roots LNG facility in Australia. Studies for both the FEED and EPC were performed as well as Management of Change (MOC) reviews. *Client: Gladstone LNG.*

Process Hazards Analysis (PHA) of Multiple Nitrogen Rejection (NRU) and Cryogenic Processing Units: *Directed* the HAZOP and MOC studies for multiple nitrogen rejection and cryogenic units in Texas, New Mexico, and Wyoming. *Client: BCCK Engineering.*

Process Hazards Analysis (PHA) of a Refinery Crude Unit: *Directed* the HAZOP for a refinery crude unit. *Client: Caltex Corporation (now part of ChevronTexaco).*

Development of an Improved Hydrogen Fluoride Alkylation Catalyst: *Project Manager* for a research project involving the large scale outdoor release of anhydrous hydrogen fluoride (HF) and hydrogen fluoride mixed with vapor pressure reducing additives. The purpose of the testing was to validate lab scale results with respect to the reduction of aerosol formation of the released HF. *Client: Mobil Research and Development Corporation (now a part of Exxon/Mobil).*

Development of an Improved Hydrogen Fluoride Alkylation Catalyst: *Project Manager* for a research project involving the large scale outdoor release of anhydrous hydrogen fluoride (HF) and hydrogen fluoride mixed with vapor pressure reducing additives. The purpose of the testing was to validate lab scale results with respect to the reduction of aerosol formation of the released HF. *Client: Texaco Inc. (now a part of ChevronTexaco).*

APPENDIX B

**HAZARD ZONE CALCULATION SUMMARY TABLES
FOR
NEW/MODIFIED EQUIPMENT**

Table B-1
Unit A (5,000 BPD) - Consequence Modeling Results for New/Modified Equipment

| Case Name | Description | Distance in Feet to Specified Hazard Endpoint | | | | |
|-----------|---|---|-------------------------|-----------------------------|-----------|--|
| | | LFL | Toxic | Torch Fire | Pool Fire | BLEVE |
| | | | 30 ppm H ₂ S | 1600 Btu/hr-ft ² | | 740,000 (Btu/hr-ft ²) ^{4/3} -sec |
| 03A | Treated Feed to HDO Reactor Release | 180 | 91 | 365 | na | na |
| 04A | Recycle Gas Release | 59 | 80 | 67 | na | na |
| 05A | Effluent from HDO Reactors Release | 179 | 94 | 357 | na | na |
| 06A | Hot Separator Liquid Release | 149 | 34 | 359 | na | na |
| 07A | Hot Separator Vapor Release | 69 | 96 | 145 | na | na |
| 08A | Cold Separator Vapor to HP Amine Absorber Release | 53 | 90 | 83 | na | na |
| 09A | Feed to Stripper Column Release | 81 | 49 | 225 | na | na |
| 10A | Stripper Overheads to Condenser Release | 50 | 42 | 103 | na | na |
| 11A | Stripper Bottoms to Surge Drum Release | 161 | na | 196 | na | na |
| 13A | Hot Isomerization Separator Vapor Release | 59 | na | 91 | na | na |
| 14A | Feed to Fractionator Release after Heater | 309 | na | 273 | na | na |
| 15A | Fractionator Overheads Release | 90 | na | 201 | na | na |
| 16A | Cracking Fractionator to Jet Reboiler Release | 151 | na | 343 | na | na |
| 18A | Fractionator Condensed Overheads Release | 397 | na | 181 | 104 | na |
| 20A | Jet SC Stripper Bottoms to Storage Release | 34 | na | 131 | na | na |

na = no accident scenario; not applicable

Table B-2
Unit B (20,000 BPD) - Consequence Modeling Results for New/Modified Equipment

| Case Name | Description | Distance in Feet to Specified Hazard Endpoint | | | | |
|-----------|---|---|-------------------------|-----------------------------|-----------|--|
| | | LFL | Toxic | Torch Fire | Pool Fire | BLEVE |
| | | | 30 ppm H ₂ S | 1600 Btu/hr-ft ² | | 740,000 (Btu/hr-ft ²) ^{4/3} -sec |
| 03B | Treated Feed to HDO Reactor Release | 197 | <10 | 398 | na | na |
| 04B | Recycle Gas Release | 158 | <10 | 223 | na | na |
| 05B | Combined Effluent from HDO Reactors Release | 292 | 132 | 601 | na | na |
| 06B | Hot Separator Liquid Release | 439 | 314 | 593 | na | na |
| 07B | Hot Separator Vapor Release | 139 | 139 | 276 | na | na |
| 08B | Cold Separator to HP Amine Absorber Release | 162 | 164 | 230 | na | na |
| 09B | Feed to Stripper Column Release | 136 | 51 | 333 | na | na |
| 10B | Stripper Overheads to Condenser Release | 89 | 86 | 165 | na | na |
| 11B | Stripper Bottoms to Surge Drum Release | 51 | na | na | 109 | na |
| 13B | Hot Isomerization Separator Vapor Release | 117 | na | 218 | na | na |
| 14B | Feed to Fractionator after Heater Release | 450 | na | 351 | na | na |

na = no accident scenario; not applicable

Table B-3
Units A-B (25,000 BPD) Common Equipment - Consequence Modeling Results for New/Modified Equipment

| Case Name | Description | Distance in Feet to Specified Hazard Endpoint | | | | |
|--|--------------------------------------|---|-------------------------|-----------------------------|-----------|---|
| | | LFL | Toxic | Torch Fire | Pool Fire | BLEVE |
| | | | 30 ppm H ₂ S | 1600 Btu/hr-ft ² | | 740,000 (Btu/hr-ft ^{2,4/3})-sec |
| Propane Recovery and Naphtha Splitter | | | | | | |
| PR01 | Stripper Bottoms before Pump | 167 | na | 254 | na | na |
| PR02 | Debutanizer Feed | 171 | na | 280 | na | na |
| PR03 | Depropanizer Overheads from Receiver | 361 | na | 211 | na | na |
| PR04 | Debutanizer Overheads | 431 | na | 216 | na | na |
| NS01 | Feed to Naphtha Splitter before Pump | 326 | na | 189 | 95 | na |
| NS02 | Naphtha Splitter Condenser Overheads | 225 | na | 134 | 69 | na |
| NS03 | Naphtha Splitter Bottoms | 271 | na | 151 | na | na |
| H2 Production | | | | | | |
| H2P01 | Natural Gas from Coalescer | 64 | na | 114 | na | na |
| H2P02 | Hydrogen from PSA | 115 | na | 76 | na | na |
| H2P03 | Hydrogen Product from Coalescer | 88 | na | 65 | na | na |
| H2S Recovery | | | | | | |
| H2S01 | Combined Feed to H2S Recovery | non-flam | 216 | non-flam | na | na |
| H2S02a | Concentrated Acid Gas Leaving Unit | <10 | 253 | 13 | na | na |
| Sour Water Stripper | | | | | | |
| SWS01 | Acid Gas from Stripper Column | <10 | 187 | <5 | na | na |
| Amine Regeneration | | | | | | |
| AMN01 | Combined Acid Gas to Regen | non-flam | 213 | non-flam | na | na |
| Pretreatment | | | | | | |

| Case Name | Description | Distance in Feet to Specified Hazard Endpoint | | | | |
|----------------------------------|---|---|-------------------------|-----------------------------|-----------|---|
| | | LFL | Toxic | Torch Fire | Pool Fire | BLEVE |
| | | | 30 ppm H ₂ S | 1600 Btu/hr-ft ² | | 740,000 (Btu/hr-ft ²) ^{4/3} -sec |
| PT01 | Pool Fire in Pretreatment Area | na | na | na | 127 | na |
| Tankage | | | | | | |
| TK-125001-A | Tank Top Fire, TK-125001 | na | na | na | 214 | na |
| Pressurized Storage | | | | | | |
| TK-1201 | TK-1201 at Safe Fill Condition | 304 | na | 126 | na | 1,397 |
| Existing and New Flares | | | | | | |
| F06 | New Flare at Design Case | na | na | <5 | na | na |
| Railcar Loading/Unloading | | | | | | |
| RCL02 | Railcar loading at new rail spur location | na | na | na | 127 | na |
| RCU02 | Railcar unloading at new rail spur location | na | na | na | 127 | na |
| Truck Loading/Unloading | | | | | | |
| TRL02 | Truck loading at new location | na | na | na | 127 | na |
| TRU02 | Truck unloading at new location | na | na | na | 127 | na |
| Natural Gas Pipeline | | | | | | |
| NG01 | Inside Facility | 96 | na | 159 | na | na |
| NG03 | Outside Facility | 96 | na | 183 | na | na |
| NG04 | Pipeline Blowdown Station | <5 | na | 89 | na | na |
| Hydrogen Pipeline | | | | | | |
| H201 | Within Facility | 100 | na | 74 | na | na |
| H203 | Exterior to Facility | 95 | na | 75 | na | na |
| Product Pipeline | | | | | | |
| PL5-02N | Renewable Jet Fuel | na | na | na | 138 | na |

| Case Name | Description | Distance in Feet to Specified Hazard Endpoint | | | | |
|-----------|-----------------------|---|-------------------------|-----------------------------|-----------|---|
| | | LFL | Toxic | Torch Fire | Pool Fire | BLEVE |
| | | | 30 ppm H ₂ S | 1600 Btu/hr-ft ² | | 740,000 (Btu/hr-ft ²) ^{4/3} -sec |
| PL4-03N | Renewable Diesel Fuel | <i>na</i> | <i>na</i> | <i>na</i> | 119 | <i>na</i> |

na = no accident scenario; not applicable

Table B-4
Overpressure Consequence Modeling Results for New/Modified Equipment
 (for PES locations refer to Figure C-5)

| PES Number | Distance in feet to 1 psig endpoint (from edge of PES) |
|---------------|--|
| 01 | 215 |
| 02 | 300 |
| 03 | 315 |
| 04 | 246 |
| 05 | 352 |
| 06 | 100 |
| 07 | 286 |
| 08 | 368 |
| 09 | 245 |
| 10 | 348 |
| 11 | 351 |
| 12 | 510 |
| 13 | 474 |
| 14 | 322 |
| 15 | 322 |
| 16 | 322 |
| 17 | 322 |
| 18 | 330 |
| 19 | 402 |
| 20 | 221 |
| 21 | 150 |
| 22 | 174 |
| 23 | 112 |
| 24 | 276 |
| 25 | 212 |
| 26 | 401 |
| 27 | 348 |
| 28 | 335 |
| 29 | 310 |
| 30 | 430 |
| 31 | 421 |
| 32 | 421 |
| 33 | 421 |
| 34 | 188 |
| 35 | 242 |
| 36 | 203 |
| 37 | 313 |
| 38 | 252 |

APPENDIX C

HAZARD ZONE COMPOSITE SUMMARY FIGURES FOR EXISTING AND NEW/MODIFIED EQUIPMENT AND EXTERIOR NATURAL GAS AND HYDROGEN PIPELINES

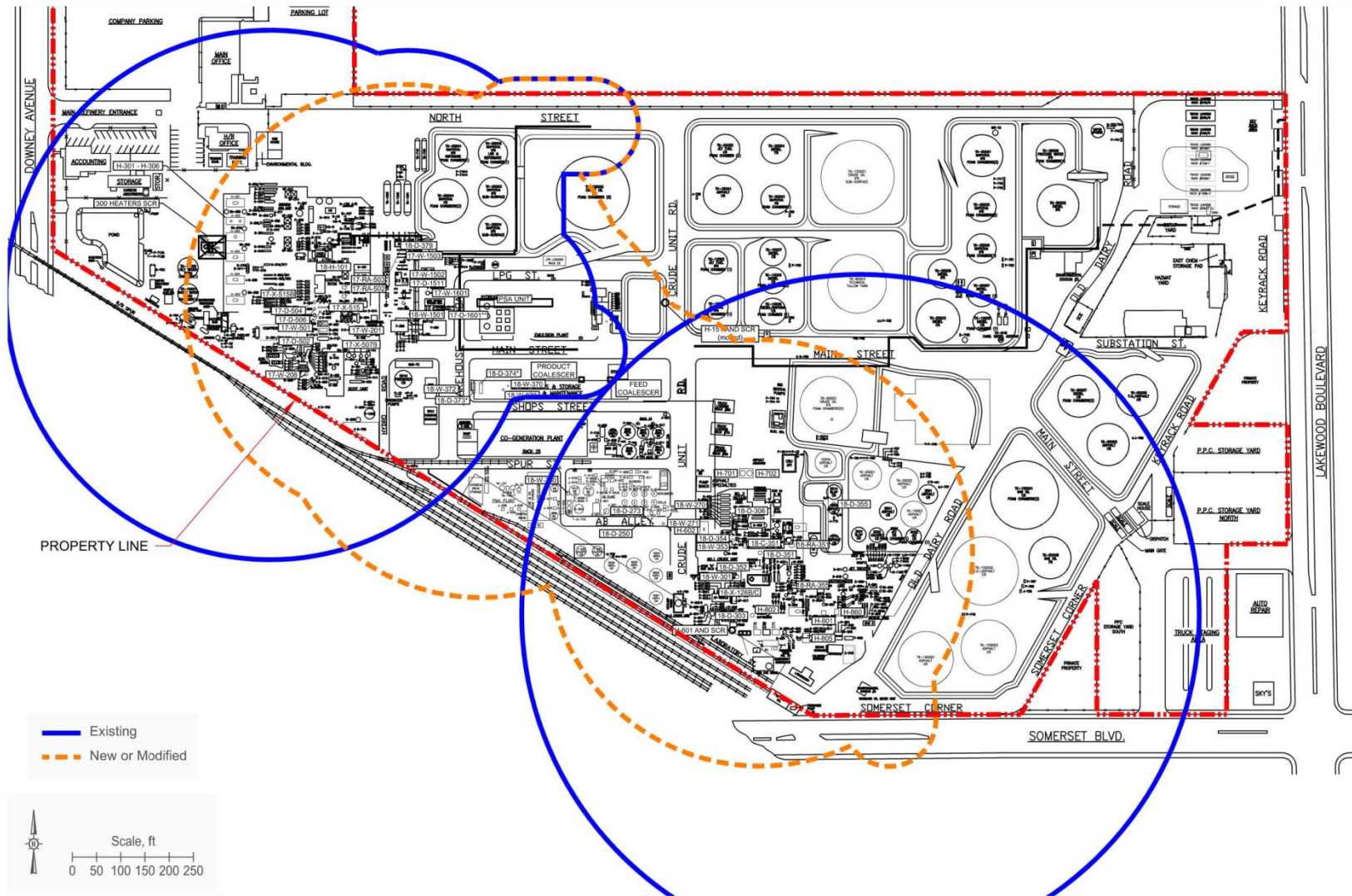


Figure C-1
Flash Fires (LFL) Composite Vulnerability Zone for Existing and New/Modified Equipment

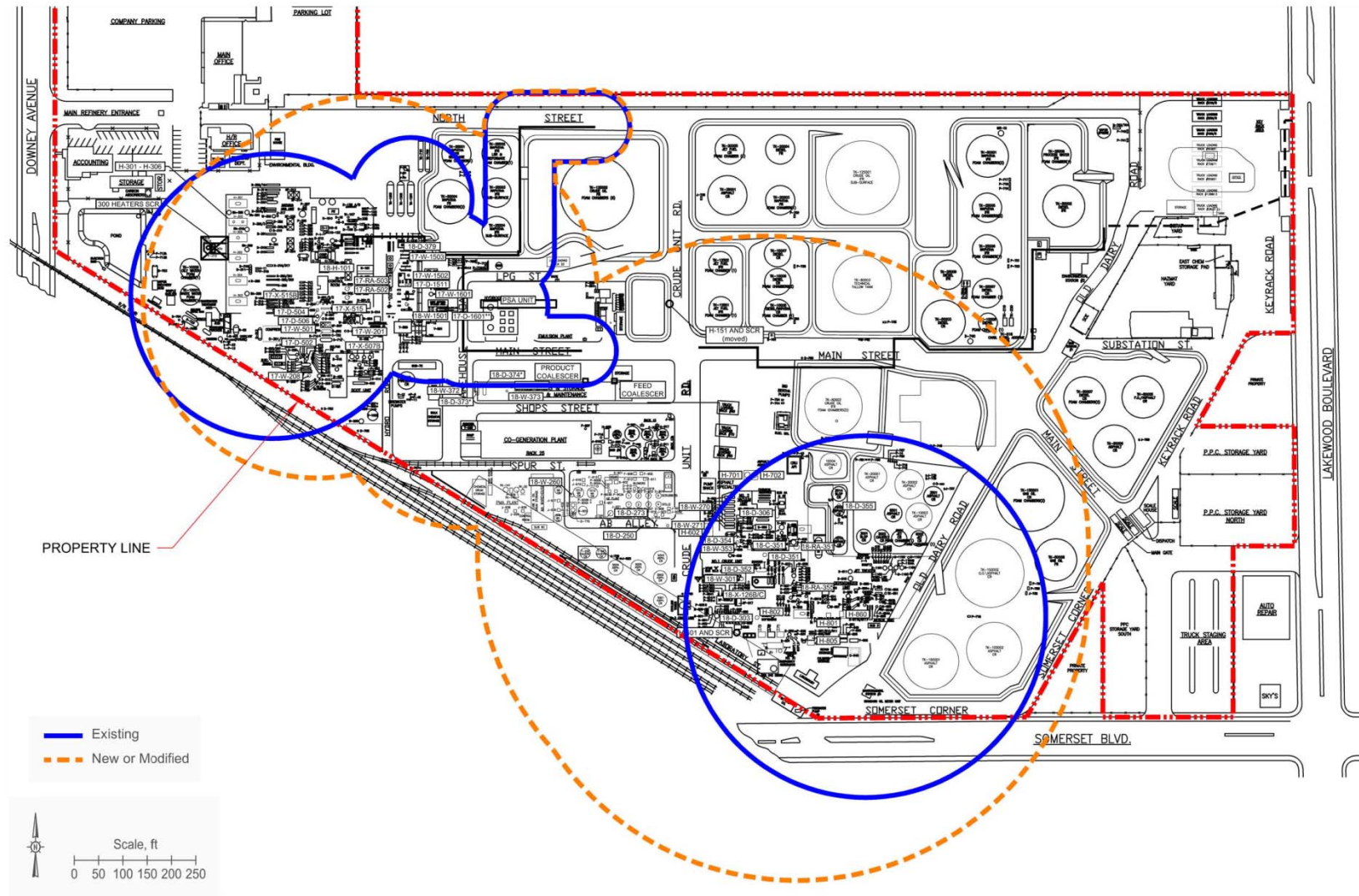


Figure C-2
Torch Fire Composite Vulnerability Zone for Existing and New/Modified Equipment

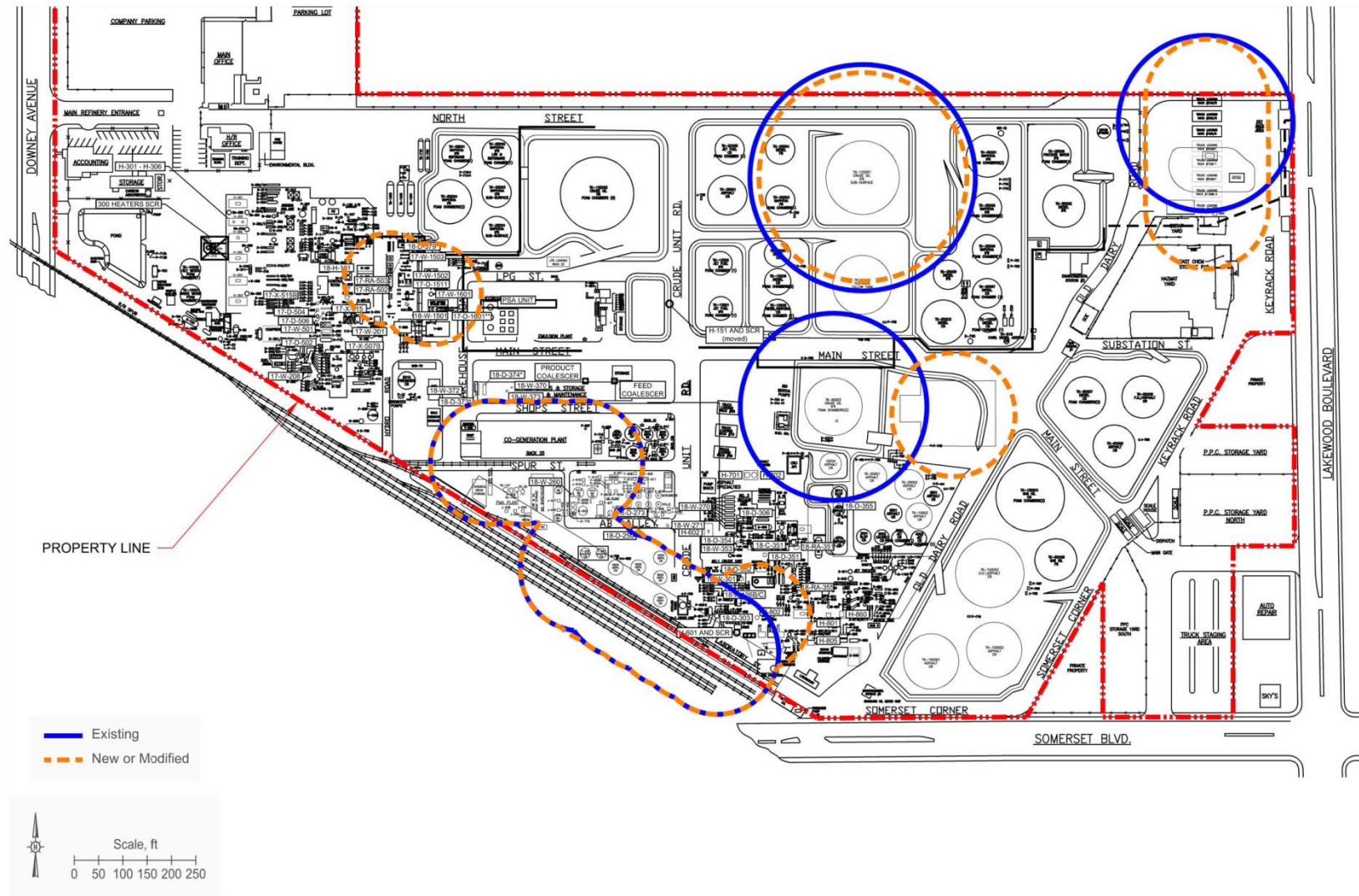


Figure C-3
Pool Fire Composite Vulnerability Zone for Existing and New/Modified Equipment



Figure C-4
Toxic Composite Vulnerability Zone for Existing and New/Modified Equipment

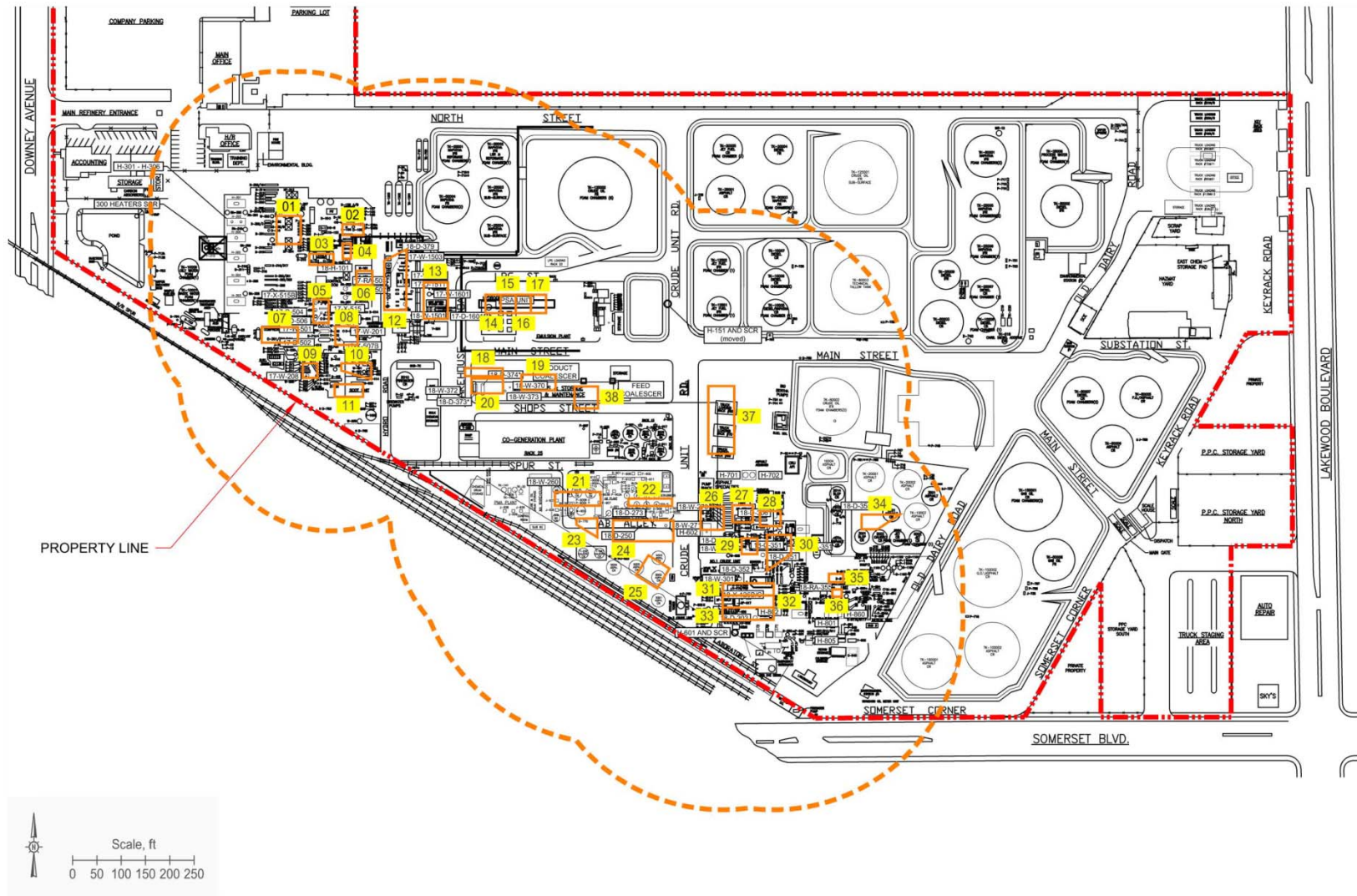


Figure C-5
Overpressure (1 psig) Composite Vulnerability Zone for New/Modified Equipment

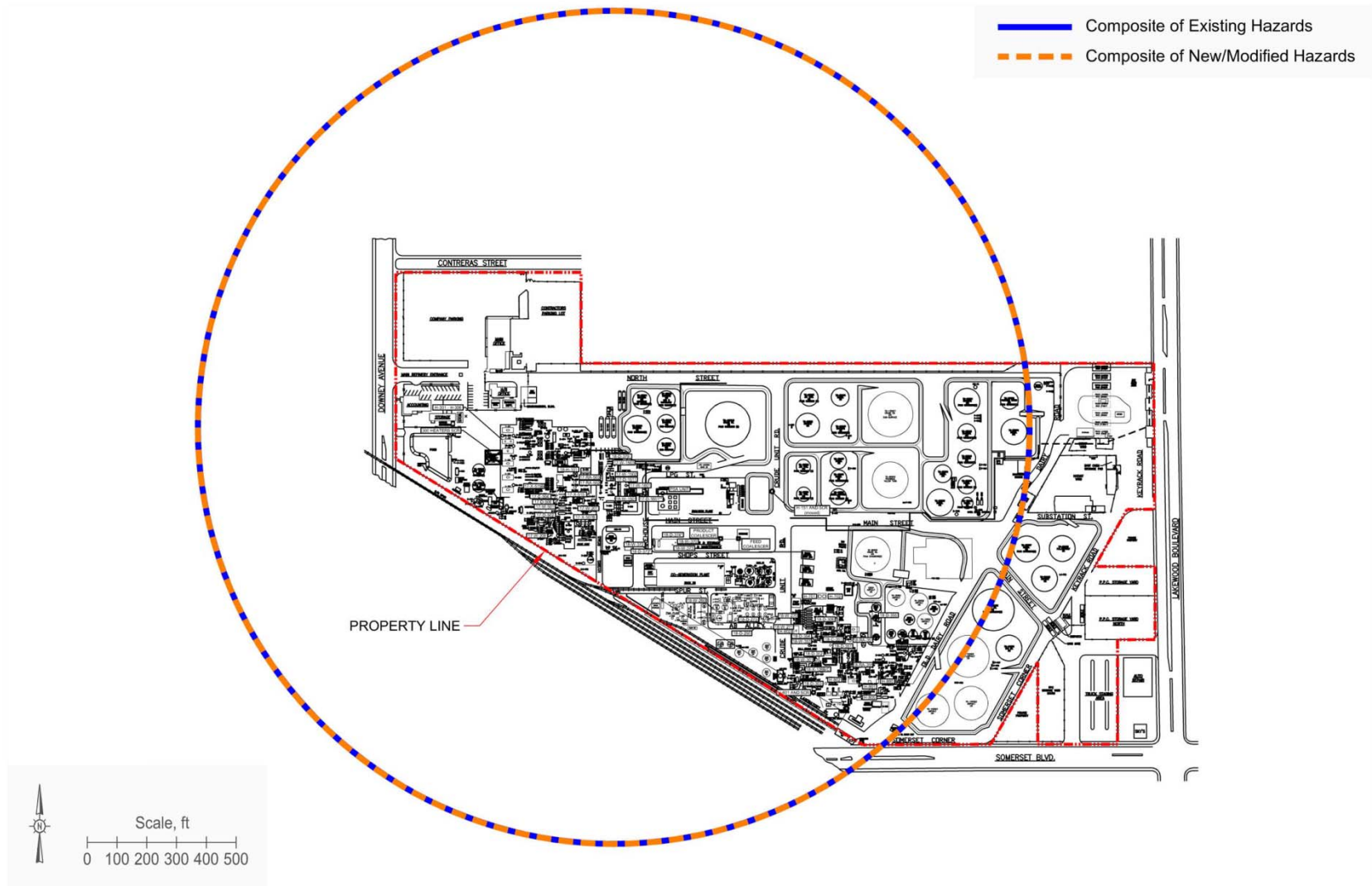


Figure C-6
BLEVE Composite Vulnerability Zone for Existing and New/Modified Equipment

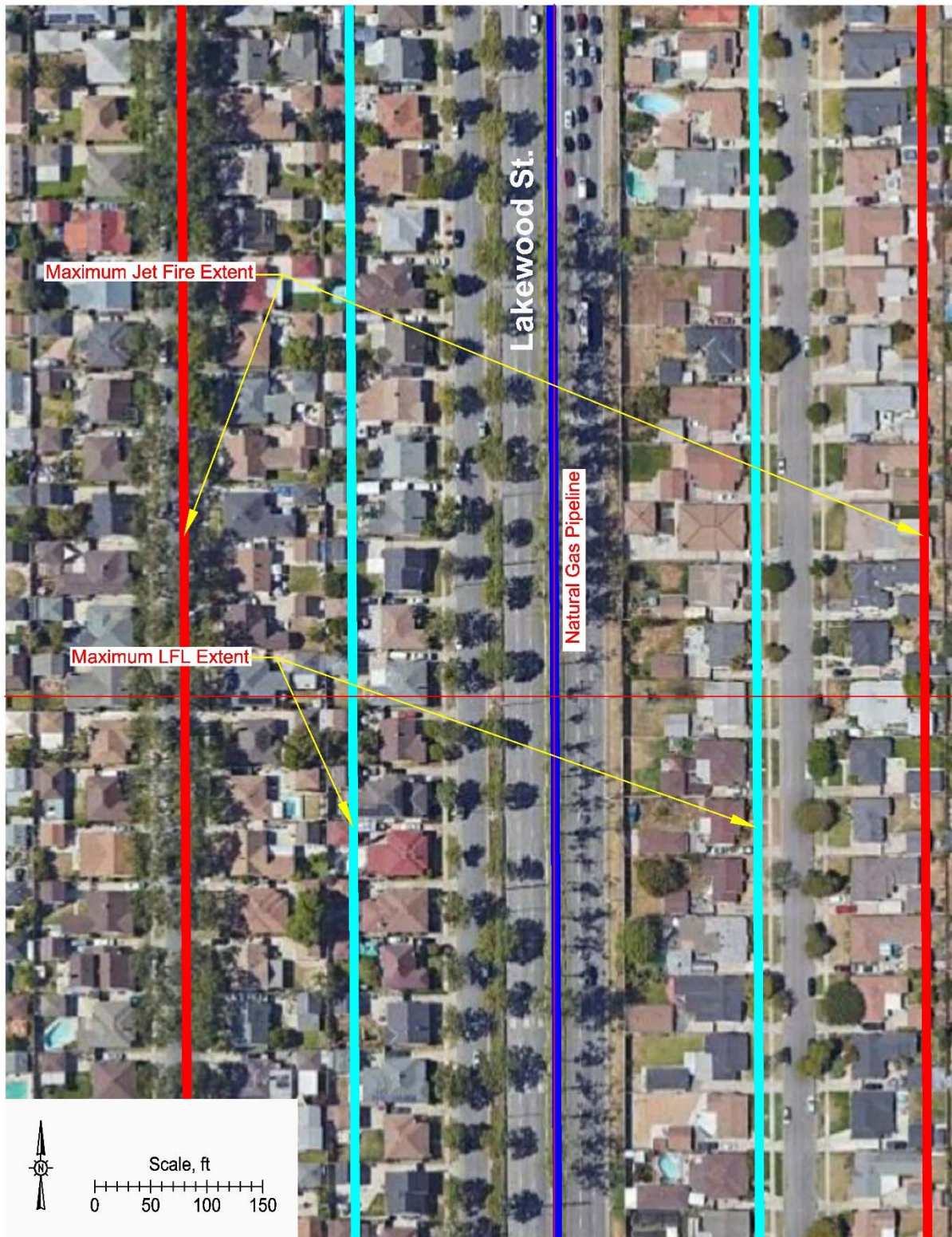


Figure C-7
Natural Gas Pipeline (exterior to facility) Vulnerability Zones (LFL, Torch Fire)



Figure C-8
Hydrogen Pipeline (exterior to facility) Typical Vulnerability Zones (LFL, Torch Fire)



Case Inputs

Case Type : Fireball
Case Name : ALTPAR-TK-1201-B-SafeFill
User ID : dwj
Project Number : 7162
Type of Units : English Units

NOTES: TK-1201 liqluid at safe fill volume ambient temperature conditions

MATERIAL MENU

| Materials Released | Number | Formula | Name | Fraction |
|--------------------|--------|----------|---------|----------|
| Component 1 | : | 3 = C3H8 | Propane | 1.000000 |
| Component 2 | : | | | |
| Component 3 | : | | | |
| Component 4 | : | | | |
| Component 5 | : | | | |
| Component 6 | : | | | |
| Component 7 | : | | | |
| Component 8 | : | | | |
| Component 9 | : | | | |
| Component 10 | : | | | |

Temperature : 65.00 °F
Pressure : 116.40 psia
The material is LIQUID

NOTES: Safe fill at ambient temperature conditions

ENVIRONMENT MENU

Relative humidity : 65 %
Air temperature : 65.0 °F

NOTES:

FIRE TYPE MENU

Fireball
Total Volume : 6042.0 cu.ft

NOTES: Using World Oil capacity data for safe fill of TK-1201/02/03



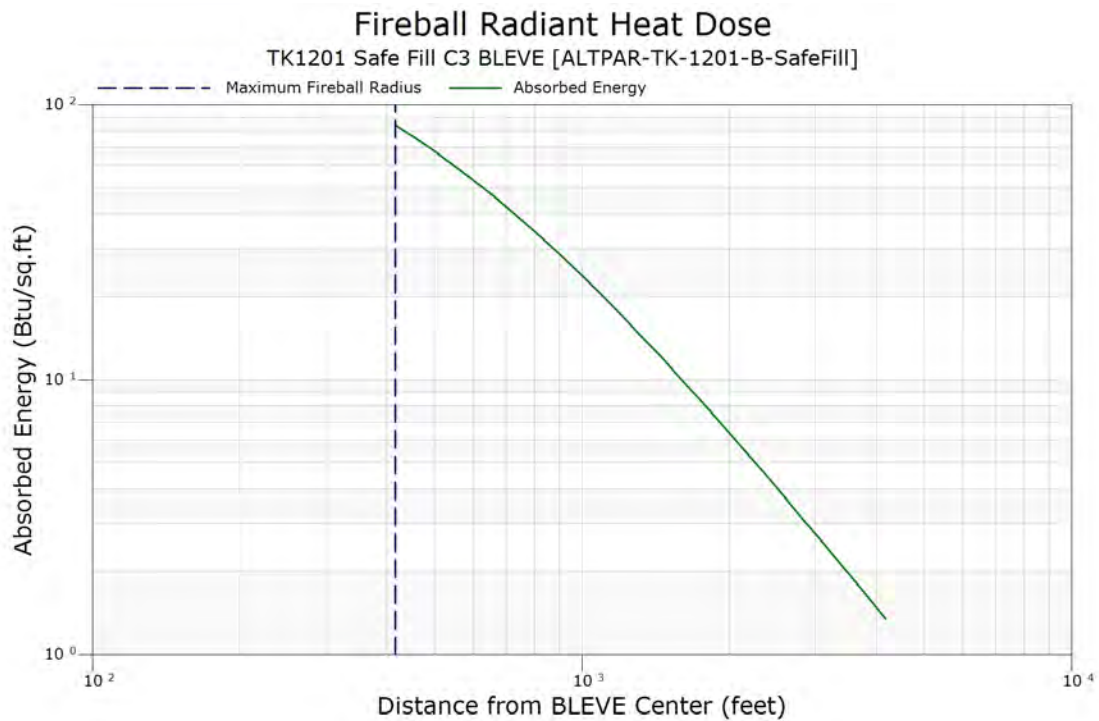
BLEVE

Mass of Fuel in Fireball : 184581.0 pounds
 Maximum Radius : 416.2 feet
 Liftoff Time : 5.1 sec
 Fireball Duration : 15.3 sec

| Distance from Center of Vessel (feet) | Average Flux (Btu/hr-sq.ft) | Absorbed Energy (Btu/sq.ft) | Integrated Dosage ([(Btu/hr-sq.ft) ^{4/3} s] |
|---|-----------------------------------|-----------------------------------|--|
| 416.2 | 19775.7 | 84.1 | 9369655.2 |
| 457.9 | 17739.2 | 75.4 | 8069782.7 |
| 504.0 | 15781.4 | 67.1 | 6873025.8 |
| 554.8 | 13937.2 | 59.3 | 5796589.9 |
| 610.8 | 12221.0 | 52.0 | 4842467.3 |
| 672.4 | 10642.2 | 45.3 | 4008552.9 |
| 740.1 | 9206.0 | 39.1 | 3289368.7 |
| 814.8 | 7913.2 | 33.7 | 2676906.6 |
| 896.9 | 6760.9 | 28.8 | 2161481.1 |
| 987.3 | 5743.5 | 24.4 | 1732510.8 |
| 1086.9 | 4853.0 | 20.6 | 1379176.4 |
| 1196.5 | 4080.2 | 17.4 | 1090933.4 |
| 1317.1 | 3414.6 | 14.5 | 857879.8 |
| 1449.9 | 2845.4 | 12.1 | 670992.1 |
| 1596.1 | 2361.8 | 10.0 | 522250.9 |
| 1757.0 | 1953.5 | 8.3 | 404680.8 |
| 1934.2 | 1610.7 | 6.8 | 312326.0 |
| 2129.2 | 1324.2 | 5.6 | 240184.1 |
| 2343.9 | 1085.8 | 4.6 | 184113.2 |
| 2580.2 | 888.4 | 3.8 | 140727.4 |
| 2840.3 | 725.3 | 3.1 | 107289.5 |
| 3126.7 | 591.1 | 2.5 | 81608.9 |
| 3441.9 | 480.9 | 2.0 | 61946.7 |
| 3789.0 | 390.7 | 1.7 | 46933.6 |
| 4171.0 | 317.0 | 1.3 | 35498.2 |

Distances to Integrated Dosage Levels from Radiation Probit:

| Distance (feet) | Integrated Dosage ([(Btu/hr-sq.ft) ^{4/3} s] | Mortality Level |
|--------------------|---|--------------------|
| 564.3 | 5618782.8 | 99% |
| 879.2 | 2261342.8 | 50% |
| 1286.7 | 910103.1 | 1% |





Case Inputs

Case Type : Vapor Dispersion
Case Name : ALTPAR-TK-1201-D-2021
User ID : dwj
Project Number : 7162
Type of Units : English Units

NOTES:

MATERIAL MENU

| Materials Released | Number | Formula | Name | Fraction |
|--------------------|--------|---------|---------|----------|
| Component 1 | : 3 | = C3H8 | Propane | 1.000000 |
| Component 2 | : | | | |
| Component 3 | : | | | |
| Component 4 | : | | | |
| Component 5 | : | | | |
| Component 6 | : | | | |
| Component 7 | : | | | |
| Component 8 | : | | | |
| Component 9 | : | | | |
| Component 10 | : | | | |

Temperature : 65.00 °F
Pressure : 116.50 psia
The material is LIQUID

NOTES:

ENVIRONMENT MENU

| | |
|-------------------------------|-----------|
| Wind speed | 3.36 mph |
| Wind speed measurement height | 32.8 feet |
| Stability class <A-F> | F |
| Relative humidity | 65 % |
| Air temperature | 65.0 °F |
| Spill surface temperature | 80.3 °F |

| | |
|--------------------------------|--------------------------------------|
| Substrate name | High density concrete |
| Substrate thermal conductivity | 2.1999 Btu/hr-ft-F |
| Substrate density | 150 lb/cu.ft |
| Substrate heat Capacity | 0.16 Btu/lb-F |
| Substrate delay time | 0 sec |
| Surrounding terrain | Forest, dense urban, or process area |

NOTES:



RELEASE MENU

Type of release: Unregulated, Continuous release
Release duration 10 min
Normal flow rate 0.00 lb/sec
Duration of normal flow 10 min
Volume of vessel 7134.26 cu.ft
Percent of vessel filled with liquid 84.7 %
Liquid head above release point 0 feet
Pipe inner diameter 2.07 inches
Equivalent release diameter 2.07 inches
Pipe length upstream of break 20.0 feet
Height of release point 4.0 feet
Angle of release from horizontal 0.0 degrees

NOTES: Filled to Safe Fill level with 20 ft piping

IMPOUNDMENT MENU

Unconfined

NOTES:

VDVE MENU

Vapor generation and dispersion - Flammable calculation
Concentration endpoint 1 LFL mol%
Concentration endpoint 2 LFL mol%
Concentration endpoint 3 LFL mol%
Dispersion coefficient averaging time 1 min

NOTES:

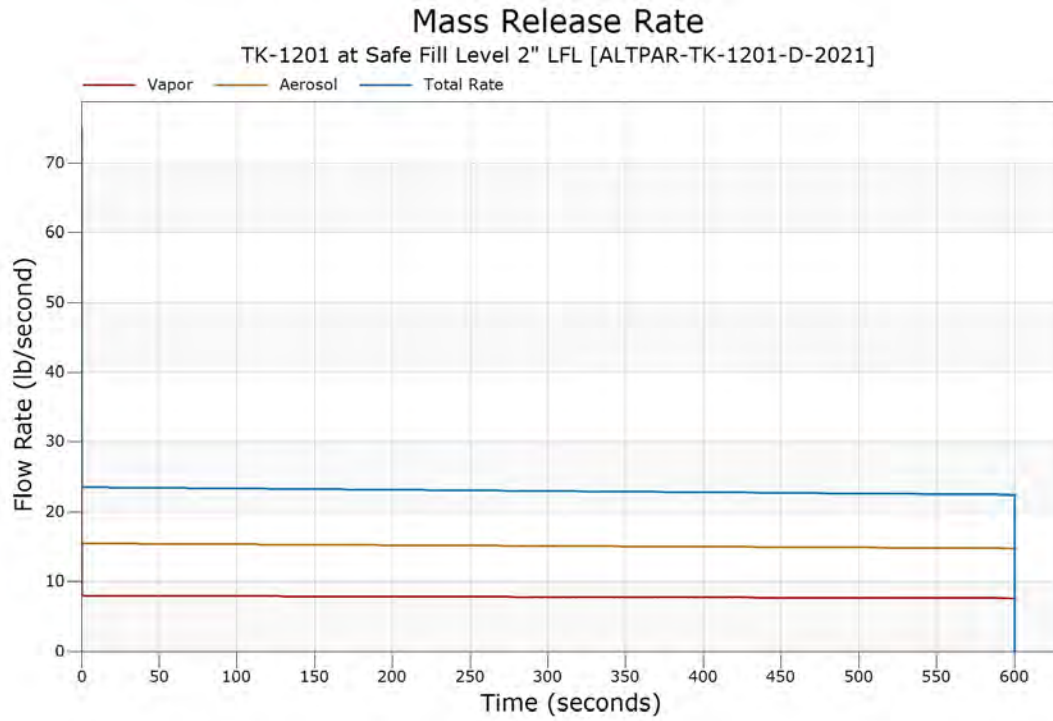


Release Model

| Time (sec) | Vapor (lb/sec) | Aerosol Rate (lb/sec) | Liquid Rate (lb/sec) | Total Rate (lb/sec) |
|---------------|-------------------|--------------------------|-------------------------|------------------------|
| 0.000000 | 25.52690 | 49.49553 | 0.000000 | 75.02243 |
| 0.100000 | 8.041639 | 15.59238 | 0.000000 | 23.63402 |
| 0.300000 | 8.036451 | 15.58232 | 0.000000 | 23.61877 |
| 0.500000 | 8.030926 | 15.57161 | 0.000000 | 23.60253 |
| 0.700000 | 8.025581 | 15.56124 | 0.000000 | 23.58683 |
| 1.000000 | 8.017347 | 15.54528 | 0.000000 | 23.56262 |
| 3.000000 | 7.992791 | 15.49766 | 0.000000 | 23.49045 |
| 5.000000 | 7.991695 | 15.49554 | 0.000000 | 23.48723 |
| 7.000000 | 7.990325 | 15.49288 | 0.000000 | 23.48321 |
| 10.00000 | 7.988397 | 15.48914 | 0.000000 | 23.47754 |
| 20.00000 | 7.982672 | 15.47805 | 0.000000 | 23.46072 |
| 30.00000 | 7.975922 | 15.46496 | 0.000000 | 23.44088 |
| 40.00000 | 7.970386 | 15.45422 | 0.000000 | 23.42461 |
| 50.00000 | 7.964200 | 15.44223 | 0.000000 | 23.40643 |
| 60.00000 | 7.958057 | 15.43032 | 0.000000 | 23.38838 |
| 70.00000 | 7.951173 | 15.41697 | 0.000000 | 23.36814 |
| 85.00000 | 7.941695 | 15.39859 | 0.000000 | 23.34029 |
| 100.0000 | 7.933080 | 15.38189 | 0.000000 | 23.31497 |
| 200.0000 | 7.870929 | 15.26138 | 0.000000 | 23.13231 |
| 300.0000 | 7.808896 | 15.14110 | 0.000000 | 22.95000 |
| 400.0000 | 7.748408 | 15.02382 | 0.000000 | 22.77222 |
| 500.0000 | 7.688571 | 14.90780 | 0.000000 | 22.59637 |
| 600.0000 | 7.629683 | 14.79362 | 0.000000 | 22.42330 |
| Totals (lb) | 4686.176 | 9086.287 | 0.000000 | 13772.46 |

Flowrate for Torch Fire [immediate ignition] = 23.44540 lb/sec.
Torch Fire [delayed ignition] = 23.22153 lb/sec.

Reason for Ending: Reached Stop Time





Momentum Jet Dispersion

concentration limits

concentration 3 (highest) = 0.021000 mole fraction
concentration 2 (middle) = 0.021000 mole fraction
concentration 1 (lowest) = 0.021000 mole fraction

| downwind distance x(ft) | centerline conc. c(mole frac.) | ground conc. c(mole frac.) | y(c1) 1/2 width (ft) | y(c2) 1/2 width (ft) | y(c3) 1/2 width (ft) | centerline height (ft) |
|-------------------------------|--------------------------------------|----------------------------------|----------------------------|----------------------------|----------------------------|------------------------------|
| 0 | 1.000000 | 0.000000 | 0.5 | 0.5 | 0.5 | 4.0 |
| 5 | 0.790315 | 0.000000 | 0.7 | 0.7 | 0.7 | 4.0 |
| 10 | 0.627150 | 0.000000 | 1.1 | 1.1 | 1.1 | 4.0 |
| 15 | 0.490942 | 0.000000 | 1.5 | 1.5 | 1.5 | 3.9 |
| 20 | 0.383984 | 0.000002 | 2.0 | 2.0 | 2.0 | 3.8 |
| 25 | 0.304207 | 0.000684 | 2.5 | 2.5 | 2.5 | 3.6 |
| 30 | 0.243883 | 0.013696 | 3.0 | 3.0 | 3.0 | 3.2 |
| 35 | 0.203154 | 0.061464 | 3.6 | 3.6 | 3.6 | 2.7 |
| 40 | 0.171882 | 0.118727 | 4.2 | 4.2 | 4.2 | 1.9 |
| 45 | 0.164869 | 0.164869 | 20.0 | 20.0 | 20.0 | 0.0 |
| 50 | 0.164869 | 0.164869 | 26.3 | 26.3 | 26.3 | 0.0 |
| 55 | 0.164869 | 0.164869 | 32.7 | 32.7 | 32.7 | 0.0 |
| 60 | 0.164869 | 0.164869 | 39.1 | 39.1 | 39.1 | 0.0 |
| 65 | 0.164869 | 0.164869 | 45.6 | 45.6 | 45.6 | 0.0 |
| 70 | 0.162879 | 0.162879 | 51.9 | 51.9 | 51.9 | 0.0 |
| 75 | 0.160880 | 0.160880 | 58.2 | 58.2 | 58.2 | 0.0 |
| 80 | 0.155095 | 0.155095 | 64.0 | 64.0 | 64.0 | 0.0 |
| 85 | 0.143868 | 0.143868 | 69.1 | 69.1 | 69.1 | 0.0 |
| 90 | 0.134028 | 0.134028 | 74.2 | 74.2 | 74.2 | 0.0 |
| 95 | 0.125341 | 0.125341 | 79.3 | 79.3 | 79.3 | 0.0 |
| 100 | 0.116717 | 0.116717 | 83.3 | 83.3 | 83.3 | 0.0 |
| 105 | 0.108957 | 0.108957 | 87.1 | 87.1 | 87.1 | 0.0 |
| 110 | 0.102038 | 0.102038 | 90.9 | 90.9 | 90.9 | 0.0 |
| 115 | 0.095838 | 0.095838 | 94.7 | 94.7 | 94.7 | 0.0 |
| 120 | 0.090255 | 0.090255 | 98.4 | 98.4 | 98.4 | 0.0 |
| 125 | 0.085205 | 0.085205 | 102.2 | 102.2 | 102.2 | 0.0 |
| 130 | 0.080388 | 0.080388 | 104.9 | 104.9 | 104.9 | 0.0 |
| 135 | 0.075913 | 0.075913 | 107.1 | 107.1 | 107.1 | 0.0 |
| 140 | 0.071837 | 0.071837 | 109.3 | 109.3 | 109.3 | 0.0 |
| 145 | 0.068111 | 0.068111 | 111.5 | 111.5 | 111.5 | 0.0 |
| 150 | 0.064695 | 0.064695 | 113.7 | 113.7 | 113.7 | 0.0 |
| 155 | 0.061555 | 0.061555 | 115.9 | 115.9 | 115.9 | 0.0 |
| 160 | 0.058627 | 0.058627 | 117.6 | 117.6 | 117.6 | 0.0 |
| 165 | 0.055845 | 0.055845 | 118.0 | 118.0 | 118.0 | 0.0 |
| 170 | 0.053273 | 0.053273 | 118.3 | 118.3 | 118.3 | 0.0 |



CANARY by Quest Output Report
 Report Date: 16 May 2021
 Case Title: TK-1201 at Safe Fill Level 2" LFL

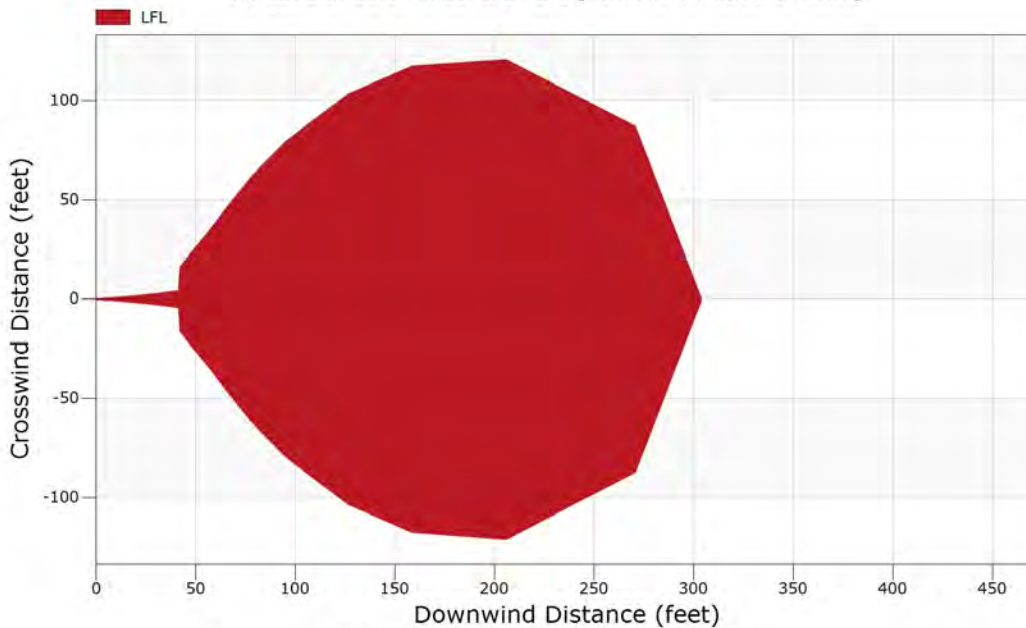
| downwind distance x(ft) | centerline conc. c(mole frac.) | ground conc. c(mole frac.) | y(c1) 1/2 width (ft) | y(c2) 1/2 width (ft) | y(c3) 1/2 width (ft) | centerline height (ft) |
|-------------------------------|--------------------------------------|----------------------------------|----------------------------|----------------------------|----------------------------|------------------------------|
| 175 | 0.050889 | 0.050889 | 118.7 | 118.7 | 118.7 | 0.0 |
| 180 | 0.048674 | 0.048674 | 119.0 | 119.0 | 119.0 | 0.0 |
| 185 | 0.046612 | 0.046612 | 119.4 | 119.4 | 119.4 | 0.0 |
| 190 | 0.044689 | 0.044689 | 119.8 | 119.8 | 119.8 | 0.0 |
| 195 | 0.042893 | 0.042893 | 120.1 | 120.1 | 120.1 | 0.0 |
| 200 | 0.041211 | 0.041211 | 120.5 | 120.5 | 120.5 | 0.0 |
| 205 | 0.039635 | 0.039635 | 120.9 | 120.9 | 120.9 | 0.0 |
| 210 | 0.038133 | 0.038133 | 118.9 | 118.9 | 118.9 | 0.0 |
| 215 | 0.036716 | 0.036716 | 116.3 | 116.3 | 116.3 | 0.0 |
| 220 | 0.035383 | 0.035383 | 113.7 | 113.7 | 113.7 | 0.0 |
| 225 | 0.034126 | 0.034126 | 111.1 | 111.1 | 111.1 | 0.0 |
| 230 | 0.032941 | 0.032941 | 108.5 | 108.5 | 108.5 | 0.0 |
| 235 | 0.031820 | 0.031820 | 105.9 | 105.9 | 105.9 | 0.0 |
| 240 | 0.030761 | 0.030761 | 103.3 | 103.3 | 103.3 | 0.0 |
| 245 | 0.029757 | 0.029757 | 100.7 | 100.7 | 100.7 | 0.0 |
| 250 | 0.028805 | 0.028805 | 98.1 | 98.1 | 98.1 | 0.0 |
| 255 | 0.027902 | 0.027902 | 95.5 | 95.5 | 95.5 | 0.0 |
| 260 | 0.027043 | 0.027043 | 92.9 | 92.9 | 92.9 | 0.0 |
| 265 | 0.026227 | 0.026227 | 90.2 | 90.2 | 90.2 | 0.0 |
| 270 | 0.025450 | 0.025450 | 87.6 | 87.6 | 87.6 | 0.0 |
| 275 | 0.024710 | 0.024710 | 76.6 | 76.6 | 76.6 | 0.0 |
| 280 | 0.024005 | 0.024005 | 63.5 | 63.5 | 63.5 | 0.0 |
| 285 | 0.023331 | 0.023331 | 50.4 | 50.4 | 50.4 | 0.0 |
| 290 | 0.022688 | 0.022688 | 37.4 | 37.4 | 37.4 | 0.0 |
| 295 | 0.022072 | 0.022072 | 24.3 | 24.3 | 24.3 | 0.0 |
| 300 | 0.021484 | 0.021484 | 11.2 | 11.2 | 11.2 | 0.0 |
| 305 | 0.020920 | 0.020920 | 0.0 | 0.0 | 0.0 | 0.0 |

The momentum jet model coupled to the heavy gas model at 41.27 ft in 1 sec
 The downwind distance to c3 is 304.28 ft after about 69 seconds
 The downwind distance to c2 is 304.28 ft after about 69 seconds
 The downwind distance to c1 is 304.28 ft after about 69 seconds



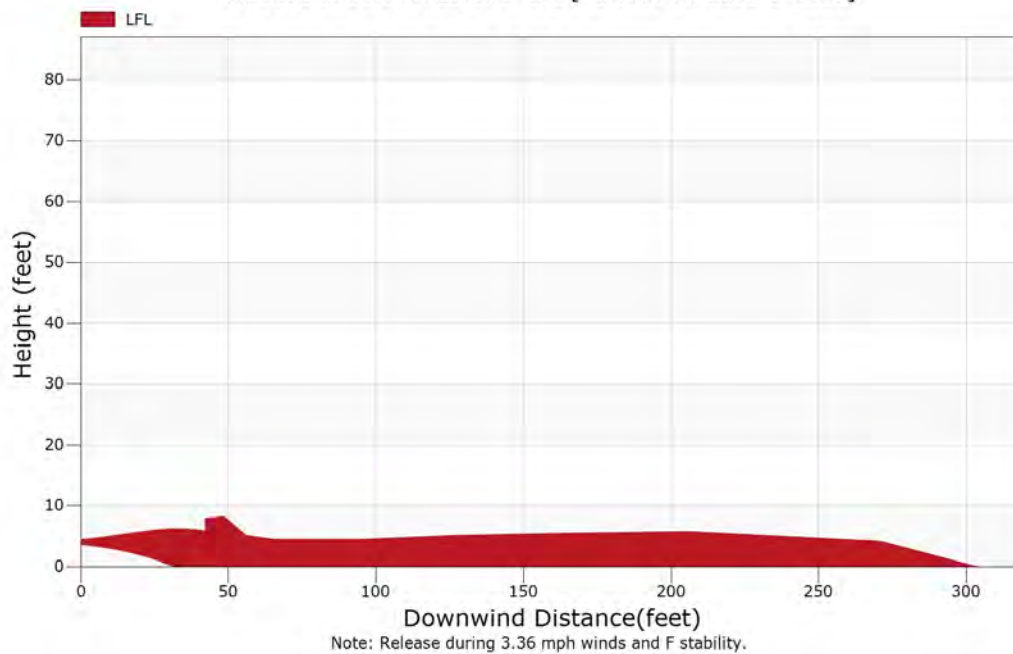
Momentum Jet Contours - Overhead View

TK-1201 at Safe Fill Level 2" LFL [ALTPAR-TK-1201-D-2021]



Momentum Jet Contours - Side View

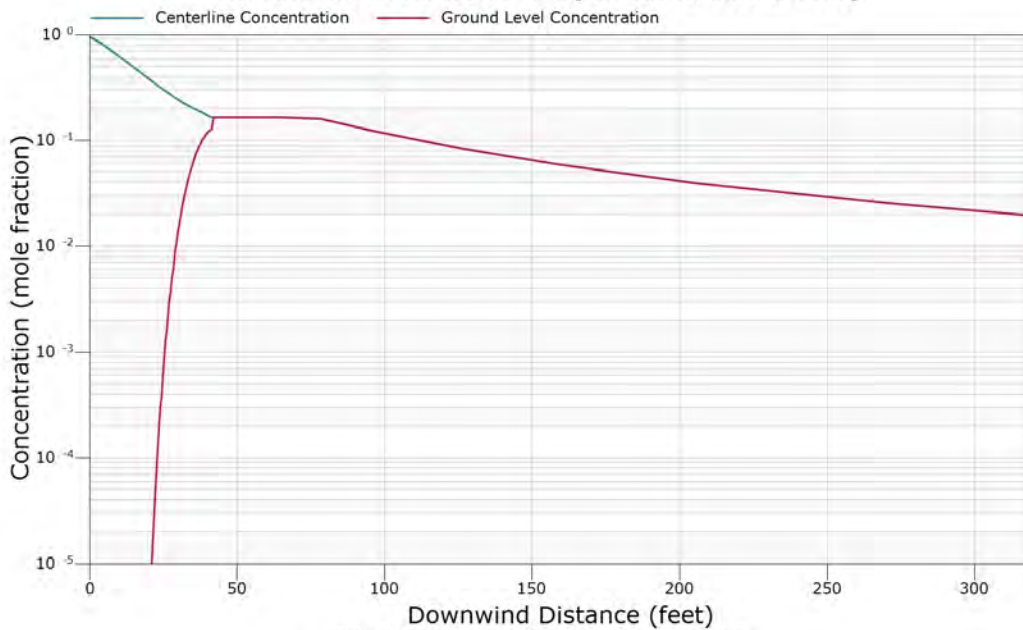
TK-1201 at Safe Fill Level 2" LFL [ALTPAR-TK-1201-D-2021]





Momentum Jet Concentration

TK-1201 at Safe Fill Level 2" LFL [ALTPAR-TK-1201-D-2021]



Note: Release during 3.36 mph winds and F stability.



Case Inputs

Case Type : Fire Radiation
Case Name : ALTPAR-TK-1201-T-2021
User ID : dwj
Project Number : 7162
Type of Units : English Units

NOTES:

MATERIAL MENU

| Materials Released | Number | Formula | Name | Fraction |
|--------------------|--------|---------|---------|----------|
| Component 1 | 3 | = C3H8 | Propane | 1.000000 |
| Component 2 | : | | | |
| Component 3 | : | | | |
| Component 4 | : | | | |
| Component 5 | : | | | |
| Component 6 | : | | | |
| Component 7 | : | | | |
| Component 8 | : | | | |
| Component 9 | : | | | |
| Component 10 | : | | | |

Temperature : 65.00 °F
Pressure : 116.50 psia
The material is LIQUID

NOTES:

ENVIRONMENT MENU

Wind speed : 20.00 mph
Relative humidity : 65 %
Air temperature : 65.0 °F

NOTES:

FIRE TYPE MENU

Fire radiation division: Jet fire
Horizontal isopleths only
Elevation of flame base (from grade) : 4.0 feet
Elevation of target (from grade) : 0.0 feet
Diameter of jet fire tip : 0.1722 feet
Flow rate : 23.40 lb/sec
Angle of release from horizontal : 0.0 degrees

Fire radiation flux values

Radiation endpoint 1 : 1600 Btu/hr-sq.ft
Radiation endpoint 2 : 1600 Btu/hr-sq.ft
Radiation endpoint 3 : 1600 Btu/hr-sq.ft

NOTES:



Jet Fire Radiation

Length of Flame : 70.4 feet
Flame Tilt from Horizontal: 5.5 degrees
Release Angle : 0.0 degrees
Release Point Elevation : 4.0 feet
Target Elevation : 0.0 feet
Wind Speed : 20.0 mph

| Downwind Distance at Target Height (feet) | Maximum Flux (Btu/hr-sq.ft) |
|---|-----------------------------------|
| 16.4 | 76331 |
| 18.2 | 80833 |
| 20.3 | 85134 |
| 22.5 | 90360 |
| 25.0 | 95093 |
| 27.8 | 100620 |
| 30.9 | 106048 |
| 34.4 | 111360 |
| 38.2 | 117682 |
| 42.4 | 124313 |
| 47.2 | 131648 |
| 52.4 | 130808 |
| 58.2 | 145527 |
| 64.7 | *** |
| 71.9 | 44937 |
| 79.9 | 16441 |
| 88.8 | 7967 |
| 98.7 | 4503 |
| 109.7 | 2766 |
| 122.0 | 1790 |
| 135.5 | 1205 |
| 150.6 | 833 |
| 167.4 | 589 |
| 186.0 | 424 |
| 206.8 | 310 |

*** Target Location inside Flame

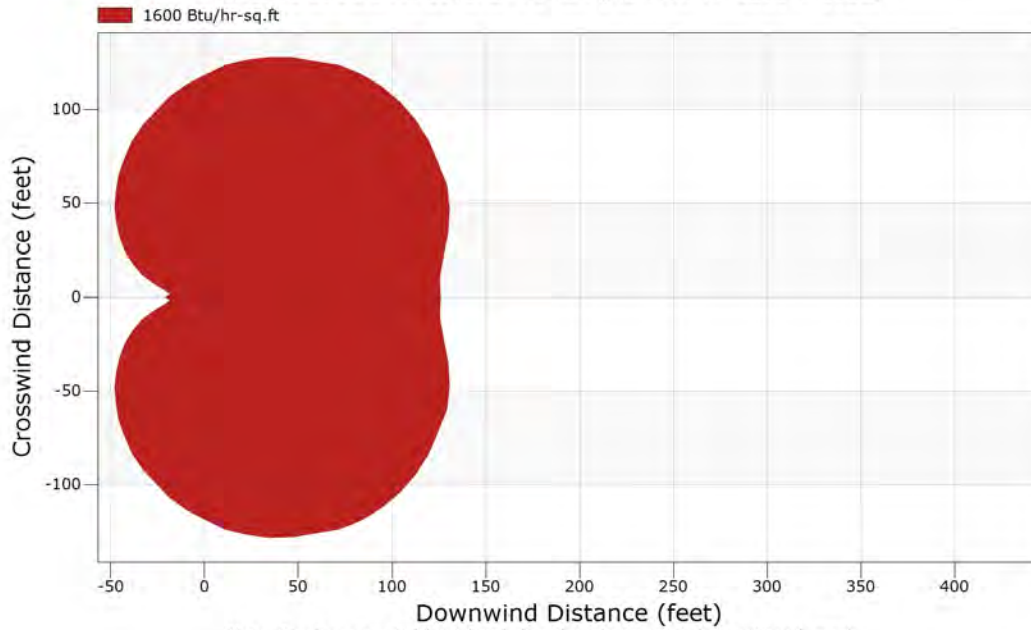
Downwind Distances to Endpoints

| Distance (feet) | Maximum Flux (Btu/hr-sq.ft) |
|--------------------|--------------------------------|
| 125.9 | 1600 |
| 125.9 | 1600 |
| 125.9 | 1600 |



Jet Fire Radiant Heat Contours - Overhead View

TK-1201 at Safe Fill Level 2" TORCH [ALTPAR-TK-1201-T-2021]



Note: Results presented for 4 feet below the release point during 20 mph winds.



Case Inputs

Case Type : Vapor Dispersion
Case Name : ALTPAR-SWS01-D-15-2020
User ID : dwj
Project Number : 7162
Type of Units : English Units

NOTES: Stream 8

MATERIAL MENU

| Materials Released | Number | Formula | Name | Fraction |
|--------------------|--------|---------|------------------|----------|
| Component 1 | : 17 | = CO2 | Carbon Dioxide | 0.569690 |
| Component 2 | : 52 | = H2O | Water | 0.235510 |
| Component 3 | : 18 | = H2S | Hydrogen Sulfide | 0.051890 |
| Component 4 | : 53 | = H3N | Ammonia | 0.140940 |
| Component 5 | : 43 | = CO | Carbon Monoxide | 0.001970 |
| Component 6 | : | | | |
| Component 7 | : | | | |
| Component 8 | : | | | |
| Component 9 | : | | | |
| Component 10 | : | | | |

Temperature : 187.00 °F
Pressure : 34.70 psia
The material is GAS

NOTES:

ENVIRONMENT MENU

| | |
|-------------------------------|-----------|
| Wind speed | 3.36 mph |
| Wind speed measurement height | 32.8 feet |
| Stability class <A-F> | F |
| Relative humidity | 65 % |
| Air temperature | 65.0 °F |
| Spill surface temperature | 80.3 °F |

| | |
|--------------------------------|--------------------------------------|
| Substrate name | Ice |
| Substrate thermal conductivity | 2.1999 Btu/hr-ft-F |
| Substrate density | 150 lb/cu.ft |
| Substrate heat Capacity | 0.16 Btu/lb-F |
| Substrate delay time | 0 sec |
| Surrounding terrain | Forest, dense urban, or process area |

NOTES:



RELEASE MENU

Type of release: Unregulated, Continuous release
Release duration 10 min
Normal flow rate 0.05 lb/sec
Duration of normal flow 10 min
Volume of vessel 2643.00 cu.ft
Percent of vessel filled with liquid 7 %
Liquid head above release point 0 feet
Pipe inner diameter 2.07 inches
Equivalent release diameter 2.07 inches
Pipe length upstream of break 10.0 feet
Height of release point 15.0 feet
Angle of release from horizontal 0.0 degrees

NOTES: Estimated 6 ft liquid level or 7% full

IMPOUNDMENT MENU

Unconfined

NOTES:

VDVE MENU

Vapor generation and dispersion - Flammable calculation
Concentration endpoint 1 LFL mol%
Concentration endpoint 2 LFL mol%
Concentration endpoint 3 LFL mol%
Dispersion coefficient averaging time 1 min

NOTES:



Release Model

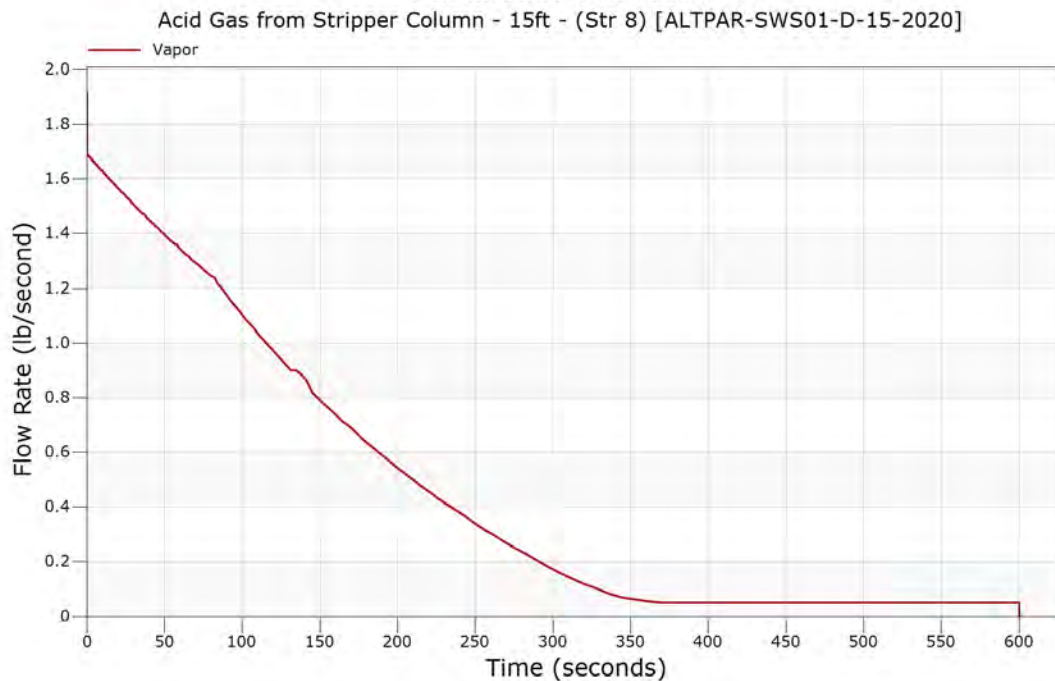
| Time (sec) | Vapor (lb/sec) | Aerosol Rate (lb/sec) | Liquid Rate (lb/sec) | Total Rate (lb/sec) |
|---------------|-------------------|--------------------------|-------------------------|------------------------|
| 0.000000 | 1.914881 | 0.000000 | 0.000000 | 1.914881 |
| 0.100000 | 1.691331 | 0.000000 | 0.000000 | 1.691331 |
| 0.300000 | 1.690425 | 0.000000 | 0.000000 | 1.690425 |
| 0.500000 | 1.688814 | 0.000000 | 0.000000 | 1.688814 |
| 0.700000 | 1.687469 | 0.000000 | 0.000000 | 1.687469 |
| 1.000000 | 1.685893 | 0.000000 | 0.000000 | 1.685893 |
| 3.000000 | 1.673099 | 0.000000 | 0.000000 | 1.673099 |
| 5.000000 | 1.660125 | 0.000000 | 0.000000 | 1.660125 |
| 7.000000 | 1.647315 | 0.000000 | 0.000000 | 1.647315 |
| 10.000000 | 1.631257 | 0.000000 | 0.000000 | 1.631257 |
| 20.000000 | 1.566893 | 0.000000 | 0.000000 | 1.566893 |
| 30.000000 | 1.509222 | 0.000000 | 0.000000 | 1.509222 |
| 40.000000 | 1.451478 | 0.000000 | 0.000000 | 1.451478 |
| 50.000000 | 1.397762 | 0.000000 | 0.000000 | 1.397762 |
| 60.000000 | 1.344222 | 0.000000 | 0.000000 | 1.344222 |
| 70.000000 | 1.293894 | 0.000000 | 0.000000 | 1.293894 |
| 85.000000 | 1.212656 | 0.000000 | 0.000000 | 1.212656 |
| 100.000000 | 1.105482 | 0.000000 | 0.000000 | 1.105482 |
| 200.000000 | .5430864 | 0.000000 | 0.000000 | .5430864 |
| 300.000000 | .1727782 | 0.000000 | 0.000000 | .1727782 |
| 400.000000 | .5049999E-01 | 0.000000 | 0.000000 | .5049999E-01 |
| 500.000000 | .5049999E-01 | 0.000000 | 0.000000 | .5049999E-01 |
| 600.000000 | .5049999E-01 | 0.000000 | 0.000000 | .5049999E-01 |
| Totals (lb) | 273.6523 | 0.000000 | 0.000000 | 273.6523 |

Flowrate for Torch Fire [immediate ignition] = 1.511883 lb/sec.
Torch Fire [delayed ignition] = 0.8008579 lb/sec.

Reason for Ending: Reached Stop Time



Mass Release Rate





Release Compositions

| Component Number | Component Name, Formula |
|------------------|------------------------------------|
| 17 | Carbon Dioxide, CO ₂ |
| 52 | Water, H ₂ O |
| 18 | Hydrogen Sulfide, H ₂ S |
| 53 | Ammonia, H ₃ N |
| 43 | Carbon Monoxide, CO |

Composition (Mole Fraction) of Fluid Streams

| Comp. No. | Feed Stream | Momentum Jet Stream | | | Total Stream | Liquid Pool Stream |
|-----------|-------------|---------------------|------------------|----------------|--------------|--------------------|
| | | Flashed Vapor | Evaporated Vapor | Aerosol Liquid | | Liquid to Ground |
| 17 | 0.569690 | 0.569690 | 0.000000 | 0.000000 | 0.569690 | 0.000000 |
| 52 | 0.235510 | 0.235510 | 0.000000 | 0.000000 | 0.235510 | 0.000000 |
| 18 | 0.051890 | 0.051890 | 0.000000 | 0.000000 | 0.051890 | 0.000000 |
| 53 | 0.140940 | 0.140940 | 0.000000 | 0.000000 | 0.140940 | 0.000000 |
| 43 | 0.001970 | 0.001970 | 0.000000 | 0.000000 | 0.001970 | 0.000000 |
| ----- | | ----- | ----- | ----- | ----- | ----- |
| | 1.000000 | 1.000000 | 0.000000 | 0.000000 | 1.000000 | 0.000000 |

Flammable Limits (Mole %) of Fluid Streams

| Limit | Feed Stream | Momentum Jet Stream | Liquid Pool Stream |
|-------|-------------|---------------------|--------------------|
| LFL | 44.39 | 44.39 | |
| UFL | 55.92 | 55.92 | |
| LBV | | 0.01 m/s | |



Momentum Jet Dispersion

concentration limits

concentration 3 (highest) = 0.443929 mole fraction
concentration 2 (middle) = 0.443929 mole fraction
concentration 1 (lowest) = 0.443929 mole fraction

| downwind distance x(ft) | centerline conc. c(mole frac.) | ground conc. c(mole frac.) | y(c1) 1/2 width (ft) | y(c2) 1/2 width (ft) | y(c3) 1/2 width (ft) | centerline height (ft) |
|-------------------------------|--------------------------------------|----------------------------------|----------------------------|----------------------------|----------------------------|------------------------------|
| 0 | 1.000000 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |
| 0.03 | 0.961082 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |
| 0.05 | 0.939093 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |
| 0.08 | 0.918035 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |
| 0.10 | 0.897891 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |
| 0.13 | 0.878397 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |
| 0.15 | 0.859610 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |
| 0.18 | 0.841631 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |
| 0.20 | 0.824192 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |
| 0.23 | 0.807645 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |
| 0.25 | 0.791772 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |
| 0.28 | 0.776389 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |
| 0.30 | 0.761479 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |
| 0.33 | 0.747133 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |
| 0.35 | 0.733190 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |
| 0.38 | 0.719854 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |
| 0.40 | 0.707052 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |
| 0.43 | 0.694635 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |
| 0.45 | 0.682545 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |
| 0.48 | 0.670850 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |
| 0.50 | 0.659516 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |
| 0.53 | 0.648559 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |
| 0.55 | 0.638071 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |
| 0.58 | 0.627870 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |
| 0.60 | 0.617896 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |
| 0.63 | 0.608201 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |
| 0.65 | 0.598798 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |
| 0.68 | 0.589665 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |
| 0.70 | 0.580782 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |
| 0.73 | 0.572167 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |
| 0.75 | 0.563825 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |
| 0.78 | 0.555747 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |
| 0.80 | 0.547907 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |
| 0.83 | 0.540217 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |
| 0.85 | 0.532716 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |

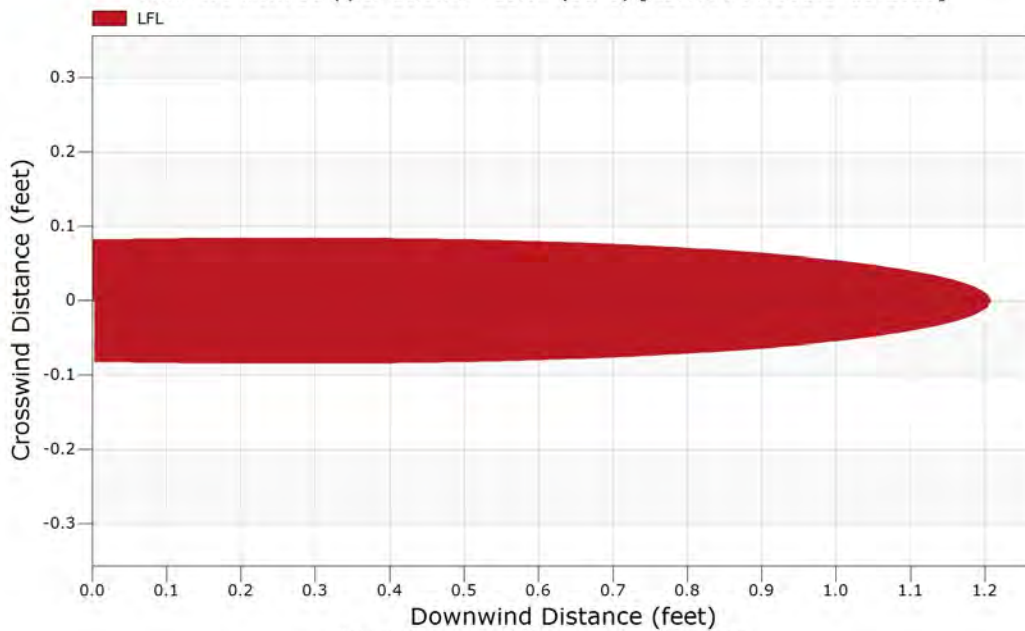


| downwind distance | centerline conc. | ground conc. | y(c1) 1/2 width | y(c2) 1/2 width | y(c3) 1/2 width | centerline height |
|-------------------|------------------|---------------|-----------------|-----------------|-----------------|-------------------|
| x(ft) | c(mole frac.) | c(mole frac.) | (ft) | (ft) | (ft) | (ft) |
| 0.88 | 0.525404 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |
| 0.90 | 0.518256 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |
| 0.93 | 0.511296 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |
| 0.95 | 0.504562 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |
| 0.98 | 0.498036 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |
| 1.00 | 0.491599 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |
| 1.03 | 0.485353 | 0.000000 | 0.1 | 0.1 | 0.1 | 15.0 |
| 1.05 | 0.479263 | 0.000000 | 0.0 | 0.0 | 0.0 | 15.0 |
| 1.08 | 0.473282 | 0.000000 | 0.0 | 0.0 | 0.0 | 15.0 |
| 1.10 | 0.467460 | 0.000000 | 0.0 | 0.0 | 0.0 | 15.0 |
| 1.13 | 0.461678 | 0.000000 | 0.0 | 0.0 | 0.0 | 15.0 |
| 1.15 | 0.456093 | 0.000000 | 0.0 | 0.0 | 0.0 | 15.0 |
| 1.18 | 0.450697 | 0.000000 | 0.0 | 0.0 | 0.0 | 15.0 |
| 1.20 | 0.445452 | 0.000000 | 0.0 | 0.0 | 0.0 | 15.0 |

The downwind distance to c3 is 1.21 ft after about 0 seconds
 The downwind distance to c2 is 1.21 ft after about 0 seconds
 The downwind distance to c1 is 1.21 ft after about 0 seconds

Momentum Jet Contours - Overhead View

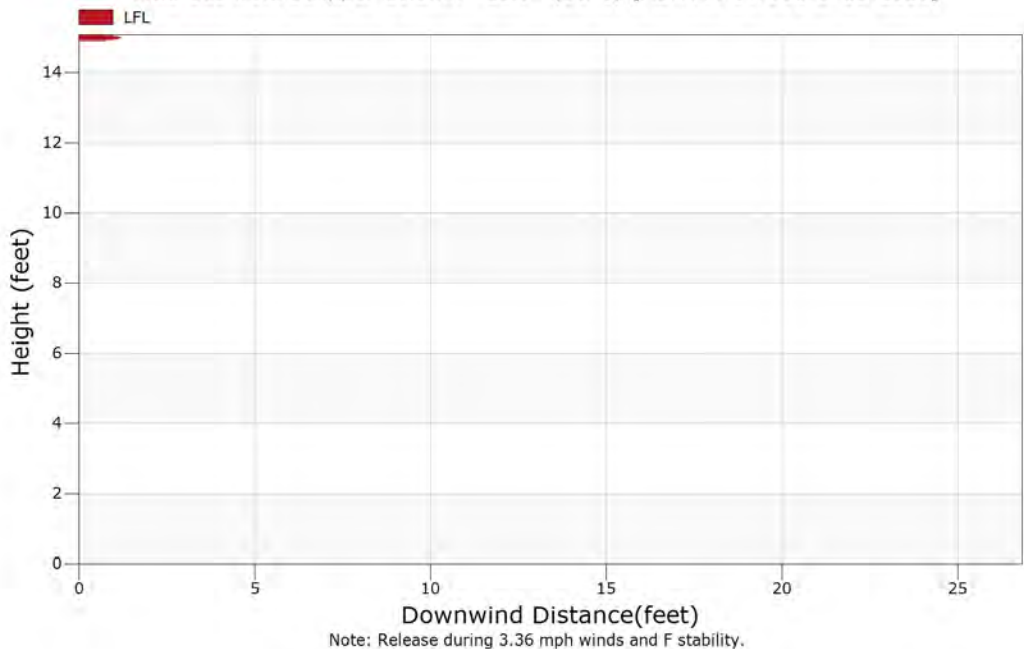
Acid Gas from Stripper Column - 15ft - (Str 8) [ALTPAR-SWS01-D-15-2020]





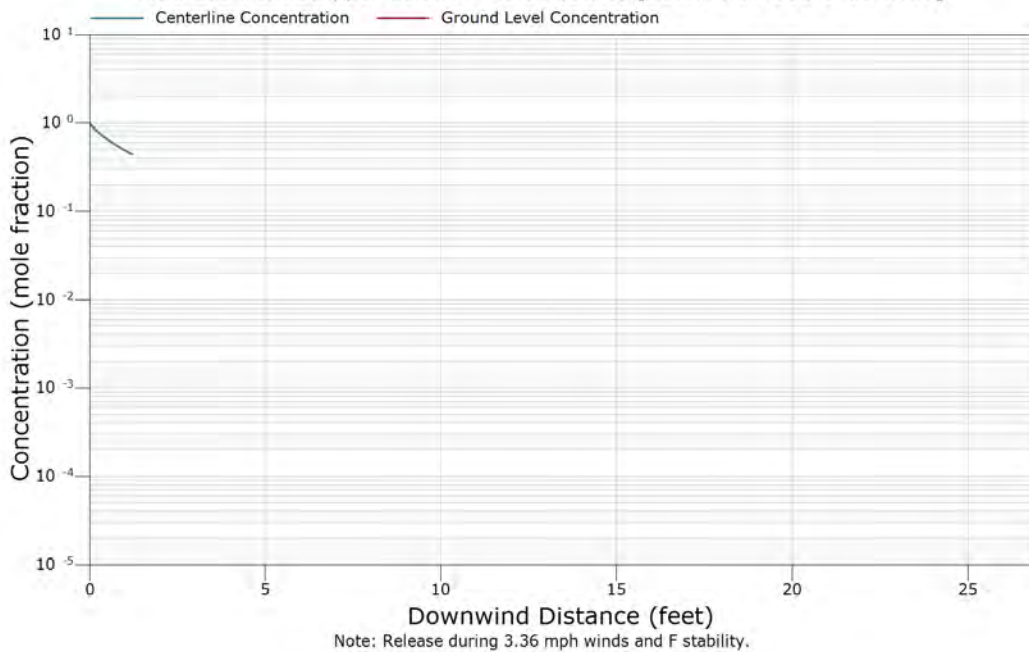
Momentum Jet Contours - Side View

Acid Gas from Stripper Column - 15ft - (Str 8) [ALTPAR-SWS01-D-15-2020]



Momentum Jet Concentration

Acid Gas from Stripper Column - 15ft - (Str 8) [ALTPAR-SWS01-D-15-2020]





Case Inputs

Case Type : Vapor Dispersion
Case Name : ALTPAR-SWS01-DT-15-2020
User ID : dwj
Project Number : 7162
Type of Units : English Units

NOTES: Stream 8

MATERIAL MENU

| Materials Released | : Number | Formula | Name | Fraction |
|--------------------|----------|---------|------------------|----------|
| Component 1 | : 17 | = CO2 | Carbon Dioxide | 0.569690 |
| Component 2 | : 52 | = H2O | Water | 0.235510 |
| Component 3 | : 18 | = H2S | Hydrogen Sulfide | 0.051890 |
| Component 4 | : 53 | = H3N | Ammonia | 0.140940 |
| Component 5 | : 43 | = CO | Carbon Monoxide | 0.001970 |
| Component 6 | : | | | |
| Component 7 | : | | | |
| Component 8 | : | | | |
| Component 9 | : | | | |
| Component 10 | : | | | |

Temperature : 187.00 °F
Pressure : 34.70 psia
The material is GAS

NOTES:

ENVIRONMENT MENU

| | |
|-------------------------------|-----------|
| Wind speed | 3.36 mph |
| Wind speed measurement height | 32.8 feet |
| Stability class <A-F> | F |
| Relative humidity | 65 % |
| Air temperature | 65.0 °F |
| Spill surface temperature | 80.3 °F |

| | |
|--------------------------------|--------------------------------------|
| Substrate name | Ice |
| Substrate thermal conductivity | 2.1999 Btu/hr-ft-F |
| Substrate density | 150 lb/cu.ft |
| Substrate heat Capacity | 0.16 Btu/lb-F |
| Substrate delay time | 0 sec |
| Surrounding terrain | Forest, dense urban, or process area |

NOTES:



RELEASE MENU

Type of release: Unregulated, Continuous release
Release duration 10 min
Normal flow rate 0.05 lb/sec
Duration of normal flow 10 min
Volume of vessel 2643.00 cu.ft
Percent of vessel filled with liquid 7 %
Liquid head above release point 0 feet
Pipe inner diameter 2.07 inches
Equivalent release diameter 2.07 inches
Pipe length upstream of break 10.0 feet
Height of release point 15.0 feet
Angle of release from horizontal 0.0 degrees

NOTES: Estimated 6 ft liquid level or 7% full

IMPOUNDMENT MENU

Unconfined

NOTES:

VDVE MENU

Vapor generation and dispersion - Toxic calculation
Tracking component 18 = H2S Hydrogen Sulfide
Concentration endpoint 1 30.0 ppm
Concentration endpoint 2 30.0 ppm
Concentration endpoint 3 30.0 ppm
Dispersion coefficient averaging time 6e+01 min

NOTES:



Release Model

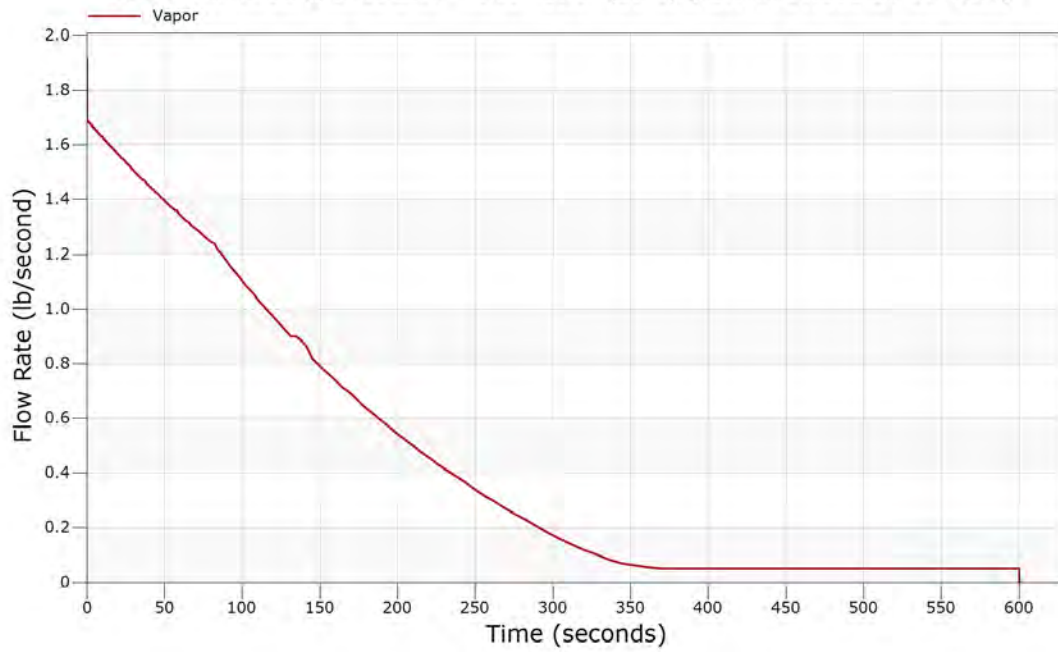
| Time (sec) | Vapor (lb/sec) | Aerosol Rate (lb/sec) | Liquid Rate (lb/sec) | Total Rate (lb/sec) |
|---------------|-------------------|--------------------------|-------------------------|------------------------|
| 0.000000 | 1.914881 | 0.000000 | 0.000000 | 1.914881 |
| 0.100000 | 1.691331 | 0.000000 | 0.000000 | 1.691331 |
| 0.300000 | 1.690425 | 0.000000 | 0.000000 | 1.690425 |
| 0.500000 | 1.688814 | 0.000000 | 0.000000 | 1.688814 |
| 0.700000 | 1.687469 | 0.000000 | 0.000000 | 1.687469 |
| 1.000000 | 1.685893 | 0.000000 | 0.000000 | 1.685893 |
| 3.000000 | 1.673099 | 0.000000 | 0.000000 | 1.673099 |
| 5.000000 | 1.660125 | 0.000000 | 0.000000 | 1.660125 |
| 7.000000 | 1.647315 | 0.000000 | 0.000000 | 1.647315 |
| 10.00000 | 1.631257 | 0.000000 | 0.000000 | 1.631257 |
| 20.00000 | 1.566893 | 0.000000 | 0.000000 | 1.566893 |
| 30.00000 | 1.509222 | 0.000000 | 0.000000 | 1.509222 |
| 40.00000 | 1.451478 | 0.000000 | 0.000000 | 1.451478 |
| 50.00000 | 1.397762 | 0.000000 | 0.000000 | 1.397762 |
| 60.00000 | 1.344222 | 0.000000 | 0.000000 | 1.344222 |
| 70.00000 | 1.293894 | 0.000000 | 0.000000 | 1.293894 |
| 85.00000 | 1.212656 | 0.000000 | 0.000000 | 1.212656 |
| 100.0000 | 1.105482 | 0.000000 | 0.000000 | 1.105482 |
| 200.0000 | .5430864 | 0.000000 | 0.000000 | .5430864 |
| 300.0000 | .1727782 | 0.000000 | 0.000000 | .1727782 |
| 400.0000 | .5049999E-01 | 0.000000 | 0.000000 | .5049999E-01 |
| 500.0000 | .5049999E-01 | 0.000000 | 0.000000 | .5049999E-01 |
| 600.0000 | .5049999E-01 | 0.000000 | 0.000000 | .5049999E-01 |
| Totals (lb) | 273.6523 | 0.000000 | 0.000000 | 273.6523 |

Reason for Ending: Reached Stop Time



Mass Release Rate

Acid Gas from Stripper Column - Toxic - 15ft (Str 8) [ALTPAR-SWS01-DT-15-2020]





Release Compositions

| Component Number | Component Name, Formula |
|------------------|------------------------------------|
| 17 | Carbon Dioxide, CO ₂ |
| 52 | Water, H ₂ O |
| 18 | Hydrogen Sulfide, H ₂ S |
| 53 | Ammonia, H ₃ N |
| 43 | Carbon Monoxide, CO |

Composition (Mole Fraction) of Fluid Streams

| Comp. No. | Feed Stream | Momentum Jet Stream | | | Total Stream | Liquid Pool Stream |
|-----------|-------------|---------------------|------------------|----------------|--------------|--------------------|
| | | Flashed Vapor | Evaporated Vapor | Aerosol Liquid | | |
| 17 | 0.569690 | 0.569690 | 0.000000 | 0.000000 | 0.569690 | 0.000000 |
| 52 | 0.235510 | 0.235510 | 0.000000 | 0.000000 | 0.235510 | 0.000000 |
| 18 | 0.051890 | 0.051890 | 0.000000 | 0.000000 | 0.051890 | 0.000000 |
| 53 | 0.140940 | 0.140940 | 0.000000 | 0.000000 | 0.140940 | 0.000000 |
| 43 | 0.001970 | 0.001970 | 0.000000 | 0.000000 | 0.001970 | 0.000000 |
| | 1.000000 | 1.000000 | 0.000000 | 0.000000 | 1.000000 | 0.000000 |



Momentum Jet Dispersion

concentration limits

concentration 3 (highest) = 30.000 ppm
 concentration 2 (middle) = 30.000 ppm
 concentration 1 (lowest) = 30.000 ppm

| downwind distance x(ft) | centerline conc. c(ppm) | ground conc. c(ppm) | y(c1) 1/2 width (ft) | y(c2) 1/2 width (ft) | y(c3) 1/2 width (ft) | centerline height (ft) |
|----------------------------|----------------------------|------------------------|----------------------------|----------------------------|----------------------------|---------------------------|
| 0 | 51890.000 | 0.000 | 0.3 | 0.3 | 0.3 | 15.0 |
| 3 | 14161.959 | 0.000 | 0.8 | 0.8 | 0.8 | 15.0 |
| 5 | 7865.414 | 0.000 | 1.2 | 1.2 | 1.2 | 15.0 |
| 7 | 5289.888 | 0.000 | 1.7 | 1.7 | 1.7 | 15.0 |
| 10 | 3891.961 | 0.000 | 2.2 | 2.2 | 2.2 | 15.0 |
| 13 | 3023.013 | 0.000 | 2.8 | 2.8 | 2.8 | 15.0 |
| 15 | 2432.747 | 0.000 | 3.3 | 3.3 | 3.3 | 15.0 |
| 18 | 2006.708 | 0.000 | 3.8 | 3.8 | 3.8 | 15.0 |
| 20 | 1687.464 | 0.000 | 4.4 | 4.4 | 4.4 | 15.0 |
| 23 | 1439.182 | 0.000 | 5.0 | 5.0 | 5.0 | 15.0 |
| 25 | 1242.557 | 0.000 | 5.6 | 5.6 | 5.6 | 15.0 |
| 28 | 1083.726 | 0.000 | 6.2 | 6.2 | 6.2 | 15.0 |
| 30 | 953.249 | 0.000 | 6.8 | 6.8 | 6.8 | 15.0 |
| 33 | 844.810 | 0.001 | 7.4 | 7.4 | 7.4 | 15.0 |
| 35 | 752.923 | 0.008 | 8.0 | 8.0 | 8.0 | 15.0 |
| 38 | 674.119 | 0.049 | 8.6 | 8.6 | 8.6 | 15.0 |
| 40 | 607.906 | 0.198 | 9.2 | 9.2 | 9.2 | 15.0 |
| 43 | 549.605 | 0.590 | 9.8 | 9.8 | 9.8 | 15.0 |
| 45 | 499.384 | 1.436 | 10.4 | 10.4 | 10.4 | 15.0 |
| 48 | 455.122 | 2.886 | 11.0 | 11.0 | 11.0 | 15.0 |
| 50 | 416.551 | 5.079 | 11.6 | 11.6 | 11.6 | 15.0 |
| 53 | 382.336 | 8.018 | 12.2 | 12.2 | 12.2 | 15.0 |
| 55 | 351.936 | 11.646 | 12.8 | 12.8 | 12.8 | 15.0 |
| 58 | 325.022 | 15.859 | 13.3 | 13.3 | 13.3 | 15.0 |
| 60 | 300.604 | 20.340 | 13.9 | 13.9 | 13.9 | 15.0 |
| 62 | 278.909 | 24.957 | 14.4 | 14.4 | 14.4 | 15.0 |
| 65 | 258.946 | 29.566 | 15.0 | 15.0 | 15.0 | 15.0 |
| 68 | 241.413 | 33.906 | 15.5 | 15.5 | 15.5 | 15.0 |
| 70 | 225.448 | 37.994 | 16.0 | 16.0 | 16.0 | 15.0 |
| 73 | 210.764 | 41.583 | 16.5 | 16.5 | 16.5 | 15.0 |
| 75 | 197.442 | 44.825 | 16.9 | 16.9 | 16.9 | 15.0 |
| 78 | 185.358 | 47.616 | 17.4 | 17.4 | 17.4 | 15.0 |
| 80 | 174.228 | 49.915 | 17.8 | 17.8 | 17.8 | 15.0 |
| 83 | 163.984 | 51.799 | 18.2 | 18.2 | 18.2 | 15.0 |
| 85 | 154.623 | 53.237 | 18.6 | 18.6 | 18.6 | 15.0 |



CANARY by Quest Output Report

Report Date: 8 March 2021

Case Title: Acid Gas from Stripper Column - Toxic - 15ft (Str 8)

| downwind distance x(ft) | centerline conc. c(ppm) | ground conc. c(ppm) | y(c1) 1/2 width (ft) | y(c2) 1/2 width (ft) | y(c3) 1/2 width (ft) | centerline height (ft) |
|----------------------------|----------------------------|------------------------|----------------------------|----------------------------|----------------------------|---------------------------|
| 88 | 146.044 | 54.307 | 19.0 | 19.0 | 19.0 | 15.0 |
| 90 | 138.011 | 55.022 | 19.4 | 19.4 | 19.4 | 15.0 |
| 93 | 130.610 | 55.440 | 19.7 | 19.7 | 19.7 | 15.0 |
| 95 | 123.788 | 55.642 | 20.0 | 20.0 | 20.0 | 15.0 |
| 98 | 117.485 | 55.583 | 20.3 | 20.3 | 20.3 | 15.0 |
| 100 | 111.569 | 55.324 | 20.6 | 20.6 | 20.6 | 15.0 |
| 103 | 106.072 | 54.871 | 20.8 | 20.8 | 20.8 | 15.0 |
| 105 | 100.969 | 54.312 | 21.0 | 21.0 | 21.0 | 15.0 |
| 108 | 96.223 | 53.640 | 21.2 | 21.2 | 21.2 | 15.0 |
| 110 | 91.789 | 52.870 | 21.4 | 21.4 | 21.4 | 15.0 |
| 112 | 87.625 | 52.014 | 21.5 | 21.5 | 21.5 | 15.0 |
| 115 | 83.736 | 51.093 | 21.7 | 21.7 | 21.7 | 15.0 |
| 118 | 80.097 | 50.149 | 21.8 | 21.8 | 21.8 | 15.0 |
| 120 | 76.688 | 49.166 | 21.8 | 21.8 | 21.8 | 15.0 |
| 123 | 73.481 | 48.154 | 21.9 | 21.9 | 21.9 | 15.0 |
| 125 | 70.442 | 47.110 | 21.9 | 21.9 | 21.9 | 15.0 |
| 128 | 67.584 | 46.073 | 21.9 | 21.9 | 21.9 | 15.0 |
| 130 | 64.879 | 45.021 | 21.8 | 21.8 | 21.8 | 15.0 |
| 133 | 62.360 | 43.994 | 21.8 | 21.8 | 21.8 | 15.0 |
| 135 | 59.946 | 42.948 | 21.6 | 21.6 | 21.6 | 15.0 |
| 138 | 57.702 | 41.941 | 21.5 | 21.5 | 21.5 | 15.0 |
| 140 | 55.552 | 40.924 | 21.3 | 21.3 | 21.3 | 15.0 |
| 143 | 53.519 | 39.932 | 21.1 | 21.1 | 21.1 | 15.0 |
| 145 | 51.583 | 38.952 | 20.9 | 20.9 | 20.9 | 15.0 |
| 148 | 49.768 | 38.004 | 20.6 | 20.6 | 20.6 | 15.0 |
| 150 | 48.036 | 37.067 | 20.2 | 20.2 | 20.2 | 15.0 |
| 153 | 46.378 | 36.149 | 19.9 | 19.9 | 19.9 | 15.0 |
| 155 | 44.817 | 35.259 | 19.4 | 19.4 | 19.4 | 15.0 |
| 158 | 43.321 | 34.387 | 19.0 | 19.0 | 19.0 | 15.0 |
| 160 | 41.898 | 33.538 | 18.4 | 18.4 | 18.4 | 15.0 |
| 163 | 40.543 | 32.712 | 17.8 | 17.8 | 17.8 | 15.0 |
| 165 | 39.251 | 31.907 | 17.1 | 17.1 | 17.1 | 15.0 |
| 168 | 38.019 | 31.125 | 16.4 | 16.4 | 16.4 | 15.0 |
| 170 | 36.842 | 30.367 | 15.5 | 15.5 | 15.5 | 15.0 |
| 173 | 35.715 | 29.628 | 14.5 | 14.5 | 14.5 | 15.0 |
| 175 | 34.638 | 28.910 | 13.4 | 13.4 | 13.4 | 15.0 |
| 178 | 33.607 | 28.215 | 12.1 | 12.1 | 12.1 | 15.0 |
| 180 | 32.622 | 27.541 | 10.6 | 10.6 | 10.6 | 15.0 |
| 183 | 31.678 | 26.885 | 8.6 | 8.6 | 8.6 | 15.0 |
| 185 | 30.774 | 26.249 | 5.9 | 5.9 | 5.9 | 15.0 |
| 188 | 29.907 | 25.633 | 0.0 | 0.0 | 0.0 | 15.0 |

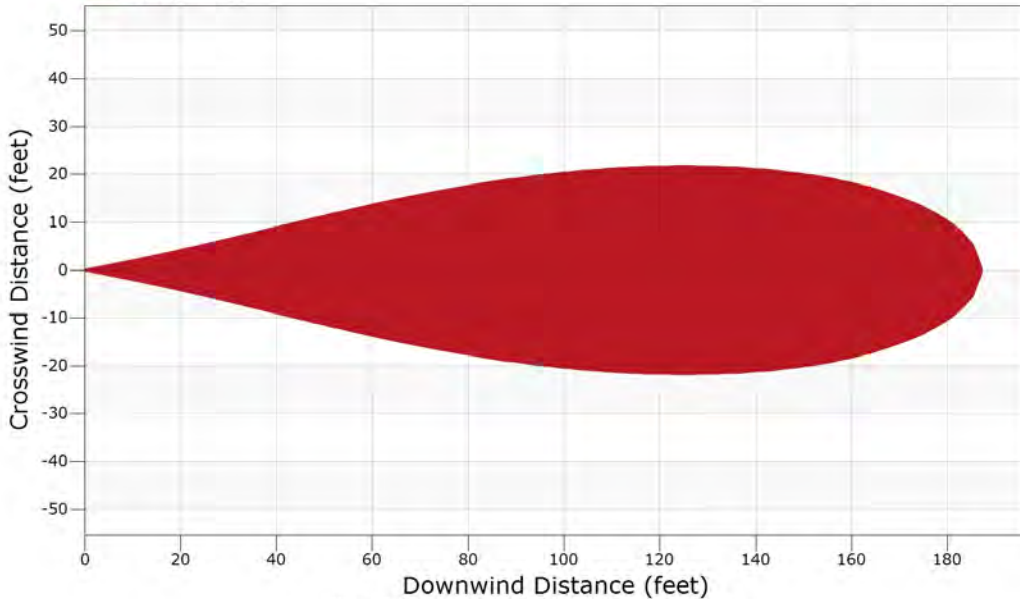
The downwind distance to c3 is 187.23 ft after about 27 seconds
 The downwind distance to c2 is 187.23 ft after about 27 seconds
 The downwind distance to c1 is 187.23 ft after about 27 seconds



Momentum Jet Contours - Overhead View

Acid Gas from Stripper Column - Toxic - 15ft (Str 8) [ALTPAR-SWS01-DT-15-2020]

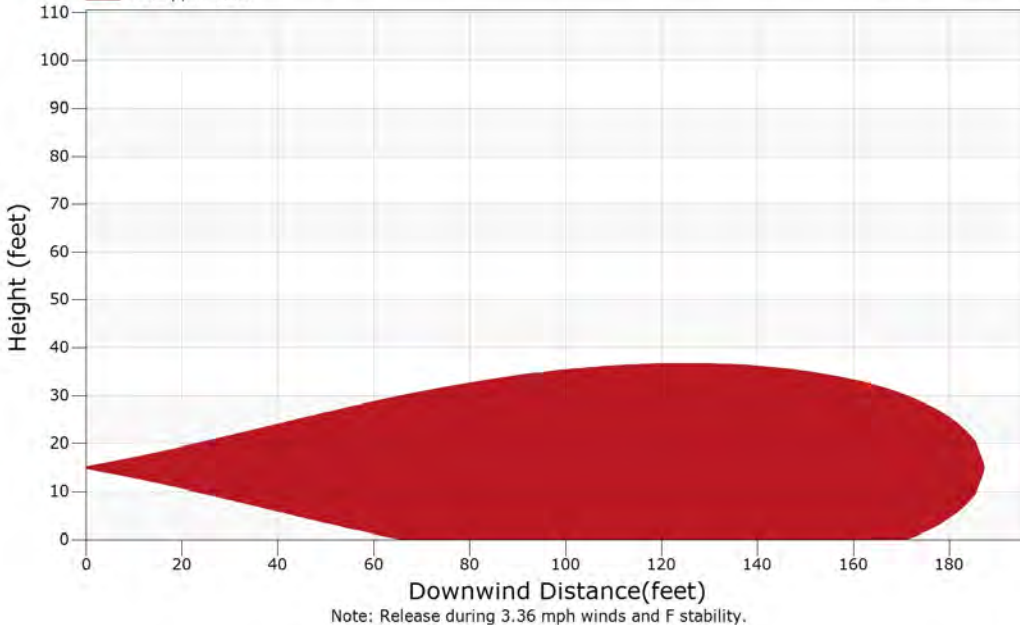
30.0 ppm H2S



Momentum Jet Contours - Side View

Acid Gas from Stripper Column - Toxic - 15ft (Str 8) [ALTPAR-SWS01-DT-15-2020]

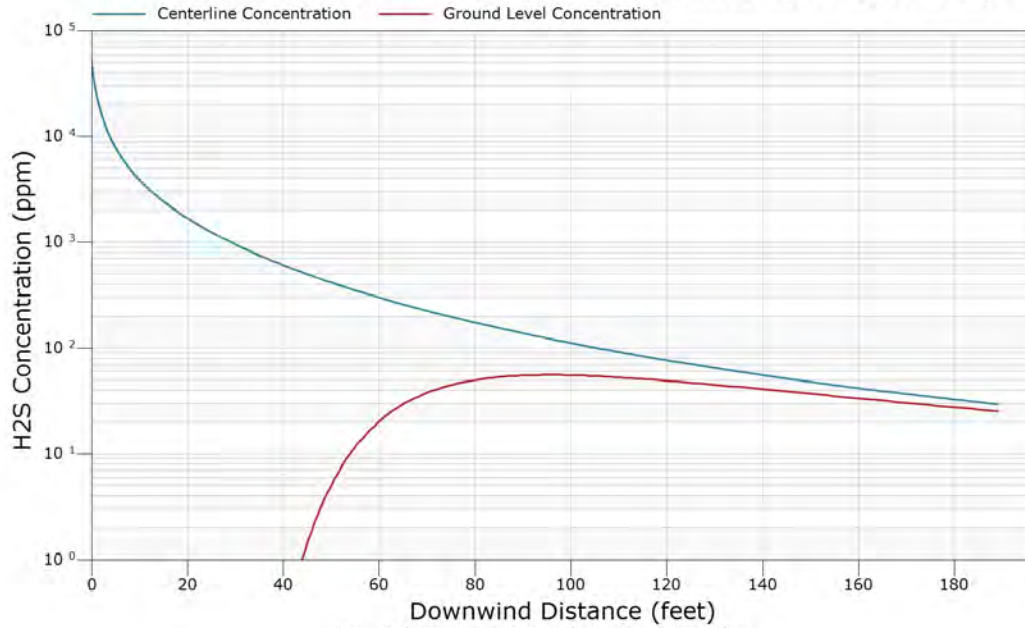
30.0 ppm H2S





Momentum Jet Concentration

Acid Gas from Stripper Column - Toxic - 15ft (Str 8) [ALTPAR-SWS01-DT-15-2020]



Note: Release during 3.36 mph winds and F stability.



Case Inputs

Case Type : Fire Radiation
Case Name : ALTPAR-SWS01-T-15-20mph-2020
User ID : dwj
Project Number : 7162
Type of Units : English Units

NOTES: Stream 8

MATERIAL MENU

| Materials Released | Number | Formula | Name | Fraction |
|--------------------|--------|---------|------------------|----------|
| Component 1 | : 17 | = CO2 | Carbon Dioxide | 0.569690 |
| Component 2 | : 52 | = H2O | Water | 0.235510 |
| Component 3 | : 18 | = H2S | Hydrogen Sulfide | 0.051890 |
| Component 4 | : 53 | = H3N | Ammonia | 0.140940 |
| Component 5 | : 43 | = CO | Carbon Monoxide | 0.001970 |
| Component 6 | : | | | |
| Component 7 | : | | | |
| Component 8 | : | | | |
| Component 9 | : | | | |
| Component 10 | : | | | |

Temperature : 187.00 °F
Pressure : 34.70 psia
The material is GAS

NOTES:

ENVIRONMENT MENU

Wind speed : 20.00 mph
Relative humidity : 65 %
Air temperature : 65.0 °F

NOTES:

FIRE TYPE MENU

Fire radiation division: Jet fire
Horizontal isopleths only
Elevation of flame base (from grade) : 15.0 feet
Elevation of target (from grade) : 0.0 feet
Diameter of jet fire tip : 0.1722 feet
Flow rate : 1.51 lb/sec
Angle of release from horizontal : 0.0 degrees

Fire radiation flux values

Radiation endpoint 1 : 1600 Btu/hr-sq.ft
Radiation endpoint 2 : 1600 Btu/hr-sq.ft
Radiation endpoint 3 : 1600 Btu/hr-sq.ft

NOTES:



Jet Fire Radiation

Length of Flame : 15.4 feet
Flame Tilt from Horizontal: 1.9 degrees
Release Angle : 0.0 degrees
Release Point Elevation : 15.0 feet
Target Elevation : 0.0 feet
Wind Speed : 20.0 mph

| Downwind Distance at Target Height (feet) | Maximum Flux (Btu/hr-sq.ft) |
|---|-----------------------------------|
| 3.3 | 333 |
| 3.5 | 336 |
| 3.7 | 340 |
| 4.0 | 344 |
| 4.3 | 348 |
| 4.6 | 352 |
| 4.9 | 356 |
| 5.2 | 360 |
| 5.5 | 364 |
| 5.9 | 368 |
| 6.3 | 372 |
| 6.7 | 376 |
| 7.2 | 379 |
| 7.7 | 382 |
| 8.2 | 384 |
| 8.8 | 385 |
| 9.4 | 385 |
| 10.0 | 383 |
| 10.7 | 380 |
| 11.4 | 374 |
| 12.2 | 367 |
| 13.0 | 357 |
| 13.9 | 344 |
| 14.8 | 329 |
| 15.8 | 310 |

Downwind Distances to Endpoints

| Distance (feet) | Maximum Flux (Btu/hr-sq.ft) |
|--------------------|--------------------------------|
| ** | 1600 |
| ** | 1600 |
| ** | 1600 |

** Endpoint does not exist at this elevation



Case Inputs

Case Type : Vapor Dispersion
Case Name : ALTPAR-AMN01-D-2020
User ID : dwj
Project Number : 7162
Type of Units : English Units

NOTES: Stream 100

MATERIAL MENU

| Materials Released | Number | Formula | Name | Fraction |
|--------------------|--------|---------|------------------|----------|
| Component 1 | 17 | = CO2 | Carbon Dioxide | 0.910171 |
| Component 2 | 52 | = H2O | Water | 0.038240 |
| Component 3 | 1 | = CH4 | Methane | 0.000580 |
| Component 4 | 2 | = C2H6 | Ethane | 0.001140 |
| Component 5 | 3 | = C3H8 | Propane | 0.011560 |
| Component 6 | 4 | = C4H10 | Isobutane | 0.001920 |
| Component 7 | 6 | = C5H12 | Isopentane | 0.001490 |
| Component 8 | 18 | = H2S | Hydrogen Sulfide | 0.034900 |
| Component 9 | | | | |
| Component 10 | | | | |

Temperature : 105.00 °F
Pressure : 25.70 psia
The material is GAS

NOTES:

ENVIRONMENT MENU

Wind speed 3.36 mph
Wind speed measurement height 32.8 feet
Stability class <A-F> F
Relative humidity 65 %
Air temperature 65.0 °F
Spill surface temperature 80.3 °F

Substrate name High density concrete
Substrate thermal conductivity 2.1999 Btu/hr-ft-F
Substrate density 150 lb/cu.ft
Substrate heat Capacity 0.16 Btu/lb-F
Substrate delay time 0 sec
Surrounding terrain Forest, dense urban, or process area

NOTES:



RELEASE MENU

Type of release: Unregulated, Continuous release
Release duration 10 min
Normal flow rate 5.41 lb/sec
Duration of normal flow 10 min
Volume of vessel 0.00 cu.ft
Pipe inner diameter 13.13 inches
Equivalent release diameter 13.13 inches
Pipe length upstream of break 10.0 feet
Pipe length downstream of break 0.0 feet
Height of release point 4.0 feet
Angle of release from horizontal 0.0 degrees

NOTES: Streams from control valves

IMPOUNDMENT MENU

Unconfined

NOTES:

VDVE MENU

Vapor generation and dispersion - Flammable calculation
Concentration endpoint 1 LFL mol%
Concentration endpoint 2 LFL mol%
Concentration endpoint 3 LFL mol%

Dispersion coefficient averaging time 1 min

NOTES:

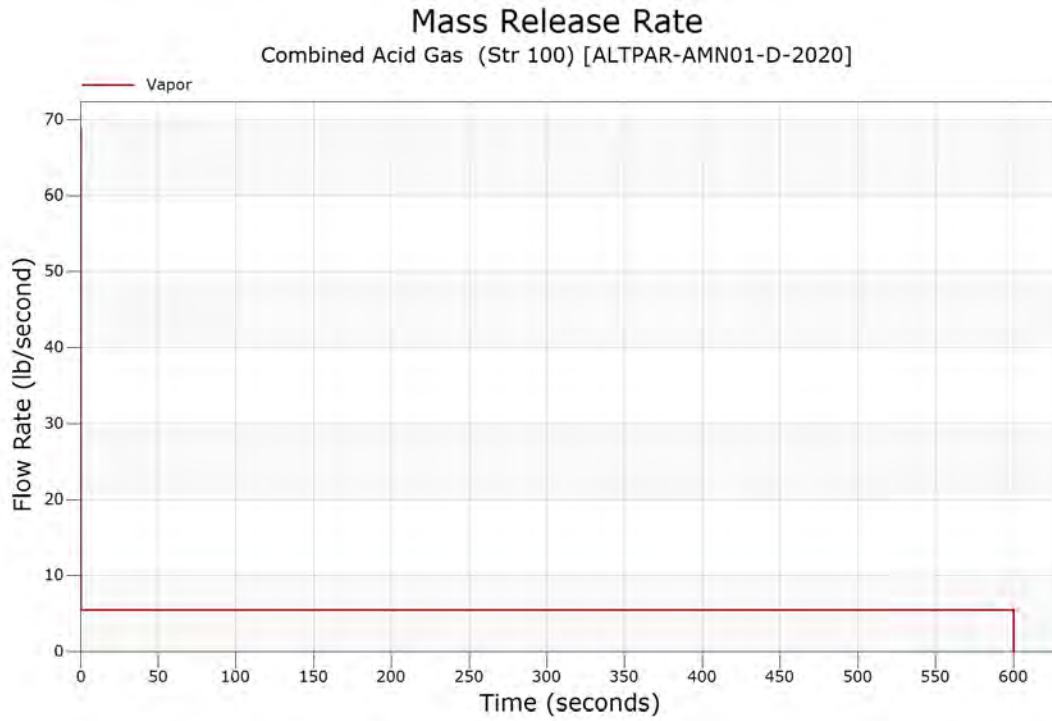


Release Model

| Time (sec) | Vapor (lb/sec) | Aerosol Rate (lb/sec) | Liquid Rate (lb/sec) | Total Rate (lb/sec) |
|---------------|-------------------|--------------------------|-------------------------|------------------------|
| 0.000000 | 68.91421 | 0.000000 | 0.000000 | 68.91421 |
| 0.100000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 0.300000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 0.500000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 0.700000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 1.000000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 3.000000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 5.000000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 7.000000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 10.000000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 20.000000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 30.000000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 40.000000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 50.000000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 60.000000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 70.000000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 85.000000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 100.000000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 200.000000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 300.000000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 400.000000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 500.000000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 600.000000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| Totals (lb) | 3246.766 | 0.000000 | 0.000000 | 3246.766 |

Flowrate for Torch Fire [immediate ignition] = 5.422756 lb/sec.
Torch Fire [delayed ignition] = 5.410000 lb/sec.

Reason for Ending: Reached Stop Time





Release Compositions

| Component Number | Component Name, Formula |
|------------------|-------------------------|
| 17 | Carbon Dioxide, CO2 |
| 52 | Water, H2O |
| 1 | Methane, CH4 |
| 2 | Ethane, C2H6 |
| 3 | Propane, C3H8 |
| 4 | Isobutane, C4H10 |
| 6 | Isopentane, C5H12 |
| 18 | Hydrogen Sulfide, H2S |

Composition (Mole Fraction) of Fluid Streams

| Comp. No. | Feed Stream | Momentum Jet Stream | | | Liquid Pool Stream | |
|-----------|-------------|---------------------|------------------|----------------|--------------------|------------------|
| | | Flashed Vapor | Evaporated Vapor | Aerosol Liquid | Total Stream | Liquid to Ground |
| 17 | 0.910171 | 0.910171 | 0.000000 | 0.000000 | 0.910171 | 0.000000 |
| 52 | 0.038240 | 0.038240 | 0.000000 | 0.000000 | 0.038240 | 0.000000 |
| 1 | 0.000580 | 0.000580 | 0.000000 | 0.000000 | 0.000580 | 0.000000 |
| 2 | 0.001140 | 0.001140 | 0.000000 | 0.000000 | 0.001140 | 0.000000 |
| 3 | 0.011560 | 0.011560 | 0.000000 | 0.000000 | 0.011560 | 0.000000 |
| 4 | 0.001920 | 0.001920 | 0.000000 | 0.000000 | 0.001920 | 0.000000 |
| 6 | 0.001490 | 0.001490 | 0.000000 | 0.000000 | 0.001490 | 0.000000 |
| 18 | 0.034900 | 0.034900 | 0.000000 | 0.000000 | 0.034900 | 0.000000 |
| ----- | | ----- | ----- | ----- | ----- | ----- |
| | 1.000000 | 1.000000 | 0.000000 | 0.000000 | 1.000000 | 0.000000 |

Flammable Limits (Mole %) of Fluid Streams

| Limit | Feed Stream | Momentum Jet Stream | Liquid Pool Stream |
|-------|-------------|---------------------|--------------------|
| LFL | 100.00 | 100.00 | |
| UFL | 100.00 | 100.00 | |
| LBV | | 0.00 m/s | |



Momentum Jet Dispersion

concentration limits

concentration 3 (highest) = 1.000000 mole fraction
concentration 2 (middle) = 1.000000 mole fraction
concentration 1 (lowest) = 1.000000 mole fraction

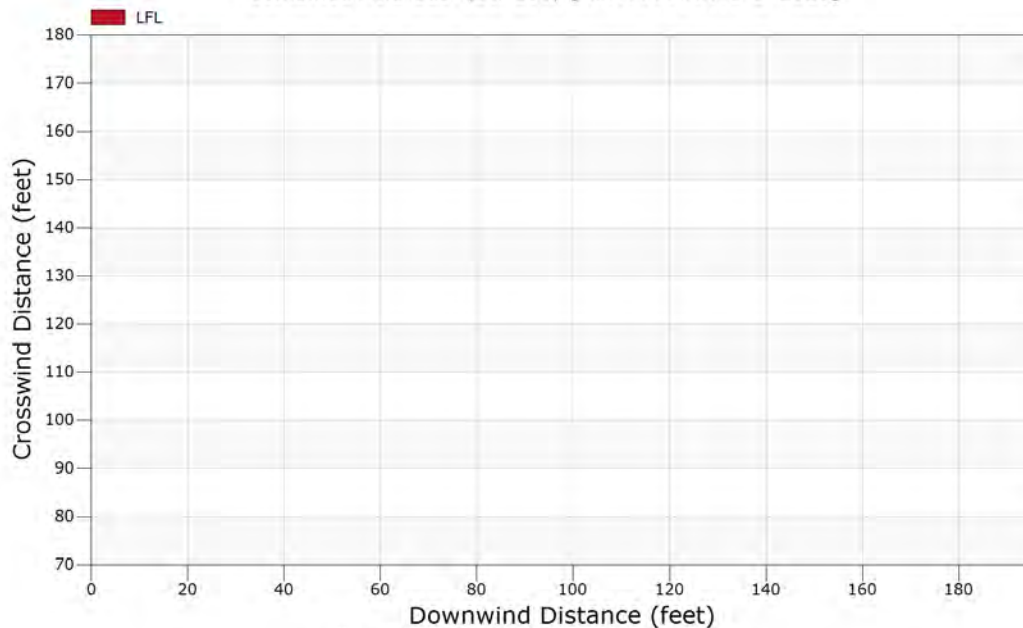
| downwind distance | centerline conc. | ground conc. | y(c1) 1/2 width | y(c2) 1/2 width | y(c3) 1/2 width | centerline height |
|-------------------|------------------|---------------|-----------------|-----------------|-----------------|-------------------|
| x(ft) | c(mole frac.) | c(mole frac.) | (ft) | (ft) | (ft) | (ft) |
| 0 | 1.000000 | 0.000000 | 0.0 | 0.0 | 0.0 | 4.0 |

Concentrations of concern do not exist downwind of the release location. If this was an upwind release (release angle > 90 deg. or < -90 deg) check the side-view plot.

The downwind distance to c3 is 0.00 ft after about 0 seconds
The downwind distance to c2 is 0.00 ft after about 0 seconds
The downwind distance to c1 is 0.00 ft after about 0 seconds

Momentum Jet Contours - Overhead View

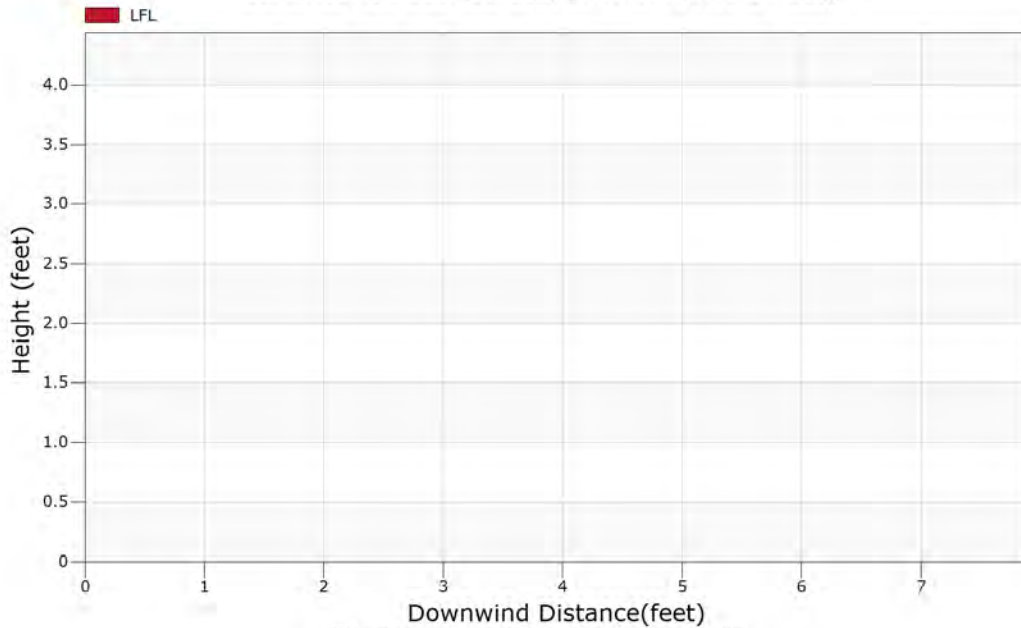
Combined Acid Gas (Str 100) [ALTPAR-AMN01-D-2020]





Momentum Jet Contours - Side View

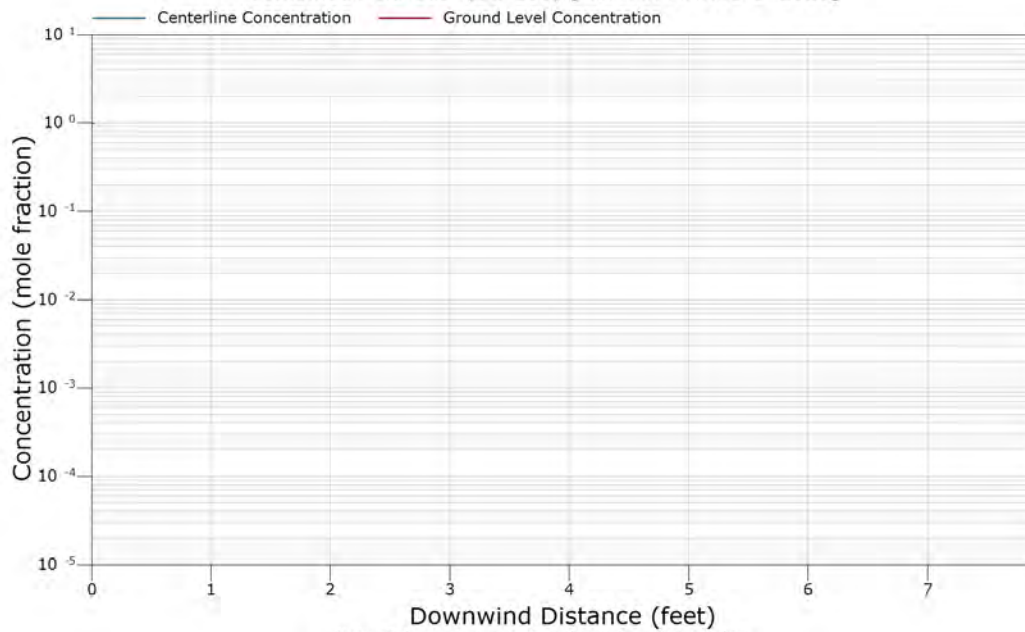
Combined Acid Gas (Str 100) [ALTPAR-AMN01-D-2020]



Note: Release during 3.36 mph winds and F stability.

Momentum Jet Concentration

Combined Acid Gas (Str 100) [ALTPAR-AMN01-D-2020]



Note: Release during 3.36 mph winds and F stability.



Case Inputs

Case Type : Vapor Dispersion
Case Name : ALTPAR-AMN01-DT-30-2020
User ID : dwj
Project Number : 7162
Type of Units : English Units

NOTES: Stream 100

MATERIAL MENU

| Materials Released | Number | Formula | Name | Fraction |
|--------------------|--------|---------|------------------|----------|
| Component 1 | : 17 | = CO2 | Carbon Dioxide | 0.910171 |
| Component 2 | : 52 | = H2O | Water | 0.038240 |
| Component 3 | : 1 | = CH4 | Methane | 0.000580 |
| Component 4 | : 2 | = C2H6 | Ethane | 0.001140 |
| Component 5 | : 3 | = C3H8 | Propane | 0.011560 |
| Component 6 | : 4 | = C4H10 | Isobutane | 0.001920 |
| Component 7 | : 6 | = C5H12 | Isopentane | 0.001490 |
| Component 8 | : 18 | = H2S | Hydrogen Sulfide | 0.034900 |
| Component 9 | : | | | |
| Component 10 | : | | | |

Temperature : 105.00 °F
Pressure : 25.70 psia
The material is GAS

NOTES:

ENVIRONMENT MENU

Wind speed 3.36 mph
Wind speed measurement height 32.8 feet
Stability class <A-F> F
Relative humidity 65 %
Air temperature 65.0 °F
Spill surface temperature 80.3 °F

Substrate name High density concrete
Substrate thermal conductivity 2.1999 Btu/hr-ft-F
Substrate density 150 lb/cu.ft
Substrate heat Capacity 0.16 Btu/lb-F
Substrate delay time 0 sec
Surrounding terrain Forest, dense urban, or process area

NOTES:



RELEASE MENU

Type of release: Unregulated, Continuous release
Release duration 10 min
Normal flow rate 5.41 lb/sec
Duration of normal flow 10 min
Volume of vessel 0.00 cu.ft
Pipe inner diameter 13.13 inches
Equivalent release diameter 13.13 inches
Pipe length upstream of break 10.0 feet
Pipe length downstream of break 0.0 feet
Height of release point 30.0 feet
Angle of release from horizontal 0.0 degrees

NOTES: Streams from control valves

IMPOUNDMENT MENU

Unconfined

NOTES:

VDVE MENU

Vapor generation and dispersion - Toxic calculation
Tracking component 18 = H2S Hydrogen Sulfide
Concentration endpoint 1 30.0 ppm
Concentration endpoint 2 30.0 ppm
Concentration endpoint 3 30.0 ppm
Dispersion coefficient averaging time 6e+01 min

NOTES:



Release Model

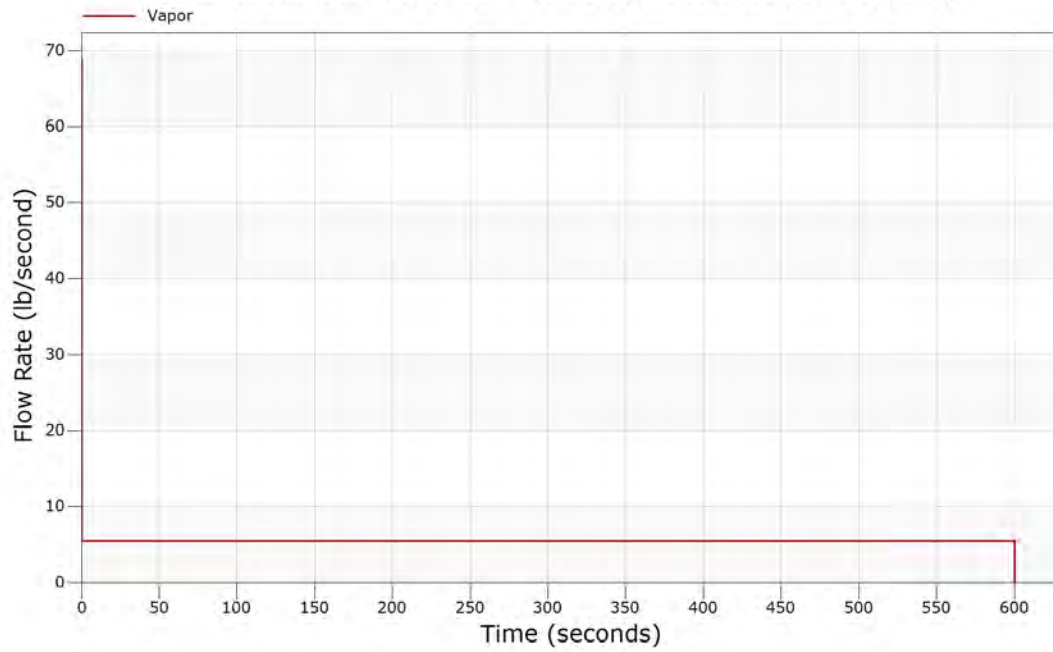
| Time (sec) | Vapor (lb/sec) | Aerosol Rate (lb/sec) | Liquid Rate (lb/sec) | Total Rate (lb/sec) |
|---------------|-------------------|--------------------------|-------------------------|------------------------|
| 0.000000 | 68.91421 | 0.000000 | 0.000000 | 68.91421 |
| 0.100000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 0.300000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 0.500000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 0.700000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 1.000000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 3.000000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 5.000000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 7.000000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 10.00000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 20.00000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 30.00000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 40.00000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 50.00000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 60.00000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 70.00000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 85.00000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 100.0000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 200.0000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 300.0000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 400.0000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 500.0000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| 600.0000 | 5.410000 | 0.000000 | 0.000000 | 5.410000 |
| Totals (lb) | 3246.766 | 0.000000 | 0.000000 | 3246.766 |

Reason for Ending: Reached Stop Time



Mass Release Rate

Combined Acid Gas - Toxic - 30 ft (Str 100) [ALTPAR-AMN01-DT-30-2020]





Release Compositions

| Component Number | Component Name, Formula |
|------------------|-------------------------|
| 17 | Carbon Dioxide, CO2 |
| 52 | Water, H2O |
| 1 | Methane, CH4 |
| 2 | Ethane, C2H6 |
| 3 | Propane, C3H8 |
| 4 | Isobutane, C4H10 |
| 6 | Isopentane, C5H12 |
| 18 | Hydrogen Sulfide, H2S |

Composition (Mole Fraction) of Fluid Streams

| Comp. No. | Feed Stream | Momentum Jet Stream | | | Total Stream | Liquid Pool Stream Liquid to Ground |
|-----------|-------------|---------------------|------------------|----------------|--------------|--|
| | | Flashed Vapor | Evaporated Vapor | Aerosol Liquid | | |
| 17 | 0.910171 | 0.910171 | 0.000000 | 0.000000 | 0.910171 | 0.000000 |
| 52 | 0.038240 | 0.038240 | 0.000000 | 0.000000 | 0.038240 | 0.000000 |
| 1 | 0.000580 | 0.000580 | 0.000000 | 0.000000 | 0.000580 | 0.000000 |
| 2 | 0.001140 | 0.001140 | 0.000000 | 0.000000 | 0.001140 | 0.000000 |
| 3 | 0.011560 | 0.011560 | 0.000000 | 0.000000 | 0.011560 | 0.000000 |
| 4 | 0.001920 | 0.001920 | 0.000000 | 0.000000 | 0.001920 | 0.000000 |
| 6 | 0.001490 | 0.001490 | 0.000000 | 0.000000 | 0.001490 | 0.000000 |
| 18 | 0.034900 | 0.034900 | 0.000000 | 0.000000 | 0.034900 | 0.000000 |
| | 1.000000 | 1.000000 | 0.000000 | 0.000000 | 1.000000 | 0.000000 |



Momentum Jet Dispersion

concentration limits

concentration 3 (highest) = 30.000 ppm
concentration 2 (middle) = 30.000 ppm
concentration 1 (lowest) = 30.000 ppm

| downwind distance x(ft) | centerline conc. c(ppm) | ground conc. c(ppm) | y(c1) 1/2 width (ft) | y(c2) 1/2 width (ft) | y(c3) 1/2 width (ft) | centerline height (ft) |
|-------------------------------|-------------------------------|---------------------------|----------------------------|----------------------------|----------------------------|------------------------------|
| 0 | 34899.600 | 0.000 | 1.6 | 1.6 | 1.6 | 30.0 |
| 5 | 14928.005 | 0.000 | 3.1 | 3.1 | 3.1 | 29.9 |
| 10 | 7762.084 | 0.000 | 5.0 | 5.0 | 5.0 | 29.6 |
| 15 | 4532.560 | 0.000 | 7.0 | 7.0 | 7.0 | 29.1 |
| 20 | 2874.654 | 0.000 | 9.1 | 9.1 | 9.1 | 28.5 |
| 25 | 1950.576 | 0.000 | 11.2 | 11.2 | 11.2 | 27.7 |
| 30 | 1394.902 | 0.000 | 13.2 | 13.2 | 13.2 | 26.9 |
| 35 | 1040.103 | 0.023 | 15.0 | 15.0 | 15.0 | 26.2 |
| 40 | 802.487 | 0.438 | 16.8 | 16.8 | 16.8 | 25.4 |
| 45 | 637.137 | 2.677 | 18.4 | 18.4 | 18.4 | 24.6 |
| 50 | 516.805 | 8.590 | 19.9 | 19.9 | 19.9 | 23.9 |
| 55 | 427.260 | 18.465 | 21.3 | 21.3 | 21.3 | 23.2 |
| 60 | 359.128 | 30.835 | 22.6 | 22.6 | 22.6 | 22.5 |
| 65 | 306.106 | 43.724 | 23.8 | 23.8 | 23.8 | 21.8 |
| 70 | 264.115 | 54.732 | 24.9 | 24.9 | 24.9 | 21.2 |
| 75 | 230.597 | 62.993 | 25.9 | 25.9 | 25.9 | 20.7 |
| 80 | 203.071 | 68.508 | 26.8 | 26.8 | 26.8 | 20.2 |
| 85 | 180.376 | 71.689 | 27.6 | 27.6 | 27.6 | 19.8 |
| 90 | 161.177 | 73.028 | 28.4 | 28.4 | 28.4 | 19.5 |
| 95 | 144.994 | 72.944 | 29.0 | 29.0 | 29.0 | 19.1 |
| 100 | 131.094 | 71.868 | 29.5 | 29.5 | 29.5 | 18.8 |
| 105 | 119.254 | 70.143 | 30.0 | 30.0 | 30.0 | 18.6 |
| 110 | 108.851 | 67.950 | 30.3 | 30.3 | 30.3 | 18.3 |
| 115 | 99.841 | 65.522 | 30.6 | 30.6 | 30.6 | 18.1 |
| 120 | 91.912 | 62.943 | 30.8 | 30.8 | 30.8 | 17.9 |
| 125 | 84.839 | 60.271 | 30.9 | 30.9 | 30.9 | 17.7 |
| 130 | 78.581 | 57.616 | 30.9 | 30.9 | 30.9 | 17.5 |
| 135 | 72.997 | 55.014 | 30.8 | 30.8 | 30.8 | 17.4 |
| 140 | 68.005 | 52.491 | 30.6 | 30.6 | 30.6 | 17.2 |
| 145 | 63.490 | 50.053 | 30.4 | 30.4 | 30.4 | 17.1 |
| 150 | 59.419 | 47.726 | 30.0 | 30.0 | 30.0 | 17.0 |
| 155 | 55.724 | 45.508 | 29.5 | 29.5 | 29.5 | 16.8 |
| 160 | 52.363 | 43.402 | 28.8 | 28.8 | 28.8 | 16.7 |
| 165 | 49.299 | 41.403 | 28.0 | 28.0 | 28.0 | 16.6 |
| 170 | 46.497 | 39.515 | 27.1 | 27.1 | 27.1 | 16.5 |



CANARY by Quest Output Report

Report Date: 8 March 2021

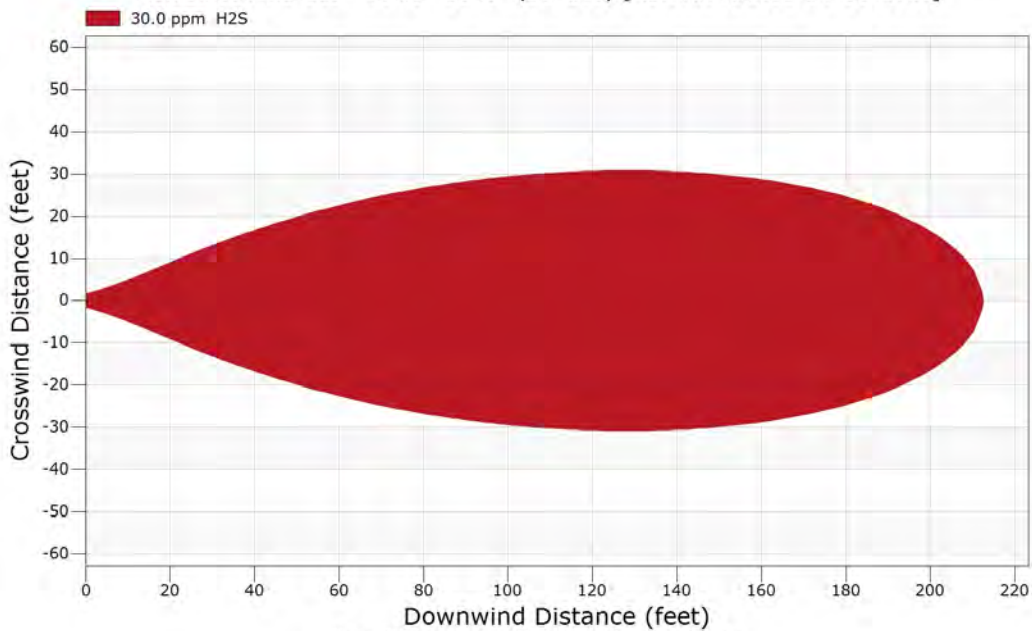
Case Title: Combined Acid Gas - Toxic - 30 ft (Str 100)

| downwind distance x(ft) | centerline conc. c(ppm) | ground conc. c(ppm) | y(c1) 1/2 width (ft) | y(c2) 1/2 width (ft) | y(c3) 1/2 width (ft) | centerline height (ft) |
|----------------------------|----------------------------|------------------------|----------------------------|----------------------------|----------------------------|---------------------------|
| 175 | 43.926 | 37.736 | 26.0 | 26.0 | 26.0 | 16.4 |
| 180 | 41.564 | 36.057 | 24.7 | 24.7 | 24.7 | 16.3 |
| 185 | 39.388 | 34.472 | 23.2 | 23.2 | 23.2 | 16.3 |
| 190 | 37.380 | 32.980 | 21.4 | 21.4 | 21.4 | 16.2 |
| 195 | 35.516 | 31.568 | 19.3 | 19.3 | 19.3 | 16.1 |
| 200 | 33.791 | 30.233 | 16.6 | 16.6 | 16.6 | 16.0 |
| 205 | 32.189 | 28.980 | 13.0 | 13.0 | 13.0 | 16.0 |
| 210 | 30.698 | 27.794 | 7.6 | 7.6 | 7.6 | 15.9 |

The downwind distance to c3 is 212.50 ft after about 50 seconds
 The downwind distance to c2 is 212.50 ft after about 50 seconds
 The downwind distance to c1 is 212.50 ft after about 50 seconds

Momentum Jet Contours - Overhead View

Combined Acid Gas - Toxic - 30 ft (Str 100) [ALTPAR-AMN01-DT-30-2020]

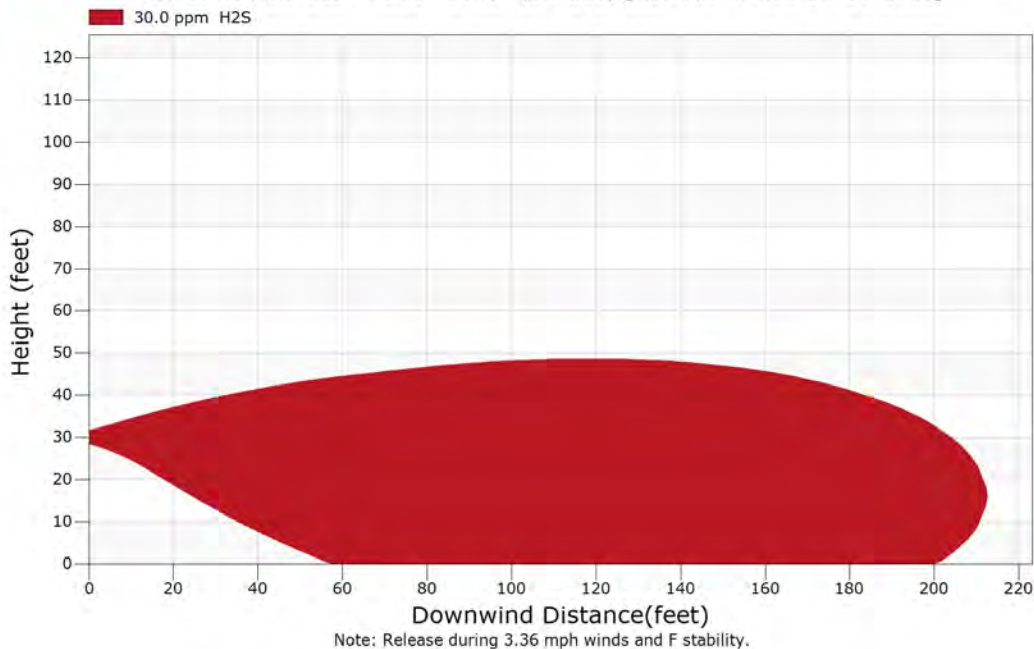


Note: Release during 3.36 mph winds and F stability.



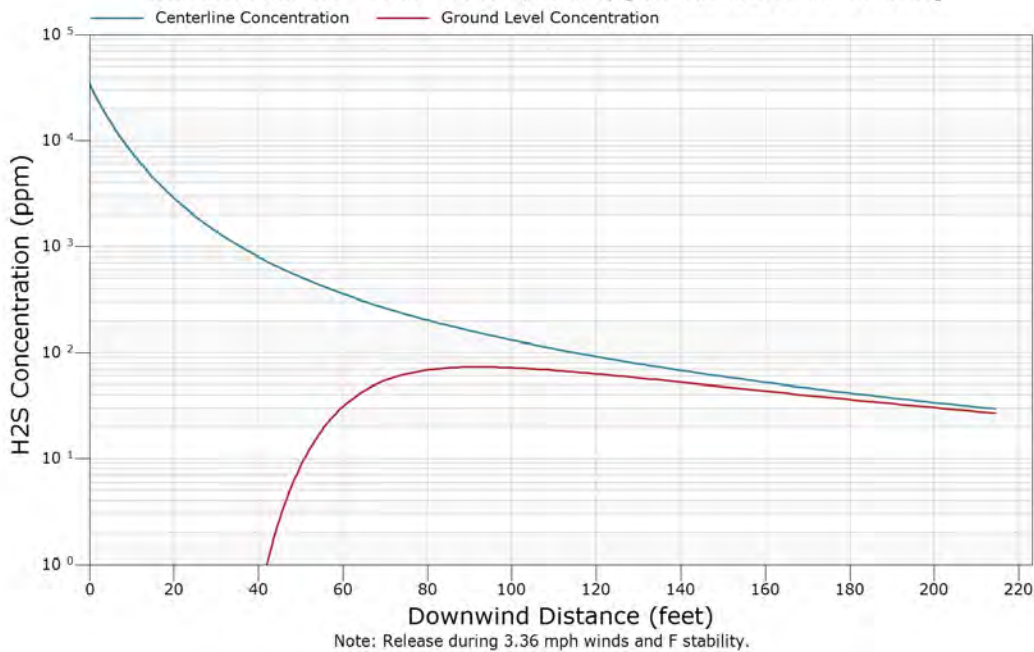
Momentum Jet Contours - Side View

Combined Acid Gas - Toxic - 30 ft (Str 100) [ALTPAR-AMN01-DT-30-2020]



Momentum Jet Concentration

Combined Acid Gas - Toxic - 30 ft (Str 100) [ALTPAR-AMN01-DT-30-2020]





Case Inputs

Case Type : Vapor Dispersion
Case Name : ALTPAR-H2S01-D-2020
User ID : dwj
Project Number : 7162
Type of Units : English Units

NOTES: Stream 101

MATERIAL MENU

| Materials Released | Number | Formula | Name | Fraction |
|--------------------|--------|---------|-----------------------|----------|
| Component 1 | : 51 | = H2 | Hydrogen(equilibrium) | 0.000530 |
| Component 2 | : 17 | = CO2 | Carbon Dioxide | 0.907529 |
| Component 3 | : 52 | = H2O | Water | 0.037350 |
| Component 4 | : 2 | = C2H6 | Ethane | 0.001390 |
| Component 5 | : 3 | = C3H8 | Propane | 0.011350 |
| Component 6 | : 4 | = C4H10 | Isobutane | 0.003750 |
| Component 7 | : 6 | = C5H12 | Isopentane | 0.001400 |
| Component 8 | : 8 | = C6H14 | n-Hexane | 0.000790 |
| Component 9 | : 18 | = H2S | Hydrogen Sulfide | 0.035910 |
| Component 10 | : | | | |

Temperature : 105.10 °F
Pressure : 24.70 psia
The material is GAS

NOTES:

ENVIRONMENT MENU

Wind speed 3.36 mph
Wind speed measurement height 32.8 feet
Stability class <A-F> F
Relative humidity 65 %
Air temperature 65.0 °F
Spill surface temperature 80.3 °F

Substrate name High density concrete
Substrate thermal conductivity 2.1999 Btu/hr-ft-F
Substrate density 150 lb/cu.ft
Substrate heat Capacity 0.16 Btu/lb-F
Substrate delay time 0 sec
Surrounding terrain Forest, dense urban, or process area

NOTES:



RELEASE MENU

Type of release: Unregulated, Continuous release
Release duration 10 min
Normal flow rate 5.59 lb/sec
Duration of normal flow 10 min
Volume of vessel 0.00 cu.ft
Pipe inner diameter 12.00 inches
Equivalent release diameter 12.00 inches
Pipe length upstream of break 100.0 feet
Pipe length downstream of break 0.0 feet
Height of release point 4.0 feet
Angle of release from horizontal 0.0 degrees

NOTES: Sized vessel for 2 minutes liquid hold up at 20% full

IMPOUNDMENT MENU

Unconfined

NOTES:

VDVE MENU

Vapor generation and dispersion - Flammable calculation
Concentration endpoint 1 LFL mol%
Concentration endpoint 2 LFL mol%
Concentration endpoint 3 LFL mol%

Dispersion coefficient averaging time 1 min

NOTES:

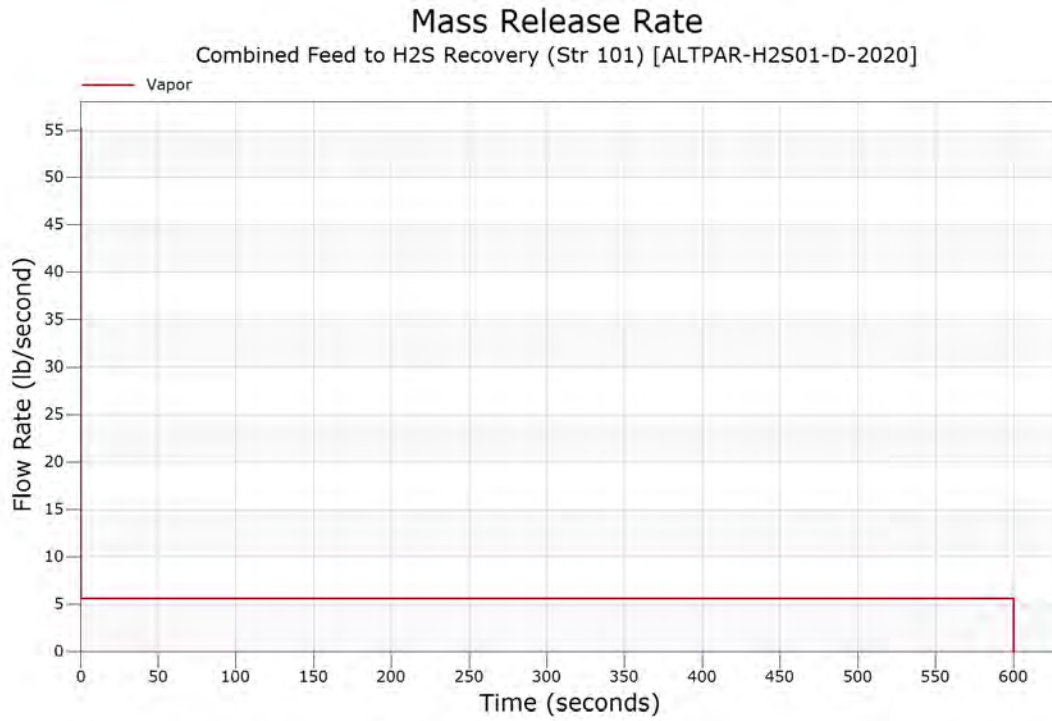


Release Model

| Time (sec) | Vapor (lb/sec) | Aerosol Rate (lb/sec) | Liquid Rate (lb/sec) | Total Rate (lb/sec) |
|---------------|-------------------|--------------------------|-------------------------|------------------------|
| 0.000000 | 55.25738 | 0.000000 | 0.000000 | 55.25738 |
| 0.100000 | 47.55660 | 0.000000 | 0.000000 | 47.55660 |
| 0.300000 | 5.918351 | 0.000000 | 0.000000 | 5.918351 |
| 0.500000 | 5.592153 | 0.000000 | 0.000000 | 5.592153 |
| 0.700000 | 5.590009 | 0.000000 | 0.000000 | 5.590009 |
| 1.000000 | 5.589999 | 0.000000 | 0.000000 | 5.589999 |
| 3.000000 | 5.589999 | 0.000000 | 0.000000 | 5.589999 |
| 5.000000 | 5.589999 | 0.000000 | 0.000000 | 5.589999 |
| 7.000000 | 5.589999 | 0.000000 | 0.000000 | 5.589999 |
| 10.00000 | 5.589999 | 0.000000 | 0.000000 | 5.589999 |
| 20.00000 | 5.589999 | 0.000000 | 0.000000 | 5.589999 |
| 30.00000 | 5.589999 | 0.000000 | 0.000000 | 5.589999 |
| 40.00000 | 5.589999 | 0.000000 | 0.000000 | 5.589999 |
| 50.00000 | 5.589999 | 0.000000 | 0.000000 | 5.589999 |
| 60.00000 | 5.589999 | 0.000000 | 0.000000 | 5.589999 |
| 70.00000 | 5.589999 | 0.000000 | 0.000000 | 5.589999 |
| 85.00000 | 5.589999 | 0.000000 | 0.000000 | 5.589999 |
| 100.0000 | 5.589999 | 0.000000 | 0.000000 | 5.589999 |
| 200.0000 | 5.589999 | 0.000000 | 0.000000 | 5.589999 |
| 300.0000 | 5.589999 | 0.000000 | 0.000000 | 5.589999 |
| 400.0000 | 5.589999 | 0.000000 | 0.000000 | 5.589999 |
| 500.0000 | 5.589999 | 0.000000 | 0.000000 | 5.589999 |
| 600.0000 | 5.589999 | 0.000000 | 0.000000 | 5.589999 |
| Totals (lb) | 3359.578 | 0.000000 | 0.000000 | 3359.578 |

Flowrate for Torch Fire [immediate ignition] = 5.682972 lb/sec.
Torch Fire [delayed ignition] = 5.589999 lb/sec.

Reason for Ending: Reached Stop Time





Release Compositions

| Component Number | Component Name, Formula |
|------------------|---------------------------|
| 51 | Hydrogen(equilibrium), H2 |
| 17 | Carbon Dioxide, CO2 |
| 52 | Water, H2O |
| 2 | Ethane, C2H6 |
| 3 | Propane, C3H8 |
| 4 | Isobutane, C4H10 |
| 6 | Isopentane, C5H12 |
| 8 | n-Hexane, C6H14 |
| 18 | Hydrogen Sulfide, H2S |

Composition (Mole Fraction) of Fluid Streams

| Comp. No. | Feed Stream | Momentum Jet Stream | | | Total Stream | Liquid Pool Stream |
|-----------|-------------|---------------------|------------------|----------------|--------------|--------------------|
| | | Flashed Vapor | Evaporated Vapor | Aerosol Liquid | | Liquid to Ground |
| 51 | 0.000530 | 0.000530 | 0.000000 | 0.000000 | 0.000530 | 0.000000 |
| 17 | 0.907529 | 0.907529 | 0.000000 | 0.000000 | 0.907529 | 0.000000 |
| 52 | 0.037350 | 0.037350 | 0.000000 | 0.000000 | 0.037350 | 0.000000 |
| 2 | 0.001390 | 0.001390 | 0.000000 | 0.000000 | 0.001390 | 0.000000 |
| 3 | 0.011350 | 0.011350 | 0.000000 | 0.000000 | 0.011350 | 0.000000 |
| 4 | 0.003750 | 0.003750 | 0.000000 | 0.000000 | 0.003750 | 0.000000 |
| 6 | 0.001400 | 0.001400 | 0.000000 | 0.000000 | 0.001400 | 0.000000 |
| 8 | 0.000790 | 0.000790 | 0.000000 | 0.000000 | 0.000790 | 0.000000 |
| 18 | 0.035910 | 0.035910 | 0.000000 | 0.000000 | 0.035910 | 0.000000 |
| | 1.000000 | 1.000000 | 0.000000 | 0.000000 | 1.000000 | 0.000000 |

Flammable Limits (Mole %) of Fluid Streams

| Limit | Feed Stream | Momentum Jet Stream | Liquid Pool Stream |
|-------|-------------|---------------------|--------------------|
| LFL | 100.00 | 100.00 | |
| UFL | 100.00 | 100.00 | |
| LBV | | 0.00 m/s | |



Momentum Jet Dispersion

concentration limits

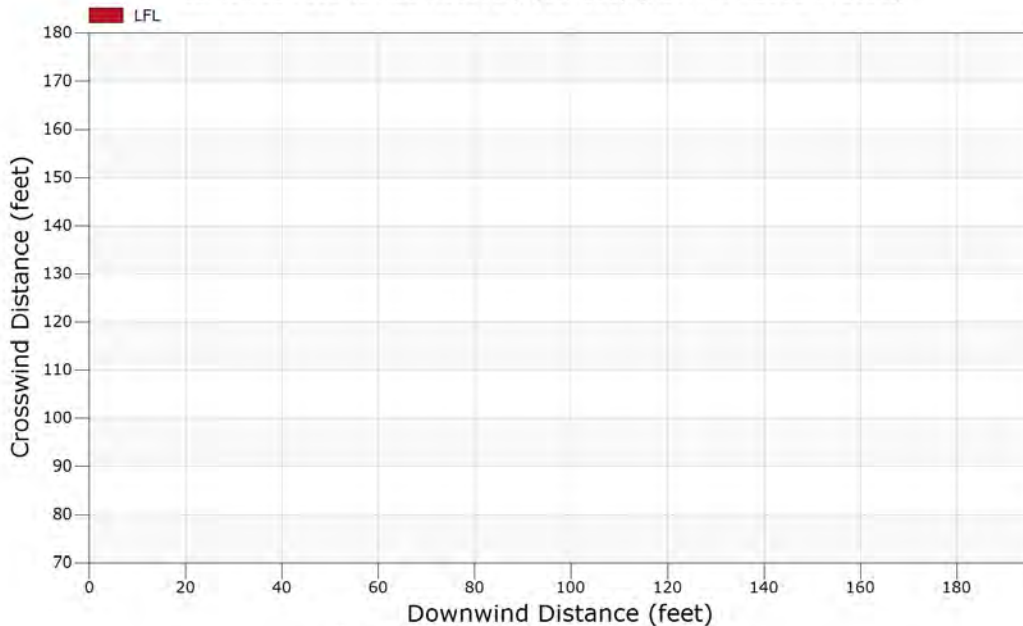
concentration 3 (highest) = 1.000000 mole fraction
 concentration 2 (middle) = 1.000000 mole fraction
 concentration 1 (lowest) = 1.000000 mole fraction

| downwind distance | centerline conc. | ground conc. | y(c1) 1/2 width | y(c2) 1/2 width | y(c3) 1/2 width | centerline height |
|-------------------|------------------|---------------|-----------------|-----------------|-----------------|-------------------|
| x(ft) | c(mole frac.) | c(mole frac.) | (ft) | (ft) | (ft) | (ft) |
| 0 | 1.000000 | 0.000000 | 0.0 | 0.0 | 0.0 | 4.0 |

Concentrations of concern do not exist downwind of the release location. If this was an upwind release (release angle > 90 deg. or < -90 deg) check the side-view plot.

The downwind distance to c3 is 0.00 ft after about 0 seconds
 The downwind distance to c2 is 0.00 ft after about 0 seconds
 The downwind distance to c1 is 0.00 ft after about 0 seconds

Momentum Jet Contours - Overhead View
 Combined Feed to H2S Recovery (Str 101) [ALTPAR-H2S01-D-2020]

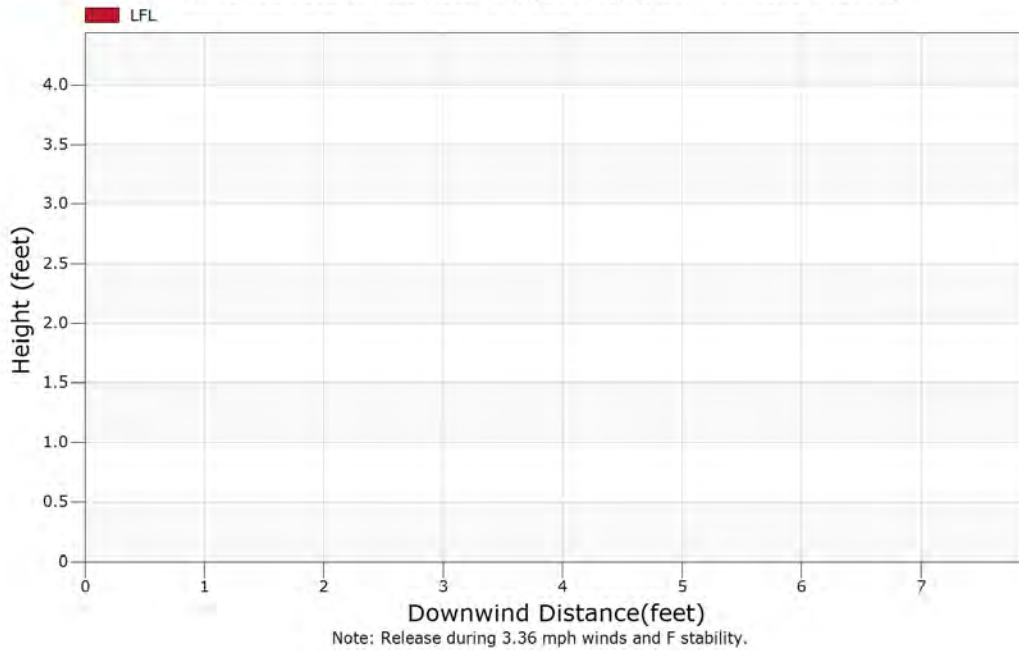


Note: Release during 3.36 mph winds and F stability.



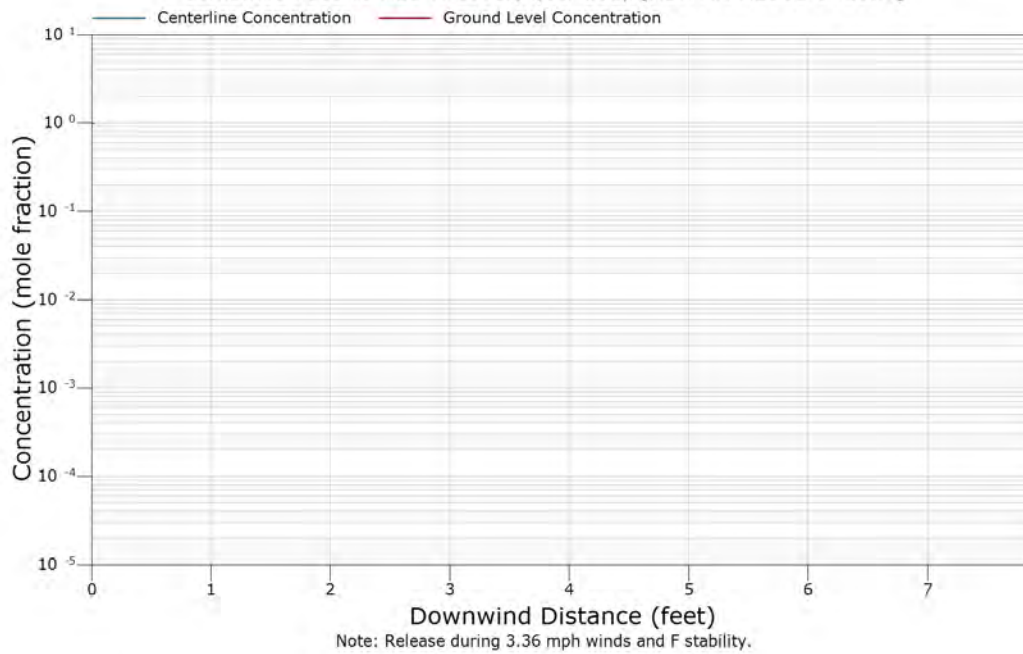
Momentum Jet Contours - Side View

Combined Feed to H2S Recovery (Str 101) [ALTPAR-H2S01-D-2020]



Momentum Jet Concentration

Combined Feed to H2S Recovery (Str 101) [ALTPAR-H2S01-D-2020]





Case Inputs

Case Type : Vapor Dispersion
Case Name : ALTPAR-H2S01-DT-33-2020
User ID : dwj
Project Number : 7162
Type of Units : English Units

NOTES: Stream 101

MATERIAL MENU

| Materials Released | Number | Formula | Name | Fraction |
|--------------------|--------|---------|-----------------------|----------|
| Component 1 | : 51 | = H2 | Hydrogen(equilibrium) | 0.000530 |
| Component 2 | : 17 | = CO2 | Carbon Dioxide | 0.907529 |
| Component 3 | : 52 | = H2O | Water | 0.037350 |
| Component 4 | : 2 | = C2H6 | Ethane | 0.001390 |
| Component 5 | : 3 | = C3H8 | Propane | 0.011350 |
| Component 6 | : 4 | = C4H10 | Isobutane | 0.003750 |
| Component 7 | : 6 | = C5H12 | Isopentane | 0.001400 |
| Component 8 | : 8 | = C6H14 | n-Hexane | 0.000790 |
| Component 9 | : 18 | = H2S | Hydrogen Sulfide | 0.035910 |
| Component 10 | : | | | |

Temperature : 105.10 °F
Pressure : 24.70 psia
The material is GAS

NOTES:

ENVIRONMENT MENU

Wind speed 3.36 mph
Wind speed measurement height 32.8 feet
Stability class <A-F> F
Relative humidity 65 %
Air temperature 65.0 °F
Spill surface temperature 80.3 °F

Substrate name High density concrete
Substrate thermal conductivity 2.1999 Btu/hr-ft-F
Substrate density 150 lb/cu.ft
Substrate heat Capacity 0.16 Btu/lb-F
Substrate delay time 0 sec
Surrounding terrain Forest, dense urban, or process area

NOTES:



RELEASE MENU

Type of release: Unregulated, Continuous release
Release duration 10 min
Normal flow rate 5.59 lb/sec
Duration of normal flow 10 min
Volume of vessel 0.00 cu.ft
Pipe inner diameter 12.00 inches
Equivalent release diameter 12.00 inches
Pipe length upstream of break 100.0 feet
Pipe length downstream of break 0.0 feet
Height of release point 33.0 feet
Angle of release from horizontal 0.0 degrees

NOTES: Sized vessel for 2 minutes liquid hold up at 20% full

IMPOUNDMENT MENU

Unconfined

NOTES:

VDVE MENU

Vapor generation and dispersion - Toxic calculation
Tracking component 18 = H2S Hydrogen Sulfide
Concentration endpoint 1 30.0 ppm
Concentration endpoint 2 30.0 ppm
Concentration endpoint 3 30.0 ppm
Dispersion coefficient averaging time 6e+01 min

NOTES:

**Release Model**

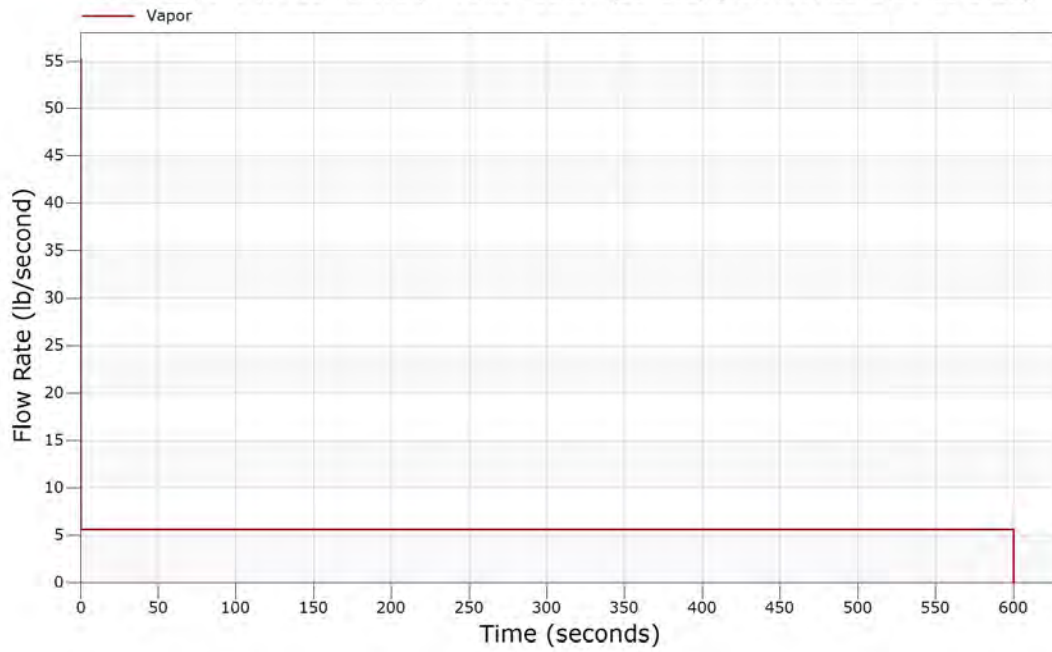
| Time (sec) | Vapor (lb/sec) | Aerosol Rate (lb/sec) | Liquid Rate (lb/sec) | Total Rate (lb/sec) |
|---------------|-------------------|--------------------------|-------------------------|------------------------|
| 0.000000 | 55.25738 | 0.000000 | 0.000000 | 55.25738 |
| 0.100000 | 47.55660 | 0.000000 | 0.000000 | 47.55660 |
| 0.300000 | 5.918351 | 0.000000 | 0.000000 | 5.918351 |
| 0.500000 | 5.592153 | 0.000000 | 0.000000 | 5.592153 |
| 0.700000 | 5.590009 | 0.000000 | 0.000000 | 5.590009 |
| 1.000000 | 5.589999 | 0.000000 | 0.000000 | 5.589999 |
| 3.000000 | 5.589999 | 0.000000 | 0.000000 | 5.589999 |
| 5.000000 | 5.589999 | 0.000000 | 0.000000 | 5.589999 |
| 7.000000 | 5.589999 | 0.000000 | 0.000000 | 5.589999 |
| 10.00000 | 5.589999 | 0.000000 | 0.000000 | 5.589999 |
| 20.00000 | 5.589999 | 0.000000 | 0.000000 | 5.589999 |
| 30.00000 | 5.589999 | 0.000000 | 0.000000 | 5.589999 |
| 40.00000 | 5.589999 | 0.000000 | 0.000000 | 5.589999 |
| 50.00000 | 5.589999 | 0.000000 | 0.000000 | 5.589999 |
| 60.00000 | 5.589999 | 0.000000 | 0.000000 | 5.589999 |
| 70.00000 | 5.589999 | 0.000000 | 0.000000 | 5.589999 |
| 85.00000 | 5.589999 | 0.000000 | 0.000000 | 5.589999 |
| 100.0000 | 5.589999 | 0.000000 | 0.000000 | 5.589999 |
| 200.0000 | 5.589999 | 0.000000 | 0.000000 | 5.589999 |
| 300.0000 | 5.589999 | 0.000000 | 0.000000 | 5.589999 |
| 400.0000 | 5.589999 | 0.000000 | 0.000000 | 5.589999 |
| 500.0000 | 5.589999 | 0.000000 | 0.000000 | 5.589999 |
| 600.0000 | 5.589999 | 0.000000 | 0.000000 | 5.589999 |
| Totals (lb) | 3359.578 | 0.000000 | 0.000000 | 3359.578 |

Reason for Ending: Reached Stop Time



Mass Release Rate

Combined Feed to H2S Recovery - Toxic - 33 ft - (Str 101) [ALTPAR-H2S01-DT-33-2020]





Release Compositions

| Component Number | Component Name, Formula |
|------------------|---------------------------|
| 51 | Hydrogen(equilibrium), H2 |
| 17 | Carbon Dioxide, CO2 |
| 52 | Water, H2O |
| 2 | Ethane, C2H6 |
| 3 | Propane, C3H8 |
| 4 | Isobutane, C4H10 |
| 6 | Isopentane, C5H12 |
| 8 | n-Hexane, C6H14 |
| 18 | Hydrogen Sulfide, H2S |

Composition (Mole Fraction) of Fluid Streams

| Comp. No. | Feed Stream | Momentum Jet Stream | | | Total Stream | Liquid Pool Stream |
|-----------|-------------|---------------------|------------------|----------------|--------------|--------------------|
| | | Flashed Vapor | Evaporated Vapor | Aerosol Liquid | | Liquid to Ground |
| 51 | 0.000530 | 0.000530 | 0.000000 | 0.000000 | 0.000530 | 0.000000 |
| 17 | 0.907529 | 0.907529 | 0.000000 | 0.000000 | 0.907529 | 0.000000 |
| 52 | 0.037350 | 0.037350 | 0.000000 | 0.000000 | 0.037350 | 0.000000 |
| 2 | 0.001390 | 0.001390 | 0.000000 | 0.000000 | 0.001390 | 0.000000 |
| 3 | 0.011350 | 0.011350 | 0.000000 | 0.000000 | 0.011350 | 0.000000 |
| 4 | 0.003750 | 0.003750 | 0.000000 | 0.000000 | 0.003750 | 0.000000 |
| 6 | 0.001400 | 0.001400 | 0.000000 | 0.000000 | 0.001400 | 0.000000 |
| 8 | 0.000790 | 0.000790 | 0.000000 | 0.000000 | 0.000790 | 0.000000 |
| 18 | 0.035910 | 0.035910 | 0.000000 | 0.000000 | 0.035910 | 0.000000 |
| | 1.000000 | 1.000000 | 0.000000 | 0.000000 | 1.000000 | 0.000000 |



Momentum Jet Dispersion

concentration limits

concentration 3 (highest) = 30.000 ppm
 concentration 2 (middle) = 30.000 ppm
 concentration 1 (lowest) = 30.000 ppm

| downwind distance x(ft) | centerline conc. c(ppm) | ground conc. c(ppm) | y(c1) 1/2 width (ft) | y(c2) 1/2 width (ft) | y(c3) 1/2 width (ft) | centerline height (ft) |
|----------------------------|----------------------------|------------------------|----------------------------|----------------------------|----------------------------|---------------------------|
| 0 | 35910.400 | 0.000 | 1.5 | 1.5 | 1.5 | 33.0 |
| 5 | 15391.755 | 0.000 | 2.9 | 2.9 | 2.9 | 32.9 |
| 10 | 8096.358 | 0.000 | 4.7 | 4.7 | 4.7 | 32.7 |
| 15 | 4787.025 | 0.000 | 6.6 | 6.6 | 6.6 | 32.4 |
| 20 | 3063.656 | 0.000 | 8.7 | 8.7 | 8.7 | 31.8 |
| 25 | 2089.159 | 0.000 | 10.7 | 10.7 | 10.7 | 31.2 |
| 30 | 1498.160 | 0.000 | 12.7 | 12.7 | 12.7 | 30.6 |
| 35 | 1118.657 | 0.000 | 14.5 | 14.5 | 14.5 | 29.9 |
| 40 | 862.079 | 0.017 | 16.3 | 16.3 | 16.3 | 29.3 |
| 45 | 683.468 | 0.241 | 17.9 | 17.9 | 17.9 | 28.6 |
| 50 | 553.920 | 1.348 | 19.5 | 19.5 | 19.5 | 28.0 |
| 55 | 457.126 | 4.335 | 20.9 | 20.9 | 20.9 | 27.3 |
| 60 | 383.685 | 9.635 | 22.2 | 22.2 | 22.2 | 26.7 |
| 65 | 326.487 | 16.902 | 23.4 | 23.4 | 23.4 | 26.1 |
| 70 | 281.160 | 25.084 | 24.6 | 24.6 | 24.6 | 25.6 |
| 75 | 244.938 | 32.802 | 25.6 | 25.6 | 25.6 | 25.1 |
| 80 | 215.284 | 39.434 | 26.6 | 26.6 | 26.6 | 24.7 |
| 85 | 190.865 | 44.659 | 27.4 | 27.4 | 27.4 | 24.3 |
| 90 | 170.395 | 48.499 | 28.2 | 28.2 | 28.2 | 24.0 |
| 95 | 153.005 | 51.089 | 28.8 | 28.8 | 28.8 | 23.7 |
| 100 | 138.231 | 52.588 | 29.4 | 29.4 | 29.4 | 23.4 |
| 105 | 125.505 | 53.237 | 29.9 | 29.9 | 29.9 | 23.2 |
| 110 | 114.460 | 53.206 | 30.3 | 30.3 | 30.3 | 22.9 |
| 115 | 104.803 | 52.669 | 30.7 | 30.7 | 30.7 | 22.7 |
| 120 | 96.372 | 51.757 | 30.9 | 30.9 | 30.9 | 22.5 |
| 125 | 88.897 | 50.568 | 31.1 | 31.1 | 31.1 | 22.4 |
| 130 | 82.262 | 49.183 | 31.1 | 31.1 | 31.1 | 22.2 |
| 135 | 76.345 | 47.671 | 31.1 | 31.1 | 31.1 | 22.1 |
| 140 | 71.058 | 46.101 | 31.0 | 31.0 | 31.0 | 21.9 |
| 145 | 66.296 | 44.490 | 30.8 | 30.8 | 30.8 | 21.8 |
| 150 | 61.992 | 42.866 | 30.4 | 30.4 | 30.4 | 21.7 |
| 155 | 58.094 | 41.261 | 30.0 | 30.0 | 30.0 | 21.6 |
| 160 | 54.551 | 39.684 | 29.4 | 29.4 | 29.4 | 21.5 |
| 165 | 51.323 | 38.144 | 28.8 | 28.8 | 28.8 | 21.4 |
| 170 | 48.373 | 36.657 | 27.9 | 27.9 | 27.9 | 21.3 |

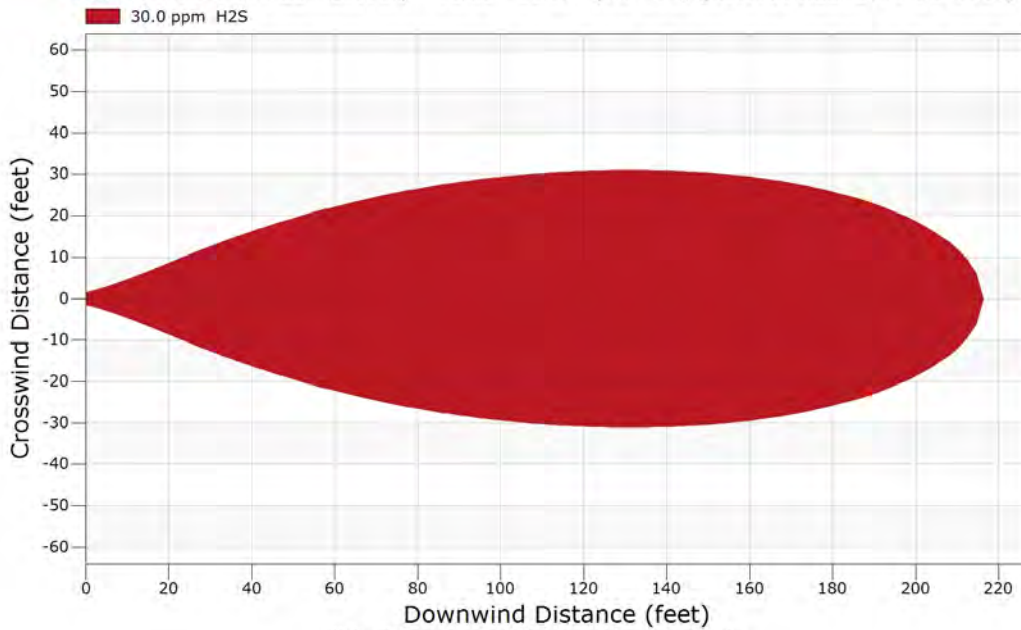


| downwind distance x(ft) | centerline conc. c(ppm) | ground conc. c(ppm) | y(c1) 1/2 width (ft) | y(c2) 1/2 width (ft) | y(c3) 1/2 width (ft) | centerline height (ft) |
|----------------------------|----------------------------|------------------------|-------------------------|-------------------------|-------------------------|---------------------------|
| 175 | 45.671 | 35.234 | 27.0 | 27.0 | 27.0 | 21.2 |
| 180 | 43.190 | 33.850 | 25.8 | 25.8 | 25.8 | 21.1 |
| 185 | 40.906 | 32.527 | 24.5 | 24.5 | 24.5 | 21.0 |
| 190 | 38.798 | 31.269 | 22.9 | 22.9 | 22.9 | 21.0 |
| 195 | 36.849 | 30.054 | 21.0 | 21.0 | 21.0 | 20.9 |
| 200 | 35.033 | 28.901 | 18.7 | 18.7 | 18.7 | 20.8 |
| 205 | 33.362 | 27.804 | 15.8 | 15.8 | 15.8 | 20.8 |
| 210 | 31.810 | 26.763 | 12.0 | 12.0 | 12.0 | 20.7 |
| 215 | 30.351 | 25.760 | 4.8 | 4.8 | 4.8 | 20.7 |

The downwind distance to c3 is 216.28 ft after about 44 seconds
 The downwind distance to c2 is 216.28 ft after about 44 seconds
 The downwind distance to c1 is 216.28 ft after about 44 seconds

Momentum Jet Contours - Overhead View

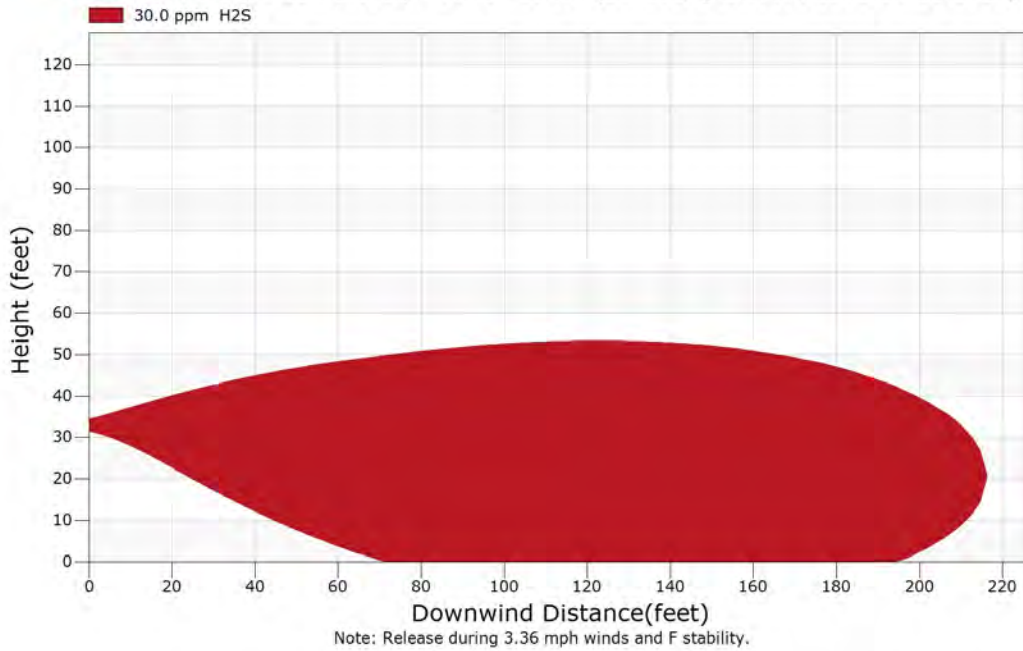
Combined Feed to H2S Recovery - Toxic - 33 ft - (Str 101) [ALTPAR-H2S01-DT-33-2020]





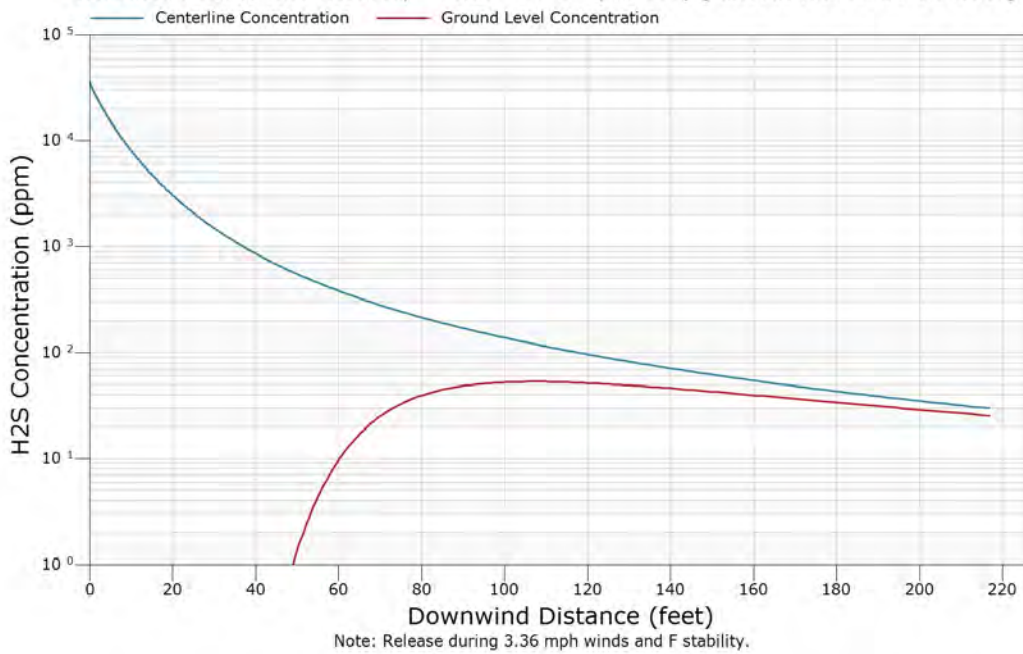
Momentum Jet Contours - Side View

Combined Feed to H2S Recovery - Toxic - 33 ft - (Str 101) [ALTPAR-H2S01-DT-33-2020]



Momentum Jet Concentration

Combined Feed to H2S Recovery - Toxic - 33 ft - (Str 101) [ALTPAR-H2S01-DT-33-2020]





Case Inputs

Case Type : Vapor Dispersion
Case Name : ALTPAR-H2S02a-D-2020
User ID : dwj
Project Number : 7162
Type of Units : English Units

NOTES: Information via email from M. Baverman - stream after compression

MATERIAL MENU

| Materials Released | Number | Formula | Name | Fraction |
|--------------------|--------|---------|------------------|----------|
| Component 1 | : 17 | = CO2 | Carbon Dioxide | 0.429500 |
| Component 2 | : 52 | = H2O | Water | 0.013200 |
| Component 3 | : 18 | = H2S | Hydrogen Sulfide | 0.557300 |
| Component 4 | : | | | |
| Component 5 | : | | | |
| Component 6 | : | | | |
| Component 7 | : | | | |
| Component 8 | : | | | |
| Component 9 | : | | | |
| Component 10 | : | | | |

Temperature : 400.00 °F
Pressure : 1084.70 psia
The material is GAS

NOTES:

ENVIRONMENT MENU

| | |
|-------------------------------|-----------|
| Wind speed | 3.36 mph |
| Wind speed measurement height | 32.8 feet |
| Stability class <A-F> | F |
| Relative humidity | 65 % |
| Air temperature | 65.0 °F |
| Spill surface temperature | 80.3 °F |

| | |
|--------------------------------|--------------------------------------|
| Substrate name | High density concrete |
| Substrate thermal conductivity | 2.1999 Btu/hr-ft-F |
| Substrate density | 150 lb/cu.ft |
| Substrate heat Capacity | 0.16 Btu/lb-F |
| Substrate delay time | 0 sec |
| Surrounding terrain | Forest, dense urban, or process area |

NOTES:



RELEASE MENU

Type of release: Unregulated, Continuous release
Release duration 10 min
Normal flow rate 0.29 lb/sec
Duration of normal flow 10 min
Volume of vessel 0.00 cu.ft
Pipe inner diameter 2.07 inches
Equivalent release diameter 2.07 inches
Pipe length upstream of break 10.0 feet
Pipe length downstream of break 0.0 feet
Height of release point 4.0 feet
Angle of release from horizontal 0.0 degrees

NOTES:

IMPOUNDMENT MENU

Unconfined

NOTES:

VDVE MENU

Vapor generation and dispersion - Flammable calculation
Concentration endpoint 1 LFL mol%
Concentration endpoint 2 LFL mol%
Concentration endpoint 3 LFL mol%

Dispersion coefficient averaging time 1 min

NOTES:

**Release Model**

| Time (sec) | Vapor (lb/sec) | Aerosol Rate (lb/sec) | Liquid Rate (lb/sec) | Total Rate (lb/sec) |
|---------------|-------------------|--------------------------|-------------------------|------------------------|
| 0.000000 | 58.37226 | 0.000000 | 0.000000 | 58.37226 |
| 0.100000 | .5991720 | 0.000000 | 0.000000 | .5991720 |
| 0.300000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| 0.500000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| 0.700000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| 1.000000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| 3.000000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| 5.000000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| 7.000000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| 10.00000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| 20.00000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| 30.00000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| 40.00000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| 50.00000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| 60.00000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| 70.00000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| 85.00000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| 100.0000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| 200.0000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| 300.0000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| 400.0000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| 500.0000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| 600.0000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| Totals (lb) | 175.5309 | 0.000000 | 0.000000 | 175.5309 |

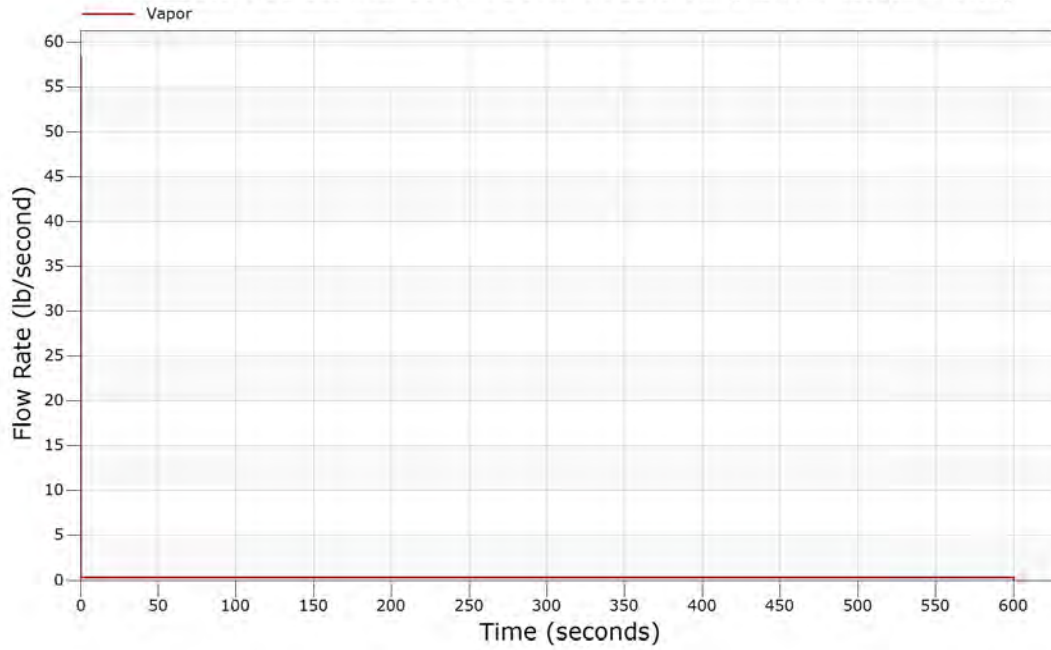
Flowrate for Torch Fire [immediate ignition] = 0.3105104 lb/sec.
Torch Fire [delayed ignition] = 0.2905561 lb/sec.

Reason for Ending: Reached Stop Time



Mass Release Rate

Concentrated Acid Gas after Comp. via email M. Baverman [ALTPAR-H2S02a-D-2020]





Release Compositions

| Component Number | Component Name, Formula |
|------------------|------------------------------------|
| 17 | Carbon Dioxide, CO ₂ |
| 52 | Water, H ₂ O |
| 18 | Hydrogen Sulfide, H ₂ S |

Composition (Mole Fraction) of Fluid Streams

| Comp. No. | Feed Stream | Momentum Jet Stream | | | Total Stream | Liquid Pool Stream |
|-----------|-------------|---------------------|------------------|----------------|--------------|--------------------|
| | | Flashed Vapor | Evaporated Vapor | Aerosol Liquid | | |
| 17 | 0.429500 | 0.429500 | 0.000000 | 0.000000 | 0.429500 | 0.000000 |
| 52 | 0.013200 | 0.013200 | 0.000000 | 0.000000 | 0.013200 | 0.000000 |
| 18 | 0.557300 | 0.557300 | 0.000000 | 0.000000 | 0.557300 | 0.000000 |
| | 1.000000 | 1.000000 | 0.000000 | 0.000000 | 1.000000 | 0.000000 |

Flammable Limits (Mole %) of Fluid Streams

| Limit | Feed Stream | Momentum Jet Stream | Liquid Pool Stream |
|-------|-------------|---------------------|--------------------|
| LFL | 7.18 | 7.18 | |
| UFL | 48.27 | 48.27 | |
| LBV | | 0.20 m/s | |



Momentum Jet Dispersion

concentration limits

concentration 3 (highest) = 0.071775 mole fraction
concentration 2 (middle) = 0.071775 mole fraction
concentration 1 (lowest) = 0.071775 mole fraction

| downwind distance x(ft) | centerline conc. c(mole frac.) | ground conc. c(mole frac.) | y(c1) 1/2 width (ft) | y(c2) 1/2 width (ft) | y(c3) 1/2 width (ft) | centerline height (ft) |
|-------------------------------|--------------------------------------|----------------------------------|----------------------------|----------------------------|----------------------------|------------------------------|
| 0 | 1.000000 | 0.000000 | 0.1 | 0.1 | 0.1 | 4.0 |
| 0.1 | 0.869172 | 0.000000 | 0.2 | 0.2 | 0.2 | 4.0 |
| 0.2 | 0.776262 | 0.000000 | 0.2 | 0.2 | 0.2 | 4.0 |
| 0.3 | 0.698765 | 0.000000 | 0.2 | 0.2 | 0.2 | 4.0 |
| 0.4 | 0.634067 | 0.000000 | 0.2 | 0.2 | 0.2 | 4.0 |
| 0.5 | 0.578996 | 0.000000 | 0.2 | 0.2 | 0.2 | 4.0 |
| 0.6 | 0.532013 | 0.000000 | 0.2 | 0.2 | 0.2 | 4.0 |
| 0.7 | 0.491339 | 0.000000 | 0.2 | 0.2 | 0.2 | 4.0 |
| 0.8 | 0.455666 | 0.000000 | 0.2 | 0.2 | 0.2 | 4.0 |
| 0.9 | 0.424662 | 0.000000 | 0.2 | 0.2 | 0.2 | 4.0 |
| 1.0 | 0.396941 | 0.000000 | 0.2 | 0.2 | 0.2 | 4.0 |
| 1.1 | 0.372292 | 0.000000 | 0.3 | 0.3 | 0.3 | 4.0 |
| 1.2 | 0.350134 | 0.000000 | 0.3 | 0.3 | 0.3 | 4.0 |
| 1.3 | 0.330318 | 0.000000 | 0.3 | 0.3 | 0.3 | 4.0 |
| 1.4 | 0.312253 | 0.000000 | 0.3 | 0.3 | 0.3 | 4.0 |
| 1.5 | 0.295896 | 0.000000 | 0.3 | 0.3 | 0.3 | 4.0 |
| 1.6 | 0.280876 | 0.000000 | 0.3 | 0.3 | 0.3 | 4.0 |
| 1.7 | 0.267138 | 0.000000 | 0.3 | 0.3 | 0.3 | 4.0 |
| 1.8 | 0.254610 | 0.000000 | 0.3 | 0.3 | 0.3 | 4.0 |
| 1.9 | 0.242927 | 0.000000 | 0.3 | 0.3 | 0.3 | 4.0 |
| 2.0 | 0.232156 | 0.000000 | 0.3 | 0.3 | 0.3 | 4.0 |
| 2.1 | 0.222173 | 0.000000 | 0.3 | 0.3 | 0.3 | 4.0 |
| 2.2 | 0.212910 | 0.000000 | 0.3 | 0.3 | 0.3 | 4.0 |
| 2.3 | 0.204271 | 0.000000 | 0.3 | 0.3 | 0.3 | 4.0 |
| 2.4 | 0.196183 | 0.000000 | 0.3 | 0.3 | 0.3 | 4.0 |
| 2.5 | 0.188608 | 0.000000 | 0.3 | 0.3 | 0.3 | 4.0 |
| 2.6 | 0.181556 | 0.000000 | 0.4 | 0.4 | 0.4 | 4.0 |
| 2.7 | 0.174979 | 0.000000 | 0.4 | 0.4 | 0.4 | 4.0 |
| 2.8 | 0.168659 | 0.000000 | 0.4 | 0.4 | 0.4 | 4.0 |
| 2.9 | 0.162728 | 0.000000 | 0.4 | 0.4 | 0.4 | 4.0 |
| 3.0 | 0.157075 | 0.000000 | 0.4 | 0.4 | 0.4 | 4.0 |
| 3.1 | 0.151774 | 0.000000 | 0.4 | 0.4 | 0.4 | 4.0 |
| 3.2 | 0.146767 | 0.000000 | 0.4 | 0.4 | 0.4 | 4.0 |
| 3.3 | 0.142057 | 0.000000 | 0.4 | 0.4 | 0.4 | 4.0 |
| 3.4 | 0.137556 | 0.000000 | 0.4 | 0.4 | 0.4 | 4.0 |



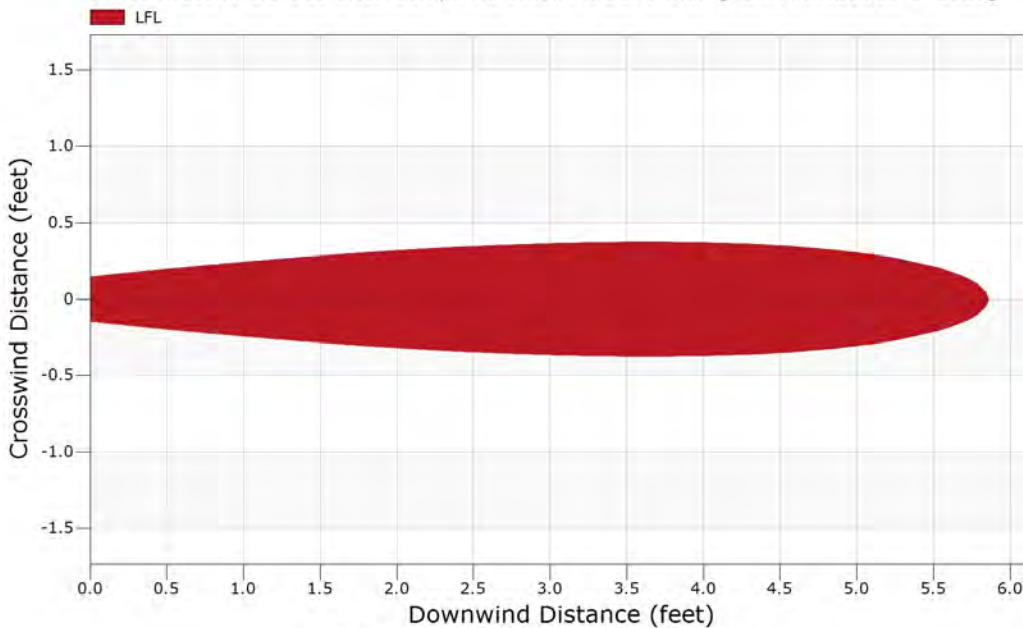
| downwind distance x(ft) | centerline conc. c(mole frac.) | ground conc. c(mole frac.) | y(c1) 1/2 width (ft) | y(c2) 1/2 width (ft) | y(c3) 1/2 width (ft) | centerline height (ft) |
|-------------------------------|--------------------------------------|----------------------------------|----------------------------|----------------------------|----------------------------|------------------------------|
| 3.5 | 0.133327 | 0.000000 | 0.4 | 0.4 | 0.4 | 4.0 |
| 3.6 | 0.129232 | 0.000000 | 0.4 | 0.4 | 0.4 | 4.0 |
| 3.7 | 0.125369 | 0.000000 | 0.4 | 0.4 | 0.4 | 4.0 |
| 3.8 | 0.121655 | 0.000000 | 0.4 | 0.4 | 0.4 | 4.0 |
| 3.9 | 0.118107 | 0.000000 | 0.4 | 0.4 | 0.4 | 4.0 |
| 4.0 | 0.114740 | 0.000000 | 0.4 | 0.4 | 0.4 | 4.0 |
| 4.1 | 0.111504 | 0.000000 | 0.4 | 0.4 | 0.4 | 4.0 |
| 4.2 | 0.108434 | 0.000000 | 0.4 | 0.4 | 0.4 | 4.0 |
| 4.3 | 0.105486 | 0.000000 | 0.4 | 0.4 | 0.4 | 4.0 |
| 4.4 | 0.102650 | 0.000000 | 0.4 | 0.4 | 0.4 | 4.0 |
| 4.5 | 0.099951 | 0.000000 | 0.4 | 0.4 | 0.4 | 4.0 |
| 4.6 | 0.097335 | 0.000000 | 0.3 | 0.3 | 0.3 | 4.0 |
| 4.7 | 0.094820 | 0.000000 | 0.3 | 0.3 | 0.3 | 4.0 |
| 4.8 | 0.092420 | 0.000000 | 0.3 | 0.3 | 0.3 | 4.0 |
| 4.9 | 0.090101 | 0.000000 | 0.3 | 0.3 | 0.3 | 4.0 |
| 5.0 | 0.087871 | 0.000000 | 0.3 | 0.3 | 0.3 | 4.0 |
| 5.1 | 0.085740 | 0.000000 | 0.3 | 0.3 | 0.3 | 4.0 |
| 5.2 | 0.083680 | 0.000000 | 0.3 | 0.3 | 0.3 | 4.0 |
| 5.3 | 0.081688 | 0.000000 | 0.3 | 0.3 | 0.3 | 4.0 |
| 5.4 | 0.079780 | 0.000000 | 0.2 | 0.2 | 0.2 | 4.0 |
| 5.5 | 0.077944 | 0.000000 | 0.2 | 0.2 | 0.2 | 4.0 |
| 5.6 | 0.076138 | 0.000000 | 0.2 | 0.2 | 0.2 | 4.0 |
| 5.7 | 0.074405 | 0.000000 | 0.1 | 0.1 | 0.1 | 4.0 |
| 5.8 | 0.072741 | 0.000000 | 0.1 | 0.1 | 0.1 | 4.0 |
| 5.9 | 0.071125 | 0.000000 | 0.0 | 0.0 | 0.0 | 4.0 |

The downwind distance to c3 is 5.86 ft after about 0 seconds
 The downwind distance to c2 is 5.86 ft after about 0 seconds
 The downwind distance to c1 is 5.86 ft after about 0 seconds



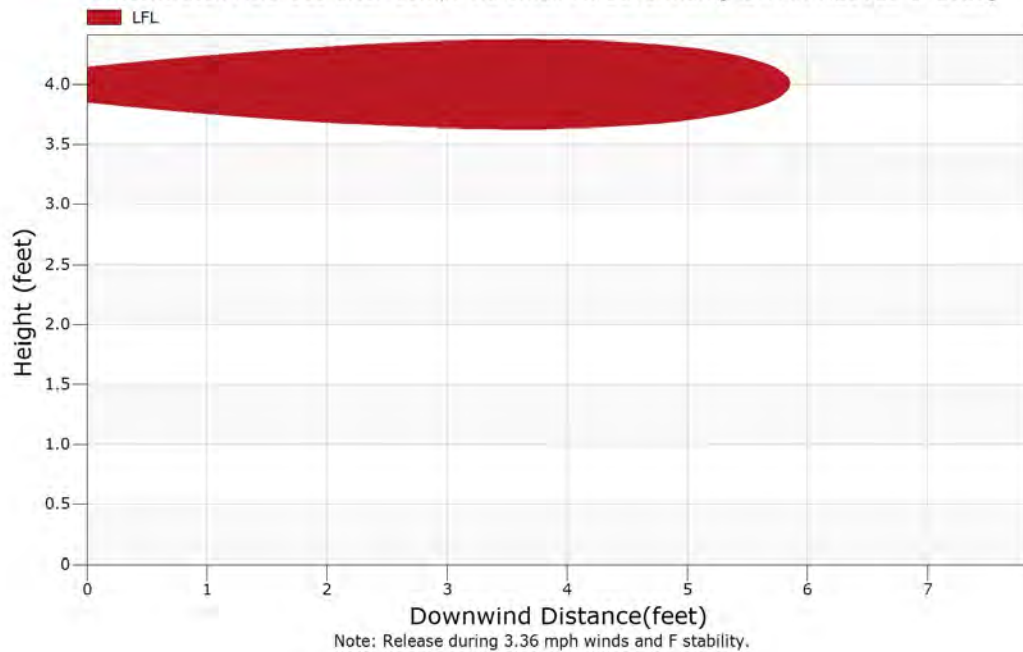
Momentum Jet Contours - Overhead View

Concentrated Acid Gas after Comp. via email M. Baverman [ALTPAR-H2S02a-D-2020]



Momentum Jet Contours - Side View

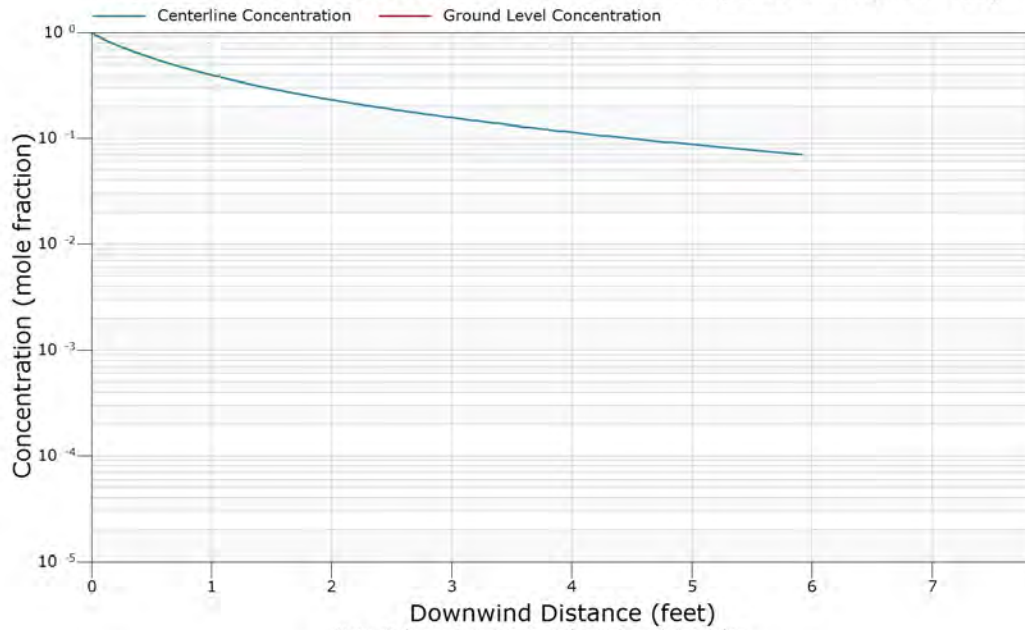
Concentrated Acid Gas after Comp. via email M. Baverman [ALTPAR-H2S02a-D-2020]





Momentum Jet Concentration

Concentrated Acid Gas after Comp. via email M. Baverman [ALTPAR-H2S02a-D-2020]





Case Inputs

Case Type : Vapor Dispersion
Case Name : ALTPAR-H2S02a-DT-2020
User ID : dwj
Project Number : 7162
Type of Units : English Units

NOTES: Information via email from M. Baverman - stream after compression

MATERIAL MENU

| Materials Released | Number | Formula | Name | Fraction |
|--------------------|--------|---------|------------------|----------|
| Component 1 | : 17 | = CO2 | Carbon Dioxide | 0.429500 |
| Component 2 | : 52 | = H2O | Water | 0.013200 |
| Component 3 | : 18 | = H2S | Hydrogen Sulfide | 0.557300 |
| Component 4 | : | | | |
| Component 5 | : | | | |
| Component 6 | : | | | |
| Component 7 | : | | | |
| Component 8 | : | | | |
| Component 9 | : | | | |
| Component 10 | : | | | |

Temperature : 400.00 °F
Pressure : 1084.70 psia
The material is GAS

NOTES:

ENVIRONMENT MENU

| | |
|-------------------------------|-----------|
| Wind speed | 3.36 mph |
| Wind speed measurement height | 32.8 feet |
| Stability class <A-F> | F |
| Relative humidity | 65 % |
| Air temperature | 65.0 °F |
| Spill surface temperature | 80.3 °F |

| | |
|--------------------------------|--------------------------------------|
| Substrate name | High density concrete |
| Substrate thermal conductivity | 2.1999 Btu/hr-ft-F |
| Substrate density | 150 lb/cu.ft |
| Substrate heat Capacity | 0.16 Btu/lb-F |
| Substrate delay time | 0 sec |
| Surrounding terrain | Forest, dense urban, or process area |

NOTES:



RELEASE MENU

Type of release: Unregulated, Continuous release
Release duration 10 min
Normal flow rate 0.29 lb/sec
Duration of normal flow 10 min
Volume of vessel 0.00 cu.ft
Pipe inner diameter 2.07 inches
Equivalent release diameter 2.07 inches
Pipe length upstream of break 10.0 feet
Pipe length downstream of break 0.0 feet
Height of release point 4.0 feet
Angle of release from horizontal 0.0 degrees

NOTES:

IMPOUNDMENT MENU

Unconfined

NOTES:

VDVE MENU

Vapor generation and dispersion - Toxic calculation
Tracking component 18 = H2S Hydrogen Sulfide
Concentration endpoint 1 30.0 ppm
Concentration endpoint 2 30.0 ppm
Concentration endpoint 3 30.0 ppm
Dispersion coefficient averaging time 6e+01 min

NOTES:

**Release Model**

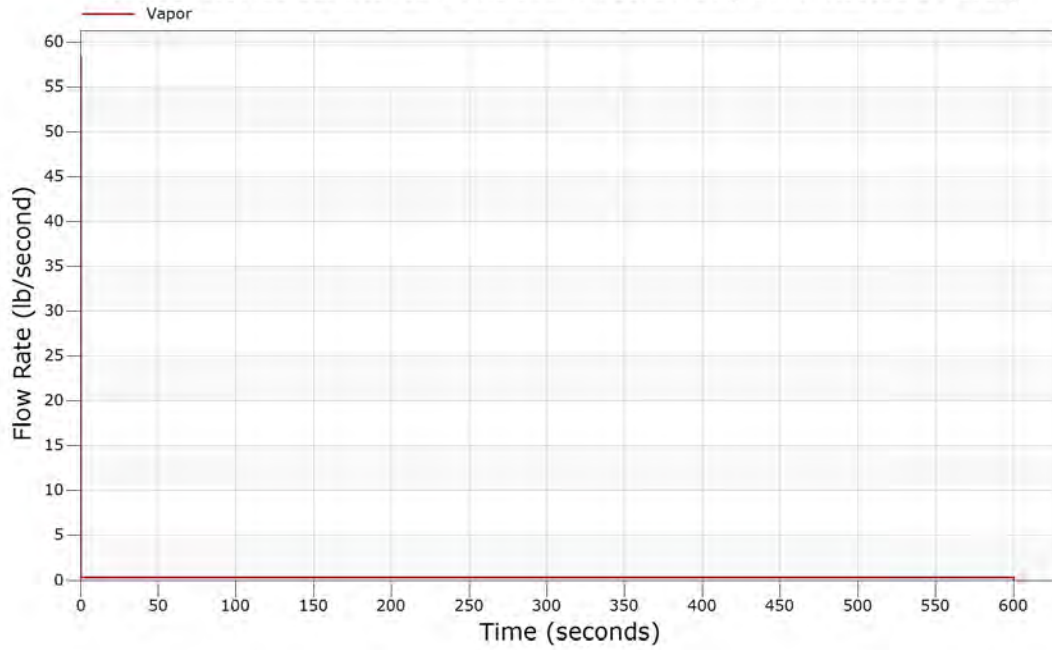
| Time (sec) | Vapor (lb/sec) | Aerosol Rate (lb/sec) | Liquid Rate (lb/sec) | Total Rate (lb/sec) |
|---------------|-------------------|--------------------------|-------------------------|------------------------|
| 0.000000 | 58.37226 | 0.000000 | 0.000000 | 58.37226 |
| 0.100000 | .5991720 | 0.000000 | 0.000000 | .5991720 |
| 0.300000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| 0.500000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| 0.700000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| 1.000000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| 3.000000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| 5.000000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| 7.000000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| 10.00000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| 20.00000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| 30.00000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| 40.00000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| 50.00000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| 60.00000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| 70.00000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| 85.00000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| 100.0000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| 200.0000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| 300.0000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| 400.0000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| 500.0000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| 600.0000 | .2905561 | 0.000000 | 0.000000 | .2905561 |
| Totals (lb) | 175.5309 | 0.000000 | 0.000000 | 175.5309 |

Reason for Ending: Reached Stop Time



Mass Release Rate

Concentrated Acid Gas after Comp. via email M. Baverman [ALTPAR-H2S02a-DT-2020]





Release Compositions

| Component Number | Component Name, Formula |
|------------------|-------------------------|
| 17 | Carbon Dioxide, CO2 |
| 52 | Water, H2O |
| 18 | Hydrogen Sulfide, H2S |

Composition (Mole Fraction) of Fluid Streams

| Comp. No. | Feed Stream | Momentum Jet Stream | | | | Liquid Pool Stream |
|-----------|-------------|---------------------|------------------|----------------|--------------|--------------------|
| | | Flashed Vapor | Evaporated Vapor | Aerosol Liquid | Total Stream | Liquid to Ground |
| 17 | 0.429500 | 0.429500 | 0.000000 | 0.000000 | 0.429500 | 0.000000 |
| 52 | 0.013200 | 0.013200 | 0.000000 | 0.000000 | 0.013200 | 0.000000 |
| 18 | 0.557300 | 0.557300 | 0.000000 | 0.000000 | 0.557300 | 0.000000 |
| | 1.000000 | 1.000000 | 0.000000 | 0.000000 | 1.000000 | 0.000000 |



Momentum Jet Dispersion

concentration limits

concentration 3 (highest) = 30.000 ppm
 concentration 2 (middle) = 30.000 ppm
 concentration 1 (lowest) = 30.000 ppm

| downwind distance x(ft) | centerline conc. c(ppm) | ground conc. c(ppm) | y(c1) 1/2 width (ft) | y(c2) 1/2 width (ft) | y(c3) 1/2 width (ft) | centerline height (ft) |
|----------------------------|-------------------------------|---------------------------|----------------------------|----------------------------|----------------------------|------------------------------|
| 0 | 557300.000 | 0.000 | 0.3 | 0.3 | 0.3 | 4.0 |
| 5 | 48947.824 | 0.000 | 1.9 | 1.9 | 1.9 | 4.0 |
| 10 | 18480.360 | 18.905 | 3.9 | 3.9 | 3.9 | 4.0 |
| 15 | 9364.842 | 726.309 | 6.1 | 6.1 | 6.1 | 4.1 |
| 20 | 5510.592 | 1559.249 | 8.3 | 8.3 | 8.3 | 4.1 |
| 25 | 3579.328 | 1708.993 | 10.5 | 10.5 | 10.5 | 4.1 |
| 30 | 2488.135 | 1536.500 | 12.5 | 12.5 | 12.5 | 4.1 |
| 35 | 1817.687 | 1295.453 | 14.4 | 14.4 | 14.4 | 4.1 |
| 40 | 1380.976 | 1074.767 | 16.2 | 16.2 | 16.2 | 4.1 |
| 45 | 1082.408 | 892.416 | 17.9 | 17.9 | 17.9 | 4.2 |
| 50 | 869.696 | 746.190 | 19.5 | 19.5 | 19.5 | 4.2 |
| 55 | 712.639 | 629.241 | 21.0 | 21.0 | 21.0 | 4.2 |
| 60 | 594.212 | 535.942 | 22.4 | 22.4 | 22.4 | 4.2 |
| 65 | 502.060 | 460.262 | 23.7 | 23.7 | 23.7 | 4.2 |
| 70 | 430.363 | 399.537 | 25.0 | 25.0 | 25.0 | 4.2 |
| 75 | 372.522 | 349.364 | 26.1 | 26.1 | 26.1 | 4.2 |
| 80 | 325.479 | 307.735 | 27.2 | 27.2 | 27.2 | 4.2 |
| 85 | 286.757 | 272.957 | 28.2 | 28.2 | 28.2 | 4.2 |
| 90 | 254.479 | 243.577 | 29.2 | 29.2 | 29.2 | 4.2 |
| 95 | 227.372 | 218.654 | 30.1 | 30.1 | 30.1 | 4.2 |
| 100 | 204.334 | 197.284 | 30.9 | 30.9 | 30.9 | 4.2 |
| 105 | 184.589 | 178.819 | 31.6 | 31.6 | 31.6 | 4.2 |
| 110 | 167.542 | 162.781 | 32.3 | 32.3 | 32.3 | 4.2 |
| 115 | 152.726 | 148.763 | 32.9 | 32.9 | 32.9 | 4.2 |
| 120 | 139.772 | 136.449 | 33.4 | 33.4 | 33.4 | 4.2 |
| 125 | 128.380 | 125.567 | 33.9 | 33.9 | 33.9 | 4.2 |
| 130 | 118.289 | 115.898 | 34.3 | 34.3 | 34.3 | 4.2 |
| 135 | 109.379 | 107.332 | 34.6 | 34.6 | 34.6 | 4.2 |
| 140 | 101.483 | 99.720 | 34.9 | 34.9 | 34.9 | 4.2 |
| 145 | 94.352 | 92.827 | 35.1 | 35.1 | 35.1 | 4.2 |
| 150 | 87.934 | 86.608 | 35.2 | 35.2 | 35.2 | 4.2 |
| 155 | 82.185 | 81.025 | 35.2 | 35.2 | 35.2 | 4.2 |
| 160 | 76.950 | 75.931 | 35.2 | 35.2 | 35.2 | 4.2 |
| 165 | 72.196 | 71.298 | 35.1 | 35.1 | 35.1 | 4.2 |
| 170 | 67.873 | 67.078 | 34.8 | 34.8 | 34.8 | 4.2 |

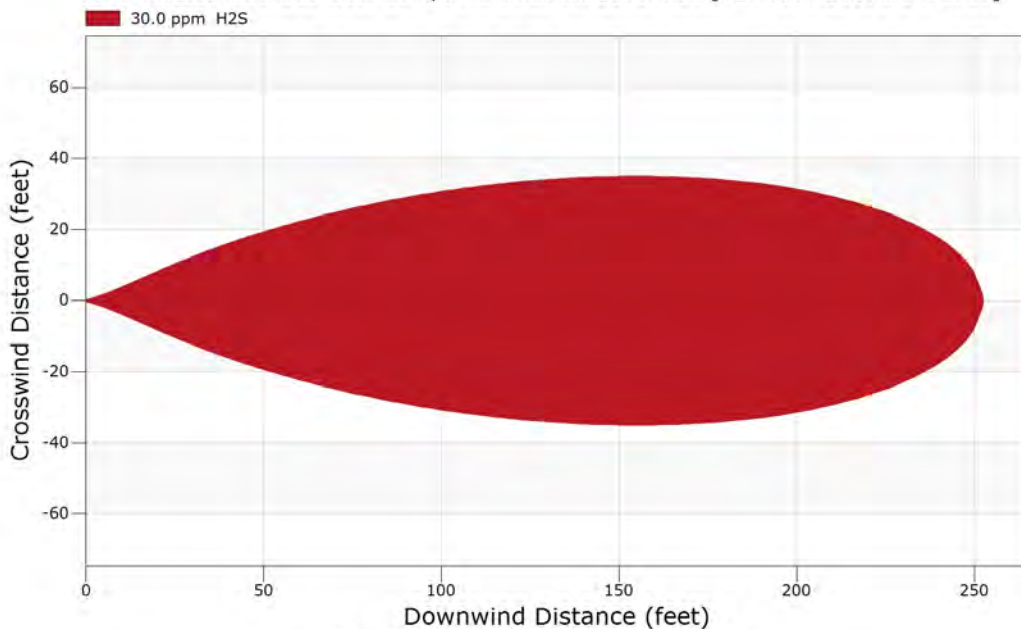


| downwind distance x(ft) | centerline conc. c(ppm) | ground conc. c(ppm) | y(c1) 1/2 width (ft) | y(c2) 1/2 width (ft) | y(c3) 1/2 width (ft) | centerline height (ft) |
|----------------------------|-------------------------------|---------------------------|----------------------------|----------------------------|----------------------------|------------------------------|
| 175 | 63.923 | 63.218 | 34.6 | 34.6 | 34.6 | 4.2 |
| 180 | 60.305 | 59.676 | 34.2 | 34.2 | 34.2 | 4.2 |
| 185 | 56.982 | 56.420 | 33.7 | 33.7 | 33.7 | 4.2 |
| 190 | 53.927 | 53.424 | 33.1 | 33.1 | 33.1 | 4.2 |
| 195 | 51.109 | 50.657 | 32.4 | 32.4 | 32.4 | 4.2 |
| 200 | 48.494 | 48.086 | 31.6 | 31.6 | 31.6 | 4.2 |
| 205 | 46.092 | 45.723 | 30.6 | 30.6 | 30.6 | 4.2 |
| 210 | 43.854 | 43.520 | 29.5 | 29.5 | 29.5 | 4.2 |
| 215 | 41.767 | 41.463 | 28.2 | 28.2 | 28.2 | 4.2 |
| 220 | 39.833 | 39.557 | 26.7 | 26.7 | 26.7 | 4.2 |
| 225 | 38.042 | 37.790 | 25.0 | 25.0 | 25.0 | 4.2 |
| 230 | 36.358 | 36.127 | 23.0 | 23.0 | 23.0 | 4.2 |
| 235 | 34.782 | 34.570 | 20.6 | 20.6 | 20.6 | 4.2 |
| 240 | 33.306 | 33.113 | 17.7 | 17.7 | 17.7 | 4.2 |
| 245 | 31.922 | 31.744 | 14.0 | 14.0 | 14.0 | 4.2 |
| 250 | 30.622 | 30.458 | 8.1 | 8.1 | 8.1 | 4.2 |

The downwind distance to c3 is 252.50 ft after about 68 seconds
 The downwind distance to c2 is 252.50 ft after about 68 seconds
 The downwind distance to c1 is 252.50 ft after about 68 seconds

Momentum Jet Contours - Overhead View

Concentrated Acid Gas after Comp. via email M. Baverman [ALTPAR-H2S02a-DT-2020]

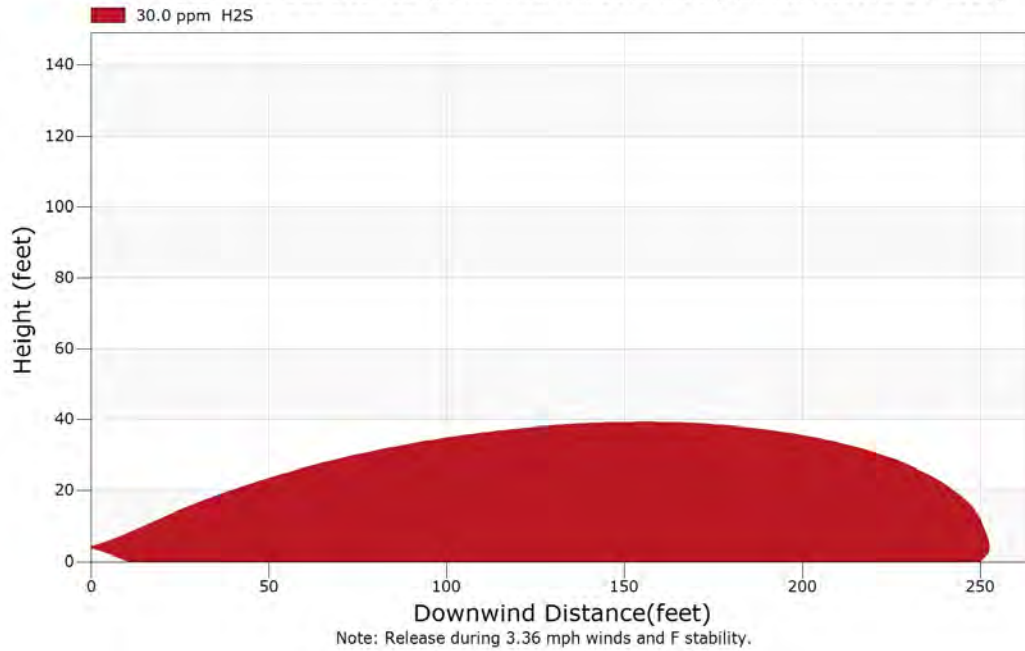


Note: Release during 3.36 mph winds and F stability.



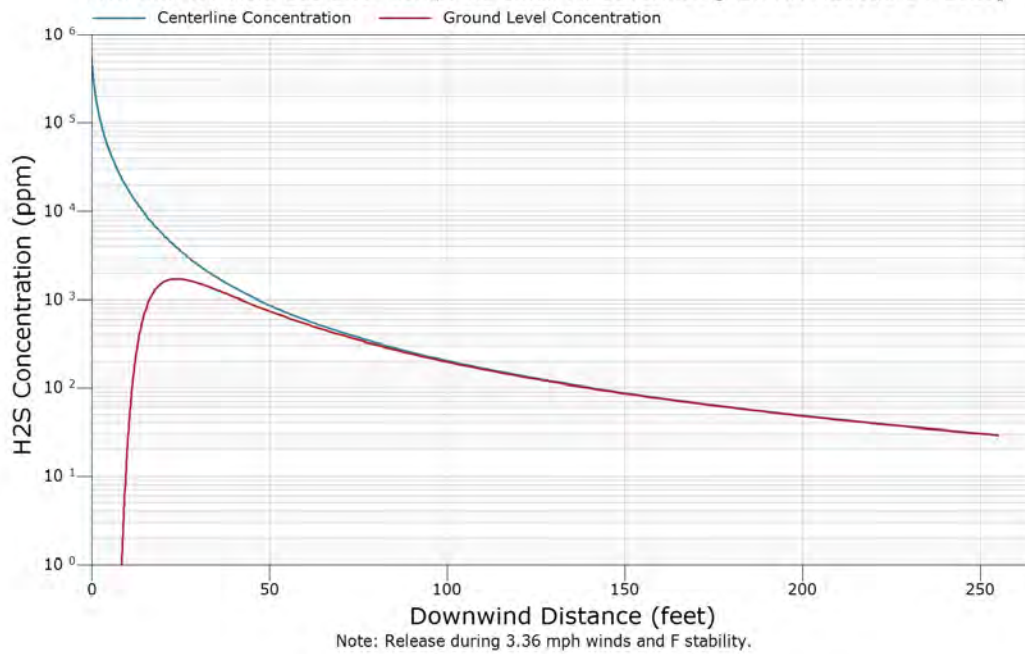
Momentum Jet Contours - Side View

Concentrated Acid Gas after Comp. via email M. Baverman [ALTPAR-H2S02a-DT-2020]



Momentum Jet Concentration

Concentrated Acid Gas after Comp. via email M. Baverman [ALTPAR-H2S02a-DT-2020]





Case Inputs

Case Type : Fire Radiation
Case Name : ALTPAR-H2S02a-T-2020
User ID : dwj
Project Number : 7162
Type of Units : English Units

NOTES: Information via email from M. Baverman - stream after compression

MATERIAL MENU

| Materials Released | Number | Formula | Name | Fraction |
|--------------------|--------|---------|------------------|----------|
| Component 1 | : 17 | = CO2 | Carbon Dioxide | 0.429500 |
| Component 2 | : 52 | = H2O | Water | 0.013200 |
| Component 3 | : 18 | = H2S | Hydrogen Sulfide | 0.557300 |
| Component 4 | : | | | |
| Component 5 | : | | | |
| Component 6 | : | | | |
| Component 7 | : | | | |
| Component 8 | : | | | |
| Component 9 | : | | | |
| Component 10 | : | | | |

Temperature : 400.00 °F
Pressure : 1084.70 psia
The material is GAS

NOTES:

ENVIRONMENT MENU

Wind speed : 20.00 mph
Relative humidity : 65 %
Air temperature : 65.0 °F

NOTES:

FIRE TYPE MENU

Fire radiation division: Jet fire
Horizontal isopleths only
Elevation of flame base (from grade) : 4.0 feet
Elevation of target (from grade) : 0.0 feet
Diameter of jet fire tip : 0.1722 feet
Flow rate : 0.31 lb/sec
Angle of release from horizontal : 0.0 degrees

Fire radiation flux values

Radiation endpoint 1 : 1600 Btu/hr-sq.ft
Radiation endpoint 2 : 1600 Btu/hr-sq.ft
Radiation endpoint 3 : 1600 Btu/hr-sq.ft

NOTES:



Jet Fire Radiation

Length of Flame : 12.7 feet
Flame Tilt from Horizontal: 12.1 degrees
Release Angle : 0.0 degrees
Release Point Elevation : 4.0 feet
Target Elevation : 0.0 feet
Wind Speed : 20.0 mph

| Downwind Distance at Target Height (feet) | Maximum Flux (Btu/hr-sq.ft) |
|---|-----------------------------------|
| 3.3 | 1902 |
| 3.5 | 1953 |
| 3.8 | 2000 |
| 4.1 | 2067 |
| 4.5 | 2139 |
| 4.8 | 2212 |
| 5.2 | 2284 |
| 5.6 | 2356 |
| 6.1 | 2421 |
| 6.6 | 2474 |
| 7.1 | 2506 |
| 7.7 | 2508 |
| 8.3 | 2478 |
| 9.0 | 2438 |
| 9.7 | 2377 |
| 10.5 | 2243 |
| 11.3 | 2033 |
| 12.2 | 1771 |
| 13.2 | 1484 |
| 14.3 | 1201 |
| 15.4 | 944 |
| 16.7 | 725 |
| 18.0 | 551 |
| 19.5 | 417 |
| 21.0 | 315 |

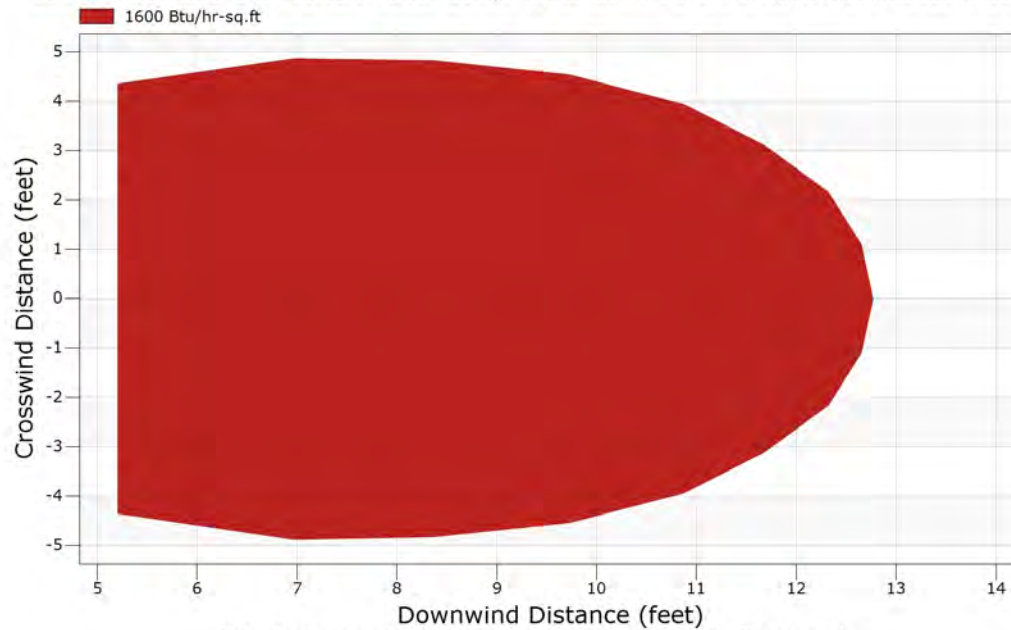
Downwind Distances to Endpoints

| Distance (feet) | Maximum Flux (Btu/hr-sq.ft) |
|--------------------|--------------------------------|
| 12.8 | 1600 |
| 12.8 | 1600 |
| 12.8 | 1600 |



Jet Fire Radiant Heat Contours - Overhead View

Concentrated Acid Gas -TORCH - after Comp. via email M. Baverman [ALTPAR-H2S02a-T-2020]



Note: Results presented for 4 feet below the release point during 20 mph winds.



Case Inputs

Case Type : Vapor Dispersion
Case Name : CrudeVCE
User ID :
Project Number :
Type of Units : English Units

NOTES:

MATERIAL MENU

| Materials Released | Number | Formula | Name | Fraction |
|--------------------|--------|---------|---------------|----------|
| Component 1 | 8 | C6H14 | n-Hexane | 0.011000 |
| Component 2 | 11 | C9H20 | n-Nonane | 0.033000 |
| Component 3 | 13 | C11H24 | n-Undecane | 0.048000 |
| Component 4 | 22 | C38H61 | PHC-500 | 0.367000 |
| Component 5 | 24 | C51H82 | PHC-700 | 0.192000 |
| Component 6 | 32 | C13H28 | Tridecane | 0.064000 |
| Component 7 | 34 | C15H32 | Pentadecane | 0.112000 |
| Component 8 | 36 | C17H36 | n-Heptadecane | 0.173000 |
| Component 9 | | | | |
| Component 10 | | | | |

Temperature : 68.00 °F
Pressure : 15.00 psia
The material is LIQUID
The mixture is Heavy Crude

NOTES:

ENVIRONMENT MENU

| | |
|--------------------------------|------------------------------------|
| Wind speed | 3.36 mph |
| Wind speed measurement height | 32.8 feet |
| Stability class <A-F> | F |
| Relative humidity | 70 % |
| Air temperature | 68.0 °F |
| Spill surface temperature | 68.0 °F |
| Substrate name | High density concrete |
| Substrate thermal conductivity | 2.1999 Btu/hr-ft-F |
| Substrate density | 150 lb/cu.ft |
| Substrate heat Capacity | 0.16 Btu/lb-F |
| Substrate delay time | 0 sec |
| Surrounding terrain | Long grass or crops > 15 cm (6 in) |

NOTES:



RELEASE MENU

Type of release: Unregulated, Continuous release
Release duration 10 min
Normal flow rate 99.26 lb/sec
Duration of normal flow 10 min
Volume of vessel 1336.81 cu.ft
Percent of vessel filled with liquid 80 %
Liquid head above release point 6 feet
Pipe inner diameter 3.07 inches
Equivalent release diameter 3.07 inches
Pipe length upstream of break 0.0 feet
Height of release point 1.0 feet
Angle of release from horizontal 0.0 degrees

NOTES:

IMPOUNDMENT MENU

Unconfined

NOTES:

VDVE MENU

Vapor generation, dispersion and cloud explosion - Flammable calculation

Concentration endpoint 1 LFL mol%
Concentration endpoint 2 LFL mol%
Concentration endpoint 3 LFL mol%

Dispersion coefficient averaging time 1 min

Baker-Strehlow-Tang parameters

Fuel reactivity Medium
Obstacle density Low
Flame expansion 2.5-D

Overpressure values

Overpressure endpoint 1 1.00 psi
Overpressure endpoint 2 1.00 psi
Overpressure endpoint 3 1.00 psi

NOTES:

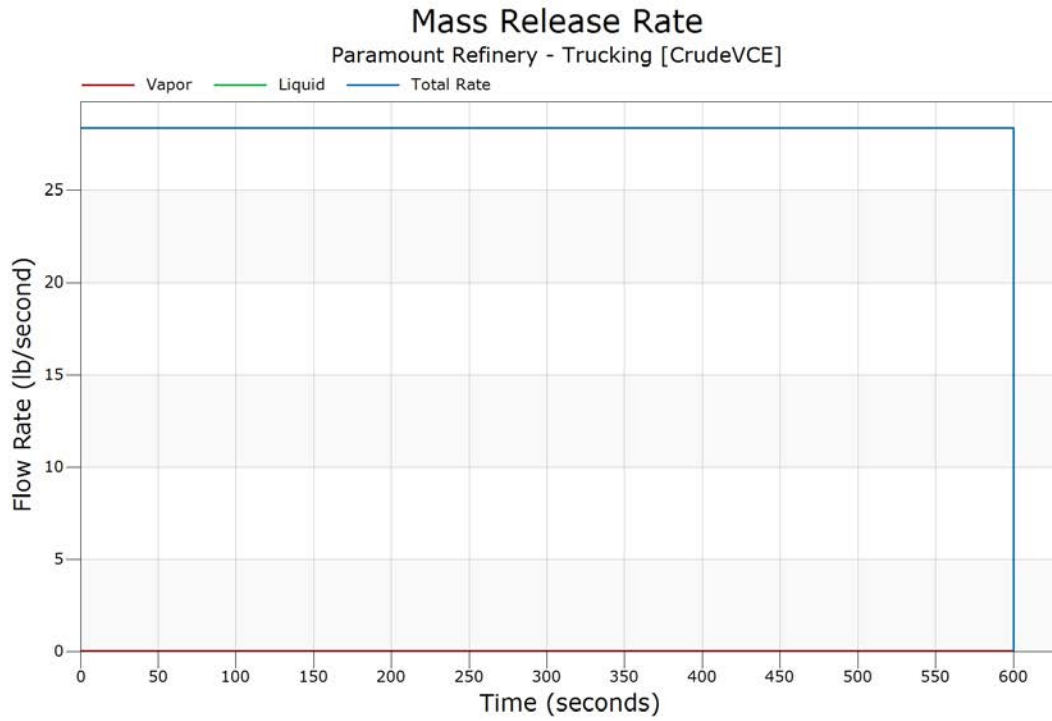


Release Model

| Time (sec) | Vapor (lb/sec) | Aerosol Rate (lb/sec) | Liquid Rate (lb/sec) | Total Rate (lb/sec) |
|---------------|-------------------|--------------------------|-------------------------|------------------------|
| 0.000000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 0.100000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 0.300000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 0.500000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 0.700000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 1.000000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 3.000000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 5.000000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 7.000000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 10.00000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 20.00000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 30.00000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 40.00000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 50.00000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 60.00000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 70.00000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 85.00000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 100.0000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 200.0000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 300.0000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 400.0000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 500.0000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 600.0000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| Totals (lb) | 3.926202 | 0.000000 | 17041.61 | 17045.54 |

Flowrate for Jet Fire [immediate ignition] = 0.6543670E-02 lb/sec.
Jet Fire [delayed ignition] = 0.6543670E-02 lb/sec.

Reason for Ending: Reached Stop Time





Release Compositions

| Component Number | Component Name, Formula |
|------------------|-------------------------|
| 8 | n-Hexane, C6H14 |
| 11 | n-Nonane, C9H20 |
| 13 | n-Undecane, C11H24 |
| 22 | PHC-500, C38H61 |
| 24 | PHC-700, C51H82 |
| 32 | Tridecane, C13H28 |
| 34 | Pentadecane, C15H32 |
| 36 | n-Heptadecane, C17H36 |

Composition (Mole Fraction) of Fluid Streams

| Comp. No. | Feed Stream | Momentum Jet Stream | | | Total Stream | Liquid Pool Stream |
|-----------|-------------|---------------------|------------------|----------------|------------------|--------------------|
| | | Flashed Vapor | Evaporated Vapor | Aerosol Liquid | Liquid to Ground | |
| 8 | 0.011000 | 0.000000 | 0.896417 | 0.000000 | 0.896417 | 0.010998 |
| 11 | 0.033000 | 0.000000 | 0.087394 | 0.000000 | 0.087394 | 0.033000 |
| 13 | 0.048000 | 0.000000 | 0.013673 | 0.000000 | 0.013673 | 0.048000 |
| 22 | 0.367000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.367001 |
| 24 | 0.192000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.192000 |
| 32 | 0.064000 | 0.000000 | 0.002033 | 0.000000 | 0.002033 | 0.064000 |
| 34 | 0.112000 | 0.000000 | 0.000401 | 0.000000 | 0.000401 | 0.112000 |
| 36 | 0.173000 | 0.000000 | 0.000083 | 0.000000 | 0.000083 | 0.173000 |
| | 1.000000 | 0.000000 | 1.000000 | 0.000000 | 1.000000 | 1.000000 |

Flammable Limits (Mole %) of Fluid Streams

| Limit | Feed Stream | Momentum Jet Stream | Liquid Pool Stream |
|-------|-------------|---------------------|--------------------|
| LFL | 0.44 | 1.05 | 0.44 |
| UFL | 6.25 | 6.53 | 6.25 |
| LBV | | 0.42 m/s | 0.40 m/s |



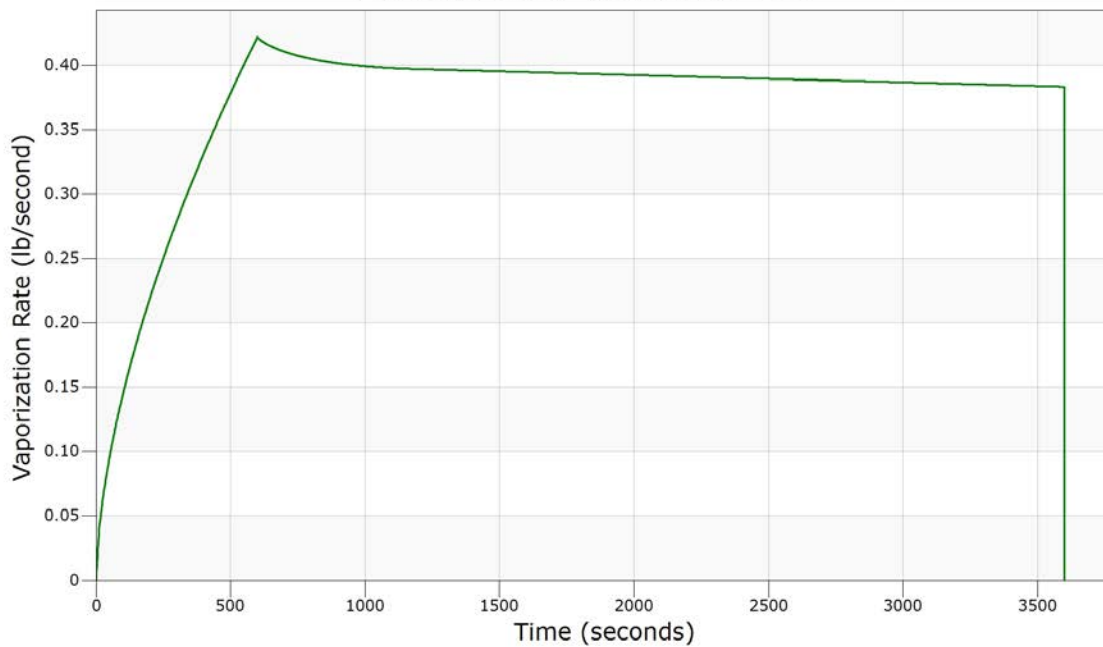
Pool Spreading and Vaporization

| Time (sec) | Liquid Remaining (ft3) | Pool/Dike Radius (feet) | Vapor Rate (lb/sec) |
|---------------|------------------------------|-------------------------------|------------------------|
| 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| 40.0000 | 26.0739 | 7.34679 | 0.835905E-01 |
| 80.0000 | 52.0962 | 9.25492 | 0.126627 |
| 120.000 | 78.0843 | 10.5919 | 0.161433 |
| 160.000 | 104.041 | 11.6549 | 0.191771 |
| 200.000 | 129.972 | 12.5518 | 0.219146 |
| 240.000 | 155.879 | 13.3353 | 0.244382 |
| 280.000 | 181.761 | 14.0354 | 0.267972 |
| 320.000 | 207.626 | 14.6709 | 0.290194 |
| 360.000 | 233.469 | 15.2556 | 0.311315 |
| 400.000 | 259.291 | 15.7979 | 0.331531 |
| 440.000 | 285.099 | 16.3051 | 0.350932 |
| 480.000 | 310.886 | 16.7822 | 0.369627 |
| 520.000 | 336.658 | 17.2333 | 0.387683 |
| 560.000 | 362.399 | 17.6614 | 0.405210 |
| 600.000 | 388.143 | 18.0699 | 0.422229 |
| 640.000 | 387.755 | 18.0640 | 0.416233 |
| 680.000 | 387.402 | 18.0581 | 0.412485 |
| 720.000 | 387.013 | 18.0522 | 0.409619 |
| 760.000 | 386.625 | 18.0466 | 0.407282 |
| 800.000 | 386.272 | 18.0407 | 0.405342 |
| 840.000 | 385.883 | 18.0348 | 0.403733 |
| 880.000 | 385.530 | 18.0292 | 0.402366 |
| 1130.00 | 383.235 | 17.9931 | 0.397692 |
| 1380.00 | 380.939 | 17.9573 | 0.396171 |
| 1630.00 | 378.679 | 17.9216 | 0.394760 |
| 1880.00 | 376.384 | 17.8858 | 0.393327 |
| 2130.00 | 374.159 | 17.8497 | 0.391916 |
| 2380.00 | 371.899 | 17.8140 | 0.390505 |
| 2630.00 | 369.639 | 17.7782 | 0.389094 |
| 2880.00 | 367.414 | 17.7425 | 0.387683 |
| 3130.00 | 365.189 | 17.7064 | 0.386272 |
| 3380.00 | 362.999 | 17.6706 | 0.384861 |
| 3600.00 | 361.022 | 17.6391 | 0.383626 |

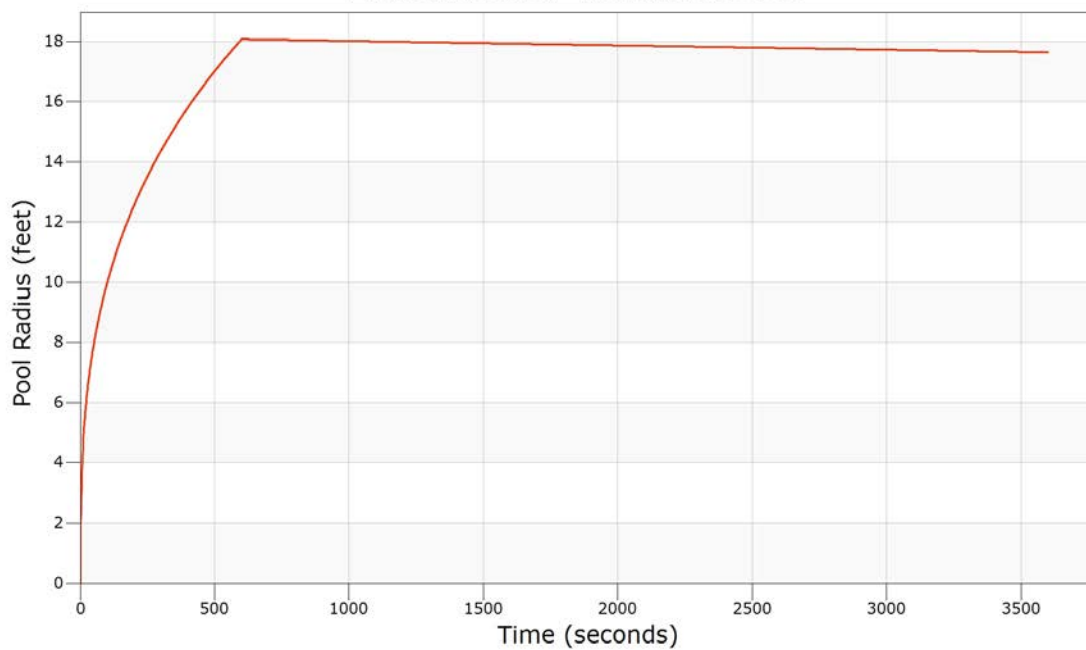
Ending Message: Normal Ending



Pool Vaporization Rate
Paramount Refinery - Trucking [CrudeVCE]



Pool Radius
Paramount Refinery - Trucking [CrudeVCE]





Momentum Jet Dispersion

concentration limits

Endpoint 1 (highest) = 0.010531 mole fraction
Endpoint 2 (middle) = 0.010531 mole fraction
Endpoint 3 (lowest) = 0.010531 mole fraction

| downwind distance (ft) | centerline conc. (mole frac.) | ground conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) | centerline height (ft) |
|------------------------------|-------------------------------------|---------------------------------|--------------------------------|--------------------------------|--------------------------------|------------------------------|
| 0 | 1.000000 | 0.000000 | 0.1 | 0.1 | 0.1 | 1.0 |
| 0.3 | 0.712278 | 0.000000 | 0.1 | 0.1 | 0.1 | 1.0 |
| 0.5 | 0.507982 | 0.000000 | 0.1 | 0.1 | 0.1 | 1.0 |
| 0.8 | 0.360523 | 0.360523 | 0.2 | 0.2 | 0.2 | 0.0 |
| 1.0 | 0.279558 | 0.279558 | 0.3 | 0.3 | 0.3 | 0.0 |
| 1.3 | 0.229505 | 0.229505 | 0.4 | 0.4 | 0.4 | 0.0 |
| 1.5 | 0.195338 | 0.195338 | 0.5 | 0.5 | 0.5 | 0.0 |
| 1.7 | 0.170450 | 0.170450 | 0.5 | 0.5 | 0.5 | 0.0 |
| 2.0 | 0.151469 | 0.151469 | 0.6 | 0.6 | 0.6 | 0.0 |
| 2.3 | 0.136490 | 0.136490 | 0.7 | 0.7 | 0.7 | 0.0 |
| 2.5 | 0.124350 | 0.124350 | 0.8 | 0.8 | 0.8 | 0.0 |
| 2.8 | 0.114300 | 0.114300 | 0.9 | 0.9 | 0.9 | 0.0 |
| 3.0 | 0.105837 | 0.105837 | 1.0 | 1.0 | 1.0 | 0.0 |
| 3.3 | 0.098606 | 0.098606 | 1.1 | 1.1 | 1.1 | 0.0 |
| 3.5 | 0.092353 | 0.092353 | 1.2 | 1.2 | 1.2 | 0.0 |
| 3.7 | 0.086888 | 0.086888 | 1.3 | 1.3 | 1.3 | 0.0 |
| 4.0 | 0.082069 | 0.082069 | 1.4 | 1.4 | 1.4 | 0.0 |
| 4.3 | 0.077786 | 0.077786 | 1.5 | 1.5 | 1.5 | 0.0 |
| 4.5 | 0.073952 | 0.073952 | 1.6 | 1.6 | 1.6 | 0.0 |
| 4.8 | 0.070500 | 0.070500 | 1.7 | 1.7 | 1.7 | 0.0 |
| 5.0 | 0.067375 | 0.067375 | 1.8 | 1.8 | 1.8 | 0.0 |
| 5.3 | 0.064530 | 0.064530 | 1.9 | 1.9 | 1.9 | 0.0 |
| 5.5 | 0.061930 | 0.061930 | 2.0 | 2.0 | 2.0 | 0.0 |
| 5.8 | 0.059543 | 0.059543 | 2.1 | 2.1 | 2.1 | 0.0 |
| 6.0 | 0.057344 | 0.057344 | 2.2 | 2.2 | 2.2 | 0.0 |
| 6.3 | 0.055312 | 0.055312 | 2.2 | 2.2 | 2.2 | 0.0 |
| 6.5 | 0.053427 | 0.053427 | 2.3 | 2.3 | 2.3 | 0.0 |
| 6.8 | 0.051673 | 0.051673 | 2.4 | 2.4 | 2.4 | 0.0 |
| 7.0 | 0.050038 | 0.050038 | 2.5 | 2.5 | 2.5 | 0.0 |
| 7.3 | 0.048510 | 0.048510 | 2.6 | 2.6 | 2.6 | 0.0 |
| 7.5 | 0.047077 | 0.047077 | 2.7 | 2.7 | 2.7 | 0.0 |
| 7.8 | 0.045732 | 0.045732 | 2.8 | 2.8 | 2.8 | 0.0 |
| 8.0 | 0.044466 | 0.044466 | 2.9 | 2.9 | 2.9 | 0.0 |
| 8.3 | 0.042935 | 0.042935 | 3.0 | 3.0 | 3.0 | 0.0 |
| 8.5 | 0.040759 | 0.040759 | 2.9 | 2.9 | 2.9 | 0.0 |



CANARY by Quest Output Report
 Report Date: 11 June 2021
 Case Title: Paramount Refinery - Trucking

| downwind distance (ft) | centerline conc. (mole frac.) | ground conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) | centerline height (ft) |
|------------------------|-------------------------------|---------------------------|--------------------------|--------------------------|--------------------------|------------------------|
| 8.8 | 0.038752 | 0.038752 | 2.9 | 2.9 | 2.9 | 0.0 |
| 9.0 | 0.036896 | 0.036896 | 2.8 | 2.8 | 2.8 | 0.0 |
| 9.3 | 0.035176 | 0.035176 | 2.8 | 2.8 | 2.8 | 0.0 |
| 9.5 | 0.033580 | 0.033580 | 2.8 | 2.8 | 2.8 | 0.0 |
| 9.8 | 0.032094 | 0.032094 | 2.7 | 2.7 | 2.7 | 0.0 |
| 10.0 | 0.030709 | 0.030709 | 2.7 | 2.7 | 2.7 | 0.0 |
| 10.3 | 0.029416 | 0.029416 | 2.6 | 2.6 | 2.6 | 0.0 |
| 10.5 | 0.028207 | 0.028207 | 2.6 | 2.6 | 2.6 | 0.0 |
| 10.8 | 0.027074 | 0.027074 | 2.6 | 2.6 | 2.6 | 0.0 |
| 11.0 | 0.026011 | 0.026011 | 2.5 | 2.5 | 2.5 | 0.0 |
| 11.3 | 0.025012 | 0.025012 | 2.5 | 2.5 | 2.5 | 0.0 |
| 11.5 | 0.024073 | 0.024073 | 2.4 | 2.4 | 2.4 | 0.0 |
| 11.8 | 0.023187 | 0.023187 | 2.4 | 2.4 | 2.4 | 0.0 |
| 12.0 | 0.022352 | 0.022352 | 2.4 | 2.4 | 2.4 | 0.0 |
| 12.3 | 0.021564 | 0.021564 | 2.3 | 2.3 | 2.3 | 0.0 |
| 12.5 | 0.020818 | 0.020818 | 2.3 | 2.3 | 2.3 | 0.0 |
| 12.8 | 0.020112 | 0.020112 | 2.2 | 2.2 | 2.2 | 0.0 |
| 13.0 | 0.019443 | 0.019443 | 2.2 | 2.2 | 2.2 | 0.0 |
| 13.2 | 0.018808 | 0.018808 | 2.2 | 2.2 | 2.2 | 0.0 |
| 13.5 | 0.018206 | 0.018206 | 2.1 | 2.1 | 2.1 | 0.0 |
| 13.8 | 0.017633 | 0.017633 | 2.1 | 2.1 | 2.1 | 0.0 |
| 14.0 | 0.017088 | 0.017088 | 2.0 | 2.0 | 2.0 | 0.0 |
| 14.3 | 0.016569 | 0.016569 | 2.0 | 2.0 | 2.0 | 0.0 |
| 14.5 | 0.016075 | 0.016075 | 2.0 | 2.0 | 2.0 | 0.0 |
| 14.8 | 0.015603 | 0.015603 | 1.9 | 1.9 | 1.9 | 0.0 |
| 15.0 | 0.015153 | 0.015153 | 1.9 | 1.9 | 1.9 | 0.0 |
| 15.3 | 0.014723 | 0.014723 | 1.8 | 1.8 | 1.8 | 0.0 |
| 15.5 | 0.014311 | 0.014311 | 1.8 | 1.8 | 1.8 | 0.0 |
| 15.7 | 0.013918 | 0.013918 | 1.8 | 1.8 | 1.8 | 0.0 |
| 16.0 | 0.013541 | 0.013541 | 1.7 | 1.7 | 1.7 | 0.0 |
| 16.3 | 0.013164 | 0.013164 | 1.6 | 1.6 | 1.6 | 0.0 |
| 16.5 | 0.012802 | 0.012802 | 1.4 | 1.4 | 1.4 | 0.0 |
| 16.8 | 0.012454 | 0.012454 | 1.2 | 1.2 | 1.2 | 0.0 |
| 17.0 | 0.012121 | 0.012121 | 1.0 | 1.0 | 1.0 | 0.0 |
| 17.3 | 0.011802 | 0.011802 | 0.8 | 0.8 | 0.8 | 0.0 |
| 17.5 | 0.011495 | 0.011495 | 0.6 | 0.6 | 0.6 | 0.0 |
| 17.8 | 0.011200 | 0.011200 | 0.4 | 0.4 | 0.4 | 0.0 |
| 18.0 | 0.010917 | 0.010917 | 0.3 | 0.3 | 0.3 | 0.0 |
| 18.3 | 0.010645 | 0.010645 | 0.1 | 0.1 | 0.1 | 0.0 |
| 18.5 | 0.010383 | 0.010383 | 0.0 | 0.0 | 0.0 | 0.0 |

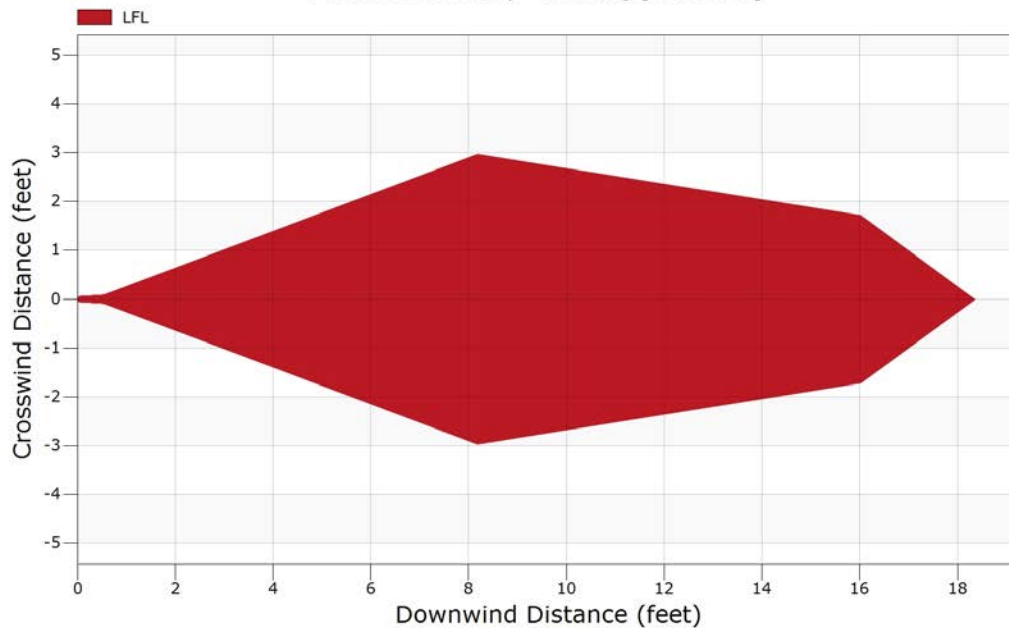
The momentum jet model coupled to the heavy gas model at 0.56 ft in 0 sec.

| Endpoint (mole frac., mixture) | Downwind Distance (feet) | Approximate Time (seconds) |
|--------------------------------|--------------------------|----------------------------|
| 1 0.010531 (LFL) | 18.4 | 5 |
| 2 0.010531 (LFL) | 18.4 | 5 |
| 3 0.010531 (LFL) | 18.4 | 5 |



Momentum Jet Contours - Overhead View

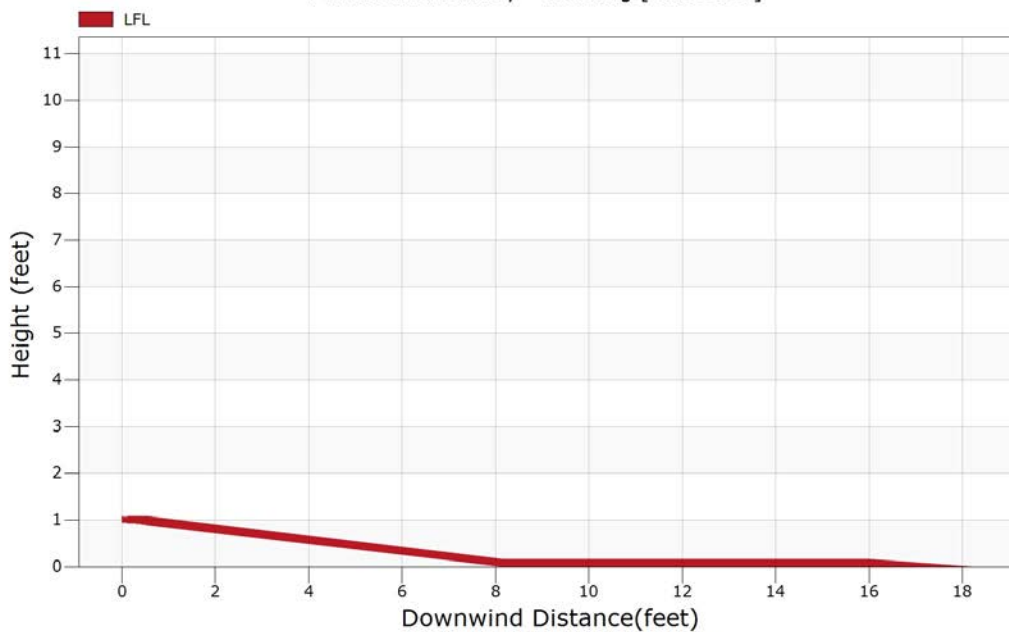
Paramount Refinery - Trucking [CrudeVCE]



Note: Release during 3.36 mph winds and F stability.

Momentum Jet Contours - Side View

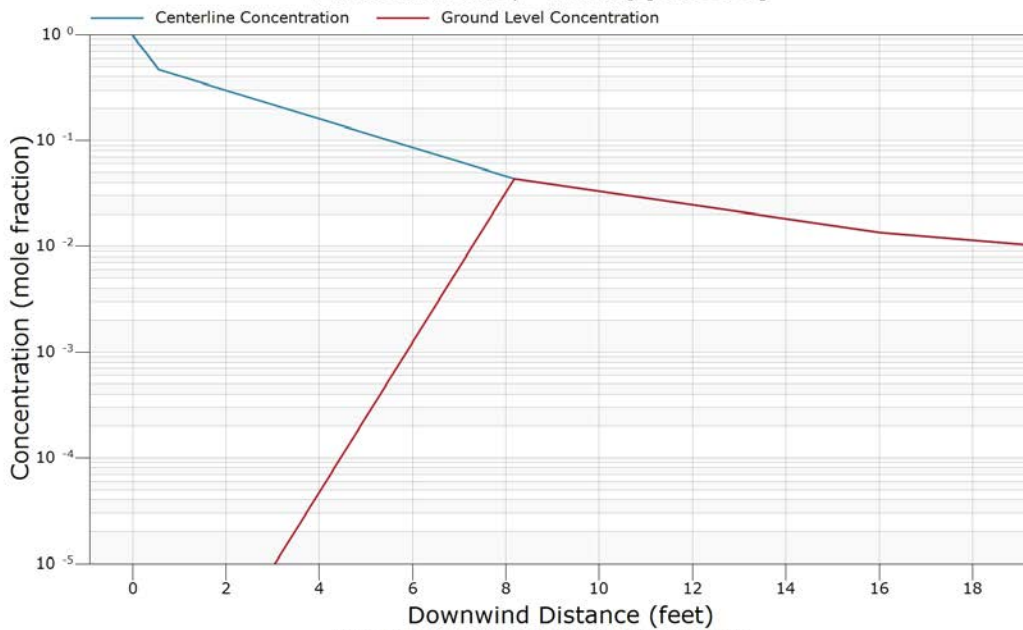
Paramount Refinery - Trucking [CrudeVCE]



Note: Release during 3.36 mph winds and F stability.



Momentum Jet Concentration Paramount Refinery - Trucking [CrudeVCE]



Note: Release during 3.36 mph winds and F stability.



Heavier-than-Air Dispersion

concentration limits

Endpoint 1 (highest) = 0.004354 mole fraction
Endpoint 2 (middle) = 0.004354 mole fraction
Endpoint 3 (lowest) = 0.004354 mole fraction

| downwind distance (ft) | centerline conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) |
|------------------------------|-------------------------------------|--------------------------------|--------------------------------|--------------------------------|
|------------------------------|-------------------------------------|--------------------------------|--------------------------------|--------------------------------|

* Vapor cloud does not leave source.



Momentum Jet Explosion

Fuel Reactivity: Medium Obstacle Density: Low
Flame Expansion: 2.5-D Flame Speed: 0.29

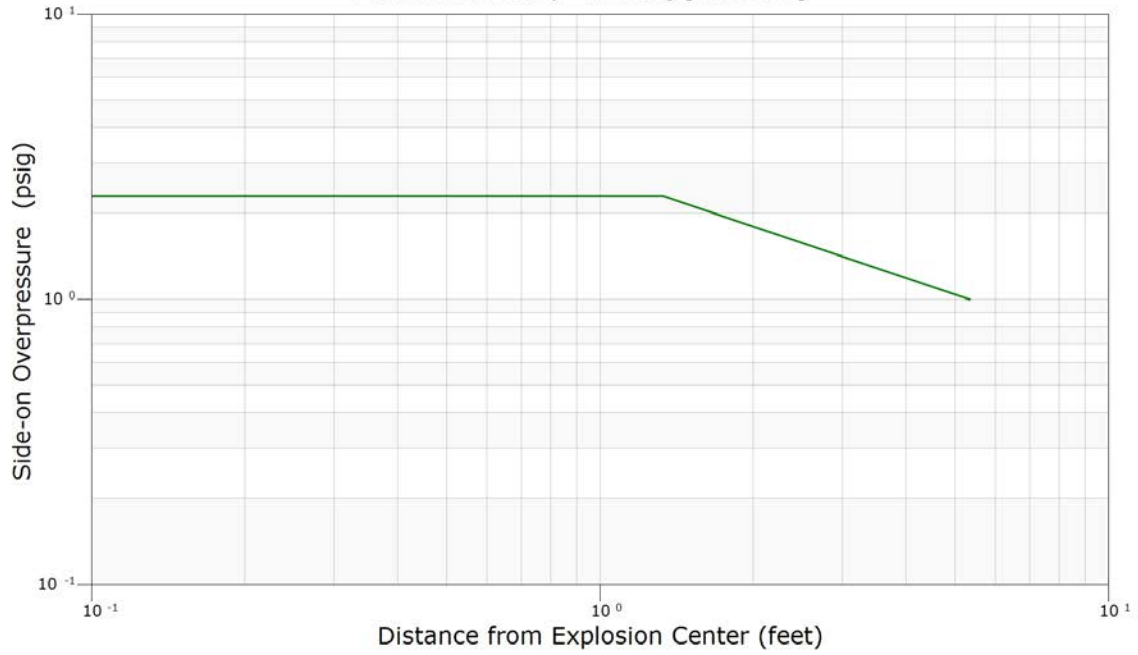
Mass of released material involved in explosion: 0.0287289 lbs.

| Distance from Center of Flammable Cloud (feet) | Overpressure (psi gauge) | Impulse (psi-s) |
|--|-----------------------------|--------------------|
| 0.0 | 2.30 | 0.0100 |
| 0.6 | 2.30 | 0.0100 |
| 0.6 | 2.30 | 0.0100 |
| 0.6 | 2.30 | 0.0100 |
| 0.6 | 2.30 | 0.0100 |
| 0.7 | 2.30 | 0.0100 |
| 0.7 | 2.30 | 0.0100 |
| 0.7 | 2.30 | 0.0100 |
| 0.8 | 2.30 | 0.0100 |
| 0.8 | 2.30 | 0.0100 |
| 0.8 | 2.30 | 0.0100 |
| 0.8 | 2.30 | 0.0100 |
| 0.9 | 2.30 | 0.0100 |
| 0.9 | 2.30 | 0.0100 |
| 0.9 | 2.30 | 0.0100 |
| 1.0 | 2.30 | 0.0099 |
| 1.0 | 2.30 | 0.0095 |
| 1.1 | 2.30 | 0.0092 |
| 1.1 | 2.30 | 0.0088 |
| 1.1 | 2.30 | 0.0085 |
| 1.2 | 2.30 | 0.0082 |
| 1.2 | 2.30 | 0.0079 |
| 1.3 | 2.30 | 0.0076 |
| 1.3 | 2.30 | 0.0073 |
| 5.3 | 1.00 | 0.0019 |

The downwind distance to 1.00 psi is 5.3 feet
The downwind distance to 1.00 psi is 5.3 feet
The downwind distance to 1.00 psi is 5.3 feet



Momentum Jet Explosion Overpressure - Baker-Strehlow-Tang
Paramount Refinery - Trucking [CrudeVCE]





Heavier-than-Air Explosion

Fuel Reactivity: Medium Obstacle Density: Low
Flame Expansion: 2.5-D Flame Speed: 0.29

Mass of released material involved in explosion: 170.828 lbs.

| Distance from Center of Flammable Cloud (feet) | Overpressure (psi gauge) | Impulse (psi-s) |
|--|-----------------------------|--------------------|
| 0.0 | 2.30 | 0.1816 |
| 10.5 | 2.30 | 0.1816 |
| 11.6 | 2.30 | 0.1816 |
| 12.8 | 2.30 | 0.1816 |
| 14.1 | 2.30 | 0.1816 |
| 15.5 | 2.30 | 0.1816 |
| 17.1 | 2.30 | 0.1816 |
| 18.9 | 2.30 | 0.1689 |
| 20.8 | 2.30 | 0.1535 |
| 23.0 | 2.30 | 0.1394 |
| 25.3 | 2.30 | 0.1266 |
| 28.0 | 2.30 | 0.1150 |
| 30.8 | 2.30 | 0.1045 |
| 34.0 | 2.30 | 0.0949 |
| 37.5 | 2.30 | 0.0862 |
| 41.4 | 2.30 | 0.0783 |
| 45.7 | 2.12 | 0.0711 |
| 50.4 | 1.92 | 0.0646 |
| 55.5 | 1.74 | 0.0587 |
| 61.3 | 1.58 | 0.0533 |
| 67.6 | 1.43 | 0.0484 |
| 74.5 | 1.30 | 0.0440 |
| 82.2 | 1.18 | 0.0400 |
| 90.7 | 1.07 | 0.0363 |
| 110.4 | 0.88 | 0.0300 |

The downwind distance to 1.00 psi is 97.6 feet
The downwind distance to 1.00 psi is 97.6 feet
The downwind distance to 1.00 psi is 97.6 feet



Heavier-than-Air Explosion Overpressure - Baker-Strehlow-Tang Paramount Refinery - Trucking [CrudeVCE]





Case Inputs

Case Type : Fire Radiation
Case Name : CrudePool
User ID :
Project Number :
Type of Units : English Units

NOTES:

MATERIAL MENU

| Materials Released | Number | Formula | Name | Fraction |
|--------------------|--------|---------|---------------|----------|
| Component 1 | 8 | C6H14 | n-Hexane | 0.011000 |
| Component 2 | 11 | C9H20 | n-Nonane | 0.033000 |
| Component 3 | 13 | C11H24 | n-Undecane | 0.048000 |
| Component 4 | 22 | C38H61 | PHC-500 | 0.367000 |
| Component 5 | 24 | C51H82 | PHC-700 | 0.192000 |
| Component 6 | 32 | C13H28 | Tridecane | 0.064000 |
| Component 7 | 34 | C15H32 | Pentadecane | 0.112000 |
| Component 8 | 36 | C17H36 | n-Heptadecane | 0.173000 |
| Component 9 | | | | |
| Component 10 | | | | |

Temperature : 68.00 °F
Pressure : 14.70 psia
The material is LIQUID
The mixture is Heavy Crude

NOTES:

ENVIRONMENT MENU

Wind speed : 20.00 mph
Relative humidity : 70 %
Air temperature : 68.0 °F

NOTES:

FIRE TYPE MENU

Fire radiation division: Circular pool fires
Horizontal isopleths only
Spill surface: land
Elevation of flame base (from grade) : 1.0 feet
Elevation of target (from grade) : 0.0 feet
Diameter of pool : 36.0 feet

Fire radiation flux values

Radiation endpoint 1 : 3487 Btu/hr-sq.ft
Radiation endpoint 2 : 1600 Btu/hr-sq.ft
Radiation endpoint 3 : 500 Btu/hr-sq.ft

NOTES:



Pool Fire Radiation

Length of Flame : 43.1 feet
 Flame Tilt from Vertical : 53.5 degrees
 Target Elevation : 0.0 feet
 Pool Elevation : 1.0 feet
 Wind Speed : 20.0 mph
 Substrate : Land

| Downwind Distance from Center of Pool (feet) | Flux to Vertical Target (Btu/hr-sq.ft) | Flux to Horizontal Target (Btu/hr-sq.ft) | Maximum Flux (Btu/hr-sq.ft) |
|--|--|--|-----------------------------------|
| 19.8 | 8450 | 21378 | 22988 |
| 21.1 | 7674 | 22124 | 23417 |
| 22.5 | 5946 | 24017 | 24017 |
| 24.0 | 7486 | 24017 | 24017 |
| 25.6 | 8253 | 24017 | 24017 |
| 27.3 | 8338 | 22354 | 23858 |
| 29.1 | 7686 | 24017 | 24017 |
| 31.0 | 11095 | 24017 | 24017 |
| 33.0 | 12133 | 19159 | 22678 |
| 35.2 | 10506 | 17438 | 23179 |
| 37.5 | 10438 | 15357 | 19572 |
| 40.0 | 9502 | 10190 | 14262 |
| 42.7 | 7237 | 6432 | 9824 |
| 45.5 | 5335 | 4756 | 7234 |
| 48.5 | 4153 | 3931 | 5779 |
| 51.7 | 3403 | 3396 | 4850 |
| 55.1 | 2890 | 2965 | 4171 |
| 58.7 | 2514 | 2568 | 3615 |
| 62.6 | 2222 | 2179 | 3126 |
| 66.8 | 1984 | 1791 | 2682 |
| 71.2 | 1768 | 1413 | 2269 |
| 75.9 | 1546 | 1066 | 1882 |
| 80.9 | 1317 | 773 | 1529 |
| 86.2 | 1096 | 543 | 1224 |
| 91.9 | 897 | 375 | 973 |
| 98.0 | 726 | 258 | 771 |
| 104.5 | 586 | 178 | 612 |
| 111.4 | 473 | 123 | 489 |
| 118.7 | 383 | 87 | 393 |
| 126.6 | 311 | 61 | 317 |

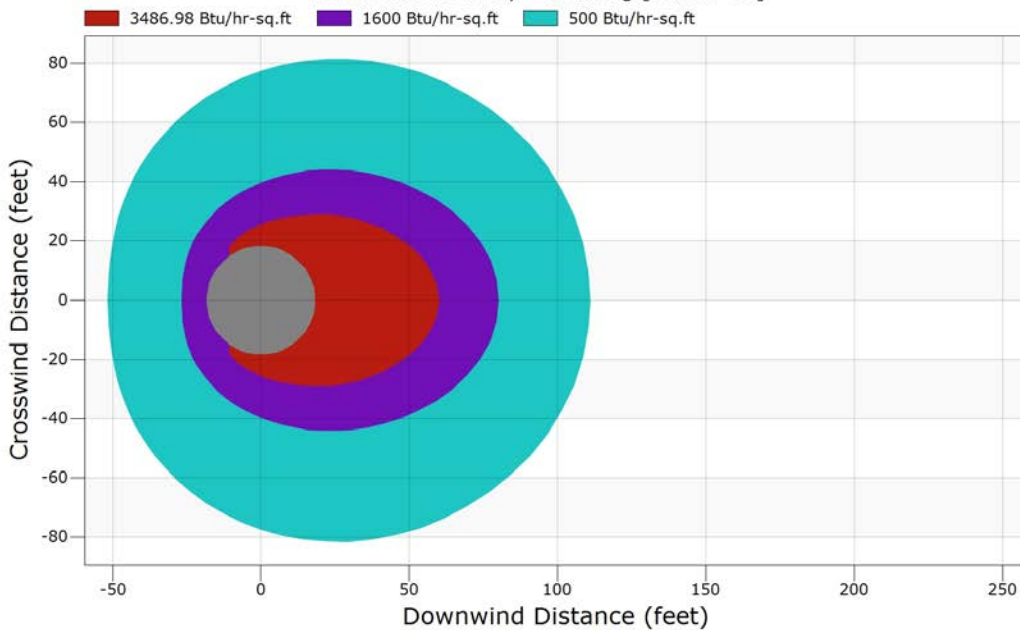
Downwind Distances to Endpoints:

| Distance (feet) | Maximum Flux (Btu/hr-sq.ft) |
|--------------------|--------------------------------|
| 59.8 | 3487 |
| 79.9 | 1600 |
| 110.7 | 500 |



Pool Fire Radiant Heat Contours - Overhead View

Paramount Refinery - Trucking [CrudePool]



Note: Results presented for 1 feet below the flame base during 20 mph winds.



Case Inputs

Case Type : Vapor Dispersion
Case Name : DieselVCE
User ID :
Project Number :
Type of Units : English Units

NOTES:

MATERIAL MENU

| Materials Released | Number | Formula | Name | Fraction |
|--------------------|--------|---------|---------------|----------|
| Component 1 | 11 | C9H20 | n-Nonane | 0.020000 |
| Component 2 | 12 | C10H22 | n-Decane | 0.030000 |
| Component 3 | 13 | C11H24 | n-Undecane | 0.050000 |
| Component 4 | 20 | C22H38 | PHC-300 | 0.200000 |
| Component 5 | 21 | C28H42 | PHC-400 | 0.140000 |
| Component 6 | 31 | C12H26 | Dodecane | 0.060000 |
| Component 7 | 32 | C13H28 | Tridecane | 0.080000 |
| Component 8 | 33 | C14H30 | Tetradecane | 0.100000 |
| Component 9 | 34 | C15H32 | Pentadecane | 0.150000 |
| Component 10 | 36 | C17H36 | n-Heptadecane | 0.170000 |

Temperature : 68.00 °F
Pressure : 15.00 psia
The material is LIQUID
The mixture is Diesel

NOTES:

ENVIRONMENT MENU

Wind speed 3.36 mph
Wind speed measurement height 32.8 feet
Stability class <A-F> F
Relative humidity 70 %
Air temperature 68.0 °F
Spill surface temperature 68.0 °F

Substrate name High density concrete
Substrate thermal conductivity 2.1999 Btu/hr-ft-F
Substrate density 150 lb/cu.ft
Substrate heat Capacity 0.16 Btu/lb-F
Substrate delay time 0 sec
Surrounding terrain Long grass or crops > 15 cm (6 in)

NOTES:



RELEASE MENU

Type of release: Unregulated, Continuous release
Release duration 10 min
Normal flow rate 101.10 lb/sec
Duration of normal flow 10 min
Volume of vessel 1336.81 cu.ft
Percent of vessel filled with liquid 80 %
Liquid head above release point 6 feet
Pipe inner diameter 3.07 inches
Equivalent release diameter 3.07 inches
Pipe length upstream of break 0.0 feet
Height of release point 1.0 feet
Angle of release from horizontal 0.0 degrees

NOTES:

IMPOUNDMENT MENU

Unconfined

NOTES:

VDVE MENU

Vapor generation, dispersion and cloud explosion - Flammable calculation

Concentration endpoint 1 LFL mol%
Concentration endpoint 2 LFL mol%
Concentration endpoint 3 LFL mol%

Dispersion coefficient averaging time 1 min

Baker-Strehlow-Tang parameters

Fuel reactivity Medium
Obstacle density Low
Flame expansion 2.5-D

Overpressure values

Overpressure endpoint 1 1.00 psi
Overpressure endpoint 2 1.00 psi
Overpressure endpoint 3 1.00 psi

NOTES:

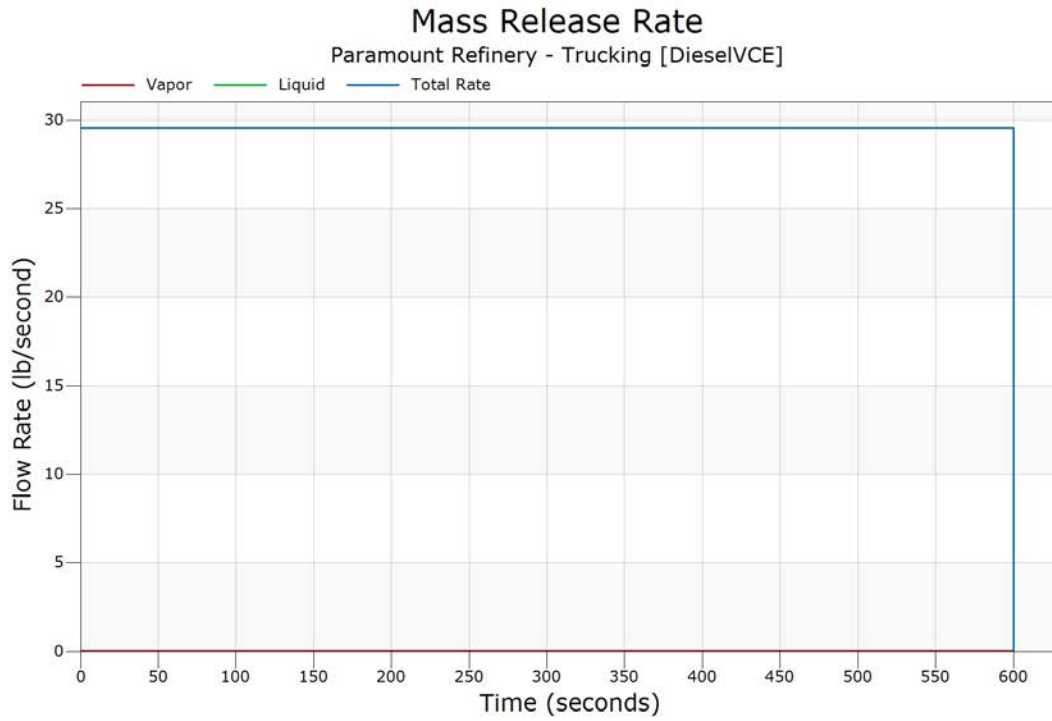


Release Model

| Time (sec) | Vapor (lb/sec) | Aerosol Rate (lb/sec) | Liquid Rate (lb/sec) | Total Rate (lb/sec) |
|---------------|-------------------|--------------------------|-------------------------|------------------------|
| 0.000000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 0.100000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 0.300000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 0.500000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 0.700000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 1.000000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 3.000000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 5.000000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 7.000000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 10.00000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 20.00000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 30.00000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 40.00000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 50.00000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 60.00000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 70.00000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 85.00000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 100.0000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 200.0000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 300.0000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 400.0000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 500.0000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 600.0000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| Totals (lb) | .3202545 | 0.000000 | 17734.43 | 17734.75 |

Flowrate for Jet Fire [immediate ignition] = 0.5337575E-03 lb/sec.
Jet Fire [delayed ignition] = 0.5337575E-03 lb/sec.

Reason for Ending: Reached Stop Time





Release Compositions

| Component Number | Component Name, Formula |
|------------------|--|
| 11 | n-Nonane, C ₉ H ₂₀ |
| 12 | n-Decane, C ₁₀ H ₂₂ |
| 13 | n-Undecane, C ₁₁ H ₂₄ |
| 20 | PHC-300, C ₂₂ H ₃₈ |
| 21 | PHC-400, C ₂₈ H ₄₂ |
| 31 | Dodecane, C ₁₂ H ₂₆ |
| 32 | Tridecane, C ₁₃ H ₂₈ |
| 33 | Tetradecane, C ₁₄ H ₃₀ |
| 34 | Pentadecane, C ₁₅ H ₃₂ |
| 36 | n-Heptadecane, C ₁₇ H ₃₆ |

Composition (Mole Fraction) of Fluid Streams

| Comp. No. | Feed Stream | Momentum Jet Stream | | | Liquid Pool Stream | |
|-----------|-------------|---------------------|------------------|----------------|--------------------|------------------|
| | | Flashed Vapor | Evaporated Vapor | Aerosol Liquid | Total Stream | Liquid to Ground |
| 11 | 0.020000 | 0.000000 | 0.508847 | 0.000000 | 0.508847 | 0.020000 |
| 12 | 0.030000 | 0.000000 | 0.253701 | 0.000000 | 0.253701 | 0.030000 |
| 13 | 0.050000 | 0.000000 | 0.138489 | 0.000000 | 0.138489 | 0.050000 |
| 20 | 0.200000 | 0.000000 | 0.000027 | 0.000000 | 0.000027 | 0.200000 |
| 21 | 0.140000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.140000 |
| 31 | 0.060000 | 0.000000 | 0.056142 | 0.000000 | 0.056142 | 0.060000 |
| 32 | 0.080000 | 0.000000 | 0.025379 | 0.000000 | 0.025379 | 0.080000 |
| 33 | 0.100000 | 0.000000 | 0.010902 | 0.000000 | 0.010902 | 0.100000 |
| 34 | 0.150000 | 0.000000 | 0.005560 | 0.000000 | 0.005560 | 0.150000 |
| 36 | 0.170000 | 0.000000 | 0.000953 | 0.000000 | 0.000953 | 0.170000 |
| ----- | | | | | | |
| | 1.000000 | 0.000000 | 1.000000 | 0.000000 | 1.000000 | 1.000000 |

Flammable Limits (Mole %) of Fluid Streams

| Limit | Feed Stream | Momentum Jet Stream | Liquid Pool Stream |
|-------|-------------|---------------------|--------------------|
| LFL | 0.46 | 0.75 | 0.46 |
| UFL | 5.65 | 3.67 | 5.65 |
| LBV | | 0.40 m/s | 0.40 m/s |



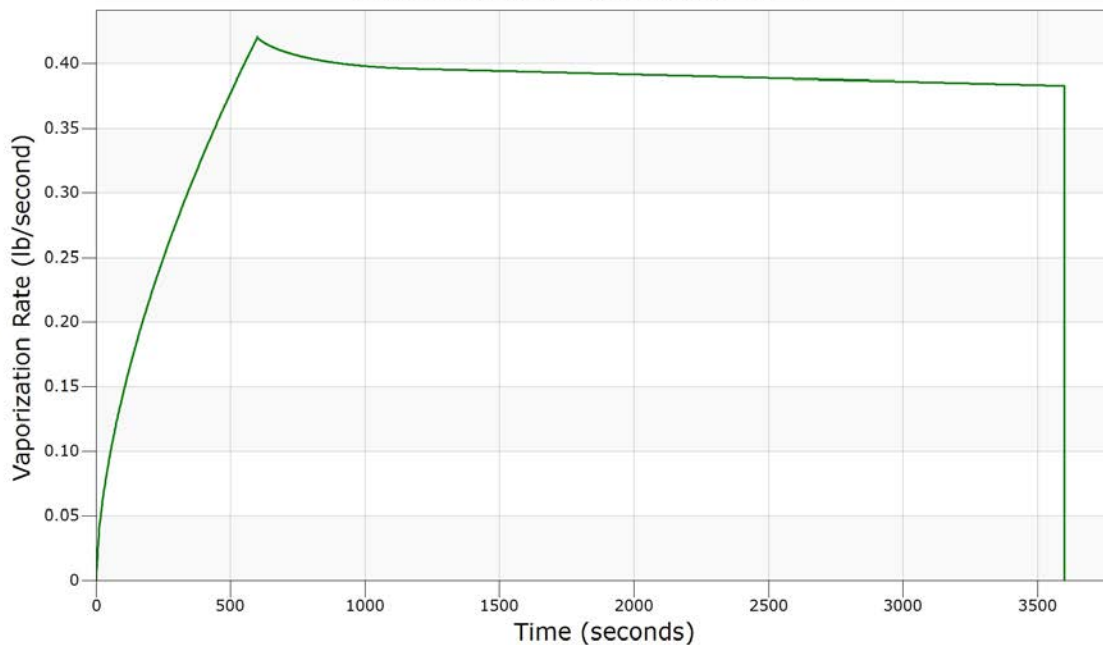
Pool Spreading and Vaporization

| Time (sec) | Liquid Remaining (ft3) | Pool/Dike Radius (feet) | Vapor Rate (lb/sec) |
|---------------|------------------------------|-------------------------------|------------------------|
| 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| 40.0000 | 26.0036 | 7.33924 | 0.832730E-01 |
| 80.0000 | 51.9585 | 9.24574 | 0.126144 |
| 120.000 | 77.8794 | 10.5810 | 0.160825 |
| 160.000 | 103.772 | 11.6430 | 0.191044 |
| 200.000 | 129.637 | 12.5394 | 0.218330 |
| 240.000 | 155.483 | 13.3222 | 0.243479 |
| 280.000 | 181.305 | 14.0217 | 0.266958 |
| 320.000 | 207.106 | 14.6568 | 0.289114 |
| 360.000 | 232.890 | 15.2408 | 0.310168 |
| 400.000 | 258.655 | 15.7828 | 0.330319 |
| 440.000 | 284.403 | 16.2894 | 0.349631 |
| 480.000 | 310.133 | 16.7664 | 0.368260 |
| 520.000 | 335.850 | 17.2172 | 0.386272 |
| 560.000 | 361.552 | 17.6450 | 0.403733 |
| 600.000 | 387.225 | 18.0528 | 0.420664 |
| 640.000 | 386.872 | 18.0472 | 0.414712 |
| 680.000 | 386.519 | 18.0417 | 0.411008 |
| 720.000 | 386.131 | 18.0361 | 0.408142 |
| 760.000 | 385.777 | 18.0305 | 0.405827 |
| 800.000 | 385.424 | 18.0249 | 0.403931 |
| 840.000 | 385.071 | 18.0194 | 0.402322 |
| 880.000 | 384.718 | 18.0138 | 0.400977 |
| 1130.00 | 382.528 | 17.9793 | 0.396369 |
| 1380.00 | 380.339 | 17.9452 | 0.394914 |
| 1630.00 | 378.185 | 17.9108 | 0.393547 |
| 1880.00 | 375.995 | 17.8766 | 0.392202 |
| 2130.00 | 373.841 | 17.8425 | 0.390858 |
| 2380.00 | 371.687 | 17.8084 | 0.389513 |
| 2630.00 | 369.568 | 17.7743 | 0.388168 |
| 2880.00 | 367.414 | 17.7398 | 0.386823 |
| 3130.00 | 365.295 | 17.7057 | 0.385478 |
| 3380.00 | 363.176 | 17.6713 | 0.384133 |
| 3600.00 | 361.304 | 17.6414 | 0.382965 |

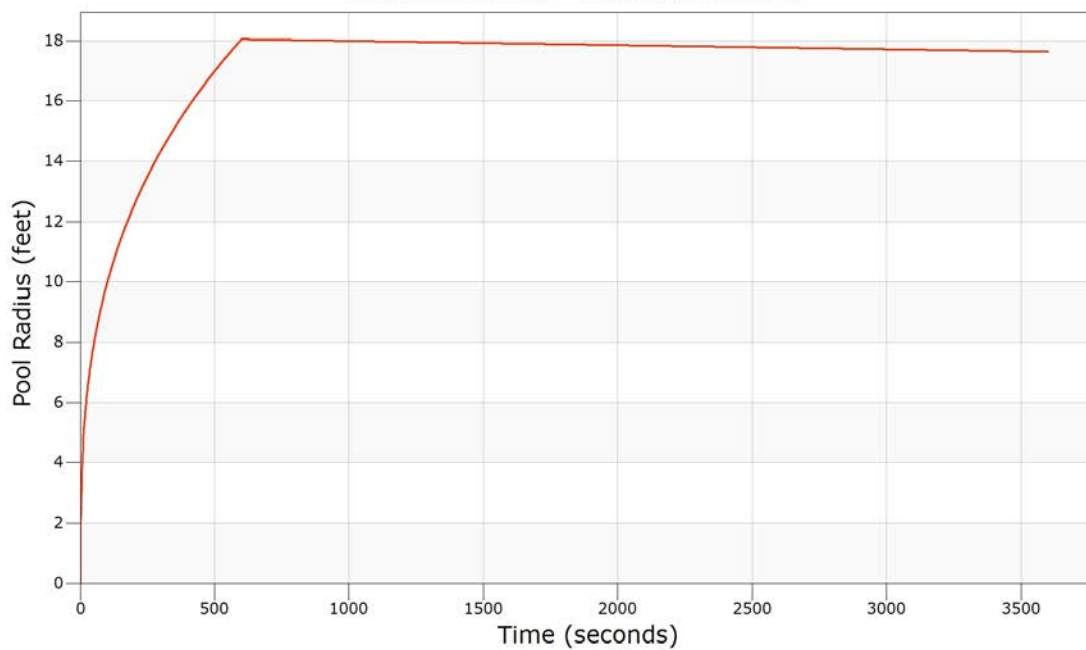
Ending Message: Normal Ending



Pool Vaporization Rate
Paramount Refinery - Trucking [DieselVCE]



Pool Radius
Paramount Refinery - Trucking [DieselVCE]





Momentum Jet Dispersion

concentration limits

Endpoint 1 (highest) = 0.007477 mole fraction
Endpoint 2 (middle) = 0.007477 mole fraction
Endpoint 3 (lowest) = 0.007477 mole fraction

| downwind distance (ft) | centerline conc. (mole frac.) | ground conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) | centerline height (ft) |
|------------------------------|-------------------------------------|---------------------------------|--------------------------------|--------------------------------|--------------------------------|------------------------------|
| 0 | 1.000000 | 0.000000 | 0.0 | 0.0 | 0.0 | 1.0 |
| 0.1 | 0.689942 | 0.000000 | 0.0 | 0.0 | 0.0 | 1.0 |
| 0.2 | 0.473120 | 0.000000 | 0.0 | 0.0 | 0.0 | 1.0 |
| 0.3 | 0.310035 | 0.000000 | 0.0 | 0.0 | 0.0 | 1.0 |
| 0.4 | 0.203108 | 0.000000 | 0.0 | 0.0 | 0.0 | 1.0 |
| 0.5 | 0.134308 | 0.000000 | 0.0 | 0.0 | 0.0 | 1.0 |
| 0.6 | 0.098949 | 0.098949 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.7 | 0.081796 | 0.081796 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.8 | 0.069361 | 0.069361 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.9 | 0.059972 | 0.059972 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1.0 | 0.052655 | 0.052655 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1.1 | 0.046808 | 0.046808 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1.2 | 0.042039 | 0.042039 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1.3 | 0.038083 | 0.038083 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1.4 | 0.034752 | 0.034752 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1.5 | 0.031914 | 0.031914 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1.6 | 0.029469 | 0.029469 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1.7 | 0.027343 | 0.027343 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1.8 | 0.025480 | 0.025480 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1.9 | 0.023834 | 0.023834 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2.0 | 0.022371 | 0.022371 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2.1 | 0.021063 | 0.021063 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2.2 | 0.019887 | 0.019887 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2.3 | 0.018825 | 0.018825 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2.4 | 0.017861 | 0.017861 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2.5 | 0.016983 | 0.016983 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2.6 | 0.016180 | 0.016180 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2.7 | 0.015443 | 0.015443 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2.8 | 0.014765 | 0.014765 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2.9 | 0.014139 | 0.014139 | 0.0 | 0.0 | 0.0 | 0.0 |
| 3.0 | 0.013559 | 0.013559 | 0.0 | 0.0 | 0.0 | 0.0 |
| 3.1 | 0.013021 | 0.013021 | 0.0 | 0.0 | 0.0 | 0.0 |
| 3.2 | 0.012520 | 0.012520 | 0.0 | 0.0 | 0.0 | 0.0 |
| 3.3 | 0.012053 | 0.012053 | 0.0 | 0.0 | 0.0 | 0.0 |
| 3.4 | 0.011617 | 0.011617 | 0.0 | 0.0 | 0.0 | 0.0 |

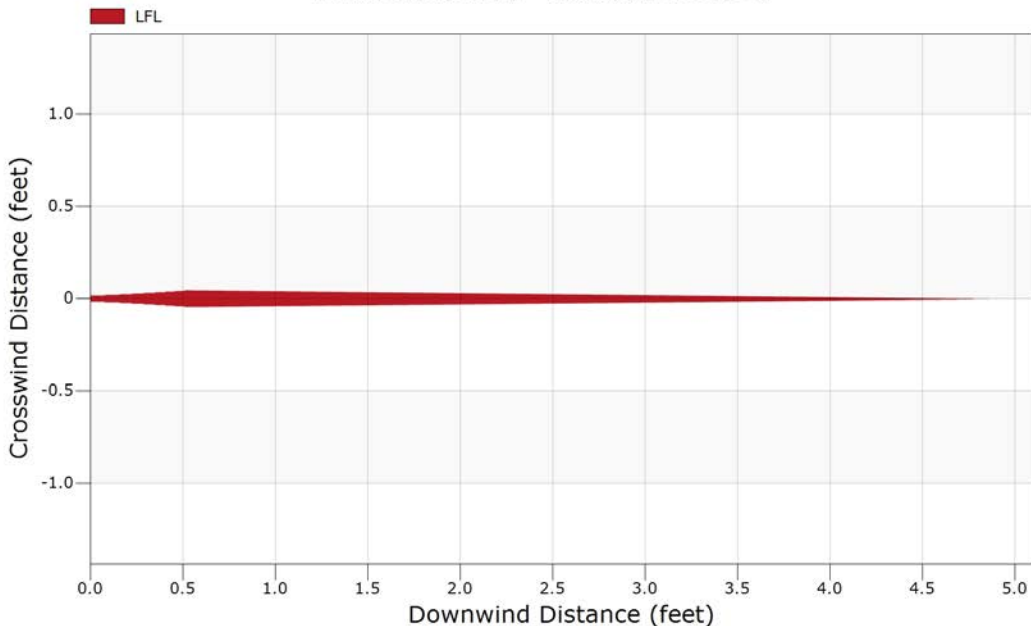


| downwind distance (ft) | centerline conc. (mole frac.) | ground conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) | centerline height (ft) |
|------------------------|-------------------------------|---------------------------|--------------------------|--------------------------|--------------------------|------------------------|
| 3.5 | 0.011209 | 0.011209 | 0.0 | 0.0 | 0.0 | 0.0 |
| 3.6 | 0.010825 | 0.010825 | 0.0 | 0.0 | 0.0 | 0.0 |
| 3.7 | 0.010465 | 0.010465 | 0.0 | 0.0 | 0.0 | 0.0 |
| 3.8 | 0.010126 | 0.010126 | 0.0 | 0.0 | 0.0 | 0.0 |
| 3.9 | 0.009806 | 0.009806 | 0.0 | 0.0 | 0.0 | 0.0 |
| 4.0 | 0.009505 | 0.009505 | 0.0 | 0.0 | 0.0 | 0.0 |
| 4.1 | 0.009219 | 0.009219 | 0.0 | 0.0 | 0.0 | 0.0 |
| 4.2 | 0.008949 | 0.008949 | 0.0 | 0.0 | 0.0 | 0.0 |
| 4.3 | 0.008693 | 0.008693 | 0.0 | 0.0 | 0.0 | 0.0 |
| 4.4 | 0.008449 | 0.008449 | 0.0 | 0.0 | 0.0 | 0.0 |
| 4.5 | 0.008218 | 0.008218 | 0.0 | 0.0 | 0.0 | 0.0 |
| 4.6 | 0.007998 | 0.007998 | 0.0 | 0.0 | 0.0 | 0.0 |
| 4.7 | 0.007788 | 0.007788 | 0.0 | 0.0 | 0.0 | 0.0 |
| 4.8 | 0.007588 | 0.007588 | 0.0 | 0.0 | 0.0 | 0.0 |
| 4.9 | 0.007398 | 0.007398 | 0.0 | 0.0 | 0.0 | 0.0 |

The momentum jet model coupled to the heavy gas model at 0.55 ft in 0 sec.

| Endpoint (mole frac., mixture) | Downwind Distance (feet) | Approximate Time (seconds) |
|--------------------------------|--------------------------|----------------------------|
| 1 0.007477 (LFL) | 4.9 | 1 |
| 2 0.007477 (LFL) | 4.9 | 1 |
| 3 0.007477 (LFL) | 4.9 | 1 |

Momentum Jet Contours - Overhead View
 Paramount Refinery - Trucking [DieselVCE]

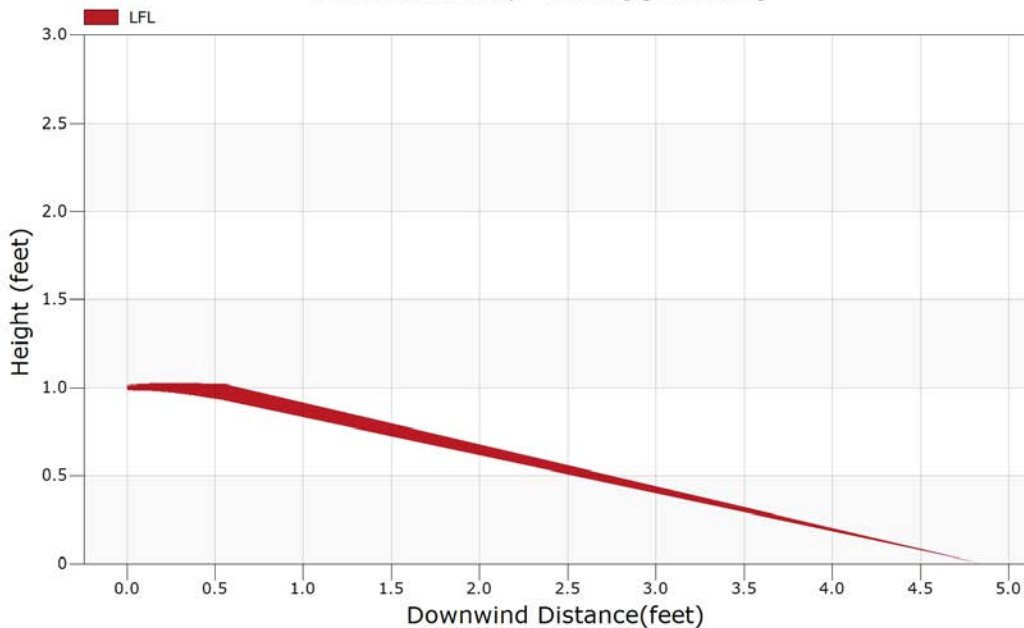


Note: Release during 3.36 mph winds and F stability.



Momentum Jet Contours - Side View

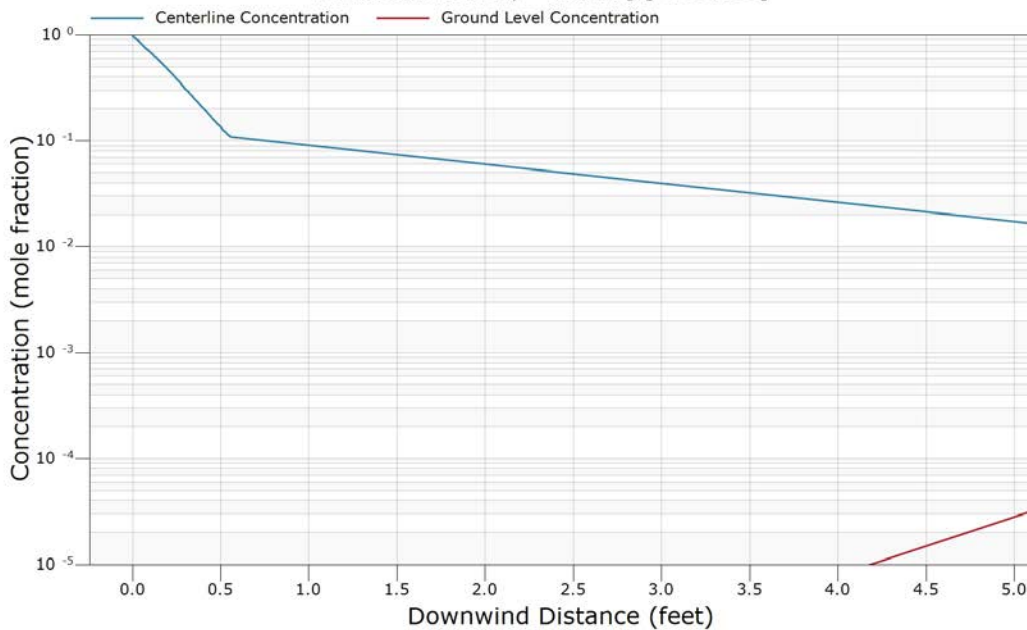
Paramount Refinery - Trucking [DieselVCE]



Note: Release during 3.36 mph winds and F stability.

Momentum Jet Concentration

Paramount Refinery - Trucking [DieselVCE]



Note: Release during 3.36 mph winds and F stability.



Heavier-than-Air Dispersion

concentration limits

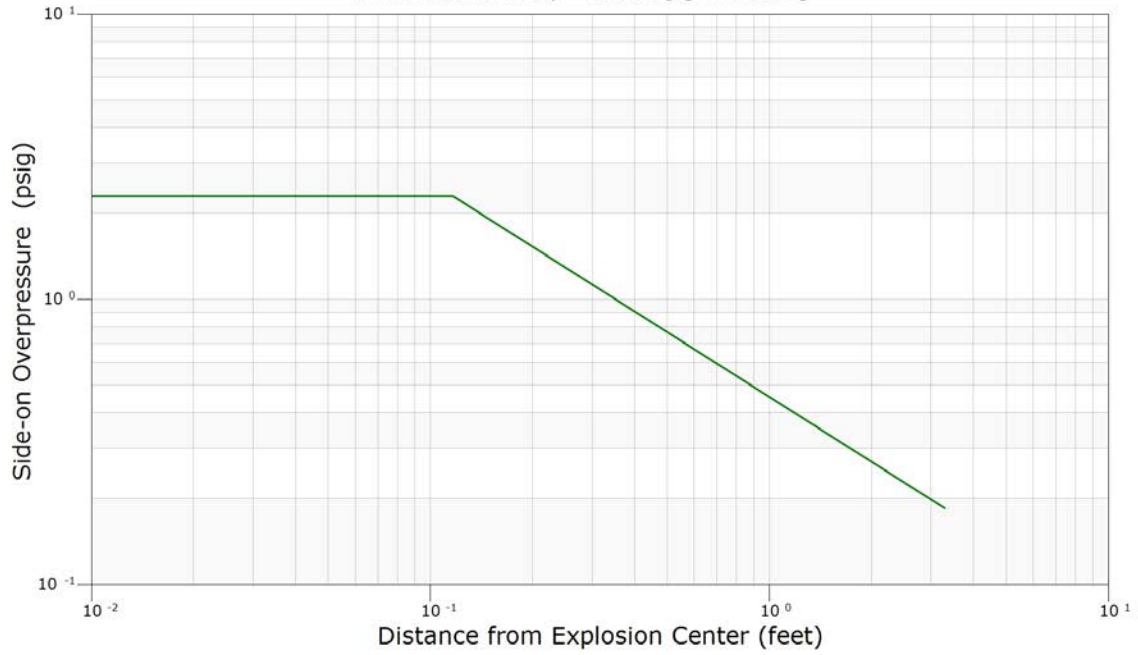
Endpoint 1 (highest) = 0.004625 mole fraction
Endpoint 2 (middle) = 0.004625 mole fraction
Endpoint 3 (lowest) = 0.004625 mole fraction

| downwind distance (ft) | centerline conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) |
|------------------------------|-------------------------------------|--------------------------------|--------------------------------|--------------------------------|
|------------------------------|-------------------------------------|--------------------------------|--------------------------------|--------------------------------|

* Vapor cloud does not leave source.



Momentum Jet Explosion Overpressure - Baker-Strehlow-Tang
Paramount Refinery - Trucking [DieselVCE]





Heavier-than-Air Explosion

Fuel Reactivity: Medium Obstacle Density: Low
Flame Expansion: 2.5-D Flame Speed: 0.29

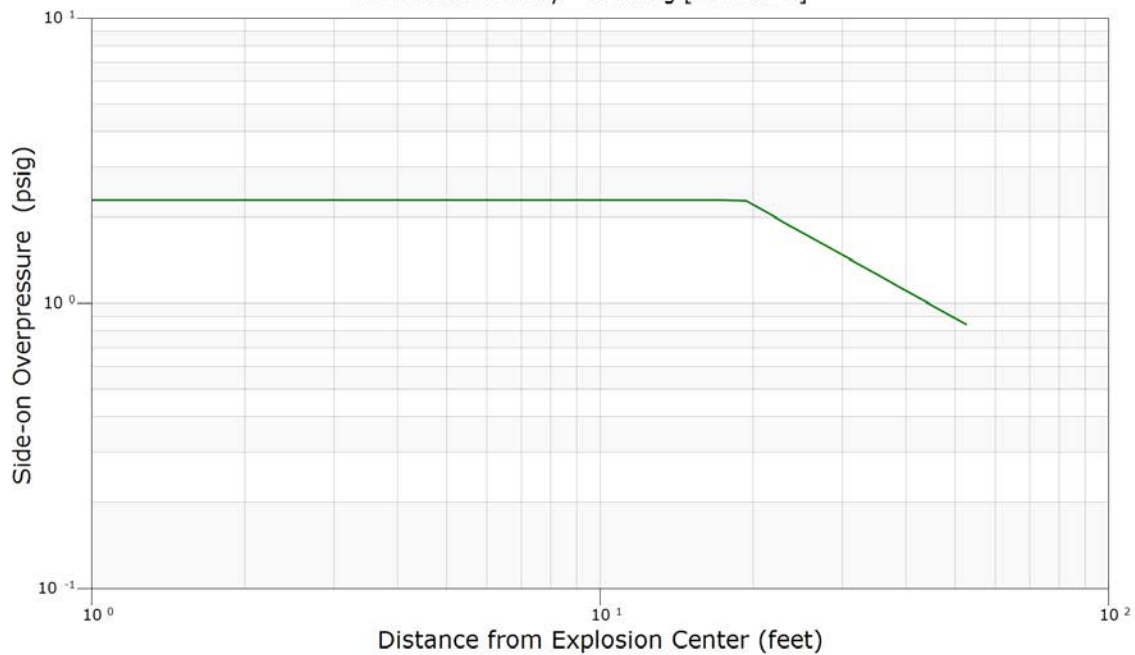
Mass of released material involved in explosion: 16.123 lbs.

| Distance from Center of Flammable Cloud (feet) | Overpressure (psi gauge) | Impulse (psi-s) |
|--|-----------------------------|--------------------|
| 0.0 | 2.30 | 0.0830 |
| 4.8 | 2.30 | 0.0830 |
| 5.3 | 2.30 | 0.0830 |
| 5.9 | 2.30 | 0.0830 |
| 6.5 | 2.30 | 0.0830 |
| 7.1 | 2.30 | 0.0830 |
| 7.9 | 2.30 | 0.0830 |
| 8.7 | 2.30 | 0.0765 |
| 9.6 | 2.30 | 0.0694 |
| 10.6 | 2.30 | 0.0629 |
| 11.8 | 2.30 | 0.0570 |
| 13.0 | 2.30 | 0.0517 |
| 14.4 | 2.30 | 0.0469 |
| 15.9 | 2.30 | 0.0425 |
| 17.5 | 2.30 | 0.0386 |
| 19.4 | 2.28 | 0.0350 |
| 21.4 | 2.07 | 0.0317 |
| 23.6 | 1.87 | 0.0288 |
| 26.1 | 1.69 | 0.0261 |
| 28.9 | 1.53 | 0.0237 |
| 31.9 | 1.39 | 0.0215 |
| 35.2 | 1.26 | 0.0195 |
| 38.9 | 1.14 | 0.0177 |
| 43.0 | 1.03 | 0.0160 |
| 52.5 | 0.84 | 0.0132 |

The downwind distance to 1.00 psi is 44.5 feet
The downwind distance to 1.00 psi is 44.5 feet
The downwind distance to 1.00 psi is 44.5 feet



Heavier-than-Air Explosion Overpressure - Baker-Strehlow-Tang Paramount Refinery - Trucking [DieselVCE]





Case Inputs

Case Type : Fire Radiation
Case Name : DieselPool
User ID :
Project Number :
Type of Units : English Units

NOTES:

MATERIAL MENU

| Materials Released | Number | Formula | Name | Fraction |
|--------------------|--------|---------|---------------|----------|
| Component 1 | 11 | C9H20 | n-Nonane | 0.020000 |
| Component 2 | 12 | C10H22 | n-Decane | 0.030000 |
| Component 3 | 13 | C11H24 | n-Undecane | 0.050000 |
| Component 4 | 20 | C22H38 | PHC-300 | 0.200000 |
| Component 5 | 21 | C28H42 | PHC-400 | 0.140000 |
| Component 6 | 31 | C12H26 | Dodecane | 0.060000 |
| Component 7 | 32 | C13H28 | Tridecane | 0.080000 |
| Component 8 | 33 | C14H30 | Tetradecane | 0.100000 |
| Component 9 | 34 | C15H32 | Pentadecane | 0.150000 |
| Component 10 | 36 | C17H36 | n-Heptadecane | 0.170000 |

Temperature : 68.00 °F
Pressure : 14.70 psia
The material is LIQUID
The mixture is Diesel

NOTES:

ENVIRONMENT MENU

Wind speed : 20.00 mph
Relative humidity : 70 %
Air temperature : 68.0 °F

NOTES:

FIRE TYPE MENU

Fire radiation division: Circular pool fires
Horizontal isopleths only
Spill surface: land
Elevation of flame base (from grade) : 1.0 feet
Elevation of target (from grade) : 0.0 feet
Diameter of pool : 36.0 feet

Fire radiation flux values

Radiation endpoint 1 : 3487 Btu/hr-sq.ft
Radiation endpoint 2 : 1600 Btu/hr-sq.ft
Radiation endpoint 3 : 500 Btu/hr-sq.ft

NOTES:



Pool Fire Radiation

Length of Flame : 47.5 feet
 Flame Tilt from Vertical : 56.6 degrees
 Target Elevation : 0.0 feet
 Pool Elevation : 1.0 feet
 Wind Speed : 20.0 mph
 Substrate : Land

| Downwind Distance from Center of Pool (feet) | Flux to Vertical Target (Btu/hr-sq.ft) | Flux to Horizontal Target (Btu/hr-sq.ft) | Maximum Flux (Btu/hr-sq.ft) |
|--|--|--|-----------------------------------|
| 19.8 | 8861 | 22418 | 24106 |
| 21.1 | 8407 | 22993 | 24481 |
| 22.6 | 7462 | 25186 | 25186 |
| 24.1 | 7252 | 25186 | 25186 |
| 25.7 | 7761 | 25186 | 25186 |
| 27.5 | 7975 | 23924 | 25186 |
| 29.4 | 11531 | 25186 | 25186 |
| 31.3 | 14064 | 23463 | 25186 |
| 33.5 | 11328 | 20139 | 23114 |
| 35.7 | 10814 | 19826 | 25186 |
| 38.2 | 10818 | 16859 | 20927 |
| 40.7 | 10098 | 12176 | 16150 |
| 43.5 | 8294 | 7756 | 11490 |
| 46.5 | 6143 | 5411 | 8262 |
| 49.6 | 4676 | 4309 | 6410 |
| 53.0 | 3742 | 3669 | 5278 |
| 56.6 | 3119 | 3197 | 4493 |
| 60.4 | 2675 | 2787 | 3883 |
| 64.5 | 2339 | 2390 | 3358 |
| 68.9 | 2073 | 1990 | 2883 |
| 73.5 | 1847 | 1588 | 2442 |
| 78.5 | 1627 | 1205 | 2028 |
| 83.9 | 1392 | 870 | 1644 |
| 89.5 | 1158 | 604 | 1307 |
| 95.6 | 942 | 409 | 1027 |
| 102.1 | 755 | 275 | 804 |
| 109.0 | 603 | 185 | 631 |
| 116.4 | 482 | 125 | 498 |
| 124.3 | 386 | 86 | 396 |
| 132.7 | 311 | 60 | 317 |

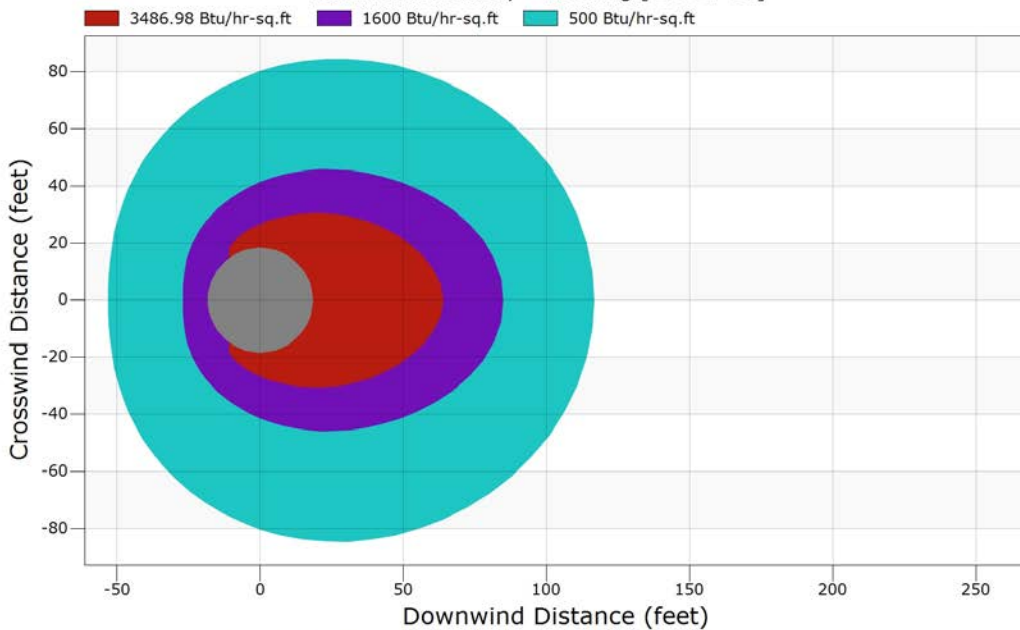
Downwind Distances to Endpoints:

| Distance (feet) | Maximum Flux (Btu/hr-sq.ft) |
|--------------------|--------------------------------|
| 63.5 | 3487 |
| 84.6 | 1600 |
| 116.3 | 500 |



Pool Fire Radiant Heat Contours - Overhead View

Paramount Refinery - Trucking [DieselPool]



Note: Results presented for 1 feet below the flame base during 20 mph winds.



Case Inputs

Case Type : Vapor Dispersion
Case Name : FeedStockVCE
User ID :
Project Number :
Type of Units : English Units

NOTES:

MATERIAL MENU

| Materials Released | Number | Formula | Name | Fraction |
|--------------------|--------|----------|---------------|----------|
| Component 1 | : 20 | = C22H38 | PHC-300 | 0.240000 |
| Component 2 | : 21 | = C28H42 | PHC-400 | 0.250000 |
| Component 3 | : 22 | = C38H61 | PHC-500 | 0.220000 |
| Component 4 | : 32 | = C13H28 | Tridecane | 0.030000 |
| Component 5 | : 33 | = C14H30 | Tetradecane | 0.050000 |
| Component 6 | : 34 | = C15H32 | Pentadecane | 0.080000 |
| Component 7 | : 36 | = C17H36 | n-Heptadecane | 0.130000 |
| Component 8 | : | | | |
| Component 9 | : | | | |
| Component 10 | : | | | |

Temperature : 68.00 °F
Pressure : 15.00 psia
The material is LIQUID
The mixture is Fuel Oil

NOTES:

ENVIRONMENT MENU

| | |
|--------------------------------|------------------------------------|
| Wind speed | 3.36 mph |
| Wind speed measurement height | 32.8 feet |
| Stability class <A-F> | F |
| Relative humidity | 70 % |
| Air temperature | 68.0 °F |
| Spill surface temperature | 68.0 °F |
| Substrate name | High density concrete |
| Substrate thermal conductivity | 2.1999 Btu/hr-ft-F |
| Substrate density | 150 lb/cu.ft |
| Substrate heat Capacity | 0.16 Btu/lb-F |
| Substrate delay time | 0 sec |
| Surrounding terrain | Long grass or crops > 15 cm (6 in) |

NOTES:



RELEASE MENU

Type of release: Unregulated, Continuous release
Release duration 10 min
Normal flow rate 99.26 lb/sec
Duration of normal flow 10 min
Volume of vessel 1336.81 cu.ft
Percent of vessel filled with liquid 80 %
Liquid head above release point 6 feet
Pipe inner diameter 3.07 inches
Equivalent release diameter 3.07 inches
Pipe length upstream of break 0.0 feet
Height of release point 1.0 feet
Angle of release from horizontal 0.0 degrees

NOTES:

IMPOUNDMENT MENU

Unconfined

NOTES:

VDVE MENU

Vapor generation, dispersion and cloud explosion - Flammable calculation

Concentration endpoint 1 LFL mol%
Concentration endpoint 2 LFL mol%
Concentration endpoint 3 LFL mol%

Dispersion coefficient averaging time 1 min

Baker-Strehlow-Tang parameters

Fuel reactivity Medium
Obstacle density Low
Flame expansion 2.5-D

Overpressure values

Overpressure endpoint 1 1.00 psi
Overpressure endpoint 2 1.00 psi
Overpressure endpoint 3 1.00 psi

NOTES:

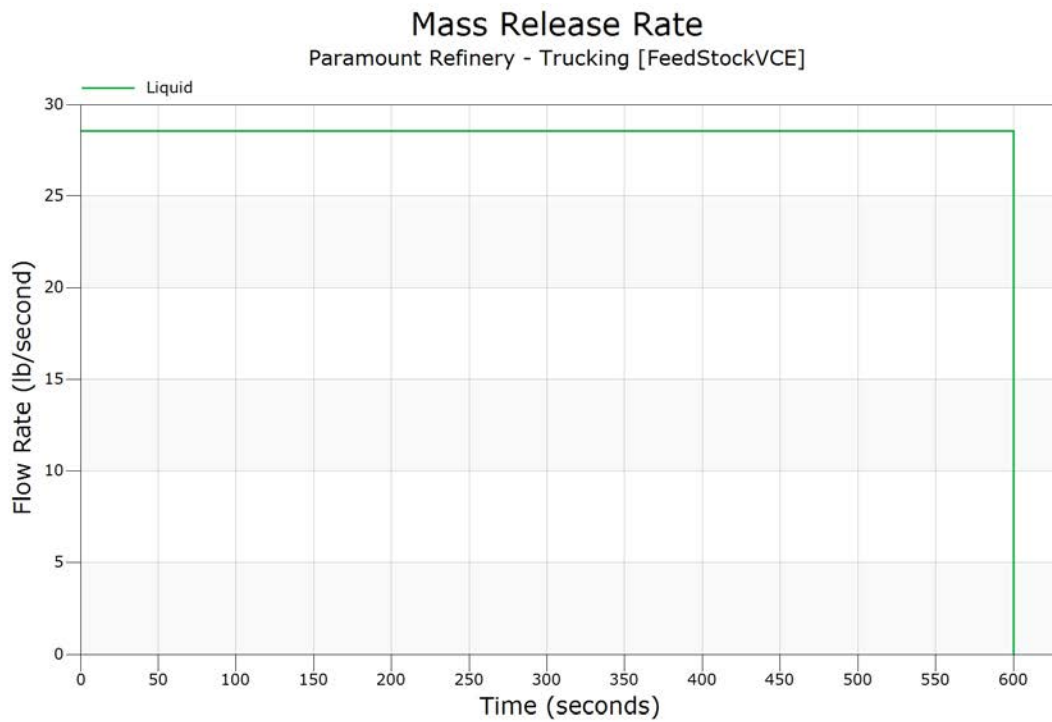


Release Model

| Time (sec) | Vapor (lb/sec) | Aerosol Rate (lb/sec) | Liquid Rate (lb/sec) | Total Rate (lb/sec) |
|---------------|-------------------|--------------------------|-------------------------|------------------------|
| 0.000000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 0.100000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 0.300000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 0.500000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 0.700000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 1.000000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 3.000000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 5.000000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 7.000000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 10.00000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 20.00000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 30.00000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 40.00000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 50.00000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 60.00000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 70.00000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 85.00000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 100.0000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 200.0000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 300.0000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 400.0000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 500.0000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 600.0000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| Totals (lb) | 0.000000 | 0.000000 | 17138.55 | 17138.55 |

Flowrate for Jet Fire [immediate ignition] = 0.000000 lb/sec.
Jet Fire [delayed ignition] = 0.000000 lb/sec.

Reason for Ending: Reached Stop Time





Release Compositions

| Component Number | Component Name, Formula |
|------------------|-------------------------|
| 20 | PHC-300, C22H38 |
| 21 | PHC-400, C28H42 |
| 22 | PHC-500, C38H61 |
| 32 | Tridecane, C13H28 |
| 33 | Tetradecane, C14H30 |
| 34 | Pentadecane, C15H32 |
| 36 | n-Heptadecane, C17H36 |

Composition (Mole Fraction) of Fluid Streams

| Comp. No. | Feed Stream | Momentum Jet Stream | | | Total Stream | Liquid Pool Stream |
|-----------|-------------|---------------------|------------------|----------------|------------------|--------------------|
| | | Flashed Vapor | Evaporated Vapor | Aerosol Liquid | Liquid to Ground | |
| 20 | 0.240000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.240000 |
| 21 | 0.250000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.250000 |
| 22 | 0.220000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.220000 |
| 32 | 0.030000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.030000 |
| 33 | 0.050000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.050000 |
| 34 | 0.080000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.080000 |
| 36 | 0.130000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.130000 |
| <hr/> | | | | | | |
| | 1.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 1.000000 |

Flammable Limits (Mole %) of Fluid Streams

| Limit | Feed Stream | Momentum Jet Stream | Liquid Pool Stream |
|-------|-------------|---------------------|--------------------|
| LFL | 0.41 | | 0.41 |
| UFL | 6.90 | | 6.90 |
| LBV | | | 0.40 m/s |



Pool Spreading and Vaporization

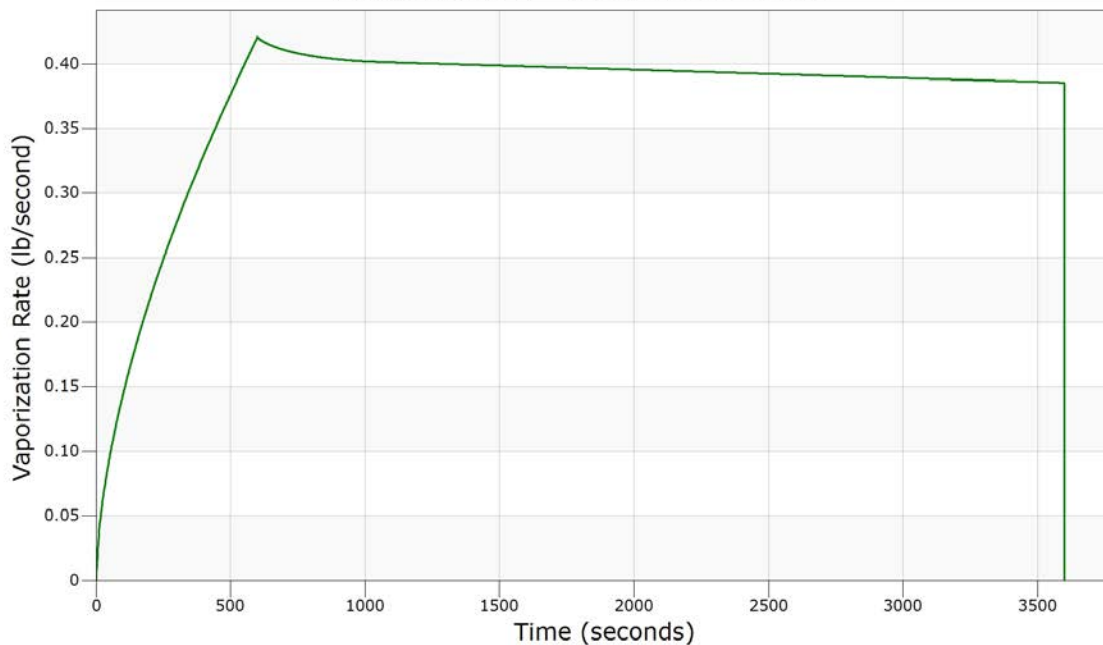
| Time (sec) | Liquid Remaining (ft3) | Pool/Dike Radius (feet) | Vapor Rate (lb/sec) |
|---------------|------------------------------|-------------------------------|------------------------|
| 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| 40.0000 | 26.0703 | 7.34646 | 0.830305E-01 |
| 80.0000 | 52.0891 | 9.25459 | 0.125783 |
| 120.000 | 78.0737 | 10.5912 | 0.160358 |
| 160.000 | 104.030 | 11.6542 | 0.190486 |
| 200.000 | 129.958 | 12.5512 | 0.217684 |
| 240.000 | 155.865 | 13.3346 | 0.242751 |
| 280.000 | 181.747 | 14.0348 | 0.266164 |
| 320.000 | 207.608 | 14.6706 | 0.288254 |
| 360.000 | 233.451 | 15.2549 | 0.309242 |
| 400.000 | 259.273 | 15.7976 | 0.329327 |
| 440.000 | 285.081 | 16.3045 | 0.348595 |
| 480.000 | 310.868 | 16.7818 | 0.367180 |
| 520.000 | 336.641 | 17.2329 | 0.385368 |
| 560.000 | 362.399 | 17.6611 | 0.403248 |
| 600.000 | 388.143 | 18.0689 | 0.420730 |
| 640.000 | 387.755 | 18.0630 | 0.415351 |
| 680.000 | 387.367 | 18.0571 | 0.412132 |
| 720.000 | 387.013 | 18.0515 | 0.409685 |
| 760.000 | 386.625 | 18.0456 | 0.407745 |
| 800.000 | 386.237 | 18.0397 | 0.406202 |
| 840.000 | 385.883 | 18.0341 | 0.404945 |
| 880.000 | 385.495 | 18.0282 | 0.403909 |
| 1130.00 | 383.199 | 17.9925 | 0.400911 |
| 1380.00 | 380.939 | 17.9570 | 0.399323 |
| 1630.00 | 378.644 | 17.9213 | 0.397736 |
| 1880.00 | 376.384 | 17.8855 | 0.396149 |
| 2130.00 | 374.124 | 17.8494 | 0.394561 |
| 2380.00 | 371.863 | 17.8136 | 0.392974 |
| 2630.00 | 369.639 | 17.7776 | 0.391387 |
| 2880.00 | 367.414 | 17.7418 | 0.389821 |
| 3130.00 | 365.189 | 17.7060 | 0.388234 |
| 3380.00 | 362.964 | 17.6703 | 0.386669 |
| 3600.00 | 361.022 | 17.6388 | 0.385302 |

Ending Message: Normal Ending



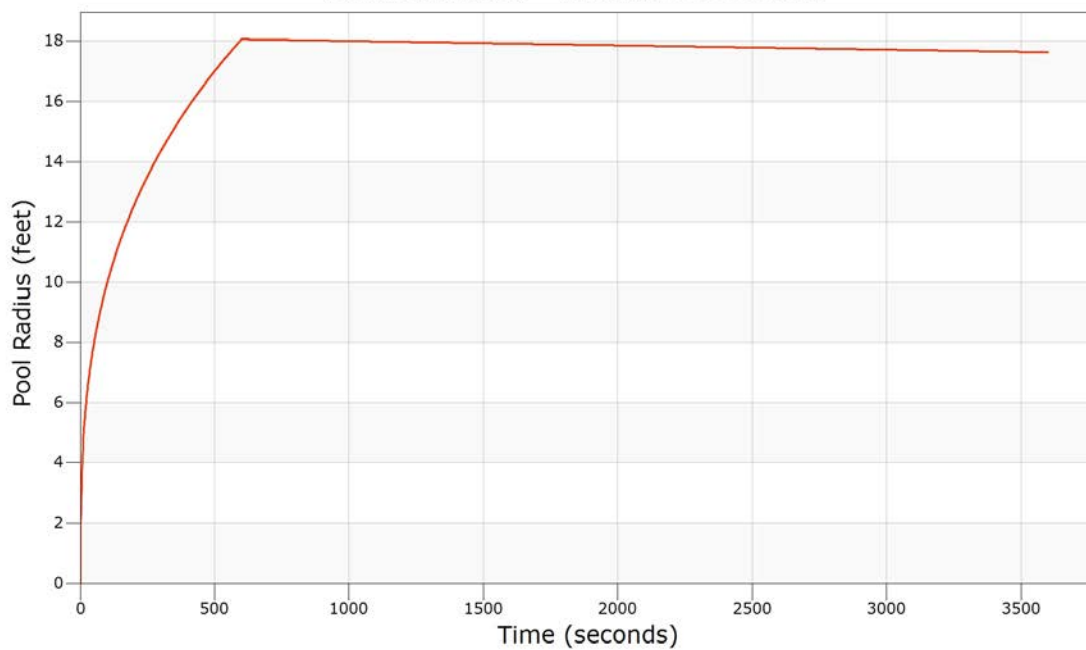
Pool Vaporization Rate

Paramount Refinery - Trucking [FeedStockVCE]



Pool Radius

Paramount Refinery - Trucking [FeedStockVCE]





Heavier-than-Air Dispersion

concentration limits

Endpoint 1 (highest) = 0.004138 mole fraction
Endpoint 2 (middle) = 0.004138 mole fraction
Endpoint 3 (lowest) = 0.004138 mole fraction

| downwind distance (ft) | centerline conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) |
|------------------------------|-------------------------------------|--------------------------------|--------------------------------|--------------------------------|
|------------------------------|-------------------------------------|--------------------------------|--------------------------------|--------------------------------|

* Vapor cloud does not leave source.



Case Inputs

Case Type : Fire Radiation
Case Name : FeedStockPool
User ID :
Project Number :
Type of Units : English Units

NOTES:

MATERIAL MENU

| Materials Released | Number | Formula | Name | Fraction |
|--------------------|--------|----------|---------------|----------|
| Component 1 | 20 | = C22H38 | PHC-300 | 0.240000 |
| Component 2 | 21 | = C28H42 | PHC-400 | 0.250000 |
| Component 3 | 22 | = C38H61 | PHC-500 | 0.220000 |
| Component 4 | 32 | = C13H28 | Tridecane | 0.030000 |
| Component 5 | 33 | = C14H30 | Tetradecane | 0.050000 |
| Component 6 | 34 | = C15H32 | Pentadecane | 0.080000 |
| Component 7 | 36 | = C17H36 | n-Heptadecane | 0.130000 |
| Component 8 | | | | |
| Component 9 | | | | |
| Component 10 | | | | |

Temperature : 68.00 °F
Pressure : 14.70 psia
The material is LIQUID
The mixture is Fuel Oil

NOTES:

ENVIRONMENT MENU

Wind speed : 20.00 mph
Relative humidity : 70 %
Air temperature : 68.0 °F

NOTES:

FIRE TYPE MENU

Fire radiation division: Circular pool fires
Horizontal isopleths only
Spill surface: land
Elevation of flame base (from grade) : 1.0 feet
Elevation of target (from grade) : 0.0 feet
Diameter of pool : 36.0 feet

Fire radiation flux values

Radiation endpoint 1 : 3487 Btu/hr-sq.ft
Radiation endpoint 2 : 1600 Btu/hr-sq.ft
Radiation endpoint 3 : 500 Btu/hr-sq.ft

NOTES:



Pool Fire Radiation

Length of Flame : 43.5 feet
 Flame Tilt from Vertical : 54.9 degrees
 Target Elevation : 0.0 feet
 Pool Elevation : 1.0 feet
 Wind Speed : 20.0 mph
 Substrate : Land

| Downwind Distance from Center of Pool (feet) | Flux to Vertical Target (Btu/hr-sq.ft) | Flux to Horizontal Target (Btu/hr-sq.ft) | Maximum Flux (Btu/hr-sq.ft) |
|--|--|--|-----------------------------------|
| 19.8 | 8047 | 20358 | 21891 |
| 21.1 | 7138 | 21156 | 22327 |
| 22.5 | 5802 | 22871 | 22871 |
| 23.9 | 7409 | 22871 | 22871 |
| 25.5 | 8284 | 22871 | 22871 |
| 27.2 | 8513 | 20759 | 22437 |
| 28.9 | 7958 | 22871 | 22871 |
| 30.8 | 7914 | 22871 | 22871 |
| 32.8 | 10976 | 19587 | 22452 |
| 35.0 | 11251 | 16763 | 22182 |
| 37.2 | 9994 | 14609 | 18761 |
| 39.7 | 8846 | 8957 | 12909 |
| 42.3 | 6346 | 5695 | 8677 |
| 45.0 | 4666 | 4435 | 6535 |
| 47.9 | 3693 | 3797 | 5365 |
| 51.1 | 3080 | 3352 | 4601 |
| 54.4 | 2656 | 2973 | 4021 |
| 57.9 | 2339 | 2614 | 3532 |
| 61.7 | 2090 | 2253 | 3089 |
| 65.8 | 1884 | 1883 | 2674 |
| 70.0 | 1700 | 1511 | 2281 |
| 74.6 | 1511 | 1158 | 1908 |
| 79.5 | 1305 | 848 | 1559 |
| 84.7 | 1096 | 599 | 1250 |
| 90.2 | 901 | 414 | 992 |
| 96.0 | 730 | 283 | 783 |
| 102.3 | 588 | 194 | 619 |
| 109.0 | 473 | 134 | 492 |
| 116.1 | 382 | 93 | 393 |
| 123.7 | 310 | 66 | 316 |

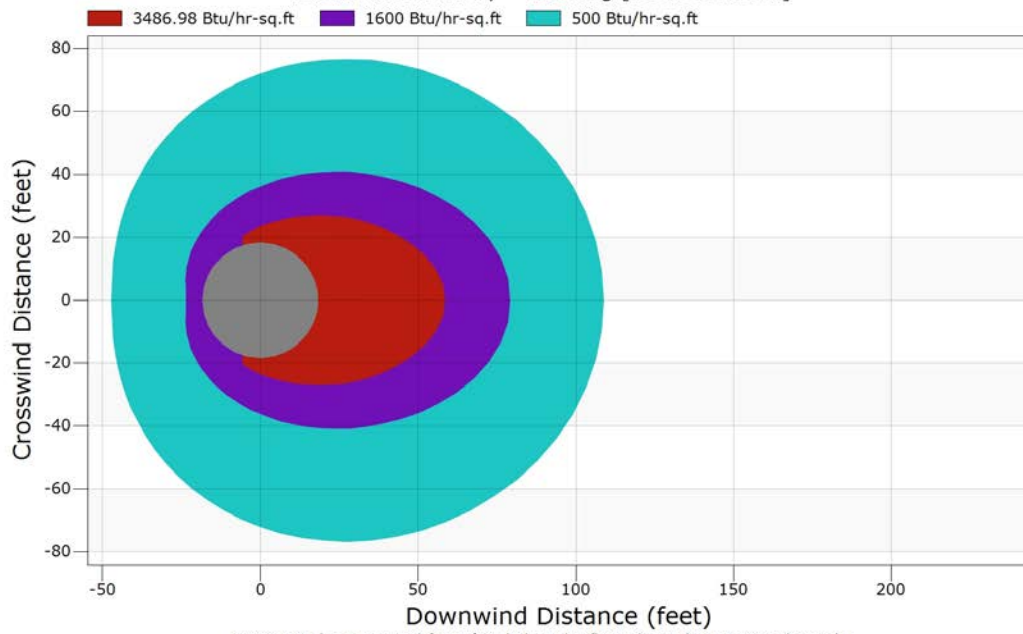
Downwind Distances to Endpoints:

| Distance (feet) | Maximum Flux (Btu/hr-sq.ft) |
|--------------------|--------------------------------|
| 58.3 | 3487 |
| 78.9 | 1600 |
| 108.6 | 500 |



Pool Fire Radiant Heat Contours - Overhead View

Paramount Refinery - Trucking [FeedStockPool]



Note: Results presented for 1 feet below the flame base during 20 mph winds.



Case Inputs

Case Type : Vapor Dispersion
Case Name : GasolineVCE
User ID :
Project Number :
Type of Units : English Units

NOTES:

MATERIAL MENU

| Materials Released | : Number | Formula | Name | Fraction |
|--------------------|----------|----------|----------------------------|----------|
| Component 1 | : 5 | = C4H10 | n-Butane | 0.020000 |
| Component 2 | : 8 | = C6H14 | n-Hexane | 0.100000 |
| Component 3 | : 9 | = C7H16 | n-Heptane | 0.100000 |
| Component 4 | : 11 | = C9H20 | n-Nonane | 0.100000 |
| Component 5 | : 12 | = C10H22 | n-Decane | 0.030000 |
| Component 6 | : 254 | = C5H12 | 2,2-Dimethylpropane (Neop) | 0.200000 |
| Component 7 | : 273 | = C6H12 | Methylcyclopentane | 0.100000 |
| Component 8 | : 281 | = C7H8 | Toluene | 0.100000 |
| Component 9 | : 286 | = C8H10 | para-Xylene | 0.100000 |
| Component 10 | : 289 | = C8H18 | 3-Methylheptane | 0.150000 |

Temperature : 68.00 °F
Pressure : 15.00 psia
The material is LIQUID
The mixture is Gasoline

NOTES:

ENVIRONMENT MENU

Wind speed 3.36 mph
Wind speed measurement height 32.8 feet
Stability class <A-F> F
Relative humidity 70 %
Air temperature 68.0 °F
Spill surface temperature 80.3 °F

Substrate name High density concrete
Substrate thermal conductivity 2.1999 Btu/hr-ft-F
Substrate density 150 lb/cu.ft
Substrate heat Capacity 0.16 Btu/lb-F
Substrate delay time 0 sec
Surrounding terrain Long grass or crops > 15 cm (6 in)

NOTES:



RELEASE MENU

Type of release: Unregulated, Continuous release
Release duration 10 min
Normal flow rate 99.26 lb/sec
Duration of normal flow 10 min
Volume of vessel 1336.81 cu.ft
Percent of vessel filled with liquid 80 %
Liquid head above release point 6 feet
Pipe inner diameter 3.07 inches
Equivalent release diameter 3.07 inches
Pipe length upstream of break 0.0 feet
Height of release point 1.0 feet
Angle of release from horizontal 0.0 degrees

NOTES:

IMPOUNDMENT MENU

Unconfined

NOTES:

VDVE MENU

Vapor generation, dispersion and cloud explosion - Flammable calculation

Concentration endpoint 1 LFL mol%
Concentration endpoint 2 LFL mol%
Concentration endpoint 3 LFL mol%

Dispersion coefficient averaging time 1 min

Baker-Strehlow-Tang parameters

Fuel reactivity Medium
Obstacle density Low
Flame expansion 2.5-D

Overpressure values

Overpressure endpoint 1 1.00 psi
Overpressure endpoint 2 1.00 psi
Overpressure endpoint 3 1.00 psi

NOTES:

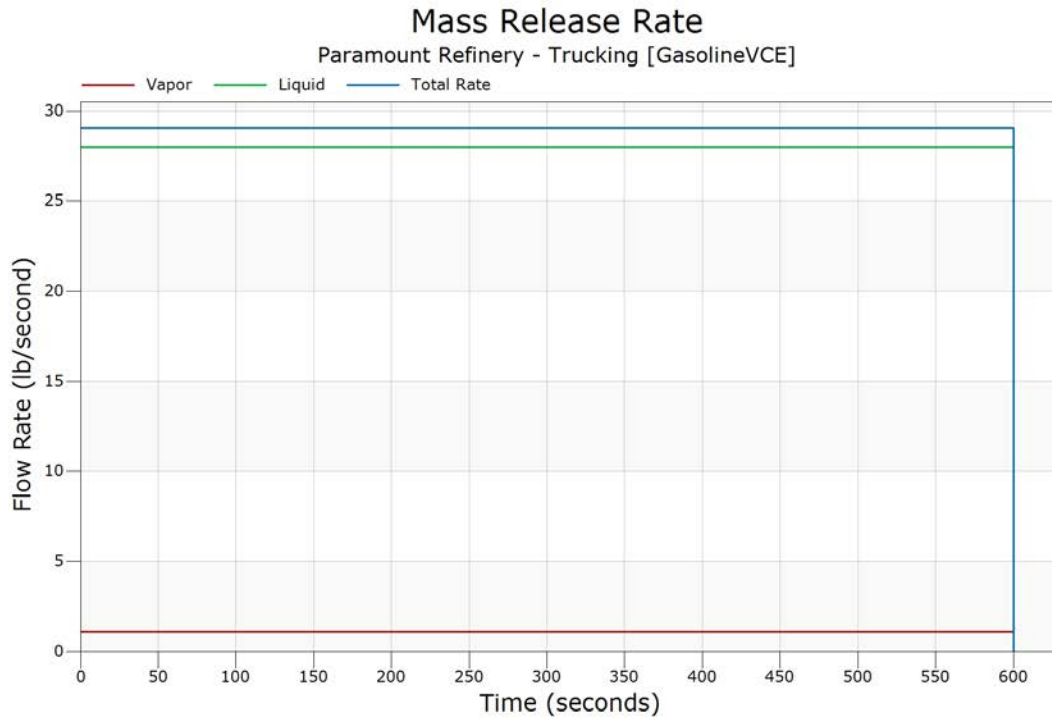


Release Model

| Time (sec) | Vapor (lb/sec) | Aerosol Rate (lb/sec) | Liquid Rate (lb/sec) | Total Rate (lb/sec) |
|---------------|-------------------|--------------------------|-------------------------|------------------------|
| 0.000000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 0.100000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 0.300000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 0.500000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 0.700000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 1.000000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 3.000000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 5.000000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 7.000000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 10.00000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 20.00000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 30.00000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 40.00000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 50.00000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 60.00000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 70.00000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 85.00000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 100.0000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 200.0000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 300.0000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 400.0000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 500.0000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 600.0000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| Totals (lb) | 659.1990 | 0.000000 | 16775.74 | 17434.94 |

Flowrate for Jet Fire [immediate ignition] = 1.098665 lb/sec.
Jet Fire [delayed ignition] = 1.098665 lb/sec.

Reason for Ending: Reached Stop Time





Release Compositions

| Component Number | Component Name, Formula |
|------------------|---|
| 5 | n-Butane, C4H10 |
| 8 | n-Hexane, C6H14 |
| 9 | n-Heptane, C7H16 |
| 11 | n-Nonane, C9H20 |
| 12 | n-Decane, C10H22 |
| 254 | 2,2-Dimethylpropane (Neopentane), C5H12 |
| 273 | Methylcyclopentane, C6H12 |
| 281 | Toluene, C7H8 |
| 286 | para-Xylene, C8H10 |
| 289 | 3-Methylheptane, C8H18 |

Composition (Mole Fraction) of Fluid Streams

| Comp. No. | Feed Stream | Momentum Jet Stream | | | Total Stream | Liquid Pool Stream |
|-----------|-------------|---------------------|------------------|----------------|--------------|--------------------|
| | | Flashed Vapor | Evaporated Vapor | Aerosol Liquid | | Liquid to Ground |
| 5 | 0.020000 | 0.000000 | 0.099926 | 0.000000 | 0.099926 | 0.018487 |
| 8 | 0.100000 | 0.000000 | 0.046678 | 0.000000 | 0.046678 | 0.101009 |
| 9 | 0.100000 | 0.000000 | 0.014321 | 0.000000 | 0.014321 | 0.101622 |
| 11 | 0.100000 | 0.000000 | 0.001421 | 0.000000 | 0.001421 | 0.101866 |
| 12 | 0.030000 | 0.000000 | 0.000140 | 0.000000 | 0.000140 | 0.030565 |
| 254 | 0.200000 | 0.000000 | 0.769694 | 0.000000 | 0.769694 | 0.189218 |
| 273 | 0.100000 | 0.000000 | 0.044270 | 0.000000 | 0.044270 | 0.101055 |
| 281 | 0.100000 | 0.000000 | 0.011003 | 0.000000 | 0.011003 | 0.101684 |
| 286 | 0.100000 | 0.000000 | 0.003145 | 0.000000 | 0.003145 | 0.101833 |
| 289 | 0.150000 | 0.000000 | 0.009402 | 0.000000 | 0.009402 | 0.152661 |
| | 1.000000 | 0.000000 | 1.000000 | 0.000000 | 1.000000 | 1.000000 |

Flammable Limits (Mole %) of Fluid Streams

| Limit | Feed Stream | Momentum Jet Stream | Liquid Pool Stream |
|-------|-------------|---------------------|--------------------|
| LFL | 1.08 | 1.37 | 1.08 |
| UFL | 6.11 | 7.56 | 6.09 |
| LBV | | 0.38 m/s | 0.39 m/s |



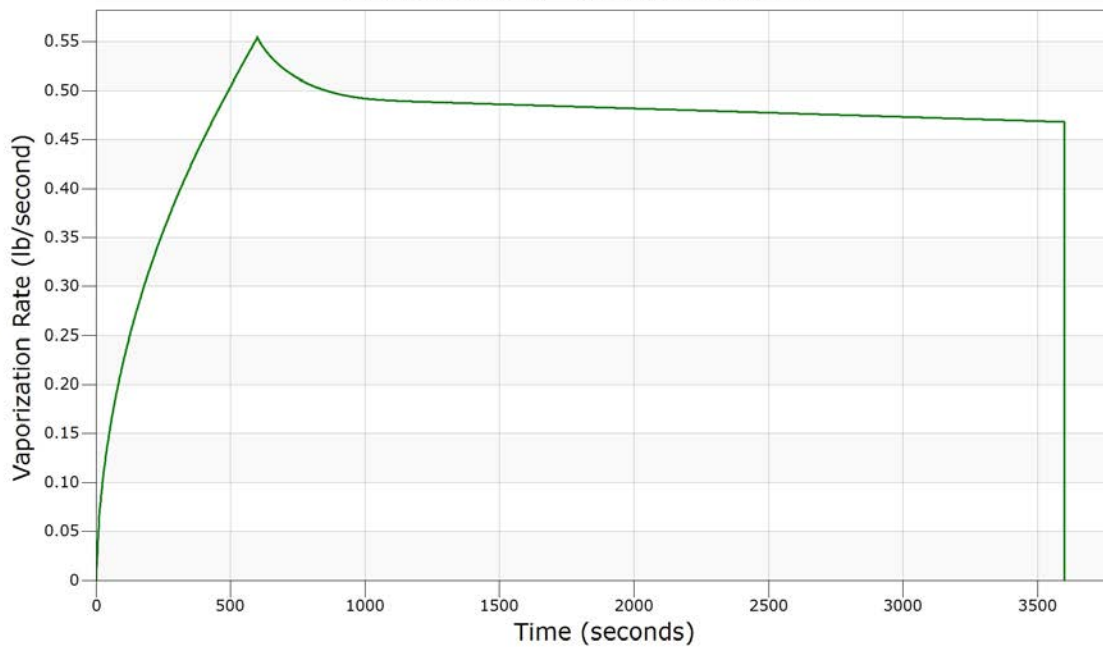
Pool Spreading and Vaporization

| Time (sec) | Liquid Remaining (ft3) | Pool/Dike Radius (feet) | Vapor Rate (lb/sec) |
|---------------|------------------------------|-------------------------------|------------------------|
| 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| 40.0000 | 25.0307 | 7.23327 | 0.134065 |
| 80.0000 | 49.9844 | 9.11024 | 0.196681 |
| 120.000 | 74.8883 | 10.4249 | 0.244272 |
| 160.000 | 99.7569 | 11.4701 | 0.283933 |
| 200.000 | 124.587 | 12.3517 | 0.318480 |
| 240.000 | 149.392 | 13.1220 | 0.349455 |
| 280.000 | 174.168 | 13.8100 | 0.377740 |
| 320.000 | 198.920 | 14.4347 | 0.403821 |
| 360.000 | 223.651 | 15.0092 | 0.428226 |
| 400.000 | 248.357 | 15.5420 | 0.451198 |
| 440.000 | 273.046 | 16.0404 | 0.472958 |
| 480.000 | 297.717 | 16.5092 | 0.493924 |
| 520.000 | 322.366 | 16.9524 | 0.514625 |
| 560.000 | 346.998 | 17.3734 | 0.534908 |
| 600.000 | 371.616 | 17.7743 | 0.554749 |
| 640.000 | 371.122 | 17.7664 | 0.537751 |
| 680.000 | 370.663 | 17.7589 | 0.526398 |
| 720.000 | 370.168 | 17.7513 | 0.517822 |
| 760.000 | 369.709 | 17.7441 | 0.511120 |
| 800.000 | 369.250 | 17.7365 | 0.505785 |
| 840.000 | 368.791 | 17.7293 | 0.501530 |
| 880.000 | 368.367 | 17.7221 | 0.498157 |
| 1130.00 | 365.577 | 17.6778 | 0.489448 |
| 1380.00 | 362.858 | 17.6335 | 0.487133 |
| 1630.00 | 360.139 | 17.5892 | 0.484929 |
| 1880.00 | 357.420 | 17.5453 | 0.482746 |
| 2130.00 | 354.701 | 17.5010 | 0.480564 |
| 2380.00 | 352.017 | 17.4564 | 0.478359 |
| 2630.00 | 349.340 | 17.4121 | 0.476176 |
| 2880.00 | 346.673 | 17.3678 | 0.474016 |
| 3130.00 | 344.021 | 17.3235 | 0.471833 |
| 3380.00 | 341.380 | 17.2792 | 0.469651 |
| 3600.00 | 339.063 | 17.2402 | 0.467755 |

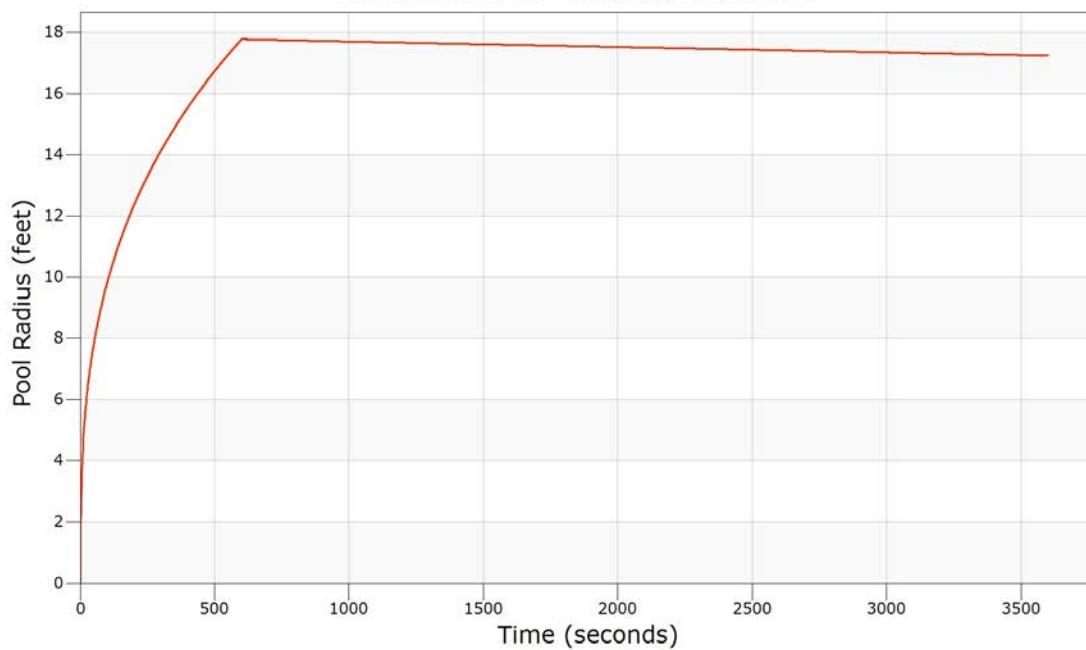
Ending Message: Normal Ending



Pool Vaporization Rate
Paramount Refinery - Trucking [GasolineVCE]



Pool Radius
Paramount Refinery - Trucking [GasolineVCE]





Momentum Jet Dispersion

concentration limits

Endpoint 1 (highest) = 0.013706 mole fraction
Endpoint 2 (middle) = 0.013706 mole fraction
Endpoint 3 (lowest) = 0.013706 mole fraction

| downwind distance (ft) | centerline conc. (mole frac.) | ground conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) | centerline height (ft) |
|------------------------------|-------------------------------------|---------------------------------|--------------------------------|--------------------------------|--------------------------------|------------------------------|
| 0 | 1.000000 | 0.000000 | 0.9 | 0.9 | 0.9 | 1.0 |
| 3 | 0.925795 | 0.925795 | 4.3 | 4.3 | 4.3 | 0.0 |
| 5 | 0.925792 | 0.925792 | 8.8 | 8.8 | 8.8 | 0.0 |
| 7 | 0.835471 | 0.835471 | 12.6 | 12.6 | 12.6 | 0.0 |
| 10 | 0.719502 | 0.719502 | 15.9 | 15.9 | 15.9 | 0.0 |
| 13 | 0.640756 | 0.640756 | 19.3 | 19.3 | 19.3 | 0.0 |
| 15 | 0.582857 | 0.582857 | 22.6 | 22.6 | 22.6 | 0.0 |
| 18 | 0.509493 | 0.509493 | 25.3 | 25.3 | 25.3 | 0.0 |
| 20 | 0.439226 | 0.439226 | 27.5 | 27.5 | 27.5 | 0.0 |
| 23 | 0.385335 | 0.385335 | 29.6 | 29.6 | 29.6 | 0.0 |
| 25 | 0.342756 | 0.342756 | 31.8 | 31.8 | 31.8 | 0.0 |
| 28 | 0.301742 | 0.301742 | 33.2 | 33.2 | 33.2 | 0.0 |
| 30 | 0.266593 | 0.266593 | 34.3 | 34.3 | 34.3 | 0.0 |
| 33 | 0.237886 | 0.237886 | 35.4 | 35.4 | 35.4 | 0.0 |
| 35 | 0.214071 | 0.214071 | 36.5 | 36.5 | 36.5 | 0.0 |
| 38 | 0.194048 | 0.194048 | 37.6 | 37.6 | 37.6 | 0.0 |
| 40 | 0.176798 | 0.176798 | 38.7 | 38.7 | 38.7 | 0.0 |
| 43 | 0.159693 | 0.159693 | 39.1 | 39.1 | 39.1 | 0.0 |
| 45 | 0.145085 | 0.145085 | 39.6 | 39.6 | 39.6 | 0.0 |
| 48 | 0.132499 | 0.132499 | 40.1 | 40.1 | 40.1 | 0.0 |
| 50 | 0.121569 | 0.121569 | 40.5 | 40.5 | 40.5 | 0.0 |
| 53 | 0.112011 | 0.112011 | 41.0 | 41.0 | 41.0 | 0.0 |
| 55 | 0.103598 | 0.103598 | 41.5 | 41.5 | 41.5 | 0.0 |
| 58 | 0.095887 | 0.095887 | 41.8 | 41.8 | 41.8 | 0.0 |
| 60 | 0.088554 | 0.088554 | 41.7 | 41.7 | 41.7 | 0.0 |
| 62 | 0.082048 | 0.082048 | 41.7 | 41.7 | 41.7 | 0.0 |
| 65 | 0.076248 | 0.076248 | 41.6 | 41.6 | 41.6 | 0.0 |
| 68 | 0.071054 | 0.071054 | 41.6 | 41.6 | 41.6 | 0.0 |
| 70 | 0.066384 | 0.066384 | 41.6 | 41.6 | 41.6 | 0.0 |
| 73 | 0.062170 | 0.062170 | 41.5 | 41.5 | 41.5 | 0.0 |
| 75 | 0.058352 | 0.058352 | 41.5 | 41.5 | 41.5 | 0.0 |
| 78 | 0.054864 | 0.054864 | 41.4 | 41.4 | 41.4 | 0.0 |
| 80 | 0.051478 | 0.051478 | 41.0 | 41.0 | 41.0 | 0.0 |
| 83 | 0.048395 | 0.048395 | 40.6 | 40.6 | 40.6 | 0.0 |
| 85 | 0.045581 | 0.045581 | 40.2 | 40.2 | 40.2 | 0.0 |



CANARY by Quest Output Report
 Report Date: 11 June 2021
 Case Title: Paramount Refinery - Trucking

| downwind distance (ft) | centerline conc. (mole frac.) | ground conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) | centerline height (ft) |
|------------------------|-------------------------------|---------------------------|--------------------------|--------------------------|--------------------------|------------------------|
| 88 | 0.043005 | 0.043005 | 39.8 | 39.8 | 39.8 | 0.0 |
| 90 | 0.040641 | 0.040641 | 39.4 | 39.4 | 39.4 | 0.0 |
| 93 | 0.038467 | 0.038467 | 39.0 | 39.0 | 39.0 | 0.0 |
| 95 | 0.036462 | 0.036462 | 38.5 | 38.5 | 38.5 | 0.0 |
| 98 | 0.034610 | 0.034610 | 38.1 | 38.1 | 38.1 | 0.0 |
| 100 | 0.032896 | 0.032896 | 37.7 | 37.7 | 37.7 | 0.0 |
| 103 | 0.031305 | 0.031305 | 37.3 | 37.3 | 37.3 | 0.0 |
| 105 | 0.029799 | 0.029799 | 36.6 | 36.6 | 36.6 | 0.0 |
| 108 | 0.028365 | 0.028365 | 35.5 | 35.5 | 35.5 | 0.0 |
| 110 | 0.027031 | 0.027031 | 34.5 | 34.5 | 34.5 | 0.0 |
| 112 | 0.025787 | 0.025787 | 33.4 | 33.4 | 33.4 | 0.0 |
| 115 | 0.024626 | 0.024626 | 32.3 | 32.3 | 32.3 | 0.0 |
| 118 | 0.023540 | 0.023540 | 31.3 | 31.3 | 31.3 | 0.0 |
| 120 | 0.022524 | 0.022524 | 30.2 | 30.2 | 30.2 | 0.0 |
| 123 | 0.021571 | 0.021571 | 29.1 | 29.1 | 29.1 | 0.0 |
| 125 | 0.020677 | 0.020677 | 28.1 | 28.1 | 28.1 | 0.0 |
| 128 | 0.019836 | 0.019836 | 27.0 | 27.0 | 27.0 | 0.0 |
| 130 | 0.019045 | 0.019045 | 25.9 | 25.9 | 25.9 | 0.0 |
| 133 | 0.018300 | 0.018300 | 24.9 | 24.9 | 24.9 | 0.0 |
| 135 | 0.017597 | 0.017597 | 23.8 | 23.8 | 23.8 | 0.0 |
| 138 | 0.016929 | 0.016929 | 22.0 | 22.0 | 22.0 | 0.0 |
| 140 | 0.016287 | 0.016287 | 18.2 | 18.2 | 18.2 | 0.0 |
| 143 | 0.015681 | 0.015681 | 14.3 | 14.3 | 14.3 | 0.0 |
| 145 | 0.015107 | 0.015107 | 10.4 | 10.4 | 10.4 | 0.0 |
| 148 | 0.014563 | 0.014563 | 6.6 | 6.6 | 6.6 | 0.0 |
| 150 | 0.014047 | 0.014047 | 2.7 | 2.7 | 2.7 | 0.0 |
| 153 | 0.013558 | 0.013558 | 0.0 | 0.0 | 0.0 | 0.0 |

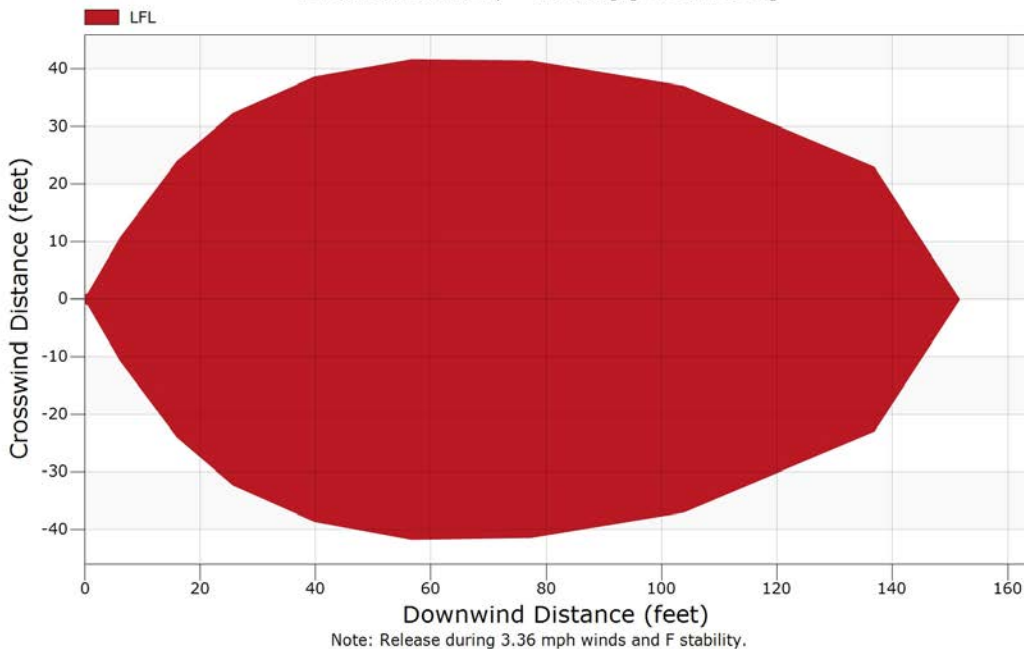
The momentum jet model coupled to the heavy gas model at 0.56 ft in 0 sec.

| Endpoint (mole frac., mixture) | Downwind Distance (feet) | Approximate Time (seconds) |
|--------------------------------|--------------------------|----------------------------|
| 1 0.013706 (LFL) | 151.7 | 44 |
| 2 0.013706 (LFL) | 151.7 | 44 |
| 3 0.013706 (LFL) | 151.7 | 44 |



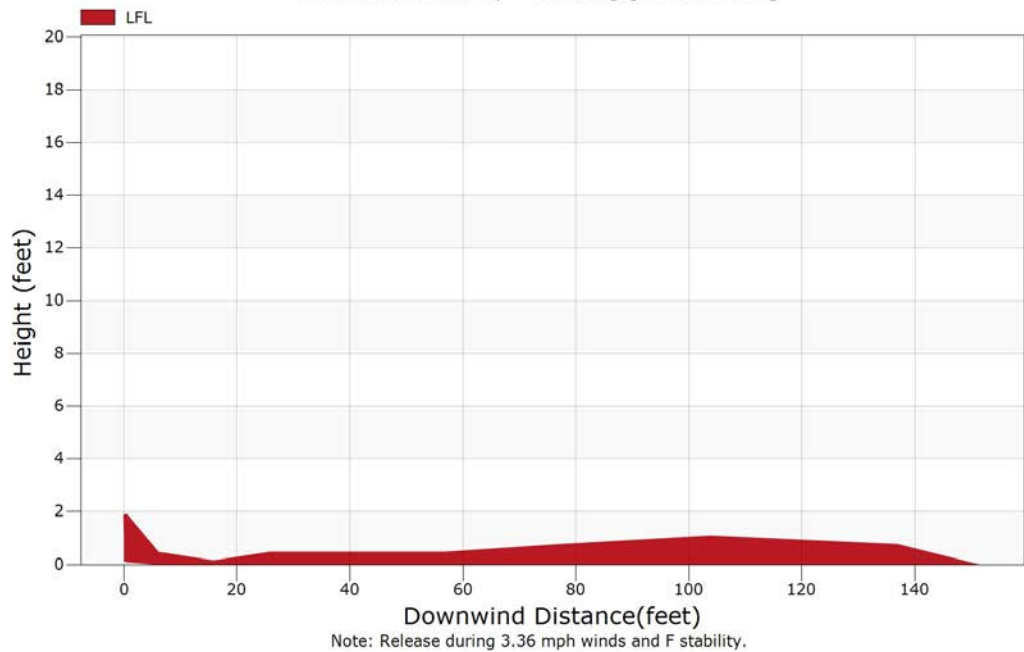
Momentum Jet Contours - Overhead View

Paramount Refinery - Trucking [GasolineVCE]



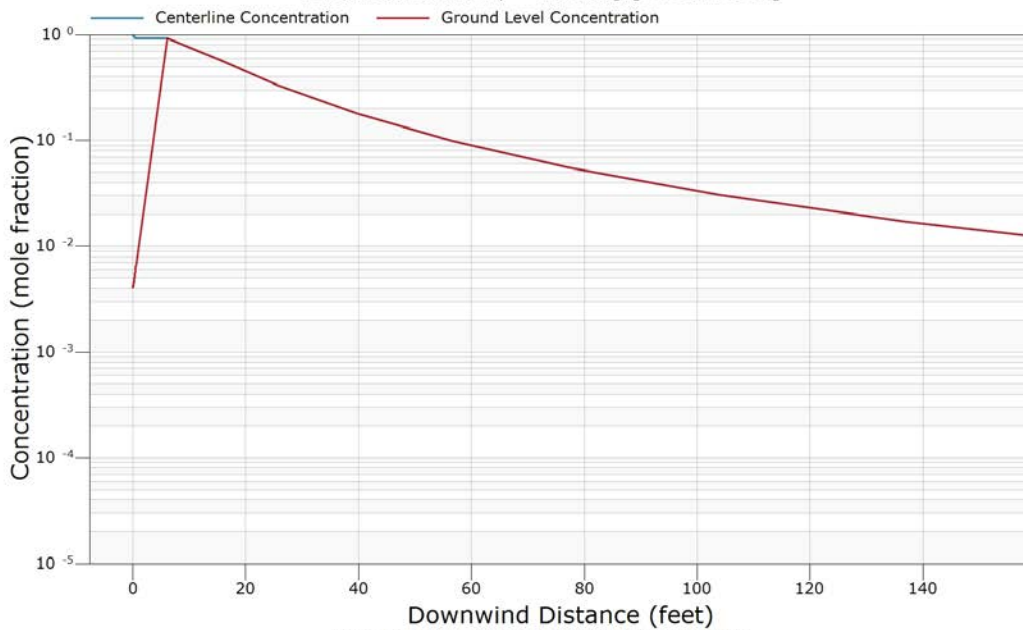
Momentum Jet Contours - Side View

Paramount Refinery - Trucking [GasolineVCE]





Momentum Jet Concentration Paramount Refinery - Trucking [GasolineVCE]



Note: Release during 3.36 mph winds and F stability.



Heavier-than-Air Dispersion

concentration limits

Endpoint 1 (highest) = 0.010801 mole fraction
Endpoint 2 (middle) = 0.010801 mole fraction
Endpoint 3 (lowest) = 0.010801 mole fraction

| downwind distance (ft) | centerline conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) |
|------------------------------|-------------------------------------|--------------------------------|--------------------------------|--------------------------------|
| 0.00 | 0.014837 | 58.07 | 58.07 | 58.07 |
| 1.00 | 0.015083 | 7.27 | 7.27 | 7.27 |
| 2.00 | 0.016151 | 7.26 | 7.26 | 7.26 |
| 3.00 | 0.017457 | 7.26 | 7.26 | 7.26 |
| 4.00 | 0.018349 | 7.26 | 7.26 | 7.26 |
| 5.00 | 0.019003 | 7.26 | 7.26 | 7.26 |
| 6.00 | 0.019555 | 7.25 | 7.25 | 7.25 |
| 7.00 | 0.020034 | 7.25 | 7.25 | 7.25 |
| 8.00 | 0.023346 | 7.25 | 7.25 | 7.25 |
| 9.00 | 0.023382 | 7.24 | 7.24 | 7.24 |
| 10.00 | 0.023414 | 7.24 | 7.24 | 7.24 |
| 11.00 | 0.023443 | 7.24 | 7.24 | 7.24 |
| 12.00 | 0.023469 | 7.23 | 7.23 | 7.23 |
| 13.00 | 0.023493 | 7.23 | 7.23 | 7.23 |
| 14.00 | 0.023516 | 7.23 | 7.23 | 7.23 |
| 15.00 | 0.023514 | 7.23 | 7.23 | 7.23 |
| 16.00 | 0.022952 | 7.22 | 7.22 | 7.22 |
| 17.00 | 0.022435 | 7.22 | 7.22 | 7.22 |
| 18.00 | 0.021924 | 7.22 | 7.22 | 7.22 |
| 19.00 | 0.021324 | 7.21 | 7.21 | 7.21 |
| 20.00 | 0.020801 | 7.21 | 7.21 | 7.21 |
| 21.00 | 0.020495 | 7.21 | 7.21 | 7.21 |
| 22.00 | 0.020208 | 7.20 | 7.20 | 7.20 |
| 23.00 | 0.019937 | 7.20 | 7.20 | 7.20 |
| 24.00 | 0.019681 | 7.20 | 7.20 | 7.20 |
| 25.00 | 0.019438 | 7.20 | 7.20 | 7.20 |
| 26.00 | 0.019208 | 7.19 | 7.19 | 7.19 |
| 27.00 | 0.018989 | 7.19 | 7.19 | 7.19 |
| 28.00 | 0.018780 | 7.19 | 7.19 | 7.19 |
| 29.00 | 0.018500 | 7.18 | 7.18 | 7.18 |
| 30.00 | 0.017830 | 7.18 | 7.18 | 7.18 |
| 31.00 | 0.017153 | 7.18 | 7.18 | 7.18 |
| 32.00 | 0.016873 | 7.17 | 7.17 | 7.17 |
| 33.00 | 0.016605 | 7.17 | 7.17 | 7.17 |
| 34.00 | 0.016349 | 7.17 | 7.17 | 7.17 |



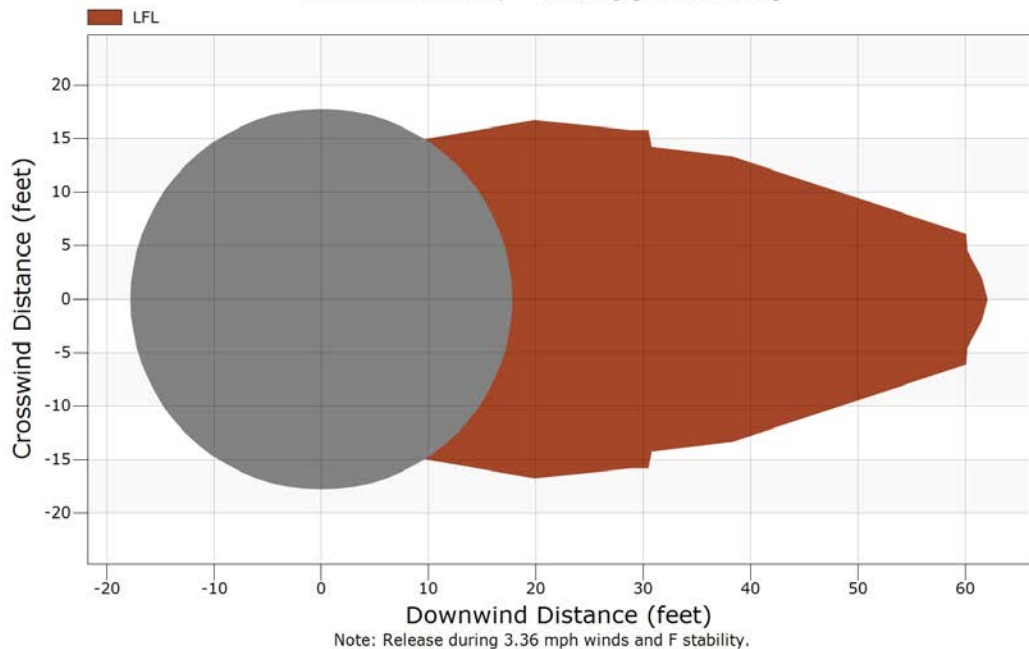
| downwind distance (ft) | centerline conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) |
|------------------------|-------------------------------|--------------------------|--------------------------|--------------------------|
| 35.00 | 0.016105 | 7.17 | 7.17 | 7.17 |
| 36.00 | 0.015870 | 7.16 | 7.16 | 7.16 |
| 37.00 | 0.015646 | 7.16 | 7.16 | 7.16 |
| 38.00 | 0.015431 | 7.16 | 7.16 | 7.16 |
| 39.00 | 0.015178 | 7.15 | 7.15 | 7.15 |
| 40.00 | 0.014920 | 7.15 | 7.15 | 7.15 |
| 41.00 | 0.014673 | 7.15 | 7.15 | 7.15 |
| 42.00 | 0.014436 | 7.15 | 7.15 | 7.15 |
| 43.00 | 0.014208 | 7.14 | 7.14 | 7.14 |
| 44.00 | 0.013988 | 7.14 | 7.14 | 7.14 |
| 45.00 | 0.013777 | 7.14 | 7.14 | 7.14 |
| 46.00 | 0.013574 | 7.13 | 7.13 | 7.13 |
| 47.00 | 0.013378 | 7.13 | 7.13 | 7.13 |
| 48.00 | 0.013188 | 7.13 | 7.13 | 7.13 |
| 49.00 | 0.013006 | 7.12 | 7.12 | 7.12 |
| 50.00 | 0.012829 | 7.12 | 7.12 | 7.12 |
| 51.00 | 0.012658 | 7.12 | 7.12 | 7.12 |
| 52.00 | 0.012493 | 7.12 | 7.12 | 7.12 |
| 53.00 | 0.012333 | 7.11 | 7.11 | 7.11 |
| 54.00 | 0.012178 | 7.11 | 7.11 | 7.11 |
| 55.00 | 0.012028 | 7.11 | 7.11 | 7.11 |
| 56.00 | 0.011882 | 7.10 | 7.10 | 7.10 |
| 57.00 | 0.011741 | 7.10 | 7.10 | 7.10 |
| 58.00 | 0.011603 | 6.77 | 6.77 | 6.77 |
| 59.00 | 0.011470 | 6.44 | 6.44 | 6.44 |
| 60.00 | 0.011340 | 6.11 | 6.11 | 6.11 |
| 61.00 | 0.010934 | 2.98 | 2.98 | 2.98 |
| 62.00 | 0.010804 | 0.12 | 0.12 | 0.12 |

| Endpoint (mole frac., mixture) | Downwind Distance (feet) | Approximate Time (seconds) |
|--------------------------------|--------------------------|----------------------------|
| 1 0.010801 (LFL) | 62.0 | 19 |
| 2 0.010801 (LFL) | 62.0 | 19 |
| 3 0.010801 (LFL) | 62.0 | 19 |



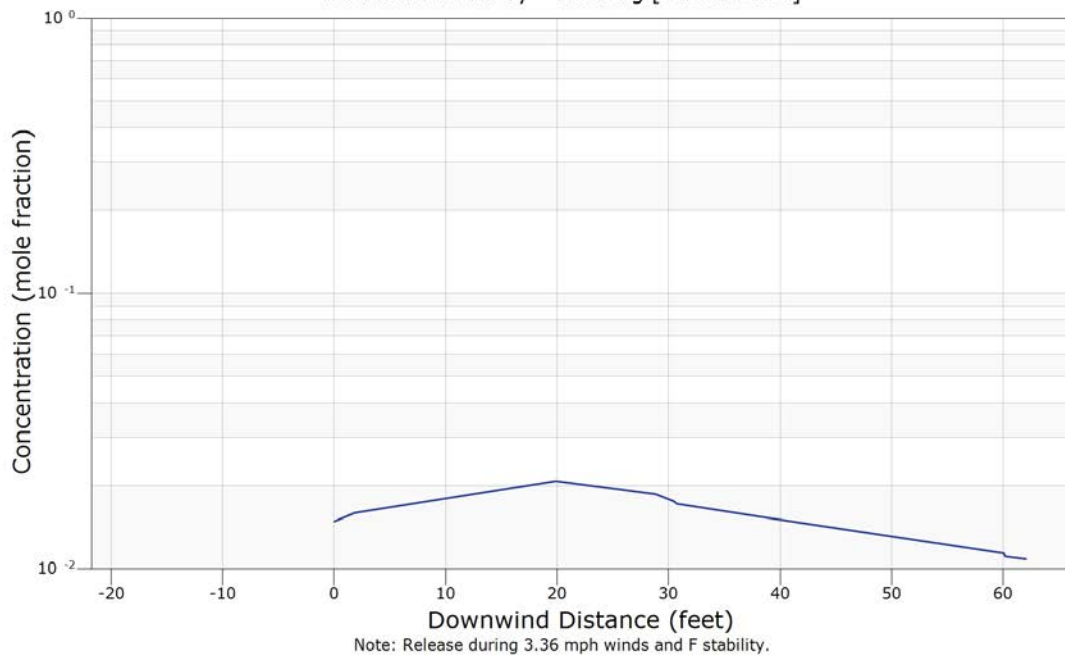
Heavier-than-Air Contours - Overhead View

Paramount Refinery - Trucking [GasolineVCE]



Heavier-than-Air Centerline Concentration

Paramount Refinery - Trucking [GasolineVCE]





Momentum Jet Explosion

Fuel Reactivity: Medium Obstacle Density: Low
Flame Expansion: 2.5-D Flame Speed: 0.29

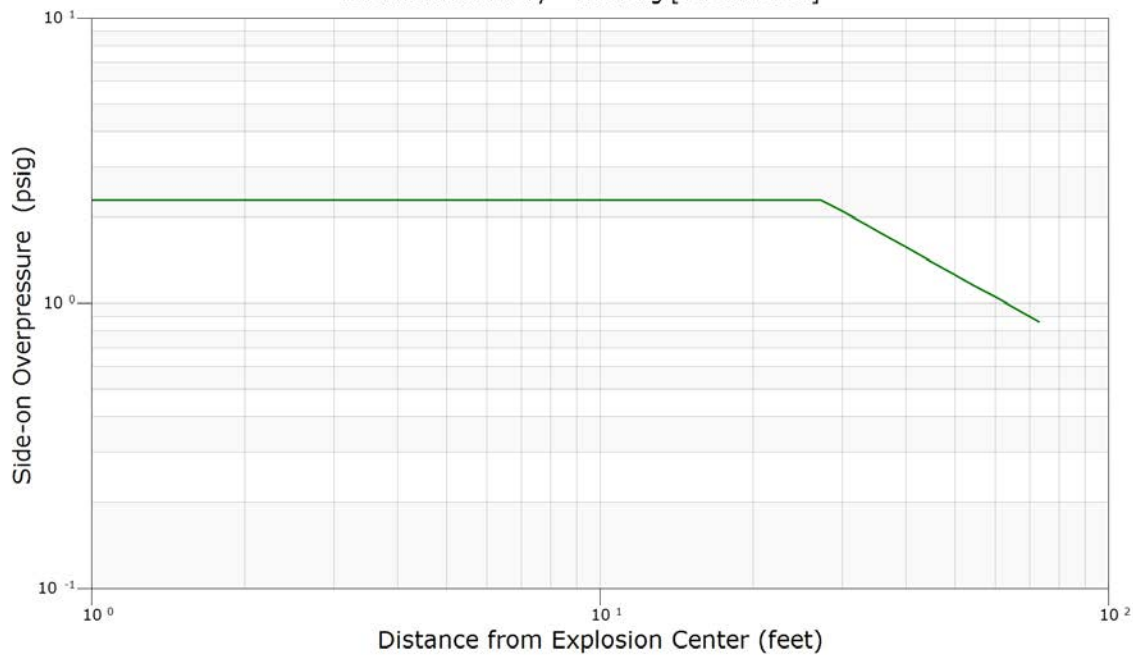
Mass of released material involved in explosion: 45.7426 lbs.

| Distance from Center of Flammable Cloud (feet) | Overpressure (psi gauge) | Impulse (psi-s) |
|--|-----------------------------|--------------------|
| 0.0 | 2.30 | 0.1179 |
| 6.8 | 2.30 | 0.1179 |
| 7.5 | 2.30 | 0.1179 |
| 8.3 | 2.30 | 0.1179 |
| 9.2 | 2.30 | 0.1179 |
| 10.1 | 2.30 | 0.1179 |
| 11.2 | 2.30 | 0.1179 |
| 12.3 | 2.30 | 0.1093 |
| 13.6 | 2.30 | 0.0992 |
| 15.0 | 2.30 | 0.0900 |
| 16.6 | 2.30 | 0.0817 |
| 18.3 | 2.30 | 0.0742 |
| 20.2 | 2.30 | 0.0673 |
| 22.3 | 2.30 | 0.0611 |
| 24.6 | 2.30 | 0.0555 |
| 27.2 | 2.30 | 0.0503 |
| 30.0 | 2.10 | 0.0457 |
| 33.1 | 1.90 | 0.0415 |
| 36.6 | 1.72 | 0.0376 |
| 40.4 | 1.56 | 0.0342 |
| 44.5 | 1.41 | 0.0310 |
| 49.2 | 1.28 | 0.0282 |
| 54.3 | 1.16 | 0.0256 |
| 59.9 | 1.05 | 0.0232 |
| 73.0 | 0.86 | 0.0191 |

The downwind distance to 1.00 psi is 63.3 feet
The downwind distance to 1.00 psi is 63.3 feet
The downwind distance to 1.00 psi is 63.3 feet



Momentum Jet Explosion Overpressure - Baker-Strehlow-Tang
Paramount Refinery - Trucking [GasolineVCE]





Heavier-than-Air Explosion

Fuel Reactivity: Medium Obstacle Density: Low
Flame Expansion: 2.5-D Flame Speed: 0.29

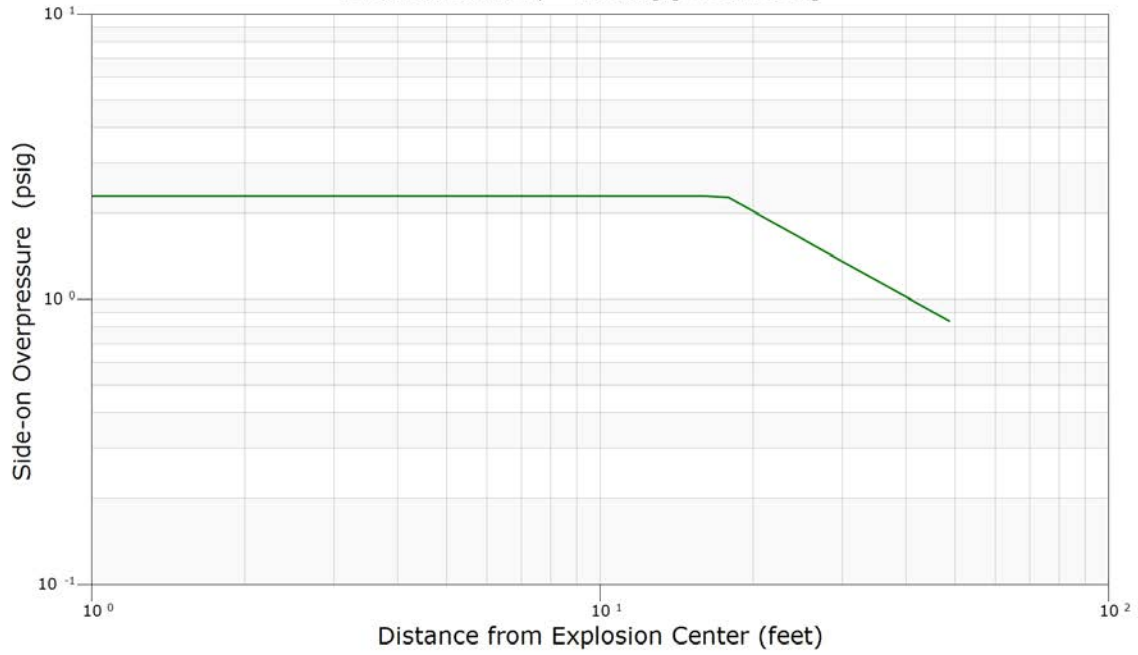
Mass of released material involved in explosion: 12.4299 lbs.

| Distance from Center of Flammable Cloud (feet) | Overpressure (psi gauge) | Impulse (psi-s) |
|--|-----------------------------|--------------------|
| 0.0 | 2.30 | 0.0764 |
| 4.4 | 2.30 | 0.0764 |
| 4.9 | 2.30 | 0.0764 |
| 5.4 | 2.30 | 0.0764 |
| 6.0 | 2.30 | 0.0764 |
| 6.6 | 2.30 | 0.0764 |
| 7.3 | 2.30 | 0.0764 |
| 8.0 | 2.30 | 0.0703 |
| 8.9 | 2.30 | 0.0637 |
| 9.8 | 2.30 | 0.0578 |
| 10.9 | 2.30 | 0.0524 |
| 12.0 | 2.30 | 0.0475 |
| 13.3 | 2.30 | 0.0431 |
| 14.6 | 2.30 | 0.0390 |
| 16.2 | 2.30 | 0.0354 |
| 17.9 | 2.28 | 0.0321 |
| 19.8 | 2.06 | 0.0291 |
| 21.8 | 1.86 | 0.0264 |
| 24.1 | 1.69 | 0.0239 |
| 26.7 | 1.53 | 0.0217 |
| 29.5 | 1.38 | 0.0197 |
| 32.6 | 1.25 | 0.0178 |
| 36.0 | 1.13 | 0.0162 |
| 39.8 | 1.02 | 0.0147 |
| 48.6 | 0.84 | 0.0120 |

The downwind distance to 1.00 psi is 40.9 feet
The downwind distance to 1.00 psi is 40.9 feet
The downwind distance to 1.00 psi is 40.9 feet



Heavier-than-Air Explosion Overpressure - Baker-Strehlow-Tang Paramount Refinery - Trucking [GasolineVCE]





Case Inputs

Case Type : Fire Radiation
Case Name : GasolinePool
User ID :
Project Number :
Type of Units : English Units

NOTES:

MATERIAL MENU

| Materials Released | Number | Formula | Name | Fraction |
|--------------------|--------|---------|----------------------------|----------|
| Component 1 | 5 | C4H10 | n-Butane | 0.020000 |
| Component 2 | 8 | C6H14 | n-Hexane | 0.100000 |
| Component 3 | 9 | C7H16 | n-Heptane | 0.100000 |
| Component 4 | 11 | C9H20 | n-Nonane | 0.100000 |
| Component 5 | 12 | C10H22 | n-Decane | 0.030000 |
| Component 6 | 254 | C5H12 | 2,2-Dimethylpropane (Neop) | 0.200000 |
| Component 7 | 273 | C6H12 | Methylcyclopentane | 0.100000 |
| Component 8 | 281 | C7H8 | Toluene | 0.100000 |
| Component 9 | 286 | C8H10 | para-Xylene | 0.100000 |
| Component 10 | 289 | C8H18 | 3-Methylheptane | 0.150000 |

Temperature : 68.00 °F
Pressure : 14.70 psia
The material is LIQUID
The mixture is Gasoline

NOTES:

ENVIRONMENT MENU

Wind speed : 20.00 mph
Relative humidity : 70 %
Air temperature : 68.0 °F

NOTES:

FIRE TYPE MENU

Fire radiation division: Circular pool fires
Horizontal isopleths only
Spill surface: land
Elevation of flame base (from grade) : 0.0 feet
Elevation of target (from grade) : 0.0 feet
Diameter of pool : 36.0 feet

Fire radiation flux values

Radiation endpoint 1 : 3487 Btu/hr-sq.ft
Radiation endpoint 2 : 1600 Btu/hr-sq.ft
Radiation endpoint 3 : 500 Btu/hr-sq.ft

NOTES:



Pool Fire Radiation

Length of Flame : 68.8 feet
 Flame Tilt from Vertical : 60.7 degrees
 Target Elevation : 0.0 feet
 Pool Elevation : 0.0 feet
 Wind Speed : 20.0 mph
 Substrate : Land

| Downwind Distance from Center of Pool (feet) | Flux to Vertical Target (Btu/hr-sq.ft) | Flux to Horizontal Target (Btu/hr-sq.ft) | Maximum Flux (Btu/hr-sq.ft) |
|--|--|--|-----------------------------------|
| 36.7 | 19728 | 26912 | 33368 |
| 38.9 | 18285 | 31572 | 36485 |
| 41.3 | 17392 | 28721 | 33576 |
| 43.8 | 16420 | 25038 | 29942 |
| 46.5 | 15369 | 20379 | 25525 |
| 49.3 | 13660 | 15735 | 20838 |
| 52.3 | 11334 | 12505 | 16877 |
| 55.5 | 9362 | 10588 | 14133 |
| 58.9 | 7912 | 9357 | 12254 |
| 62.4 | 6856 | 8446 | 10878 |
| 66.2 | 6056 | 7675 | 9776 |
| 70.3 | 5423 | 6966 | 8828 |
| 74.5 | 4904 | 6270 | 7960 |
| 79.1 | 4469 | 5562 | 7135 |
| 83.9 | 4092 | 4820 | 6323 |
| 89.0 | 3758 | 4048 | 5523 |
| 94.4 | 3443 | 3265 | 4745 |
| 100.1 | 3096 | 2518 | 3991 |
| 106.2 | 2701 | 1859 | 3279 |
| 112.6 | 2290 | 1326 | 2646 |
| 119.5 | 1898 | 924 | 2111 |
| 126.8 | 1550 | 638 | 1676 |
| 134.5 | 1257 | 440 | 1332 |
| 142.6 | 1019 | 306 | 1064 |
| 151.3 | 828 | 214 | 855 |
| 160.5 | 675 | 152 | 692 |
| 170.3 | 553 | 109 | 564 |
| 180.6 | 456 | 80 | 463 |
| 191.6 | 377 | 58 | 382 |
| 203.3 | 314 | 43 | 317 |

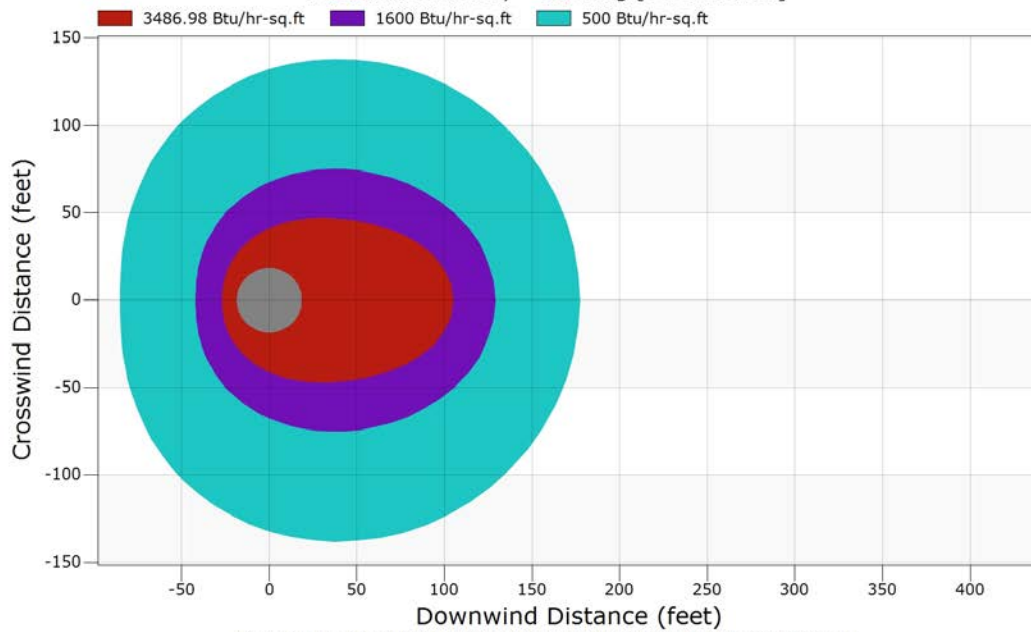
Downwind Distances to Endpoints:

| Distance (feet) | Maximum Flux (Btu/hr-sq.ft) |
|--------------------|--------------------------------|
| 104.4 | 3487 |
| 128.5 | 1600 |
| 176.8 | 500 |



Pool Fire Radiant Heat Contours - Overhead View

Paramount Refinery - Trucking [GasolinePool]



Note: Results presented for 0 feet above the flame base during 20 mph winds.



Case Inputs

Case Type : Vapor Dispersion
Case Name : JetVCE
User ID :
Project Number :
Type of Units : English Units

NOTES:

MATERIAL MENU

| Materials Released | Number | Formula | Name | Fraction |
|--------------------|--------|---------|-------------|----------|
| Component 1 | 9 | C7H16 | n-Heptane | 0.040000 |
| Component 2 | 10 | C8H18 | n-Octane | 0.080000 |
| Component 3 | 11 | C9H20 | n-Nonane | 0.120000 |
| Component 4 | 12 | C10H22 | n-Decane | 0.170000 |
| Component 5 | 13 | C11H24 | n-Undecane | 0.170000 |
| Component 6 | 31 | C12H26 | Dodecane | 0.170000 |
| Component 7 | 32 | C13H28 | Tridecane | 0.130000 |
| Component 8 | 33 | C14H30 | Tetradecane | 0.080000 |
| Component 9 | 34 | C15H32 | Pentadecane | 0.040000 |
| Component 10 | | | | |

Temperature : 68.00 °F
Pressure : 15.00 psia
The material is LIQUID
The mixture is Jet A1

NOTES:

ENVIRONMENT MENU

| | |
|--------------------------------|------------------------------------|
| Wind speed | 3.36 mph |
| Wind speed measurement height | 32.8 feet |
| Stability class <A-F> | F |
| Relative humidity | 70 % |
| Air temperature | 68.0 °F |
| Spill surface temperature | 68.0 °F |
| Substrate name | High density concrete |
| Substrate thermal conductivity | 2.1999 Btu/hr-ft-F |
| Substrate density | 150 lb/cu.ft |
| Substrate heat Capacity | 0.16 Btu/lb-F |
| Substrate delay time | 0 sec |
| Surrounding terrain | Long grass or crops > 15 cm (6 in) |

NOTES:



RELEASE MENU

Type of release: Unregulated, Continuous release
Release duration 10 min
Normal flow rate 101.10 lb/sec
Duration of normal flow 10 min
Volume of vessel 1336.81 cu.ft
Percent of vessel filled with liquid 80 %
Liquid head above release point 6 feet
Pipe inner diameter 3.07 inches
Equivalent release diameter 3.07 inches
Pipe length upstream of break 0.0 feet
Height of release point 1.0 feet
Angle of release from horizontal 0.0 degrees

NOTES:

IMPOUNDMENT MENU

Unconfined

NOTES:

VDVE MENU

Vapor generation, dispersion and cloud explosion - Flammable calculation

Concentration endpoint 1 LFL mol%
Concentration endpoint 2 LFL mol%
Concentration endpoint 3 LFL mol%

Dispersion coefficient averaging time 1 min

Baker-Strehlow-Tang parameters

Fuel reactivity Medium
Obstacle density Low
Flame expansion 2.5-D

Overpressure values

Overpressure endpoint 1 1.00 psi
Overpressure endpoint 2 1.00 psi
Overpressure endpoint 3 1.00 psi

NOTES:

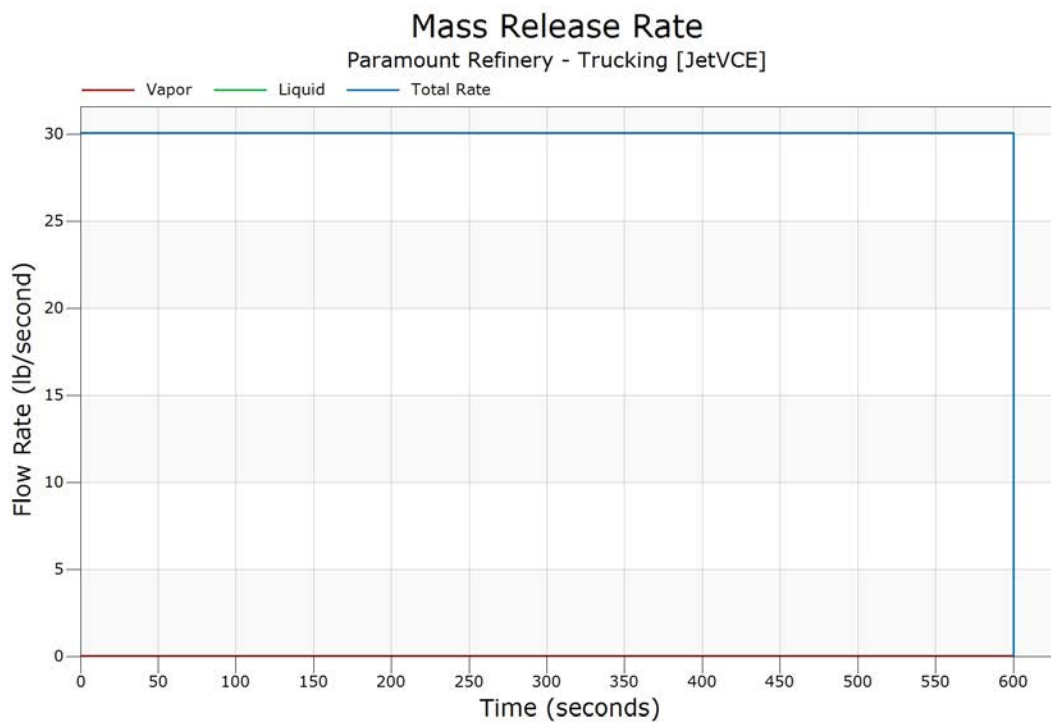


Release Model

| Time (sec) | Vapor (lb/sec) | Aerosol Rate (lb/sec) | Liquid Rate (lb/sec) | Total Rate (lb/sec) |
|---------------|-------------------|--------------------------|-------------------------|------------------------|
| 0.000000 | .1205895E-01 | 0.000000 | 30.07165 | 30.08371 |
| 0.100000 | .1205895E-01 | 0.000000 | 30.07165 | 30.08371 |
| 0.300000 | .1205895E-01 | 0.000000 | 30.07165 | 30.08371 |
| 0.500000 | .1205895E-01 | 0.000000 | 30.07165 | 30.08371 |
| 0.700000 | .1205895E-01 | 0.000000 | 30.07165 | 30.08371 |
| 1.000000 | .1205895E-01 | 0.000000 | 30.07165 | 30.08371 |
| 3.000000 | .1205895E-01 | 0.000000 | 30.07165 | 30.08371 |
| 5.000000 | .1205895E-01 | 0.000000 | 30.07165 | 30.08371 |
| 7.000000 | .1205895E-01 | 0.000000 | 30.07165 | 30.08371 |
| 10.00000 | .1205895E-01 | 0.000000 | 30.07165 | 30.08371 |
| 20.00000 | .1205895E-01 | 0.000000 | 30.07165 | 30.08371 |
| 30.00000 | .1205895E-01 | 0.000000 | 30.07165 | 30.08371 |
| 40.00000 | .1205895E-01 | 0.000000 | 30.07165 | 30.08371 |
| 50.00000 | .1205895E-01 | 0.000000 | 30.07165 | 30.08371 |
| 60.00000 | .1205895E-01 | 0.000000 | 30.07165 | 30.08371 |
| 70.00000 | .1205895E-01 | 0.000000 | 30.07165 | 30.08371 |
| 85.00000 | .1205895E-01 | 0.000000 | 30.07165 | 30.08371 |
| 100.0000 | .1205895E-01 | 0.000000 | 30.07165 | 30.08371 |
| 200.0000 | .1205895E-01 | 0.000000 | 30.07165 | 30.08371 |
| 300.0000 | .1205895E-01 | 0.000000 | 30.07165 | 30.08371 |
| 400.0000 | .1205895E-01 | 0.000000 | 30.07165 | 30.08371 |
| 500.0000 | .1205895E-01 | 0.000000 | 30.07165 | 30.08371 |
| 600.0000 | .1205895E-01 | 0.000000 | 30.07165 | 30.08371 |
| Totals (lb) | 7.235368 | 0.000000 | 18042.99 | 18050.22 |

Flowrate for Jet Fire [immediate ignition] = 0.1205895E-01 lb/sec.
Jet Fire [delayed ignition] = 0.1205895E-01 lb/sec.

Reason for Ending: Reached Stop Time





Release Compositions

| Component Number | Component Name, Formula |
|------------------|-------------------------|
| 9 | n-Heptane, C7H16 |
| 10 | n-Octane, C8H18 |
| 11 | n-Nonane, C9H20 |
| 12 | n-Decane, C10H22 |
| 13 | n-Undecane, C11H24 |
| 31 | Dodecane, C12H26 |
| 32 | Tridecane, C13H28 |
| 33 | Tetradecane, C14H30 |
| 34 | Pentadecane, C15H32 |

Composition (Mole Fraction) of Fluid Streams

| Comp. No. | Feed Stream | Momentum Jet Stream | | | Liquid Pool Stream | |
|-----------|-------------|---------------------|------------------|----------------|--------------------|------------------|
| | | Flashed Vapor | Evaporated Vapor | Aerosol Liquid | Total Stream | Liquid to Ground |
| 9 | 0.040000 | 0.000000 | 0.468816 | 0.000000 | 0.468816 | 0.039999 |
| 10 | 0.080000 | 0.000000 | 0.294246 | 0.000000 | 0.294246 | 0.080000 |
| 11 | 0.120000 | 0.000000 | 0.140511 | 0.000000 | 0.140511 | 0.120000 |
| 12 | 0.170000 | 0.000000 | 0.065554 | 0.000000 | 0.065554 | 0.170000 |
| 13 | 0.170000 | 0.000000 | 0.021309 | 0.000000 | 0.021309 | 0.170000 |
| 31 | 0.170000 | 0.000000 | 0.007241 | 0.000000 | 0.007241 | 0.170000 |
| 32 | 0.130000 | 0.000000 | 0.001862 | 0.000000 | 0.001862 | 0.130000 |
| 33 | 0.080000 | 0.000000 | 0.000393 | 0.000000 | 0.000393 | 0.080000 |
| 34 | 0.040000 | 0.000000 | 0.000067 | 0.000000 | 0.000067 | 0.040000 |
| | 1.000000 | 0.000000 | 1.000000 | 0.000000 | 1.000000 | 1.000000 |

Flammable Limits (Mole %) of Fluid Streams

| Limit | Feed Stream | Momentum Jet Stream | Liquid Pool Stream |
|-------|-------------|---------------------|--------------------|
| LFL | 0.67 | 0.96 | 0.67 |
| UFL | 4.63 | 5.48 | 4.63 |
| LBV | | 0.41 m/s | 0.40 m/s |



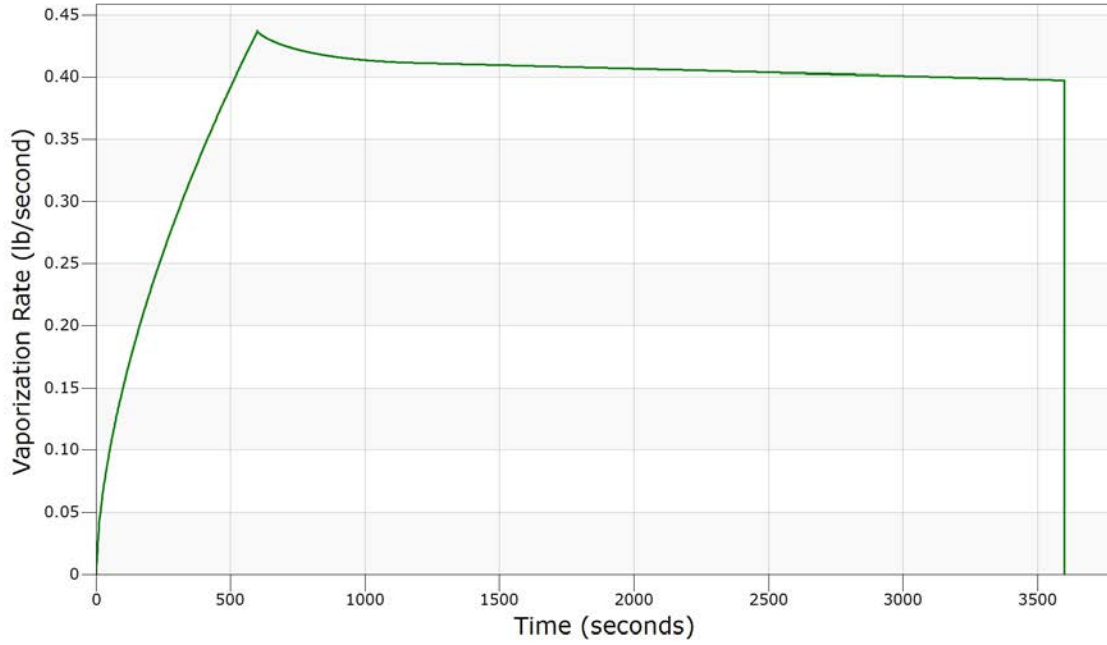
Pool Spreading and Vaporization

| Time (sec) | Liquid Remaining (ft3) | Pool/Dike Radius (feet) | Vapor Rate (lb/sec) |
|---------------|------------------------------|-------------------------------|------------------------|
| 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| 40.0000 | 25.9588 | 7.33432 | 0.865204E-01 |
| 80.0000 | 51.8667 | 9.23950 | 0.131074 |
| 120.000 | 77.7417 | 10.5738 | 0.167104 |
| 160.000 | 103.589 | 11.6352 | 0.198500 |
| 200.000 | 129.407 | 12.5308 | 0.226856 |
| 240.000 | 155.204 | 13.3130 | 0.252980 |
| 280.000 | 180.977 | 14.0121 | 0.277364 |
| 320.000 | 206.732 | 14.6470 | 0.300402 |
| 360.000 | 232.466 | 15.2303 | 0.322272 |
| 400.000 | 258.182 | 15.7720 | 0.343194 |
| 440.000 | 283.880 | 16.2782 | 0.363278 |
| 480.000 | 309.561 | 16.7546 | 0.382634 |
| 520.000 | 335.224 | 17.2047 | 0.401329 |
| 560.000 | 360.881 | 17.6325 | 0.419474 |
| 600.000 | 386.519 | 18.0404 | 0.437088 |
| 640.000 | 386.131 | 18.0344 | 0.430893 |
| 680.000 | 385.777 | 18.0289 | 0.427035 |
| 720.000 | 385.389 | 18.0230 | 0.424059 |
| 760.000 | 385.036 | 18.0174 | 0.421656 |
| 800.000 | 384.647 | 18.0118 | 0.419650 |
| 840.000 | 384.294 | 18.0059 | 0.417974 |
| 880.000 | 383.941 | 18.0003 | 0.416563 |
| 1130.00 | 381.716 | 17.9652 | 0.411757 |
| 1380.00 | 379.491 | 17.9301 | 0.410214 |
| 1630.00 | 377.267 | 17.8950 | 0.408759 |
| 1880.00 | 375.077 | 17.8602 | 0.407326 |
| 2130.00 | 372.852 | 17.8251 | 0.405915 |
| 2380.00 | 370.663 | 17.7904 | 0.404482 |
| 2630.00 | 368.509 | 17.7556 | 0.403071 |
| 2880.00 | 366.319 | 17.7208 | 0.401638 |
| 3130.00 | 364.165 | 17.6857 | 0.400205 |
| 3380.00 | 362.011 | 17.6506 | 0.398794 |
| 3600.00 | 360.104 | 17.6201 | 0.397538 |

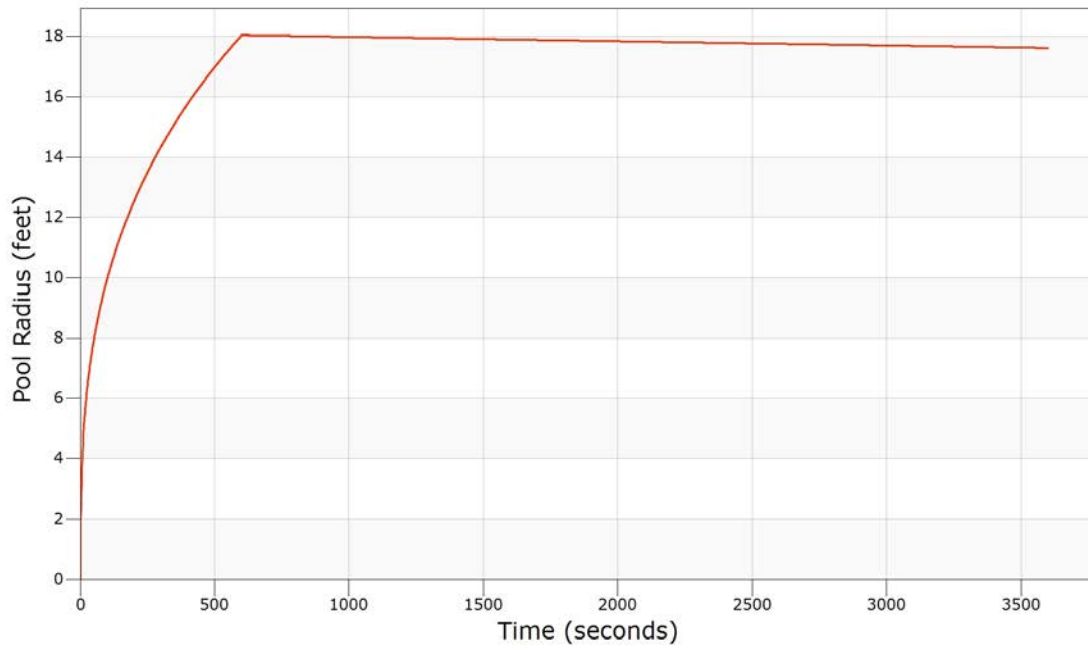
Ending Message: Normal Ending



Pool Vaporization Rate
Paramount Refinery - Trucking [JetVCE]



Pool Radius
Paramount Refinery - Trucking [JetVCE]





Momentum Jet Dispersion

concentration limits

Endpoint 1 (highest) = 0.009552 mole fraction
Endpoint 2 (middle) = 0.009552 mole fraction
Endpoint 3 (lowest) = 0.009552 mole fraction

| downwind distance (ft) | centerline conc. (mole frac.) | ground conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) | centerline height (ft) |
|------------------------------|-------------------------------------|---------------------------------|--------------------------------|--------------------------------|--------------------------------|------------------------------|
| 0 | 1.000000 | 0.000000 | 0.1 | 0.1 | 0.1 | 1.0 |
| 0.5 | 0.621010 | 0.000000 | 0.1 | 0.1 | 0.1 | 1.0 |
| 1.0 | 0.346697 | 0.346697 | 0.3 | 0.3 | 0.3 | 0.0 |
| 1.5 | 0.241587 | 0.241587 | 0.5 | 0.5 | 0.5 | 0.0 |
| 2.0 | 0.186968 | 0.186968 | 0.7 | 0.7 | 0.7 | 0.0 |
| 2.5 | 0.153261 | 0.153261 | 1.0 | 1.0 | 1.0 | 0.0 |
| 3.0 | 0.130283 | 0.130283 | 1.2 | 1.2 | 1.2 | 0.0 |
| 3.5 | 0.113566 | 0.113566 | 1.4 | 1.4 | 1.4 | 0.0 |
| 4.0 | 0.100828 | 0.100828 | 1.6 | 1.6 | 1.6 | 0.0 |
| 4.5 | 0.090784 | 0.090784 | 1.8 | 1.8 | 1.8 | 0.0 |
| 5.0 | 0.082651 | 0.082651 | 2.1 | 2.1 | 2.1 | 0.0 |
| 5.5 | 0.075922 | 0.075922 | 2.3 | 2.3 | 2.3 | 0.0 |
| 6.0 | 0.070259 | 0.070259 | 2.5 | 2.5 | 2.5 | 0.0 |
| 6.5 | 0.065424 | 0.065424 | 2.7 | 2.7 | 2.7 | 0.0 |
| 7.0 | 0.061244 | 0.061244 | 2.9 | 2.9 | 2.9 | 0.0 |
| 7.5 | 0.057593 | 0.057593 | 3.2 | 3.2 | 3.2 | 0.0 |
| 8.0 | 0.054375 | 0.054375 | 3.4 | 3.4 | 3.4 | 0.0 |
| 8.5 | 0.051516 | 0.051516 | 3.6 | 3.6 | 3.6 | 0.0 |
| 9.0 | 0.048958 | 0.048958 | 3.8 | 3.8 | 3.8 | 0.0 |
| 9.5 | 0.045486 | 0.045486 | 3.9 | 3.9 | 3.9 | 0.0 |
| 10.0 | 0.041559 | 0.041559 | 3.8 | 3.8 | 3.8 | 0.0 |
| 10.5 | 0.038139 | 0.038139 | 3.7 | 3.7 | 3.7 | 0.0 |
| 11.0 | 0.035140 | 0.035140 | 3.7 | 3.7 | 3.7 | 0.0 |
| 11.5 | 0.032495 | 0.032495 | 3.6 | 3.6 | 3.6 | 0.0 |
| 12.0 | 0.030150 | 0.030150 | 3.5 | 3.5 | 3.5 | 0.0 |
| 12.5 | 0.028059 | 0.028059 | 3.5 | 3.5 | 3.5 | 0.0 |
| 13.0 | 0.026188 | 0.026188 | 3.4 | 3.4 | 3.4 | 0.0 |
| 13.5 | 0.024504 | 0.024504 | 3.3 | 3.3 | 3.3 | 0.0 |
| 14.0 | 0.022985 | 0.022985 | 3.2 | 3.2 | 3.2 | 0.0 |
| 14.5 | 0.021608 | 0.021608 | 3.2 | 3.2 | 3.2 | 0.0 |
| 15.0 | 0.020356 | 0.020356 | 3.1 | 3.1 | 3.1 | 0.0 |
| 15.5 | 0.019215 | 0.019215 | 3.0 | 3.0 | 3.0 | 0.0 |
| 16.0 | 0.018170 | 0.018170 | 3.0 | 3.0 | 3.0 | 0.0 |
| 16.5 | 0.017212 | 0.017212 | 2.9 | 2.9 | 2.9 | 0.0 |
| 17.0 | 0.016331 | 0.016331 | 2.8 | 2.8 | 2.8 | 0.0 |



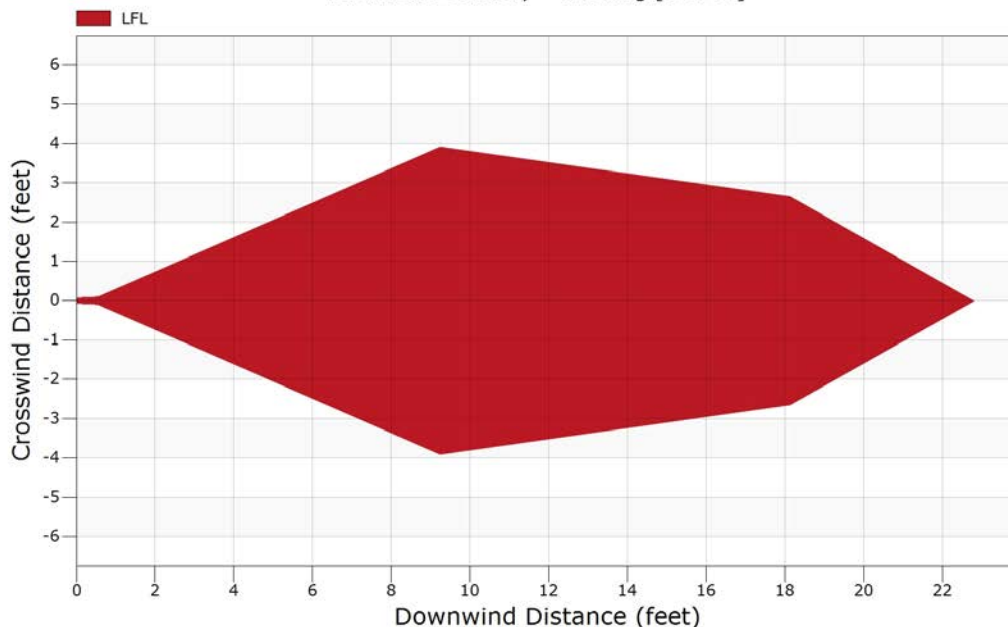
| downwind distance (ft) | centerline conc. (mole frac.) | ground conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) | centerline height (ft) |
|------------------------|-------------------------------|---------------------------|--------------------------|--------------------------|--------------------------|------------------------|
| 17.5 | 0.015519 | 0.015519 | 2.7 | 2.7 | 2.7 | 0.0 |
| 18.0 | 0.014768 | 0.014768 | 2.7 | 2.7 | 2.7 | 0.0 |
| 18.5 | 0.014047 | 0.014047 | 2.4 | 2.4 | 2.4 | 0.0 |
| 19.0 | 0.013372 | 0.013372 | 2.2 | 2.2 | 2.2 | 0.0 |
| 19.5 | 0.012745 | 0.012745 | 1.9 | 1.9 | 1.9 | 0.0 |
| 20.0 | 0.012163 | 0.012163 | 1.6 | 1.6 | 1.6 | 0.0 |
| 20.5 | 0.011620 | 0.011620 | 1.3 | 1.3 | 1.3 | 0.0 |
| 21.0 | 0.011114 | 0.011114 | 1.0 | 1.0 | 1.0 | 0.0 |
| 21.5 | 0.010641 | 0.010641 | 0.7 | 0.7 | 0.7 | 0.0 |
| 22.0 | 0.010199 | 0.010199 | 0.5 | 0.5 | 0.5 | 0.0 |
| 22.5 | 0.009784 | 0.009784 | 0.2 | 0.2 | 0.2 | 0.0 |
| 23.0 | 0.009395 | 0.009395 | 0.0 | 0.0 | 0.0 | 0.0 |

The momentum jet model coupled to the heavy gas model at 0.56 ft in 0 sec.

| Endpoint (mole frac., mixture) | Downwind Distance (feet) | Approximate Time (seconds) |
|--------------------------------|--------------------------|----------------------------|
| 1 0.009552 (LFL) | 22.8 | 6 |
| 2 0.009552 (LFL) | 22.8 | 6 |
| 3 0.009552 (LFL) | 22.8 | 6 |

Momentum Jet Contours - Overhead View

Paramount Refinery - Trucking [JetVCE]

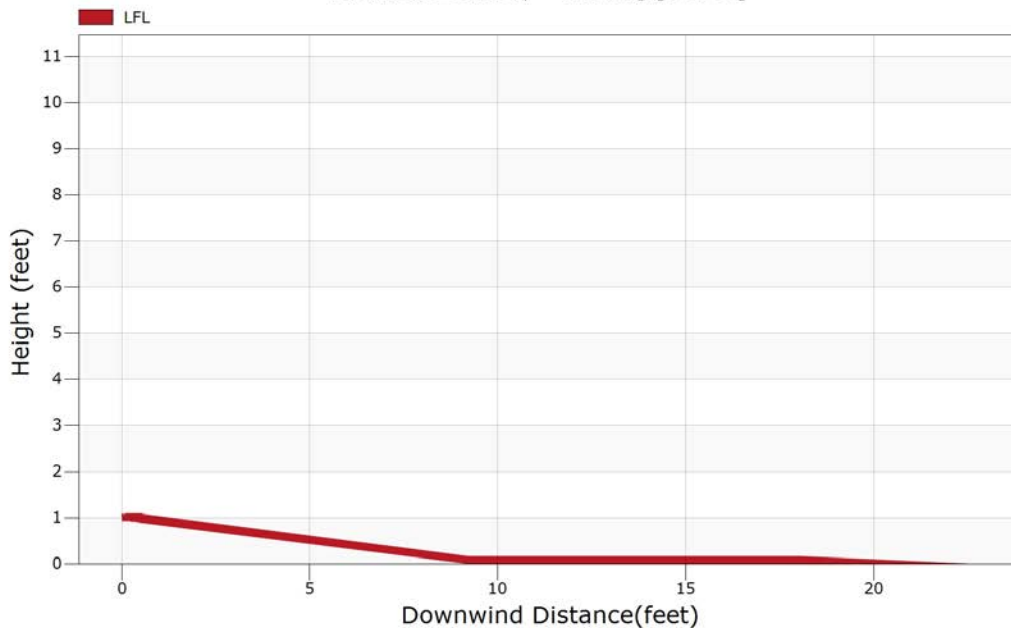


Note: Release during 3.36 mph winds and F stability.



Momentum Jet Contours - Side View

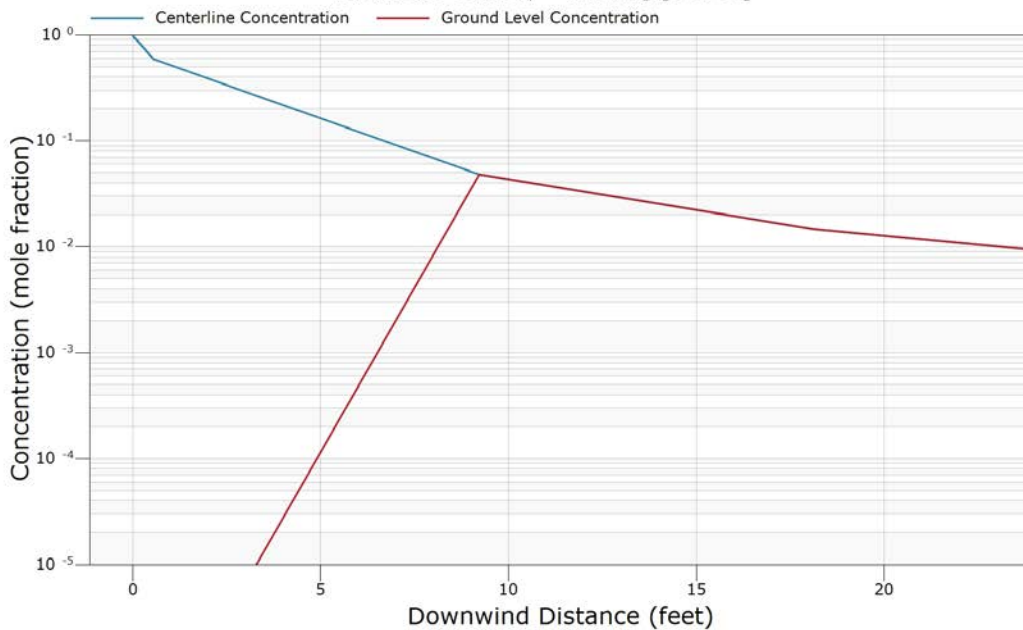
Paramount Refinery - Trucking [JetVCE]



Note: Release during 3.36 mph winds and F stability.

Momentum Jet Concentration

Paramount Refinery - Trucking [JetVCE]



Note: Release during 3.36 mph winds and F stability.



Heavier-than-Air Dispersion

concentration limits

Endpoint 1 (highest) = 0.006688 mole fraction
Endpoint 2 (middle) = 0.006688 mole fraction
Endpoint 3 (lowest) = 0.006688 mole fraction

| downwind distance (ft) | centerline conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) |
|------------------------------|-------------------------------------|--------------------------------|--------------------------------|--------------------------------|
|------------------------------|-------------------------------------|--------------------------------|--------------------------------|--------------------------------|

* Vapor cloud does not leave source.



Momentum Jet Explosion

Fuel Reactivity: Medium Obstacle Density: Low
Flame Expansion: 2.5-D Flame Speed: 0.29

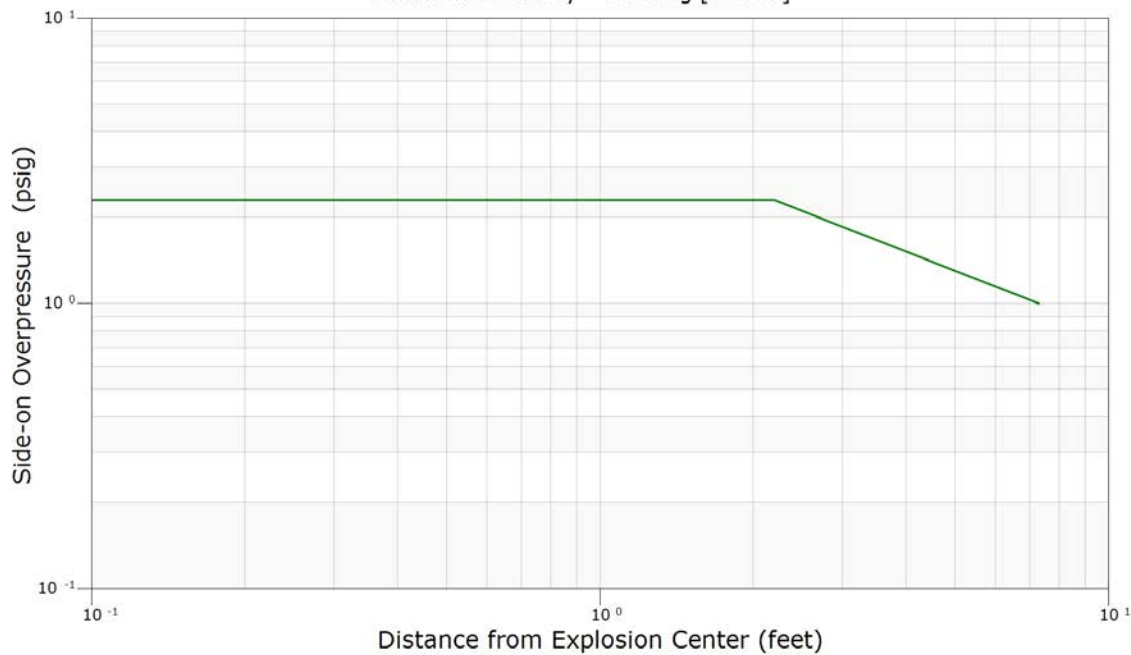
Mass of released material involved in explosion: 0.0707076 lbs.

| Distance from Center of Flammable Cloud (feet) | Overpressure (psi gauge) | Impulse (psi-s) |
|--|-----------------------------|--------------------|
| 0.0 | 2.30 | 0.0137 |
| 0.8 | 2.30 | 0.0137 |
| 0.8 | 2.30 | 0.0137 |
| 0.9 | 2.30 | 0.0137 |
| 0.9 | 2.30 | 0.0137 |
| 1.0 | 2.30 | 0.0137 |
| 1.0 | 2.30 | 0.0137 |
| 1.0 | 2.30 | 0.0137 |
| 1.1 | 2.30 | 0.0137 |
| 1.1 | 2.30 | 0.0137 |
| 1.2 | 2.30 | 0.0137 |
| 1.3 | 2.30 | 0.0137 |
| 1.3 | 2.30 | 0.0137 |
| 1.4 | 2.30 | 0.0131 |
| 1.5 | 2.30 | 0.0125 |
| 1.5 | 2.30 | 0.0119 |
| 1.6 | 2.30 | 0.0114 |
| 1.7 | 2.30 | 0.0109 |
| 1.7 | 2.30 | 0.0104 |
| 1.8 | 2.30 | 0.0099 |
| 1.9 | 2.30 | 0.0095 |
| 2.0 | 2.30 | 0.0091 |
| 2.1 | 2.30 | 0.0087 |
| 2.2 | 2.30 | 0.0083 |
| 7.3 | 1.00 | 0.0026 |

The downwind distance to 1.00 psi is 7.3 feet
The downwind distance to 1.00 psi is 7.3 feet
The downwind distance to 1.00 psi is 7.3 feet



Momentum Jet Explosion Overpressure - Baker-Strehlow-Tang
Paramount Refinery - Trucking [JetVCE]





Heavier-than-Air Explosion

Fuel Reactivity: Medium Obstacle Density: Low
Flame Expansion: 2.5-D Flame Speed: 0.29

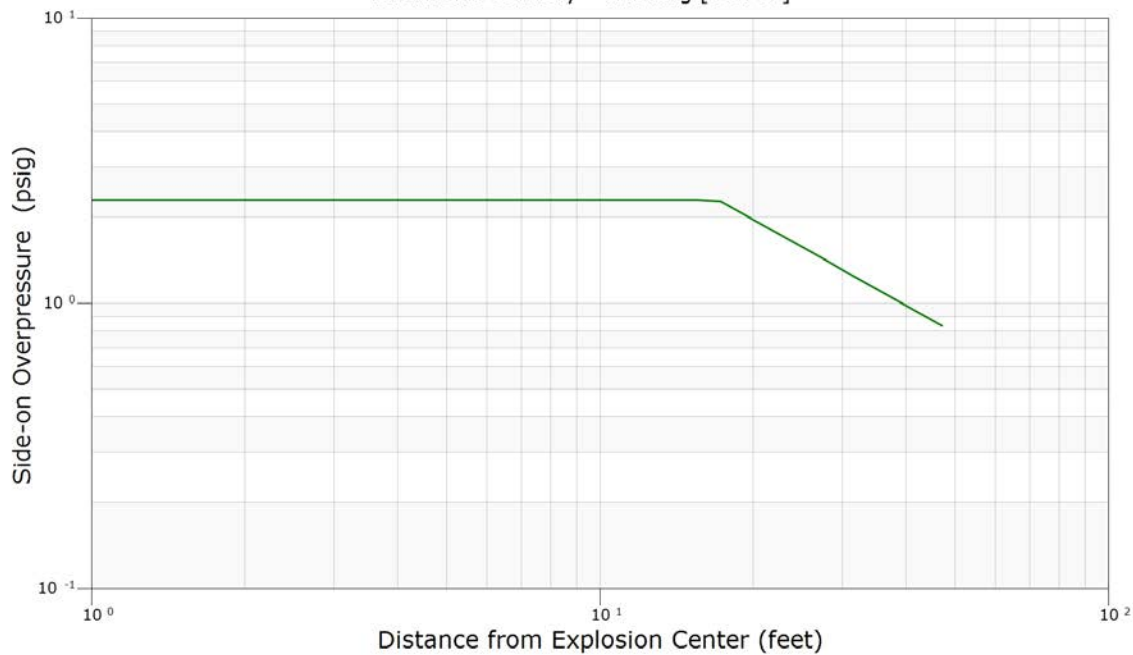
Mass of released material involved in explosion: 11.0666 lbs.

| Distance from Center of Flammable Cloud (feet) | Overpressure (psi gauge) | Impulse (psi-s) |
|--|-----------------------------|--------------------|
| 0.0 | 2.30 | 0.0737 |
| 4.3 | 2.30 | 0.0737 |
| 4.7 | 2.30 | 0.0737 |
| 5.2 | 2.30 | 0.0737 |
| 5.8 | 2.30 | 0.0737 |
| 6.4 | 2.30 | 0.0737 |
| 7.0 | 2.30 | 0.0737 |
| 7.8 | 2.30 | 0.0678 |
| 8.6 | 2.30 | 0.0615 |
| 9.5 | 2.30 | 0.0557 |
| 10.5 | 2.30 | 0.0505 |
| 11.6 | 2.30 | 0.0458 |
| 12.8 | 2.30 | 0.0415 |
| 14.2 | 2.30 | 0.0376 |
| 15.6 | 2.30 | 0.0341 |
| 17.3 | 2.27 | 0.0309 |
| 19.1 | 2.06 | 0.0280 |
| 21.1 | 1.86 | 0.0254 |
| 23.4 | 1.68 | 0.0230 |
| 25.8 | 1.52 | 0.0209 |
| 28.5 | 1.38 | 0.0189 |
| 31.5 | 1.25 | 0.0172 |
| 34.9 | 1.13 | 0.0156 |
| 38.5 | 1.02 | 0.0141 |
| 47.1 | 0.84 | 0.0116 |

The downwind distance to 1.00 psi is 39.5 feet
The downwind distance to 1.00 psi is 39.5 feet
The downwind distance to 1.00 psi is 39.5 feet



Heavier-than-Air Explosion Overpressure - Baker-Strehlow-Tang Paramount Refinery - Trucking [JetVCE]





Case Inputs

Case Type : Fire Radiation
Case Name : JetPool
User ID :
Project Number :
Type of Units : English Units

NOTES:

MATERIAL MENU

| Materials Released | Number | Formula | Name | Fraction |
|--------------------|--------|---------|-------------|----------|
| Component 1 | 9 | C7H16 | n-Heptane | 0.040000 |
| Component 2 | 10 | C8H18 | n-Octane | 0.080000 |
| Component 3 | 11 | C9H20 | n-Nonane | 0.120000 |
| Component 4 | 12 | C10H22 | n-Decane | 0.170000 |
| Component 5 | 13 | C11H24 | n-Undecane | 0.170000 |
| Component 6 | 31 | C12H26 | Dodecane | 0.170000 |
| Component 7 | 32 | C13H28 | Tridecane | 0.130000 |
| Component 8 | 33 | C14H30 | Tetradecane | 0.080000 |
| Component 9 | 34 | C15H32 | Pentadecane | 0.040000 |
| Component 10 | | | | |

Temperature : 68.00 °F
Pressure : 14.70 psia
The material is LIQUID
The mixture is Jet A1

NOTES:

ENVIRONMENT MENU

Wind speed : 20.00 mph
Relative humidity : 70 %
Air temperature : 68.0 °F

NOTES:

FIRE TYPE MENU

Fire radiation division: Circular pool fires
Horizontal isopleths only
Spill surface: land
Elevation of flame base (from grade) : 1.0 feet
Elevation of target (from grade) : 0.0 feet
Diameter of pool : 36.0 feet

Fire radiation flux values

Radiation endpoint 1 : 3487 Btu/hr-sq.ft
Radiation endpoint 2 : 1600 Btu/hr-sq.ft
Radiation endpoint 3 : 500 Btu/hr-sq.ft

NOTES:



Pool Fire Radiation

Length of Flame : 57.5 feet
 Flame Tilt from Vertical : 58.7 degrees
 Target Elevation : 0.0 feet
 Pool Elevation : 1.0 feet
 Wind Speed : 20.0 mph
 Substrate : Land

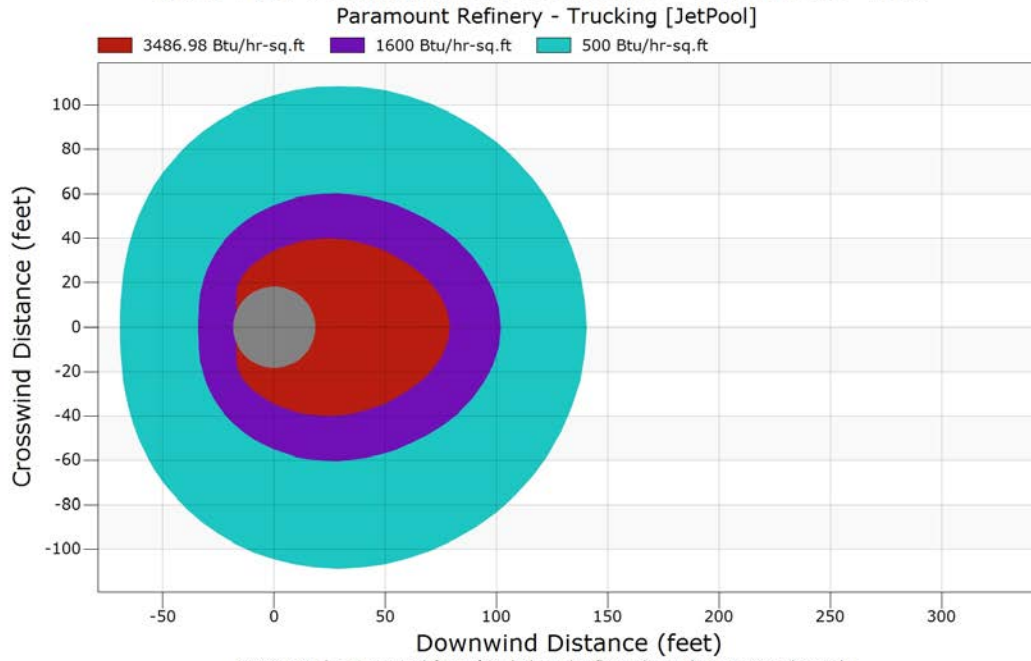
| Downwind Distance from Center of Pool (feet) | Flux to Vertical Target (Btu/hr-sq.ft) | Flux to Horizontal Target (Btu/hr-sq.ft) | Maximum Flux (Btu/hr-sq.ft) |
|--|--|--|-----------------------------------|
| 19.8 | 11142 | 28188 | 30310 |
| 21.3 | 11974 | 27767 | 30239 |
| 22.9 | 14318 | 31668 | 31668 |
| 24.6 | 15479 | 30939 | 31668 |
| 26.4 | 16587 | 28428 | 31668 |
| 28.4 | 14456 | 27526 | 31091 |
| 30.5 | 11635 | 31668 | 31668 |
| 32.8 | 15208 | 27106 | 31081 |
| 35.3 | 13331 | 24378 | 31668 |
| 37.9 | 13657 | 24026 | 28996 |
| 40.8 | 12878 | 21119 | 25301 |
| 43.8 | 11999 | 17616 | 21583 |
| 47.1 | 11093 | 13290 | 17438 |
| 50.6 | 9431 | 9211 | 13244 |
| 54.4 | 7353 | 6533 | 9871 |
| 58.5 | 5680 | 5028 | 7609 |
| 62.9 | 4506 | 4108 | 6114 |
| 67.6 | 3691 | 3439 | 5057 |
| 72.6 | 3103 | 2861 | 4229 |
| 78.1 | 2661 | 2313 | 3531 |
| 83.9 | 2302 | 1783 | 2915 |
| 90.2 | 1966 | 1296 | 2357 |
| 96.9 | 1628 | 891 | 1857 |
| 104.2 | 1310 | 588 | 1437 |
| 112.0 | 1035 | 381 | 1103 |
| 120.4 | 810 | 246 | 847 |
| 129.4 | 634 | 160 | 654 |
| 139.1 | 498 | 106 | 509 |
| 149.5 | 394 | 71 | 400 |
| 160.7 | 314 | 49 | 317 |

Downwind Distances to Endpoints:

| Distance (feet) | Maximum Flux (Btu/hr-sq.ft) |
|--------------------|--------------------------------|
| 78.5 | 3487 |
| 101.4 | 1600 |
| 140.0 | 500 |



Pool Fire Radiant Heat Contours - Overhead View



Note: Results presented for 1 feet below the flame base during 20 mph winds.



Case Inputs

Case Type : Vapor Dispersion
Case Name : LPG-VCE
User ID :
Project Number :
Type of Units : English Units

NOTES:

MATERIAL MENU

| Materials Released | Number | Formula | Name | Fraction |
|--------------------|--------|---------|---------|----------|
| Component 1 | 3 | C3H8 | Propane | 1.000000 |
| Component 2 | : | | | |
| Component 3 | : | | | |
| Component 4 | : | | | |
| Component 5 | : | | | |
| Component 6 | : | | | |
| Component 7 | : | | | |
| Component 8 | : | | | |
| Component 9 | : | | | |
| Component 10 | : | | | |

Temperature : 68.00 °F
Pressure : 125.00 psia
The material is LIQUID

NOTES:

ENVIRONMENT MENU

| | |
|-------------------------------|-----------|
| Wind speed | 3.36 mph |
| Wind speed measurement height | 32.8 feet |
| Stability class <A-F> | F |
| Relative humidity | 70 % |
| Air temperature | 68.0 °F |
| Spill surface temperature | 68.0 °F |

| | |
|--------------------------------|------------------------------------|
| Substrate name | High density concrete |
| Substrate thermal conductivity | 2.1999 Btu/hr-ft-F |
| Substrate density | 150 lb/cu.ft |
| Substrate heat Capacity | 0.16 Btu/lb-F |
| Substrate delay time | 0 sec |
| Surrounding terrain | Long grass or crops > 15 cm (6 in) |

NOTES:



RELEASE MENU

Type of release: Unregulated, Continuous release
Release duration 10 min
Normal flow rate 39.00 lb/sec
Duration of normal flow 10 min
Volume of vessel 668.40 cu.ft
Percent of vessel filled with liquid 80 %
Liquid head above release point 6 feet
Pipe inner diameter 3.07 inches
Equivalent release diameter 3.07 inches
Pipe length upstream of break 0.0 feet
Height of release point 1.0 feet
Angle of release from horizontal 0.0 degrees

NOTES:

IMPOUNDMENT MENU

Unconfined

NOTES:

VDVE MENU

Vapor generation, dispersion and cloud explosion - Flammable calculation

Concentration endpoint 1 LFL mol%
Concentration endpoint 2 LFL mol%
Concentration endpoint 3 LFL mol%

Dispersion coefficient averaging time 1 min

Baker-Strehlow-Tang parameters

Fuel reactivity Medium
Obstacle density Low
Flame expansion 2.5-D

Overpressure values

Overpressure endpoint 1 1.00 psi
Overpressure endpoint 2 1.00 psi
Overpressure endpoint 3 1.00 psi

NOTES:

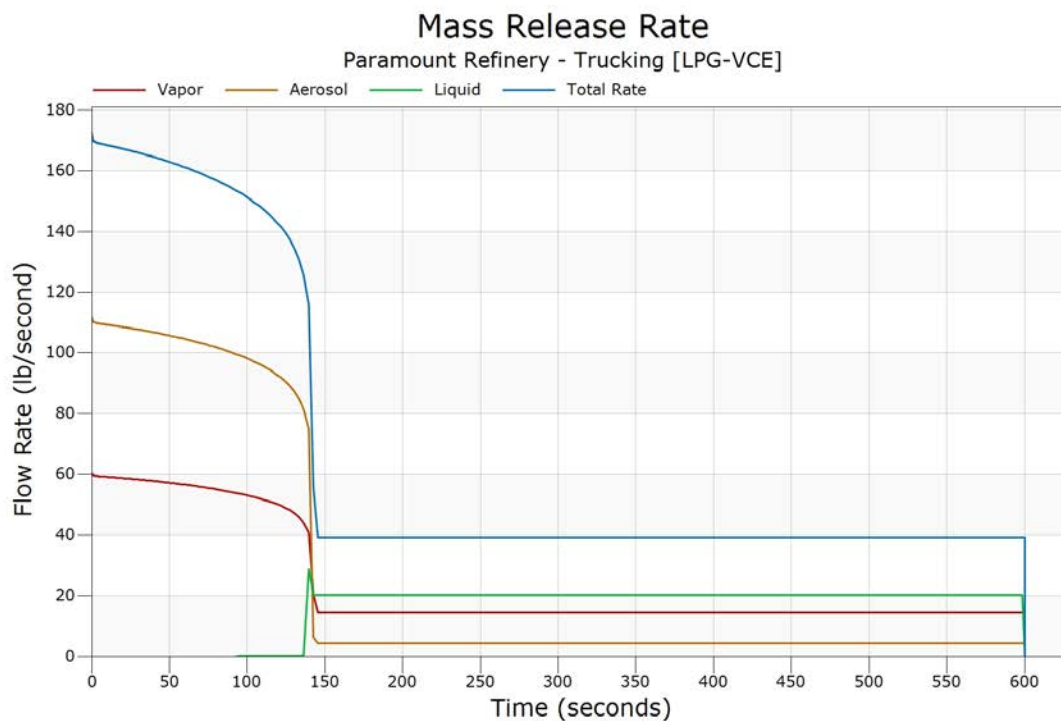


Release Model

| Time (sec) | Vapor (lb/sec) | Aerosol Rate (lb/sec) | Liquid Rate (lb/sec) | Total Rate (lb/sec) |
|---------------|-------------------|--------------------------|-------------------------|------------------------|
| 0.000000 | 60.53298 | 111.9512 | 0.000000 | 172.4842 |
| 0.100000 | 60.43858 | 111.7766 | 0.000000 | 172.2152 |
| 0.300000 | 60.22348 | 111.3788 | 0.000000 | 171.6023 |
| 0.500000 | 60.01128 | 110.9864 | 0.000000 | 170.9976 |
| 0.700000 | 59.80190 | 110.5991 | 0.000000 | 170.4010 |
| 1.000000 | 59.59732 | 110.2208 | 0.000000 | 169.8181 |
| 3.000000 | 59.40938 | 109.8732 | 0.000000 | 169.2826 |
| 5.000000 | 59.27956 | 109.6331 | 0.000000 | 168.9127 |
| 7.000000 | 59.20416 | 109.4936 | 0.000000 | 168.6978 |
| 10.00000 | 59.08688 | 109.2767 | 0.000000 | 168.3636 |
| 20.00000 | 58.68215 | 108.5282 | 0.000000 | 167.2104 |
| 30.00000 | 58.23587 | 107.7029 | 0.000000 | 165.9388 |
| 40.00000 | 57.73681 | 106.7799 | 0.000000 | 164.5167 |
| 50.00000 | 57.18413 | 105.7578 | 0.000000 | 162.9419 |
| 60.00000 | 56.56647 | 104.6154 | 0.000000 | 161.1819 |
| 70.00000 | 55.87210 | 103.3313 | 0.000000 | 159.2033 |
| 85.00000 | 54.64362 | 101.0593 | 0.000000 | 155.7029 |
| 100.0000 | 53.09224 | 98.18879 | .1283129E-02 | 151.2823 |
| 200.0000 | 14.36123 | 4.446663 | 20.19210 | 38.99999 |
| 300.0000 | 14.36123 | 4.446663 | 20.19210 | 38.99999 |
| 400.0000 | 14.36123 | 4.446663 | 20.19210 | 38.99999 |
| 500.0000 | 14.36123 | 4.446663 | 20.19210 | 38.99999 |
| 600.0000 | 14.36123 | 4.446663 | 20.19210 | 38.99999 |
| Totals (lb) | 14306.98 | 16278.52 | 9296.632 | 39882.13 |

Flowrate for Jet Fire [immediate ignition] = 165.7647 lb/sec.
Jet Fire [delayed ignition] = 58.76326 lb/sec.

Reason for Ending: Reached Stop Time





Release Compositions

| Component Number | Component Name, Formula |
|------------------|-------------------------|
| 3 | Propane, C3H8 |

Composition (Mole Fraction) of Fluid Streams

| Comp. No. | Feed Stream | Momentum Jet Stream | | | | Liquid Pool Stream |
|-----------|-------------|---------------------|------------------|----------------|--------------|--------------------|
| | | Flashed Vapor | Evaporated Vapor | Aerosol Liquid | Total Stream | Liquid to Ground |
| 3 | 1.000000 | 1.000000 | 0.000000 | 1.000000 | 1.000000 | 0.000000 |

Flammable Limits (Mole %) of Fluid Streams

| Limit | Feed Stream | Momentum Jet Stream | Liquid Pool Stream |
|-------|-------------|---------------------|--------------------|
| LFL | 2.10 | 2.10 | |
| UFL | 9.50 | 9.50 | |
| LBV | | 0.43 m/s | |



Pool Spreading and Vaporization

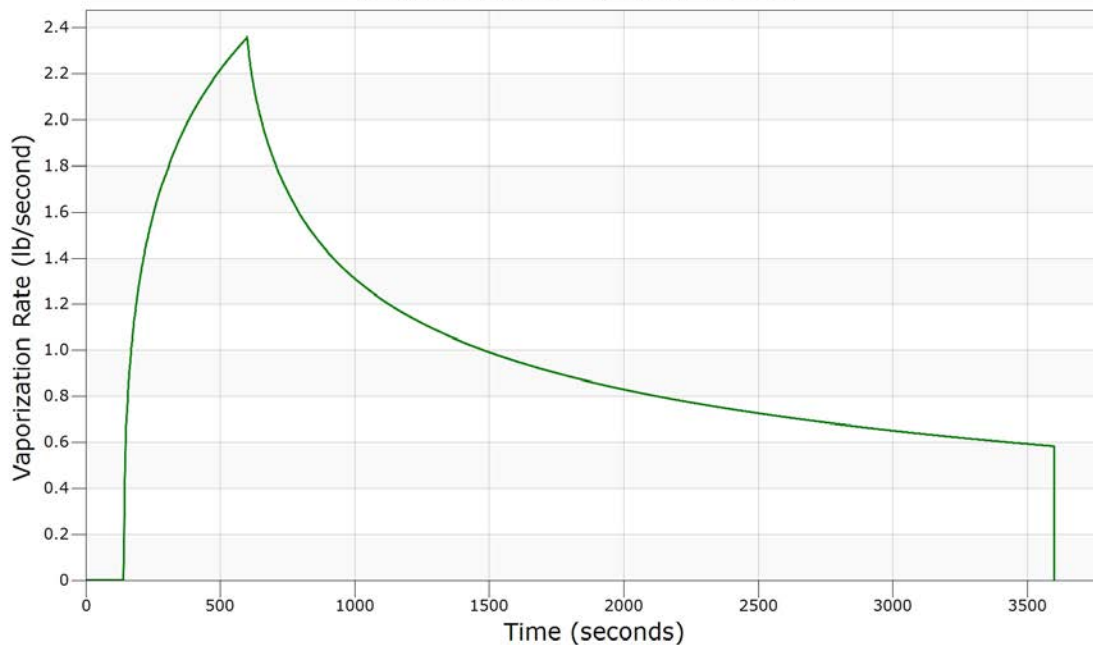
| Time (sec) | Liquid Remaining (ft3) | Pool/Dike Radius (feet) | Vapor Rate (lb/sec) |
|---------------|------------------------------|-------------------------------|------------------------|
| 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| 40.0000 | 0.908328E-02 | 0.174393 | 0.578295E-03 |
| 80.0000 | 0.852602E-02 | 0.168960 | 0.421877E-03 |
| 120.000 | 0.981783E-02 | 0.181309 | 0.513898E-03 |
| 160.000 | 11.6694 | 5.51378 | 0.878013 |
| 200.000 | 33.3325 | 7.82874 | 1.30463 |
| 240.000 | 54.6389 | 9.22867 | 1.54112 |
| 280.000 | 75.7182 | 10.2877 | 1.71006 |
| 320.000 | 96.6315 | 11.1585 | 1.83835 |
| 360.000 | 117.407 | 11.9062 | 1.94792 |
| 400.000 | 138.073 | 12.5669 | 2.03883 |
| 440.000 | 158.641 | 13.1617 | 2.11721 |
| 480.000 | 179.123 | 13.7047 | 2.18692 |
| 520.000 | 199.531 | 14.2064 | 2.24982 |
| 560.000 | 219.873 | 14.6729 | 2.30736 |
| 600.000 | 240.147 | 15.1106 | 2.36027 |
| 640.000 | 237.664 | 15.0584 | 2.05605 |
| 680.000 | 235.429 | 15.0108 | 1.88852 |
| 720.000 | 233.356 | 14.9669 | 1.76414 |
| 760.000 | 231.410 | 14.9252 | 1.66636 |
| 800.000 | 229.563 | 14.8855 | 1.58325 |
| 840.000 | 227.808 | 14.8474 | 1.51323 |
| 880.000 | 226.123 | 14.8107 | 1.45282 |
| 1130.00 | 216.807 | 14.6047 | 1.19793 |
| 1380.00 | 208.883 | 14.4245 | 1.04614 |
| 1630.00 | 201.848 | 14.2608 | 0.940735 |
| 1880.00 | 195.467 | 14.1093 | 0.861478 |
| 2130.00 | 189.583 | 13.9662 | 0.798757 |
| 2380.00 | 184.102 | 13.8307 | 0.747323 |
| 2630.00 | 178.954 | 13.7005 | 0.704002 |
| 2880.00 | 174.094 | 13.5755 | 0.666788 |
| 3130.00 | 169.479 | 13.4544 | 0.634292 |
| 3380.00 | 165.082 | 13.3373 | 0.605544 |
| 3600.00 | 161.370 | 13.2369 | 0.582770 |

Ending Message: Normal Ending



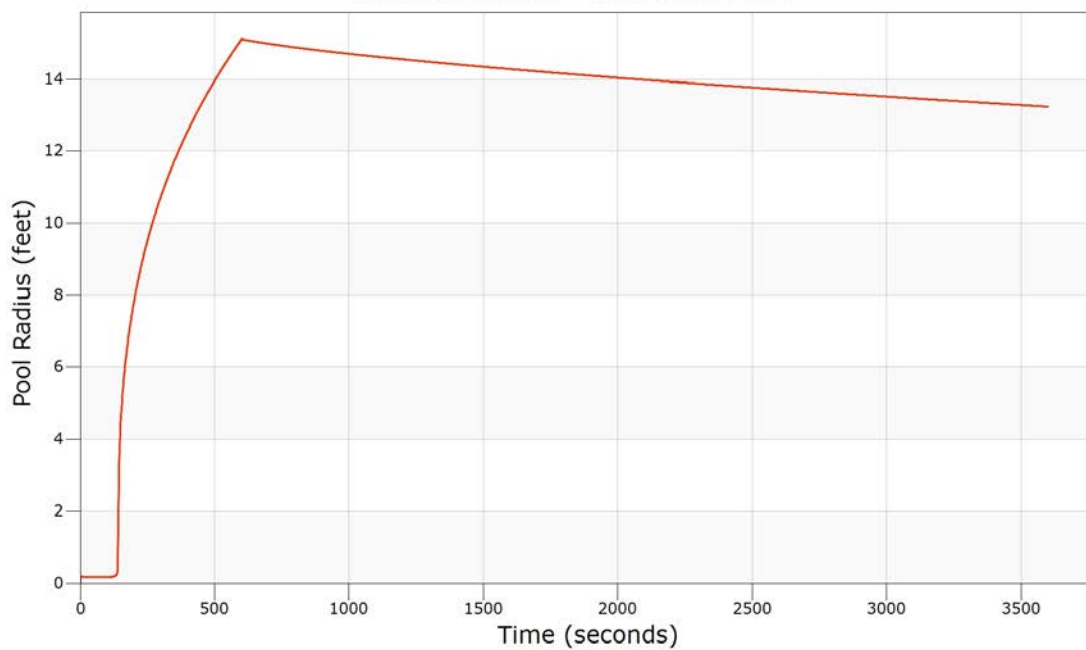
Pool Vaporization Rate

Paramount Refinery - Trucking [LPG-VCE]



Pool Radius

Paramount Refinery - Trucking [LPG-VCE]





Momentum Jet Dispersion

concentration limits

Endpoint 1 (highest) = 0.021000 mole fraction
Endpoint 2 (middle) = 0.021000 mole fraction
Endpoint 3 (lowest) = 0.021000 mole fraction

| downwind distance (ft) | centerline conc. (mole frac.) | ground conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) | centerline height (ft) |
|------------------------------|-------------------------------------|---------------------------------|--------------------------------|--------------------------------|--------------------------------|------------------------------|
| 0 | 1.000000 | 0.000000 | 1.3 | 1.3 | 1.3 | 1.0 |
| 20 | 0.722592 | 0.068509 | 2.3 | 2.3 | 2.3 | 2.0 |
| 40 | 0.530952 | 0.125238 | 3.6 | 3.6 | 3.6 | 2.5 |
| 60 | 0.395950 | 0.221681 | 5.0 | 5.0 | 5.0 | 2.3 |
| 80 | 0.305336 | 0.295313 | 6.5 | 6.5 | 6.5 | 0.7 |
| 100 | 0.246115 | 0.246106 | 8.0 | 8.0 | 8.0 | 0.0 |
| 120 | 0.209097 | 0.209093 | 9.4 | 9.4 | 9.4 | 0.0 |
| 140 | 0.181610 | 0.181607 | 10.8 | 10.8 | 10.8 | 0.0 |
| 160 | 0.166371 | 0.166371 | 51.2 | 51.2 | 51.2 | 0.0 |
| 180 | 0.166371 | 0.166371 | 76.9 | 76.9 | 76.9 | 0.0 |
| 200 | 0.166371 | 0.166371 | 102.8 | 102.8 | 102.8 | 0.0 |
| 220 | 0.166371 | 0.166371 | 128.6 | 128.6 | 128.6 | 0.0 |
| 240 | 0.166367 | 0.166367 | 154.5 | 154.5 | 154.5 | 0.0 |
| 260 | 0.166360 | 0.166360 | 180.3 | 180.3 | 180.3 | 0.0 |
| 280 | 0.166337 | 0.166337 | 206.2 | 206.2 | 206.2 | 0.0 |
| 300 | 0.163693 | 0.163693 | 231.2 | 231.2 | 231.2 | 0.0 |
| 320 | 0.161258 | 0.161258 | 256.2 | 256.2 | 256.2 | 0.0 |
| 340 | 0.159004 | 0.159004 | 281.1 | 281.1 | 281.1 | 0.0 |
| 360 | 0.149809 | 0.149809 | 302.1 | 302.1 | 302.1 | 0.0 |
| 380 | 0.138563 | 0.138563 | 321.1 | 321.1 | 321.1 | 0.0 |
| 400 | 0.128676 | 0.128676 | 340.2 | 340.2 | 340.2 | 0.0 |
| 420 | 0.119926 | 0.119926 | 359.2 | 359.2 | 359.2 | 0.0 |
| 440 | 0.112138 | 0.112138 | 378.2 | 378.2 | 378.2 | 0.0 |
| 460 | 0.102613 | 0.102613 | 390.0 | 390.0 | 390.0 | 0.0 |
| 480 | 0.094020 | 0.094020 | 400.9 | 400.9 | 400.9 | 0.0 |
| 500 | 0.086456 | 0.086456 | 411.9 | 411.9 | 411.9 | 0.0 |
| 520 | 0.079762 | 0.079762 | 422.9 | 422.9 | 422.9 | 0.0 |
| 540 | 0.073811 | 0.073811 | 433.9 | 433.9 | 433.9 | 0.0 |
| 560 | 0.068248 | 0.068248 | 442.0 | 442.0 | 442.0 | 0.0 |
| 580 | 0.062542 | 0.062542 | 441.0 | 441.0 | 441.0 | 0.0 |
| 600 | 0.057484 | 0.057484 | 440.0 | 440.0 | 440.0 | 0.0 |
| 620 | 0.052980 | 0.052980 | 439.0 | 439.0 | 439.0 | 0.0 |
| 640 | 0.048957 | 0.048957 | 438.0 | 438.0 | 438.0 | 0.0 |
| 660 | 0.045349 | 0.045349 | 437.0 | 437.0 | 437.0 | 0.0 |
| 680 | 0.042103 | 0.042103 | 436.0 | 436.0 | 436.0 | 0.0 |

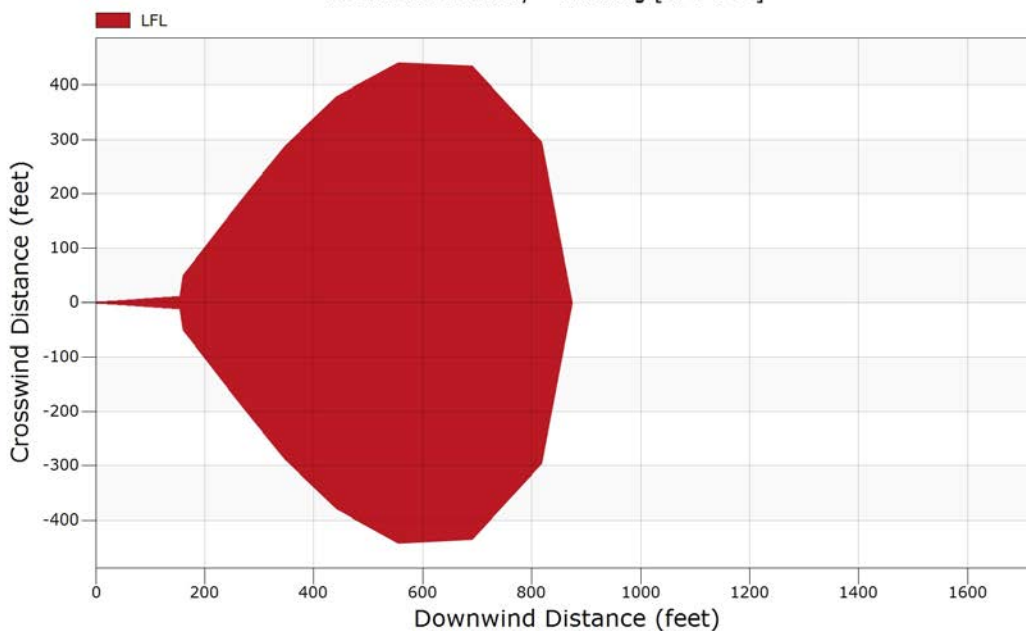


| downwind distance (ft) | centerline conc. (mole frac.) | ground conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) | centerline height (ft) |
|------------------------|-------------------------------|---------------------------|--------------------------|--------------------------|--------------------------|------------------------|
| 700 | 0.039056 | 0.039056 | 426.0 | 426.0 | 426.0 | 0.0 |
| 720 | 0.036164 | 0.036164 | 404.0 | 404.0 | 404.0 | 0.0 |
| 740 | 0.033557 | 0.033557 | 382.0 | 382.0 | 382.0 | 0.0 |
| 760 | 0.031200 | 0.031200 | 360.1 | 360.1 | 360.1 | 0.0 |
| 780 | 0.029063 | 0.029063 | 338.1 | 338.1 | 338.1 | 0.0 |
| 800 | 0.027121 | 0.027121 | 316.1 | 316.1 | 316.1 | 0.0 |
| 820 | 0.025346 | 0.025346 | 289.0 | 289.0 | 289.0 | 0.0 |
| 840 | 0.023629 | 0.023629 | 183.4 | 183.4 | 183.4 | 0.0 |
| 860 | 0.022066 | 0.022066 | 77.9 | 77.9 | 77.9 | 0.0 |
| 880 | 0.020638 | 0.020638 | 0.0 | 0.0 | 0.0 | 0.0 |

The momentum jet model coupled to the heavy gas model at 153.15 ft in 2 sec.

| Endpoint (mole frac., mixture) | Downwind Distance (feet) | Approximate Time (seconds) |
|--------------------------------|--------------------------|----------------------------|
| 1 0.021000 (LFL) | 874.8 | 158 |
| 2 0.021000 (LFL) | 874.8 | 158 |
| 3 0.021000 (LFL) | 874.8 | 158 |

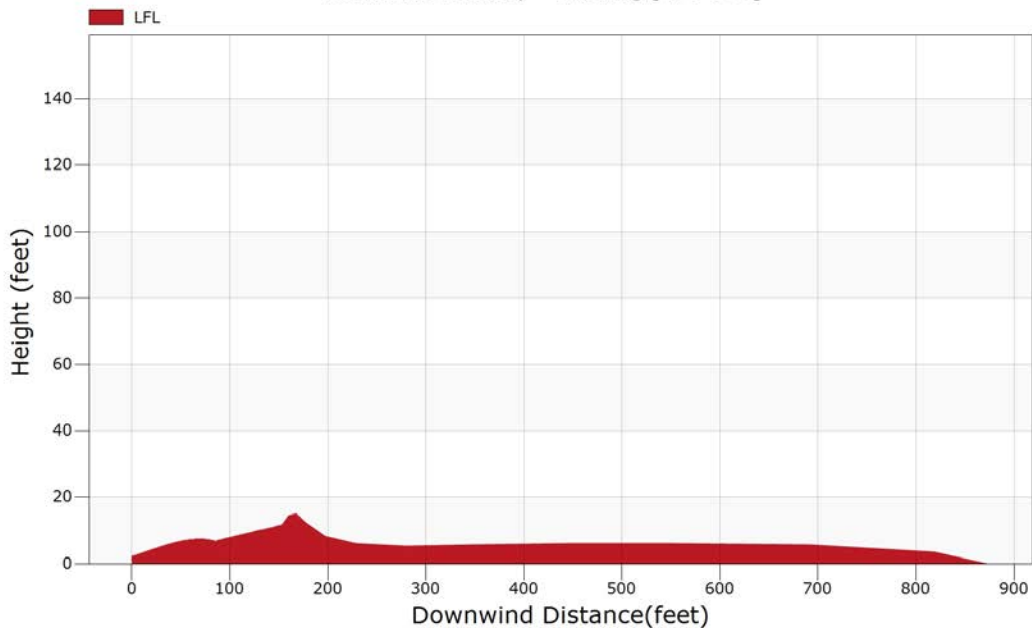
Momentum Jet Contours - Overhead View
 Paramount Refinery - Trucking [LPG-VCE]





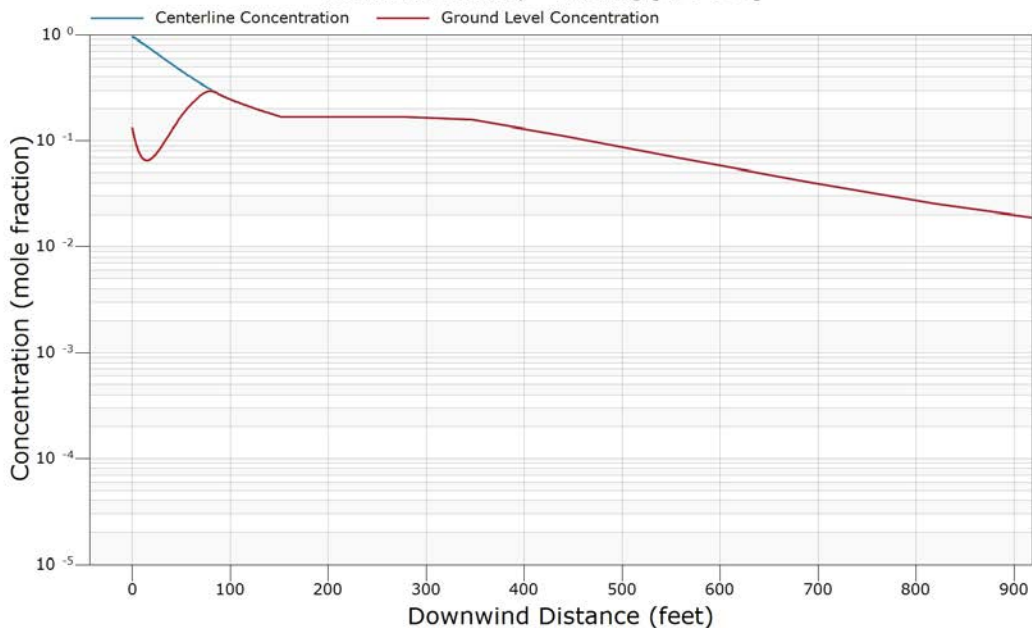
Momentum Jet Contours - Side View

Paramount Refinery - Trucking [LPG-VCE]



Momentum Jet Concentration

Paramount Refinery - Trucking [LPG-VCE]





Heavier-than-Air Dispersion

concentration limits

Endpoint 1 (highest) = 0.021000 mole fraction
Endpoint 2 (middle) = 0.021000 mole fraction
Endpoint 3 (lowest) = 0.021000 mole fraction

| downwind distance (ft) | centerline conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) |
|------------------------------|-------------------------------------|--------------------------------|--------------------------------|--------------------------------|
| 2.50 | 0.225022 | 14.48 | 14.48 | 14.48 |
| 5.00 | 0.246747 | 16.86 | 16.86 | 16.86 |
| 7.50 | 0.262693 | 17.35 | 17.35 | 17.35 |
| 10.00 | 0.271737 | 18.04 | 18.04 | 18.04 |
| 12.50 | 0.274031 | 20.37 | 20.37 | 20.37 |
| 15.00 | 0.272327 | 22.63 | 22.63 | 22.63 |
| 17.50 | 0.252237 | 24.38 | 24.38 | 24.38 |
| 20.00 | 0.236035 | 26.14 | 26.14 | 26.14 |
| 22.50 | 0.222235 | 27.94 | 27.94 | 27.94 |
| 25.00 | 0.212317 | 28.56 | 28.56 | 28.56 |
| 27.50 | 0.198508 | 28.81 | 28.81 | 28.81 |
| 30.00 | 0.187257 | 29.06 | 29.06 | 29.06 |
| 32.50 | 0.180672 | 32.29 | 32.29 | 32.29 |
| 35.00 | 0.175508 | 34.29 | 34.29 | 34.29 |
| 37.50 | 0.160125 | 34.50 | 34.50 | 34.50 |
| 40.00 | 0.151699 | 34.71 | 34.71 | 34.71 |
| 42.50 | 0.144187 | 36.18 | 36.18 | 36.18 |
| 45.00 | 0.137640 | 38.24 | 38.24 | 38.24 |
| 47.50 | 0.126389 | 38.24 | 38.24 | 38.24 |
| 50.00 | 0.119578 | 38.24 | 38.24 | 38.24 |
| 52.50 | 0.114290 | 39.34 | 39.34 | 39.34 |
| 55.00 | 0.109467 | 40.45 | 40.45 | 40.45 |
| 57.50 | 0.105048 | 41.55 | 41.55 | 41.55 |
| 60.00 | 0.100984 | 42.66 | 42.66 | 42.66 |
| 62.50 | 0.097235 | 43.76 | 43.76 | 43.76 |
| 65.00 | 0.093763 | 44.87 | 44.87 | 44.87 |
| 67.50 | 0.087411 | 44.90 | 44.90 | 44.90 |
| 70.00 | 0.081612 | 44.93 | 44.93 | 44.93 |
| 72.50 | 0.076380 | 44.97 | 44.97 | 44.97 |
| 75.00 | 0.071645 | 45.00 | 45.00 | 45.00 |
| 77.50 | 0.067345 | 45.04 | 45.04 | 45.04 |
| 80.00 | 0.063427 | 45.07 | 45.07 | 45.07 |
| 82.50 | 0.059848 | 45.10 | 45.10 | 45.10 |
| 85.00 | 0.056746 | 45.14 | 45.14 | 45.14 |
| 87.50 | 0.056279 | 45.17 | 45.17 | 45.17 |



CANARY by Quest Output Report
 Report Date: 11 June 2021
 Case Title: Paramount Refinery - Trucking

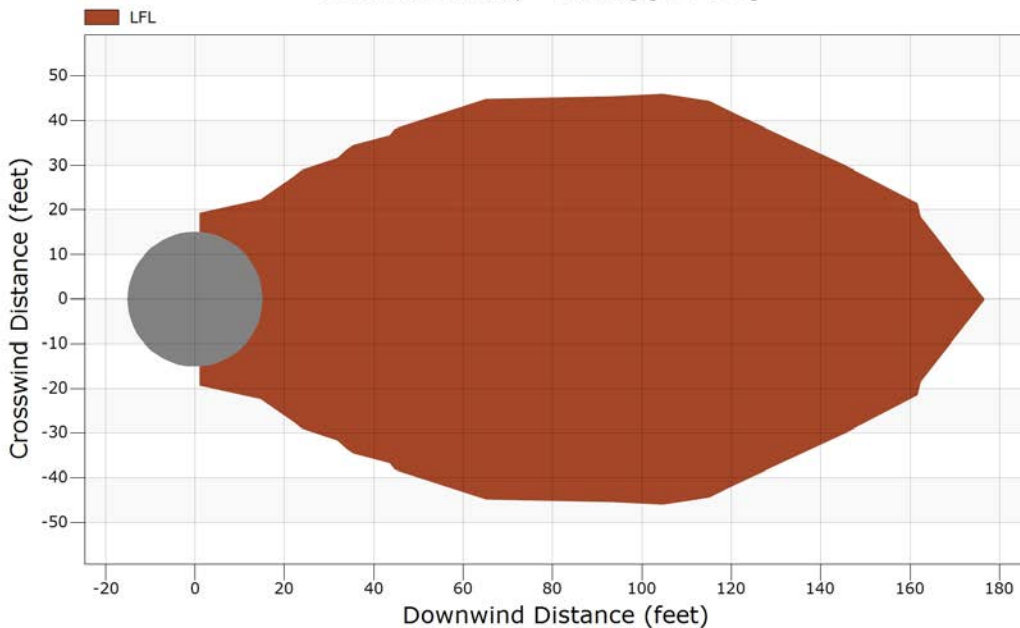
| downwind distance (ft) | centerline conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) |
|------------------------|-------------------------------|--------------------------|--------------------------|--------------------------|
| 90.00 | 0.055829 | 45.20 | 45.20 | 45.20 |
| 92.50 | 0.055394 | 45.24 | 45.24 | 45.24 |
| 95.00 | 0.049220 | 45.41 | 45.41 | 45.41 |
| 97.50 | 0.048834 | 45.59 | 45.59 | 45.59 |
| 100.00 | 0.048508 | 45.76 | 45.76 | 45.76 |
| 102.50 | 0.048193 | 45.93 | 45.93 | 45.93 |
| 105.00 | 0.047730 | 46.11 | 46.11 | 46.11 |
| 107.50 | 0.046065 | 45.73 | 45.73 | 45.73 |
| 110.00 | 0.044494 | 45.35 | 45.35 | 45.35 |
| 112.50 | 0.043011 | 44.97 | 44.97 | 44.97 |
| 115.00 | 0.041608 | 44.59 | 44.59 | 44.59 |
| 117.50 | 0.039732 | 43.31 | 43.31 | 43.31 |
| 120.00 | 0.037978 | 42.04 | 42.04 | 42.04 |
| 122.50 | 0.036470 | 40.81 | 40.81 | 40.81 |
| 125.00 | 0.035158 | 39.63 | 39.63 | 39.63 |
| 127.50 | 0.033918 | 38.44 | 38.44 | 38.44 |
| 130.00 | 0.032745 | 37.26 | 37.26 | 37.26 |
| 132.50 | 0.031633 | 36.08 | 36.08 | 36.08 |
| 135.00 | 0.030579 | 34.89 | 34.89 | 34.89 |
| 137.50 | 0.029578 | 33.71 | 33.71 | 33.71 |
| 140.00 | 0.028628 | 32.53 | 32.53 | 32.53 |
| 142.50 | 0.027723 | 31.34 | 31.34 | 31.34 |
| 145.00 | 0.026863 | 30.16 | 30.16 | 30.16 |
| 147.50 | 0.026234 | 28.88 | 28.88 | 28.88 |
| 150.00 | 0.025687 | 27.57 | 27.57 | 27.57 |
| 152.50 | 0.025160 | 26.26 | 26.26 | 26.26 |
| 155.00 | 0.024653 | 24.95 | 24.95 | 24.95 |
| 157.50 | 0.024163 | 23.64 | 23.64 | 23.64 |
| 160.00 | 0.023691 | 22.33 | 22.33 | 22.33 |
| 162.50 | 0.022620 | 18.40 | 18.40 | 18.40 |
| 165.00 | 0.022314 | 15.15 | 15.15 | 15.15 |
| 167.50 | 0.022017 | 11.89 | 11.89 | 11.89 |
| 170.00 | 0.021728 | 8.63 | 8.63 | 8.63 |
| 172.50 | 0.021447 | 5.37 | 5.37 | 5.37 |
| 175.00 | 0.021174 | 2.12 | 2.12 | 2.12 |

| Endpoint (mole frac., mixture) | Downwind Distance (feet) | Approximate Time (seconds) |
|--------------------------------|--------------------------|----------------------------|
| 1 0.021000 (LFL) | 176.6 | 104 |
| 2 0.021000 (LFL) | 176.6 | 104 |
| 3 0.021000 (LFL) | 176.6 | 104 |



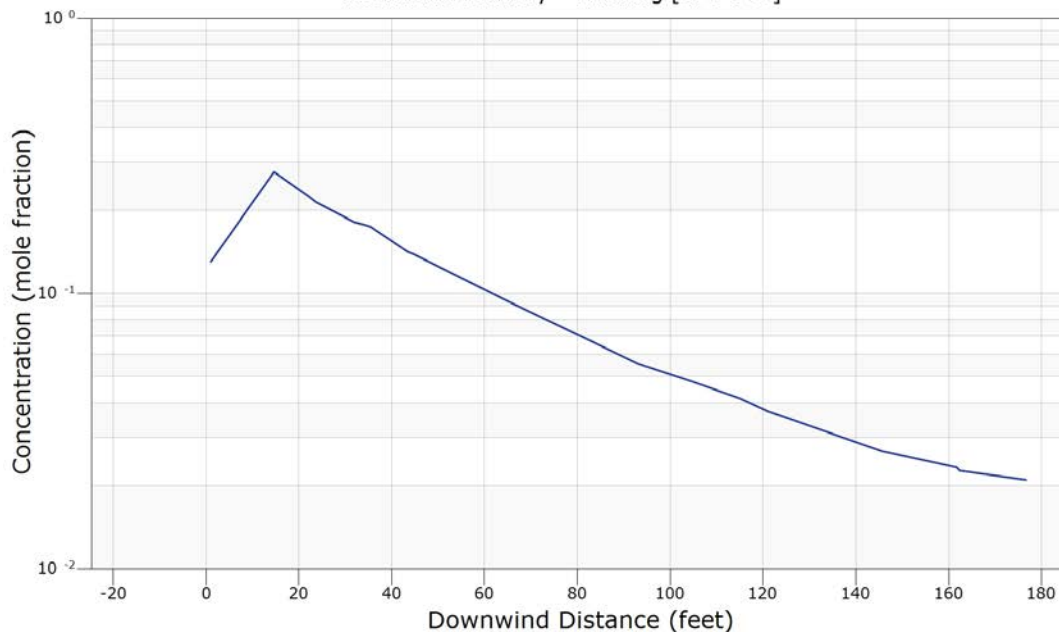
Heavier-than-Air Contours - Overhead View

Paramount Refinery - Trucking [LPG-VCE]



Heavier-than-Air Centerline Concentration

Paramount Refinery - Trucking [LPG-VCE]





Momentum Jet Explosion

Fuel Reactivity: Medium Obstacle Density: Low
Flame Expansion: 2.5-D Flame Speed: 0.29

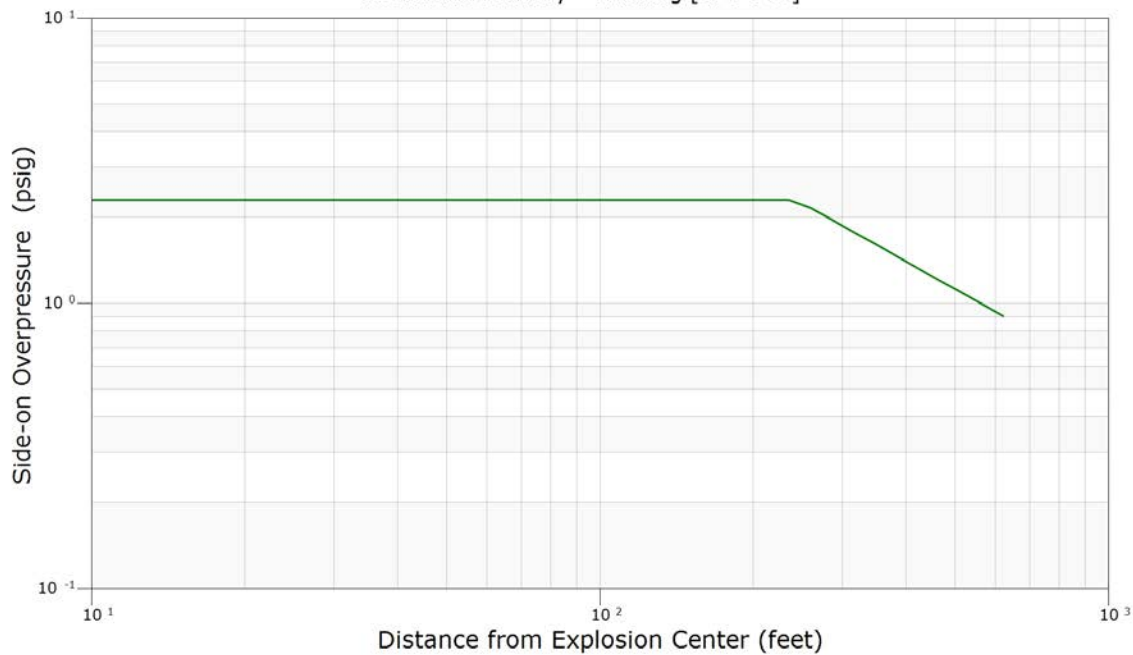
Mass of released material involved in explosion: 30585.7 lbs.

| Distance from Center of Flammable Cloud (feet) | Overpressure (psi gauge) | Impulse (psi-s) |
|--|-----------------------------|--------------------|
| 0.0 | 2.30 | 1.0515 |
| 60.7 | 2.30 | 1.0515 |
| 66.9 | 2.30 | 1.0515 |
| 73.7 | 2.30 | 1.0515 |
| 81.2 | 2.30 | 1.0515 |
| 89.5 | 2.30 | 1.0515 |
| 98.6 | 2.30 | 1.0515 |
| 108.6 | 2.30 | 0.9853 |
| 119.6 | 2.30 | 0.8961 |
| 131.8 | 2.30 | 0.8149 |
| 145.2 | 2.30 | 0.7411 |
| 160.0 | 2.30 | 0.6740 |
| 176.3 | 2.30 | 0.6129 |
| 194.2 | 2.30 | 0.5574 |
| 214.0 | 2.30 | 0.5069 |
| 235.7 | 2.30 | 0.4610 |
| 259.7 | 2.16 | 0.4193 |
| 286.1 | 1.96 | 0.3813 |
| 315.2 | 1.78 | 0.3468 |
| 347.3 | 1.61 | 0.3154 |
| 382.6 | 1.46 | 0.2868 |
| 421.5 | 1.33 | 0.2608 |
| 464.4 | 1.21 | 0.2372 |
| 511.6 | 1.10 | 0.2157 |
| 621.0 | 0.90 | 0.1784 |

The downwind distance to 1.00 psi is 565.7 feet
The downwind distance to 1.00 psi is 565.7 feet
The downwind distance to 1.00 psi is 565.7 feet



Momentum Jet Explosion Overpressure - Baker-Strehlow-Tang
Paramount Refinery - Trucking [LPG-VCE]





Heavier-than-Air Explosion

Fuel Reactivity: Medium Obstacle Density: Low
Flame Expansion: 2.5-D Flame Speed: 0.29

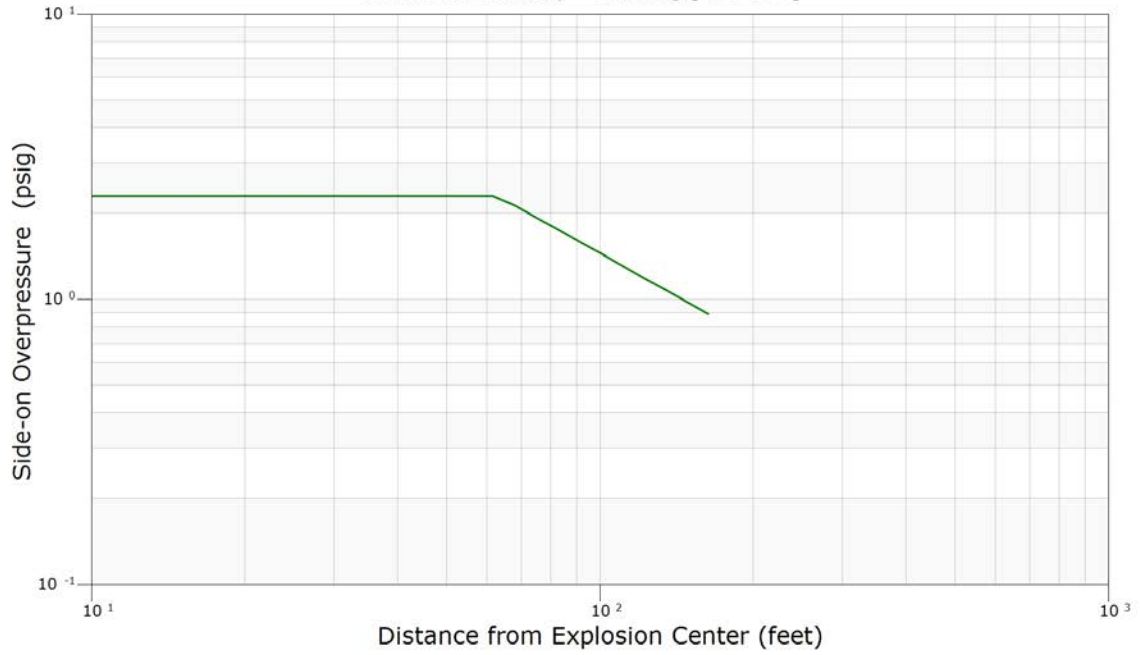
Mass of released material involved in explosion: 530.277 lbs.

| Distance from Center of Flammable Cloud (feet) | Overpressure (psi gauge) | Impulse (psi-s) |
|--|-----------------------------|--------------------|
| 0.0 | 2.30 | 0.2722 |
| 15.7 | 2.30 | 0.2722 |
| 17.3 | 2.30 | 0.2722 |
| 19.1 | 2.30 | 0.2722 |
| 21.1 | 2.30 | 0.2722 |
| 23.2 | 2.30 | 0.2722 |
| 25.6 | 2.30 | 0.2722 |
| 28.2 | 2.30 | 0.2539 |
| 31.1 | 2.30 | 0.2308 |
| 34.3 | 2.30 | 0.2097 |
| 37.8 | 2.30 | 0.1906 |
| 41.7 | 2.30 | 0.1732 |
| 46.0 | 2.30 | 0.1574 |
| 50.7 | 2.30 | 0.1431 |
| 55.9 | 2.30 | 0.1300 |
| 61.6 | 2.30 | 0.1182 |
| 67.9 | 2.13 | 0.1074 |
| 74.9 | 1.94 | 0.0976 |
| 82.6 | 1.76 | 0.0887 |
| 91.1 | 1.59 | 0.0806 |
| 100.4 | 1.44 | 0.0732 |
| 110.7 | 1.31 | 0.0666 |
| 122.0 | 1.19 | 0.0605 |
| 134.5 | 1.08 | 0.0550 |
| 163.5 | 0.89 | 0.0454 |

The downwind distance to 1.00 psi is 146.4 feet
The downwind distance to 1.00 psi is 146.4 feet
The downwind distance to 1.00 psi is 146.4 feet



Heavier-than-Air Explosion Overpressure - Baker-Strehlow-Tang
Paramount Refinery - Trucking [LPG-VCE]





Case Inputs

Case Type : Fire Radiation
Case Name : LPG-Torch
User ID :
Project Number :
Type of Units : English Units

NOTES:

MATERIAL MENU

| Materials Released | Number | Formula | Name | Fraction |
|--------------------|--------|---------|---------|----------|
| Component 1 | 3 | C3H8 | Propane | 1.000000 |
| Component 2 | : | | | |
| Component 3 | : | | | |
| Component 4 | : | | | |
| Component 5 | : | | | |
| Component 6 | : | | | |
| Component 7 | : | | | |
| Component 8 | : | | | |
| Component 9 | : | | | |
| Component 10 | : | | | |

Temperature : 68.00 °F
Pressure : 125.00 psia
The material is LIQUID

NOTES:

ENVIRONMENT MENU

Wind speed 20.00 mph
Relative humidity 70 %
Air temperature 68.0 °F

NOTES:

FIRE TYPE MENU

Fire radiation division: Jet fire
Horizontal isopleths only
Elevation of flame base (from grade) 1.0 feet
Elevation of target (from grade) 0.0 feet
Diameter of jet fire tip 0.2500 feet
Flow rate 166.00 lb/sec
Angle of release from horizontal 0.0 degrees

Fire radiation flux values

Radiation endpoint 1 3487 Btu/hr-sq.ft
Radiation endpoint 2 1600 Btu/hr-sq.ft
Radiation endpoint 3 500 Btu/hr-sq.ft

NOTES:



Jet Fire Radiation

Length of Flame : 156.9 feet
Flame Tilt from Horizontal: 2.2 degrees
Release Angle : 0.0 degrees
Release Point Elevation : 1.0 feet
Target Elevation : 0.0 feet
Wind Speed : 20.0 mph

| Downwind Distance at Target Height (feet) | Maximum Flux (Btu/hr-sq.ft) |
|---|-----------------------------------|
| 3.3 | *** |
| 16.4 | *** |
| 19.0 | *** |
| 22.1 | *** |
| 25.6 | *** |
| 29.7 | *** |
| 34.5 | *** |
| 40.1 | *** |
| 46.5 | *** |
| 54.0 | *** |
| 62.6 | *** |
| 72.7 | *** |
| 84.3 | *** |
| 97.8 | *** |
| 113.5 | *** |
| 131.8 | *** |
| 152.9 | *** |
| 177.4 | 18873 |
| 205.9 | 8274 |
| 239.0 | 4058 |
| 277.3 | 2185 |
| 321.8 | 1266 |
| 373.4 | 768 |
| 433.4 | 483 |
| 502.9 | 312 |

*** Target Location inside Flame

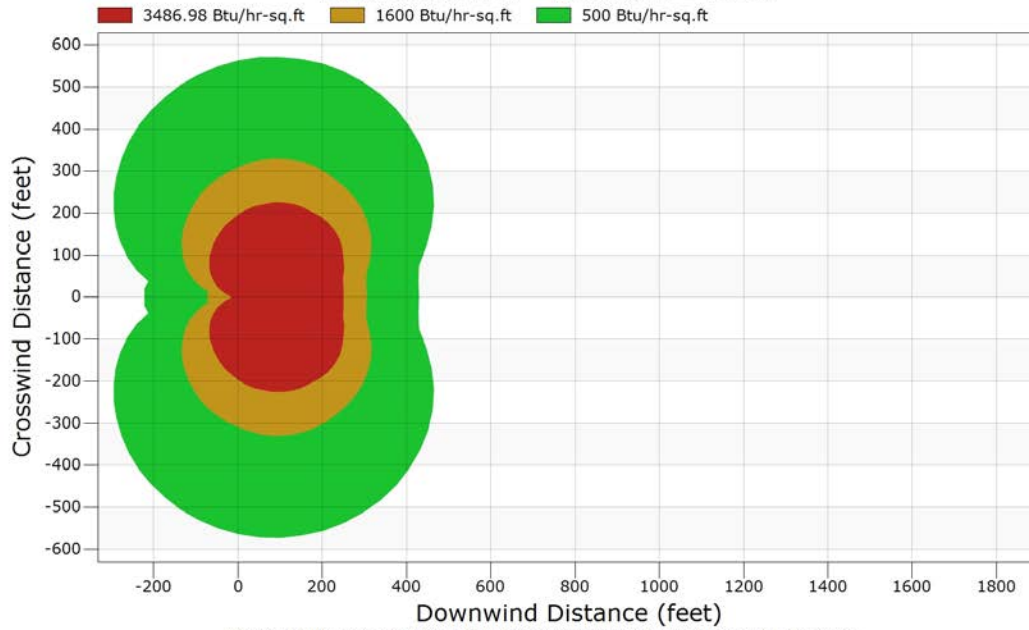
Downwind Distances to Endpoints

| Distance (feet) | Maximum Flux (Btu/hr-sq.ft) |
|--------------------|--------------------------------|
| 250.7 | 3487 |
| 305.6 | 1600 |
| 429.8 | 500 |



Jet Fire Radiant Heat Contours - Overhead View

Paramount Refinery - Trucking [LPG-Torch]





Case Inputs

Case Type : Vapor Dispersion
Case Name : PipelineCrude-VCE
User ID :
Project Number :
Type of Units : English Units

NOTES:

MATERIAL MENU

| Materials Released | Number | Formula | Name | Fraction |
|--------------------|--------|---------|---------------|----------|
| Component 1 | 8 | C6H14 | n-Hexane | 0.011000 |
| Component 2 | 11 | C9H20 | n-Nonane | 0.033000 |
| Component 3 | 13 | C11H24 | n-Undecane | 0.048000 |
| Component 4 | 22 | C38H61 | PHC-500 | 0.367000 |
| Component 5 | 24 | C51H82 | PHC-700 | 0.192000 |
| Component 6 | 32 | C13H28 | Tridecane | 0.064000 |
| Component 7 | 34 | C15H32 | Pentadecane | 0.112000 |
| Component 8 | 36 | C17H36 | n-Heptadecane | 0.173000 |
| Component 9 | | | | |
| Component 10 | | | | |

Temperature : 68.00 °F
Pressure : 500.00 psia
The material is LIQUID
The mixture is Heavy Crude

NOTES:

ENVIRONMENT MENU

Wind speed 3.36 mph
Wind speed measurement height 32.8 feet
Stability class <A-F> F
Relative humidity 70 %
Air temperature 68.0 °F
Spill surface temperature 68.0 °F

Substrate name Soil
Substrate thermal conductivity 1.0000 Btu/hr-ft-F
Substrate density 100 lb/cu.ft
Substrate heat Capacity 0.24 Btu/lb-F
Substrate delay time 60 sec
Surrounding terrain Long grass or crops > 15 cm (6 in)

NOTES:



RELEASE MENU

Type of release: Unregulated, Continuous release
Release duration 60 min
Normal flow rate 28.47 lb/sec
Duration of normal flow 10 min
Volume of vessel 700.00 cu.ft
Percent of vessel filled with liquid 100 %
Liquid head above release point 0 feet
Pipe inner diameter 7.98 inches
Equivalent release diameter 7.98 inches
Pipe length upstream of break 2000.0 feet
Height of release point 1.0 feet
Angle of release from horizontal 0.0 degrees

NOTES:

IMPOUNDMENT MENU

Unconfined

NOTES:

VDVE MENU

Vapor generation, dispersion and cloud explosion - Flammable calculation

Concentration endpoint 1 LFL mol%
Concentration endpoint 2 LFL mol%
Concentration endpoint 3 LFL mol%

Dispersion coefficient averaging time 1 min

Baker-Strehlow-Tang parameters

Fuel reactivity Medium
Obstacle density Low
Flame expansion 2.5-D

Overpressure values

Overpressure endpoint 1 1.00 psi
Overpressure endpoint 2 1.00 psi
Overpressure endpoint 3 1.00 psi

NOTES:



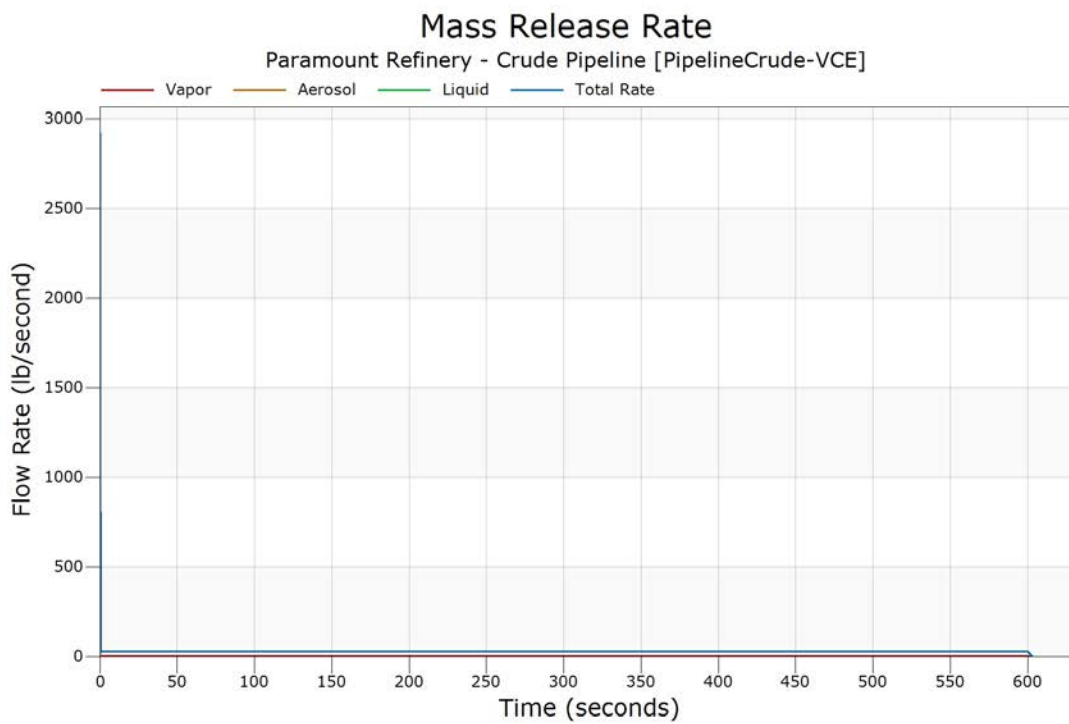
Release Model

| Time (sec) | Vapor (lb/sec) | Aerosol Rate (lb/sec) | Liquid Rate (lb/sec) | Total Rate (lb/sec) |
|---------------|-------------------|--------------------------|-------------------------|------------------------|
| 0.000000 | .2684553E-01 | 2512.981 | 407.9738 | 2920.982 |
| 0.100000 | .2188034 | 15.36114 | 1471.135 | 1486.715 |
| 0.300000 | .1895780 | .3098723E-02 | 940.1154 | 940.3081 |
| 0.500000 | .1591522 | 0.000000 | 741.8673 | 742.0265 |
| 0.700000 | .6557546E-02 | 0.000000 | 28.46343 | 28.46999 |
| 1.000000 | .6557546E-02 | 0.000000 | 28.46343 | 28.46999 |
| 3.000000 | .6557546E-02 | 0.000000 | 28.46343 | 28.46999 |
| 5.000000 | .6557546E-02 | 0.000000 | 28.46343 | 28.46999 |
| 7.000000 | .6557546E-02 | 0.000000 | 28.46343 | 28.46999 |
| 10.00000 | .6557546E-02 | 0.000000 | 28.46343 | 28.46999 |
| 20.00000 | .6557546E-02 | 0.000000 | 28.46343 | 28.46999 |
| 30.00000 | .6557546E-02 | 0.000000 | 28.46343 | 28.46999 |
| 40.00000 | .6557546E-02 | 0.000000 | 28.46343 | 28.46999 |
| 50.00000 | .6557546E-02 | 0.000000 | 28.46343 | 28.46999 |
| 60.00000 | .6557546E-02 | 0.000000 | 28.46343 | 28.46999 |
| 70.00000 | .6557546E-02 | 0.000000 | 28.46343 | 28.46999 |
| 85.00000 | .6557546E-02 | 0.000000 | 28.46343 | 28.46999 |
| 100.0000 | .6557546E-02 | 0.000000 | 28.46343 | 28.46999 |
| 200.0000 | .6557546E-02 | 0.000000 | 28.46343 | 28.46999 |
| 300.0000 | .6557546E-02 | 0.000000 | 28.46343 | 28.46999 |
| 400.0000 | .6557546E-02 | 0.000000 | 28.46343 | 28.46999 |
| 500.0000 | .6557546E-02 | 0.000000 | 28.46343 | 28.46999 |
| 600.0000 | .6557546E-02 | 0.000000 | 28.46343 | 28.46999 |
| 603.0000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| Totals (lb) | 4.040297 | 56.28258 | 17676.54 | 17736.86 |

Flowrate for Jet Fire [immediate ignition] = 0.9461995 lb/sec.

Jet Fire [delayed ignition] = 0.6557546E-02 lb/sec.

Reason for Ending: Pressure Near Atmospheric





Release Compositions

| Component Number | Component Name, Formula |
|------------------|-------------------------|
| 8 | n-Hexane, C6H14 |
| 11 | n-Nonane, C9H20 |
| 13 | n-Undecane, C11H24 |
| 22 | PHC-500, C38H61 |
| 24 | PHC-700, C51H82 |
| 32 | Tridecane, C13H28 |
| 34 | Pentadecane, C15H32 |
| 36 | n-Heptadecane, C17H36 |

Composition (Mole Fraction) of Fluid Streams

| Comp. No. | Feed Stream | Momentum Jet Stream | | | Liquid Pool Stream | |
|-----------|-------------|---------------------|------------------|----------------|--------------------|------------------|
| | | Flashed Vapor | Evaporated Vapor | Aerosol Liquid | Total Stream | Liquid to Ground |
| 8 | 0.011000 | 0.000000 | 0.888552 | 0.011000 | 0.700105 | 0.010998 |
| 11 | 0.033000 | 0.000000 | 0.093175 | 0.033000 | 0.080253 | 0.033000 |
| 13 | 0.048000 | 0.000000 | 0.015291 | 0.048000 | 0.022315 | 0.048000 |
| 22 | 0.367000 | 0.000000 | 0.000000 | 0.367000 | 0.078810 | 0.367001 |
| 24 | 0.192000 | 0.000000 | 0.000000 | 0.192000 | 0.041230 | 0.192000 |
| 32 | 0.064000 | 0.000000 | 0.002383 | 0.064000 | 0.015615 | 0.064000 |
| 34 | 0.112000 | 0.000000 | 0.000493 | 0.112000 | 0.024438 | 0.112000 |
| 36 | 0.173000 | 0.000000 | 0.000106 | 0.173000 | 0.037233 | 0.173000 |
| | 1.000000 | 0.000000 | 1.000000 | 1.000000 | 1.000000 | 1.000000 |

Flammable Limits (Mole %) of Fluid Streams

| Limit | Feed Stream | Momentum Jet Stream | Liquid Pool Stream |
|-------|-------------|---------------------|--------------------|
| LFL | 0.44 | 0.81 | 0.44 |
| UFL | 6.25 | 6.43 | 6.25 |
| LBV | | 0.42 m/s | 0.40 m/s |



Pool Spreading and Vaporization

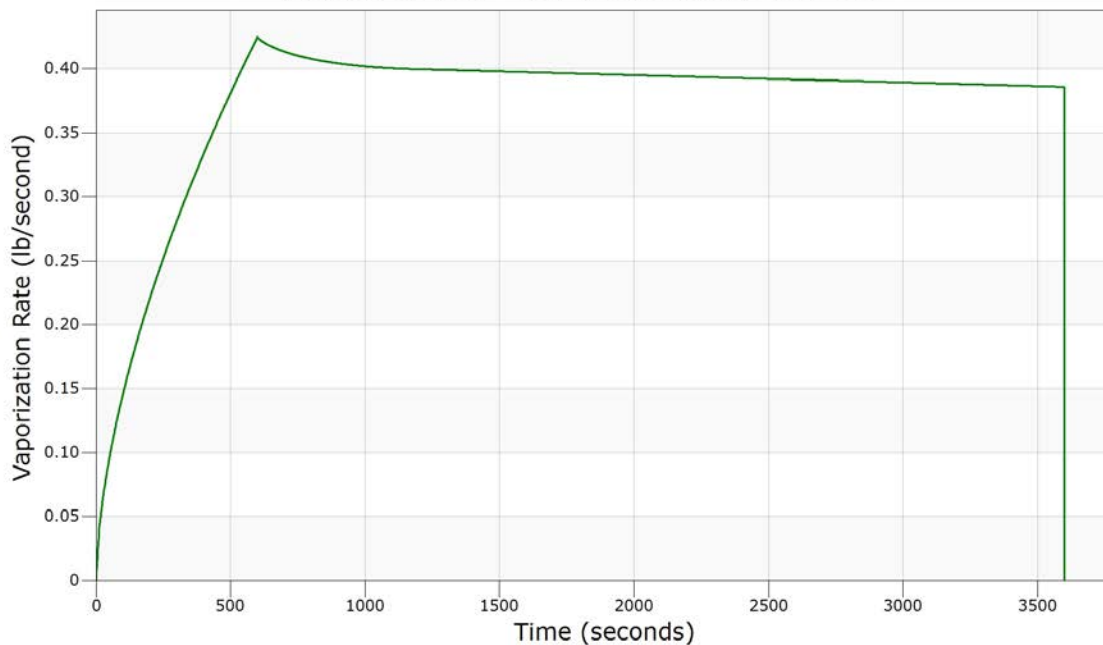
| Time (sec) | Liquid Remaining (ft3) | Pool/Dike Radius (feet) | Vapor Rate (lb/sec) |
|---------------|------------------------------|-------------------------------|------------------------|
| 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| 40.0000 | 26.1947 | 7.37664 | 0.842430E-01 |
| 80.0000 | 52.3363 | 9.29035 | 0.127515 |
| 120.000 | 78.4445 | 10.6309 | 0.162518 |
| 160.000 | 104.521 | 11.6975 | 0.193032 |
| 200.000 | 130.572 | 12.5974 | 0.220572 |
| 240.000 | 156.596 | 13.3832 | 0.245970 |
| 280.000 | 182.602 | 14.0860 | 0.269691 |
| 320.000 | 208.583 | 14.7241 | 0.292068 |
| 360.000 | 234.542 | 15.3107 | 0.313343 |
| 400.000 | 260.485 | 15.8550 | 0.333692 |
| 440.000 | 286.409 | 16.3638 | 0.353203 |
| 480.000 | 312.316 | 16.8428 | 0.372030 |
| 520.000 | 338.205 | 17.2953 | 0.390218 |
| 560.000 | 364.094 | 17.7251 | 0.407833 |
| 600.000 | 389.945 | 18.1348 | 0.424963 |
| 640.000 | 389.556 | 18.1289 | 0.418922 |
| 680.000 | 389.168 | 18.1230 | 0.415152 |
| 720.000 | 388.779 | 18.1171 | 0.412264 |
| 760.000 | 388.391 | 18.1112 | 0.409905 |
| 800.000 | 388.038 | 18.1053 | 0.407965 |
| 840.000 | 387.649 | 18.0994 | 0.406334 |
| 880.000 | 387.261 | 18.0935 | 0.404967 |
| 1130.00 | 384.965 | 18.0574 | 0.400249 |
| 1380.00 | 382.670 | 18.0213 | 0.398706 |
| 1630.00 | 380.374 | 17.9852 | 0.397273 |
| 1880.00 | 378.079 | 17.9491 | 0.395840 |
| 2130.00 | 375.819 | 17.9131 | 0.394407 |
| 2380.00 | 373.523 | 17.8770 | 0.392996 |
| 2630.00 | 371.263 | 17.8409 | 0.391563 |
| 2880.00 | 369.038 | 17.8051 | 0.390152 |
| 3130.00 | 366.778 | 17.7690 | 0.388719 |
| 3380.00 | 364.553 | 17.7326 | 0.387308 |
| 3600.00 | 362.576 | 17.7008 | 0.386051 |

Ending Message: Normal Ending



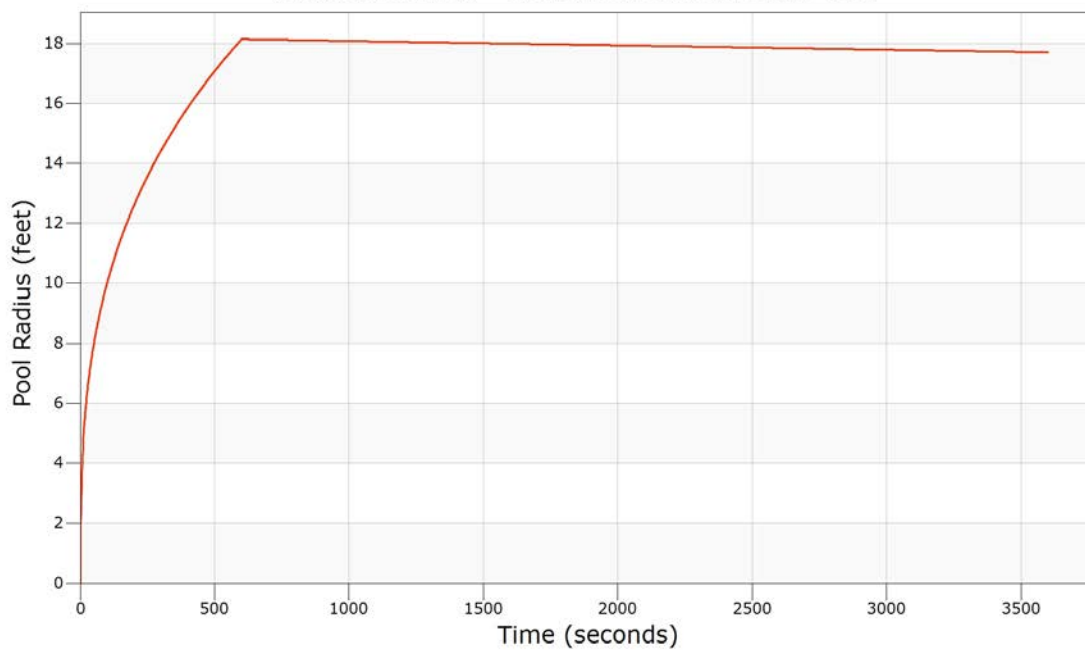
Pool Vaporization Rate

Paramount Refinery - Crude Pipeline [PipelineCrude-VCE]



Pool Radius

Paramount Refinery - Crude Pipeline [PipelineCrude-VCE]





Momentum Jet Dispersion

concentration limits

Endpoint 1 (highest) = 0.008055 mole fraction

Endpoint 2 (middle) = 0.008055 mole fraction

Endpoint 3 (lowest) = 0.008055 mole fraction

| downwind distance (ft) | centerline conc. (mole frac.) | ground conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) | centerline height (ft) |
|------------------------------|-------------------------------------|---------------------------------|--------------------------------|--------------------------------|--------------------------------|------------------------------|
| 0 | 1.000000 | 0.000000 | 0.2 | 0.2 | 0.2 | 1.0 |
| 0.5 | 0.717739 | 0.717739 | 0.2 | 0.2 | 0.2 | 0.0 |
| 1.0 | 0.392737 | 0.392737 | 0.5 | 0.5 | 0.5 | 0.0 |
| 1.5 | 0.276008 | 0.276008 | 0.8 | 0.8 | 0.8 | 0.0 |
| 2.0 | 0.214901 | 0.214901 | 1.1 | 1.1 | 1.1 | 0.0 |
| 2.5 | 0.176985 | 0.176985 | 1.3 | 1.3 | 1.3 | 0.0 |
| 3.0 | 0.151028 | 0.151028 | 1.6 | 1.6 | 1.6 | 0.0 |
| 3.5 | 0.132075 | 0.132075 | 1.9 | 1.9 | 1.9 | 0.0 |
| 4.0 | 0.117591 | 0.117591 | 2.2 | 2.2 | 2.2 | 0.0 |
| 4.5 | 0.106139 | 0.106139 | 2.5 | 2.5 | 2.5 | 0.0 |
| 5.0 | 0.096844 | 0.096844 | 2.8 | 2.8 | 2.8 | 0.0 |
| 5.5 | 0.089138 | 0.089138 | 3.1 | 3.1 | 3.1 | 0.0 |
| 6.0 | 0.082640 | 0.082640 | 3.3 | 3.3 | 3.3 | 0.0 |
| 6.5 | 0.077082 | 0.077082 | 3.6 | 3.6 | 3.6 | 0.0 |
| 7.0 | 0.072270 | 0.072270 | 3.9 | 3.9 | 3.9 | 0.0 |
| 7.5 | 0.068060 | 0.068060 | 4.2 | 4.2 | 4.2 | 0.0 |
| 8.0 | 0.060957 | 0.060957 | 4.2 | 4.2 | 4.2 | 0.0 |
| 8.5 | 0.054626 | 0.054626 | 4.2 | 4.2 | 4.2 | 0.0 |
| 9.0 | 0.049261 | 0.049261 | 4.2 | 4.2 | 4.2 | 0.0 |
| 9.5 | 0.044671 | 0.044671 | 4.1 | 4.1 | 4.1 | 0.0 |
| 10.0 | 0.040713 | 0.040713 | 4.1 | 4.1 | 4.1 | 0.0 |
| 10.5 | 0.037274 | 0.037274 | 4.1 | 4.1 | 4.1 | 0.0 |
| 11.0 | 0.034266 | 0.034266 | 4.1 | 4.1 | 4.1 | 0.0 |
| 11.5 | 0.031619 | 0.031619 | 4.1 | 4.1 | 4.1 | 0.0 |
| 12.0 | 0.029277 | 0.029277 | 4.0 | 4.0 | 4.0 | 0.0 |
| 12.5 | 0.027193 | 0.027193 | 4.0 | 4.0 | 4.0 | 0.0 |
| 13.0 | 0.025331 | 0.025331 | 4.0 | 4.0 | 4.0 | 0.0 |
| 13.5 | 0.023659 | 0.023659 | 4.0 | 4.0 | 4.0 | 0.0 |
| 14.0 | 0.022153 | 0.022153 | 4.0 | 4.0 | 4.0 | 0.0 |
| 14.5 | 0.020791 | 0.020791 | 3.9 | 3.9 | 3.9 | 0.0 |
| 15.0 | 0.019554 | 0.019554 | 3.9 | 3.9 | 3.9 | 0.0 |
| 15.5 | 0.018397 | 0.018397 | 3.7 | 3.7 | 3.7 | 0.0 |
| 16.0 | 0.017341 | 0.017341 | 3.5 | 3.5 | 3.5 | 0.0 |
| 16.5 | 0.016374 | 0.016374 | 3.3 | 3.3 | 3.3 | 0.0 |
| 17.0 | 0.015488 | 0.015488 | 3.1 | 3.1 | 3.1 | 0.0 |



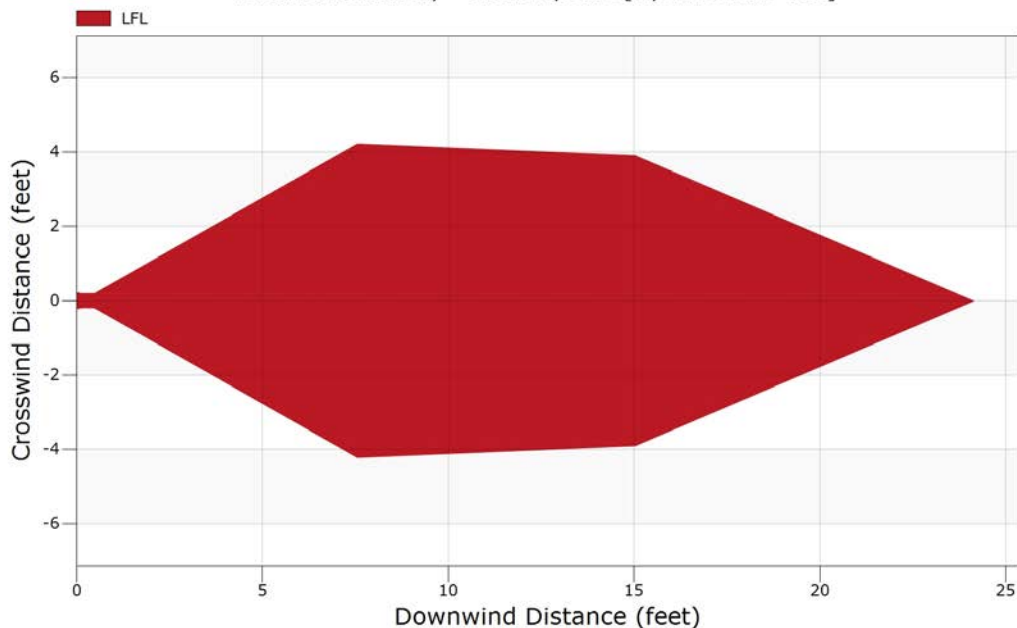
| downwind distance (ft) | centerline conc. (mole frac.) | ground conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) | centerline height (ft) |
|------------------------|-------------------------------|---------------------------|--------------------------|--------------------------|--------------------------|------------------------|
| 17.5 | 0.014674 | 0.014674 | 2.9 | 2.9 | 2.9 | 0.0 |
| 18.0 | 0.013924 | 0.013924 | 2.6 | 2.6 | 2.6 | 0.0 |
| 18.5 | 0.013231 | 0.013231 | 2.4 | 2.4 | 2.4 | 0.0 |
| 19.0 | 0.012589 | 0.012589 | 2.2 | 2.2 | 2.2 | 0.0 |
| 19.5 | 0.011994 | 0.011994 | 2.0 | 2.0 | 2.0 | 0.0 |
| 20.0 | 0.011442 | 0.011442 | 1.8 | 1.8 | 1.8 | 0.0 |
| 20.5 | 0.010927 | 0.010927 | 1.6 | 1.6 | 1.6 | 0.0 |
| 21.0 | 0.010447 | 0.010447 | 1.4 | 1.4 | 1.4 | 0.0 |
| 21.5 | 0.009999 | 0.009999 | 1.1 | 1.1 | 1.1 | 0.0 |
| 22.0 | 0.009580 | 0.009580 | 0.9 | 0.9 | 0.9 | 0.0 |
| 22.5 | 0.009187 | 0.009187 | 0.7 | 0.7 | 0.7 | 0.0 |
| 23.0 | 0.008819 | 0.008819 | 0.5 | 0.5 | 0.5 | 0.0 |
| 23.5 | 0.008472 | 0.008472 | 0.3 | 0.3 | 0.3 | 0.0 |
| 24.0 | 0.008146 | 0.008146 | 0.1 | 0.1 | 0.1 | 0.0 |
| 24.5 | 0.007839 | 0.007839 | 0.0 | 0.0 | 0.0 | 0.0 |

The momentum jet model coupled to the heavy gas model at 0.49 ft in 0 sec.

| Endpoint (mole frac., mixture) | Downwind Distance (feet) | Approximate Time (seconds) |
|--------------------------------|--------------------------|----------------------------|
| 1 0.008055 (LFL) | 24.1 | 7 |
| 2 0.008055 (LFL) | 24.1 | 7 |
| 3 0.008055 (LFL) | 24.1 | 7 |

Momentum Jet Contours - Overhead View

Paramount Refinery - Crude Pipeline [PipelineCrude-VCE]

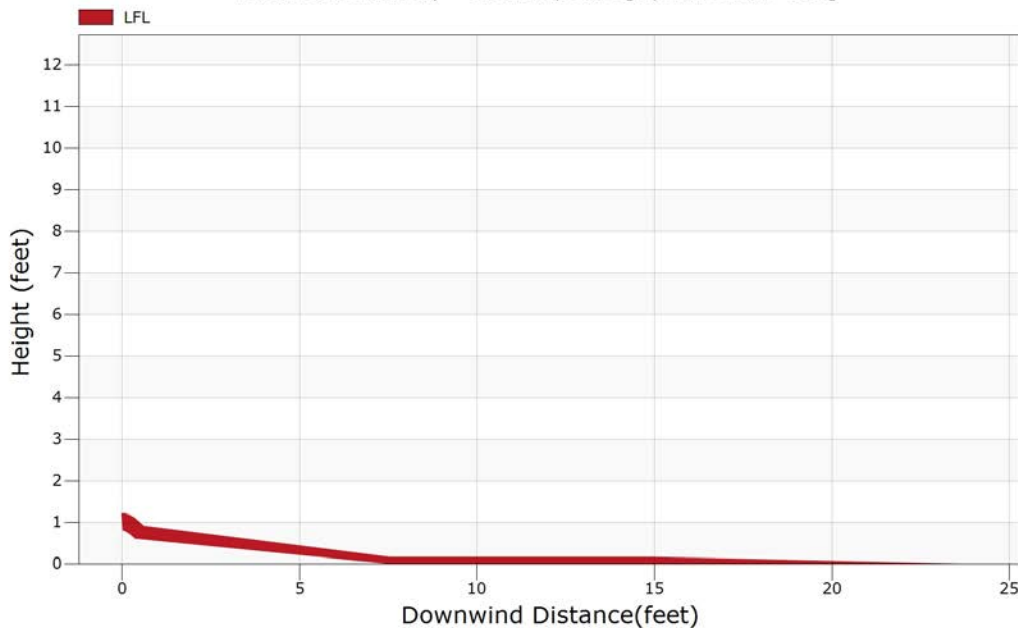


Note: Release during 3.36 mph winds and F stability.



Momentum Jet Contours - Side View

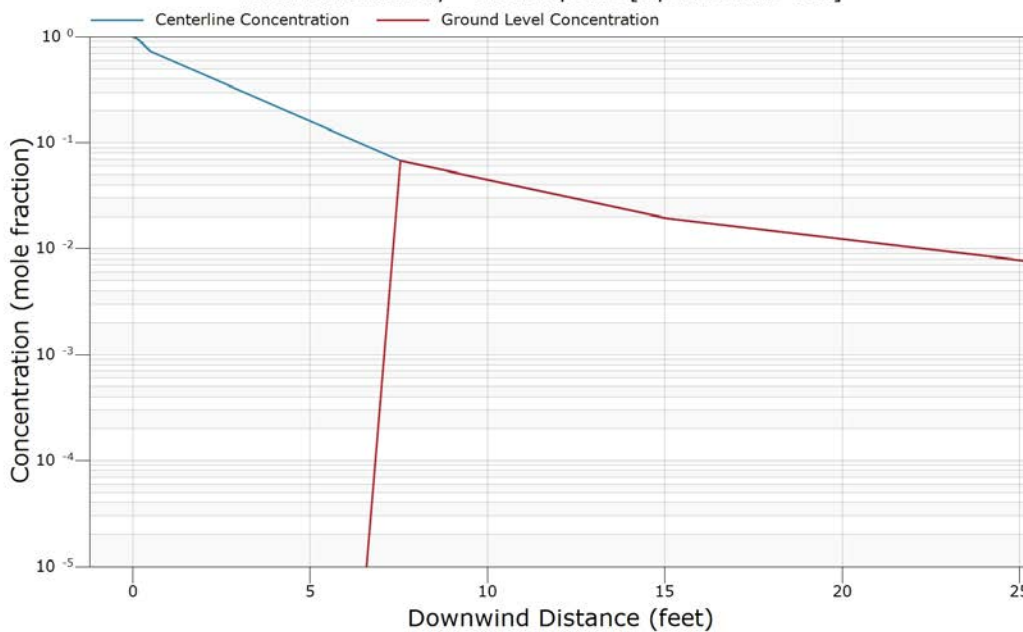
Paramount Refinery - Crude Pipeline [PipelineCrude-VCE]



Note: Release during 3.36 mph winds and F stability.

Momentum Jet Concentration

Paramount Refinery - Crude Pipeline [PipelineCrude-VCE]



Note: Release during 3.36 mph winds and F stability.



Heavier-than-Air Dispersion

concentration limits

Endpoint 1 (highest) = 0.004354 mole fraction
Endpoint 2 (middle) = 0.004354 mole fraction
Endpoint 3 (lowest) = 0.004354 mole fraction

| downwind distance (ft) | centerline conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) |
|------------------------------|-------------------------------------|--------------------------------|--------------------------------|--------------------------------|
|------------------------------|-------------------------------------|--------------------------------|--------------------------------|--------------------------------|

* Vapor cloud does not leave source.



Momentum Jet Explosion

Fuel Reactivity: Medium Obstacle Density: Low
Flame Expansion: 2.5-D Flame Speed: 0.29

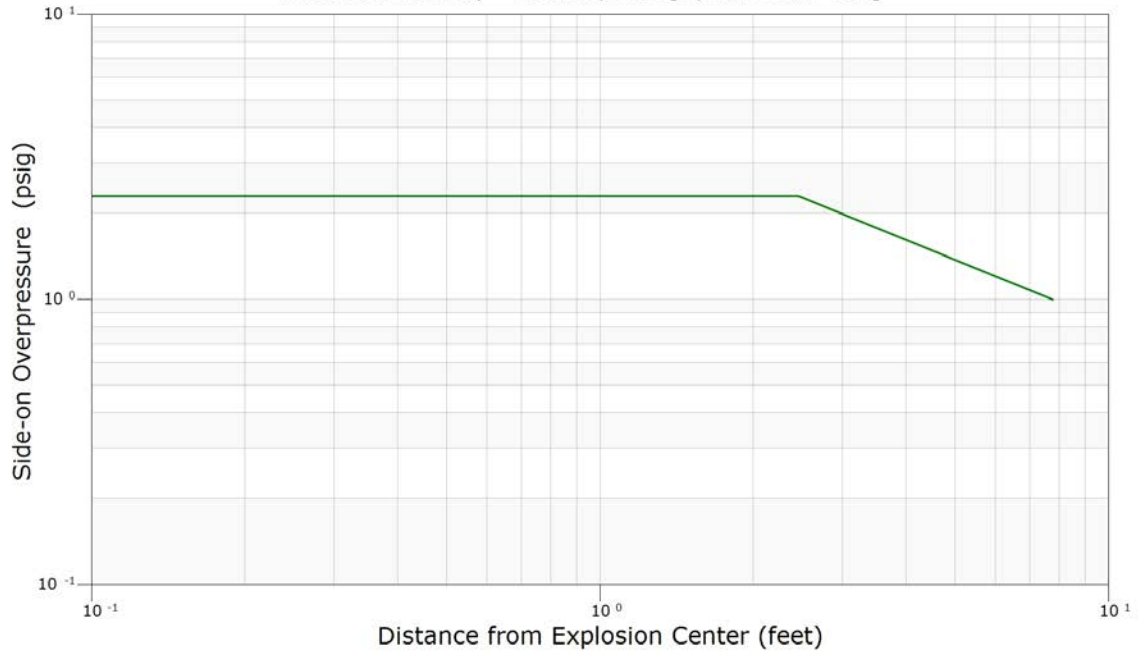
Mass of released material involved in explosion: 0.0885993 lbs.

| Distance from Center of Flammable Cloud (feet) | Overpressure (psi gauge) | Impulse (psi-s) |
|--|-----------------------------|--------------------|
| 0.0 | 2.30 | 0.0146 |
| 0.8 | 2.30 | 0.0146 |
| 0.9 | 2.30 | 0.0146 |
| 0.9 | 2.30 | 0.0146 |
| 1.0 | 2.30 | 0.0146 |
| 1.0 | 2.30 | 0.0146 |
| 1.1 | 2.30 | 0.0146 |
| 1.1 | 2.30 | 0.0146 |
| 1.2 | 2.30 | 0.0146 |
| 1.2 | 2.30 | 0.0146 |
| 1.3 | 2.30 | 0.0146 |
| 1.4 | 2.30 | 0.0146 |
| 1.4 | 2.30 | 0.0143 |
| 1.5 | 2.30 | 0.0136 |
| 1.6 | 2.30 | 0.0130 |
| 1.7 | 2.30 | 0.0124 |
| 1.7 | 2.30 | 0.0118 |
| 1.8 | 2.30 | 0.0113 |
| 1.9 | 2.30 | 0.0107 |
| 2.0 | 2.30 | 0.0102 |
| 2.1 | 2.30 | 0.0098 |
| 2.2 | 2.30 | 0.0093 |
| 2.3 | 2.30 | 0.0089 |
| 2.5 | 2.30 | 0.0085 |
| 7.8 | 1.00 | 0.0027 |

The downwind distance to 1.00 psi is 7.8 feet
The downwind distance to 1.00 psi is 7.8 feet
The downwind distance to 1.00 psi is 7.8 feet



Momentum Jet Explosion Overpressure - Baker-Strehlow-Tang
Paramount Refinery - Crude Pipeline [PipelineCrude-VCE]





Heavier-than-Air Explosion

Fuel Reactivity: Medium

Obstacle Density: Low

Flame Expansion: 2.5-D

Flame Speed: 0.29

Mass of released material involved in explosion: 157.1 lbs.

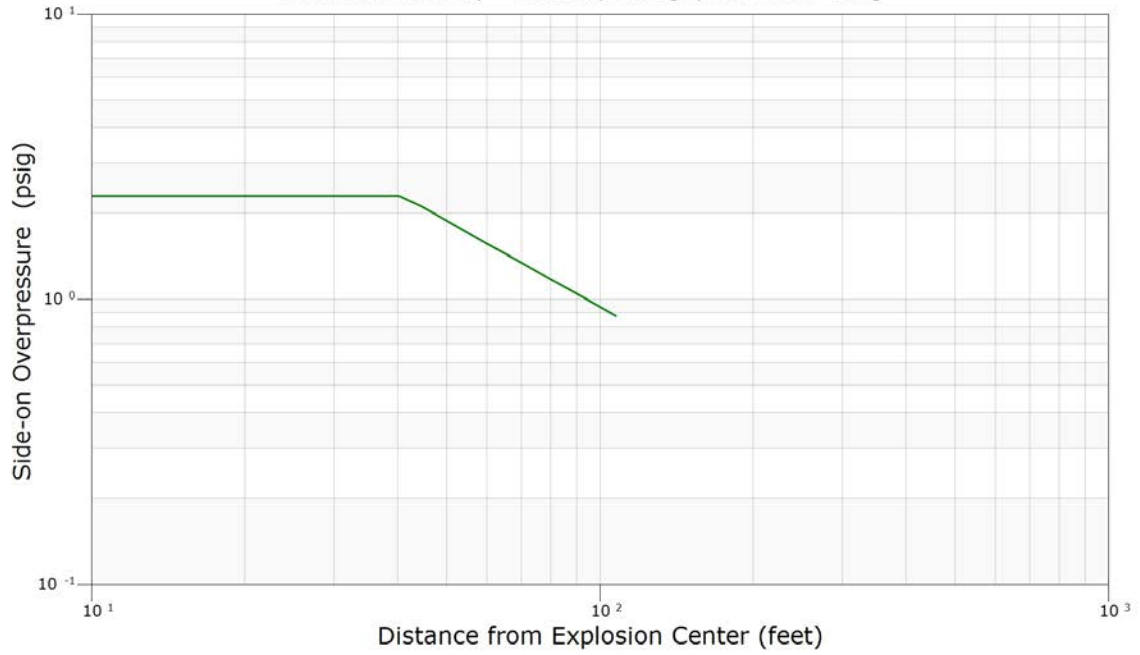
| Distance from Center of Flammable Cloud (feet) | Overpressure (psi gauge) | Impulse (psi-s) |
|--|-----------------------------|--------------------|
| 0.0 | 2.30 | 0.1766 |
| 10.2 | 2.30 | 0.1766 |
| 11.2 | 2.30 | 0.1766 |
| 12.4 | 2.30 | 0.1766 |
| 13.7 | 2.30 | 0.1766 |
| 15.1 | 2.30 | 0.1766 |
| 16.7 | 2.30 | 0.1766 |
| 18.4 | 2.30 | 0.1642 |
| 20.3 | 2.30 | 0.1492 |
| 22.4 | 2.30 | 0.1355 |
| 24.7 | 2.30 | 0.1231 |
| 27.2 | 2.30 | 0.1118 |
| 30.0 | 2.30 | 0.1016 |
| 33.1 | 2.30 | 0.0922 |
| 36.5 | 2.30 | 0.0838 |
| 40.3 | 2.30 | 0.0761 |
| 44.4 | 2.12 | 0.0691 |
| 49.0 | 1.92 | 0.0628 |
| 54.1 | 1.74 | 0.0570 |
| 59.6 | 1.58 | 0.0518 |
| 65.8 | 1.43 | 0.0471 |
| 72.6 | 1.30 | 0.0427 |
| 80.0 | 1.18 | 0.0388 |
| 88.3 | 1.07 | 0.0353 |
| 107.4 | 0.88 | 0.0291 |

The downwind distance to 1.00 psi is 94.9 feet
The downwind distance to 1.00 psi is 94.9 feet
The downwind distance to 1.00 psi is 94.9 feet



Heavier-than-Air Explosion Overpressure - Baker-Strehlow-Tang

Paramount Refinery - Crude Pipeline [PipelineCrude-VCE]





Case Inputs

Case Type : Fire Radiation
Case Name : PipelineCrude-Pool
User ID :
Project Number :
Type of Units : English Units

NOTES:

MATERIAL MENU

| Materials Released | Number | Formula | Name | Fraction |
|--------------------|--------|---------|---------------|----------|
| Component 1 | 8 | C6H14 | n-Hexane | 0.011000 |
| Component 2 | 11 | C9H20 | n-Nonane | 0.033000 |
| Component 3 | 13 | C11H24 | n-Undecane | 0.048000 |
| Component 4 | 22 | C38H61 | PHC-500 | 0.367000 |
| Component 5 | 24 | C51H82 | PHC-700 | 0.192000 |
| Component 6 | 32 | C13H28 | Tridecane | 0.064000 |
| Component 7 | 34 | C15H32 | Pentadecane | 0.112000 |
| Component 8 | 36 | C17H36 | n-Heptadecane | 0.173000 |
| Component 9 | | | | |
| Component 10 | | | | |

Temperature : 68.00 °F
Pressure : 14.70 psia
The material is LIQUID
The mixture is Heavy Crude

NOTES:

ENVIRONMENT MENU

Wind speed : 3.36 mph
Relative humidity : 70 %
Air temperature : 68.0 °F

NOTES:

FIRE TYPE MENU

Fire radiation division: Circular pool fires
Vertical and horizontal isopleths
Spill surface: land
Elevation of flame base (from grade) : 1.0 feet
Elevation of target (from grade) : 0.0 feet
Diameter of pool : 36.0 feet

Fire radiation flux values

Radiation endpoint 1 : 3487 Btu/hr-sq.ft
Radiation endpoint 2 : 1600 Btu/hr-sq.ft
Radiation endpoint 3 : 500 Btu/hr-sq.ft

NOTES:



Pool Fire Radiation

Length of Flame : 43.1 feet
 Flame Tilt from Vertical : 9.2 degrees
 Target Elevation : 0.0 feet
 Pool Elevation : 1.0 feet
 Wind Speed : 3.4 mph
 Substrate : Land

| Downwind Distance from Center of Pool (feet) | Flux to Vertical Target (Btu/hr-sq.ft) | Flux to Horizontal Target (Btu/hr-sq.ft) | Maximum Flux (Btu/hr-sq.ft) |
|--|--|--|-----------------------------------|
| 19.8 | 5482 | 20751 | 21463 |
| 21.0 | 7947 | 22340 | 23712 |
| 22.3 | 9259 | 19461 | 21552 |
| 23.7 | 9653 | 10357 | 14963 |
| 25.1 | 8735 | 7854 | 12235 |
| 26.7 | 7555 | 5381 | 9457 |
| 28.3 | 6210 | 3811 | 7369 |
| 30.0 | 5099 | 2871 | 5897 |
| 31.9 | 4249 | 2283 | 4851 |
| 33.8 | 3602 | 1885 | 4083 |
| 35.9 | 3100 | 1595 | 3498 |
| 38.1 | 2699 | 1367 | 3034 |
| 40.4 | 2373 | 1182 | 2657 |
| 42.9 | 2100 | 1025 | 2341 |
| 45.5 | 1867 | 889 | 2071 |
| 48.3 | 1665 | 770 | 1837 |
| 51.3 | 1487 | 665 | 1630 |
| 54.4 | 1329 | 571 | 1447 |
| 57.8 | 1188 | 488 | 1285 |
| 61.3 | 1060 | 415 | 1139 |
| 65.1 | 944 | 352 | 1008 |
| 69.1 | 840 | 296 | 891 |
| 73.3 | 746 | 248 | 786 |
| 77.8 | 661 | 207 | 693 |
| 82.6 | 585 | 172 | 610 |
| 87.6 | 517 | 143 | 536 |
| 93.0 | 456 | 118 | 471 |
| 98.7 | 401 | 97 | 413 |
| 104.7 | 353 | 80 | 362 |
| 111.1 | 310 | 66 | 317 |

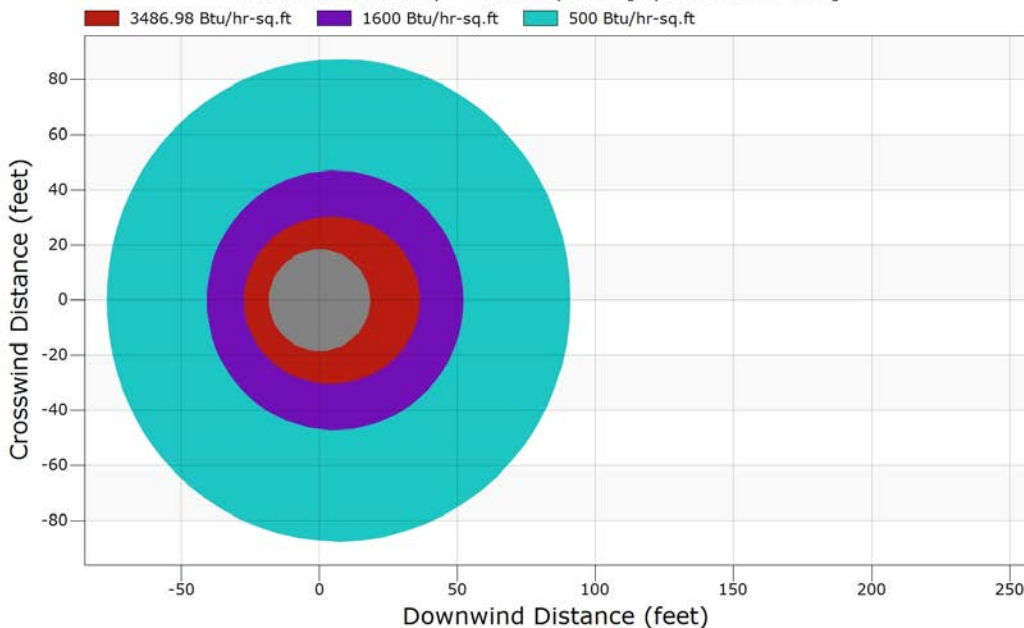
Downwind Distances to Endpoints:

| Distance (feet) | Maximum Flux (Btu/hr-sq.ft) |
|--------------------|--------------------------------|
| 35.9 | 3487 |
| 51.8 | 1600 |
| 90.6 | 500 |



Pool Fire Radiant Heat Contours - Overhead View

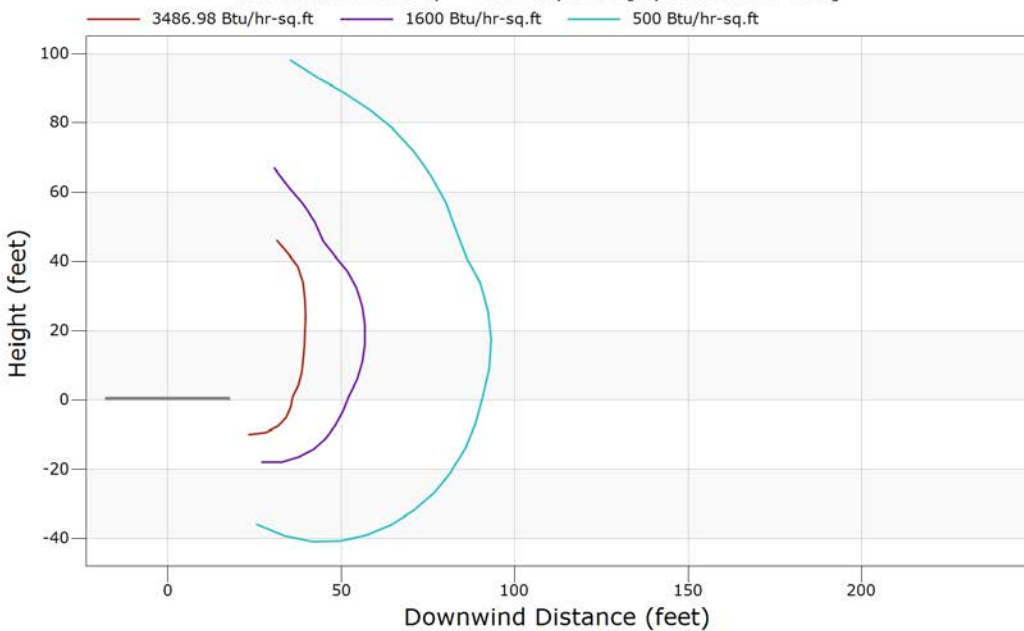
Paramount Refinery - Crude Pipeline [PipelineCrude-Pool]



Note: Results presented for 1 feet below the flame base during 3.36 mph winds.

Pool Fire Radiant Heat Contours - Side View

Paramount Refinery - Crude Pipeline [PipelineCrude-Pool]



Note: Results presented during 3.36 mph winds.



Case Inputs

Case Type : Vapor Dispersion
Case Name : PipelineGasoline-VCE
User ID :
Project Number :
Type of Units : English Units

NOTES:

MATERIAL MENU

| Materials Released | Number | Formula | Name | Fraction |
|--------------------|--------|---------|----------------------------|----------|
| Component 1 | 5 | C4H10 | n-Butane | 0.020000 |
| Component 2 | 8 | C6H14 | n-Hexane | 0.100000 |
| Component 3 | 9 | C7H16 | n-Heptane | 0.100000 |
| Component 4 | 11 | C9H20 | n-Nonane | 0.100000 |
| Component 5 | 12 | C10H22 | n-Decane | 0.030000 |
| Component 6 | 254 | C5H12 | 2,2-Dimethylpropane (Neop) | 0.200000 |
| Component 7 | 273 | C6H12 | Methylcyclopentane | 0.100000 |
| Component 8 | 281 | C7H8 | Toluene | 0.100000 |
| Component 9 | 286 | C8H10 | para-Xylene | 0.100000 |
| Component 10 | 289 | C8H18 | 3-Methylheptane | 0.150000 |

Temperature : 68.00 °F
Pressure : 500.00 psia

The material is LIQUID
The mixture is Gasoline

NOTES:

ENVIRONMENT MENU

Wind speed 3.36 mph
Wind speed measurement height 32.8 feet
Stability class <A-F> F
Relative humidity 70 %
Air temperature 68.0 °F
Spill surface temperature 68.0 °F

Substrate name Soil
Substrate thermal conductivity 1.0000 Btu/hr-ft-F
Substrate density 100 lb/cu.ft
Substrate heat Capacity 0.24 Btu/lb-F
Substrate delay time 60 sec
Surrounding terrain Long grass or crops > 15 cm (6 in)

NOTES:



RELEASE MENU

Type of release: Unregulated, Continuous release
Release duration 60 min
Normal flow rate 28.47 lb/sec
Duration of normal flow 10 min
Volume of vessel 700.00 cu.ft
Percent of vessel filled with liquid 100 %
Liquid head above release point 0 feet
Pipe inner diameter 7.98 inches
Equivalent release diameter 7.98 inches
Pipe length upstream of break 2000.0 feet
Height of release point 1.0 feet
Angle of release from horizontal 0.0 degrees

NOTES:

IMPOUNDMENT MENU

Unconfined

NOTES:

VDVE MENU

Vapor generation, dispersion and cloud explosion - Flammable calculation

Concentration endpoint 1 LFL mol%
Concentration endpoint 2 LFL mol%
Concentration endpoint 3 LFL mol%

Dispersion coefficient averaging time 1 min

Baker-Strehlow-Tang parameters

Fuel reactivity Medium
Obstacle density Low
Flame expansion 2.5-D

Overpressure values

Overpressure endpoint 1 1.00 psi
Overpressure endpoint 2 1.00 psi
Overpressure endpoint 3 1.00 psi

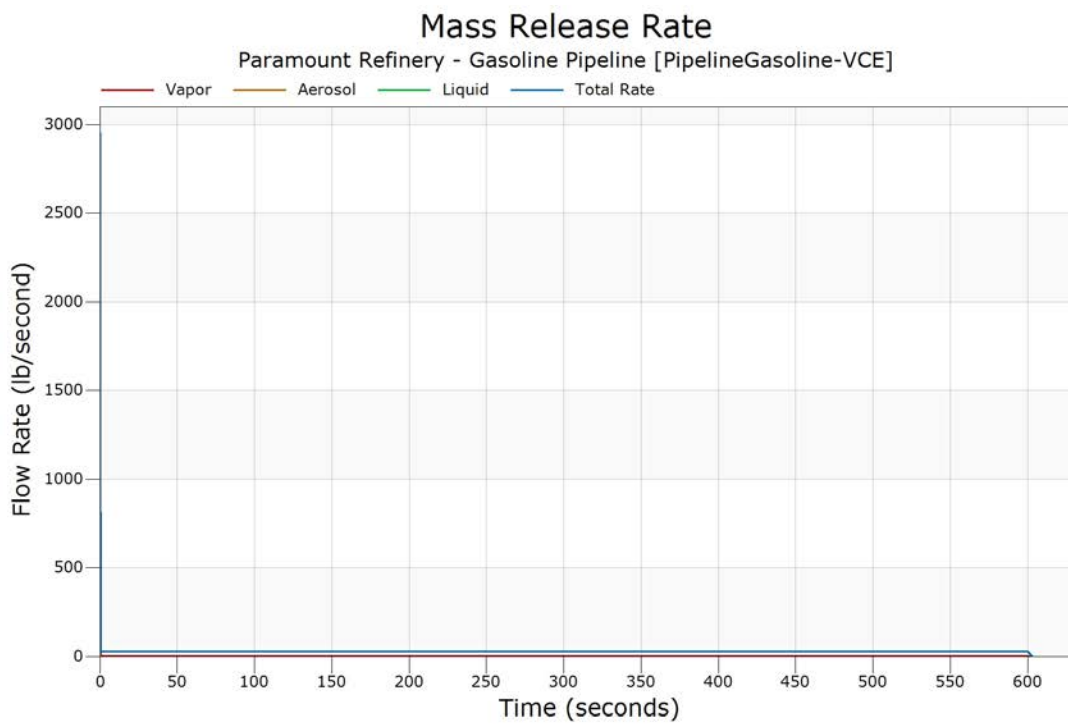
NOTES:

**Release Model**

| Time (sec) | Vapor (lb/sec) | Aerosol Rate (lb/sec) | Liquid Rate (lb/sec) | Total Rate (lb/sec) |
|---------------|-------------------|--------------------------|-------------------------|------------------------|
| 0.000000 | .2209392 | 2930.038 | 22.41748 | 2952.676 |
| 0.100000 | 20.62667 | 266.8619 | 1211.486 | 1498.975 |
| 0.300000 | 27.12138 | 1.102790 | 921.5147 | 949.7389 |
| 0.500000 | 24.41093 | .1588473E-01 | 726.3554 | 750.7823 |
| 0.700000 | 1.076870 | 0.000000 | 27.39312 | 28.46999 |
| 1.000000 | 1.076870 | 0.000000 | 27.39312 | 28.46999 |
| 3.000000 | 1.076870 | 0.000000 | 27.39312 | 28.46999 |
| 5.000000 | 1.076870 | 0.000000 | 27.39312 | 28.46999 |
| 7.000000 | 1.076870 | 0.000000 | 27.39312 | 28.46999 |
| 10.00000 | 1.076870 | 0.000000 | 27.39312 | 28.46999 |
| 20.00000 | 1.076870 | 0.000000 | 27.39312 | 28.46999 |
| 30.00000 | 1.076870 | 0.000000 | 27.39312 | 28.46999 |
| 40.00000 | 1.076870 | 0.000000 | 27.39312 | 28.46999 |
| 50.00000 | 1.076870 | 0.000000 | 27.39312 | 28.46999 |
| 60.00000 | 1.076870 | 0.000000 | 27.39312 | 28.46999 |
| 70.00000 | 1.076870 | 0.000000 | 27.39312 | 28.46999 |
| 85.00000 | 1.076870 | 0.000000 | 27.39312 | 28.46999 |
| 100.0000 | 1.076870 | 0.000000 | 27.39312 | 28.46999 |
| 200.0000 | 1.076870 | 0.000000 | 27.39312 | 28.46999 |
| 300.0000 | 1.076870 | 0.000000 | 27.39312 | 28.46999 |
| 400.0000 | 1.076870 | 0.000000 | 27.39312 | 28.46999 |
| 500.0000 | 1.076870 | 0.000000 | 27.39312 | 28.46999 |
| 600.0000 | 1.076870 | 0.000000 | 27.39312 | 28.46999 |
| 603.0000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| Totals (lb) | 659.3724 | 136.5795 | 16937.83 | 17733.78 |

Flowrate for Jet Fire [immediate ignition] = 3.547113 lb/sec.
Jet Fire [delayed ignition] = 1.076870 lb/sec.

Reason for Ending: Pressure Near Atmospheric





Release Compositions

| Component Number | Component Name, Formula |
|------------------|---|
| 5 | n-Butane, C4H10 |
| 8 | n-Hexane, C6H14 |
| 9 | n-Heptane, C7H16 |
| 11 | n-Nonane, C9H20 |
| 12 | n-Decane, C10H22 |
| 254 | 2,2-Dimethylpropane (Neopentane), C5H12 |
| 273 | Methylcyclopentane, C6H12 |
| 281 | Toluene, C7H8 |
| 286 | para-Xylene, C8H10 |
| 289 | 3-Methylheptane, C8H18 |

Composition (Mole Fraction) of Fluid Streams

| Comp. No. | Feed Stream | Momentum Jet Stream | | | Total Stream | Liquid Pool Stream |
|-----------|-------------|---------------------|------------------|----------------|--------------|--------------------|
| | | Flashed Vapor | Evaporated Vapor | Aerosol Liquid | | Liquid to Ground |
| 5 | 0.020000 | 0.000000 | 0.099735 | 0.020000 | 0.068316 | 0.018604 |
| 8 | 0.100000 | 0.000000 | 0.047277 | 0.100000 | 0.068052 | 0.100923 |
| 9 | 0.100000 | 0.000000 | 0.014656 | 0.100000 | 0.048285 | 0.101494 |
| 11 | 0.100000 | 0.000000 | 0.001485 | 0.100000 | 0.040304 | 0.101724 |
| 12 | 0.030000 | 0.000000 | 0.000148 | 0.030000 | 0.011911 | 0.030523 |
| 254 | 0.200000 | 0.000000 | 0.767681 | 0.200000 | 0.543991 | 0.190063 |
| 273 | 0.100000 | 0.000000 | 0.044799 | 0.100000 | 0.066551 | 0.100966 |
| 281 | 0.100000 | 0.000000 | 0.011274 | 0.100000 | 0.046236 | 0.101553 |
| 286 | 0.100000 | 0.000000 | 0.003259 | 0.100000 | 0.041379 | 0.101693 |
| 289 | 0.150000 | 0.000000 | 0.009687 | 0.150000 | 0.064976 | 0.152456 |
| 1.000000 | | 0.000000 | 1.000000 | 1.000000 | 1.000000 | 1.000000 |

Flammable Limits (Mole %) of Fluid Streams

| Limit | Feed Stream | Momentum Jet Stream | Liquid Pool Stream |
|-------|-------------|---------------------|--------------------|
| LFL | 1.08 | 1.24 | 1.08 |
| UFL | 6.11 | 6.91 | 6.09 |
| LBV | | 0.38 m/s | 0.39 m/s |

**Pool Spreading and Vaporization**

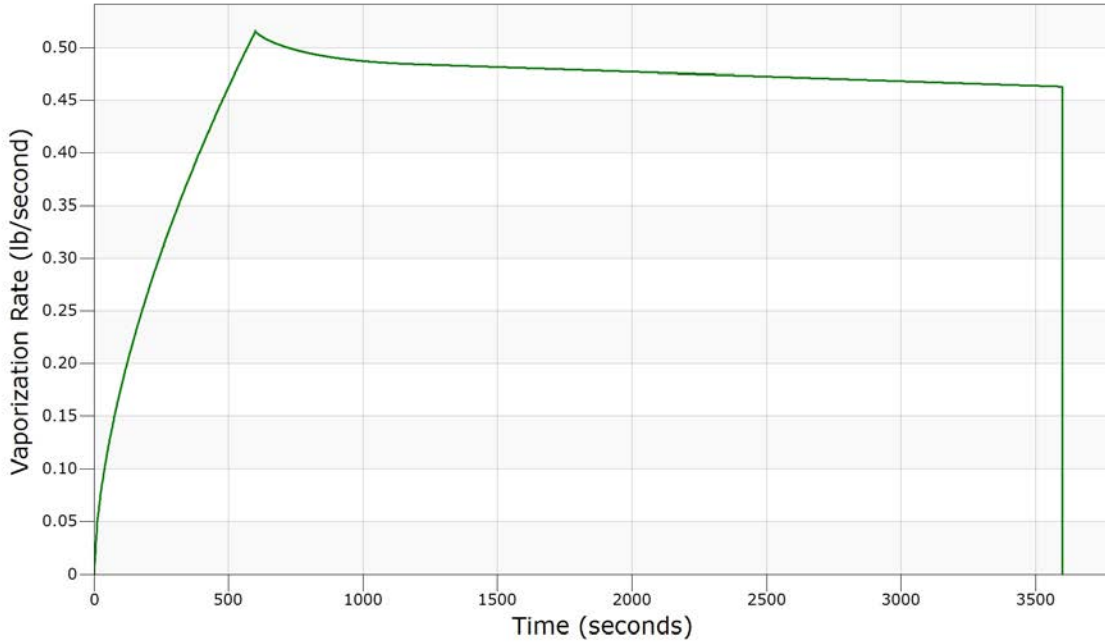
| Time (sec) | Liquid Remaining (ft3) | Pool/Dike Radius (feet) | Vapor Rate (lb/sec) |
|---------------|------------------------------|-------------------------------|------------------------|
| 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| 40.0000 | 24.5893 | 7.19816 | 0.102420 |
| 80.0000 | 49.1156 | 9.06496 | 0.155014 |
| 120.000 | 73.6028 | 10.3727 | 0.197547 |
| 160.000 | 98.0512 | 11.4124 | 0.234616 |
| 200.000 | 122.471 | 12.2897 | 0.268060 |
| 240.000 | 146.860 | 13.0561 | 0.298903 |
| 280.000 | 171.223 | 13.7411 | 0.327717 |
| 320.000 | 195.559 | 14.3629 | 0.354878 |
| 360.000 | 219.873 | 14.9344 | 0.380694 |
| 400.000 | 244.162 | 15.4649 | 0.405364 |
| 440.000 | 268.430 | 15.9606 | 0.429064 |
| 480.000 | 292.681 | 16.4268 | 0.451881 |
| 520.000 | 316.907 | 16.8678 | 0.473928 |
| 560.000 | 341.115 | 17.2864 | 0.495313 |
| 600.000 | 365.295 | 17.6854 | 0.516058 |
| 640.000 | 364.836 | 17.6782 | 0.508650 |
| 680.000 | 364.377 | 17.6706 | 0.503999 |
| 720.000 | 363.953 | 17.6634 | 0.500383 |
| 760.000 | 363.494 | 17.6562 | 0.497451 |
| 800.000 | 363.035 | 17.6489 | 0.495026 |
| 840.000 | 362.611 | 17.6417 | 0.492976 |
| 880.000 | 362.152 | 17.6345 | 0.491234 |
| 1130.00 | 359.397 | 17.5899 | 0.485083 |
| 1380.00 | 356.678 | 17.5456 | 0.482746 |
| 1630.00 | 353.994 | 17.5010 | 0.480564 |
| 1880.00 | 351.289 | 17.4564 | 0.478359 |
| 2130.00 | 348.605 | 17.4121 | 0.476176 |
| 2380.00 | 345.932 | 17.3675 | 0.473994 |
| 2630.00 | 343.273 | 17.3228 | 0.471789 |
| 2880.00 | 340.628 | 17.2782 | 0.469607 |
| 3130.00 | 337.993 | 17.2336 | 0.467446 |
| 3380.00 | 335.369 | 17.1890 | 0.465264 |
| 3600.00 | 333.074 | 17.1496 | 0.463346 |

Ending Message: Normal Ending



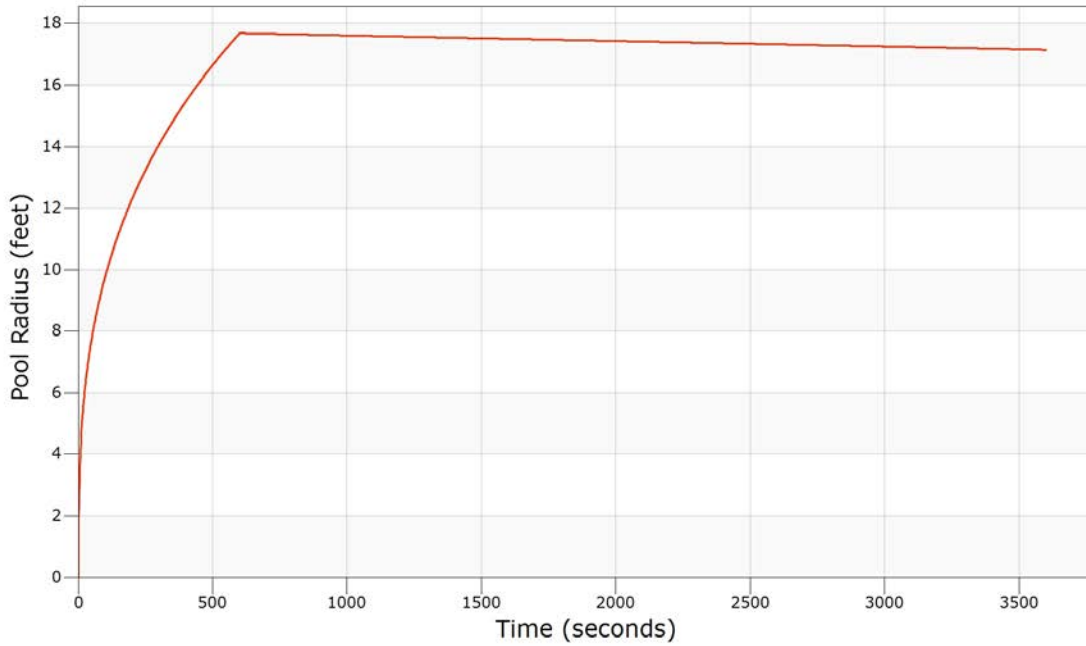
Pool Vaporization Rate

Paramount Refinery - Gasoline Pipeline [PipelineGasoline-VCE]



Pool Radius

Paramount Refinery - Gasoline Pipeline [PipelineGasoline-VCE]





Momentum Jet Dispersion

concentration limits

Endpoint 1 (highest) = 0.012410 mole fraction
Endpoint 2 (middle) = 0.012410 mole fraction
Endpoint 3 (lowest) = 0.012410 mole fraction

| downwind distance (ft) | centerline conc. (mole frac.) | ground conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) | centerline height (ft) |
|------------------------------|-------------------------------------|---------------------------------|--------------------------------|--------------------------------|--------------------------------|------------------------------|
| 0 | 1.000000 | 0.000000 | 2.3 | 2.3 | 2.3 | 1.0 |
| 5 | 0.941935 | 0.941935 | 10.5 | 10.5 | 10.5 | 0.0 |
| 10 | 0.834356 | 0.834356 | 18.0 | 18.0 | 18.0 | 0.0 |
| 15 | 0.777216 | 0.777216 | 25.6 | 25.6 | 25.6 | 0.0 |
| 20 | 0.675640 | 0.675640 | 32.2 | 32.2 | 32.2 | 0.0 |
| 25 | 0.560205 | 0.560205 | 38.1 | 38.1 | 38.1 | 0.0 |
| 30 | 0.456950 | 0.456950 | 42.7 | 42.7 | 42.7 | 0.0 |
| 35 | 0.384645 | 0.384645 | 47.3 | 47.3 | 47.3 | 0.0 |
| 40 | 0.321396 | 0.321396 | 50.4 | 50.4 | 50.4 | 0.0 |
| 45 | 0.272031 | 0.272031 | 53.1 | 53.1 | 53.1 | 0.0 |
| 50 | 0.234334 | 0.234334 | 55.9 | 55.9 | 55.9 | 0.0 |
| 55 | 0.204754 | 0.204754 | 58.6 | 58.6 | 58.6 | 0.0 |
| 60 | 0.177945 | 0.177945 | 60.5 | 60.5 | 60.5 | 0.0 |
| 65 | 0.154787 | 0.154787 | 61.9 | 61.9 | 61.9 | 0.0 |
| 70 | 0.136043 | 0.136043 | 63.4 | 63.4 | 63.4 | 0.0 |
| 75 | 0.120638 | 0.120638 | 64.8 | 64.8 | 64.8 | 0.0 |
| 80 | 0.106805 | 0.106805 | 65.7 | 65.7 | 65.7 | 0.0 |
| 85 | 0.094313 | 0.094313 | 66.2 | 66.2 | 66.2 | 0.0 |
| 90 | 0.083876 | 0.083876 | 66.6 | 66.6 | 66.6 | 0.0 |
| 95 | 0.075069 | 0.075069 | 67.0 | 67.0 | 67.0 | 0.0 |
| 100 | 0.067074 | 0.067074 | 67.0 | 67.0 | 67.0 | 0.0 |
| 105 | 0.060045 | 0.060045 | 66.8 | 66.8 | 66.8 | 0.0 |
| 110 | 0.054030 | 0.054030 | 66.6 | 66.6 | 66.6 | 0.0 |
| 115 | 0.048837 | 0.048837 | 66.0 | 66.0 | 66.0 | 0.0 |
| 120 | 0.044329 | 0.044329 | 65.3 | 65.3 | 65.3 | 0.0 |
| 125 | 0.040296 | 0.040296 | 64.5 | 64.5 | 64.5 | 0.0 |
| 130 | 0.036762 | 0.036762 | 63.6 | 63.6 | 63.6 | 0.0 |
| 135 | 0.033655 | 0.033655 | 62.3 | 62.3 | 62.3 | 0.0 |
| 140 | 0.030909 | 0.030909 | 61.0 | 61.0 | 61.0 | 0.0 |
| 145 | 0.028462 | 0.028462 | 59.6 | 59.6 | 59.6 | 0.0 |
| 150 | 0.026267 | 0.026267 | 57.9 | 57.9 | 57.9 | 0.0 |
| 155 | 0.024304 | 0.024304 | 56.2 | 56.2 | 56.2 | 0.0 |
| 160 | 0.022561 | 0.022561 | 54.2 | 54.2 | 54.2 | 0.0 |
| 165 | 0.020965 | 0.020965 | 52.0 | 52.0 | 52.0 | 0.0 |
| 170 | 0.019454 | 0.019454 | 49.2 | 49.2 | 49.2 | 0.0 |



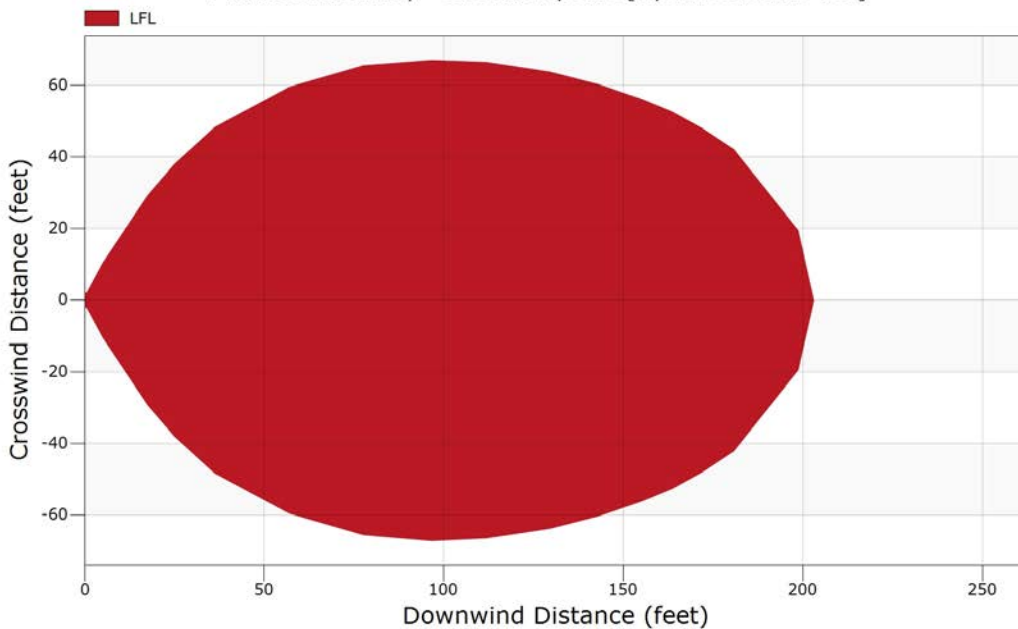
| downwind distance (ft) | centerline conc. (mole frac.) | ground conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) | centerline height (ft) |
|------------------------|-------------------------------|---------------------------|--------------------------|--------------------------|--------------------------|------------------------|
| 175 | 0.018099 | 0.018099 | 46.1 | 46.1 | 46.1 | 0.0 |
| 180 | 0.016878 | 0.016878 | 42.7 | 42.7 | 42.7 | 0.0 |
| 185 | 0.015745 | 0.015745 | 36.9 | 36.9 | 36.9 | 0.0 |
| 190 | 0.014711 | 0.014711 | 30.7 | 30.7 | 30.7 | 0.0 |
| 195 | 0.013769 | 0.013769 | 24.4 | 24.4 | 24.4 | 0.0 |
| 200 | 0.012912 | 0.012912 | 14.4 | 14.4 | 14.4 | 0.0 |
| 205 | 0.012139 | 0.012139 | 0.0 | 0.0 | 0.0 | 0.0 |

The momentum jet model coupled to the heavy gas model at 0.47 ft in 0 sec.

| Endpoint (mole frac., mixture) | Downwind Distance (feet) | Approximate Time (seconds) |
|--------------------------------|--------------------------|----------------------------|
| 1 0.012410 (LFL) | 203.2 | 60 |
| 2 0.012410 (LFL) | 203.2 | 60 |
| 3 0.012410 (LFL) | 203.2 | 60 |

Momentum Jet Contours - Overhead View

Paramount Refinery - Gasoline Pipeline [PipelineGasoline-VCE]

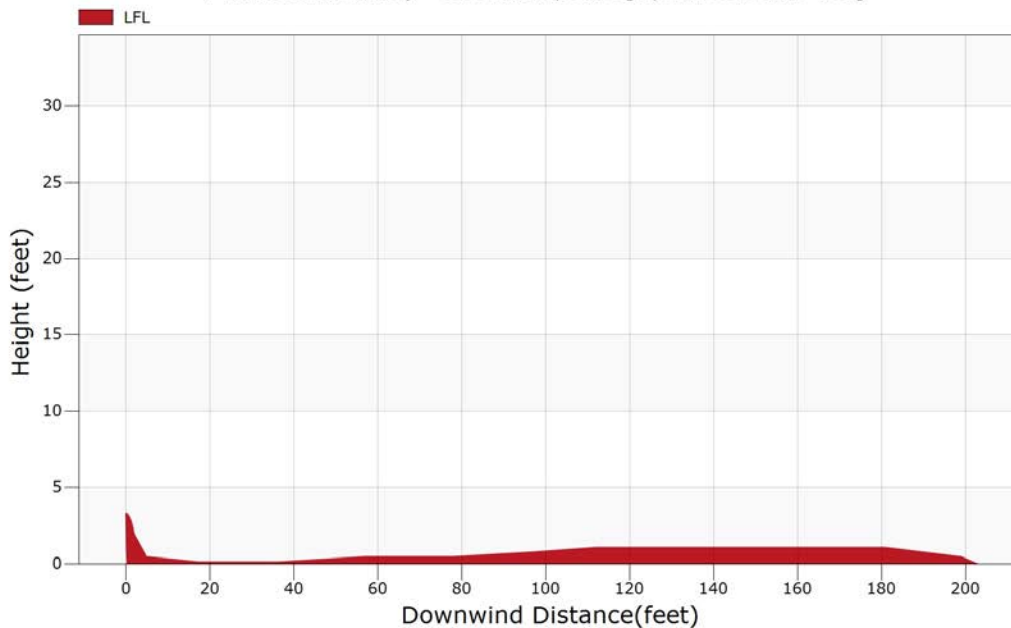


Note: Release during 3.36 mph winds and F stability.



Momentum Jet Contours - Side View

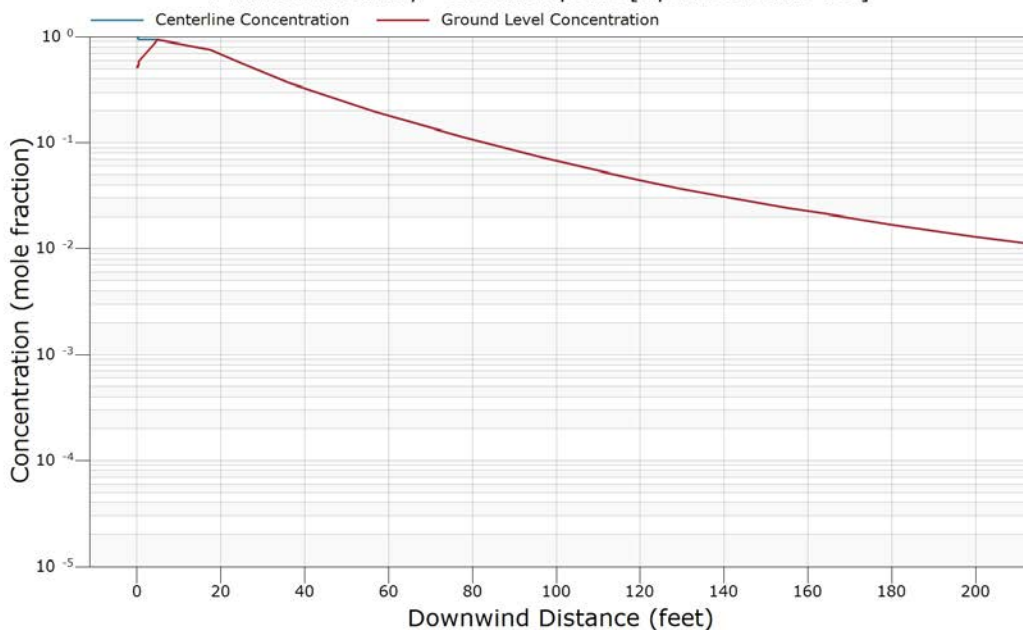
Paramount Refinery - Gasoline Pipeline [PipelineGasoline-VCE]



Note: Release during 3.36 mph winds and F stability.

Momentum Jet Concentration

Paramount Refinery - Gasoline Pipeline [PipelineGasoline-VCE]



Note: Release during 3.36 mph winds and F stability.



Heavier-than-Air Dispersion

concentration limits

Endpoint 1 (highest) = 0.010804 mole fraction
Endpoint 2 (middle) = 0.010804 mole fraction
Endpoint 3 (lowest) = 0.010804 mole fraction

| downwind distance (ft) | centerline conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) |
|------------------------------|-------------------------------------|--------------------------------|--------------------------------|--------------------------------|
| 1.00 | 0.013914 | 7.40 | 7.40 | 7.40 |
| 2.00 | 0.015013 | 11.20 | 11.20 | 11.20 |
| 3.00 | 0.016964 | 11.51 | 11.51 | 11.51 |
| 4.00 | 0.017181 | 11.83 | 11.83 | 11.83 |
| 5.00 | 0.017351 | 12.14 | 12.14 | 12.14 |
| 6.00 | 0.017744 | 12.46 | 12.46 | 12.46 |
| 7.00 | 0.018218 | 14.08 | 14.08 | 14.08 |
| 8.00 | 0.018497 | 14.75 | 14.75 | 14.75 |
| 9.00 | 0.018618 | 14.75 | 14.75 | 14.75 |
| 10.00 | 0.018727 | 14.76 | 14.76 | 14.76 |
| 11.00 | 0.018827 | 14.76 | 14.76 | 14.76 |
| 12.00 | 0.018900 | 14.77 | 14.77 | 14.77 |
| 13.00 | 0.018901 | 14.77 | 14.77 | 14.77 |
| 14.00 | 0.018903 | 14.78 | 14.78 | 14.78 |
| 15.00 | 0.018904 | 14.78 | 14.78 | 14.78 |
| 16.00 | 0.018958 | 15.14 | 15.14 | 15.14 |
| 17.00 | 0.018985 | 15.47 | 15.47 | 15.47 |
| 18.00 | 0.018679 | 15.36 | 15.36 | 15.36 |
| 19.00 | 0.018395 | 15.24 | 15.24 | 15.24 |
| 20.00 | 0.018128 | 15.13 | 15.13 | 15.13 |
| 21.00 | 0.017879 | 15.01 | 15.01 | 15.01 |
| 22.00 | 0.017644 | 14.89 | 14.89 | 14.89 |
| 23.00 | 0.017423 | 14.78 | 14.78 | 14.78 |
| 24.00 | 0.017213 | 14.66 | 14.66 | 14.66 |
| 25.00 | 0.017015 | 14.55 | 14.55 | 14.55 |
| 26.00 | 0.016826 | 14.43 | 14.43 | 14.43 |
| 27.00 | 0.016647 | 14.32 | 14.32 | 14.32 |
| 28.00 | 0.016475 | 14.20 | 14.20 | 14.20 |
| 29.00 | 0.016312 | 14.08 | 14.08 | 14.08 |
| 30.00 | 0.016156 | 13.97 | 13.97 | 13.97 |
| 31.00 | 0.015887 | 13.59 | 13.59 | 13.59 |
| 32.00 | 0.015561 | 13.04 | 13.04 | 13.04 |
| 33.00 | 0.015251 | 12.50 | 12.50 | 12.50 |
| 34.00 | 0.014956 | 11.95 | 11.95 | 11.95 |
| 35.00 | 0.014675 | 11.41 | 11.41 | 11.41 |



CANARY by Quest Output Report

Report Date: 11 June 2021

Case Title: Paramount Refinery - Gasoline Pipeline

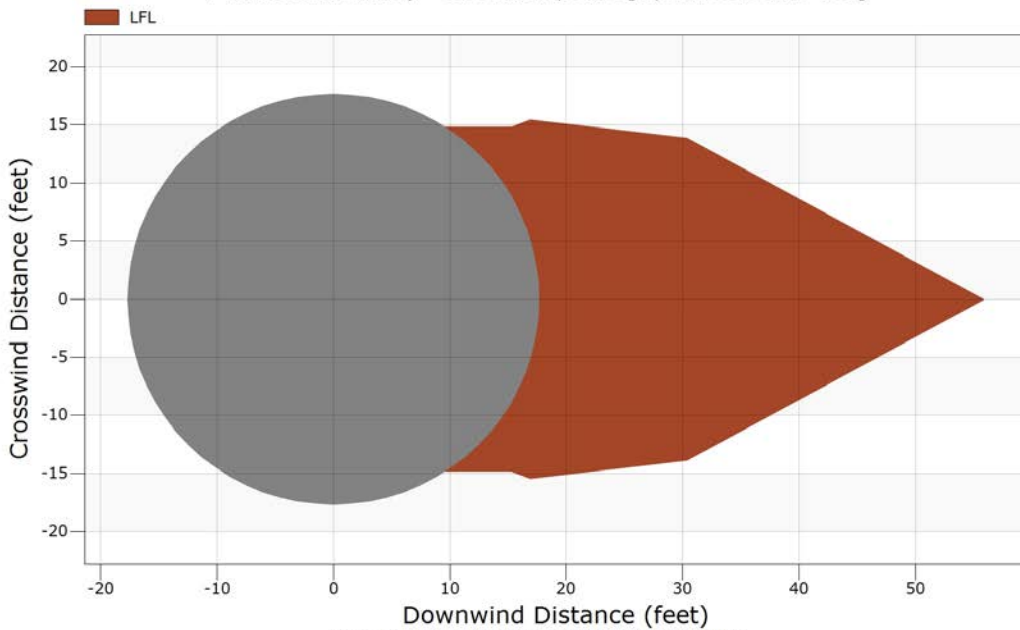
| downwind distance (ft) | centerline conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) |
|---------------------------|----------------------------------|--------------------------------|--------------------------------|--------------------------------|
| 36.00 | 0.014407 | 10.86 | 10.86 | 10.86 |
| 37.00 | 0.014152 | 10.31 | 10.31 | 10.31 |
| 38.00 | 0.013907 | 9.77 | 9.77 | 9.77 |
| 39.00 | 0.013673 | 9.22 | 9.22 | 9.22 |
| 40.00 | 0.013448 | 8.68 | 8.68 | 8.68 |
| 41.00 | 0.013233 | 8.13 | 8.13 | 8.13 |
| 42.00 | 0.013026 | 7.59 | 7.59 | 7.59 |
| 43.00 | 0.012827 | 7.04 | 7.04 | 7.04 |
| 44.00 | 0.012636 | 6.50 | 6.50 | 6.50 |
| 45.00 | 0.012452 | 5.95 | 5.95 | 5.95 |
| 46.00 | 0.012274 | 5.41 | 5.41 | 5.41 |
| 47.00 | 0.012103 | 4.86 | 4.86 | 4.86 |
| 48.00 | 0.011937 | 4.31 | 4.31 | 4.31 |
| 49.00 | 0.011777 | 3.77 | 3.77 | 3.77 |
| 50.00 | 0.011623 | 3.22 | 3.22 | 3.22 |
| 51.00 | 0.011473 | 2.68 | 2.68 | 2.68 |
| 52.00 | 0.011328 | 2.13 | 2.13 | 2.13 |
| 53.00 | 0.011188 | 1.59 | 1.59 | 1.59 |
| 54.00 | 0.011052 | 1.04 | 1.04 | 1.04 |
| 55.00 | 0.010921 | 0.50 | 0.50 | 0.50 |

| Endpoint (mole frac., mixture) | Downwind Distance (feet) | Approximate Time (seconds) |
|-----------------------------------|-----------------------------|-------------------------------|
| 1 0.010804 (LFL) | 55.9 | 17 |
| 2 0.010804 (LFL) | 55.9 | 17 |
| 3 0.010804 (LFL) | 55.9 | 17 |



Heavier-than-Air Contours - Overhead View

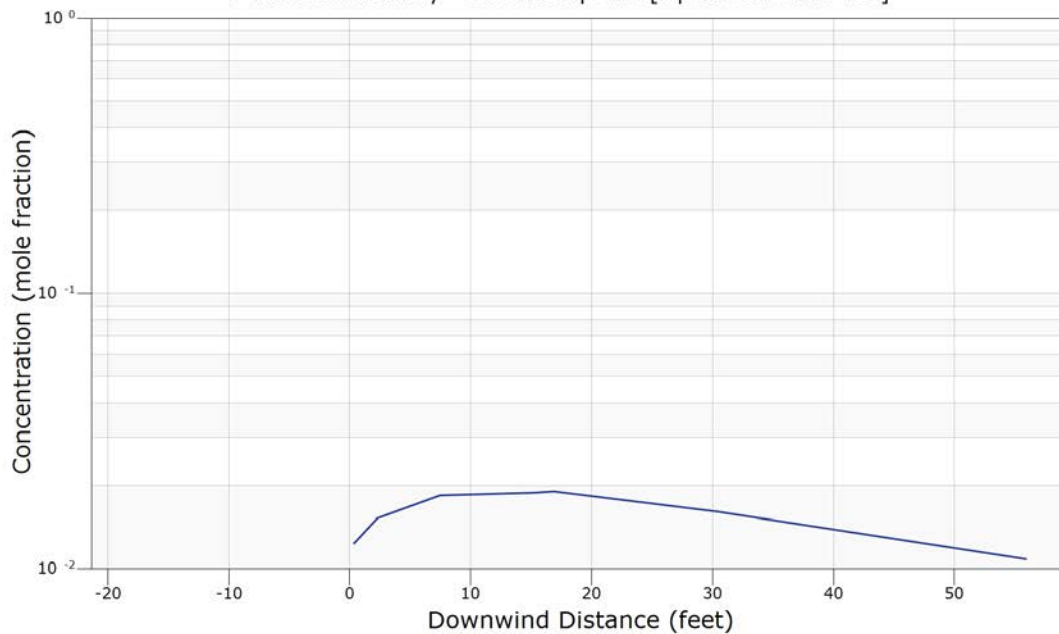
Paramount Refinery - Gasoline Pipeline [PipelineGasoline-VCE]



Note: Release during 3.36 mph winds and F stability.

Heavier-than-Air Centerline Concentration

Paramount Refinery - Gasoline Pipeline [PipelineGasoline-VCE]



Note: Release during 3.36 mph winds and F stability.



Momentum Jet Explosion

Fuel Reactivity: Medium

Obstacle Density: Low

Flame Expansion: 2.5-D

Flame Speed: 0.29

Mass of released material involved in explosion: 144.941 lbs.

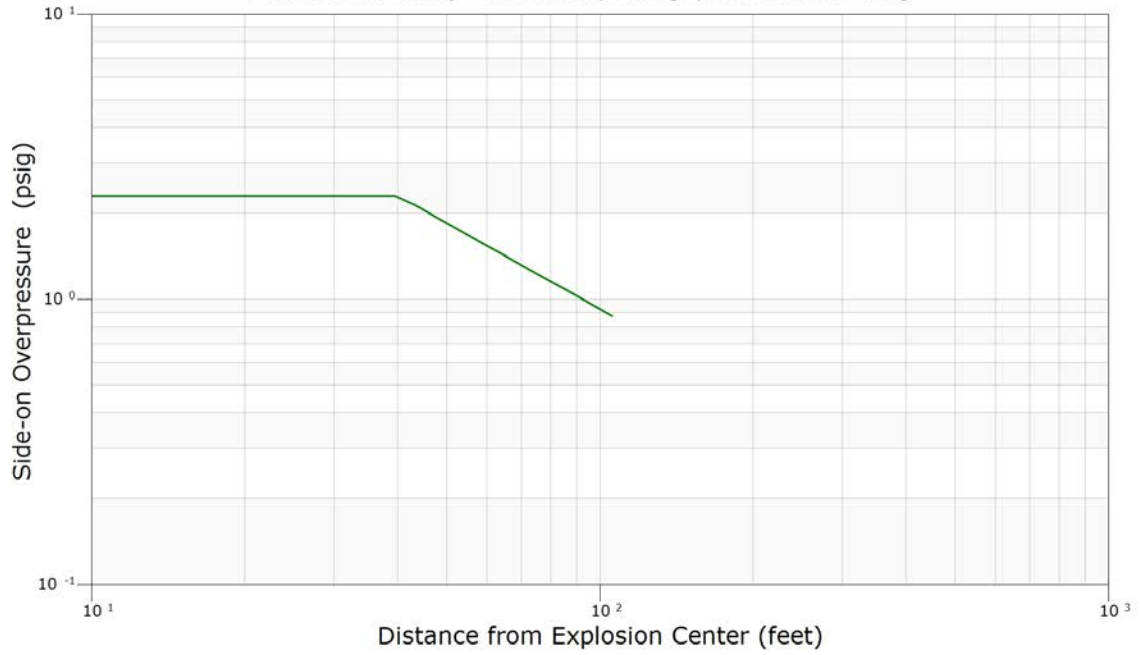
| Distance from Center of Flammable Cloud (feet) | Overpressure (psi gauge) | Impulse (psi-s) |
|--|-----------------------------|--------------------|
| 0.0 | 2.30 | 0.1732 |
| 10.0 | 2.30 | 0.1732 |
| 11.0 | 2.30 | 0.1732 |
| 12.2 | 2.30 | 0.1732 |
| 13.4 | 2.30 | 0.1732 |
| 14.8 | 2.30 | 0.1732 |
| 16.3 | 2.30 | 0.1732 |
| 18.0 | 2.30 | 0.1611 |
| 19.9 | 2.30 | 0.1463 |
| 21.9 | 2.30 | 0.1329 |
| 24.2 | 2.30 | 0.1207 |
| 26.7 | 2.30 | 0.1097 |
| 29.4 | 2.30 | 0.0996 |
| 32.5 | 2.30 | 0.0905 |
| 35.8 | 2.30 | 0.0822 |
| 39.5 | 2.30 | 0.0746 |
| 43.6 | 2.12 | 0.0678 |
| 48.1 | 1.92 | 0.0616 |
| 53.1 | 1.74 | 0.0559 |
| 58.5 | 1.58 | 0.0508 |
| 64.6 | 1.43 | 0.0462 |
| 71.2 | 1.30 | 0.0419 |
| 78.6 | 1.18 | 0.0381 |
| 86.7 | 1.07 | 0.0346 |
| 105.5 | 0.88 | 0.0285 |

The downwind distance to 1.00 psi is 93.1 feet
The downwind distance to 1.00 psi is 93.1 feet
The downwind distance to 1.00 psi is 93.1 feet



Momentum Jet Explosion Overpressure - Baker-Strehlow-Tang

Paramount Refinery - Gasoline Pipeline [PipelineGasoline-VCE]





Heavier-than-Air Explosion

Fuel Reactivity: Medium
Flame Expansion: 2.5-D

Obstacle Density: Low
Flame Speed: 0.29

Mass of released material involved in explosion: 8.26001 lbs.

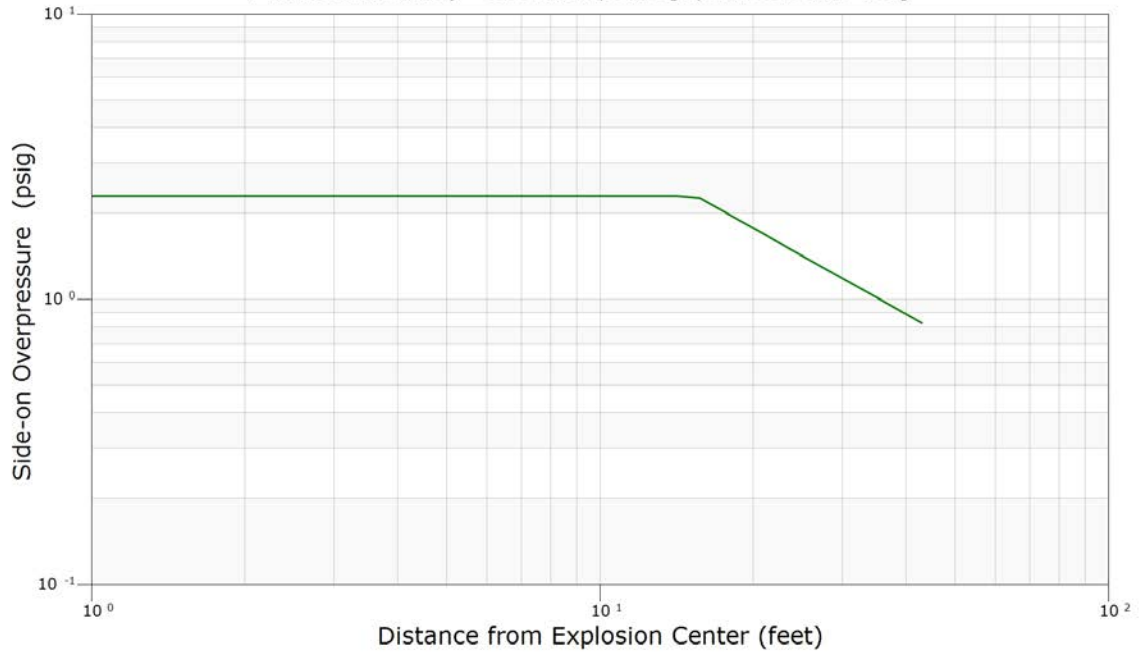
| Distance from Center of Flammable Cloud (feet) | Overpressure (psi gauge) | Impulse (psi-s) |
|--|-----------------------------|--------------------|
| 0.0 | 2.30 | 0.0667 |
| 3.9 | 2.30 | 0.0667 |
| 4.3 | 2.30 | 0.0667 |
| 4.7 | 2.30 | 0.0667 |
| 5.2 | 2.30 | 0.0667 |
| 5.8 | 2.30 | 0.0667 |
| 6.4 | 2.30 | 0.0667 |
| 7.0 | 2.30 | 0.0612 |
| 7.8 | 2.30 | 0.0554 |
| 8.6 | 2.30 | 0.0502 |
| 9.5 | 2.30 | 0.0455 |
| 10.5 | 2.30 | 0.0413 |
| 11.6 | 2.30 | 0.0374 |
| 12.9 | 2.30 | 0.0339 |
| 14.2 | 2.30 | 0.0307 |
| 15.7 | 2.26 | 0.0278 |
| 17.4 | 2.04 | 0.0252 |
| 19.2 | 1.85 | 0.0229 |
| 21.2 | 1.67 | 0.0207 |
| 23.5 | 1.51 | 0.0188 |
| 26.0 | 1.37 | 0.0170 |
| 28.7 | 1.24 | 0.0154 |
| 31.7 | 1.12 | 0.0140 |
| 35.1 | 1.01 | 0.0127 |
| 42.9 | 0.83 | 0.0104 |

The downwind distance to 1.00 psi is 35.6 feet
The downwind distance to 1.00 psi is 35.6 feet
The downwind distance to 1.00 psi is 35.6 feet



Heavier-than-Air Explosion Overpressure - Baker-Strehlow-Tang

Paramount Refinery - Gasoline Pipeline [PipelineGasoline-VCE]





Case Inputs

Case Type : Fire Radiation
Case Name : PipelineGasoline-Pool
User ID :
Project Number :
Type of Units : English Units

NOTES:

MATERIAL MENU

| Materials Released | Number | Formula | Name | Fraction |
|--------------------|--------|---------|----------------------------|----------|
| Component 1 | 5 | C4H10 | n-Butane | 0.020000 |
| Component 2 | 8 | C6H14 | n-Hexane | 0.100000 |
| Component 3 | 9 | C7H16 | n-Heptane | 0.100000 |
| Component 4 | 11 | C9H20 | n-Nonane | 0.100000 |
| Component 5 | 12 | C10H22 | n-Decane | 0.030000 |
| Component 6 | 254 | C5H12 | 2,2-Dimethylpropane (Neop) | 0.200000 |
| Component 7 | 273 | C6H12 | Methylcyclopentane | 0.100000 |
| Component 8 | 281 | C7H8 | Toluene | 0.100000 |
| Component 9 | 286 | C8H10 | para-Xylene | 0.100000 |
| Component 10 | 289 | C8H18 | 3-Methylheptane | 0.150000 |

Temperature : 68.00 °F
Pressure : 14.70 psia
The material is LIQUID
The mixture is Gasoline

NOTES:

ENVIRONMENT MENU

Wind speed : 3.36 mph
Relative humidity : 70 %
Air temperature : 68.0 °F

NOTES:

FIRE TYPE MENU

Fire radiation division: Circular pool fires
Vertical and horizontal isopleths
Spill surface: land
Elevation of flame base (from grade) : 1.0 feet
Elevation of target (from grade) : 0.0 feet
Diameter of pool : 36.0 feet

Fire radiation flux values

Radiation endpoint 1 : 3487 Btu/hr-sq.ft
Radiation endpoint 2 : 1600 Btu/hr-sq.ft
Radiation endpoint 3 : 500 Btu/hr-sq.ft

NOTES:



Pool Fire Radiation

Length of Flame : 68.8 feet
 Flame Tilt from Vertical : 14.3 degrees
 Target Elevation : 0.0 feet
 Pool Elevation : 1.0 feet
 Wind Speed : 3.4 mph
 Substrate : Land

| Downwind Distance from Center of Pool (feet) | Flux to Vertical Target (Btu/hr-sq.ft) | Flux to Horizontal Target (Btu/hr-sq.ft) | Maximum Flux (Btu/hr-sq.ft) |
|--|--|--|-----------------------------------|
| 19.8 | 9103 | 34455 | 35637 |
| 21.5 | 11647 | 39878 | 39878 |
| 23.3 | 17259 | 21178 | 27750 |
| 25.2 | 14856 | 17056 | 23796 |
| 27.4 | 14171 | 13362 | 19867 |
| 29.7 | 12705 | 10449 | 16610 |
| 32.2 | 11104 | 8168 | 13858 |
| 34.9 | 9561 | 6442 | 11566 |
| 37.9 | 8173 | 5157 | 9685 |
| 41.0 | 6984 | 4201 | 8163 |
| 44.5 | 5990 | 3475 | 6932 |
| 48.3 | 5158 | 2903 | 5923 |
| 52.3 | 4460 | 2438 | 5086 |
| 56.8 | 3873 | 2053 | 4385 |
| 61.5 | 3368 | 1723 | 3785 |
| 66.7 | 2934 | 1440 | 3269 |
| 72.4 | 2552 | 1195 | 2819 |
| 78.5 | 2216 | 983 | 2424 |
| 85.1 | 1919 | 801 | 2080 |
| 92.3 | 1656 | 647 | 1778 |
| 100.1 | 1422 | 517 | 1514 |
| 108.5 | 1217 | 410 | 1285 |
| 117.7 | 1037 | 323 | 1087 |
| 127.6 | 881 | 252 | 916 |
| 138.4 | 745 | 196 | 770 |
| 150.0 | 628 | 151 | 646 |
| 162.7 | 529 | 117 | 542 |
| 176.4 | 444 | 90 | 453 |
| 191.3 | 373 | 69 | 379 |
| 207.5 | 312 | 53 | 317 |

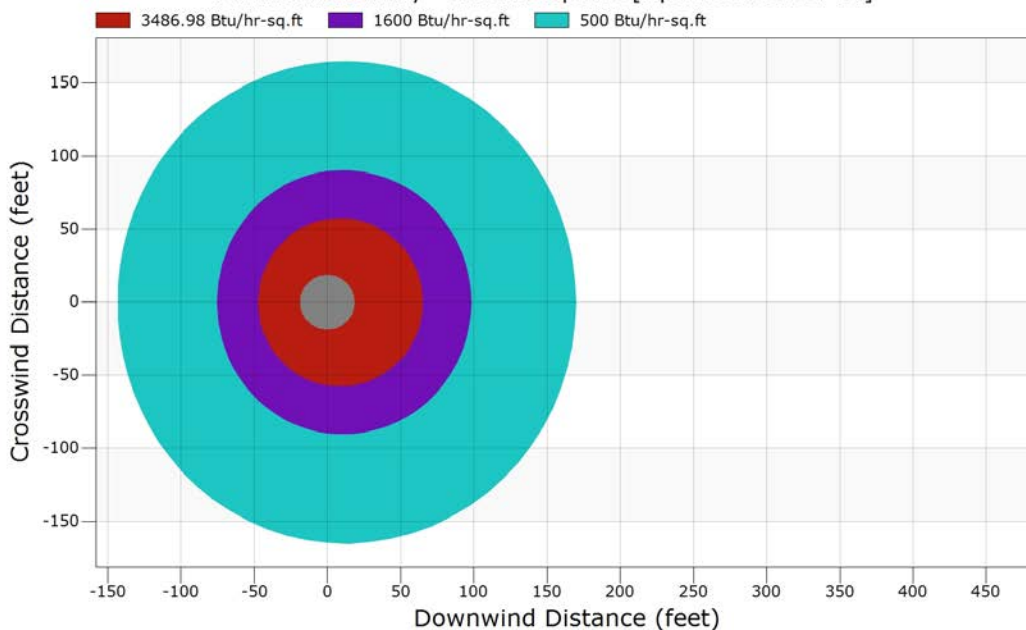
Downwind Distances to Endpoints:

| Distance (feet) | Maximum Flux (Btu/hr-sq.ft) |
|--------------------|--------------------------------|
| 64.5 | 3487 |
| 97.5 | 1600 |
| 169.2 | 500 |



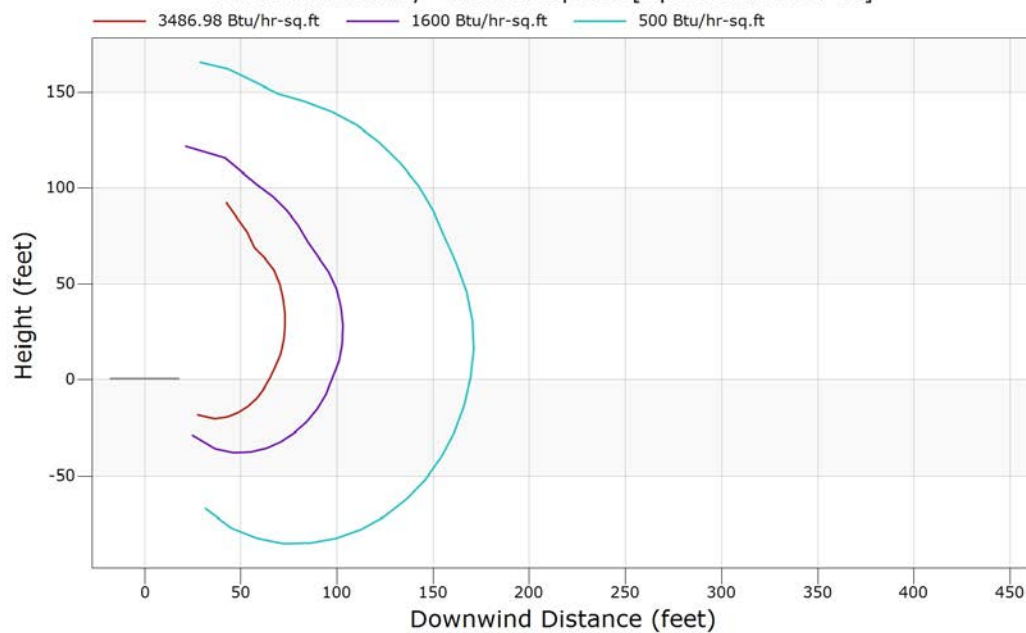
Pool Fire Radiant Heat Contours - Overhead View

Paramount Refinery - Gasoline Pipeline [PipelineGasoline-Pool]



Pool Fire Radiant Heat Contours - Side View

Paramount Refinery - Gasoline Pipeline [PipelineGasoline-Pool]





Case Inputs

Case Type : Vapor Dispersion
Case Name : PipelineJet-VCE
User ID :
Project Number :
Type of Units : English Units

NOTES:

MATERIAL MENU

| Materials Released | Number | Formula | Name | Fraction |
|--------------------|--------|---------|-------------|----------|
| Component 1 | 9 | C7H16 | n-Heptane | 0.040000 |
| Component 2 | 10 | C8H18 | n-Octane | 0.080000 |
| Component 3 | 11 | C9H20 | n-Nonane | 0.120000 |
| Component 4 | 12 | C10H22 | n-Decane | 0.170000 |
| Component 5 | 13 | C11H24 | n-Undecane | 0.170000 |
| Component 6 | 31 | C12H26 | Dodecane | 0.170000 |
| Component 7 | 32 | C13H28 | Tridecane | 0.130000 |
| Component 8 | 33 | C14H30 | Tetradecane | 0.080000 |
| Component 9 | 34 | C15H32 | Pentadecane | 0.040000 |
| Component 10 | | | | |

Temperature : 68.00 °F
Pressure : 500.00 psia
The material is LIQUID
The mixture is Jet A1

NOTES:

ENVIRONMENT MENU

Wind speed 3.36 mph
Wind speed measurement height 32.8 feet
Stability class <A-F> F
Relative humidity 70 %
Air temperature 68.0 °F
Spill surface temperature 68.0 °F

Substrate name Soil
Substrate thermal conductivity 1.0000 Btu/hr-ft-F
Substrate density 100 lb/cu.ft
Substrate heat Capacity 0.24 Btu/lb-F
Substrate delay time 60 sec
Surrounding terrain Long grass or crops > 15 cm (6 in)

NOTES:



RELEASE MENU

Type of release: Unregulated, Continuous release
Release duration 60 min
Normal flow rate 28.47 lb/sec
Duration of normal flow 10 min
Volume of vessel 700.00 cu.ft
Percent of vessel filled with liquid 100 %
Liquid head above release point 0 feet
Pipe inner diameter 7.98 inches
Equivalent release diameter 7.98 inches
Pipe length upstream of break 2000.0 feet
Height of release point 1.0 feet
Angle of release from horizontal 0.0 degrees

NOTES:

IMPOUNDMENT MENU

Unconfined

NOTES:

VDVE MENU

Vapor generation, dispersion and cloud explosion - Flammable calculation

Concentration endpoint 1 LFL mol%
Concentration endpoint 2 LFL mol%
Concentration endpoint 3 LFL mol%

Dispersion coefficient averaging time 1 min

Baker-Strehlow-Tang parameters

Fuel reactivity Medium
Obstacle density Low
Flame expansion 2.5-D

Overpressure values

Overpressure endpoint 1 1.00 psi
Overpressure endpoint 2 1.00 psi
Overpressure endpoint 3 1.00 psi

NOTES:



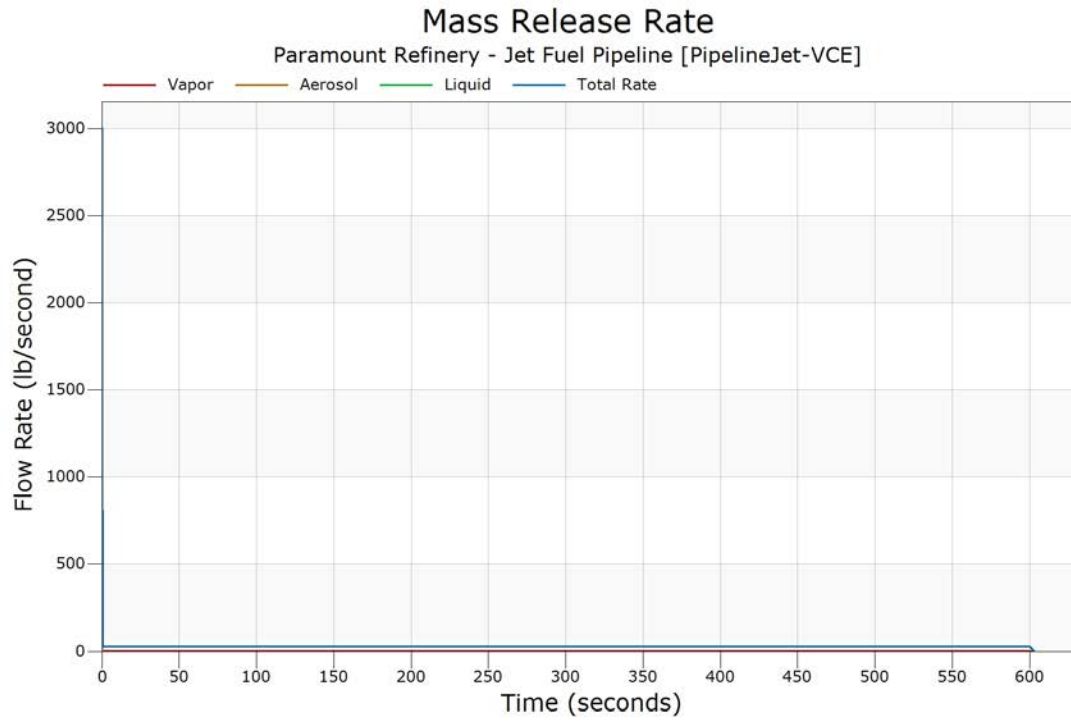
Release Model

| Time (sec) | Vapor (lb/sec) | Aerosol Rate (lb/sec) | Liquid Rate (lb/sec) | Total Rate (lb/sec) |
|---------------|-------------------|--------------------------|-------------------------|------------------------|
| 0.000000 | .3107378E-02 | 2974.689 | 29.36477 | 3004.057 |
| 0.100000 | .2843988 | 169.1312 | 1327.940 | 1497.356 |
| 0.300000 | .3111724 | .2670543 | 944.3386 | 944.9168 |
| 0.500000 | .2691624 | .1984158E-02 | 745.9329 | 746.2041 |
| 0.700000 | .1141197E-01 | 0.000000 | 28.45858 | 28.46999 |
| 1.000000 | .1141197E-01 | 0.000000 | 28.45858 | 28.46999 |
| 3.000000 | .1141197E-01 | 0.000000 | 28.45858 | 28.46999 |
| 5.000000 | .1141197E-01 | 0.000000 | 28.45858 | 28.46999 |
| 7.000000 | .1141197E-01 | 0.000000 | 28.45858 | 28.46999 |
| 10.00000 | .1141197E-01 | 0.000000 | 28.45858 | 28.46999 |
| 20.00000 | .1141197E-01 | 0.000000 | 28.45858 | 28.46999 |
| 30.00000 | .1141197E-01 | 0.000000 | 28.45858 | 28.46999 |
| 40.00000 | .1141197E-01 | 0.000000 | 28.45858 | 28.46999 |
| 50.00000 | .1141197E-01 | 0.000000 | 28.45858 | 28.46999 |
| 60.00000 | .1141197E-01 | 0.000000 | 28.45858 | 28.46999 |
| 70.00000 | .1141197E-01 | 0.000000 | 28.45858 | 28.46999 |
| 85.00000 | .1141197E-01 | 0.000000 | 28.45858 | 28.46999 |
| 100.0000 | .1141197E-01 | 0.000000 | 28.45858 | 28.46999 |
| 200.0000 | .1141197E-01 | 0.000000 | 28.45858 | 28.46999 |
| 300.0000 | .1141197E-01 | 0.000000 | 28.45858 | 28.46999 |
| 400.0000 | .1141197E-01 | 0.000000 | 28.45858 | 28.46999 |
| 500.0000 | .1141197E-01 | 0.000000 | 28.45858 | 28.46999 |
| 600.0000 | .1141197E-01 | 0.000000 | 28.45858 | 28.46999 |
| 603.0000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| Totals (lb) | 6.997778 | 121.2757 | 17588.70 | 17716.98 |

Flowrate for Jet Fire [immediate ignition] = 2.034898 lb/sec.

Jet Fire [delayed ignition] = 0.1141197E-01 lb/sec.

Reason for Ending: Pressure Near Atmospheric





Release Compositions

| Component Number | Component Name, Formula |
|------------------|-------------------------|
| 9 | n-Heptane, C7H16 |
| 10 | n-Octane, C8H18 |
| 11 | n-Nonane, C9H20 |
| 12 | n-Decane, C10H22 |
| 13 | n-Undecane, C11H24 |
| 31 | Dodecane, C12H26 |
| 32 | Tridecane, C13H28 |
| 33 | Tetradecane, C14H30 |
| 34 | Pentadecane, C15H32 |

Composition (Mole Fraction) of Fluid Streams

| Comp. No. | Feed Stream | Momentum Jet Stream | | | Total Stream | Liquid Pool Stream |
|-----------|-------------|---------------------|------------------|----------------|--------------|--------------------|
| | | Flashed Vapor | Evaporated Vapor | Aerosol Liquid | | Liquid to Ground |
| 9 | 0.040000 | 0.000000 | 0.463538 | 0.040000 | 0.339316 | 0.039999 |
| 10 | 0.080000 | 0.000000 | 0.294586 | 0.080000 | 0.231649 | 0.080000 |
| 11 | 0.120000 | 0.000000 | 0.142422 | 0.120000 | 0.135846 | 0.120000 |
| 12 | 0.170000 | 0.000000 | 0.067245 | 0.170000 | 0.097382 | 0.170000 |
| 13 | 0.170000 | 0.000000 | 0.022128 | 0.170000 | 0.065498 | 0.170000 |
| 31 | 0.170000 | 0.000000 | 0.007606 | 0.170000 | 0.055236 | 0.170000 |
| 32 | 0.130000 | 0.000000 | 0.001979 | 0.130000 | 0.039527 | 0.130000 |
| 33 | 0.080000 | 0.000000 | 0.000423 | 0.080000 | 0.023763 | 0.080000 |
| 34 | 0.040000 | 0.000000 | 0.000073 | 0.040000 | 0.011784 | 0.040000 |
| | 1.000000 | 0.000000 | 1.000000 | 1.000000 | 1.000000 | 1.000000 |

Flammable Limits (Mole %) of Fluid Streams

| Limit | Feed Stream | Momentum Jet Stream | Liquid Pool Stream |
|-------|-------------|---------------------|--------------------|
| LFL | 0.67 | 0.85 | 0.67 |
| UFL | 4.63 | 5.19 | 4.63 |
| LBV | | 0.41 m/s | 0.40 m/s |

**Pool Spreading and Vaporization**

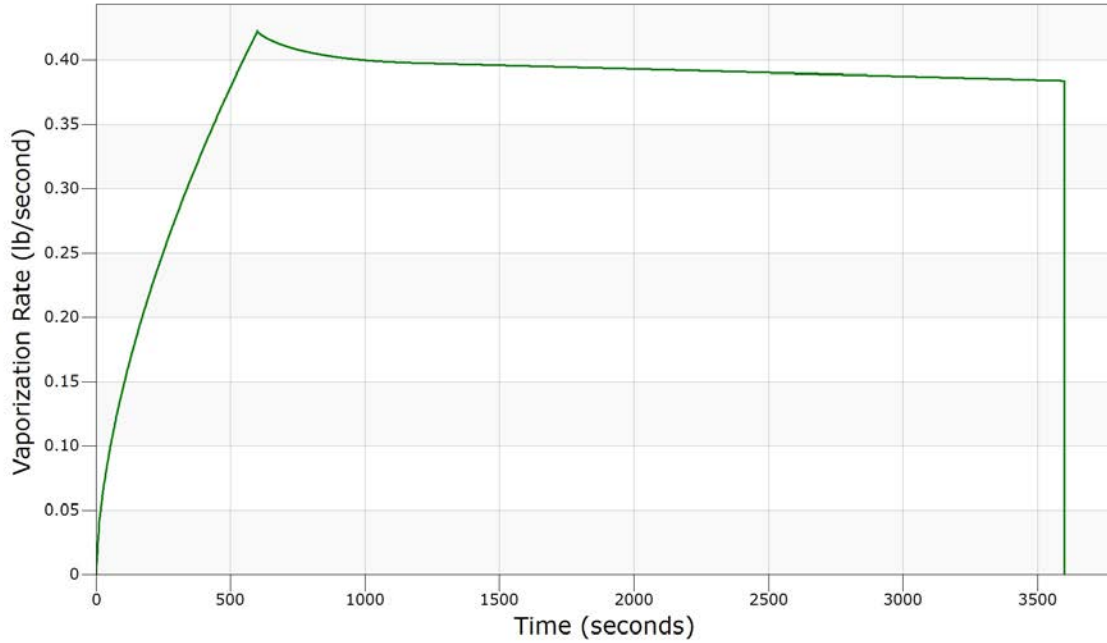
| Time (sec) | Liquid Remaining (ft3) | Pool/Dike Radius (feet) | Vapor Rate (lb/sec) |
|---------------|------------------------------|-------------------------------|------------------------|
| 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| 40.0000 | 24.6055 | 7.19948 | 0.837161E-01 |
| 80.0000 | 49.1615 | 9.06758 | 0.126735 |
| 120.000 | 73.6876 | 10.3763 | 0.161528 |
| 160.000 | 98.1818 | 11.4173 | 0.191859 |
| 200.000 | 122.651 | 12.2956 | 0.219241 |
| 240.000 | 147.100 | 13.0630 | 0.244493 |
| 280.000 | 171.527 | 13.7490 | 0.268060 |
| 320.000 | 195.933 | 14.3717 | 0.290327 |
| 360.000 | 220.321 | 14.9442 | 0.311469 |
| 400.000 | 244.692 | 15.4757 | 0.331685 |
| 440.000 | 269.045 | 15.9728 | 0.351086 |
| 480.000 | 293.380 | 16.4400 | 0.369781 |
| 520.000 | 317.701 | 16.8819 | 0.387859 |
| 560.000 | 342.005 | 17.3012 | 0.405386 |
| 600.000 | 366.284 | 17.7011 | 0.422406 |
| 640.000 | 365.931 | 17.6952 | 0.416409 |
| 680.000 | 365.577 | 17.6896 | 0.412661 |
| 720.000 | 365.224 | 17.6837 | 0.409795 |
| 760.000 | 364.871 | 17.6782 | 0.407458 |
| 800.000 | 364.518 | 17.6722 | 0.405518 |
| 840.000 | 364.165 | 17.6667 | 0.403909 |
| 880.000 | 363.812 | 17.6611 | 0.402542 |
| 1130.00 | 361.658 | 17.6260 | 0.397868 |
| 1380.00 | 359.503 | 17.5912 | 0.396347 |
| 1630.00 | 357.349 | 17.5561 | 0.394936 |
| 1880.00 | 355.230 | 17.5213 | 0.393525 |
| 2130.00 | 353.097 | 17.4862 | 0.392114 |
| 2380.00 | 350.978 | 17.4511 | 0.390703 |
| 2630.00 | 348.867 | 17.4160 | 0.389292 |
| 2880.00 | 346.765 | 17.3812 | 0.387881 |
| 3130.00 | 344.668 | 17.3461 | 0.386492 |
| 3380.00 | 342.581 | 17.3110 | 0.385081 |
| 3600.00 | 340.748 | 17.2802 | 0.383825 |

Ending Message: Normal Ending



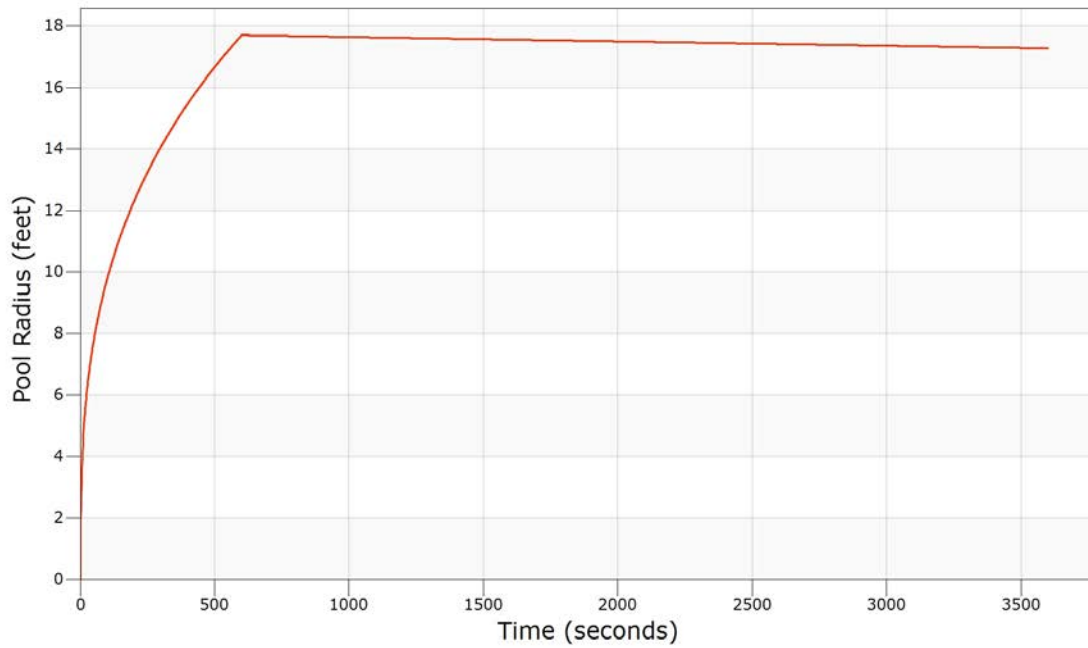
Pool Vaporization Rate

Paramount Refinery - Jet Fuel Pipeline [PipelineJet-VCE]



Pool Radius

Paramount Refinery - Jet Fuel Pipeline [PipelineJet-VCE]





Momentum Jet Dispersion

concentration limits

Endpoint 1 (highest) = 0.008476 mole fraction
Endpoint 2 (middle) = 0.008476 mole fraction
Endpoint 3 (lowest) = 0.008476 mole fraction

| downwind distance (ft) | centerline conc. (mole frac.) | ground conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) | centerline height (ft) |
|------------------------------|-------------------------------------|---------------------------------|--------------------------------|--------------------------------|--------------------------------|------------------------------|
| 0 | 1.000000 | 0.000000 | 0.3 | 0.3 | 0.3 | 1.0 |
| 0.5 | 0.763862 | 0.763862 | 0.3 | 0.3 | 0.3 | 0.0 |
| 1.0 | 0.442647 | 0.442647 | 0.5 | 0.5 | 0.5 | 0.0 |
| 1.5 | 0.321697 | 0.321697 | 0.8 | 0.8 | 0.8 | 0.0 |
| 2.0 | 0.256508 | 0.256508 | 1.1 | 1.1 | 1.1 | 0.0 |
| 2.5 | 0.215188 | 0.215188 | 1.3 | 1.3 | 1.3 | 0.0 |
| 3.0 | 0.186419 | 0.186419 | 1.6 | 1.6 | 1.6 | 0.0 |
| 3.5 | 0.165117 | 0.165117 | 1.9 | 1.9 | 1.9 | 0.0 |
| 4.0 | 0.148643 | 0.148643 | 2.1 | 2.1 | 2.1 | 0.0 |
| 4.5 | 0.135481 | 0.135481 | 2.4 | 2.4 | 2.4 | 0.0 |
| 5.0 | 0.124698 | 0.124698 | 2.6 | 2.6 | 2.6 | 0.0 |
| 5.5 | 0.115685 | 0.115685 | 2.9 | 2.9 | 2.9 | 0.0 |
| 6.0 | 0.108027 | 0.108027 | 3.2 | 3.2 | 3.2 | 0.0 |
| 6.5 | 0.101431 | 0.101431 | 3.4 | 3.4 | 3.4 | 0.0 |
| 7.0 | 0.095683 | 0.095683 | 3.7 | 3.7 | 3.7 | 0.0 |
| 7.5 | 0.090625 | 0.090625 | 4.0 | 4.0 | 4.0 | 0.0 |
| 8.0 | 0.086136 | 0.086136 | 4.2 | 4.2 | 4.2 | 0.0 |
| 8.5 | 0.082122 | 0.082122 | 4.5 | 4.5 | 4.5 | 0.0 |
| 9.0 | 0.074834 | 0.074834 | 4.5 | 4.5 | 4.5 | 0.0 |
| 9.5 | 0.067882 | 0.067882 | 4.5 | 4.5 | 4.5 | 0.0 |
| 10.0 | 0.061884 | 0.061884 | 4.5 | 4.5 | 4.5 | 0.0 |
| 10.5 | 0.056672 | 0.056672 | 4.5 | 4.5 | 4.5 | 0.0 |
| 11.0 | 0.052112 | 0.052112 | 4.5 | 4.5 | 4.5 | 0.0 |
| 11.5 | 0.048098 | 0.048098 | 4.5 | 4.5 | 4.5 | 0.0 |
| 12.0 | 0.044544 | 0.044544 | 4.5 | 4.5 | 4.5 | 0.0 |
| 12.5 | 0.041383 | 0.041383 | 4.5 | 4.5 | 4.5 | 0.0 |
| 13.0 | 0.038557 | 0.038557 | 4.5 | 4.5 | 4.5 | 0.0 |
| 13.5 | 0.036020 | 0.036020 | 4.5 | 4.5 | 4.5 | 0.0 |
| 14.0 | 0.033734 | 0.033734 | 4.5 | 4.5 | 4.5 | 0.0 |
| 14.5 | 0.031665 | 0.031665 | 4.5 | 4.5 | 4.5 | 0.0 |
| 15.0 | 0.029787 | 0.029787 | 4.5 | 4.5 | 4.5 | 0.0 |
| 15.5 | 0.028077 | 0.028077 | 4.5 | 4.5 | 4.5 | 0.0 |
| 16.0 | 0.026515 | 0.026515 | 4.5 | 4.5 | 4.5 | 0.0 |
| 16.5 | 0.025083 | 0.025083 | 4.5 | 4.5 | 4.5 | 0.0 |
| 17.0 | 0.023769 | 0.023769 | 4.5 | 4.5 | 4.5 | 0.0 |



| downwind distance (ft) | centerline conc. (mole frac.) | ground conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) | centerline height (ft) |
|------------------------|-------------------------------|---------------------------|--------------------------|--------------------------|--------------------------|------------------------|
| 17.5 | 0.022546 | 0.022546 | 4.5 | 4.5 | 4.5 | 0.0 |
| 18.0 | 0.021378 | 0.021378 | 4.3 | 4.3 | 4.3 | 0.0 |
| 18.5 | 0.020299 | 0.020299 | 4.1 | 4.1 | 4.1 | 0.0 |
| 19.0 | 0.019302 | 0.019302 | 3.9 | 3.9 | 3.9 | 0.0 |
| 19.5 | 0.018378 | 0.018378 | 3.7 | 3.7 | 3.7 | 0.0 |
| 20.0 | 0.017520 | 0.017520 | 3.5 | 3.5 | 3.5 | 0.0 |
| 20.5 | 0.016721 | 0.016721 | 3.4 | 3.4 | 3.4 | 0.0 |
| 21.0 | 0.015977 | 0.015977 | 3.2 | 3.2 | 3.2 | 0.0 |
| 21.5 | 0.015283 | 0.015283 | 3.0 | 3.0 | 3.0 | 0.0 |
| 22.0 | 0.014633 | 0.014633 | 2.8 | 2.8 | 2.8 | 0.0 |
| 22.5 | 0.014025 | 0.014025 | 2.6 | 2.6 | 2.6 | 0.0 |
| 23.0 | 0.013455 | 0.013455 | 2.4 | 2.4 | 2.4 | 0.0 |
| 23.5 | 0.012919 | 0.012919 | 2.2 | 2.2 | 2.2 | 0.0 |
| 24.0 | 0.012416 | 0.012416 | 2.0 | 2.0 | 2.0 | 0.0 |
| 24.5 | 0.011941 | 0.011941 | 1.8 | 1.8 | 1.8 | 0.0 |
| 25.0 | 0.011494 | 0.011494 | 1.7 | 1.7 | 1.7 | 0.0 |
| 25.5 | 0.011072 | 0.011072 | 1.5 | 1.5 | 1.5 | 0.0 |
| 26.0 | 0.010673 | 0.010673 | 1.3 | 1.3 | 1.3 | 0.0 |
| 26.5 | 0.010296 | 0.010296 | 1.1 | 1.1 | 1.1 | 0.0 |
| 27.0 | 0.009939 | 0.009939 | 0.9 | 0.9 | 0.9 | 0.0 |
| 27.5 | 0.009600 | 0.009600 | 0.7 | 0.7 | 0.7 | 0.0 |
| 28.0 | 0.009279 | 0.009279 | 0.5 | 0.5 | 0.5 | 0.0 |
| 28.5 | 0.008974 | 0.008974 | 0.3 | 0.3 | 0.3 | 0.0 |
| 29.0 | 0.008684 | 0.008684 | 0.1 | 0.1 | 0.1 | 0.0 |
| 29.5 | 0.008408 | 0.008408 | 0.0 | 0.0 | 0.0 | 0.0 |

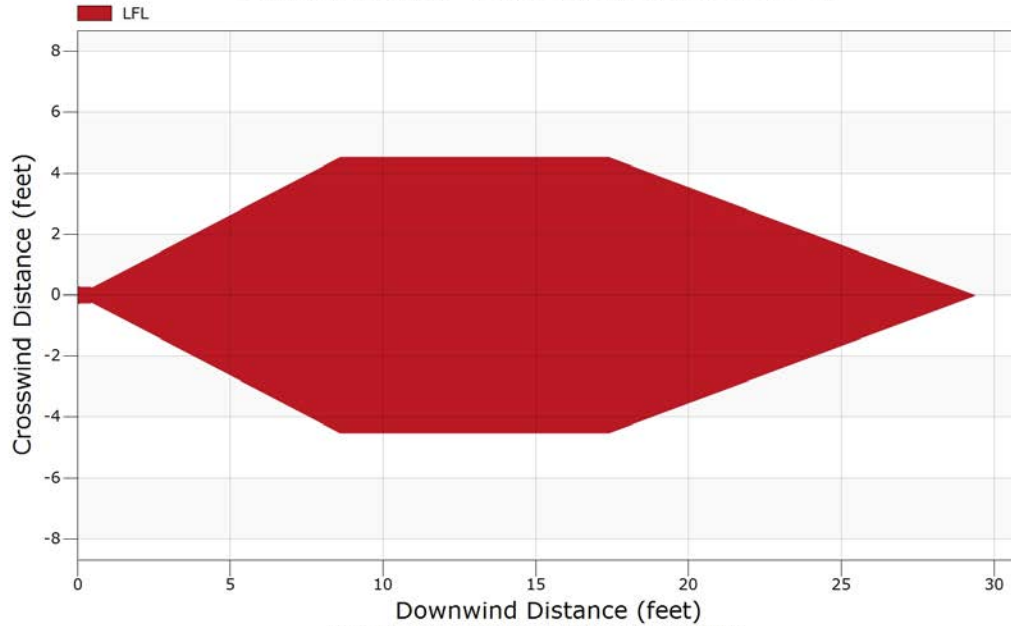
The momentum jet model coupled to the heavy gas model at 0.48 ft in 0 sec.

| Endpoint (mole frac., mixture) | Downwind Distance (feet) | Approximate Time (seconds) |
|--------------------------------|--------------------------|----------------------------|
| 1 0.008476 (LFL) | 29.4 | 8 |
| 2 0.008476 (LFL) | 29.4 | 8 |
| 3 0.008476 (LFL) | 29.4 | 8 |



Momentum Jet Contours - Overhead View

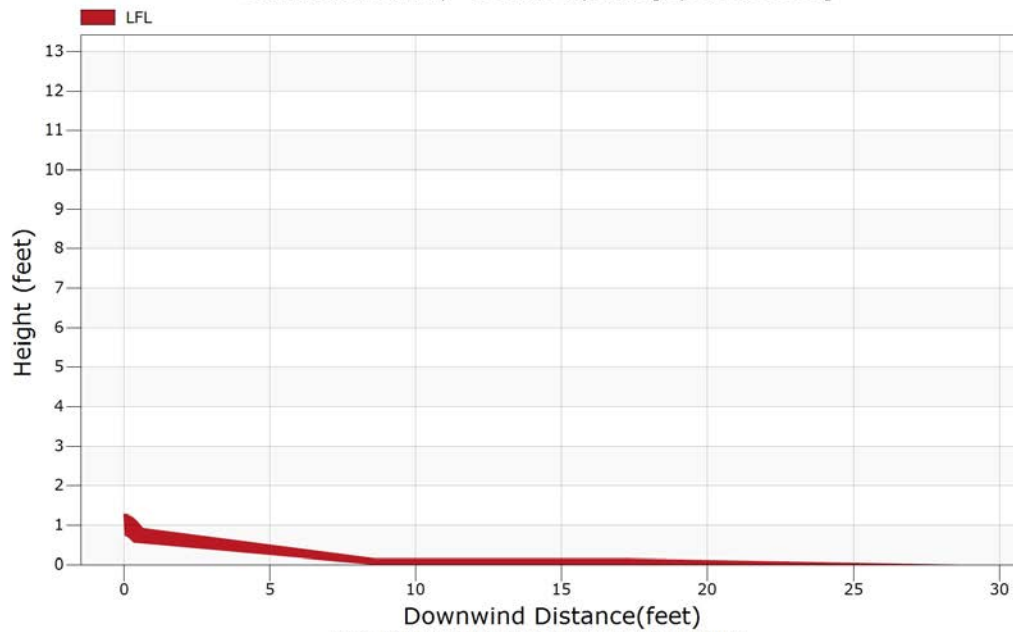
Paramount Refinery - Jet Fuel Pipeline [PipelineJet-VCE]



Note: Release during 3.36 mph winds and F stability.

Momentum Jet Contours - Side View

Paramount Refinery - Jet Fuel Pipeline [PipelineJet-VCE]

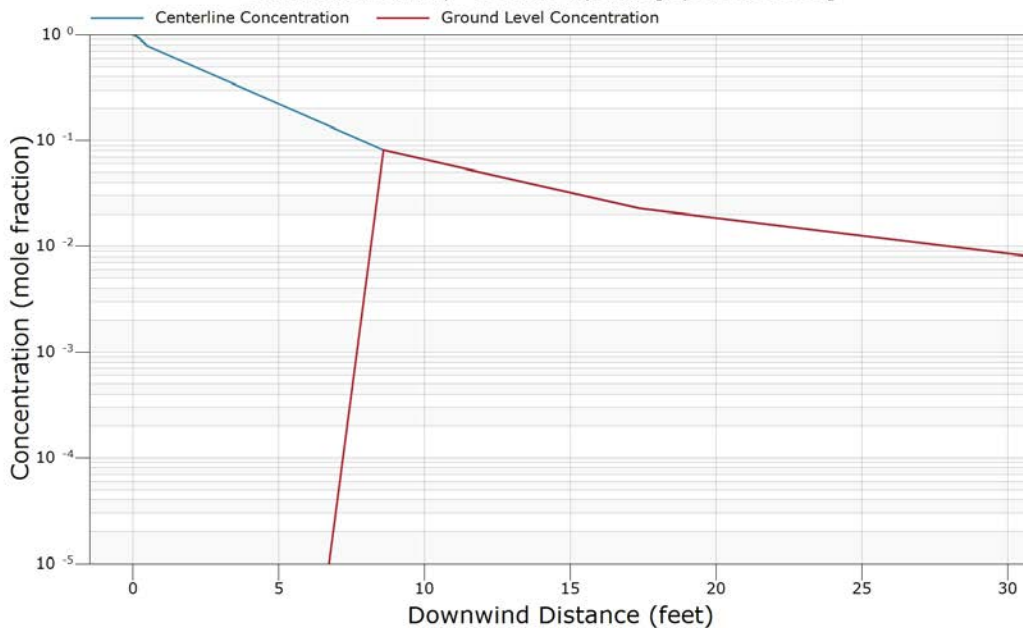


Note: Release during 3.36 mph winds and F stability.



Momentum Jet Concentration

Paramount Refinery - Jet Fuel Pipeline [PipelineJet-VCE]



Note: Release during 3.36 mph winds and F stability.



Heavier-than-Air Dispersion

concentration limits

Endpoint 1 (highest) = 0.006688 mole fraction
Endpoint 2 (middle) = 0.006688 mole fraction
Endpoint 3 (lowest) = 0.006688 mole fraction

| downwind distance (ft) | centerline conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) |
|------------------------------|-------------------------------------|--------------------------------|--------------------------------|--------------------------------|
|------------------------------|-------------------------------------|--------------------------------|--------------------------------|--------------------------------|

* Vapor cloud does not leave source.



Momentum Jet Explosion

Fuel Reactivity: Medium

Obstacle Density: Low

Flame Expansion: 2.5-D

Flame Speed: 0.29

Mass of released material involved in explosion: 0.112535 lbs.

| Distance from Center of Flammable Cloud (feet) | Overpressure (psi gauge) | Impulse (psi-s) |
|--|-----------------------------|--------------------|
| 0.0 | 2.30 | 0.0160 |
| 0.9 | 2.30 | 0.0160 |
| 1.0 | 2.30 | 0.0160 |
| 1.0 | 2.30 | 0.0160 |
| 1.1 | 2.30 | 0.0160 |
| 1.1 | 2.30 | 0.0160 |
| 1.2 | 2.30 | 0.0160 |
| 1.3 | 2.30 | 0.0160 |
| 1.3 | 2.30 | 0.0160 |
| 1.4 | 2.30 | 0.0160 |
| 1.5 | 2.30 | 0.0160 |
| 1.5 | 2.30 | 0.0160 |
| 1.6 | 2.30 | 0.0152 |
| 1.7 | 2.30 | 0.0144 |
| 1.8 | 2.30 | 0.0137 |
| 1.9 | 2.30 | 0.0131 |
| 2.0 | 2.30 | 0.0124 |
| 2.1 | 2.30 | 0.0118 |
| 2.2 | 2.30 | 0.0112 |
| 2.3 | 2.30 | 0.0107 |
| 2.5 | 2.30 | 0.0101 |
| 2.6 | 2.30 | 0.0096 |
| 2.7 | 2.30 | 0.0092 |
| 2.9 | 2.30 | 0.0087 |
| 8.5 | 1.00 | 0.0030 |

The downwind distance to 1.00 psi is 8.5 feet

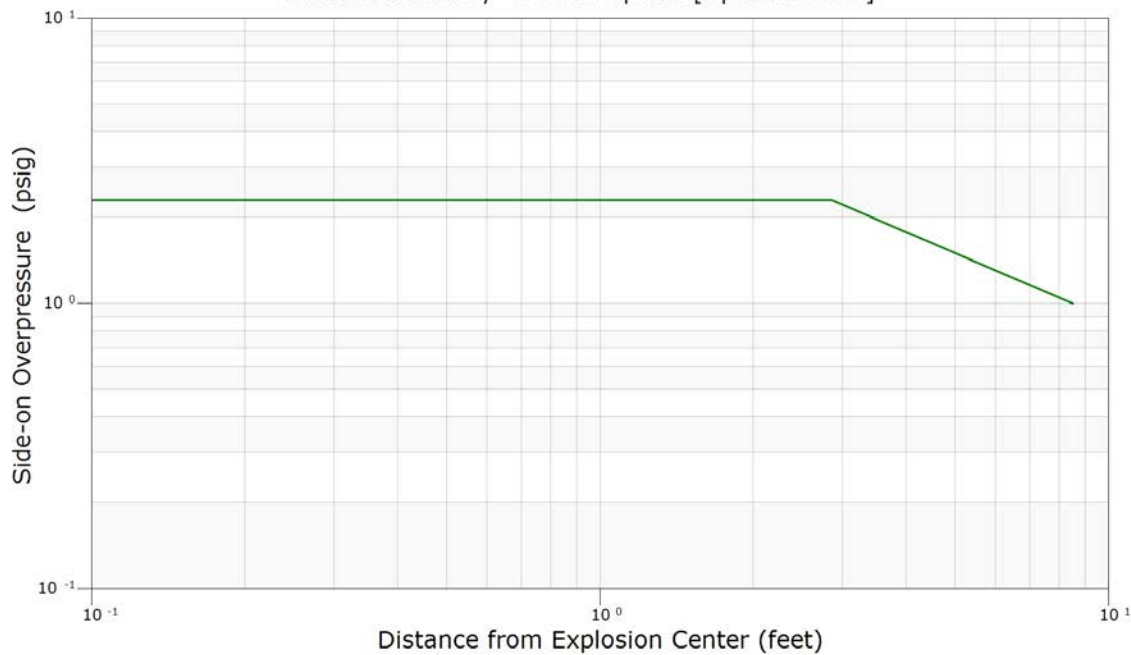
The downwind distance to 1.00 psi is 8.5 feet

The downwind distance to 1.00 psi is 8.5 feet



Momentum Jet Explosion Overpressure - Baker-Strehlow-Tang

Paramount Refinery - Jet Fuel Pipeline [PipelineJet-VCE]





Heavier-than-Air Explosion

Fuel Reactivity: Medium

Obstacle Density: Low

Flame Expansion: 2.5-D

Flame Speed: 0.29

Mass of released material involved in explosion: 15.3905 lbs.

| Distance from Center of Flammable Cloud (feet) | Overpressure (psi gauge) | Impulse (psi-s) |
|--|-----------------------------|--------------------|
| 0.0 | 2.30 | 0.0823 |
| 4.8 | 2.30 | 0.0823 |
| 5.3 | 2.30 | 0.0823 |
| 5.8 | 2.30 | 0.0823 |
| 6.4 | 2.30 | 0.0823 |
| 7.1 | 2.30 | 0.0823 |
| 7.8 | 2.30 | 0.0823 |
| 8.6 | 2.30 | 0.0758 |
| 9.6 | 2.30 | 0.0688 |
| 10.6 | 2.30 | 0.0624 |
| 11.7 | 2.30 | 0.0566 |
| 12.9 | 2.30 | 0.0513 |
| 14.2 | 2.30 | 0.0465 |
| 15.7 | 2.30 | 0.0422 |
| 17.4 | 2.30 | 0.0383 |
| 19.2 | 2.28 | 0.0347 |
| 21.2 | 2.07 | 0.0315 |
| 23.5 | 1.87 | 0.0285 |
| 25.9 | 1.69 | 0.0259 |
| 28.6 | 1.53 | 0.0235 |
| 31.6 | 1.39 | 0.0213 |
| 35.0 | 1.26 | 0.0193 |
| 38.6 | 1.14 | 0.0175 |
| 42.7 | 1.03 | 0.0159 |
| 52.1 | 0.84 | 0.0131 |

The downwind distance to 1.00 psi is 44.1 feet
The downwind distance to 1.00 psi is 44.1 feet
The downwind distance to 1.00 psi is 44.1 feet



Heavier-than-Air Explosion Overpressure - Baker-Strehlow-Tang

Paramount Refinery - Jet Fuel Pipeline [PipelineJet-VCE]





Case Inputs

Case Type : Fire Radiation
Case Name : PipelineJet-Pool
User ID :
Project Number :
Type of Units : English Units

NOTES:

MATERIAL MENU

| Materials Released | Number | Formula | Name | Fraction |
|--------------------|--------|---------|-------------|----------|
| Component 1 | 9 | C7H16 | n-Heptane | 0.040000 |
| Component 2 | 10 | C8H18 | n-Octane | 0.080000 |
| Component 3 | 11 | C9H20 | n-Nonane | 0.120000 |
| Component 4 | 12 | C10H22 | n-Decane | 0.170000 |
| Component 5 | 13 | C11H24 | n-Undecane | 0.170000 |
| Component 6 | 31 | C12H26 | Dodecane | 0.170000 |
| Component 7 | 32 | C13H28 | Tridecane | 0.130000 |
| Component 8 | 33 | C14H30 | Tetradecane | 0.080000 |
| Component 9 | 34 | C15H32 | Pentadecane | 0.040000 |
| Component 10 | | | | |

Temperature : 68.00 °F
Pressure : 14.70 psia
The material is LIQUID
The mixture is Jet A1

NOTES:

ENVIRONMENT MENU

Wind speed : 20.00 mph
Relative humidity : 70 %
Air temperature : 68.0 °F

NOTES:

FIRE TYPE MENU

Fire radiation division: Circular pool fires
Vertical and horizontal isopleths
Spill surface: land
Elevation of flame base (from grade) : 1.0 feet
Elevation of target (from grade) : 0.0 feet
Diameter of pool : 36.0 feet

Fire radiation flux values

Radiation endpoint 1 : 3487 Btu/hr-sq.ft
Radiation endpoint 2 : 1600 Btu/hr-sq.ft
Radiation endpoint 3 : 500 Btu/hr-sq.ft

NOTES:



Pool Fire Radiation

Length of Flame : 57.5 feet
 Flame Tilt from Vertical : 58.7 degrees
 Target Elevation : 0.0 feet
 Pool Elevation : 1.0 feet
 Wind Speed : 20.0 mph
 Substrate : Land

| Downwind Distance from Center of Pool (feet) | Flux to Vertical Target (Btu/hr-sq.ft) | Flux to Horizontal Target (Btu/hr-sq.ft) | Maximum Flux (Btu/hr-sq.ft) |
|--|--|--|-----------------------------------|
| 19.8 | 11142 | 28188 | 30310 |
| 21.3 | 11974 | 27767 | 30239 |
| 22.9 | 14318 | 31668 | 31668 |
| 24.6 | 15479 | 30939 | 31668 |
| 26.4 | 16587 | 28428 | 31668 |
| 28.4 | 14456 | 27526 | 31091 |
| 30.5 | 11635 | 31668 | 31668 |
| 32.8 | 15208 | 27106 | 31081 |
| 35.3 | 13331 | 24378 | 31668 |
| 37.9 | 13657 | 24026 | 28996 |
| 40.8 | 12878 | 21119 | 25301 |
| 43.8 | 11999 | 17616 | 21583 |
| 47.1 | 11093 | 13290 | 17438 |
| 50.6 | 9431 | 9211 | 13244 |
| 54.4 | 7353 | 6533 | 9871 |
| 58.5 | 5680 | 5028 | 7609 |
| 62.9 | 4506 | 4108 | 6114 |
| 67.6 | 3691 | 3439 | 5057 |
| 72.6 | 3103 | 2861 | 4229 |
| 78.1 | 2661 | 2313 | 3531 |
| 83.9 | 2302 | 1783 | 2915 |
| 90.2 | 1966 | 1296 | 2357 |
| 96.9 | 1628 | 891 | 1857 |
| 104.2 | 1310 | 588 | 1437 |
| 112.0 | 1035 | 381 | 1103 |
| 120.4 | 810 | 246 | 847 |
| 129.4 | 634 | 160 | 654 |
| 139.1 | 498 | 106 | 509 |
| 149.5 | 394 | 71 | 400 |
| 160.7 | 314 | 49 | 317 |

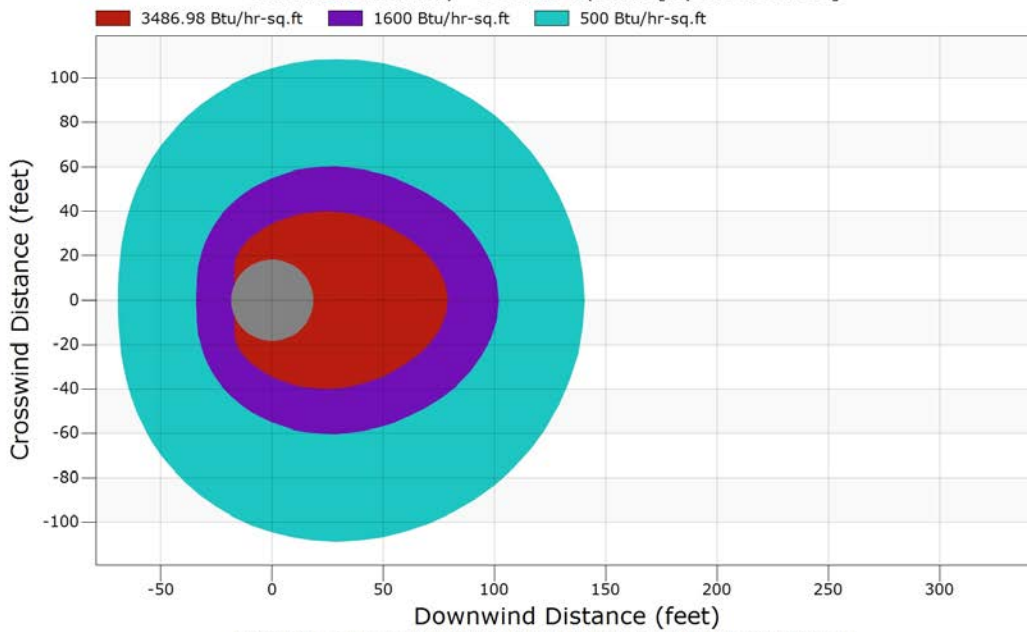
Downwind Distances to Endpoints:

| Distance (feet) | Maximum Flux (Btu/hr-sq.ft) |
|--------------------|--------------------------------|
| 78.5 | 3487 |
| 101.4 | 1600 |
| 140.0 | 500 |



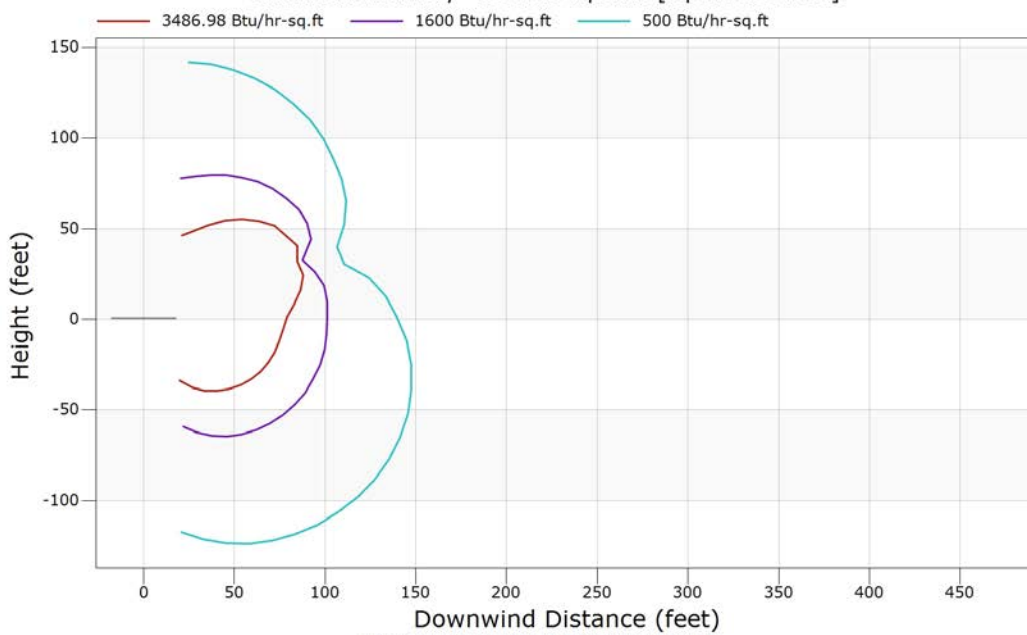
Pool Fire Radiant Heat Contours - Overhead View

Paramount Refinery - Jet Fuel Pipeline [PipelineJet-Pool]



Pool Fire Radiant Heat Contours - Side View

Paramount Refinery - Jet Fuel Pipeline [PipelineJet-Pool]





Case Inputs

Case Type : Vapor Dispersion
Case Name : PipelineNG-VCE
User ID :
Project Number :
Type of Units : English Units

NOTES:

MATERIAL MENU

| Materials Released | Number | Formula | Name | Fraction |
|--------------------|--------|--------------------------------|----------------|----------|
| Component 1 | 1 | CH ₄ | Methane | 0.903000 |
| Component 2 | 2 | C ₂ H ₆ | Ethane | 0.047000 |
| Component 3 | 3 | C ₃ H ₈ | Propane | 0.015000 |
| Component 4 | 5 | C ₄ H ₁₀ | n-Butane | 0.004000 |
| Component 5 | 7 | C ₅ H ₁₂ | n-Pentane | 0.001000 |
| Component 6 | 16 | N ₂ | Nitrogen | 0.010000 |
| Component 7 | 17 | CO ₂ | Carbon Dioxide | 0.020000 |
| Component 8 | | | | |
| Component 9 | | | | |
| Component 10 | | | | |

Temperature : 80.33 °F
Pressure : 500.00 psia
The material is GAS
The mixture is Natural Gas

NOTES:

ENVIRONMENT MENU

| | |
|--------------------------------|------------------------------------|
| Wind speed | 3.36 mph |
| Wind speed measurement height | 32.8 feet |
| Stability class <A-F> | F |
| Relative humidity | 70 % |
| Air temperature | 68.0 °F |
| Spill surface temperature | 68.0 °F |
| Substrate name | Soil |
| Substrate thermal conductivity | 1.0000 Btu/hr-ft-F |
| Substrate density | 100 lb/cu.ft |
| Substrate heat Capacity | 0.24 Btu/lb-F |
| Substrate delay time | 60 sec |
| Surrounding terrain | Long grass or crops > 15 cm (6 in) |

NOTES:



RELEASE MENU

Type of release: Unregulated, Continuous release
Release duration 60 min
Normal flow rate 1.10 lb/sec
Duration of normal flow 10 min
Volume of vessel 700.00 cu.ft
Percent of vessel filled with liquid 100 %
Liquid head above release point 0 feet
Pipe inner diameter 7.98 inches
Equivalent release diameter 7.98 inches
Pipe length upstream of break 2000.0 feet
Height of release point 1.0 feet
Angle of release from horizontal 0.0 degrees

NOTES:

IMPOUNDMENT MENU

Unconfined

NOTES:

VDVE MENU

Vapor generation, dispersion and cloud explosion - Flammable calculation

Concentration endpoint 1 LFL mol%
Concentration endpoint 2 LFL mol%
Concentration endpoint 3 LFL mol%

Dispersion coefficient averaging time 1 min

Baker-Strehlow-Tang parameters

Fuel reactivity Medium
Obstacle density Low
Flame expansion 2.5-D

Overpressure values

Overpressure endpoint 1 1.00 psi
Overpressure endpoint 2 1.00 psi
Overpressure endpoint 3 1.00 psi

NOTES:



Release Model

| Time (sec) | Vapor (lb/sec) | Aerosol Rate (lb/sec) | Liquid Rate (lb/sec) | Total Rate (lb/sec) |
|---------------|-------------------|--------------------------|-------------------------|------------------------|
| 0.000000 | 345.0070 | 0.000000 | 0.000000 | 345.0070 |
| 0.100000 | 262.1345 | 0.000000 | 0.000000 | 262.1345 |
| 0.300000 | 193.0689 | 0.000000 | 0.000000 | 193.0689 |
| 0.500000 | 159.9449 | 0.000000 | 0.000000 | 159.9449 |
| 0.700000 | 139.5511 | 0.000000 | 0.000000 | 139.5511 |
| 1.000000 | 119.7434 | 0.000000 | 0.000000 | 119.7434 |
| 3.000000 | 38.39912 | 0.000000 | 0.000000 | 38.39912 |
| 5.000000 | 35.42095 | 0.000000 | 0.000000 | 35.42095 |
| 7.000000 | 32.67491 | 0.000000 | 0.000000 | 32.67491 |
| 10.00000 | 28.95524 | 0.000000 | 0.000000 | 28.95524 |
| 20.00000 | 19.40590 | 0.000000 | 0.000000 | 19.40590 |
| 30.00000 | 12.99396 | 0.000000 | 0.000000 | 12.99396 |
| 40.00000 | 8.665091 | 0.000000 | 0.000000 | 8.665091 |
| 50.00000 | 5.820305 | 0.000000 | 0.000000 | 5.820305 |
| 60.00000 | 3.915461 | 0.000000 | 0.000000 | 3.915461 |
| 70.00000 | 2.650710 | 0.000000 | 0.000000 | 2.650710 |
| 85.00000 | 1.574851 | 0.000000 | 0.000000 | 1.574851 |
| 100.0000 | 1.196595 | 0.000000 | 0.000000 | 1.196595 |
| 200.0000 | 1.101000 | 0.000000 | 0.000000 | 1.101000 |
| 300.0000 | 1.101000 | 0.000000 | 0.000000 | 1.101000 |
| 400.0000 | 1.101000 | 0.000000 | 0.000000 | 1.101000 |
| 500.0000 | 1.101000 | 0.000000 | 0.000000 | 1.101000 |
| 600.0000 | 1.101000 | 0.000000 | 0.000000 | 1.101000 |
| 609.0750 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| Totals (lb) | 1790.124 | 0.000000 | 0.000000 | 1790.124 |

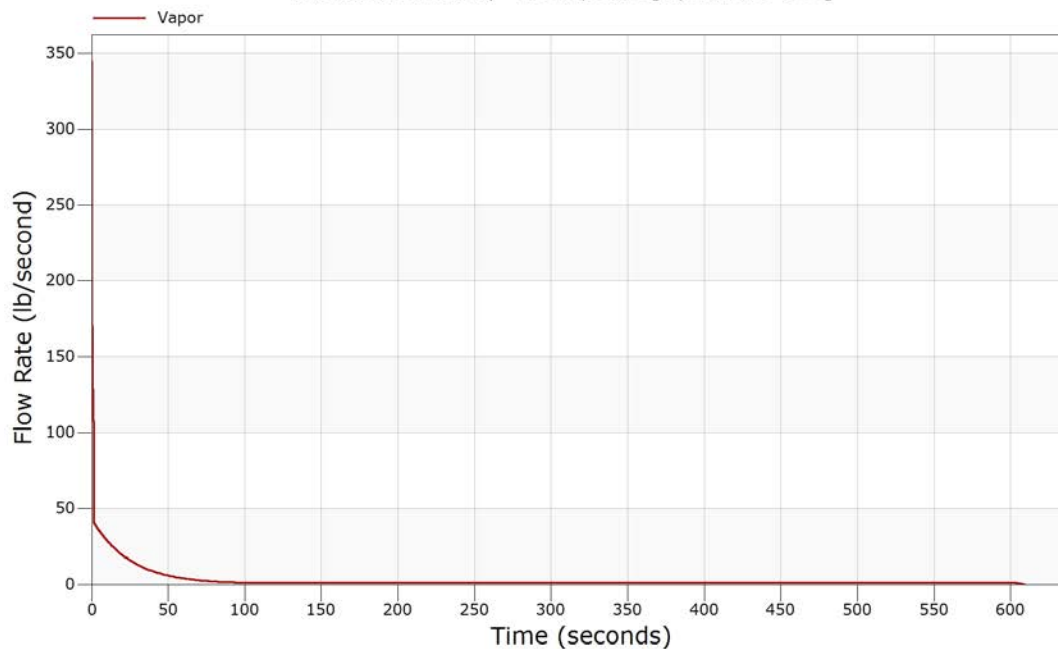
Flowrate for Jet Fire [immediate ignition] = 19.14845 lb/sec.
Jet Fire [delayed ignition] = 1.101337 lb/sec.

Reason for Ending: Pressure Near Atmospheric



Mass Release Rate

Paramount Refinery - NG Pipeline [PipelineNG-VCE]





Release Compositions

| Component Number | Component Name, Formula |
|------------------|---|
| 1 | Methane, CH ₄ |
| 2 | Ethane, C ₂ H ₆ |
| 3 | Propane, C ₃ H ₈ |
| 5 | n-Butane, C ₄ H ₁₀ |
| 7 | n-Pentane, C ₅ H ₁₂ |
| 16 | Nitrogen, N ₂ |
| 17 | Carbon Dioxide, CO ₂ |

Composition (Mole Fraction) of Fluid Streams

| Comp. No. | Feed Stream | Momentum Jet Stream | | | Total Stream | Liquid Pool Stream |
|-----------|-------------|---------------------|------------------|----------------|--------------|--------------------|
| | | Flashed Vapor | Evaporated Vapor | Aerosol Liquid | | |
| 1 | 0.903000 | 0.903000 | 0.000000 | 0.000000 | 0.903000 | 0.000000 |
| 2 | 0.047000 | 0.047000 | 0.000000 | 0.000000 | 0.047000 | 0.000000 |
| 3 | 0.015000 | 0.015000 | 0.000000 | 0.000000 | 0.015000 | 0.000000 |
| 5 | 0.004000 | 0.004000 | 0.000000 | 0.000000 | 0.004000 | 0.000000 |
| 7 | 0.001000 | 0.001000 | 0.000000 | 0.000000 | 0.001000 | 0.000000 |
| 16 | 0.010000 | 0.010000 | 0.000000 | 0.000000 | 0.010000 | 0.000000 |
| 17 | 0.020000 | 0.020000 | 0.000000 | 0.000000 | 0.020000 | 0.000000 |
| | 1.000000 | 1.000000 | 0.000000 | 0.000000 | 1.000000 | 0.000000 |

Flammable Limits (Mole %) of Fluid Streams

| Limit | Feed Stream | Momentum Jet Stream | Liquid Pool Stream |
|-------|-------------|---------------------|--------------------|
| LFL | 4.84 | 4.84 | |
| UFL | 15.03 | 15.03 | |
| LBV | | 0.36 m/s | |



Momentum Jet Dispersion

concentration limits

Endpoint 1 (highest) = 0.048408 mole fraction
Endpoint 2 (middle) = 0.048408 mole fraction
Endpoint 3 (lowest) = 0.048408 mole fraction

| downwind distance (ft) | centerline conc. (mole frac.) | ground conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) | centerline height (ft) |
|------------------------------|-------------------------------------|---------------------------------|--------------------------------|--------------------------------|--------------------------------|------------------------------|
| 0 | 1.000000 | 0.000000 | 0.7 | 0.7 | 0.7 | 1.0 |
| 2 | 0.670455 | 0.014421 | 0.9 | 0.9 | 0.9 | 1.1 |
| 4 | 0.515106 | 0.034962 | 1.1 | 1.1 | 1.1 | 1.2 |
| 6 | 0.420391 | 0.051198 | 1.3 | 1.3 | 1.3 | 1.3 |
| 8 | 0.355949 | 0.061565 | 1.5 | 1.5 | 1.5 | 1.4 |
| 10 | 0.308972 | 0.067289 | 1.7 | 1.7 | 1.7 | 1.5 |
| 12 | 0.273142 | 0.070001 | 1.8 | 1.8 | 1.8 | 1.6 |
| 14 | 0.244770 | 0.070753 | 2.0 | 2.0 | 2.0 | 1.7 |
| 16 | 0.221882 | 0.070355 | 2.1 | 2.1 | 2.1 | 1.8 |
| 18 | 0.202931 | 0.069215 | 2.2 | 2.2 | 2.2 | 1.9 |
| 20 | 0.186941 | 0.067644 | 2.4 | 2.4 | 2.4 | 2.0 |
| 22 | 0.173296 | 0.065859 | 2.5 | 2.5 | 2.5 | 2.2 |
| 24 | 0.161506 | 0.063933 | 2.6 | 2.6 | 2.6 | 2.3 |
| 26 | 0.151191 | 0.061951 | 2.7 | 2.7 | 2.7 | 2.4 |
| 28 | 0.142113 | 0.059966 | 2.8 | 2.8 | 2.8 | 2.5 |
| 30 | 0.134046 | 0.058006 | 2.8 | 2.8 | 2.8 | 2.6 |
| 32 | 0.126875 | 0.056134 | 2.9 | 2.9 | 2.9 | 2.7 |
| 34 | 0.120354 | 0.054304 | 3.0 | 3.0 | 3.0 | 2.8 |
| 36 | 0.114511 | 0.052561 | 3.0 | 3.0 | 3.0 | 2.9 |
| 38 | 0.109163 | 0.050875 | 3.1 | 3.1 | 3.1 | 3.0 |
| 40 | 0.104320 | 0.049277 | 3.1 | 3.1 | 3.1 | 3.1 |
| 42 | 0.099847 | 0.047734 | 3.2 | 3.2 | 3.2 | 3.2 |
| 44 | 0.095750 | 0.046257 | 3.2 | 3.2 | 3.2 | 3.3 |
| 46 | 0.091957 | 0.044859 | 3.2 | 3.2 | 3.2 | 3.4 |
| 48 | 0.088460 | 0.043529 | 3.3 | 3.3 | 3.3 | 3.5 |
| 50 | 0.085201 | 0.042251 | 3.3 | 3.3 | 3.3 | 3.6 |
| 52 | 0.082190 | 0.041043 | 3.3 | 3.3 | 3.3 | 3.8 |
| 54 | 0.079349 | 0.039883 | 3.3 | 3.3 | 3.3 | 3.9 |
| 56 | 0.076684 | 0.038766 | 3.3 | 3.3 | 3.3 | 4.0 |
| 58 | 0.074262 | 0.037729 | 3.3 | 3.3 | 3.3 | 4.1 |
| 60 | 0.071932 | 0.036696 | 3.2 | 3.2 | 3.2 | 4.2 |
| 62 | 0.069722 | 0.035719 | 3.2 | 3.2 | 3.2 | 4.3 |
| 64 | 0.067676 | 0.034777 | 3.1 | 3.1 | 3.1 | 4.4 |
| 66 | 0.065716 | 0.033885 | 3.1 | 3.1 | 3.1 | 4.5 |
| 68 | 0.063864 | 0.033014 | 3.0 | 3.0 | 3.0 | 4.7 |

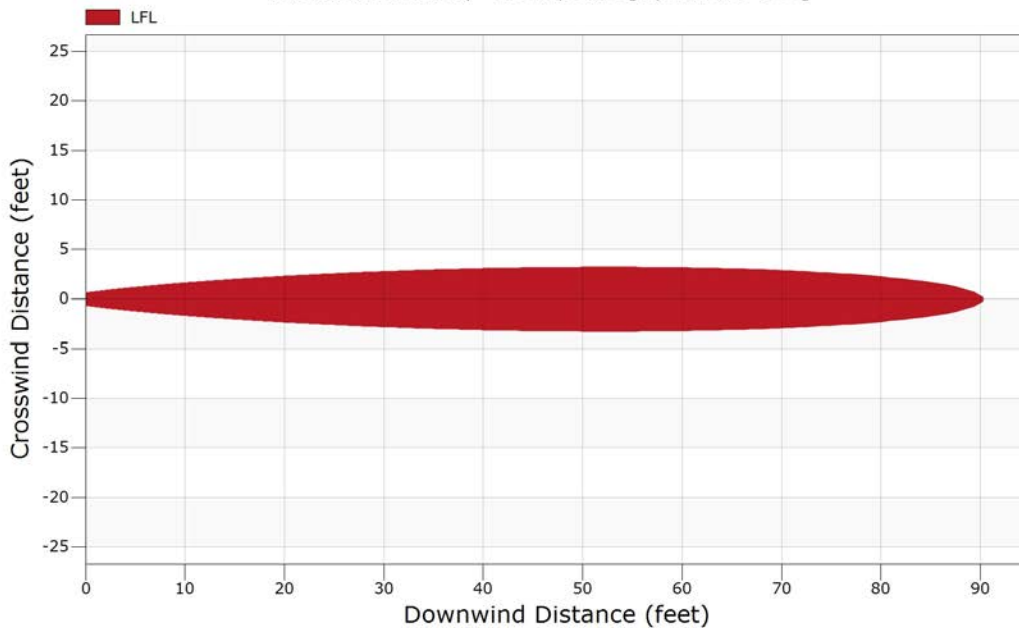


| downwind distance (ft) | centerline conc. (mole frac.) | ground conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) | centerline height (ft) |
|------------------------|-------------------------------|---------------------------|--------------------------|--------------------------|--------------------------|------------------------|
| 70 | 0.062116 | 0.032203 | 2.9 | 2.9 | 2.9 | 4.8 |
| 72 | 0.060426 | 0.031376 | 2.8 | 2.8 | 2.8 | 4.9 |
| 74 | 0.058868 | 0.030624 | 2.7 | 2.7 | 2.7 | 5.0 |
| 76 | 0.057362 | 0.029908 | 2.6 | 2.6 | 2.6 | 5.1 |
| 78 | 0.055917 | 0.029191 | 2.5 | 2.5 | 2.5 | 5.3 |
| 80 | 0.054547 | 0.028500 | 2.3 | 2.3 | 2.3 | 5.4 |
| 82 | 0.053259 | 0.027856 | 2.1 | 2.1 | 2.1 | 5.5 |
| 84 | 0.051991 | 0.027200 | 1.9 | 1.9 | 1.9 | 5.6 |
| 86 | 0.050802 | 0.026582 | 1.6 | 1.6 | 1.6 | 5.7 |
| 88 | 0.049659 | 0.025995 | 1.2 | 1.2 | 1.2 | 5.9 |
| 90 | 0.048564 | 0.025416 | 0.3 | 0.3 | 0.3 | 6.0 |

| Endpoint (mole frac., mixture) | Downwind Distance (feet) | Approximate Time (seconds) |
|--------------------------------|--------------------------|----------------------------|
| 1 0.048408 (LFL) | 90.3 | 1 |
| 2 0.048408 (LFL) | 90.3 | 1 |
| 3 0.048408 (LFL) | 90.3 | 1 |

Momentum Jet Contours - Overhead View

Paramount Refinery - NG Pipeline [PipelineNG-VCE]

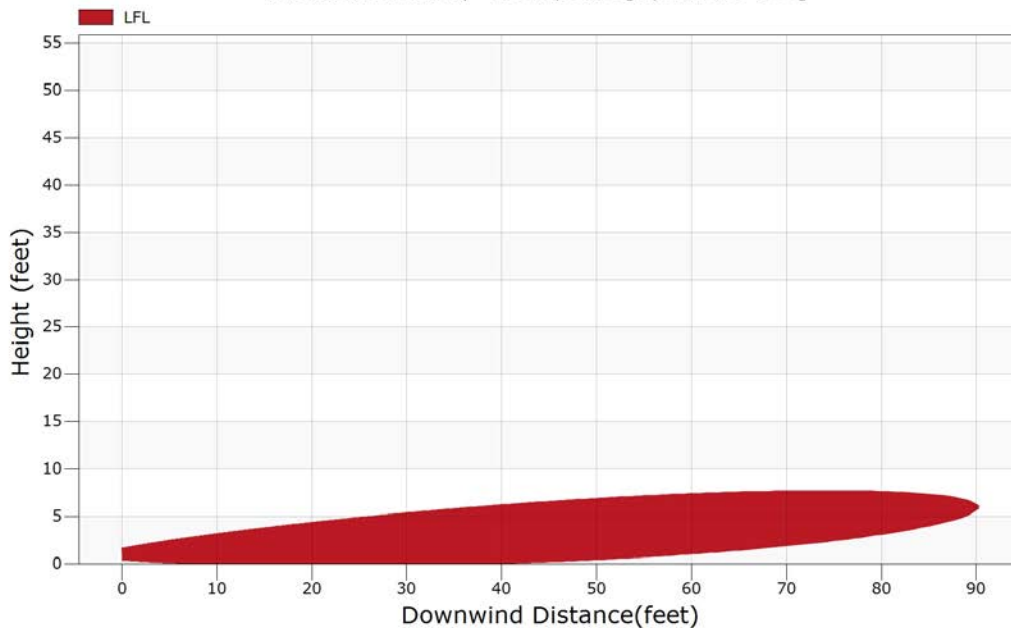


Note: Release during 3.36 mph winds and F stability.



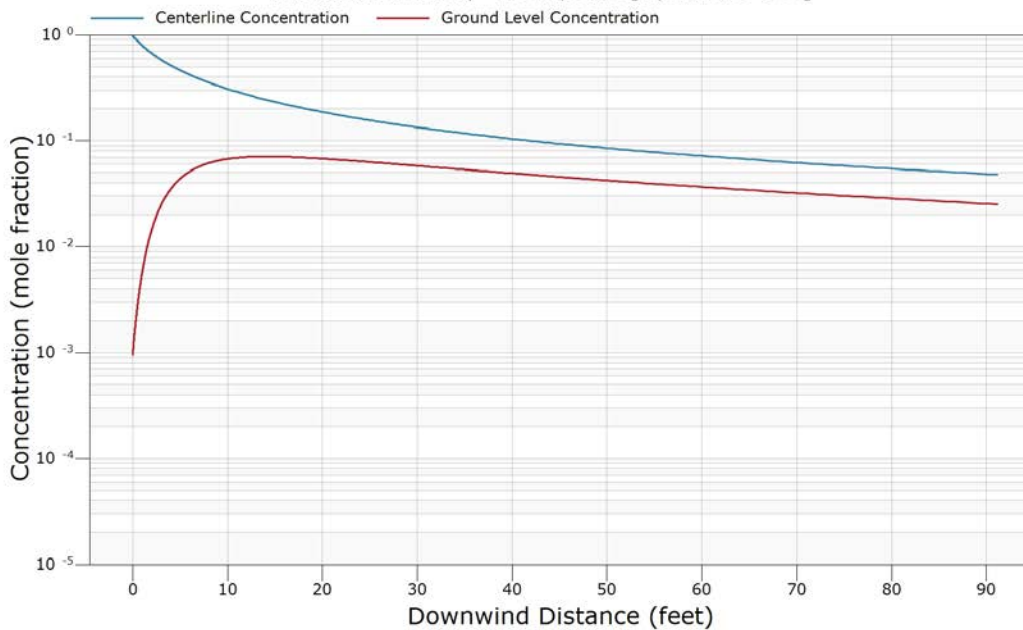
Momentum Jet Contours - Side View

Paramount Refinery - NG Pipeline [PipelineNG-VCE]



Momentum Jet Concentration

Paramount Refinery - NG Pipeline [PipelineNG-VCE]





Momentum Jet Explosion

Fuel Reactivity: Medium Obstacle Density: Low
Flame Expansion: 2.5-D Flame Speed: 0.29

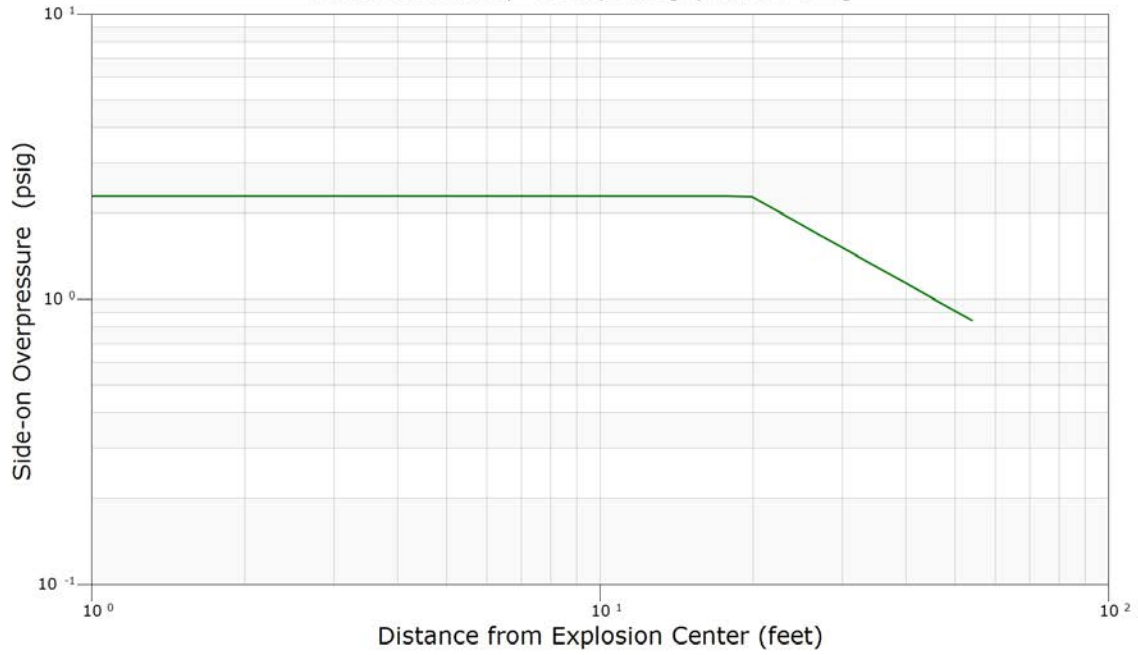
Mass of released material involved in explosion: 16.3758 lbs.

| Distance from Center of Flammable Cloud (feet) | Overpressure (psi gauge) | Impulse (psi-s) |
|--|-----------------------------|--------------------|
| 0.0 | 2.30 | 0.0854 |
| 4.9 | 2.30 | 0.0854 |
| 5.5 | 2.30 | 0.0854 |
| 6.0 | 2.30 | 0.0854 |
| 6.7 | 2.30 | 0.0854 |
| 7.3 | 2.30 | 0.0854 |
| 8.1 | 2.30 | 0.0854 |
| 9.0 | 2.30 | 0.0787 |
| 9.9 | 2.30 | 0.0714 |
| 10.9 | 2.30 | 0.0648 |
| 12.1 | 2.30 | 0.0587 |
| 13.4 | 2.30 | 0.0533 |
| 14.8 | 2.30 | 0.0483 |
| 16.3 | 2.30 | 0.0438 |
| 18.0 | 2.30 | 0.0398 |
| 19.9 | 2.29 | 0.0361 |
| 22.0 | 2.07 | 0.0327 |
| 24.3 | 1.87 | 0.0297 |
| 26.8 | 1.70 | 0.0269 |
| 29.7 | 1.54 | 0.0244 |
| 32.8 | 1.39 | 0.0221 |
| 36.2 | 1.26 | 0.0201 |
| 40.0 | 1.14 | 0.0182 |
| 44.2 | 1.03 | 0.0165 |
| 53.9 | 0.84 | 0.0136 |

The downwind distance to 1.00 psi is 45.8 feet
The downwind distance to 1.00 psi is 45.8 feet
The downwind distance to 1.00 psi is 45.8 feet



Momentum Jet Explosion Overpressure - Baker-Strehlow-Tang
Paramount Refinery - NG Pipeline [PipelineNG-VCE]





Case Inputs

Case Type : Fire Radiation
Case Name : PipelineNG-Jet
User ID :
Project Number :
Type of Units : English Units

NOTES:

MATERIAL MENU

| Materials Released | Number | Formula | Name | Fraction |
|--------------------|--------|--------------------------------|----------------|----------|
| Component 1 | 1 | CH ₄ | Methane | 0.903000 |
| Component 2 | 2 | C ₂ H ₆ | Ethane | 0.047000 |
| Component 3 | 3 | C ₃ H ₈ | Propane | 0.015000 |
| Component 4 | 5 | C ₄ H ₁₀ | n-Butane | 0.004000 |
| Component 5 | 7 | C ₅ H ₁₂ | n-Pentane | 0.001000 |
| Component 6 | 16 | N ₂ | Nitrogen | 0.010000 |
| Component 7 | 17 | CO ₂ | Carbon Dioxide | 0.020000 |
| Component 8 | | | | |
| Component 9 | | | | |
| Component 10 | | | | |

Temperature : 68.00 °F
Pressure : 500.00 psia
The material is GAS
The mixture is Natural Gas

NOTES:

ENVIRONMENT MENU

Wind speed : 20.00 mph
Relative humidity : 70 %
Air temperature : 68.0 °F

NOTES:

FIRE TYPE MENU

Fire radiation division: Jet fire
Vertical and horizontal isopleths
Elevation of flame base (from grade) : 1.0 feet
Elevation of target (from grade) : 0.0 feet
Diameter of jet fire tip : 8.0000 feet
Flow rate : 19.00 lb/sec
Angle of release from horizontal : 0.0 degrees

Fire radiation flux values

Radiation endpoint 1 : 3487 Btu/hr-sq.ft
Radiation endpoint 2 : 1600 Btu/hr-sq.ft
Radiation endpoint 3 : 500 Btu/hr-sq.ft

NOTES:



Jet Fire Radiation

Length of Flame : 83.0 feet
Flame Tilt from Horizontal: 18.3 degrees
Release Angle : 0.0 degrees
Release Point Elevation : 1.0 feet
Target Elevation : 0.0 feet
Wind Speed : 20.0 mph

| Downwind Distance at Target Height (feet) | Maximum Flux (Btu/hr-sq.ft) |
|---|-----------------------------------|
| 3.3 | *** |
| 16.4 | *** |
| 18.3 | *** |
| 20.5 | *** |
| 22.9 | *** |
| 25.6 | *** |
| 28.6 | *** |
| 32.0 | *** |
| 35.8 | *** |
| 40.0 | 7476 |
| 44.7 | 32029 |
| 50.0 | 33445 |
| 55.9 | 31220 |
| 62.5 | 28143 |
| 69.9 | 22826 |
| 78.1 | 15708 |
| 87.3 | 9146 |
| 97.6 | 5181 |
| 109.1 | 3072 |
| 122.0 | 1930 |
| 136.4 | 1270 |
| 152.4 | 866 |
| 170.4 | 605 |
| 190.5 | 432 |
| 213.0 | 313 |

*** Target Location inside Flame

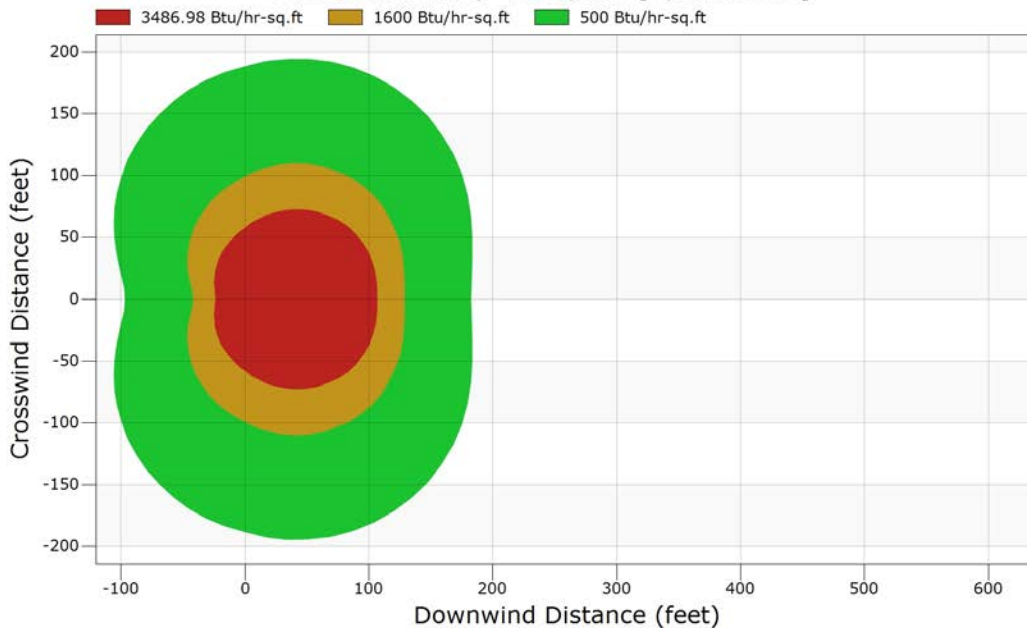
Downwind Distances to Endpoints

| Distance (feet) | Maximum Flux (Btu/hr-sq.ft) |
|--------------------|--------------------------------|
| 106.8 | 3487 |
| 129.2 | 1600 |
| 182.6 | 500 |



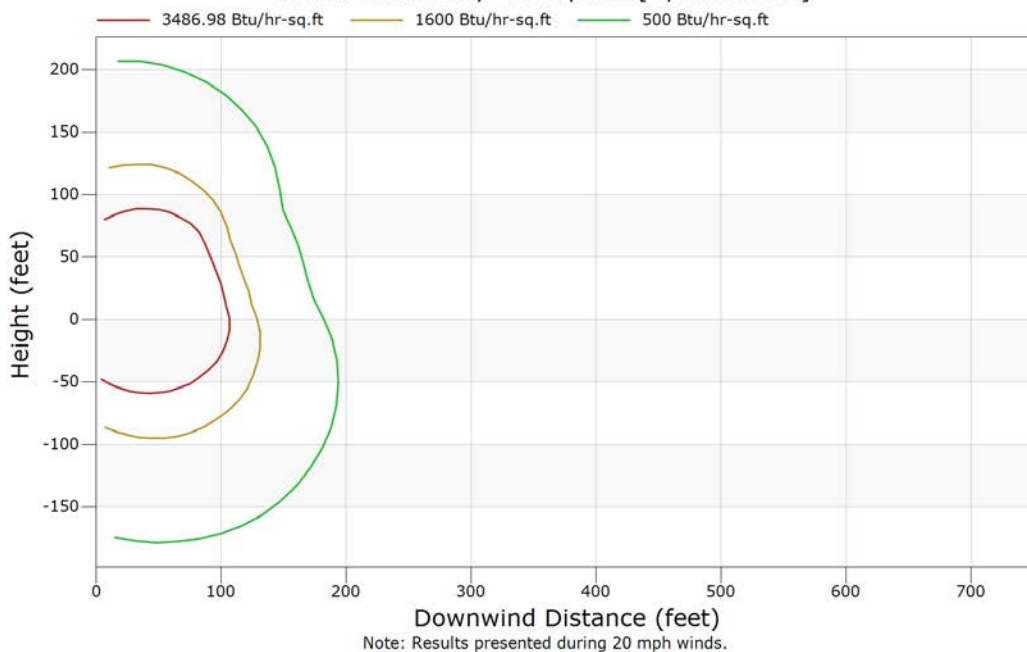
Jet Fire Radiant Heat Contours - Overhead View

Paramount Refinery - NG Pipeline [PipelineNG-Jet]



Jet Fire Radiant Heat Contours - Side View

Paramount Refinery - NG Pipeline [PipelineNG-Jet]





Case Inputs

Case Type : Vapor Dispersion
Case Name : PipelineNGProject-VCE
User ID :
Project Number :
Type of Units : English Units

NOTES:

MATERIAL MENU

| Materials Released | Number | Formula | Name | Fraction |
|--------------------|--------|--------------------------------|----------------|----------|
| Component 1 | 1 | CH ₄ | Methane | 0.903000 |
| Component 2 | 2 | C ₂ H ₆ | Ethane | 0.047000 |
| Component 3 | 3 | C ₃ H ₈ | Propane | 0.015000 |
| Component 4 | 5 | C ₄ H ₁₀ | n-Butane | 0.004000 |
| Component 5 | 7 | C ₅ H ₁₂ | n-Pentane | 0.001000 |
| Component 6 | 16 | N ₂ | Nitrogen | 0.010000 |
| Component 7 | 17 | CO ₂ | Carbon Dioxide | 0.020000 |
| Component 8 | | | | |
| Component 9 | | | | |
| Component 10 | | | | |

Temperature : 80.33 °F
Pressure : 1000.00 psia
The material is GAS
The mixture is Natural Gas

NOTES:

ENVIRONMENT MENU

| | |
|-------------------------------|-----------|
| Wind speed | 3.36 mph |
| Wind speed measurement height | 32.8 feet |
| Stability class <A-F> | F |
| Relative humidity | 70 % |
| Air temperature | 68.0 °F |
| Spill surface temperature | 68.0 °F |

| | |
|--------------------------------|------------------------------------|
| Substrate name | Soil |
| Substrate thermal conductivity | 1.0000 Btu/hr-ft-F |
| Substrate density | 100 lb/cu.ft |
| Substrate heat Capacity | 0.24 Btu/lb-F |
| Substrate delay time | 60 sec |
| Surrounding terrain | Long grass or crops > 15 cm (6 in) |

NOTES:



RELEASE MENU

Type of release: Unregulated, Continuous release
Release duration 60 min
Normal flow rate 15.41 lb/sec
Duration of normal flow 10 min
Volume of vessel 2793.00 cu.ft
Percent of vessel filled with liquid 100 %
Liquid head above release point 0 feet
Pipe inner diameter 15.00 inches
Equivalent release diameter 15.00 inches
Pipe length upstream of break 2000.0 feet
Height of release point 1.0 feet
Angle of release from horizontal 0.0 degrees

NOTES:

IMPOUNDMENT MENU

Unconfined

NOTES:

VDVE MENU

Vapor generation, dispersion and cloud explosion - Flammable calculation

Concentration endpoint 1 LFL mol%
Concentration endpoint 2 LFL mol%
Concentration endpoint 3 LFL mol%

Dispersion coefficient averaging time 1 min

Baker-Strehlow-Tang parameters

Fuel reactivity Medium
Obstacle density Low
Flame expansion 2.5-D

Overpressure values

Overpressure endpoint 1 1.00 psi
Overpressure endpoint 2 1.00 psi
Overpressure endpoint 3 1.00 psi

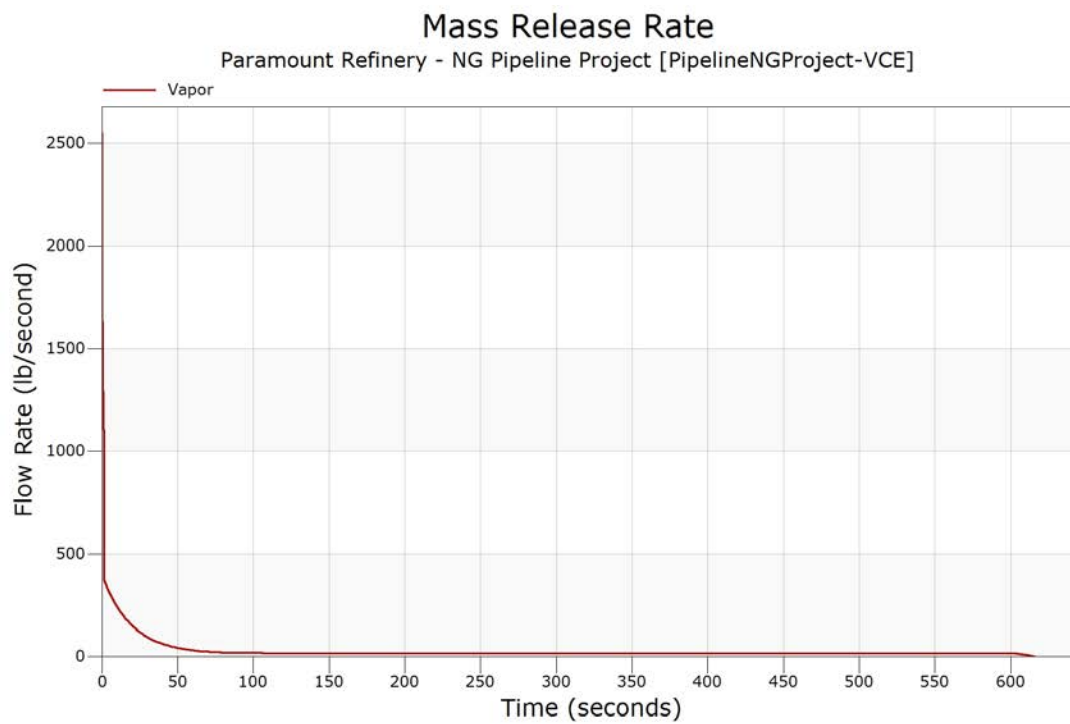
NOTES:

**Release Model**

| Time (sec) | Vapor (lb/sec) | Aerosol Rate (lb/sec) | Liquid Rate (lb/sec) | Total Rate (lb/sec) |
|---------------|-------------------|--------------------------|-------------------------|------------------------|
| 0.000000 | 2552.689 | 0.000000 | 0.000000 | 2552.689 |
| 0.100000 | 2209.479 | 0.000000 | 0.000000 | 2209.479 |
| 0.300000 | 1801.895 | 0.000000 | 0.000000 | 1801.895 |
| 0.500000 | 1559.236 | 0.000000 | 0.000000 | 1559.236 |
| 0.700000 | 1393.886 | 0.000000 | 0.000000 | 1393.886 |
| 1.000000 | 1221.922 | 0.000000 | 0.000000 | 1221.922 |
| 3.000000 | 344.2140 | 0.000000 | 0.000000 | 344.2140 |
| 5.000000 | 311.7222 | 0.000000 | 0.000000 | 311.7222 |
| 7.000000 | 282.3788 | 0.000000 | 0.000000 | 282.3788 |
| 10.00000 | 243.6251 | 0.000000 | 0.000000 | 243.6251 |
| 20.00000 | 150.1858 | 0.000000 | 0.000000 | 150.1858 |
| 30.00000 | 94.52364 | 0.000000 | 0.000000 | 94.52364 |
| 40.00000 | 61.60285 | 0.000000 | 0.000000 | 61.60285 |
| 50.00000 | 41.10363 | 0.000000 | 0.000000 | 41.10363 |
| 60.00000 | 29.10712 | 0.000000 | 0.000000 | 29.10712 |
| 70.00000 | 22.41097 | 0.000000 | 0.000000 | 22.41097 |
| 85.00000 | 17.79197 | 0.000000 | 0.000000 | 17.79197 |
| 100.0000 | 16.09239 | 0.000000 | 0.000000 | 16.09239 |
| 200.0000 | 15.41000 | 0.000000 | 0.000000 | 15.41000 |
| 300.0000 | 15.41000 | 0.000000 | 0.000000 | 15.41000 |
| 400.0000 | 15.41000 | 0.000000 | 0.000000 | 15.41000 |
| 500.0000 | 15.41000 | 0.000000 | 0.000000 | 15.41000 |
| 600.0000 | 15.41000 | 0.000000 | 0.000000 | 15.41000 |
| 615.4575 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| Totals (lb) | 18186.35 | 0.000000 | 0.000000 | 18186.35 |

Flowrate for Jet Fire [immediate ignition] = 158.8052 lb/sec.
Jet Fire [delayed ignition] = 15.41834 lb/sec.

Reason for Ending: Pressure Near Atmospheric





Release Compositions

| Component Number | Component Name, Formula |
|------------------|---|
| 1 | Methane, CH ₄ |
| 2 | Ethane, C ₂ H ₆ |
| 3 | Propane, C ₃ H ₈ |
| 5 | n-Butane, C ₄ H ₁₀ |
| 7 | n-Pentane, C ₅ H ₁₂ |
| 16 | Nitrogen, N ₂ |
| 17 | Carbon Dioxide, CO ₂ |

Composition (Mole Fraction) of Fluid Streams

| Comp. No. | Feed Stream | Momentum Jet Stream | | | Total Stream | Liquid Pool Stream |
|-----------|-------------|---------------------|------------------|----------------|--------------|--------------------|
| | | Flashed Vapor | Evaporated Vapor | Aerosol Liquid | | Liquid to Ground |
| 1 | 0.903000 | 0.903000 | 0.000000 | 0.000000 | 0.903000 | 0.000000 |
| 2 | 0.047000 | 0.047000 | 0.000000 | 0.000000 | 0.047000 | 0.000000 |
| 3 | 0.015000 | 0.015000 | 0.000000 | 0.000000 | 0.015000 | 0.000000 |
| 5 | 0.004000 | 0.004000 | 0.000000 | 0.000000 | 0.004000 | 0.000000 |
| 7 | 0.001000 | 0.001000 | 0.000000 | 0.000000 | 0.001000 | 0.000000 |
| 16 | 0.010000 | 0.010000 | 0.000000 | 0.000000 | 0.010000 | 0.000000 |
| 17 | 0.020000 | 0.020000 | 0.000000 | 0.000000 | 0.020000 | 0.000000 |
| | 1.000000 | 1.000000 | 0.000000 | 0.000000 | 1.000000 | 0.000000 |

Flammable Limits (Mole %) of Fluid Streams

| Limit | Feed Stream | Momentum Jet Stream | Liquid Pool Stream |
|-------|-------------|---------------------|--------------------|
| LFL | 4.84 | 4.84 | |
| UFL | 15.03 | 15.03 | |
| LBV | | 0.36 m/s | |



Momentum Jet Dispersion

concentration limits

Endpoint 1 (highest) = 0.048408 mole fraction
Endpoint 2 (middle) = 0.048408 mole fraction
Endpoint 3 (lowest) = 0.048408 mole fraction

| downwind distance (ft) | centerline conc. (mole frac.) | ground conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) | centerline height (ft) |
|------------------------------|-------------------------------------|---------------------------------|--------------------------------|--------------------------------|--------------------------------|------------------------------|
| 0 | 1.000000 | 0.000000 | 1.7 | 1.7 | 1.7 | 1.0 |
| 5 | 0.693025 | 0.322115 | 2.3 | 2.3 | 2.3 | 1.3 |
| 10 | 0.540711 | 0.277937 | 2.9 | 2.9 | 2.9 | 1.5 |
| 15 | 0.445249 | 0.241416 | 3.4 | 3.4 | 3.4 | 1.8 |
| 20 | 0.379077 | 0.212276 | 3.8 | 3.8 | 3.8 | 2.0 |
| 25 | 0.330416 | 0.189040 | 4.3 | 4.3 | 4.3 | 2.3 |
| 30 | 0.293099 | 0.170232 | 4.7 | 4.7 | 4.7 | 2.6 |
| 35 | 0.263376 | 0.154636 | 5.0 | 5.0 | 5.0 | 2.8 |
| 40 | 0.239119 | 0.141587 | 5.4 | 5.4 | 5.4 | 3.1 |
| 45 | 0.219032 | 0.130458 | 5.7 | 5.7 | 5.7 | 3.4 |
| 50 | 0.202127 | 0.120953 | 6.0 | 6.0 | 6.0 | 3.6 |
| 55 | 0.187511 | 0.112681 | 6.3 | 6.3 | 6.3 | 3.9 |
| 60 | 0.174990 | 0.105395 | 6.6 | 6.6 | 6.6 | 4.2 |
| 65 | 0.163963 | 0.098946 | 6.9 | 6.9 | 6.9 | 4.4 |
| 70 | 0.154280 | 0.093226 | 7.1 | 7.1 | 7.1 | 4.7 |
| 75 | 0.145599 | 0.088009 | 7.3 | 7.3 | 7.3 | 5.0 |
| 80 | 0.137873 | 0.083413 | 7.6 | 7.6 | 7.6 | 5.2 |
| 85 | 0.130834 | 0.079125 | 7.8 | 7.8 | 7.8 | 5.5 |
| 90 | 0.124564 | 0.075303 | 7.9 | 7.9 | 7.9 | 5.8 |
| 95 | 0.118860 | 0.071826 | 8.1 | 8.1 | 8.1 | 6.1 |
| 100 | 0.113678 | 0.068647 | 8.3 | 8.3 | 8.3 | 6.3 |
| 105 | 0.108856 | 0.065681 | 8.4 | 8.4 | 8.4 | 6.6 |
| 110 | 0.104415 | 0.062930 | 8.5 | 8.5 | 8.5 | 6.9 |
| 115 | 0.100335 | 0.060369 | 8.6 | 8.6 | 8.6 | 7.2 |
| 120 | 0.096530 | 0.057996 | 8.7 | 8.7 | 8.7 | 7.5 |
| 125 | 0.093020 | 0.055760 | 8.8 | 8.8 | 8.8 | 7.8 |
| 130 | 0.089768 | 0.053716 | 8.8 | 8.8 | 8.8 | 8.1 |
| 135 | 0.086675 | 0.051754 | 8.9 | 8.9 | 8.9 | 8.4 |
| 140 | 0.083815 | 0.049918 | 8.9 | 8.9 | 8.9 | 8.7 |
| 145 | 0.081152 | 0.048215 | 8.9 | 8.9 | 8.9 | 9.0 |
| 150 | 0.078614 | 0.046594 | 8.9 | 8.9 | 8.9 | 9.3 |
| 155 | 0.076227 | 0.045037 | 8.9 | 8.9 | 8.9 | 9.6 |
| 160 | 0.074000 | 0.043602 | 8.8 | 8.8 | 8.8 | 9.9 |
| 165 | 0.071887 | 0.042221 | 8.8 | 8.8 | 8.8 | 10.2 |
| 170 | 0.069873 | 0.040905 | 8.7 | 8.7 | 8.7 | 10.5 |

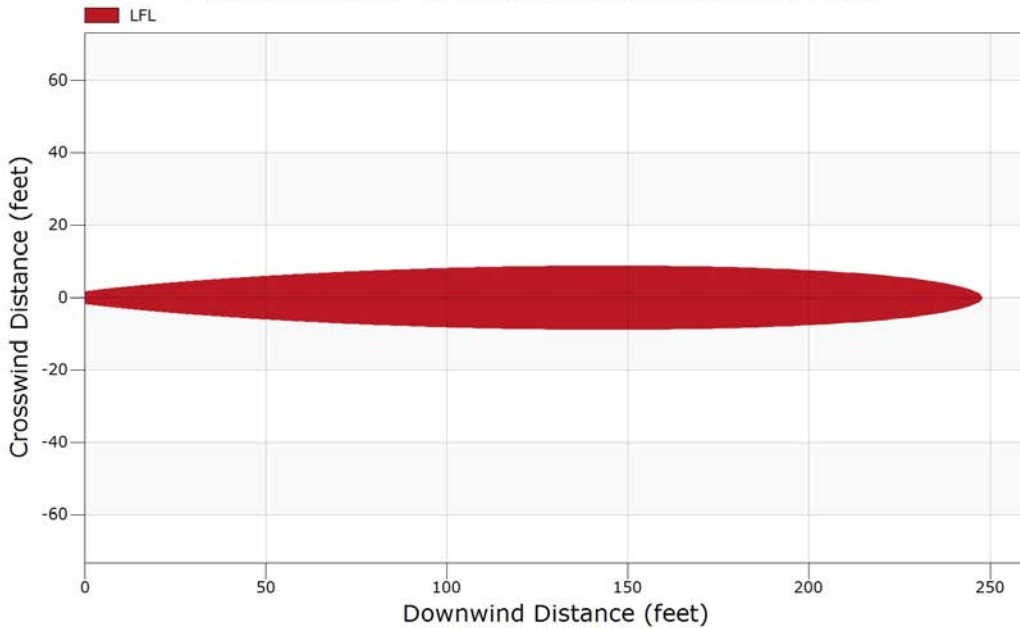


| downwind distance (ft) | centerline conc. (mole frac.) | ground conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) | centerline height (ft) |
|------------------------|-------------------------------|---------------------------|--------------------------|--------------------------|--------------------------|------------------------|
| 175 | 0.067972 | 0.039654 | 8.6 | 8.6 | 8.6 | 10.8 |
| 180 | 0.066180 | 0.038468 | 8.4 | 8.4 | 8.4 | 11.1 |
| 185 | 0.064483 | 0.037328 | 8.3 | 8.3 | 8.3 | 11.4 |
| 190 | 0.062843 | 0.036236 | 8.1 | 8.1 | 8.1 | 11.8 |
| 195 | 0.061283 | 0.035188 | 7.9 | 7.9 | 7.9 | 12.1 |
| 200 | 0.059787 | 0.034181 | 7.6 | 7.6 | 7.6 | 12.4 |
| 205 | 0.058379 | 0.033241 | 7.4 | 7.4 | 7.4 | 12.8 |
| 210 | 0.057029 | 0.032325 | 7.0 | 7.0 | 7.0 | 13.1 |
| 215 | 0.055715 | 0.031438 | 6.7 | 6.7 | 6.7 | 13.5 |
| 220 | 0.054470 | 0.030584 | 6.2 | 6.2 | 6.2 | 13.8 |
| 225 | 0.053280 | 0.029775 | 5.7 | 5.7 | 5.7 | 14.2 |
| 230 | 0.052142 | 0.028992 | 5.2 | 5.2 | 5.2 | 14.5 |
| 235 | 0.051044 | 0.028236 | 4.5 | 4.5 | 4.5 | 14.9 |
| 240 | 0.049982 | 0.027505 | 3.5 | 3.5 | 3.5 | 15.2 |
| 245 | 0.048960 | 0.026795 | 2.1 | 2.1 | 2.1 | 15.6 |

| Endpoint (mole frac., mixture) | Downwind Distance (feet) | Approximate Time (seconds) |
|--------------------------------|--------------------------|----------------------------|
| 1 0.048408 (LFL) | 247.8 | 2 |
| 2 0.048408 (LFL) | 247.8 | 2 |
| 3 0.048408 (LFL) | 247.8 | 2 |

Momentum Jet Contours - Overhead View

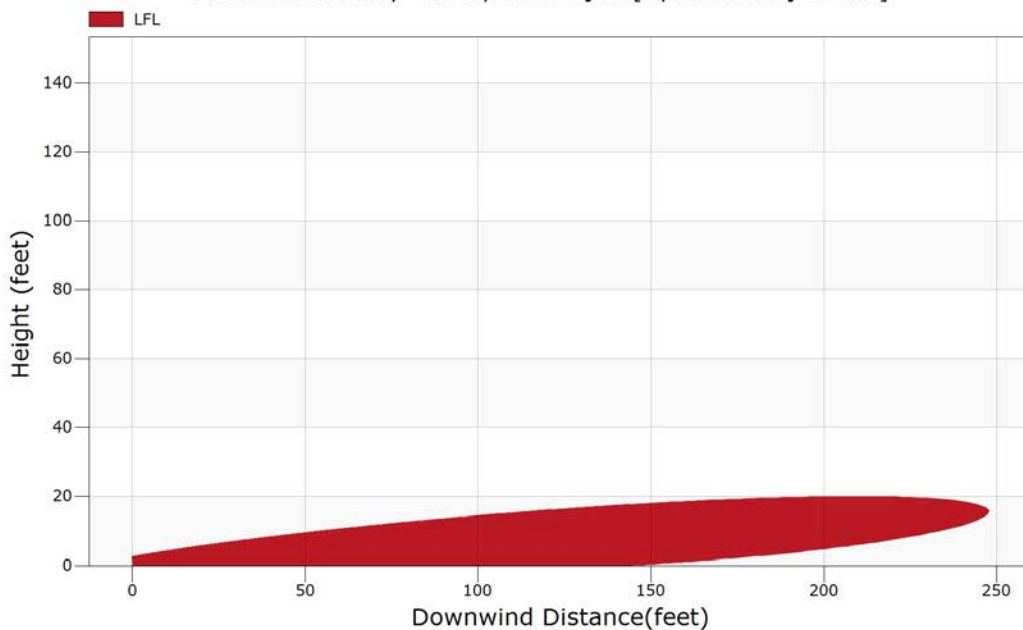
Paramount Refinery - NG Pipeline Project [PipelineNGProject-VCE]





Momentum Jet Contours - Side View

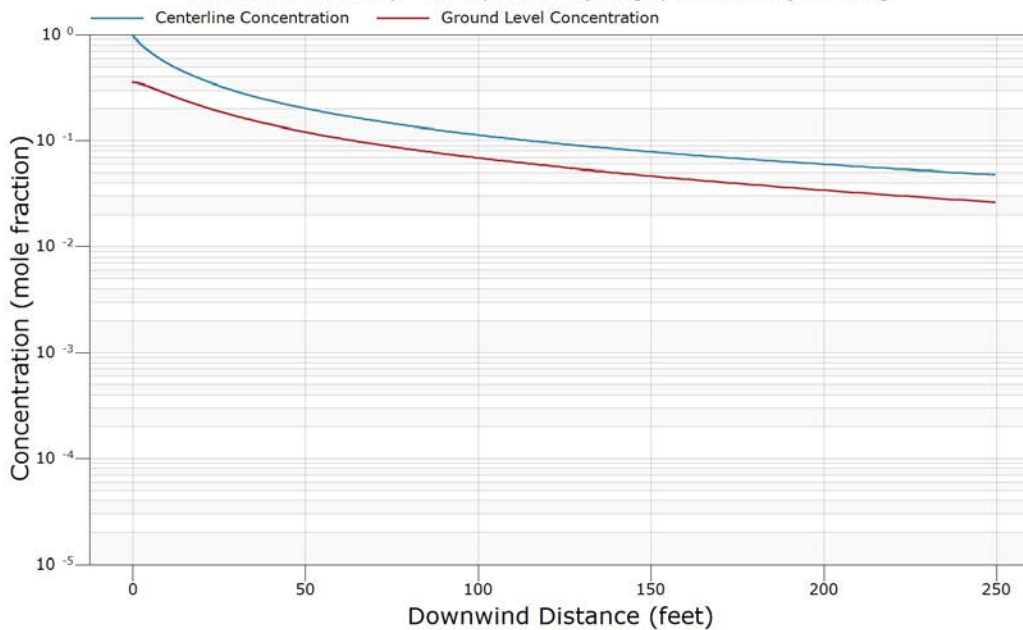
Paramount Refinery - NG Pipeline Project [PipelineNGProject-VCE]



Note: Release during 3.36 mph winds and F stability.

Momentum Jet Concentration

Paramount Refinery - NG Pipeline Project [PipelineNGProject-VCE]



Note: Release during 3.36 mph winds and F stability.



Momentum Jet Explosion

Fuel Reactivity: Medium

Obstacle Density: Low

Flame Expansion: 2.5-D

Flame Speed: 0.29

Mass of released material involved in explosion: 331.11 lbs.

| Distance from Center of Flammable Cloud (feet) | Overpressure (psi gauge) | Impulse (psi-s) |
|--|-----------------------------|--------------------|
| 0.0 | 2.30 | 0.2327 |
| 13.4 | 2.30 | 0.2327 |
| 14.8 | 2.30 | 0.2327 |
| 16.3 | 2.30 | 0.2327 |
| 18.0 | 2.30 | 0.2327 |
| 19.9 | 2.30 | 0.2327 |
| 21.9 | 2.30 | 0.2327 |
| 24.2 | 2.30 | 0.2169 |
| 26.6 | 2.30 | 0.1971 |
| 29.4 | 2.30 | 0.1791 |
| 32.4 | 2.30 | 0.1627 |
| 35.7 | 2.30 | 0.1479 |
| 39.4 | 2.30 | 0.1344 |
| 43.4 | 2.30 | 0.1221 |
| 47.9 | 2.30 | 0.1109 |
| 52.8 | 2.30 | 0.1008 |
| 58.2 | 2.13 | 0.0916 |
| 64.2 | 1.93 | 0.0832 |
| 70.8 | 1.75 | 0.0756 |
| 78.1 | 1.59 | 0.0687 |
| 86.1 | 1.44 | 0.0624 |
| 94.9 | 1.31 | 0.0567 |
| 104.7 | 1.18 | 0.0516 |
| 115.4 | 1.07 | 0.0468 |
| 140.4 | 0.88 | 0.0387 |

The downwind distance to 1.00 psi is 125.2 feet

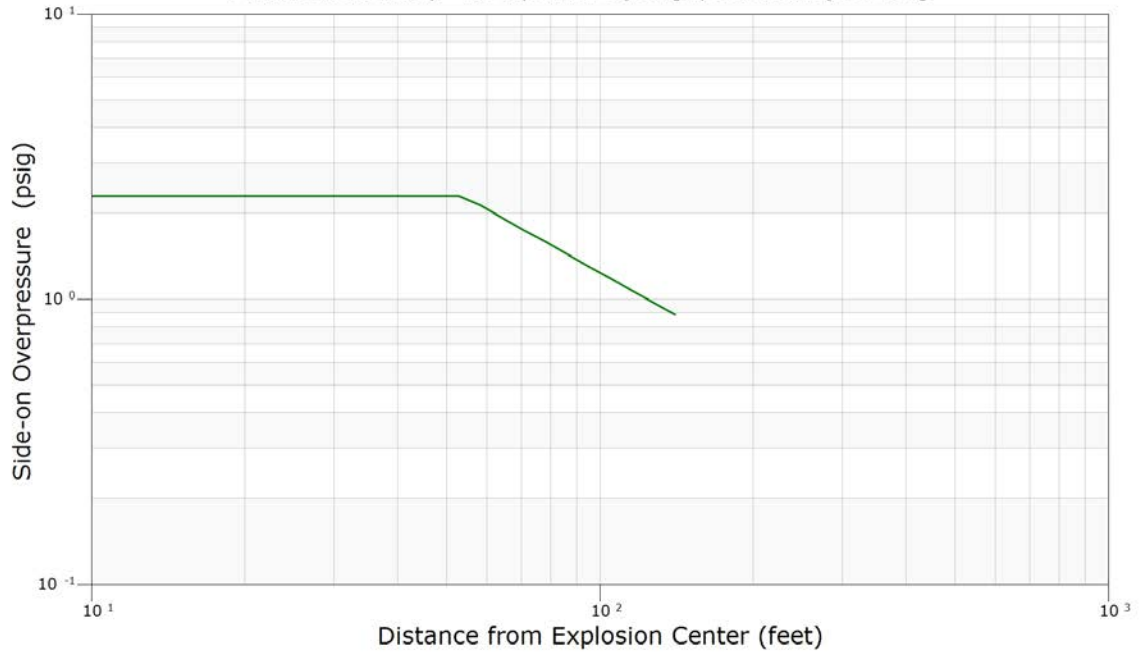
The downwind distance to 1.00 psi is 125.2 feet

The downwind distance to 1.00 psi is 125.2 feet



Momentum Jet Explosion Overpressure - Baker-Strehlow-Tang

Paramount Refinery - NG Pipeline Project [PipelineNGProject-VCE]





Case Inputs

Case Type : Fire Radiation
Case Name : PipelineNGProject-Torch
User ID :
Project Number :
Type of Units : English Units

NOTES:

MATERIAL MENU

| Materials Released | Number | Formula | Name | Fraction |
|--------------------|--------|--------------------------------|----------------|----------|
| Component 1 | 1 | CH ₄ | Methane | 0.903000 |
| Component 2 | 2 | C ₂ H ₆ | Ethane | 0.047000 |
| Component 3 | 3 | C ₃ H ₈ | Propane | 0.015000 |
| Component 4 | 5 | C ₄ H ₁₀ | n-Butane | 0.004000 |
| Component 5 | 7 | C ₅ H ₁₂ | n-Pentane | 0.001000 |
| Component 6 | 16 | N ₂ | Nitrogen | 0.010000 |
| Component 7 | 17 | CO ₂ | Carbon Dioxide | 0.020000 |
| Component 8 | | | | |
| Component 9 | | | | |
| Component 10 | | | | |

Temperature : 68.00 °F
Pressure : 1000.00 psia
The material is GAS
The mixture is Natural Gas

NOTES:

ENVIRONMENT MENU

Wind speed : 20.00 mph
Relative humidity : 70 %
Air temperature : 68.0 °F

NOTES:

FIRE TYPE MENU

Fire radiation division: Jet fire
Vertical and horizontal isopleths
Elevation of flame base (from grade) : 1.0 feet
Elevation of target (from grade) : 0.0 feet
Diameter of jet fire tip : 1.3300 feet
Flow rate : 159.00 lb/sec
Angle of release from horizontal : 0.0 degrees

Fire radiation flux values

Radiation endpoint 1 : 3487 Btu/hr-sq.ft
Radiation endpoint 2 : 1600 Btu/hr-sq.ft
Radiation endpoint 3 : 500 Btu/hr-sq.ft

NOTES:



Jet Fire Radiation

Length of Flame : 221.6 feet
Flame Tilt from Horizontal: 7.4 degrees
Release Angle : 0.0 degrees
Release Point Elevation : 1.0 feet
Target Elevation : 0.0 feet
Wind Speed : 20.0 mph

| Downwind Distance at Target Height (feet) | Maximum Flux (Btu/hr-sq.ft) |
|---|-----------------------------------|
| 3.3 | *** |
| 16.4 | *** |
| 19.0 | *** |
| 22.0 | *** |
| 25.5 | *** |
| 29.5 | *** |
| 34.2 | *** |
| 39.6 | *** |
| 45.9 | *** |
| 53.2 | *** |
| 61.6 | *** |
| 71.3 | *** |
| 82.6 | *** |
| 95.7 | *** |
| 110.8 | *** |
| 128.4 | *** |
| 148.7 | *** |
| 172.3 | *** |
| 199.5 | *** |
| 231.1 | 14255 |
| 267.7 | 4071 |
| 310.1 | 1793 |
| 359.2 | 926 |
| 416.0 | 521 |
| 481.9 | 311 |

*** Target Location inside Flame

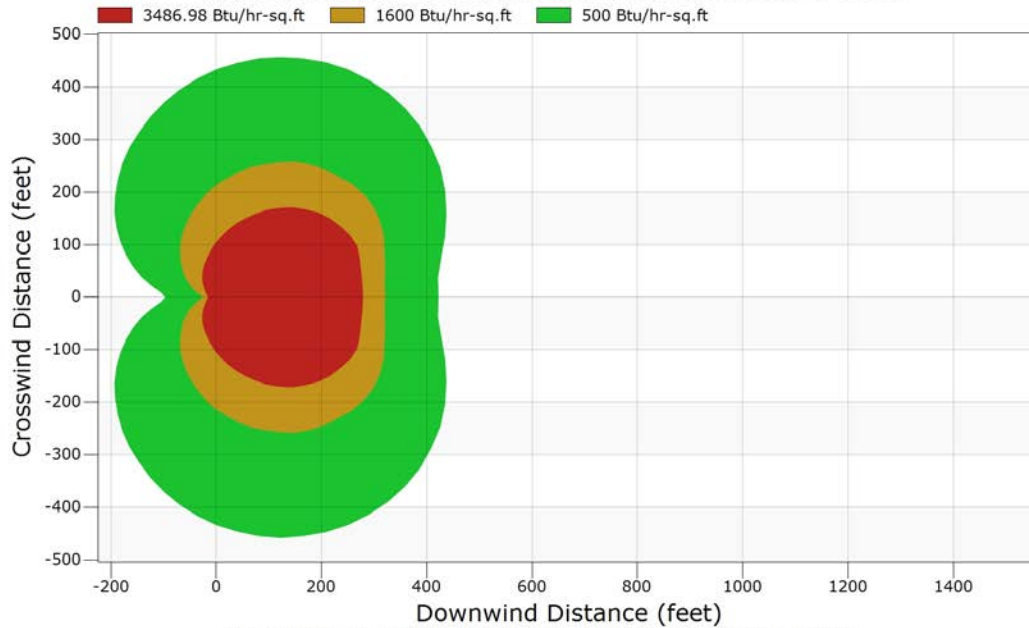
Downwind Distances to Endpoints

| Distance (feet) | Maximum Flux (Btu/hr-sq.ft) |
|--------------------|--------------------------------|
| 278.6 | 3487 |
| 321.0 | 1600 |
| 422.7 | 500 |



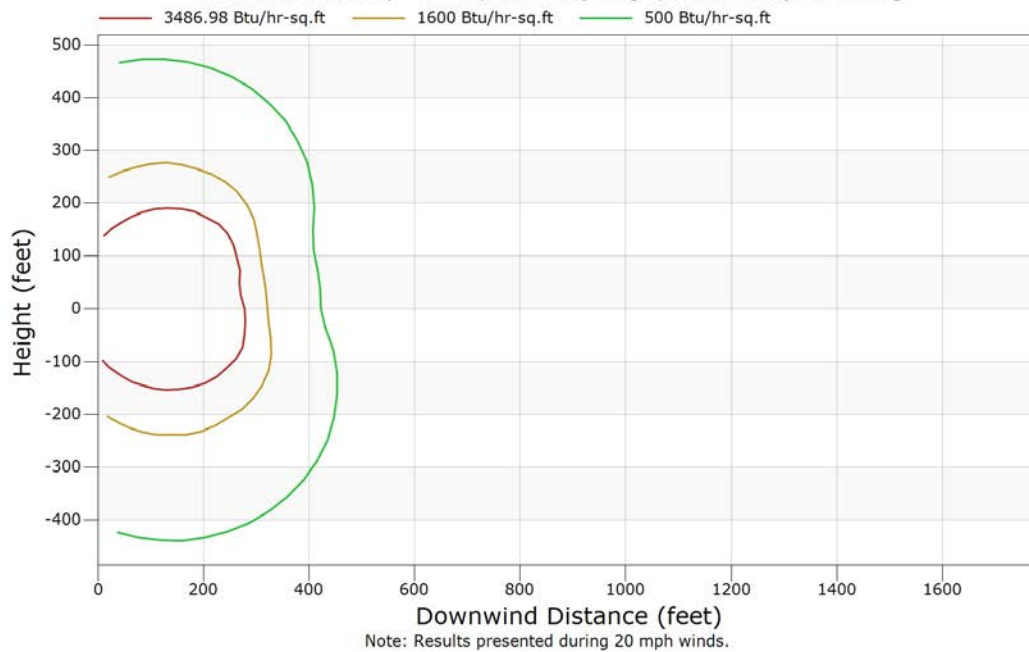
Jet Fire Radiant Heat Contours - Overhead View

Paramount Refinery - NG Pipeline Project [PipelineNGProject-Torch]



Jet Fire Radiant Heat Contours - Side View

Paramount Refinery - NG Pipeline Project [PipelineNGProject-Torch]





Case Inputs

Case Type : Vapor Dispersion
Case Name : RailCrudeVCE
User ID :
Project Number :
Type of Units : English Units

NOTES:

MATERIAL MENU

| Materials Released | Number | Formula | Name | Fraction |
|--------------------|--------|---------|---------------|----------|
| Component 1 | 8 | C6H14 | n-Hexane | 0.011000 |
| Component 2 | 11 | C9H20 | n-Nonane | 0.033000 |
| Component 3 | 13 | C11H24 | n-Undecane | 0.048000 |
| Component 4 | 22 | C38H61 | PHC-500 | 0.367000 |
| Component 5 | 24 | C51H82 | PHC-700 | 0.192000 |
| Component 6 | 32 | C13H28 | Tridecane | 0.064000 |
| Component 7 | 34 | C15H32 | Pentadecane | 0.112000 |
| Component 8 | 36 | C17H36 | n-Heptadecane | 0.173000 |
| Component 9 | | | | |
| Component 10 | | | | |

Temperature : 68.00 °F
Pressure : 15.00 psia

The material is LIQUID
The mixture is Heavy Crude

NOTES:

ENVIRONMENT MENU

Wind speed 3.36 mph
Wind speed measurement height 32.8 feet
Stability class <A-F> F
Relative humidity 70 %
Air temperature 68.0 °F
Spill surface temperature 68.0 °F

Substrate name High density concrete
Substrate thermal conductivity 2.1999 Btu/hr-ft-F
Substrate density 150 lb/cu.ft
Substrate heat Capacity 0.16 Btu/lb-F
Substrate delay time 0 sec
Surrounding terrain Long grass or crops > 15 cm (6 in)

NOTES:



RELEASE MENU

Type of release: Unregulated, Continuous release
Release duration 10 min
Normal flow rate 290.70 lb/sec
Duration of normal flow 10 min
Volume of vessel 4010.42 cu.ft
Percent of vessel filled with liquid 80 %
Liquid head above release point 6 feet
Pipe inner diameter 3.07 inches
Equivalent release diameter 3.07 inches
Pipe length upstream of break 0.0 feet
Height of release point 1.0 feet
Angle of release from horizontal 0.0 degrees

NOTES:

IMPOUNDMENT MENU

Unconfined

NOTES:

VDVE MENU

Vapor generation, dispersion and cloud explosion - Flammable calculation

Concentration endpoint 1 LFL mol%
Concentration endpoint 2 LFL mol%
Concentration endpoint 3 LFL mol%

Dispersion coefficient averaging time 1 min

Baker-Strehlow-Tang parameters

Fuel reactivity Medium
Obstacle density Low
Flame expansion 2.5-D

Overpressure values

Overpressure endpoint 1 1.00 psi
Overpressure endpoint 2 1.00 psi
Overpressure endpoint 3 1.00 psi

NOTES:

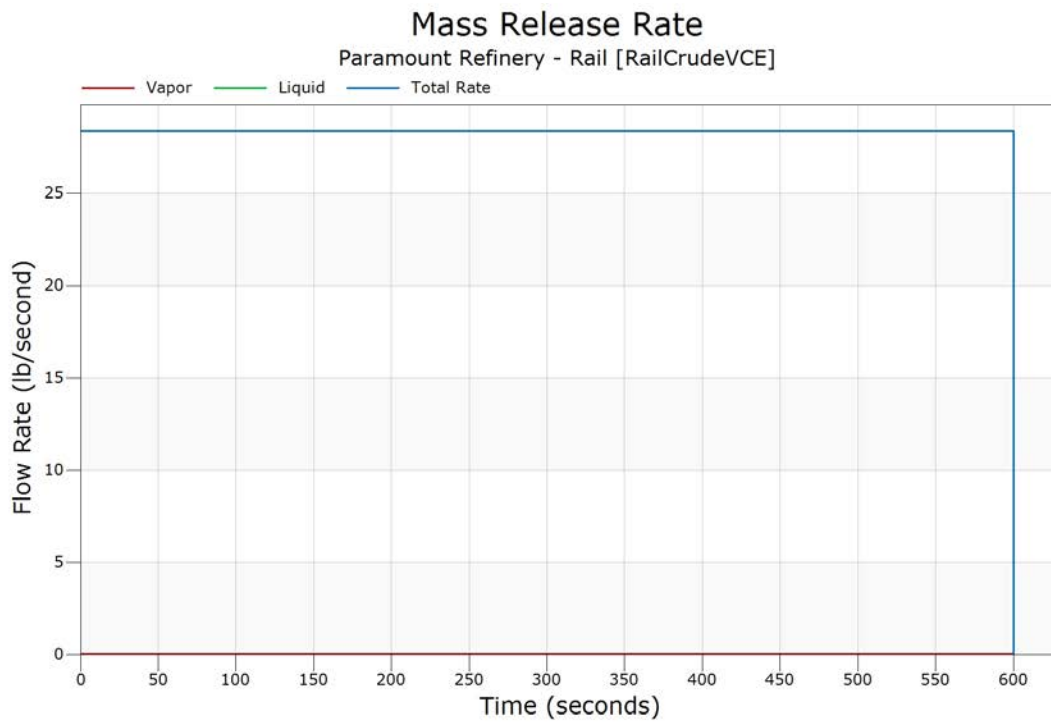


Release Model

| Time (sec) | Vapor (lb/sec) | Aerosol Rate (lb/sec) | Liquid Rate (lb/sec) | Total Rate (lb/sec) |
|---------------|-------------------|--------------------------|-------------------------|------------------------|
| 0.000000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 0.100000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 0.300000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 0.500000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 0.700000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 1.000000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 3.000000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 5.000000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 7.000000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 10.00000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 20.00000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 30.00000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 40.00000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 50.00000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 60.00000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 70.00000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 85.00000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 100.0000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 200.0000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 300.0000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 400.0000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 500.0000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| 600.0000 | .6543670E-02 | 0.000000 | 28.40268 | 28.40923 |
| Totals (lb) | 3.926202 | 0.000000 | 17041.61 | 17045.54 |

Flowrate for Jet Fire [immediate ignition] = 0.6543670E-02 lb/sec.
Jet Fire [delayed ignition] = 0.6543670E-02 lb/sec.

Reason for Ending: Reached Stop Time





Release Compositions

| Component Number | Component Name, Formula |
|------------------|-------------------------|
| 8 | n-Hexane, C6H14 |
| 11 | n-Nonane, C9H20 |
| 13 | n-Undecane, C11H24 |
| 22 | PHC-500, C38H61 |
| 24 | PHC-700, C51H82 |
| 32 | Tridecane, C13H28 |
| 34 | Pentadecane, C15H32 |
| 36 | n-Heptadecane, C17H36 |

Composition (Mole Fraction) of Fluid Streams

| Comp. No. | Feed Stream | Momentum Jet Stream | | | Total Stream | Liquid Pool Stream |
|-----------|-------------|---------------------|------------------|----------------|--------------|--------------------|
| | | Flashed Vapor | Evaporated Vapor | Aerosol Liquid | | Liquid to Ground |
| 8 | 0.011000 | 0.000000 | 0.896417 | 0.000000 | 0.896417 | 0.010998 |
| 11 | 0.033000 | 0.000000 | 0.087394 | 0.000000 | 0.087394 | 0.033000 |
| 13 | 0.048000 | 0.000000 | 0.013673 | 0.000000 | 0.013673 | 0.048000 |
| 22 | 0.367000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.367001 |
| 24 | 0.192000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.192000 |
| 32 | 0.064000 | 0.000000 | 0.002033 | 0.000000 | 0.002033 | 0.064000 |
| 34 | 0.112000 | 0.000000 | 0.000401 | 0.000000 | 0.000401 | 0.112000 |
| 36 | 0.173000 | 0.000000 | 0.000083 | 0.000000 | 0.000083 | 0.173000 |
| | 1.000000 | 0.000000 | 1.000000 | 0.000000 | 1.000000 | 1.000000 |

Flammable Limits (Mole %) of Fluid Streams

| Limit | Feed Stream | Momentum Jet Stream | Liquid Pool Stream |
|-------|-------------|---------------------|--------------------|
| LFL | 0.44 | 1.05 | 0.44 |
| UFL | 6.25 | 6.53 | 6.25 |
| LBV | | 0.42 m/s | 0.40 m/s |



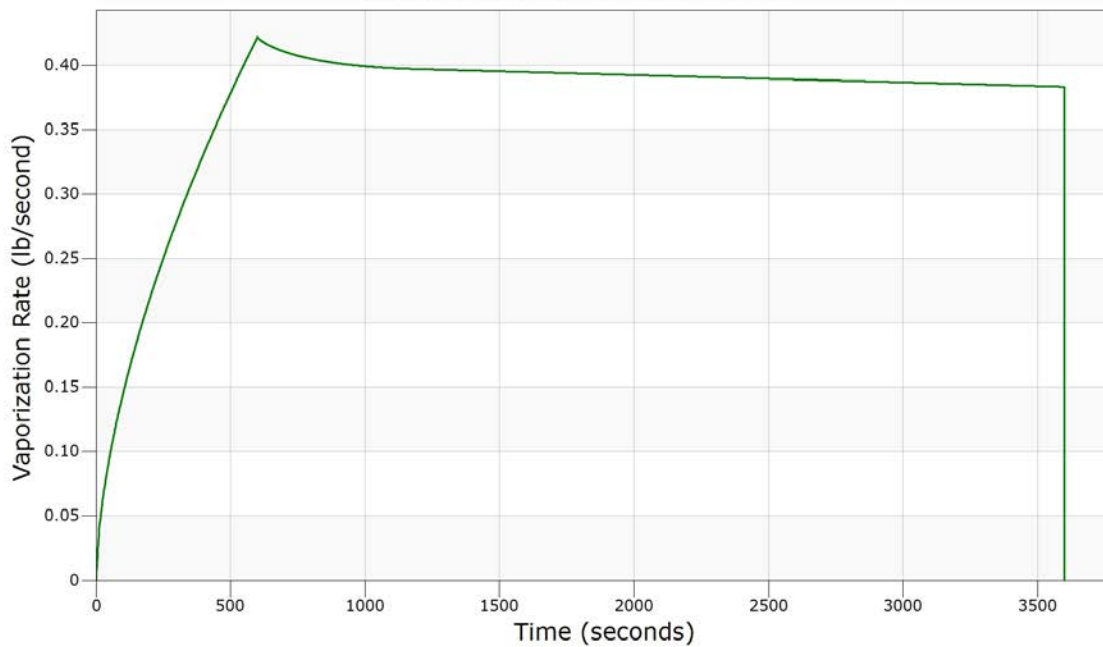
Pool Spreading and Vaporization

| Time (sec) | Liquid Remaining (ft3) | Pool/Dike Radius (feet) | Vapor Rate (lb/sec) |
|---------------|------------------------------|-------------------------------|------------------------|
| 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| 40.0000 | 26.0739 | 7.34679 | 0.835905E-01 |
| 80.0000 | 52.0962 | 9.25492 | 0.126627 |
| 120.000 | 78.0843 | 10.5919 | 0.161433 |
| 160.000 | 104.041 | 11.6549 | 0.191771 |
| 200.000 | 129.972 | 12.5518 | 0.219146 |
| 240.000 | 155.879 | 13.3353 | 0.244382 |
| 280.000 | 181.761 | 14.0354 | 0.267972 |
| 320.000 | 207.626 | 14.6709 | 0.290194 |
| 360.000 | 233.469 | 15.2556 | 0.311315 |
| 400.000 | 259.291 | 15.7979 | 0.331531 |
| 440.000 | 285.099 | 16.3051 | 0.350932 |
| 480.000 | 310.886 | 16.7822 | 0.369627 |
| 520.000 | 336.658 | 17.2333 | 0.387683 |
| 560.000 | 362.399 | 17.6614 | 0.405210 |
| 600.000 | 388.143 | 18.0699 | 0.422229 |
| 640.000 | 387.755 | 18.0640 | 0.416233 |
| 680.000 | 387.402 | 18.0581 | 0.412485 |
| 720.000 | 387.013 | 18.0522 | 0.409619 |
| 760.000 | 386.625 | 18.0466 | 0.407282 |
| 800.000 | 386.272 | 18.0407 | 0.405342 |
| 840.000 | 385.883 | 18.0348 | 0.403733 |
| 880.000 | 385.530 | 18.0292 | 0.402366 |
| 1130.00 | 383.235 | 17.9931 | 0.397692 |
| 1380.00 | 380.939 | 17.9573 | 0.396171 |
| 1630.00 | 378.679 | 17.9216 | 0.394760 |
| 1880.00 | 376.384 | 17.8858 | 0.393327 |
| 2130.00 | 374.159 | 17.8497 | 0.391916 |
| 2380.00 | 371.899 | 17.8140 | 0.390505 |
| 2630.00 | 369.639 | 17.7782 | 0.389094 |
| 2880.00 | 367.414 | 17.7425 | 0.387683 |
| 3130.00 | 365.189 | 17.7064 | 0.386272 |
| 3380.00 | 362.999 | 17.6706 | 0.384861 |
| 3600.00 | 361.022 | 17.6391 | 0.383626 |

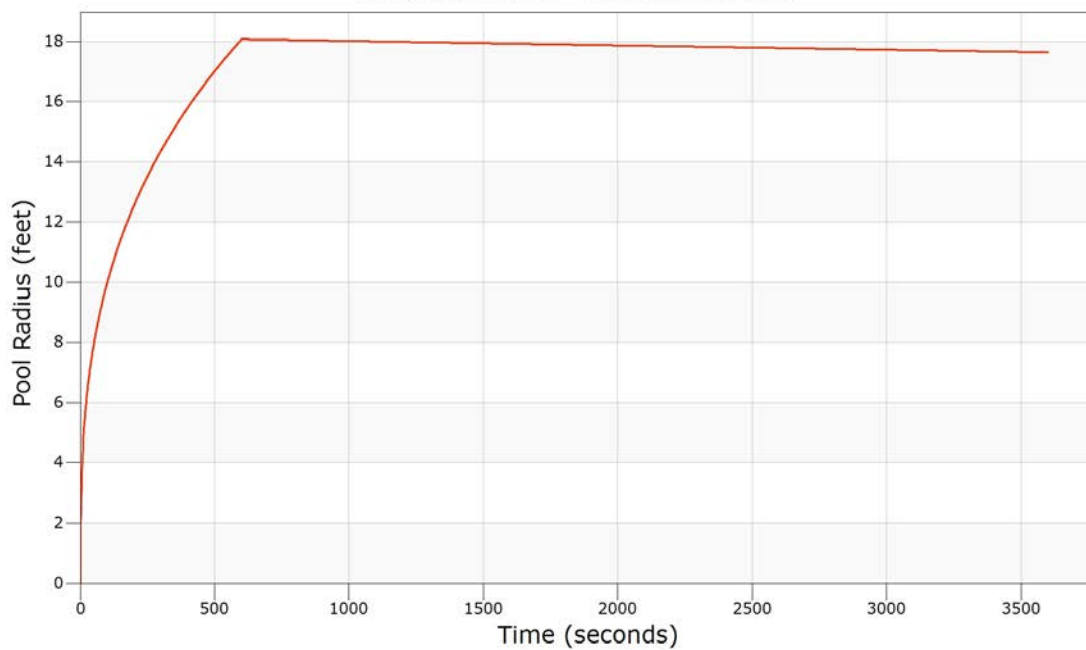
Ending Message: Normal Ending



Pool Vaporization Rate
Paramount Refinery - Rail [RailCrudeVCE]



Pool Radius
Paramount Refinery - Rail [RailCrudeVCE]





Momentum Jet Dispersion

concentration limits

Endpoint 1 (highest) = 0.010531 mole fraction
Endpoint 2 (middle) = 0.010531 mole fraction
Endpoint 3 (lowest) = 0.010531 mole fraction

| downwind distance (ft) | centerline conc. (mole frac.) | ground conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) | centerline height (ft) |
|------------------------------|-------------------------------------|---------------------------------|--------------------------------|--------------------------------|--------------------------------|------------------------------|
| 0 | 1.000000 | 0.000000 | 0.1 | 0.1 | 0.1 | 1.0 |
| 0.3 | 0.712278 | 0.000000 | 0.1 | 0.1 | 0.1 | 1.0 |
| 0.5 | 0.507982 | 0.000000 | 0.1 | 0.1 | 0.1 | 1.0 |
| 0.8 | 0.360523 | 0.360523 | 0.2 | 0.2 | 0.2 | 0.0 |
| 1.0 | 0.279558 | 0.279558 | 0.3 | 0.3 | 0.3 | 0.0 |
| 1.3 | 0.229505 | 0.229505 | 0.4 | 0.4 | 0.4 | 0.0 |
| 1.5 | 0.195338 | 0.195338 | 0.5 | 0.5 | 0.5 | 0.0 |
| 1.7 | 0.170450 | 0.170450 | 0.5 | 0.5 | 0.5 | 0.0 |
| 2.0 | 0.151469 | 0.151469 | 0.6 | 0.6 | 0.6 | 0.0 |
| 2.3 | 0.136490 | 0.136490 | 0.7 | 0.7 | 0.7 | 0.0 |
| 2.5 | 0.124350 | 0.124350 | 0.8 | 0.8 | 0.8 | 0.0 |
| 2.8 | 0.114300 | 0.114300 | 0.9 | 0.9 | 0.9 | 0.0 |
| 3.0 | 0.105837 | 0.105837 | 1.0 | 1.0 | 1.0 | 0.0 |
| 3.3 | 0.098606 | 0.098606 | 1.1 | 1.1 | 1.1 | 0.0 |
| 3.5 | 0.092353 | 0.092353 | 1.2 | 1.2 | 1.2 | 0.0 |
| 3.7 | 0.086888 | 0.086888 | 1.3 | 1.3 | 1.3 | 0.0 |
| 4.0 | 0.082069 | 0.082069 | 1.4 | 1.4 | 1.4 | 0.0 |
| 4.3 | 0.077786 | 0.077786 | 1.5 | 1.5 | 1.5 | 0.0 |
| 4.5 | 0.073952 | 0.073952 | 1.6 | 1.6 | 1.6 | 0.0 |
| 4.8 | 0.070500 | 0.070500 | 1.7 | 1.7 | 1.7 | 0.0 |
| 5.0 | 0.067375 | 0.067375 | 1.8 | 1.8 | 1.8 | 0.0 |
| 5.3 | 0.064530 | 0.064530 | 1.9 | 1.9 | 1.9 | 0.0 |
| 5.5 | 0.061930 | 0.061930 | 2.0 | 2.0 | 2.0 | 0.0 |
| 5.8 | 0.059543 | 0.059543 | 2.1 | 2.1 | 2.1 | 0.0 |
| 6.0 | 0.057344 | 0.057344 | 2.2 | 2.2 | 2.2 | 0.0 |
| 6.3 | 0.055312 | 0.055312 | 2.2 | 2.2 | 2.2 | 0.0 |
| 6.5 | 0.053427 | 0.053427 | 2.3 | 2.3 | 2.3 | 0.0 |
| 6.8 | 0.051673 | 0.051673 | 2.4 | 2.4 | 2.4 | 0.0 |
| 7.0 | 0.050038 | 0.050038 | 2.5 | 2.5 | 2.5 | 0.0 |
| 7.3 | 0.048510 | 0.048510 | 2.6 | 2.6 | 2.6 | 0.0 |
| 7.5 | 0.047077 | 0.047077 | 2.7 | 2.7 | 2.7 | 0.0 |
| 7.8 | 0.045732 | 0.045732 | 2.8 | 2.8 | 2.8 | 0.0 |
| 8.0 | 0.044466 | 0.044466 | 2.9 | 2.9 | 2.9 | 0.0 |
| 8.3 | 0.042935 | 0.042935 | 3.0 | 3.0 | 3.0 | 0.0 |
| 8.5 | 0.040759 | 0.040759 | 2.9 | 2.9 | 2.9 | 0.0 |



CANARY by Quest Output Report
 Report Date: 11 June 2021
 Case Title: Paramount Refinery - Rail

| downwind distance (ft) | centerline conc. (mole frac.) | ground conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) | centerline height (ft) |
|------------------------|-------------------------------|---------------------------|--------------------------|--------------------------|--------------------------|------------------------|
| 8.8 | 0.038752 | 0.038752 | 2.9 | 2.9 | 2.9 | 0.0 |
| 9.0 | 0.036896 | 0.036896 | 2.8 | 2.8 | 2.8 | 0.0 |
| 9.3 | 0.035176 | 0.035176 | 2.8 | 2.8 | 2.8 | 0.0 |
| 9.5 | 0.033580 | 0.033580 | 2.8 | 2.8 | 2.8 | 0.0 |
| 9.8 | 0.032094 | 0.032094 | 2.7 | 2.7 | 2.7 | 0.0 |
| 10.0 | 0.030709 | 0.030709 | 2.7 | 2.7 | 2.7 | 0.0 |
| 10.3 | 0.029416 | 0.029416 | 2.6 | 2.6 | 2.6 | 0.0 |
| 10.5 | 0.028207 | 0.028207 | 2.6 | 2.6 | 2.6 | 0.0 |
| 10.8 | 0.027074 | 0.027074 | 2.6 | 2.6 | 2.6 | 0.0 |
| 11.0 | 0.026011 | 0.026011 | 2.5 | 2.5 | 2.5 | 0.0 |
| 11.3 | 0.025012 | 0.025012 | 2.5 | 2.5 | 2.5 | 0.0 |
| 11.5 | 0.024073 | 0.024073 | 2.4 | 2.4 | 2.4 | 0.0 |
| 11.8 | 0.023187 | 0.023187 | 2.4 | 2.4 | 2.4 | 0.0 |
| 12.0 | 0.022352 | 0.022352 | 2.4 | 2.4 | 2.4 | 0.0 |
| 12.3 | 0.021564 | 0.021564 | 2.3 | 2.3 | 2.3 | 0.0 |
| 12.5 | 0.020818 | 0.020818 | 2.3 | 2.3 | 2.3 | 0.0 |
| 12.8 | 0.020112 | 0.020112 | 2.2 | 2.2 | 2.2 | 0.0 |
| 13.0 | 0.019443 | 0.019443 | 2.2 | 2.2 | 2.2 | 0.0 |
| 13.2 | 0.018808 | 0.018808 | 2.2 | 2.2 | 2.2 | 0.0 |
| 13.5 | 0.018206 | 0.018206 | 2.1 | 2.1 | 2.1 | 0.0 |
| 13.8 | 0.017633 | 0.017633 | 2.1 | 2.1 | 2.1 | 0.0 |
| 14.0 | 0.017088 | 0.017088 | 2.0 | 2.0 | 2.0 | 0.0 |
| 14.3 | 0.016569 | 0.016569 | 2.0 | 2.0 | 2.0 | 0.0 |
| 14.5 | 0.016075 | 0.016075 | 2.0 | 2.0 | 2.0 | 0.0 |
| 14.8 | 0.015603 | 0.015603 | 1.9 | 1.9 | 1.9 | 0.0 |
| 15.0 | 0.015153 | 0.015153 | 1.9 | 1.9 | 1.9 | 0.0 |
| 15.3 | 0.014723 | 0.014723 | 1.8 | 1.8 | 1.8 | 0.0 |
| 15.5 | 0.014311 | 0.014311 | 1.8 | 1.8 | 1.8 | 0.0 |
| 15.7 | 0.013918 | 0.013918 | 1.8 | 1.8 | 1.8 | 0.0 |
| 16.0 | 0.013541 | 0.013541 | 1.7 | 1.7 | 1.7 | 0.0 |
| 16.3 | 0.013164 | 0.013164 | 1.6 | 1.6 | 1.6 | 0.0 |
| 16.5 | 0.012802 | 0.012802 | 1.4 | 1.4 | 1.4 | 0.0 |
| 16.8 | 0.012454 | 0.012454 | 1.2 | 1.2 | 1.2 | 0.0 |
| 17.0 | 0.012121 | 0.012121 | 1.0 | 1.0 | 1.0 | 0.0 |
| 17.3 | 0.011802 | 0.011802 | 0.8 | 0.8 | 0.8 | 0.0 |
| 17.5 | 0.011495 | 0.011495 | 0.6 | 0.6 | 0.6 | 0.0 |
| 17.8 | 0.011200 | 0.011200 | 0.4 | 0.4 | 0.4 | 0.0 |
| 18.0 | 0.010917 | 0.010917 | 0.3 | 0.3 | 0.3 | 0.0 |
| 18.3 | 0.010645 | 0.010645 | 0.1 | 0.1 | 0.1 | 0.0 |
| 18.5 | 0.010383 | 0.010383 | 0.0 | 0.0 | 0.0 | 0.0 |

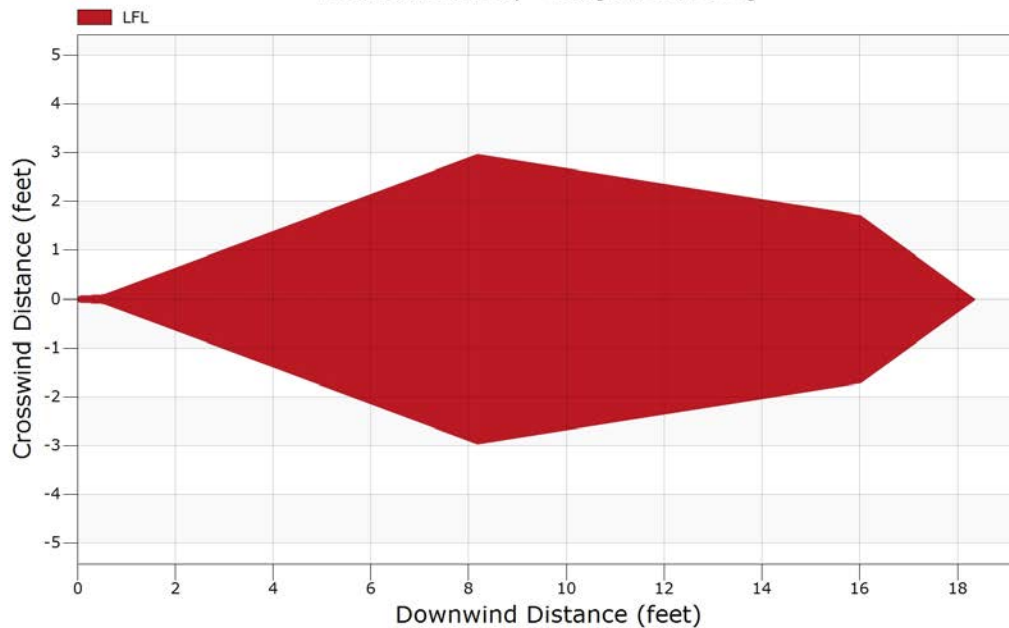
The momentum jet model coupled to the heavy gas model at 0.56 ft in 0 sec.

| Endpoint (mole frac., mixture) | Downwind Distance (feet) | Approximate Time (seconds) |
|--------------------------------|--------------------------|----------------------------|
| 1 0.010531 (LFL) | 18.4 | 5 |
| 2 0.010531 (LFL) | 18.4 | 5 |
| 3 0.010531 (LFL) | 18.4 | 5 |



Momentum Jet Contours - Overhead View

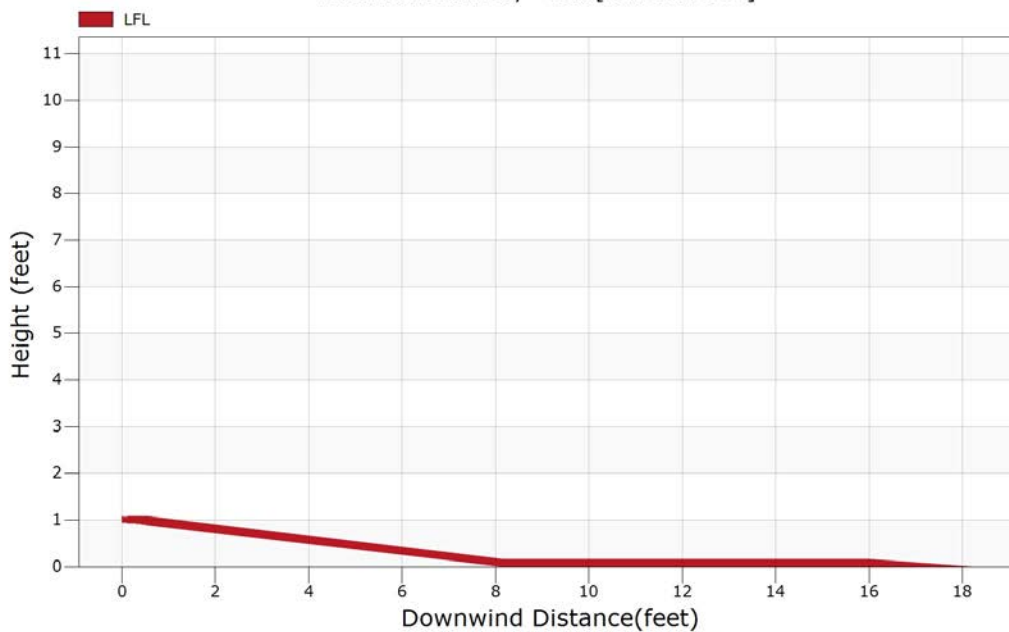
Paramount Refinery - Rail [RailCrudeVCE]



Note: Release during 3.36 mph winds and F stability.

Momentum Jet Contours - Side View

Paramount Refinery - Rail [RailCrudeVCE]

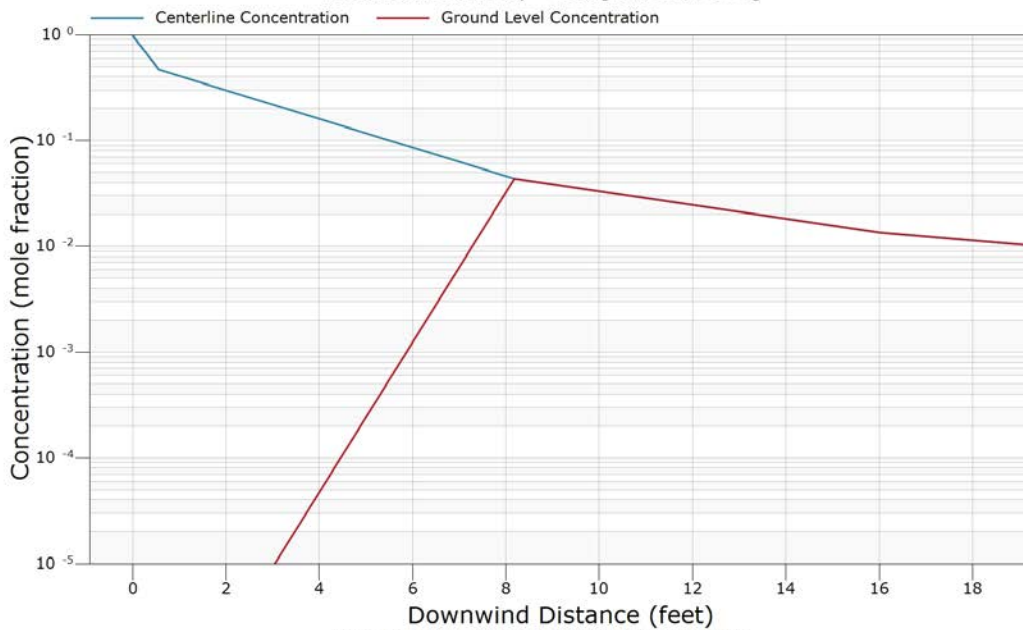


Note: Release during 3.36 mph winds and F stability.



Momentum Jet Concentration

Paramount Refinery - Rail [RailCrudeVCE]



Note: Release during 3.36 mph winds and F stability.



Heavier-than-Air Dispersion

concentration limits

Endpoint 1 (highest) = 0.004354 mole fraction
Endpoint 2 (middle) = 0.004354 mole fraction
Endpoint 3 (lowest) = 0.004354 mole fraction

| downwind distance (ft) | centerline conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) |
|------------------------------|-------------------------------------|--------------------------------|--------------------------------|--------------------------------|
|------------------------------|-------------------------------------|--------------------------------|--------------------------------|--------------------------------|

* Vapor cloud does not leave source.



Momentum Jet Explosion

Fuel Reactivity: Medium Obstacle Density: Low
Flame Expansion: 2.5-D Flame Speed: 0.29

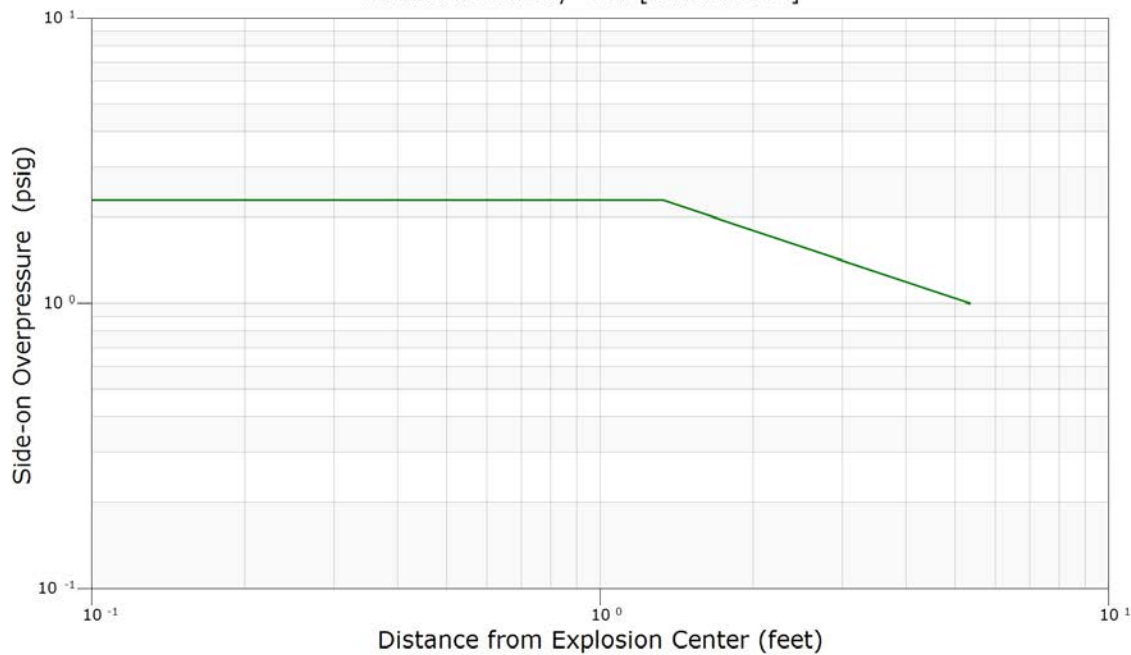
Mass of released material involved in explosion: 0.0287289 lbs.

| Distance from Center of Flammable Cloud (feet) | Overpressure (psi gauge) | Impulse (psi-s) |
|--|-----------------------------|--------------------|
| 0.0 | 2.30 | 0.0100 |
| 0.6 | 2.30 | 0.0100 |
| 0.6 | 2.30 | 0.0100 |
| 0.6 | 2.30 | 0.0100 |
| 0.6 | 2.30 | 0.0100 |
| 0.7 | 2.30 | 0.0100 |
| 0.7 | 2.30 | 0.0100 |
| 0.7 | 2.30 | 0.0100 |
| 0.8 | 2.30 | 0.0100 |
| 0.8 | 2.30 | 0.0100 |
| 0.8 | 2.30 | 0.0100 |
| 0.8 | 2.30 | 0.0100 |
| 0.9 | 2.30 | 0.0100 |
| 0.9 | 2.30 | 0.0100 |
| 0.9 | 2.30 | 0.0100 |
| 1.0 | 2.30 | 0.0099 |
| 1.0 | 2.30 | 0.0095 |
| 1.1 | 2.30 | 0.0092 |
| 1.1 | 2.30 | 0.0088 |
| 1.1 | 2.30 | 0.0085 |
| 1.2 | 2.30 | 0.0082 |
| 1.2 | 2.30 | 0.0079 |
| 1.3 | 2.30 | 0.0076 |
| 1.3 | 2.30 | 0.0073 |
| 5.3 | 1.00 | 0.0019 |

The downwind distance to 1.00 psi is 5.3 feet
The downwind distance to 1.00 psi is 5.3 feet
The downwind distance to 1.00 psi is 5.3 feet



Momentum Jet Explosion Overpressure - Baker-Strehlow-Tang Paramount Refinery - Rail [RailCrudeVCE]





Heavier-than-Air Explosion

Fuel Reactivity: Medium Obstacle Density: Low
Flame Expansion: 2.5-D Flame Speed: 0.29

Mass of released material involved in explosion: 170.828 lbs.

| Distance from Center of Flammable Cloud (feet) | Overpressure (psi gauge) | Impulse (psi-s) |
|--|-----------------------------|--------------------|
| 0.0 | 2.30 | 0.1816 |
| 10.5 | 2.30 | 0.1816 |
| 11.6 | 2.30 | 0.1816 |
| 12.8 | 2.30 | 0.1816 |
| 14.1 | 2.30 | 0.1816 |
| 15.5 | 2.30 | 0.1816 |
| 17.1 | 2.30 | 0.1816 |
| 18.9 | 2.30 | 0.1689 |
| 20.8 | 2.30 | 0.1535 |
| 23.0 | 2.30 | 0.1394 |
| 25.3 | 2.30 | 0.1266 |
| 28.0 | 2.30 | 0.1150 |
| 30.8 | 2.30 | 0.1045 |
| 34.0 | 2.30 | 0.0949 |
| 37.5 | 2.30 | 0.0862 |
| 41.4 | 2.30 | 0.0783 |
| 45.7 | 2.12 | 0.0711 |
| 50.4 | 1.92 | 0.0646 |
| 55.5 | 1.74 | 0.0587 |
| 61.3 | 1.58 | 0.0533 |
| 67.6 | 1.43 | 0.0484 |
| 74.5 | 1.30 | 0.0440 |
| 82.2 | 1.18 | 0.0400 |
| 90.7 | 1.07 | 0.0363 |
| 110.4 | 0.88 | 0.0300 |

The downwind distance to 1.00 psi is 97.6 feet
The downwind distance to 1.00 psi is 97.6 feet
The downwind distance to 1.00 psi is 97.6 feet



Heavier-than-Air Explosion Overpressure - Baker-Strehlow-Tang Paramount Refinery - Rail [RailCrudeVCE]





Case Inputs

Case Type : Fire Radiation
Case Name : RailCrudePool
User ID :
Project Number :
Type of Units : English Units

NOTES:

MATERIAL MENU

| Materials Released | Number | Formula | Name | Fraction |
|--------------------|--------|---------|---------------|----------|
| Component 1 | 8 | C6H14 | n-Hexane | 0.011000 |
| Component 2 | 11 | C9H20 | n-Nonane | 0.033000 |
| Component 3 | 13 | C11H24 | n-Undecane | 0.048000 |
| Component 4 | 22 | C38H61 | PHC-500 | 0.367000 |
| Component 5 | 24 | C51H82 | PHC-700 | 0.192000 |
| Component 6 | 32 | C13H28 | Tridecane | 0.064000 |
| Component 7 | 34 | C15H32 | Pentadecane | 0.112000 |
| Component 8 | 36 | C17H36 | n-Heptadecane | 0.173000 |
| Component 9 | | | | |
| Component 10 | | | | |

Temperature : 68.00 °F
Pressure : 14.70 psia
The material is LIQUID
The mixture is Heavy Crude

NOTES:

ENVIRONMENT MENU

Wind speed : 20.00 mph
Relative humidity : 70 %
Air temperature : 68.0 °F

NOTES:

FIRE TYPE MENU

Fire radiation division: Circular pool fires
Horizontal isopleths only
Spill surface: land
Elevation of flame base (from grade) : 1.0 feet
Elevation of target (from grade) : 0.0 feet
Diameter of pool : 40.0 feet

Fire radiation flux values

Radiation endpoint 1 : 3487 Btu/hr-sq.ft
Radiation endpoint 2 : 1600 Btu/hr-sq.ft
Radiation endpoint 3 : 500 Btu/hr-sq.ft

NOTES:



Pool Fire Radiation

Length of Flame : 46.4 feet
 Flame Tilt from Vertical : 52.4 degrees
 Target Elevation : 0.0 feet
 Pool Elevation : 1.0 feet
 Wind Speed : 20.0 mph
 Substrate : Land

| Downwind Distance from Center of Pool (feet) | Flux to Vertical Target (Btu/hr-sq.ft) | Flux to Horizontal Target (Btu/hr-sq.ft) | Maximum Flux (Btu/hr-sq.ft) |
|--|--|--|-----------------------------------|
| 22.0 | 8564 | 19193 | 21018 |
| 23.4 | 10460 | 20475 | 22992 |
| 25.0 | 9720 | 24017 | 24017 |
| 26.6 | 7768 | 24017 | 24017 |
| 28.3 | 6894 | 24017 | 24017 |
| 30.1 | 7021 | 23376 | 24017 |
| 32.1 | 9540 | 24017 | 24017 |
| 34.2 | 13833 | 24017 | 24017 |
| 36.4 | 12326 | 18078 | 21880 |
| 38.8 | 10016 | 16904 | 22693 |
| 41.3 | 10445 | 13917 | 18245 |
| 44.0 | 8757 | 8195 | 12250 |
| 46.8 | 6213 | 5391 | 8355 |
| 49.9 | 4631 | 4270 | 6385 |
| 53.1 | 3700 | 3658 | 5263 |
| 56.5 | 3100 | 3211 | 4505 |
| 60.2 | 2678 | 2822 | 3920 |
| 64.1 | 2359 | 2451 | 3422 |
| 68.3 | 2105 | 2082 | 2974 |
| 72.7 | 1892 | 1713 | 2561 |
| 77.4 | 1694 | 1355 | 2174 |
| 82.5 | 1486 | 1028 | 1810 |
| 87.8 | 1271 | 751 | 1478 |
| 93.5 | 1063 | 533 | 1190 |
| 99.6 | 874 | 373 | 951 |
| 106.1 | 712 | 259 | 758 |
| 113.0 | 577 | 180 | 605 |
| 120.3 | 468 | 126 | 485 |
| 128.1 | 381 | 89 | 391 |
| 136.4 | 311 | 64 | 317 |

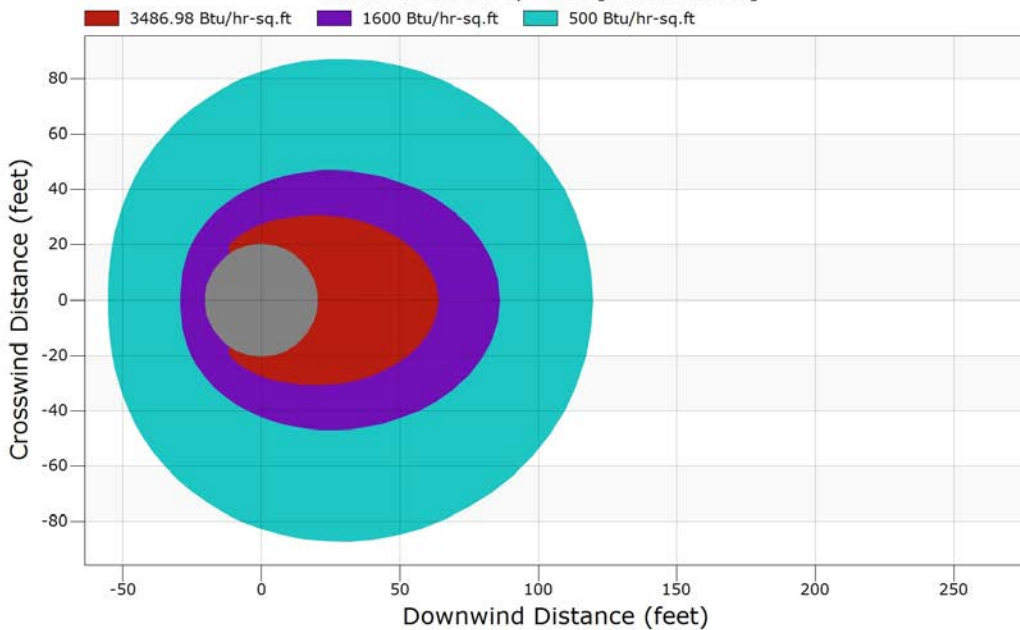
Downwind Distances to Endpoints:

| Distance (feet) | Maximum Flux (Btu/hr-sq.ft) |
|--------------------|--------------------------------|
| 63.6 | 3487 |
| 85.9 | 1600 |
| 119.4 | 500 |



Pool Fire Radiant Heat Contours - Overhead View

Paramount Refinery - Rail [RailCrudePool]



Note: Results presented for 1 feet below the flame base during 20 mph winds.



Case Inputs

Case Type : Vapor Dispersion
Case Name : RailDieselVCE
User ID :
Project Number :
Type of Units : English Units

NOTES:

MATERIAL MENU

| Materials Released | Number | Formula | Name | Fraction |
|--------------------|--------|---------|---------------|----------|
| Component 1 | 11 | C9H20 | n-Nonane | 0.020000 |
| Component 2 | 12 | C10H22 | n-Decane | 0.030000 |
| Component 3 | 13 | C11H24 | n-Undecane | 0.050000 |
| Component 4 | 20 | C22H38 | PHC-300 | 0.200000 |
| Component 5 | 21 | C28H42 | PHC-400 | 0.140000 |
| Component 6 | 31 | C12H26 | Dodecane | 0.060000 |
| Component 7 | 32 | C13H28 | Tridecane | 0.080000 |
| Component 8 | 33 | C14H30 | Tetradecane | 0.100000 |
| Component 9 | 34 | C15H32 | Pentadecane | 0.150000 |
| Component 10 | 36 | C17H36 | n-Heptadecane | 0.170000 |

Temperature : 68.00 °F
Pressure : 15.00 psia
The material is LIQUID
The mixture is Diesel

NOTES:

ENVIRONMENT MENU

Wind speed 3.36 mph
Wind speed measurement height 32.8 feet
Stability class <A-F> F
Relative humidity 70 %
Air temperature 68.0 °F
Spill surface temperature 68.0 °F

Substrate name High density concrete
Substrate thermal conductivity 2.1999 Btu/hr-ft-F
Substrate density 150 lb/cu.ft
Substrate heat Capacity 0.16 Btu/lb-F
Substrate delay time 0 sec
Surrounding terrain Long grass or crops > 15 cm (6 in)

NOTES:



RELEASE MENU

Type of release: Unregulated, Continuous release
Release duration 10 min
Normal flow rate 303.40 lb/sec
Duration of normal flow 10 min
Volume of vessel 4010.42 cu.ft
Percent of vessel filled with liquid 80 %
Liquid head above release point 6 feet
Pipe inner diameter 3.07 inches
Equivalent release diameter 3.07 inches
Pipe length upstream of break 0.0 feet
Height of release point 1.0 feet
Angle of release from horizontal 0.0 degrees

NOTES:

IMPOUNDMENT MENU

Unconfined

NOTES:

VDVE MENU

Vapor generation, dispersion and cloud explosion - Flammable calculation

Concentration endpoint 1 LFL mol%
Concentration endpoint 2 LFL mol%
Concentration endpoint 3 LFL mol%

Dispersion coefficient averaging time 1 min

Baker-Strehlow-Tang parameters

Fuel reactivity Medium
Obstacle density Low
Flame expansion 2.5-D

Overpressure values

Overpressure endpoint 1 1.00 psi
Overpressure endpoint 2 1.00 psi
Overpressure endpoint 3 1.00 psi

NOTES:

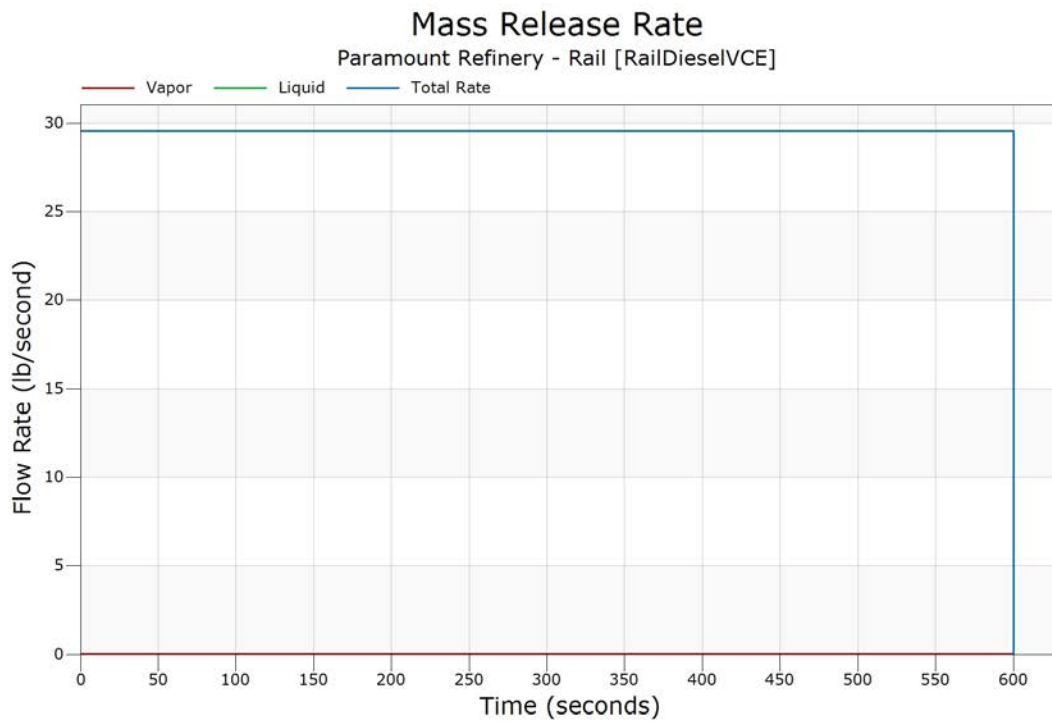


Release Model

| Time (sec) | Vapor (lb/sec) | Aerosol Rate (lb/sec) | Liquid Rate (lb/sec) | Total Rate (lb/sec) |
|---------------|-------------------|--------------------------|-------------------------|------------------------|
| 0.000000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 0.100000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 0.300000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 0.500000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 0.700000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 1.000000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 3.000000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 5.000000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 7.000000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 10.00000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 20.00000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 30.00000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 40.00000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 50.00000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 60.00000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 70.00000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 85.00000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 100.0000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 200.0000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 300.0000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 400.0000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 500.0000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| 600.0000 | .5337575E-03 | 0.000000 | 29.55738 | 29.55792 |
| Totals (lb) | .3202545 | 0.000000 | 17734.43 | 17734.75 |

Flowrate for Jet Fire [immediate ignition] = 0.5337575E-03 lb/sec.
Jet Fire [delayed ignition] = 0.5337575E-03 lb/sec.

Reason for Ending: Reached Stop Time





Release Compositions

| Component Number | Component Name, Formula |
|------------------|--|
| 11 | n-Nonane, C ₉ H ₂₀ |
| 12 | n-Decane, C ₁₀ H ₂₂ |
| 13 | n-Undecane, C ₁₁ H ₂₄ |
| 20 | PHC-300, C ₂₂ H ₃₈ |
| 21 | PHC-400, C ₂₈ H ₄₂ |
| 31 | Dodecane, C ₁₂ H ₂₆ |
| 32 | Tridecane, C ₁₃ H ₂₈ |
| 33 | Tetradecane, C ₁₄ H ₃₀ |
| 34 | Pentadecane, C ₁₅ H ₃₂ |
| 36 | n-Heptadecane, C ₁₇ H ₃₆ |

Composition (Mole Fraction) of Fluid Streams

| Comp. No. | Feed Stream | Momentum Jet Stream | | | Total Stream | Liquid Pool Stream |
|-----------|-------------|---------------------|------------------|----------------|--------------|--------------------|
| | | Flashed Vapor | Evaporated Vapor | Aerosol Liquid | | Liquid to Ground |
| 11 | 0.020000 | 0.000000 | 0.508847 | 0.000000 | 0.508847 | 0.020000 |
| 12 | 0.030000 | 0.000000 | 0.253701 | 0.000000 | 0.253701 | 0.030000 |
| 13 | 0.050000 | 0.000000 | 0.138489 | 0.000000 | 0.138489 | 0.050000 |
| 20 | 0.200000 | 0.000000 | 0.000027 | 0.000000 | 0.000027 | 0.200000 |
| 21 | 0.140000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.140000 |
| 31 | 0.060000 | 0.000000 | 0.056142 | 0.000000 | 0.056142 | 0.060000 |
| 32 | 0.080000 | 0.000000 | 0.025379 | 0.000000 | 0.025379 | 0.080000 |
| 33 | 0.100000 | 0.000000 | 0.010902 | 0.000000 | 0.010902 | 0.100000 |
| 34 | 0.150000 | 0.000000 | 0.005560 | 0.000000 | 0.005560 | 0.150000 |
| 36 | 0.170000 | 0.000000 | 0.000953 | 0.000000 | 0.000953 | 0.170000 |
| | 1.000000 | 0.000000 | 1.000000 | 0.000000 | 1.000000 | 1.000000 |

Flammable Limits (Mole %) of Fluid Streams

| Limit | Feed Stream | Momentum Jet Stream | Liquid Pool Stream |
|-------|-------------|---------------------|--------------------|
| LFL | 0.46 | 0.75 | 0.46 |
| UFL | 5.65 | 3.67 | 5.65 |
| LBV | | 0.40 m/s | 0.40 m/s |



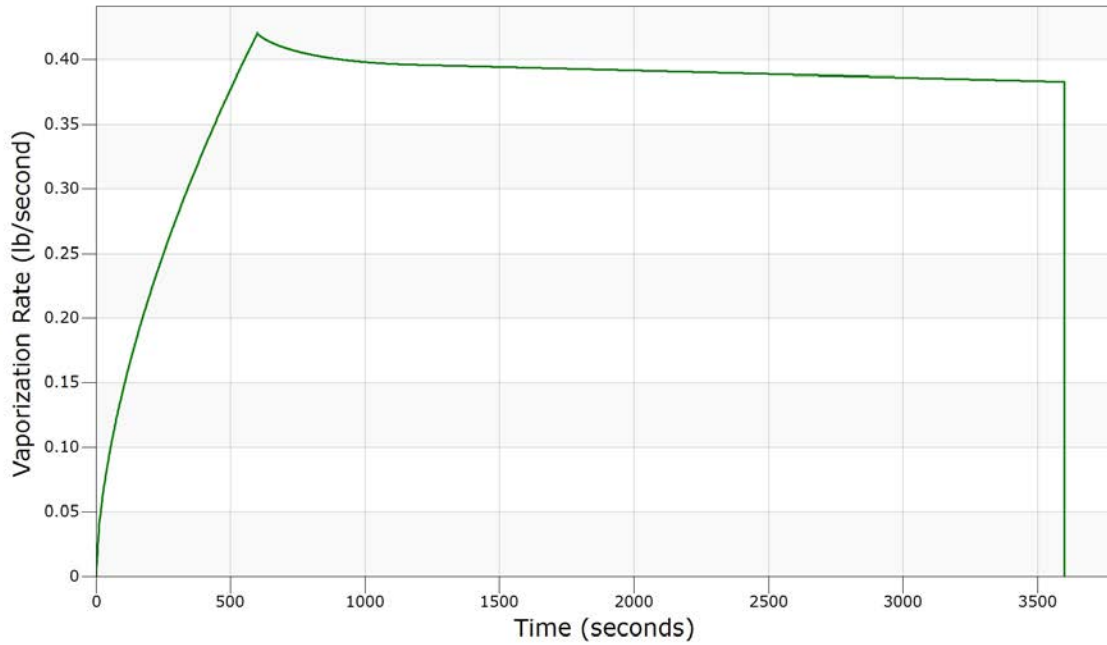
Pool Spreading and Vaporization

| Time (sec) | Liquid Remaining (ft3) | Pool/Dike Radius (feet) | Vapor Rate (lb/sec) |
|---------------|------------------------------|-------------------------------|------------------------|
| 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| 40.0000 | 26.0036 | 7.33924 | 0.832730E-01 |
| 80.0000 | 51.9585 | 9.24574 | 0.126144 |
| 120.000 | 77.8794 | 10.5810 | 0.160825 |
| 160.000 | 103.772 | 11.6430 | 0.191044 |
| 200.000 | 129.637 | 12.5394 | 0.218330 |
| 240.000 | 155.483 | 13.3222 | 0.243479 |
| 280.000 | 181.305 | 14.0217 | 0.266958 |
| 320.000 | 207.106 | 14.6568 | 0.289114 |
| 360.000 | 232.890 | 15.2408 | 0.310168 |
| 400.000 | 258.655 | 15.7828 | 0.330319 |
| 440.000 | 284.403 | 16.2894 | 0.349631 |
| 480.000 | 310.133 | 16.7664 | 0.368260 |
| 520.000 | 335.850 | 17.2172 | 0.386272 |
| 560.000 | 361.552 | 17.6450 | 0.403733 |
| 600.000 | 387.225 | 18.0528 | 0.420664 |
| 640.000 | 386.872 | 18.0472 | 0.414712 |
| 680.000 | 386.519 | 18.0417 | 0.411008 |
| 720.000 | 386.131 | 18.0361 | 0.408142 |
| 760.000 | 385.777 | 18.0305 | 0.405827 |
| 800.000 | 385.424 | 18.0249 | 0.403931 |
| 840.000 | 385.071 | 18.0194 | 0.402322 |
| 880.000 | 384.718 | 18.0138 | 0.400977 |
| 1130.00 | 382.528 | 17.9793 | 0.396369 |
| 1380.00 | 380.339 | 17.9452 | 0.394914 |
| 1630.00 | 378.185 | 17.9108 | 0.393547 |
| 1880.00 | 375.995 | 17.8766 | 0.392202 |
| 2130.00 | 373.841 | 17.8425 | 0.390858 |
| 2380.00 | 371.687 | 17.8084 | 0.389513 |
| 2630.00 | 369.568 | 17.7743 | 0.388168 |
| 2880.00 | 367.414 | 17.7398 | 0.386823 |
| 3130.00 | 365.295 | 17.7057 | 0.385478 |
| 3380.00 | 363.176 | 17.6713 | 0.384133 |
| 3600.00 | 361.304 | 17.6414 | 0.382965 |

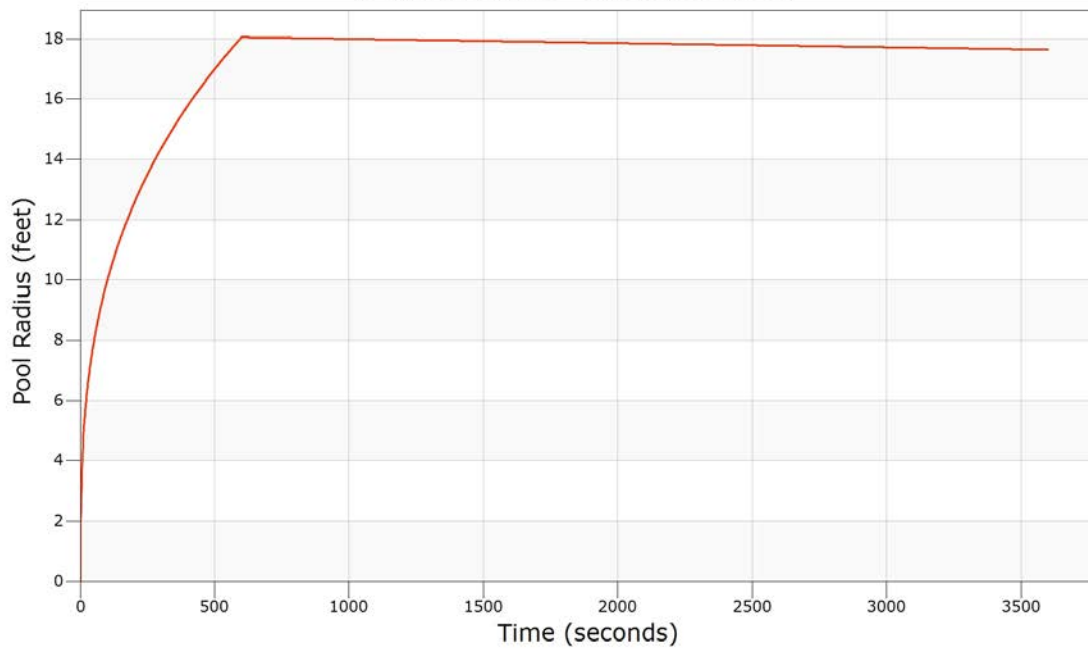
Ending Message: Normal Ending



Pool Vaporization Rate
Paramount Refinery - Rail [RailDieselVCE]



Pool Radius
Paramount Refinery - Rail [RailDieselVCE]





Momentum Jet Dispersion

concentration limits

Endpoint 1 (highest) = 0.007477 mole fraction
Endpoint 2 (middle) = 0.007477 mole fraction
Endpoint 3 (lowest) = 0.007477 mole fraction

| downwind distance (ft) | centerline conc. (mole frac.) | ground conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) | centerline height (ft) |
|------------------------------|-------------------------------------|---------------------------------|--------------------------------|--------------------------------|--------------------------------|------------------------------|
| 0 | 1.000000 | 0.000000 | 0.0 | 0.0 | 0.0 | 1.0 |
| 0.1 | 0.689942 | 0.000000 | 0.0 | 0.0 | 0.0 | 1.0 |
| 0.2 | 0.473120 | 0.000000 | 0.0 | 0.0 | 0.0 | 1.0 |
| 0.3 | 0.310035 | 0.000000 | 0.0 | 0.0 | 0.0 | 1.0 |
| 0.4 | 0.203108 | 0.000000 | 0.0 | 0.0 | 0.0 | 1.0 |
| 0.5 | 0.134308 | 0.000000 | 0.0 | 0.0 | 0.0 | 1.0 |
| 0.6 | 0.098949 | 0.098949 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.7 | 0.081796 | 0.081796 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.8 | 0.069361 | 0.069361 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.9 | 0.059972 | 0.059972 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1.0 | 0.052655 | 0.052655 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1.1 | 0.046808 | 0.046808 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1.2 | 0.042039 | 0.042039 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1.3 | 0.038083 | 0.038083 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1.4 | 0.034752 | 0.034752 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1.5 | 0.031914 | 0.031914 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1.6 | 0.029469 | 0.029469 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1.7 | 0.027343 | 0.027343 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1.8 | 0.025480 | 0.025480 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1.9 | 0.023834 | 0.023834 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2.0 | 0.022371 | 0.022371 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2.1 | 0.021063 | 0.021063 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2.2 | 0.019887 | 0.019887 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2.3 | 0.018825 | 0.018825 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2.4 | 0.017861 | 0.017861 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2.5 | 0.016983 | 0.016983 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2.6 | 0.016180 | 0.016180 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2.7 | 0.015443 | 0.015443 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2.8 | 0.014765 | 0.014765 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2.9 | 0.014139 | 0.014139 | 0.0 | 0.0 | 0.0 | 0.0 |
| 3.0 | 0.013559 | 0.013559 | 0.0 | 0.0 | 0.0 | 0.0 |
| 3.1 | 0.013021 | 0.013021 | 0.0 | 0.0 | 0.0 | 0.0 |
| 3.2 | 0.012520 | 0.012520 | 0.0 | 0.0 | 0.0 | 0.0 |
| 3.3 | 0.012053 | 0.012053 | 0.0 | 0.0 | 0.0 | 0.0 |
| 3.4 | 0.011617 | 0.011617 | 0.0 | 0.0 | 0.0 | 0.0 |

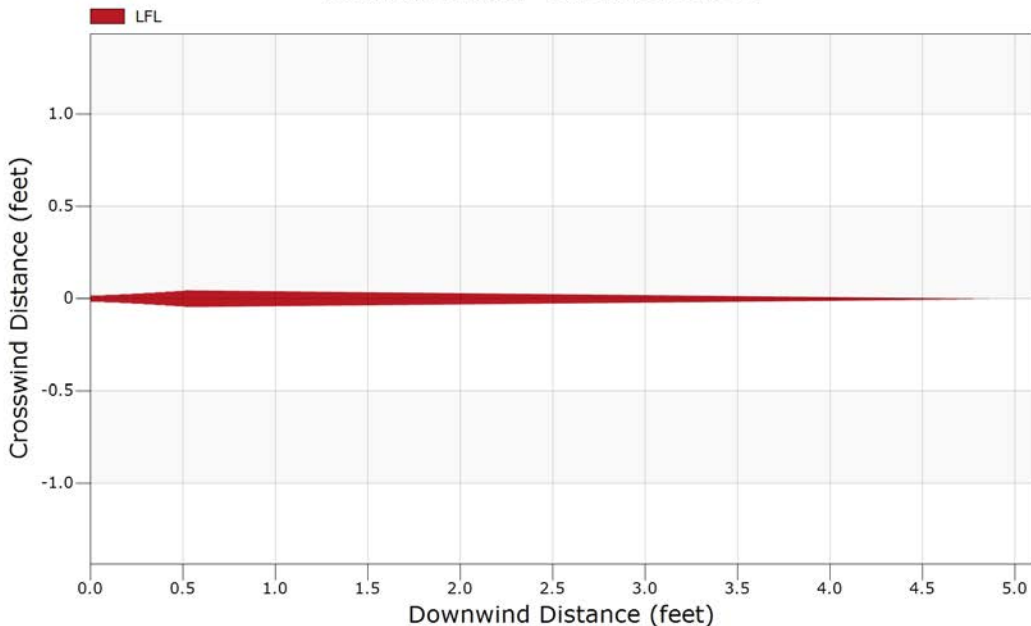


| downwind distance (ft) | centerline conc. (mole frac.) | ground conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) | centerline height (ft) |
|------------------------|-------------------------------|---------------------------|--------------------------|--------------------------|--------------------------|------------------------|
| 3.5 | 0.011209 | 0.011209 | 0.0 | 0.0 | 0.0 | 0.0 |
| 3.6 | 0.010825 | 0.010825 | 0.0 | 0.0 | 0.0 | 0.0 |
| 3.7 | 0.010465 | 0.010465 | 0.0 | 0.0 | 0.0 | 0.0 |
| 3.8 | 0.010126 | 0.010126 | 0.0 | 0.0 | 0.0 | 0.0 |
| 3.9 | 0.009806 | 0.009806 | 0.0 | 0.0 | 0.0 | 0.0 |
| 4.0 | 0.009505 | 0.009505 | 0.0 | 0.0 | 0.0 | 0.0 |
| 4.1 | 0.009219 | 0.009219 | 0.0 | 0.0 | 0.0 | 0.0 |
| 4.2 | 0.008949 | 0.008949 | 0.0 | 0.0 | 0.0 | 0.0 |
| 4.3 | 0.008693 | 0.008693 | 0.0 | 0.0 | 0.0 | 0.0 |
| 4.4 | 0.008449 | 0.008449 | 0.0 | 0.0 | 0.0 | 0.0 |
| 4.5 | 0.008218 | 0.008218 | 0.0 | 0.0 | 0.0 | 0.0 |
| 4.6 | 0.007998 | 0.007998 | 0.0 | 0.0 | 0.0 | 0.0 |
| 4.7 | 0.007788 | 0.007788 | 0.0 | 0.0 | 0.0 | 0.0 |
| 4.8 | 0.007588 | 0.007588 | 0.0 | 0.0 | 0.0 | 0.0 |
| 4.9 | 0.007398 | 0.007398 | 0.0 | 0.0 | 0.0 | 0.0 |

The momentum jet model coupled to the heavy gas model at 0.55 ft in 0 sec.

| Endpoint (mole frac., mixture) | Downwind Distance (feet) | Approximate Time (seconds) |
|--------------------------------|--------------------------|----------------------------|
| 1 0.007477 (LFL) | 4.9 | 1 |
| 2 0.007477 (LFL) | 4.9 | 1 |
| 3 0.007477 (LFL) | 4.9 | 1 |

Momentum Jet Contours - Overhead View
 Paramount Refinery - Rail [RailDieselVCE]

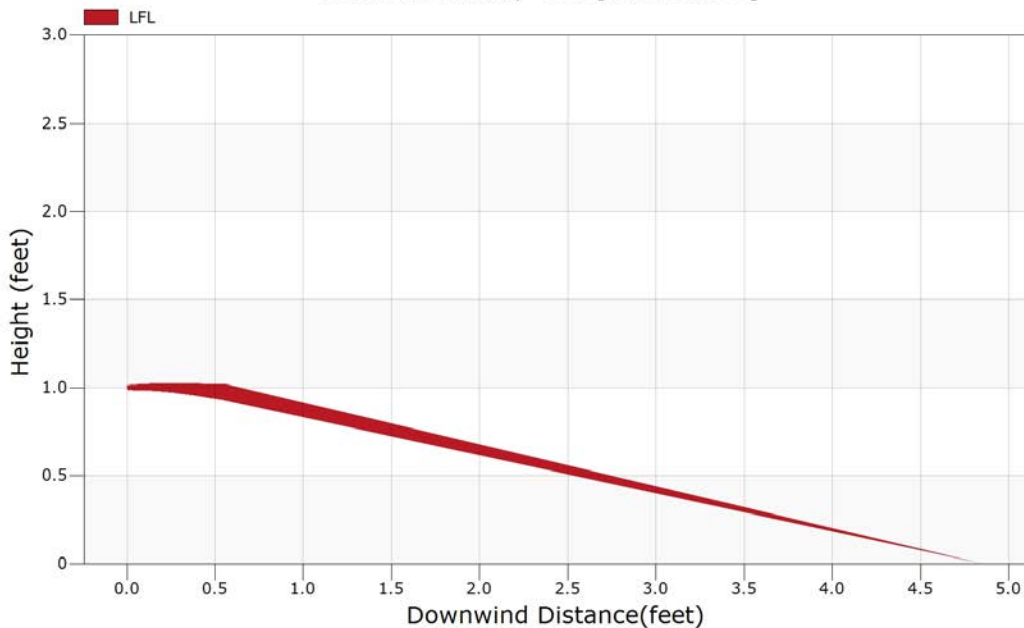


Note: Release during 3.36 mph winds and F stability.



Momentum Jet Contours - Side View

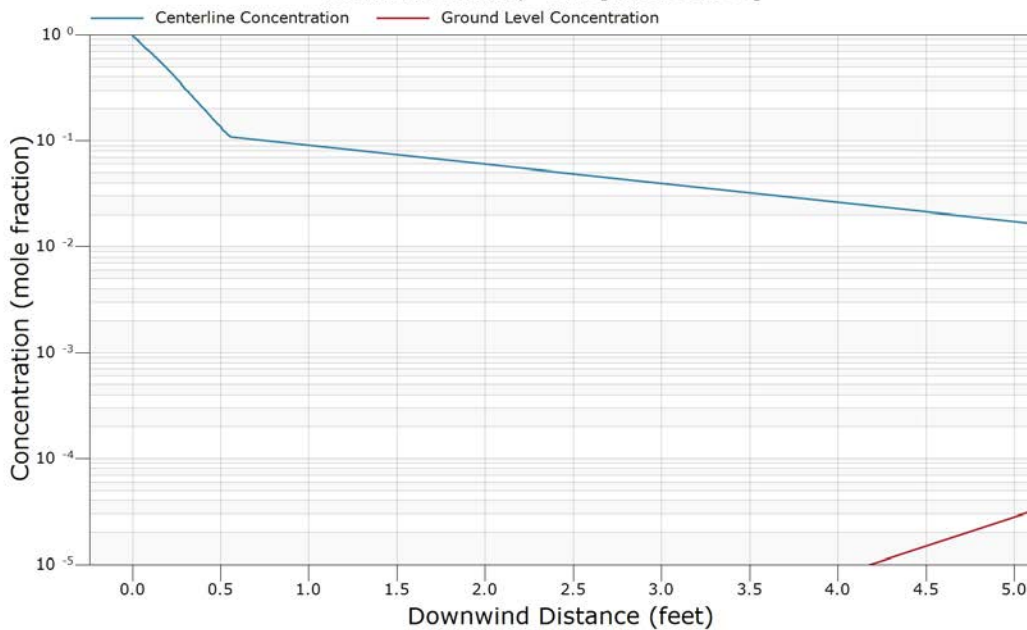
Paramount Refinery - Rail [RailDieselVCE]



Note: Release during 3.36 mph winds and F stability.

Momentum Jet Concentration

Paramount Refinery - Rail [RailDieselVCE]



Note: Release during 3.36 mph winds and F stability.



Heavier-than-Air Dispersion

concentration limits

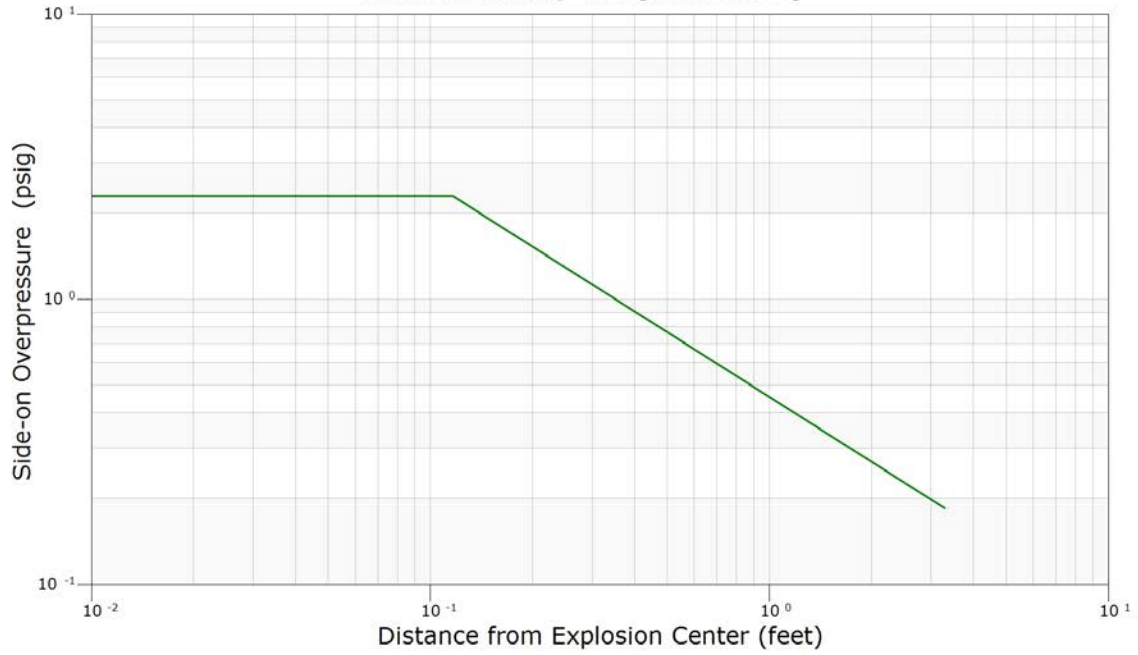
Endpoint 1 (highest) = 0.004625 mole fraction
Endpoint 2 (middle) = 0.004625 mole fraction
Endpoint 3 (lowest) = 0.004625 mole fraction

| downwind distance (ft) | centerline conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) |
|------------------------------|-------------------------------------|--------------------------------|--------------------------------|--------------------------------|
|------------------------------|-------------------------------------|--------------------------------|--------------------------------|--------------------------------|

* Vapor cloud does not leave source.



Momentum Jet Explosion Overpressure - Baker-Strehlow-Tang
Paramount Refinery - Rail [RailDieselVCE]





Heavier-than-Air Explosion

Fuel Reactivity: Medium Obstacle Density: Low
Flame Expansion: 2.5-D Flame Speed: 0.29

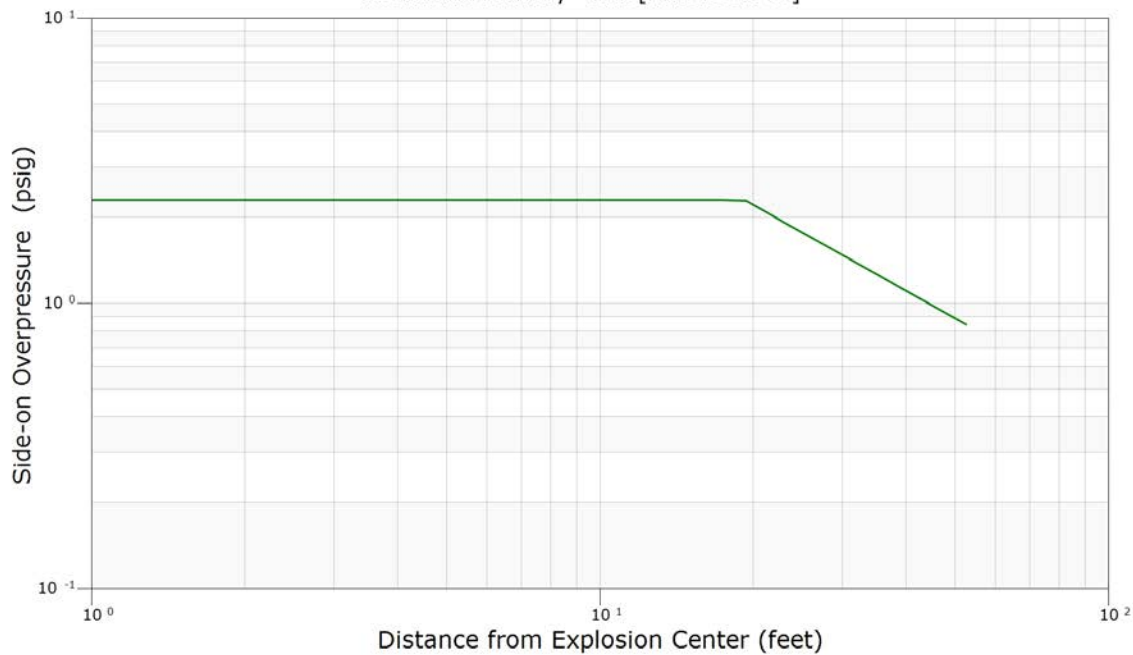
Mass of released material involved in explosion: 16.123 lbs.

| Distance from Center of Flammable Cloud (feet) | Overpressure (psi gauge) | Impulse (psi-s) |
|--|-----------------------------|--------------------|
| 0.0 | 2.30 | 0.0830 |
| 4.8 | 2.30 | 0.0830 |
| 5.3 | 2.30 | 0.0830 |
| 5.9 | 2.30 | 0.0830 |
| 6.5 | 2.30 | 0.0830 |
| 7.1 | 2.30 | 0.0830 |
| 7.9 | 2.30 | 0.0830 |
| 8.7 | 2.30 | 0.0765 |
| 9.6 | 2.30 | 0.0694 |
| 10.6 | 2.30 | 0.0629 |
| 11.8 | 2.30 | 0.0570 |
| 13.0 | 2.30 | 0.0517 |
| 14.4 | 2.30 | 0.0469 |
| 15.9 | 2.30 | 0.0425 |
| 17.5 | 2.30 | 0.0386 |
| 19.4 | 2.28 | 0.0350 |
| 21.4 | 2.07 | 0.0317 |
| 23.6 | 1.87 | 0.0288 |
| 26.1 | 1.69 | 0.0261 |
| 28.9 | 1.53 | 0.0237 |
| 31.9 | 1.39 | 0.0215 |
| 35.2 | 1.26 | 0.0195 |
| 38.9 | 1.14 | 0.0177 |
| 43.0 | 1.03 | 0.0160 |
| 52.5 | 0.84 | 0.0132 |

The downwind distance to 1.00 psi is 44.5 feet
The downwind distance to 1.00 psi is 44.5 feet
The downwind distance to 1.00 psi is 44.5 feet



Heavier-than-Air Explosion Overpressure - Baker-Strehlow-Tang Paramount Refinery - Rail [RailDieselVCE]





Case Inputs

Case Type : Fire Radiation
Case Name : RailDieselPool
User ID :
Project Number :
Type of Units : English Units

NOTES:

MATERIAL MENU

| Materials Released | Number | Formula | Name | Fraction |
|--------------------|--------|---------|---------------|----------|
| Component 1 | 11 | C9H20 | n-Nonane | 0.020000 |
| Component 2 | 12 | C10H22 | n-Decane | 0.030000 |
| Component 3 | 13 | C11H24 | n-Undecane | 0.050000 |
| Component 4 | 20 | C22H38 | PHC-300 | 0.200000 |
| Component 5 | 21 | C28H42 | PHC-400 | 0.140000 |
| Component 6 | 31 | C12H26 | Dodecane | 0.060000 |
| Component 7 | 32 | C13H28 | Tridecane | 0.080000 |
| Component 8 | 33 | C14H30 | Tetradecane | 0.100000 |
| Component 9 | 34 | C15H32 | Pentadecane | 0.150000 |
| Component 10 | 36 | C17H36 | n-Heptadecane | 0.170000 |

Temperature : 68.00 °F
Pressure : 14.70 psia
The material is LIQUID
The mixture is Diesel

NOTES:

ENVIRONMENT MENU

Wind speed : 20.00 mph
Relative humidity : 70 %
Air temperature : 68.0 °F

NOTES:

FIRE TYPE MENU

Fire radiation division: Circular pool fires
Horizontal isopleths only
Spill surface: land
Elevation of flame base (from grade) : 1.0 feet
Elevation of target (from grade) : 0.0 feet
Diameter of pool : 40.0 feet

Fire radiation flux values

Radiation endpoint 1 : 3487 Btu/hr-sq.ft
Radiation endpoint 2 : 1600 Btu/hr-sq.ft
Radiation endpoint 3 : 500 Btu/hr-sq.ft

NOTES:



Pool Fire Radiation

Length of Flame : 51.1 feet
 Flame Tilt from Vertical : 55.5 degrees
 Target Elevation : 0.0 feet
 Pool Elevation : 1.0 feet
 Wind Speed : 20.0 mph
 Substrate : Land

| Downwind Distance from Center of Pool (feet) | Flux to Vertical Target (Btu/hr-sq.ft) | Flux to Horizontal Target (Btu/hr-sq.ft) | Maximum Flux (Btu/hr-sq.ft) |
|--|--|--|-----------------------------------|
| 22.0 | 8981 | 20127 | 22040 |
| 23.5 | 11038 | 21132 | 23841 |
| 25.0 | 11081 | 24657 | 25186 |
| 26.7 | 10722 | 25186 | 25186 |
| 28.5 | 9721 | 25186 | 25186 |
| 30.4 | 10372 | 23719 | 25186 |
| 32.4 | 14459 | 25186 | 25186 |
| 34.6 | 14604 | 21695 | 25186 |
| 36.9 | 10596 | 20639 | 23200 |
| 39.3 | 10907 | 19524 | 24907 |
| 42.0 | 10809 | 15655 | 19799 |
| 44.8 | 9752 | 10088 | 14287 |
| 47.7 | 7266 | 6343 | 9760 |
| 50.9 | 5323 | 4746 | 7204 |
| 54.3 | 4140 | 3963 | 5782 |
| 58.0 | 3391 | 3452 | 4876 |
| 61.8 | 2879 | 3040 | 4214 |
| 65.9 | 2505 | 2662 | 3674 |
| 70.3 | 2214 | 2286 | 3195 |
| 75.0 | 1978 | 1905 | 2755 |
| 80.0 | 1772 | 1522 | 2342 |
| 85.4 | 1566 | 1161 | 1953 |
| 91.1 | 1345 | 845 | 1590 |
| 97.1 | 1124 | 592 | 1271 |
| 103.6 | 919 | 406 | 1005 |
| 110.5 | 742 | 276 | 792 |
| 117.9 | 596 | 187 | 625 |
| 125.8 | 478 | 128 | 495 |
| 134.2 | 385 | 89 | 395 |
| 143.1 | 311 | 62 | 318 |

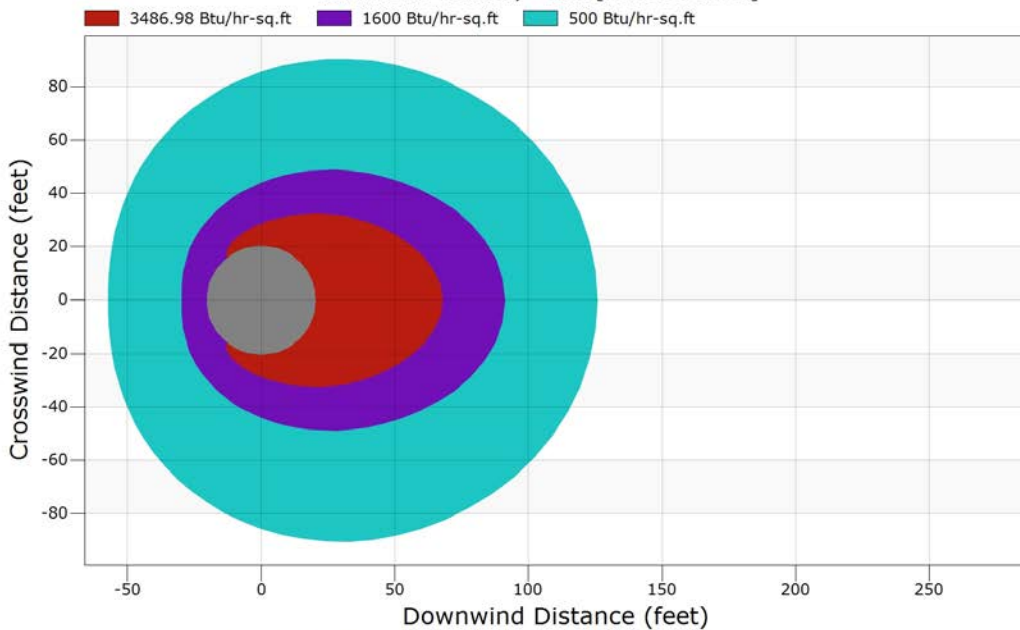
Downwind Distances to Endpoints:

| Distance (feet) | Maximum Flux (Btu/hr-sq.ft) |
|--------------------|--------------------------------|
| 67.7 | 3487 |
| 90.9 | 1600 |
| 125.5 | 500 |



Pool Fire Radiant Heat Contours - Overhead View

Paramount Refinery - Rail [RailDieselPool]



Note: Results presented for 1 feet below the flame base during 20 mph winds.



Case Inputs

Case Type : Vapor Dispersion
Case Name : RailFeedStockVCE
User ID :
Project Number :
Type of Units : English Units

NOTES:

MATERIAL MENU

| Materials Released | Number | Formula | Name | Fraction |
|--------------------|--------|----------|---------------|----------|
| Component 1 | : 20 | = C22H38 | PHC-300 | 0.240000 |
| Component 2 | : 21 | = C28H42 | PHC-400 | 0.250000 |
| Component 3 | : 22 | = C38H61 | PHC-500 | 0.220000 |
| Component 4 | : 32 | = C13H28 | Tridecane | 0.030000 |
| Component 5 | : 33 | = C14H30 | Tetradecane | 0.050000 |
| Component 6 | : 34 | = C15H32 | Pentadecane | 0.080000 |
| Component 7 | : 36 | = C17H36 | n-Heptadecane | 0.130000 |
| Component 8 | : | | | |
| Component 9 | : | | | |
| Component 10 | : | | | |

Temperature : 68.00 °F
Pressure : 15.00 psia
The material is LIQUID
The mixture is Fuel Oil

NOTES:

ENVIRONMENT MENU

| | |
|--------------------------------|------------------------------------|
| Wind speed | 3.36 mph |
| Wind speed measurement height | 32.8 feet |
| Stability class <A-F> | F |
| Relative humidity | 70 % |
| Air temperature | 68.0 °F |
| Spill surface temperature | 68.0 °F |
| Substrate name | High density concrete |
| Substrate thermal conductivity | 2.1999 Btu/hr-ft-F |
| Substrate density | 150 lb/cu.ft |
| Substrate heat Capacity | 0.16 Btu/lb-F |
| Substrate delay time | 0 sec |
| Surrounding terrain | Long grass or crops > 15 cm (6 in) |

NOTES:



RELEASE MENU

Type of release: Unregulated, Continuous release
Release duration 10 min
Normal flow rate 297.80 lb/sec
Duration of normal flow 10 min
Volume of vessel 4010.42 cu.ft
Percent of vessel filled with liquid 80 %
Liquid head above release point 6 feet
Pipe inner diameter 3.07 inches
Equivalent release diameter 3.07 inches
Pipe length upstream of break 0.0 feet
Height of release point 1.0 feet
Angle of release from horizontal 0.0 degrees

NOTES:

IMPOUNDMENT MENU

Unconfined

NOTES:

VDVE MENU

Vapor generation, dispersion and cloud explosion - Flammable calculation

Concentration endpoint 1 LFL mol%
Concentration endpoint 2 LFL mol%
Concentration endpoint 3 LFL mol%

Dispersion coefficient averaging time 1 min

Baker-Strehlow-Tang parameters

Fuel reactivity Medium
Obstacle density Low
Flame expansion 2.5-D

Overpressure values

Overpressure endpoint 1 1.00 psi
Overpressure endpoint 2 1.00 psi
Overpressure endpoint 3 1.00 psi

NOTES:

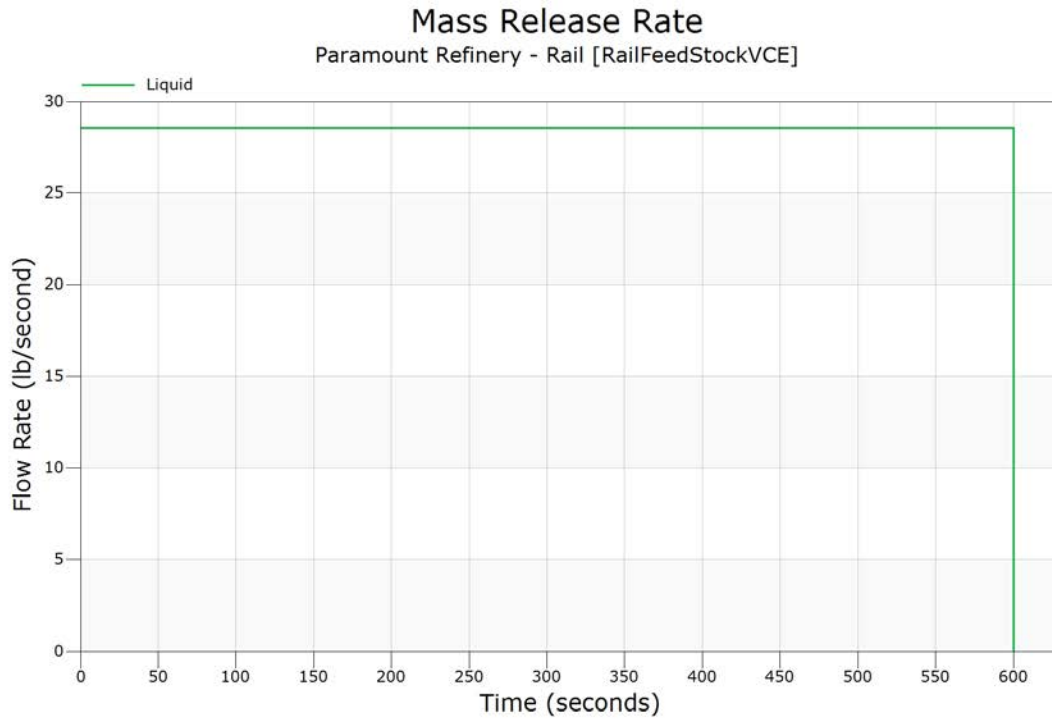


Release Model

| Time (sec) | Vapor (lb/sec) | Aerosol Rate (lb/sec) | Liquid Rate (lb/sec) | Total Rate (lb/sec) |
|---------------|-------------------|--------------------------|-------------------------|------------------------|
| 0.000000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 0.100000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 0.300000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 0.500000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 0.700000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 1.000000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 3.000000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 5.000000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 7.000000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 10.00000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 20.00000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 30.00000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 40.00000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 50.00000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 60.00000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 70.00000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 85.00000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 100.0000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 200.0000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 300.0000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 400.0000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 500.0000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| 600.0000 | 0.000000 | 0.000000 | 28.56425 | 28.56426 |
| Totals (lb) | 0.000000 | 0.000000 | 17138.55 | 17138.55 |

Flowrate for Jet Fire [immediate ignition] = 0.000000 lb/sec.
Jet Fire [delayed ignition] = 0.000000 lb/sec.

Reason for Ending: Reached Stop Time





Release Compositions

| Component Number | Component Name, Formula |
|------------------|-------------------------|
| 20 | PHC-300, C22H38 |
| 21 | PHC-400, C28H42 |
| 22 | PHC-500, C38H61 |
| 32 | Tridecane, C13H28 |
| 33 | Tetradecane, C14H30 |
| 34 | Pentadecane, C15H32 |
| 36 | n-Heptadecane, C17H36 |

Composition (Mole Fraction) of Fluid Streams

| Comp. No. | Feed Stream | Momentum Jet Stream | | | Total Stream | Liquid Pool Stream |
|-----------|-------------|---------------------|------------------|----------------|--------------|--------------------|
| | | Flashed Vapor | Evaporated Vapor | Aerosol Liquid | | |
| 20 | 0.240000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.240000 |
| 21 | 0.250000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.250000 |
| 22 | 0.220000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.220000 |
| 32 | 0.030000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.030000 |
| 33 | 0.050000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.050000 |
| 34 | 0.080000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.080000 |
| 36 | 0.130000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.130000 |
| | 1.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 1.000000 |

Flammable Limits (Mole %) of Fluid Streams

| Limit | Feed Stream | Momentum Jet Stream | Liquid Pool Stream |
|-------|-------------|---------------------|--------------------|
| LFL | 0.41 | | 0.41 |
| UFL | 6.90 | | 6.90 |
| LBV | | | 0.40 m/s |



Pool Spreading and Vaporization

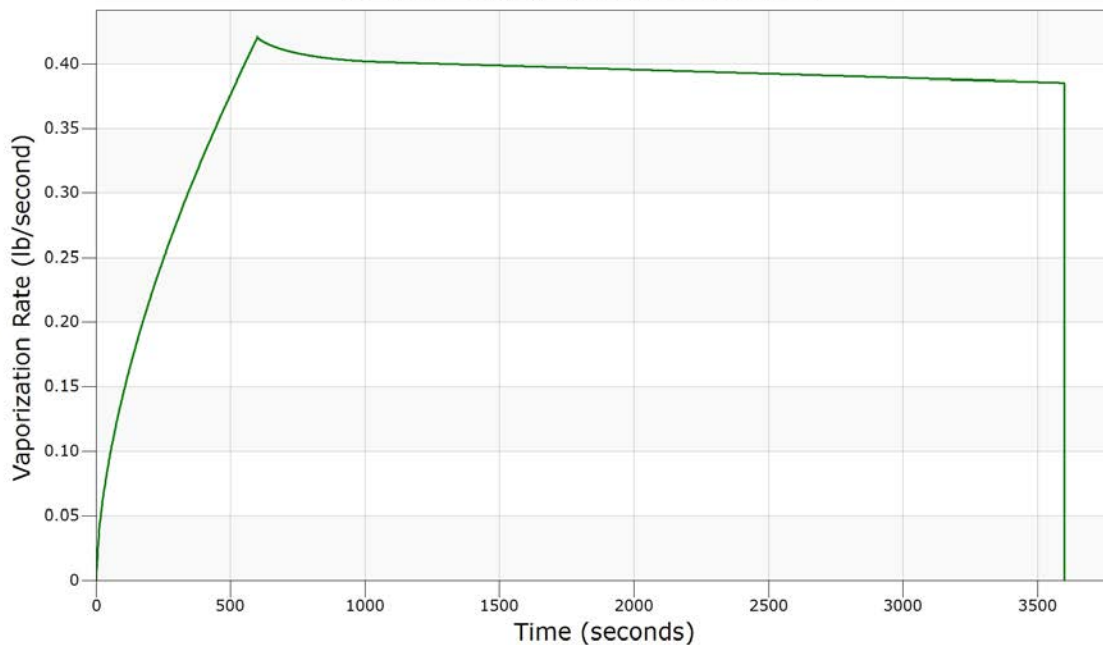
| Time (sec) | Liquid Remaining (ft3) | Pool/Dike Radius (feet) | Vapor Rate (lb/sec) |
|---------------|------------------------------|-------------------------------|------------------------|
| 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| 40.0000 | 26.0703 | 7.34646 | 0.830305E-01 |
| 80.0000 | 52.0891 | 9.25459 | 0.125783 |
| 120.000 | 78.0737 | 10.5912 | 0.160358 |
| 160.000 | 104.030 | 11.6542 | 0.190486 |
| 200.000 | 129.958 | 12.5512 | 0.217684 |
| 240.000 | 155.865 | 13.3346 | 0.242751 |
| 280.000 | 181.747 | 14.0348 | 0.266164 |
| 320.000 | 207.608 | 14.6706 | 0.288254 |
| 360.000 | 233.451 | 15.2549 | 0.309242 |
| 400.000 | 259.273 | 15.7976 | 0.329327 |
| 440.000 | 285.081 | 16.3045 | 0.348595 |
| 480.000 | 310.868 | 16.7818 | 0.367180 |
| 520.000 | 336.641 | 17.2329 | 0.385368 |
| 560.000 | 362.399 | 17.6611 | 0.403248 |
| 600.000 | 388.143 | 18.0689 | 0.420730 |
| 640.000 | 387.755 | 18.0630 | 0.415351 |
| 680.000 | 387.367 | 18.0571 | 0.412132 |
| 720.000 | 387.013 | 18.0515 | 0.409685 |
| 760.000 | 386.625 | 18.0456 | 0.407745 |
| 800.000 | 386.237 | 18.0397 | 0.406202 |
| 840.000 | 385.883 | 18.0341 | 0.404945 |
| 880.000 | 385.495 | 18.0282 | 0.403909 |
| 1130.00 | 383.199 | 17.9925 | 0.400911 |
| 1380.00 | 380.939 | 17.9570 | 0.399323 |
| 1630.00 | 378.644 | 17.9213 | 0.397736 |
| 1880.00 | 376.384 | 17.8855 | 0.396149 |
| 2130.00 | 374.124 | 17.8494 | 0.394561 |
| 2380.00 | 371.863 | 17.8136 | 0.392974 |
| 2630.00 | 369.639 | 17.7776 | 0.391387 |
| 2880.00 | 367.414 | 17.7418 | 0.389821 |
| 3130.00 | 365.189 | 17.7060 | 0.388234 |
| 3380.00 | 362.964 | 17.6703 | 0.386669 |
| 3600.00 | 361.022 | 17.6388 | 0.385302 |

Ending Message: Normal Ending



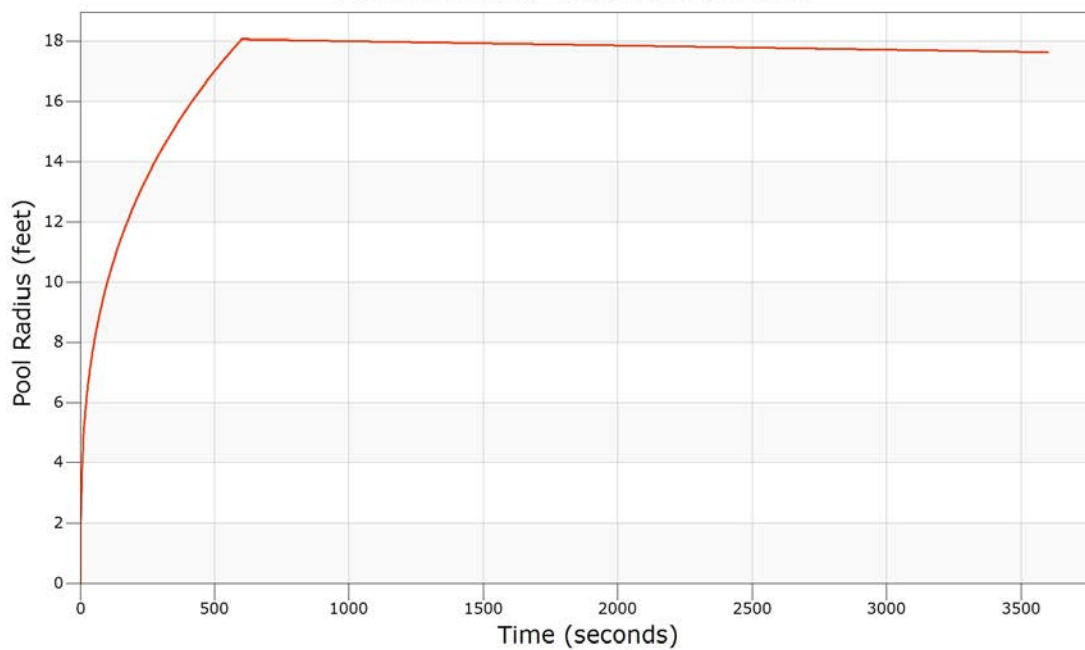
Pool Vaporization Rate

Paramount Refinery - Rail [RailFeedStockVCE]



Pool Radius

Paramount Refinery - Rail [RailFeedStockVCE]





Heavier-than-Air Dispersion

concentration limits

Endpoint 1 (highest) = 0.004138 mole fraction
Endpoint 2 (middle) = 0.004138 mole fraction
Endpoint 3 (lowest) = 0.004138 mole fraction

| downwind distance (ft) | centerline conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) |
|------------------------------|-------------------------------------|--------------------------------|--------------------------------|--------------------------------|
|------------------------------|-------------------------------------|--------------------------------|--------------------------------|--------------------------------|

* Vapor cloud does not leave source.



Case Inputs

Case Type : Fire Radiation
Case Name : RailFeedStockPool
User ID :
Project Number :
Type of Units : English Units

NOTES:

MATERIAL MENU

| Materials Released | Number | Formula | Name | Fraction |
|--------------------|--------|----------|---------------|----------|
| Component 1 | 20 | = C22H38 | PHC-300 | 0.240000 |
| Component 2 | 21 | = C28H42 | PHC-400 | 0.250000 |
| Component 3 | 22 | = C38H61 | PHC-500 | 0.220000 |
| Component 4 | 32 | = C13H28 | Tridecane | 0.030000 |
| Component 5 | 33 | = C14H30 | Tetradecane | 0.050000 |
| Component 6 | 34 | = C15H32 | Pentadecane | 0.080000 |
| Component 7 | 36 | = C17H36 | n-Heptadecane | 0.130000 |
| Component 8 | | | | |
| Component 9 | | | | |
| Component 10 | | | | |

Temperature : 68.00 °F
Pressure : 14.70 psia
The material is LIQUID
The mixture is Fuel Oil

NOTES:

ENVIRONMENT MENU

Wind speed : 20.00 mph
Relative humidity : 70 %
Air temperature : 68.0 °F

NOTES:

FIRE TYPE MENU

Fire radiation division: Circular pool fires
Horizontal isopleths only
Spill surface: land
Elevation of flame base (from grade) : 1.0 feet
Elevation of target (from grade) : 0.0 feet
Diameter of pool : 36.0 feet

Fire radiation flux values

Radiation endpoint 1 : 3487 Btu/hr-sq.ft
Radiation endpoint 2 : 1600 Btu/hr-sq.ft
Radiation endpoint 3 : 500 Btu/hr-sq.ft

NOTES:



Pool Fire Radiation

Length of Flame : 43.5 feet
 Flame Tilt from Vertical : 54.9 degrees
 Target Elevation : 0.0 feet
 Pool Elevation : 1.0 feet
 Wind Speed : 20.0 mph
 Substrate : Land

| Downwind Distance from Center of Pool (feet) | Flux to Vertical Target (Btu/hr-sq.ft) | Flux to Horizontal Target (Btu/hr-sq.ft) | Maximum Flux (Btu/hr-sq.ft) |
|--|--|--|-----------------------------------|
| 19.8 | 8047 | 20358 | 21891 |
| 21.1 | 7138 | 21156 | 22327 |
| 22.5 | 5802 | 22871 | 22871 |
| 23.9 | 7409 | 22871 | 22871 |
| 25.5 | 8284 | 22871 | 22871 |
| 27.2 | 8513 | 20759 | 22437 |
| 28.9 | 7958 | 22871 | 22871 |
| 30.8 | 7914 | 22871 | 22871 |
| 32.8 | 10976 | 19587 | 22452 |
| 35.0 | 11251 | 16763 | 22182 |
| 37.2 | 9994 | 14609 | 18761 |
| 39.7 | 8846 | 8957 | 12909 |
| 42.3 | 6346 | 5695 | 8677 |
| 45.0 | 4666 | 4435 | 6535 |
| 47.9 | 3693 | 3797 | 5365 |
| 51.1 | 3080 | 3352 | 4601 |
| 54.4 | 2656 | 2973 | 4021 |
| 57.9 | 2339 | 2614 | 3532 |
| 61.7 | 2090 | 2253 | 3089 |
| 65.8 | 1884 | 1883 | 2674 |
| 70.0 | 1700 | 1511 | 2281 |
| 74.6 | 1511 | 1158 | 1908 |
| 79.5 | 1305 | 848 | 1559 |
| 84.7 | 1096 | 599 | 1250 |
| 90.2 | 901 | 414 | 992 |
| 96.0 | 730 | 283 | 783 |
| 102.3 | 588 | 194 | 619 |
| 109.0 | 473 | 134 | 492 |
| 116.1 | 382 | 93 | 393 |
| 123.7 | 310 | 66 | 316 |

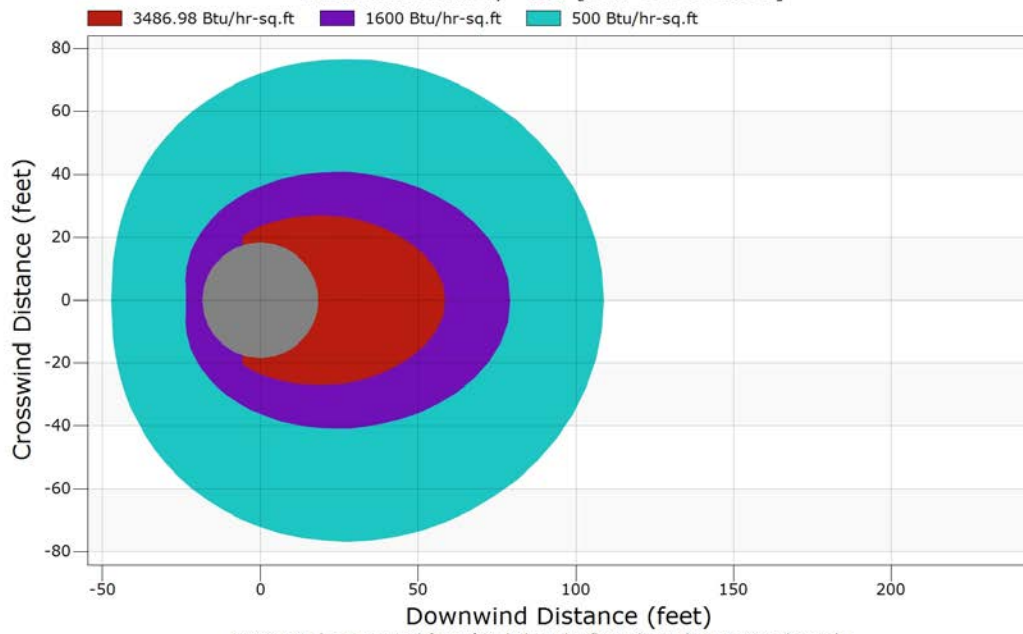
Downwind Distances to Endpoints:

| Distance (feet) | Maximum Flux (Btu/hr-sq.ft) |
|--------------------|--------------------------------|
| 58.3 | 3487 |
| 78.9 | 1600 |
| 108.6 | 500 |



Pool Fire Radiant Heat Contours - Overhead View

Paramount Refinery - Rail [RailFeedStockPool]



Note: Results presented for 1 feet below the flame base during 20 mph winds.



Case Inputs

Case Type : Vapor Dispersion
Case Name : RailGasolineVCE
User ID :
Project Number :
Type of Units : English Units

NOTES:

MATERIAL MENU

| Materials Released | Number | Formula | Name | Fraction |
|--------------------|--------|---------|----------------------------|----------|
| Component 1 | 5 | C4H10 | n-Butane | 0.020000 |
| Component 2 | 8 | C6H14 | n-Hexane | 0.100000 |
| Component 3 | 9 | C7H16 | n-Heptane | 0.100000 |
| Component 4 | 11 | C9H20 | n-Nonane | 0.100000 |
| Component 5 | 12 | C10H22 | n-Decane | 0.030000 |
| Component 6 | 254 | C5H12 | 2,2-Dimethylpropane (Neop) | 0.200000 |
| Component 7 | 273 | C6H12 | Methylcyclopentane | 0.100000 |
| Component 8 | 281 | C7H8 | Toluene | 0.100000 |
| Component 9 | 286 | C8H10 | para-Xylene | 0.100000 |
| Component 10 | 289 | C8H18 | 3-Methylheptane | 0.150000 |

Temperature : 68.00 °F
Pressure : 15.00 psia
The material is LIQUID
The mixture is Gasoline

NOTES:

ENVIRONMENT MENU

Wind speed 3.36 mph
Wind speed measurement height 32.8 feet
Stability class <A-F> F
Relative humidity 70 %
Air temperature 68.0 °F
Spill surface temperature 68.0 °F

Substrate name High density concrete
Substrate thermal conductivity 2.1999 Btu/hr-ft-F
Substrate density 150 lb/cu.ft
Substrate heat Capacity 0.16 Btu/lb-F
Substrate delay time 0 sec
Surrounding terrain Long grass or crops > 15 cm (6 in)

NOTES:



RELEASE MENU

Type of release: Unregulated, Continuous release
Release duration 10 min
Normal flow rate 297.80 lb/sec
Duration of normal flow 10 min
Volume of vessel 4010.42 cu.ft
Percent of vessel filled with liquid 80 %
Liquid head above release point 6 feet
Pipe inner diameter 3.07 inches
Equivalent release diameter 3.07 inches
Pipe length upstream of break 0.0 feet
Height of release point 1.0 feet
Angle of release from horizontal 0.0 degrees

NOTES:

IMPOUNDMENT MENU

Unconfined

NOTES:

VDVE MENU

Vapor generation, dispersion and cloud explosion - Flammable calculation

Concentration endpoint 1 LFL mol%
Concentration endpoint 2 LFL mol%
Concentration endpoint 3 LFL mol%

Dispersion coefficient averaging time 1 min

Baker-Strehlow-Tang parameters

Fuel reactivity Medium
Obstacle density Low
Flame expansion 2.5-D

Overpressure values

Overpressure endpoint 1 1.00 psi
Overpressure endpoint 2 1.00 psi
Overpressure endpoint 3 1.00 psi

NOTES:

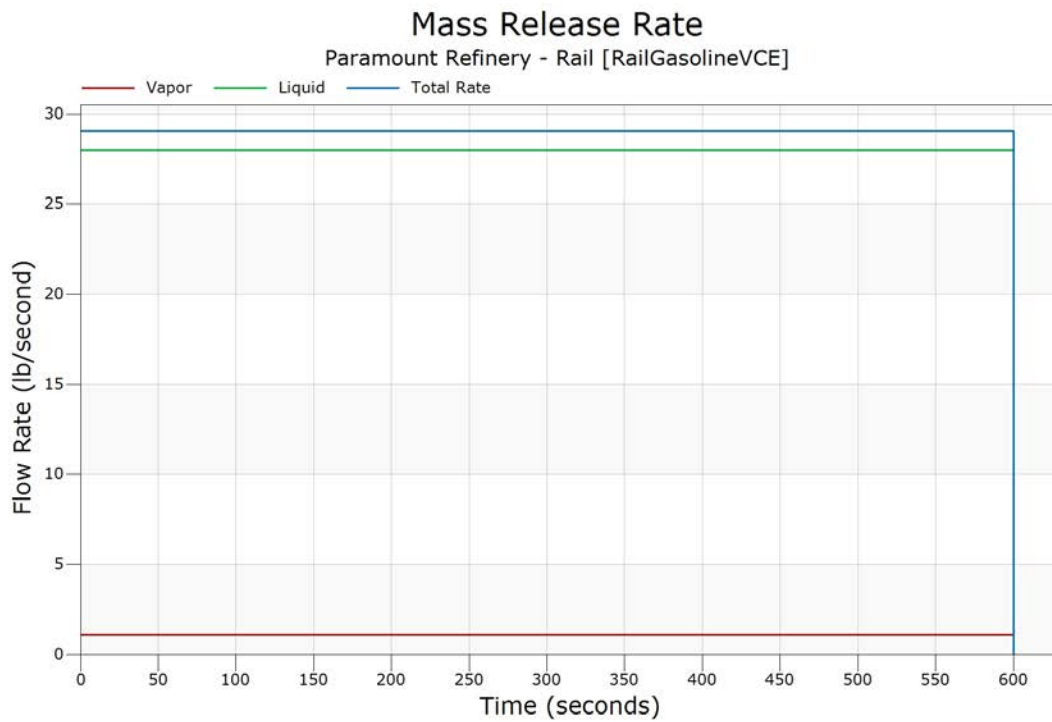


Release Model

| Time (sec) | Vapor (lb/sec) | Aerosol Rate (lb/sec) | Liquid Rate (lb/sec) | Total Rate (lb/sec) |
|---------------|-------------------|--------------------------|-------------------------|------------------------|
| 0.000000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 0.100000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 0.300000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 0.500000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 0.700000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 1.000000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 3.000000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 5.000000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 7.000000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 10.00000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 20.00000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 30.00000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 40.00000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 50.00000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 60.00000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 70.00000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 85.00000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 100.0000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 200.0000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 300.0000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 400.0000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 500.0000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| 600.0000 | 1.098665 | 0.000000 | 27.95956 | 29.05823 |
| Totals (lb) | 659.1990 | 0.000000 | 16775.74 | 17434.94 |

Flowrate for Jet Fire [immediate ignition] = 1.098665 lb/sec.
Jet Fire [delayed ignition] = 1.098665 lb/sec.

Reason for Ending: Reached Stop Time





Release Compositions

| Component Number | Component Name, Formula |
|------------------|---|
| 5 | n-Butane, C4H10 |
| 8 | n-Hexane, C6H14 |
| 9 | n-Heptane, C7H16 |
| 11 | n-Nonane, C9H20 |
| 12 | n-Decane, C10H22 |
| 254 | 2,2-Dimethylpropane (Neopentane), C5H12 |
| 273 | Methylcyclopentane, C6H12 |
| 281 | Toluene, C7H8 |
| 286 | para-Xylene, C8H10 |
| 289 | 3-Methylheptane, C8H18 |

Composition (Mole Fraction) of Fluid Streams

| Comp. No. | Feed Stream | Momentum Jet Stream | | | Total Stream | Liquid Pool Stream |
|-----------|-------------|---------------------|------------------|----------------|--------------|--------------------|
| | | Flashed Vapor | Evaporated Vapor | Aerosol Liquid | | Liquid to Ground |
| 5 | 0.020000 | 0.000000 | 0.099926 | 0.000000 | 0.099926 | 0.018487 |
| 8 | 0.100000 | 0.000000 | 0.046678 | 0.000000 | 0.046678 | 0.101009 |
| 9 | 0.100000 | 0.000000 | 0.014321 | 0.000000 | 0.014321 | 0.101622 |
| 11 | 0.100000 | 0.000000 | 0.001421 | 0.000000 | 0.001421 | 0.101866 |
| 12 | 0.030000 | 0.000000 | 0.000140 | 0.000000 | 0.000140 | 0.030565 |
| 254 | 0.200000 | 0.000000 | 0.769694 | 0.000000 | 0.769694 | 0.189218 |
| 273 | 0.100000 | 0.000000 | 0.044270 | 0.000000 | 0.044270 | 0.101055 |
| 281 | 0.100000 | 0.000000 | 0.011003 | 0.000000 | 0.011003 | 0.101684 |
| 286 | 0.100000 | 0.000000 | 0.003145 | 0.000000 | 0.003145 | 0.101833 |
| 289 | 0.150000 | 0.000000 | 0.009402 | 0.000000 | 0.009402 | 0.152661 |
| 1.000000 | | 0.000000 | 1.000000 | 0.000000 | 1.000000 | 1.000000 |

Flammable Limits (Mole %) of Fluid Streams

| Limit | Feed Stream | Momentum Jet Stream | Liquid Pool Stream |
|-------|-------------|---------------------|--------------------|
| LFL | 1.08 | 1.37 | 1.08 |
| UFL | 6.11 | 7.56 | 6.09 |
| LBV | | 0.38 m/s | 0.39 m/s |



Pool Spreading and Vaporization

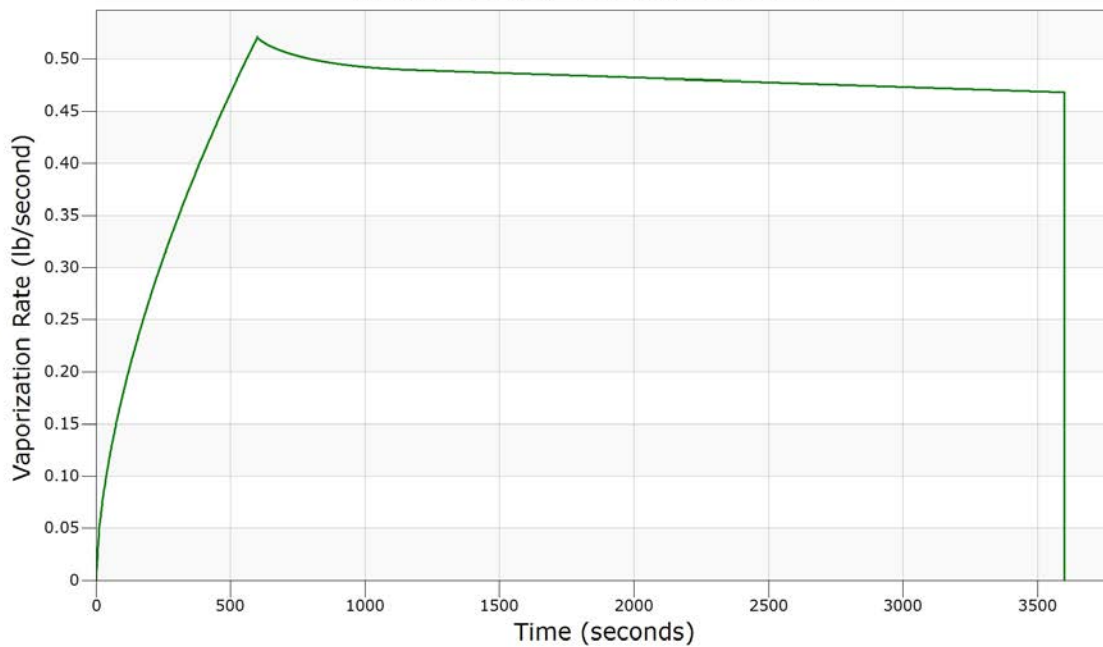
| Time (sec) | Liquid Remaining (ft3) | Pool/Dike Radius (feet) | Vapor Rate (lb/sec) |
|---------------|------------------------------|-------------------------------|------------------------|
| 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| 40.0000 | 25.0480 | 7.23491 | 0.103322 |
| 80.0000 | 50.0338 | 9.11319 | 0.156486 |
| 120.000 | 74.9766 | 10.4288 | 0.199472 |
| 160.000 | 99.8840 | 11.4751 | 0.236931 |
| 200.000 | 124.760 | 12.3573 | 0.270728 |
| 240.000 | 149.607 | 13.1283 | 0.301879 |
| 280.000 | 174.426 | 13.8169 | 0.330980 |
| 320.000 | 199.221 | 14.4419 | 0.358405 |
| 360.000 | 223.990 | 15.0167 | 0.384486 |
| 400.000 | 248.735 | 15.5499 | 0.409398 |
| 440.000 | 273.459 | 16.0486 | 0.433319 |
| 480.000 | 298.165 | 16.5174 | 0.456379 |
| 520.000 | 322.847 | 16.9610 | 0.478646 |
| 560.000 | 347.510 | 17.3819 | 0.500229 |
| 600.000 | 372.146 | 17.7831 | 0.521195 |
| 640.000 | 371.687 | 17.7756 | 0.513721 |
| 680.000 | 371.228 | 17.7684 | 0.509025 |
| 720.000 | 370.769 | 17.7612 | 0.505388 |
| 760.000 | 370.310 | 17.7539 | 0.502433 |
| 800.000 | 369.886 | 17.7467 | 0.499964 |
| 840.000 | 369.427 | 17.7395 | 0.497892 |
| 880.000 | 368.968 | 17.7323 | 0.496150 |
| 1130.00 | 366.213 | 17.6880 | 0.489955 |
| 1380.00 | 363.459 | 17.6437 | 0.487640 |
| 1630.00 | 360.739 | 17.5994 | 0.485436 |
| 1880.00 | 358.020 | 17.5551 | 0.483253 |
| 2130.00 | 355.336 | 17.5112 | 0.481071 |
| 2380.00 | 352.628 | 17.4665 | 0.478866 |
| 2630.00 | 349.947 | 17.4222 | 0.476683 |
| 2880.00 | 347.277 | 17.3780 | 0.474501 |
| 3130.00 | 344.622 | 17.3333 | 0.472318 |
| 3380.00 | 341.977 | 17.2890 | 0.470158 |
| 3600.00 | 339.660 | 17.2500 | 0.468240 |

Ending Message: Normal Ending



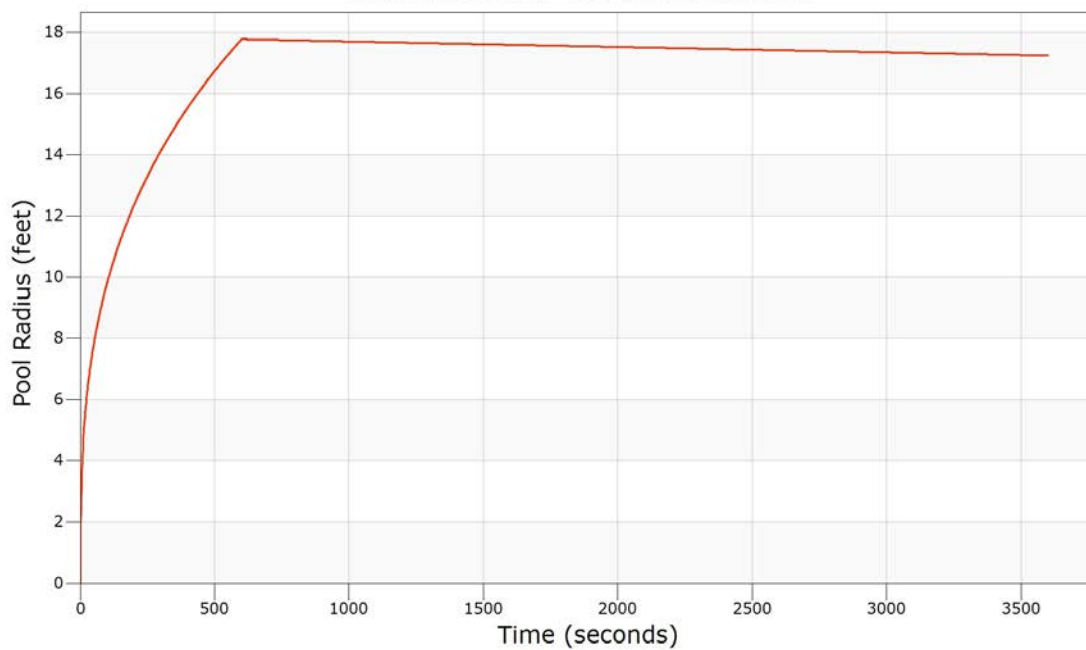
Pool Vaporization Rate

Paramount Refinery - Rail [RailGasolineVCE]



Pool Radius

Paramount Refinery - Rail [RailGasolineVCE]





Momentum Jet Dispersion

concentration limits

Endpoint 1 (highest) = 0.013706 mole fraction
Endpoint 2 (middle) = 0.013706 mole fraction
Endpoint 3 (lowest) = 0.013706 mole fraction

| downwind distance (ft) | centerline conc. (mole frac.) | ground conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) | centerline height (ft) |
|------------------------------|-------------------------------------|---------------------------------|--------------------------------|--------------------------------|--------------------------------|------------------------------|
| 0 | 1.000000 | 0.000000 | 0.9 | 0.9 | 0.9 | 1.0 |
| 3 | 0.925795 | 0.925795 | 4.3 | 4.3 | 4.3 | 0.0 |
| 5 | 0.925792 | 0.925792 | 8.8 | 8.8 | 8.8 | 0.0 |
| 7 | 0.835471 | 0.835471 | 12.6 | 12.6 | 12.6 | 0.0 |
| 10 | 0.719502 | 0.719502 | 15.9 | 15.9 | 15.9 | 0.0 |
| 13 | 0.640756 | 0.640756 | 19.3 | 19.3 | 19.3 | 0.0 |
| 15 | 0.582857 | 0.582857 | 22.6 | 22.6 | 22.6 | 0.0 |
| 18 | 0.509493 | 0.509493 | 25.3 | 25.3 | 25.3 | 0.0 |
| 20 | 0.439226 | 0.439226 | 27.5 | 27.5 | 27.5 | 0.0 |
| 23 | 0.385335 | 0.385335 | 29.6 | 29.6 | 29.6 | 0.0 |
| 25 | 0.342756 | 0.342756 | 31.8 | 31.8 | 31.8 | 0.0 |
| 28 | 0.301742 | 0.301742 | 33.2 | 33.2 | 33.2 | 0.0 |
| 30 | 0.266593 | 0.266593 | 34.3 | 34.3 | 34.3 | 0.0 |
| 33 | 0.237886 | 0.237886 | 35.4 | 35.4 | 35.4 | 0.0 |
| 35 | 0.214071 | 0.214071 | 36.5 | 36.5 | 36.5 | 0.0 |
| 38 | 0.194048 | 0.194048 | 37.6 | 37.6 | 37.6 | 0.0 |
| 40 | 0.176798 | 0.176798 | 38.7 | 38.7 | 38.7 | 0.0 |
| 43 | 0.159693 | 0.159693 | 39.1 | 39.1 | 39.1 | 0.0 |
| 45 | 0.145085 | 0.145085 | 39.6 | 39.6 | 39.6 | 0.0 |
| 48 | 0.132499 | 0.132499 | 40.1 | 40.1 | 40.1 | 0.0 |
| 50 | 0.121569 | 0.121569 | 40.5 | 40.5 | 40.5 | 0.0 |
| 53 | 0.112011 | 0.112011 | 41.0 | 41.0 | 41.0 | 0.0 |
| 55 | 0.103598 | 0.103598 | 41.5 | 41.5 | 41.5 | 0.0 |
| 58 | 0.095887 | 0.095887 | 41.8 | 41.8 | 41.8 | 0.0 |
| 60 | 0.088554 | 0.088554 | 41.7 | 41.7 | 41.7 | 0.0 |
| 62 | 0.082048 | 0.082048 | 41.7 | 41.7 | 41.7 | 0.0 |
| 65 | 0.076248 | 0.076248 | 41.6 | 41.6 | 41.6 | 0.0 |
| 68 | 0.071054 | 0.071054 | 41.6 | 41.6 | 41.6 | 0.0 |
| 70 | 0.066384 | 0.066384 | 41.6 | 41.6 | 41.6 | 0.0 |
| 73 | 0.062170 | 0.062170 | 41.5 | 41.5 | 41.5 | 0.0 |
| 75 | 0.058352 | 0.058352 | 41.5 | 41.5 | 41.5 | 0.0 |
| 78 | 0.054864 | 0.054864 | 41.4 | 41.4 | 41.4 | 0.0 |
| 80 | 0.051478 | 0.051478 | 41.0 | 41.0 | 41.0 | 0.0 |
| 83 | 0.048395 | 0.048395 | 40.6 | 40.6 | 40.6 | 0.0 |
| 85 | 0.045581 | 0.045581 | 40.2 | 40.2 | 40.2 | 0.0 |



CANARY by Quest Output Report
 Report Date: 11 June 2021
 Case Title: Paramount Refinery - Rail

| downwind distance (ft) | centerline conc. (mole frac.) | ground conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) | centerline height (ft) |
|------------------------|-------------------------------|---------------------------|--------------------------|--------------------------|--------------------------|------------------------|
| 88 | 0.043005 | 0.043005 | 39.8 | 39.8 | 39.8 | 0.0 |
| 90 | 0.040641 | 0.040641 | 39.4 | 39.4 | 39.4 | 0.0 |
| 93 | 0.038467 | 0.038467 | 39.0 | 39.0 | 39.0 | 0.0 |
| 95 | 0.036462 | 0.036462 | 38.5 | 38.5 | 38.5 | 0.0 |
| 98 | 0.034610 | 0.034610 | 38.1 | 38.1 | 38.1 | 0.0 |
| 100 | 0.032896 | 0.032896 | 37.7 | 37.7 | 37.7 | 0.0 |
| 103 | 0.031305 | 0.031305 | 37.3 | 37.3 | 37.3 | 0.0 |
| 105 | 0.029799 | 0.029799 | 36.6 | 36.6 | 36.6 | 0.0 |
| 108 | 0.028365 | 0.028365 | 35.5 | 35.5 | 35.5 | 0.0 |
| 110 | 0.027031 | 0.027031 | 34.5 | 34.5 | 34.5 | 0.0 |
| 112 | 0.025787 | 0.025787 | 33.4 | 33.4 | 33.4 | 0.0 |
| 115 | 0.024626 | 0.024626 | 32.3 | 32.3 | 32.3 | 0.0 |
| 118 | 0.023540 | 0.023540 | 31.3 | 31.3 | 31.3 | 0.0 |
| 120 | 0.022524 | 0.022524 | 30.2 | 30.2 | 30.2 | 0.0 |
| 123 | 0.021571 | 0.021571 | 29.1 | 29.1 | 29.1 | 0.0 |
| 125 | 0.020677 | 0.020677 | 28.1 | 28.1 | 28.1 | 0.0 |
| 128 | 0.019836 | 0.019836 | 27.0 | 27.0 | 27.0 | 0.0 |
| 130 | 0.019045 | 0.019045 | 25.9 | 25.9 | 25.9 | 0.0 |
| 133 | 0.018300 | 0.018300 | 24.9 | 24.9 | 24.9 | 0.0 |
| 135 | 0.017597 | 0.017597 | 23.8 | 23.8 | 23.8 | 0.0 |
| 138 | 0.016929 | 0.016929 | 22.0 | 22.0 | 22.0 | 0.0 |
| 140 | 0.016287 | 0.016287 | 18.2 | 18.2 | 18.2 | 0.0 |
| 143 | 0.015681 | 0.015681 | 14.3 | 14.3 | 14.3 | 0.0 |
| 145 | 0.015107 | 0.015107 | 10.4 | 10.4 | 10.4 | 0.0 |
| 148 | 0.014563 | 0.014563 | 6.6 | 6.6 | 6.6 | 0.0 |
| 150 | 0.014047 | 0.014047 | 2.7 | 2.7 | 2.7 | 0.0 |
| 153 | 0.013558 | 0.013558 | 0.0 | 0.0 | 0.0 | 0.0 |

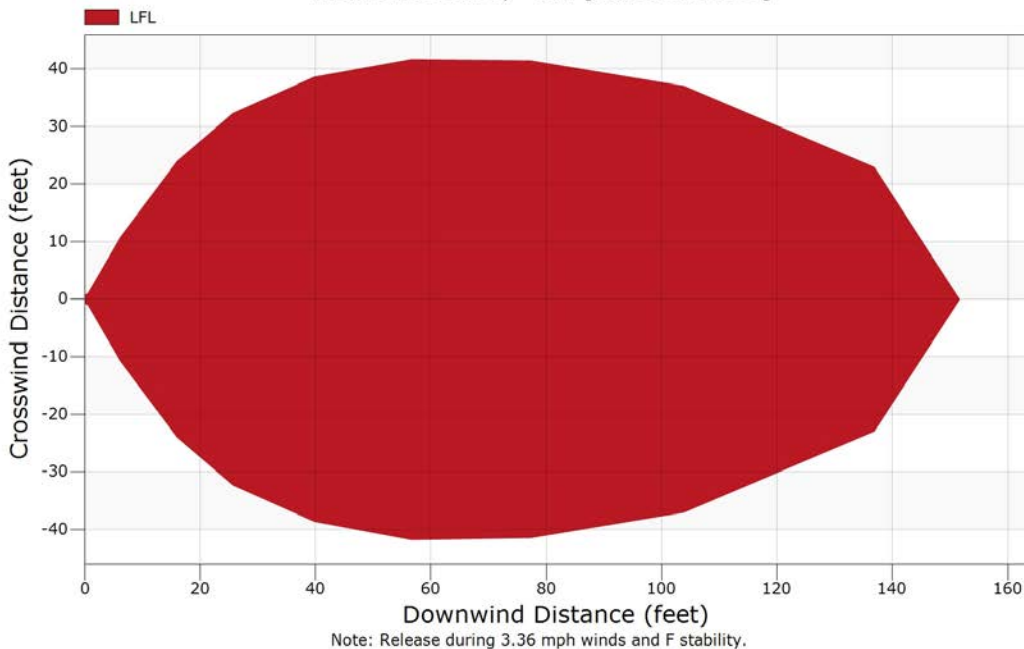
The momentum jet model coupled to the heavy gas model at 0.56 ft in 0 sec.

| Endpoint (mole frac., mixture) | Downwind Distance (feet) | Approximate Time (seconds) |
|--------------------------------|--------------------------|----------------------------|
| 1 0.013706 (LFL) | 151.7 | 44 |
| 2 0.013706 (LFL) | 151.7 | 44 |
| 3 0.013706 (LFL) | 151.7 | 44 |



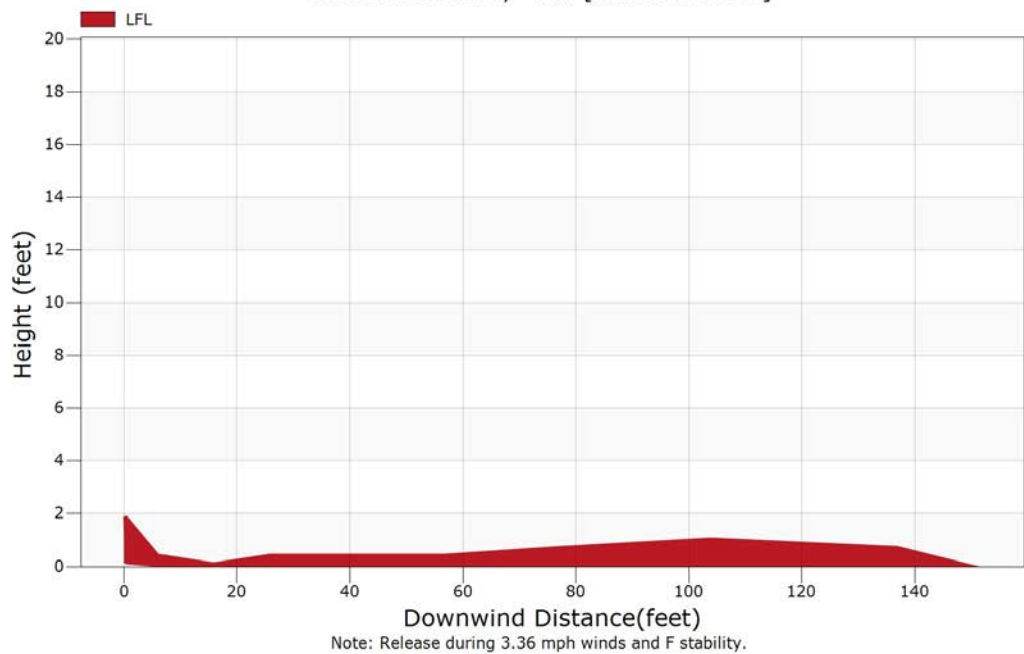
Momentum Jet Contours - Overhead View

Paramount Refinery - Rail [RailGasolineVCE]



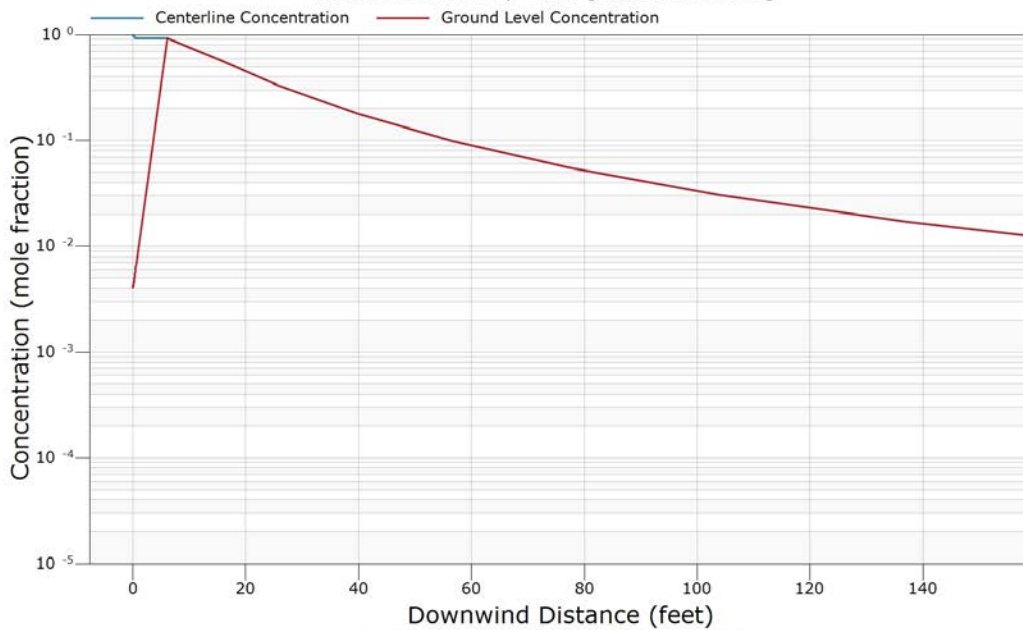
Momentum Jet Contours - Side View

Paramount Refinery - Rail [RailGasolineVCE]





Momentum Jet Concentration Paramount Refinery - Rail [RailGasolineVCE]



Note: Release during 3.36 mph winds and F stability.



Heavier-than-Air Dispersion

concentration limits

Endpoint 1 (highest) = 0.010801 mole fraction
Endpoint 2 (middle) = 0.010801 mole fraction
Endpoint 3 (lowest) = 0.010801 mole fraction

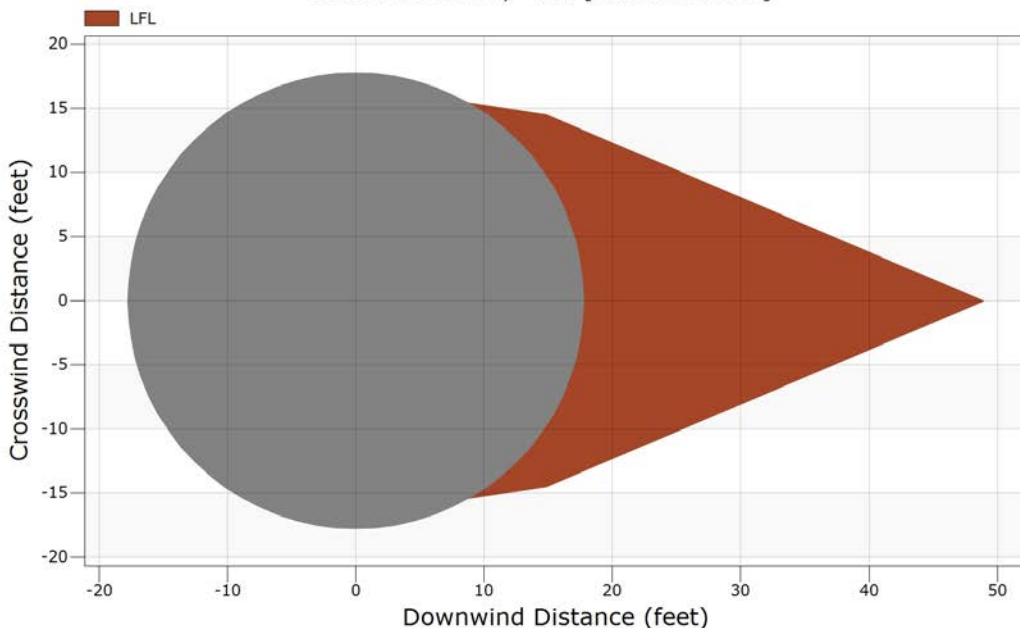
| downwind distance (ft) | centerline conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) |
|------------------------------|-------------------------------------|--------------------------------|--------------------------------|--------------------------------|
| 1.00 | 0.011925 | 5.48 | 5.48 | 5.48 |
| 2.00 | 0.018123 | 14.88 | 14.88 | 14.88 |
| 3.00 | 0.018549 | 14.97 | 14.97 | 14.97 |
| 4.00 | 0.018857 | 15.07 | 15.07 | 15.07 |
| 5.00 | 0.019100 | 15.16 | 15.16 | 15.16 |
| 6.00 | 0.019300 | 15.26 | 15.26 | 15.26 |
| 7.00 | 0.019472 | 15.35 | 15.35 | 15.35 |
| 8.00 | 0.019621 | 15.44 | 15.44 | 15.44 |
| 9.00 | 0.019700 | 15.41 | 15.41 | 15.41 |
| 10.00 | 0.019729 | 15.26 | 15.26 | 15.26 |
| 11.00 | 0.019755 | 15.11 | 15.11 | 15.11 |
| 12.00 | 0.019779 | 14.97 | 14.97 | 14.97 |
| 13.00 | 0.019800 | 14.82 | 14.82 | 14.82 |
| 14.00 | 0.019821 | 14.67 | 14.67 | 14.67 |
| 15.00 | 0.019740 | 14.49 | 14.49 | 14.49 |
| 16.00 | 0.019101 | 14.06 | 14.06 | 14.06 |
| 17.00 | 0.018520 | 13.64 | 13.64 | 13.64 |
| 18.00 | 0.017988 | 13.21 | 13.21 | 13.21 |
| 19.00 | 0.017500 | 12.78 | 12.78 | 12.78 |
| 20.00 | 0.017048 | 12.36 | 12.36 | 12.36 |
| 21.00 | 0.016629 | 11.93 | 11.93 | 11.93 |
| 22.00 | 0.016240 | 11.50 | 11.50 | 11.50 |
| 23.00 | 0.015876 | 11.08 | 11.08 | 11.08 |
| 24.00 | 0.015536 | 10.65 | 10.65 | 10.65 |
| 25.00 | 0.015216 | 10.22 | 10.22 | 10.22 |
| 26.00 | 0.014915 | 9.80 | 9.80 | 9.80 |
| 27.00 | 0.014631 | 9.37 | 9.37 | 9.37 |
| 28.00 | 0.014362 | 8.95 | 8.95 | 8.95 |
| 29.00 | 0.014107 | 8.52 | 8.52 | 8.52 |
| 30.00 | 0.013866 | 8.09 | 8.09 | 8.09 |
| 31.00 | 0.013636 | 7.67 | 7.67 | 7.67 |
| 32.00 | 0.013417 | 7.24 | 7.24 | 7.24 |
| 33.00 | 0.013208 | 6.81 | 6.81 | 6.81 |
| 34.00 | 0.013009 | 6.39 | 6.39 | 6.39 |
| 35.00 | 0.012818 | 5.96 | 5.96 | 5.96 |



| downwind distance (ft) | centerline conc. (mole frac.) | Endpoint3 1/2 width (ft) | Endpoint2 1/2 width (ft) | Endpoint1 1/2 width (ft) |
|------------------------|-------------------------------|--------------------------|--------------------------|--------------------------|
| 36.00 | 0.012635 | 5.53 | 5.53 | 5.53 |
| 37.00 | 0.012460 | 5.11 | 5.11 | 5.11 |
| 38.00 | 0.012292 | 4.68 | 4.68 | 4.68 |
| 39.00 | 0.012130 | 4.26 | 4.26 | 4.26 |
| 40.00 | 0.011975 | 3.83 | 3.83 | 3.83 |
| 41.00 | 0.011825 | 3.40 | 3.40 | 3.40 |
| 42.00 | 0.011681 | 2.98 | 2.98 | 2.98 |
| 43.00 | 0.011542 | 2.55 | 2.55 | 2.55 |
| 44.00 | 0.011407 | 2.12 | 2.12 | 2.12 |
| 45.00 | 0.011277 | 1.70 | 1.70 | 1.70 |
| 46.00 | 0.011152 | 1.27 | 1.27 | 1.27 |
| 47.00 | 0.011030 | 0.84 | 0.84 | 0.84 |
| 48.00 | 0.010913 | 0.42 | 0.42 | 0.42 |

| Endpoint (mole frac., mixture) | Downwind Distance (feet) | Approximate Time (seconds) |
|--------------------------------|--------------------------|----------------------------|
| 1 0.010801 (LFL) | 49.0 | 15 |
| 2 0.010801 (LFL) | 49.0 | 15 |
| 3 0.010801 (LFL) | 49.0 | 15 |

Heavier-than-Air Contours - Overhead View
 Paramount Refinery - Rail [RailGasolineVCE]

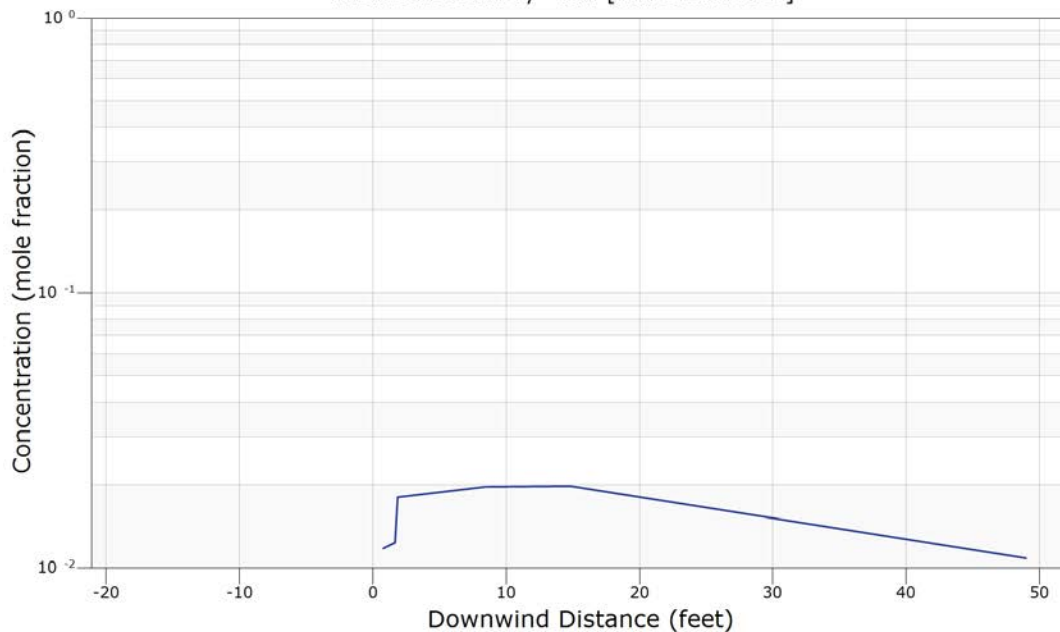


Note: Release during 3.36 mph winds and F stability.



Heavier-than-Air Centerline Concentration

Paramount Refinery - Rail [RailGasolineVCE]



Note: Release during 3.36 mph winds and F stability.



Momentum Jet Explosion

Fuel Reactivity: Medium Obstacle Density: Low
Flame Expansion: 2.5-D Flame Speed: 0.29

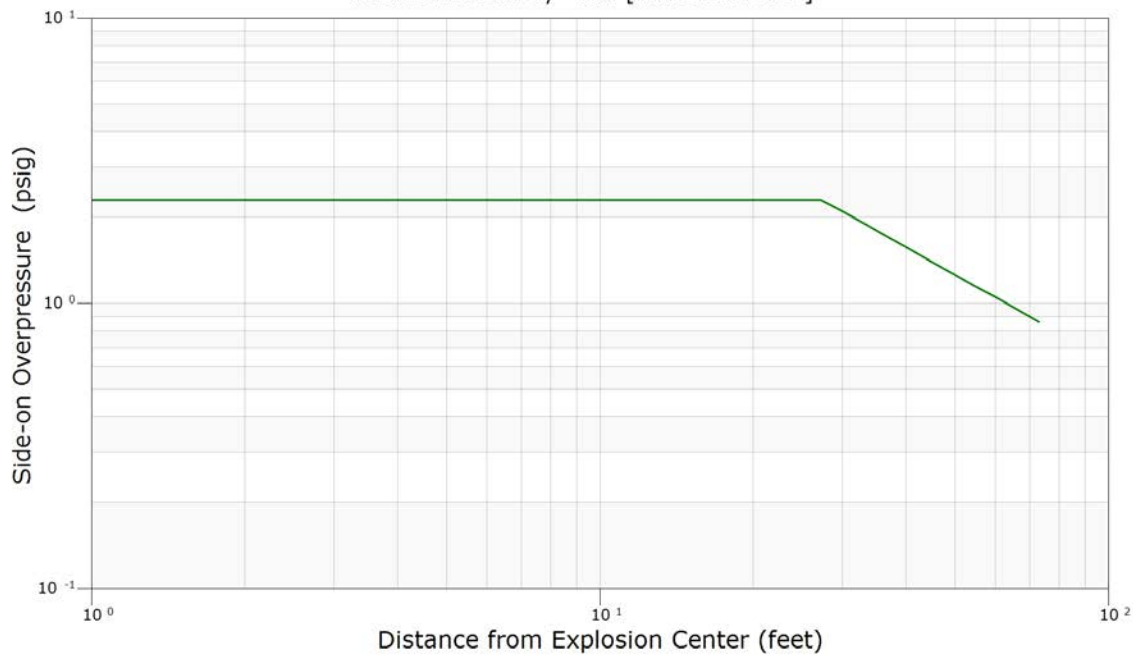
Mass of released material involved in explosion: 45.7426 lbs.

| Distance from Center of Flammable Cloud (feet) | Overpressure (psi gauge) | Impulse (psi-s) |
|--|-----------------------------|--------------------|
| 0.0 | 2.30 | 0.1179 |
| 6.8 | 2.30 | 0.1179 |
| 7.5 | 2.30 | 0.1179 |
| 8.3 | 2.30 | 0.1179 |
| 9.2 | 2.30 | 0.1179 |
| 10.1 | 2.30 | 0.1179 |
| 11.2 | 2.30 | 0.1179 |
| 12.3 | 2.30 | 0.1093 |
| 13.6 | 2.30 | 0.0992 |
| 15.0 | 2.30 | 0.0900 |
| 16.6 | 2.30 | 0.0817 |
| 18.3 | 2.30 | 0.0742 |
| 20.2 | 2.30 | 0.0673 |
| 22.3 | 2.30 | 0.0611 |
| 24.6 | 2.30 | 0.0555 |
| 27.2 | 2.30 | 0.0503 |
| 30.0 | 2.10 | 0.0457 |
| 33.1 | 1.90 | 0.0415 |
| 36.6 | 1.72 | 0.0376 |
| 40.4 | 1.56 | 0.0342 |
| 44.5 | 1.41 | 0.0310 |
| 49.2 | 1.28 | 0.0282 |
| 54.3 | 1.16 | 0.0256 |
| 59.9 | 1.05 | 0.0232 |
| 73.0 | 0.86 | 0.0191 |

The downwind distance to 1.00 psi is 63.3 feet
The downwind distance to 1.00 psi is 63.3 feet
The downwind distance to 1.00 psi is 63.3 feet



Momentum Jet Explosion Overpressure - Baker-Strehlow-Tang
Paramount Refinery - Rail [RailGasolineVCE]





Heavier-than-Air Explosion

Fuel Reactivity: Medium Obstacle Density: Low
Flame Expansion: 2.5-D Flame Speed: 0.29

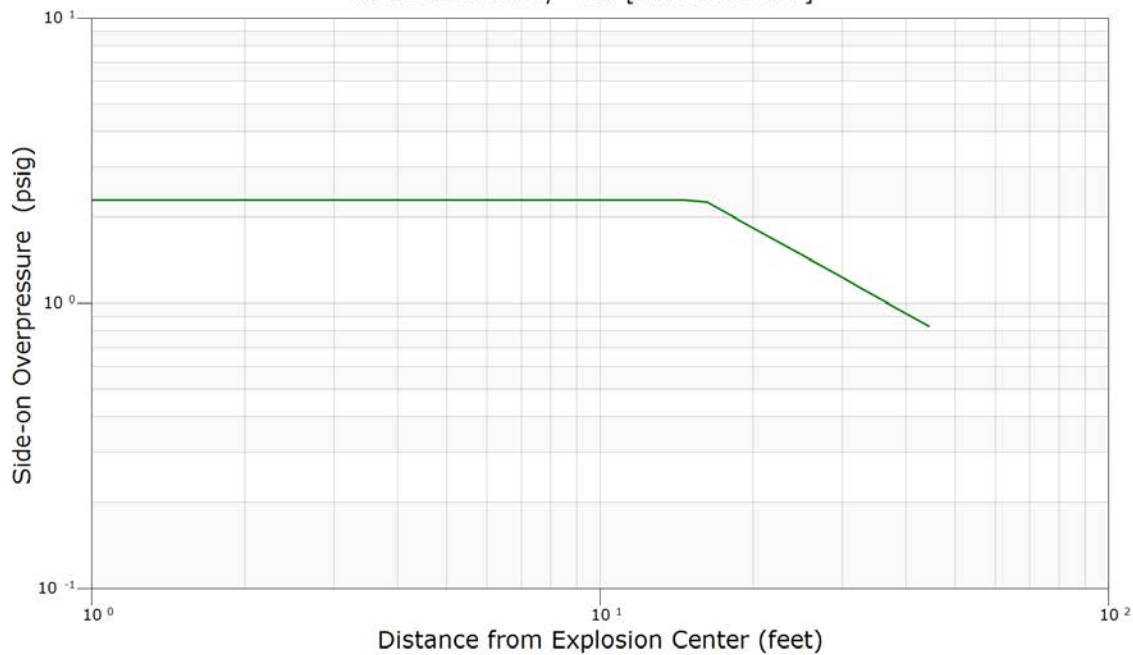
Mass of released material involved in explosion: 9.19691 lbs.

| Distance from Center of Flammable Cloud (feet) | Overpressure (psi gauge) | Impulse (psi-s) |
|--|-----------------------------|--------------------|
| 0.0 | 2.30 | 0.0691 |
| 4.0 | 2.30 | 0.0691 |
| 4.4 | 2.30 | 0.0691 |
| 4.9 | 2.30 | 0.0691 |
| 5.4 | 2.30 | 0.0691 |
| 6.0 | 2.30 | 0.0691 |
| 6.6 | 2.30 | 0.0691 |
| 7.3 | 2.30 | 0.0634 |
| 8.1 | 2.30 | 0.0575 |
| 8.9 | 2.30 | 0.0521 |
| 9.8 | 2.30 | 0.0472 |
| 10.9 | 2.30 | 0.0428 |
| 12.0 | 2.30 | 0.0388 |
| 13.3 | 2.30 | 0.0352 |
| 14.7 | 2.30 | 0.0319 |
| 16.3 | 2.27 | 0.0289 |
| 18.0 | 2.05 | 0.0262 |
| 19.9 | 1.85 | 0.0237 |
| 22.0 | 1.68 | 0.0215 |
| 24.3 | 1.52 | 0.0195 |
| 26.8 | 1.37 | 0.0177 |
| 29.7 | 1.24 | 0.0160 |
| 32.8 | 1.12 | 0.0145 |
| 36.3 | 1.02 | 0.0132 |
| 44.3 | 0.83 | 0.0108 |

The downwind distance to 1.00 psi is 36.9 feet
The downwind distance to 1.00 psi is 36.9 feet
The downwind distance to 1.00 psi is 36.9 feet



Heavier-than-Air Explosion Overpressure - Baker-Strehlow-Tang Paramount Refinery - Rail [RailGasolineVCE]





Case Inputs

Case Type : Fire Radiation
Case Name : RailGasolinePool
User ID :
Project Number :
Type of Units : English Units

NOTES:

MATERIAL MENU

| Materials Released | Number | Formula | Name | Fraction |
|--------------------|--------|---------|----------------------------|----------|
| Component 1 | 5 | C4H10 | n-Butane | 0.020000 |
| Component 2 | 8 | C6H14 | n-Hexane | 0.100000 |
| Component 3 | 9 | C7H16 | n-Heptane | 0.100000 |
| Component 4 | 11 | C9H20 | n-Nonane | 0.100000 |
| Component 5 | 12 | C10H22 | n-Decane | 0.030000 |
| Component 6 | 254 | C5H12 | 2,2-Dimethylpropane (Neop) | 0.200000 |
| Component 7 | 273 | C6H12 | Methylcyclopentane | 0.100000 |
| Component 8 | 281 | C7H8 | Toluene | 0.100000 |
| Component 9 | 286 | C8H10 | para-Xylene | 0.100000 |
| Component 10 | 289 | C8H18 | 3-Methylheptane | 0.150000 |

Temperature : 68.00 °F
Pressure : 14.70 psia
The material is LIQUID
The mixture is Gasoline

NOTES:

ENVIRONMENT MENU

Wind speed : 20.00 mph
Relative humidity : 70 %
Air temperature : 68.0 °F

NOTES:

FIRE TYPE MENU

Fire radiation division: Circular pool fires
Horizontal isopleths only
Spill surface: land
Elevation of flame base (from grade) : 1.0 feet
Elevation of target (from grade) : 0.0 feet
Diameter of pool : 40.0 feet

Fire radiation flux values

Radiation endpoint 1 : 3487 Btu/hr-sq.ft
Radiation endpoint 2 : 1600 Btu/hr-sq.ft
Radiation endpoint 3 : 500 Btu/hr-sq.ft

NOTES:



Pool Fire Radiation

Length of Flame : 74.1 feet
 Flame Tilt from Vertical : 59.7 degrees
 Target Elevation : 0.0 feet
 Pool Elevation : 1.0 feet
 Wind Speed : 20.0 mph
 Substrate : Land

| Downwind Distance from Center of Pool (feet) | Flux to Vertical Target (Btu/hr-sq.ft) | Flux to Horizontal Target (Btu/hr-sq.ft) | Maximum Flux (Btu/hr-sq.ft) |
|--|--|--|-----------------------------------|
| 22.0 | 14220 | 31869 | 34897 |
| 23.8 | 16267 | 31568 | 35513 |
| 25.8 | 16691 | 35035 | 38808 |
| 27.9 | 14844 | 38572 | 39878 |
| 30.2 | 12729 | 38756 | 39878 |
| 32.7 | 23002 | 36257 | 39878 |
| 35.4 | 14065 | 37226 | 39794 |
| 38.3 | 20738 | 29125 | 38833 |
| 41.5 | 17711 | 30882 | 37295 |
| 44.9 | 16345 | 26500 | 31772 |
| 48.6 | 15067 | 20781 | 25940 |
| 52.6 | 12994 | 14764 | 19791 |
| 56.9 | 10082 | 11048 | 15028 |
| 61.6 | 7930 | 9117 | 12130 |
| 66.7 | 6509 | 7902 | 10270 |
| 72.2 | 5525 | 6945 | 8897 |
| 78.2 | 4795 | 6074 | 7754 |
| 84.6 | 4226 | 5210 | 6719 |
| 91.6 | 3758 | 4305 | 5721 |
| 99.1 | 3356 | 3368 | 4758 |
| 107.3 | 2945 | 2454 | 3836 |
| 116.1 | 2466 | 1664 | 2976 |
| 125.7 | 1972 | 1067 | 2243 |
| 136.1 | 1527 | 664 | 1665 |
| 147.3 | 1163 | 410 | 1234 |
| 159.4 | 884 | 256 | 920 |
| 172.6 | 674 | 163 | 694 |
| 186.8 | 518 | 105 | 529 |
| 202.2 | 402 | 69 | 408 |
| 218.9 | 314 | 47 | 317 |

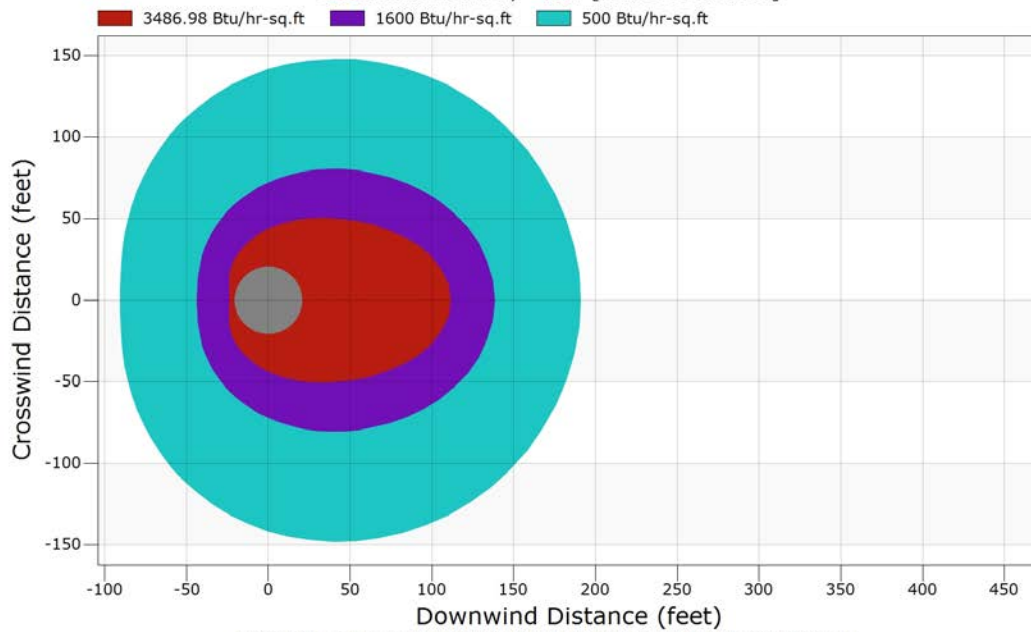
Downwind Distances to Endpoints:

| Distance (feet) | Maximum Flux (Btu/hr-sq.ft) |
|--------------------|--------------------------------|
| 110.9 | 3487 |
| 137.8 | 1600 |
| 190.5 | 500 |



Pool Fire Radiant Heat Contours - Overhead View

Paramount Refinery - Rail [RailGasolinePool]



Note: Results presented for 1 feet below the flame base during 20 mph winds.