

ANEXO G

MEMORIAS DE CÁLCULO PARA LAS EMPRESAS

“DISEÑO Y DESARROLLO DE UNA BASE DE DATOS GEOGRÁFICA Y MODELOS DE ANÁLISIS SOPORTADOS EN LA INFRAESTRUCTURA TECNOLÓGICA DEL FONDO DE PREVENCIÓN Y ATENCIÓN DE EMERGENCIAS - FOPAE, PARA EL ALMACENAMIENTO, CONSULTA DE DATOS Y GENERACIÓN DEL MAPA DE RIESGO INDUSTRIAL DE BOGOTÁ D.C., CON BASE EN EL RIESGO TECNOLÓGICO QUE LAS INDUSTRIAS PUEDAN GENERAR, Y EL DESARROLLO DE LAS METODOLOGÍAS SUBYACENTES PARA LA IDENTIFICACIÓN Y VALORACIÓN SISTEMÁTICA DE ESTOS RIESGOS”.

MULTIPROCESOS SIG S.A.

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ANEXO G. MEMORIAS DE CÁLCULO PARA LAS EMPRESAS

G.1. Empresa Acabados 1ª.

La sustancia que genera el peor caso para esta empresa fue el monoetilenglicol, que para modelar en ALOHA se considero como Etanol.

SITE DATA:

Location: BOGOTA, COLOMBIA

Building Air Exchanges Per Hour: 0.20 (sheltered single storied)

CHEMICAL DATA:

Chemical Name: ETHANOL Molecular Weight: 46.07 g/mol

TEEL-1: 3000 ppm TEEL-2: 3300 ppm TEEL-3: 3300 ppm

IDLH: 3300 ppm LEL: 43000 ppm UEL: 190000 ppm

Carcinogenic risk - see CAMEO

Ambient Boiling Point: 69.8° C

Vapor Pressure at Ambient Temperature: 0.052 atm

Ambient Saturation Concentration: 72,652 ppm or 7.27%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)

Wind: 1 meters/second from 0° true at 3 meters

Ground Roughness: urban or forest Cloud Cover: 5 tenths

Air Temperature: 18° C Stability Class: B

No Inversion Height Relative Humidity: 50%

SOURCE STRENGTH:

BLEVE of flammable liquid in vertical cylindrical tank

Tank Diameter: 0.55 meters Tank Length: 0.9 meters

Tank Volume: 0.21 cubic meters

Tank contains liquid

Internal Storage Temperature: 18° C

Chemical Mass in Tank: 0.13 tons Tank is 65% full

Percentage of Tank Mass in Fireball: 100%

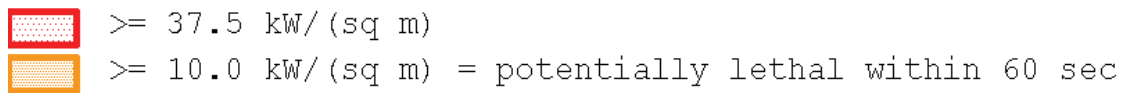
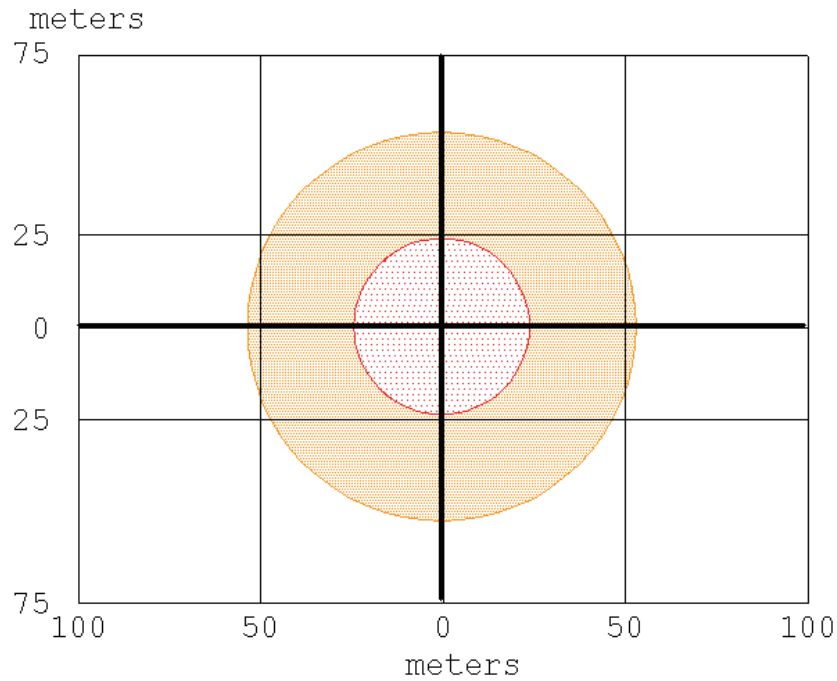
Fireball Diameter: 28 meters Burn Duration: 3 seconds

THREAT ZONE:

Threat Modeled: Thermal radiation from fireball

Red : 24 meters --- (37.5 kW/(sq m))

Orange: 53 meters --- (10.0 kW/(sq m) = potentially lethal within 60 sec) .



Conclusión:

Radio de 24 metros para una radiación de $37.5 \text{ kW}/\text{m}^2$
 Radio de 53 metros para una radiación de $10.0 \text{ kW}/\text{m}^2$

G.2. Empresa Agroquímicos San Victorino.

El producto que genera el peor caso para esta empresa es el Alcohol Etílico, para el modelamiento en ALOHA se consideró el Etanol.

SITE DATA:

Location: BOGOTA, COLOMBIA
 Building Air Exchanges Per Hour: 0.20 (sheltered single storied)

CHEMICAL DATA:

Chemical Name: ETHANOL Molecular Weight: 46.07 g/mol
 TEEL-1: 3000 ppm TEEL-2: 3300 ppm TEEL-3: 3300 ppm
 IDLH: 3300 ppm LEL: 43000 ppm UEL: 190000 ppm
 Ambient Boiling Point: 69.8°C
 Vapor Pressure at Ambient Temperature: 0.052 atm
 Ambient Saturation Concentration: 72,653 ppm or 7.27%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)

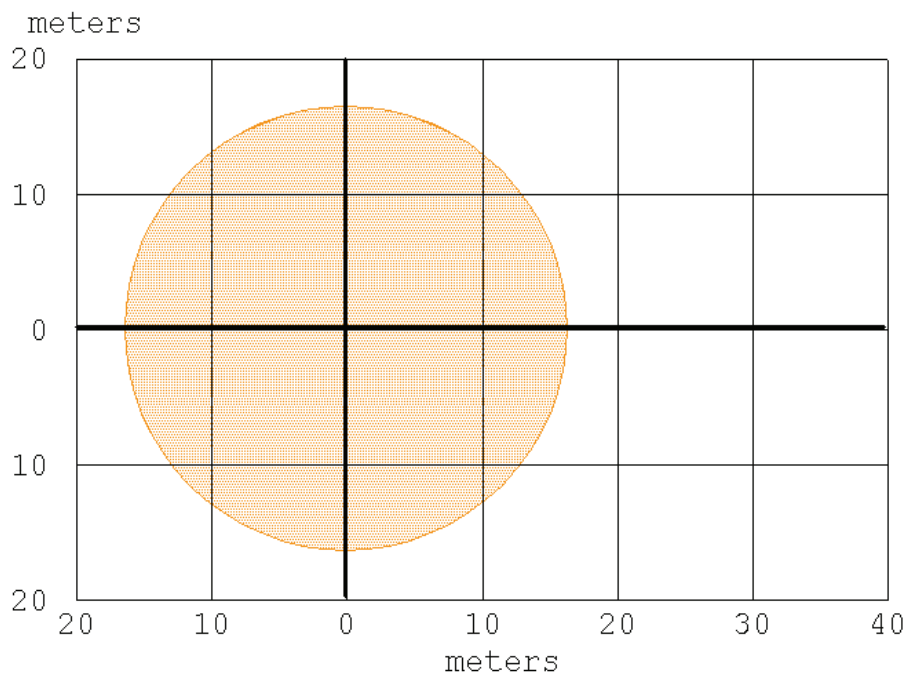
Wind: 1 meters/second from 0° true at 3 meters
 Ground Roughness: urban or forest Cloud Cover: 5 tenths
 Air Temperature: 18° C Stability Class: B
 No Inversion Height Relative Humidity: 50%



SOURCE STRENGTH:

BLEVE of flammable liquid in vertical cylindrical tank
 Tank Diameter: 0.2 meters Tank Length: 0.5 meters
 Tank Volume: 0.016 cubic meters
 Tank contains liquid
 Internal Storage Temperature: 18° C
 Chemical Mass in Tank: 2.99 kilograms
 Tank is 24% full
 Percentage of Tank Mass in Fireball: 100%
 Fireball Diameter: 8 meters Burn Duration: 1 second

THREAT ZONE:

Threat Modeled: Thermal radiation from fireball
 Red : less than 10 meters(10.9 yards) --- (37.5 kW/(sq m))
 Orange: 16 meters --- (10.0 kW/(sq m) = potentially lethal within 60 sec)



 $\geq 37.5 \text{ kW}/(\text{sq m})$ (not drawn)
 $\geq 10.0 \text{ kW}/(\text{sq m}) = \text{potentially lethal within 60 sec}$

Conclusión:

Radio de menos de 10 metros para una radiación de 37.5 kW/m²
 Radio de 16 metros para una radiación de 10.0 kW/m²

G.3. Empresa Boehringer Ingelheim.

Para el caso de esta empresa se modelo el producto que podía generar mayor peligro por su volumen e inflamabilidad. Para efecto de modelación se considera el ACPM, en ALOHA el N- Pentane, en una bodega a cielo abierto.

SITE DATA:

Location: BOGOTA, COLOMBIA

Building Air Exchanges Per Hour: 4 (user specified)

CHEMICAL DATA:

Chemical Name: N-PENTANE Molecular Weight: 72.15 g/mol

TEEL-1: 610 ppm TEEL-2: 610 ppm TEEL-3: 1500 ppm

IDLH: 1500 ppm LEL: 13000 ppm UEL: 80000 ppm

Ambient Boiling Point: 26.4° C

Vapor Pressure at Ambient Temperature: 0.52 atm

Ambient Saturation Concentration: 728,228 ppm or 72.8%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)

Wind: 1 meters/second from 0° true at 3 meters

Ground Roughness: urban or forest Cloud Cover: 5 tenths

Air Temperature: 18° C

Stability Class: B

No Inversion Height

Relative Humidity: 50%

SOURCE STRENGTH:

BLEVE of flammable liquid in horizontal cylindrical tank

Tank Diameter: 2.18 meters

Tank Length: 12 meters

Tank Volume: 44.8 cubic meters

Tank contains liquid

Internal Storage Temperature: 18° C

Chemical Mass in Tank: 26.3 tons Tank is 85% full

Percentage of Tank Mass in Fireball: 100%

Fireball Diameter: 167 meters

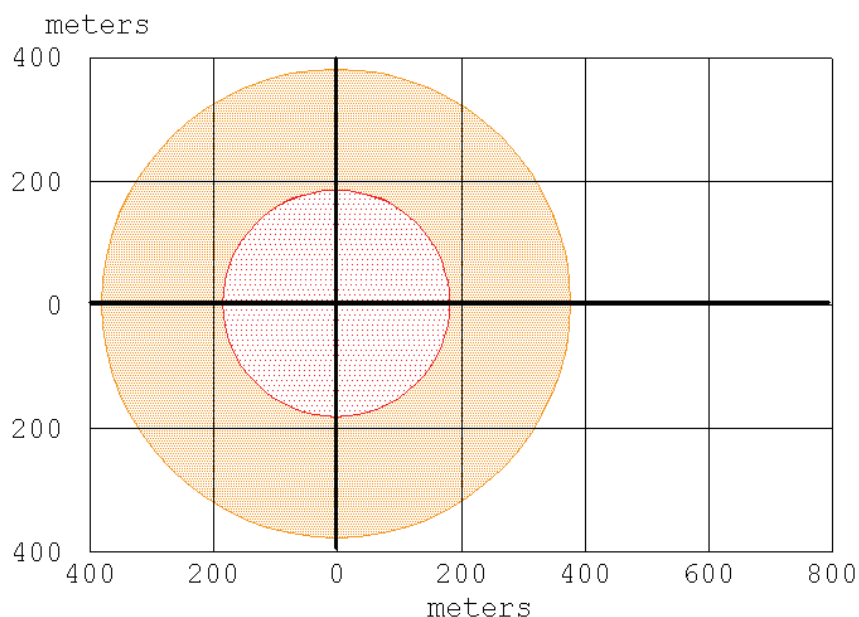
Burn Duration: 11 seconds



THREAT ZONE:

Threat Modeled: Thermal radiation from fireball

Red : 183 meters --- (37.5 kW/(sq m))

Orange: 378 meters --- (10.0 kW/(sq m) = potentially lethal within 60 sec)



-  $\geq 37.5 \text{ kW}/(\text{sq m})$
-  $\geq 10.0 \text{ kW}/(\text{sq m}) = \text{potentially lethal within 60 sec}$

Conclusión:

Radio de 183 metros para una radiación de $37.5 \text{ kW}/\text{m}^2$

Radio de 378 metros para una radiación de $10.0 \text{ kW}/\text{m}^2$

G.4. Empresa Carboquímica.

Para esta empresa se modeló el O Xylene, por tratarse del producto más peligroso.

SITE DATA:

Location: BOGOTA, COLOMBIA

Building Air Exchanges Per Hour: 4 (user specified)

CHEMICAL DATA:

Chemical Name: O-XYLENE Molecular Weight: 106.17 g/mol

TEEL-1: 150 ppm TEEL-2: 200 ppm TEEL-3: 900 ppm

IDLH: 900 ppm LEL: 9000 ppm UEL: 67000 ppm

Carcinogenic risk - see CAMEO

Ambient Boiling Point: 131.8°C

Vapor Pressure at Ambient Temperature: 0.0057 atm

Ambient Saturation Concentration: 8,045 ppm or 0.80%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)

Wind: 1 meters/second from 0° true at 3 meters

Ground Roughness: urban or forest Cloud Cover: 5 tenths
 Air Temperature: 18° C Stability Class: F
 No Inversion Height Relative Humidity: 50%

SOURCE STRENGTH:

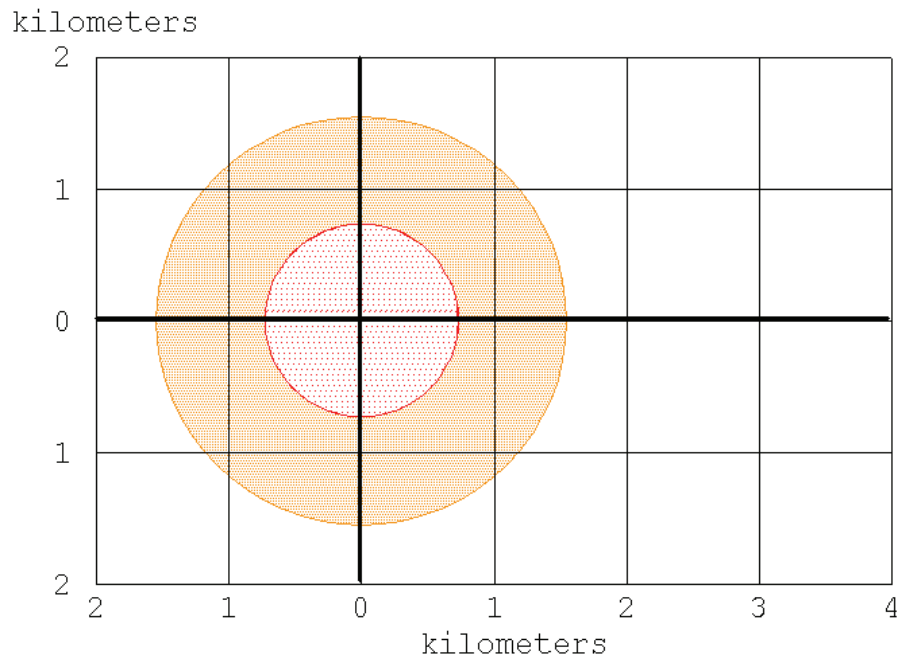
BLEVE of flammable liquid in horizontal cylindrical tank
 Tank Diameter: 14 meters Tank Length: 21 meters
 Tank Volume: 3,233 cubic meters
 Tank contains liquid
 Internal Storage Temperature: 18° C
 Chemical Mass in Tank: 2,629 tons Tank is 84% full
 Percentage of Tank Mass in Fireball: 100%
 Fireball Diameter: 775 meters Burn Duration: 35 seconds

THREAT ZONE:


Threat Modeled: Thermal radiation from fireball

Red : 730 meters --- (37.5 kW/(sq m))

Orange: 1.5 kilometers --- (10.0 kW/(sq m) = potentially lethal within 60 sec)



 $\geq 37.5 \text{ kW}/(\text{sq m})$

 $\geq 10.0 \text{ kW}/(\text{sq m}) = \text{potentially lethal within 60 sec}$

Conclusión:

Radio de 730 metros para una radiación de 37.5 kW/m²

Radio de 1500 metros para una radiación de 10.0 kW/m²

G.5. Empresa Colorquímicos.

Para esta empresa se eligió el Acido Acético, como el pero caso.

SITE DATA:

Location: BOGOTA, COLOMBIA

Building Air Exchanges Per Hour: 0.20 (sheltered single storied)

CHEMICAL DATA:

Chemical Name: ACETIC ACID, GLACIAL Molecular Weight: 60.05 g/mol

TEEL-1: 5 ppm TEEL-2: 35 ppm TEEL-3: 250 ppm

IDLH: 50 ppm LEL: 54000 ppm UEL: 160000 ppm

Ambient Boiling Point: 117.9° C

Vapor Pressure at Ambient Temperature: 0.014 atm

Ambient Saturation Concentration: 13,665 ppm or 1.37%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)

Wind: 1 meters/second from 0° true at 3 meters

Ground Roughness: urban or forest Cloud Cover: 5 tenths

Air Temperature: 18° C

Stability Class: B

No Inversion Height

Relative Humidity: 50%

SOURCE STRENGTH:

BLEVE of flammable liquid in vertical cylindrical tank

Tank Diameter: 0.30 meters

Tank Length: 0.5 meters

Tank Volume: 0.035 cubic meters

Tank contains liquid

Internal Storage Temperature: 18° C

Chemical Mass in Tank: 25.2 kilograms

Tank is 68% full

Percentage of Tank Mass in Fireball: 100%

Fireball Diameter: 17 meters

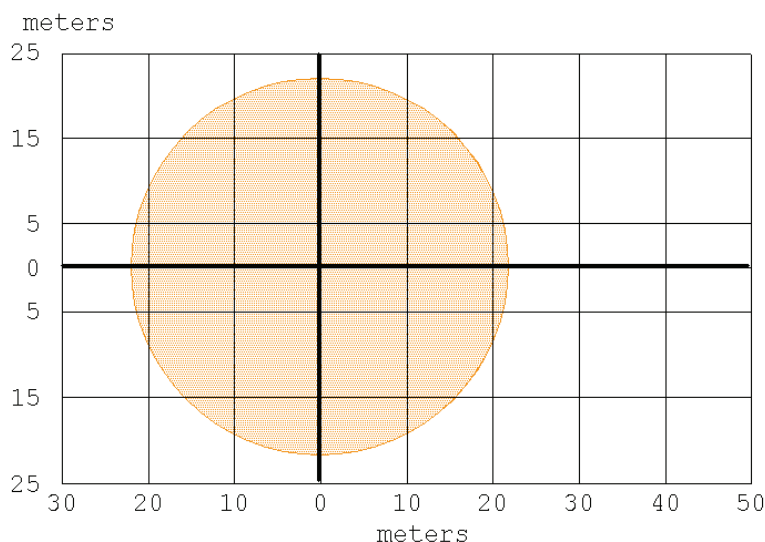
Burn Duration: 2 seconds

THREAT ZONE:

Threat Modeled: Thermal radiation from fireball

Red : LOC was never exceeded --- (37.5 kW/(sq m))

Orange: 22 meters --- (10.0 kW/(sq m) = potentially lethal within 60 sec)



-  $\geq 37.5 \text{ kW}/(\text{sq m})$
 $\geq 10.0 \text{ kW}/(\text{sq m}) = \text{potentially lethal within 60 sec}$

Conclusión:

Radio de 0 metros para una radiación de $37.5 \text{ kW}/\text{m}^2$
 Radio de 22 metros para una radiación de $10.0 \text{ kW}/\text{m}^2$

G.6. Empresa Compañía Colombiana de Químicos.

El producto más peligroso manejado por esta empresa es Resina Epoxica (10 m3). "Una Resina Epoxi o poliepóxido es un polímero termoestable que se endurece cuando se mezcla con un agente catalizador o "endurecedor". Las resinas epoxi más frecuentes son producto de una reacción entre epiclorohidrina y bisfenol-a" (http://es.wikipedia.org/wiki/Resina_epoxi.)

El producto mas peligroso de esta reacción es el Bisfenol-a, lo mas cercano que se encuentra en ALOHA, es el 2,4-DIMETHYLPHENOL, para que este producto este en estado liquido es necesaria una temperatura de $25 \text{ }^\circ\text{C}$

SITE DATA:

Location: BOGOTA, COLOMBIA

Building Air Exchanges Per Hour: 0.27 (sheltered single storied)

CHEMICAL DATA:

Chemical Name: 2,4-DIMETHYLPHENOL Molecular Weight: 122.16 g/mol

TEEL-1: 1 mg/(cu m) TEEL-2: 6 mg/(cu m) TEEL-3: 500 mg/(cu m)

LEL: 11000 ppm UEL: 64000 ppm

Ambient Boiling Point: $197.6 \text{ }^\circ\text{C}$

Vapor Pressure at Ambient Temperature: $1.40\text{e-}004 \text{ atm}$

Ambient Saturation Concentration: 198 ppm or 0.020%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)

Wind: 1 meters/second from 0° true at 3 meters

Ground Roughness: urban or forest Cloud Cover: 5 tenths

Air Temperature: 25° C

Stability Class: F

No Inversion Height

Relative Humidity: 50%

SOURCE STRENGTH:

BLEVE of flammable liquid in vertical cylindrical tank

Tank Diameter: 2.5 meters Tank Length: 3.5 meters

Tank Volume: 17.2 cubic meters

Tank contains liquid

Internal Storage Temperature: 25° C

Chemical Mass in Tank: 11.5 tons Tank is 60% full

Percentage of Tank Mass in Fireball: 100%

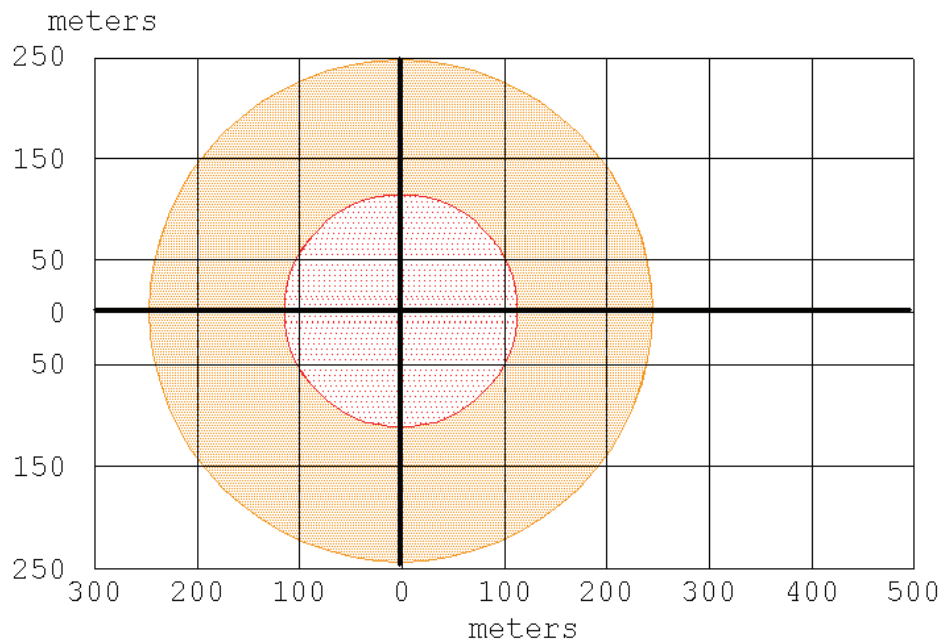
Fireball Diameter: 127 meters Burn Duration: 9 seconds

THREAT ZONE:

Threat Modeled: Thermal radiation from fireball

Red : 114 meters --- (37.5 kW/(sq m))

Orange: 246 meters --- (10.0 kW/(sq m) = potentially lethal within 60 sec



≥ 37.5 kW/(sq m)

≥ 10.0 kW/(sq m) = potentially lethal within 60 sec

Conclusión:

Radio de 114 metros para una radiación de 37.5 kW/m²
Radio de 246 metros para una radiación de 10.0 kW/m²

G.7. Empresa Discarburantes.

Por el volumen de la sustancia manejada, el peor caso es el almacenamiento de 12000 galones de gasolina.

SITE DATA:

Location: BOGOTA, COLOMBIA
Building Air Exchanges Per Hour: 4 (user specified)

CHEMICAL DATA:

Chemical Name: BUTANE Molecular Weight: 58.12 g/mol
TEEL-1: 2400 ppm TEEL-2: 4000 ppm TEEL-3: 19000 ppm
LEL: 15000 ppm UEL: 90000 ppm
Ambient Boiling Point: -9.2° C
Vapor Pressure at Ambient Temperature: greater than 1 atm
Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)

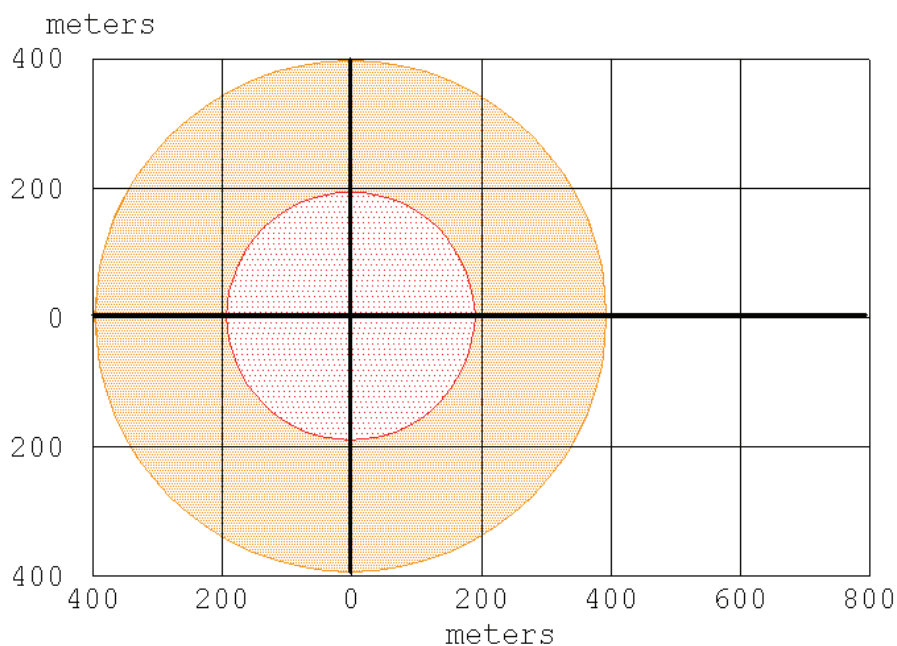
Wind: 1 meters/second from 0° true at 3 meters
Ground Roughness: urban or forest Cloud Cover: 5 tenths
Air Temperature: 18° C Stability Class: B
No Inversion Height Relative Humidity: 50%



SOURCE STRENGTH:

BLEVE of flammable liquid in vertical cylindrical tank
Tank Diameter: 3.5 meters Tank Length: 6 meters
Tank Volume: 57.7 cubic meters
Tank contains liquid
Internal Storage Temperature: 18° C
Chemical Mass in Tank: 26,577 kilograms
Tank is 79% full
Percentage of Tank Mass in Fireball: 100%
Fireball Diameter: 173 meters Burn Duration: 11 seconds

THREAT ZONE:

Threat Modeled: Thermal radiation from fireball
Red : 191 meters --- (37.5 kW/(sq m))
Orange: 395 meters --- (10.0 kW/(sq m) = potentially lethal within 60 sec)



-  $\geq 37.5 \text{ kW}/(\text{sq m})$
-  $\geq 10.0 \text{ kW}/(\text{sq m}) = \text{potentially lethal within 60 sec}$

Conclusión:

Radio de 191 metros para una radiación de $37.5 \text{ kW}/\text{m}^2$

Radio de 395 metros para una radiación de $10.0 \text{ kW}/\text{m}^2$

G.8. Empresa Disproalquímicos.

Para esta empresa el peor caso se encuentra en el Alcohol Etilico (Etanol)

SITE DATA:

Location: BOGOTA, COLOMBIA

Building Air Exchanges Per Hour: 0.20 (sheltered single storied)

CHEMICAL DATA:

Chemical Name: ETHANOL Molecular Weight: 46.07 g/mol

TEEL-1: 3000 ppm TEEL-2: 3300 ppm TEEL-3: 3300 ppm

IDLH: 3300 ppm LEL: 43000 ppm UEL: 190000 ppm

Carcinogenic risk - see CAMEO

Ambient Boiling Point: 69.8°C

Vapor Pressure at Ambient Temperature: 0.052 atm

Ambient Saturation Concentration: 72,653 ppm or 7.27%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)

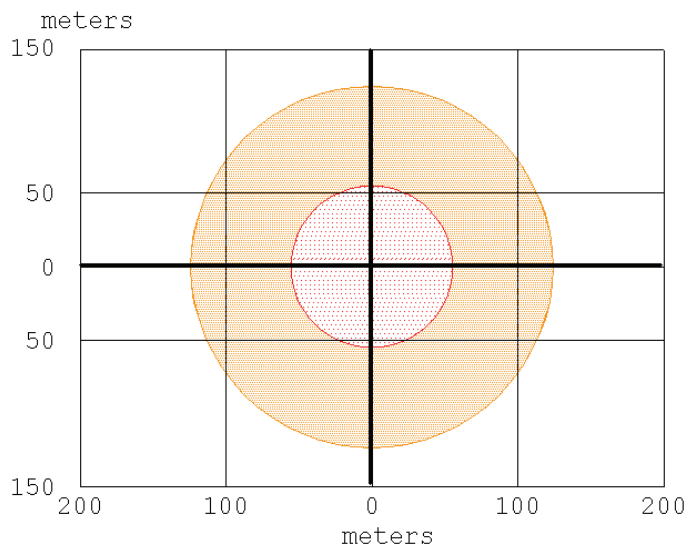
Wind: 1 meters/second from 0° true at 3 meters
 Ground Roughness: urban or forest Cloud Cover: 5 tenths
 Air Temperature: 18° C Stability Class: B
 No Inversion Height Relative Humidity: 50%

SOURCE STRENGTH:

BLEVE of flammable liquid in vertical cylindrical tank
 Tank Diameter: 1.2 meters Tank Length: 3 meters
 Tank Volume: 3.39 cubic meters
 Tank contains liquid
 Internal Storage Temperature: 18° C
 Chemical Mass in Tank: 1,666 kilograms
 Tank is 62% full
 Percentage of Tank Mass in Fireball: 100%
 Fireball Diameter: 69 meters Burn Duration: 6 seconds

THREAT ZONE:

Threat Modeled: Thermal radiation from fireball
 Red : 55 meters --- (37.5 kW/(sq m))
 Orange: 124 meters --- (10.0 kW/(sq m) = potentially lethal within 60 sec)



-  $\geq 37.5 \text{ kW}/(\text{sq m})$
-  $\geq 10.0 \text{ kW}/(\text{sq m}) = \text{potentially lethal within 60 sec}$

Conclusión:

Radio de 55 metros para una radiación de 37.5 kW/m²
 Radio de 124 metros para una radiación de 10.0 kW/m²

G.9. Empresa Transportes El Palmar

La empresa el Palmar esta dedicada a transporte de carga de mercancías que no que presentan ningún grado de peligrosidad, por el contrario la gran mayoría de ellas son comestibles, tuberías, materiales de embalaje y empaques. Con esta información, se concluye que a esta empresa no se le hace ningún tipo de modelación.

G.10. Industrias Químicas FIQ LTDA.

La situación mas critica para esta empresa se presenta con el Xyleno, dado que las propiedades del Xyleno solo no se encuentran en ALOHA, se procedió a modelar con M Xyleno que para efectos de combustión, son similares los efectos de radiación.

SITE DATA:

Location: BOGOTA, COLOMBIA

Building Air Exchanges Per Hour: 0.20 (sheltered single storied)

CHEMICAL DATA:

Chemical Name: M-XYLENE Molecular Weight: 106.17 g/mol

TEEL-1: 150 ppm TEEL-2: 200 ppm TEEL-3: 900 ppm

IDLH: 900 ppm LEL: 11000 ppm UEL: 70000 ppm

Ambient Boiling Point: 126.8° C

Vapor Pressure at Ambient Temperature: 0.0073 atm

Ambient Saturation Concentration: 10,275 ppm or 1.03%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)

Wind: 1 meters/second from 0° true at 3 meters

Ground Roughness: urban or forest Cloud Cover: 5 tenths

Air Temperature: 18° C Stability Class: B

No Inversion Height Relative Humidity: 50%

SOURCE STRENGTH:

BLEVE of flammable liquid in vertical cylindrical tank

Tank Diameter: 2.3 meters Tank Length: 3 meters

Tank Volume: 12.5 cubic meters

Tank contains liquid

Internal Storage Temperature: 18° C

Chemical Mass in Tank: 8,527 kilograms

Tank is 79% full

Percentage of Tank Mass in Fireball: 100%

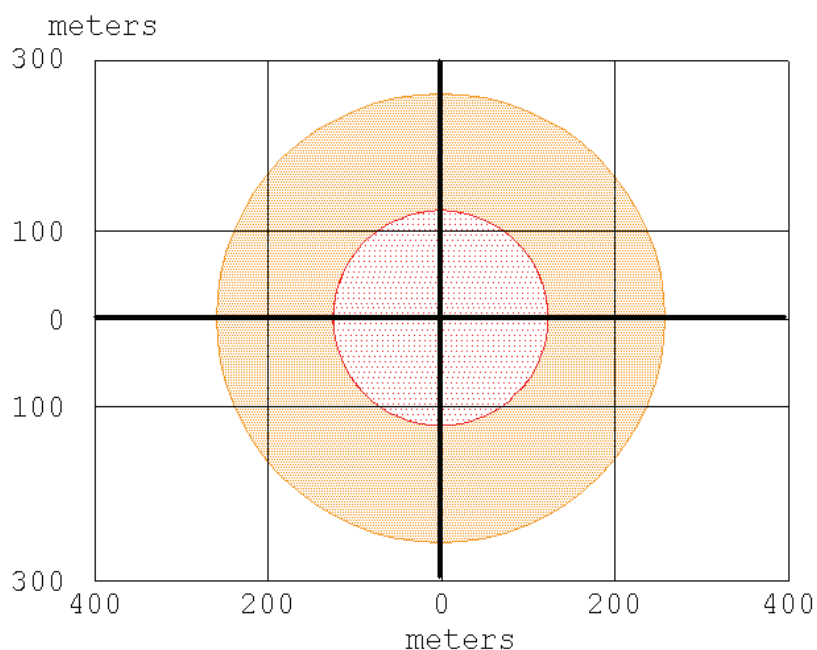
Fireball Diameter: 118 meters Burn Duration: 9 seconds



THREAT ZONE:

Threat Modeled: Thermal radiation from fireball

Red : 124 meters --- (37.5 kW/(sq m))

Orange: 259 meters --- (10.0 kW/(sq m) = potentially lethal within 60 sec)



-  ≥ 37.5 kW/(sq m)
-  ≥ 10.0 kW/(sq m) = potentially lethal within 60 sec

Conclusión:

Radio de 124 metros para una radiación de 37.5 kW/m²

Radio de 259 metros para una radiación de 10.0 kW/m²

G.11. Empresa Improquim

Para esta industria el peor caso se encuentra con el almacenamiento de Xyleno. Para la simulación en ALOHA, se trabaja con M-Xyleno (ALOHA no tiene todas las propiedades de Xyleno para la modelación).

SITE DATA:

Location: BOGOTA, COLOMBIA

Building Air Exchanges Per Hour: 4 (user specified)

CHEMICAL DATA:

Chemical Name: M-XYLENE Molecular Weight: 106.17 g/mol

TEEL-1: 150 ppm TEEL-2: 200 ppm TEEL-3: 900 ppm

IDLH: 900 ppm LEL: 11000 ppm UEL: 70000 ppm

Carcinogenic risk - see CAMEO

Ambient Boiling Point: 126.8° C

Vapor Pressure at Ambient Temperature: 0.0073 atm

Ambient Saturation Concentration: 10,275 ppm or 1.03%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)

Wind: 1 meters/second from 0° true at 3 meters

Ground Roughness: urban or forest Cloud Cover: 5 tenths

Air Temperature: 18° C

Stability Class: F

No Inversion Height

Relative Humidity: 50%

SOURCE STRENGTH:

BLEVE of flammable liquid in vertical cylindrical tank

Tank Diameter: 4 meters

Tank Length: 8 meters

Tank Volume: 101 cubic meters

Tank contains liquid

Internal Storage Temperature: 18° C

Chemical Mass in Tank: 66.2 tons Tank is 69% full

Percentage of Tank Mass in Fireball: 100%

Fireball Diameter: 227 meters

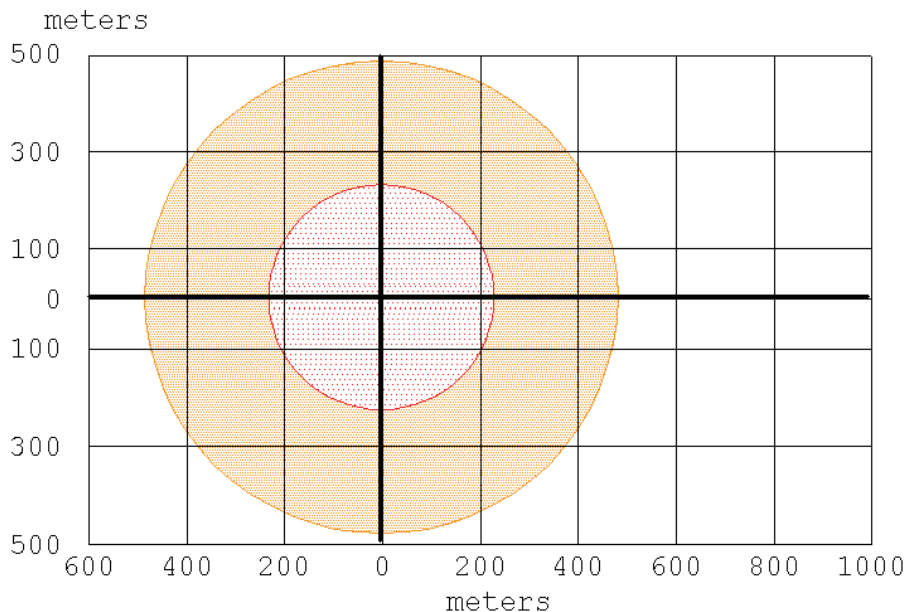
Burn Duration: 14 seconds

THREAT ZONE:


Threat Modeled: Thermal radiation from fireball

Red : 230 meters --- (37.5 kW/(sq m))

Orange: 482 meters --- (10.0 kW/(sq m) = potentially lethal within 60 sec)



 $\geq 37.5 \text{ kW}/(\text{sq m})$

 $\geq 10.0 \text{ kW}/(\text{sq m}) = \text{potentially lethal within 60 sec}$

CONCLUSION

Radio de 230 metros para una radiación de 37.5 kW/m²

Radio de 482 metros para una radiación de 10.0 kW/m²

G.12. Empresa Inversiones Suárez Ríos.

El peor caso que se le pudo presentar a esta empresa es el derrame del Acido Clorhídrico, para lo cual no se simula en ALOHA. En el sistema de información geográfico se simula un derrame.

Se anexa la ficha del producto que se encuentra en CAMEO.

HYDROCHLORIC ACID, SOLUTION UN 1789

Note: Most foams will react with the material and release corrosive/toxic gases. SMALL FIRES: CO₂ (except for Cyanides), dry chemical, dry sand, alcohol-resistant foam. LARGE FIRES: Water spray, fog or alcohol-resistant foam. Move containers from fire area if you can do it without risk. Use water spray or fog; do not use straight streams. Dike fire control water for later disposal; do not scatter the material. FIRE INVOLVING TANKS OR CAR/TRAILER LOADS: Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. (DOT, 2000)

Special Hazards of Combustion Products: Toxic and irritating vapors are generated when heated. (USCG, 1999)
Inhalation of fumes results in coughing and choking sensation, and irritation of nose and lungs. Liquid causes burns. (USCG, 1999)

G.13. Empresa Miratex.

En visita realizada a la industria se pudo determinar que en esa planta solamente se realizan procesos relacionados con el hilado de fibras sintéticas y textiles, en la planta no se realizan almacenamientos de sustancias químicas, no cuenta con sistemas de generación de calor (Calderas) y no realiza procesos de teñido, por lo tanto no se puede realizar ningún tipo de simulación con los elementos que esta empresa maneja.

G.14. Empresa Pintubler.

Los productos con el mayor potencial de peligro, que maneja esta empresa, son el Varsol y la Resina ((RESIN SOLUTION, UN 1866), el producto que puede representar estas dos sustancias (40 ton), para modelar el peor caso en ALOHA es el Etanol.

SITE DATA:

Location: BOGOTA, COLOMBIA

Building Air Exchanges Per Hour: 4 (user specified)

CHEMICAL DATA:

Chemical Name: ETHANOL Molecular Weight: 46.07 g/mol
TEEL-1: 3000 ppm TEEL-2: 3300 ppm TEEL-3: 3300 ppm
IDLH: 3300 ppm LEL: 43000 ppm UEL: 190000 ppm
Carcinogenic risk - see CAMEO
Ambient Boiling Point: 69.8° C
Vapor Pressure at Ambient Temperature: 0.052 atm
Ambient Saturation Concentration: 72,652 ppm or 7.27%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)

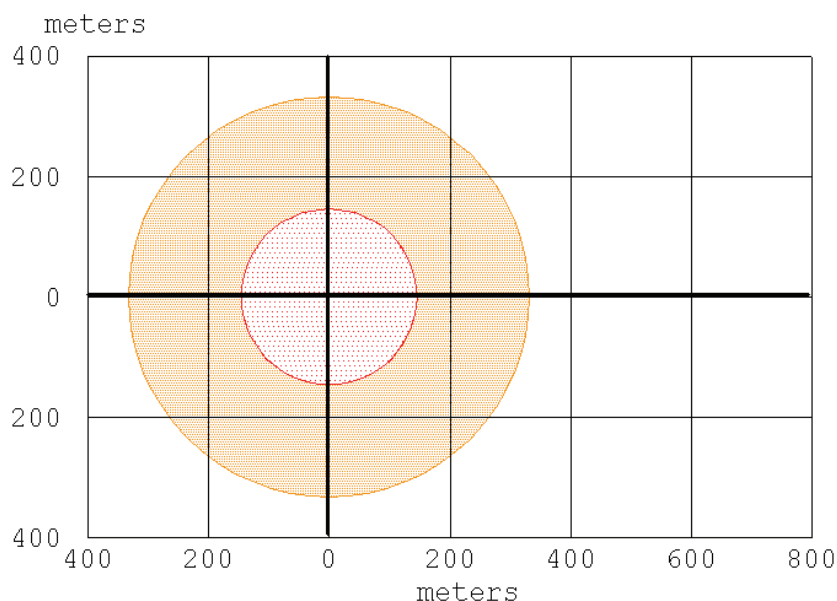
Wind: 1 meters/second from 0° true at 3 meters
Ground Roughness: urban or forest Cloud Cover: 5 tenths
Air Temperature: 18° C Stability Class: F
No Inversion Height Relative Humidity: 50%

SOURCE STRENGTH:

BLEVE of flammable liquid in horizontal cylindrical tank
Tank Diameter: 4 meters Tank Length: 8 meters
Tank Volume: 101 cubic meters
Tank contains liquid
Internal Storage Temperature: 18° C
Chemical Mass in Tank: 40.6 tons Tank is 46% full
Percentage of Tank Mass in Fireball: 100%
Fireball Diameter: 193 meters Burn Duration: 12 seconds

THREAT ZONE:

Threat Modeled: Thermal radiation from fireball
Red : 146 meters --- (37.5 kW/(sq m))
Orange: 332 meters --- (10.0 kW/(sq m) = potentially lethal within 60 sec)



-  $\geq 37.5 \text{ kW}/(\text{sq m})$
 $\geq 10.0 \text{ kW}/(\text{sq m}) = \text{potentially lethal within 60 sec}$

CONCLUSION

Radio de 146 metros para una radiación de $37.5 \text{ kW}/\text{m}^2$
 Radio de 332 metros para una radiación de $10.0 \text{ kW}/\text{m}^2$.

G.15. Empresa Pinturas y adhesivos.

El peor caso para esta empresa es el almacenamiento de Tolueno, y su peor peligro es la radiación originada por una Blevé.

SITE DATA:

Location: BOGOTA, COLOMBIA
 Building Air Exchanges Per Hour: 0.20 (sheltered single storied)

CHEMICAL DATA:

Chemical Name: TOLUENE Molecular Weight: 92.14 g/mol
 ERPG-1: 50 ppm ERPG-2: 300 ppm ERPG-3: 1000 ppm
 IDLH: 500 ppm LEL: 12000 ppm UEL: 71000 ppm
 Carcinogenic risk - see CAMEO
 Ambient Boiling Point: 99.0°C
 Vapor Pressure at Ambient Temperature: 0.026 atm
 Ambient Saturation Concentration: 36,529 ppm or 3.65%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)

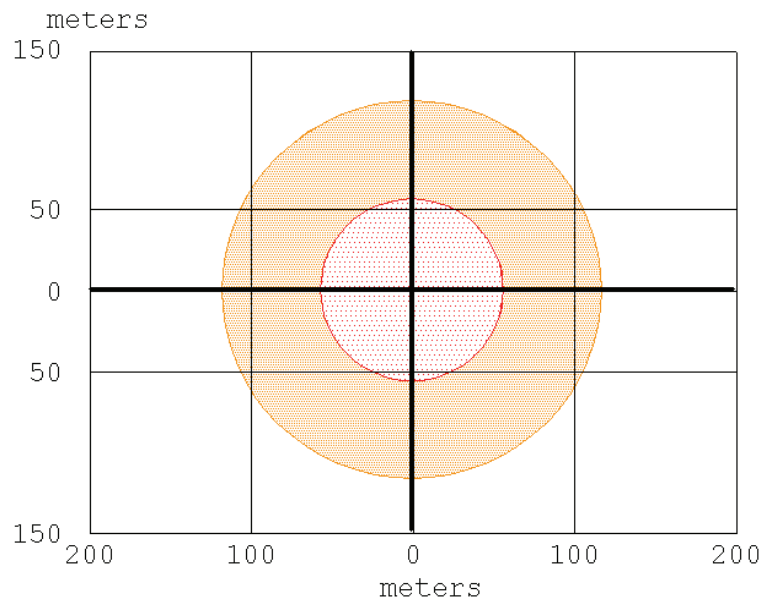
Wind: 1 meters/second from 0° true at 3 meters
 Ground Roughness: urban or forest Cloud Cover: 5 tenths
 Air Temperature: 18° C Stability Class: F
 No Inversion Height Relative Humidity: 50%



SOURCE STRENGTH:

BLEVE of flammable liquid in vertical cylindrical tank
 Tank Diameter: 1 meters Tank Length: 2 meters
 Tank Volume: 1.57 cubic meters
 Tank contains liquid
 Internal Storage Temperature: 18° C
 Chemical Mass in Tank: 0.80 tons Tank is 53% full
 Percentage of Tank Mass in Fireball: 100%
 Fireball Diameter: 52 meters Burn Duration: 5 seconds

THREAT ZONE:

Threat Modeled: Thermal radiation from fireball
 Red : 57 meters --- (37.5 kW/(sq m))
 Orange: 118 meters --- (10.0 kW/(sq m) = potentially lethal within 60 sec)



-  $\geq 37.5 \text{ kW}/(\text{sq m})$
-  $\geq 10.0 \text{ kW}/(\text{sq m}) = \text{potentially lethal within 60 sec}$

CONCLUSION

Radio de 57 metros para una radiación de 37.5 kW/m²
 Radio de 118 metros para una radiación de 10.0 kW/m².

G.16. Empresa Progas.

El peor caso para esta empresa es la Blevé originada por el almacenamiento del GLP (El GLP es una mezcla de gas Butano y gas Propano), para modelar en ALOHA se considera que todo es Butano (producto con mayor peligro).

SITE DATA:

Location: BOGOTA, COLOMBIA
Building Air Exchanges Per Hour: 4 (user specified)

CHEMICAL DATA:

Chemical Name: M-XYLENE Molecular Weight: 106.17 g/mol
TEEL-1: 150 ppm TEEL-2: 200 ppm TEEL-3: 900 ppm
IDLH: 900 ppm LEL: 11000 ppm UEL: 70000 ppm
Carcinogenic risk - see CAMEO
Ambient Boiling Point: 126.8° C
Vapor Pressure at Ambient Temperature: 0.0073 atm
Ambient Saturation Concentration: 10,275 ppm or 1.03%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)

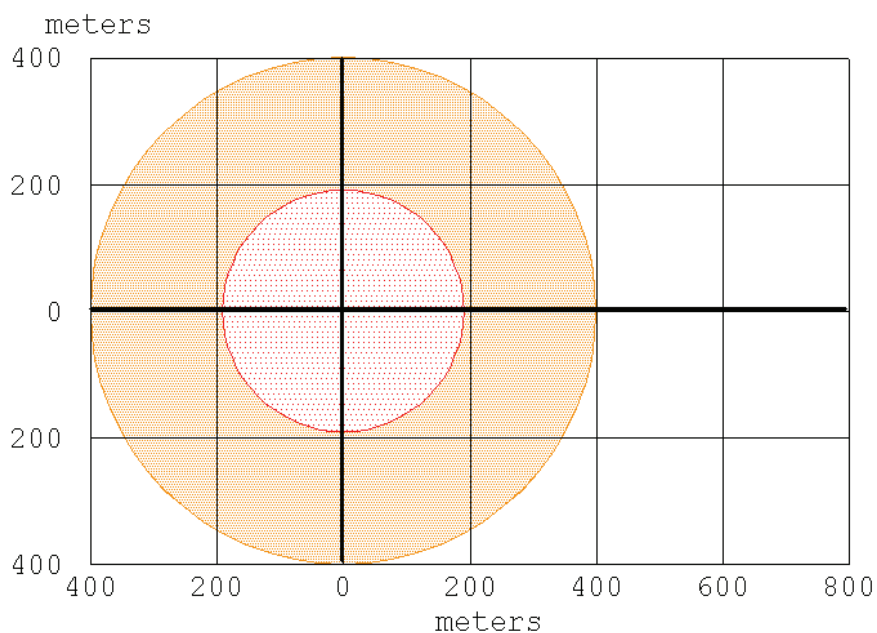
Wind: 1 meters/second from 0° true at 3 meters
Ground Roughness: urban or forest Cloud Cover: 5 tenths
Air Temperature: 18° C Stability Class: F
No Inversion Height Relative Humidity: 50%



SOURCE STRENGTH:

BLEVE of flammable liquid in horizontal cylindrical tank
Tank Diameter: 3 meters Tank Length: 8 meters
Tank Volume: 56.5 cubic meters
Tank contains liquid
Internal Storage Temperature: 18° C
Chemical Mass in Tank: 36.5 tons Tank is 68% full
Percentage of Tank Mass in Fireball: 100%
Fireball Diameter: 186 meters Burn Duration: 12 seconds

THREAT ZONE:

Threat Modeled: Thermal radiation from fireball
Red : 191 meters --- (37.5 kW/(sq m))
Orange: 399 meters --- (10.0 kW/(sq m) = potentially lethal within 60 sec)



-  $\geq 37.5 \text{ kW}/(\text{sq m})$
-  $\geq 10.0 \text{ kW}/(\text{sq m}) = \text{potentially lethal within 60 sec}$

CONCLUSION

Radio de 191 metros para una radiación de $37.5 \text{ kW}/\text{m}^2$.
Radio de 399 metros para una radiación de $10.0 \text{ kW}/\text{m}^2$.

G.17. Empresa Progas Transporte

El peor caso para esta empresa es una Blevé en un carro tanque que transporte GLP (El GLP es una mezcla de gas Butano y gas Propano), para modelar en ALOHA se considera que todo es Butano.

SITE DATA:

Location: BOGOTA, COLOMBIA
Building Air Exchanges Per Hour: 4 (user specified)

CHEMICAL DATA:

Chemical Name: M-XYLENE Molecular Weight: 106.17 g/mol
TEEL-1: 150 ppm TEEL-2: 200 ppm TEEL-3: 900 ppm
IDLH: 900 ppm LEL: 11000 ppm UEL: 70000 ppm
Carcinogenic risk - see CAMEO
Ambient Boiling Point: 126.8°C
Vapor Pressure at Ambient Temperature: 0.0073 atm
Ambient Saturation Concentration: 10,275 ppm or 1.03%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)

Wind: 1 meters/second from 0° true at 3 meters

Ground Roughness: urban or forest Cloud Cover: 5 tenths

Air Temperature: 18° C

Stability Class: F

No Inversion Height

Relative Humidity: 50%

SOURCE STRENGTH:

BLEVE of flammable liquid in horizontal cylindrical tank

Tank Diameter: 3 meters

Tank Length: 8 meters

Tank Volume: 56.5 cubic meters

Tank contains liquid

Internal Storage Temperature: 18° C

Chemical Mass in Tank: 36.5 tons Tank is 68% full

Percentage of Tank Mass in Fireball: 100%

Fireball Diameter: 186 meters

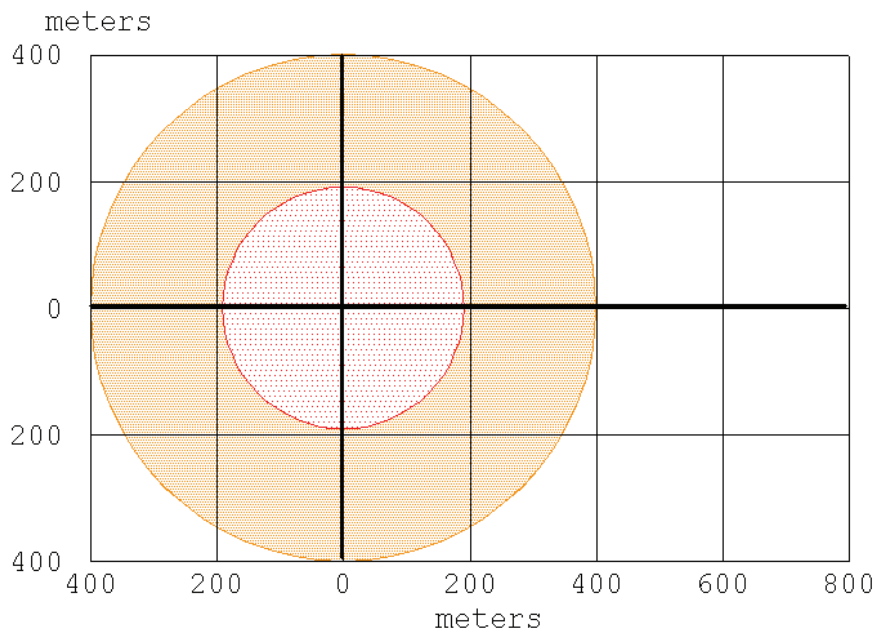
Burn Duration: 12 seconds

THREAT ZONE:

Threat Modeled: Thermal radiation from fireball

Red : 191 meters --- (37.5 kW/(sq m))

Orange: 399 meters --- (10.0 kW/(sq m) = potentially lethal within 60 sec)



≥ 37.5 kW/(sq m)

≥ 10.0 kW/(sq m) = potentially lethal within 60 sec

CONCLUSION

Radio de 191 metros para una radiación de 37.5 kW/m².

Radio de 399 metros para una radiación de 10.0 kW/m².

G.18. Empresa Proton

Esta empresa utiliza Resina de poliestireno para recubrir partes de los elementos que fabrica, esta sustancia a temperatura ambiente se encuentra en estado sólido.

“Resina termoplástica obtenida por polimerización del estireno y otros productos químicos, se endurece a la temperatura ordinaria y es muy resistente a la humedad, a los productos químicos y a las fuerzas mecánicas. Se usa en la fabricación de fibras, recubrimientos de láminas, etc.”

<http://es.wikipedia.org/wiki/resina>

La empresa utiliza el Dimetil Ester para la polimerización de la resina, siendo es el producto que genera el peor caso para esta industria. En la base de datos el producto mas cercano que se encontró fue el STYRENE MONOMER, con le cual se realizo la simulación.

SITE DATA:

Location: BOGOTA, COLOMBIA

Building Air Exchanges Per Hour: 0.20 (sheltered single storied)

CHEMICAL DATA:

Chemical Name: STYRENE MONOMER Molecular Weight: 104.15 g/mol

ERPG-1: 50 ppm ERPG-2: 250 ppm ERPG-3: 1000 ppm

IDLH: 700 ppm LEL: 11000 ppm UEL: 61000 ppm

Carcinogenic risk - see CAMEO

Ambient Boiling Point: 132.9° C

Vapor Pressure at Ambient Temperature: 0.0052 atm

Ambient Saturation Concentration: 7,338 ppm or 0.73%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)

Wind: 1 meters/second from 0° true at 3 meters

Ground Roughness: urban or forest Cloud Cover: 5 tenths

Air Temperature: 18° C Stability Class: F

No Inversion Height Relative Humidity: 50%

SOURCE STRENGTH:

BLEVE of flammable liquid in vertical cylindrical tank

Tank Diameter: 1.2 meters Tank Length: 2 meters

Tank Volume: 2.26 cubic meters

Tank contains liquid

Internal Storage Temperature: 18° C

Chemical Mass in Tank: 1.47 tons Tank is 65% full

Percentage of Tank Mass in Fireball: 100%

Fireball Diameter: 64 meters

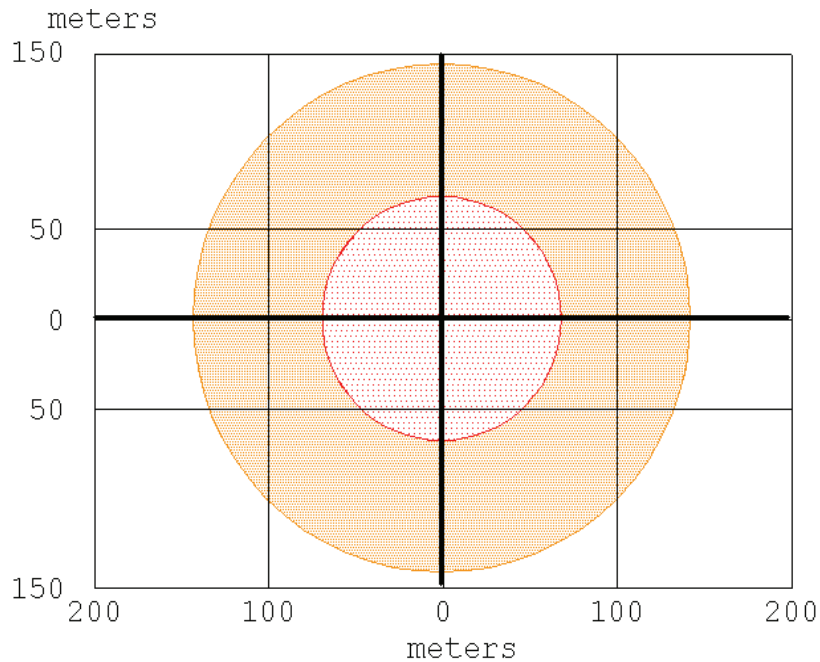
Burn Duration: 5 seconds

THREAT ZONE:

Threat Modeled: Thermal radiation from fireball

Red : 69 meters --- (37.5 kW/(sq m))

Orange: 143 meters --- (10.0 kW/(sq m) = potentially lethal within 60 sec)



≥ 37.5 kW/(sq m)



≥ 10.0 kW/(sq m) = potentially lethal within 60 sec

CONCLUSION

Radio de 69 metros para una radiación de 37.5 kW/m².

Radio de 143 metros para una radiación de 10.0 kW/m².

G.19. Empresa Syntoforma

Por el tipo de sustancias que maneja (capsulas, tabletas y polvos para hacer penicilina) esta empresa no genera peligros que puedan salir de sus limites.

G.20. Empresa Tintorería el Dorado

El producto que le genera el peor caso a esta empresa es el ACPM, el cual para simularlo en ALOHA se considera como N- Pentane.

SITE DATA:

Location: BOGOTA, COLOMBIA

Building Air Exchanges Per Hour: 0.20 (sheltered single storied)

CHEMICAL DATA:

Chemical Name: N-PENTANE Molecular Weight: 72.15 g/mol

TEEL-1: 610 ppm TEEL-2: 610 ppm TEEL-3: 1500 ppm

IDLH: 1500 ppm LEL: 13000 ppm UEL: 80000 ppm

Ambient Boiling Point: 26.4° C

Vapor Pressure at Ambient Temperature: 0.52 atm

Ambient Saturation Concentration: 728,218 ppm or 72.8%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)

Wind: 1 meters/second from 0° true at 3 meters

Ground Roughness: urban or forest Cloud Cover: 5 tenths

Air Temperature: 18° C Stability Class: F

No Inversion Height Relative Humidity: 50%

SOURCE STRENGTH:

BLEVE of flammable liquid in vertical cylindrical tank

Tank Diameter: 1 meters Tank Length: 1.5 meters

Tank Volume: 1.18 cubic meters

Tank contains liquid

Internal Storage Temperature: 18° C

Chemical Mass in Tank: 0.53 tons Tank is 65% full

Percentage of Tank Mass in Fireball: 100%

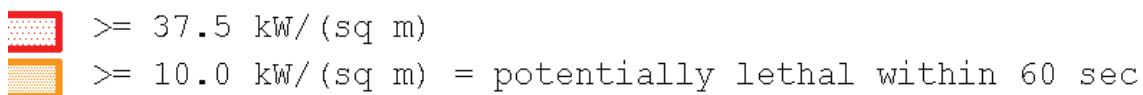
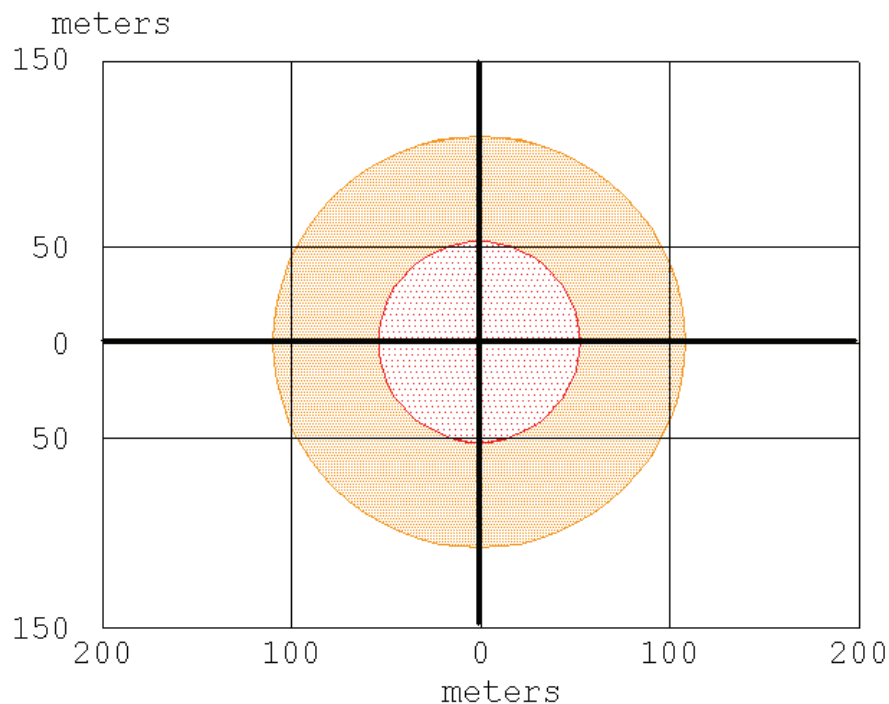
Fireball Diameter: 45 meters Burn Duration: 4 seconds

THREAT ZONE:

Threat Modeled: Thermal radiation from fireball

Red : 53 meters --- (37.5 kW/(sq m))

Orange: 109 meters --- (10.0 kW/(sq m) = potentially lethal within 60 sec)



CONCLUSION

Radio de 53 metros para una radiación de $37.5 \text{ kW}/\text{m}^2$.
 Radio de 109 metros para una radiación de $10 \text{ kW}/\text{m}^2$.

G.21. Empresa Tornillos Gutemberto

El producto que le genera el peor caso a esta empresa es el Aceite térmico, el cual se procedió a simular en ALOHA como N Octano, dado que es el producto más cercano.

SITE DATA:

Location: BOGOTA, COLOMBIA
 Building Air Exchanges Per Hour: 4 (user specified)

CHEMICAL DATA:

Chemical Name: N-OCTANE Molecular Weight: 114.23 g/mol
 TEEL-1: 300 ppm TEEL-2: 400 ppm TEEL-3: 1000 ppm
 IDLH: 1000 ppm LEL: 8000 ppm UEL: 65000 ppm
 Ambient Boiling Point: 113.8°C
 Vapor Pressure at Ambient Temperature: 0.012 atm
 Ambient Saturation Concentration: 17,349 ppm or 1.73%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)

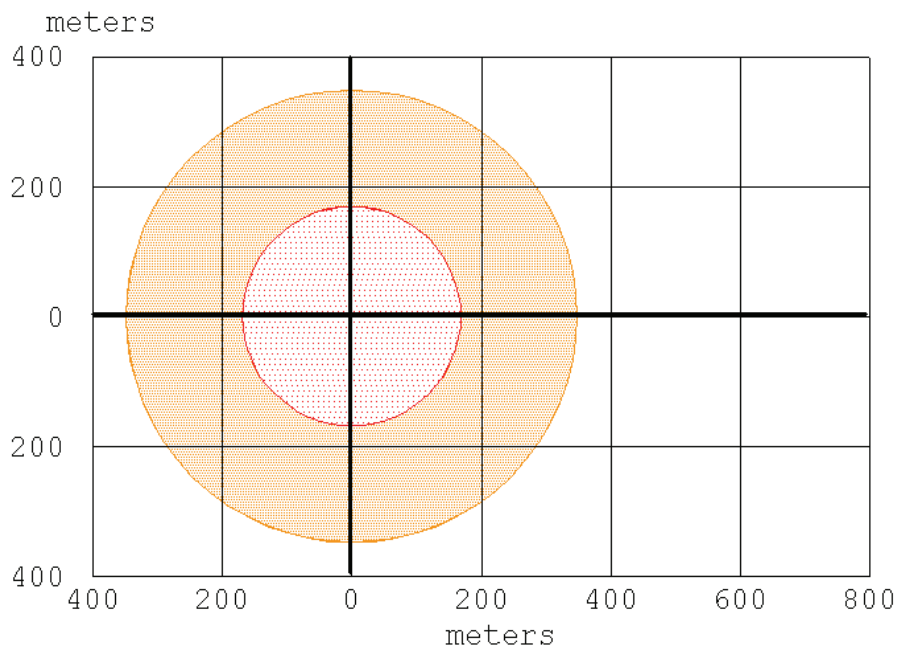
Wind: 1 meters/second from 0° true at 3 meters
 Ground Roughness: urban or forest Cloud Cover: 5 tenths
 Air Temperature: 18° C Stability Class: F
 No Inversion Height Relative Humidity: 50%



SOURCE STRENGTH:

BLEVE of flammable liquid in vertical cylindrical tank
 Tank Diameter: 3 meters Tank Length: 5 meters
 Tank Volume: 35.3 cubic meters
 Tank contains liquid
 Internal Storage Temperature: 18° C
 Chemical Mass in Tank: 20.7 tons Tank is 75% full
 Percentage of Tank Mass in Fireball: 100%
 Fireball Diameter: 154 meters Burn Duration: 11 seconds

THREAT ZONE:

Threat Modeled: Thermal radiation from fireball
 Red : 168 meters --- (37.5 kW/(sq m))
 Orange: 348 meters --- (10.0 kW/(sq m) = potentially lethal within 60 sec)



 $\geq 37.5 \text{ kW}/(\text{sq m})$
 $\geq 10.0 \text{ kW}/(\text{sq m}) = \text{potentially lethal within 60 sec}$

CONCLUSION

Radio de 168 metros para una radiación de 37.5 kW/m².
 Radio de 348 metros para una radiación de 10 kW/m².

G.22. Empresa Transporte Caravana

Analizando el tipo de mercado que tiene esta empresa, el cual es para el transporte petrolero, el peor caso es una BLEVE de una tractomula cargada con lubricantes castrol, este lubricante se tratara como un octano, el producto mas cernaco en ALOHA es el N OCTANE.

Se supone que el tanque de la tractomula lo máximo que puede cargar son 35 toneladas de producto

SITE DATA:

Location: BOGOTA, COLOMBIA
Building Air Exchanges Per Hour: 4 (user specified)

CHEMICAL DATA:

Chemical Name: N-OCTANE Molecular Weight: 114.23 g/mol
TEEL-1: 300 ppm TEEL-2: 400 ppm TEEL-3: 1000 ppm
IDLH: 1000 ppm LEL: 8000 ppm UEL: 65000 ppm
Ambient Boiling Point: 113.8° C
Vapor Pressure at Ambient Temperature: 0.012 atm
Ambient Saturation Concentration: 17,349 ppm or 1.73%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)

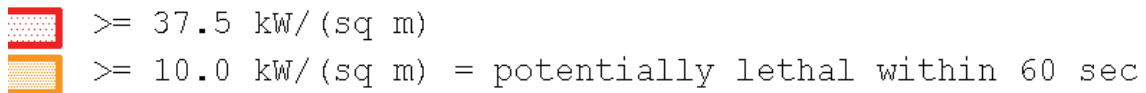
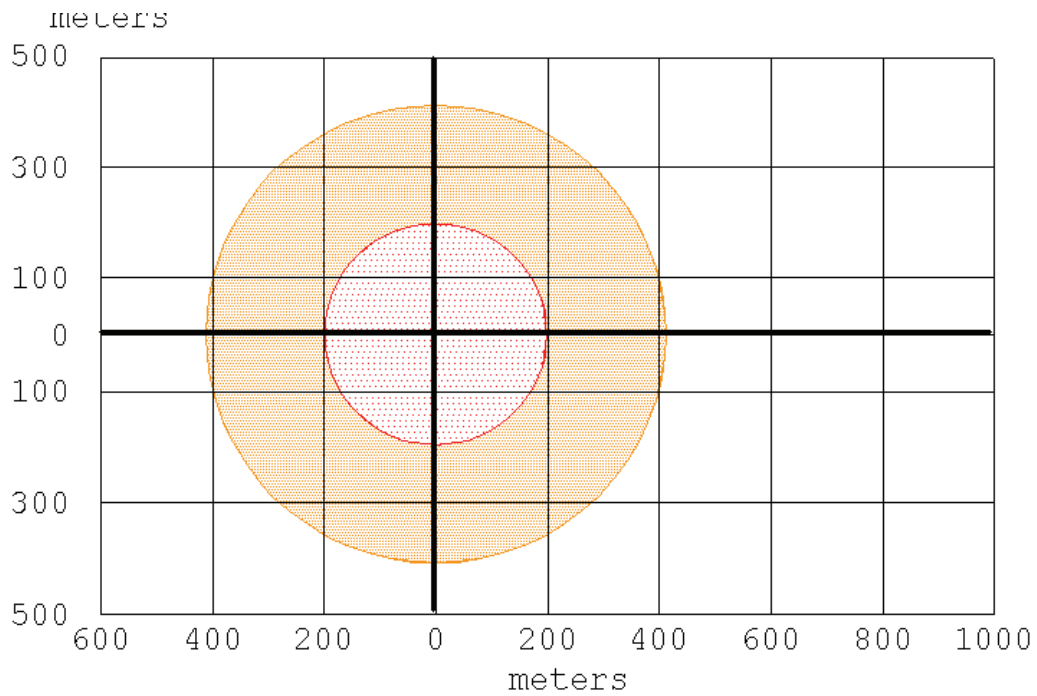
Wind: 1 meters/second from 0° true at 3 meters
Ground Roughness: urban or forest Cloud Cover: 5 tenths
Air Temperature: 18° C Stability Class: F
No Inversion Height Relative Humidity: 50%

SOURCE STRENGTH:

BLEVE of flammable liquid in horizontal cylindrical tank
Tank Diameter: 2.8 meters Tank Length: 8 meters
Tank Volume: 49.3 cubic meters
Tank contains liquid
Internal Storage Temperature: 18° C
Chemical Mass in Tank: 35.2 tons Tank is 92% full
Percentage of Tank Mass in Fireball: 100%
Fireball Diameter: 184 meters Burn Duration: 12 seconds

THREAT ZONE:

Threat Modeled: Thermal radiation from fireball
Red : 199 meters --- (37.5 kW/(sq m))
Orange: 412 meters --- (10.0 kW/(sq m) = potentially lethal within 60 sec)



CONCLUSION

Radio de 199 metros para una radiación de $37.5 \text{ kW}/\text{m}^2$.

Radio de 412 metros para una radiación de $10 \text{ kW}/\text{m}^2$.

G.23. Empresa Transporte Trial

En visita realizada a la empresa se pudo determinar que la operación de la misma es solamente la coordinación de procesos relacionados con el transporte de mercancías.

En el lugar que se visitó solamente funcionan oficinas administrativas y por lo tanto no se realizan almacenamientos de sustancias químicas, se realiza transporte variado de mercancías, en la mayoría de los servicios no se transportan sustancias peligrosas.

En este aspecto los vehículos recogen el material en las instalaciones del cliente y lo conducen hasta el destino, sin contar con almacenamientos temporales del mismo.

Para esta empresa no se realiza ningún tipo de simulación

G.24. Empresa Vaseline S.A.

El producto que genera el peor caso para esta empresa es el ACPM, por la cantidad de almacenamiento. Para ALOHA se simulo como N PENTANE

SITE DATA:

Location: BOGOTA, COLOMBIA
Building Air Exchanges Per Hour: 4 (user specified)

CHEMICAL DATA:

Chemical Name: N-PENTANE Molecular Weight: 72.15 g/mol
TEEL-1: 610 ppm TEEL-2: 610 ppm TEEL-3: 1500 ppm
IDLH: 1500 ppm LEL: 13000 ppm UEL: 80000 ppm
Ambient Boiling Point: 26.4° C
Vapor Pressure at Ambient Temperature: 0.52 atm
Ambient Saturation Concentration: 728,218 ppm or 72.8%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)

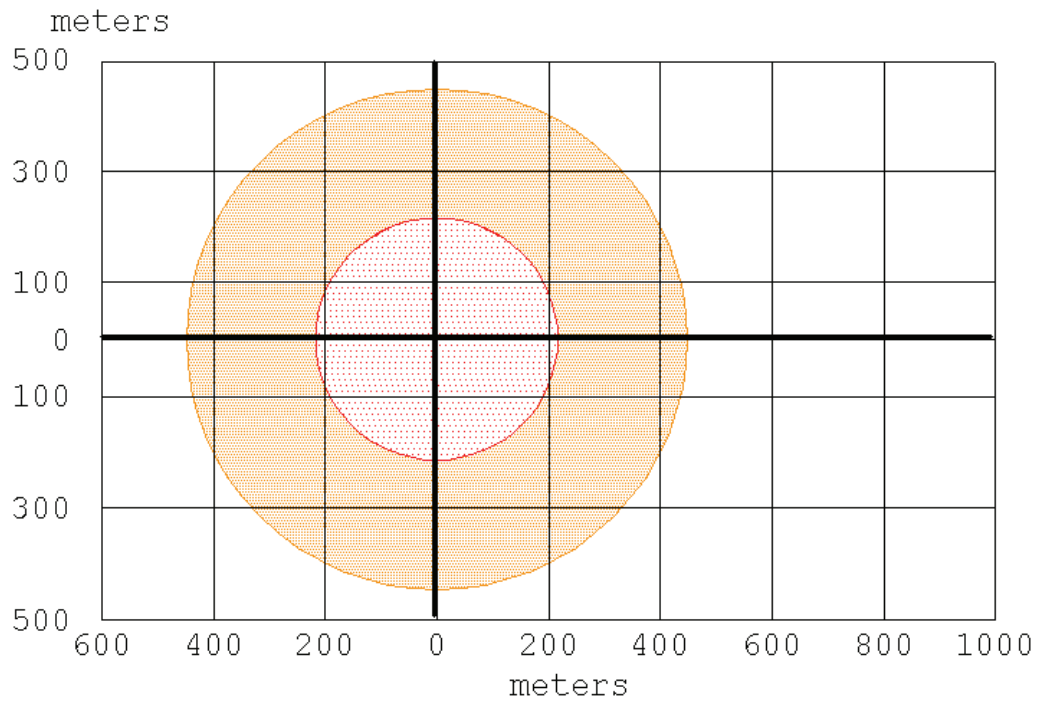
Wind: 1 meters/second from 0° true at 3 meters
Ground Roughness: urban or forest Cloud Cover: 5 tenths
Air Temperature: 18° C Stability Class: F
No Inversion Height Relative Humidity: 50%



SOURCE STRENGTH:

BLEVE of flammable liquid in vertical cylindrical tank
Tank Diameter: 4 meters Tank Length: 6 meters
Tank Volume: 75.4 cubic meters
Tank contains liquid
Internal Storage Temperature: 18° C
Chemical Mass in Tank: 45.0 tons Tank is 86% full
Percentage of Tank Mass in Fireball: 100%
Fireball Diameter: 200 meters Burn Duration: 13 seconds

THREAT ZONE:

Threat Modeled: Thermal radiation from fireball
Red : 217 meters --- (37.5 kW/(sq m))
Orange: 448 meters --- (10.0 kW/(sq m) = potentially lethal within 60 sec)



-  $\geq 37.5 \text{ kW}/(\text{sq m})$
-  $\geq 10.0 \text{ kW}/(\text{sq m}) = \text{potentially lethal within 60 sec}$

CONCLUSION

Radio de 217 metros para una radiación de $37.5 \text{ kW}/\text{m}^2$.
Radio de 448 metros para una radiación de $10 \text{ kW}/\text{m}^2$.