

## **CAMEO Refresher Exercise Set: November, 2010 Train Derailment Exercise**

### **Scenario:**

At 6:30 am on December 1, 2010, a freight train accident resulted in a derailment of 11 railcars. The derailment occurred at \_\_\_\_\_ and \_\_\_\_\_ in your local community. Responders have secured the immediate area, and have obtained some limited information on the materials contained in the 11 railcars. While the materials involved present a number of hazards, responders are particularly concerned about the materials in the following railcars:

UN # 1789  
UN # 2428  
Acetone  
CAS # 108-91-8

At present, none of the railcars appear to be leaking any material. However, the four railcars listed above have sustained noticeable damage.

Current weather conditions are as follows:

Wind: from the southwest; 16 mph with gusts to 22 mph (obtained from local airport)	
Ground Roughness: open country	Cloud Cover: Clear Skies
Air Temperature: 35° F	Stability Class: D
No Inversion Height	Relative Humidity: 22%

The forecast is calling for the following weather conditions at noon:

Wind: from the West; 12 mph with gusts to 22 mph (obtained from local airport)	
Ground Roughness: open country	Cloud Cover: Clear Skies
Air Temperature: 55° F	Stability Class: D
No Inversion Height	Relative Humidity: 33%

You are directed to operate CAMEO and supply information to Incident Command for the duration of this event.

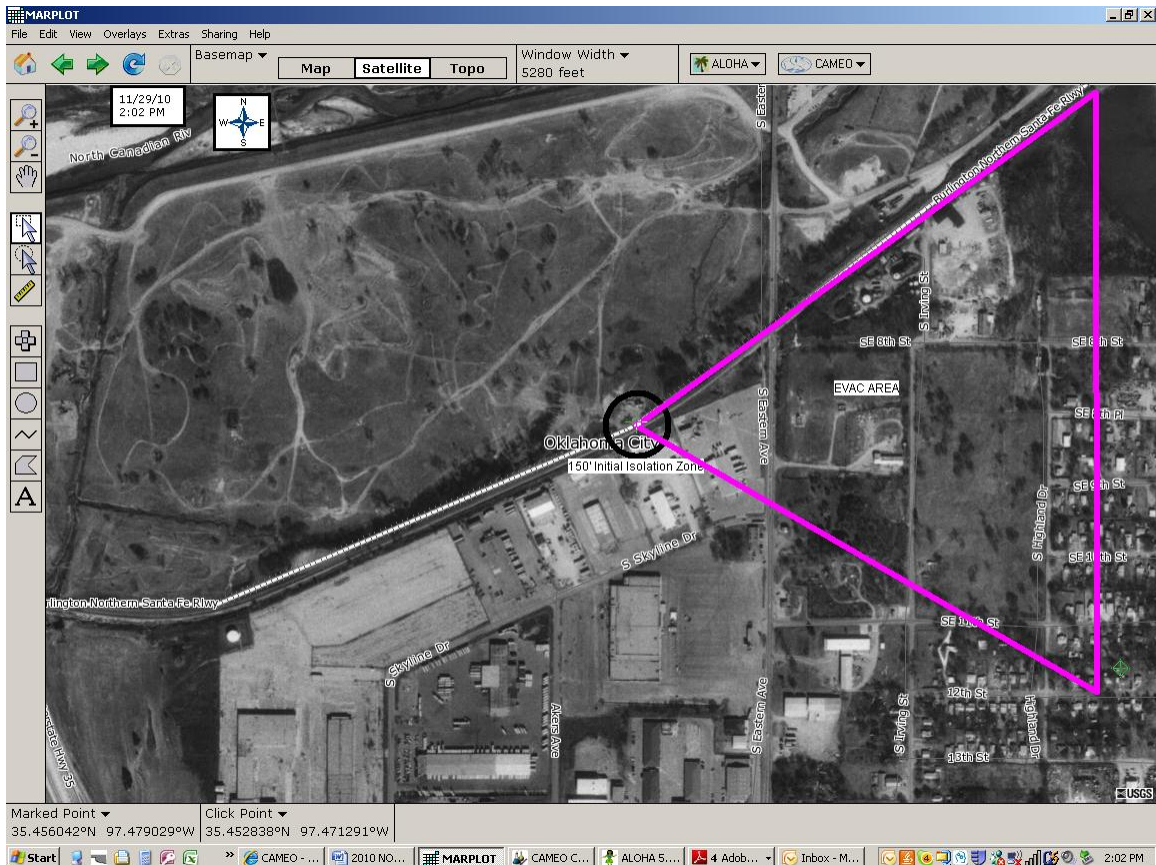
### **CAMEO Chemicals**

1. Use CAMEO Chemicals to gather information for the various chemicals. (CAMEO Companion pages 31-34)
  - a. Are these materials liquid, solid, or gas?
  - b. Is it likely that these materials are carried in Liquid Tankers or Pressurized Tankers?
  - c. What are the primary hazards associated with these materials?

2. Use the CAMEO Chemicals “Predict Reactivity” module to evaluate the potential reactive hazards for this incident. (CAMEO Companion pages 34-35)
3. Determine the Initial Isolation Zone and Evacuation distances appropriate for this scenario. (CAMEO Companion pages 31-34)

## MARPLOT

1. Launch MARPLOT
2. Select a location in your area to use as the incident site
3. Navigate to the incident location (CAMEO Companion pages 57-62)
4. Mark the incident location using the “Extras / Marked Point / Mark Click Point” menu (CAMEO Companion pages 65-66)
5. Use the “Circle” drawing tool to display the Immediate Isolation Zone on the map (CAMEO Companion pages 74, 81)
6. Use the “Polygon” drawing tool to display the largest ERG-suggestion downwind evacuation area
7. Copy and paste a screenshot of the mapped area from MARPLOT to WORD. (CAMEO Companion pages 85)



## ALOHA

1. Determine which, if any, of these materials can be modeled using ALOHA.
  - a. For the first ALOHA scenario, use Acetone
  - b. Model for the Toxic, Vapor Cloud Explosion, and BLEVE zones
  - c. Repeat for the other substances
2. Use the following weather data:

Wind: 16 miles/hour from SW at 10 meters  
Ground Roughness: open country      Cloud Cover: 0 tenths  
Air Temperature: 35° F                  Stability Class: D  
No Inversion Height                      Relative Humidity: 22%

3. Use "Tank" for your Source option. (Consult [http://worldtraderref.com/WTR\\_site/Rail\\_Cars/Guide\\_to\\_Rail\\_Cars.asp](http://worldtraderref.com/WTR_site/Rail_Cars/Guide_to_Rail_Cars.asp) to determine the estimated Tank dimensions)

### ***Tanker***

[Back to Top](#)

### **Dimensions**

Length over couplers	59' 9"	18.21 m
Length over strikers	57' 1 <sup>1</sup> / <sub>2</sub> "	17.41 m
Truck centers	46' 3 <sup>1</sup> / <sub>4</sub> "	14.10 m
Height, extreme	15' 5"	4.70 m
Width, extreme	10' 7 <sup>1</sup> / <sub>2</sub> "	3.24 m

### **Weight/Capacity**

Light weight	65,700 lbs	29,801 kg
Gross rail load	263,000 lbs	119,295 kg
Shell full capacity	30,000 gallons	113,562 liters

### **Tank**

Inside diameter	9'11 <sup>1</sup> / <sub>8</sub> "	3.03 m
Length over tank heads	53' 10 <sup>13</sup> / <sub>16</sub> "	16.43 m
Tank slope	1/4" per foot	-
Plate thickness	7/16"	1.11 cm
Manway nozzle	20"	50.8 cm

NOTE: *from the above railcar guide, I input a 30,000 gallon tank capacity and 54 feet tank length to ALOHA; ALOHA then determined a Tank Diameter of 9.72 feet.*

**SITE DATA:**

Location: OKLAHOMA CITY, OKLAHOMA  
Building Air Exchanges Per Hour: 1.26 (unsheltered single storied)  
Time: December 1, 2010 0630 hours CST (user specified)

**CHEMICAL DATA:**

Chemical Name: ACETONE                      Molecular Weight: 58.08 g/mol  
TEEL-1: 200 ppm    TEEL-2: 3200 ppm    TEEL-3: 5700 ppm  
LEL: 26000 ppm    UEL: 128000 ppm  
Ambient Boiling Point: 130.7° F  
Vapor Pressure at Ambient Temperature: 0.10 atm  
Ambient Saturation Concentration: 105,579 ppm or 10.6%

**ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)**

Wind: 16 miles/hour from sw at 10 meters  
Ground Roughness: open country      Cloud Cover: 0 tenths  
Air Temperature: 35° F                      Stability Class: D  
No Inversion Height                      Relative Humidity: 22%

**SOURCE STRENGTH:**

BLEVE of flammable liquid in horizontal cylindrical tank  
Tank Diameter: 9.72 feet                      Tank Length: 54 feet  
Tank Volume: 30000 gallons  
Tank contains liquid  
Internal Storage Temperature: 35° F  
Chemical Mass in Tank: 172,918 pounds  
Tank is 85% full  
Percentage of Tank Mass in Fireball: 100%  
Fireball Diameter: 272 yards                      Burn Duration: 15 seconds

## Estimating BLEVE, VCE, and Toxic Threat Zone data: ACETONE

1. Enter the Tank dimensions as given above

**Tank Size and Orientation**

Select tank type and orientation:

Horizontal cylinder  Vertical cylinder  Sphere

Enter two of three values:

length  diameter   feet  meters

length   gallons  cu feet

volume

OK Cancel Help

2. Enter Chemical State and Temperature as “Liquid” and “Ambient”

**Chemical State and Temperature**

Enter state of the chemical:  Tank contains liquid  Tank contains gas only  Unknown

Enter the temperature within the tank:  Chemical stored at ambient temperature  Chemical stored at  degrees  F  C

OK Cancel

3. Assume the railcar is essentially completely full at the time of the derailment and enter “85” % full by volume

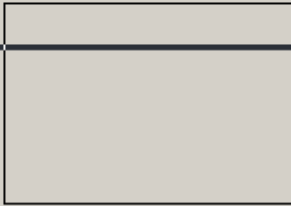
**Liquid Mass or Volume**

Enter the mass in the tank OR volume of the liquid

The mass in the tank is:   pounds  
 tons(2,000 lbs)  
 kilograms

OR

Enter liquid level OR volume

   gallons  
 cubic feet  
 liters  
 cubic meters

% full by volume

4. Select “BLEVE” as the Type of Tank Failure

**Type of Tank Failure**

Scenario:  
Tank containing an unpressurized flammable liquid.

Type of Tank Failure:

Leaking tank, chemical is not burning and forms an evaporating puddle  
 Leaking tank, chemical is burning and forms a pool fire  
 BLEVE, tank explodes and chemical burns in a fireball

Potential hazards from BLEVE:

- Thermal radiation from fireball and pool fire
- Hazardous fragments and blast force from explosion  
[cannot be modeled by ALOHA]
- Downwind toxic effects of fire byproducts  
[cannot be modeled by ALOHA]

## 5. Accept the ALOHA default values for the BLEVE

**BLEVE Percent Mass in Fireball**

**BLEVE / Fireball Scenario:**  
The higher the internal tank pressure (or tank temperature) at the time of tank failure, the larger the fireball. Any liquid not consumed by the fireball will form a pool fire.

Enter one of the following:

Percentage of mass in the fireball: (0 % - 100%)  
 %

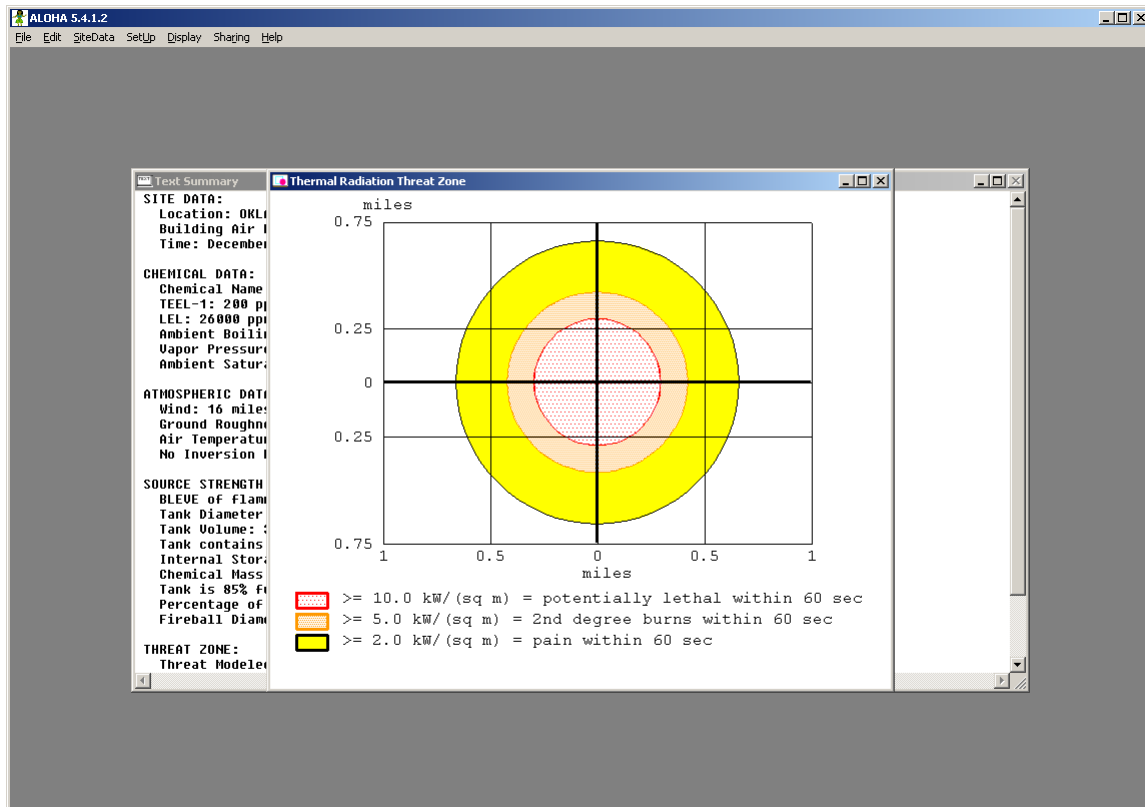
Pressure inside the tank at time of failure:  
  psia     mmHg  
 atm     Pa

Temperature inside the tank at time of failure:  
 degrees  F  
 C

## BLEVE AREA Threat Zone

Select the Display / Threat Zone menu



**SOURCE STRENGTH:**

BLEVE of flammable liquid in horizontal cylindrical tank

Tank Diameter: 9.72 feet                      Tank Length: 54 feet

Tank Volume: 30000 gallons

Tank contains liquid

Internal Storage Temperature: 35° F

Chemical Mass in Tank: 172,918 pounds

Tank is 85% full

Percentage of Tank Mass in Fireball: 100%

Fireball Diameter: 272 yards                      Burn Duration: 15 seconds

**THREAT ZONE:**

Threat Modeled: Thermal radiation from fireball

Red : 520 yards --- (10.0 kW/(sq m) = potentially lethal within 60 sec)

Orange: 741 yards --- (5.0 kW/(sq m) = 2nd degree burns within 60 sec)

Yellow: 1164 yards --- (2.0 kW/(sq m) = pain within 60 sec)



## VAPOR CLOUD EXPLOSION AREA

*Using a 3 inch short pipe or valve located at the bottom of the tank*

1. Use the same Tank Dimensions, Chemical State, and Liquid Volume as above
2. Select “Leaking tank, chemical is not burning and forms an evaporating puddle” as the Type of Tank Failure

**Type of Tank Failure**

Scenario:  
Tank containing an unpressurized flammable liquid.

Type of Tank Failure:

Leaking tank, chemical is not burning and forms an evaporating puddle

Leaking tank, chemical is burning and forms a pool fire

BLEVE, tank explodes and chemical burns in a fireball

Potential hazards from flammable chemical which is not burning as it leaks from tank:


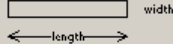
- Downwind toxic effects
- Vapor cloud flash fire
- Overpressure (blast force) from vapor cloud explosion

OK Cancel Help

3. Enter “Circular opening”, “3” inches; and “Short pipe or valve”

**Area and Type of Leak**

Select the shape that best represents the shape of the opening through which the pollutant is exiting

Circular opening  Rectangular opening

Opening diameter:   inches  feet  centimeters  meters

Is leak through a hole or short pipe/valve?

Hole  Short pipe/valve

OK Cancel Help

4. Enter "0" for the bottom of the leak is value

**Height of the Tank Opening**

liq.level

The bottom of the leak is:  
  in  ft  cm  m  
above the bottom of the tank

OR

% of the way to the top of the tank

OK Cancel Help

5. Select "Default soil"; "Use air temperature"; and "Unknown" for the Puddle Parameters

**Puddle Parameters**

Select ground type

Default soil (select this if unknown)  
 Concrete  
 Sandy dry soil  
 Moist sandy soil  
 Water

Input ground temperature

Use air temperature (select this if unknown)  
 Ground temperature is  deg.  F  C

Input maximum puddle diameter or area

Unknown  
 Maximum diameter is   
 Maximum area is

ft  
 yds  
 meters

OK Cancel

6. Select “Blast Area of Vapor Cloud” as the Hazard to Analyze

**Hazard To Analyze**

Scenario:  
Flammable chemical escaping from tank.  
Chemical is NOT on fire.

Choose Hazard to Analyze:

Toxic Area of Vapor Cloud

Flammable Area of Vapor Cloud

Blast Area of Vapor Cloud Explosion

OK Cancel Help

7. Select “unknown”; “ignited by spark or flame”; and “uncongested” for the Vapor Cloud Explosion Parameters

**Vapor Cloud Explosion Parameters**

Time of vapor cloud ignition: Help

unknown [show composite threat zone from all possible ignition times]

known, ignition time is :

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Type of vapor cloud ignition: Help

ignited by spark or flame

ignited by detonation

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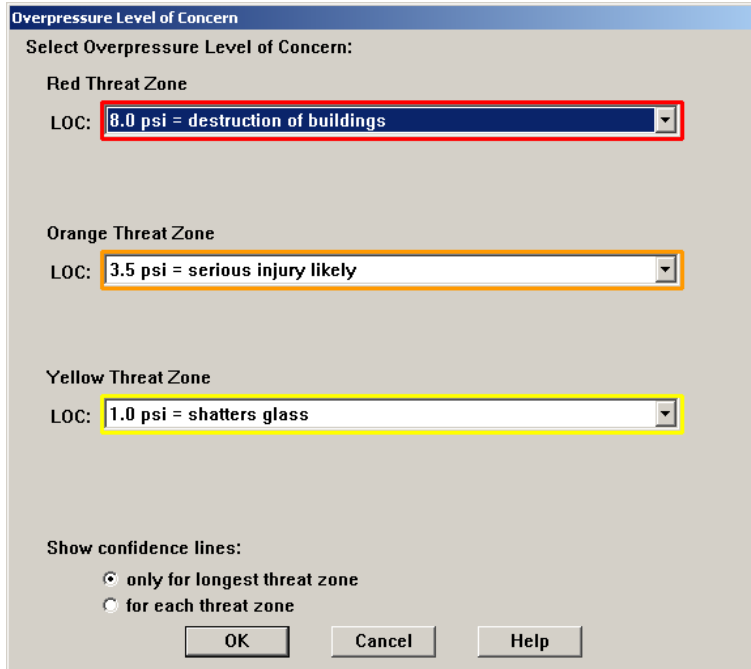
Level of congestion : Help  
(in the flammable part of the vapor cloud)

congested, difficult to walk through (e.g. pipe rack, dense forest)

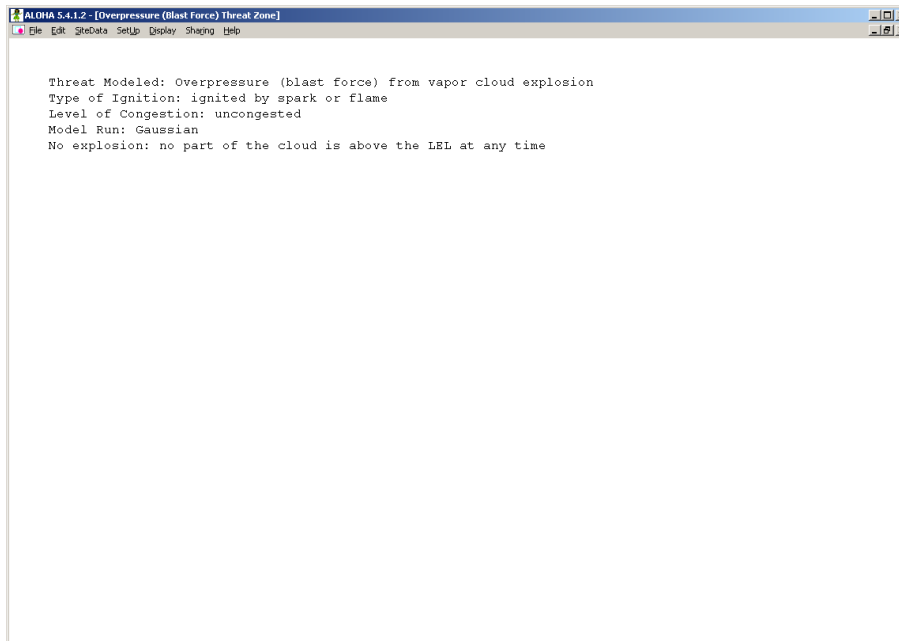
uncongested, easy to walk through (e.g. residential neighborhood)

OK Cancel

8. Accept the ALOHA defaults for the Level of Concern values



9. Select the Display / Threat Zone menu



*Note: ALOHA predicts there will not be any explosion from an ACETONE release with these conditions because the LEL for Acetone is never exceeded.*

#### SOURCE STRENGTH:

Leak from short pipe or valve in horizontal cylindrical tank

Flammable chemical escaping from tank (not burning)

Tank Diameter: 9.72 feet      Tank Length: 54 feet

Tank Volume: 30000 gallons

Tank contains liquid      Internal Temperature: 35° F

Chemical Mass in Tank: 172,918 pounds

Tank is 85% full

Circular Opening Diameter: 3 inches

Opening is 0 feet from tank bottom

Ground Type: Default soil

Ground Temperature: equal to ambient

Max Puddle Diameter: Unknown

Release Duration: ALOHA limited the duration to 1 hour

Max Average Sustained Release Rate: 327 pounds/min

(averaged over a minute or more)

Total Amount Released: 13,653 pounds

Note: The chemical escaped as a liquid and formed an evaporating puddle.

The puddle spread to a diameter of 50 yards.

#### THREAT ZONE:

Threat Modeled: Overpressure (blast force) from vapor cloud explosion

Type of Ignition: ignited by spark or flame

Level of Congestion: uncongested

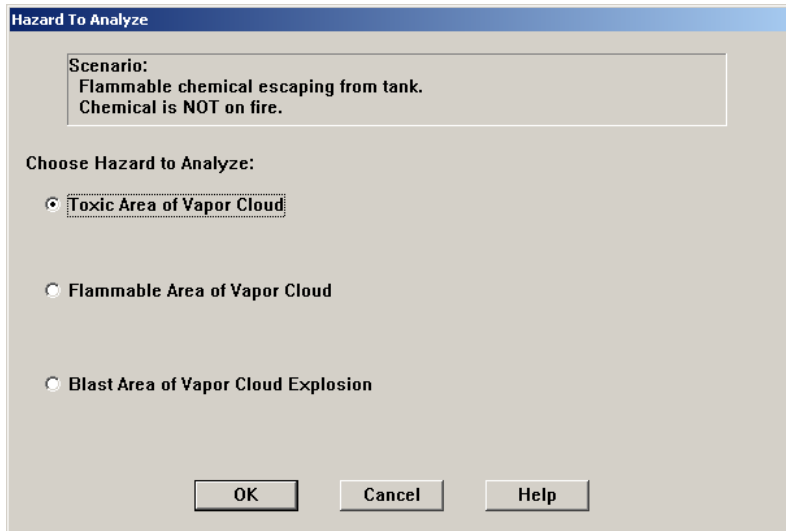
Model Run: Gaussian

No explosion: no part of the cloud is above the LEL at any time

## TOXIC THREAT ZONE AREA

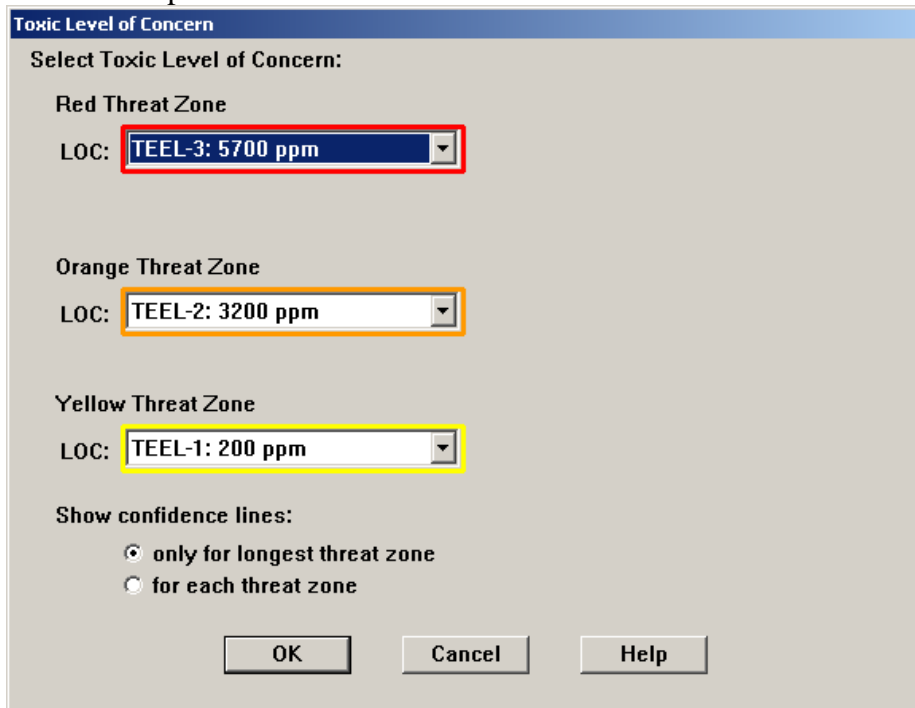
*Using a 3 inch short pipe or valve located at the bottom of the tank*

1. Select the Display / Threat Zone menu
2. Select “Toxic Area of Vapor Cloud” as the Hazard to Analyze

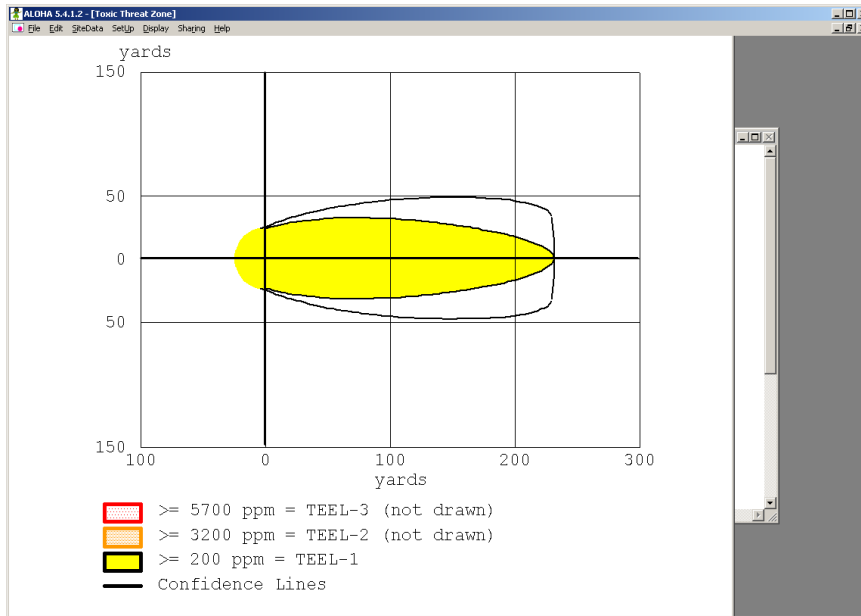


The screenshot shows a dialog box titled "Hazard To Analyze". It contains a text area with the following text: "Scenario: Flammable chemical escaping from tank. Chemical is NOT on fire." Below this, there is a section labeled "Choose Hazard to Analyze:" with three radio button options: "Toxic Area of Vapor Cloud" (which is selected), "Flammable Area of Vapor Cloud", and "Blast Area of Vapor Cloud Explosion". At the bottom of the dialog are three buttons: "OK", "Cancel", and "Help".

3. Accept the ALOHA default values for the Level of Concern



The screenshot shows a dialog box titled "Toxic Level of Concern". It contains three sections for selecting the Level of Concern (LOC) for different threat zones. Each section has a dropdown menu for the LOC value. The "Red Threat Zone" section has a dropdown menu with "TEEL-3: 5700 ppm" selected, highlighted with a red box. The "Orange Threat Zone" section has a dropdown menu with "TEEL-2: 3200 ppm" selected, highlighted with an orange box. The "Yellow Threat Zone" section has a dropdown menu with "TEEL-1: 200 ppm" selected, highlighted with a yellow box. Below these sections is a section labeled "Show confidence lines:" with two radio button options: "only for longest threat zone" (which is selected) and "for each threat zone". At the bottom of the dialog are three buttons: "OK", "Cancel", and "Help".



#### SOURCE STRENGTH:

Leak from short pipe or valve in horizontal cylindrical tank

Flammable chemical escaping from tank (not burning)

Tank Diameter: 9.72 feet      Tank Length: 54 feet

Tank Volume: 30000 gallons

Tank contains liquid      Internal Temperature: 35° F

Chemical Mass in Tank: 172,918 pounds

Tank is 85% full

Circular Opening Diameter: 3 inches

Opening is 0 feet from tank bottom

Ground Type: Default soil

Ground Temperature: equal to ambient

Max Puddle Diameter: Unknown

Release Duration: ALOHA limited the duration to 1 hour

Max Average Sustained Release Rate: 327 pounds/min  
(averaged over a minute or more)

Total Amount Released: 13,653 pounds

Note: The chemical escaped as a liquid and formed an evaporating puddle.  
The puddle spread to a diameter of 50 yards.

#### THREAT ZONE:

Model Run: Gaussian

Red : 24 yards --- (5700 ppm = TEEL-3)

Note: Threat zone was not drawn because effects of near-field patchiness  
make dispersion predictions less reliable for short distances.

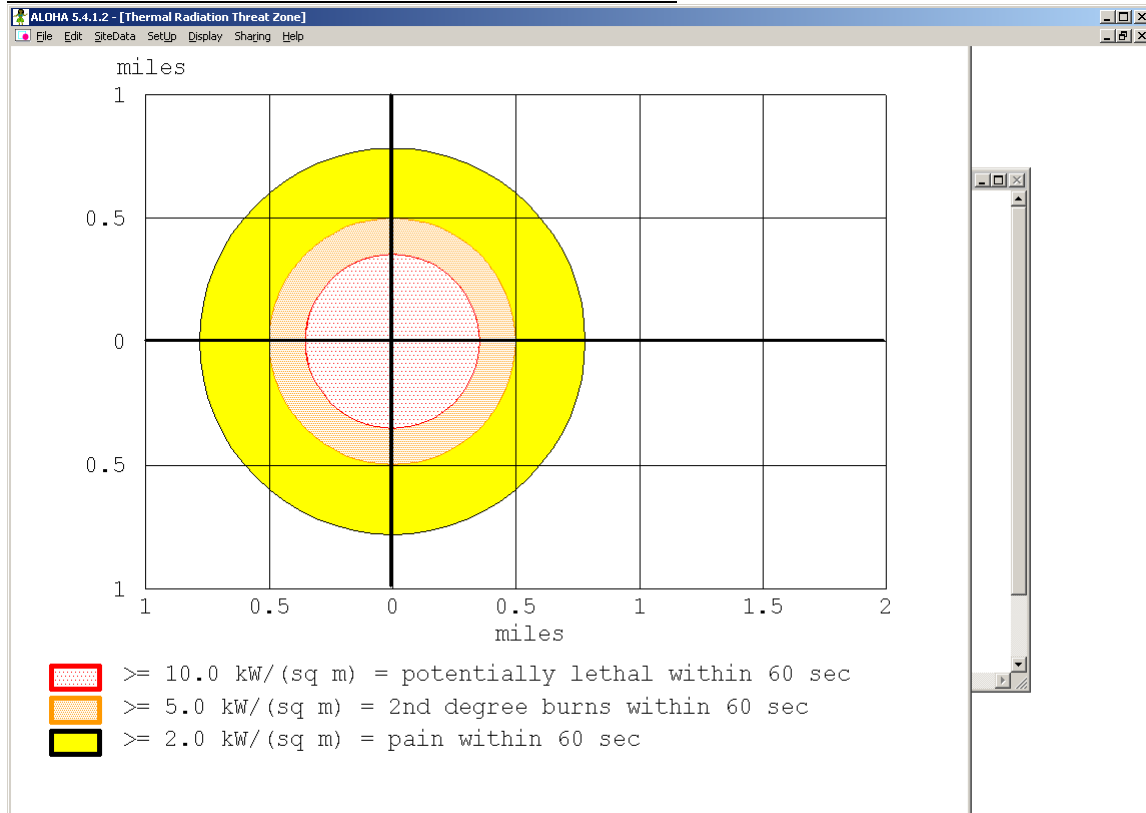
Orange: 29 yards --- (3200 ppm = TEEL-2)

Note: Threat zone was not drawn because effects of near-field patchiness  
make dispersion predictions less reliable for short distances.

Yellow: 232 yards --- (200 ppm = TEEL-1)

## **REPEAT THE ABOVE STEPS USING CHEMICAL "CYCLOHEXYLAMINE"**

### **BLEVE THREAT ZONE: CYCLOHEXYLAMINE**



#### **SITE DATA:**

Location: OKLAHOMA CITY, OKLAHOMA

Building Air Exchanges Per Hour: 1.26 (unsheltered single storied)

Time: December 1, 2010 0630 hours CST (user specified)

#### **CHEMICAL DATA:**

Chemical Name: CYCLOHEXYLAMINE      Molecular Weight: 99.17 g/mol

AEGL-1(60 min): 1.8 ppm    AEGL-2(60 min): 8.6 ppm    AEGL-3(60 min): 30 ppm

LEL: 6600 ppm    UEL: 93000 ppm

Ambient Boiling Point: 270.7° F

Vapor Pressure at Ambient Temperature: 0.0030 atm

Ambient Saturation Concentration: 3,130 ppm or 0.31%

#### **ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)**

Wind: 16 miles/hour from sw at 10 meters

Ground Roughness: open country      Cloud Cover: 0 tenths

Air Temperature: 35° F      Stability Class: D

No Inversion Height      Relative Humidity: 22%



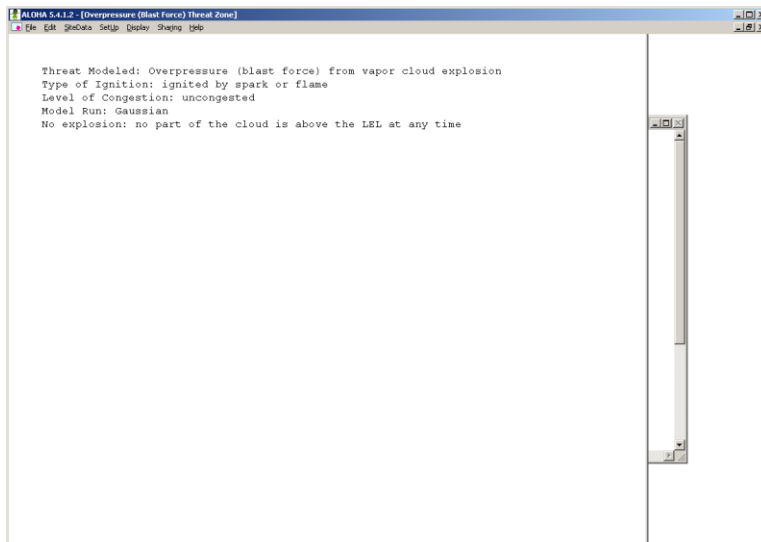
**SOURCE STRENGTH:**

BLEVE of flammable liquid in horizontal cylindrical tank  
Tank Diameter: 9.72 feet      Tank Length: 54 feet  
Tank Volume: 30000 gallons  
Tank contains liquid  
Internal Storage Temperature: 35° F  
Chemical Mass in Tank: 187,668 pounds  
Tank is 85% full  
Percentage of Tank Mass in Fireball: 100%  
Fireball Diameter: 279 yards      Burn Duration: 15 seconds

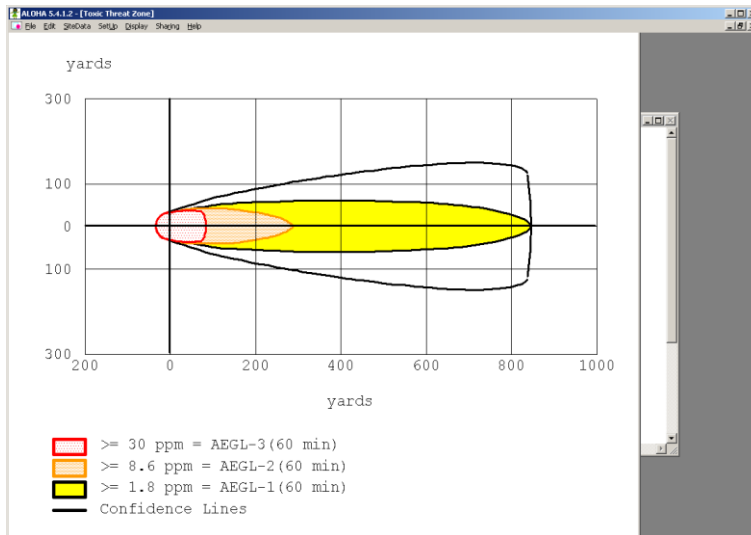
**THREAT ZONE:**

Threat Modeled: Thermal radiation from fireball  
Red : 620 yards --- (10.0 kW/(sq m) = potentially lethal within 60 sec)  
Orange: 878 yards --- (5.0 kW/(sq m) = 2nd degree burns within 60 sec)  
Yellow: 1375 yards --- (2.0 kW/(sq m) = pain within 60 sec)

**VAPOR CLOUD EXPLOSION THREAT ZONE: CYCLOHEXYLAMINE**



## TOXIC AREA THREAT ZONE: CYCLOHEXYLAMINE



### SITE DATA:

Location: OKLAHOMA CITY, OKLAHOMA

Building Air Exchanges Per Hour: 1.26 (unsheltered single storied)

Time: December 1, 2010 0630 hours CST (user specified)

### CHEMICAL DATA:

Chemical Name: CYCLOHEXYLAMINE Molecular Weight: 99.17 g/mol

AEGL-1(60 min): 1.8 ppm AEGL-2(60 min): 8.6 ppm AEGL-3(60 min): 30 ppm

LEL: 6600 ppm UEL: 93000 ppm

Ambient Boiling Point: 270.7° F

Vapor Pressure at Ambient Temperature: 0.0030 atm

Ambient Saturation Concentration: 3,130 ppm or 0.31%

### ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)

Wind: 16 miles/hour from sw at 10 meters

Ground Roughness: open country Cloud Cover: 0 tenths

Air Temperature: 35° F Stability Class: D

No Inversion Height Relative Humidity: 22%

### SOURCE STRENGTH:

Leak from short pipe or valve in horizontal cylindrical tank

Flammable chemical escaping from tank (not burning)

Tank Diameter: 9.72 feet Tank Length: 54 feet

Tank Volume: 30000 gallons

Tank contains liquid Internal Temperature: 35° F

Chemical Mass in Tank: 187,668 pounds

Tank is 85% full

Circular Opening Diameter: 3 inches

Opening is 0 feet from tank bottom  
Ground Type: Default soil  
Ground Temperature: equal to ambient  
Max Puddle Diameter: Unknown  
Release Duration: ALOHA limited the duration to 1 hour  
Max Average Sustained Release Rate: 37.3 pounds/min  
(averaged over a minute or more)  
Total Amount Released: 1,285 pounds  
Note: The chemical escaped as a liquid and formed an evaporating puddle.  
The puddle spread to a diameter of 66 yards.

**THREAT ZONE:**

Model Run: Gaussian  
Red : 84 yards --- (30 ppm = AEGL-3(60 min))  
Orange: 288 yards --- (8.6 ppm = AEGL-2(60 min))  
Yellow: 847 yards --- (1.8 ppm = AEGL-1(60 min))

**REPEAT THE ABOVE STEPS USING CHEMICAL “HYDROCHLORIC ACID, SOLUTION”**

1. Select the Setup / Chemical menu
2. Select “Solutions”

**Chemical Information**

View:  Pure Chemicals  
 Solutions

AQUEOUS AMMONIA  
HYDROCHLORIC ACID  
HYDROFLUORIC ACID  
NITRIC ACID  
OLEUM

Solution Strength:  % (by Weight)

The percentage of ammonia in solution.  
Allowable range is 0 to 30 percent.

Select  
Cancel  
Help

3. Select "Hydrochloric Acid" and enter "42" % (by Weight)

**Chemical Information**

View:  Pure Chemicals  
 Solutions

AQUEOUS AMMONIA  
**HYDROCHLORIC ACID**  
HYDROFLUORIC ACID  
NITRIC ACID  
OLEUM

Solution Strength:  % (by Weight)

The percentage of hydrogen chloride in solution. Allowable range is 20 to 42 percent.

Select  
Cancel  
Help

4. Select the Setup / Source / Puddle menu
5. Enter diameter = 170 yards and Volume = 25,500 gallons (which is 85% of the 30,000 gallon tank capacity)

**Puddle Input**

Puddle  area  feet  
 diameter is:   yards  
 meters

Select one and enter appropriate data

Volume of puddle  
 Average depth of puddle  
 Mass of puddle

Volume is:   gallons  liters  
 cubic feet  cubic meters

OK Cancel Help

6. Select “Default”; “Air Temp”; and “Ground Temp”

**Ground Type, Ground and Puddle Temperature**

Select ground type Help

- Default soil [select this if unknown]
- Concrete
- Sandy dry soil
- Moist sandy soil
- Water [ALOHA does not model solutions on water]

---

Input ground temperature Help

- Use air temperature [select this if unknown]
- Ground temperature is   F  C

---

Input initial puddle temperature Help

- Use ground temperature [select this if unknown]
- Use air temperature
- Initial puddle temperature is   F  C

OK Cancel

7. Select the Display / Threat Zone menu

**Toxic Level of Concern**

Select Toxic Level of Concern:

Red Threat Zone

LOC:

Orange Threat Zone

LOC:

Yellow Threat Zone

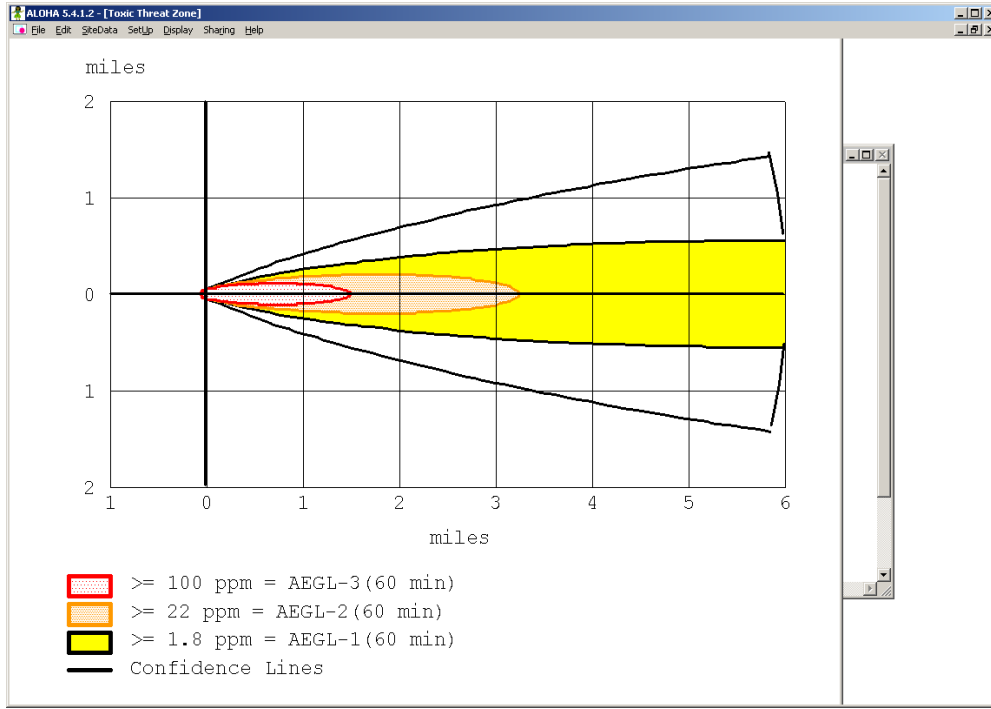
LOC:

Show confidence lines:

- only for longest threat zone
- for each threat zone

OK Cancel Help

## 8. Accept the ALOHA default values for the Level of Concern



### SITE DATA:

Location: OKLAHOMA CITY, OKLAHOMA

Building Air Exchanges Per Hour: 1.26 (unsheltered single storied)

Time: December 1, 2010 0630 hours CST (user specified)

### CHEMICAL DATA:

Chemical Name: HYDROCHLORIC ACID

Solution Strength: 42% (by weight)

Ambient Boiling Point: 68.9° F

Partial Pressure at Ambient Temperature: 0.36 atm

Ambient Saturation Concentration: 381,055 ppm or 38.1%

Hazardous Component: HYDROGEN CHLORIDE

Molecular Weight: 36.46 g/mol

AEGL-1(60 min): 1.8 ppm AEGL-2(60 min): 22 ppm AEGL-3(60 min): 100 ppm

IDLH: 50 ppm

### ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)

Wind: 16 miles/hour from sw at 10 meters

Ground Roughness: open country Cloud Cover: 0 tenths

Air Temperature: 35° F Stability Class: D

No Inversion Height Relative Humidity: 22%

SOURCE STRENGTH:

Evaporating Puddle  
Puddle Diameter: 170 yards      Puddle Volume: 25500 gallons  
Ground Type: Default soil      Ground Temperature: 35° F  
Initial Puddle Temperature: Ground temperature  
Release Duration: ALOHA limited the duration to 1 hour  
Max Average Sustained Release Rate: 8,090 pounds/min  
(averaged over a minute or more)  
Total Amount Hazardous Component Released: 42,025 pounds

THREAT ZONE:

Model Run: Gaussian  
Red : 1.5 miles --- (100 ppm = AEGL-3(60 min))  
Orange: 3.3 miles --- (22 ppm = AEGL-2(60 min))  
Yellow: greater than 6 miles --- (1.8 ppm = AEGL-1(60 min))

*Notice ALOHA does not offer either “BLEVE” or “Vapor Cloud Explosion” as hazard to Analyze choices for the Hydrochloric Acid. However, the Toxic Threat Zone Area for the Hydrochloric is very large when compared to the Threat Zones for Cyclohexylamine and Acetone.*

*Notice that for all three chemicals, ALOHA predicts the length of time for the liquid to completely volatilize is greater than one hour. You can find this by reviewing the SOURCE STRENGTH part of the ALOHA Text Summary.*

ACETONE:

SOURCE STRENGTH:

Leak from short pipe or valve in horizontal cylindrical tank  
Flammable chemical escaping from tank (not burning)  
Tank Diameter: 9.72 feet      Tank Length: 54 feet  
Tank Volume: 30000 gallons  
Tank contains liquid      Internal Temperature: 35° F  
Chemical Mass in Tank: 172,918 pounds  
Tank is 85% full  
Circular Opening Diameter: 3 inches  
Opening is 0 feet from tank bottom  
Ground Type: Default soil  
Ground Temperature: equal to ambient  
Max Puddle Diameter: Unknown  
Release Duration: **ALOHA limited the duration to 1 hour**  
Max Average Sustained Release Rate: 327 pounds/min  
(averaged over a minute or more)  
Total Amount Released: **13,653 pounds**  
Note: The chemical escaped as a liquid and formed an evaporating puddle.  
The puddle spread to a diameter of 50 yards.

CYCLOHEXYLAMINE:

SOURCE STRENGTH:

Leak from short pipe or valve in horizontal cylindrical tank  
Flammable chemical escaping from tank (not burning)  
Tank Diameter: 9.72 feet                      Tank Length: 54 feet  
Tank Volume: 30000 gallons  
Tank contains liquid                      Internal Temperature: 35° F  
Chemical Mass in Tank: 187,668 pounds  
Tank is 85% full  
Circular Opening Diameter: 3 inches  
Opening is 0 feet from tank bottom  
Ground Type: Default soil  
Ground Temperature: equal to ambient  
Max Puddle Diameter: Unknown  
Release Duration: **ALOHA limited the duration to 1 hour**  
Max Average Sustained Release Rate: 37.3 pounds/min  
(averaged over a minute or more)  
Total Amount Released: **1,285 pounds**  
Note: The chemical escaped as a liquid and formed an evaporating puddle.  
The puddle spread to a diameter of 66 yards.

HYDROCHLORIC ACID:

SOURCE STRENGTH:

Evaporating Puddle  
Puddle Diameter: 170 yards                      Puddle Volume: 25500 gallons  
Ground Type: Default soil                      Ground Temperature: 35° F  
Initial Puddle Temperature: Ground temperature  
Release Duration: ALOHA **limited the duration to 1 hour**  
Max Average Sustained Release Rate: 8,090 pounds/min  
(averaged over a minute or more)  
Total Amount Hazardous Component Released: **42,025 pounds**

*Notice the amount of Hydrochloric Acid release during the first hour compared to the Cyclohexylamine and the Acetone*

<u>ACETONE:</u>	Total Amount Released: <u>13,653 pounds</u>
<u>CYCLOHEXYLAMINE:</u>	Total Amount Released: <u>1,285 pounds</u>
<u>HYDROCHLORIC ACID:</u>	Total Amount Hazardous Component Released: <u>42,025 pounds</u>

*Notice ALOHA does not allow us to use the “tank” source model for any of the chemical “solutions”. Thus, the amount of time needed for the Hydrochloric to exit the railcar is not considered by ALOHA. ALOHA modeled the Hydrochloric as if it were as instantaneously formed “puddle” that is 170 yards in diameter.*



*To effectively compare the volatilization rate of the Acetone and the Cyclohexylamine to the Hydrochloric Acid, users would need to use the “puddle” model for all three materials. However, using the puddle model ignores the time necessary for the material to vacate the tanker via a 3” valve leak. Thus, the ALOHA results for the Acetone and the Cyclohexylamine will likely be more accurate using the Tank course model.*

**In any case, ALOHA provides additional information that may be critical to a safe and effective response to this derailment event. Incident Command should be appraised of the potential BLEVE area and the Toxic Threat Zone areas. The ERG-suggested Isolation Zone of 150 feet may not offer sufficient protective distances in this case.**

**Additionally, one should consider modeling all the above release scenarios using the forecasted weather. The fact that the temperature is going to be 55 degrees rather than 35 degrees may significantly alter the ALOHA Threat Zone predictions. And the wind direction and speed will be changing, too. Remember, no chemical release is occurring at 6:30 am, and we are using ALOHA to evaluate what might happen. As such, we should consider future weather conditions in our ALOHA analyses.**

**ANSWERS:**

UN # 1789	Hydrochloric Acid, Solution
UN # 2428	Sodium Chlorate, Aqueous Solution
Acetone	Acetone
CAS # 108-91-8	Cyclohexylamine

**CAMEO Chemicals**

1. Use CAMEO Chemicals to gather information for the various chemicals. (CAMEO Companion pages 31-34)
  - a. Are these materials liquid, solid, or gas? **ALL ARE LIQUIDS**
  - b. Is it likely that these materials are carried in Liquid Tankers or Pressurized Tankers? **ALL WOULD LIKELY SHIP IN LIQUID TANKERS**
  - c. What are the primary hazards associated with these materials?  
**ACETONE: FLAMMABLE**  
**HYDROCHLORIC ACID: REACTIVE AND TOXIC**  
**CYCLOHEXYLAMINE: TOXIC AND FLAMMABLE**  
**SODIUM CHLORATE: OXIDIZER**
  
2. Use the CAMEO Chemicals “Predict Reactivity” module to evaluate the potential reactive hazards for this incident. (CAMEO Companion pages 34-35)

	CYCLOHEXYLAMINE		
HYDROCHLORIC ACID, SOLUTION	Corrosive Heat generation Intense reaction Toxic gas	HYDROCHLORIC ACID, SOLUTION	
SODIUM CHLORATE, AQUEOUS SOLUTION	Corrosive Explosive Flammable Flammable gas Heat generation Toxic gas	Combustion-enhancing gas Corrosive Explosive Flammable Heat generation Intense reaction Toxic gas	SODIUM CHLORATE, AQUEOUS SOLUTION
ACETONE	Flammable gas	Heat generation	Explosive Flammable Heat generation Intense reaction Toxic Toxic gas

3. Determine the Initial Isolation Zone and Evacuation distances appropriate for this scenario. (CAMEO Companion pages 31-34) **ERG SUGGESTS 150 IMMEDIATE ISOLATION ZONE FOR ALL FOUR OF THESE SUBSTANCES. EVACUATION DISTANCES VARY FROM 100 FEET TO 1000 FEET (NON-FIRE); AND 1/2 MILE (FIRE)**