ALLEGATO N. 1

"Fogli di Calcolo"

Fiamma 2000 S.p.A.

DOTT. ING.

Direttore Tecniq

Fiamma 2000 S.p.A.
Gestore
Inc. Benito Camardella



Case description: Rilascio intempestivo da PSV

Model: Liquefied Gas Vapour Release

version: 5.09 (01/09/2010)

Reference: Yellow Book, CPR-14E, 3rd edition 1997, Paragraph 2.5.4

Parameters

inputs Chemical name Use which representative step Type of release Pipeline length (m) Pipeline diameter (mm) Hole diameter (mm) Hole rounding Discharge coefficient (-) Initial temperature in equipment (°C) Pressure inside vessel determination Initial (absolute) pressure in vessel (bar) Vessel volume (m3) Vessel type Length cylinder (m) Filling degree (%) Type of calculation

Results

Initial mass in vessel (kg)
Mass flow rate at time t (kg/s)
Total mass released at time t (kg)
Time needed to empty vessel (s)
Pressure at time t (bar)
Temperature at time t (°C)
Filling degree at time t (%)
Density gas at time t (kg/m3)
Maximum mass flow rate (kg/s)
Representative release rate (kg/s)
Representative temperature (°C)
Representative pressure (bar)
Representative density (kg/m3)

Time t after start release (s)

Other information

Main program Chemical database Chemical database path Chemical database date Propane (YAWS) First 20% average (flammable) Release through hole in vessel

55,7
User defined
0,8
20
Use actual pressure
8,3
5000
Horizontal cylinder
57

Calculate until specified time 1

1,2918E06 4,3941 4,4161 8,3567

20 50 15,119 4,3941 4,3941 1 20

20 8,3568 15,119

Effects 8.0.1.3218
YAWS database
C:\Programmi\TNO\Effects 8.0\Shared data\Databases\Purple Book (1999).rdb
12/02/2009

Effects report created by FIAMMAWK\$051\(\).monacelli at 01/09/2010 11.49.09



Case description: Rilascio intempestivo da PSV

Model: Dense Gas Dispersion: Explosive mass

version: 5.13 (01/09/2010)

Reference: Yellow Book 3rd edition 1997 chapter 4; Ermak, D.L. User manual for SLAB Lawrence Livermore National Laboratory, June 1990

| Parameters | |
|--|----------------------|
| Inputs | |
| Chemical name | Propane (YAWS) |
| Type of release | Vertical Jet release |
| Total mass released (kg) | |
| Mass flow rate of the source (kg/s) | 4,39 |
| Duration of the release (s) | 900 |
| Initial liquid mass fraction (%) | 0 |
| Fixed pool surface (m2) | |
| Diameter of expanded jet (m) | 0,056 |
| Temperature after release (°C) | 20 |
| X-coordinate of release (m) | 0 |
| Y-coordinate of release (m) | 15 |
| Z-coordinate (height) of release (m) | 0 |
| Pasquill stability class | F (Very Stable) |
| Wind speed at 10 m height (m/s) | ż |
| Predefined wind direction | S |
| Wind comes from (North = 0 degrees) (deg) | 180 |
| Roughness length description | Cultivated land |
| Time t after start release (s) | 900 |
| Concentration averaging time (s) | 900 |
| | |
| Results | |
| Explosive mass at time t (kg) | 0 |
| Height to LEL at time t (m) | 0 |
| Length of cloud (between LEL) at time t (m) | 0 |
| Width of cloud (between LEL) at time t (m) | 0 |
| Offset between release location and LEL at time t (m) | 0,001 |
| Maximum explosive mass (kg) | 0 |
| at time tmem (s) | 990 |
| Start time where 95% of maximum of explosive mass is reached (s) | 0 |
| Time where explosive mass starts decreasing below 95% of max (s) | 990 |
| Length of cloud (between LEL) at time tmem (m) | -0,97773 |
| Width of cloud (between LEL) at time tmem (m) | 0 |
| Offset between release location and LEL at time timem (m) | 0,001 |
| Maximum area of explosive cloud (m2) | 0 |
| at time tmac (s) | 900 |
| Explosive mass at time tmac (kg) | 0 |
| Length of cloud (between LEL) at time tmac (m) | 6,2284 |
| Width of cloud (between LEL) at time tmac (m) | 0 |
| Offset between release location and LEL at time tmac (m) | 0,97773 |
| Offset between release centre and cloud centre at time tmac (m) | 4.0919 |
| Inverse Monin-Obukhov length (1/L) used (1/m) | 0,04733 |
| | |

Other information

Main program Chemical database Chemical database path Chemical database date

Effects 8.0.1.3218 YAWS database C:\Programmi\TNO\Effects 8.0\Shared data\Databases\Purple Book (1999).rdb

12/02/2009

Effects report created by FIAMMAWKS051\I.monacelli at 01/09/2010 12-45.28



Case description: Rilascio intempestivo da PSV

Model: Dense Gas Dispersion: Explosive mass

version: 5.13 (01/09/2010)

Reference: Yellow Book 3rd edition 1997 chapter 4; Ermak, D.L. User manual for SLAB Lawrence Livermore National Laboratory, June 1990

| Parameters Inputs Chemical name Type of release Total mass released (kg) Mass flow rate of the source (kg/s) Duration of the release (s) Initial liquid mass fraction (%) Fixed pool surface (m2) Diameter of expanded jet (m) Temperature after release (°C) | Propane (YAWS) Vertical Jet release 4,39 900 0 0,056 20 |
|--|---|
| X-coordinate of release (m) Y-coordinate of release (m) Z-coordinate (height) of release (m) Pasquill stability class Wind speed at 10 m height (m/s) Predefined wind direction Wind comes from (North = 0 degrees) (deg) Roughness length description Time t after start release (s) Concentration averaging time (s) | 0 15 0 D (Neutral) 5 S 180 Cultivated land 900 |
| Results Explosive mass at time t (kg) Height to LEL at time t (m) Length of cloud (between LEL) at time t (m) Width of cloud (between LEL) at time t (m) Offset between release location and LEL at time t (m) Maximum explosive mass (kg) at time tmem (s) Start time where 95% of maximum of explosive mass is reached (s) Time where explosive mass starts decreasing below 95% of max (s) Length of cloud (between LEL) at time tmem (m) Width of cloud (between LEL) at time tmem (m) Offset between release location and LEL at time tmem (m) Maximum area of explosive cloud (m2) at time tmac (s) Explosive mass at time tmac (kg) Length of cloud (between LEL) at time tmac (m) Width of cloud (between LEL) at time tmac (m) Offset between release location and LEL at time tmac (m) Offset between release centre and cloud centre at time tmac (m) Inverse Monin-Obukhov length (1/L) used (1/m) | 0 0 0 0,001 0 990 0 990 -0,97773 0 0,001 0 900 0 4,4456 0 0,97773 3,2006 |

Other information

Main program Chemical database Chemical database path Chemical database date Effects 8.0.1.3218 YAWS database

C:\Programmi\TNO\Effects 8.0\Shared data\Databases\Purple Book (1999).rdb

Effects report created by FIAMMAWKS051\I.monacelli at 01/09/2010 12-48.24



Case description: Rottura braccio di carico in discarica

Model: Liquid release

version: 5.08 (29/07/2010)

Reference: Yellow Book, CPR-14E, 3rd edition 1997, Paragraph 2.5.4Yellow Book, CPR-14E, 3rd edition 1997, Paragraph 2.5.4

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|---|----|----|---|----|---|----|
| | | | | | | |

| inputs | |
|--|--|
| Chemical name | Propane (YAWS) |
| Use which representative step | First 20% average (flammable) |
| Type of release | Release from vessel through (a hole in) pipe |
| Pipeline length (m) | 40 |
| Pipeline diameter (mm) | 150 |
| Hole diameter (mm) | 50 |
| Hole rounding | User defined |
| Discharge coefficient (-) | 8,0 |
| Vessel type | Horizontal cylinder |
| Vessel volume (m3) | 300 |
| Length cylinder (m) | 26 |
| Filling degree (%) | 80 |
| Overpressure above liquid (assuming closed system) (bar) | 0 |
| Height leak above tank bottom (m) | 0 |
| Initial temperature in vessel (°C) | 20 |
| Type of calculation | Calculate until specified time |
| Time t after start release (s) | 1 |
| | |

Results Initial mass in vessel (kg) 1,204E05 Mass flow rate at time t (kg/s)
Total mass released at time t (kg) 5,8032 5,8323 Time needed to empty vessel (s) Filling degree at time t (%) 79,996 Height of liquid at time t (m) 2,859 Maximum mass flow rate (kg/s) 5,8034 Representative release rate (kg/s) 5,8034 Representative outflow duration (s) 1,0151 Representative pressure (bar)

Other information Main program Chemical database Chemical database path Chemical database date

Effects 8.0.1.3218 YAWS database

C:\Programmi\TNO\Effects 8.0\Shared data\Databases\Purple Book (1999).rdb 12/02/2009

Effects report created by FIAMMAWKS051\t.monacelli at 29/07/2010 16.59.34



Case description: Rottura manichetta flessibile in discarica lato ATB

Model: Liquefied Gas Vapour Release

version: 5.09 (29/07/2010)

Reference: Yellow Book, CPR-14E, 3rd edition 1997, Paragraph 2.5.4

Parameters

Inputs Chemical name Propane (YAWS) Use which representative step First 20% average (flammable) Type of release Release from vessel through (a hole in) pipe Pipeline length (m) Pipeline diameter (mm) Hole diameter (mm) 37,5 Hole rounding User defined Discharge coefficient (-) 0,8 Initial temperature in equipment (°C) Pressure inside vessel determination Use actual pressure Initial (absolute) pressure in vessel (bar) Vessel volume (m3) 300 Vessel type Horizontal cylinder Length cylinder (m) Filling degree (%) Type of calculation Calculate until specified time Time t after start release (s)

50

26

80

Results Initial mass in vessel (kg) 1,2127E05 Mass flow rate at time t (kg/s) 1,348 Total mass released at time t (kg) 1,3548 Time needed to empty vessel (s) Pressure at time t (bar) 8,3565 Temperature at time t (°C) 19,998 Filling degree at time t (%) 79,999 Density gas at time t (kg/m3) 15,118 Maximum mass flow rate (kg/s) 1,3481 Representative release rate (kg/s) 1,348 Representative outflow duration (s) Representative temperature (°C) 20 Representative pressure (bar) 8,3568 Representative density (kg/m3) 15,119

Other information Main program Effects 8.0.1.3218 Chemical database YAWS database Chemical database path C:\Programmi\TNO\Effects 8.0\Shared data\Databases\Purple Book (1999).rdb Chemical database date 12/02/2009

Effects report created by FIAMMAWKS051\I.monacelli at 29/07/2010 17.09.48



Case description: Rottura manichetta flessibile in discarica lato impianto

Model: Liquefied Gas Vapour Release

version: 5.09 (29/07/2010)

Reference: Yellow Book, CPR-14E, 3rd edition 1997, Paragraph 2.5.4

Parameters

Inputs

Chemical name Use which representative step Type of release Pipeline length (m) Pipeline diameter (mm) Hole diameter (mm) Hole rounding Discharge coefficient (-) Initial temperature in equipment (°C) Pressure inside vessel determination Initial (absolute) pressure in vessel (bar) Vessel volume (m3) Vessel type Length cylinder (m) Filling degree (%) Type of calculation Time t after start release (s)

Results

Initial mass in vessel (kg)
Mass flow rate at time t (kg/s)
Total mass released at time t (kg)
Time needed to empty vessel (s)
Pressure at time t (bar)
Temperature at time t (%)
Density gas at time t (kg/m3)
Maximum mass flow rate (kg/s)
Representative release rate (kg/s)
Representative temperature (*C)
Representative temperature (*C)
Representative density (kg/m3)

Other Information

Main program
Chemical database
Chemical database path
Chemical database date

Propane (YAWS) First 20% average (flammable)

Release from vessel through (a hole in) pipe 40 75 37.5

User defined 0.8 20 Use actual pressure 8.2 300

Horizontal cylinder 26 0,8

Calculate until specified time

5619 1,8543 1,8683 8,3112

19,793 0,79876 15.047 1,8638 1,8629 1 19,979 8,3522

15,112

Effects 8.0.1.3218
YAWS database
C:\ProgrammiTNO\Effects 8.0\Shared data\Databases\Purple Book (1999).rdb
12/02/2009

Effects report created by FIAMMAWKS051\I.monacelli at 29/07/2010 17 20.45



Case description: Rottura manichetta flessibile in caricazione lato ATB

Model: Liquefied Gas Vapour Release

version: 5.09 (29/07/2010)

Reference: Yellow Book, CPR-14E, 3rd edition 1997, Paragraph 2.5.4

Parameters

Inputs

Chemical name Use which representative step Type of release Pipeline length (m) Pipeline diameter (mm) Hole diameter (mm) Hole rounding Discharge coefficient (-) Initial temperature in equipment (°C) Pressure inside vessel determination Initial (absolute) pressure in vessel (bar) Vessel volume (m3) Vessel type Length cylinder (m) Filling degree (%) Type of calculation Time t after start release (s)

Results

Initial mass in vessel (kg)
Mass flow rate at time t (kg/s)
Total mass released at time t (kg)
Time needed to empty vessel (s)
Pressure at time t (bar)
Temperature at time t (°C)
Filling degree at time t (%)
Density gas at time t (kg/m3)
Maximum mass flow rate (kg/s)
Representative release rate (kg/s)
Representative temperature (°C)
Representative temperature (°C)
Representative pressure (bar)
Representative density (kg/m3)

Other information

Main program Chemical database Chemical database path Chemical database date Propane (YAWS) First 20% average (flammable) Release from vessel through (a hole in) pipe

> 50 50 User defined 0,8 20

Use actual pressure 8,3 1666 Horizontal cylinder

60 80

Calculate until specified time

6,7365E05 3,0216 3,0368

8.3567

19,999 80 15,119 3,0217 3,0217 1 20

1 20 8,3568 15,119

Effects 8.0.1.3218
YAWS database
C:\Programmi\TNO\Effects 8.0\Shared data\Databases\Purple Book (1999).rdb

Effects report created by FIAMMAWKS051\I.monacelli at 29/07/2010 18.06.13



Case description: Rottura manichetta flessibile in caricazione lato impianto

Model: Liquefied Gas Vapour Release

version: 5.09 (29/07/2010)

Reference: Yellow Book, CPR-14E, 3rd edition 1997, Paragraph 2.5.4

Parameters

Inputs

Chemical name Use which representative step Type of release Pipeline length (m) Pipeline diameter (mm) Hole diameter (mm) Hole rounding Discharge coefficient (-) Initial temperature in equipment (*C) Pressure inside vessel determination Initial (absolute) pressure in vessel (bar) Vessel volume (m3) Vessel type Length cylinder (m) Filling degree (%) Type of calculation Time t after start release (s)

Results

Initial mass in vessel (kg)
Mass flow rate at time t (kg/s)
Total mass released at time t (kg)
Time needed to empty vessel (s)
Pressure at time t (bar)
Temperature at time t (°C)
Filling degree at time t (%)
Density gas at time t (kg/m3)
Maximum mass flow rate (kg/s)
Representative release rate (kg/s)
Representative temperature (°C)
Representative temperature (°C)
Representative pressure (bar)
Representative density (kg/m3)

Other information

Main program Chemical database Chemical database path Chemical database date Propane (YAWS)
First 20% average (flammable)
Release from vessel through (a hole in) pipe
100
75
50
User defined
0,8
20
Use actual pressure
8,3
1666

Horizontal cylinder 60 80

Calculate until specified time

6,7365E05 2,4318 2,4439

8,3567

20 80 15,119 2,4318 2,4318 1 20 8,3568

15,119

Effects 8.0.1.3218 YAWS database

C:\Programmi\TNO\Effects 8.0\Shared data\Databases\Purple Book (1999).rdb

Effects report created by FIAMMAWKS051\I.monacelli at 29/07/2010 18.16.56



Case description: Rottura catastrofica pompa Sala pompe attuale

Model: Liquid release

version: 5.08 (29/07/2010)

Reference: Yellow Book, CPR-14E, 3rd edition 1997, Paragraph 2.5.4Yellow Book, CPR-14E, 3rd edition 1997, Paragraph 2.5.4

Parameters

Inputs Propage (YAWS) Chemical name Use which representative step First 20% average (flammable) Release from vessel through (a hole in) pipe Type of release Pipeline length (m) Pipeline diameter (mm) 150 Hole diameter (mm) 50 User defined Hole rounding Discharge coefficient (-) 0.8 Vessel type Vessel volume (m3) Horizontal cylinder Length cylinder (m) 30 Filling degree (%) Overpressure above liquid (assuming closed system) (bar) Height leak above tank bottom (m) 0 Initial temperature in vessel ("C) 20 Calculate until specified time Type of calculation Time t after start release (s)

Results

Initial mass in vessel (kg) 1,204E05 Mass flow rate at time t (kg/s) 5,6577 Total mass released at time t (kg) 5,686 Time needed to empty vessel (s) 79.996 Filling degree at time t (%) 2.6615 Height of liquid at time t (m) 5.6578 Maximum mass flow rate (kg/s) 5,6578 Representative release rate (kg/s) Representative outflow duration (s) 1,0151 Representative pressure (bar)

Other information Main program Effects 8.0.1.3218 YAWS database Chemical database C:\Programmi\TNO\Effects 8.0\Shared data\Databases\Purple Book (1999).rdb Chemical database path 12/02/2009 Chemical database date

Effects report created by FIAMMAWKS051\I.monacelli at 29/07/2010 18.45.19



Case description: Rottura catastrofica pompa della Nuova Sala pompe

Model: Liquid release

version: 5.08 (29/07/2010)

Reference: Yellow Book, CPR-14E, 3rd edition 1997, Paragraph 2.5.4Yellow Book, CPR-14E, 3rd edition 1997, Paragraph 2.5.4

| | Pa | ra | m | et | e | rs |
|--|----|----|---|----|---|----|
|--|----|----|---|----|---|----|

Inputs

Chemical name Use which representative step Type of release Pipeline length (m) Pipeline diameter (mm) Hole diameter (mm) Hole rounding Discharge coefficient (-) Vessel type Vessel volume (m3) Length cylinder (m) Filling degree (%) Overpressure above liquid (assuming closed system) (bar) Height leak above tank bottom (m) Initial temperature in vessel (°C) Type of calculation Time t after start release (s)

Results

Initial mass in vessel (kg) 6,6865E05 Mass flow rate at time t (kg/s) 7,3464 Total mass released at time t (kg) 7.3832 Time needed to empty vessel (s) Filling degree at time t (%) 79,999 Height of liquid at time t (m) 4,4352 Maximum mass flow rate (kg/s) 7,3465 Representative release rate (kg/s) 7,3465 Representative outflow duration (s) 1,0151 Representative pressure (bar)

Other information

Main program Chemical database Chemical database path Chemical database date Effects 8.0.1.3218

YAWS database

C:\Programmi\TNO\Effects 8.0\Shared data\Databases\Purple Book (1999).rdb 12/02/2009

Propane (YAWS)

250

User defined

Horizontal cylinder

Calculate until specified time

50

0.8

80

20

0 0

First 20% average (flammable)

Release from vessel through (a hole in) pipe

Effects report created by FIAMMAWKS051\I.monacelli at 29/07/2010 18:53:16



Model: Dense Gas Dispersion: Explosive mass

version: 5.13 (02/08/2010)

Reference: Yellow Book 3rd edition 1997 chapter 4; Ermak, D.L. User manual for SLAB Lawrence Livermore National Laboratory, June 1990

| Parameters | |
|--|------------------------|
| Inputs | |
| Chemical name | Propane (YAWS) |
| Type of release | Horizontal Jet release |
| Total mass released (kg) | |
| Mass flow rate of the source (kg/s) | 10,6 |
| Duration of the release (s) | 20 |
| Initial liquid mass fraction (%) | 100 |
| Fixed pool surface (m2) | |
| Diameter of expanded jet (m) | 0.05 |
| Temperature after release (°C) | 20 |
| X-coordinate of release (m) | 10 |
| Y-coordinate of release (m) | 0 |
| Z-coordinate (height) of release (m) | 0 |
| Pasquill stability class | F (Very Stable) |
| Wind speed at 10 m height (m/s) | 2 |
| Predefined wind direction | S |
| Wind comes from (North = 0 degrees) (deg) | 180 |
| Roughness length description | Cultivated land |
| Time t after start release (s) | 20 |
| Concentration averaging time (s) | 20 |
| Results | |
| Explosive mass at time t (kg) | 112,94 |
| Height to LEL at time t (M) | 2.4 |
| Length of cloud (between LEL) at time t (m) | 17.339 |
| Width of cloud (between LEL) at time t (m) | 57.863 |
| Offset between release location and LEL at time t (m) | 37,803 |
| Maximum explosive mass (kg) | 131.63 |
| maximum times (kg)at time timem (s) | 24.75 |
| Start time where 95% of maximum of explosive mass is reached (s) | 22,985 |
| Time where explosive mass starts decreasing below 95% of max(s) | 25,153 |
| Length of cloud (between LEL) at time tmem (m) | 37,585 |
| Width of cloud (between LEL) at time timem (m) | 69,697 |
| Offset between release location and LEL at time timem (m) | 1 |
| Maximum area of explosive cloud (m2) | 1795.7 |
| maximum trace of exposive cloud (112) | 24,75 |
| Explosive mass at time tmac (kg) | 131.63 |
| Length of cloud (between LEL) at time tmac (m) | 37.585 |
| Width of cloud (between LEL) at time tmac (m) | 69.697 |
| Offset between release location and LEL at time tmac (m) | 09,097 |
| | 10 700 |
| Offset between release centre and cloud centre at time tmac (m) | 19,792 |
| Inverse Monin-Obukhov length (1/L) used (1/m) | 0,04733 |

Other information

Main program Chemical database Chemical database path Chemical database date

YAWS database C:\Programmi\TNO\Effects 8.0\Shared data\Databases\Purple Book (1999).rdb

Effects 8.0.1.3218

Effects report created by FIAMMAWKS051\l.monacelli at 02/08/2010 16.13.26

Foglio di Calcolo nº 6



Model: Dense Gas Dispersion: Explosive mass

version: 5.13 (02/08/2010)

Reference: Yellow Book 3rd edition 1997 chapter 4; Ermak, D.L. User manual for SLAB Lawrence Livermore National Laboratory, June 1990

| Parameters Inputs Chemical name Type of release | Propane (YAWS) Horizontal Jet release |
|--|---|
| Total mass released (kg) Mass flow rate of the source (kg/s) Duration of the release (s) Initial liquid mass fraction (%) Fixed pool surface (m2) | 10,6 20 100 |
| Diameter of expanded jet (m) Temperature after release (°C) X-coordinate of release (m) Y-coordinate of release (m) Z-coordinate (height) of release (m) Pasquill stability class Wind speed at 10 m height (m/s) | 0,05 20 10 0 0 D (Neutral) |
| Predefined wind direction Wind comes from (North = 0 degrees) (deg) Roughness length description Time t after start release (s) Concentration averaging time (s) | S 180 Cultivated land 20 20 |
| Results Explosive mass at time t (kg) Height to LEL at time t (m) Length of cloud (between LEL) at time t (m) Width of cloud (between LEL) at time t (m) Offset between release location and LEL at time t (m) Maximum explosive mass (kg) at time tmem (s) Start time where 95% of maximum of explosive mass is reached (s) Time where explosive mass starts decreasing below 95% of max (s) Length of cloud (between LEL) at time tmem (m) Width of cloud (between LEL) at time tmem (m) Offset between release location and LEL at time tmem (m) Maximum area of explosive cloud (m2) at time tmac (s) Explosive mass at time tmac (kg) Length of cloud (between LEL) at time tmac (m) Width of cloud (between LEL) at time tmac (m) Offset between release location and LEL at time tmac (m) Offset between release centre and cloud centre at time tmac (m) Inverse Monin-Obukhov length (1/L) used (1/m) | 86,423 |

Other information

Main program Chemical database Chemical database path Chemical database date Effects 8.0.1.3218 YAWS database

C:\Programmi\TNO\Effects 8.0\Shared data\Databases\Purple Book (1999).rdb 12/02/2009

Effects report created by FIAMMAWKS0511/.monacelli at 02/08/2010 16.37.16



Model: Dense Gas Dispersion: Concentration

version: 5.13 (03/08/2010)

Reference: Yellow Book 3rd edition 1997 chapter 4; Ermak, D.L. User manual for SLAB Lawrence Livermore National Laboratory, June 1990

| Parameters | |
|------------|--|
|------------|--|

| Inputs | |
|---|------------------------|
| Chemical name | Propane (YAWS) |
| Type of release | Horizontal Jet release |
| Total mass released (kg) | |
| Mass flow rate of the source (kg/s) | 10,6 |
| Duration of the release (s) | 20 |
| Initial liquid mass fraction (%) | 100 |
| Fixed pool surface (m2) | |
| Diameter of expanded jet (m) | 0.05 |
| Temperature after release (°C) | 20 |
| X-coordinate of release (m) | 10 |
| Y-coordinate of release (m) | 0 |
| Z-coordinate (height) of release (m) | 0 |
| Pasquill stability class | F (Very Stable) |
| Wind speed at 10 m height (m/s) | Ź |
| Roughness length description | Cultivated land |
| Time t after start release (s) | 58 |
| Concentration averaging time (s) | 20 |
| Distance from release (Xd) (m) | 10 |
| Distance perpendicular to wind direction (Yd) (m) | 0 |
| Height (Zd) (m) | 0 |
| Predefined concentration | User defined |
| Threshold concentration (mg/m3) | 18900 |
| Predefined wind direction | S |
| Wind comes from (North = 0 degrees) (deg) | 180 |
| Perform Max Conc vs Distance graph | Yes |
| | |
| | |

 Wind comes from (North = 0 degrees) (deg)
 180

 Perform Max Conc vs Distance graph
 Yes

 Results
 Concentration at (Xd, Yd, Zd, t) (mg/m3)

 Maximum concentration at (Yd, Zd) (mg/m3)
 1,9048E06

 ...at distance (m)
 1,11

 Maximum distance to threshold concentration (m)
 37,419

Other information

Main program
Chemical database
Chemical database path
Chemical database date

Effects 8.0.1.3218
YAWS database
C:\Programmi\TNO\Effects 8.0\Shared data\Databases\Purple Book (1999).rdb

12/02/2009

Effects report created by FIAMMAWKS051\L.Monacelli at 03/08/2010 16.51.56

Foglio di Calcolo nº 8



Model: Dense Gas Dispersion: Concentration

version: 5.13 (03/08/2010)

Reference: Yellow Book 3rd edition 1997 chapter 4; Ermak, D.L. User manual for SLAB Lawrence Livermore National Laboratory, June 1990

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| Inputs | |
|---|------------------------|
| Chemical name | Propane (YAWS) |
| Type of release | Horizontal Jet release |
| Total mass released (kg) | |
| Mass flow rate of the source (kg/s) | 10,6 |
| Duration of the release (s) | 20 |
| Initial liquid mass fraction (%) | 100 |
| Fixed pool surface (m2) | |
| Diameter of expanded jet (m) | 0,05 |
| Temperature after release (°C) | 20 |
| X-coordinate of release (m) | 10 |
| Y-coordinate of release (m) | 0 |
| Z-coordinate (height) of release (m) | 0 |
| Pasquill stability class | D (Neutral) |
| Wind speed at 10 m height (m/s) | 5 |
| Roughness length description | Cultivated land |
| Time t after start release (s) | 31 |
| Concentration averaging time (s) | 20 |
| Distance from release (Xd) (m) | 10 |
| Distance perpendicular to wind direction (Yd) (m) | 0 |
| Height (Zd) (m) | 0 |
| Predefined concentration | User defined |
| Threshold concentration (mg/m3) | 18900 |
| Predefined wind direction | \$ |
| Wind comes from (North = 0 degrees) (deg) | 180 |
| Perform Max Conc vs Distance graph | Yes |
| | |
| | |

Concentration at (Xd, Yd, Zd, t) (mg/m3) 1,9048E06 Maximum concentration at (Yd, Zd) (mg/m3) ..at distance (m) Maximum distance to threshold concentration (m)

Other information

Main program Chemical database Chemical database path Chemical database date

Effects 8.0.1.3218 YAWS database C:\Programm\\TNO\Effects 8.0\Shared data\Databases\Purple Book (1999).rdb

3288,6

1.1481

52.131

12/02/2009

Effects report created by FIAMMAWKS051\L.Monacelli at 03/08/2010 16.54.09



Model: Dense Gas Dispersion: Concentration

version: 5.13 (03/08/2010)

Reference: Yellow Book 3rd edition 1997 chapter 4; Ermak, D.L. User manual for SLAB Lawrence Livermore National Laboratory, June 1990

| Para | ami | ete | rs |
|------|-----|-----|----|
|------|-----|-----|----|

| Inputs Chemical name | Propane (YAWS) |
|---|-----------------------------|
| Type of release Total mass released (kg) | Horizontal Jet release |
| Mass flow rate of the source (kg/s) | 10,6 |
| Duration of the release (s) | 20 |
| Initial liquid mass fraction (%) | 100 |
| Fixed pool surface (m2) | 100 |
| Diameter of expanded jet (m) | 0,05 |
| Temperature after release (°C) | 20 |
| X-coordinate of release (m) | 10 |
| Y-coordinate of release (m) | 0 |
| Z-coordinate (height) of release (m) | 0 |
| Pasquill stability class | F (Very Stable) |
| Wind speed at 10 m height (m/s) | Ź |
| Roughness length description | Cultivated land |
| Time t after start release (s) | 36 |
| Concentration averaging time (s) | 20 |
| Distance from release (Xd) (m) | 10 |
| Distance perpendicular to wind direction (Yd) (m) | 0 |
| Height (Zd) (m) | 0 |
| Predefined concentration | LEL (Lower Explosion Limit) |
| Threshold concentration (mg/m3) | 38504 |
| Predefined wind direction | S |
| Wind comes from (North = 0 degrees) (deg) | 180 |
| Perform Max Conc vs Distance graph | Yes |
| | |

Results

Concentration at (Xd, Yd, Zd, t) (mg/m3)
Maximum concentration at (Yd, Zd) (mg/m3) 38222 1,9048E06 ...at distance (m) Maximum distance to threshold concentration (m) 31,01

Other information Effects 8.0.1.3218 Main program YAWS database Chemical database Chemical database path C:\Programmi\TNO\Effects 8.0\Shared data\Databases\Purple Book (1999).rdb Chemical database date 12/02/2009

Effects report created by FIAMMAWKS051\L.Monacelli at 03/08/2010 16.46.10



Model: Dense Gas Dispersion: Concentration

version: 5.13 (03/08/2010)

Reference: Yellow Book 3rd edition 1997 chapter 4; Ermak, D.L. User manual for SLAB Lawrence Livermore National Laboratory, June 1990

| Parameters |
|-------------------|
| Inputs |
| Chaminal on |

hemical name Type of release Total mass released (kg) Mass flow rate of the source (kg/s) Duration of the release (s) Initial liquid mass fraction (%) Fixed pool surface (m2) Diameter of expanded jet (m) Temperature after release (°C) X-coordinate of release (m) Y-coordinate of release (m) Z-coordinate (height) of release (m) Pasquill stability class Wind speed at 10 m height (m/s) Roughness length description Time t after start release (s) Concentration averaging time (s) Distance from release (Xd) (m) Distance perpendicular to wind direction (Yd) (m) Height (Zd) (m) Predefined concentration

Threshold concentration (mg/m3) Predefined wind direction

Wind comes from (North = 0 degrees) (deg) Perform Max Conc vs Distance graph

Results

Concentration at (Xd, Yd, Zd, t) (mg/m3) Maximum concentration at (Yd, Zd) (mg/m3) Maximum distance to threshold concentration (m)

Other information Main program Chemical database Chemical database path Chemical database date

Propane (YAWS) Horizontal Jet release

> 10.6 0,05 20 10

D (Neutral) Cultivated land 20

0

10

Yes

0 LEL (Lower Explosion Limit) 38504

180

21990 1.9048E06 1,1481 32.73

Effects 8.0.1.3218 YAWS database

C:\Programmi\TNO\Effects 8.0\Shared data\Databases\Purple Book (1999).rdb 12/02/2009

Effects report created by FIAMMAWKS051\L.Monacelli at 03/08/2010 16.47.55



Model: Dense Gas Dispersion: Explosive mass

version: 5.13 (04/08/2010)

Reference: Yellow Book 3rd edition 1997 chapter 4; Ermak, D.L. User manual for SLAB Lawrence Livermore National Laboratory, June 1990

| Parameters | |
|--|------------------------|
| Inputs | |
| Chemical name | Propane (YAWS) |
| Type of release | Horizontal Jet release |
| Total mass released (kg) | |
| Mass flow rate of the source (kg/s) | 20,9 |
| Duration of the release (s) | 20 |
| Initial liquid mass fraction (%) | 100 |
| Fixed pool surface (m2) | |
| Diameter of expanded jet (m) | 0.05 |
| Temperature after release (°C) | 20 |
| X-coordinate of release (m) | 10 |
| Y-coordinate of release (m) | 0 |
| Z-coordinate (height) of release (m) | 0,5 |
| Pasquill stability class | F (Very Stable) |
| Wind speed at 10 m height (m/s) | 2 |
| Predefined wind direction | S |
| Wind comes from (North = 0 degrees) (deg) | 180 |
| Roughness length description | Cultivated land |
| Time t after start release (s) | 20 |
| Concentration averaging time (s) | 20 |
| Results | |
| Explosive mass at time t (kg) | 216,01 |
| Height to LEL at time t (m) | 2.8 |
| Length of cloud (between LEL) at time t (m) | 19.019 |
| Width of cloud (between LEL) at time t (m) | 72,904 |
| Offset between release location and LEL at time t (m) | 6,0635 |
| Maximum explosive mass (kg) | 317,28 |
| at (time them (s) | 24.75 |
| Start time where 95% of maximum of explosive mass is reached (s) | 24,16 |
| Time where explosive mass starts decreasing below 95% of max (s) | 25.457 |
| Length of cloud (between LEL) at time timem (m) | 44.783 |
| Width of cloud (between LEL) at time timen (m) | 94.668 |
| Offset between release location and LEL at time them (m) | 6,4997 |
| Maximum area of explosive cloud (m2) | 3111.6 |
| maximum area of exposive close (III2)at time trac (s) | 27,225 |
| Explosive mass at time tmac (kg) | 261.73 |
| Length of cloud (between LEL) at time tmac (m) | 48.925 |
| Width of cloud (between LEL) at time timac (m) | 46,925 87,826 |
| Offset between release location and LEL at time (mac (m) | 6,5354 |
| | |
| Offset between release centre and cloud centre at time tmac (m) | 30,998 |
| Inverse Monin-Obukhov length (1/L) used (1/m) | 0,04733 |

Other information

Main program Chemical database Chemical database path Chemical database date Effects 8.0.1.3218
YAWS database
C:\Programmi\TNO\Effects 8.0\Shared data\Databases\Purple Book (1999).rdb
12/02/2009

Effects report created by FIAMMAWKS051\I.monacelli at 04/08/2010 19.17,06



Model: Dense Gas Dispersion: Explosive mass

version: 5.13 (04/08/2010)

Parameters

Reference: Yellow Book 3rd edition 1997 chapter 4; Ermak, D.L. User manual for SLAB Lawrence Livermore National Laboratory, June 1990

| · · · · · · · · · · · · · · · · · · · | |
|--|--|
| Inputs Chemical name Type of release | Propane (YAWS) Horizontal Jet release |
| Total mass released (kg) | 00.0 |
| Mass flow rate of the source (kg/s) | 20,9 |
| Duration of the release (s) | 20 |
| Initial liquid mass fraction (%) | 100 |
| Fixed pool surface (m2) | 0.05 |
| Diameter of expanded jet (m) | 0,05 |
| Temperature after release (°C) X-coordinate of release (m) | 20 10 |
| Y-coordinate of release (m) | 0 |
| Z-coordinate (height) of release (m) | 0 |
| Pasquill stability class | D (Neutral) |
| Wind speed at 10 m height (m/s) | 5 (Neutral) |
| Predefined wind direction | Š |
| Wind comes from (North = 0 degrees) (deg) | 180 |
| Roughness length description | Cultivated land |
| Time t after start release (s) | 20 |
| Concentration averaging time (s) | 20 |
| Results | |
| Explosive mass at time t (kg) | 201,49 |
| Height to LEL at time ((m) | 3.2 |
| Length of cloud (between LEL) at time t (m) | 41,788 |
| Width of cloud (between LEL) at time t (m) | 33.528 |
| Offset between release location and LEL at time t (m) | 1 |
| Maximum explosive mass (kg) | 246.19 |
| at time tmem (s) | 21,45 |
| Start time where 95% of maximum of explosive mass is reached (s) | 20,996 |
| Time where explosive mass starts decreasing below 95% of max (s) | 21,622 |
| Length of cloud (between LEL) at time tmem (m) | 49,577 |
| Width of cloud (between LEL) at time tmem (m) | 42,913 |
| Offset between release location and LEL at time tmem (m) | 3,3837 |
| Maximum area of explosive cloud (m2) | 1432 |
| at time tmac (s) | 21,45 |
| Explosive mass at time tmac (kg) | 246,19 |
| Length of cloud (between LEL) at time tmac (m) | 49,577 |
| Width of cloud (between LEL) at time trnac (m) | 42,913 |
| Offset between release location and LEL at time tmac (m) | 3,3837 |
| Offset between release centre and cloud centre at time tmac (m) | 28,172 |
| Inverse Monin-Obukhov length (1/L) used (1/m) | 0 |

Other information

Main program Chemical database Chemical database path Chemical database date

Effects 8.0.1.3218 YAWS database C:\Programmi\TNO\Effects 8.0\Shared data\Databases\Purple Book (1999).rdb

12/02/2009

Effects report created by FIAMMAWKS051\I.monacelli at 04/08/2010 19.22.10



Model: Dense Gas Dispersion: Concentration

version: 5.13 (04/08/2010)

Reference: Yellow Book 3rd edition 1997 chapter 4; Ermak, D.L. User manual for SLAB Lawrence Livermore National Laboratory, June 1990

| Paramete | ers |
|----------|-----|
|----------|-----|

Innuts

| inputs | |
|---|------------------------|
| Chemical name | Propane (YAWS) |
| Type of release | Horizontal Jet release |
| Total mass released (kg) | |
| Mass flow rate of the source (kg/s) | 20,9 |
| Duration of the release (s) | 20 |
| Initial liquid mass fraction (%) | 100 |
| Fixed pool surface (m2) | |
| Diameter of expanded jet (m) | 0,05 |
| Temperature after release (°C) | 20 |
| X-coordinate of release (m) | 10 |
| Y-coordinate of release (m) | 0 |
| Z-coordinate (height) of release (m) | 0.5 |
| Pasquill stability class | F (Very Stable) |
| Wind speed at 10 m height (m/s) | 2 |
| Roughness length description | Cultivated land |
| Time (after start release (s) | 75 |
| Concentration averaging time (s) | 20 |
| Distance from release (Xd) (m) | 10 |
| Distance perpendicular to wind direction (Yd) (m) | 0 |
| Height (Zd) (m) | 0 |
| Predefined concentration | User defined |
| Threshold concentration (mg/m3) | 18900 |
| Predefined wind direction | S |
| Wind comes from (North = 0 degrees) (deg) | 180 |
| Perform Max Conc vs Distance graph | Yes |
| · · · · · · · · · · · · · · · · · · · | |
| Paralla | |
| Results | |

Concentration at (Xd, Yd, Zd, t) (mg/m3) 14774 Maximum concentration at (Yd, Zd) (mg/m3) 1,9048E06 7.2226 55.073 Maximum distance to threshold concentration (m)

Other information Effects 8.0.1.3218 Main program Chemical database YAWS database Chemical database path C:\Programmi\TNO\Effects 8.0\Shared data\Databases\Purple Book (1999).rdb Chemical database date 12/02/2009

Effects report created by FIAMMAWKS051\I.monacelli at 04/08/2010 19.34.32



Model: Dense Gas Dispersion: Concentration

version: 5.13 (04/08/2010)

Reference: Yellow Book 3rd edition 1997 chapter 4; Ermak, D.L. User manual for SLAB Lawrence Livermore National Laboratory, June 1990

| _ | | | | | |
|----|-----|---|----|---|------|
| Pa | rai | m | el | e | r's. |

| Inputs Chemical name Type of release | Propane (YAWS) Horizontal Jet release |
|---|---------------------------------------|
| Total mass released (kg) | |
| Mass flow rate of the source (kg/s) | 20.9 |
| Duration of the release (s) | 20 |
| Initial liquid mass fraction (%) | 100 |
| Fixed pool surface (m2) | |
| Diameter of expanded jet (m) | 0,05 |
| Temperature after release (°C) | 20 |
| X-coordinate of release (m) | 10 |
| Y-coordinate of release (m) | 0 |
| Z-coordinate (height) of release (m) | 0 |
| Pasquill stability class | D (Neutral) |
| Wind speed at 10 m height (m/s) | 5 |
| Roughness length description | Cultivated land |
| Time t after start release (s) | 36 |
| Concentration averaging time (s) | 20 |
| Distance from release (Xd) (m) | 10 |
| Distance perpendicular to wind direction (Yd) (m) | 0 |
| Height (Zd) (m) | 0 |
| Predefined concentration | User defined |
| Threshold concentration (mg/m3) | 18900 |
| Predefined wind direction | S |
| Wind comes from (North = 0 degrees) (deg) | 180 |
| Perform Max Conc vs Distance graph | Yes |
| Results | |
| Leanita | |

Results
Concentration at (Xd, Yd, Zd, t) (mg/m3)
Maximum concentration at (Yd, Zd) (mg/m3)
...at distance (m)
Maximum distance to threshold concentration (m)

1,9048E06
1,1481
68,08

Other information
Main program
Chemical database
Chemical database path
Chemical database date

C:\Programmi\TNO\Effects 8.0\Shared data\Databases\Purple Book (1999).rdb
Chemical database date

Effects report created by FIAMMAWKS051\Lmonacelli at 04/08/2010 19.38.58



Model: Dense Gas Dispersion: Concentration

version: 5.13 (04/08/2010)

Reference: Yellow Book 3rd edition 1997 chapter 4; Ermak, D.L. User manual for SLAB Lawrence Livermore National Laboratory, June 1990

| Pai | rai | m | et | e | rs |
|-----|-----|---|----|---|----|
|-----|-----|---|----|---|----|

| Chemical name | Propane (YAWS) |
|---|-----------------------------|
| Type of release | Horizontal Jet release |
| Total mass released (kg) | |
| Mass flow rate of the source (kg/s) | 20,9 |
| Duration of the release (s) | 20 |
| Initial liquid mass fraction (%) | 100 |
| Fixed pool surface (m2) | |
| Diameter of expanded jet (m) | 0,05 |
| Temperature after release (°C) | 20 |
| X-coordinate of release (m) | 10 |
| Y-coordinate of release (m) | 0 |
| Z-coordinate (height) of release (m) | 0,5 |
| Pasquill stability class | F (Very Stable) |
| Wind speed at 10 m height (m/s) | 2 |
| Roughness length description | Cultivated land |
| Time t after start release (s) | 45 |
| Concentration averaging time (s) | 20 |
| Distance from release (Xd) (m) | 10 |
| Distance perpendicular to wind direction (Yd) (m) | 0 |
| Height (Zd) (m) | 0 |
| Predefined concentration | LEL (Lower Explosion Limit) |
| Threshold concentration (mg/m3) | 38504 |
| Predefined wind direction | S |
| Wind comes from (North = 0 degrees) (deg) | 180 |
| Perform Max Conc vs Distance graph | Yes |
| - Antonio manta de managina di albut | |
| | |
| | |

Results

Concentration at (Xd, Yd, Zd, t) (mg/m3) Maximum concentration at (Yd, Zd) (mg/m3) ...at distance (m)

Maximum distance to threshold concentration (m)

Other information

Main program Chemical database Chemical database path Chemical database date

Effects 8.0.1.3218 YAWS database C:\Programmi\TNO\Effects 8.0\Shared data\Databases\Purple Book (1999).rdb 12/02/2009

35978

7,2226

1.9048E06

Effects report created by FIAMMAWKS051\L.monacelli at 04/08/2010 19.43.15



Model: Dense Gas Dispersion: Concentration

version: 5.13 (04/08/2010)

Reference: Yellow Book 3rd edition 1997 chapter 4; Ermak, D.L. User manual for SLAB Lawrence Livermore National Laboratory, June 1990

| Pa | | | |
|----|--|--|--|
| | | | |
| | | | |

| Inputs | | | |
|------------------------|----------------------------------|--|--|
| Chemical name | | | |
| Type of release | | | |
| Total mass release | d (kg) | | |
| Mass flow rate of th | ne source (kg/s) | | |
| Duration of the rele | ase (s) | | |
| nitial liquid mass for | raction (%) | | |
| Fixed pool surface | (m2) | | |
| Diameter of expand | ded jet (m) | | |
| Temperature after | release (°C) | | |
| X-coordinate of rele | ease (m) | | |
| Y-coordinate of rele | ease (m) | | |
| Z-coordinate (heigl | nt) of release (m) | | |
| Pasquill stability cla | ass | | |
| Wind speed at 10 r | n height (m/s) | | |
| Roughness length | description | | |
| Time t after start re | lease (s) | | |
| Concentration aver | aging time (s) | | |
| Distance from relea | ase (Xd) (m) | | |
| Distance perpendic | cular to wind direction (Yd) (m) | | |
| Height (Zd) (m) | | | |
| Predefined concen | tration | | |
| Threshold concent | ration (mg/m3) | | |
| Predefined wind di | | | |
| Wind comes from (| (North = 0 degrees) (deg) | | |
| Perform Max Conc | vs Distance graph | | |

Results

Concentration at (Xd, Yd, Zd, t) (mg/m3)
Maximum concentration at (Yd, Zd) (mg/m3)
...at distance (m)
Maximum distance to threshold concentration (m)

Other information

Main program Chemical database Chemical database path Chemical database date 1,9048E06 1,1481 44,38 Effects 8.0.1.3218 YAWS database

C:\Programmi\TNO\Effects 8.0\Shared data\Databases\Purple Book (1999).rdb

Propane (YAWS) Horizontal Jet release

> > 10

38504 S 180 Yes

9775,8

12/02/2009

D (Neutral)

Cultivated land 28 20

LEL (Lower Explosion Limit)

Effects report created by FIAMMAWKS051\I.monacelli at 04/08/2010 19.47.04



Model: Dense Gas Dispersion: Explosive mass

version: 5.13 (01/09/2010)

Reference: Yellow Book 3rd edition 1997 chapter 4; Ermak, D.L. User manual for SLAB Lawrence Livermore National Laboratory, June 1990

| Parameters Inputs Chemical name | Propane (YAWS) |
|--|--|
| Type of release Total mass released (kg) | Horizontal Jet release |
| Mass flow rate of the source (kg/s) Duration of the release (s) Initial liquid mass fraction (%) Fixed pool surface (m2) | 5,66 20 93 |
| Diameter of expanded jet (m) Temperature after release (°C) X-coordinate of release (m) Y-coordinate of release (m) | 0.05 20 100 0 |
| Z-coordinate (height) of release (m) Pasquill stability class Wind speed at 10 m height (m/s) | F (Very Stable) |
| Predefined wind direction Wind comes from (North = 0 degrees) (deg) Roughness length description Time t after start release (s) Concentration averaging time (s) | S 180 Cultivated land 20 20 |
| Explosive mass at time t (kg) Height to LEL at time t (m) Length of cloud (between LEL) at time t (m) Width of cloud (between LEL) at time t (m) Offset between release location and LEL at time t (m) Maximum explosive mass (kg)at time them (s) Start time where 95% of maximum of explosive mass is reached (s) Time where explosive mass starts decreasing below 95% of max (s) Length of cloud (between LEL) at time tmem (m) Width of cloud (between LEL) at time tmem (m) Offset between release location and LEL at time tmem (m) Maximum area of explosive cloud (m2)at time tmac (s) Explosive mass at time tmac (kg) Length of cloud (between LEL) at time tmac (m) Width of cloud (between LEL) at time tmac (m) Offset between release location and LEL at time tmac (m) Offset between release contra and cloud centre at time tmac (m) Inverse Monin-Obukhov length (1/L) used (1/m) | 58,56 5,5 14,666 47,282 1 58,56 19,8 14,121 20,303 14,666 47,282 1 854,97 24,75 29,262 34,245 36,503 1 18,122 0,04733 |

Other information

Main program Chemical database Chemical database path Chemical database date Effects 8.0.1.3218
YAWS database
C:\Programmi\TNO\Effects 8.0\Shared data\Databases\Purple Book (1999).rdb
12/02/2009

Effects report created by FIAMMAWKS051\I.monacelli at 01/09/2010 16.13.55



Model: Dense Gas Dispersion: Explosive mass

version: 5.13 (01/09/2010)

Reference: Yellow Book 3rd edition 1997 chapter 4; Ermak, D.L. User manual for SLAB Lawrence Livermore National Laboratory, June 1990

| Parameters Inputs Chemical name | Propane (YAWS) |
|---|------------------------|
| Type of release | Horizontal Jet release |
| Total mass released (kg) Mass flow rate of the source (kg/s) | 5,66 |
| Duration of the release (s) | 20 |
| Initial liquid mass fraction (%) | 93 |
| Fixed pool surface (m2) | 0.05 |
| Diameter of expanded jet (m) Temperature after release (°C) | 0.05 20 |
| remperature after release (C) X-coordinate of release (M) | 100 |
| Y-coordinate of release (m) | 0 |
| Z-coordinate (height) of release (m) | 0 |
| Pasquill stability class | D (Neutral) |
| Wind speed at 10 m height (m/s) Predefined wind direction | 5 S |
| Wind comes from (North = 0 degrees) (deg) | 180 |
| Roughness length description | Cultivated land |
| Time t after start release (s) | 20 |
| Concentration averaging time (s) | 20 |
| | |
| Results Explosive mass at time t (kg) | 30,207 |
| Height to LEL at time t (m) | 3,6 |
| Length of cloud (between LEL) at time ((m) | 22.345 |
| Width of cloud (between LEL) at time t (m) | 14,626 |
| Offset between release location and LEL at time t (m) | 1 |
| Maximum explosive mass (kg) | 30,207 |
| at time them (s) Start time where 85% of previous of evaluative mass is seeded (s) | 11 8,4248 |
| Start time where 95% of maximum of explosive mass is reached (s) Time where explosive mass starts decreasing below 95% of max (s) | 0,4240 |
| Length of cloud (between LEL) at time timen (m) | 22,345 |
| Width of cloud (between LEL) at time tmem (m) | 14,626 |
| Offset between release location and LEL at time tmem (m) | 1 |
| Maximum area of explosive cloud (m2) | 238,18 |
| al time tmac (s) | 20 |
| Explosive mass at time tmac (kg) | 30,207 22,345 |
| Length of cloud (between LEL) at time tmac (m) Width of cloud (between LEL) at time tmac (m) | 14,626 |
| Offset between release location and LEL at time (m) | 1-1,020 |
| Offset between release centre and cloud centre at time tmac (m) | 12,172 |

Other information

Inverse Monin-Obukhov length (1/L) used (1/m)

Main program Chemical database C:\Programmi\TNO\Effects 8.0\Shared data\Databases\Purple Book (1999).rdb Chemical database path Chemical database date

Effects report created by FIAMMAWKS051\I.monacelli at 01/09/2010 16.16.40

Effects 8.0.1.3218 YAWS database

12/02/2009

Propane (YAWS)



Case description: Rottura pompa Sala Pompe e Compressori attuale

Model: Dense Gas Dispersion: Concentration

version: 5.13 (01/09/2010)

Reference: Yellow Book 3rd edition 1997 chapter 4; Ermak, D.L. User manual for SLAB Lawrence Livermore National Laboratory, June 1990

| Parameters |
|---------------|
| Inputs |
| Chemical name |

| Type of release | Horizontal Jet release |
|---|------------------------|
| Total mass released (kg) | |
| Mass flow rate of the source (kg/s) | 5,66 |
| Duration of the release (s) | 20 |
| Initial liquid mass fraction (%) | 93 |
| Fixed pool surface (m2) | |
| Diameter of expanded jet (m) | 0,05 |
| Temperature after release (°C) | 20 |
| X-coordinate of release (m) | 10 |
| Y-coordinate of release (m) | 0 |
| Z-coordinate (height) of release (m) | 0 |
| Pasquill stability class | F (Very Stable) |
| Wind speed at 10 m height (m/s) | 2 |
| Roughness length description | Cultivated land |
| Time t after start release (s) | 20 |
| Concentration averaging time (s) | 20 |
| Distance from release (Xd) (m) | 10 |
| Distance perpendicular to wind direction (Yd) (m) | 0 |
| Height (Zd) (m) | 0 |
| Predefined concentration | User defined |
| Threshold concentration (mg/m3) | 18900 |
| Predefined wind direction | S |
| Wind comes from (North = 0 degrees) (deg) | 180 |
| Perform Max Conc vs Distance graph | Yes |
| | |
| Results | |
| Concentration at (Xd, Yd, Zd, t) (mg/m3) | 1,4996E05 |

Maximum concentration at (Yd, Zd) (mg/m3) 3,462E05 ...at distance (m) 17,015 Maximum distance to threshold concentration (m)

Other information Effects 8.0.1.3218 YAWS database Main program Chemical database C:\Programmi\TNO\Effects 8.0\Shared data\Databases\Purple Book (1999).rdb Chemical database path 12/02/2009 Chemical database date

Effects report created by FIAMMAWKS051\Lmonacelli at 01/09/2010 16.22-38



Model: Dense Gas Dispersion: Concentration

version: 5.13 (01/09/2010)

Reference: Yellow Book 3rd edition 1997 chapter 4; Ermak, D.L. User manual for SLAB Lawrence Livermore National Laboratory, June 1990

| Parameters | |
|------------|--|
| Inputs | |

| inputs | _ |
|---|------------------------|
| Chemical name | Propane (YAWS) |
| Type of release | Horizontal Jet release |
| Total mass released (kg) | |
| Mass flow rate of the source (kg/s) | 5,66 |
| Duration of the release (s) | 20 |
| Initial liquid mass fraction (%) | 93 |
| Fixed pool surface (m2) | |
| Diameter of expanded jet (m) | 0,05 |
| Temperature after release (°C) | 20 |
| X-coordinate of release (m) | 10 |
| Y-coordinate of release (m) | 0 |
| Z-coordinate (height) of release (m) | 0 |
| Pasquill stability class | D (Neutral) |
| Wind speed at 10 m height (m/s) | 5 |
| Roughness length description | Cultivated land |
| Time t after start release (s) | 20 |
| Concentration averaging time (s) | 20 |
| Distance from release (Xd) (m) | 10 |
| Distance perpendicular to wind direction (Yd) (m) | 0 |
| Height (Zd) (m) | 0 |
| Predefined concentration | User defined |
| Threshold concentration (mg/m3) | 18900 |
| Predefined wind direction | |
| Wind comes from (North = 0 degrees) (deg) | 180 |
| Perform Max Conc vs Distance graph | Yes |
| - Charlin Hain Golfa to Sistanot graph | 163 |
| | |
| | |

Results Concentration at (Xd, Yd, Zd, t) (mg/m3) 1.1735E05 Maximum concentration at (Yd, Zd) (mg/m3) 4,2751E05 ...at distance (m) Maximum distance to threshold concentration (m) 36.047

Other information Main program Effects 8.0.1.3218 Chemical database YAWS database C:\Programm\TNO\Effects 8.0\Shared data\Databases\Purple Book (1999).rdb Chemical database path Chemical database date 12/02/2009

Effects report created by FIAMMAWKS051V.monacelli at 01/09/2010 16.23.27



Model: Dense Gas Dispersion: Concentration

version: 5.13 (01/09/2010)

Reference: Yellow Book 3rd edition 1997 chapter 4; Ermak, D.L. User manual for SLAB Lawrence Livermore National Laboratory, June 1990

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|----|----|---|----|---|----|
| | | | | | |

Inputs

| Chemical name Type of release | Propane (YAWS) Horizontal Jet release |
|---|---|
| Total mass released (kg) Mass flow rate of the source (kg/s) Duration of the release (s) Initial liquid mass fraction (%) | 5.66 20 93 |
| Fixed pool surface (m2) Diameter of expanded jet (m) Temperature after release (°C) X-coordinate of release (m) Y-coordinate of release (m) Z-coordinate (height) of release (m) Pasquill stability class Wind speed at 10 m height (m/s) Roughness length description Time t after start release (s) Concentration averaging time (s) Distance from release (Xd) (m) Distance perpendicular to wind direction (Yd) (m) Height (Zd) (m) Predefined concentration Threshold concentration (mg/m3) Predefined wind direction Wind comes from (North = 0 degrees) (deg) Perform Max Conc vs Distance graph | 0,05 20 10 0 F (Very Stable) 2 Cultivated land 20 20 10 0 LEL (Lower Explosion Limit) 38504 S 180 Yes |
| | |

Results Concentration at (Xd, Yd, Zd, t) (mg/m3) 1,4996E05 Maximum concentration at (Yd, Zd) (mg/m3) 3,462E05 ...at distance (m) Maximum distance to threshold concentration (m) 15,666

Other information Effects 8.0.1.3218 Main program YAWS database Chemical database Chemical database path C:\Programmi\TNO\Effects 8.0\Shared data\Databases\Purple Book (1999).rdb Chemical database date 12/02/2009

Effects report created by FIAMMAWKS051\I.monacelli at 01/09/2010 16.19.26



Model: Dense Gas Dispersion: Concentration

version: 5.13 (01/09/2010)

Reference: Yellow Book 3rd edition 1997 chapter 4; Ermak, D.L. User manual for SLAB Lawrence Livermore National Laboratory, June 1990

| Ра | | | |
|----|--|--|--|
| | | | |

Inputs Chemical name Propane (YAWS) Type of release Horizontal Jet release Total mass released (kg) 5.66 Mass flow rate of the source (kg/s) 20 Duration of the release (s) 93 Initial liquid mass fraction (%) Fixed pool surface (m2) Diameter of expanded jet (m) 0,05 Temperature after release (°C) 20 10 X-coordinate of release (m) 0 Y-coordinate of release (m) Z-coordinate (height) of release (m) Pasquill stability class D (Neutral) Wind speed at 10 m height (m/s) Roughness length description Cultivated land Time t after start release (s) 20 Concentration averaging time (s) 10 Distance from release (Xd) (m) Distance perpendicular to wind direction (Yd) (m) 0 Height (Zd) (m) LEL (Lower Explosion Limit) Predefined concentration Threshold concentration (mg/m3) Predefined wind direction Wind comes from (North = 0 degrees) (deg) 180 Perform Max Conc vs Distance graph Yes Results

 Results
 1,1735E05

 Concentration at (Xd, Yd, Zd, t) (mg/m3)
 1,1735E05

 Maximum concentration at (Yd, Zd) (mg/m3)
 4,2751E05

 ...at distance (m)
 1,1

 Maximum distance to threshold concentration (m)
 23,345

Other information

Main program

Chemical database

Chemical database path
Chemical database date

C:\Programm\TNO\Effects 8.0\Shared data\Databases\Purple Book (1999).rdb
Chemical database date

Effects report created by FIAMMAWKS051\I.monacelli at 01/09/2010 16.20.55



Model: Dense Gas Dispersion: Explosive mass

version: 5.13 (05/08/2010)

Reference: Yellow Book 3rd edition 1997 chapter 4; Ermak, D.L. User manual for SLAB Lawrence Livermore National Laboratory, June 1990

| Parameters | |
|--|------------------------|
| Inputs | |
| Chemical name | Propane (YAWS) |
| Type of release | Horizontal Jet release |
| Total mass released (kg) | |
| Mass flow rate of the source (kg/s) | 1,52 |
| Duration of the release (s) | 30 |
| Initial liquid mass fraction (%) | 100 |
| Fixed pool surface (m2) | 0.00 |
| Diameter of expanded jet (m) | 0,05 |
| Temperature after release (°C) | 20 |
| X-coordinate of release (m) Y-coordinate of release (m) | 100 0 |
| Z-coordinate (height) of release (m) | 0 |
| Pasquill stability class | F (Very Stable) |
| Wind speed at 10 m height (m/s) | r (very Stable) |
| while speed at 10 th neight (1115) Predefined wind direction | 2 S |
| Wind comes from (North = 0 degrees) (deg) | 180 |
| Roughness length description | Cultivated land |
| Time tafter start release (s) | 20 |
| Concentration averaging time (s) | 20 |
| | |
| Results | 19,875 |
| Explosive mass at time t (kg) Height to LEL at time t (m) | 1,6 |
| Length of cloud (between LEL) at time t (m) | 10,609 |
| Width of cloud (between LEL) at time t (m) | 31.589 |
| Offset between release location and LEL at time t (m) | 31,369 |
| Maximum explosive mass (kg) | 20,116 |
| maximum temposite inas (kg)at time tem (s) | 29,7 |
| Start time where 95% of maximum of explosive mass is reached (s) | 18,761 |
| Time where explosive mass starts decreasing below 95% of max (s) | 34.687 |
| Length of cloud (between LEL) at time tmem (m) | 8.7552 |
| Width of cloud (between LEL) at time trnem (m) | 31,724 |
| Offset between release location and LEL at time tmem (m) | 1 |
| Maximum area of explosive cloud (m2) | 379,31 |
| at time tmac (s) | 34,65 |
| Explosive mass at time tmac (kg) | 19,397 |
| Length of cloud (between LEL) at time tmac (m) | 13,323 |
| Width of cloud (between LEL) at time trnac (m) | 42,15 |
| Offset between release location and LEL at time tmac (m) | 3,7131 |
| Offset between release centre and cloud centre at time tmac (m) | 10,375 |
| Inverse Monin-Obukhov length (1/L) used (1/m) | 0,04733 |
| | |

Other information

Main program Chemical database Chemical database path Chemical database date Effects 8.0.1.3218 YAWS database

C:\Programmi\TNO\Effects 8.0\Shared data\Databases\Purple Book (1999).rdb 12/02/2009

Effects report created by FIAMMAWKS051\L.monacelli at 05/08/2010 9.55.58



Model: Dense Gas Dispersion: Explosive mass

version: 5.13 (05/08/2010)

Reference: Yellow Book 3rd edition 1997 chapter 4; Ermak, D.L. User manual for SLAB Lawrence Livermore National Laboratory, June 1990

| Parameters | |
|--|------------------------|
| Inputs | |
| Chemical name | Propane (YAWS) |
| Type of release | Horizontal Jet release |
| Total mass released (kg) | 4.50 |
| Mass flow rate of the source (kg/s) | 1,52 |
| Duration of the release (s) Initial liquid mass fraction (%) | 30 100 |
| Fixed pool surface (m2) | 100 |
| Diameter of expanded jet (m) | 0,05 |
| Temperature after release (°C) | 20 |
| X-coordinate of release (0) | 100 |
| Y-coordinate of release (m) | 0 |
| Z-coordinate (height) of release (m) | 0 |
| Pasquill stability class | D (Neutral) |
| Wind speed at 10 m height (m/s) | 5 (11041141) |
| Predefined wind direction | Š |
| Wind comes from (North = 0 degrees) (deg) | 180 |
| Roughness length description | Cultivated land |
| Time t after start release (s) | 20 |
| Concentration averaging time (s) | 20 |
| | |
| Results | 5.000 |
| Explosive mass at time t (kg) | 5,808 |
| Height to LEL at time t (m) | 1,6 |
| Length of cloud (between LEL) at time t (m) | 9,5612 |
| Width of cloud (between LEL) at time t (m) | 7,9636 1 |
| Offset between release location and LEL at time t (m) | 5.808 |
| Maximum explosive mass (kg)at time tmem (s) | 29,7 |
| Start time where 95% of maximum of explosive mass is reached (s) | 5.8076 |
| Time where explosive mass starts decreasing below 95% of max(s) | 30 |
| Length of cloud (between LEL) at time tmem (m) | 9.5612 |
| Width of cloud (between LEL) at time timem (m) | 7.9636 |
| Offset between release location and LEL at time (me) | 1,3030 |
| Maximum area of explosive cloud (m2) | 59,154 |
| at time tmac (s) | 30 |
| Explosive mass at time tmac (kg) | 5,808 |
| Length of cloud (between LEL) at time tmac (m) | 9,5612 |
| Width of cloud (between LEL) at time tmac (m) | 7,9636 |
| Offset between release location and LEL at time tmac (m) | 1 |
| Offset between release centre and cloud centre at time tmac (m) | 5,7806 |
| Inverse Monin-Obukhov length (1/L) used (1/m) | 0,00 |

Other information

Main program Chemical database Chemical database path Chemical database date Effects 8.0.1.3218 YAWS database

C:\Programmi\TNO\Effects 8.0\Shared data\Databases\Purple Book (1999).rdb 12/02/2009

Effects report created by FIAMMAWKS051\I.monacelli at 05/08/2010 10.06.49



Model: Dense Gas Dispersion: Concentration

version: 5.13 (05/08/2010)

Reference: Yellow Book 3rd edition 1997 chapter 4; Ermak, D.L. User manual for SLAB Lawrence Livermore National Laboratory, June 1990

| Parameters 4 8 1 |
|------------------|
| Inputs |

| Chemical name Type of release | Propane (YAWS) Horizontal Jet release |
|---|--|
| Total mass released (kg) | |
| Mass flow rate of the source (kg/s) | 1,52 |
| Duration of the release (s) | 30 |
| Initial liquid mass fraction (%) | 100 |
| Fixed pool surface (m2) | |
| Diameter of expanded jet (m) | 0.05 |
| Temperature after release (°C) | 20 |
| X-coordinate of release (m) | 10 |
| Y-coordinate of release (m) | 0 |
| Z-coordinate (height) of release (m) | 0 |
| Pasquill stability class | F (Very Stable) |
| Wind speed at 10 m height (m/s) | 2 |
| Roughness length description | Cultivated land |
| Time t after start release (s) | 45 |
| Concentration averaging time (s) | 20 |
| Distance from release (Xd) (m) | 10 |
| Distance perpendicular to wind direction (Yd) (m) | 0 |
| Height (Zd) (m) | 0 |
| Predefined concentration | User defined |
| Threshold concentration (mg/m3) | 18900 |
| Predefined wind direction | \$ |
| Wind comes from (North = 0 degrees) (deg) | 180 |
| Perform Max Conc vs Distance graph | Yes |
| | |
| Results | |

Concentration at (Xd, Yd, Zd, t) (mg/m3) 18543 Maximum concentration at (Yd, Zd) (mg/m3) 1,6771E06 ...at distance (m) 22,106 Maximum distance to threshold concentration (m)

Other information Main program Chemical database Effects 8.0.1.3218 YAWS database Chemical database path C:\Programmi\TNO\Effects 8.0\Shared data\Databases\Purple Book (1999).rdb Chemical database date 12/02/2009

Effects report created by FIAMMAWKS051V.monacelli at 05/08/2010 10.14.50



Model: Dense Gas Dispersion: Concentration

version: 5.13 (05/08/2010)

Reference: Yellow Book 3rd edition 1997 chapter 4; Ermak, D.L. User manual for SLAB Lawrence Livermore National Laboratory, June 1990

| Pa | | - | - | |
|----|------|---|---|--|
| | | | | |

| Inputs Chemical name | Propane (YAWS) |
|---|------------------------|
| Type of release | Horizontal Jet release |
| Total mass released (kg) | |
| Mass flow rate of the source (kg/s) | 1,52 |
| Duration of the release (s) | 30 |
| Initial liquid mass fraction (%) | 100 |
| Fixed pool surface (m2) | |
| Diameter of expanded jet (m) | 0,05 |
| Temperature after release (°C) | 20 |
| X-coordinate of release (m) | 10 |
| Y-coordinate of release (m) | 0 |
| Z-coordinate (height) of release (m) | 0 |
| Pasquill stability class | D (Neutral) |
| Wind speed at 10 m height (m/s) | 5 |
| Roughness length description | Cultivated land |
| Time t after start release (s) | 30 |
| Concentration averaging time (s) | 20 |
| Distance from release (Xd) (m) | 10 |
| Distance perpendicular to wind direction (Yd) (m) | 0 |
| Height (Zd) (m) | 0 |
| Predefined concentration | User defined |
| Threshold concentration (mg/m3) | 18900 |
| Predefined wind direction | \$ |
| Wind comes from (North = 0 degrees) (deg) | 180 |
| Perform Max Conc vs Distance graph | No |
| Results | |
| Concentration at (Xd, Yd, Zd, t) (mg/m3) | 41337 |
| Maximum distance to threshold concentration (m) | 18 AAQ |

Maximum distance to threshold concentration (m) 18,449

Other information

Main program Effects 8.0.1.3218 Chemical database YAWS database Chemical database path C:\Programmi\TNO\Effects 8.0\Shared data\Databases\Purple Book (1999).rdb Chemical database date 12/02/2009

Effects report created by FIAMMAWKS051\I.monacelli at 05/08/2010 10.20.17



Model: Dense Gas Dispersion: Concentration

version: 5.13 (05/08/2010)

Reference: Yellow Book 3rd edition 1997 chapter 4; Ermak, D.L. User manual for SLAB Lawrence Livermore National Laboratory, June 1990

| Pa | ιга | m | et | e | rs |
|----|-----|---|----|---|----|
|----|-----|---|----|---|----|

| Inputs |
|---|
| Chemical name |
| Type of release |
| Total mass released (kg) |
| Mass flow rate of the source (kg/s) |
| Duration of the release (s) |
| Initial liquid mass fraction (%) |
| Fixed pool surface (m2) |
| Diameter of expanded jet (m) |
| Temperature after release (°C) |
| X-coordinate of release (m) |
| Y-coordinate of release (m) |
| Z-coordinate (height) of release (m) |
| Pasquill stability class |
| Wind speed at 10 m height (m/s) |
| Roughness length description |
| Time t after start release (s) |
| Concentration averaging time (s) |
| Distance from release (Xd) (m) |
| Distance perpendicular to wind direction (Yd) (m) |
| Height (Zd) (m) |
| Predefined concentration |
| Threshold concentration (mg/m3) |
| Predefined wind direction |
| Wind comes from (North = 0 degrees) (deg) |
| Perform Max Conc vs Distance graph |
| |

Results

Concentration at (Xd, Yd, Zd, t) (mg/m3) Maximum concentration at (Yd, Zd) (mg/m3) ...at distance (m) Maximum distance to threshold concentration (m)

Other information

| Main program | |
|-------------------|------|
| Chemical database | |
| Chemical database | path |
| Chemical database | date |
| | |

| Effects 8.0 | 1.3218 |
|--|----------|
| YAWS d | |
| C:\Programmi\TNO\Effects 8.0\Shared data\Databases\Purple Book (19 | 999).rdb |
| 12/ | 02/2009 |

Propane (YAWS) Horizontal Jet release

> F (Very Stable) Cultivated land

LEL (Lower Explosion Limit)

> 20 10 n

Yes

66584

17,932

1,6771E06

Effects report created by FIAMMAWKS051\I.monacelli at 05/08/2010 10.24.20



Model: Dense Gas Dispersion: Concentration

version: 5.13 (05/08/2010)

Reference: Yellow Book 3rd edition 1997 chapter 4; Ermak, D.L. User manual for SLAB Lawrence Livermore National Laboratory, June 1990

| Paramete | 15 |
|----------|----|
| Inputs | |

| Chemical name | Propane (YAWS) |
|---|-----------------------------|
| Type of release | Horizontal Jet release |
| Total mass released (kg) | |
| Mass flow rate of the source (kg/s) | 1,52 |
| Duration of the release (s) | 30 |
| Initial liquid mass fraction (%) | 100 |
| Fixed pool surface (m2) | |
| Diameter of expanded jet (m) | 0,05 |
| Temperature after release (°C) | 20 |
| X-coordinate of release (m) | 10 |
| Y-coordinate of release (m) | 0 |
| Z-coordinate (height) of release (m) | 0 |
| Pasquill stability class | D (Neutral) |
| Wind speed at 10 m height (m/s) | 5 |
| Roughness length description | Cultivated land |
| Time t after start release (s) | 30 |
| Concentration averaging time (s) | 20 |
| Distance from release (Xd) (m) | 10 |
| Distance perpendicular to wind direction (Yd) (m) | 0 |
| Height (Zd) (m) | 0 |
| Predefined concentration | LEL (Lower Explosion Limit) |
| Threshold concentration (mg/m3) | 38504 |
| Predefined wind direction | \$ |
| Wind comes from (North = 0 degrees) (deg) | 180 |
| Perform Max Conc vs Distance graph | No |
| Results | |
| 0 | 44007 |

Concentration at (Xd, Yd, Zd, t) (mg/m3) 41337 Maximum distance to threshold concentration (m) 10,561

Other information

Main program Effects 8.0.1.3218 Chemical database YAWS database Chemical database path C:\Programmi\TNO\Effects 8.0\Shared data\Databases\Purple Book (1999).rdb Chemical database date 12/02/2009

Effects report created by FIAMMAWKS051\I.monacelli at 05/08/2010 10.27.50



Model: Dense Gas Dispersion: Explosive mass

version: 5.13 (05/08/2010)

Reference: Yellow Book 3rd edition 1997 chapter 4; Ermak, D.L. User manual for SLAB Lawrence Livermore National Laboratory, June 1990

| Parameters Inputs Chemical name Type of release Total mass released (kg) Mass flow rate of the source (kg/s) Duration of the release (s) Initial liquid mass fraction (%) | Propane (YAWS) Horizontal Jet release 7.35 20 93 |
|--|--|
| Fixed pool surface (m2) Diameter of expanded jet (m) Temperature after release (°C) X-coordinate of release (m) Y-coordinate of release (m) Z-coordinate (height) of release (m) Pasquill stability class Wind speed at 10 m height (m/s) Predefined wind direction Wind comes from (North = 0 degrees) (deg) Roughness length description Time t after start release (s) Concentration averaging time (s) | 0.05 20 100 0 0 F (Very Stable) 2 S 180 Cultivated land 20 20 |
| Results Explosive mass at time t (kg) Height to LEL at time t (m) Length of cloud (between LEL) at time t (m) Width of cloud (between LEL) at time t (m) Offset between release location and LEL at time t (m) Maximum explosive mass (kg) at time tmem (s) Start time where 95% of maximum of explosive mass is reached (s) Time where explosive mass starts decreasing below 95% of max (s) Length of cloud (between LEL) at time tmem (m) Width of cloud (between LEL) at time tmem (m) Offset between release location and LEL at time tmem (m) Maximum area of explosive cloud (m2) at time tmac (s) Explosive mass at time tmac (kg) Length of cloud (between LEL) at time tmac (m) Width of cloud (between LEL) at time tmac (m) Offset between release location and LEL at time tmac (m) Offset between release centre and cloud centre at time tmac (m) Inverse Monin-Obukhov length (1/L) used (1/m) | 67,232 5,5 16,695 45,339 1 81,106 23,1 21,576 23,397 32,884 56,751 1 1214,7 23,1 81,106 32,884 56,751 1 17,442 |

Other information

Main program Chemical database Chemical database path Chemical database date Effects 8.0.1.3218
YAWS database
C:\Programmi\TNO\Effects 8.0\Shared data\Databases\Purple Book (1999).rdb
12/02/2009

Effects report created by FIAMMAWKS051V.monacelli at 05/08/2010 12.41.04



Model: Dense Gas Dispersion: Explosive mass

version: 5.13 (05/08/2010)

Other information Main program

Chemical database

Chemical database path

Chemical database date

Reference: Yellow Book 3rd edition 1997 chapter 4; Ermak, D.L. User manual for SLAB Lawrence Livermore National Laboratory, June 1990

| Parameters | |
|--|------------------------|
| Inputs | |
| Chemical name | Propane (YAWS) |
| Type of release | Horizontal Jet release |
| Total mass released (kg) | |
| Mass flow rate of the source (kg/s) | 7,35 |
| Duration of the release (s) | 20 |
| Initial liquid mass fraction (%) | 93 |
| Fixed pool surface (m2) | |
| Diameter of expanded jet (m) | 0,05 |
| Temperature after release (°C) | 20 |
| X-coordinate of release (m) | 100 |
| Y-coordinate of release (m) | 0 |
| Z-coordinate (height) of release (m) | 0 |
| Pasquill stability class | D (Neutral) |
| Wind speed at 10 m height (m/s) | 5 |
| Predefined wind direction | S |
| Wind comes from (North = 0 degrees) (deg) | 180 |
| Roughness length description | Cultivated land |
| Time t after start release (s) | 20 |
| Concentration averaging time (s) | 20 |
| Results | |
| | 42,711 |
| Explosive mass at time t (kg) Height to LEL at time t (m) | |
| Length of cloud (between LEL) at time t (m) | 3.9 |
| Width of cloud (between LEL) at time t (m) | 26,4 |
| Offset between release location and LEL at time t (m) | 16.364 |
| Maximum explosive mass (kg) | 1 42, 71 1 |
| at time tmem (s) | 11,55 |
| Start time where 95% of maximum of explosive mass is reached (s) | 9,3363 |
| Time where explosive mass starts decreasing below 95% of max (s) | 9,3303 |
| Length of cloud (between LEL) at time tmem (m) | 26.4 |
| Width of cloud (between LEL) at time timen (m) | 16,364 |
| Offset between release location and LEL at time timem (m) | 10,304 |
| Maximum area of explosive cloud (m2) | 314,95 |
| washing trac (s) | 20 |
| Explosive mass at time tmac (kg) | 42,711 |
| Length of cloud (between LEL) at time tmac (m) | 26.4 |
| Width of cloud (between LEL) at time tmac (m) | 16,364 |
| Offset between release location and LEL at time tmac (m) | 10,304 |
| Offset between release centre and cloud centre at time timac (m) | 14,2 |
| Inverse Monin-Obukhov length (1/L) used (1/m) | 0 |
| mirerae menini Operanor rengan (mr.) daed (mm) | U |

Effects report created by FIAMMAWKS051\l.monacelli at 05/08/2010 12.45.15

Effects 8.0.1.3218

C:\Programmi\TNO\Effects 8.0\Shared data\Databases\Purple Book (1999).rdb

YAWS database

12/02/2009



Model: Dense Gas Dispersion: Concentration

version: 5.13 (05/08/2010)

Reference: Yellow Book 3rd edition 1997 chapter 4; Ermak, D.L. User manual for SLAB Lawrence Livermore National Laboratory, June 1990

| Paramete | rs |
|----------|----|
| Inouts | |

| Chemical name Type of release | Propane (YAWS) Horizontal Jet release |
|---|--|
| Total mass released (kg) Mass flow rate of the source (kg/s) Duration of the release (s) Initial liquid mass fraction (%) | 7,35 20 93 |
| Fixed pool surface (m2) Diameter of expanded jet (m) Temperature after release (°C) X-coordinate of release (m) Y-coordinate of release (m) | 0.05 20 10 0 |
| Z-coordinate (height) of release (m) Pasquill stability class Wind speed at 10 m height (m/s) | F (Very Stable) |
| Roughness length description Time t after start release (s) Concentration averaging time (s) | Cultivated land 47 20 |
| Distance from release (Xd) (m) Distance perpendicular to wind direction (Yd) (m) Height (Zd) (m) | 10 0 0 |
| Predefined concentration Threshold concentration (mg/m3) Predefined wind direction | User defined 18900 S |
| Wind comes from (North = 0 degrees) (deg) Perform Max Conc vs Distance graph | 180 Yes |
| Populto | |

Results

Other information

Main program Chemical database Chemical database path Chemical database date Effects 8.0.1.3218
YAWS database

C:\Programmi\TNO\Effects 8.0\Shared data\Databases\Purple Book (1999).rdb 12/02/2009

Effects report created by FIAMMAWKS051\I.monacelli at 05/08/2010 17.02.34



Model: Dense Gas Dispersion: Concentration

version: 5.13 (05/08/2010)

Reference: Yellow Book 3rd edition 1997 chapter 4; Ermak, D.L. User manual for SLAB Lawrence Livermore National Laboratory, June 1990

| n | - | | -4 | - | TS. |
|---|---|------|----|---|-----|
| | | | | | |

Inputs

| Chemical name | Propane (YAWS) |
|---|------------------------|
| Type of release | Horizontal Jet release |
| Total mass released (kg) | |
| Mass flow rate of the source (kg/s) | 7,35 |
| Duration of the release (s) | 20 |
| Initial liquid mass fraction (%) | 93 |
| Fixed pool surface (m2) | |
| Diameter of expanded jet (m) | 0,05 |
| Temperature after release (°C) | 20 |
| X-coordinate of release (m) | 10 |
| Y-coordinate of release (m) | 0 |
| Z-coordinate (height) of release (m) | 0 |
| Pasquill stability class | D (Neutral) |
| Wind speed at 10 m height (m/s) | 5 |
| Roughness length description | Cultivated land |
| Time t after start release (s) | 26 |
| Concentration averaging time (s) | 20 |
| Distance from release (Xd) (m) | 10 |
| Distance perpendicular to wind direction (Yd) (m) | 0 |
| Height (Zd) (m) | 0 |
| Predefined concentration | User defined |
| Threshold concentration (mg/m3) | 18900 |
| Predefined wind direction | S |
| Wind comes from (North = 0 degrees) (deg) | 180 |
| Perform Max Conc vs Distance graph | No |
| Results | |
| Concentration at (Xd, Yd, Zd, t) (mg/m3) | 6311,1 |
| Maximum distance to threshold concentration (m) | 55,741 |

Other information Effects 8.0.1.3218 Main program YAWS database Chemical database Chemical database path C:\Programmi\TNO\Effects 8.0\Shared data\Databases\Purple Book (1999).rdb Chemical database date 12/02/2009

Effects report created by FIAMMAWKS051V.monacelli at 05/08/2010 17.06.10



Model: Dense Gas Dispersion: Concentration

version: 5.13 (05/08/2010)

Reference: Yellow Book 3rd edition 1997 chapter 4; Ermak, D.L. User manual for SLAB Lawrence Livermore National Laboratory, June 1990

| - | | | | |
|----|-----|----|----------------|-----|
| Pa | rai | me | >1 6 | ars |

Inputs

Chemical name Type of release Total mass released (kg) Mass flow rate of the source (kg/s) Duration of the release (s) Initial liquid mass fraction (%) Fixed pool surface (m2) Diameter of expanded jet (m) Temperature after release (°C) X-coordinate of release (m) Y-coordinate of release (m) Z-coordinate (height) of release (m) Pasquill stability class Wind speed at 10 m height (m/s) Roughness length description Time t after start release (s) Concentration averaging time (s) Distance from release (Xd) (m) Distance perpendicular to wind direction (Yd) (m) Height (Zd) (m) Predefined concentration Threshold concentration (mg/m3) Predefined wind direction Wind comes from (North = 0 degrees) (deg) Perform Max Conc vs Distance graph

Results

Concentration at (Xd, Yd, Zd, t) (mg/m3)
Maximum distance to threshold concentration (m)

Other information Main program

Chemical database
Chemical database path
Chemical database date

Propane (YAWS) Horizontal Jet release

> 7,35 20 93 0,05

0 0 F (Very Stable) 2 Cultivated land

20 10 0 0 Explosion Limit)

LEL (Lower Explosion Limit)

No 40928

34,995

180

Effects 8.0.1.3218
YAWS database
C:\Programmi\TNO\Effects 8.0\Shared data\Databases\Purple Book (1999).rdb
12/02/2009

Effects report created by FIAMMAWKS051\I.monacelli at 05/08/2010 17:15.39



Model: Dense Gas Dispersion: Concentration

version: 5.13 (05/08/2010)

Reference: Yellow Book 3rd edition 1997 chapter 4; Ermak, D.L. User manual for SLAB Lawrence Livermore National Laboratory, June 1990

| Parameters 4 8 1 |
|------------------|
|------------------|

| T proprietors | |
|---|-----------------------------|
| Inputs | |
| Chemical name | Propane (YAWS) |
| Type of release | Horizontal Jet release |
| Total mass released (kg) | |
| Mass flow rate of the source (kg/s) | 7,35 |
| Duration of the release (s) | 20 |
| Initial liquid mass fraction (%) | 93 |
| Fixed pool surface (m2) | |
| Diameter of expanded jet (m) | 0,05 |
| Temperature after release (°C) | 20 |
| X-coordinate of release (m) | 10 |
| Y-coordinate of release (m) | 0 |
| Z-coordinate (height) of release (m) | 0 |
| Pasquill stability class | D (Neutral) |
| Wind speed at 10 m height (m/s) | 5 |
| Roughness length description | Cultivated land |
| Time t after start release (s) | 22 |
| Concentration averaging time (s) | 20 |
| Distance from release (Xd) (m) | 10 |
| Distance perpendicular to wind direction (Yd) (m) | 0 |
| Height (Zd) (m) | 0 |
| Predefined concentration | LEL (Lower Explosion Limit) |
| Threshold concentration (mg/m3) | 38504 |
| Predefined wind direction | S |
| Wind comes from (North = 0 degrees) (deg) | 180 |
| Perform Max Conc vs Distance graph | Yes |
| 5 . | |
| Posuite | |

Concentration at (Xd, Yd, Zd, t) (mg/m3) Maximum concentration at (Yd, Zd) (mg/m3) 4,2675E05 ...at distance (m) 51,772 Maximum distance to threshold concentration (m)

Other information

Main program Chemical database Chemical database path Chemical database date

Effects 8.0.1.3218 YAWS database C:\Programmi\TNO\Effects 8.0\Shared data\Databases\Purple Book (1999).rdb 12/02/2009

Effects report created by FIAMMAWKS051\I.monacelli at 05/08/2010 17.21.17

RIEPILOGO

| OTNEVE | LEL | il. | 50% LEL | LEL |
|--|--------|---------|-----------------|--------|
| | D-5 mt | F-2 mt | D-5 mt | F-2 mt |
| Rottura braccio carico 1-2 e 3 | 32,73 | 31,01 | 52,13 | 37,41 |
| Rottura braccio carico 4-5 e 6 | 44,38 | 30,01 | 68,08 | 55,07 |
| Rottura sala pompa e compressori attuali | 23,34 | 15,66 | 36,04 | 17,01 |
| Rottura pompa booster | 10,56 | 17,93 | 18,44 | 22,1 |
| Rottura pompa nuova sala pompe | 51,77 | 34,99 | 55,74 | 36,8 |
| | | | | |
| EVENTO | | MASSA E | MASSA ESPLOSIVA | |
| | D-5 kg | kg | F-2 kg | kg |
| Rottura braccio 1-2-3 | 92,22 | 22 | 131,63 | ,63 |
| Rottura braccio 4-5-6 | 246,19 | ,19 | 317,28 | ,28 |
| Rottura catastrofica pompa attuale | 30,2 | ,2 | 58,56 | ,56 |
| Rottura catastrofica pompa booster | 5,8 | 8 | 20,11 | 11 |
| Rottura catastrofica pompa nuova | 42,71 | 71 | 81,1 | -1 |
| Scatto PSV serbatoio da 5000 mc | 0 | | 0 |) |
| | | | | |