STUDIO DI INGEGNERIA
BENVENUTO & Associati

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# SIMULAZIONI RILASCIO LIQUIDO INFIAMMABILE DA AUTOCISTERNA

L'ipotesi riguarda il danneggiamento del serbatoio di un'autocisterna contenente liquido infiammabile durante il trasporto su strada. L'incidente comporta la rottura della parete del serbatoio con rilascio di liquido e successivo incendio della pozza.

### *Ipotesi simulazioni*

Sostanza pericolosa: Benzina
Stato fisico: liquido
Classificazione: Estremamente infiammabile

Tipo di contenitore: autocisterna
Volume: 30 $m^3$

Tipo di rottura: rottura grave
Dimensione foro: 51 mm

Condizioni meteo: 4D
(maggiormente ricorrenti)

### *Risultati delle simulazioni*

| *Scenario incidentale* | *Raggi di danno [m]* | | | | | *Durata effetti [min]* |
|---|---|---|---|---|---|---|
| | *37.5 kW/$m^2$* | *12,5 kW/m²* | *7 kW/m²* | *5 kW/m²* | *3 kW/m²* | |
| Pool fire | 15 | 21 | 25 | 27 | 31 | > 20 |

**Tabella 5**

Project : Rilascio - IMO 3 - MDPO
Session 1
---------- START OF SESSION 1(mYBNewLiquidRelease) ----------
INPUT

| | |
|---|---|
| Model | Liquid release (193) |
| Version | 5.08 |
| Reference | Yellow Book, CPR-14E, 3rd edition 1997, Paragraph 2.5.4Yellow Book, CPR-14E, 3rd edition 1997, Paragraph 2.5.4 |
| Case description | Rilascio - IMO 3 - MDPO |
| Chemical name | Gasoline |
| Use which representative step | First 20% average (flammable) |
| Type of release | Release through hole in vessel |
| Hole diameter | 51 mm |
| Hole rounding | Sharp edges |
| Discharge coefficient | 0.62 - |
| Vessel type | Horizontal cylinder |
| Vessel volume | 30 m3 |
| Length cylinder | 12 m |
| Filling degree | 80 % |
| Overpressure above liquid (assuming closed system) | 0 bar |
| Height leak above tank bottom | 0 m |
| Initial temperature in vessel | 16 °C |
| Type of calculation | Calculate until device is empty |

RESULTS

| | |
|---|---|
| Initial mass in vessel | 17744 kg |
| Total mass released | 17744 kg |
| Time needed to empty vessel | 5893 s |
| Maximum mass flow rate | 4.784 kg/s |
| Representative release rate | 4.6841 kg/s |
| Representative outflow duration | 1800 s |
| Representative pressure | 1.0151 bar |

---------- END OF SESSION 1 ----------

Administrative & version data:

| | |
|---|---|
| Main program (production date) | Effects (24 Apr 2009  03:00:37) |
| Run mode (complexity level) | Expert |
| Model name | Liquid release (193) |
| Date of this calculation | 23 Oct 2013  17:03:59 |
| License owner | rachele |
| Calculation performed by | rachele |
| Software library version | 7.6.4.3276 |
| Model driver version(s) | 5.08 |
| Model driver last modification | 10 July 2007 |
| Model executable version(s) | N/A |
| Session nr. | 1 |
| References | Yellow Book, CPR-14E, 3rd edition 1997, Paragraph 2.5.4Yellow Book, CPR-14E, 3rd edition 1997, Paragraph 2.5.4 |
| Project file name | "Rilascio - IMO 3 - MDPO.alf |
| Chemical database used | "Purple Book (1999).rdb" (30 ago 2013  15:58:00) |
| Environment database used | "Purple Book (1999).Env" (20 mag 2008  09:53:47) |
| System database used | "Purple Book (1999).SPF" (20 mag 2008  09:53:47) |
| Dispersion database used | "Purple Book (1999).dpf" (20 mag 2008  09:53:47) |
| Map background file used | "Rilascio - IMO 3 - MDPO.gbf" (01 gen    0  00:00:00) |
| Project file directory | "C:\PC08_Rachele\RISP\RISP_2013\Simulazioni trasporti\IMO 3\Rilascio MDPO 30m3" |
| Chemical database directory | "C:\Program Files (x86)\TNO\Effects 7.6\Shared data\Databases" |
| Environment database directory | "C:\Program Files (x86)\TNO\Effects 7.6\Shared data\Databases" |
| System database directory | "C:\Program Files (x86)\TNO\Effects 7.6\Shared data\Databases" |
| Dispersion database directory | "C:\Program Files (x86)\TNO\Effects 7.6\Shared data\Databases" |
| Map background directory | "C:\PC08_Rachele\RISP\RISP_2013\Simulazioni trasporti\IMO 3\Rilascio MDPO 30m3" |

End of administrative & version data:

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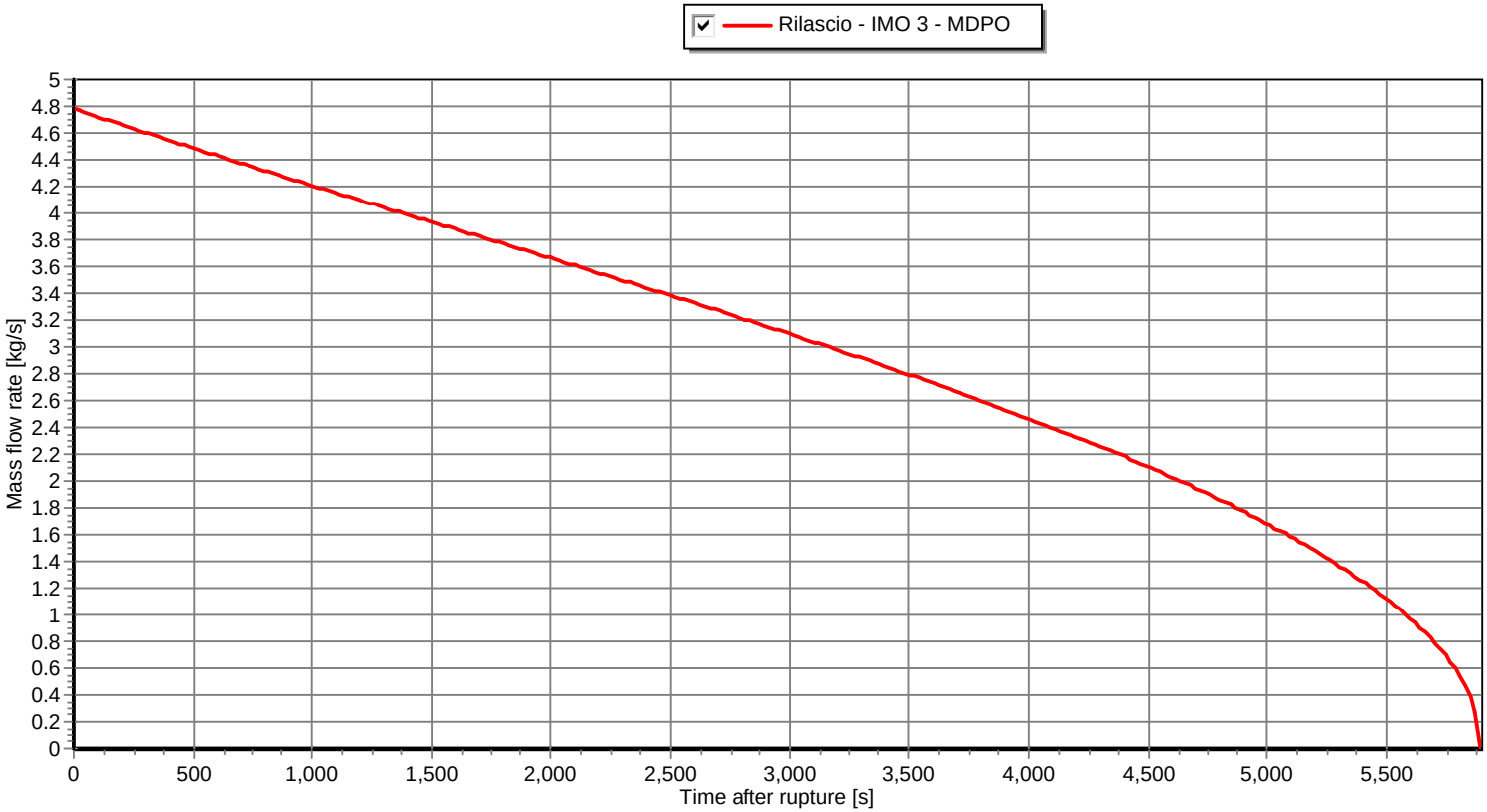
Effects 7.6.4.3276 Calculation: 23 Oct 2013 17:04:16
Model: Liquid release (193)
Graph: Mass flow rate vs Time (Liquid Release)



Project : Rilascio - IMO 3 - MDPO
Session 1
---------- START OF SESSION 1(mYBPoolFire) ----------
INPUT

| | |
|---|---|
| Model | Pool fire (137) |
| Version | 5.11 |
| Reference | Yellow Book (CPR-14E), 3rd edition 1997, Paragraph 6.5.4 |
| Case description | Rilascio - IMO 3 - MDPO |
| Chemical name | Gasoline |
| Type of confinement | Unconfined |
| Total mass released | 17744 kg |
| Fixed pool surface | 101.07 m2 |
| Height of the observer position above ground level | 1.7 m |
| Hole diameter | 51 mm |
| Discharge coefficient | 0.62 - |
| Initial height of the liquid above release point | 1.8 m |
| Cross-sectional area of the tank | 2.5 m2 |
| Pool thickness | 10 mm |
| Temperature of the pool | 16 °C |
| Pool burning rate | Calculate/Default |
| Fraction combustion heat radiated | 13 % |
| Soot Fraction | Calculate/Default |
| Wind speed at 10 m height | 4 m/s |
| Ambient temperature | 16 °C |
| Ambient relative humidity | 66 % |
| Amount of CO2 in atmosphere | 0.03 % |
| Distance from the edge of the pool | 50 m |
| Exposure duration to heat radiation | 20 s |
| Take protective effects of clothing into account | No |
| X-coordinate of release | 0 m |
| Y-coordinate of release | 0 m |
| Predefined wind direction | User defined |
| Wind comes from (West = 180 degrees) | 180 deg |
| Calculate all contours for | Physical effects |
| Heat radiation level (lowest) for first contour plot | 3 kW/m2 |
| Heat radiation level for second contour plot | 5 kW/m2 |
| Heat radiation level (highest) for third contour plot | 12.5 kW/m2 |

RESULTS

| | |
|---|---|
| Heat radiation at X | 0.35645 kW/m2 |
| Heat radiation first contour at | 24.583 m |
| Heat radiation second contour at | 21.143 m |
| Heat radiation third contour at | 15.284 m |
| Combustion rate | 5.559 kg/s |
| Duration of the pool fire | 3191.9 s |
| Heat emission from fire surface | 27.186 kW/m2 |
| Flame tilt | 51.528 deg |
| View factor | 1.9061 % |
| Atmospheric transmissivity | 68.789 % |
| Flame temperature | 561.98 °C |
| Height of the Flame | 13.479 m |
| Weight ratio of HCL/chemical | 0 % |
| Weight ratio of NO2/chemical | 0 % |
| Weight ratio of SO2/chemical | 0 % |
| Weight ratio of CO2/chemical | 366.58 % |
| Weight ratio of H2O/chemical | 0 % |

---------- END OF SESSION 1 ----------

Administrative & version data:

| | |
|---|---|
| Main program (production date) | Effects (24 Apr 2009  03:00:37) |
| Run mode (complexity level) | Expert |
| Model name | Pool fire (137) |
| Date of this calculation | 23 Oct 2013  17:05:25 |
| License owner | rachele |
| Calculation performed by | rachele |
| Software library version | 7.6.4.3276 |
| Model driver version(s) | 5.11 |
| Model driver last modification | 30 Nov 2007 |
| Model executable version(s) | N/A |
| Session nr. | 1 |
| References | Yellow Book (CPR-14E), 3rd edition 1997, Paragraph 6.5.4 |
| Project file name | "Rilascio - IMO 3 - MDPO.alf |
| Chemical database used | "Purple Book (1999).rdb" (30 ago 2013  15:58:00) |
| Environment database used | "Purple Book (1999).Env" (20 mag 2008  09:53:47) |
| System database used | "Purple Book (1999).SPF" (20 mag 2008  09:53:47) |
| Dispersion database used | "Purple Book (1999).dpf" (20 mag 2008  09:53:47) |
| Map background file used | "Rilascio - IMO 3 - MDPO.gbf" (01 gen  0  00:00:00) |
| Project file directory | "C:\PC08_Rachele\RISP\RISP_2013\Simulazioni trasporti\IMO 3\Rilascio MDPO 30m3" |
| Chemical database directory | "C:\Program Files (x86)\TNO\Effects 7.6\Shared data\Databases" |
| Environment database directory | "C:\Program Files (x86)\TNO\Effects 7.6\Shared data\Databases" |
| System database directory | "C:\Program Files (x86)\TNO\Effects 7.6\Shared data\Databases" |
| Dispersion database directory | "C:\Program Files (x86)\TNO\Effects 7.6\Shared data\Databases" |
| Map background directory | "C:\PC08_Rachele\RISP\RISP_2013\Simulazioni trasporti\IMO 3\Rilascio MDPO 30m3" |

End of administrative & version data:

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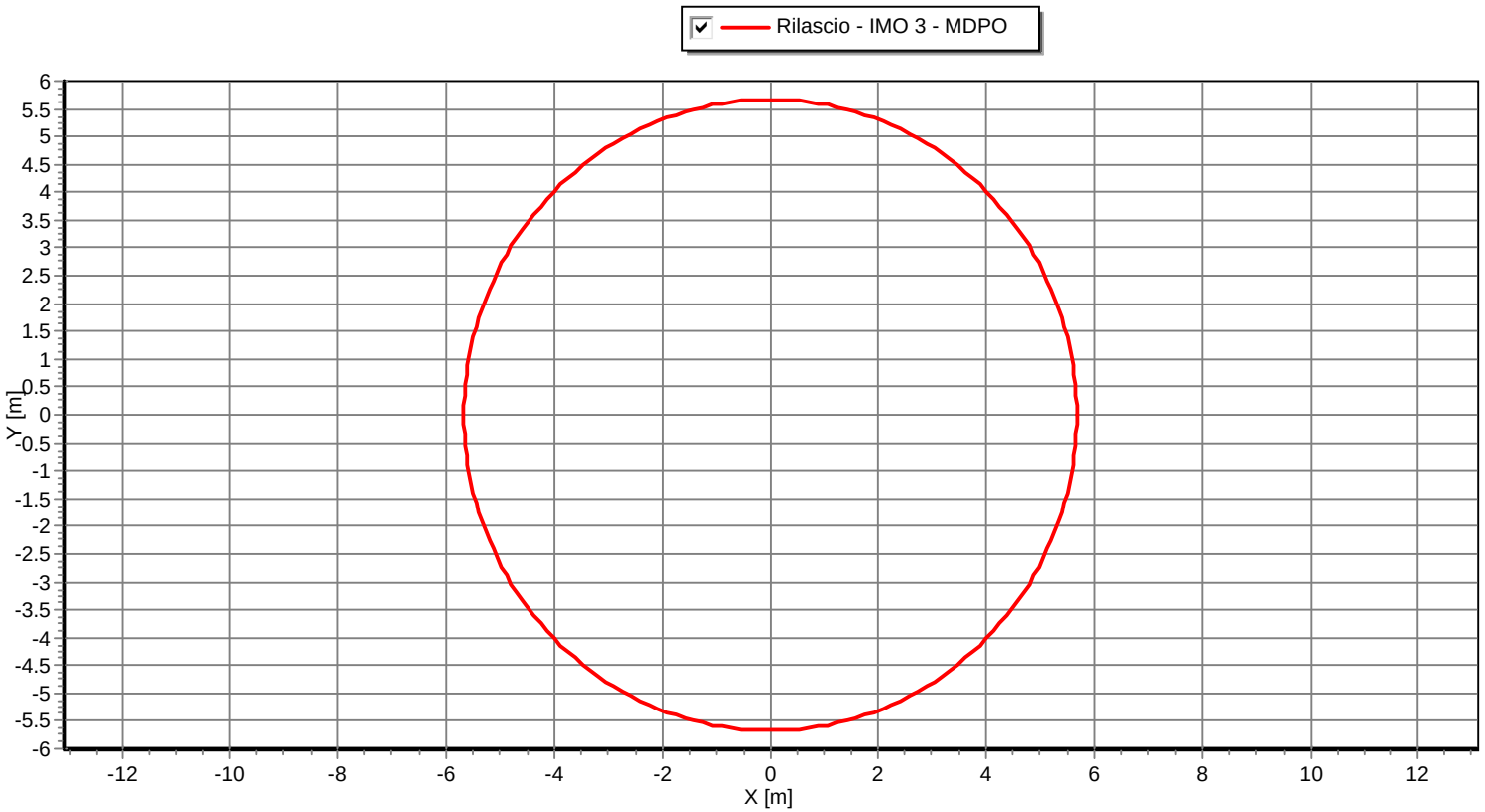
Effects 7.6.4.3276 Calculation: 23 Oct 2013 17:05:33
Model: Pool fire (137)
Graph: Pool contour (Pool Fire)



Effects 7.6.4.3276 Calculation: 23 Oct 2013 17:05:48
Model: Pool fire (137)
Graph: Heat radiation vs. distance (Pool Fire)