


| | | | |
|---|--|----------------------------------|--------------------|
|  | PROGETTISTA  Tecnologia Ricerca Rischi | COMMESSA NQ/R21300/L01 | UNITA' - |
| | LOCALITA' PORTO TORRES (SS) (SARDEGNA) | 001-CI-E-60001 | |
| | PROGETTO / IMPIANTO FSRU Porto Torres e Opere Connesse | Allegato C.4.2_1 | Rev. 00 |

Rif. TRR: 72556

FSRU di PORTO TORRES e OPERE CONNESSE

Rapporto Preliminare di Sicurezza ai sensi del D.Lgs. 105/15

ALLEGATO C.4.2_1

ELABORATI DI CALCOLO 7R

| | | | | | |
|-------------|------------------------|------------------|-------------------|------------------|-------------|
| | | | | | |
| 0 | Emissione per permessi | A.VISIGOTI | V.ROMANO | G.ROMANO | AGOSTO 2024 |
| Rev. | Descrizione | Elaborato | Verificato | Approvato | Data |

Input Report

Workspace: 1RiempFSRU-7R

Riempimento FSRU-ME4

Study

1RiempFSRU-7R

| Tab | Group | Field | Value |
|----------------------------|-----------------------------|--|------------------------------|
| Context of calculations | Selection of context | Weathers to use for this study | Weather folder |
| | | Parameters to use for this study | Parameter set ME4 |
| | | Obstructions to use for this study | Multi-Energy obstruction set |
| Bund, building and terrain | Terrain and bund definition | Type of terrain for dispersion | Default terrain |
| | | Type of pool substrate and bunds | No bund |
| Toxic parameters | Indoor toxic calculations | Specify the downwind building type | Unselected |
| | | Building type (downwind building type) | Buildings\Building type |

7R Linee BOG a metaniera

Pressure vessel

1RiempFSRU-7R\Riempimento FSRU-ME4

| Tab | Group | Field | Value | Units |
|----------------------|----------------------------|--|---|----------|
| Material | Material | Material | GAS NATURALE | |
| | | Specify volume inventory? | Yes | |
| | | Mass inventory | 1930,32 | kg |
| | | Volume inventory | 342,2 | m3 |
| | | Material to track | GAS NATURALE | |
| | Phase | Specified condition | Pressure/temperature | |
| | | Temperature | -110 | degC |
| | | Pressure (gauge) | 2,96 | bar |
| | | Fluid state | Vapour | |
| | | Liquid mole fraction | 0 | fraction |
| Scenario | Pipe dimensions | Pipe length | | m |
| | Release location | Elevation | 17 | m |
| | | Tank head | 0 | m |
| | Direction | Outdoor release direction | Horizontal | |
| | | Outdoor release angle | 0 | deg |
| Discharge parameters | Model settings | Atmospheric expansion method | DNV recommended | |
| | | Phase change upstream of orifice? | Disallow liquid phase change only (metastable liquid) | |
| | Droplet break-up mechanism | Droplet break-up mechanism - instantaneous | Use flashing correlation | |
| | | Droplet break-up mechanism - continuous | Do not force correlation | |
| Short pipe | Pipe | Pipe roughness | 0,045 | mm |

| | | | | |
|-----------------------|---|--|-----------|----------------|
| | characteristics | | | |
| | Frequencies | Frequency of bends in pipe | 0 | /m |
| | | Frequency of couplings in pipe | 0 | /m |
| | | Frequency of junctions in pipe | 0 | /m |
| | Frequencies of valves | Frequency of excess flow valves | 0 | /m |
| | | Frequency of non-return valves | 0 | /m |
| | | Frequency of shut-off valves | 0 | /m |
| | Velocity head losses | Excess flow valve velocity head losses | 0 | |
| | | Non-return valve velocity head losses | 0 | |
| | | Shut-off valve velocity head losses | 0 | |
| Time varying releases | Modelling of time-varying leaks and line ruptures | Vacuum relief valve | Operating | |
| | | Vacuum relief valve set point | 0 | bar |
| | Inventory data for time-varying releases | Tank volume | 342,2 | m ³ |
| | | Tank vapour volume | 342,2 | m ³ |
| | | Tank liquid volume | 0 | m ³ |
| | | Tank liquid level | 0 | m |
| | | Maximum vapour release height | 0 | m |

| | | | | |
|----------------------------|--|---|-----------------|-----|
| | | Minimum mass inventory | 0,1 | kg |
| | | Maximum mass inventory | 1E+09 | kg |
| | Safety system modelling for time-varying releases | Safety system modelling (isolation and blowdown) | No | |
| Dispersion | User-defined dispersion scope (N.B Based on the material to track) | Concentrations of interest | | ppm |
| | | Distances of interest | | m |
| | | Averaging time for concentrations and distances of interest | | |
| | | Specify user-defined averaging time | No | |
| | | User defined averaging time | | s |
| Bund, building and terrain | Terrain and bund definition | Type of terrain for dispersion | Default terrain | |
| | | Type of pool substrate and bunds | No bund | |
| | Building definition | Release building | | |
| | | In-building release? | Outdoor | |
| | | Building wake effect | None | |
| | | Wind or release angle from North | 0 | deg |
| | | Handling of | Trapped | |

| | | | | |
|----------------------|--|--|---------------------------------------|----------|
| | | droplets | | |
| | | Indoor mass modification factor | 3 | |
| Explosion parameters | Explosion method (Consequence calculations only) | Explosion method | Multi-Energy: Uniform confined | |
| | Ignition | Supply late ignition location | No ignition location | |
| | | Location of late ignition | | m |
| | Vapour liquid method | Use explosion mass modification factor | Yes | |
| | | Explosion mass modification factor | 3 | |
| Fireball | Result types to calculate | Calculate probit | No | |
| | | Calculate dose | No | |
| | | Calculate lethality | No | |
| | Radiation levels | Number of input radiation levels | 3 | |
| | | Intensity levels | 4; 12,5; 37,5 | kW/m2 |
| | | Probit levels | 2,73; 3,72; 7,5 | |
| | | Dose levels | 1,27E+06; 5,8E+06; 2,51E+07 | |
| | | Lethality levels | 0,01; 0,1; 0,99 | fraction |
| | Parameters | Mass modification factor | 3 | |
| | | Fireball maximum exposure duration | 20 | s |
| | Calculation method | Fireball model | Martinsen time varying | |
| | | TNO model flame temperature | 1726,85 | degC |
| Jet fire | Jet fire method | Selection for jet fire method | Automatic selection / DNV recommended | |

| | | | | |
|-----------|---------------------------|---|-----------------------------|----------|
| | Result types to calculate | Calculate probit | No | |
| | | Calculate dose | No | |
| | | Calculate lethality | No | |
| | Radiation levels | Number of input radiation levels | 5 | |
| | | Intensity levels | 3; 5; 7; 12,5; 37,5 | kW/m2 |
| | | Probit levels | 2,73; 3,72; 7,5 | |
| | | Dose levels | 1,27E+06; 5,8E+06; 2,51E+07 | |
| | | Lethality levels | 0,01; 0,1; 0,99 | fraction |
| | Parameters | Rate modification factor | 3 | |
| | | Jet fire maximum exposure duration | 20 | s |
| | Cone model data | Horizontal options | Use standard method | |
| | | Correlation | Recommended | |
| | | Flame-shape adjustment if grounded | Yes | |
| | Surface emissive power | Calculation method for surface emissive power | Calculate SEP | |
| | | Flame emissive power | | kW/m2 |
| | | Emissivity fraction | | fraction |
| Pool fire | Result types to calculate | Calculate probit | No | |
| | | Calculate dose | No | |
| | | Calculate lethality | No | |
| | Radiation levels | Number of input radiation levels | 5 | |
| | | Intensity levels | 3; 5; 7; 12,5; 37,5 | kW/m2 |
| | | Probit levels | 2,73; 3,72; 7,5 | |
| | | Dose levels | 1,27E+06; 5,8E+06; 2,51E+07 | |



| | | | | |
|----------|------------|--------------------------------------|-----------------|----------|
| | | Lethality levels | 0,01; 0,1; 0,99 | fraction |
| | Parameters | Radiative fraction for general fires | 0,4 | fraction |
| | | Pool fire maximum exposure duration | 20 | s |
| Geometry | Geometry | East | 0 | m |
| | | North | 0 | m |

90mm

Leak

1RiempFSRU-7R\RIEMPIMENTO FSRU-ME4\7R Linee BOG a metaniera

| Tab | Group | Field | Value | Units |
|----------------------|--|---|---|----------|
| Scenario | Hole | Orifice diameter | 90 | mm |
| | | Use specified discharge coefficient? | Yes | |
| | | Discharge coefficient | 0,62 | fraction |
| | Release location | Elevation | 17 | m |
| | | Tank head | 0 | m |
| | Direction | Outdoor release direction | Horizontal | |
| | | Outdoor release angle | 0 | deg |
| Material | Material | Material characteristics | Flammable only | |
| | | Material to track | GAS NATURALE | |
| | | Type of risk effects to model | Flammable only | |
| | Phase | Phase to be released | Vapour | |
| Discharge parameters | Model settings | Atmospheric expansion method | DNV recommended | |
| | | Phase change upstream of orifice? | Disallow liquid phase change only (metastable liquid) | |
| | Droplet break-up mechanism | Droplet break-up mechanism - continuous | Do not force correlation | |
| Dispersion | User-defined dispersion scope (N.B Based on the material to track) | Concentrations of interest | | ppm |
| | | Distances of interest | | m |
| | | Averaging time for | | |

| | | | | |
|----------------------------|-----------------------------|--|--------------------------------|-------------------|
| | | concentrations and distances of interest | | |
| | | Specify user-defined averaging time | No | |
| | | User defined averaging time | | s |
| Bund, building and terrain | Terrain and bund definition | Type of terrain for dispersion | Default terrain | |
| | | Type of pool substrate and bunds | No bund | |
| Explosion parameters | Explosion method | Explosion method | Multi-Energy: Uniform confined | |
| | Ignition | Supply late ignition location | No ignition location | |
| | | Location of late ignition | | m |
| | Vapour liquid method | Use explosion mass modification factor | Yes | |
| | | Explosion mass modification factor | 3 | |
| Fireball | Result types to calculate | Calculate probit | No | |
| | | Calculate dose | No | |
| | | Calculate lethality | No | |
| | Radiation levels | Number of input radiation levels | 3 | |
| | | Intensity levels | 4; 12,5; 37,5 | kW/m ² |
| | | Probit levels | 2,73; 3,72; 7,5 | |
| | | Dose levels | 1,27E+06; 5,8E+06; 2,51E+07 | |
| | | Lethality levels | 0,01; 0,1; 0,99 | fraction |
| | Parameters | Mass modification factor | 3 | |
| | | Fireball maximum exposure duration | 20 | s |
| | Calculation method | Fireball model | Martinsen time varying | |

| | | | | |
|-----------|---------------------------|---|---------------------------------------|----------|
| | | TNO model flame temperature | 1726,85 | degC |
| Jet fire | Jet fire method | Selection for jet fire method | Automatic selection / DNV recommended | |
| | Result types to calculate | Calculate probit | No | |
| | | Calculate dose | No | |
| | | Calculate lethality | No | |
| | Radiation levels | Number of input radiation levels | 5 | |
| | | Intensity levels | 3; 5; 7; 12,5; 37,5 | kW/m2 |
| | | Probit levels | 2,73; 3,72; 7,5 | |
| | Parameters | Dose levels | 1,27E+06; 5,8E+06; 2,51E+07 | |
| | | Lethality levels | 0,01; 0,1; 0,99 | fraction |
| | | Rate modification factor | 3 | |
| | Cone model data | Jet fire maximum exposure duration | 20 | s |
| | | Correlation | Recommended | |
| | | Horizontal options | Use standard method | |
| | | Flame-shape adjustment if grounded | Yes | |
| | Surface emissive power | Calculation method for surface emissive power | Calculate SEP | |
| | | Flame emissive power | | kW/m2 |
| | | Emissivity fraction | | fraction |
| Pool fire | Result types to calculate | Calculate probit | No | |
| | | Calculate dose | No | |
| | | Calculate lethality | No | |
| | Radiation levels | Number of input | 5 | |

| | | radiation levels | | |
|--|------------|---|--------------------------------|----------|
| | | Intensity levels | 3; 5; 7; 12,5; 37,5 | kW/m2 |
| | | Probit levels | 2,73; 3,72; 7,5 | |
| | | Dose levels | 1,27E+06; 5,8E+06; 2,51E+07 | |
| | | Lethality levels | 0,01; 0,1; 0,99 | fraction |
| | Parameters | Radiative fraction for general fires | 0,4 | fraction |
| | | Pool fire maximum exposure duration | 20 | s |



Discharge Report

Workspace: 1RiempFSRU-7R

Study: Riempimento FSRU-ME4

Equipment Item: 7R Linee BOG a metaniera

1RiempFSRU-7R\Riempimento FSRU-ME4\7R Linee BOG a metaniera

| | | |
|----------|---------------------|---|
| Material | GAS NATURALE | |
| East | 0 | m |
| North | 0 | m |

Scenario (Leak) : 90mm

1RiempFSRU-7R\Riempimento FSRU-ME4\7R Linee BOG a metaniera\90mm

Weather: Category 2/F

INPUT DATA

Inventory data

| | | |
|----------------|----------------|----|
| Mass in vessel | 1930,32 | kg |
|----------------|----------------|----|

Stagnation Data (upstream end for long pipe)

| | | |
|--------------------------|------------------------|------|
| Initial pressure (gauge) | 2,96 | bar |
| Initial temperature | -110 | degC |
| Fluid state | Pressurized gas | |

Scenario data

| | | |
|-----------------------|-------------|----------|
| Phase to be released | Vapour | |
| Hole diameter | 90 | mm |
| Discharge coefficient | 0,62 | fraction |

OUTPUT DATA

| | | |
|------------------|---------|------|
| Mass flow rate | 3,94226 | kg/s |
| Release duration | 489,648 | s |

Orifice or pipe exit data (before atmospheric expansion)

| | | |
|----------|---------|-----|
| Pressure | 2,16547 | bar |
|----------|---------|-----|



| | | |
|--|----------|----------|
| Temperature | -133,123 | degC |
| Liquid mass fraction | 0 | fraction |
| Velocity at vena contracta (at exit for pipe releases) | 282,429 | m/s |
| Discharge coefficient | 0,62 | |

Final Data (after atmospheric expansion)

| | | |
|----------------------|------------------|----------|
| Temperature | -138,027 | degC |
| Liquid mass fraction | 0 | fraction |
| Droplet diameter | 0 | um |
| Expanded diameter | 0,0999812 | m |
| Velocity | 300 | m/s |



Weather: Category 5/D

INPUT DATA

Inventory data

| | | |
|----------------|---------|----|
| Mass in vessel | 1930,32 | kg |
|----------------|---------|----|

Stagnation Data (upstream end for long pipe)

| | | |
|--------------------------|-----------------|------|
| Initial pressure (gauge) | 2,96 | bar |
| Initial temperature | -110 | degC |
| Fluid state | Pressurized gas | |

Scenario data

| | | |
|-----------------------|--------|----------|
| Phase to be released | Vapour | |
| Hole diameter | 90 | mm |
| Discharge coefficient | 0,62 | fraction |

OUTPUT DATA

| | | |
|------------------|---------|------|
| Mass flow rate | 3,94226 | kg/s |
| Release duration | 489,648 | s |

Orifice or pipe exit data (before atmospheric expansion)

| | | |
|--|----------|----------|
| Pressure | 2,16547 | bar |
| Temperature | -133,123 | degC |
| Liquid mass fraction | 0 | fraction |
| Velocity at vena contracta (at exit for pipe releases) | 282,429 | m/s |
| Discharge coefficient | 0,62 | |

Final Data (after atmospheric expansion)

| | | |
|----------------------|-----------|----------|
| Temperature | -138,027 | degC |
| Liquid mass fraction | 0 | fraction |
| Droplet diameter | 0 | um |
| Expanded diameter | 0,0999812 | m |
| Velocity | 300 | m/s |







Dispersion Report

Workspace: 1RiempFSRU-7R

Study: Riempimento FSRU-ME4

Equipment Item: 7R Linee BOG a metaniera

1RiempFSRU-7R\Riempimento FSRU-ME4\7R Linee BOG a metaniera

| | | |
|----------|---------------------|---|
| Material | GAS NATURALE | |
| East | 0 | m |
| North | 0 | m |

Scenario (Leak) : 90mm

1RiempFSRU-7R\Riempimento FSRU-ME4\7R Linee BOG a metaniera\90mm

| | |
|-------------------|---------------------|
| Material to track | GAS NATURALE |
|-------------------|---------------------|

Weather: Category 2/F

| | |
|--------------------------------|--|
| Wind speed [m/s] | 2 |
| Pasquill stability | F stable - night with moderate clouds and light/moderate wind |
| Atmospheric temperature [degC] | 25 |
| Relative humidity [fraction] | 0,75 |
| Solar radiation flux [kW/m2] | 0,5 |
| Mixing layer height [m] | 100 |

Observer Release Data and Observer Mass Data

| Observer number | Release type | Start time [s] | Start downwind distance [m] | Unit | Masses or mass rates | | |
|-----------------|--------------|----------------|-----------------------------|------|----------------------|---------|---------|
| | | | | | Release | Rainout | Final |
| 1 | Continuous | 0 | 0 | kg/s | 3,94226 | 0 | 3,94226 |
| 2 | Continuous | 489,648 | 0 | kg/s | 3,94226 | 0 | 3,94226 |



Weather: Category 5/D

| | |
|---------------------------------------|---|
| Wind speed [m/s] | 5 |
| Pasquill stability | D neutral - little sun and high wind or overcast/windy night |
| Atmospheric temperature [degC] | 25 |
| Relative humidity [fraction] | 0,75 |
| Solar radiation flux [kW/m2] | 0,5 |
| Mixing layer height [m] | 800 |

Observer Release Data and Observer Mass Data

| Observer number | Release type | Start time [s] | Start downwind distance [m] | Unit | Masses or mass rates | | |
|-----------------|--------------|----------------|-----------------------------|------|----------------------|---------|---------|
| | | | | | Release | Rainout | Final |
| 1 | Continuous | 0 | 0 | kg/s | 3,94226 | 0 | 3,94226 |
| 2 | Continuous | 489,648 | 0 | kg/s | 3,94226 | 0 | 3,94226 |



Jet Fire

Workspace: 1RiempFSRU-7R

Study: Riempimento FSRU-ME4

Equipment Item: 7R Linee BOG a metaniera

1RiempFSRU-7R\Riempimento FSRU-ME4\7R Linee BOG a metaniera

| | | |
|----------|---------------------|---|
| Material | GAS NATURALE | |
| East | 0 | m |
| North | 0 | m |

Scenario (Leak) : 90mm

1RiempFSRU-7R\Riempimento FSRU-ME4\7R Linee BOG a metaniera\90mm

Weather: Category 2/F

| | |
|--------------------------------|--|
| Wind speed [m/s] | 2 |
| Pasquill stability | F stable - night with moderate clouds and light/moderate wind |
| Atmospheric temperature [degC] | 25 |
| Relative humidity [fraction] | 0,75 |
| Solar radiation flux [kW/m2] | 0,5 |

Jet fire model results

INPUT DATA

Scenario

| | | |
|-------------------------------|----|-----|
| Elevation | 17 | m |
| Release angle from horizontal | 0 | deg |

Jet fire method

| | |
|-------------------------------|---------------------------------------|
| Selection for jet fire method | Automatic selection / DNV recommended |
|-------------------------------|---------------------------------------|

Jet Fire Parameters

| | | |
|--|---|-----|
| Wind orientation about the z-axis (anti-clockwise from the East) | 0 | deg |
| Rotation about the z-axis (anti-clockwise from the east) | 0 | deg |



| | | |
|--------------------------|---|--|
| Rate modification factor | 3 | |
|--------------------------|---|--|

Automatic selection of method

| | |
|--------------------------------------|------------|
| Jet fire method used in calculations | Cone model |
|--------------------------------------|------------|

Calculated inputs

| | | |
|--|------------|----------|
| Mass flow rate | 3,94226 | kg/s |
| Temperature after atmospheric expansion | -138,027 | degC |
| Liquid fraction | 0 | fraction |
| Velocity after atmospheric expansion (input) | 300 | m/s |
| Rainout fraction time averaged | 0 | fraction |

OUTPUT DATA

| | | |
|---------------------------|-----------|----------|
| Flame emissive power | 174,177 | kW/m2 |
| Fraction of emissivity | 0,18803 | fraction |
| Jet velocity | 300 | m/s |
| Flame length | 23,655 | m |
| Frustum length | 18,6399 | m |
| Frustum base width | 1,60194 | m |
| Frustum tip width | 4,84312 | m |
| Frustum lift-off distance | 5,25279 | m |
| Flame length in still air | 30,3962 | m |
| Hole to flame angle | 19,5595 | deg |
| Expanded diameter | 0,0999812 | m |
| Plane angular rotation | 0 | deg |

Radiation Intensity Ellipse Results

INPUT DATA

For ellipses 'observer direction' refers to whether inclination is 'fixed' or 'variable'. Orientation is always variable.

| | | |
|--------------------|----------|---|
| Observer direction | Variable | |
| Exposure duration | 20 | s |

Height of interest **1,7** m

OUTPUT DATA

Radiation intensity

| Incident radiation [kW/m ²] | Lethality [%] | View factor | Probit | Dose [(W/m ²) ^{Probit} N.s] | Ellipse half-length [m] | Ellipse half-width [m] | Ellipse centre downwind distance [m] | Effect downwind distance [m] | Ellipse area [m ²] |
|---|---------------|-------------|----------|--|-------------------------|------------------------|--------------------------------------|------------------------------|--------------------------------|
| 3 | 0 | 0,0172239 | -1,38321 | 865.119 | 17,9876 | 21,7342 | 17,7899 | 35,7774 | 1228,19 |
| 5 | 0,000174704 | 0,0287065 | 0,360367 | 1.709.491 | 9,73267 | 11,5518 | 16,6944 | 26,427 | 353,208 |
| 7 | 0,02405 | 0,040189 | 1,50883 | 2.677.313 | Not reached | Not reached | | n/a | n/a |
| 12,5 | 6,52536 | 0,0717662 | 3,48789 | 5.800.162 | Not reached | Not reached | | n/a | n/a |
| 37,5 | 98,7381 | 0,215298 | 7,23773 | 25.094.924 | Not reached | Not reached | | n/a | n/a |

Radiation v Distance Results

INPUT DATA

| | | |
|--|------------|---|
| Maximum distance | 45,6341 | m |
| Observer type radiation modelling flag | Planar | |
| Observer direction | Variable | |
| Height of interest | 1,7 | m |

OUTPUT DATA

| Downwind distance [m] | Maximum incident radiation [kW/m ²] | Lethality level [fraction] |
|-----------------------|---|----------------------------|
| 0 | 3,05031 | 0 |



| | | |
|----------|---------|-------------|
| 0,931308 | 3,29189 | 0 |
| 1,86262 | 3,53842 | 0 |
| 2,79392 | 3,78643 | 1,14779E-08 |
| 3,72523 | 4,03208 | 3,8587E-08 |
| 4,65654 | 4,27133 | 1,12793E-07 |
| 5,58785 | 4,50019 | 2,88429E-07 |
| 6,51915 | 4,71494 | 6,50081E-07 |
| 7,45046 | 4,91238 | 1,30248E-06 |
| 8,38177 | 5,08997 | 2,34104E-06 |
| 9,31308 | 5,24691 | 3,82207E-06 |
| 10,2444 | 5,5489 | 9,18045E-06 |
| 11,1757 | 5,82749 | 1,92109E-05 |
| 12,107 | 6,08022 | 3,56528E-05 |
| 13,0383 | 6,28747 | 5,72768E-05 |
| 13,9696 | 6,46156 | 8,35136E-05 |
| 14,9009 | 6,59265 | 0,000109625 |
| 15,8322 | 6,67945 | 0,00013056 |
| 16,7635 | 6,72146 | 0,000141876 |
| 17,6948 | 6,71902 | 0,000141197 |
| 18,6262 | 6,67322 | 0,000128952 |
| 19,5575 | 6,58593 | 0,000108131 |
| 20,4888 | 6,45973 | 8,31906E-05 |
| 21,4201 | 6,30038 | 5,89398E-05 |
| 22,3514 | 6,10695 | 3,79622E-05 |
| 23,2827 | 5,88583 | 2,22505E-05 |
| 24,214 | 5,64181 | 1,18268E-05 |
| 25,1453 | 5,37896 | 5,66504E-06 |
| 26,0766 | 5,10526 | 2,45835E-06 |
| 27,0079 | 4,82378 | 9,59138E-07 |
| 27,9392 | 4,53905 | 3,35694E-07 |
| 28,8705 | 4,27013 | 1,12216E-07 |
| 29,8018 | 4,04845 | 4,166E-08 |
| 30,7332 | 3,84561 | 1,55452E-08 |
| 31,6645 | 3,68561 | 0 |
| 32,5958 | 3,52628 | 0 |



| | | |
|---------|---------|---|
| 33,5271 | 3,36883 | 0 |
| 34,4584 | 3,21429 | 0 |
| 35,3897 | 3,06353 | 0 |
| 36,321 | 2,91555 | 0 |
| 37,2523 | 2,77445 | 0 |
| 38,1836 | 2,6387 | 0 |
| 39,1149 | 2,50856 | 0 |
| 40,0462 | 2,38417 | 0 |
| 40,9775 | 2,26558 | 0 |
| 41,9089 | 2,15279 | 0 |
| 42,8402 | 2,04569 | 0 |
| 43,7715 | 1,94418 | 0 |
| 44,7028 | 1,84807 | 0 |
| 45,6341 | 1,75719 | 0 |



Weather: Category 5/D

| | |
|--------------------------------|--|
| Wind speed [m/s] | 5 |
| Pasquill stability | D neutral - little sun and high wind or overcast/windy night |
| Atmospheric temperature [degC] | 25 |
| Relative humidity [fraction] | 0,75 |
| Solar radiation flux [kW/m2] | 0,5 |

Jet fire model results

INPUT DATA

Scenario

| | | |
|-------------------------------|----|-----|
| Elevation | 17 | m |
| Release angle from horizontal | 0 | deg |

Jet fire method

| | |
|-------------------------------|---------------------------------------|
| Selection for jet fire method | Automatic selection / DNV recommended |
|-------------------------------|---------------------------------------|

Jet Fire Parameters

| | | |
|--|---|-----|
| Wind orientation about the z-axis (anti-clockwise from the East) | 0 | deg |
| Rotation about the z-axis (anti-clockwise from the east) | 0 | deg |
| Rate modification factor | 3 | |

Automatic selection of method

| | |
|--------------------------------------|------------|
| Jet fire method used in calculations | Cone model |
|--------------------------------------|------------|

Calculated inputs

| | | |
|--|----------|----------|
| Mass flow rate | 3,94226 | kg/s |
| Temperature after atmospheric expansion | -138,027 | degC |
| Liquid fraction | 0 | fraction |
| Velocity after atmospheric expansion (input) | 300 | m/s |



| | | |
|--------------------------------|---|----------|
| Rainout fraction time averaged | 0 | fraction |
|--------------------------------|---|----------|

OUTPUT DATA

| | | |
|---------------------------|-----------|----------|
| Flame emissive power | 165,46 | kW/m2 |
| Fraction of emissivity | 0,179791 | fraction |
| Jet velocity | 300 | m/s |
| Flame length | 26,2928 | m |
| Frustum length | 21,1108 | m |
| Frustum base width | 1,60194 | m |
| Frustum tip width | 4,26482 | m |
| Frustum lift-off distance | 5,25279 | m |
| Flame length in still air | 30,3962 | m |
| Hole to flame angle | 10,5162 | deg |
| Expanded diameter | 0,0999812 | m |
| Plane angular rotation | 0 | deg |

Radiation Intensity Ellipse Results

INPUT DATA

For ellipses 'observer direction' refers to whether inclination is 'fixed' or 'variable'. Orientation is always variable.

| | | |
|--------------------|----------|---|
| Observer direction | Variable | |
| Exposure duration | 20 | s |
| Height of interest | 1,7 | m |

OUTPUT DATA

Radiation intensity

| Incident radiation [kW/m2] | Lethality [%] | View factor | Probit | Dose [(W/m2)^ProbitN.s] | Ellipse half-length [m] | Ellipse half-width [m] | Ellipse centre downwind distance [m] | Effect downwind distance [m] | Ellipse area [m2] |
|----------------------------|---------------|-------------|----------|-------------------------|-------------------------|------------------------|--------------------------------------|------------------------------|-------------------|
| 3 | 0 | 0,0181313 | -1,38321 | 865.119 | 19,0133 | 22,1145 | 18,6196 | 37,6329 | 1320,94 |



| | | | | | | | | | |
|------|-----------------|---------------|--------------|------------|--------------------|--------------------|---------|---------|-------------|
| 5 | 0,00017 4704 | 0,0302 188 | 0,360 367 | 1.709.491 | 10,64 16 | 12,70 04 | 17,6118 | 28,2534 | 424,5 94 |
| 7 | 0,02405 | 0,0423 063 | 1,508 83 | 2.677.313 | 4,077 1 | 4,108 67 | 17,6101 | 21,6872 | 52,62 62 |
| 12,5 | 6,52536 | 0,0755 47 | 3,487 89 | 5.800.162 | Not reach ed | Not reach ed | | n/a | n/a |
| 37,5 | 98,7381 | 0,2266 41 | 7,237 73 | 25.094.924 | Not reach ed | Not reach ed | | n/a | n/a |

Radiation v Distance Results

INPUT DATA

| | | |
|--|------------|---|
| Maximum distance | 52,0179 | m |
| Observer type radiation modelling flag | Planar | |
| Observer direction | Variable | |
| Height of interest | 1,7 | m |

OUTPUT DATA

| Downwind distance [m] | Maximum incident radiation [kW/m ²] | Lethality level [fraction] |
|-----------------------|---|----------------------------|
| 0 | 3,09478 | 0 |
| 1,06159 | 3,35578 | 0 |
| 2,12318 | 3,62126 | 0 |
| 3,18477 | 3,88641 | 1,90786E-08 |
| 4,24636 | 4,14596 | 6,50985E-08 |
| 5,30795 | 4,39466 | 1,88934E-07 |
| 6,36954 | 4,62764 | 4,70715E-07 |
| 7,43113 | 4,89016 | 1,20732E-06 |
| 8,49272 | 5,28754 | 4,32175E-06 |
| 9,55431 | 5,67996 | 1,30958E-05 |
| 10,6159 | 6,0596 | 3,39573E-05 |
| 11,6775 | 6,37336 | 6,91501E-05 |
| 12,7391 | 6,66141 | 0,000125947 |
| 13,8007 | 6,9035 | 0,000201205 |



| | | |
|---------|---------|-------------|
| 14,8623 | 7,09562 | 0,000285726 |
| 15,9239 | 7,23456 | 0,000364237 |
| 16,9854 | 7,31778 | 0,000419506 |
| 18,047 | 7,34351 | 0,000437959 |
| 19,1086 | 7,31076 | 0,000414581 |
| 20,1702 | 7,21959 | 0,000354986 |
| 21,2318 | 7,07935 | 0,000277554 |
| 22,2934 | 6,87873 | 0,000192057 |
| 23,355 | 6,61568 | 0,000114873 |
| 24,4166 | 6,31853 | 6,13473E-05 |
| 25,4782 | 5,98445 | 2,83584E-05 |
| 26,5398 | 5,6219 | 1,12088E-05 |
| 27,6013 | 5,24007 | 3,74321E-06 |
| 28,6629 | 4,86906 | 1,12278E-06 |
| 29,7245 | 4,59421 | 4,1485E-07 |
| 30,7861 | 4,38292 | 1,80062E-07 |
| 31,8477 | 4,16526 | 7,09688E-08 |
| 32,9093 | 3,94476 | 2,54236E-08 |
| 33,9709 | 3,72462 | 8,29421E-09 |
| 35,0325 | 3,50762 | 0 |
| 36,0941 | 3,29609 | 0 |
| 37,1557 | 3,08868 | 0 |
| 38,2173 | 2,89388 | 0 |
| 39,2788 | 2,7085 | 0 |
| 40,3404 | 2,53315 | 0 |
| 41,402 | 2,36808 | 0 |
| 42,4636 | 2,21332 | 0 |
| 43,5252 | 2,06869 | 0 |
| 44,5868 | 1,93391 | 0 |
| 45,6484 | 1,80855 | 0 |
| 46,71 | 1,69216 | 0 |
| 47,7716 | 1,58422 | 0 |
| 48,8332 | 1,48419 | 0 |
| 49,8947 | 1,39155 | 0 |
| 50,9563 | 1,30577 | 0 |



52,0179

1,22634

0

