

ANNESSO TECNICO 6.

Elaborati di calcolo Scenari incidentali ragionevolmente credibili

Ipotesi N. 18

TRR S.r.l.

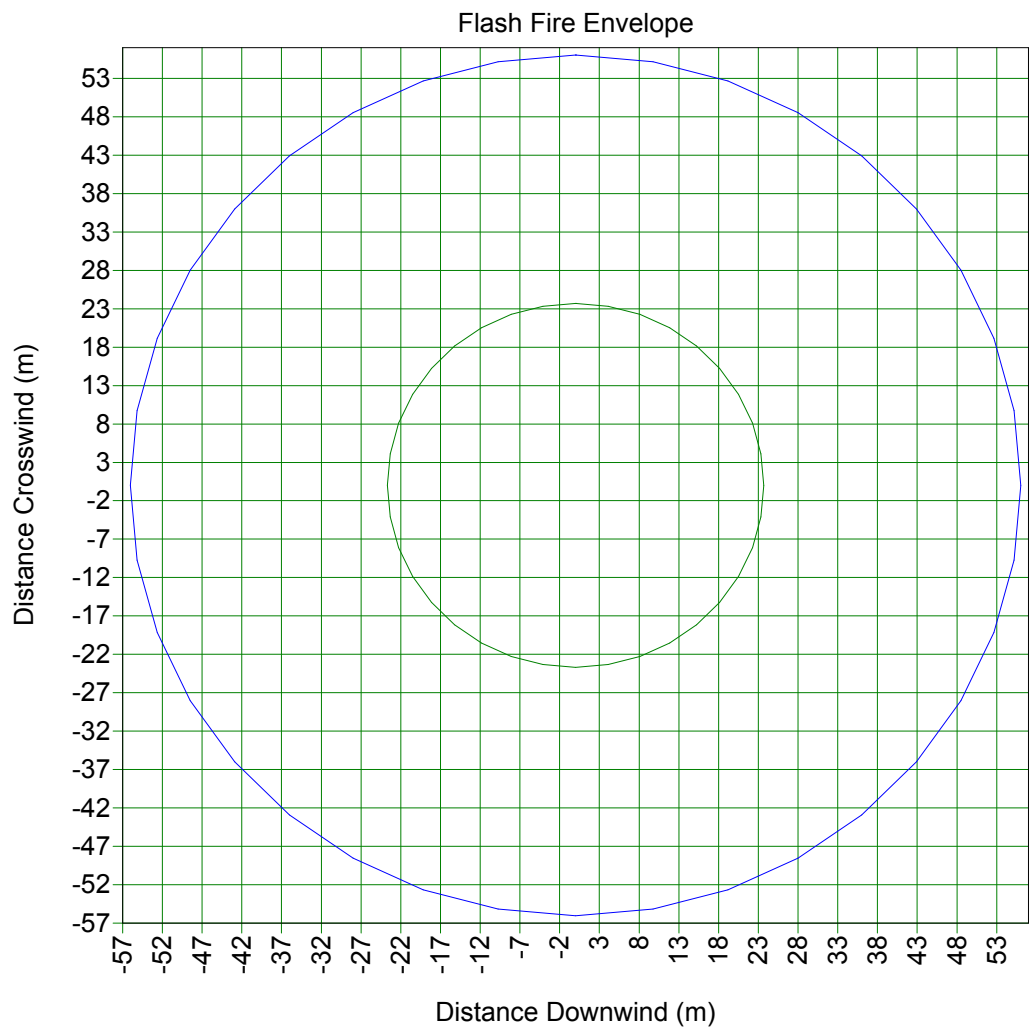
Il Direttore Generale

Ing. *Alfredo Romano*



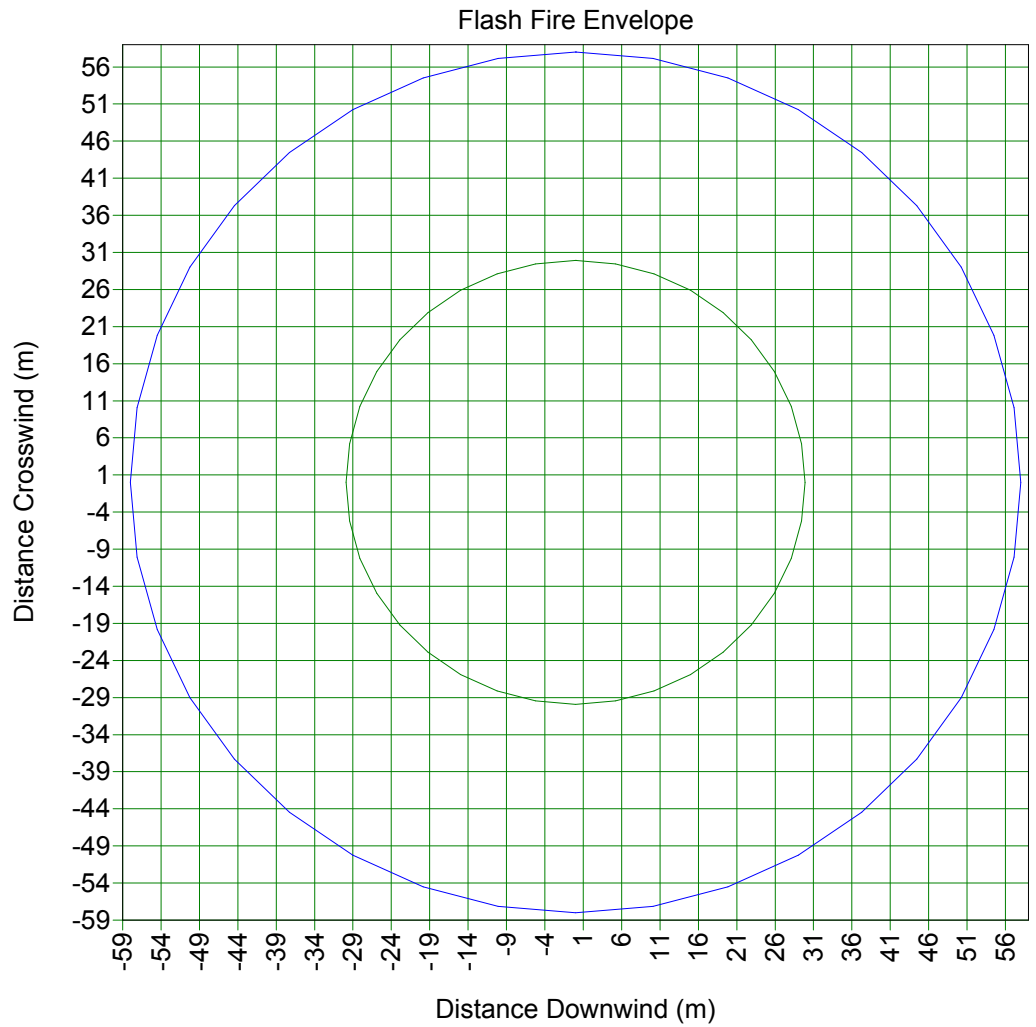
Study Folder: 70977-Fase
1-lp18
Audit No: 65705
Model: 25mm
Weather: Category 5/D
Material: METHANE
Concentration

— 2.2e+004 ppm
— 4.4e+004 ppm



Study Folder: 70977-Fase
1-lp18
Audit No: 65705
Model: 25mm
Weather: Category 2/F
Material: METHANE
Concentration

— 2.2e+004 ppm
— 4.4e+004 ppm



JET FIRE REPORT

Study Folder: 70977-Fase 1-Ip18

Unique Audit Number: 65.705



Phast 6.6

70977-Fase 1-Ip18

Compressore

25mm

Base Case

Data



Weather: Global Weathers\Category 2/F

Speed: 2,00 m/s

Stability: F

\\70977-Fase 1-Ip18\Compressore\25mm

Flame Data

User-Defined Quantities

	API	
Model Correlation Type	METHANE	
Material		
Ambient Temperature	25,00	degC
Ambient Relative Humidity	0,75	fraction
Ambient Wind Speed	2,00	m/s
Maximum Exposure Duration	20,00	s
Elevation	1,00	m
Expanded Temperature	19,33	degC
Release Rate	6,81	kg/s

	Input	Output	
Flame Emissive Power		120,65	kW/m2
Fraction of Emissivity		0,15	fraction
Expanded Radius		0,08	m
Jet Velocity	500,00	500,00	m/s
Flame Length		39,19	m
Maximum Flame Radius		2,44	m

Flame Co-ordinates

X	Z	R	Phi
m	m	m	deg
0,00	1,00	0,08	90,00
4,35	1,00	0,94	90,00
8,71	1,00	1,55	90,00
13,06	1,00	1,99	90,00
17,42	1,00	2,27	90,00
21,77	1,00	2,42	90,00
26,12	1,00	2,41	90,00
30,48	1,00	2,22	90,00
34,83	1,00	1,73	90,00
39,19	1,00	0,00	90,00



Radiation Intensity Ellipse

User-Defined Quantities

Observer Inclination	Variable	deg
Observer Orientation	Variable	deg
Exposure Duration	20,00	s
Effect Height	0,00	m

Calculated Quantities

Incident Radiation Level:	3,00	kW/m2
Lethality Level	0,00	%
View Factor	0,02	
Dose Level	865.118,83	(W/m2)^Probit N.s

Downwind semi-axis (A)	23,60	m
Crosswind semi-axis (B)	33,83	m
Offset Ratio (D)	0,90	
Effect Distance	44,96	m
Area	2.508,60	m2

Incident Radiation Level:	5,00	kW/m2
Lethality Level	0,00	%
View Factor	0,04	
Dose Level	1.709.490,54	(W/m2)^Probit N.s

Downwind semi-axis (A)	21,90	m
Crosswind semi-axis (B)	25,54	m
Offset Ratio (D)	0,94	
Effect Distance	42,43	m
Area	1.757,76	m2

Incident Radiation Level:	7,00	kW/m2
Lethality Level	0,02	%
View Factor	0,06	
Dose Level	2.677.313,40	(W/m2)^Probit N.s

Downwind semi-axis (A)	21,03	m
Crosswind semi-axis (B)	20,97	m
Offset Ratio (D)	0,96	
Effect Distance	41,20	m
Area	1.385,66	m2

JET FIRE REPORT

Study Folder: 70977-Fase 1-Ip18

Unique Audit Number: 65.705



Phast 6.6

Incident Radiation Level:	12,50	kW/m2
Lethality Level	6,53	%
View Factor	0,10	
Dose Level	5.800.161,90	(W/m2)^Probit N.s
Downwind semi-axis (A)	19,92	m
Crosswind semi-axis (B)	14,46	m
Offset Ratio (D)	1,00	
Effect Distance	39,76	m
Area	905,09	m2

JET FIRE REPORT

Study Folder: 70977-Fase 1-Ip18

Unique Audit Number: 65.705



Phast 6.6

Radiation Distance

User-Defined Quantities

Maximum Distance	500,00	m
Angle from Wind Direction	0,00	deg
Height above Origin	0,00	m
Observer Inclination	Variable	deg
Observer Orientation	Variable	deg

Calculated Quantities

X Coordinates m	Y Coordinates m	Z Coordinates m	Incident Radiation kW/m2	Lethality Level %	View Factor
0,00			13,99		
10,20			120,65		
20,41			120,65		
30,61			120,65		
40,82			8,06		
51,02			1,19		
61,22			0,48		
71,43			0,26		
81,63			0,17		
91,84			0,12		
102,04			0,08		
112,24			0,06		
122,45			0,05		
132,65			0,04		
142,86			0,03		
153,06			0,03		
163,27			0,02		
173,47			0,02		
183,67			0,02		
193,88			0,02		
204,08			0,01		
214,29			0,01		
224,49			0,01		
234,69			0,01		
244,90			0,01		
255,10			0,01		
265,31			0,01		
275,51			0,01		
285,71			0,01		
295,92			0,01		
306,12			0,01		
316,33			0,00		
326,53			0,00		
336,73			0,00		
346,94			0,00		
357,14			0,00		
367,35			0,00		

JET FIRE REPORT


Study Folder: 70977-Fase 1-1p18

Unique Audit Number: 65.705



Phast 6.6

X Coordinates m	Y Coordinates m	Z Coordinates m	Incident Radiation kW/m2	Lethality Level %	View Factor
377,55			0,00		
387,76			0,00		
397,96			0,00		
408,16			0,00		
418,37			0,00		
428,57			0,00		
438,78			0,00		
448,98			0,00		
459,18			0,00		
469,39			0,00		
479,59			0,00		
489,80			0,00		
500,00			0,00		

 **Weather:** Global Weathers\Category 5/D
Speed: 5.00 **m/s** **Stability:** D

\70977-Fase 1-1p18\Compressore\25mm

Flame Data

User-Defined Quantities

	API
Model Correlation Type	METHANE
Material	
Ambient Temperature	25,00 degC
Ambient Relative Humidity	0,75 fraction
Ambient Wind Speed	5,00 m/s
Maximum Exposure Duration	20,00 s
Elevation	1,00 m
Expanded Temperature	19,33 degC
Release Rate	6,81 kg/s

	Input	Output
Flame Emissive Power		120,65 kW/m2
Fraction of Emissivity		0,15 fraction
Expanded Radius		0,08 m
Jet Velocity	500,00	500,00 m/s
Flame Length		39,19 m
Maximum Flame Radius		2,44 m

JET FIRE REPORT

Study Folder: 70977-Fase 1-Ip18

Unique Audit Number: 65.705



Phast 6.6

Flame Co-ordinates

X	Z	R	Phi
m	m	m	deg
0,00	1,00	0,08	90,00
4,35	1,00	0,94	90,00
8,71	1,00	1,55	90,00
13,06	1,00	1,99	90,00
17,42	1,00	2,27	90,00
21,77	1,00	2,42	90,00
26,12	1,00	2,41	90,00
30,48	1,00	2,22	90,00
34,83	1,00	1,73	90,00
39,19	1,00	0,00	90,00



Radiation Intensity Ellipse

User-Defined Quantities

Observer Inclination	Variable	deg
Observer Orientation	Variable	deg
Exposure Duration	20,00	s
Effect Height	0,00	m

Calculated Quantities

Incident Radiation Level:	3,00	kW/m2
Lethality Level	0,00	%
View Factor	0,02	
Dose Level	865.118,83	(W/m2)^Probit N.s

Downwind semi-axis (A)	23,60	m
Crosswind semi-axis (B)	33,83	m
Offset Ratio (D)	0,90	
Effect Distance	44,96	m
Area	2.508,60	m2

Incident Radiation Level:	5,00	kW/m2
Lethality Level	0,00	%
View Factor	0,04	
Dose Level	1.709.490,54	(W/m2)^Probit N.s

Downwind semi-axis (A)	21,90	m
Crosswind semi-axis (B)	25,54	m
Offset Ratio (D)	0,94	
Effect Distance	42,43	m
Area	1.757,76	m2

Incident Radiation Level:	7,00	kW/m2
Lethality Level	0,02	%
View Factor	0,06	
Dose Level	2.677.313,40	(W/m2)^Probit N.s

Downwind semi-axis (A)	21,03	m
Crosswind semi-axis (B)	20,97	m
Offset Ratio (D)	0,96	
Effect Distance	41,20	m
Area	1.385,66	m2

JET FIRE REPORT

Study Folder: 70977-Fase 1-Ip18

Unique Audit Number: 65.705



Phast 6.6

Incident Radiation Level:	12,50	kW/m2
Lethality Level	6,53	%
View Factor	0,10	
Dose Level	5.800.161,90	(W/m2)^Probit N.s
Downwind semi-axis (A)	19,92	m
Crosswind semi-axis (B)	14,46	m
Offset Ratio (D)	1,00	
Effect Distance	39,76	m
Area	905,09	m2

JET FIRE REPORT

Study Folder: 70977-Fase 1-Ip18

Unique Audit Number: 65.705



Phast 6.6

Radiation Distance

User-Defined Quantities

Maximum Distance	500,00	m
Angle from Wind Direction	0,00	deg
Height above Origin	0,00	m
Observer Inclination	Variable	deg
Observer Orientation	Variable	deg

Calculated Quantities

X Coordinates m	Y Coordinates m	Z Coordinates m	Incident Radiation kW/m2	Lethality Level %	View Factor
0,00			13,99		
10,20			120,65		
20,41			120,65		
30,61			120,65		
40,82			8,06		
51,02			1,19		
61,22			0,48		
71,43			0,26		
81,63			0,17		
91,84			0,12		
102,04			0,08		
112,24			0,06		
122,45			0,05		
132,65			0,04		
142,86			0,03		
153,06			0,03		
163,27			0,02		
173,47			0,02		
183,67			0,02		
193,88			0,02		
204,08			0,01		
214,29			0,01		
224,49			0,01		
234,69			0,01		
244,90			0,01		
255,10			0,01		
265,31			0,01		
275,51			0,01		
285,71			0,01		
295,92			0,01		
306,12			0,01		
316,33			0,00		
326,53			0,00		
336,73			0,00		
346,94			0,00		
357,14			0,00		
367,35			0,00		

JET FIRE REPORT

Study Folder: 70977-Fase 1-Ip18

Unique Audit Number: 65.705

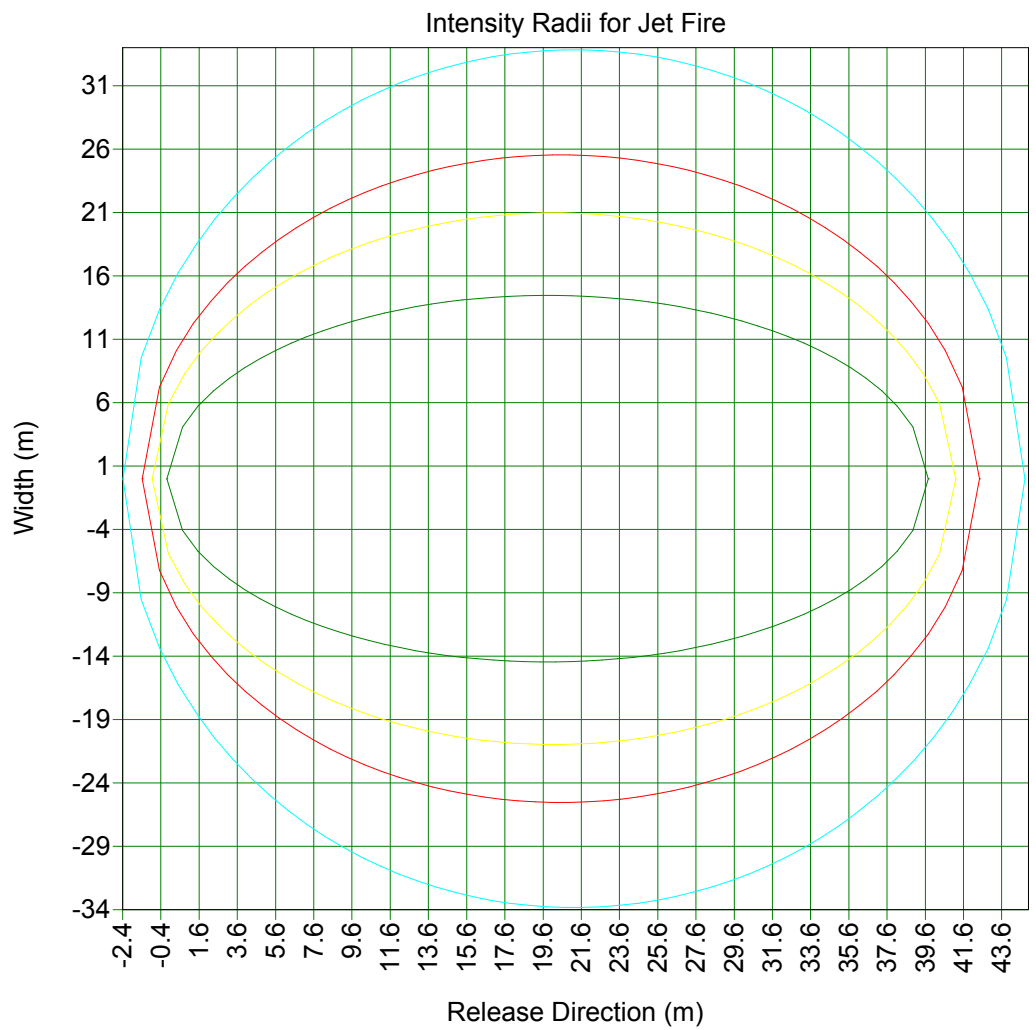


Phast 6.6

X Coordinates m	Y Coordinates m	Z Coordinates m	Incident Radiation kW/m2	Lethality Level %	View Factor
377,55			0,00		
387,76			0,00		
397,96			0,00		
408,16			0,00		
418,37			0,00		
428,57			0,00		
438,78			0,00		
448,98			0,00		
459,18			0,00		
469,39			0,00		
479,59			0,00		
489,80			0,00		
500,00			0,00		

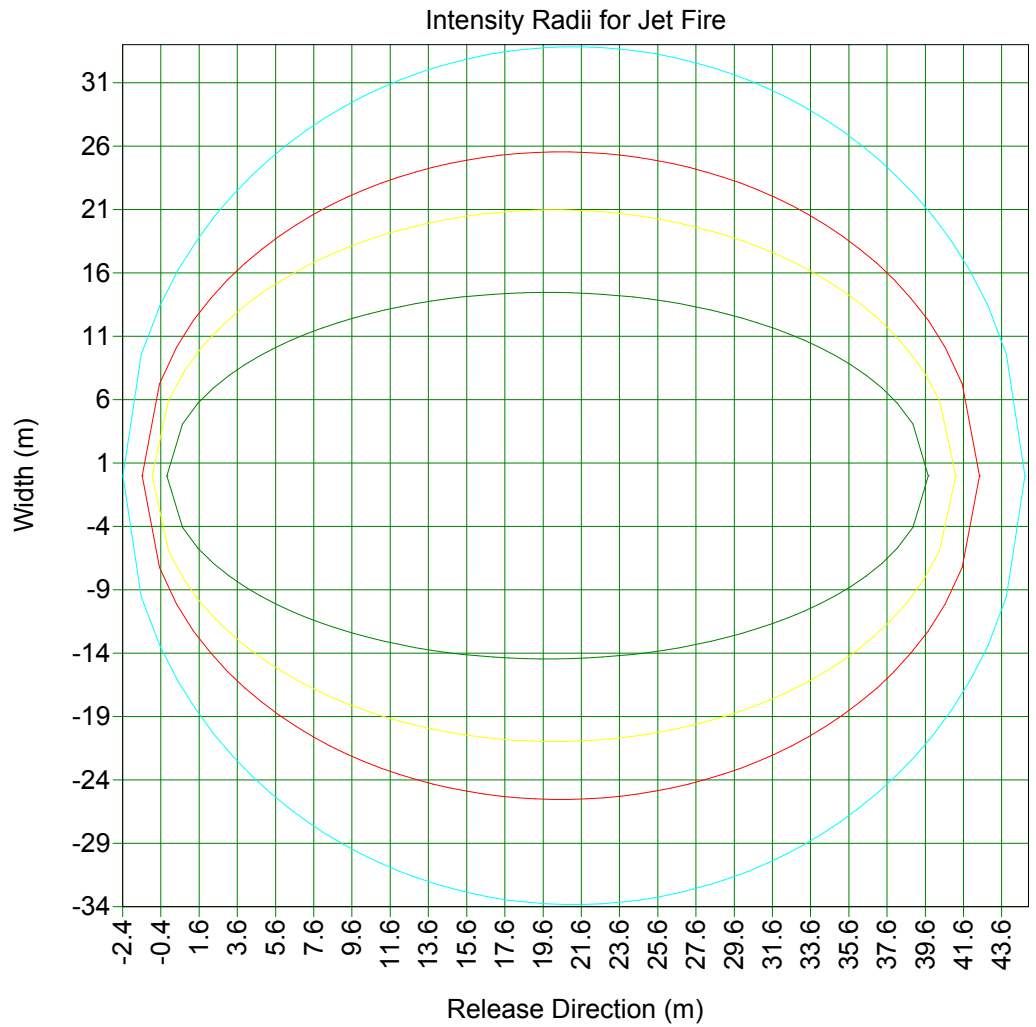
Study Folder: 70977-Fase
1-lp18
Audit No: 65705
Model: 25mm
Weather: Category 5/D
Material: METHANE

- Ellipse @12.5 kW/m²
- Ellipse @7 kW/m²
- Ellipse @5 kW/m²
- Ellipse @3 kW/m²



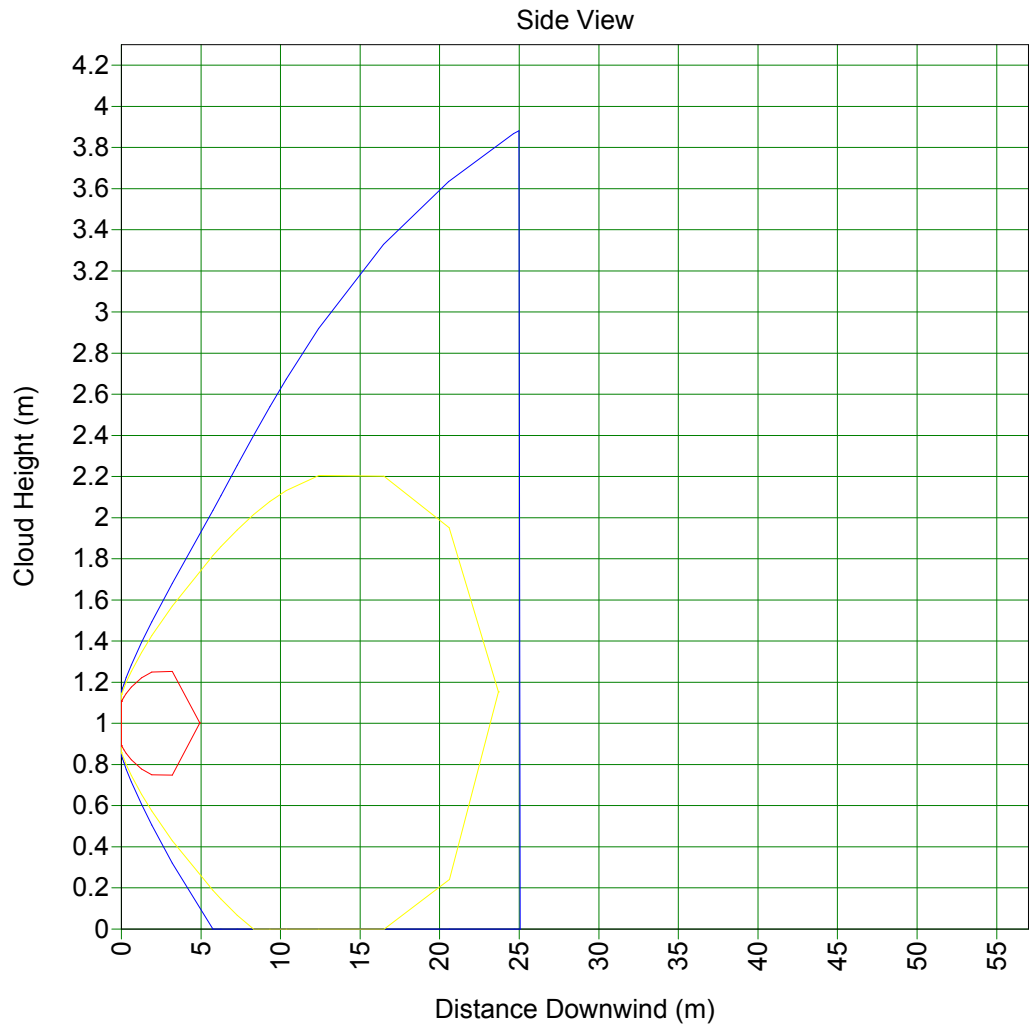
Study Folder: 70977-Fase
1-lp18
Audit No: 65705
Model: 25mm
Weather: Category 2/F
Material: METHANE

- Ellipse @12.5 kW/m²
- Ellipse @7 kW/m²
- Ellipse @5 kW/m²
- Ellipse @3 kW/m²



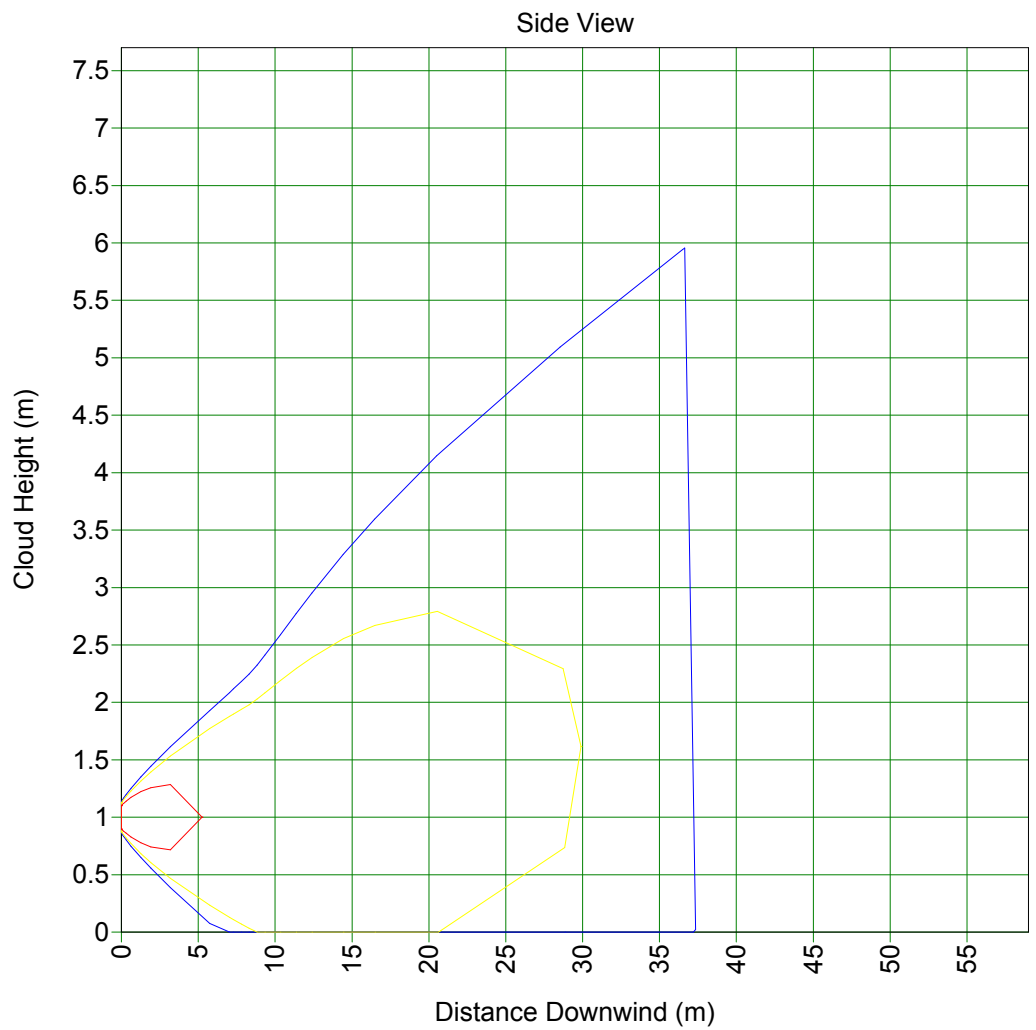
Study Folder: 70977-Fase
1-lp18
Audit No: 65705
Model: 25mm
Weather: Category 5/D
Material: METHANE
Averaging Time:
Flammable(18.75 s)
C/L Offset: 0 m
Concentration
Time: 1.283 s

— 2.2e+004 ppm
— 4.4e+004 ppm
— 1.65e+005 ppm



Study Folder: 70977-Fase
1-lp18
Audit No: 65705
Model: 25mm
Weather: Category 2/F
Material: METHANE
Averaging Time:
Flammable(18.75 s)
C/L Offset: 0 m
Concentration
Time: 3.649 s

— 2.2e+004 ppm
— 4.4e+004 ppm
— 1.65e+005 ppm



SUMMARY REPORT

Unique Audit Number: 65.705



Study Folder: 70977-Fase 1-1p18

Phast 6.6

70977-Fase 1-1p18

Compressore

25mm

Base Case

CASE Name: Data

Path: \70977-Fase 1-1p18\Compressore\25mm

User-Defined Data

Material

Material Identifier	METHANE
Type of Vessel	Pressurized Gas
Pressure Specification	Pressure specified
Storage Pressure - gauge	100 bar
Temperature	100 degC
Mass Inventory	1300 kg

Scenario

Scenario Type	Leak
Phase to be Released	Vapor
Hole Diameter	25 mm
Building Wake Effect	None

Location

[Elevation	1 m]
Concentration of Interest	2.2E4 ppm
Averaging time associated with Concentration	Flammable
Distances for Radiation Modeling and Dispersion Scope(1)	50 m
Distances for Radiation Modeling and Dispersion Scope(2)	250 m
Distances for Radiation Modeling and Dispersion Scope(3)	500 m
Use ERPG averaging time	ERPG not selected
Use IDLH averaging time	IDLH not selected
Use STEL averaging time	STEL not selected
Supply a user defined averaging time	Not supplied

Bund

Status of Bund	No bund present
[Type of Bund Surface	Concrete]
[Bund Height	0 m]
[Bund Failure Modeling	Bund cannot fail]

Indoor/Outdoor

Location of release	Open air release
Outdoor Release Direction	Horizontal

Flammable

Explosion Method	TNT
Jet Fire Method	API Model

Dispersion

Late Ignition Location	No ignition location
Mass Inventory of material to Disperse	1300 kg

SUMMARY REPORT

Unique Audit Number: 65.705



Study Folder: 70977-Fase 1-Ip18

Phast 6.6

Fireball Parameters

[Mass Modification Factor 3]
[Calculation method for fireball DNV Recommended]
[TNO model flame temperature 1727 degC]

Toxic Parameters

[Indoor Calculations Unselected]
[Wind Dependent Exchange Rate Case Specified]
[Building Exchange Rate 4 /hr]
[Tail Time 1800 s]
[Set averaging time equal to exposure time Use a fixed averaging time]
[Cut-off fraction of toxic load for exposure time calculation 0.05 fraction]
[Cut-off concentration for exposure time calculations 0 fraction]

Geometry

Shape Point
Dimension 2D
System Absolute
East(1) 0 m
North(1) 0 m

Path: \70977-Fase 1-Ip18\Compressore\25mm

Discharge Data

User-Defined Quantities

Material METHANE
Temperature 100,00 degC
Pressure 101,01 bar
Inventory 1.300,00 kg
Scenario Leak
Fixed Duration n/a s

Calculated Quantities

Weather: Global Weathers\Category 2/F

Mass Flow of Air (Vent from Vapor Space Only) n/a

Average Values for Segment Number 1

Liquid Fraction 0,00 fraction
Final Temperature 19,33 degC
Final Velocity 500,00 m/s
Droplet Diameter 0,00 um

Continuous Release Data:

Mass Flowrate 6.80507E+000 kg/s
Release Duration 191,03 s
Orifice Velocity 462,46 m/s
Exit Pressure 54,05 bar
Exit Temperature 48,46 degC
Discharge Coefficient 0,87
Expanded Radius 0,08 m

SUMMARY REPORT

Study Folder: 70977-Fase 1-1p18

Unique Audit Number: 65.705

Phast 6.6



Weather: Global Weathers\Category 5/D

Mass Flow of Air (Vent from Vapor Space Only) n/a

Average Values for Segment Number 1

Liquid Fraction 0,00 fraction

Final Temperature 19,33 degC

Final Velocity 500,00 m/s

Droplet Diameter 0,00 um

Continuous Release Data:

Mass Flowrate 6.80507E+000 kg/s

Release Duration 191,03 s

Orifice Velocity 462,46 m/s

Exit Pressure 54,05 bar

Exit Temperature 48,46 degC

Discharge Coefficient 0,87

Expanded Radius 0,08 m

SUMMARY REPORT

Study Folder: 70977-Fase 1-1p18

Unique Audit Number: 65.705

Phast 6.6



Consequence Results

Distance to Concentration Results

Path: \70977-Fase 1-1p18\Compressore\25mm

The height for user defined concentrations is the user defined height 0 m
All toxic results are reported at the toxic effect height 0 m
All flammable results are reported at the cloud centreline height

Concentration(ppm) Averaging Time				Distance (m)	
				Category 2/F	Category 5/D
User Conc (22000)	18.75	s		46.3494	47.5216
UFL (165000)	18.75	s		5.25344	4.93554
LFL (44000)	18.75	s		29.9039	23.6873
LFL Frac (22000)	18.75	s		58.013	56.0257

Concentration(ppm) Averaging Time				Heights (m) for above distances	
				Category 2/F	Category 5/D
User Conc (22000)	18.75	s		0	0
UFL (165000)	18.75	s		1.00182	1.00158
LFL (44000)	18.75	s		1.61563	1.15316
LFL Frac (22000)	18.75	s		6.24835	2.90212

SUMMARY REPORT

Study Folder: 70977-Fase 1-1p18

Unique Audit Number: 65.705

Phast 6.6



Concentration At Distance Results

Path: \70977-Fase 1-1p18\Compressore\25mm

The height for user defined concentrations is the user defined height 0 m
All toxic results are reported at the toxic effect height 0 m
All flammable results are reported at the cloud centreline height

Distance		Conc.(ppm) at Flammable Avg. Time of 18.75 s	
		Category 2/F	Category 5/D
50	m	27710.7	24791.5
250	m	1167.45	1573.26
500	m	744.641	511.268

Distance		Heights (m) for above concentrations	
		Category 2/F	Category 5/D
50	m	4.51133	2.39539
250	m	31.0308	15.3899
500	m	49.8036	23.2058

Distance		Conc.(ppm) at Core Avg. Time of 18.75 s	
		Category 2/F	Category 5/D
50	m	27710.7	24791.5
250	m	1167.45	1573.26
500	m	744.641	511.268

Distance		Heights (m) for above concentrations	
		Category 2/F	Category 5/D
50	m	4.51133	2.39539
250	m	31.0308	15.3899
500	m	49.8036	23.2058

Jet Fire Hazard

Path: \70977-Fase 1-1p18\Compressore\25mm

Jet fire method used: API

	Category 2/F	Category 5/D
Jet Fire Status	Hazard	Hazard
Flame Direction	Horizontal	Horizontal

Radiation Effects: Jet Fire Ellipse

Path: \70977-Fase 1-1p18\Compressore\25mm

This table gives the distances to the specified radiation levels for each jet fire listed in the above hazard table

			Distance (m)	
			Category 2/F	Category 5/D
Radiation Level	12.5	kW/m2	39.7648	39.7648
Radiation Level	7	kW/m2	41.1997	41.1997
Radiation Level	5	kW/m2	42.4344	42.4344
Radiation Level	3	kW/m2	44.9555	44.9555

SUMMARY REPORT

Study Folder: 70977-Fase 1-1p18

Unique Audit Number: 65.705

Phast 6.6



Radiation Effects: Jet Fire Distance

Path: \70977-Fase 1-1p18\Compressore\25mm

		Radiation Level (kW/m2)	
		Category 2/F	Category 5/D
Distance Of Interest 50	m	1.34665	1.34665
Distance Of Interest 250	m	0.00833546	0.00833546
Distance Of Interest 500	m	0.00163613	0.00163613

Flash Fire Envelope

Path: \70977-Fase 1-1p18\Compressore\25mm

All flammable results are reported at the cloud centreline height

			Distance (m)	
			Category 2/F	Category 5/D
Furthest Extent	22000	ppm	58.013	56.0257
Furthest Extent	44000	ppm	29.9039	23.6873

			Heights (m) for above distances	
			Category 2/F	Category 5/D
Furthest Extent	22000	ppm	6.24835	2.90212
Furthest Extent	44000	ppm	1.61563	1.15316

SUMMARY REPORT

Study Folder: 70977-Fase 1-Ip18

Unique Audit Number: 65.705

Phast 6.6



Explosion Effects: Late Ignition

Path: \70977-Fase 1-Ip18\Compressore\25mm

Explosion Model Used : TNT

Explosion Location Criterion: Cloud Front (LFL Fraction)

All distances are measured from the Source

All flammable results are reported at the cloud centreline height

			Maximum Distance (m) at Overpressure Level	
			Category 2/F	Category 5/D
Overpressure	0.02068	bar	107.049	95.1862
Overpressure	0.1379	bar	64.7713	61.6998
Overpressure	0.2068	bar	61.4297	59.0531

			Supplementary Data at 0.02068 bar	
			Category 2/F	Category 5/D
Supplied Flammable Mass		kg	4.76433	2.36748
Used Flammable Mass		kg	4.76433	2.36748
Overpressure Radius		m	57.0486	45.1862
Distance to:				
- Ignition Source		m	50	50
- Cloud Front/Centre		m	50	50
- Explosion Centre		m	50	50

			Supplementary Data at 0.1379 bar	
			Category 2/F	Category 5/D
Supplied Flammable Mass		kg	4.76433	2.36748
Used Flammable Mass		kg	4.76433	2.36748
Overpressure Radius		m	14.7713	11.6998
Distance to:				
- Ignition Source		m	50	50
- Cloud Front/Centre		m	50	50
- Explosion Centre		m	50	50

			Supplementary Data at 0.2068 bar	
			Category 2/F	Category 5/D
Supplied Flammable Mass		kg	4.76433	2.36748
Used Flammable Mass		kg	4.76433	2.36748
Overpressure Radius		m	11.4297	9.05306
Distance to:				
- Ignition Source		m	50	50
- Cloud Front/Centre		m	50	50
- Explosion Centre		m	50	50

			Overpressures (bar gauge) at Distances	
			Category 2/F	Category 5/D
Distance	50	m	1	1
Distance	250	m	0.00507657	0.00406288
Distance	500	m	0.00246023	0.002052

			Supplementary Data at 50 m	
			Category 2/F	Category 5/D
Supplied Flammable Mass		kg	4.76433	2.36748

SUMMARY REPORT

Study Folder: 70977-Fase 1-Ip18

Unique Audit Number: 65.705

Phast 6.6



Used Flammable Mass	kg	4.76433	2.36748
Supplementary Data at 250 m			
		Category 2/F	Category 5/D
Supplied Flammable Mass	kg	4.76433	2.36748
Used Flammable Mass	kg	4.76433	2.36748
Supplementary Data at 500 m			
		Category 2/F	Category 5/D
Supplied Flammable Mass	kg	4.76433	2.36748
Used Flammable Mass	kg	4.76433	2.36748

Weather Conditions

Path: \70977-Fase 1-Ip18\Compressore\25mm

		Category 2/F	Category 5/D
Wind Speed	m/s	2	5
Pasquill Stability		F	D
Surface Roughness Length	mm	1000	1000
Surface Roughness Parameter		0.173718	0.173718
Atmospheric Temperature	degC	25	25
Surface Temperature	degC	25	25
Relative Humidity	fraction	0.75	0.75