

## **ANNESSO TECNICO 6.**

### **Elaborati di calcolo Scenari incidentali ragionevolmente credibili**

### ***Ipotesi N. 22***

TRR S.r.l.

Il Direttore Generale

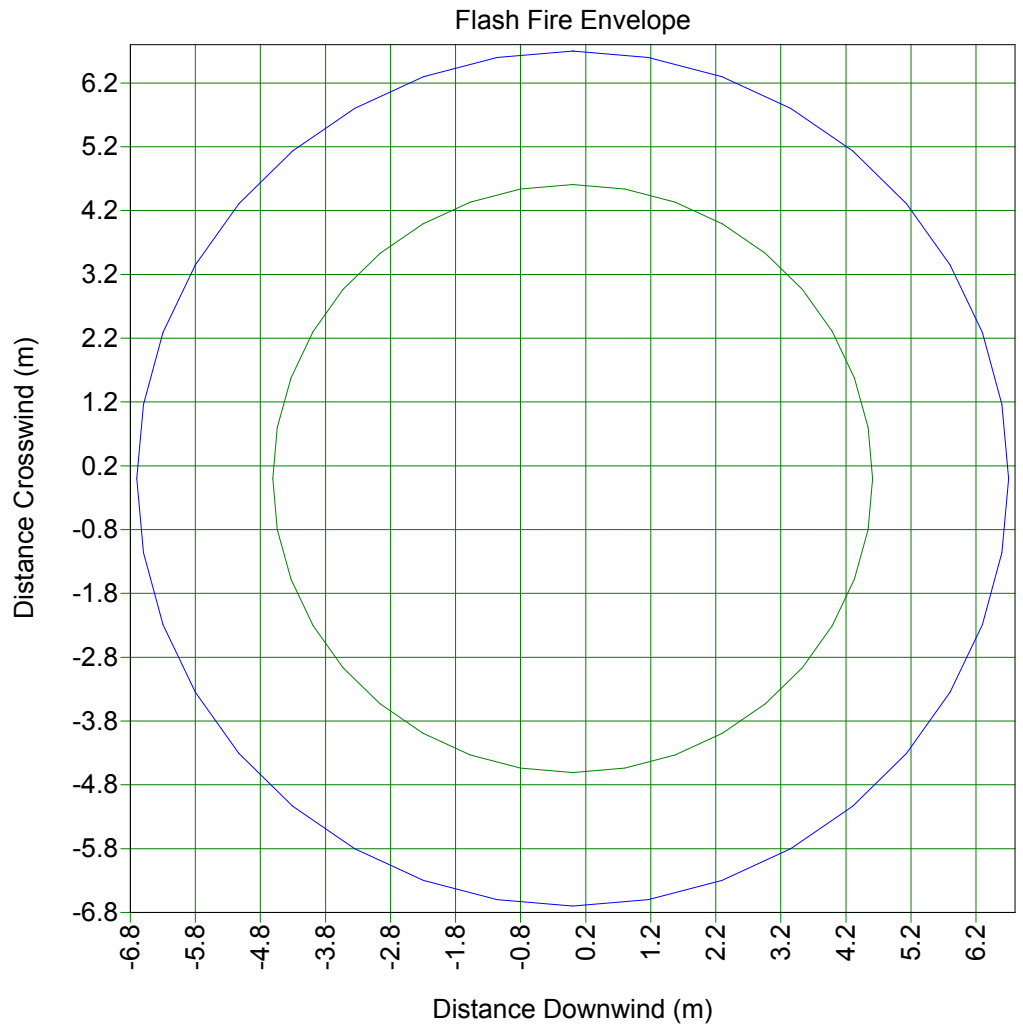
Ing. *Alfredo Romano*





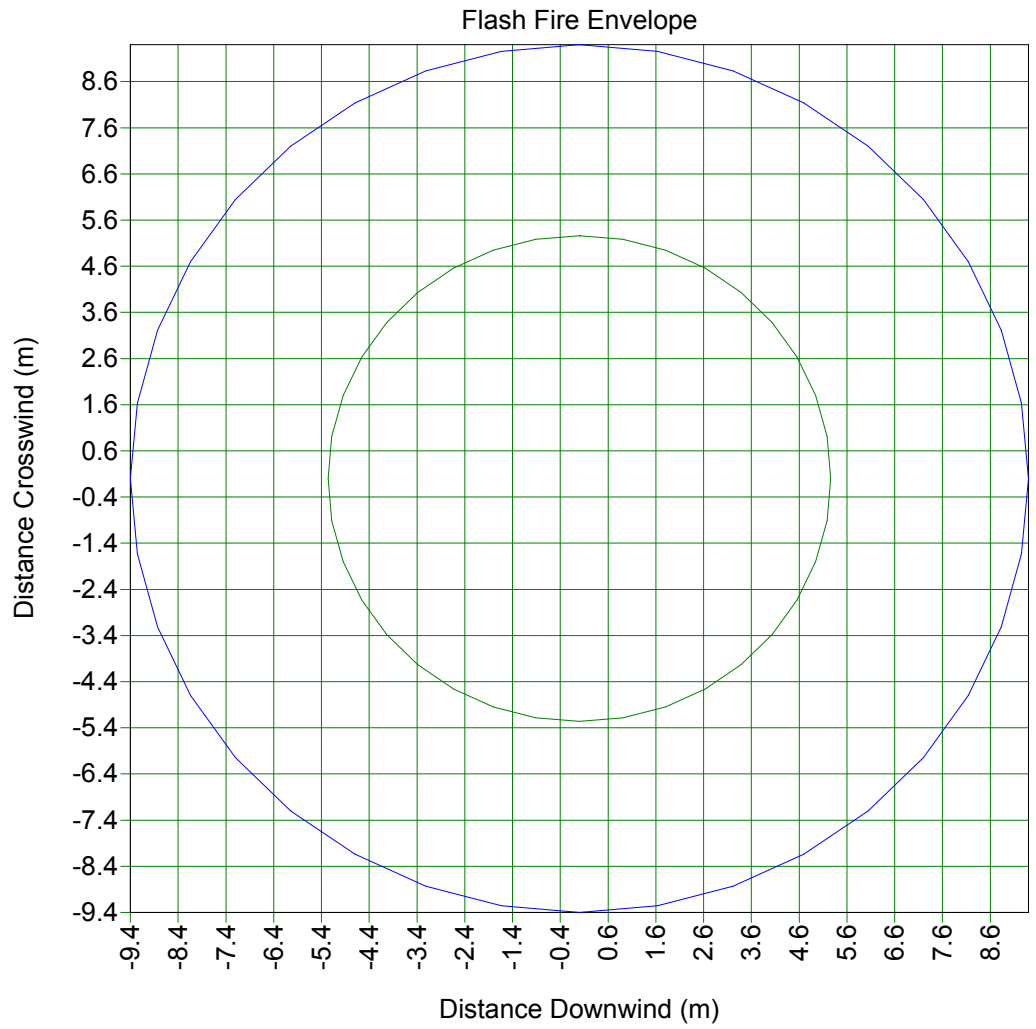
Study Folder: 70977-Fase  
1-lp22  
Audit No: 65844  
Model: 10mm  
Weather: Category 5/D  
Material: METHANE  
Concentration

— 2.2e+004 ppm  
— 4.4e+004 ppm



Study Folder: 70977-Fase  
1-lp22  
Audit No: 65844  
Model: 10mm  
Weather: Category 2/F  
Material: METHANE  
Concentration

— 2.2e+004 ppm  
— 4.4e+004 ppm



# JET FIRE REPORT

Study Folder: 70977-Fase 1-Ip22

Unique Audit Number: 65.844



Phast 6.6

70977-Fase 1-Ip22

Filtri Gas Combustibile

10mm

Base Case

Data



Weather: Global Weathers\Category 2/F

Speed: 2,00 m/s

Stability: F

\70977-Fase 1-Ip22\Filtri Gas Combustibile\10mm

## 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	-26,43	degC
Release Rate	0,42	kg/s

### Input

### Output

Flame Emissive Power	106,74	kW/m2
Fraction of Emissivity	0,15	fraction
Expanded Radius	0,02	m
Jet Velocity	500,00	500,00 m/s
Flame Length		10,31 m
Maximum Flame Radius		0,64 m

### Flame Co-ordinates

X	Z	R	Phi
m	m	m	deg
0,00	1,00	0,02	90,00
1,15	1,00	0,25	90,00
2,29	1,00	0,41	90,00
3,44	1,00	0,52	90,00
4,58	1,00	0,60	90,00
5,73	1,00	0,64	90,00
6,88	1,00	0,63	90,00
8,02	1,00	0,58	90,00
9,17	1,00	0,46	90,00
10,31	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**

<b>Incident Radiation Level:</b>	<b>3,00</b>	<b>kW/m2</b>
Lethality Level	0,00	%
View Factor	0,03	
Dose Level	865.118,83	(W/m2)^Probit N.s

Downwind semi-axis (A)	6,59	m
Crosswind semi-axis (B)	8,81	m
Offset Ratio (D)	0,83	
Effect Distance	12,04	m
Area	182,58	m2

<b>Incident Radiation Level:</b>	<b>5,00</b>	<b>kW/m2</b>
Lethality Level	0,00	%
View Factor	0,05	
Dose Level	1.709.490,54	(W/m2)^Probit N.s

Downwind semi-axis (A)	5,93	m
Crosswind semi-axis (B)	6,60	m
Offset Ratio (D)	0,91	
Effect Distance	11,35	m
Area	122,96	m2

<b>Incident Radiation Level:</b>	<b>7,00</b>	<b>kW/m2</b>
Lethality Level	0,02	%
View Factor	0,07	
Dose Level	2.677.313,40	(W/m2)^Probit N.s

Downwind semi-axis (A)	5,53	m
Crosswind semi-axis (B)	5,38	m
Offset Ratio (D)	0,98	
Effect Distance	10,95	m
Area	93,45	m2

# JET FIRE REPORT

Study Folder: 70977-Fase 1-1p22

Unique Audit Number: 65.844



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<b>Incident Radiation Level:</b>	<b>12,50</b>	kW/m2
Lethality Level	6,53	%
View Factor	0,12	
Dose Level	5.800.161,90	(W/m2)^Probit N.s
Downwind semi-axis (A)	5,05	m
Crosswind semi-axis (B)	3,62	m
Offset Ratio (D)	1,06	
Effect Distance	10,43	m
Area	57,51	m2

# JET FIRE REPORT

Study Folder: 70977-Fase 1-1p22

Unique Audit Number: 65.844



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## 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			8,23		
10,20			17,00		
20,41			0,22		
30,61			0,06		
40,82			0,03		
51,02			0,02		
61,22			0,01		
71,43			0,01		
81,63			0,01		
91,84			0,00		
102,04			0,00		
112,24			0,00		
122,45			0,00		
132,65			0,00		
142,86			0,00		
153,06			0,00		
163,27			0,00		
173,47			0,00		
183,67			0,00		
193,88			0,00		
204,08			0,00		
214,29			0,00		
224,49			0,00		
234,69			0,00		
244,90			0,00		
255,10			0,00		
265,31			0,00		
275,51			0,00		
285,71			0,00		
295,92			0,00		
306,12			0,00		
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-Ip22

Unique Audit Number: 65.844



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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-Ip22\Filtri Gas Combustibile\10mm

## 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	-26,43 degC
Release Rate	0,42 kg/s

	Input	Output
Flame Emissive Power		106,74 kW/m2
Fraction of Emissivity		0,15 fraction
Expanded Radius		0,02 m
Jet Velocity	500,00	500,00 m/s
Flame Length		10,31 m
Maximum Flame Radius		0,64 m

# JET FIRE REPORT

Study Folder: 70977-Fase 1-Ip22

Unique Audit Number: 65.844



Phast 6.6

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## Flame Co-ordinates

<b>X</b>	<b>Z</b>	<b>R</b>	<b>Phi</b>
m	m	m	deg
0,00	1,00	0,02	90,00
1,15	1,00	0,25	90,00
2,29	1,00	0,41	90,00
3,44	1,00	0,52	90,00
4,58	1,00	0,60	90,00
5,73	1,00	0,64	90,00
6,88	1,00	0,63	90,00
8,02	1,00	0,58	90,00
9,17	1,00	0,46	90,00
10,31	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**

<b>Incident Radiation Level:</b>	<b>3,00</b>	<b>kW/m2</b>
Lethality Level	0,00	%
View Factor	0,03	
Dose Level	865.118,83	(W/m2)^Probit N.s

Downwind semi-axis (A)	6,59	m
Crosswind semi-axis (B)	8,81	m
Offset Ratio (D)	0,83	
Effect Distance	12,04	m
Area	182,58	m2

<b>Incident Radiation Level:</b>	<b>5,00</b>	<b>kW/m2</b>
Lethality Level	0,00	%
View Factor	0,05	
Dose Level	1.709.490,54	(W/m2)^Probit N.s

Downwind semi-axis (A)	5,93	m
Crosswind semi-axis (B)	6,60	m
Offset Ratio (D)	0,91	
Effect Distance	11,35	m
Area	122,96	m2

<b>Incident Radiation Level:</b>	<b>7,00</b>	<b>kW/m2</b>
Lethality Level	0,02	%
View Factor	0,07	
Dose Level	2.677.313,40	(W/m2)^Probit N.s

Downwind semi-axis (A)	5,53	m
Crosswind semi-axis (B)	5,38	m
Offset Ratio (D)	0,98	
Effect Distance	10,95	m
Area	93,45	m2

# JET FIRE REPORT

Study Folder: 70977-Fase 1-Ip22

Unique Audit Number: 65.844



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<b>Incident Radiation Level:</b>	<b>12,50</b>	kW/m2
Lethality Level	6,53	%
View Factor	0,12	
Dose Level	5.800.161,90	(W/m2)^Probit N.s
Downwind semi-axis (A)	5,05	m
Crosswind semi-axis (B)	3,62	m
Offset Ratio (D)	1,06	
Effect Distance	10,43	m
Area	57,51	m2

# JET FIRE REPORT

Study Folder: 70977-Fase 1-1p22

Unique Audit Number: 65.844



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## 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			8,23		
10,20			17,00		
20,41			0,22		
30,61			0,06		
40,82			0,03		
51,02			0,02		
61,22			0,01		
71,43			0,01		
81,63			0,01		
91,84			0,00		
102,04			0,00		
112,24			0,00		
122,45			0,00		
132,65			0,00		
142,86			0,00		
153,06			0,00		
163,27			0,00		
173,47			0,00		
183,67			0,00		
193,88			0,00		
204,08			0,00		
214,29			0,00		
224,49			0,00		
234,69			0,00		
244,90			0,00		
255,10			0,00		
265,31			0,00		
275,51			0,00		
285,71			0,00		
295,92			0,00		
306,12			0,00		
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-Ip22

Unique Audit Number: 65.844



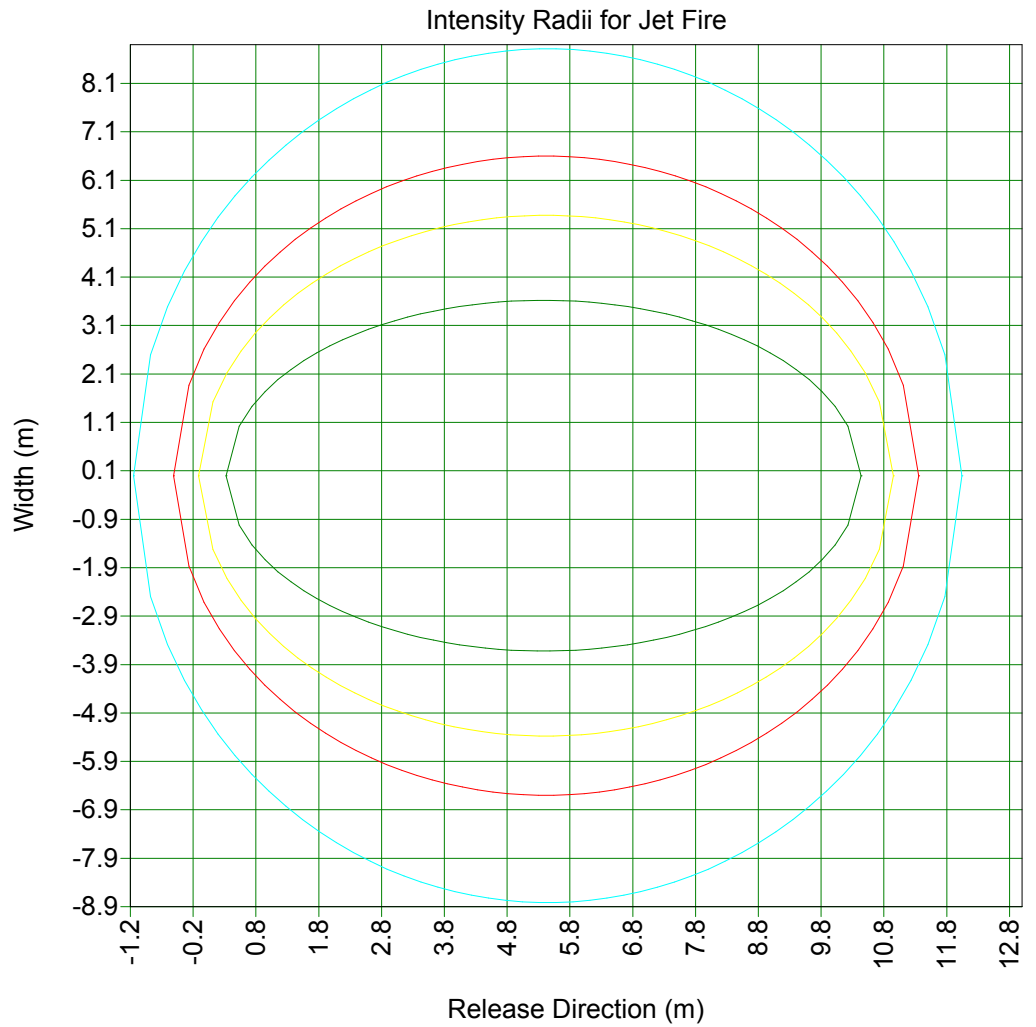
Phast 6.6

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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		

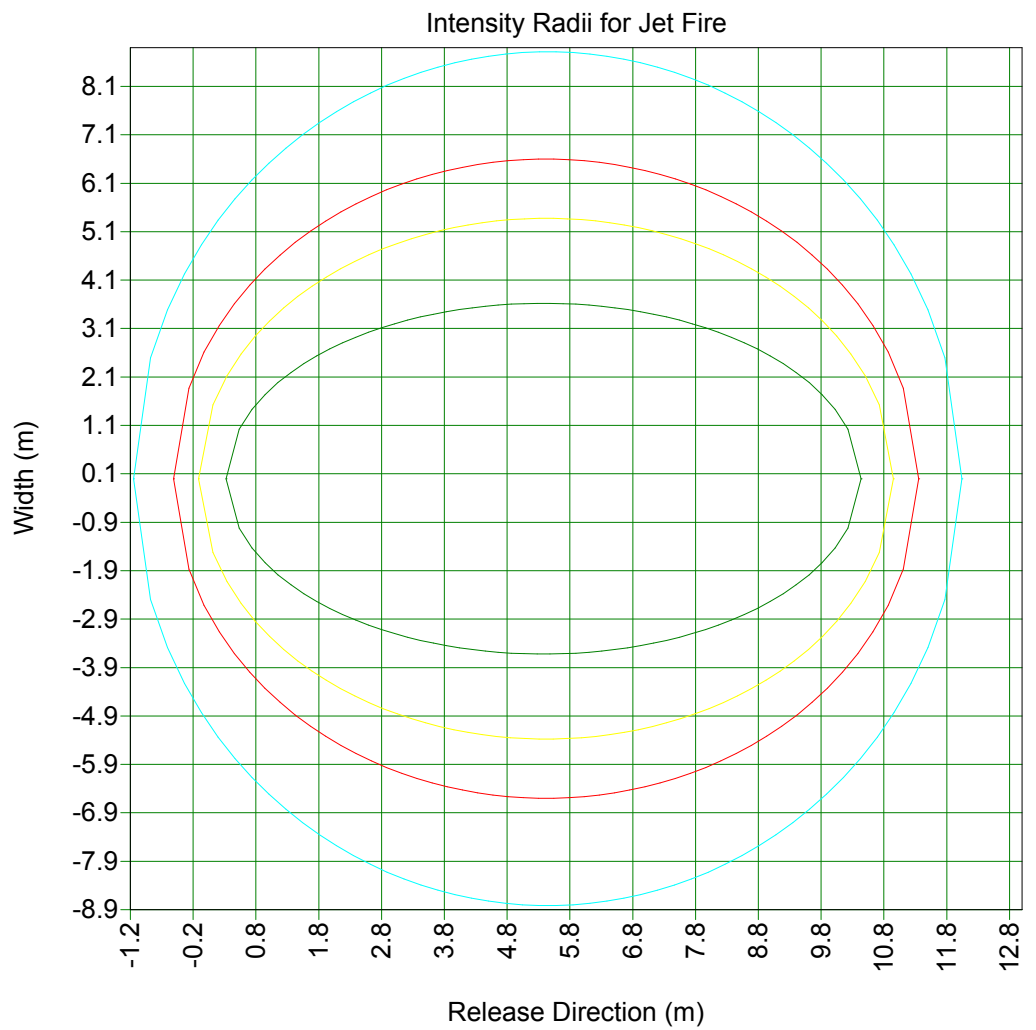
Study Folder: 70977-Fase  
1-lp22  
Audit No: 65844  
Model: 10mm  
Weather: Category 5/D  
Material: METHANE

- Ellipse @12.5 kW/m<sup>2</sup>
- Ellipse @7 kW/m<sup>2</sup>
- Ellipse @5 kW/m<sup>2</sup>
- Ellipse @3 kW/m<sup>2</sup>



Study Folder: 70977-Fase  
1-lp22  
Audit No: 65844  
Model: 10mm  
Weather: Category 2/F  
Material: METHANE

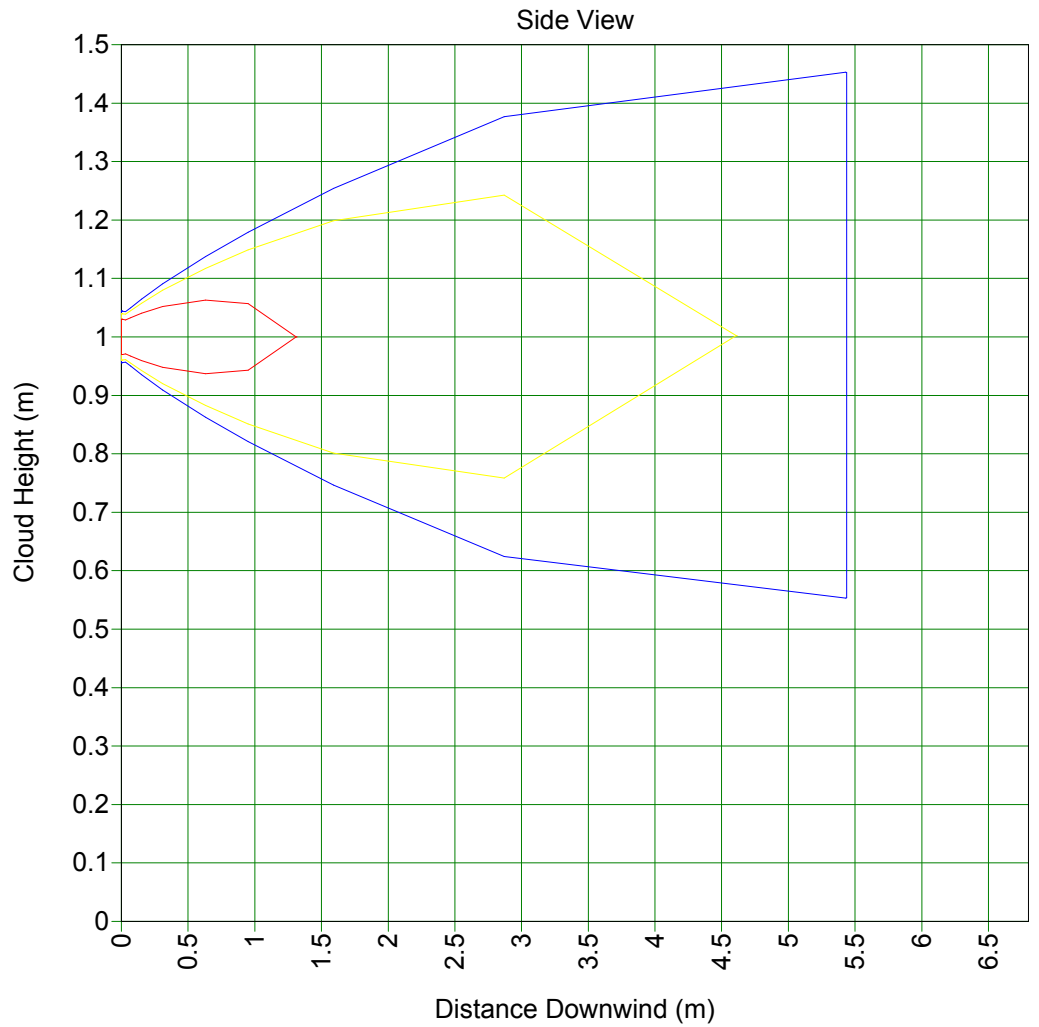
- Ellipse @12.5 kW/m<sup>2</sup>
- Ellipse @7 kW/m<sup>2</sup>
- Ellipse @5 kW/m<sup>2</sup>
- Ellipse @3 kW/m<sup>2</sup>





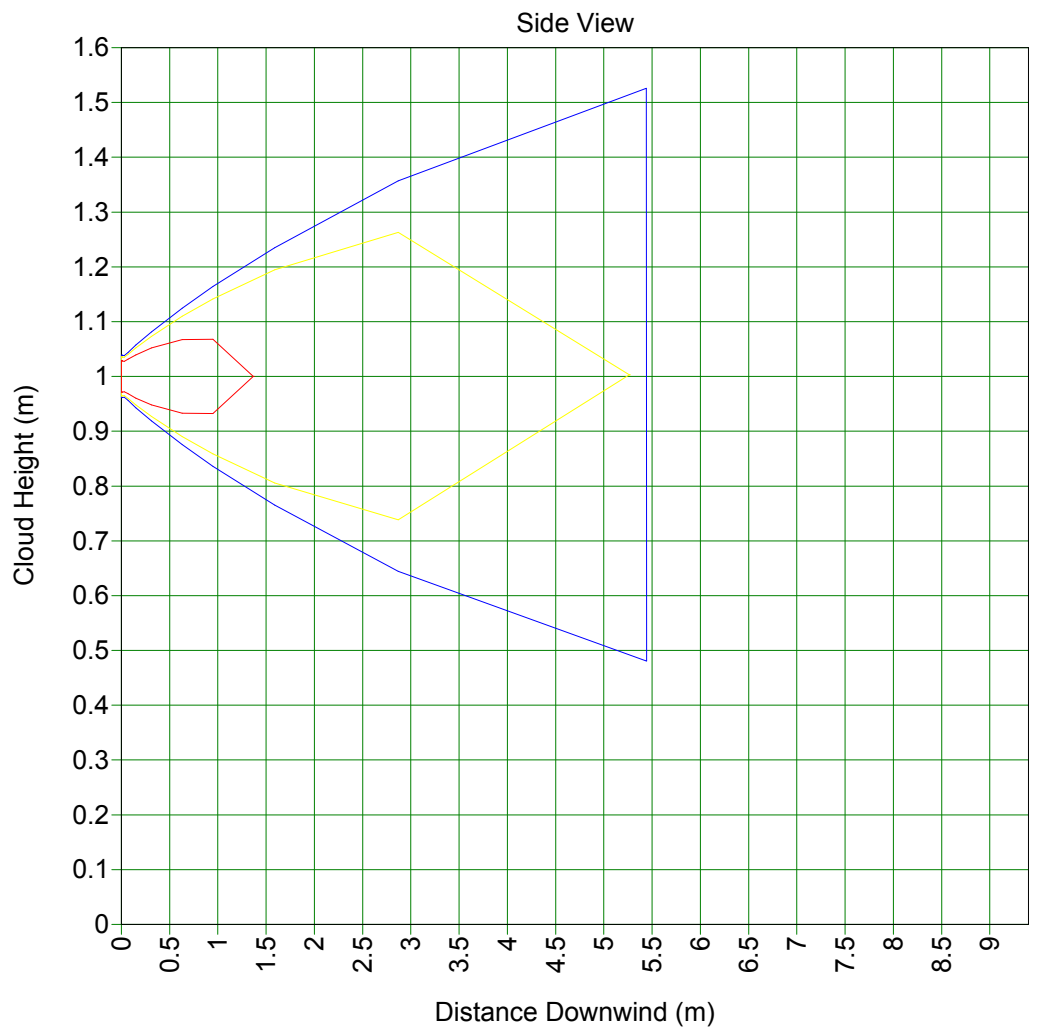
Study Folder: 70977-Fase  
1-lp22  
Audit No: 65844  
Model: 10mm  
Weather: Category 5/D  
Material: METHANE  
Averaging Time:  
Flammable(18.75 s)  
C/L Offset: 0 m  
Concentration  
Time: 0.2085 s

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



Study Folder: 70977-Fase  
1-lp22  
Audit No: 65844  
Model: 10mm  
Weather: Category 2/F  
Material: METHANE  
Averaging Time:  
Flammable(18.75 s)  
C/L Offset: 0 m  
Concentration  
Time: 0.2007 s

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



# SUMMARY REPORT

Unique Audit Number: 65.844



Study Folder: 70977-Fase 1-Ip22

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## 70977-Fase 1-Ip22

### Filtri Gas Combustibile

10mm

#### Base Case

CASE Name: Data

Path: \70977-Fase 1-Ip22\Filtri Gas Combustibile\10mm

#### User-Defined Data

##### Material

Material Identifier	METHANE
Type of Vessel	Pressurized Gas
Pressure Specification	Pressure specified
Storage Pressure - gauge	35 bar
Temperature	45 degC
Mass Inventory	100 kg

##### Scenario

Scenario Type	Leak
Phase to be Released	Vapor
Hole Diameter	10 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	100 kg

# SUMMARY REPORT

Unique Audit Number: 65.844



Study Folder: 70977-Fase 1-Ip22

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## 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-Ip22\Filtri Gas Combustibile\10mm

## Discharge Data

### User-Defined Quantities

Material METHANE  
Temperature 45,00 degC  
Pressure 36,01 bar  
Inventory 100,00 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 -26,43 degC  
Final Velocity 500,00 m/s  
Droplet Diameter 0,00 um

### Continuous Release Data:

Mass Flowrate 4.16953E-001 kg/s  
Release Duration 239,84 s  
Orifice Velocity 424,23 m/s  
Exit Pressure 19,46 bar  
Exit Temperature 0,26 degC  
Discharge Coefficient 0,87  
Expanded Radius 0,02 m

# SUMMARY REPORT

Study Folder: 70977-Fase 1-1p22

Unique Audit Number: 65.844

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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 -26,43 degC

Final Velocity 500,00 m/s

Droplet Diameter 0,00 um

Continuous Release Data:

Mass Flowrate 4.16953E-001 kg/s

Release Duration 239,84 s

Orifice Velocity 424,23 m/s

Exit Pressure 19,46 bar

Exit Temperature 0,26 degC

Discharge Coefficient 0,87

Expanded Radius 0,02 m

# SUMMARY REPORT

Study Folder: 70977-Fase 1-1p22

Unique Audit Number: 65.844

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## Consequence Results

### Distance to Concentration Results

**Path:** \70977-Fase 1-1p22\Filtri Gas Combustibile\10mm

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		No Hazard	No Hazard
UFL (165000)	18.75	s		1.3664	1.30891
LFL (44000)	18.75	s		5.26255	4.60949
LFL Frac (22000)	18.75	s		9.39856	6.70106

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		1.00009	1.00008
LFL (44000)	18.75	s		1.00317	1.0022
LFL Frac (22000)	18.75	s		1.0169	1.00526

# SUMMARY REPORT

Unique Audit Number: 65.844



Study Folder: 70977-Fase 1-IP22

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## Concentration At Distance Results

Path: \70977-Fase 1-IP22\Filtri Gas Combustibile\10mm

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	4370.25	3317.74
250	m	610.301	205.342
500	m	240.093	57.9835

Distance		Heights (m) for above concentrations	
		Category 2/F	Category 5/D
50	m	4.48487	1.64584
250	m	18.6003	3.60606
500	m	28.6865	4.36473

Distance		Conc.(ppm) at Core Avg. Time of 18.75 s	
		Category 2/F	Category 5/D
50	m	4370.25	3317.74
250	m	610.301	205.342
500	m	240.093	57.9835

Distance		Heights (m) for above concentrations	
		Category 2/F	Category 5/D
50	m	4.48487	1.64584
250	m	18.6003	3.60606
500	m	28.6865	4.36473

## Jet Fire Hazard

Path: \70977-Fase 1-IP22\Filtri Gas Combustibile\10mm

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-IP22\Filtri Gas Combustibile\10mm

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	10.4344	10.4344
Radiation Level	7	kW/m2	10.9531	10.9531
Radiation Level	5	kW/m2	11.353	11.353
Radiation Level	3	kW/m2	12.0397	12.0397

# SUMMARY REPORT

Unique Audit Number: 65.844



Study Folder: 70977-Fase 1-Ip22

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## Radiation Effects: Jet Fire Distance

Path: \70977-Fase 1-Ip22\Filtri Gas Combustibile\10mm

		Radiation Level (kW/m2)	
		Category 2/F	Category 5/D
Distance Of Interest 50	m	0.0170681	0.0170681
Distance Of Interest 250	m	0.000427425	0.000427425
Distance Of Interest 500	m	9.20259e-005	9.20259e-005

## Flash Fire Envelope

Path: \70977-Fase 1-Ip22\Filtri Gas Combustibile\10mm

All flammable results are reported at the cloud centreline height

		Distance (m)	
		Category 2/F	Category 5/D
Furthest Extent	22000 ppm	9.39856	6.70106
Furthest Extent	44000 ppm	5.26255	4.60949

		Heights (m) for above distances	
		Category 2/F	Category 5/D
Furthest Extent	22000 ppm	1.0169	1.00526
Furthest Extent	44000 ppm	1.00317	1.0022

## Weather Conditions

Path: \70977-Fase 1-Ip22\Filtri Gas Combustibile\10mm

		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