

ANNESSO TECNICO 6.

Elaborati di calcolo Scenari incidentali ragionevolmente credibili

Ipotesi N. 12

TRR S.r.l.

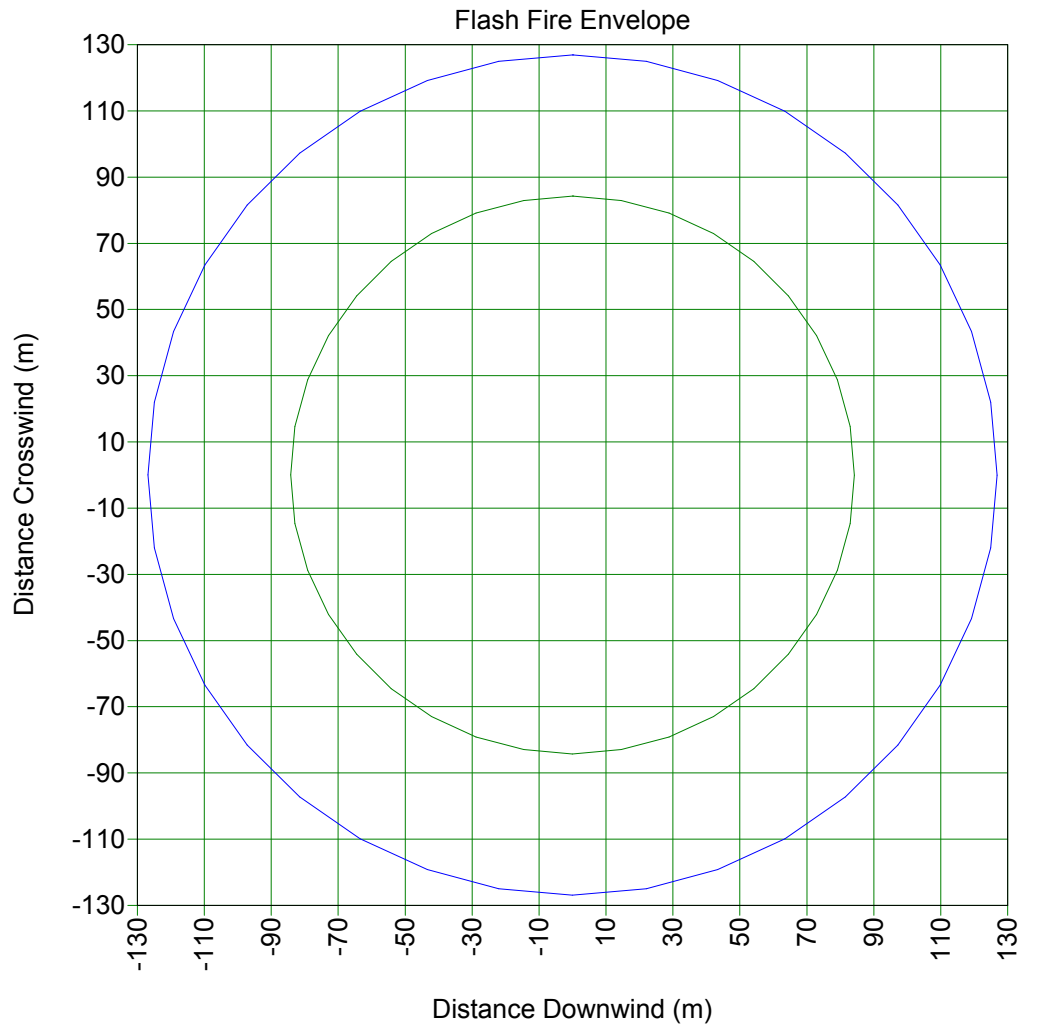
Il Direttore Generale

Ing. *Alfredo Romano*



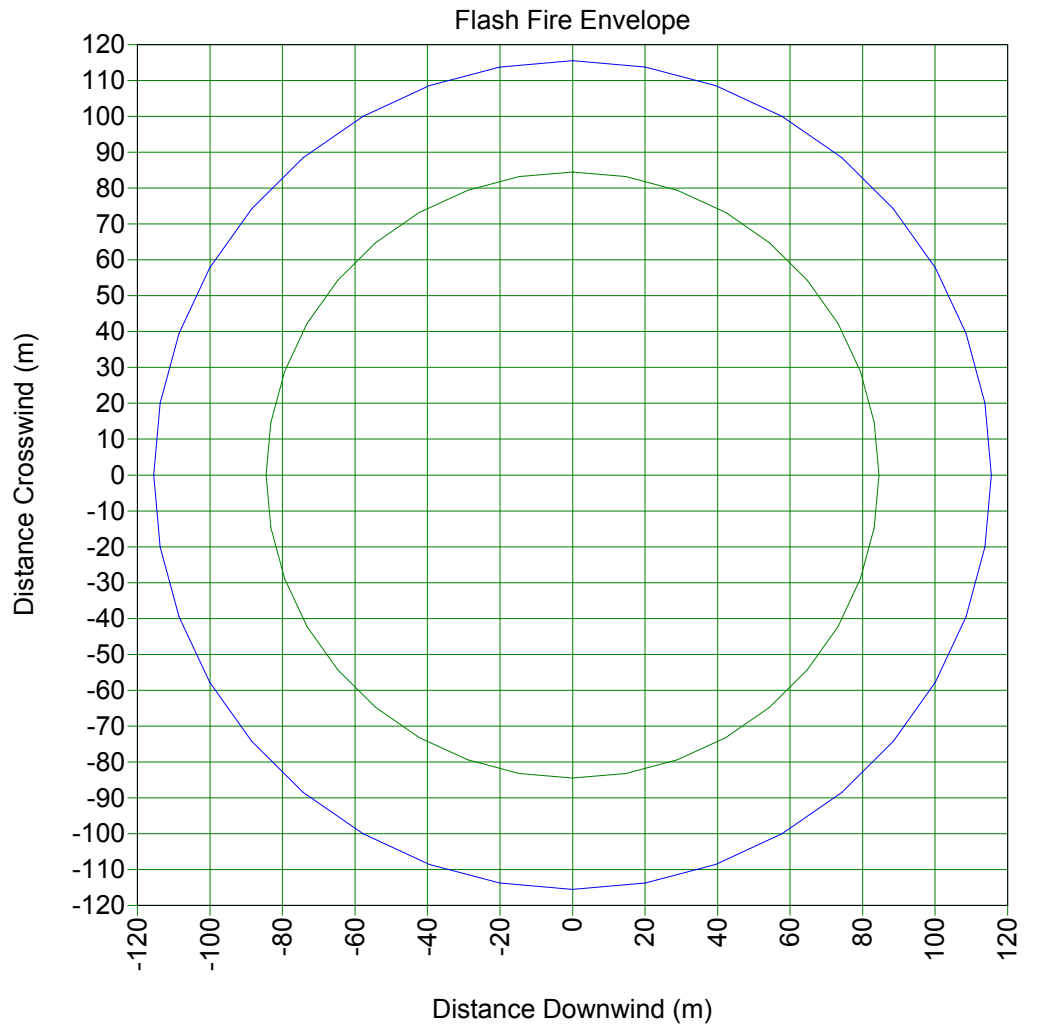
Study Folder: 70977-Fase
1-lp12
Audit No: 65926
Model: 90mm
Weather: Category 5/D
Material: METHANE
Concentration

— 2.2e+004 ppm
— 4.4e+004 ppm



Study Folder: 70977-Fase
1-lp12
Audit No: 65926
Model: 90mm
Weather: Category 2/F
Material: METHANE
Concentration

— 2.2e+004 ppm
— 4.4e+004 ppm



JET FIRE REPORT

Study Folder: 70977-Fase 1-Ip12

Unique Audit Number: 65.926



Phast 6.6

70977-Fase 1-Ip12

Misura Fiscale - Iniezione

90mm

Base Case

Data



Weather: Global Weathers\Category 2/F

Speed: 2.00 m/s

Stability: F

\70977-Fase 1-Ip12\Misura Fiscale - Iniezione\90mm

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	0,71	degC
Release Rate	40,66	kg/s

Input

Output

Flame Emissive Power	130,53	kW/m2
Fraction of Emissivity	0,15	fraction
Expanded Radius	0,19	m
Jet Velocity	500,00	500,00 m/s
Flame Length	92,10	m
Maximum Flame Radius	5,73	m

Flame Co-ordinates

X	Z	R	Phi
m	m	m	deg
0,00	1,00	0,19	90,00
10,23	1,00	2,20	90,00
20,47	1,00	3,64	90,00
30,70	1,00	4,67	90,00
40,93	1,00	5,34	90,00
51,16	1,00	5,69	90,00
61,40	1,00	5,67	90,00
71,63	1,00	5,21	90,00
81,86	1,00	4,07	90,00
92,10	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)	54,51	m
Crosswind semi-axis (B)	78,95	m
Offset Ratio (D)	0,93	
Effect Distance	105,69	m
Area	13.520,41	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)	51,09	m
Crosswind semi-axis (B)	59,79	m
Offset Ratio (D)	0,96	
Effect Distance	100,12	m
Area	9.596,58	m2

Incident Radiation Level:	7,00	kW/m2
Lethality Level	0,02	%
View Factor	0,05	
Dose Level	2.677.313,40	(W/m2)^Probit N.s

Downwind semi-axis (A)	49,35	m
Crosswind semi-axis (B)	49,21	m
Offset Ratio (D)	0,97	
Effect Distance	97,27	m
Area	7.628,46	m2

JET FIRE REPORT

Study Folder: 70977-Fase 1-Ip12

Unique Audit Number: 65.926



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)	47,04	m
Crosswind semi-axis (B)	34,07	m
Offset Ratio (D)	0,99	
Effect Distance	93,43	m
Area	5.034,46	m2

JET FIRE REPORT

Study Folder: 70977-Fase 1-1p12

Unique Audit Number: 65.926



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			22,67		
10,20			130,53		
20,41			130,53		
30,61			130,53		
40,82			130,53		
51,02			130,53		
61,22			130,53		
71,43			130,53		
81,63			130,53		
91,84			31,60		
102,04			4,09		
112,24			1,77		
122,45			1,02		
132,65			0,68		
142,86			0,49		
153,06			0,37		
163,27			0,29		
173,47			0,23		
183,67			0,19		
193,88			0,16		
204,08			0,13		
214,29			0,11		
224,49			0,10		
234,69			0,09		
244,90			0,08		
255,10			0,07		
265,31			0,06		
275,51			0,06		
285,71			0,05		
295,92			0,05		
306,12			0,04		
316,33			0,04		
326,53			0,03		
336,73			0,03		
346,94			0,03		
357,14			0,03		
367,35			0,03		

JET FIRE REPORT


Study Folder: 70977-Fase 1-Ip12

Unique Audit Number: 65.926



Phast 6.6

X Coordinates m	Y Coordinates m	Z Coordinates m	Incident Radiation kW/m2	Lethality Level %	View Factor
377,55			0,02		
387,76			0,02		
397,96			0,02		
408,16			0,02		
418,37			0,02		
428,57			0,02		
438,78			0,02		
448,98			0,02		
459,18			0,01		
469,39			0,01		
479,59			0,01		
489,80			0,01		
500,00			0,01		

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

\70977-Fase 1-Ip12\Misura Fiscale - Iniezione\90mm

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	0,71	degC
Release Rate	40,66	kg/s

	Input	Output
Flame Emissive Power		130,53 kW/m2
Fraction of Emissivity		0,15 fraction
Expanded Radius		0,19 m
Jet Velocity	500,00	500,00 m/s
Flame Length		92,10 m
Maximum Flame Radius		5,73 m

JET FIRE REPORT

Study Folder: 70977-Fase 1-Ip12

Unique Audit Number: 65.926



Phast 6.6

Flame Co-ordinates

X	Z	R	Phi
m	m	m	deg
0,00	1,00	0,19	90,00
10,23	1,00	2,20	90,00
20,47	1,00	3,64	90,00
30,70	1,00	4,67	90,00
40,93	1,00	5,34	90,00
51,16	1,00	5,69	90,00
61,40	1,00	5,67	90,00
71,63	1,00	5,21	90,00
81,86	1,00	4,07	90,00
92,10	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)	54,51	m
Crosswind semi-axis (B)	78,95	m
Offset Ratio (D)	0,93	
Effect Distance	105,69	m
Area	13.520,41	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)	51,09	m
Crosswind semi-axis (B)	59,79	m
Offset Ratio (D)	0,96	
Effect Distance	100,12	m
Area	9.596,58	m2

Incident Radiation Level:	7,00	kW/m2
Lethality Level	0,02	%
View Factor	0,05	
Dose Level	2.677.313,40	(W/m2)^Probit N.s

Downwind semi-axis (A)	49,35	m
Crosswind semi-axis (B)	49,21	m
Offset Ratio (D)	0,97	
Effect Distance	97,27	m
Area	7.628,46	m2

JET FIRE REPORT

Study Folder: 70977-Fase 1-Ip12

Unique Audit Number: 65.926



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)	47,04	m
Crosswind semi-axis (B)	34,07	m
Offset Ratio (D)	0,99	
Effect Distance	93,43	m
Area	5.034,46	m2

JET FIRE REPORT

Study Folder: 70977-Fase 1-1p12

Unique Audit Number: 65.926



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			22,67		
10,20			130,53		
20,41			130,53		
30,61			130,53		
40,82			130,53		
51,02			130,53		
61,22			130,53		
71,43			130,53		
81,63			130,53		
91,84			31,60		
102,04			4,09		
112,24			1,77		
122,45			1,02		
132,65			0,68		
142,86			0,49		
153,06			0,37		
163,27			0,29		
173,47			0,23		
183,67			0,19		
193,88			0,16		
204,08			0,13		
214,29			0,11		
224,49			0,10		
234,69			0,09		
244,90			0,08		
255,10			0,07		
265,31			0,06		
275,51			0,06		
285,71			0,05		
295,92			0,05		
306,12			0,04		
316,33			0,04		
326,53			0,03		
336,73			0,03		
346,94			0,03		
357,14			0,03		
367,35			0,03		

JET FIRE REPORT

Study Folder: 70977-Fase 1-Ip12

Unique Audit Number: 65.926

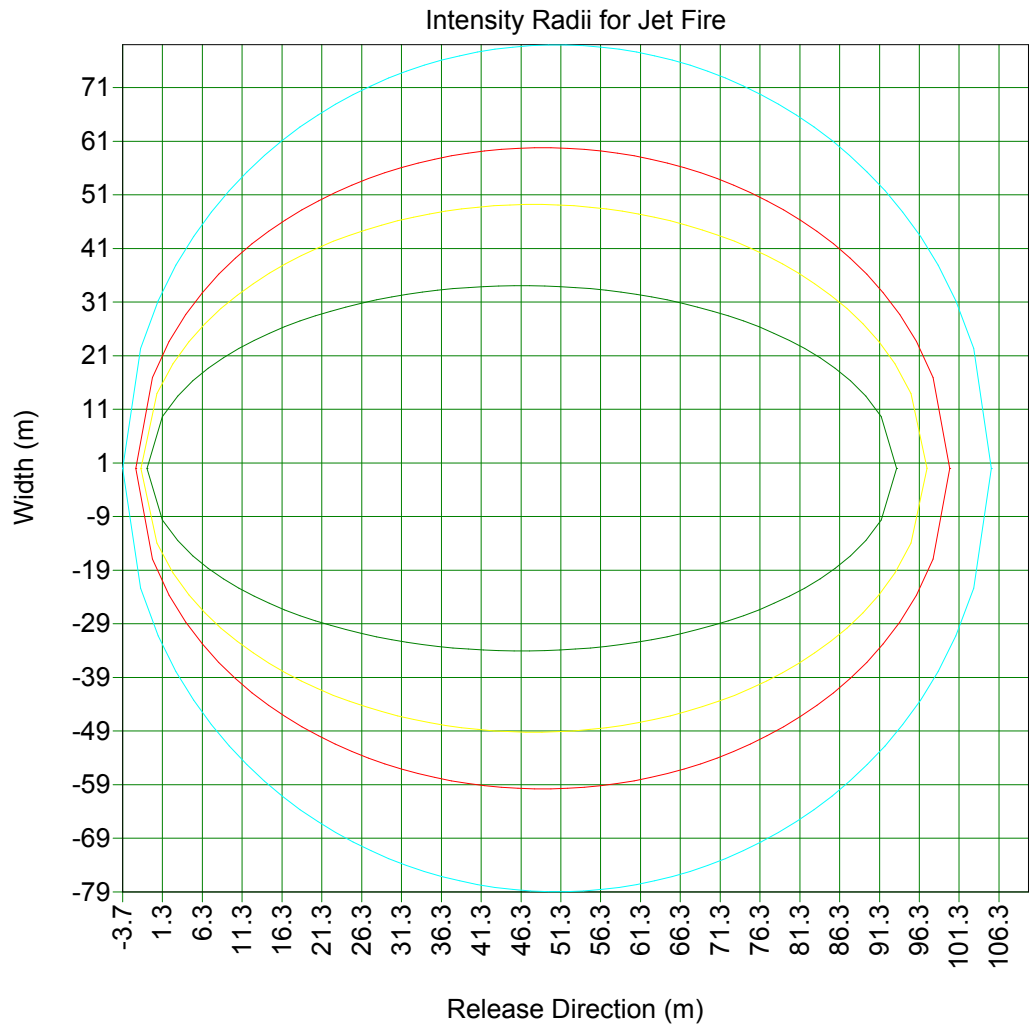


Phast 6.6

X Coordinates m	Y Coordinates m	Z Coordinates m	Incident Radiation kW/m2	Lethality Level %	View Factor
377,55			0,02		
387,76			0,02		
397,96			0,02		
408,16			0,02		
418,37			0,02		
428,57			0,02		
438,78			0,02		
448,98			0,02		
459,18			0,01		
469,39			0,01		
479,59			0,01		
489,80			0,01		
500,00			0,01		

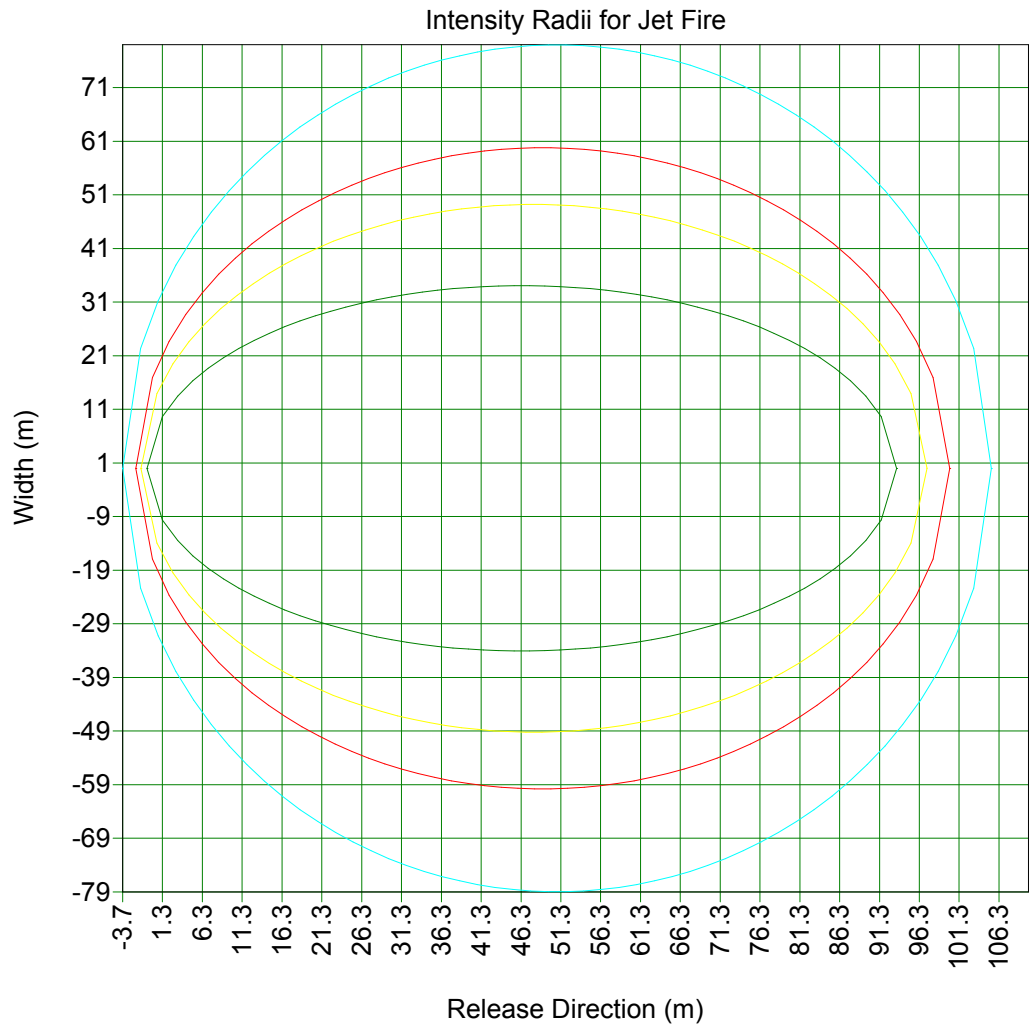
Study Folder: 70977-Fase
1-lp12
Audit No: 65926
Model: 90mm
Weather: Category 5/D
Material: METHANE

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



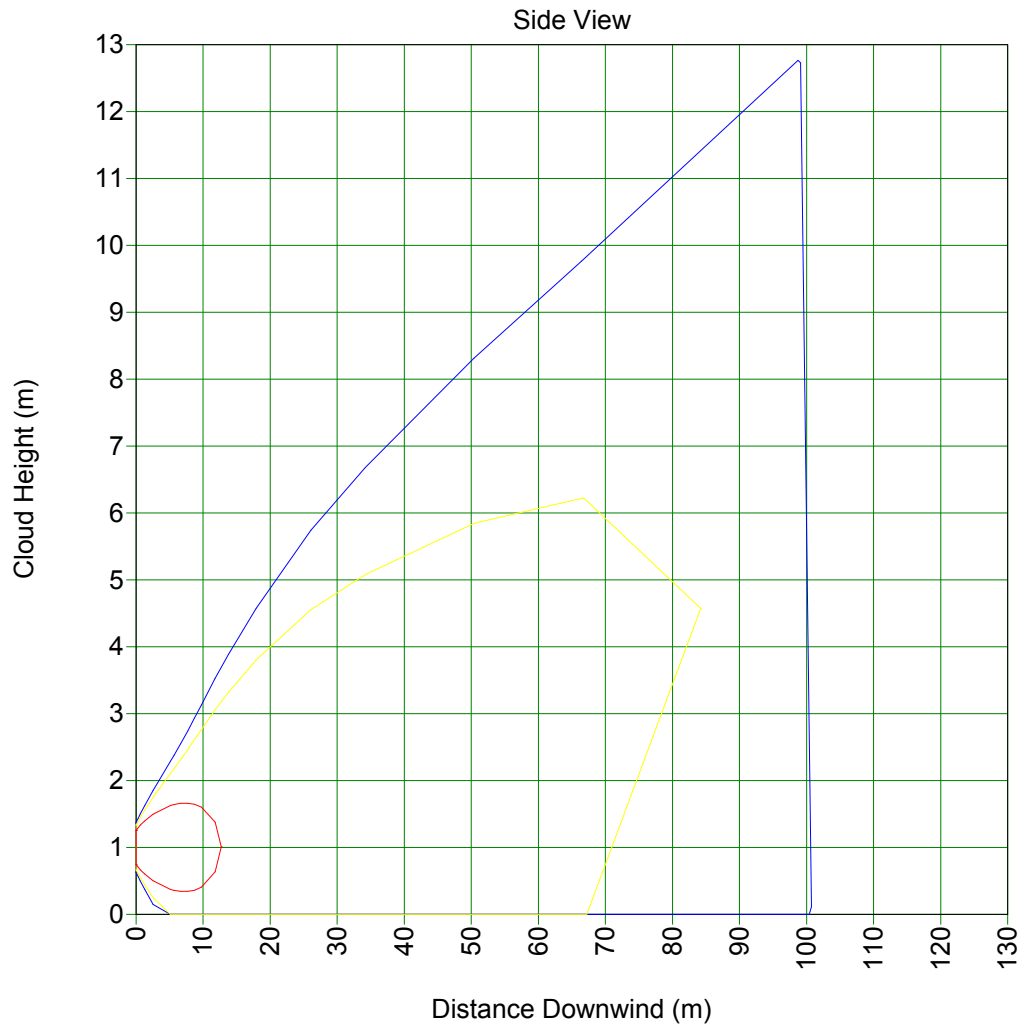
Study Folder: 70977-Fase
1-lp12
Audit No: 65926
Model: 90mm
Weather: Category 2/F
Material: METHANE

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



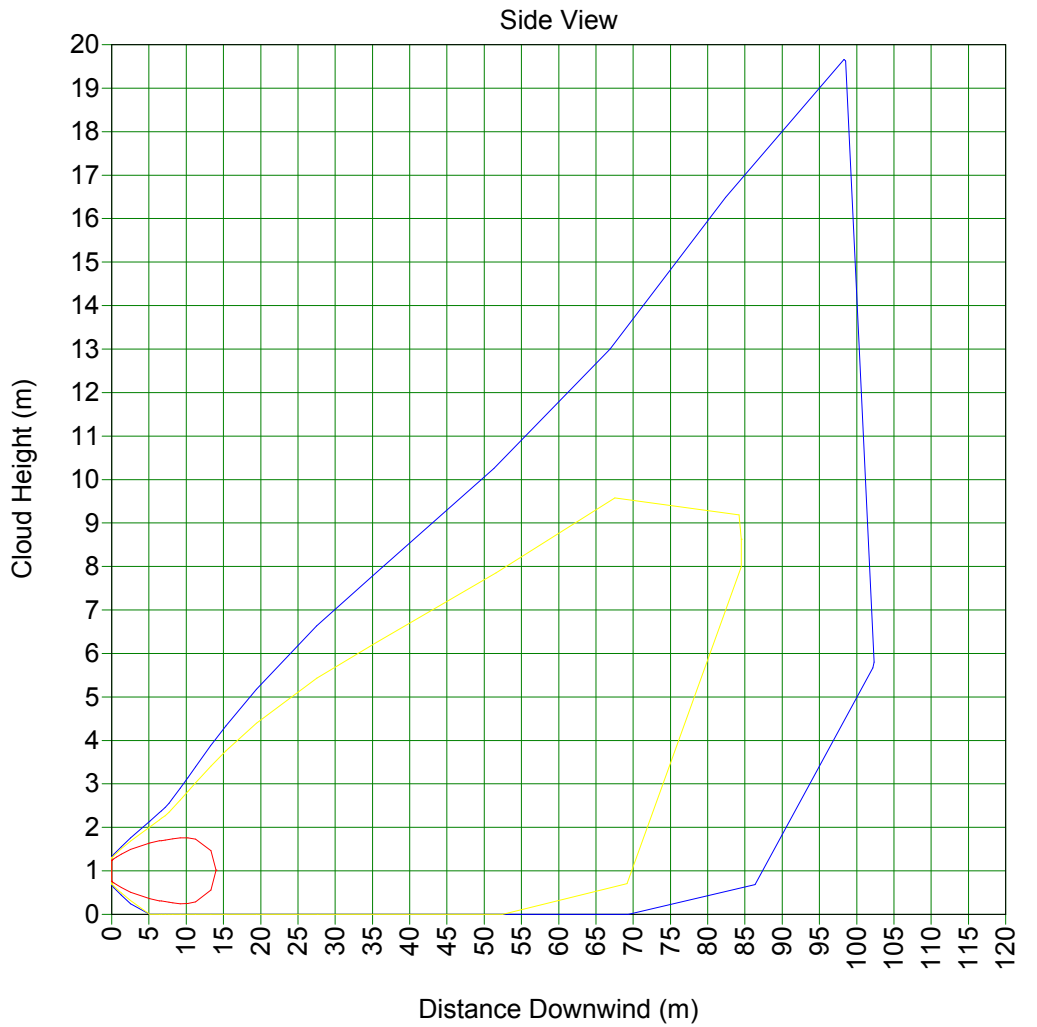
Study Folder: 70977-Fase
1-lp12
Audit No: 65926
Model: 90mm
Weather: Category 5/D
Material: METHANE
Averaging Time:
Flammable(18.75 s)
C/L Offset: 0 m
Concentration
Time: 7.836 s

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



Study Folder: 70977-Fase
1-lp12
Audit No: 65926
Model: 90mm
Weather: Category 2/F
Material: METHANE
Averaging Time:
Flammable(18.75 s)
C/L Offset: 0 m
Concentration
Time: 11.86 s

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



SUMMARY REPORT

Unique Audit Number: 65.926



Study Folder: 70977-Fase 1-Ip12

Phast 6.6

70977-Fase 1-Ip12

Misura Fiscale - Iniezione

90mm

Base Case

CASE Name: Data

Path: \70977-Fase 1-Ip12\Misura Fiscale - Iniezione\90mm

User-Defined Data

Material

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

Scenario

Scenario Type	Long Pipeline
Phase to be Released	Vapor
Building Wake Effect	None

Pipe

Internal Diameter	450 mm
Line length	40 m
Distance To Break	1 m
Relative Aperture	0.2 fraction
Pumped Inflow	40 kg/s
Use Ambient Temperature	Use ambient temperature

Vessel/Tank

Duration of Interest	300 s
Method Used for Time Varying Releases	Average Rates

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

SUMMARY REPORT

Unique Audit Number: 65.926



Study Folder: 70977-Fase 1-Ip12

Phast 6.6

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

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-Ip12\Misura Fiscale - Iniezione\90mm

Discharge Data

User-Defined Quantities

Material METHANE
Temperature 25,00 degC
Pressure 36,01 bar
Inventory 14.000,00 kg
Scenario Long Pipeline
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 0,71 degC
Final Velocity 500,00 m/s
Droplet Diameter 0,00 um

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Study Folder: 70977-Fase 1-Ip12

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Continuous Release Data:

Mass Flowrate	4.06628E+001 kg/s
Release Duration	300,00 s
Orifice Velocity	n/a m/s
Exit Pressure	n/a bar
Exit Temperature	n/a degC
Discharge Coefficient	n/a
Expanded Radius	n/a m

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
FinalTemperature	0,71 degC
Final Velocity	500,00 m/s
Droplet Diameter	0,00 um

Continuous Release Data:

Mass Flowrate	4.06628E+001 kg/s
Release Duration	300,00 s
Orifice Velocity	n/a m/s
Exit Pressure	n/a bar
Exit Temperature	n/a degC
Discharge Coefficient	n/a
Expanded Radius	n/a m

SUMMARY REPORT

Study Folder: 70977-Fase 1-1p12

Unique Audit Number: 65.926

Phast 6.6



Consequence Results

Distance to Concentration Results

Path: \70977-Fase 1-1p12\Misura Fiscale - Iniezione\90mm

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		84.1585	103.572
UFL (165000)	18.75	s		14.0078	12.6761
LFL (44000)	18.75	s		84.5171	84.2235
LFL Frac (22000)	18.75	s		115.519	126.858

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		1.01473	1.00903
LFL (44000)	18.75	s		8.62468	4.57311
LFL Frac (22000)	18.75	s		16.694	9.68354

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Study Folder: 70977-Fase 1-IP12

Phast 6.6

Concentration At Distance Results

Path: \70977-Fase 1-IP12\Misura Fiscale - Iniezione\90mm

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	77078.8	69196.5
250	m	4263.73	5034.27
500	m	1302.95	1889.39

Distance		Heights (m) for above concentrations	
		Category 2/F	Category 5/D
50	m	2.58803	1.7451
250	m	42.8678	21.6357
500	m	65.6801	37.1838

Distance		Conc.(ppm) at Core Avg. Time of 18.75 s	
		Category 2/F	Category 5/D
50	m	77078.8	69196.5
250	m	4263.73	5034.27
500	m	1302.95	1889.39

Distance		Heights (m) for above concentrations	
		Category 2/F	Category 5/D
50	m	2.58803	1.7451
250	m	42.8678	21.6357
500	m	65.6801	37.1838

Jet Fire Hazard

Path: \70977-Fase 1-IP12\Misura Fiscale - Iniezione\90mm

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-IP12\Misura Fiscale - Iniezione\90mm

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	93.4315	93.4315
Radiation Level	7	kW/m2	97.2742	97.2742
Radiation Level	5	kW/m2	100.12	100.12
Radiation Level	3	kW/m2	105.691	105.691

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Unique Audit Number: 65.926



Study Folder: 70977-Fase 1-Ip12

Phast 6.6

Radiation Effects: Jet Fire Distance

Path: \70977-Fase 1-Ip12\Misura Fiscale - Iniezione\90mm

		Radiation Level (kW/m2)	
		Category 2/F	Category 5/D
Distance Of Interest 50	m	Engulfed	Engulfed
Distance Of Interest 250	m	0.0727391	0.0727391
Distance Of Interest 500	m	0.0116304	0.0116304

Flash Fire Envelope

Path: \70977-Fase 1-Ip12\Misura Fiscale - Iniezione\90mm

All flammable results are reported at the cloud centreline height

		Distance (m)	
		Category 2/F	Category 5/D
Furthest Extent	22000 ppm	115.519	126.858
Furthest Extent	44000 ppm	84.5171	84.2235

		Heights (m) for above distances	
		Category 2/F	Category 5/D
Furthest Extent	22000 ppm	16.694	9.68354
Furthest Extent	44000 ppm	8.62468	4.57311

SUMMARY REPORT

Unique Audit Number: 65.926



Study Folder: 70977-Fase 1-1p12

Phast 6.6

Explosion Effects: Late Ignition

Path: \70977-Fase 1-1p12\Misura Fiscale - Iniezione\90mm

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	286.039	274.85
Overpressure	0.1379	bar	155.581	160.094
Overpressure	0.2068	bar	145.269	151.024

			Supplementary Data at 0.02068 bar	
			Category 2/F	Category 5/D
Supplied Flammable Mass	kg		139.989	95.2798
Used Flammable Mass	kg		139.989	95.2798
Overpressure Radius	m		176.039	154.85
Distance to:				
- Ignition Source	m		110	120
- Cloud Front/Centre	m		110	120
- Explosion Centre	m		110	120

			Supplementary Data at 0.1379 bar	
			Category 2/F	Category 5/D
Supplied Flammable Mass	kg		139.989	95.2798
Used Flammable Mass	kg		139.989	95.2798
Overpressure Radius	m		45.5808	40.0945
Distance to:				
- Ignition Source	m		110	120
- Cloud Front/Centre	m		110	120
- Explosion Centre	m		110	120

			Supplementary Data at 0.2068 bar	
			Category 2/F	Category 5/D
Supplied Flammable Mass	kg		139.989	95.2798
Used Flammable Mass	kg		139.989	95.2798
Overpressure Radius	m		35.2694	31.0242
Distance to:				
- Ignition Source	m		110	120
- Cloud Front/Centre	m		110	120
- Explosion Centre	m		110	120

			Overpressures (bar gauge) at Distances	
			Category 2/F	Category 5/D
Distance	50	m	1	1
Distance	250	m	0.0276749	0.025798
Distance	500	m	0.00814287	0.00729912

			Supplementary Data at 50 m	
			Category 2/F	Category 5/D
Supplied Flammable Mass	kg		52.0686	50.4666

SUMMARY REPORT

Study Folder: 70977-Fase 1-Ip12

Unique Audit Number: 65.926

Phast 6.6



Used Flammable Mass	kg	52.0686	50.4666
Supplementary Data at 250 m			
		Category 2/F	Category 5/D
Supplied Flammable Mass	kg	139.989	95.2798
Used Flammable Mass	kg	139.989	95.2798
Supplementary Data at 500 m			
		Category 2/F	Category 5/D
Supplied Flammable Mass	kg	139.989	95.2798
Used Flammable Mass	kg	139.989	95.2798

Weather Conditions

Path: \70977-Fase 1-Ip12\Misura Fiscale - Iniezione\90mm

		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