

## **ANNESSO TECNICO 6.**

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

### ***Ipotesi N. 14***

TRR S.r.l.

Il Direttore Generale

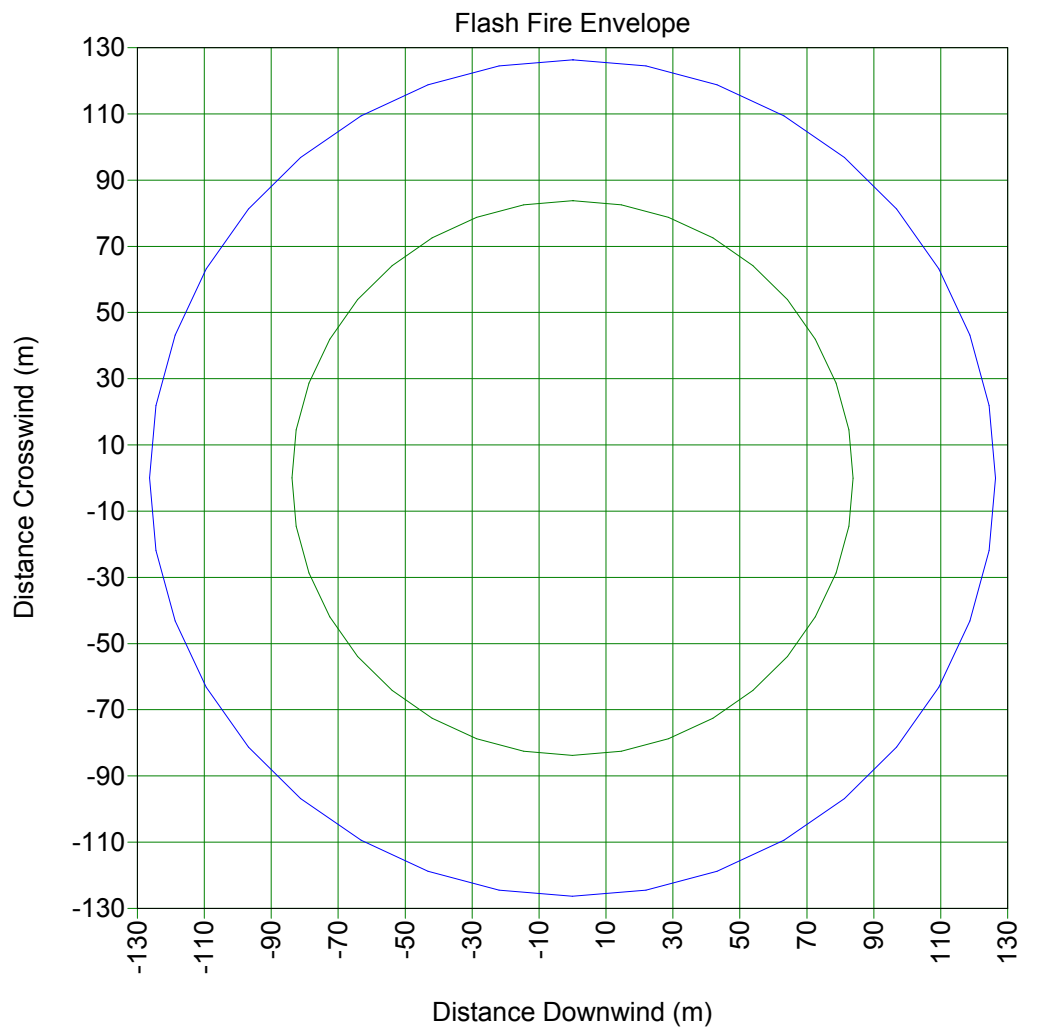
Ing. *Alfredo Romano*





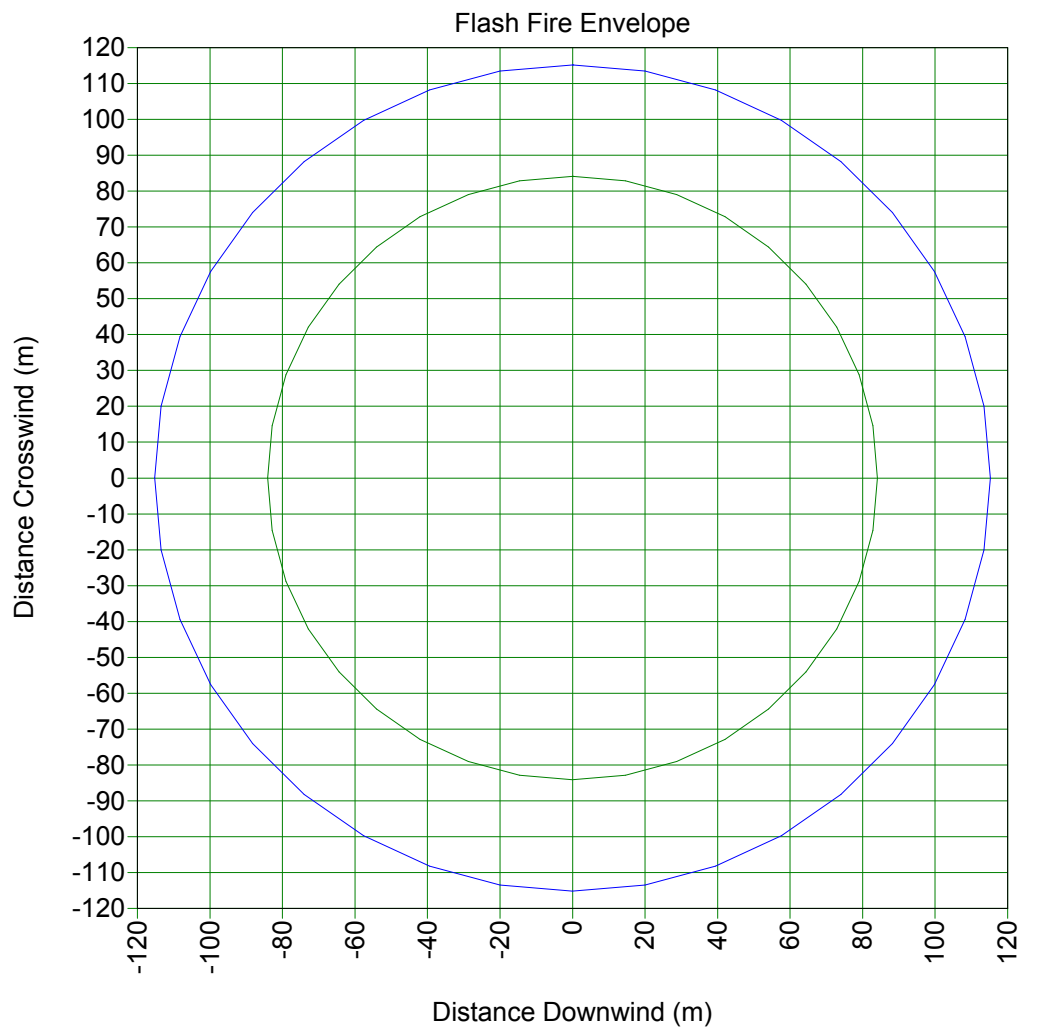
Study Folder: 70977-Fase  
1-lp14  
Audit No: 77520  
Model: 90mm  
Weather: Category 5/D  
Material: METHANE  
Concentration

— 2.2e+004 ppm  
— 4.4e+004 ppm



Study Folder: 70977-Fase  
1-lp14  
Audit No: 77520  
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-Ip14

Unique Audit Number: 77.520



Phast 6.6

70977-Fase 1-Ip14

Collegamento Rete SNAM - Iniezione

90mm

Base Case

Data



Weather: Global Weathers\Category 2/F

Speed: 2,00

m/s

Stability: F

\\70977-Fase 1-Ip14\Collegamento Rete SNAM - 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	0,88	degC
Release Rate	40,26	kg/s

### Input

### Output

Flame Emissive Power	130,63	kW/m2
Fraction of Emissivity	0,15	fraction
Expanded Radius	0,19	m
Jet Velocity	498,63	m/s
Flame Length	91,66	m
Maximum Flame Radius	5,70	m

### Flame Co-ordinates

X	Z	R	Phi
m	m	m	deg
0,00	1,00	0,19	90,00
10,18	1,00	2,19	90,00
20,37	1,00	3,62	90,00
30,55	1,00	4,64	90,00
40,74	1,00	5,32	90,00
50,92	1,00	5,66	90,00
61,11	1,00	5,64	90,00
71,29	1,00	5,18	90,00
81,47	1,00	4,05	90,00
91,66	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	0,02	
Dose Level	865.118,83	(W/m2)^Probit N.s

Downwind semi-axis (A)	54,27	m
Crosswind semi-axis (B)	78,63	m
Offset Ratio (D)	0,93	
Effect Distance	105,21	m
Area	13.405,38	m2

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

Downwind semi-axis (A)	50,86	m
Crosswind semi-axis (B)	59,55	m
Offset Ratio (D)	0,96	
Effect Distance	99,66	m
Area	9.514,66	m2

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

Downwind semi-axis (A)	49,12	m
Crosswind semi-axis (B)	49,01	m
Offset Ratio (D)	0,97	
Effect Distance	96,82	m
Area	7.563,22	m2

# JET FIRE REPORT

Study Folder: 70977-Fase 1-Ip14

Unique Audit Number: 77.520



Phast 6.6

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<b>Incident Radiation Level:</b>	<b>12,50</b>	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)	46,82	m
Crosswind semi-axis (B)	33,94	m
Offset Ratio (D)	0,99	
Effect Distance	92,99	m
Area	4.991,56	m2

# JET FIRE REPORT

Study Folder: 70977-Fase 1-Ip14

Unique Audit Number: 77.520



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			22,65		
10,20			130,63		
20,41			130,63		
30,61			130,63		
40,82			130,63		
51,02			130,63		
61,22			130,63		
71,43			130,63		
81,63			130,63		
91,84			19,32		
102,04			3,90		
112,24			1,71		
122,45			0,99		
132,65			0,67		
142,86			0,48		
153,06			0,36		
163,27			0,28		
173,47			0,23		
183,67			0,18		
193,88			0,15		
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			0,05		
285,71			0,05		
295,92			0,04		
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-Ip14

Unique Audit Number: 77.520



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-Ip14\Collegamento Rete SNAM - 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	0,88 degC
Release Rate	40,26 kg/s

	Input	Output
Flame Emissive Power		130,63 kW/m2
Fraction of Emissivity		0,15 fraction
Expanded Radius		0,19 m
Jet Velocity	498,63	498,63 m/s
Flame Length		91,66 m
Maximum Flame Radius		5,70 m

# JET FIRE REPORT

Study Folder: 70977-Fase 1-Ip14

Unique Audit Number: 77.520



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	0,19	90,00
10,18	1,00	2,19	90,00
20,37	1,00	3,62	90,00
30,55	1,00	4,64	90,00
40,74	1,00	5,32	90,00
50,92	1,00	5,66	90,00
61,11	1,00	5,64	90,00
71,29	1,00	5,18	90,00
81,47	1,00	4,05	90,00
91,66	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	0,02	
Dose Level	865.118,83	(W/m2)^Probit N.s

Downwind semi-axis (A)	54,27	m
Crosswind semi-axis (B)	78,63	m
Offset Ratio (D)	0,93	
Effect Distance	105,21	m
Area	13.405,38	m2

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

Downwind semi-axis (A)	50,86	m
Crosswind semi-axis (B)	59,55	m
Offset Ratio (D)	0,96	
Effect Distance	99,66	m
Area	9.514,66	m2

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

Downwind semi-axis (A)	49,12	m
Crosswind semi-axis (B)	49,01	m
Offset Ratio (D)	0,97	
Effect Distance	96,82	m
Area	7.563,22	m2

# JET FIRE REPORT

Study Folder: 70977-Fase 1-Ip14

Unique Audit Number: 77.520



Phast 6.6

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<b>Incident Radiation Level:</b>	<b>12,50</b>	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)	46,82	m
Crosswind semi-axis (B)	33,94	m
Offset Ratio (D)	0,99	
Effect Distance	92,99	m
Area	4.991,56	m2

# JET FIRE REPORT

Study Folder: 70977-Fase 1-Ip14

Unique Audit Number: 77.520



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			22,65		
10,20			130,63		
20,41			130,63		
30,61			130,63		
40,82			130,63		
51,02			130,63		
61,22			130,63		
71,43			130,63		
81,63			130,63		
91,84			19,32		
102,04			3,90		
112,24			1,71		
122,45			0,99		
132,65			0,67		
142,86			0,48		
153,06			0,36		
163,27			0,28		
173,47			0,23		
183,67			0,18		
193,88			0,15		
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			0,05		
285,71			0,05		
295,92			0,04		
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-Ip14

Unique Audit Number: 77.520



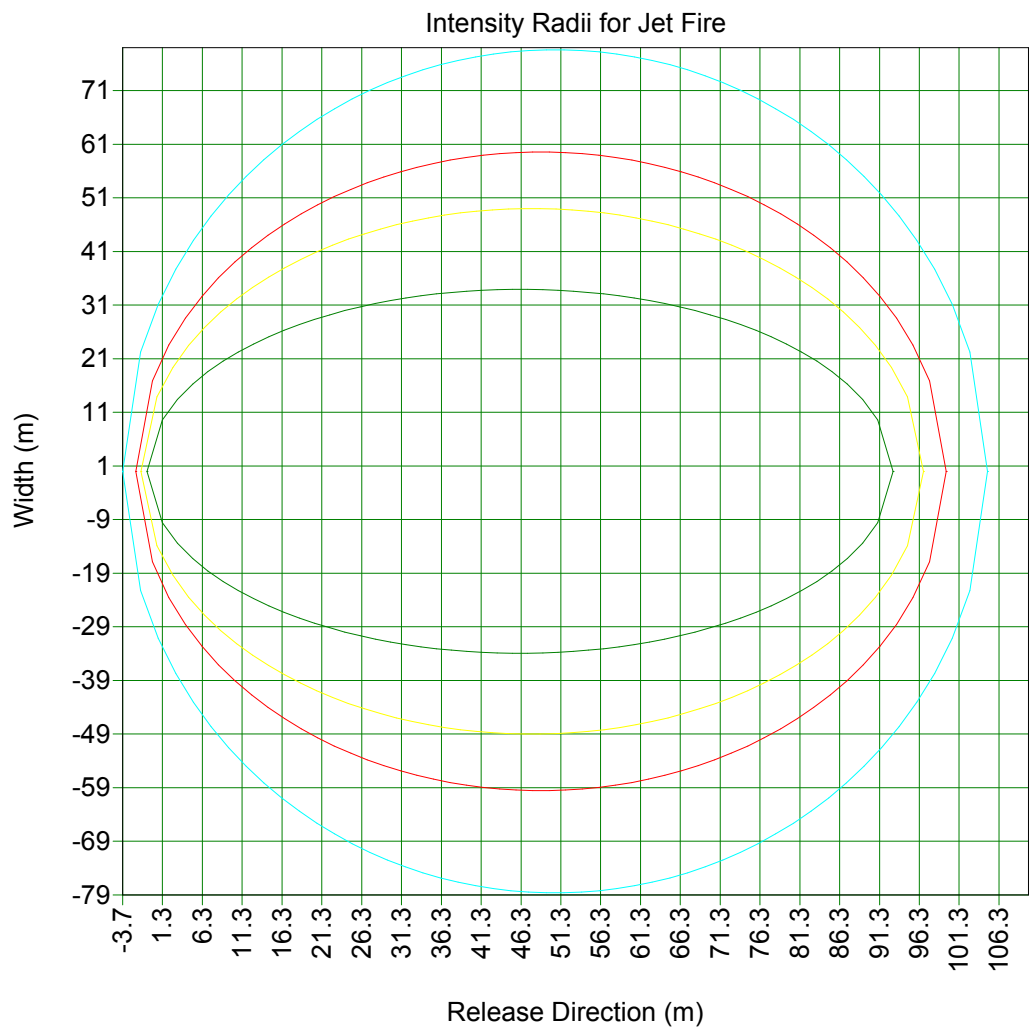
Phast 6.6

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X Coordinates m	Y Coordinates m	Z Coordinates m	Incident Radiation kW/m2	Lethality Level %	View Factor
377,55			0,02		
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		

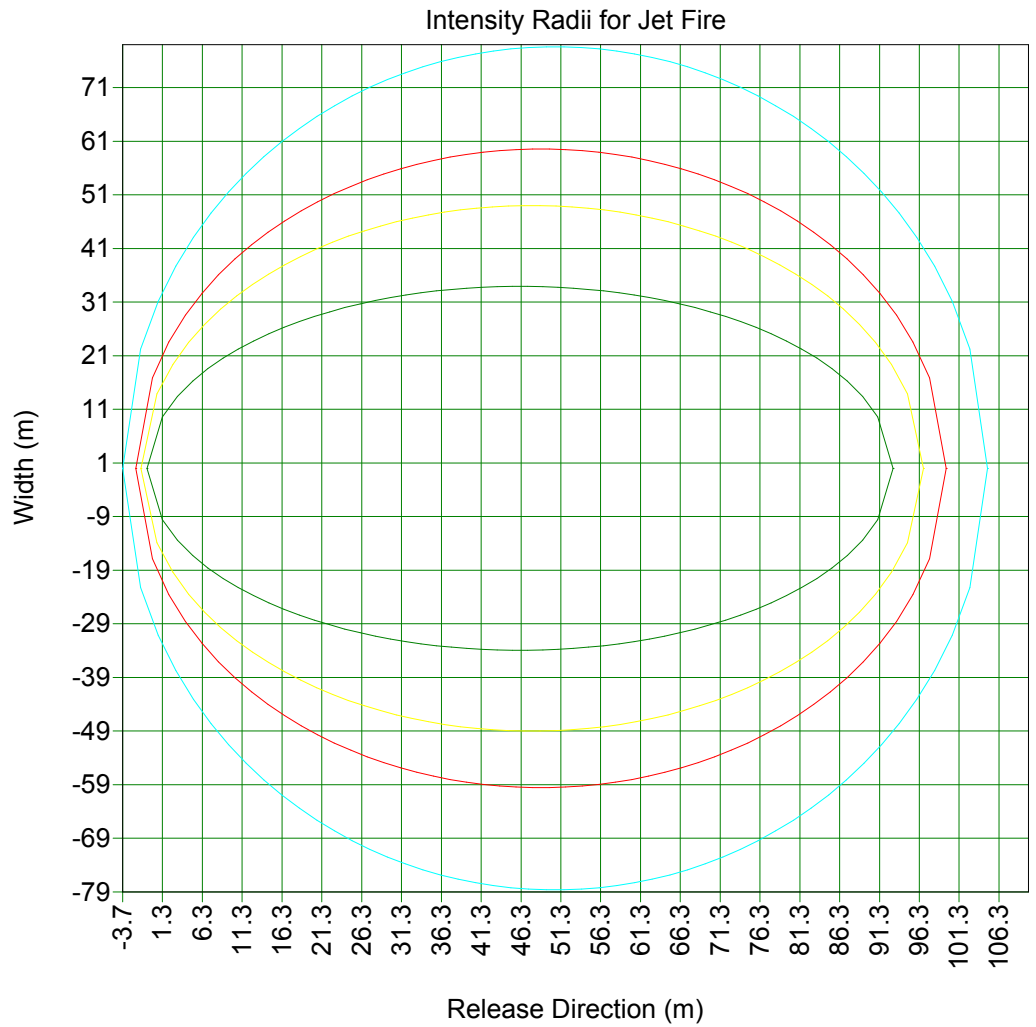
Study Folder: 70977-Fase  
1-lp14  
Audit No: 77520  
Model: 90mm  
Weather: Category 5/D  
Material: METHANE

- 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-lp14  
Audit No: 77520  
Model: 90mm  
Weather: Category 2/F  
Material: METHANE

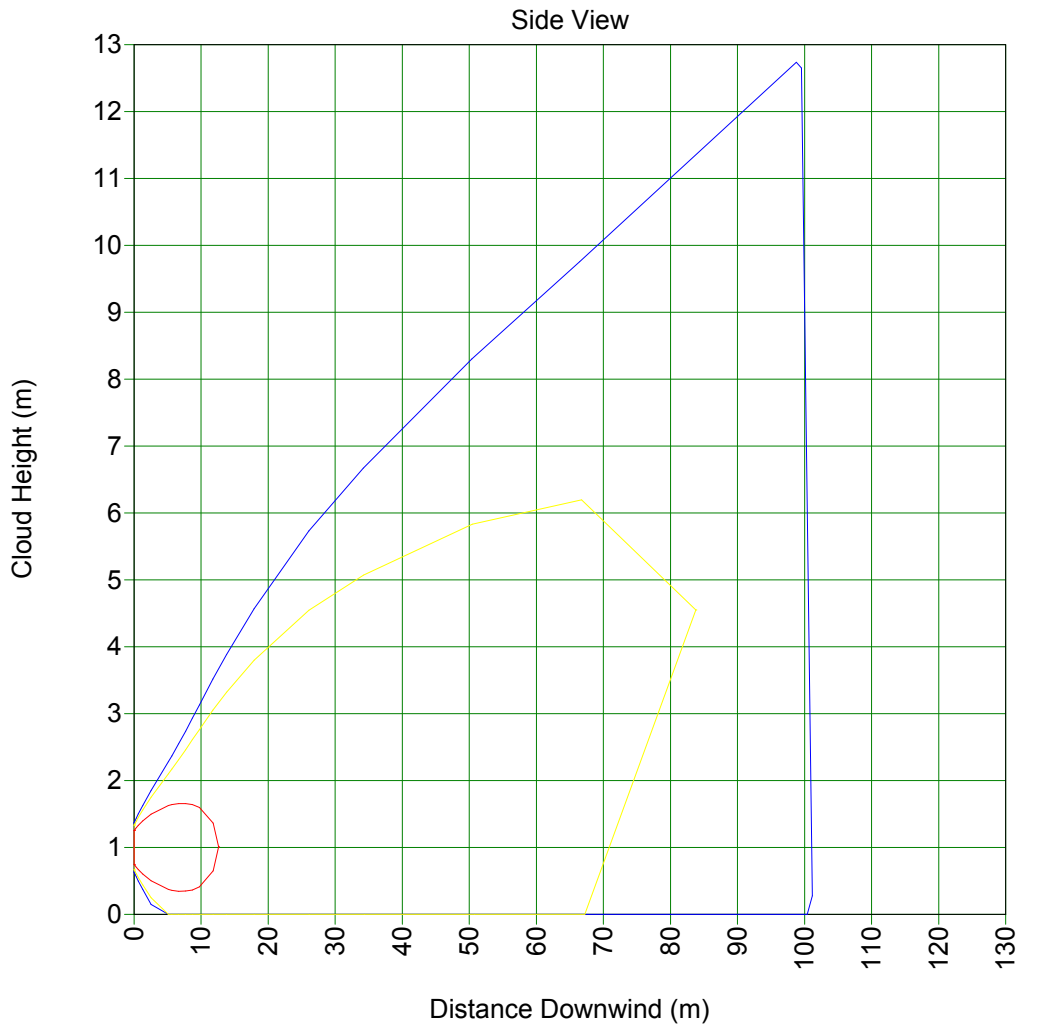
- Ellipse @12.5 kW/m<sup>2</sup>
- Ellipse @7 kW/m<sup>2</sup>
- Ellipse @5 kW/m<sup>2</sup>
- Ellipse @3 kW/m<sup>2</sup>





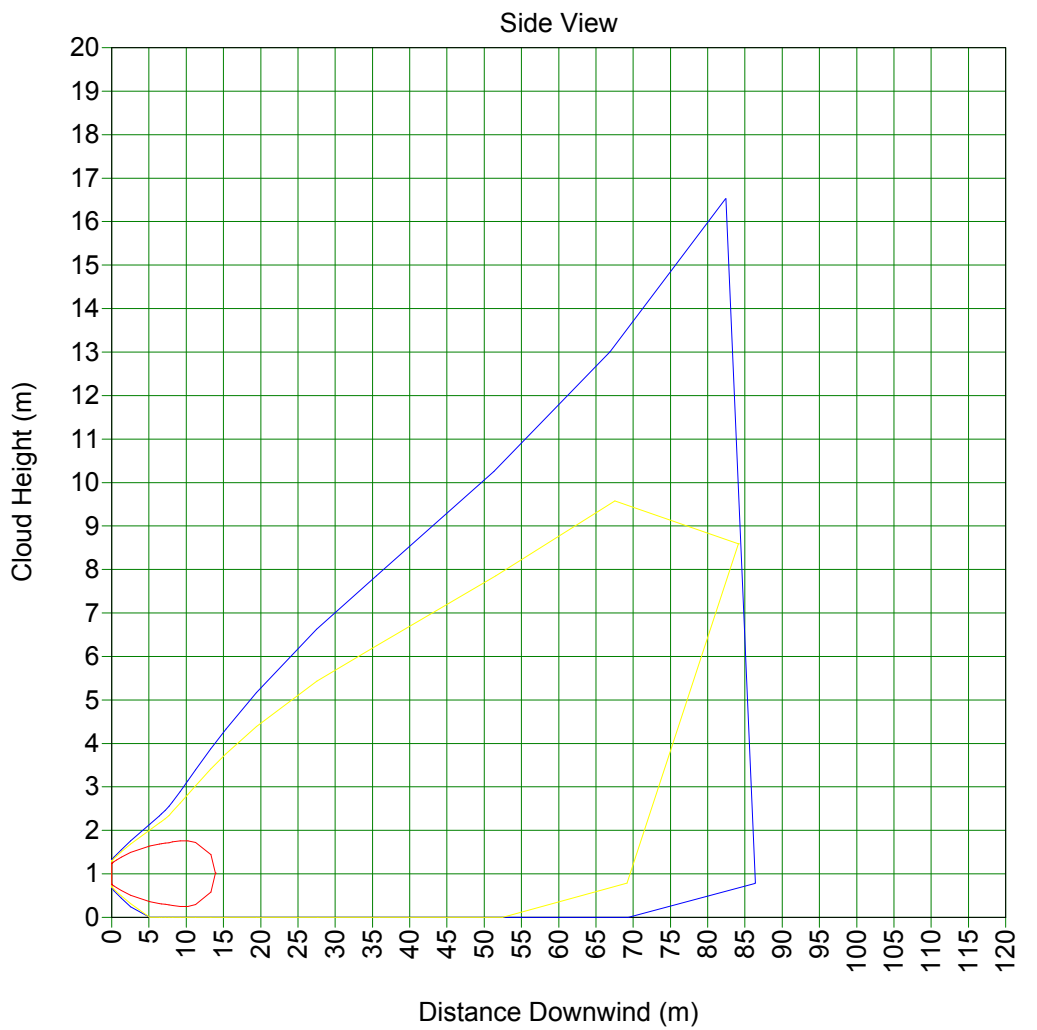
Study Folder: 70977-Fase  
1-lp14  
Audit No: 77520  
Model: 90mm  
Weather: Category 5/D  
Material: METHANE  
Averaging Time:  
Flammable(18.75 s)  
C/L Offset: 0 m  
Concentration  
Time: 7.941 s

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



Study Folder: 70977-Fase  
1-lp14  
Audit No: 77520  
Model: 90mm  
Weather: Category 2/F  
Material: METHANE  
Averaging Time:  
Flammable(18.75 s)  
C/L Offset: 0 m  
Concentration  
Time: 8.547 s

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



# SUMMARY REPORT

Unique Audit Number: 77.520



Study Folder: 70977-Fase 1-Ip14

Phast 6.6

## 70977-Fase 1-Ip14

### Collegamento Rete SNAM - Iniezione

90mm

#### Base Case

CASE Name: Data

Path: \70977-Fase 1-Ip14\Collegamento Rete SNAM - 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	20 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: 77.520



Study Folder: 70977-Fase 1-Ip14

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-Ip14\Collegamento Rete SNAM - 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 0,88 degC  
Final Velocity 498,63 m/s  
Droplet Diameter 0,00 um

# SUMMARY REPORT

Unique Audit Number: 77.520



Study Folder: 70977-Fase 1-Ip14

Phast 6.6

## Continuous Release Data:

Mass Flowrate	4.02604E+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	0,88 degC
Final Velocity	498,63 m/s
Droplet Diameter	0,00 um

## Continuous Release Data:

Mass Flowrate	4.02604E+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

Unique Audit Number: 77.520



Study Folder: 70977-Fase 1-1p14

Phast 6.6

## Consequence Results

### Distance to Concentration Results

**Path:** \70977-Fase 1-1p14\Collegamento Rete SNAM - 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		83.8595	102.893
UFL (165000)	18.75	s		13.9287	12.6077
LFL (44000)	18.75	s		84.1066	83.7971
LFL Frac (22000)	18.75	s		115.201	126.367

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		1.01456	1.00897
LFL (44000)	18.75	s		8.59179	4.55154
LFL Frac (22000)	18.75	s		16.5914	9.65134

# SUMMARY REPORT

Unique Audit Number: 77.520



Study Folder: 70977-Fase 1-IP14

Phast 6.6

## Concentration At Distance Results

**Path:** \70977-Fase 1-IP14\Collegamento Rete SNAM - 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	76773.2	68916.1
250	m	4227.8	4986.6
500	m	1292.83	1872.04

Distance		Heights (m) for above concentrations	
		Category 2/F	Category 5/D
50	m	2.60371	1.7518
250	m	42.7873	21.6222
500	m	65.5268	37.0956

Distance		Conc.(ppm) at Core Avg. Time of 18.75 s	
		Category 2/F	Category 5/D
50	m	76773.2	68916.1
250	m	4227.8	4986.6
500	m	1292.83	1872.04

Distance		Heights (m) for above concentrations	
		Category 2/F	Category 5/D
50	m	2.60371	1.7518
250	m	42.7873	21.6222
500	m	65.5268	37.0956

## Jet Fire Hazard

**Path:** \70977-Fase 1-IP14\Collegamento Rete SNAM - 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-IP14\Collegamento Rete SNAM - 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/m <sup>2</sup>	92.9945	92.9945
Radiation Level	7	kW/m <sup>2</sup>	96.8206	96.8206
Radiation Level	5	kW/m <sup>2</sup>	99.6552	99.6552
Radiation Level	3	kW/m <sup>2</sup>	105.212	105.212

# SUMMARY REPORT

Unique Audit Number: 77.520



Study Folder: 70977-Fase 1-Ip14

Phast 6.6

## Radiation Effects: Jet Fire Distance

Path: \70977-Fase 1-Ip14\Collegamento Rete SNAM - Iniezione\90mm

		Radiation Level (kW/m2)	
		Category 2/F	Category 5/D
Distance Of Interest 50	m	Engulfed	Engulfed
Distance Of Interest 250	m	0.0718609	0.0718609
Distance Of Interest 500	m	0.0115122	0.0115122

## Flash Fire Envelope

Path: \70977-Fase 1-Ip14\Collegamento Rete SNAM - Iniezione\90mm

All flammable results are reported at the cloud centreline height

		Distance (m)		Heights (m) for above distances		
			Category 2/F	Category 5/D	Category 2/F	Category 5/D
Furthest Extent	22000	ppm	115.201	126.367	16.5914	9.65134
Furthest Extent	44000	ppm	84.1066	83.7971	8.59179	4.55154



# SUMMARY REPORT

Study Folder: 70977-Fase 1-1p14

Unique Audit Number: 77.520

Phast 6.6



## Explosion Effects: Late Ignition

Path: \70977-Fase 1-1p14\Collegamento Rete SNAM - 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	285.241	274.224
Overpressure	0.1379	bar	155.374	159.932
Overpressure	0.2068	bar	145.109	150.899

			Supplementary Data at 0.02068 bar	
			Category 2/F	Category 5/D
Supplied Flammable Mass	kg		138.093	94.1292
Used Flammable Mass	kg		138.093	94.1292
Overpressure Radius	m		175.241	154.224
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		138.093	94.1292
Used Flammable Mass	kg		138.093	94.1292
Overpressure Radius	m		45.3742	39.9324
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		138.093	94.1292
Used Flammable Mass	kg		138.093	94.1292
Overpressure Radius	m		35.1095	30.8988
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	0.0275113	0.0256633
Distance	500	m	0.00810298	0.0072679

			Supplementary Data at 50 m	
			Category 2/F	Category 5/D
Supplied Flammable Mass	kg		51.7931	50.1196

# SUMMARY REPORT

Unique Audit Number: 77.520



Study Folder: 70977-Fase 1-Ip14

Phast 6.6

Used Flammable Mass	kg	51.7931	50.1196
		Supplementary Data at 250 m	
		Category 2/F	Category 5/D
Supplied Flammable Mass	kg	138.093	94.1292
Used Flammable Mass	kg	138.093	94.1292
		Supplementary Data at 500 m	
		Category 2/F	Category 5/D
Supplied Flammable Mass	kg	138.093	94.1292
Used Flammable Mass	kg	138.093	94.1292

## Weather Conditions

**Path:** \70977-Fase 1-Ip14\Collegamento Rete SNAM - 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