ANNESSO TECNICO 6.

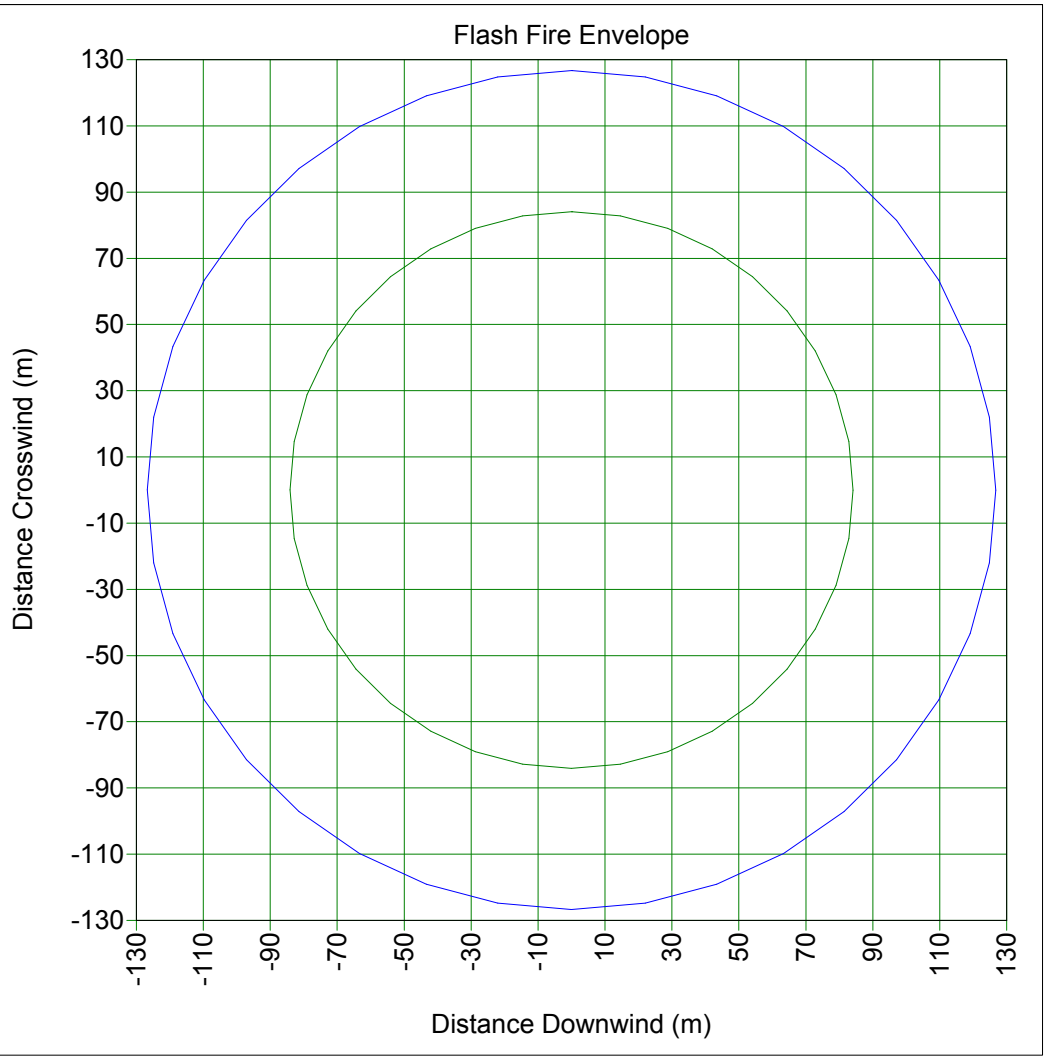
Elaborati di calcolo
Scenari incidentali ragionevolmente credibili

Ipotesi N. 13

TRR S.r.l.
Il Direttore Generale
Ing. Alfredo Romano

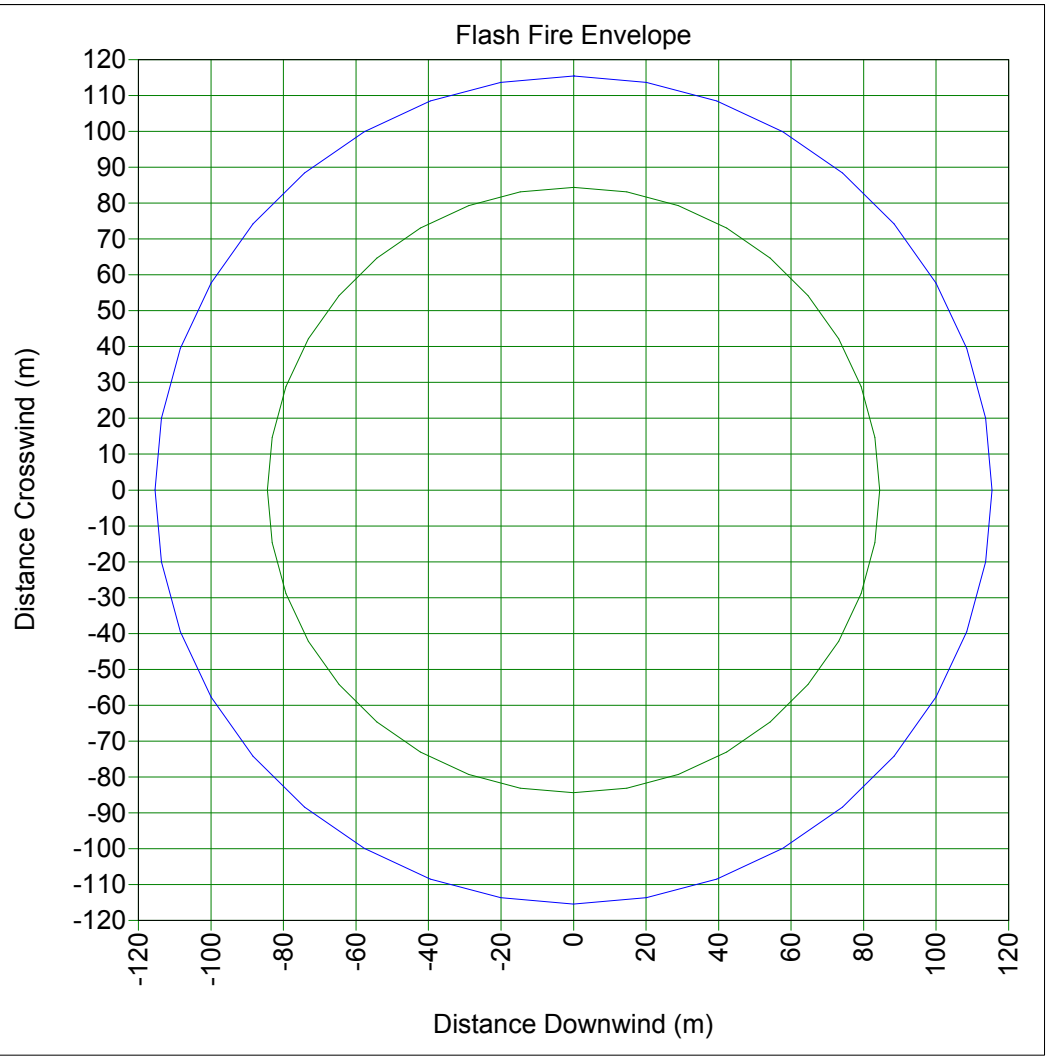
Study Folder: 70977-Fase 1-Ip13
Audit No: 65986
Model: 90mm
Weather: Category 5/D
Material: METHANE
Concentration

- 2.2e+004 ppm
- 4.4e+004 ppm



Study Folder: 70977-Fase 1-Ip13
Audit No: 65986
Model: 90mm
Weather: Category 2/F
Material: METHANE
Concentration

2.2e+004 ppm
4.4e+004 ppm



70977-Fase 1-Ip13

Collegamento Rete SNAM - Erogazione

90mm

Base Case

Data

Weather: **Global Weathers\Category 2/F**

Speed: 2,00 **m/s** **Stability: F**

\70977-Fase 1-Ip13\Collegamento Rete SNAM - Erogazione\90mm

Flame Data

User-Defined Quantities

Model Correlation Type	**API**	
Material	METHANE	
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	0,76	degC
Release Rate	40,55	kg/s

	Input	**Output**	
Flame Emissive Power		130,51	kW/m2
Fraction of Emissivity		0,15	fraction
Expanded Radius		0,19	m
Jet Velocity	500,00	500,00	m/s
Flame Length		91,98	m
Maximum Flame Radius		5,72	m

Flame Co-ordinates

X	**Z**	**R**	**Phi**
m	m	m	deg
0,00	1,00	0,19	90,00
10,22	1,00	2,20	90,00
20,44	1,00	3,63	90,00
30,66	1,00	4,66	90,00
40,88	1,00	5,34	90,00
51,10	1,00	5,68	90,00
61,32	1,00	5,66	90,00
71,54	1,00	5,20	90,00
81,76	1,00	4,07	90,00
91,98	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)	54,44	m
Crosswind semi-axis (B)	78,84	m
Offset Ratio (D)	0,93	
Effect Distance	105,55	m
Area	13.485,70	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)	51,02	m
Crosswind semi-axis (B)	59,72	m
Offset Ratio (D)	0,96	
Effect Distance	99,99	m
Area	9.571,81	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)	49,28	m
Crosswind semi-axis (B)	49,14	m
Offset Ratio (D)	0,97	
Effect Distance	97,15	m
Area	7.608,72	m2

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)	46,98	m
Crosswind semi-axis (B)	34,02	m
Offset Ratio (D)	0,99	
Effect Distance	93,31	m
Area	5.021,37	m2

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			22,66		
10,20			130,51		
20,41			130,51		
30,61			130,51		
40,82			130,51		
51,02			130,51		
61,22			130,51		
71,43			130,51		
81,63			130,51		
91,84			27,71		
102,04			4,03		
112,24			1,76		
122,45			1,01		
132,65			0,68		
142,86			0,49		
153,06			0,37		
163,27			0,28		
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		

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-Ip13\Collegamento Rete SNAM - Erogazione\90mm

Flame Data

User-Defined Quantities

Model Correlation Type		**API**	
Material		METHANE	
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		0,76	degC
Release Rate		40,55	kg/s
	Input	**Output**	
Flame Emissive Power		130,51	kW/m2
Fraction of Emissivity		0,15	fraction
Expanded Radius		0,19	m
Jet Velocity	500,00	500,00	m/s
Flame Length		91,98	m
Maximum Flame Radius		5,72	m

Flame Co-ordinates

X	Z	R	Phi
m	m	m	deg
0,00	1,00	0,19	90,00
10,22	1,00	2,20	90,00
20,44	1,00	3,63	90,00
30,66	1,00	4,66	90,00
40,88	1,00	5,34	90,00
51,10	1,00	5,68	90,00
61,32	1,00	5,66	90,00
71,54	1,00	5,20	90,00
81,76	1,00	4,07	90,00
91,98	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)	54,44	m
Crosswind semi-axis (B)	78,84	m
Offset Ratio (D)	0,93	
Effect Distance	105,55	m
Area	13.485,70	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)	51,02	m
Crosswind semi-axis (B)	59,72	m
Offset Ratio (D)	0,96	
Effect Distance	99,99	m
Area	9.571,81	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)	49,28	m
Crosswind semi-axis (B)	49,14	m
Offset Ratio (D)	0,97	
Effect Distance	97,15	m
Area	7.608,72	m2

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)	46,98	m
Crosswind semi-axis (B)	34,02	m
Offset Ratio (D)	0,99	
Effect Distance	93,31	m
Area	5.021,37	m2

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

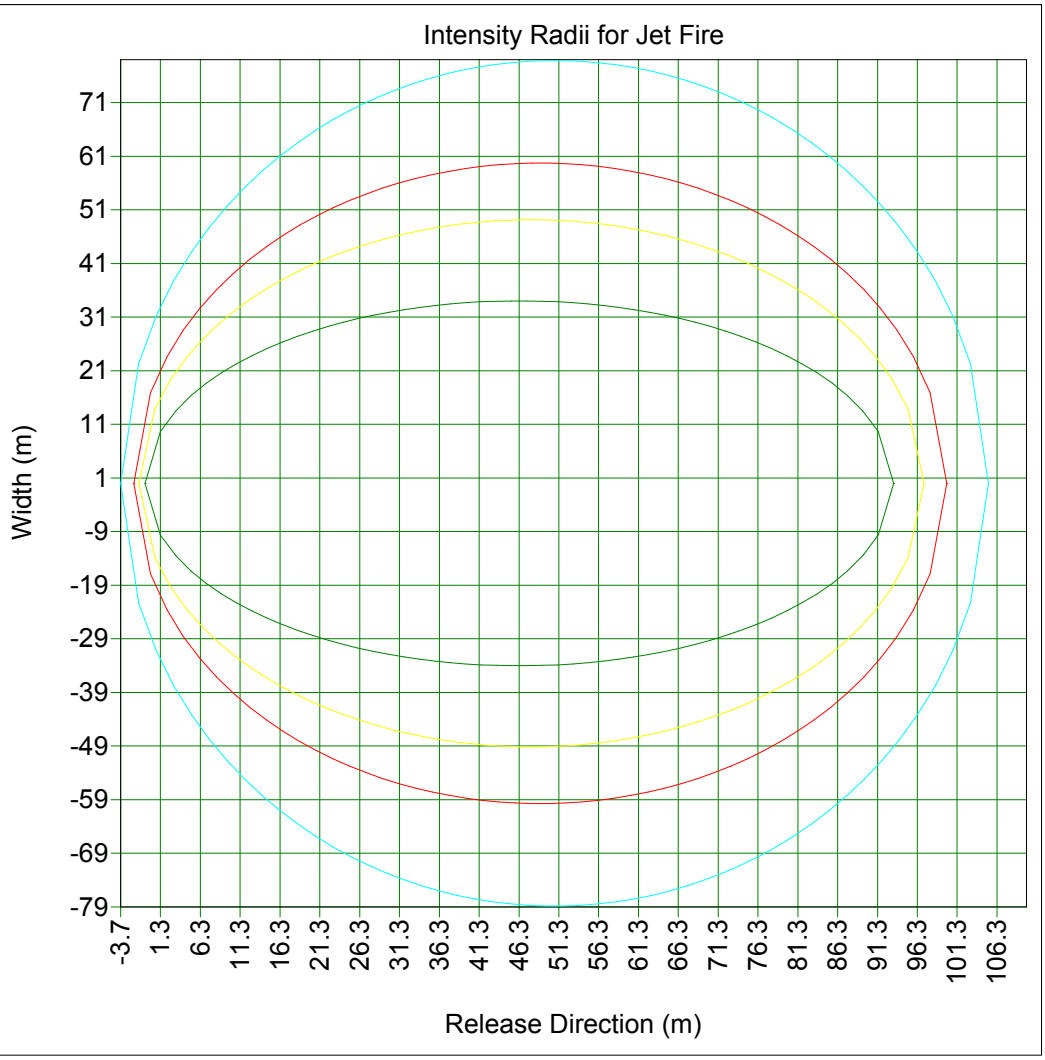
Calculated Quantities

X Coordinates m	Y Coordinates m	Z Coordinates m	Incident Radiation kW/m2	Lethality Level %	View Factor
0,00			22,66		
10,20			130,51		
20,41			130,51		
30,61			130,51		
40,82			130,51		
51,02			130,51		
61,22			130,51		
71,43			130,51		
81,63			130,51		
91,84			27,71		
102,04			4,03		
112,24			1,76		
122,45			1,01		
132,65			0,68		
142,86			0,49		
153,06			0,37		
163,27			0,28		
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		

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		

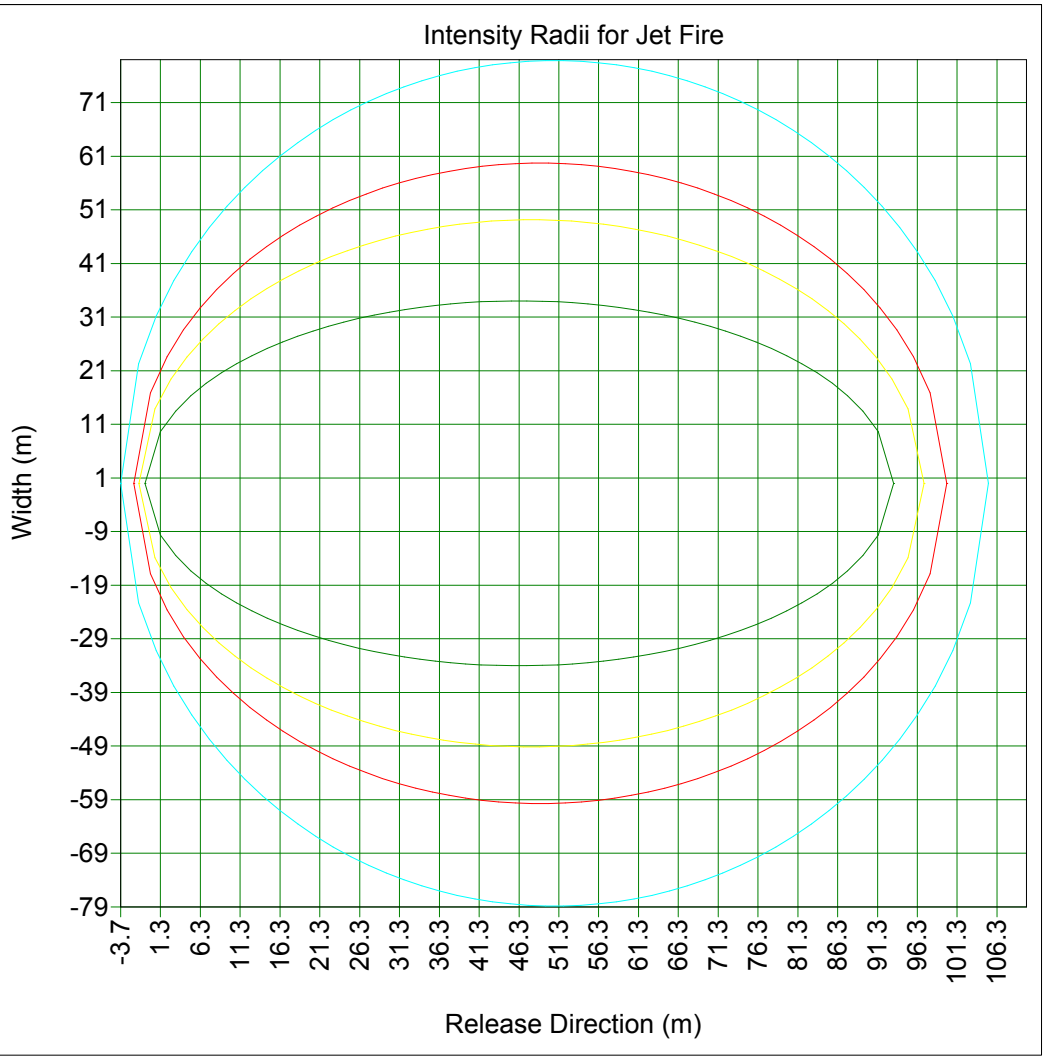
Study Folder: 70977-Fase 1-Ip13
Audit No: 65986
Model: 90mm
Weather: Category 5/D
Material: METHANE

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



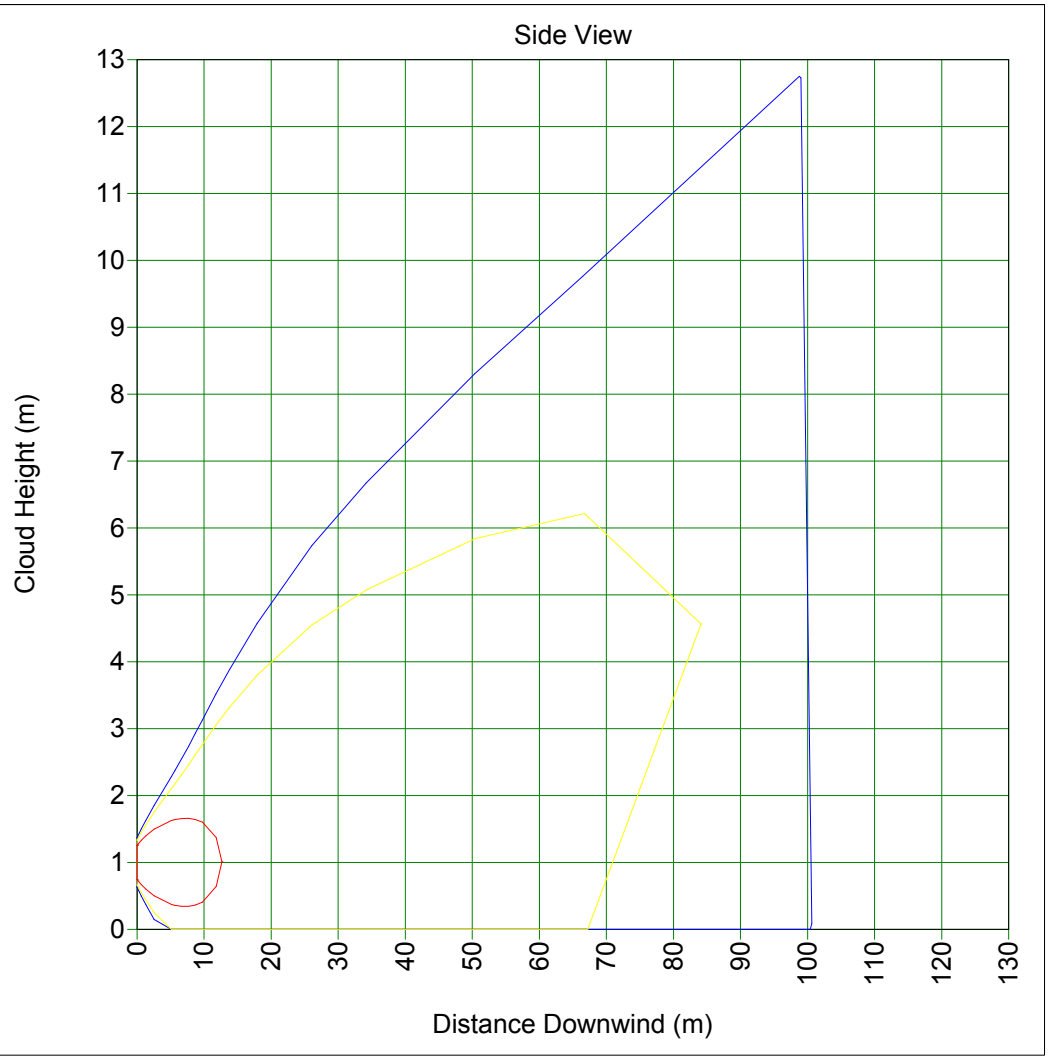
Study Folder: 70977-Fase 1-Ip13
Audit No: 65986
Model: 90mm
Weather: Category 2/F
Material: METHANE

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



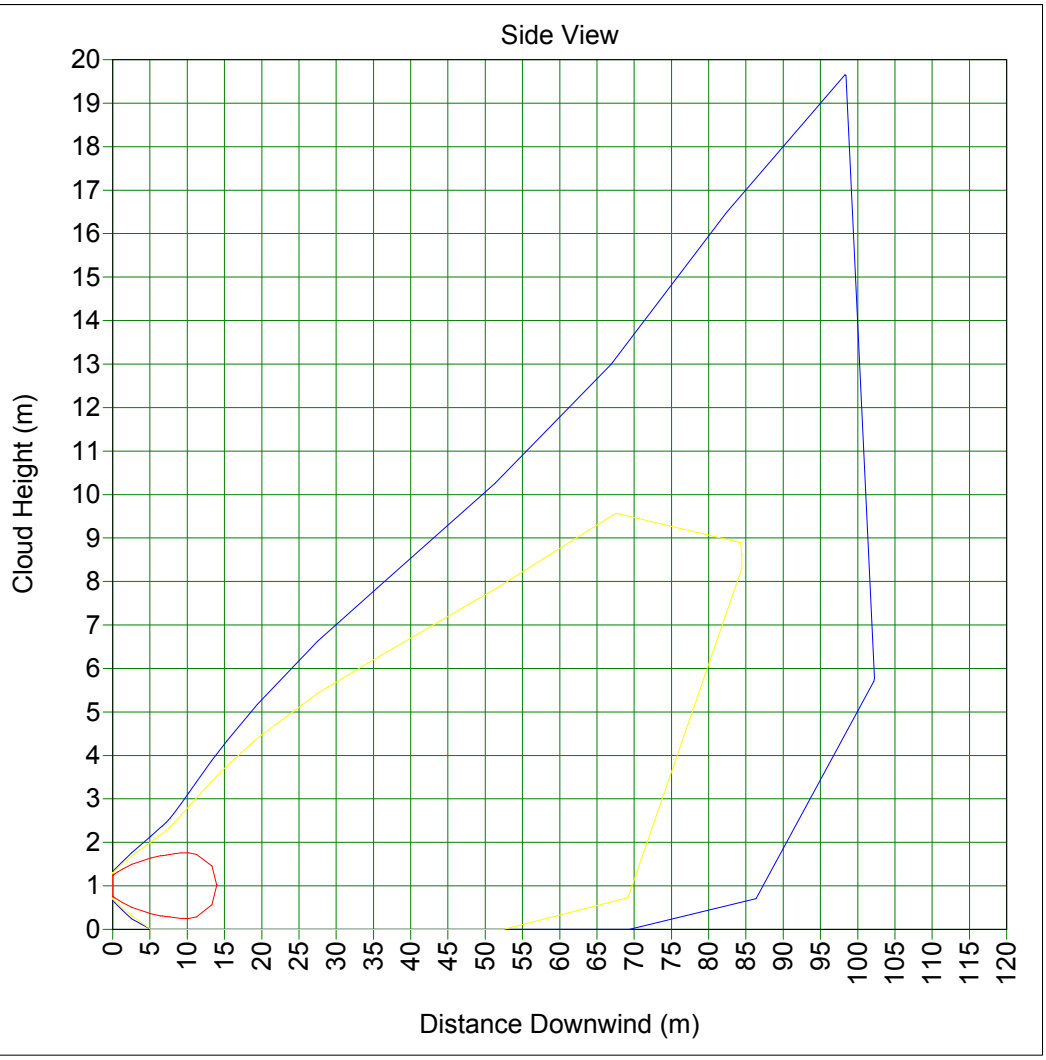
Study Folder: 70977-Fase 1-Ip13
Audit No: 65986
Model: 90mm
Weather: Category 5/D
Material: METHANE
Averaging Time: Flammable(18.75 s)
C/L Offset: 0 m
Concentration
Time: 7.832 s

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



Study Folder: 70977-Fase 1-Ip13
Audit No: 65986
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



70977-Fase 1-Ip13

Collegamento Rete SNAM - Erogazione

90mm

Base Case

CASE Name: **Data**

Path: \70977-Fase 1-Ip13\Collegamento Rete SNAM - Erogazione\90mm

User-Defined Data

Material

Material Identifier	METHANE	
Type of Vessel	Pressurized Gas	
Pressure Specification	Pressure specified	
Storage Pressure - gauge	70	bar
Temperature	50	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

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-Ip13\Collegamento Rete SNAM - Erogazione\90mm

Discharge Data

User-Defined Quantities

Material	METHANE	
Temperature	25,00	degC
Pressure	71,01	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
FinalTemperature	0,76	degC
Final Velocity	500,00	m/s
Droplet Diameter	0,00	um

Continuous Release Data:		
Mass Flowrate	4.05519E+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	0,76	degC
Final Velocity	500,00	m/s
Droplet Diameter	0,00	um
Continuous Release Data:		
Mass Flowrate	4.05519E+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

Consequence Results

Distance to Concentration Results

Path: \70977-Fase 1-Ip13\Collegamento Rete SNAM - Erogazione\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	84.0925	103.413
UFL (165000)	18.75	s	13.9786	12.6518
LFL (44000)	18.75	s	84.4057	84.0996
LFL Frac (22000)	18.75	s	115.412	126.736

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	1.01464	1.00899
LFL (44000)	18.75	s	8.60677	4.56384
LFL Frac (22000)	18.75	s	16.6792	9.67211

Concentration At Distance Results

Path: \70977-Fase 1-Ip13\Collegamento Rete SNAM - Erogazione\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	76972.5	69099.1
250	m	4253.44	5022.41
500	m	1300.07	1884.9

Distance		Heights (m) for above concentrations	
		Category 2/F	Category 5/D
50	m	2.59074	1.74621
250	m	42.8605	21.6294
500	m	65.6504	37.1598

Distance		Conc.(ppm) at Core Avg.Time of 18.75 s	
		Category 2/F	Category 5/D
50	m	76972.5	69099.1
250	m	4253.44	5022.41
500	m	1300.07	1884.9

Distance		Heights (m) for above concentrations	
		Category 2/F	Category 5/D
50	m	2.59074	1.74621
250	m	42.8605	21.6294
500	m	65.6504	37.1598

Jet Fire Hazard

Path: \70977-Fase 1-Ip13\Collegamento Rete SNAM - Erogazione\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-Ip13\Collegamento Rete SNAM - Erogazione\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	93.3099	93.3099
Radiation Level	7	kW/m2	97.1468	97.1468
Radiation Level	5	kW/m2	99.9893	99.9893
Radiation Level	3	kW/m2	105.553	105.553

Radiation Effects: Jet Fire Distance

Path: \70977-Fase 1-Ip13\Collegamento Rete SNAM - Erogazione\90mm

			Radiation Level (kW/m2)
		Category 2/F	Category 5/D
Distance Of Interest 50	m	Engulfed	Engulfed
Distance Of Interest 250	m	0.0724724	0.0724724
Distance Of Interest 500	m	0.0115939	0.0115939

Flash Fire Envelope

Path: \70977-Fase 1-Ip13\Collegamento Rete SNAM - Erogazione\90mm

All flammable results are reported at the cloud centreline height

			Distance (m)	
			Category 2/F	Category 5/D
Furthest Extent	22000	ppm	115.412	126.736
Furthest Extent	44000	ppm	84.4057	84.0996

			Heights (m) for above distances	
			Category 2/F	Category 5/D
Furthest Extent	22000	ppm	16.6792	9.67211
Furthest Extent	44000	ppm	8.60677	4.56384

Explosion Effects: Late Ignition

Path: \70977-Fase 1-Ip13\Collegamento Rete SNAM - Erogazione\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	285.686	274.639
Overpressure	0.1379	bar	155.489	160.04
Overpressure	0.2068	bar	145.199	150.982

		Supplementary Data at 0.02068 bar Category 2/F	Category 5/D
Supplied Flammable Mass	kg	139.149	94.8901
Used Flammable Mass	kg	139.149	94.8901
Overpressure Radius	m	175.686	154.639
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	139.149	94.8901
Used Flammable Mass	kg	139.149	94.8901
Overpressure Radius	m	45.4895	40.0398
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	139.149	94.8901
Used Flammable Mass	kg	139.149	94.8901
Overpressure Radius	m	35.1987	30.9819
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	0.0276026	0.0257525
Distance	500	m	0.00812523	0.00728857

		Supplementary Data at 50 m Category 2/F	Category 5/D
Supplied Flammable Mass	kg	51.9647	50.3407

Used Flammable Mass	kg	51.9647	50.3407
		Supplementary Data at 250 m	
		Category 2/F	Category 5/D
Supplied Flammable Mass	kg	139.149	94.8901
Used Flammable Mass	kg	139.149	94.8901
		Supplementary Data at 500 m	
		Category 2/F	Category 5/D
Supplied Flammable Mass	kg	139.149	94.8901
Used Flammable Mass	kg	139.149	94.8901

Weather Conditions

Path: \70977-Fase 1-Ip13\Collegamento Rete SNAM - Erogazione\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