

ANNESSO TECNICO 6.

Elaborati di calcolo Scenari incidentali ragionevolmente credibili

Ipotesi N. 2

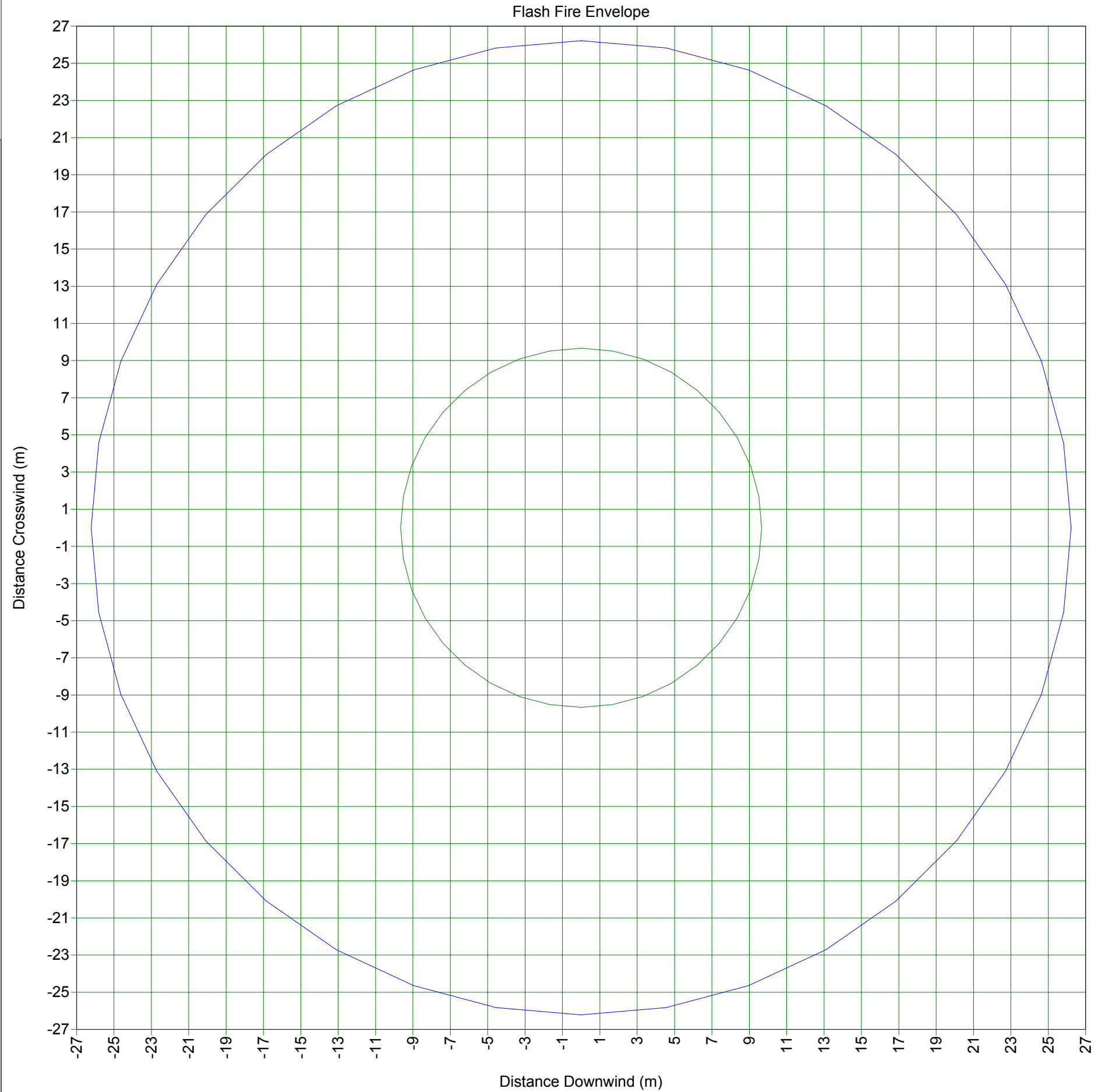
TRR S.r.l.

Il Direttore Generale

Ing. Alfredo Romano

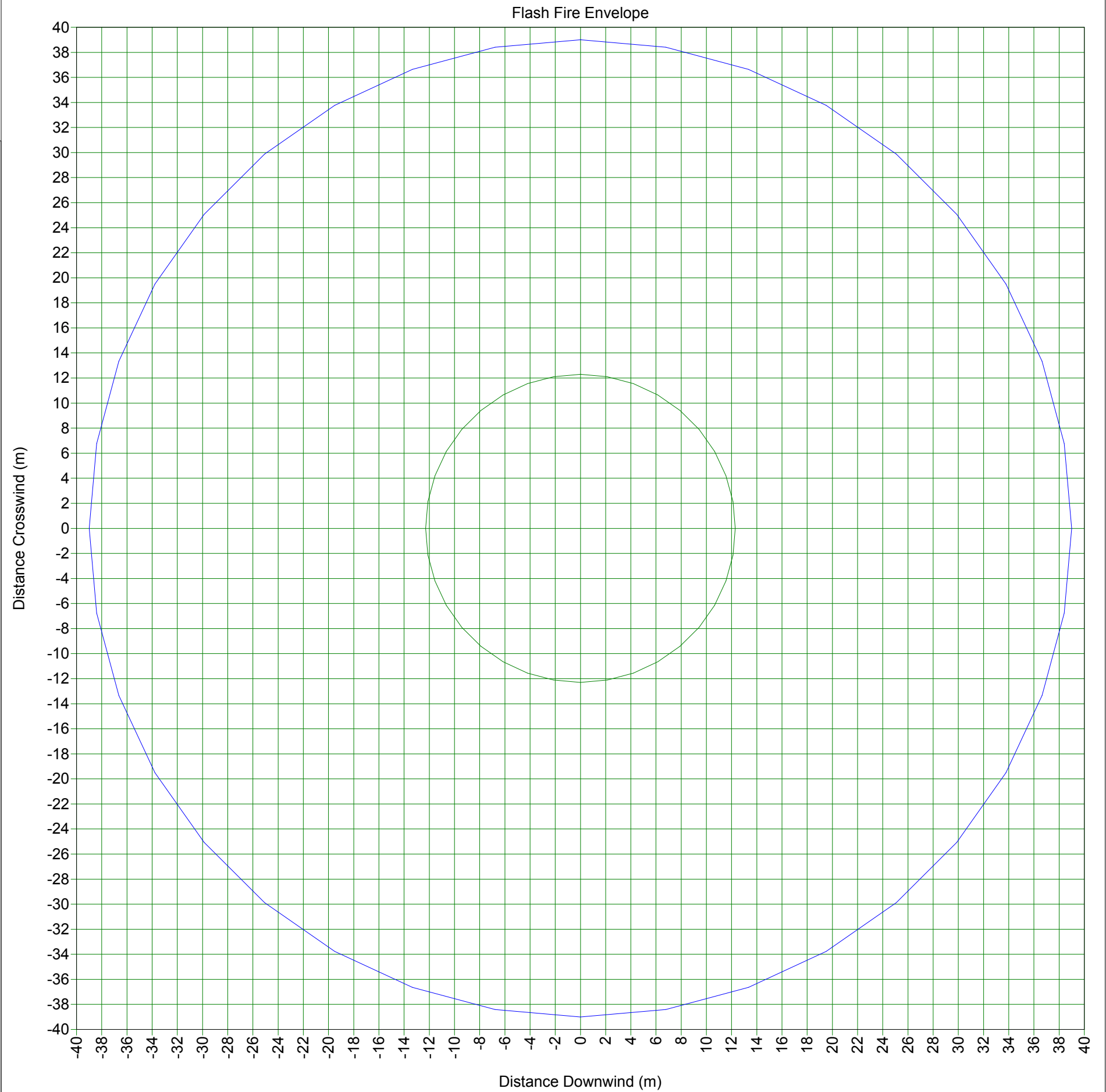

Study Folder: 70977-Fase
2-lp2
Audit No: 53975
Model: 10mm
Weather: Category 5/D
Material: METHANE
Concentration

— 2.2e+004 ppm
— 4.4e+004 ppm



Study Folder: 70977-Fase
2-lp2
Audit No: 53975
Model: 10mm
Weather: Category 2/F
Material: METHANE
Concentration

— 2.2e+004 ppm
— 4.4e+004 ppm



JET FIRE REPORT

Study Folder: 70977-Fase 2-IP2

Unique Audit Number: 53.975



Phast 6.6



70977-Fase 2-IP2



Separatore Testa Pozzo

10mm

Base Case

Data



Weather: Global Weathers\Category 2/F

Speed: 2,00 m/s

Stability: F

\\70977-Fase 2-IP2\\Separatore Testa Pozzo\\10mm

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	-103,54 degC
Release Rate	2,10 kg/s

Input

Output

Flame Emissive Power	114,65 kW/m2
Fraction of Emissivity	0,15 fraction
Expanded Radius	0,03 m
Jet Velocity	500,00 m/s
Flame Length	22,35 m
Maximum Flame Radius	1,39 m

Flame Co-ordinates

X	Z	R	Phi
m	m	m	deg
0,00	1,00	0,03	90,00
2,48	1,00	0,53	90,00
4,97	1,00	0,88	90,00
7,45	1,00	1,13	90,00
9,93	1,00	1,30	90,00
12,41	1,00	1,38	90,00
14,90	1,00	1,38	90,00
17,38	1,00	1,26	90,00
19,86	1,00	0,99	90,00
22,35	1,00	0,00	90,00

JET FIRE REPORT

Study Folder: 70977-Fase 2-Ip2

Unique Audit Number: 53.975



Phast 6.6

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	0,03	
Dose Level	865.118,83	(W/m2)^Probit N.s

Downwind semi-axis (A)	13,69	m
Crosswind semi-axis (B)	19,28	m
Offset Ratio (D)	0,87	
Effect Distance	25,67	m
Area	829,62	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)	12,59	m
Crosswind semi-axis (B)	14,52	m
Offset Ratio (D)	0,92	
Effect Distance	24,24	m
Area	574,70	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)	12,02	m
Crosswind semi-axis (B)	11,91	m
Offset Ratio (D)	0,96	
Effect Distance	23,59	m
Area	449,68	m2

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Unique Audit Number: 53.975



Study Folder: 70977-Fase 2-Ip2

Phast 6.6

Incident Radiation Level:	12,50	kW/m2
Lethality Level	6,53	%
View Factor	0,11	
Dose Level	5.800.161,90	(W/m2)^Probit N.s
Downwind semi-axis (A)	11,27	m
Crosswind semi-axis (B)	8,17	m
Offset Ratio (D)	1,01	
Effect Distance	22,67	m
Area	289,23	m2

JET FIRE REPORT

Study Folder: 70977-Fase 2-Ip2

Unique Audit Number: 53.975



Phast 6.6

Radiation Distance

User-Defined Quantities

Maximum Distance	44,69	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			10,53		
0,91			27,11		
1,82			46,11		
2,74			63,84		
3,65			79,63		
4,56			94,53		
5,47			108,72		
6,38			114,65		
7,30			114,65		
8,21			114,65		
9,12			114,65		
10,03			114,65		
10,95			114,65		
11,86			114,65		
12,77			114,65		
13,68			114,65		
14,59			114,65		
15,51			114,65		
16,42			114,65		
17,33			114,65		
18,24			114,65		
19,15			114,65		
20,07			102,66		
20,98			66,08		
21,89			32,04		
22,80			11,09		
23,71			6,55		
24,63			4,22		
25,54			3,08		
26,45			2,34		
27,36			1,84		
28,27			1,48		
29,19			1,22		
30,10			1,02		
31,01			0,87		
31,92			0,75		
32,84			0,65		

JET FIRE REPORT

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Study Folder: 70977-Fase 2-Ip2

Phast 6.6

X Coordinates m	Y Coordinates m	Z Coordinates m	Incident Radiation kW/m2	Lethality Level %	View Factor
33,75			0,57		
34,66			0,51		
35,57			0,45		
36,48			0,41		
37,40			0,37		
38,31			0,34		
39,22			0,31		
40,13			0,28		
41,04			0,26		
41,96			0,24		
42,87			0,23		
43,78			0,21		
44,69			0,20		



Weather: Global Weathers\Category 5/D

Speed: 5,00

m/s

Stability: D

\70977-Fase 2-Ip2\Separatore Testa Pozzo\10mm

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	-103,54	degC
Release Rate	2,10	kg/s

Input		Output	
Flame Emissive Power		114,65	kW/m2
Fraction of Emissivity		0,15	fraction
Expanded Radius		0,03	m
Jet Velocity	500,00	500,00	m/s
Flame Length		22,35	m
Maximum Flame Radius		1,39	m

JET FIRE REPORT

Unique Audit Number: 53.975



Study Folder: 70977-Fase 2-Ip2

Phast 6.6

Flame Co-ordinates

X	Z	R	Phi
m	m	m	deg
0,00	1,00	0,03	90,00
2,48	1,00	0,53	90,00
4,97	1,00	0,88	90,00
7,45	1,00	1,13	90,00
9,93	1,00	1,30	90,00
12,41	1,00	1,38	90,00
14,90	1,00	1,38	90,00
17,38	1,00	1,26	90,00
19,86	1,00	0,99	90,00
22,35	1,00	0,00	90,00

JET FIRE REPORT

Study Folder: 70977-Fase 2-Ip2

Unique Audit Number: 53.975



Phast 6.6

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	0,03	
Dose Level	865.118,83	(W/m2)^Probit N.s

Downwind semi-axis (A)	13,69	m
Crosswind semi-axis (B)	19,28	m
Offset Ratio (D)	0,87	
Effect Distance	25,67	m
Area	829,62	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)	12,59	m
Crosswind semi-axis (B)	14,52	m
Offset Ratio (D)	0,92	
Effect Distance	24,24	m
Area	574,70	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)	12,02	m
Crosswind semi-axis (B)	11,91	m
Offset Ratio (D)	0,96	
Effect Distance	23,59	m
Area	449,68	m2

JET FIRE REPORT

Unique Audit Number: 53.975



Study Folder: 70977-Fase 2-Ip2

Phast 6.6

Incident Radiation Level:	12,50	kW/m2
Lethality Level	6,53	%
View Factor	0,11	
Dose Level	5.800.161,90	(W/m2)^Probit N.s
Downwind semi-axis (A)	11,27	m
Crosswind semi-axis (B)	8,17	m
Offset Ratio (D)	1,01	
Effect Distance	22,67	m
Area	289,23	m2

JET FIRE REPORT

Study Folder: 70977-Fase 2-Ip2

Unique Audit Number: 53.975



Phast 6.6

Radiation Distance

User-Defined Quantities

Maximum Distance	44,69	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			10,53		
0,91			27,11		
1,82			46,11		
2,74			63,84		
3,65			79,63		
4,56			94,53		
5,47			108,72		
6,38			114,65		
7,30			114,65		
8,21			114,65		
9,12			114,65		
10,03			114,65		
10,95			114,65		
11,86			114,65		
12,77			114,65		
13,68			114,65		
14,59			114,65		
15,51			114,65		
16,42			114,65		
17,33			114,65		
18,24			114,65		
19,15			114,65		
20,07			102,66		
20,98			66,08		
21,89			32,04		
22,80			11,09		
23,71			6,55		
24,63			4,22		
25,54			3,08		
26,45			2,34		
27,36			1,84		
28,27			1,48		
29,19			1,22		
30,10			1,02		
31,01			0,87		
31,92			0,75		
32,84			0,65		

JET FIRE REPORT

Unique Audit Number: 53.975



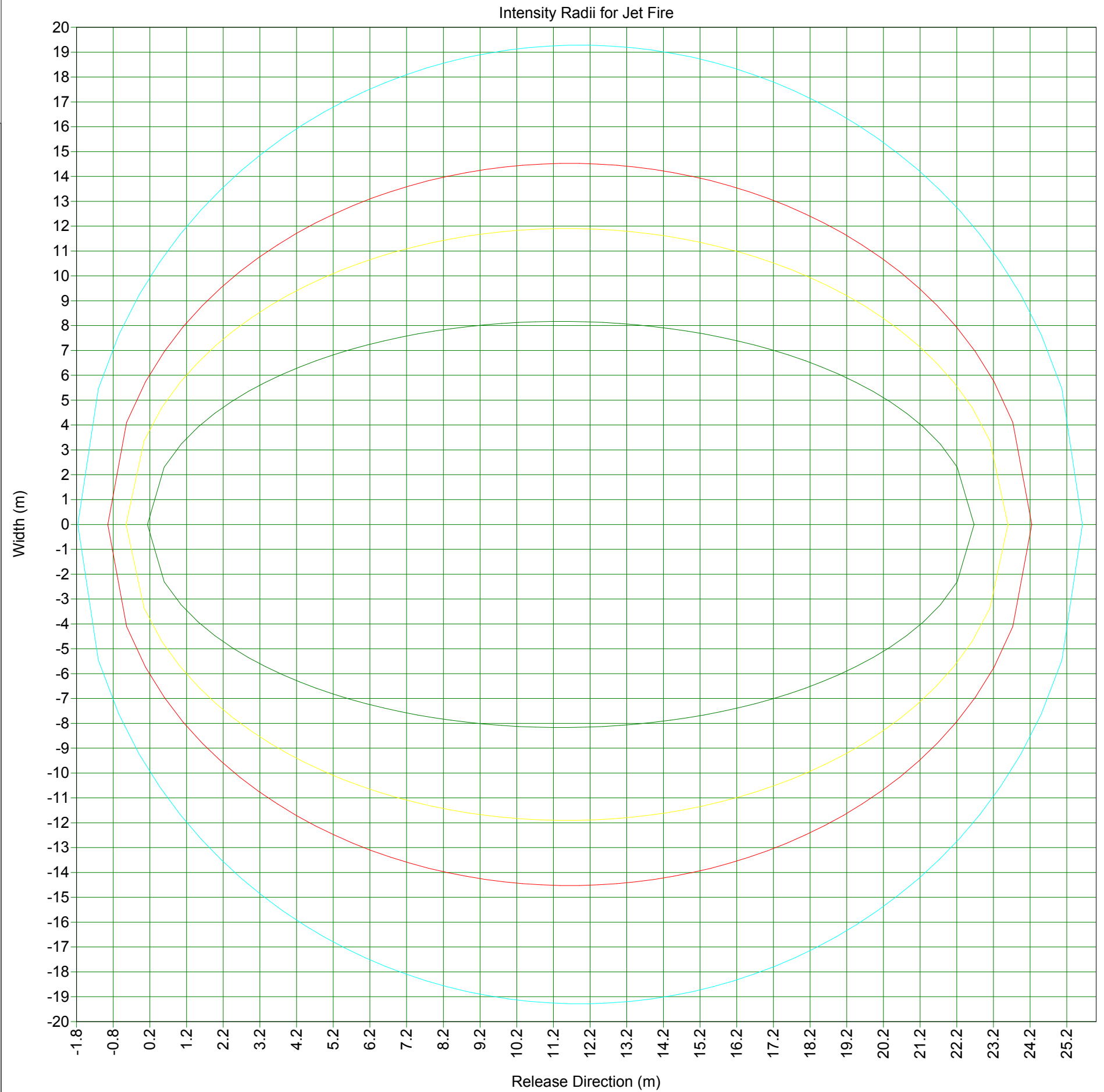
Study Folder: 70977-Fase 2-Ip2

Phast 6.6

X Coordinates m	Y Coordinates m	Z Coordinates m	Incident Radiation kW/m2	Lethality Level %	View Factor
33,75			0,57		
34,66			0,51		
35,57			0,45		
36,48			0,41		
37,40			0,37		
38,31			0,34		
39,22			0,31		
40,13			0,28		
41,04			0,26		
41,96			0,24		
42,87			0,23		
43,78			0,21		
44,69			0,20		

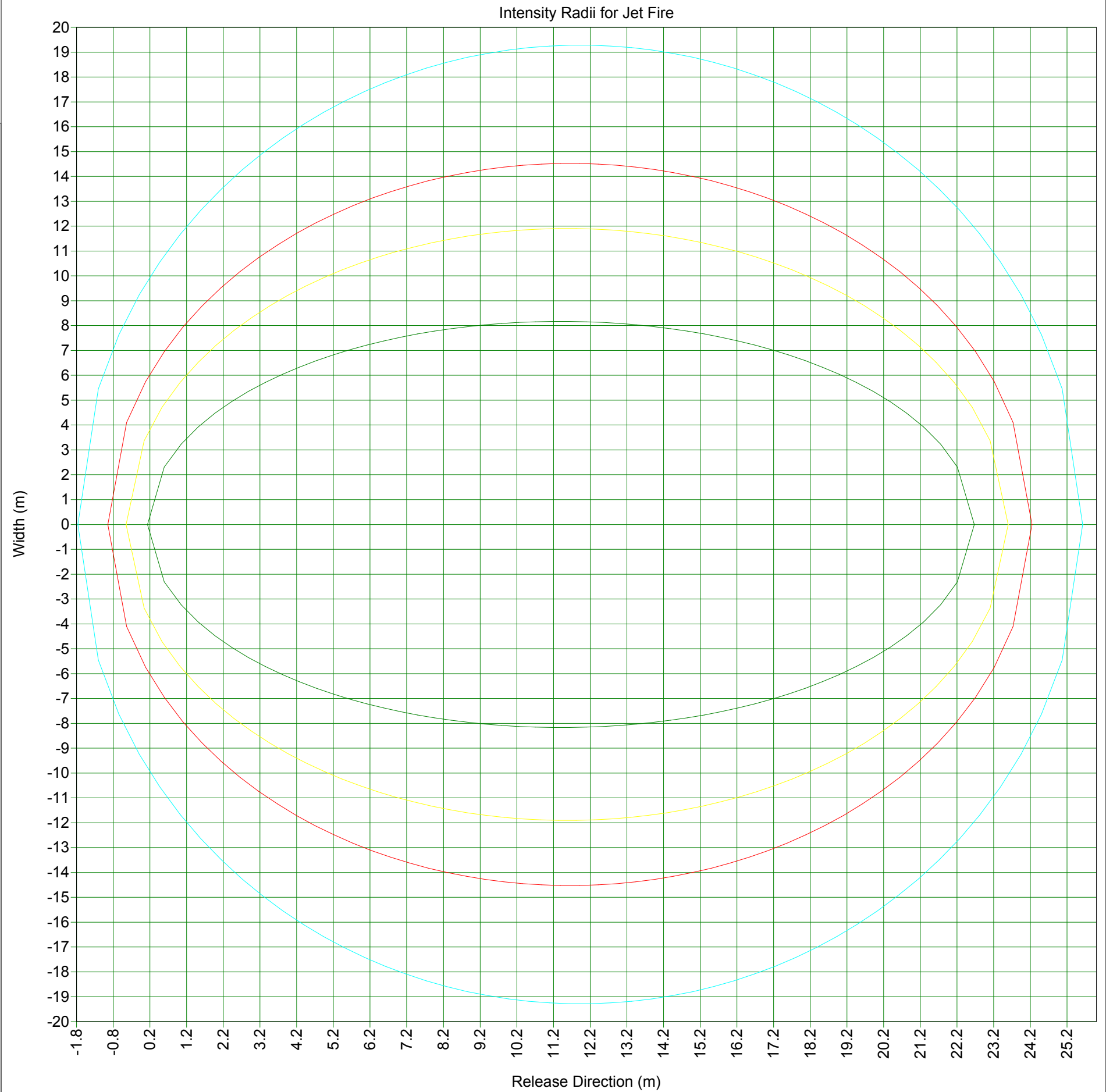
Study Folder: 70977-Fase
2-lp2
Audit No: 53995
Model: 10mm
Weather: Category 5/D
Material: METHANE

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



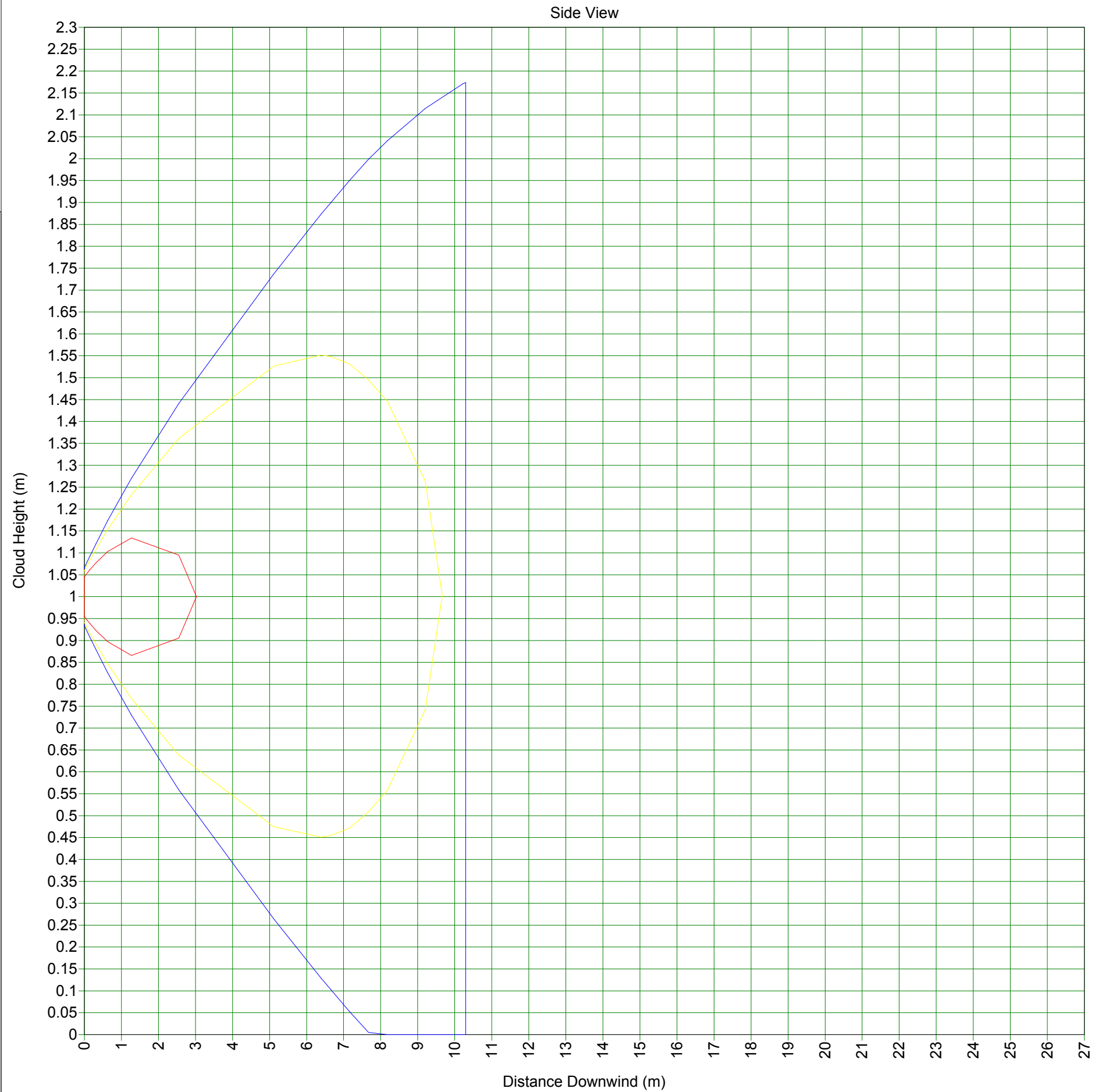
Study Folder: 70977-Fase
2-lp2
Audit No: 53995
Model: 10mm
Weather: Category 2/F
Material: METHANE

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



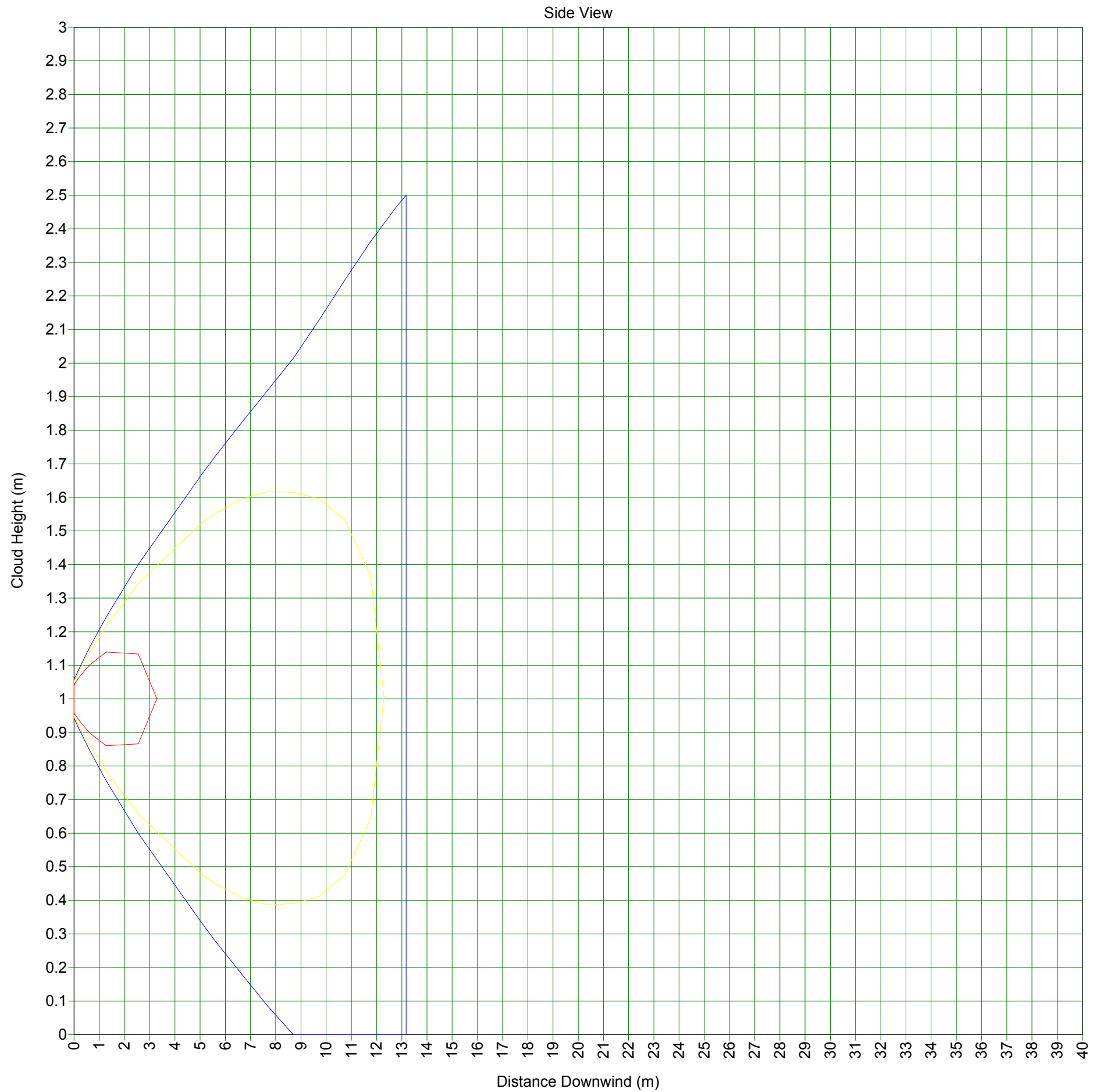
Study Folder: 70977-Fase
2-lp2
Audit No: 53975
Model: 10mm
Weather: Category 5/D
Material: METHANE
Averaging Time:
Flammable(18.75 s)
C/L Offset: 0 m
Concentration
Time: 0.3647 s

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



Study Folder: 70977-Fase
2-lp2
Audit No: 53975
Model: 10mm
Weather: Category 2/F
Material: METHANE
Averaging Time:
Flammable(18.75 s)
C/L Offset: 0 m
Concentration
Time: 0.6076 s

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



SUMMARY REPORT

Unique Audit Number: 53.975



Study Folder: 70977-Fase 2-Ip2

Phast 6.6



70977-Fase 2-Ip2



Separatore Testa Pozzo

10mm

Base Case

CASE Name: Data

Path: \70977-Fase 2-Ip2\Separatore Testa Pozzo\10mm

User-Defined Data

Material

Material Identifier	METHANE
Type of Vessel	Pressurized Gas
Pressure Specification	Pressure specified
Storage Pressure - gauge	154 bar
Temperature	25 degC
Mass Inventory	600 kg

Scenario

Scenario Type	Leak
Phase to be Released	Vapor
Hole Diameter	10 mm
Building Wake Effect	None

Location

[Elevation	1 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	600 kg

Fireball Parameters

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

SUMMARY REPORT

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Study Folder: 70977-Fase 2-Ip2

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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 2-Ip2\Separatore Testa Pozzo\10mm

Discharge Data

User-Defined Quantities

Material	METHANE
Temperature	25,00 degC
Pressure	155,01 bar
Inventory	600,00 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	-103,54 degC
Final Velocity	500,00 m/s
Droplet Diameter	0,00 um

Continuous Release Data:

Mass Flowrate	2.10142E+000 kg/s
Release Duration	285,52 s
Orifice Velocity	395,68 m/s
Exit Pressure	77,60 bar
Exit Temperature	-23,19 degC
Discharge Coefficient	0,85
Expanded Radius	0,03 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
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Study Folder: 70977-Fase 2-Ip2

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FinalTemperature	-103,54 degC
Final Velocity	500,00 m/s
Droplet Diameter	0,00 um
Continuous Release Data:	
Mass Flowrate	2.10142E+000 kg/s
Release Duration	285,52 s
Orifice Velocity	395,68 m/s
Exit Pressure	77,60 bar
Exit Temperature	-23,19 degC
Discharge Coefficient	0,85
Expanded Radius	0,03 m

SUMMARY REPORT

Study Folder: 70977-Fase 2-IP2

Unique Audit Number: 53.975

Phast 6.6



Consequence Results

Distance to Concentration Results

Path: \70977-Fase 2-IP2\Separatore Testa Pozzo\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
UFL	(165000)	18.75	s	3.28507	3.02432
LFL	(44000)	18.75	s	12.2947	9.66157
LFL Frac	(22000)	18.75	s	39.0001	26.2209

Concentration(ppm) Averaging Time				Heights (m) for above distances	
				Category 2/F	Category 5/D
UFL	(165000)	18.75	s	1.00025	1.00019
LFL	(44000)	18.75	s	1.00644	1.00302
LFL Frac	(22000)	18.75	s	0.930634	0.997034

Jet Fire Hazard

Path: \70977-Fase 2-IP2\Separatore Testa Pozzo\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 2-IP2\Separatore Testa Pozzo\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		22.6706	22.6706
Radiation Level	7	kW/m2		23.595	23.595
Radiation Level	5	kW/m2		24.2423	24.2423
Radiation Level	3	kW/m2		25.6694	25.6694

Radiation Effects: Jet Fire Distance

Path: \70977-Fase 2-IP2\Separatore Testa Pozzo\10mm

		Radiation Level (kW/m2)
		Category 2/F

SUMMARY REPORT

Study Folder: 70977-Fase 2-IP2

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Flash Fire Envelope

Path: \70977-Fase 2-IP2\Separatore Testa Pozzo\10mm

All flammable results are reported at the cloud centreline height

				Distance (m)	
				Category 2/F	Category 5/D
Furthest Extent	22000	ppm		39.0001	26.2209
Furthest Extent	44000	ppm		12.2947	9.66157
				Heights (m) for above distances	
				Category 2/F	Category 5/D
Furthest Extent	22000	ppm		0.930634	0.997034
Furthest Extent	44000	ppm		1.00644	1.00302

SUMMARY REPORT

Study Folder: 70977-Fase 2-Ip2

Unique Audit Number: 53.975

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Explosion Effects: Late Ignition

Path: \70977-Fase 2-Ip2\Separatore Testa Pozzo\10mm

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	53.5875	40.1887
Overpressure	0.1379	bar	36.1074	25.2274
Overpressure	0.2068	bar	34.7258	24.0448

			Supplementary Data at 0.02068 bar	
			Category 2/F	Category 5/D
Supplied Flammable Mass	kg		0.336754	0.211151
Used Flammable Mass	kg		0.336754	0.211151
Overpressure Radius	m		23.5875	20.1887
Distance to:				
- Ignition Source	m		30	20
- Cloud Front/Centre	m		30	20
- Explosion Centre	m		30	20

			Supplementary Data at 0.1379 bar	
			Category 2/F	Category 5/D
Supplied Flammable Mass	kg		0.336754	0.211151
Used Flammable Mass	kg		0.336754	0.211151
Overpressure Radius	m		6.10739	5.22735
Distance to:				
- Ignition Source	m		30	20
- Cloud Front/Centre	m		30	20
- Explosion Centre	m		30	20

			Supplementary Data at 0.2068 bar	
			Category 2/F	Category 5/D
Supplied Flammable Mass	kg		0.336754	0.211151
Used Flammable Mass	kg		0.336754	0.211151
Overpressure Radius	m		4.72576	4.04481
Distance to:				
- Ignition Source	m		30	20
- Cloud Front/Centre	m		30	20
- Explosion Centre	m		30	20

SUMMARY REPORT

Unique Audit Number: 53.975



Study Folder: 70977-Fase 2-Ip2

Phast 6.6

Weather Conditions

Path: \70977-Fase 2-Ip2\Separatore Testa Pozzo\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