

ANNESSO TECNICO 6.

**Elaborati di calcolo
Scenari incidentali ragionevolmente credibili**

Ipotesi N. 23

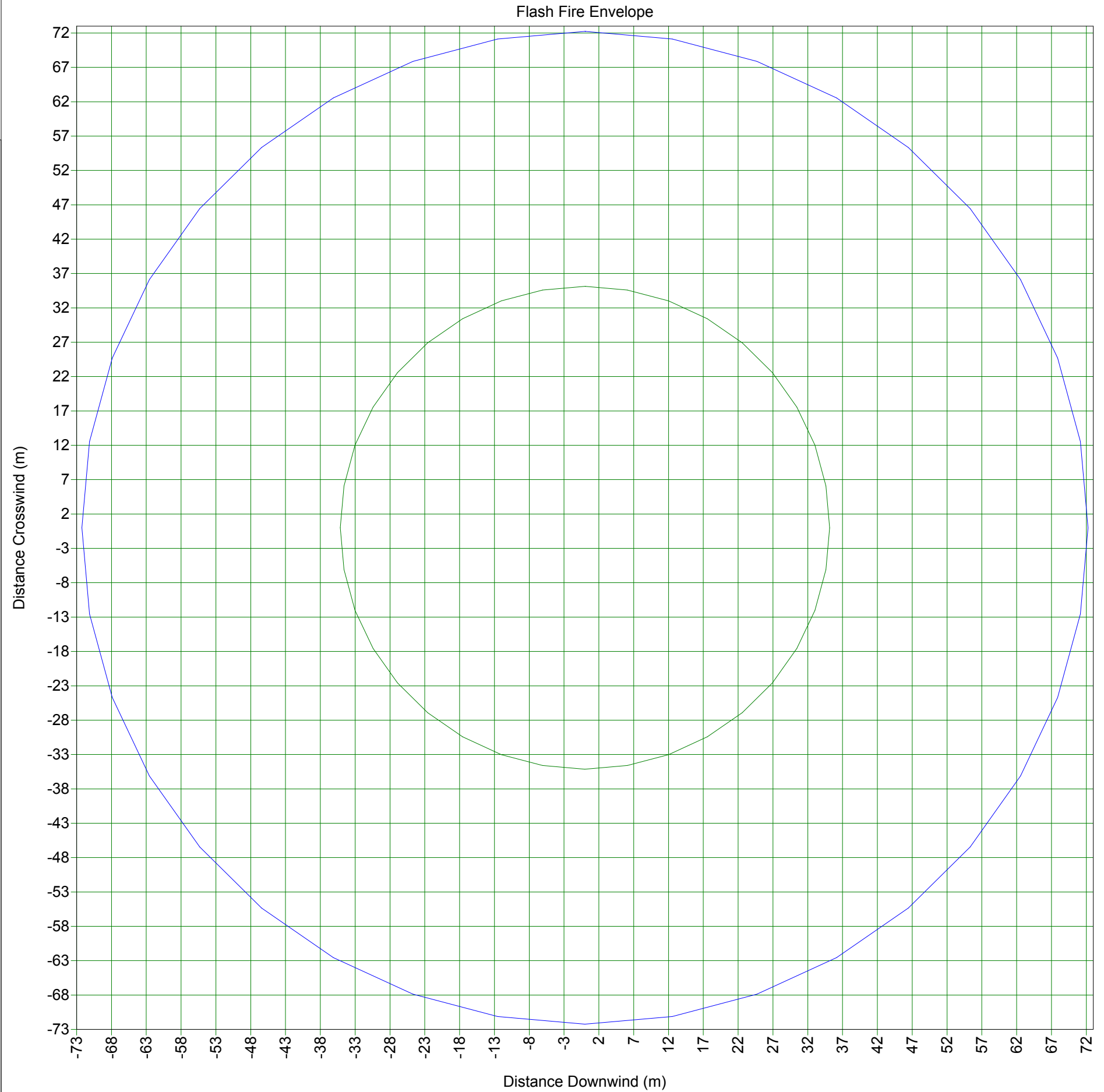
TRR S.r.l.

Il Direttore Generale

Ing. Alfredo Romano

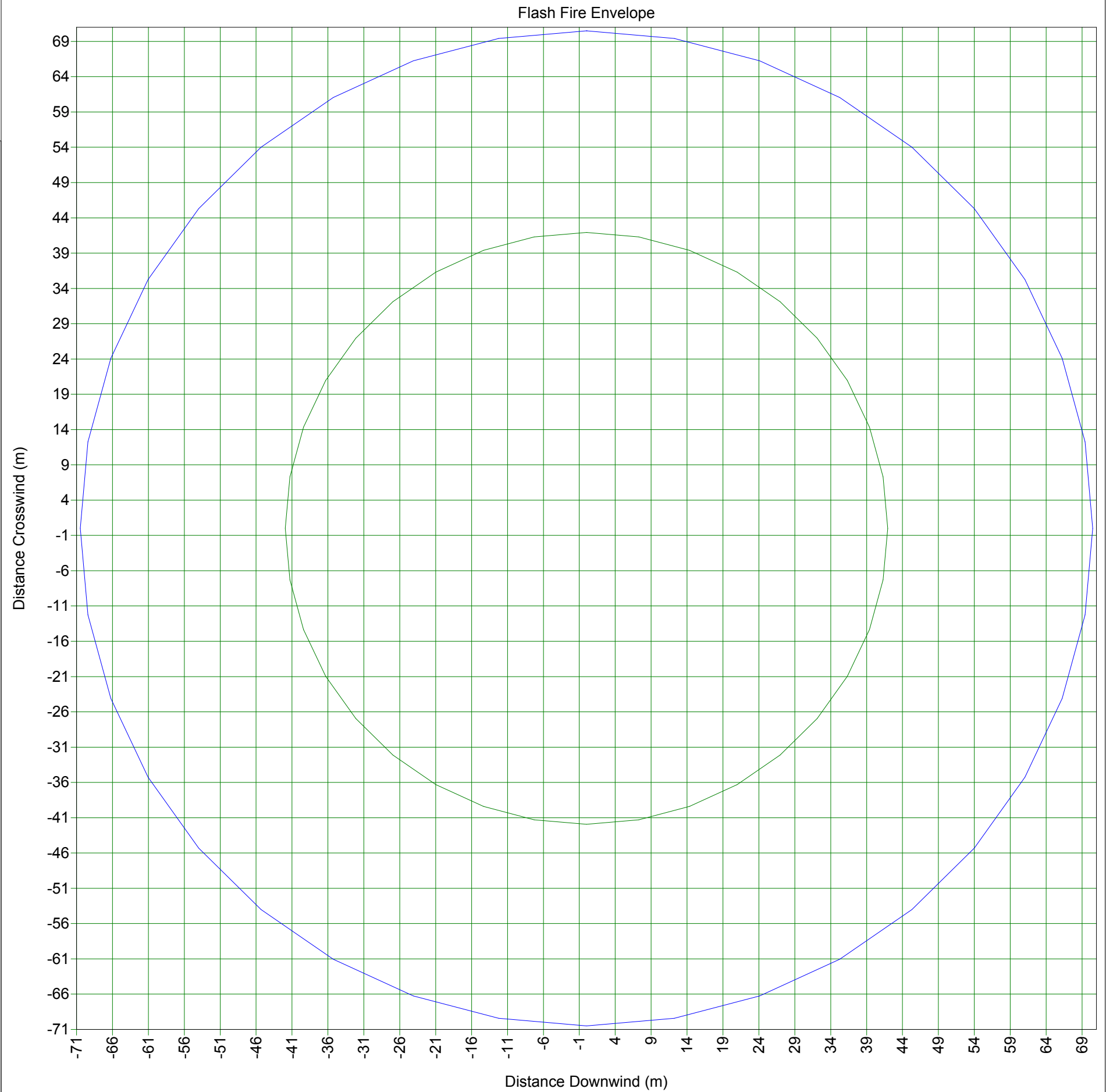

Study Folder: 70977-Fase
2-lp23
Audit No: 65666
Model: 25mm
Weather: Category 5/D
Material: METHANE
Concentration

— 2.2e+004 ppm
— 4.4e+004 ppm



Study Folder: 70977-Fase
2-lp23
Audit No: 65666
Model: 25mm
Weather: Category 2/F
Material: METHANE
Concentration

— 2.2e+004 ppm
— 4.4e+004 ppm



JET FIRE REPORT

Study Folder: 70977-Fase 2-Ip23

Unique Audit Number: 65.666



Phast 6.6



70977-Fase 2-Ip23



Compressore

25mm

Base Case

Data



Weather: Global Weathers\Category 2/F

Speed: 2,00 m/s

Stability: F

\70977-Fase 2-Ip23\Compressore\25mm

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	6,94 degC
Release Rate	10,61 kg/s

Input

Output

Flame Emissive Power	123,04 kW/m2
Fraction of Emissivity	0,15 fraction
Expanded Radius	0,10 m
Jet Velocity	500,00 m/s
Flame Length	48,45 m
Maximum Flame Radius	3,01 m

Flame Co-ordinates

X	Z	R	Phi
m	m	m	deg
0,00	1,00	0,10	90,00
5,38	1,00	1,16	90,00
10,77	1,00	1,91	90,00
16,15	1,00	2,45	90,00
21,53	1,00	2,81	90,00
26,91	1,00	2,99	90,00
32,30	1,00	2,98	90,00
37,68	1,00	2,74	90,00
43,06	1,00	2,14	90,00
48,45	1,00	0,00	90,00

JET FIRE REPORT

Study Folder: 70977-Fase 2-Ip23

Unique Audit Number: 65.666



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	0,02	
Dose Level	865.118,83	(W/m2)^Probit N.s

Downwind semi-axis (A)	29,02	m
Crosswind semi-axis (B)	41,79	m
Offset Ratio (D)	0,91	
Effect Distance	55,57	m
Area	3.809,87	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)	27,03	m
Crosswind semi-axis (B)	31,58	m
Offset Ratio (D)	0,94	
Effect Distance	52,53	m
Area	2.681,69	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)	25,97	m
Crosswind semi-axis (B)	25,94	m
Offset Ratio (D)	0,96	
Effect Distance	50,95	m
Area	2.116,71	m2

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Study Folder: 70977-Fase 2-Ip23

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)	24,67	m
Crosswind semi-axis (B)	17,92	m
Offset Ratio (D)	0,99	
Effect Distance	49,19	m
Area	1.388,64	m2

JET FIRE REPORT

Study Folder: 70977-Fase 2-Ip23

Unique Audit Number: 65.666



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			15,45		
10,20			123,04		
20,41			123,04		
30,61			123,04		
40,82			123,04		
51,02			6,89		
61,22			1,42		
71,43			0,61		
81,63			0,35		
91,84			0,23		
102,04			0,16		
112,24			0,12		
122,45			0,09		
132,65			0,07		
142,86			0,06		
153,06			0,05		
163,27			0,04		
173,47			0,04		
183,67			0,03		
193,88			0,03		
204,08			0,02		
214,29			0,02		
224,49			0,02		
234,69			0,02		
244,90			0,01		
255,10			0,01		
265,31			0,01		
275,51			0,01		
285,71			0,01		
295,92			0,01		
306,12			0,01		
316,33			0,01		
326,53			0,01		
336,73			0,01		
346,94			0,01		
357,14			0,01		
367,35			0,01		

JET FIRE REPORT

Unique Audit Number: 65.666



Study Folder: 70977-Fase 2-IP23

Phast 6.6

X Coordinates m	Y Coordinates m	Z Coordinates m	Incident Radiation kW/m2	Lethality Level %	View Factor
377,55			0,01		
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 2-IP23\Compressore\25mm

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	6,94 degC
Release Rate	10,61 kg/s

	Input	Output
Flame Emissive Power		123,04 kW/m2
Fraction of Emissivity		0,15 fraction
Expanded Radius		0,10 m
Jet Velocity	500,00	500,00 m/s
Flame Length		48,45 m
Maximum Flame Radius		3,01 m

JET FIRE REPORT

Unique Audit Number: 65.666



Study Folder: 70977-Fase 2-Ip23

Phast 6.6

Flame Co-ordinates

X	Z	R	Phi
m	m	m	deg
0,00	1,00	0,10	90,00
5,38	1,00	1,16	90,00
10,77	1,00	1,91	90,00
16,15	1,00	2,45	90,00
21,53	1,00	2,81	90,00
26,91	1,00	2,99	90,00
32,30	1,00	2,98	90,00
37,68	1,00	2,74	90,00
43,06	1,00	2,14	90,00
48,45	1,00	0,00	90,00

JET FIRE REPORT

Study Folder: 70977-Fase 2-IP23

Unique Audit Number: 65.666



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	0,02	
Dose Level	865.118,83	(W/m2)^Probit N.s

Downwind semi-axis (A)	29,02	m
Crosswind semi-axis (B)	41,79	m
Offset Ratio (D)	0,91	
Effect Distance	55,57	m
Area	3.809,87	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)	27,03	m
Crosswind semi-axis (B)	31,58	m
Offset Ratio (D)	0,94	
Effect Distance	52,53	m
Area	2.681,69	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)	25,97	m
Crosswind semi-axis (B)	25,94	m
Offset Ratio (D)	0,96	
Effect Distance	50,95	m
Area	2.116,71	m2

JET FIRE REPORT

Unique Audit Number: 65.666



Study Folder: 70977-Fase 2-Ip23

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)	24,67	m
Crosswind semi-axis (B)	17,92	m
Offset Ratio (D)	0,99	
Effect Distance	49,19	m
Area	1.388,64	m2

JET FIRE REPORT

Study Folder: 70977-Fase 2-Ip23

Unique Audit Number: 65.666



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			15,45		
10,20			123,04		
20,41			123,04		
30,61			123,04		
40,82			123,04		
51,02			6,89		
61,22			1,42		
71,43			0,61		
81,63			0,35		
91,84			0,23		
102,04			0,16		
112,24			0,12		
122,45			0,09		
132,65			0,07		
142,86			0,06		
153,06			0,05		
163,27			0,04		
173,47			0,04		
183,67			0,03		
193,88			0,03		
204,08			0,02		
214,29			0,02		
224,49			0,02		
234,69			0,02		
244,90			0,01		
255,10			0,01		
265,31			0,01		
275,51			0,01		
285,71			0,01		
295,92			0,01		
306,12			0,01		
316,33			0,01		
326,53			0,01		
336,73			0,01		
346,94			0,01		
357,14			0,01		
367,35			0,01		

JET FIRE REPORT

Unique Audit Number: 65.666



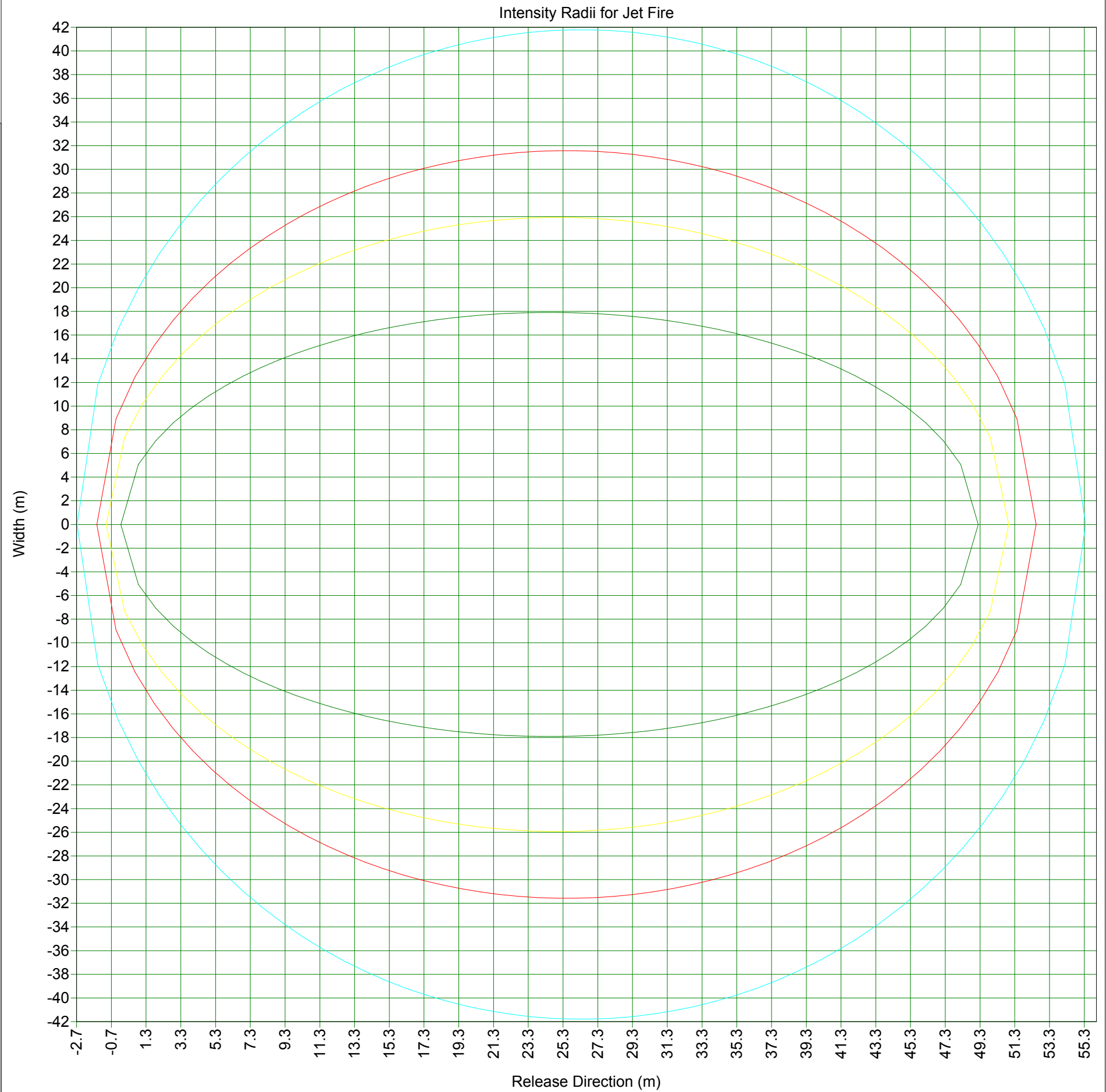
Study Folder: 70977-Fase 2-Ip23

Phast 6.6

X Coordinates m	Y Coordinates m	Z Coordinates m	Incident Radiation kW/m2	Lethality Level %	View Factor
377,55			0,01		
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		

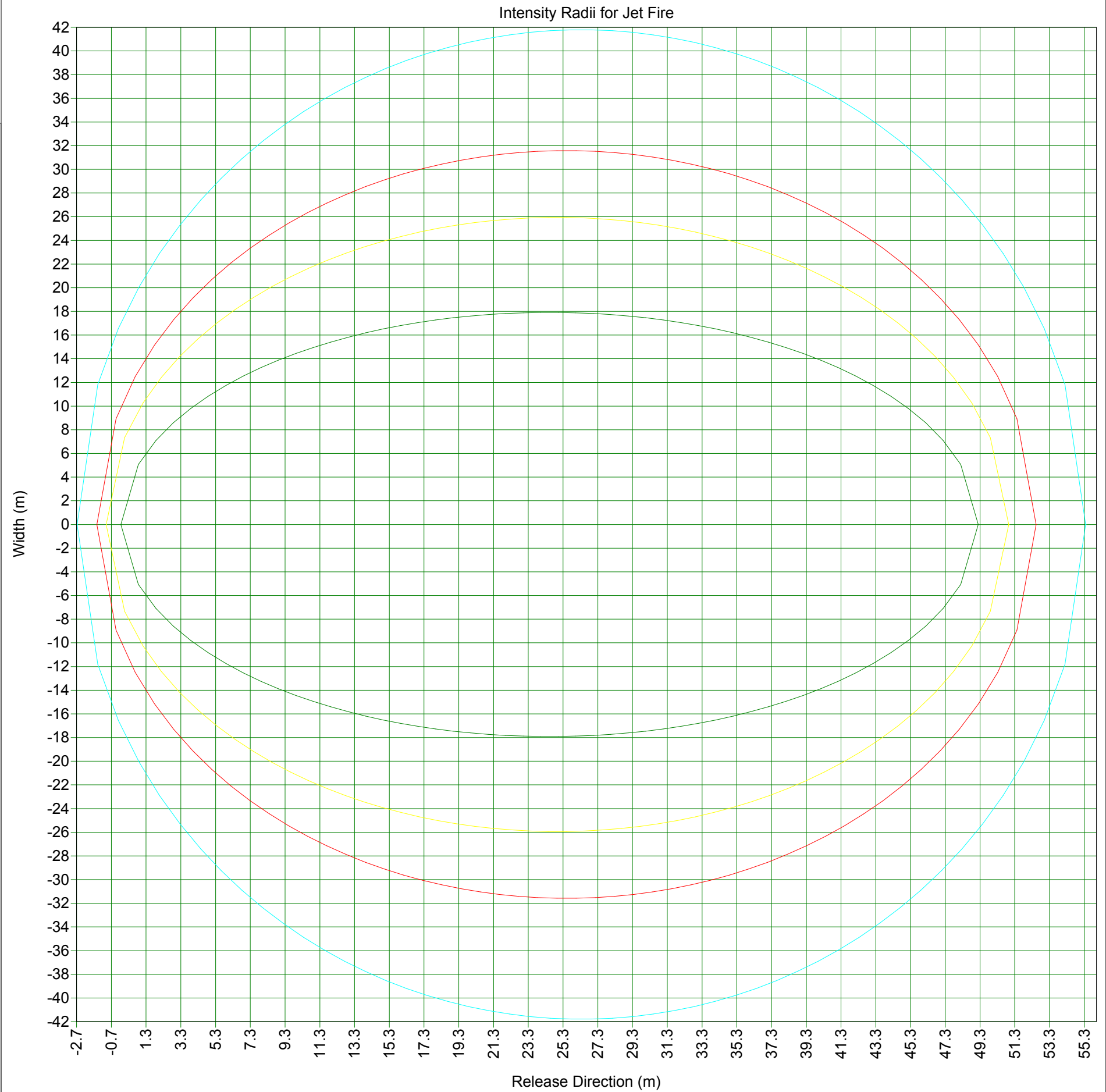
Study Folder: 70977-Fase
2-lp23
Audit No: 65666
Model: 25mm
Weather: Category 5/D
Material: METHANE

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



Study Folder: 70977-Fase
2-lp23
Audit No: 65666
Model: 25mm
Weather: Category 2/F
Material: METHANE

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



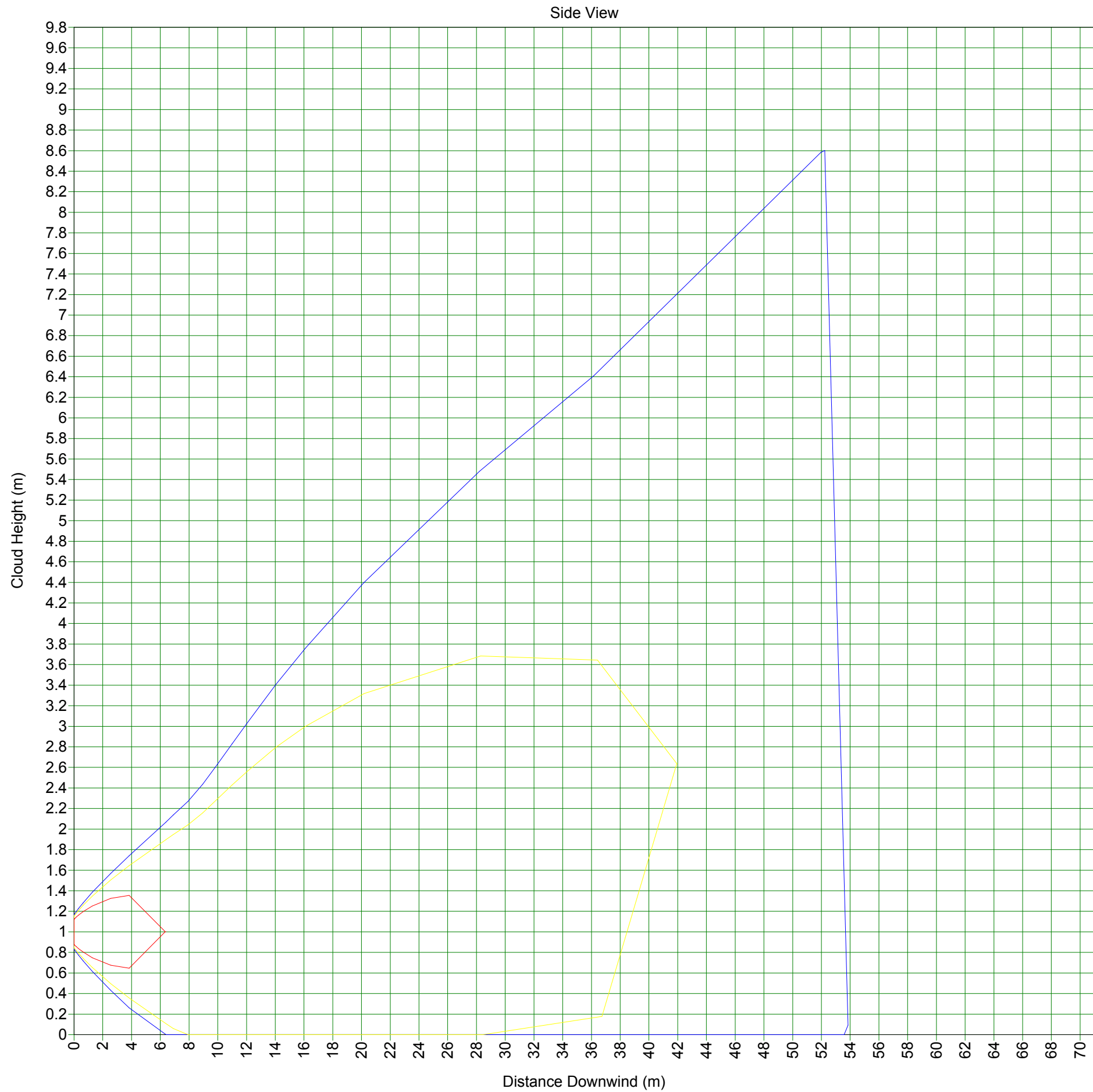
Study Folder: 70977-Fase
2-lp23
Audit No: 65666
Model: 25mm
Weather: Category 5/D
Material: METHANE
Averaging Time:
Flammable(18.75 s)
C/L Offset: 0 m
Concentration
Time: 3.422 s

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



Study Folder: 70977-Fase
2-lp23
Audit No: 65666
Model: 25mm
Weather: Category 2/F
Material: METHANE
Averaging Time:
Flammable(18.75 s)
C/L Offset: 0 m
Concentration
Time: 6.18 s

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



SUMMARY REPORT

Unique Audit Number: 65.666



Study Folder: 70977-Fase 2-Ip23

Phast 6.6



70977-Fase 2-Ip23



Compressore

25mm

Base Case

CASE Name: Data

Path: \70977-Fase 2-Ip23\Compressore\25mm

User-Defined Data

Material

Material Identifier	METHANE
Type of Vessel	Pressurized Gas
Pressure Specification	Pressure specified
Storage Pressure - gauge	154 bar
Temperature	100 degC
Mass Inventory	3000 kg

Scenario

Scenario Type	Leak
Phase to be Released	Vapor
Hole Diameter	25 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	3000 kg

SUMMARY REPORT

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Study Folder: 70977-Fase 2-Ip23

Phast 6.6

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 2-Ip23\Compressore\25mm

Discharge Data

User-Defined Quantities

Material	METHANE
Temperature	100,00 degC
Pressure	155,01 bar
Inventory	3.000,00 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	6,94 degC
Final Velocity	500,00 m/s
Droplet Diameter	0,00 um

Continuous Release Data:

Mass Flowrate	1.06060E+001 kg/s
Release Duration	282,86 s
Orifice Velocity	466,04 m/s
Exit Pressure	81,33 bar
Exit Temperature	46,49 degC
Discharge Coefficient	0,87
Expanded Radius	0,10 m

SUMMARY REPORT

Unique Audit Number: 65.666



Study Folder: 70977-Fase 2-Ip23

Phast 6.6

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 6,94 degC

Final Velocity 500,00 m/s

Droplet Diameter 0,00 um

Continuous Release Data:

Mass Flowrate 1.06060E+001 kg/s

Release Duration 282,86 s

Orifice Velocity 466,04 m/s

Exit Pressure 81,33 bar

Exit Temperature 46,49 degC

Discharge Coefficient 0,87

Expanded Radius 0,10 m

SUMMARY REPORT

Study Folder: 70977-Fase 2-IP23

Unique Audit Number: 65.666

Phast 6.6



Consequence Results

Distance to Concentration Results

Path: \70977-Fase 2-IP23\Compressore\25mm

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		55.782	61.1372
UFL (165000)	18.75	s		6.35233	5.98023
LFL (44000)	18.75	s		41.9345	35.1383
LFL Frac (22000)	18.75	s		70.4924	72.2393

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		1.00213	1.00187
LFL (44000)	18.75	s		2.63704	1.44582
LFL Frac (22000)	18.75	s		8.01128	3.96474

SUMMARY REPORT

Study Folder: 70977-Fase 2-IP23

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Phast 6.6



Concentration At Distance Results

Path: \70977-Fase 2-IP23\Compressore\25mm

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	37405.1	33279.4
250	m	1463.22	2241.85
500	m	756.009	745.496

Distance		Heights (m) for above concentrations	
		Category 2/F	Category 5/D
50	m	3.72991	2.16326
250	m	32.5247	16.3903
500	m	48.341	25.6879

Distance		Conc.(ppm) at Core Avg. Time of 18.75 s	
		Category 2/F	Category 5/D
50	m	37405.1	33279.4
250	m	1463.22	2241.85
500	m	756.009	745.496

Distance		Heights (m) for above concentrations	
		Category 2/F	Category 5/D
50	m	3.72991	2.16326
250	m	32.5247	16.3903
500	m	48.341	25.6879

Jet Fire Hazard

Path: \70977-Fase 2-IP23\Compressore\25mm

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-IP23\Compressore\25mm

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	49.1924	49.1924
Radiation Level	7	kW/m2	50.9511	50.9511
Radiation Level	5	kW/m2	52.5305	52.5305
Radiation Level	3	kW/m2	55.5678	55.5678

SUMMARY REPORT

Study Folder: 70977-Fase 2-Ip23

Unique Audit Number: 65.666

Phast 6.6



Radiation Effects: Jet Fire Distance

Path: \70977-Fase 2-Ip23\Compressore\25mm

			Radiation Level (kW/m2)	
			Category 2/F	Category 5/D
Distance Of Interest 50	m		9.28498	9.28498
Distance Of Interest 250	m		0.0138179	0.0138179
Distance Of Interest 500	m		0.00262619	0.00262619

Flash Fire Envelope

Path: \70977-Fase 2-Ip23\Compressore\25mm

All flammable results are reported at the cloud centreline height

			Distance (m)	
			Category 2/F	Category 5/D
Furthest Extent	22000	ppm	70.4924	72.2393
Furthest Extent	44000	ppm	41.9345	35.1383
			Heights (m) for above distances	
			Category 2/F	Category 5/D
Furthest Extent	22000	ppm	8.01128	3.96474
Furthest Extent	44000	ppm	2.63704	1.44582

SUMMARY REPORT

Study Folder: 70977-Fase 2-Ip23

Unique Audit Number: 65.666

Phast 6.6



Explosion Effects: Late Ignition

Path: \70977-Fase 2-Ip23\Compressore\25mm

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	152.086	134.78
Overpressure	0.1379	bar	91.2541	86.7731
Overpressure	0.2068	bar	86.4459	82.9786

			Supplementary Data at 0.02068 bar	
			Category 2/F	Category 5/D
Supplied Flammable Mass	kg		14.1929	6.97565
Used Flammable Mass	kg		14.1929	6.97565
Overpressure Radius	m		82.0858	64.7797
Distance to:				
- Ignition Source	m		70	70
- Cloud Front/Centre	m		70	70
- Explosion Centre	m		70	70

			Supplementary Data at 0.1379 bar	
			Category 2/F	Category 5/D
Supplied Flammable Mass	kg		14.1929	6.97565
Used Flammable Mass	kg		14.1929	6.97565
Overpressure Radius	m		21.2541	16.7731
Distance to:				
- Ignition Source	m		70	70
- Cloud Front/Centre	m		70	70
- Explosion Centre	m		70	70

			Supplementary Data at 0.2068 bar	
			Category 2/F	Category 5/D
Supplied Flammable Mass	kg		14.1929	6.97565
Used Flammable Mass	kg		14.1929	6.97565
Overpressure Radius	m		16.4459	12.9786
Distance to:				
- Ignition Source	m		70	70
- Cloud Front/Centre	m		70	70
- Explosion Centre	m		70	70

			Overpressures (bar gauge) at Distances	
			Category 2/F	Category 5/D
Distance	50	m	1	1
Distance	250	m	0.0082406	0.00641519
Distance	500	m	0.00348195	0.00283556

			Supplementary Data at 50 m	
			Category 2/F	Category 5/D
Supplied Flammable Mass	kg		13.7613	6.97565

SUMMARY REPORT

Study Folder: 70977-Fase 2-Ip23

Unique Audit Number: 65.666

Phast 6.6



Used Flammable Mass	kg	13.7613	6.97565
Supplementary Data at 250 m			
		Category 2/F	Category 5/D
Supplied Flammable Mass	kg	14.1929	6.97565
Used Flammable Mass	kg	14.1929	6.97565
Supplementary Data at 500 m			
		Category 2/F	Category 5/D
Supplied Flammable Mass	kg	14.1929	6.97565
Used Flammable Mass	kg	14.1929	6.97565

Weather Conditions

Path: \70977-Fase 2-Ip23\Compressore\25mm

		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