

ANNESSO TECNICO 6.

**Elaborati di calcolo
Scenari incidentali ragionevolmente credibili**

Ipotesi N. 16

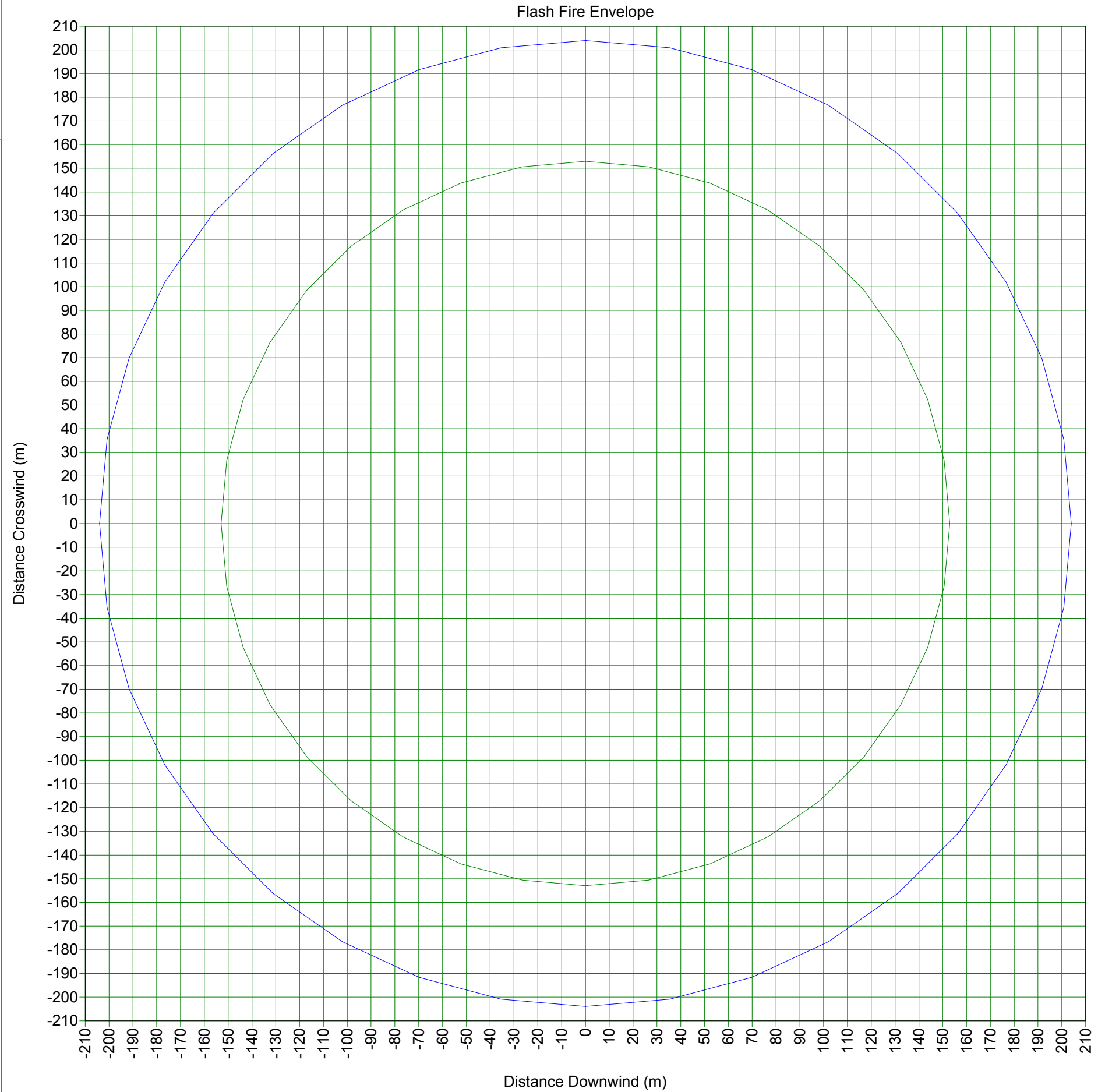
TRR S.r.l.

Il Direttore Generale

Ing. Alfredo Romano

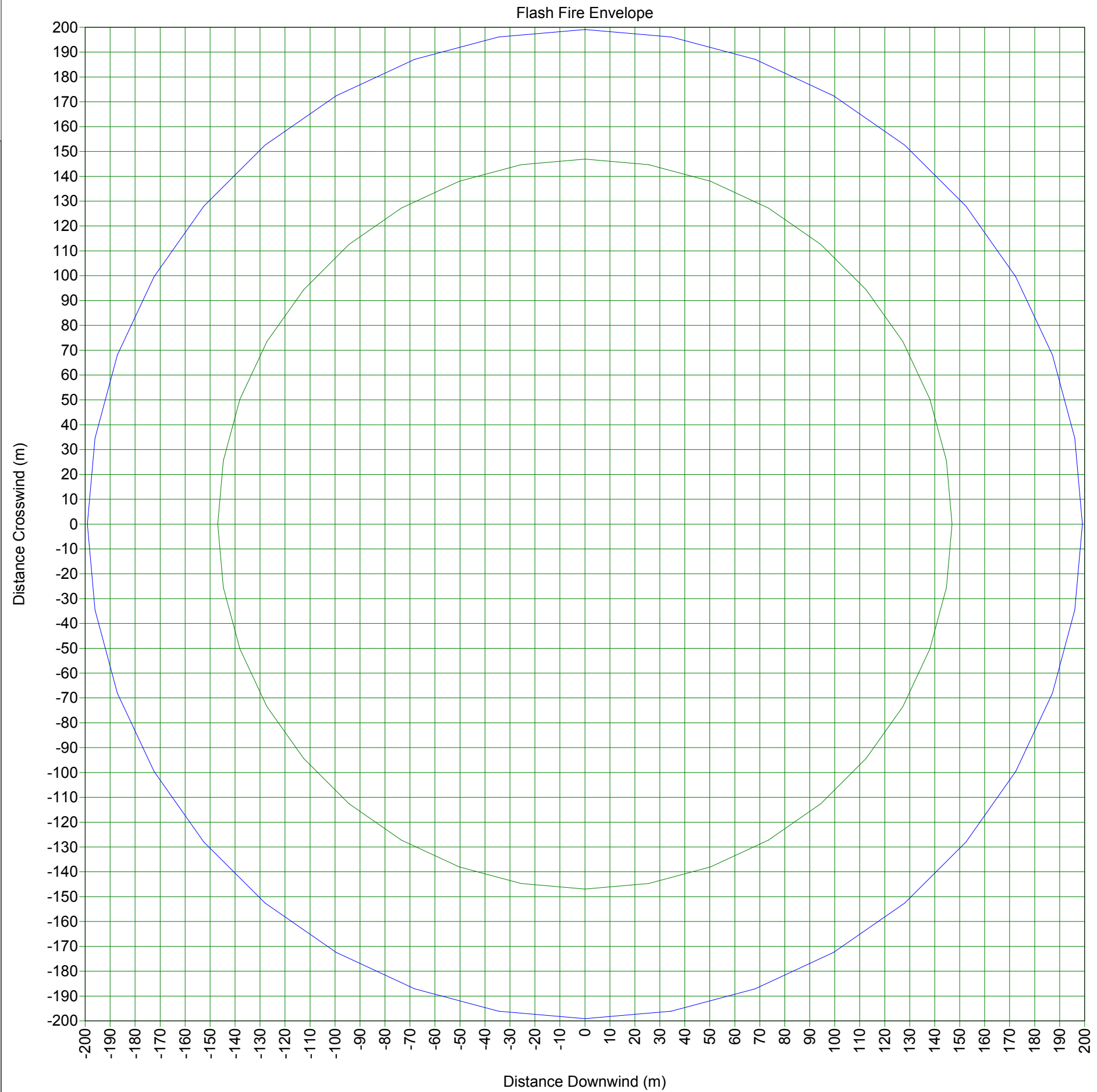

Study Folder: 70977-Fase
2-lp16
Audit No: 65868
Model: 140mm
Weather: Category 5/D
Material: METHANE
Concentration

— 2.2e+004 ppm
— 4.4e+004 ppm



Study Folder: 70977-Fase
2-lp16
Audit No: 65868
Model: 140mm
Weather: Category 2/F
Material: METHANE
Concentration

— 2.2e+004 ppm
— 4.4e+004 ppm



JET FIRE REPORT

Study Folder: 70977-Fase 2-Ip16

Unique Audit Number: 65.868



Phast 6.6



70977-Fase 2-Ip16



Misura Fiscale - Iniezione

140mm

Base Case

Data



Weather: Global Weathers\Category 2/F

Speed: 2,00 m/s

Stability: F

\70977-Fase 2-Ip16\Misura Fiscale - Iniezione\140mm

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	-1,42 degC
Release Rate	169,14 kg/s

Input

Output

Flame Emissive Power	138,96 kW/m2
Fraction of Emissivity	0,15 fraction
Expanded Radius	0,39 m
Jet Velocity	500,00 m/s
Flame Length	182,03 m
Maximum Flame Radius	11,32 m

Flame Co-ordinates

X	Z	R	Phi
m	m	m	deg
0,00	1,00	0,39	90,00
20,23	1,00	4,35	90,00
40,45	1,00	7,19	90,00
60,68	1,00	9,22	90,00
80,90	1,00	10,56	90,00
101,13	1,00	11,24	90,00
121,36	1,00	11,20	90,00
141,58	1,00	10,29	90,00
161,81	1,00	8,05	90,00
182,03	1,00	0,00	90,00

JET FIRE REPORT

Study Folder: 70977-Fase 2-Ip16

Unique Audit Number: 65.868



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)	106,62	m
Crosswind semi-axis (B)	154,00	m
Offset Ratio (D)	0,95	
Effect Distance	208,67	m
Area	51.587,23	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)	100,31	m
Crosswind semi-axis (B)	116,92	m
Offset Ratio (D)	0,97	
Effect Distance	198,03	m
Area	36.844,05	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)	97,16	m
Crosswind semi-axis (B)	96,38	m
Offset Ratio (D)	0,98	
Effect Distance	192,53	m
Area	29.419,05	m2

JET FIRE REPORT

Unique Audit Number: 65.868



Study Folder: 70977-Fase 2-Ip16

Phast 6.6

Incident Radiation Level:	12,50	kW/m2
Lethality Level	6,53	%
View Factor	0,09	
Dose Level	5.800.161,90	(W/m2)^Probit N.s
Downwind semi-axis (A)	92,71	m
Crosswind semi-axis (B)	66,93	m
Offset Ratio (D)	0,99	
Effect Distance	184,45	m
Area	19.494,05	m2

JET FIRE REPORT

Study Folder: 70977-Fase 2-Ip16

Unique Audit Number: 65.868

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			38,31		
10,20			138,96		
20,41			138,96		
30,61			138,96		
40,82			138,96		
51,02			138,96		
61,22			138,96		
71,43			138,96		
81,63			138,96		
91,84			138,96		
102,04			138,96		
112,24			138,96		
122,45			138,96		
132,65			138,96		
142,86			138,96		
153,06			138,96		
163,27			138,96		
173,47			138,96		
183,67			13,76		
193,88			6,42		
204,08			3,64		
214,29			2,32		
224,49			1,60		
234,69			1,19		
244,90			0,93		
255,10			0,76		
265,31			0,63		
275,51			0,53		
285,71			0,46		
295,92			0,39		
306,12			0,34		
316,33			0,30		
326,53			0,27		
336,73			0,24		
346,94			0,21		
357,14			0,19		
367,35			0,17		

JET FIRE REPORT

Unique Audit Number: 65.868



Study Folder: 70977-Fase 2-Ip16

Phast 6.6

X Coordinates m	Y Coordinates m	Z Coordinates m	Incident Radiation kW/m2	Lethality Level %	View Factor
377,55			0,16		
387,76			0,15		
397,96			0,13		
408,16			0,12		
418,37			0,11		
428,57			0,11		
438,78			0,10		
448,98			0,09		
459,18			0,09		
469,39			0,08		
479,59			0,08		
489,80			0,07		
500,00			0,07		



Weather: Global Weathers\Category 5/D

Speed: 5,00

m/s

Stability: D

\70977-Fase 2-Ip16\Misura Fiscale - Iniezione\140mm

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	-1,42	degC
Release Rate	169,14	kg/s

	Input	Output
Flame Emissive Power		138,96 kW/m2
Fraction of Emissivity		0,15 fraction
Expanded Radius		0,39 m
Jet Velocity	500,00	500,00 m/s
Flame Length		182,03 m
Maximum Flame Radius		11,32 m

JET FIRE REPORT

Study Folder: 70977-Fase 2-Ip16

Unique Audit Number: 65.868

Phast 6.6



Flame Co-ordinates

X	Z	R	Phi
m	m	m	deg
0,00	1,00	0,39	90,00
20,23	1,00	4,35	90,00
40,45	1,00	7,19	90,00
60,68	1,00	9,22	90,00
80,90	1,00	10,56	90,00
101,13	1,00	11,24	90,00
121,36	1,00	11,20	90,00
141,58	1,00	10,29	90,00
161,81	1,00	8,05	90,00
182,03	1,00	0,00	90,00

JET FIRE REPORT

Study Folder: 70977-Fase 2-Ip16

Unique Audit Number: 65.868



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)	106,62	m
Crosswind semi-axis (B)	154,00	m
Offset Ratio (D)	0,95	
Effect Distance	208,67	m
Area	51.587,23	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)	100,31	m
Crosswind semi-axis (B)	116,92	m
Offset Ratio (D)	0,97	
Effect Distance	198,03	m
Area	36.844,05	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)	97,16	m
Crosswind semi-axis (B)	96,38	m
Offset Ratio (D)	0,98	
Effect Distance	192,53	m
Area	29.419,05	m2

JET FIRE REPORT

Unique Audit Number: 65.868



Study Folder: 70977-Fase 2-Ip16

Phast 6.6

Incident Radiation Level:	12,50	kW/m2
Lethality Level	6,53	%
View Factor	0,09	
Dose Level	5.800.161,90	(W/m2)^Probit N.s
Downwind semi-axis (A)	92,71	m
Crosswind semi-axis (B)	66,93	m
Offset Ratio (D)	0,99	
Effect Distance	184,45	m
Area	19.494,05	m2

JET FIRE REPORT

Study Folder: 70977-Fase 2-Ip16

Unique Audit Number: 65.868

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			38,31		
10,20			138,96		
20,41			138,96		
30,61			138,96		
40,82			138,96		
51,02			138,96		
61,22			138,96		
71,43			138,96		
81,63			138,96		
91,84			138,96		
102,04			138,96		
112,24			138,96		
122,45			138,96		
132,65			138,96		
142,86			138,96		
153,06			138,96		
163,27			138,96		
173,47			138,96		
183,67			13,76		
193,88			6,42		
204,08			3,64		
214,29			2,32		
224,49			1,60		
234,69			1,19		
244,90			0,93		
255,10			0,76		
265,31			0,63		
275,51			0,53		
285,71			0,46		
295,92			0,39		
306,12			0,34		
316,33			0,30		
326,53			0,27		
336,73			0,24		
346,94			0,21		
357,14			0,19		
367,35			0,17		

JET FIRE REPORT

Study Folder: 70977-Fase 2-Ip16

Unique Audit Number: 65.868

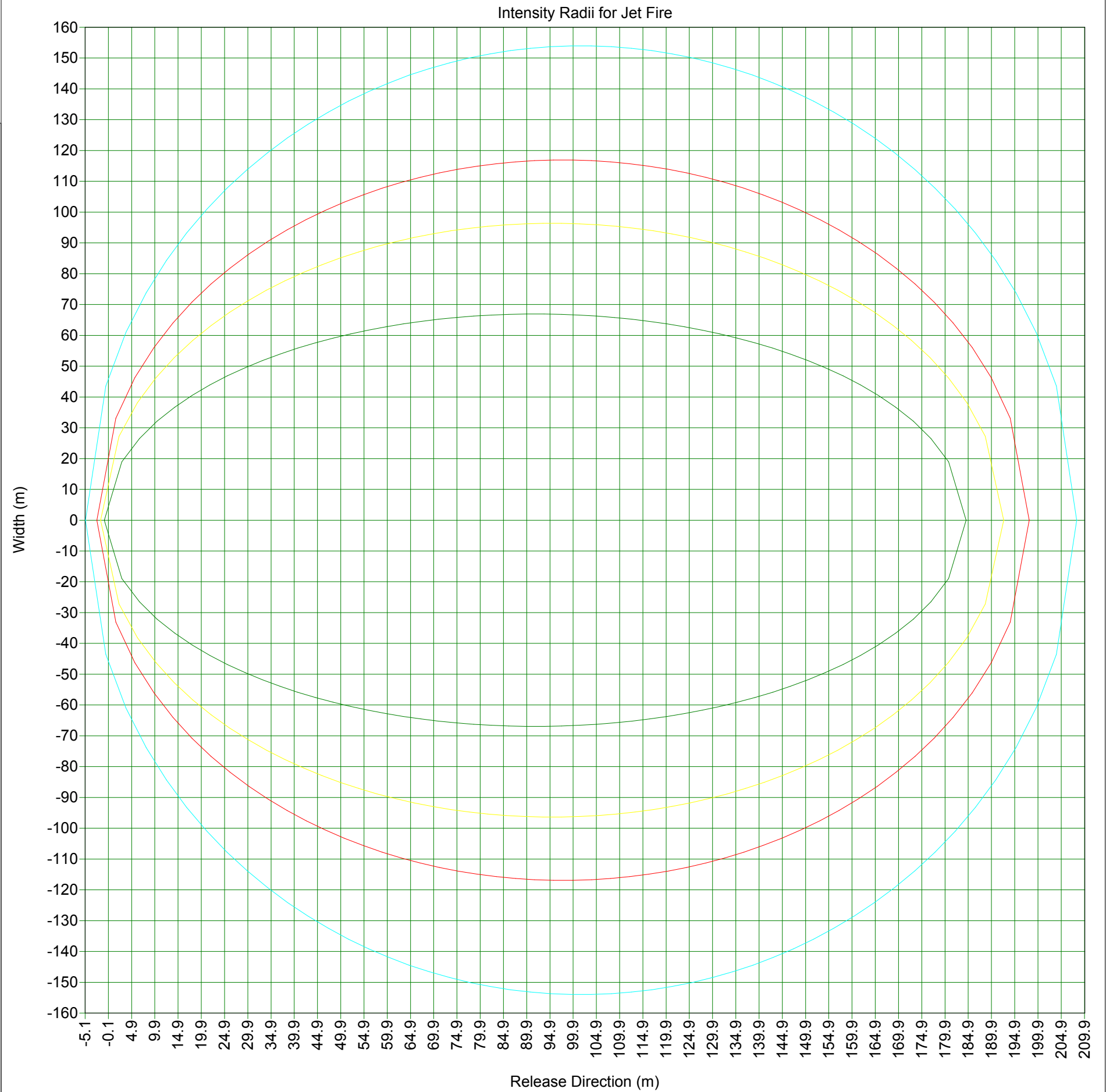
Phast 6.6



X Coordinates m	Y Coordinates m	Z Coordinates m	Incident Radiation kW/m2	Lethality Level %	View Factor
377,55			0,16		
387,76			0,15		
397,96			0,13		
408,16			0,12		
418,37			0,11		
428,57			0,11		
438,78			0,10		
448,98			0,09		
459,18			0,09		
469,39			0,08		
479,59			0,08		
489,80			0,07		
500,00			0,07		

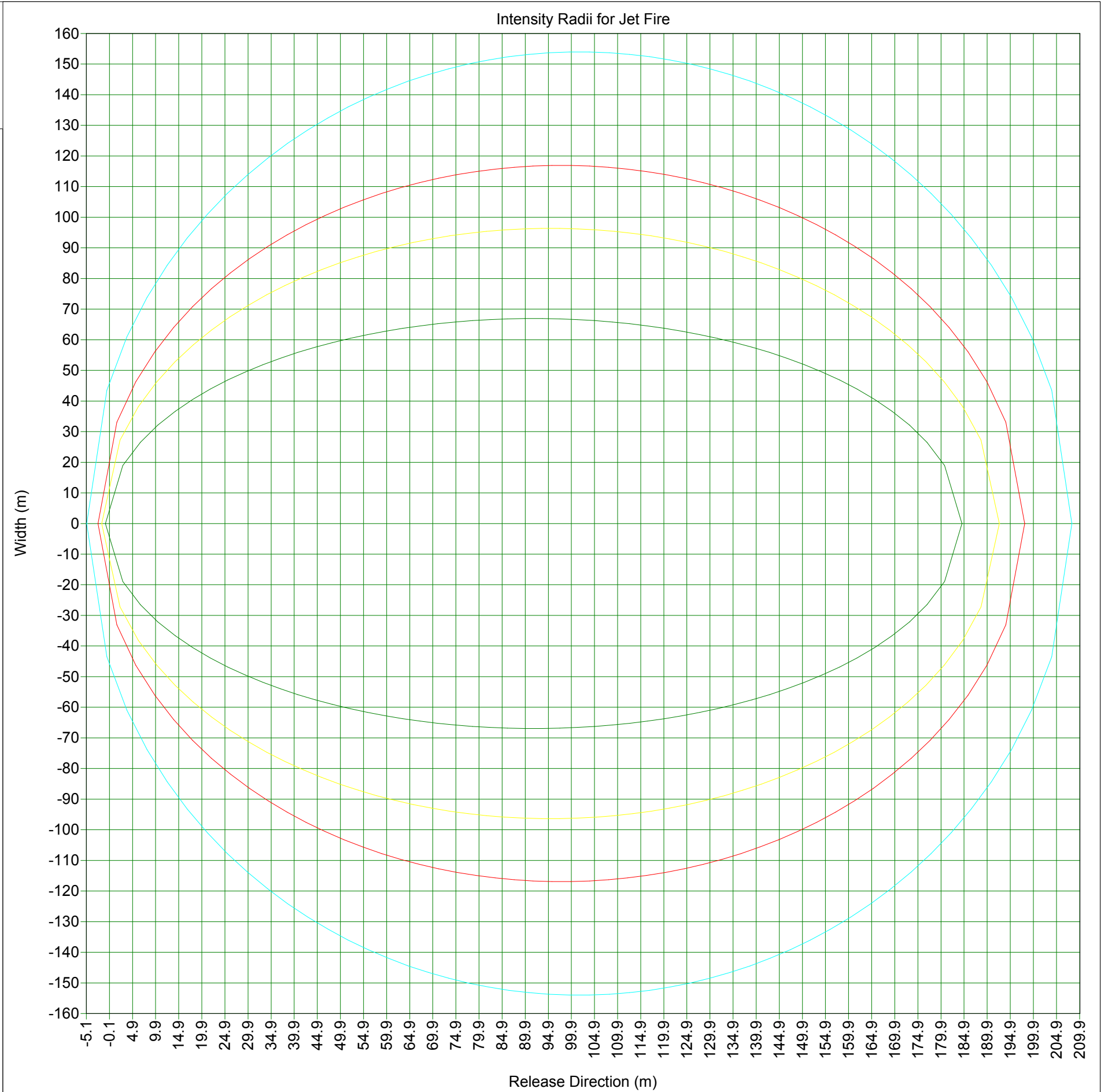
Study Folder: 70977-Fase
2-lp16
Audit No: 65868
Model: 140mm
Weather: Category 5/D
Material: METHANE

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



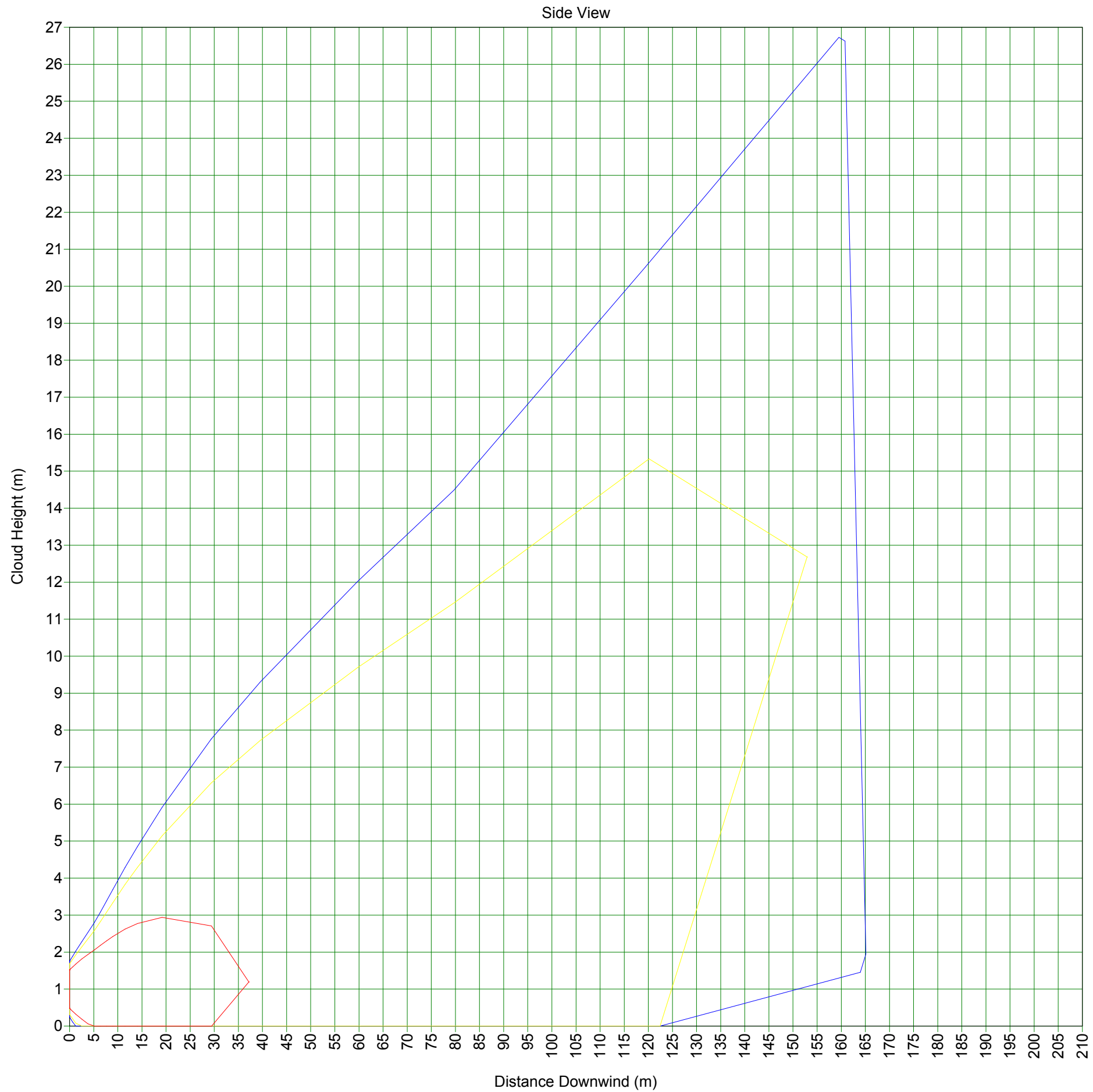
Study Folder: 70977-Fase
2-lp16
Audit No: 65868
Model: 140mm
Weather: Category 2/F
Material: METHANE

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



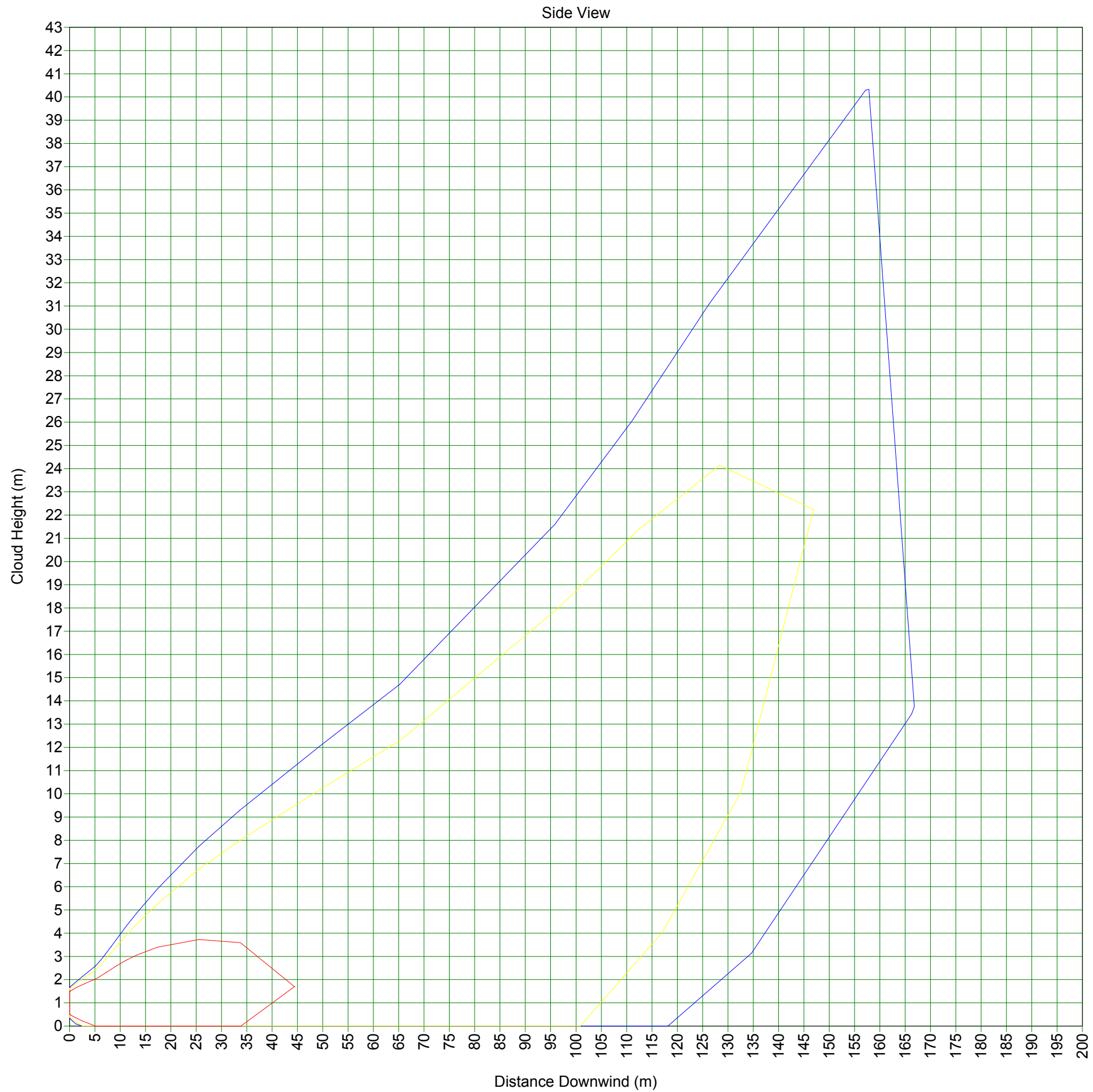
Study Folder: 70977-Fase
2-lp16
Audit No: 65868
Model: 140mm
Weather: Category 5/D
Material: METHANE
Averaging Time:
Flammable(18.75 s)
C/L Offset: 0 m
Concentration
Time: 11.21 s

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



Study Folder: 70977-Fase
2-lp16
Audit No: 65868
Model: 140mm
Weather: Category 2/F
Material: METHANE
Averaging Time:
Flammable(18.75 s)
C/L Offset: 0 m
Concentration
Time: 15.97 s

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



SUMMARY REPORT

Unique Audit Number: 65.868



Study Folder: 70977-Fase 2-Ip16

Phast 6.6



70977-Fase 2-Ip16



Misura Fiscale - Iniezione

140mm

Base Case

CASE Name: Data

Path: \70977-Fase 2-Ip16\Misura Fiscale - Iniezione\140mm

User-Defined Data

Material

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

Scenario

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

Pipe

Internal Diameter	700 mm
Line length	265 m
Distance To Break	1 m
Relative Aperture	0.2 fraction
Pumped Inflow	150 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: 65.868



Study Folder: 70977-Fase 2-Ip16

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 2-Ip16\Misura Fiscale - Iniezione\140mm

Discharge Data

User-Defined Quantities

Material	METHANE
Temperature	25,00 degC
Pressure	46,01 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	-1,42 degC
Final Velocity	500,00 m/s
Droplet Diameter	0,00 um

SUMMARY REPORT

Unique Audit Number: 65.868



Study Folder: 70977-Fase 2-Ip16

Phast 6.6

Continuous Release Data:

Mass Flowrate	1.69145E+002 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	-1,42 degC
Final Velocity	500,00 m/s
Droplet Diameter	0,00 um

Continuous Release Data:

Mass Flowrate	1.69145E+002 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 2-Ip16

Unique Audit Number: 65.868

Phast 6.6



Consequence Results

Distance to Concentration Results

Path: \70977-Fase 2-Ip16\Misura Fiscale - Iniezione\140mm

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		122.401	159.604
UFL (165000)	18.75	s		44.3951	37.1719
LFL (44000)	18.75	s		146.905	152.923
LFL Frac (22000)	18.75	s		199.111	203.944
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		1.70178	1.19114
LFL (44000)	18.75	s		22.2406	12.6824
LFL Frac (22000)	18.75	s		37.9777	20.848

SUMMARY REPORT

Study Folder: 70977-Fase 2-IP16

Unique Audit Number: 65.868

Phast 6.6



Concentration At Distance Results

Path: \70977-Fase 2-IP16\Misura Fiscale - Iniezione\140mm

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	151787	139818
250	m	14027.6	13390.9
500	m	3728.21	4099.44

Distance		Heights (m) for above concentrations	
		Category 2/F	Category 5/D
50	m	1.94139	1.53893
250	m	50.7829	27.1892
500	m	91.5658	51.2054

Distance		Conc.(ppm) at Core Avg. Time of 18.75 s	
		Category 2/F	Category 5/D
50	m	151787	139818
250	m	14027.6	13390.9
500	m	3728.21	4099.44

Distance		Heights (m) for above concentrations	
		Category 2/F	Category 5/D
50	m	1.94139	1.53893
250	m	50.7829	27.1892
500	m	91.5658	51.2054

Jet Fire Hazard

Path: \70977-Fase 2-IP16\Misura Fiscale - Iniezione\140mm

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-IP16\Misura Fiscale - Iniezione\140mm

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	184.451	184.451
Radiation Level	7	kW/m2	192.532	192.532
Radiation Level	5	kW/m2	198.032	198.032
Radiation Level	3	kW/m2	208.673	208.673

SUMMARY REPORT

Study Folder: 70977-Fase 2-Ip16

Unique Audit Number: 65.868

Phast 6.6



Radiation Effects: Jet Fire Distance

Path: \70977-Fase 2-Ip16\Misura Fiscale - Iniezione\140mm

			Radiation Level (kW/m2)	
			Category 2/F	Category 5/D
Distance Of Interest 50	m		Engulfed	Engulfed
Distance Of Interest 250	m		0.841948	0.841948
Distance Of Interest 500	m		0.0673426	0.0673426

Flash Fire Envelope

Path: \70977-Fase 2-Ip16\Misura Fiscale - Iniezione\140mm

All flammable results are reported at the cloud centreline height

			Distance (m)	
			Category 2/F	Category 5/D
Furthest Extent	22000	ppm	199.111	203.944
Furthest Extent	44000	ppm	146.905	152.923
			Heights (m) for above distances	
			Category 2/F	Category 5/D
Furthest Extent	22000	ppm	37.9777	20.848
Furthest Extent	44000	ppm	22.2406	12.6824

SUMMARY REPORT

Study Folder: 70977-Fase 2-Ip16

Unique Audit Number: 65.868

Phast 6.6



Explosion Effects: Late Ignition

Path: \70977-Fase 2-Ip16\Misura Fiscale - Iniezione\140mm

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	536.955	512.677
Overpressure	0.1379	bar	279.835	280.96
Overpressure	0.2068	bar	259.512	262.645

			Supplementary Data at 0.02068 bar	
			Category 2/F	Category 5/D
Supplied Flammable Mass	kg		1071.73	784.429
Used Flammable Mass	kg		1071.73	784.429
Overpressure Radius	m		346.955	312.677
Distance to:				
- Ignition Source	m		190	200
- Cloud Front/Centre	m		190	200
- Explosion Centre	m		190	200

			Supplementary Data at 0.1379 bar	
			Category 2/F	Category 5/D
Supplied Flammable Mass	kg		1071.73	784.429
Used Flammable Mass	kg		1071.73	784.429
Overpressure Radius	m		89.8352	80.9597
Distance to:				
- Ignition Source	m		190	200
- Cloud Front/Centre	m		190	200
- Explosion Centre	m		190	200

			Supplementary Data at 0.2068 bar	
			Category 2/F	Category 5/D
Supplied Flammable Mass	kg		1071.73	784.429
Used Flammable Mass	kg		1071.73	784.429
Overpressure Radius	m		69.5125	62.6448
Distance to:				
- Ignition Source	m		190	200
- Cloud Front/Centre	m		190	200
- Explosion Centre	m		190	200

			Overpressures (bar gauge) at Distances	
			Category 2/F	Category 5/D
Distance	50	m	1	1
Distance	250	m	0.261626	0.297716
Distance	500	m	0.0237849	0.0217261

			Supplementary Data at 50 m	
			Category 2/F	Category 5/D
Supplied Flammable Mass	kg		100.654	77.928

SUMMARY REPORT

Study Folder: 70977-Fase 2-Ip16

Unique Audit Number: 65.868

Phast 6.6



Used Flammable Mass	kg	100.654	77.928
Supplementary Data at 250 m			
		Category 2/F	Category 5/D
Supplied Flammable Mass	kg	1071.73	784.429
Used Flammable Mass	kg	1071.73	784.429
Supplementary Data at 500 m			
		Category 2/F	Category 5/D
Supplied Flammable Mass	kg	1071.73	784.429
Used Flammable Mass	kg	1071.73	784.429

Weather Conditions

Path: \70977-Fase 2-Ip16\Misura Fiscale - Iniezione\140mm

		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