



r_eni.ro.Giunta - Prot. 08/01/2024.0008320.E

TOP EVENT 2



Audit Number: 341

Date: 15/12/2023 Time: 08:48

Discharge Report

Workspace: pm_rev1

Study: Study

Equipment Item: T2A

pm_rev1\Study\T2A

Material	ISOBUTANE	
East	0	m
North	0	m

Scenario (Leak) : T2-2''leak vertical

pm_rev1\Study\T2A\T2-2''leak vertical

Weather: Category 2/F

INPUT DATA

Inventory data		
Mass in vessel	2789.35	kg

Stagnation Data (upstream end for long pipe)

Initial pressure (gauge)	32.7	bar
Initial temperature	20	degC
Fluid state	Non-saturated liquid	

Scenario data

Phase to be released	Liquid	
Tank head	0	m
Hole diameter	50.8	mm

OUTPUT DATA

Mass flow rate	75.9769	kg/s
Release duration	36.7131	s

Orifice or pipe exit data (before atmospheric expansion)

Pressure	1.01325	bar
Temperature	18.1191	degC
Liquid mass fraction	1	fraction
Velocity at vena contracta (at exit for pipe releases)	111.533	m/s
Discharge coefficient	0.6	

Final Data (after atmospheric expansion)

Temperature	-11.9098	degC
Liquid mass fraction	0.822718	fraction
Droplet diameter	166.077	um
Expanded diameter	0.210384	m



Velocity	140.805	m/s
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Weather: Category 5/D
INPUT DATA

Inventory data		
Mass in vessel	2789.35	kg

Stagnation Data (upstream end for long pipe)

Initial pressure (gauge)	32.7	bar
Initial temperature	20	degC
Fluid state	Non-saturated liquid	

Scenario data

Phase to be released	Liquid	
Tank head	0	m
Hole diameter	50.8	mm

OUTPUT DATA

Mass flow rate	75.9769	kg/s
Release duration	36.7131	s

Orifice or pipe exit data (before atmospheric expansion)

Pressure	1.01325	bar
Temperature	18.1191	degC
Liquid mass fraction	1	fraction
Velocity at vena contracta (at exit for pipe releases)	111.533	m/s
Discharge coefficient	0.6	

Final Data (after atmospheric expansion)

Temperature	-11.9098	degC
Liquid mass fraction	0.822718	fraction
Droplet diameter	166.077	um
Expanded diameter	0.210384	m
Velocity	140.805	m/s



Audit Number: 341
Date: 15/12/2023 Time: 08:49

Explosion Report

Workspace: pm_rev1

Study: Study
Equipment Item: T2A

pm_rev1\Study\T2A

Material

East
North

North

ISOBUTANE

0 m

0 m

Scenario (Leak) : T2-2"leak vertical

pm_rev1\Study\T2A\T2-2"leak vertical

Weather: Category 2/F

Explosion location criterion
Explosion height criterionExplosion height c
Explosion method

Explosion method
Uniform confined method explosion efficiency

Uniform confined method explosion strength

Cloud front (LFL fraction)

Centreline height

Multi-Energy: Uniform co

12.5 %

10

Time of explosion [s]	Distance to centre of mass [m]	Distance to explosion centre [m]	Distance to ignition point [m]	Flammable mass [kg]	Overpressures (input) [bar]	Distance to specified overpressures [m]
					0,02068	52,5375
					0,1379	18,2675
					0,2068	16,1986
0.808696	6.24133	10	10	0.933025	0,02068	83,8654
					0,1379	32,4127
1.65291	8.82545	20	20	3.15772	0,2068	29,3066
					0,02068	127,775
					0,1379	49,0033
4.66896	13.3621	30	30	11.3309	0,2068	44,2479
					0,02068	180,308
					0,1379	67,2698
9.55249	18.5081	40	40	33.4828	0,2068	60,4458
					0,02068	219,352
					0,1379	82,9147
14.9661	21.491	50	50	58.877	0,2068	74,6782
					0,02068	251,711
					0,1379	97,2603
20.5152	24.4998	60	60	85.4116	0,2068	87,9364
					0,02068	282,671
					0,1379	111,334
26.308	27.7023	70	70	116.601	0,2068	100,991
					0,02068	325,934
					0,1379	127,799
32.6395	32.5005	80	80	180.315	0,2068	115,838
					0,02068	393,507
					0,1379	148,989
45.0404	32.1585	90	90	338.91	0,2068	134,227
					0,02068	450,654
					0,1379	168,152
60.5333	34.0639	100	100	522.652	0,2068	151,098
					0,02068	468,209
					0,1379	179,62
78.9688	41.242	110	110	557.169	0,2068	162,199
					0,02068	485,459
					0,1379	191,029
97.4042	48.4202	120	120	591.686	0,2068	173,255

Weather: Category 5/D

Explosion location criterion

Explosion height criterion

Explosion method

Uniform confined method explosion efficiency

Uniform confined method explosion strength

Cloud front (LFL fraction)

Centreline height

Multi-Energy: Uniform co

12.5 %

10

Time of explosion [s]	Distance to centre of mass [m]	Distance to explosion centre [m]	Distance to ignition point [m]	Flammable mass [kg]	Overpressures (input) [bar]	Distance to specified overpressures [m]
0.638594	6.98135	10	10	0.963019	0,02068	52,9886
					0,1379	18,3551
					0,2068	16,2643
1.40061	10.8342	20	20	3.40876	0,02068	85,515
					0,1379	32,7333
					0,2068	29,5469
3.10422	17.6873	30	30	13.2257	0,02068	132,947
					0,1379	50,0085
					0,2068	45,0016
5.74353	24.0812	40	40	35.7266	0,02068	183,374
					0,1379	67,8658
					0,2068	60,8927
9.24825	30.3931	50	50	75.9668	0,02068	234,367
					0,1379	85,8329
					0,2068	76,8662
13.2923	33.962	60	60	108.137	0,02068	267,396
					0,1379	100,309
					0,2068	90,2219
17.634	35.4642	70	70	131.889	0,02068	291,587
					0,1379	113,067
					0,2068	102,29
23.0318	35.7771	80	80	151.288	0,02068	311,958
					0,1379	125,083
					0,2068	113,801
31.3869	35.0969	90	90	183.253	0,02068	337,263
					0,1379	138,057
					0,2068	126,031



Audit Number: 341
Date: 15/12/2023 Time: 08:49

Jet Fire

Workspace: pm_rev1

Study: Study
Equipment Item: T2A
pm_rev1\Study\T2A

Material
East 0 m
North 0 m

ISOBUTANE

Scenario (Leak) : T2-2"leak vertical
pm_rev1\Study\T2A\T2-2"leak vertical

Weather: Category 2/F

Wind speed [m/s] 2
Pasquill stability F stable - night with moderate clouds and light/moderate wind
Atmospheric temperature [degC] 20
Relative humidity [fraction] 0.7
Solar radiation flux [kW/m2] 0.5

Jet fire model results

INPUT DATA

Scenario		
Elevation	1	m
Release angle from horizontal	0	deg

Jet Fire Parameters

Jet fire method Cone model
Wind orientation about the z-axis (anti-clockwise from the East) 0 deg
Rotation about the z-axis (anti-clockwise from the east) 0 deg
Rate modification factor 3

Calculated inputs

Mass flow rate	40.4081	kg/s
Temperature after atmospheric expansion	-11.9098	degC
Liquid fraction	0.822718	fraction
Velocity after atmospheric expansion (input)	140.805	m/s
Rainout fraction time averaged	0.822718	fraction

OUTPUT DATA

Flame emissive power	268.106	kW/m2
Fraction of emissivity	0.4047	fraction
Jet velocity	140.805	m/s
Flame length	67.4591	m
Frustum length	66.4472	m
Frustum base width	0.702057	m
Frustum tip width	21.9911	m
Frustum lift-off distance	1.01189	m
Flame length in still air	60.6628	m
Hole to flame angle	0	deg
Expanded diameter	0.153428	m
Plane angular rotation	0	deg

Flame on ground impingement with partial truncation

Radiation Intensity Ellipse Results

INPUT DATA

For ellipses 'observer direction' refers to whether inclination is 'fixed' or 'variable'. Orientation is always variable.

Observer direction Variable
Exposure duration 20 s
Height of interest 1 m

OUTPUT DATA

Radiation intensity

Incident radiation [kW/m2]	Lethality [%]	View factor	Probit	Dose [(W/m2)^ProbitN.s]	Ellipse half-length [m]	Ellipse half-width [m]	Ellipse centre downwind distance [m]	Effect downwind distance [m]	Ellipse area [m2]
3	0	0.0111896	-1.38321	865119	86.1889	115.603	0	115.603	31301.8
5	0.000174704	0.0186493	0.360367	1709491	68.8559	89.3949	0	89.3949	19337.7
7	0.02405	0.0261091	1.50883	2677313	61.7395	75.9444	0	75.9444	14730.2
12.5	6.52536	0.0466233	3.48789	5800162	53.5027	58.4374	0	58.4374	9822.39

Radiation v Distance Results

INPUT DATA

Maximum distance	150.616	m
Observer type radiation modelling flag	Planar	
Observer direction	Variable	
Height of interest	1	m

OUTPUT DATA

Downwind distance [m]	Maximum incident radiation	Lethality level [fraction]
-59.8382	27.3627	0.877385
-56.7644	268.106	1
-53.6907	268.106	1
-50.6169	268.106	1



-47.5431	268.106	1
-44.4693	268.106	1
-41.3955	268.106	1
-38.3217	268.106	1
-35.2479	268.106	1
-32.1741	268.106	1
-29.1003	268.106	1
-26.0265	268.106	1
-22.9527	268.106	1
-19.8789	268.106	1
-16.8052	268.106	1
-13.7314	268.106	1
-10.6576	268.106	1
-7.58378	268.106	1
-4.50999	268.106	1
-1.4362	268.106	1
1.63759	268.106	1
4.71138	268.106	1
7.78517	268.106	1
10.859	138.9	1
13.9328	91.4642	1
17.0065	68.2086	0.999991
20.0803	56.3837	0.999858
23.1541	45.4957	0.998119
26.2279	37.1096	0.986168
29.3017	30.6003	0.938671
32.3755	25.5058	0.821775
35.4493	21.4809	0.631546
38.5231	18.2687	0.414141
41.5969	15.6795	0.23008
44.6707	13.571	0.109066
47.7445	11.837	0.0447429
50.8183	10.3989	0.0161672
53.892	9.19522	0.00523175
56.9658	8.17962	0.00154023
60.0396	7.31641	0.000418538
63.1134	6.57747	0.000106278
66.1872	5.94077	2.54921E-05
69.261	5.38883	5.8302E-06
72.3348	4.90764	1.28162E-06
75.4086	4.48593	2.72664E-07
78.4824	4.11451	5.64748E-08
81.5562	3.78589	1.14458E-08
84.63	3.49387	0
87.7037	3.23333	0
90.7775	3	0

Weather: Category 5/D	5
Wind speed [m/s]	D neutral - little sun and high wind or overcast/windy night
Pasquill stability	20
Atmospheric temperature [degC]	0.7
Relative humidity [fraction]	0.5
Solar radiation flux [kW/m2]	

Jet fire model results		
INPUT DATA		
Scenario		
Elevation	1	m
Release angle from horizontal	0	deg
Jet Fire Parameters		
Jet fire method	Cone model	
Wind orientation about the z-axis (anti-clockwise from the East)	0	deg
Rotation about the z-axis (anti-clockwise from the east)	0	deg
Rate modification factor	3	
Calculated inputs		
Mass flow rate	40.4081	kg/s
Temperature after atmospheric expansion	-11.9098	degC
Liquid fraction	0.822718	fraction
Velocity after atmospheric expansion (input)	140.805	m/s
Rainout fraction time averaged	0.822718	fraction
OUTPUT DATA		
Flame emissive power	350	kW/m2
Fraction of emissivity	0.4047	fraction
Jet velocity	140.805	m/s
Flame length	52.4378	m
Frustum length	51.6512	m
Frustum base width	1.19492	m
Frustum tip width	20.3292	m
Frustum lift-off distance	0.786567	m
Flame length in still air	60.6628	m
Hole to flame angle	0	deg
Expanded diameter	0.153428	m
Plane angular rotation	0	deg
Flame on ground impingement with partial truncation		
Radiation Intensity Ellipse Results		
INPUT DATA		
For ellipses 'observer direction' refers to whether inclination is 'fixed' or 'variable'. Orientation is always variable.		
Observer direction	Variable	



Exposure duration	20 s
Height of interest	1 m

OUTPUT DATA
Radiation intensity

Incident radiation [kW/m2]	Lethality [%]	View factor	Probit	Dose [(W/m2)^ProbitN.s]	Ellipse half-length [m]	Ellipse half-width [m]	Ellipse centre downwind distance [m]	Effect downwind distance [m]	Ellipse area [m2]
3	0	0.00857143	-1.38321	865119	90.3256	115.256	0	115.256	32705.7
5	0.000174704	0.0142857	0.360367	1709491	70.8212	89.2912	0	89.2912	19866.5
7	0.02405	0.02	1.50883	2677313	60.659	75.3319	0	75.3319	14355.7
12.5	6.52536	0.0357143	3.48789	5800162	48.9003	56.6278	0	56.6278	8699.44
Radiation v Distance Results									
INPUT DATA									
Maximum distance	140.254 m								
Observer type radiation modelling flag	Planar								
Observer direction	Variable								
Height of interest	1 m								

OUTPUT DATA		
Downwind distance [m]	Maximum	Lethality level [fraction]
-48.4036	123.871	1
-45.5413	350	1
-42.679	350	1
-39.8166	350	1
-36.9543	350	1
-34.093	350	1
-31.2297	350	1
-28.3673	350	1
-25.505	350	1
-22.6427	350	1
-19.7804	350	1
-16.918	350	1
-14.0557	350	1
-11.1934	350	1
-8.33106	350	1
-5.46874	350	1
-2.60641	350	1
0.255914	350	1
3.11824	350	1
5.98056	255.013	1
8.84289	137.134	1
11.7052	100.8	1
14.5675	79.3908	0.999999
17.4299	63.8784	0.999975
20.2922	51.7352	0.999575
23.1545	42.392	0.996049
26.0168	35.1384	0.978085
28.8792	29.4483	0.921133
31.7415	24.9366	0.800975
34.6038	21.32	0.621827
37.4661	18.3904	0.422993
40.3285	15.9929	0.251105
43.1908	14.0114	0.130824
46.0531	12.3599	0.0605002
48.9154	10.971	0.0251468
51.7778	9.79409	0.00951954
54.6401	8.78943	0.00332205
57.5024	7.92594	0.00108066
60.3647	7.17911	0.00033095
63.2271	6.52938	9.62544E-05
66.0894	5.96105	0.00002679
68.9517	5.46139	7.18296E-06
71.814	5.02002	1.86603E-06
74.6764	4.62841	4.72064E-07
77.5387	4.2795	1.16799E-07
80.401	3.96743	2.83716E-08
83.2633	3.68729	0
86.1257	3.43495	0
88.988	3.20685	0
91.8503	3.00017	0



Audit Number: 341
Date: 15/12/2023 Time: 08:49

Early Pool Fire Report
Workspace: pm_rev1
Study: Study
Equipment Item: T2A

Material	ISOBUTANE	
East		0 m
North		0 m

Scenario (Leak) : T2-2"leak vertical

pm_rev1\Study\T2A

Weather: Category 2/F

Wind speed [m/s]

Pasquill stability

Atmospheric temperature [degC]

Relative humidity [fraction]

Solar radiation flux [kW/m2]

2
F stable - night with moderate clouds and light/moderate wind
20
0.7
0.5

Pool fire model results

Early pool fires are assumed to occur at a time when the initial PVAP rainout rate equals the pool fire burn rate, unless the thus calculated pool fire radius exceeds the maximum PVAP pool radius. For the latter case the early pool fire radius is assumed to be the maximum PVAP pool radius. The pool fire centre is located at the rainout point.

INPUT DATA

Correlation Type: Thomas / Johnson

Surface type	Land	
Pool fire elevation		0 m
Maximum exposure duration		20 s
Downwind distance of liquid rainout		0 m
Use two zone pool fire model	Yes	

OUTPUT DATA

Pool fire diameter	25.7532	m
Downwind distance of pool fire centre		0 m
Pool fire flame length	49.2112	m
Angle between pool fire axis and vertical	28.303	deg
Luminous flame emissive power	169.985	kW/m2
Smoky flame emissive power	0	kW/m2
Ratio of luminous flame length to the total flame length		1 fraction
Total burn rate	62.5076	kg/s
Radiative fraction	0.268735	fraction

Radiation Intensity Ellipse Results

INPUT DATA

For ellipses 'observer direction' refers to whether inclination is 'fixed' or 'variable'. Orientation is always variable.

Observer direction	Variable	
Exposure duration		20 s
Height of interest		1 m

OUTPUT DATA

Radiation intensity

Incident radiation [kW/m ²]	Lethality (%)	View factor	Probit	Dose [(W/m ²) ^{Probit} N.s]	Hazard information	Ellipse half-length [m]	Ellipse half-width [m]	Ellipse centre downwind distance [m]	Effect downwind distance [m]	Ellipse area [m ²]	
3		0	0.0176486	-1.38321	865119	-	119.79	122.417	16.4676	136.257	46069.4
5		0.000174704	0.0294143	0.360367	1709491	-	93.2229	95.0348	16.2019	109.425	27832.7
7		0.02405	0.04118	1.50883	2677313	-	78.9475	79.8997	16.2097	95.1572	19816.8
12.5		6.52536	0.0735357	3.48789	5800162	-	58.4208	57.9525	15.5267	73.9475	10636.3

Radiation v Distance Results

INPUT DATA

Maximum distance		136.257 m
Angle from wind direction		0 deg
Observer direction	Variable	
Height of interest		1 m

OUTPUT DATA

Downwind distance [m]	Maximum incident radiation [kW/m2]	Lethality level (fraction)
0	169.985	1
2.78076	169.985	1
5.56152	169.985	1
8.34228	169.985	1
11.123	169.985	1
13.9038	148.699	1
16.6846	102.273	1
19.4653	82.7014	1
22.2461	70.5934	0.999995
25.0268	61.8966	0.999961
27.8076	55.1871	0.999812
30.5884	49.7351	0.999316
33.3691	45.243	0.998002
36.1499	41.4685	0.995075
38.9306	37.9749	0.988717
41.7114	34.7008	0.975749
44.4922	31.7004	0.95197
47.2729	28.9505	0.912387
50.0537	26.4586	0.852526
52.8344	24.179	0.770292
55.6152	22.1038	0.667681
58.396	20.2174	0.551336
61.1767	18.5052	0.431323
63.9575	16.9533	0.318472
66.7382	15.5483	0.221461
69.519	14.2773	0.144949
72.2998	13.1281	0.0893524
75.0805	12.0894	0.0519629
77.8613	11.1502	0.0285769
80.642	10.3008	0.0149051
83.4228	9.5319	0.00739698
86.2035	8.83533	0.00350471
88.9843	8.20356	0.00159085
91.7651	7.62986	0.000694177

94.5458	7.10816	0.000292161
97.3266	6.63306	0.000118979
100.107	6.19974	4.70246E-05
102.888	5.80389	1.80895E-05
105.669	5.44171	6.79085E-06
108.45	5.10978	2.49399E-06
111.23	4.80509	8.98106E-07
114.011	4.52495	3.1779E-07
116.792	4.27832	1.16212E-07
119.573	4.05411	4.27744E-08
122.353	3.84585	1.55635E-08
125.134	3.65215	0
127.915	3.47178	0
130.696	3.30362	0
133.476	3.14666	0
136.257	2.99999	0

Weather: Category 5/D

Wind speed [m/s]

Pasquill stability

Atmospheric temperature [degC]

Relative humidity [fraction]

Solar radiation flux [kW/m2]

5
D neutral - little sun and high wind or overcast/windy night
20
0.7
0.5

Pool fire model results

Early pool fires are assumed to occur at a time when the initial PVAP rainout rate equals the pool fire burn rate, unless the thus calculated pool fire radius exceeds the maximum PVAP pool radius. For the latter case the early pool fire radius is assumed to be the maximum PVAP pool radius. The pool fire centre is located at the rainout point.

INPUT DATA

Correlation Type: Thomas / Johnson

Surface type	Land
Pool fire elevation	0 m
Maximum exposure duration	20 s
Downwind distance of liquid rainout	0 m
Use two zone pool fire model	Yes

OUTPUT DATA

Pool fire diameter	25.7532 m
Downwind distance of pool fire centre	0 m
Pool fire flame length	49.2112 m
Angle between pool fire axis and vertical	45.8744 deg
Luminous flame emissive power	169.985 kW/m2
Smoky flame emissive power	0 kW/m2
Ratio of luminous flame length to the total flame length	1 fraction
Total burn rate	62.5076 kg/s
Radiative fraction	0.268735 fraction

Radiation Intensity Ellipse Results

INPUT DATA

For ellipses 'observer direction' refers to whether inclination is 'fixed' or 'variable'. Orientation is always variable.

Observer direction	Variable
Exposure duration	20 s
Height of interest	1 m

OUTPUT DATA

Radiation intensity

Incident radiation [kW/m2]	Lethality [%]	View factor	Probit	Dose [(W/m2)*ProbitN.s]	Hazard information	Ellipse half-length [m]	Ellipse half-width [m]	Ellipse centre downwind distance [m]	Effect downwind distance [m]	Ellip area [m2]
3	0	0.0176486	-1.38321	865119	-	114.153	120.652	24.7488	138.902	43268.4
5	0.000174704	0.0294143	0.360367	1709491	-	89.914	94.5266	24.3135	114.228	26701.2
7	0.02405	0.04118	1.50883	2677312	-	76.6906	80.1456	23.7931	100.484	19309.5
12.5	6.54536	0.0735357	3.48789	5800162	-	57.8767	59.4277	22.1398	86.0165	10805.4

Radiation v Distance Results

INPUT DATA

Maximum distance	138.902 m
Angle from wind direction	0 deg
Observer direction	Variable
Height of interest	1 m

OUTPUT DATA

Downwind distance [m]	Maximum incident radiation [kW/m2]	Lethality level (fraction)
0	169.985	1
2.83473	169.985	1
5.66946	169.985	1
8.50419	169.985	1
11.3389	169.985	1
14.1737	169.985	1
17.0084	107.938	1
19.8431	91.7205	1
22.6779	80.6448	0.999999
25.5126	72.6059	0.999996
28.3473	65.5519	0.999983
31.182	60.305	0.999943
34.0168	55.3845	0.999821
36.8515	51.369	0.999537
39.6862	47.9792	0.998961
42.521	44.6947	0.997722
45.3557	42.1433	0.995808
48.1904	39.6153	0.992346
51.0252	36.7277	0.984871
53.8599	33.5116	0.968124
56.6946	30.3455	0.935136
59.5294	27.341	0.876835
62.3641	24.5534	0.785892
65.1988	22.0081	0.662285
68.0336	19.7119	0.516992
70.8683	17.6588	0.369641
73.703	15.835	0.240436
76.5378	14.2218	0.141944
79.3725	12.7989	0.0761513
82.2072	11.6749	0.0404764
85.0419	10.7387	0.0211533
87.8767	9.89073	0.0104095
90.7114	9.12373	0.00484408
93.5461	8.43032	0.00214133
96.3809	7.80335	0.000903266
99.2156	7.23609	0.000365195
102.05	6.72233	0.000142117
104.885	6.25641	5.34451E-05



107.72	5.83327	1.94946E-05
110.555	5.44833	6.92064E-06
113.389	5.00756	2.39862E-06
116.224	4.77735	8.1395E-07
119.059	4.4845	2.71131E-07
121.893	4.2162	8.88639E-08
124.728	3.96995	2.87183E-08
127.563	3.74352	9.16875E-09
130.398	3.53496	0
133.232	3.34252	0
136.067	3.16466	0
138.902	3	0



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Consequence Summary Report
Workspace: pm_rev1

Study: Study
Summary Basis

These tables will only report global values set in the parameters. Values that are modified in the study tree will not be reported.
The report is context sensitive, and filters up to the study level. You will need to generate multiple summary reports if you have multiple studies in your workspace.
The results in this report are from the non-CFD calculations only.

Discharge Results (after atmospheric expansion)

Path	Scenario	Weather	Peak Flowrate [kg/s]	Temperature [degC]	Liquid mass fraction in material [fra	Droplet diameter [um]	Expanded diameter [m]	Velocity [m/s]	End time of release [s]
Study\T2A	T2-2"leak vertical	Category 2/F	75.9769	-11.9098	0.822718	166.077	0.210384	140.805	36.7131
		Category 5/D	75.9769	-11.9098	0.822718	166.077	0.210384	140.805	36.7131

Dispersion Results

Input dispersion parameters

Core averaging time	18.75 s
Flammable averaging	18.75 s
Toxic averaging time	600 s
Height of interest	1 m

Distance downwind to defined concentrations

The reported concentration of interest is defined at the scenario

Path	Scenario	Weather	Distance to UFL [m]	Distance to LFL [m]	Distance to LFL fraction [m]
Study\T2A	T2-2"leak vertical	Category 2/F	23.5885	69.7016	133.548
		Category 5/D	n/a	65.9934	96.3325

Jet Fire Results

Distance downwind to defined radiation levels

The reported radiations are defined in the parameters

Path	Scenario	Weather	Flame length [m]	Distance downwind to intensity level 1 (3 kW/m2) [m]	Distance downwind to intensity level 2 (5 kW/m2) [m]	Distance downwind to intensity level 3 (7 kW/m2) [m]	Distance downwind to intensity level 4 (12,5 kW/m2) [m]
Study\T2A	T2-2"leak vertical	Category 2/F	67.4591	115.603	89.3949	75.9444	58.4374
		Category 5/D	52.4378	115.256	89.2912	75.3319	56.6278

Early Pool Fire Results

Distance downwind to defined radiation levels

The reported radiations are defined in the parameters

Path	Scenario	Weather	Pool diameter [m]	Distance downwind to intensity level 1 (3 kW/m2) [m]	Distance downwind to intensity level 2 (5 kW/m2) [m]	Distance downwind to intensity level 3 (7 kW/m2) [m]	Distance downwind to intensity level 4 (12,5 kW/m2) [m]
Study\T2A	T2-2"leak vertical	Category 2/F	25.7532	136.257	109.425	95.1572	73.9475
		Category 5/D	25.7532	138.902	114.228	100.484	80.0165

Late Pool Fire Results

Distance downwind to defined radiation levels

The reported radiations are defined in the parameters

Path	Scenario	Weather	Pool diameter [m]	Distance downwind to intensity level 1 (3 kW/m2) [m]	Distance downwind to intensity level 2 (5 kW/m2) [m]	Distance downwind to intensity level 3 (7 kW/m2) [m]	Distance downwind to intensity level 4 (12,5 kW/m2) [m]
Study\T2A	T2-2"leak vertical	Category 2/F	28.8663	149.086	119.789	104.112	80.8321
		Category 5/D	28.6491	151.177	124.236	109.228	86.9847

Flash Fire Results

Distance downwind to defined concentrations

The reported LFL and LFL fraction are defined in the respective material property

Path	Scenario	Weather	Distance downwind to LFL [m]	Distance downwind to LFL Fraction [m]
Study\T2A	T2-2"leak vertical	Category 2/F	69.7016	133.548
		Category 5/D	65.9934	96.3325

Maximum distance to LFL fraction at any height

Path	Scenario	Weather	Max flash fire distance [m]	Height of the max flash fire distance [m]	Time [s]
Study\T2A	T2-2"leak vertical	Category 2/F	128.398	0	112.886
		Category 5/D	96.0162	0	58.5159

Explosion Results

Explosion scenarios for worst-case maximum downwind distance to defined overpressures.

The reported overpressures are defined in the explosion parameters

Path	Scenario	Weather	Overpressure level [bar]	Maximum distance [m]	Diameter [m]
Study\T2A	T2-2"leak vertical	Category 2/F	0,02068	485,459	730,918
			0,1379	191,029	142,059
			0,2068	173,255	106,51
		Category 5/D	0,02068	337,263	494,525
			0,1379	138,057	96,1143
			0,2068	126,031	72,0628

Supplementary data for worst-case explosion scenarios

Path	Scenario	Weather	Overpressure level [bar]	Explosion flammable mass [kg]	Ignition time [s]	Ignition source [m]	Cloud centre [m]	Explosion centre [m]
Study\T2A	T2-2"leak vertical	Category 2/F	0,02068	591,686	97,4042	120	48,4202	120
			0,1379	591,686	97,4042	120	48,4202	120
			0,2068	591,686	97,4042	120	48,4202	120
		Category 5/D	0,02068	183,253	31,3869	90	35,0969	90
			0,1379	183,253	31,3869	90	35,0969	90
			0,2068	183,253	31,3869	90	35,0969	90



Audit Number: 341
Date: 15/12/2023 Time: 08:51

Discharge Report

Workspace: pm_rev1

Study: Study

Equipment Item: T2B

pm_rev1\Study\T2B

Material

ISOBUTANE

East

0 m

North

0 m

Scenario (Leak) : T2-2"leak vertical

pm_rev1\Study\T2B\T2-2"leak vertical

Weather: Category 2/F

INPUT DATA

Inventory data

Mass in vessel	2789.35	kg
----------------	---------	----

Stagnation Data (upstream end for long pipe)

Initial pressure (gauge)	15.3	bar
Initial temperature	20	degC
Fluid state	Non-saturated liquid	

Scenario data

Phase to be released	Liquid	
Tank head	0	m
Hole diameter	50.8	mm

OUTPUT DATA

Mass flow rate	52.0225	kg/s
Release duration	53.6182	s

Orifice or pipe exit data (before atmospheric expansion)

Pressure	1.01325	bar
Temperature	19.0843	degC
Liquid mass fraction	1	fraction
Velocity at vena contracta (at exit for pipe releases)	76.5283	m/s
Discharge coefficient	0.6	

Final Data (after atmospheric expansion)

Temperature	-11.9098	degC
Liquid mass fraction	0.817044	fraction
Droplet diameter	194.998	um
Expanded diameter	0.193792	m
Velocity	117.169	m/s

Weather: Category 5/D

INPUT DATA

Inventory data

Mass in vessel	2789.35	kg
----------------	---------	----

Stagnation Data (upstream end for long pipe)

Initial pressure (gauge)	15.3	bar
Initial temperature	20	degC
Fluid state	Non-saturated liquid	

Scenario data

Phase to be released	Liquid	
Tank head	0	m
Hole diameter	50.8	mm

OUTPUT DATA

Mass flow rate	52.0225	kg/s
Release duration	53.6182	s

Orifice or pipe exit data (before atmospheric expansion)

Pressure	1.01325	bar
Temperature	19.0843	degC
Liquid mass fraction	1	fraction
Velocity at vena contracta (at exit for pipe releases)	76.5283	m/s
Discharge coefficient	0.6	

Final Data (after atmospheric expansion)

Temperature	-11.9098	degC
Liquid mass fraction	0.817044	fraction
Droplet diameter	194.998	um
Expanded diameter	0.193792	m
Velocity	117.169	m/s



Audit Number: 341
Date: 15/12/2023 Time: 08:51
Explosion Report
Workspace: pm_rev1
Study: Study
Equipment Item: T2B

pm_rev1\Study\T2B		
Material	ISOBUTANE	
East	0	m
North	0	m

Scenario (Leak) : T2-2"leak vertical
pm_rev1\Study\T2B\T2-2"leak vertical
Weather: Category 2/F

Explosion location criterion	Cloud front (LFL fraction)	
Explosion height criterion	Centreline height	
Explosion method	Multi-Energy: Uniform confined	
Uniform confined method explosion efficiency	12.5	%
Uniform confined method explosion strength	10	

Time of explosion [s]	Distance to centre of mass [m]	Distance to explosion centre [m]	Distance to ignition point [m]	Flammable mass [kg]	Overpressures (input) [bar]	Distance to specified overpressures [m]
0.740595	5.09117	10	10	0.529126	0,02068 0,1379 0,2068	45,2096 16,8432 15,1308
2.20477	8.41524	20	20	2.53836	0,02068 0,1379 0,2068	79,3826 31,5414 28,6533
6.57517	13.3796	30	30	12.15	0,02068 0,1379 0,2068	130,077 49,4506 44,5833
12.0625	17.3848	40	40	29.9868	0,02068 0,1379 0,2068	175,244 66,2856 59,7079
18.0709	20.8035	50	50	52.4453	0,02068 0,1379 0,2068	212,946 81,6696 73,7447
24.4456	23.5703	60	60	76.8075	0,02068 0,1379 0,2068	245,044 95,9646 86,9649
35.1384	27.9864	70	70	118.168	0,02068 0,1379 0,2068	283,62 111,518 101,129
49.72	32.1932	80	80	185.943	0,02068 0,1379 0,2068	328,467 128,291 116,207
65.7461	32.8561	90	90	325.997	0,02068 0,1379 0,2068	389,603 148,23 133,659
82.3263	36.7914	100	100	496.136	0,02068 0,1379 0,2068	444,621 166,979 150,219
98.9065	40.7268	110	110	666.275	0,02068 0,1379 0,2068	490,212 183,897 165,405

Weather: Category 5/D



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Explosion location criterion

Explosion height criterion

Explosion method

Uniform confined method explosion efficiency

Uniform confined method explosion strength

Cloud front (LFL fraction)

Centreline height

Multi-Energy: Uniform confined

12.5 %

10

Time of explosion [s]	Distance to centre of mass [m]	Distance to explosion centre [m]	Distance to ignition point [m]	Flammable mass [kg]	Overpressures (input) [bar]	Distance to specified overpressures [m]
0.608098	5.93234	10	10	0.602883	0,02068 0,1379	46,775 17,1475
1.7745	10.8677	20	20	3.33454	0,1379 0,2068	32,6402 29,4771
4.10184	17.8263	30	30	14.9242	0,02068 0,1379	137,178 50,8307
7.39715	23.9895	40	40	39.0111	0,02068 0,1379	187,64 68,6948
11.4308	28.396	50	50	64.8952	0,02068 0,1379	224,936 84
15.9431	29.8809	60	60	81.4685	0,02068 0,1379	248,714 96,6779
22.7207	29.8324	70	70	99.0379	0,1379 0,2068	109,145 99,3493
33.9428	29.8292	80	80	126.771	0,1379 0,2068	122,502 111,867



Audit Number: 341
Date: 15/12/2023 Time: 08:51

Jet Fire
Workspace: pm_rev1
Study: Study
Equipment Item: T2B

pm_rev1\Study\T2B	
Material	ISOBUTANE
East	0 m
North	0 m

Scenario (Leak) : T2-2"leak vertical

pm_rev1\Study\T2B\T2-2"leak vertical

Weather: Category 2/F

Wind speed [m/s]	2
Pasquill stability	F stable - night with moderate clouds and light/moderate wind
Atmospheric temperature [degC]	20
Relative humidity [fraction]	0.7
Solar radiation flux [kW/m2]	0.5

Jet fire model results

INPUT DATA

Scenario

Elevation	1 m
Release angle from horizontal	0 deg

Jet Fire Parameters

Jet fire method	Cone model
Wind orientation about the z-axis (anti-clockwise from the East)	0 deg
Rotation about the z-axis (anti-clockwise from the east)	0 deg
Rate modification factor	3

Calculated inputs

Mass flow rate	28.5534 kg/s
Temperature after atmospheric expansion	-11.9098 degC
Liquid fraction	0.817044 fraction
Velocity after atmospheric expansion (input)	117.169 m/s
Rainout fraction time averaged	0.817044 fraction

OUTPUT DATA

Flame emissive power	243.483 kW/m2
Fraction of emissivity	0.422289 fraction
Jet velocity	117.169 m/s
Flame length	59.5734 m
Frustum length	58.6798 m
Frustum base width	0.720219 m
Frustum tip width	20.049 m
Frustum lift-off distance	0.893601 m
Flame length in still air	53.5716 m
Hole to flame angle	0 deg
Expanded diameter	0.143572 m
Plane angular rotation	0 deg

Flame on ground impingement with partial truncation

Radiation Intensity Ellipse Results

INPUT DATA

For ellipses 'observer direction' refers to whether inclination is 'fixed' or 'variable'. Orientation is always variable.

Observer direction	Variable
Exposure duration	20 s
Height of interest	1 m

OUTPUT DATA

Radiation intensity

Incident radiation [kW/m2]	Lethality [%]	View factor	Probit	Dose [(W/m2)^ProbitN.s]	Ellipse half-length [m]	Ellipse half-width [m]	Ellipse centre downwind distance [m]	Effect downwind distance [m]	Ellipse area [m2]
3	0	0.0123212	-1.38321	865119	75.3471	99.7497	0	99.7497	23611.7
5	0.000174704	0.0205353	0.360367	1709491	60.3263	77.1262	0	77.1262	14617
7	0.02405	0.0287494	1.50883	2677313	54.234	65.5461	0	65.5461	11167.8
12.5	6.52536	0.0513382	3.48789	5800162	46.9897	50.4827	0	50.4827	7452.39

Radiation v Distance Results

INPUT DATA

Maximum distance	132.158 m
Observer type radiation modelling flag	Planar
Observer direction	Variable
Height of interest	1 m

OUTPUT DATA

Downwind distance [m]	Maximum incident radiation [kW/m2]	Lethality level (fraction)
-52.5528	243.483	0.960062
-49.8557	243.483	1
-47.1586	243.483	1
-44.4615	243.483	1
-41.7644	243.483	1
-39.0673	243.483	1
-36.3702	243.483	1
-33.6731	243.483	1
-30.976	243.483	1
-28.2789	243.483	1
-25.5818	243.483	1
-22.8847	243.483	1
-20.1876	243.483	1
-17.4905	243.483	1
-14.7934	243.483	1
-12.0963	243.483	1
-9.39925	243.483	1
-6.70215	243.483	1
-4.00505	243.483	1



-1.30795	243.483	1
1.38914	243.483	1
4.08624	243.483	1
6.78334	243.483	1
9.48044	147.29	1
12.1775	90.3675	1
14.8746	68.7768	0.999992
17.5717	54.9953	0.999803
20.2688	44.7809	0.997768
22.9659	36.654	0.984608
25.663	30.3069	0.934583
28.3601	25.3152	0.815018
31.0572	21.3557	0.623985
33.7543	18.1858	0.408097
36.4514	15.6236	0.226394
39.1485	13.5331	0.107293
41.8456	11.8116	0.0440547
44.5427	10.381	0.0159311
47.2398	9.18284	0.0051629
49.9369	8.17099	0.00152232
52.634	7.31041	0.000414338
55.3311	6.5753	0.000105374
58.0282	5.93788	2.53121E-05
60.7253	5.38685	5.79673E-06
63.4224	4.9063	1.2758E-06
66.1195	4.48505	2.71717E-07
68.8166	4.11396	5.63326E-08
71.5137	3.78557	1.14268E-08
74.2108	3.49372	0
76.9079	3.2333	0
79.605	3.00005	0

Weather: Category 5/D

Wind speed [m/s]	5
Pasquill stability	D neutral - little sun and high wind or overcast/windy night
Atmospheric temperature [degC]	20
Relative humidity [fraction]	0.7
Solar radiation flux [kW/m2]	0.5

Jet fire model results

INPUT DATA

Scenario

Elevation	1 m
Release angle from horizontal	0 deg

Jet Fire Parameters

Jet fire method	Cone model
Wind orientation about the z-axis (anti-clockwise from the East)	0 deg
Rotation about the z-axis (anti-clockwise from the east)	0 deg
Rate modification factor	3

Calculated inputs

Mass flow rate	28.5534 kg/s
Temperature after atmospheric expansion	-11.9098 degC
Liquid fraction	0.817044 fraction
Velocity after atmospheric expansion (input)	117.169 m/s
Rainout fraction time averaged	0.817044 fraction

OUTPUT DATA

Flame emissive power	320.009 kW/m2
Fraction of emissivity	0.422289 fraction
Jet velocity	117.169 m/s
Flame length	46.308 m
Frustum length	45.6134 m
Frustum base width	1.21257 m
Frustum tip width	18.588 m
Frustum lift-off distance	0.69462 m
Flame length in still air	53.5716 m
Hole to flame angle	0 deg
Expanded diameter	0.143572 m
Plane angular rotation	0 deg

Flame on ground impingement with partial truncation

Radiation Intensity Ellipse Results

INPUT DATA

For ellipses 'observer direction' refers to whether inclination is 'fixed' or 'variable'. Orientation is always variable.

Observer direction	Variable
Exposure duration	20 s
Height of interest	1 m

OUTPUT DATA

Radiation Intensity

Incident radiation [kW/m2]	Lethality [%]	View factor	Probit	Dose [(W/m2)^Probit[N.s]	Ellipse half-length [m]	Ellipse half-width [m]	Ellipse centre downwind distance [m]	Effect downwind distance [m]	Ellipse area [m2]
3	0	0.00937472	-1.38321	865119	79.4431	100.101	0	100.101	24982.9
5	0.000174704	0.0156245	0.360367	1709491	62.2657	77.4962	0	77.4962	15159.3
7	0.02405	0.0218744	1.50883	2677313	53.1328	65.2797	0	65.2797	10896.6
12.5	6.52536	0.0390613	3.48789	5800162	43.0944	49.1518	0	49.1518	6654.42

Radiation v Distance Results

INPUT DATA

Maximum distance	123.46 m
Observer type radiation modelling flag	Planar
Observer direction	Variable
Height of interest	1 m

OUTPUT DATA

Downwind distance [m]	Maximum incident radiation [kW/m2]	Lethality level [fraction]
-42.6349	134.791	1
-40.1153	320.009	1
-37.5957	320.009	1
-35.0762	320.009	1
-32.5566	320.009	1
-30.037	320.009	1
-27.5174	320.009	1
-24.9978	320.009	1



-22.4782	320.009	1
-19.9586	320.009	1
-17.439	320.009	1
-14.9194	320.009	1
-12.3998	320.009	1
-9.88022	320.009	1
-7.36063	320.009	1
-4.84103	320.009	1
-2.32144	320.009	1
0.198155	320.009	1
2.71775	320.009	1
5.22734	258.751	1
7.75693	135.786	1
10.2765	96.6704	1
12.7961	76.7123	0.999999
15.3157	62.1526	0.999963
17.8353	50.5525	0.999437
20.3549	41.5706	0.995194
22.8745	34.5594	0.974944
25.3941	29.0339	0.913773
27.9137	24.6396	0.789202
30.4333	21.0992	0.608182
32.9529	18.2249	0.41095
35.4725	15.868	0.242653
37.9921	13.9159	0.12593
40.5116	12.2864	0.0580966
43.0312	10.9142	0.024124
45.5508	9.7496	0.00912997
48.0704	8.75454	0.00318841
50.59	7.89949	0.00103862
53.1096	7.15748	0.000318686
55.6292	6.51234	9.29032E-05
58.1488	5.94765	2.59259E-05
60.6684	5.4509	6.97148E-06
63.188	5.01187	1.81672E-06
65.7076	4.62215	4.6109E-07
68.2272	4.27478	1.14471E-07
70.7468	3.96397	2.79029E-08
73.2664	3.68486	0
75.785	3.43338	0
78.3055	3.20604	0
80.8251	2.99993	0



Audit Number: 341
Date: 15/12/2023 Time: 08:51

Early Pool Fire Report
Workspace: pm_rev1

Study: Study
Equipment Item: T28

pm_rev1\Study\T28		
Material	ISOBUTANE	
East		0 m
North		0 m

Scenario (Leak) : T2-2"leak vertical
pm_rev1\Study\T28\T2-2"leak vertical

Weather: Category 2/F	2
Wind speed [m/s]	F stable - night with moderate clouds and light/moderate wind
Pasquill stability	
Atmospheric temperature [degC]	20
Relative humidity [fraction]	0.7
Solar radiation flux [kW/m2]	0.5

Pool fire model results

Early pool fires are assumed to occur at a time when the initial PVAP rainout rate equals the pool fire burn rate, unless the thus calculated pool fire radius exceeds the maximum PVAP pool radius. For the latter case the early pool fire radius is assumed to be the maximum PVAP pool radius. The pool fire centre is located at the rainout point.

INPUT DATA
Correlation Type: Thomas / Johnson

Surface type	Land
Pool fire elevation	0 m
Maximum exposure duration	20 s
Downwind distance of liquid rainout	0 m
Use two zone pool fire model	Yes

OUTPUT DATA

Pool fire diameter	21.2365 m
Downwind distance of pool fire centre	0 m
Pool fire flame length	43.0387 m
Angle between pool fire axis and vertical	29.5119 deg
Luminous flame emissive power	169.925 kW/m2
Smoky flame emissive power	0 kW/m2
Ratio of luminous flame length to the total flame lenc	1 fraction
Total burn rate	42.5047 kg/s
Radiative fraction	0.283031 fraction

Radiation Intensity Ellipse Results

INPUT DATA

For ellipses 'observer direction' refers to whether inclination is 'fixed' or 'variable'. Orientation is always variable.

Observer direction	Variable
Exposure duration	20 s
Height of interest	1 m

OUTPUT DATA

Radiation intensity

Incident radiation [kW/m2]	Lethality [%]	View factor	Probit	Dose [(W/m2)^ProbitN.s]	Hazard information	Ellipse half-length [m]	Ellipse half-width [m]	Ellipse centre downwind distance [m]	Effect downwind distance [m]	Ellipse area [m2]
3	0	0.0176549	-1.38321	865119	-	102.131	104.515	14.8853	117.017	33534
5	0.000174704	0.0294248	0.360367	1709491	-	79.3504	81.046	14.5427	93.8931	20203.7
7	0.02405	0.0411947	1.50883	2677313	-	67.1908	68.0712	14.5421	81.7329	14368.9
12.5	6.52536	0.073562	3.48789	5800162	-	49.7345	49.2743	13.8922	63.6267	7698.88

Radiation v Distance Results

INPUT DATA

Maximum distance	117.017 m
Angle from wind direction	0 deg
Observer direction	Variable
Height of interest	1 m

OUTPUT DATA

Downwind distance [m]	Maximum incident radiation [kW/m2]	Lethality level (fraction)
0	169.925	1
2.3881	169.925	1
4.77619	169.925	1
7.16429	169.925	1
9.55239	169.925	1
11.9405	139.926	1
14.3286	100.96	1
16.7167	82.4662	1
19.1048	70.3535	0.999994
21.4929	61.7706	0.999959
23.881	55.0115	0.999804
26.2691	49.6248	0.999238
28.6572	45.1884	0.997975
31.0453	41.4481	0.995051
33.4334	38.0492	0.988913
35.8215	34.8176	0.976395
38.2095	31.8352	0.9534
40.5976	29.1006	0.914999
42.9857	26.599	0.856649
45.3738	24.314	0.776015
47.7619	22.2303	0.674724
50.15	20.3335	0.559056
52.5381	18.6098	0.438894
54.9262	17.0459	0.325139
57.3143	15.629	0.226751
59.7024	14.3466	0.148747
62.0905	13.1867	0.0918293



64.4786		12.1379	0.0534342
66.8667		11.1897	0.0293749
69.2548		10.3321	0.0153005
71.6429		9.55605	0.00757554
74.031		8.85311	0.00357761
76.4191		8.21579	0.00161721
78.8072		7.63725	0.00070218
81.1953		7.11139	0.000293842
83.5834		6.63273	0.000118899
85.9715		6.19636	4.66646E-05
88.3596		5.79794	1.78159E-05
90.7477		5.43359	6.63474E-06
93.1358		5.09985	2.41621E-06
95.5239		4.79365	8.62499E-07
97.912		4.52569	3.18699E-07
100.3		4.283	1.18556E-07
102.688		4.05787	4.35275E-08
105.076		3.84877	1.57955E-08
107.464		3.65433	0
109.852		3.47231	0
112.241		3.30458	0
114.629		3.14712	0
117.017		2.99999	0

Weather: Category 5/D

Wind speed [m/s]

Pasquilli stability

Atmospheric temperature [degC]

Relative humidity [fraction]

Solar radiation flux [kW/m2]

D neutral - little sun and high wind or overcast/windy night
20
0.7
0.5

Pool fire model results

Early pool fires are assumed to occur at a time when the initial PVAP rainout rate equals the pool fire burn rate, unless the thus calculated pool fire radius exceeds the maximum PVAP pool radius. For the latter case the early pool fire radius is assumed to be the maximum PVAP pool radius. The pool fire centre is located at the rainout point.

INPUT DATA

Correlation Type: Thomas / Johnson

Surface type	Land
Pool fire elevation	0 m
Maximum exposure duration	20 s
Downwind distance of liquid rainout	0 m
Use two zone pool fire model	Yes

OUTPUT DATA

Pool fire diameter	21.2365 m
Downwind distance of pool fire centre	0 m
Pool fire flame length	43.0387 m
Angle between pool fire axis and vertical	47.0282 deg
Luminous flame emissive power	169.925 kW/m2
Smoky flame emissive power	0 kW/m2
Ratio of luminous flame length to the total flame leng	1 fraction
Total burn rate	42.5047 kg/s
Radiative fraction	0.283031 fraction

Radiation Intensity Ellipse Results

INPUT DATA

For ellipses 'observer direction' refers to whether inclination is 'fixed' or 'variable'. Orientation is always variable.

Observer direction	Variable
Exposure duration	20 s
Height of interest	1 m

OUTPUT DATA

Radiation intensity

Incident radiation [kW/m2]	Lethality [%]	View factor	Probit	Dose [(W/m2)^ProbitN.s]	Hazard information	Ellipse half-length [m]	Ellipse half-width [m]	Ellipse centre downwind distance [m]	Effect downwind distance [m]	Ellipse area [m2]
3	0	0.0176549	-1.38321	865119	-	97.2249	102.925	21.917	119.142	31437.5
5	0.000174704	0.0294248	0.360367	1709491	-	76.5959	80.5525	21.5092	98.1051	19383.6
7	0.02405	0.0411947	1.50883	2677313	-	65.3628	68.2418	21.0314	86.3942	14013
12.5	6.52536	0.073562	3.48789	5800162	-	49.3739	50.512	19.4897	68.8636	7835.04

Radiation v Distance Results

INPUT DATA

Maximum distance	119.142 m
Angle from wind direction	0 deg
Observer direction	Variable
Height of interest	1 m

OUTPUT DATA

Downwind distance [m]	Maximum incident radiation [kW/m2]	Lethality level [fraction]
0	169.925	1
2.43147	169.925	1
4.86293	169.925	1
7.2944	169.925	1
9.72587	169.925	1
12.1573	136.835	1
14.5888	109.338	1
17.0203	91.2451	1
19.4517	80.4476	0.999999
21.8832	72.6091	0.999996
24.3147	65.5408	0.999983
26.7461	60.3794	0.999944
29.1776	55.3853	0.999821
31.6091	51.4617	0.999547
34.0405	47.8481	0.998928
36.472	44.8742	0.997817
38.9035	42.1987	0.995863
41.3349	39.8348	0.992735
43.7664	37.0953	0.986121
46.1979	33.9465	0.971147
48.6293	30.7803	0.941059
51.0608	27.7455	0.886751
53.4923	24.9129	0.800067



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55.9237	22.3168	0.679484
58.3552	19.9694	0.534629
60.7867	17.868	0.384911
63.2181	16.0005	0.251617
65.6496	14.3491	0.148886
68.0811	12.8934	0.0798134
70.5125	11.7989	0.0437132
72.944	10.846	0.0229369
75.3755	9.98296	0.0113165
77.8069	9.20252	0.00527268
80.2384	8.49729	0.00233071
82.6699	7.86001	0.000981975
85.1014	7.2838	0.000396135
87.5328	6.76231	0.000153676
89.9643	6.28974	5.75669E-05
92.3958	5.86088	2.09024E-05
94.8272	5.47105	7.38253E-06
97.2587	5.11608	2.54447E-06
99.6902	4.79228	8.58318E-07
102.122	4.49637	2.84129E-07
104.553	4.22545	9.25221E-08
106.985	3.97696	2.9702E-08
109.416	3.74862	9.4187E-09
111.847	3.53843	0
114.279	3.3446	0
116.71	3.16556	0
119.142	2.9999	0



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Consequence Summary Report

Workspace: pm_rev1

Study: Study

Summary Basis

These tables will only report global values set in the parameters. Values that are modified in the study tree will not be reported.
The report is context sensitive, and filters up to the study level. You will need to generate multiple summary reports if you have multiple studies in your workspace.
The results in this report are from the non-CFD calculations only.

Discharge Results (after atmospheric expansion)

Path	Scenario	Weather	Peak Flowrate [kg/s]	Temperature [degC]	Liquid mass fraction in material [frac]	Droplet diameter [um]	Expanded diameter [m]	Velocity [m/s]	End time of release [s]
Study\T2B	T2-2"leak vertical	Category 2/F	52.0225	-11.9098	0.817044	194.998	0.193792	117.169	53.6182
		Category 5/D	52.0225	-11.9098	0.817044	194.998	0.193792	117.169	53.6182

Dispersion Results

Input dispersion parameters

Core averaging time	18.75 s
Flammable averaging time	18.75 s
Toxic averaging time	600 s
Height of interest	1 m

Distance downwind to defined concentrations

The reported concentration of interest is defined at the scenario

Path	Scenario	Weather	Distance to UFL [m]	Distance to LFL [m]	Distance to LFL fraction [m]
Study\T2B	T2-2"leak vertical	Category 2/F	n/a	90.6817	140.829
		Category 5/D	n/a	57.5365	86.6156

Jet Fire Results

Distance downwind to defined radiation levels

The reported radiations are defined in the parameters

Path	Scenario	Weather	Flame length [m]	Distance downwind to intensity level 1 (3 kW/m2) [m]	Distance downwind to intensity level 2 (5 kW/m2) [m]	Distance downwind to intensity level 3 (7 kW/m2) [m]	Distance downwind to intensity level 4 (12,5 kW/m2) [m]
Study\T2B	T2-2"leak vertical	Category 2/F	59.5734	99.7497	77.1262	65.5461	50.4827
		Category 5/D	46.308	100.101	77.4962	65.2797	49.1518

Early Pool Fire Results

Distance downwind to defined radiation levels

The reported radiations are defined in the parameters

Path	Scenario	Weather	Pool diameter [m]	Distance downwind to intensity level 1 (3 kW/m2) [m]	Distance downwind to intensity level 2 (5 kW/m2) [m]	Distance downwind to intensity level 3 (7 kW/m2) [m]	Distance downwind to intensity level 4 (12,5 kW/m2) [m]
Study\T2B	T2-2"leak vertical	Category 2/F	21.2365	117.017	93.8931	81.7329	63.6267
		Category 5/D	21.2365	119.142	98.1051	86.3942	68.8636

Late Pool Fire Results

Distance downwind to defined radiation levels

The reported radiations are defined in the parameters

Path	Scenario	Weather	Pool diameter [m]	Distance downwind to intensity level 1 (3 kW/m2) [m]	Distance downwind to intensity level 2 (5 kW/m2) [m]	Distance downwind to intensity level 3 (7 kW/m2) [m]	Distance downwind to intensity level 4 (12,5 kW/m2) [m]
Study\T2B	T2-2"leak vertical	Category 2/F	28.5352	147.736	118.698	103.17	80.1078
		Category 5/D	28.1949	149.27	122.681	107.87	85.9062

Flash Fire Results

Distance downwind to defined concentrations

The reported LFL and LFL fraction are defined in the respective material property

Path	Scenario	Weather	Distance downwind	Distance downwind
Study\T2B	T2-2"leak vertical	Category 2/F	90.6817	140.829
		Category 5/D	57.5365	86.6156

Maximum distance to LFL fraction at any height

Path	Scenario	Weather	Max flash fire distance [m]	Height of the max flash fire distance [m]	Time [s]
Study\T2B	T2-2"leak vertical	Category 2/F	110.659	0	99.9993
		Category 5/D	86.0174	0	62.9551

Explosion Results

Explosion scenarios for worst-case maximum downwind distance to defined overpressures.

The reported overpressures are defined in the explosion parameters

Path	Scenario	Weather	Overpressure level [bar]	Maximum distance [m]	Diameter [m]
Study\T2B	T2-2"leak vertical	Category 2/F	0,02068	490,212	760,424
			0,1379	183,897	147,794
			0,2068	165,405	110,81
		Category 5/D	0,02068	298,683	437,365
			0,1379	122,502	85,0049
			0,2068	111,867	63,7334

Supplementary data for worst-case explosion scenarios

Path	Scenario	Weather	Overpressure level [bar]	Explosion flammable mass [kg]	Ignition time [s]	Ignition source [m]	Cloud centre [m]	Explosion centre [m]
Study\T2B	T2-2"leak vertical	Category 2/F	0,02068	666,275	98,9065	110	40,7268	110
			0,1379	666,275	98,9065	110	40,7268	110
			0,2068	666,275	98,9065	110	40,7268	110
		Category 5/D	0,02068	126,771	33,9428	80	29,8292	80
			0,1379	126,771	33,9428	80	29,8292	80
			0,2068	126,771	33,9428	80	29,8292	80



Audit Number: 341
Date: 15/12/2023 Time: 08:52

Discharge Report

Workspace: pm_rev1

Study: Study

Equipment Item: T2C

pm_rev1\Study\T2C

Material	ISOBUTANE	
East		0 m
North		0 m

Scenario (Leak) : T2-2"leak vertical

pm_rev1\Study\T2C\T2-2"leak vertical

Weather: Category 2/F

INPUT DATA

Inventory data

Mass in vessel	2789.35	kg
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Stagnation Data (upstream end for long pipe)

Initial pressure (gauge)	28	bar
Initial temperature	20	degC
Fluid state	Non-saturated liquid	

Scenario data

Phase to be released	Liquid	
Tank head	0	m
Hole diameter	50.8	mm

OUTPUT DATA

Mass flow rate	70.3237	kg/s
Release duration	39.6645	s

Orifice or pipe exit data (before atmospheric expansion)

Pressure	1.01325	bar
Temperature	18.3726	degC
Liquid mass fraction	1	fraction
Velocity at vena contracta (at exit for pipe release)	103.291	m/s
Discharge coefficient	0.6	

Final Data (after atmospheric expansion)

Temperature	-11.9098	degC
Liquid mass fraction	0.821228	fraction
Droplet diameter	172.858	um
Expanded diameter	0.20768	m
Velocity	134.838	m/s

Weather: Category 5/D

INPUT DATA

Inventory data

Mass in vessel	2789.35	kg
----------------	---------	----

Stagnation Data (upstream end for long pipe)

Initial pressure (gauge)	28	bar
Initial temperature	20	degC
Fluid state	Non-saturated liquid	

Scenario data

Phase to be released	Liquid	
Tank head	0	m
Hole diameter	50.8	mm

OUTPUT DATA

Mass flow rate	70.3237	kg/s
Release duration	39.6645	s

Orifice or pipe exit data (before atmospheric expansion)

Pressure	1.01325	bar
Temperature	18.3726	degC
Liquid mass fraction	1	fraction
Velocity at vena contracta (at exit for pipe release)	103.291	m/s
Discharge coefficient	0.6	

Final Data (after atmospheric expansion)

Temperature	-11.9098	degC
Liquid mass fraction	0.821228	fraction
Droplet diameter	172.858	um
Expanded diameter	0.20768	m
Velocity	134.838	m/s



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Audit Number: 341
Date: 15/12/2023 Time: 08:53
Explosion Report
Workspace: pm_rev1
Study: Study
Equipment Item: T2C
pm_rev1\Study\T2C

Material	ISOBUTANE	
East	0	m
North	0	m

Scenario (Leak) : T2-2"leak vertical
pm_rev1\Study\T2C\T2-2"leak vertical

Weather: Category 2/F

Explosion location criterion	Cloud front (LFL fraction)	
Explosion height criterion	Centreline height	
Explosion method	Multi-Energy: Uniform confined	
Uniform confined method explosion efficiency	12.5	%
Uniform confined method explosion strength	10	

Time of explosion [s]	Distance to centre of mass [m]	Distance to explosion centre [m]	Distance to ignition point [m]	Flammable mass [kg]	Overpressures (input) [bar]	Distance to specified overpressures [m]
0.658782	5.23073	10	10	0.58765	0,02068 0,1379 0,2068	46,4626 17,0868 15,3134
1.678	9.08596	20	20	2.9569	0,02068 0,1379 0,2068	82,4818 32,1438 29,1049
5.07749	13.3358	30	30	11.9918	0,02068 0,1379 0,2068	129,641 49,3658 44,5198
10.112	17.8504	40	40	32.9706	0,02068 0,1379 0,2068	179,589 67,13 60,341
15.5946	21.2333	50	50	57.3304	0,02068 0,1379 0,2068	217,856 82,6239 74,4602
21.2259	24.0986	60	60	82.1926	0,02068 0,1379 0,2068	249,272 96,7862 87,5809
27.2518	27.2131	70	70	114.106	0,02068 0,1379 0,2068	281,143 111,037 100,768
35.4818	31.8644	80	80	178.986	0,02068 0,1379 0,2068	325,328 127,681 115,75
48.9494	31.6056	90	90	349.542	0,02068 0,1379 0,2068	396,649 149,599 134,685
64.8832	34.3809	100	100	510.52	0,02068 0,1379 0,2068	447,92 167,621 150,699
82.9018	41.4889	110	110	546.587	0,02068 0,1379 0,2068	465,927 179,177 161,866
100.92	48.5969	120	120	582.655	0,02068 0,1379 0,2068	483,59 190,666 172,983

Weather: Category 5/D

Explosion location criterion	Cloud front (LFL fraction)	
Explosion height criterion	Centreline height	
Explosion method	Multi-Energy: Uniform confined	
Uniform confined method explosion efficiency	12.5	%
Uniform confined method explosion strength	10	

Time of explosion [s]	Distance to centre of mass [m]	Distance to explosion centre [m]	Distance to ignition point [m]	Flammable mass [kg]	Overpressures (input) [bar]	Distance to specified overpressures [m]
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					0,02068 0,1379 0,2068	48,941 17,5684 15,6745
0.543088	6.20124	10	10	0.715807	0,02068 0,1379 0,2068	83,6929 32,3791 29,2814
1.38045	10.9878	20	20	3.13219	0,02068 0,1379 0,2068	131,646 49,7556 44,812
3.28755	17.0617	30	30	12.7305	0,02068 0,1379 0,2068	188,286 68,8203 61,6084
6.12328	24.4459	40	40	39.5251	0,02068 0,1379 0,2068	232,874 85,5427 76,6486
9.65655	30.0959	50	50	74.1361	0,02068 0,1379 0,2068	264,469 99,7399 89,7955
13.7224	33.4195	60	60	103.623	0,02068 0,1379 0,2068	287,001 112,176 101,622
18.3776	34.2537	70	70	123.868	0,02068 0,1379 0,2068	308,313 124,374 113,27
24.2535	34.5477	80	80	144.267	0,02068 0,1379 0,2068	336,648 137,938 125,942
35.0129	33.8744	90	90	181.889	0,02068 0,1379 0,2068	

DNV

Audit Number: 341
Date: 15/12/2023 Time: 08:53

Jet Fire
Workspace: pm_rev1
Study: Study
Equipment Item: T2C
pm_rev1\Study\T2C

Material	ISOBUTANE	
East		0 m
North		0 m

Scenario (Leak) : T2-2"leak vertical
pm_rev1\Study\T2C\T2-2"leak vertical
Weather: Category 2/F

Wind speed [m/s]	2
Pasquill stability	F stable - night with moderate clouds and light/moderate wind
Atmospheric temperature [degC]	20
Relative humidity [fraction]	0.7
Solar radiation flux [kW/m2]	0.5

Jet fire model results

INPUT DATA

Scenario	
Elevation	1 m
Release angle from horizontal	0 deg

Jet Fire Parameters

Jet fire method	Cone model
Wind orientation about the z-axis (anti-clockwise from the East)	0 deg
Rotation about the z-axis (anti-clockwise from the east)	0 deg
Rate modification factor	3

Calculated inputs

Mass flow rate	37.7158 kg/s
Temperature after atmospheric expansion	-11.9098 degC
Liquid fraction	0.821228 fraction
Velocity after atmospheric expansion (input)	134.838 m/s
Rainout fraction time averaged	0.821228 fraction

OUTPUT DATA

Flame emissive power	262.786 kW/m2
Fraction of emissivity	0.409014 fraction
Jet velocity	134.838 m/s
Flame length	65.8752 m
Frustum length	64.887 m
Frustum base width	0.710713 m
Frustum tip width	21.6319 m
Frustum lift-off distance	0.988127 m
Flame length in still air	59.2385 m
Hole to flame angle	0 deg
Expanded diameter	0.152092 m
Plane angular rotation	0 deg

Flame on ground impingement with partial truncation

Radiation Intensity Ellipse Results

INPUT DATA

For ellipses 'observer direction' refers to whether inclination is 'fixed' or 'variable'. Orientation is always variable.

Observer direction	Variable
Exposure duration	20 s
Height of interest	1 m

OUTPUT DATA

Radiation intensity

Incident radiation [kW/m2]	Lethality [%]	View factor	Probit	Dose [(W/m2)^ProbitN.s]	Ellipse half-length [m]	Ellipse half-width [m]	Ellipse centre downwind distance [m]	Effect downwind distance [m]	Ellipse area [m2]
3	0	0.0114161	-1.38321	865119	84.0322	112.378	0	112.378	29667.2
5	0.000174704	0.0190269	0.360367	1709491	67.1644	86.9009	0	86.9009	18336.4
7	0.02405	0.0266377	1.50883	2677313	60.2417	73.8279	0	73.8279	13972.3
12.5	6.52536	0.0475673	3.48789	5800162	52.2011	56.8191	0	56.8191	9318.03

Radiation v Distance Results

INPUT DATA

Maximum distance	146.924 m
Observer type radiation modelling flag	Planar
Observer direction	Variable
Height of interest	1 m

OUTPUT DATA

Downwind distance [m]	Maximum incident radiation [kW/m2]	Lethality level [fraction]
-58.368	28.6274	0.905951
-55.3696	262.786	1
-52.3711	262.786	1
-49.3727	262.786	1
-46.3742	262.786	1
-43.3758	262.786	1
-40.3773	262.786	1
-37.3789	262.786	1
-34.3804	262.786	1
-31.382	262.786	1
-28.3835	262.786	1
-25.3851	262.786	1
-22.3866	262.786	1
-19.3882	262.786	1



-16.3897	262.786	1
-13.3912	262.786	1
-10.3928	262.786	1
-7.39435	262.786	1
-4.39589	262.786	1
-1.39744	262.786	1
1.60101	262.786	1
4.59946	262.786	1
7.59791	262.786	1
10.5964	136.814	1
13.5948	91.1867	1
16.5933	67.6511	0.999989
19.5917	56.0751	0.999847
22.5902	45.2922	0.998025
25.5886	36.9751	0.989724
28.5871	30.5097	0.937435
31.5855	25.4442	0.819612
34.584	21.4383	0.62899
37.5824	18.2389	0.411968
40.5809	15.6583	0.228681
43.5793	13.5558	0.108352
46.5778	11.8259	0.044417
49.5762	10.3907	0.0160595
52.5747	9.1892	0.00519817
55.5731	8.17512	0.00153088
58.5716	7.31305	0.000416179
61.57	6.57494	0.00010573
64.5685	5.93887	2.53736E-05
67.5669	5.3874	5.80615E-06
70.5654	4.90658	1.27701E-06
73.5638	4.48515	2.71826E-07
76.5623	4.11395	5.63305E-08
79.5607	3.78549	1.14224E-08
82.5592	3.49361	0
85.5577	3.23317	0
88.5561	2.99992	0

Weather: Category 5/D

Wind speed [m/s]	5
Pasquill stability	D neutral - little sun and high wind or overcast/windy night
Atmospheric temperature [degC]	20
Relative humidity [fraction]	0.7
Solar radiation flux [kW/m2]	0.5

Jet fire model results

INPUT DATA

Scenario

Elevation	1 m
Release angle from horizontal	0 deg

Jet Fire Parameters

Jet fire method	Cone model
Wind orientation about the z-axis (anti-clockwise from the East)	0 deg
Rotation about the z-axis (anti-clockwise from the east)	0 deg
Rate modification factor	3

Calculated inputs

Mass flow rate	37.7158 kg/s
Temperature after atmospheric expansion	-11.9098 degC
Liquid fraction	0.821228 fraction
Velocity after atmospheric expansion (input)	134.838 m/s
Rainout fraction time averaged	0.821228 fraction

OUTPUT DATA

Flame emissive power	346.809 kW/m2
Fraction of emissivity	0.409014 fraction
Jet velocity	134.838 m/s
Flame length	51.2066 m
Frustum length	50.4385 m
Frustum base width	1.20756 m
Frustum tip width	20.0185 m
Frustum lift-off distance	0.768098 m
Flame length in still air	59.2385 m
Hole to flame angle	0 deg
Expanded diameter	0.152092 m
Plane angular rotation	0 deg

Flame on ground impingement with partial truncation

Radiation Intensity Ellipse Results

INPUT DATA

For ellipses 'observer direction' refers to whether inclination is 'fixed' or 'variable'. Orientation is always variable.

Observer direction	Variable	20 s
Exposure duration		1 m
Height of interest		

OUTPUT DATA

Radiation intensity

Incident radiation [kW/m2]	Lethality [%]	View factor	Probit	Dose [(W/m2)^ProbitN.s]	Ellipse half-length [m]	Ellipse half-width [m]	Ellipse centre downwind distance [m]	Effect downwind distance [m]	Ellipse area [m2]
3	0	0.00865029	-1.38321	865119	88.6146	112.751	0	112.751	31388.9
5	0.000174704	0.0144171	0.360367	1709491	69.4697	87.3491	0	87.3491	19063.5
7	0.02405	0.020184	1.50883	2677313	59.4903	73.692	0	73.692	13772.6
12.5	6.52536	0.0360429	3.48789	5800162	47.9005	55.3849	0	55.3849	8334.53

Radiation v Distance Results

INPUT DATA

Maximum distance	137.351 m
Observer type radiation modelling flag	Planar
Observer direction	Variable
Height of interest	1 m



OUTPUT DATA		
Downwind distance [m]	Maximum incident radiation [kW/m²]	Lethality level [fraction]
-47.2563	128.313	1
-44.4532	346.809	1
-41.6501	346.809	1
-38.847	346.809	1
-36.0439	346.809	1
-33.2408	346.809	1
-30.4378	346.809	1
-27.6347	346.809	1
-24.8316	346.809	1
-22.0285	346.809	1
-19.2254	346.809	1
-16.4223	346.809	1
-13.6193	346.809	1
-10.8162	346.809	1
-8.01309	346.809	1
-5.21	346.809	1
-2.40692	346.809	1
0.396166	346.809	1
3.19925	346.809	1
6.00233	242.868	1
8.80542	134.268	1
11.6085	99.2233	1
14.4116	78.2691	0.999999
17.2147	63.0536	0.99997
20.0178	51.1322	0.99951
22.8208	41.9476	0.995607
25.6239	34.8077	0.976341
28.427	29.1999	0.916794
31.2301	24.7482	0.793672
34.0332	21.1758	0.612988
36.8363	18.2791	0.414895
39.6393	15.9063	0.245236
42.4424	13.9436	0.127336
45.2455	12.3064	0.0587469
48.0486	10.9287	0.0243824
50.8517	9.76052	0.00922436
53.6548	8.76271	0.00321931
56.4578	7.90466	0.00104795
59.2609	7.16218	0.000321318
62.064	6.51594	9.36039E-05
64.8671	5.95043	2.61034E-05
67.6702	5.45306	7.01463E-06
70.4733	5.01356	1.82683E-06
73.2764	4.62347	4.63384E-07
76.0794	4.27581	1.14976E-07
78.8825	3.96478	2.80113E-08
81.6856	3.68549	0
84.4887	3.43385	0
87.2918	3.20634	0
90.0949	3.00014	0



Audit Number: 341
Date: 15/12/2023 Time: 08:53

Early Pool Fire Report

Workspace: pm_rev1

Study: Study

Equipment Item: T2C

pm_rev1\Study\T2C

Material	ISOBUTANE	
East		0 m
North		0 m

Scenario (Leak) : T2-2"leak vertical

pm_rev1\Study\T2C\T2-2"leak vertical

Weather: Category 2/F

Wind speed [m/s]

Pasquill stability

Atmospheric temperature [degC]

Relative humidity [fraction]

Solar radiation flux [kW/m2]

2
F stable - night with moderate clouds and light/moderate wind
20
0.7
0.5

Pool fire model results

Early pool fires are assumed to occur at a time when the initial PVAP rainout rate equals the pool fire burn rate, unless the thus calculated pool fire radius exceeds the maximum PVAP pool radius. For the latter case the early pool fire radius is assumed to be the maximum PVAP pool radius. The pool fire centre is located at the rainout point.

INPUT DATA

Correlation Type: Thomas / Johnson

Surface type	Land	
Pool fire elevation		0 m
Maximum exposure duration		20 s
Downwind distance of liquid rainout		0 m
Use two zone pool fire model	Yes	

OUTPUT DATA

Pool fire diameter	24.7541	m
Downwind distance of pool fire centre	0	m
Pool fire flame length	47.8764	m
Angle between pool fire axis and vertical	28.5499	deg
Luminous flame emissive power	169.979	kW/m2
Smoky flame emissive power	0	kW/m2
Ratio of luminous flame length to the total flame length	1	fraction
Total burn rate	57.7518	kg/s
Radiative fraction	0.271611	fraction

Radiation Intensity Ellipse Results

INPUT DATA

For ellipses 'observer direction' refers to whether inclination is 'fixed' or 'variable'. Orientation is always variable.

Observer direction	Variable	
Exposure duration		20 s
Height of interest		1 m

OUTPUT DATA

Radiation intensity

Incident radiation [kW/m2]	Lethality [%]	View factor	Probit	Dose [(W/m2)^ProbitN.s]	Hazard information	Ellipse half-length [m]	Ellipse half-width [m]	Ellipse centre downwind distance [m]	Effect downwind distance [m]	Ellipse area [m2]
3	0	0.0176492	-1.38321	865119	-	115.938	118.514	16.1324	132.07	43166.4
5	0.000174704	0.360367	0.0294154	1709491	-	90.1938	91.9821	15.8498	106.044	26063.3
7	0.02405	0.0411815	1.50883	2677313	-	76.3795	77.3147	15.8549	92.2344	18551.9
12.5	6.52536	0.0735385	3.48789	5800162	-	56.5222	56.0565	15.1789	71.701	9953.93

Radiation v Distance Results

INPUT DATA

Maximum distance	132.07	m
Angle from wind direction	0	deg
Observer direction	Variable	
Height of interest	1	m

OUTPUT DATA

Downwind distance [m]	Maximum incident radiati	Lethality level [fraction]
0	169.979	1
2.69531	169.979	1
5.39061	169.979	1
8.08592	169.979	1
10.7812	169.979	1
13.4765	144.502	1
16.1718	101.84	1
18.8672	82.677	1
21.5625	70.533	0.999994
24.2578	61.8643	0.99996
26.9531	55.1591	0.999811



29.6484	49.7047	0.999311
32.3437	45.2	0.997981
35.039	41.466	0.995072
37.7343	37.9883	0.988752
40.4296	34.7221	0.975868
43.1249	31.7253	0.952238
45.8202	28.9858	0.91288
48.5155	26.4849	0.853306
51.2108	24.2044	0.771377
53.9061	22.1276	0.669016
56.6015	20.2393	0.552799
59.2968	18.525	0.432756
61.9921	16.9708	0.319732
64.6874	15.5635	0.222458
67.3827	14.2904	0.145663
70.078	13.1392	0.0898172
72.7733	12.0985	0.0522383
75.4686	11.1577	0.0287258
78.1639	10.3066	0.0149785
80.8592	9.53639	0.00742996
83.5545	8.83861	0.00351805
86.2498	8.20578	0.00159559
88.9451	7.63115	0.000695566
91.6405	7.10865	0.000292416
94.3358	6.63287	0.000118933
97.0311	6.19896	4.69418E-05
99.7264	5.80263	1.80309E-05
102.422	5.44002	6.75824E-06
105.117	5.10775	2.47791E-06
107.812	4.80277	8.90787E-07
110.508	4.5224	3.14642E-07
113.203	4.2792	1.1665E-07
115.898	4.05482	4.29153E-08
118.594	3.8464	1.5607E-08
121.289	3.65256	0
123.984	3.47207	0
126.679	3.3038	0
129.375	3.14675	0
132.07	2.99999	0

Weather: Category 5/D	
Wind speed [m/s]	5
Pasquill stability	D neutral - little sun and high wind or overcast/windy night
Atmospheric temperature [degC]	20
Relative humidity [fraction]	0.7
Solar radiation flux [kW/m2]	0.5

Pool fire model results

Early pool fires are assumed to occur at a time when the initial PVAP rainout rate equals the pool fire burn rate, unless the thus calculated pool fire radius exceeds the maximum PVAP pool radius. For the latter case the early pool fire radius is assumed to be the maximum PVAP pool radius. The pool fire centre is located at the rainout point.

INPUT DATA

Correlation Type: Thomas / Johnson		
Surface type	Land	
Pool fire elevation	0	m
Maximum exposure duration	20	s
Downwind distance of liquid rainout	0	m
Use two zone pool fire model	Yes	

OUTPUT DATA

Pool fire diameter	24.7541	m
Downwind distance of pool fire centre	0	m
Pool fire flame length	47.8764	m
Angle between pool fire axis and vertical	46.1126	deg
Luminous flame emissive power	169.979	kW/m2
Smoky flame emissive power	0	kW/m2
Ratio of luminous flame length to the total flame length	1	fraction
Total burn rate	57.7518	kg/s
Radiative fraction	0.271611	fraction

Radiation Intensity Ellipse Results

INPUT DATA

For ellipses 'observer direction' refers to whether inclination is 'fixed' or 'variable'. Orientation is always variable.

Observer direction	Variable	
Exposure duration	20	s
Height of interest	1	m

OUTPUT DATA

Radiation intensity										
Incident radiation [kW/m2]	Lethality [%]	View factor	Probit	Dose [(W/m2)^ProbitN.s]	Hazard information	Ellipse half-length [m]	Ellipse half-width [m]	Ellipse centre downwind distance [m]	Effect downwind distance [m]	Ellipse area [m2]
3	0	0.0176492	-1.38321	865119	-	110.457	116.786	24.1428	134.6	40526
5	0.000174704	0.0294154	1.709491	1709491	-	87.0058	91.4776	23.7135	110.719	25004.2
7	0.02405	0.0411815	1.50883	2677313	-	74.2162	77.5456	23.2016	97.4178	18080.3
12.5	6.52536	0.0735385	3.48789	5800162	-	56.0104	57.4805	21.5633	77.5736	10114.4

Radiation v Distance Results

INPUT DATA



Maximum distance	134.6	m
Angle from wind direction	0	deg
Observer direction	Variable	
Height of interest	1	m

OUTPUT DATA

Downwind distance [m]	Maximum incident radiati	Lethality level [fraction]
0	169.979	1
2.74693	169.979	1
5.49387	169.979	1
8.2408	169.979	1
10.9877	169.979	1
13.7347	169.979	1
16.4816	108.344	1
19.2285	91.6987	1
21.9755	80.6022	0.999999
24.7224	72.5978	0.999996
27.4693	65.4801	0.999983
30.2163	60.3199	0.999943
32.9632	55.3248	0.999818
35.7101	51.4077	0.999541
38.4571	47.963	0.998957
41.204	44.7386	0.997745
43.9509	42.0204	0.995683
46.6979	39.6662	0.992438
49.4448	36.8031	0.985136
52.1917	33.5981	0.968749
54.9387	30.4312	0.936345
57.6856	27.4203	0.878837
60.4325	24.6236	0.788723
63.1795	22.0682	0.665683
65.9264	19.7619	0.520442
68.6733	17.6994	0.3726
71.4203	15.8669	0.242584
74.1672	14.2463	0.143267
76.9141	12.817	0.0768442
79.6611	11.6993	0.0411012
82.408	10.7599	0.0214968
85.1549	9.90892	0.0105838
87.9019	9.13928	0.00492642
90.6488	8.44355	0.00217771
93.3957	7.81455	0.000918394
96.1427	7.24553	0.000371149
98.8896	6.73024	0.000144345
101.637	6.26302	5.42412E-05
104.383	5.83875	1.97672E-05
107.13	5.45285	7.01035E-06
109.877	5.10125	2.42705E-06
112.624	4.78033	8.22632E-07
115.371	4.48688	2.73686E-07
118.118	4.21806	8.95871E-08
120.865	3.97136	2.89141E-08
123.612	3.74455	9.21895E-09
126.359	3.53567	0
129.106	3.34296	0
131.853	3.16486	0
134.6	3.00001	0



Audit Number: 341
Date: 15/12/2023 Time: 08:52

Consequence Summary Report

Workspace: pm_rev1

Study: Study

Summary Basis

These tables will only report global values set in the parameters. Values that are modified in the study tree will not be reported.
The report is context sensitive, and filters up to the study level. You will need to generate multiple summary reports if you have multiple studies in your workspace.
The results in this report are from the non-CFD calculations only.

Discharge Results (after atmospheric expansion)

Path	Scenario	Weather	Peak Flowrate [kg/s]	Temperature [degC]	Liquid mass fraction in material [fraction]	Droplet diameter [um]	Expanded diameter [m]	Velocity [m/s]	End time of release [s]
Study\T2C	T2-2"leak vertical	Category 2/F	70.3237	-11.9098	0.821228	172.858	0.20768	134.838	39.6645
		Category 5/D	70.3237	-11.9098	0.821228	172.858	0.20768	134.838	39.6645

Dispersion Results

Input dispersion parameters

Core averaging time	18.75 s
Flammable averaging time	18.75 s
Toxic averaging time	600 s
Height of interest	1 m

Distance downwind to defined concentrations

The reported concentration of interest is defined at the scenario

Path	Scenario	Weather	Distance to UFL [m]	Distance to LFL [m]	Distance to LFL fraction [m]
Study\T2C	T2-2"leak vertical	Category 2/F	21.4068	77.5969	136.029
		Category 5/D	n/a	64.2015	94.2991

Jet Fire Results

Distance downwind to defined radiation levels

The reported radiations are defined in the parameters

Path	Scenario	Weather	Flame length [m]	Distance downwind to intensity level 1 (3 kW/m2) [m]	Distance downwind to intensity level 2 (5 kW/m2) [m]	Distance downwind to intensity level 3 (7 kW/m2) [m]	Distance downwind to intensity level 4 (12,5 kW/m2) [m]
Study\T2C	T2-2"leak vertical	Category 2/F	65.8752	112.378	86.9009	73.8279	56.8191
		Category 5/D	51.2066	112.751	87.3491	73.692	55.3849

Early Pool Fire Results

Distance downwind to defined radiation levels

The reported radiations are defined in the parameters

Path	Scenario	Weather	Pool diameter [m]	Distance downwind to intensity level 1 (3 kW/m2) [m]	Distance downwind to intensity level 2 (5 kW/m2) [m]	Distance downwind to intensity level 3 (7 kW/m2) [m]	Distance downwind to intensity level 4 (12,5 kW/m2) [m]
Study\T2C	T2-2"leak vertical	Category 2/F	24.7541	132.07	106.044	92.2344	71.701
		Category 5/D	24.7541	134.6	110.719	97.4178	77.5736

Late Pool Fire Results

Distance downwind to defined radiation levels

The reported radiations are defined in the parameters

Path	Scenario	Weather	Pool diameter [m]	Distance downwind to intensity level 1 (3 kW/m2) [m]	Distance downwind to intensity level 2 (5 kW/m2) [m]	Distance downwind to intensity level 3 (7 kW/m2) [m]	Distance downwind to intensity level 4 (12,5 kW/m2) [m]
Study\T2C	T2-2"leak vertical	Category 2/F	28.7987	148.811	119.566	103.92	80.6845
		Category 5/D	28.635	151.118	124.188	109.186	86.9512

Flash Fire Results

Distance downwind to defined concentrations

The reported LFL and LFL fraction are defined in the respective material property

Path	Scenario	Weather	Distance downwind to LFL [m]	Distance downwind to LFL Fraction [m]
Study\T2C	T2-2"leak vertical	Category 2/F	77.5969	136.029
		Category 5/D	64.2015	94.2991

Maximum distance to LFL fraction at any height

Path	Scenario	Weather	Max flash fire distance [m]	Height of the max flash fire distance	Time [s]
Study\T2C	T2-2"leak vertical	Category 2/F	128.221	0	115.733
		Category 5/D	94.6043	0	61.4224

Explosion Results

Explosion scenarios for worst-case maximum downwind distance to defined overpressures.

The reported overpressures are defined in the explosion parameters

Path	Scenario	Weather	Overpressure level [bar]	Maximum distance [m]	Diameter [m]
Study\T2C	T2-2"leak vertical	Category 2/F	0,02068	483,59	727,18
			0,1379	190,666	141,332
			0,2068	172,983	105,966
		Category 5/D	0,02068	336,648	493,296
			0,1379	137,938	95,8753
			0,2068	125,942	71,8837

Supplementary data for worst-case explosion scenarios

Path	Scenario	Weather	Overpressure level [bar]	Explosion flammable mass [kg]	Ignition time [s]	Ignition source [m]	Cloud centre [m]	Explosion centre [m]
Study\T2C	T2-2"leak vertical	Category 2/F	0,02068	582,655	100,92	120	48,5969	120
			0,1379	582,655	100,92	120	48,5969	120
			0,2068	582,655	100,92	120	48,5969	120
		Category 5/D	0,02068	181,889	35,0129	90	33,8744	90
			0,1379	181,889	35,0129	90	33,8744	90
			0,2068	181,889	35,0129	90	33,8744	90



Audit Number: 341
Date: 15/12/2023 Time: 08:54

Discharge Report

Workspace: pm_rev1

Study: Study

Equipment Item: T2D

pm_rev1\Study\T2D

Material	ISOBUTANE	
East	0	m
North	0	m

Scenario (Leak) : T2-2"leak vertical

pm_rev1\Study\T2D\T2-2"leak vertical

Weather: Category 2/F

INPUT DATA

Inventory data

Mass in vessel	2789.35	kg
----------------	---------	----

Stagnation Data (upstream end for long pipe)

Initial pressure (gauge)	13.3	bar
Initial temperature	20	degC
Fluid state	Non-saturated liquid	

Scenario data

Phase to be released	Liquid	
Tank head	0	m
Hole diameter	50.8	mm

OUTPUT DATA

Mass flow rate	48.5092	kg/s
Release duration	57.5015	s

Orifice or pipe exit data (before atmospheric expansion)

Pressure	1.01325	bar
Temperature	19.2002	degC
Liquid mass fraction	1	fraction
Velocity at vena contracta (at exit for pipe releases)	71.378	m/s
Discharge coefficient	0.6	

Final Data (after atmospheric expansion)

Temperature	-11.9098	degC
Liquid mass fraction	0.816363	fraction
Droplet diameter	199.167	um
Expanded diameter	0.189951	m
Velocity	114.132	m/s

Weather: Category 5/D

INPUT DATA

Inventory data

Mass in vessel	2789.35	kg
----------------	---------	----

Stagnation Data (upstream end for long pipe)

Initial pressure (gauge)	13.3	bar
Initial temperature	20	degC
Fluid state	Non-saturated liquid	

Scenario data

Phase to be released	Liquid	
Tank head	0	m
Hole diameter	50.8	mm

OUTPUT DATA

Mass flow rate	48.5092	kg/s
Release duration	57.5015	s

Orifice or pipe exit data (before atmospheric expansion)

Pressure	1.01325	bar
Temperature	19.2002	degC
Liquid mass fraction	1	fraction
Velocity at vena contracta (at exit for pipe releases)	71.378	m/s
Discharge coefficient	0.6	

Final Data (after atmospheric expansion)

Temperature	-11.9098	degC
Liquid mass fraction	0.816363	fraction
Droplet diameter	199.167	um
Expanded diameter	0.189951	m
Velocity	114.132	m/s



Date: 15/12/2023 Time: 08:55

Workspace: pm rev1

Equipment Item: T2D

pm_rev1\Study\T2D

Material	ISOBTANE	
East	0	m
North	0	m

pm_rev1\Study\T2D\T2-2"leak vertical

Weather: Category 2/F

Explosion location criterion	Cloud front (LFL fraction)	
Explosion height criterion	Centreline height	
Explosion method	Multi-Energy: Uniform conf	
Uniform confined method explosion efficiency		12.5 %
Uniform confined method explosion strength		10

Time of explosion [s]	Distance to centre of mass [m]	Distance to explosion centre [m]	Distance to ignition point [m]	Flammable mass [kg]	Overpressures (input) [bar]	Distance to specified overpressures [m]
					0,02068 0,1379 0,2068	45,147 16,8311 15,1217
0.760285	5.09177	10	10	0.526309	0,02068 0,1379 0,2068	80,4188 31,7428 28,8043
2.37546	8.46757	20	20	2.67357	0,02068 0,1379 0,2068	130,405 49,5144 44,6311
6.93063	13.2778	30	30	12.2698	0,02068 0,1379 0,2068	174,663 66,1727 59,6233
12.5315	17.1812	40	40	29.602	0,02068 0,1379 0,2068	212,129 81,5109 73,6257
18.9566	20.5744	50	50	51.6607	0,02068 0,1379 0,2068	244,84 95,9249 86,9351
26.3106	23.2188	60	60	76.5531	0,02068 0,1379 0,2068	288,869 112,539 101,894
38.0029	29.0743	70	70	127.094	0,02068 0,1379 0,2068	331,072 128,798 116,587
53.1736	32.0337	80	80	191.854	0,02068 0,1379 0,2068	390,279 148,361 133,757
69.5991	32.7932	90	90	328.209	0,02068 0,1379 0,2068	444,068 166,872 150,138
86.4271	36.8448	100	100	493.751	0,02068 0,1379 0,2068	488,879 183,638 165,211
103.255	40.8965	110	110	659.292	0,02068 0,1379 0,2068	

Explosion location criterion

Explosion location criterion	Cloud front (LFL fraction)	
Explosion height criterion	Centreline height	
Explosion method	Multi-Energy: Uniform conf	
Uniform confined method explosion efficiency		12.5 %
Uniform confined method explosion strength		10

Time of explosion [s]	Distance to centre of mass [m]	Distance to explosion centre [m]	Distance to ignition point [m]	Flammable mass [kg]	Overpressures (input) [bar]	Distance to specified overpressures [m]
0.623677	5.92821	10	10	0.593278	0,02068 0,1379 0,2068	46,5786 17,1093 15,3303
1.86902	10.878	20	20	3.39926	0,02068 0,1379 0,2068	85,454 32,7214 29,538
4.29272	18.271	30	30	16.6686	0,02068 0,1379 0,2068	141,201 51,6126 46,2043
7.68999	24.4227	40	40	40.2466	0,02068 0,1379 0,2068	189,182 68,9946 61,7391
11.8246	27.8308	50	50	61.6309	0,02068 0,1379 0,2068	221,952 83,4201 75,0571
16.5329	28.9087	60	60	76.0832	0,02068 0,1379 0,2068	244,461 95,8512 86,8799
24.2101	28.934	70	70	94.5064	0,02068 0,1379 0,2068	268,287 108,539 98,8947
43.1948	28.3767	80	80	139.978	0,02068 0,1379 0,2068	306,028 123,93 112,937



DNV

Audit Number: 341
Date: 15/12/2023 Time: 08:54

Jet Fire
Workspace: pm_rev1
Study: Study
Equipment Item: T2D
pm_rev1\Study\T2D

Material	ISOBUTANE
East	0 m
North	0 m

Scenario (Leak) : T2-2"leak vertical
pm_rev1\Study\T2D\T2-2"leak vertical

Weather: Category 2/F

Wind speed [m/s]
Pasquill stability
Atmospheric temperature [degC]
Relative humidity [fraction]
Solar radiation flux [kW/m2]

F stable - night with moderate clouds and light/moderate wind
2
20
0.7
0.5

Jet fire model results

INPUT DATA

Scenario

Elevation	1 m
Release angle from horizontal	0 deg

Jet Fire Parameters

Jet fire method	Cone model
Wind orientation about the z-axis (anti-clockwise from the East)	0 deg
Rotation about the z-axis (anti-clockwise from the east)	0 deg
Rate modification factor	3

Calculated inputs

Mass flow rate	26.7242 kg/s
Temperature after atmospheric expansion	-11.9098 degC
Liquid fraction	0.816363 fraction
Velocity after atmospheric expansion (input)	114.132 m/s
Rainout fraction time averaged	0.816363 fraction

OUTPUT DATA

Flame emissive power	239.404 kW/m2
Fraction of emissivity	0.424647 fraction
Jet velocity	114.132 m/s
Flame length	58.1108 m
Frustum length	52.2392 m
Frustum base width	0.716988 m
Frustum top width	15.6497 m
Frustum lift-off distance	0.871662 m
Flame length in still air	52.2563 m
Hole to flame angle	0 deg
Expanded diameter	0.140988 m
Plane angular rotation	0 deg

Flame on ground impingement with partial truncation

Radiation Intensity Ellipse Results

INPUT DATA

For ellipses 'observer direction' refers to whether inclination is 'fixed' or 'variable'. Orientation is always variable.

Observer direction	Variable
Exposure duration	20 s
Height of interest	1 m

OUTPUT DATA

Radiation intensity

Incident radiation [kW/m2]	Lethality [%]	View factor	Probit	Dose [(W/m2)*Probit^n]	Ellipse half-length [m]	Ellipse half-width [m]	Ellipse centre downwind distance [m]	Effect downwind distance [m]	Ellipsoid area [m2]
3	0	0.0125311	-1.38321	865119	73.3201	96.8706	0	96.8706	22313.3
5	0.000174704	0.0208852	0.360367	1799494	58.2396	74.9021	0	74.9021	13822.1
7	0.02405	0.0292392	1.02883	2677313	52.8108	63.6581	0	63.6581	10565.5
12.5	6.52536	0.0522129	3.48789	5800162	45.7783	49.0371	0	49.0371	7052.36

Radiation v Distance Results

INPUT DATA

Maximum distance	128.725 m
Observer type radiation modelling flag	Planar
Observer direction	Variable
Height of interest	1 m

OUTPUT DATA

Downwind distance [m]	Maximum incident radiation [kW/m2]	Lethality level [fraction]
-51.2096	33.152	0.965399
-48.5825	239.404	1
-45.9555	239.404	1
-43.3284	239.404	1
-40.7014	239.404	1
-38.0743	239.404	1
-35.4473	239.404	1
-32.8202	239.404	1
-30.1932	239.404	1
-27.5661	239.404	1
-24.9391	239.404	1
-22.312	239.404	1
-19.686	239.404	1
-17.0579	239.404	1
-14.4309	239.404	1
-11.8038	239.404	1
-9.17679	239.404	1
-6.54974	239.404	1
-3.92269	239.404	1
-1.29564	239.404	1
1.33141	239.404	1
3.95846	239.404	1
6.58521	239.404	1
9.21256	149.598	1
11.8396	99.8763	1
14.4667	64.5851	0.999991
17.0937	54.8782	0.999798
19.7208	44.7214	0.997236
22.3478	35.6242	0.984493
24.9749	30.2909	0.943354
27.6019	24.3081	0.814764
30.229	21.3534	0.623859
32.856	18.386	0.498116
35.4831	15.625	0.226489
38.1101	13.5351	0.107383
40.7372	11.8136	0.0441095
43.3642	10.3829	0.0159562
45.9913	9.18456	0.00512243
48.6183	8.17248	0.0015254
51.2454	7.31167	0.000415213
53.8724	6.57434	0.000105598
56.4995	5.93972	2.53544E-05
59.1265	5.38751	5.80794E-06
61.7536	4.90682	1.27802E-06
64.3806	4.48543	2.72127E-07
67.0077	4.11423	5.64022E-08
69.6347	3.78574	1.14373E-08
72.2618	3.49382	0
74.8888	3.23333	0
77.5159	3.00003	0

Weather: Category 5/D

Wind speed [m/s]
Pasquill stability
Atmospheric temperature [degC]
Relative humidity [fraction]
Solar radiation flux [kW/m2]

D neutral - little sun and high wind or overcast/windy night
5
20
0.7
0.5

Jet fire model results

INPUT DATA

Scenario

Elevation	1 m
Release angle from horizontal	0 deg

Jet Fire Parameters

Jet fire method	Cone model
Wind orientation about the z-axis (anti-clockwise from the East)	0 deg
Rotation about the z-axis (anti-clockwise from the east)	0 deg
Rate modification factor	3

Calculated inputs

Mass flow rate	26.7242 kg/s
Temperature after atmospheric expansion	-11.9098 degC
Liquid fraction	0.816363 fraction
Velocity after atmospheric expansion (input)	114.132 m/s
Rainout fraction time averaged	0.816363 fraction

OUTPUT DATA

Flame emissive power	314.525 kW/m2
Fraction of emissivity	0.424647 fraction
Jet velocity	114.132 m/s
Flame length	45.1211 m
Frustum length	44.4936 m
Frustum base width	1.20432 m
Frustum top width	18.2186 m
Frustum lift-off distance	0.672567 m
Flame length in still air	52.2563 m
Hole to flame angle	0 deg
Expanded diameter	0.140988 m
Plane angular rotation	0 deg

Flame on ground impingement with partial truncation

Radiation Intensity Ellipse Results

INPUT DATA



For ellipses 'observer direction' refers to whether inclination is 'fixed' or 'variable'. Orientation is always variable.

Observer direction	Variable
Exposure duration	20 s
Height of interest	1 m

OUTPUT DATA

Radiation intensity									
Incident radiation [kW/m2]	Lethality [%]	View factor	Probit	Dose [(W/m2)* ProbitN.s]	Ellipse half-length [m]	Ellipse half-width [m]	Ellipse centre x downwind distance [m]	Effect downwind distance [m]	Ellipse area [m2]
3	0	0.00953819	-1.38321	865119	72.2948	97.2187	0	97.2187	23607.5
5	0.000124704	0.0158972	0.360367	1709491	60.5797	75.252	0	75.252	14321.7
7	0.02405	0.0222558	1.50883	2677313	51.7263	63.3958	0	63.3958	10302
12.5	6.52536	0.0397424	3.48789	5800162	41.9701	47.7319	0	47.7319	6293.59

Radiation v Distance Results

INPUT DATA

Maximum distance	120.224 m
Observer type radiation modelling flag	Planar
Observer direction	Variable
Height of interest	1 m

OUTPUT DATA

Downwind distance [m]	Maximum incident radiation [kW/m2]	Lethality level (fraction)
-41.5529	135.364	1
-39.0994	314.525	1
-36.6458	314.525	1
-34.1923	314.525	1
-31.7387	314.525	1
-29.2851	314.525	1
-26.8316	314.525	1
-24.378	314.525	1
-21.9245	314.525	1
-19.4709	314.525	1
-17.0173	314.525	1
-14.5638	314.525	1
-12.1102	314.525	1
-9.65666	314.525	1
-7.2031	314.525	1
-4.74954	314.525	1
-2.29598	314.525	1
0.157882	314.525	1
2.61114	314.525	1
5.0647	266.461	1
7.51826	136.196	1
9.97182	96.9481	1
12.4254	76.5982	0.999999
14.8789	62.0619	0.999962
17.3325	50.5036	0.999431
19.7861	41.5455	0.995165
22.2396	34.5477	0.974876
24.6932	29.0296	0.913693
27.1467	24.6352	0.789187
29.6003	21.0997	0.608279
32.0539	18.2274	0.411128
34.5074	15.8707	0.242837
36.961	13.9186	0.126965
39.4145	12.2889	0.0581786
41.8681	10.9164	0.0241634
44.3217	9.75153	0.00914659
46.7752	8.7562	0.00319465
49.2288	7.89989	0.00104071
51.6823	7.11862	0.00031939
54.1359	6.5133	9.30905E-05
56.5895	5.94844	2.19781E-05
59.043	5.45154	6.98417E-06
61.4966	5.01238	1.81976E-06
63.9501	4.62255	4.61779E-07
66.4037	4.27508	1.14619E-07
68.8573	3.96419	2.79329E-08
71.3108	3.68502	0
73.7644	3.43348	0
76.2179	3.2061	0
78.6715	2.99994	0



Audit Number: 341
Date: 15/12/2023 Time: 08:55

Early Pool Fire Report
Workspace: pm_rev1
Study: Study
Equipment Item: T2D

pm_rev1\Study\T2D	
Material	ISOBUTANE
East	0 m
North	0 m

Scenario (Leak) : T2-2"leak vertical	
pm_rev1\Study\T2D\T2-2"leak vertical	
Weather: Category 2/F	2
Wind speed [m/s]	F stable - night with moderate clouds and light/moderate wind
Pasquill stability	20
Atmospheric temperature [degC]	0.7
Relative humidity [fraction]	0.5
Solar radiation flux [kW/m2]	

Pool fire model results

Early pool fires are assumed to occur at a time when the initial PVAP rainout rate equals the pool fire burn rate, unless the thus calculated pool fire radius exceeds the maximum PVAP pool radius. For the latter case the early pool fire radius is assumed to be the maximum PVAP pool radius. The pool fire centre is located at the rainout point.

INPUT DATA	
Correlation Type: Thomas / Johnson	
Surface type	Land
Pool fire elevation	0 m
Maximum exposure duration	20 s
Downwind distance of liquid rainout	0 m
Use two zone pool fire model	Yes

OUTPUT DATA	
Pool fire diameter	20.4983 m
Downwind distance of pool fire centre	0 m
Pool fire flame length	41.9933 m
Angle between pool fire axis and vertical	29.7352 deg
Luminous flame emissive power	169.902 kW/m2
Smoky flame emissive power	0 kW/m2
Ratio of luminous flame length to the total flame length	1 fraction
Total burn rate	39.6011 kg/s
Radiative fraction	0.285725 fraction

Radiation Intensity Ellipse Results

INPUT DATA	
For ellipses 'observer direction' refers to whether inclination is 'fixed' or 'variable'. Orientation is always variable.	
Observer direction	Variable
Exposure duration	20 s
Height of interest	1 m

OUTPUT DATA										
Radiation intensity										
Incident radiation [kW/m2]	Lethality [%]	View factor	Probit	Dose [(W/m2)^ProbitN.s]	Hazard information	Ellipse half-length [m]	Ellipse half-width [m]	Ellipse centre downwind distance [m]	Effect downwind distance [m]	Ellipse area [m2]
3	0	0.0176573	-1.38321	865119	-	99.1805	101.52	14.6089	113.789	31632.1
5	0.000174704	0.0294288	0.360367	1709491	-	77.0346	78.7076	14.2546	91.2892	19048.1
7	0.02405	0.0412003	1.50883	2677313	-	65.2286	66.0968	14.2509	79.4795	13544.7
12.5	6.52536	0.073572	3.48789	5800162	-	48.2873	47.8275	13.6085	61.8958	7255.39

Radiation v Distance Results

INPUT DATA	
Maximum distance	113.789 m
Angle from wind direction	0 deg
Observer direction	Variable
Height of interest	1 m

OUTPUT DATA		
Downwind distance [m]	Maximum incident radiation [kW/m2]	Lethality level (fraction)
0	169.902	1
2.32223	169.902	1
4.64446	169.902	1
6.9667	169.902	1
9.28893	169.902	1
11.6112	138.497	1
13.9334	100.823	1
16.2556	82.4173	1
18.5779	70.3238	0.999994
20.9001	61.7548	0.999959
23.2223	54.9732	0.999802
25.5445	49.6242	0.999298
27.8668	45.1845	0.997973
30.189	41.4383	0.99504
32.5112	38.0645	0.988953
34.8335	34.8421	0.976528
37.1557	31.8634	0.953693
39.4779	29.1299	0.915531
41.8002	26.6279	0.857488
44.1224	24.3417	0.777178
46.4446	22.2562	0.676156
48.7669	20.3573	0.56063
51.0891	18.6312	0.440442
53.4113	17.0649	0.326506



55.7336	15.6455	0.22784
58.0558	14.3608	0.149532
60.378	13.1987	0.0923428
62.7003	12.1479	0.0537405
65.0225	11.1979	0.0295417
67.3447	10.3387	0.0153836
69.667	9.56111	0.00761334
71.9892	8.85688	0.00359322
74.3114	8.21843	0.00162297
76.6336	7.63893	0.000704
78.9559	7.11223	0.000294275
81.2781	6.63284	0.000118926
83.6003	6.19586	4.46112E-05
85.9226	5.79692	1.77693E-05
88.2448	5.43212	6.60699E-06
90.567	5.09802	2.40213E-06
92.8893	4.79152	8.56001E-07
95.2115	4.52687	3.20167E-07
97.5337	4.28396	1.19044E-07
99.856	4.05864	4.3684E-08
102.178	3.84937	1.58436E-08
104.5	3.65478	0
106.823	3.47363	0
109.145	3.30478	0
111.467	3.14721	0
113.789	2.99999	0

Weather: Category 5/D

Wind speed [m/s]

Pasquill stability

Atmospheric temperature [degC]

Relative humidity [fraction]

Solar radiation flux [kW/m2]

5
D neutral - little sun and high wind or overcast/windy night
20
0.7
0.5

Pool fire model results

Early pool fires are assumed to occur at a time when the initial PVAP rainout rate equals the pool fire burn rate, unless the thus calculated pool fire radius exceeds the maximum PVAP pool radius. For the latter case the early pool fire radius is assumed to be the maximum PVAP pool radius. The pool fire centre is located at the rainout point.

INPUT DATA

Correlation Type: Thomas / Johnson

Surface type	Land
Pool fire elevation	0 m
Maximum exposure duration	20 s
Downwind distance of liquid rainout	0 m
Use two zone pool fire model	Yes

OUTPUT DATA

Pool fire diameter	20.4983 m
Downwind distance of pool fire centre	0 m
Pool fire flame length	41.9933 m
Angle between pool fire axis and vertical	47.2379 deg
Luminous flame emissive power	169.902 kW/m2
Smoky flame emissive power	0 kW/m2
Ratio of luminous flame length to the total flame length	1 fraction
Total burn rate	39.6011 kg/s
Radiative fraction	0.285725 fraction

Radiation Intensity Ellipse Results

INPUT DATA

For ellipses 'observer direction' refers to whether inclination is 'fixed' or 'variable'. Orientation is always variable.

Observer direction	Variable
Exposure duration	20 s
Height of interest	1 m

OUTPUT DATA

Radiation intensity

Incident radiation [kW/m2]	Lethality [%]	View factor	Probit	Dose [(W/m2)^ProbitN.s]	Hazard information	Ellipse half-length [m]	Ellipse half-width [m]	Ellipse centre downwind distance [m]	Effect downwind distance [m]	Ellipse area [m2]
3	0	0.0176573	-1.38321	865119	-	94.3988	99.9612	21.43	115.829	29644.7
5	0.000174704	0.0294288	0.360367	1709491	-	74.3745	78.218	21.0271	95.4016	18276
7	0.02405	0.0412003	1.50883	2677313	-	63.4738	66.2544	20.5566	84.0303	13211.7
12.5	6.52536	0.073572	3.48789	5800162	-	47.9643	49.025	19.0428	67.0071	7387.3

Radiation v Distance Results

INPUT DATA

Maximum distance	115.829 m
Angle from wind direction	0 deg
Observer direction	Variable
Height of interest	1 m

OUTPUT DATA

Downwind distance [m]	Maximum incident radiation [kW/m2]	Lethality level [fraction]
0	169.902	1
2.36385	169.902	1
4.72771	169.902	1
7.09156	169.902	1
9.45542	169.902	1
11.8193	136.763	1
14.1831	111.149	1
16.547	91.0279	1
18.9108	80.4192	0.999999
21.2747	72.6214	0.999996
23.6385	65.5625	0.999983
26.0024	60.3905	0.999944
28.3663	55.4085	0.999822
30.7301	51.4565	0.999546
33.094	47.9022	0.998942
35.4578	44.7905	0.997773
37.8217	42.2304	0.995894
40.1855	39.8637	0.992785



42.5494	37.1619	0.986337
44.9132	34.03	0.971695
47.2771	30.8652	0.942156
49.6409	27.8252	0.88862
52.0048	24.9842	0.802786
54.3686	22.3784	0.682839
56.7325	20.021	0.538127
59.0964	17.9101	0.387986
61.4602	16.034	0.2539
63.8241	14.3751	0.150323
66.1879	12.9129	0.0805819
68.5518	11.8232	0.0443687
70.9156	10.8671	0.0232997
73.2795	10.0011	0.0115017
75.6433	9.21802	0.00536038
78.0072	8.51047	0.00236952
80.371	7.87116	0.000998118
82.7349	7.29319	0.000402482
85.0988	6.77018	0.000156047
87.4626	6.29631	5.84115E-05
89.8265	5.86633	2.11906E-05
92.1903	5.47554	7.47699E-06
94.5542	5.11975	2.57427E-06
96.918	4.79524	8.67378E-07
99.2819	4.49873	2.86783E-07
101.646	4.2273	9.32698E-08
104.01	3.97836	2.99036E-08
106.373	3.74965	9.47022E-09
108.737	3.53914	0
111.101	3.34504	0
113.465	3.16577	0
115.829	2.99992	0



Audit Number: 341
Date: 15/12/2023 Time: 08:54

Consequence Summary Report
Workspace: pm_rev1
Study: Study

Summary Basis
These tables will only report global values set in the parameters. Values that are modified in the study tree will not be reported.
The report is context sensitive, and filters up to the study level. You will need to generate multiple summary reports if you have multiple studies in your workspace.
The results in this report are from the non-CFD calculations only.

Discharge Results (after atmospheric expansion)

Path	Scenario	Weather	Peak Flowrate [kg/s]	Temperature [degC]	Liquid mass fraction in material [fraction]	Droplet diameter [um]	Expanded diameter [m]	Velocity [m/s]	End time of release [s]
Study\T2D	T2-2"leak vertical	Category 2/F	48.5092	-11.9098	0.816363	199.167	0.189951	114.132	57.5015
		Category 5/D	48.5092	-11.9098	0.816363	199.167	0.189951	114.132	57.5015

Dispersion Results

Input dispersion parameters

Core averaging time	18.75 s
Flammable averaging time	18.75 s
Toxic averaging time	600 s
Height of interest	1 m

Distance downwind to defined concentrations

The reported concentration of interest is defined at the scenario

Path	Scenario	Weather	Distance to UFL [m]	Distance to LFL [m]	Distance to LFL fraction [m]
Study\T2D	T2-2"leak vertical	Category 2/F	n/a	91.8765	141.24
		Category 5/D	n/a	55.981	84.8128

Jet Fire Results

Distance downwind to defined radiation levels

The reported radiations are defined in the parameters

Path	Scenario	Weather	Flame length [m]	Distance downwind to intensity level 1 (3 kW/m2) [m]	Distance downwind to intensity level 2 (5 kW/m2) [m]	Distance downwind to intensity level 3 (7 kW/m2) [m]	Distance downwind to intensity level 4 (12,5 kW/m2) [m]
Study\T2D	T2-2"leak vertical	Category 2/F	58.1108	96.8706	74.9021	63.6581	49.0371
		Category 5/D	45.1711	97.2187	75.252	63.3958	47.7319

Early Pool Fire Results

Distance downwind to defined radiation levels

The reported radiations are defined in the parameters

Path	Scenario	Weather	Pool diameter [m]	Distance downwind to intensity level 1 (3 kW/m2) [m]	Distance downwind to intensity level 2 (5 kW/m2) [m]	Distance downwind to intensity level 3 (7 kW/m2) [m]	Distance downwind to intensity level 4 (12,5 kW/m2) [m]
Study\T2D	T2-2"leak vertical	Category 2/F	20.4983	113.789	91.2892	79.4795	61.8958
		Category 5/D	20.4983	115.829	95.4016	84.0303	67.0071

Late Pool Fire Results

Distance downwind to defined radiation levels

The reported radiations are defined in the parameters

Path	Scenario	Weather	Pool diameter [m]	Distance downwind to intensity level 1 (3 kW/m2) [m]	Distance downwind to intensity level 2 (5 kW/m2) [m]	Distance downwind to intensity level 3 (7 kW/m2) [m]	Distance downwind to intensity level 4 (12,5 kW/m2) [m]
Study\T2D	T2-2"leak vertical	Category 2/F	28.4505	147.39	118.418	102.928	79.9221
		Category 5/D	28.0783	148.779	122.281	107.521	85.6274

Flash Fire Results

Distance downwind to defined concentrations

The reported LFL and LFL fraction are defined in the respective material property

Path	Scenario	Weather	Distance downwind to LFL [m]	Distance downwind to LFL Fraction [m]
Study\T2D	T2-2"leak vertical	Category 2/F	91.8765	141.24
		Category 5/D	55.981	84.8128

Maximum distance to LFL fraction at any height

Path	Scenario	Weather	Max flash fire distance [m]	Height of the max flash fire distance [m]	Time [s]
Study\T2D	T2-2"leak vertical	Category 2/F	110.353	0	103.849
		Category 5/D	84.6868	0	66.8324

Explosion Results

Explosion scenarios for worst-case maximum downwind distance to defined overpressures.

The reported overpressures are defined in the explosion parameters

Path	Scenario	Weather	Overpressure level [bar]	Maximum distance [m]	Diameter [m]
Study\T2D	T2-2"leak vertical	Category 2/F	0,02068	488,879	757,758
			0,1379	183,638	147,275
			0,2068	165,211	110,422
		Category 5/D	0,02068	306,028	452,055
			0,1379	123,93	87,86
			0,2068	112,937	65,8741

Supplementary data for worst-case explosion scenarios

Path	Scenario	Weather	Overpressure level [bar]	Explosion flammable mass [kg]	Ignition time [s]	Ignition source [m]	Cloud centre [m]	Explosion centre [m]
Study\T2D	T2-2"leak vertical	Category 2/F	0,02068	659,292	103,255	110	40,8965	110
			0,1379	659,292	103,255	110	40,8965	110
			0,2068	659,292	103,255	110	40,8965	110
		Category 5/D	0,02068	139,978	43,1948	80	28,3767	80
			0,1379	139,978	43,1948	80	28,3767	80
			0,2068	139,978	43,1948	80	28,3767	80



Audit Number: 341
Date: 15/12/2023 Time: 08:56

Discharge Report

Workspace: pm_rev1

Study: Study

Equipment Item: T2E

pm_rev1\Study\T2E

Material	ISOBUTANE	
East	0	m
North	0	m

Scenario (Leak) : T2-2"leak vertical

pm_rev1\Study\T2E\T2-2"leak vertical

Weather: Category 2/F

INPUT DATA

Inventory data

Mass in vessel	2661.7	kg
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Stagnation Data (upstream end for long pipe)

Initial pressure (gauge)	8.7	bar
Initial temperature	40	degC
Fluid state	Non-saturated liquid	

Scenario data

Phase to be released	Liquid	
Tank head	0	m
Hole diameter	50.8	mm

OUTPUT DATA

Mass flow rate	38.5776	kg/s
Release duration	68.996	s

Orifice or pipe exit data (before atmospheric expansion)

Pressure	1.01325	bar
Temperature	39.3072	degC
Liquid mass fraction	1	fraction
Velocity at vena contracta (at exit for pipe releases)	59.4871	m/s
Discharge coefficient	0.6	

Final Data (after atmospheric expansion)

Temperature	-11.9098	degC
Liquid mass fraction	0.69776	fraction
Droplet diameter	150.989	um
Expanded diameter	0.18336	m
Velocity	158.732	m/s

Weather: Category 5/D

INPUT DATA

Inventory data

Mass in vessel	2661.7	kg
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Stagnation Data (upstream end for long pipe)

Initial pressure (gauge)	8.7	bar
Initial temperature	40	degC
Fluid state	Non-saturated liquid	

Scenario data

Phase to be released	Liquid	
Tank head	0	m
Hole diameter	50.8	mm

OUTPUT DATA

Mass flow rate	38.5776	kg/s
Release duration	68.996	s

Orifice or pipe exit data (before atmospheric expansion)

Pressure	1.01325	bar
Temperature	39.3072	degC
Liquid mass fraction	1	fraction
Velocity at vena contracta (at exit for pipe releases)	59.4871	m/s
Discharge coefficient	0.6	

Final Data (after atmospheric expansion)

Temperature	-11.9098	degC
Liquid mass fraction	0.69776	fraction
Droplet diameter	150.989	um
Expanded diameter	0.18336	m
Velocity	158.732	m/s



Audit Number: 341
Date: 15/12/2023 Time: 08:57

Explosion Report
Workspace: pm_rev1
Study: Study
Equipment Item: T2E
pm_rev1\Study\T2E

Material	ISOBUTANE	
East	0	m
North	0	m

Scenario (Leak) : T2-2''leak vertical
pm_rev1\Study\T2E\T2-2''leak vertical
Weather: Category 2/F

Explosion location criterion	Cloud front (LFL fraction)	
Explosion height criterion	Centreline height	
Explosion method	Multi-Energy: Uniform confined	
Uniform confined method explosion efficiency	12.5	%
Uniform confined method explosion strength	10	

Time of explosion [s]	Distance to centre of mass [m]	Distance to explosion centre [m]	Distance to ignition point [m]	Flammable mass [kg]	Overpressures (input) [bar]	Distance to specified overpressures [m]
0.812873	6.69723	10	10	1.05899	0,02068 0,1379 0,2068	54,3717 18,6239 16,4659
1.73235	9.20164	20	20	3.16898	0,02068 0,1379 0,2068	83,9413 32,4274 29,3176
4.87897	13.9672	30	30	11.5248	0,02068 0,1379 0,2068	128,33 49,1111 44,3288
10.0457	19.469	40	40	34.4866	0,02068 0,1379 0,2068	181,696 67,5396 60,6481
15.6944	22.7808	50	50	59.592	0,02068 0,1379 0,2068	220,035 83,0474 74,7777
21.9713	26.2446	60	60	87.4703	0,02068 0,1379 0,2068	253,239 97,5573 88,159
28.9046	29.8674	70	70	118.247	0,02068 0,1379 0,2068	283,667 111,528 101,136
37.2846	35.0315	80	80	164.37	0,02068 0,1379 0,2068	318,46 126,346 114,749
51.7154	39.5014	90	90	242.904	0,02068 0,1379 0,2068	361,614 142,79 129,58
67.9694	43.3343	100	100	312.851	0,02068 0,1379 0,2068	395,52 157,436 143,064
85.1379	45.3454	110	110	512.407	0,02068 0,1379 0,2068	458,348 177,704 160,762

102.629	50.4486	120	120	583.749	0,02068 0,1379 0,2068	483,817 190,71 173,016
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Weather: Category 5/D

Explosion location criterion	Cloud front (LFL fraction)	
Explosion height criterion	Centreline height	
Explosion method	Multi-Energy: Uniform confined	
Uniform confined method explosion efficiency	12.5	%
Uniform confined method explosion strength	10	

Time of explosion [s]	Distance to centre of mass [m]	Distance to explosion centre [m]	Distance to ignition point [m]	Flammable mass [kg]	Overpressures (input) [bar]	Distance to specified overpressures [m]
0.665167	7.27409	10	10	1.00006	0,02068 0,1379 0,2068	53,5328 18,4609 16,3437
1.40711	10.9806	20	20	3.293	0,02068 0,1379 0,2068	84,7647 32,5875 29,4376
3.19223	17.8475	30	30	12.331	0,02068 0,1379 0,2068	130,571 49,5467 44,6554
5.92032	25.3104	40	40	36.9627	0,02068 0,1379 0,2068	185,009 68,1835 61,1309
9.50026	30.6844	50	50	64.5736	0,02068 0,1379 0,2068	224,646 83,9437 75,4497
13.7074	33.8684	60	60	85.954	0,02068 0,1379 0,2068	252,116 97,339 87,9954
18.4882	34.897	70	70	98.1354	0,02068 0,1379 0,2068	270,794 109,026 99,2599
26.7847	35.0972	80	80	114.189	0,02068 0,1379 0,2068	291,195 121,047 110,776
49.9245	34.1697	90	90	156.258	0,02068 0,1379 0,2068	324,471 135,571 124,167



Audit Number: 341
Date: 15/12/2023 Time: 08:57

Jet Fire
Workspace: pm_rev1
Study: Study
Equipment Item: T2E

pm_rev1\Study\T2E	
Material	ISOBUTANE
East	0 m
North	0 m

Scenario (Leak) : T2-2''leak vertical

pm_rev1\Study\T2E\T2-2''leak vertical

Weather: Category 2/F

Wind speed [m/s]	2
Pasquill stability	F stable - night with moderate clouds and light/moderate wind
Atmospheric temperature [degC]	20
Relative humidity [fraction]	0.7
Solar radiation flux [kW/m2]	0.5

Jet fire model results

INPUT DATA

Scenario

Elevation	1 m
Release angle from horizontal	0 deg

Jet Fire Parameters

Jet fire method	Cone model	
Wind orientation about the z-axis (anti-clockwise from the East)	0 deg	
Rotation about the z-axis (anti-clockwise from the east)	0 deg	
Rate modification factor	3	

Calculated inputs

Mass flow rate	34.9791 kg/s
Temperature after atmospheric expansion	-11.9098 degC
Liquid fraction	0.69776 fraction
Velocity after atmospheric expansion (input)	158.732 m/s
Rainout fraction time averaged	0.69776 fraction

OUTPUT DATA

Flame emissive power	269.352 kW/m2
Fraction of emissivity	0.392228 fraction
Jet velocity	158.732 m/s
Flame length	62.4244 m
Frustum length	61.4881 m
Frustum base width	0.574433 m
Frustum tip width	19.958 m
Frustum lift-off distance	0.936366 m
Flame length in still air	56.1354 m
Hole to flame angle	0 deg
Expanded diameter	0.174598 m
Plane angular rotation	0 deg

Flame on ground impingement with partial truncation

Radiation Intensity Ellipse Results

INPUT DATA

For ellipses 'observer direction' refers to whether inclination is 'fixed' or 'variable'. Orientation is always variable.

Observer direction	Variable
Exposure duration	20 s
Height of interest	1 m

OUTPUT DATA

Radiation intensity

Incident radiation [kW/m2]	Lethality [%]	View factor	Probit	Dose [(W/m2)^ProbitN.s]	Ellipse half-length [m]	Ellipse half-width [m]	Ellipse centre downwind distance [m]	Effect downwind distance [m]	Ellipse area [m2]
3	0	0.0111378	-1.38321	865119	78.8365	106.48	0	106.48	26372
5	0.000174704	0.018563	0.360367	1709491	63.0353	82.3136	0	82.3136	16300.7
7	0.02405	0.0259883	1.50883	2677313	56.6888	69.9515	0	69.9515	12457.9
12.5	6.52536	0.0464076	3.48789	5800162	49.2581	53.8247	0	53.8247	8329.31

Radiation v Distance Results

INPUT DATA

Maximum distance	138.569 m
Observer type radiation modelling flag	Planar
Observer direction	Variable
Height of interest	1 m



OUTPUT DATA

Downwind distance [m]	Maximum incident radiation [kW/m2]	Lethality level [fraction]
-55.3911	22.0791	0.666292
-52.5631	269.352	1
-49.7352	269.352	1
-46.9073	269.352	1
-44.0793	269.352	1
-41.2514	269.352	1
-38.4235	269.352	1
-35.5955	269.352	1
-32.7676	269.352	1
-29.9397	269.352	1
-27.1117	269.352	1
-24.2838	269.352	1
-21.4558	269.352	1
-18.6279	269.352	1
-15.8	269.352	1
-12.972	269.352	1
-10.1441	269.352	1
-7.31617	269.352	1
-4.48823	269.352	1
-1.6603	269.352	1
1.16764	269.352	1
3.99557	269.352	1
6.82351	269.352	1
9.65145	155.696	1
12.4794	97.8962	1
15.3073	70.7933	0.999995
18.1353	58.4597	0.999913
20.9632	46.9947	0.998685
23.7911	38.194	0.989285
26.6191	31.3881	0.9485
29.447	26.0827	0.840979
32.2749	21.9068	0.656514
35.1029	18.5859	0.437165
37.9308	15.9175	0.24599
40.7587	13.7509	0.117699
43.5867	11.9738	0.0485677
46.4146	10.5033	0.0175963
49.2425	9.27513	0.00569353
52.0705	8.24105	0.00167282
54.8984	7.36353	0.000452797
57.7264	6.61351	0.000114371
60.5543	5.96819	0.00002726
63.3822	5.40949	6.19006E-06
66.2102	4.92298	1.3502E-06
69.0381	4.49706	2.84905E-07
71.866	4.12231	5.85093E-08
74.694	3.79103	1.1755E-08
77.5219	3.4969	0
80.3498	3.23467	0
83.1778	3	0

Weather: Category 5/D

Wind speed [m/s]	5
Pasquill stability	D neutral - little sun and high wind or overcast/windy night
Atmospheric temperature [degC]	20
Relative humidity [fraction]	0.7
Solar radiation flux [kW/m2]	0.5

Jet fire model results

INPUT DATA

Scenario

Elevation	1 m
Release angle from horizontal	0 deg

Jet Fire Parameters

Jet fire method	Cone model
Wind orientation about the z-axis (anti-clockwise from the East)	0 deg
Rotation about the z-axis (anti-clockwise from the east)	0 deg
Rate modification factor	3

Calculated inputs

Mass flow rate	34.9791 kg/s
Temperature after atmospheric expansion	-11.9098 degC
Liquid fraction	0.69776 fraction
Velocity after atmospheric expansion (input)	158.732 m/s
Rainout fraction time averaged	0.69776 fraction

OUTPUT DATA

Flame emissive power	350 kW/m2
Fraction of emissivity	0.392228 fraction
Jet velocity	158.732 m/s
Flame length	48.5242 m
Frustum length	47.7963 m
Frustum base width	0.979919 m

Frustum tip width	18.3755	m
Frustum lift-off distance	0.727863	m
Flame length in still air	56.1354	m
Hole to flame angle	0	deg
Expanded diameter	0.174598	m
Plane angular rotation	0	deg

Flame on ground impingement with partial truncation

Radiation Intensity Ellipse Results

INPUT DATA

For ellipses 'observer direction' refers to whether inclination is 'fixed' or 'variable'. Orientation is always variable.

Observer direction	Variable	
Exposure duration	20	s
Height of interest	1	m

OUTPUT DATA

Radiation intensity

Incident radiation [kW/m2]	Lethality [%]	View factor	Probit	Dose [(W/m2)^ProbitN.s]	Ellipse half-length [m]	Ellipse half-width [m]	Ellipse centre downwind distance [m]	Effect downwind distance [m]	Ellipse area [m2]
3	0	0.00857143	-1.38321	865119	82.125	105.593	0	105.593	27243.3
5	0.000174704	0.0142857	0.360367	1709491	64.3695	81.7465	0	81.7465	16531
7	0.02405	0.02405	1.50883	2677313	55.1524	68.9378	0	68.9378	11944.6
12.5	6.52536	0.0357143	3.48789	5800162	44.6929	51.8474	0	51.8474	7279.74

Radiation v Distance Results

INPUT DATA

Maximum distance	128.47	m
Observer type radiation modelling flag	Planar	
Observer direction	Variable	
Height of interest	1	m

OUTPUT DATA

Downwind distance [m]	Maximum incident radiation [kW/m2]	Lethality level [fraction]
-44.8952	105.789	1
-42.2733	350	1
-39.6515	350	1
-37.0297	350	1
-34.4078	350	1
-31.786	350	1
-29.1642	350	1
-26.5424	350	1
-23.9205	350	1
-21.2987	350	1
-18.6769	350	1
-16.055	350	1
-13.4332	350	1
-10.8114	350	1
-8.18955	350	1
-5.56772	350	1
-2.94589	350	1
-0.324059	350	1
2.29777	350	1
4.9196	308.835	1
7.54143	152.606	1
10.1633	106.466	1
12.7851	83.8359	1
15.4069	66.8006	0.999987
18.0287	53.8622	0.999743
20.6506	43.9486	0.997276
23.2724	36.2864	0.983225
25.8942	30.3028	0.934525
28.5161	25.5786	0.824301
31.1379	21.8068	0.65075
33.7597	18.7628	0.449933
36.3816	16.2799	0.270824
39.0034	14.2341	0.142604
41.6252	12.5336	0.0664265
44.247	11.1071	0.0277242
46.8689	9.90122	0.0105097
49.4907	8.87387	0.00366419
52.1125	7.99254	0.00118856
54.7344	7.2316	0.000362394
57.3562	6.57064	0.000104803
59.978	5.99332	2.89746E-05
62.5998	5.48643	7.71066E-06
65.2217	5.03922	1.98692E-06
67.8435	4.64287	4.98339E-07
70.4653	4.29011	1.222E-07
73.0872	3.9749	2.94107E-08
75.709	3.6922	0
78.3308	3.43777	0
80.9527	3.20796	0
83.5745	2.99988	0



Audit Number: 341
Date: 15/12/2023 Time: 08:57
Early Pool Fire Report
Workspace: pm_rev1
Study: Study
Equipment Item: T2E
pm_rev1\Study\T2E

Material	ISOBUTANE	
East		0 m
North		0 m

Scenario (Leak) : T2-2"leak vertical
pm_rev1\Study\T2E\T2-2"leak vertical
Weather: Category 2/F
Wind speed [m/s] 2
Pasquill stability F stable - night with moderate clouds and light/moderate wind
Atmospheric temperature [degC] 20
Relative humidity [fraction] 0.7
Solar radiation flux [kW/m2] 0.5

Pool fire model results

Early pool fires are assumed to occur at a time when the initial PVAP rainout rate equals the pool fire burn rate, unless the thus calculated pool fire radius exceeds the maximum PVAP pool radius. For the latter case the early pool fire radius is assumed to be the maximum PVAP pool radius. The pool fire centre is located at the rainout point.

INPUT DATA

Correlation Type: Thomas / Johnson

Surface type	Land	
Pool fire elevation		0 m
Maximum exposure duration		20 s
Downwind distance of liquid rainout		0 m
Use two zone pool fire model	Yes	

OUTPUT DATA

Pool fire diameter	16.8999	m
Downwind distance of pool fire centre	0	m
Pool fire flame length	36.7212	m
Angle between pool fire axis and vertical	30.9605	deg
Luminous flame emissive power	169.636	kW/m2
Smoky flame emissive power	0	kW/m2
Ratio of luminous flame length to the total flame length	1	fraction
Total burn rate	26.9179	kg/s
Radiative fraction	0.300696	fraction

Radiation Intensity Ellipse Results

INPUT DATA

For ellipses 'observer direction' refers to whether inclination is 'fixed' or 'variable'. Orientation is always variable.

Observer direction	Variable	
Exposure duration		20 s
Height of interest		1 m

OUTPUT DATA

Radiation intensity

Incident radiation [kW/m2]	Lethality [%]	View factor	Probit	Dose [(W/m2)^ProbitN.s]	Hazard information	Ellipse half-length [m]	Ellipse half-width [m]	Ellipse centre downwind distance [m]	Effect downwind distance [m]	Ellipse area [m2]
3	0	0.017685	-1.38321	865119 -		84.4745	86.5845	13.1729	97.6474	22978.2
5	0.000174704	0.0294749	0.360367	1709491 -		65.5111	67.0518	12.7687	78.2798	13799.9
7	0.02405	0.0412649	1.50883	2677313 -		55.473	56.2594	12.7514	68.2245	9804.53
12.5	6.52536	0.0736873	3.48789	5800162 -		41.0955	40.6354	12.1448	53.2403	5246.24

Radiation v Distance Results

INPUT DATA

Maximum distance	97.6474	m
Angle from wind direction	0	deg
Observer direction	Variable	
Height of interest	1	m

OUTPUT DATA

Downwind distance [m]	Maximum incident radiation [kW/m2]	Lethality level [fraction]
0	169.636	1
1.9928	169.636	1
3.98561	169.636	1
5.97841	169.636	1
7.97122	169.636	1
9.96402	133.585	1
11.9568	99.7914	1
13.9496	82.197	1
15.9424	70.2276	0.999994
17.9352	61.6702	0.999959
19.928	54.9906	0.999803
21.9208	49.6103	0.999296
23.9137	45.0967	0.99793
25.9065	41.3249	0.994904



27.8993	38.1425	0.989154
29.8921	34.9848	0.977291
31.8849	32.0295	0.955389
33.8777	29.3035	0.918628
35.8705	26.8	0.862384
37.8633	24.5069	0.784002
39.8561	22.4109	0.684604
41.8489	20.4991	0.56996
43.8417	18.7591	0.449666
45.8345	17.1783	0.334698
47.8273	15.7446	0.234397
49.8201	14.446	0.15428
51.8129	13.2709	0.0954643
53.8057	12.2082	0.05561
55.7985	11.2473	0.0305646
57.7913	10.3782	0.0158956
59.7841	9.59201	0.0078476
61.7769	8.88015	0.00369072
63.7697	8.23502	0.00165941
65.7625	7.64972	0.000715835
67.7553	7.11802	0.000297308
69.7481	6.63434	0.000119287
71.741	6.19371	4.63835E-05
73.7338	5.79167	1.75317E-05
75.7266	5.42426	6.45948E-06
77.7194	5.08797	2.32608E-06
79.7122	4.79748	8.74268E-07
81.705	4.53386	3.28999E-07
83.6978	4.28966	1.21967E-07
85.6906	4.06318	4.46157E-08
87.6834	3.85289	1.61277E-08
89.6762	3.65739	0
91.669	3.47543	0
93.6618	3.30587	0
95.6546	3.14767	0
97.6474	2.9999	0

Weather: Category 5/D

Wind speed [m/s]	5
Pasquill stability	D neutral - little sun and high wind or overcast/windy night
Atmospheric temperature [degC]	20
Relative humidity [fraction]	0.7
Solar radiation flux [kW/m2]	0.5

Pool fire model results

Early pool fires are assumed to occur at a time when the initial PVAP rainout rate equals the pool fire burn rate, unless the thus calculated pool fire radius exceeds the maximum PVAP pool radius. For the latter case the early pool fire radius is assumed to be the maximum PVAP pool radius. The pool fire centre is located at the rainout point.

INPUT DATA

Correlation Type: Thomas / Johnson

Surface type	Land
Pool fire elevation	0 m
Maximum exposure duration	20 s
Downwind distance of liquid rainout	0 m
Use two zone pool fire model	Yes

OUTPUT DATA

Pool fire diameter	16.8999 m
Downwind distance of pool fire centre	0 m
Pool fire flame length	36.7212 m
Angle between pool fire axis and vertical	48.3713 deg
Luminous flame emissive power	169.636 kW/m2
Smoky flame emissive power	0 kW/m2
Ratio of luminous flame length to the total flame length	1 fraction
Total burn rate	26.9179 kg/s
Radiative fraction	0.300696 fraction

Radiation Intensity Ellipse Results

INPUT DATA

For ellipses 'observer direction' refers to whether inclination is 'fixed' or 'variable'. Orientation is always variable.

Observer direction	Variable
Exposure duration	20 s
Height of interest	1 m

OUTPUT DATA

Radiation intensity

Incident radiation [kW/m2]	Lethality [%]	View factor	Probit	Dose [(W/m2)^ProbitN.s]	Hazard information	Ellipse half-length [m]	Ellipse half-width [m]	Ellipse centre downwind distance [m]	Effect downwind distance [m]	Ellipse area [m2]
3	0	0.017685	-1.38321	865119	-	80.3329	85.1835	18.9371	99.2701	21498.1
5	0.000174704	0.0294749	0.360367	1709491	-	63.3225	66.5856	18.5609	81.8834	13246.1
7	0.02405	0.0412649	1.50883	2677313	-	54.0796	56.3564	18.1289	72.2084	9574.73
12.5	6.52536	0.0736873	3.48789	5800162	-	40.9558	41.6337	16.7612	57.7171	5356.87

Radiation v Distance Results

INPUT DATA

Maximum distance	99.2701 m
Angle from wind direction	0 deg
Observer direction	Variable
Height of interest	1 m



OUTPUT DATA		
Downwind distance [m]	Maximum incident radiation [kW/m2]	Lethality level [fraction]
0	169.636	1
2.02592	169.636	1
4.05184	169.636	1
6.07776	169.636	1
8.10368	169.636	1
10.1296	134.632	1
12.1555	106.431	1
14.1814	91.0086	1
16.2074	80.5671	0.999999
18.2333	72.734	0.999997
20.2592	65.7035	0.999984
22.2851	60.3351	0.999944
24.311	55.4335	0.999823
26.337	51.5256	0.999553
28.3629	48.1706	0.999007
30.3888	44.9653	0.997864
32.4147	42.1749	0.995839
34.4406	39.8439	0.992751
36.4666	37.4932	0.987361
38.4925	34.4982	0.974587
40.5184	31.353	0.948095
42.5443	28.2886	0.89895
44.5702	25.4019	0.818118
46.5961	22.7413	0.702139
48.6221	20.3269	0.558622
50.648	18.1613	0.406315
52.6739	16.2352	0.267724
54.6998	14.5321	0.159147
56.7257	13.0372	0.0855792
58.7517	11.9644	0.0482991
60.7776	10.9895	0.0254865
62.8035	10.1063	0.0126218
64.8294	9.30795	0.00589226
66.8553	8.58693	0.00260519
68.8813	7.93584	0.00109617
70.9072	7.34767	0.000441008
72.9331	6.81584	0.000170415
74.959	6.33439	6.35209E-05
76.9849	5.8979	2.29295E-05
79.0109	5.50153	8.04513E-06
81.0368	5.14096	2.75287E-06
83.0627	4.81237	9.21459E-07
85.0886	4.51238	3.02556E-07
87.1145	4.23796	9.76926E-08
89.1405	3.98649	3.10901E-08
91.1664	3.75561	9.77173E-09
93.1923	3.54325	0
95.2182	3.34758	0
97.2441	3.16697	0
99.2701	2.99997	0



Audit Number: 341
Date: 15/12/2023 Time: 08:56

Consequence Summary Report

Workspace: pm_rev1

Study: Study
Summary Basis

These tables will only report global values set in the parameters. Values that are modified in the study tree will not be reported.
The report is context sensitive, and filters up to the study level. You will need to generate multiple summary reports if you have multiple studies in your workspace.
The results in this report are from the non-CFD calculations only.

Discharge Results (after atmospheric expansion)

Path	Scenario	Weather	Peak Flowrate [kg/s]	Temperature [degC]	Liquid mass fraction in material [fraction]	Droplet diameter [um]	Expanded diameter [m]	Velocity [m/s]	End time of release [s]
Study\T2E	T2-2"leak vertical	Category 2/F	38.5776	-11.9098	0.69776	150.989	0.18336	158.732	68.996
		Category 5/D	38.5776	-11.9098	0.69776	150.989	0.18336	158.732	68.996

Dispersion Results

Input dispersion parameters

Core averaging time	18.75 s
Flammable averaging time	18.75 s
Toxic averaging time	600 s
Height of interest	1 m

Distance downwind to defined concentrations

The reported concentration of interest is defined at the scenario

Path	Scenario	Weather	Distance to UFL [m]	Distance to LFL [m]	Distance to LFL fraction [m]
Study\T2E	T2-2"leak vertical	Category 2/F	22.2329	99.1269	152.565
		Category 5/D	n/a	62.9975	92.9171

Jet Fire Results

Distance downwind to defined radiation levels

The reported radiations are defined in the parameters

Path	Scenario	Weather	Flame length [m]	Distance downwind to intensity level 1 (3 kW/m2)	Distance downwind to intensity level 2 (5 kW/m2) [m]	Distance downwind to intensity level 3 (7 kW/m2)	Distance downwind to intensity level 4 (12,5 kW/m2)
Study\T2E	T2-2"leak vertical	Category 2/F	62.4244	106.48	82.3136	69.9515	53.8247
		Category 5/D	48.5242	105.593	81.7465	68.9378	51.8474

Early Pool Fire Results

Distance downwind to defined radiation levels

The reported radiations are defined in the parameters

Path	Scenario	Weather	Pool diameter [m]	Distance downwind to intensity level 1 (3 kW/m2)	Distance downwind to intensity level 2 (5 kW/m2) [m]	Distance downwind to intensity level 3 (7 kW/m2)	Distance downwind to intensity level 4 (12,5 kW/m2)
Study\T2E	T2-2"leak vertical	Category 2/F	16.8999	97.6474	78.2798	68.2245	53.2403
		Category 5/D	16.8999	99.2701	81.8834	72.2084	57.7171

Late Pool Fire Results

Distance downwind to defined radiation levels

The reported radiations are defined in the parameters

Path	Scenario	Weather	Pool diameter [m]	Distance downwind to intensity level 1 (3 kW/m2) [m]	Distance downwind to intensity level 2 (5 kW/m2) [m]	Distance downwind to intensity level 3 (7 kW/m2)	Distance downwind to intensity level 4 (12,5 kW/m2)
Study\T2E	T2-2"leak vertical	Category 2/F	25.4792	135.112	108.5	94.358	73.3333
		Category 5/D	24.8338	134.944	111	97.6634	77.7693

Flash Fire Results

Distance downwind to defined concentrations

The reported LFL and LFL fraction are defined in the respective material property

Path	Scenario	Weather	Distance downwind to LFL	Distance downwind to LFL Fraction
Study\T2E	T2-2"leak vertical	Category 2/F	99.1269	152.565
		Category 5/D	62.9975	92.9171

Maximum distance to LFL fraction at any height

Path	Scenario	Weather	Max flash fire distance [m]	Height of the max flash fire distance [m]	Time [s]
Study\T2E	T2-2"leak vertical	Category 2/F	126.624	0	114.214
		Category 5/D	94.4185	0	78.3695

Explosion Results

Explosion scenarios for worst-case maximum downwind distance to defined overpressures.

The reported overpressures are defined in the explosion parameters

Path	Scenario	Weather	Overpressure level [bar]	Maximum distance [m]	Diameter [m]
Study\T2E	T2-2"leak vertical	Category 2/F	0,02068	483,817	727,635
			0,1379	190,71	141,421
			0,2068	173,016	106,032
		Category 5/D	0,02068	324,471	468,941
			0,1379	135,571	91,1419
			0,2068	124,167	68,3347

Supplementary data for worst-case explosion scenarios

Path	Scenario	Weather	Overpressure level [bar]	Explosion flammable mass [kg]	Ignition time [s]	Ignition source [m]	Cloud centre [m]	Explosion centre [m]
Study\T2E	T2-2"leak vertical	Category 2/F	0,02068	583,749	102,629	120	50,4486	120
			0,1379	583,749	102,629	120	50,4486	120
			0,2068	583,749	102,629	120	50,4486	120
		Category 5/D	0,02068	156,258	49,9245	90	34,1697	90
			0,1379	156,258	49,9245	90	34,1697	90
			0,2068	156,258	49,9245	90	34,1697	90
		Category 5/D	0,02068	156,258	49,9245	90	34,1697	90
			0,1379	156,258	49,9245	90	34,1697	90
			0,2068	156,258	49,9245	90	34,1697	90



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TOP EVENT 3



Audit Number: 341
Date: 15/12/2023 Time: 08:59

Discharge Report

Workspace: pm_rev1

Study: Study

Equipment Item: T3A

pm_rev1\Study\T3A

Material	ISOBUTANE	
East	0	m
North	0	m

Scenario (Leak) : T3-2"leak vertical

pm_rev1\Study\T3A\T3-2"leak vertical

Weather: Category 2/F

INPUT DATA

Inventory data

Mass in vessel	1228.58	kg
----------------	---------	----

Stagnation Data (upstream end for long pipe)

Initial pressure (gauge)	28	bar
Initial temperature	130	degC
Fluid state	Pressurized gas	

Scenario data

Phase to be released	Vapour	
Hole diameter	50.8	mm

OUTPUT DATA

Mass flow rate	15.7108	kg/s
Release duration	78.1996	s

Orifice or pipe exit data (before atmospheric expansion)

Pressure	18.6357	bar
Temperature	107.978	degC
Liquid mass fraction	0	fraction
Velocity at vena contracta (at exit for pipe releases)	182.98	m/s
Discharge coefficient	0.906022	

Final Data (after atmospheric expansion)

Temperature	54.2982	degC
Liquid mass fraction	0	fraction
Droplet diameter	0	um
Expanded diameter	0.152738	m
Velocity	388.959	m/s

Weather: Category 5/D

INPUT DATA

Inventory data

Mass in vessel	1228.58	kg
----------------	---------	----

Stagnation Data (upstream end for long pipe)

Initial pressure (gauge)	28	bar
Initial temperature	130	degC
Fluid state	Pressurized gas	

Scenario data

Phase to be released	Vapour	
Hole diameter	50.8	mm

OUTPUT DATA

Mass flow rate	15.7108	kg/s
Release duration	78.1996	s

Orifice or pipe exit data (before atmospheric expansion)

Pressure	18.6357	bar
Temperature	107.978	degC
Liquid mass fraction	0	fraction
Velocity at vena contracta (at exit for pipe releases)	182.98	m/s
Discharge coefficient	0.906022	

Final Data (after atmospheric expansion)

Temperature	54.2982	degC
Liquid mass fraction	0	fraction
Droplet diameter	0	um
Expanded diameter	0.152738	m
Velocity	388.959	m/s



Audit Number: 341
Date: 15/12/2023 Time: 09:00

Explosion Report
Workspace: pm_rev1
Study: Study
Equipment Item: T3A
pm_rev1\Study\T3A

Material	ISOBUTANE	
East		0 m
North		0 m

Scenario (Leak) : T3-2"leak vertical
pm_rev1\Study\T3A\T3-2"leak vertical
Weather: Category 2/F

Explosion location criterion	Cloud front (LFL fraction)	
Explosion height criterion	Centreline height	
Explosion method	Multi-Energy: Uniform confin	
Uniform confined method explosion efficiency	12.5 %	
Uniform confined method explosion strength	10	

Time of explosion [s]	Distance to centre of mass [m]	Distance to explosion centre [m]	Distance to ignition point [m]	Flammable mass [kg]	Overpressures (input) [bar]	Distance to specified overpressures [m]
0.85008	8.50487	10	10	2.84566	0,02068 0,1379 0,2068	71,6882 21,9895 18,9893
1.07169	9.32671	20	20	4.29607	0,02068 0,1379 0,2068	90,7672 33,7541 30,3123
2.91905	15.1918	30	30	16.6107	0,02068 0,1379 0,2068	141,072 51,5876 46,1855
6.40217	20.4345	40	40	41.5465	0,02068 0,1379 0,2068	190,772 69,3035 61,9706
11.6677	25.4668	50	50	81.7451	0,02068 0,1379 0,2068	238,928 86,7194 77,5308
18.5582	30.1625	60	60	137.694	0,02068 0,1379 0,2068	284,792 103,69 92,7569
25.8498	35.2666	70	70	219.701	0,02068 0,1379 0,2068	332,675 121,053 108,277
33.3191	40.5516	80	80	313.26	0,02068 0,1379 0,2068	375,649 137,461 123,082
40.9078	45.5404	90	90	404.455	0,02068 0,1379 0,2068	411,933 152,57 136,912
50.066	49.464	100	100	486.643	0,02068 0,1379 0,2068	442,409 166,549 149,896
65.9999	55.7592	110	110	620.304	0,02068 0,1379 0,2068	481,258 182,157 164,1

84.1985	61.8398	120	120	658.09	0,02068 0,1379 0,2068	498,649 193,593 175,177
105.14	77.125	130	130	533.93	0,02068 0,1379 0,2068	483,158 198,639 181,463
126.116	92.4945	140	140	407.469	0,02068 0,1379 0,2068	462,73 202,725 187,029

Weather: Category 5/D

Explosion location criterion	Cloud front (LFL fraction)	
Explosion height criterion	Centreline height	
Explosion method	Multi-Energy: Uniform confinement	
Uniform confined method explosion efficiency	12.5	%
Uniform confined method explosion strength	10	

Time of explosion [s]	Distance to centre of mass [m]	Distance to explosion centre [m]	Distance to ignition point [m]	Flammable mass [kg]	Overpressures (input) [bar]	Distance to specified overpressures [m]
0.85008	11.8802	10	10	4.73342	0,02068 0,1379 0,2068	83,0914 24,2058 20,651
0.85522	11.9075	20	20	4.77996	0,02068 0,1379 0,2068	93,3302 34,2522 30,6858
1.98226	17.8959	30	30	14.9845	0,02068 0,1379 0,2068	137,322 50,8587 45,6391
3.61083	24.4139	40	40	33.776	0,02068 0,1379 0,2068	180,716 67,3492 60,5054
5.67712	31.1079	50	50	58.3387	0,02068 0,1379 0,2068	218,834 82,8141 74,6027
8.61544	36.5689	60	60	84.8647	0,02068 0,1379 0,2068	251,301 97,1806 87,8766
11.8849	41.0286	70	70	106.199	0,02068 0,1379 0,2068	276,149 110,066 100,04
15.9837	42.9794	80	80	114.526	0,02068 0,1379 0,2068	291,402 121,087 110,806
20.0826	44.9302	90	90	122.853	0,02068 0,1379 0,2068	306,406 132,06 121,535
28.83	45.1915	100	100	124.066	0,02068 0,1379 0,2068	317,117 142,198 131,638
38.3623	45.1676	110	110	124.079	0,02068 0,1379 0,2068	327,124 152,199 141,64



Audit Number: 341
Date: 15/12/2023 Time: 09:00

Jet Fire
Workspace: pm_rev1

Study: Study
Equipment Item: T3A

pm_rev1\Study\T3A		
Material	ISOBUTANE	
East		0 m
North		0 m

Scenario (Leak) : T3-2"leak vertical
pm_rev1\Study\T3A\T3-2"leak vertical

Weather: Category 2/F

Wind speed [m/s]	2
Pasquill stability	F
Atmospheric temperature [degC]	stable - night with moderate clouds and light/moderate wind
Relative humidity [fraction]	20
Solar radiation flux [kW/m2]	0.7
	0.5

Jet fire model results

INPUT DATA

Scenario

Elevation	1 m
Release angle from horizontal	0 deg

Jet Fire Parameters

Jet fire method	Cone model
Wind orientation about the z-axis (anti-clockwise from the East)	0 deg
Rotation about the z-axis (anti-clockwise from the east)	0 deg
Rate modification factor	3

Calculated inputs

Mass flow rate	15.7108 kg/s
Temperature after atmospheric expansion	54.2982 degC
Liquid fraction	0 fraction
Velocity after atmospheric expansion (input)	388.959 m/s
Rainout fraction time averaged	0 fraction

OUTPUT DATA

Flame emissive power	248.728 kW/m2
Fraction of emissivity	0.191413 fraction
Jet velocity	388.959 m/s
Flame length	38.9867 m
Frustum length	27.5506 m
Frustum base width	3.40776 m
Frustum tip width	7.93077 m
Frustum lift-off distance	12.0582 m
Flame length in still air	49.7982 m
Hole to flame angle	22.1184 deg
Expanded diameter	0.152738 m
Plane angular rotation	0 deg

Flame on ground impingement with partial truncation

Radiation Intensity Ellipse Results

INPUT DATA

For ellipses 'observer direction' refers to whether inclination is 'fixed' or 'variable'. Orientation is always variable.

Observer direction	Variable
Exposure duration	20 s
Height of interest	1 m

OUTPUT DATA

Radiation intensity

Incident radiation [kW/m2]	Lethality [%]	View factor	Probit	Dose [(W/m2)^ProbitN.s]	Ellipse half-length [m]	Ellipse half-width [m]	Ellipse centre downwind distance [m]	Effect downwind distance [m]	Ellipse area [m2]
3	0	0.0120614	-1.38321	865119	42.9804	54.2839	0	54.2839	7329.79
5	0.000174704	0.0201023	0.360367	1709491	34.5206	42.1823	0	42.1823	4574.65
7	0.02405	0.0281432	1.50883	2677313	30.1244	35.6047	0	35.6047	3369.58
12.5	6.52536	0.0502557	3.48789	5800162	24.2241	26.2252	0	26.2252	1995.79

Radiation v Distance Results

INPUT DATA

Maximum distance	75.1627 m
Observer type radiation modelling flag	Planar
Observer direction	Variable
Height of interest	1 m

OUTPUT DATA

Downwind distance [m]	Maximum incident radiation [kW/m2]	Lethality level [fraction]
-30.2174	7.06957	0.000272739
-28.6835	8.41363	0.00209614
-27.1495	10.3128	0.0150553



-25.6156	13.1803	0.0915592
-24.0817	17.9508	0.390957
-22.5477	27.2722	0.875073
-21.0138	56.6807	0.999868
-19.4799	149.535	1
-17.9459	248.728	1
-16.412	248.728	1
-14.8781	248.728	1
-13.3441	248.728	1
-11.8102	228.159	1
-10.2763	187.008	1
-8.74233	160.975	1
-7.2084	142.863	1
-5.67447	129.436	1
-4.14054	118.994	1
-2.6066	110.55	1
-1.07267	103.401	1
0.461259	97.0345	1
1.99519	90.9269	1
3.52912	84.4749	1
5.06306	76.9615	0.999999
6.59699	67.709	0.99999
8.13092	56.5837	0.999865
9.66485	44.5584	0.997646
11.1988	33.9129	0.970924
12.7327	29.9542	0.929337
14.2666	26.5003	0.853762
15.8006	23.0708	0.71893
17.3345	20.0149	0.537711
18.8694	17.3503	0.347169
20.4024	15.0763	0.191473
21.9363	13.1532	0.0904076
23.4702	11.5308	0.0369209
25.0042	10.1605	0.01323
26.5381	8.99951	0.0042248
28.072	8.01151	0.00122086
29.606	7.16667	0.000323853
31.1399	6.44043	7.98552E-05
32.6738	5.81326	1.85275E-05
34.2078	5.26874	4.08368E-06
35.7417	4.79367	8.62543E-07
37.2756	4.37719	1.75872E-07
38.8096	4.01051	3.48548E-08
40.3435	3.68624	0
41.8774	3.39831	0
43.4114	3.14166	0
44.9453	2.91203	0

Weather: Category 5/D

Wind speed [m/s]	5
Pasquill stability	D neutral - little sun and high wind or overcast/windy night
Atmospheric temperature [degC]	20
Relative humidity [fraction]	0.7
Solar radiation flux [kW/m2]	0.5

Jet fire model results

INPUT DATA

Scenario	
Elevation	1 m
Release angle from horizontal	0 deg

Jet Fire Parameters

Jet fire method	Cone model
Wind orientation about the z-axis (anti-clockwise from the East)	0 deg
Rotation about the z-axis (anti-clockwise from the east)	0 deg
Rate modification factor	3

Calculated inputs

Mass flow rate	15.7108 kg/s
Temperature after atmospheric expansion	54.2982 degC
Liquid fraction	0 fraction
Velocity after atmospheric expansion (input)	388.959 m/s
Rainout fraction time averaged	0 fraction

OUTPUT DATA

Flame emissive power	239.559 kW/m2
Fraction of emissivity	0.189315 fraction
Jet velocity	388.959 m/s
Flame length	42.0491 m
Frustum length	30.2842 m
Frustum base width	3.40776 m
Frustum tip width	7.37163 m
Frustum lift-off distance	12.0582 m
Flame length in still air	49.7982 m
Hole to flame angle	14.9593 deg
Expanded diameter	0.152738 m
Plane angular rotation	0 deg

Flame on ground impingement with partial truncation

Radiation Intensity Ellipse Results

INPUT DATA

For ellipses 'observer direction' refers to whether inclination is 'fixed' or 'variable'. Orientation is always variable.

Observer direction	Variable	
Exposure duration		20 s
Height of interest		1 m

OUTPUT DATA

Radiation intensity

Incident radiation [kW/m2]	Lethality [%]	View factor	Probit	Dose [(W/m2)^ProbitN.s]	Ellipse half-length [m]	Ellipse half-width [m]	Ellipse centre downwind distance [m]	Effect downwind distance [m]	Ellipse area [m2]
3		0	0.012523	-1.38321	865119	39.9958	54.1899	0	54.1899
5	0.000174704		0.0208717	0.360367	1709491	33.1389	42.0934	0	4382.31
7	0.02405		0.0292204	1.50883	2677313	29.6147	35.5125	0	3303.99
12.5	6.52536		0.0521793	3.48789	5800162	24.8761	26.084	0	2038.48

Radiation v Distance Results

INPUT DATA

Maximum distance		82.6321 m
Observer type radiation modelling flag	Planar	
Observer direction	Variable	
Height of interest		1 m

OUTPUT DATA

Downwind distance [m]	Maximum incident radiation [kW/m2]	Lethality level [fraction]
-32.0484	5.32937	4.89635E-06
-30.362	6.59348	0.00010981
-28.6756	8.53117	0.00243155
-26.9893	11.8146	0.0441352
-25.3029	18.7851	0.451544
-23.6165	37.7875	0.988207
-21.9302	96.7766	1
-20.2438	233.518	1
-18.5574	239.559	1
-16.871	239.559	1
-15.1847	239.559	1
-13.4983	239.559	1
-11.8119	239.559	1
-10.1256	217.739	1
-8.43919	190.73	1
-6.75282	170.516	1
-5.06645	155.433	1
-3.38008	143.635	1
-1.69371	134.768	1
-0.00734317	126.096	1
1.67903	119.125	1
3.3654	112.591	1
5.05177	105.589	1
6.73814	96.3275	1
8.42451	81.6679	1
10.1109	59.7507	0.999935
11.7972	43.2329	0.996768
13.4836	37.6855	0.98792
15.17	31.0892	0.944957
16.8564	25.2613	0.81307
18.5427	20.5741	0.57485
20.2291	16.8998	0.314633
21.9155	14.0271	0.131636
23.6018	11.768	0.0428918
25.2882	9.97566	0.0112426
26.9746	8.53886	0.00245491
28.661	7.37478	0.00046132
30.3473	6.42401	7.71098E-05
32.0337	5.63655	1.16605E-05
33.7201	4.97984	1.63415E-06
35.4064	4.42754	2.15934E-07
37.0928	3.95925	2.72744E-08
38.7792	3.55924	0
40.4655	3.21519	0
42.1519	2.91736	0
43.8383	2.658	0
45.5247	2.4309	0
47.211	2.23102	0
48.8974	2.05426	0
50.5838	1.89723	0



Audit Number: 341
Date: 15/12/2023 Time: 08:59

Consequence Summary Report

Workspace: pm_rev1

Study: Study
Summary Basis

These tables will only report global values set in the parameters. Values that are modified in the study tree will not be reported.
The report is context sensitive, and filters up to the study level. You will need to generate multiple summary reports if you have multiple studies in your workspace.
The results in this report are from the non-CFD calculations only.
Discharge Results (after atmospheric expansion)

Path	Scenario	Weather	Peak Flowrate [kg/s]	Temperature [degC]	Liquid mass fraction in material [fraction]	Droplet diameter [um]	Expanded diameter [m]	Velocity [m/s]	End time of release [s]
Study\T3A	T3-2"leak vertical	Category 2/F	15.7108	54.2982	0	0	0.152738	388.959	78.1996
		Category 5/D	15.7108	54.2982	0	0	0.152738	388.959	78.1996

Dispersion Results

Input dispersion parameters

Core averaging time	18.75 s
Flammable averaging time	18.75 s
Toxic averaging time	600 s
Height of interest	1 m

Distance downwind to defined concentrations

The reported concentration of interest is defined at the scenario

Path	Scenario	Weather	Distance to UFL [m]	Distance to LFL [m]	Distance to LFL fraction [m]
Study\T3A	T3-2"leak vertical	Category 2/F	33.1352	102.662	144.164
		Category 5/D	21.6466	76.8374	108.504

Jet Fire Results

Distance downwind to defined radiation levels

The reported radiations are defined in the parameters

Path	Scenario	Weather	Flame length [m]	Distance downwind to intensity level 1 (3 kW/m2) [m]	Distance downwind to intensity level 2 (5 kW/m2) [m]	Distance downwind to intensity level 3 (7 kW/m2) [m]	Distance downwind to intensity level 4 (12,5 kW/m2) [m]
Study\T3A	T3-2"leak vertical	Category 2/F	38.9867	54.2839	42.1823	35.6047	26.2252
		Category 5/D	42.0491	54.1899	42.0934	35.5125	26.084

Flash Fire Results

Distance downwind to defined concentrations

The reported LFL and LFL fraction are defined in the respective material property

Path	Scenario	Weather	Distance downwind to LFL [m]	Distance downwind to LFL Fraction [m]
Study\T3A	T3-2"leak vertical	Category 2/F	102.662	144.164
		Category 5/D	76.8374	108.504

Maximum distance to LFL fraction at any height

Path	Scenario	Weather	Max flash fire distance [m]	Height of the max flash fire distance [m]	Time [s]
Study\T3A	T3-2"leak vertical	Category 2/F	148.733	0	178.103
		Category 5/D	111.596	0	46.9198

Explosion Results

Explosion scenarios for worst-case maximum downwind distance to defined overpressures.

The reported overpressures are defined in the explosion parameters

Path	Scenario	Weather	Overpressure level [bar]	Maximum distance [m]	Diameter [m]
Study\T3A	T3-2"leak vertical	Category 2/F	0,02068	498,649	757,297
			0,1379	202,725	125,45
		Category 5/D	0,2068	187,029	94,0573
			0,02068	327,124	434,247
			0,1379	152,199	84,3989
			0,2068	141,64	63,2791

Supplementary data for worst-case explosion scenarios

Path	Scenario	Weather	Overpressure level [bar]	Explosion flammable mass [kg]	Ignition time [s]	Ignition source [m]	Cloud centre [m]	Explosion centre [m]
Study\T3A	T3-2"leak vertical	Category 2/F	0,02068	658,09	84,1985	120	61,8398	120
			0,1379	407,469	126,116	140	92,4945	140
		Category 5/D	0,2068	407,469	126,116	140	92,4945	140
			0,02068	124,079	38,3623	110	45,1676	110
			0,1379	124,079	38,3623	110	45,1676	110
			0,2068	124,079	38,3623	110	45,1676	110



Audit Number: 341
Date: 15/12/2023 Time: 09:01

Discharge Report
Workspace: pm_rev1
Study: Study
Equipment Item: T3B

pm_rev1\Study\T3B		
Material	ISOBUTANE	
East		0 m
North		0 m

Scenario (Leak) : T3-2"leak vertical
pm_rev1\Study\T3B\T3-2"leak vertical
Weather: Category 2/F

INPUT DATA

Inventory data

Mass in vessel	440.418	kg
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Stagnation Data (upstream end for long pipe)

Initial pressure (gauge)	13.3	bar
Initial temperature	130	degC
Fluid state	Pressurized gas	

Scenario data

Phase to be released	Vapour	
Hole diameter	50.8	mm

OUTPUT DATA

Mass flow rate	7.00647	kg/s
Release duration	62.8587	s

Orifice or pipe exit data (before atmospheric expansion)

Pressure	8.69799	bar
Temperature	113.242	degC
Liquid mass fraction	0	fraction
Velocity at vena contracta (at exit for pipe releases)	221.456	m/s
Discharge coefficient	0.888743	

Final Data (after atmospheric expansion)

Temperature	73.4827	degC
Liquid mass fraction	0	fraction
Droplet diameter	0	um
Expanded diameter	0.10126	m
Velocity	419.027	m/s

Weather: Category 5/D

INPUT DATA

Inventory data

Mass in vessel	440.418	kg
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Stagnation Data (upstream end for long pipe)

Initial pressure (gauge)	13.3	bar
Initial temperature	130	degC
Fluid state	Pressurized gas	

Scenario data

Phase to be released	Vapour	
Hole diameter	50.8	mm

OUTPUT DATA

Mass flow rate	7.00647	kg/s
Release duration	62.8587	s

Orifice or pipe exit data (before atmospheric expansion)

Pressure	8.69799	bar
Temperature	113.242	degC
Liquid mass fraction	0	fraction
Velocity at vena contracta (at exit for pipe releases)	221.456	m/s
Discharge coefficient	0.888743	

Final Data (after atmospheric expansion)

Temperature	73.4827	degC
Liquid mass fraction	0	fraction
Droplet diameter	0	um
Expanded diameter	0.10126	m
Velocity	419.027	m/s

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Audit Number: 341
Date: 15/12/2023 Time: 09:02

Explosion Report
Workspace: pm_rev1
Study: Study
Equipment Item: T3B

pm_rev1\Study\T3B

Material	ISOBUTANE	
East		0 m
North		0 m

Scenario (Leak) : T3-2"leak vertical

pm_rev1\Study\T3B\T3-2"leak vertical

Weather: Category 2/F

Explosion location criterion	Cloud front (LFL fraction)	
Explosion height criterion	Centreline height	
Explosion method	Multi-Energy: Uniform confine	
Uniform confined method explosion efficiency	12.5	%
Uniform confined method explosion strength	10	

Time of explosion [s]	Distance to centre of mass [m]	Distance to explosion centre [m]	Distance to ignition point [m]	Flammable mass [kg]	Overpressures (input) [bar]	Distance to specified overpressures [m]
0.78576	6.54118	10	10	1.35309	0,02068 0,1379 0,2068	58,1486 19,358 17,0163
1.91331	10.0036	20	20	4.95167	0,02068 0,1379 0,2068	94,198 34,4209 30,8122
5.63176	15.348	30	30	17.5546	0,02068 0,1379 0,2068	143,137 51,989 46,4865
12.4131	21.0211	40	40	47.9612	0,02068 0,1379 0,2068	198,163 70,74 63,0477
21.5938	26.633	50	50	92.7828	0,02068 0,1379 0,2068	247,075 88,3028 78,718
32.1622	31.1758	60	60	139.005	0,02068 0,1379 0,2068	285,502 103,828 92,8605
44.5445	36.3122	70	70	195.245	0,02068 0,1379 0,2068	322,543 119,083 106,801
60.2941	41.4389	80	80	246.479	0,02068 0,1379 0,2068	352,94 133,048 119,773
82.1174	52.0443	90	90	184.166	0,02068 0,1379 0,2068	337,673 138,137 126,091

Weather: Category 5/D

Explosion location criterion	Cloud front (LFL fraction)	
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Explosion height criterion	Centreline height	
Explosion method	Multi-Energy: Uniform confine	
Uniform confined method explosion efficienc	12.5	%
Uniform confined method explosion strength	10	

Time of explosion [s]	Distance to centre of mass [m]	Distance to explosion centre [m]	Distance to ignition point	Flammable mass [kg]	Overpressures (input) [bar]	Distance to specified overpressures [m]
0.78576	9.31896	10	10	2.25346	0,02068 0,1379 0,2068	67,0722 21,0924 18,3166
1.34016	11.8334	20	20	4.73709	0,02068 0,1379 0,2068	93,1103 34,2095 30,6537
2.95317	17.9123	30	30	12.5822	0,02068 0,1379 0,2068	131,25 49,6786 44,7542
5.35597	24.0376	40	40	24.099	0,02068 0,1379 0,2068	165,74 64,4385 58,323
8.58887	29.1462	50	50	35.3651	0,02068 0,1379 0,2068	192,889 77,7715 70,822
12.9798	31.2048	60	60	39.5354	0,02068 0,1379 0,2068	208,299 88,8228 81,6102
18.4055	32.4554	70	70	41.8843	0,02068 0,1379 0,2068	221,179 99,3827 92,03
30.8659	32.441	80	80	41.8151	0,02068 0,1379 0,2068	231,096 109,366 102,018



Audit Number: 341
Date: 15/12/2023 Time: 09:01

Jet Fire
Workspace: pm_rev1
Study: Study
Equipment Item: T3B
pm_rev1\Study\T3B

Material	ISOBUTANE	
East		0 m
North		0 m

Scenario (Leak) : T3-2"leak vertical
pm_rev1\Study\T3B\T3-2"leak vertical
Weather: Category 2/F
Wind speed [m/s] 2
Pasquill stability F stable - night with moderate clouds and light/moderate wind
Atmospheric temperature [degC] 20
Relative humidity [fraction] 0.7
Solar radiation flux [kW/m2] 0.5

Jet fire model results

INPUT DATA

Scenario	
Elevation	1 m
Release angle from horizontal	0 deg

Jet Fire Parameters

Jet fire method	Cone model
Wind orientation about the z-axis (anti-clockwise from the East)	0 deg
Rotation about the z-axis (anti-clockwise from the east)	0 deg
Rate modification factor	3

Calculated inputs

Mass flow rate	7.00647 kg/s
Temperature after atmospheric expansion	73.4827 degC
Liquid fraction	0 fraction
Velocity after atmospheric expansion (input)	419.027 m/s
Rainout fraction time averaged	0 fraction

OUTPUT DATA

Flame emissive power	225.511 kW/m2
Fraction of emissivity	0.168114 fraction
Jet velocity	419.027 m/s
Flame length	27.7962 m
Frustum length	19.7339 m
Frustum base width	1.91171 m
Frustum tip width	5.01437 m
Frustum lift-off distance	8.35802 m
Flame length in still air	34.4599 m
Hole to flame angle	18.2151 deg
Expanded diameter	0.10126 m
Plane angular rotation	0 deg

Radiation Intensity Ellipse Results

INPUT DATA

For ellipses 'observer direction' refers to whether inclination is 'fixed' or 'variable'. Orientation is always variable.

Observer direction	Variable
Exposure duration	20 s
Height of interest	1 m

OUTPUT DATA

Radiation intensity

Incident radiation [kW/m2]	Lethality [%]	View factor	Probit	Dose [(W/m2)^ProbitN.s]	Ellipse half-length [m]	Ellipse half-width [m]	Ellipse centre downwind distance [m]	Effect downwind distance [m]	Ellipse area [m2]
3	0	0.0133031	-1.38321	865119	26.4036	34.6489	0	34.6489	2874.1
5	0.000174704	0.0221719	0.360367	1709491	21.5991	26.8633	0	26.8633	1822.82
7	0.02405	0.0310406	1.50883	2677313	19.1466	22.6328	0	22.6328	1361.38
12.5	6.52536	0.0554297	3.48789	5800162	15.8556	16.5581	0	16.5581	824.788

Radiation v Distance Results

INPUT DATA

Maximum distance	54.2061 m
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Observer type radiation modelling flag	Planar	
Observer direction	Variable	
Height of interest		1 m

OUTPUT DATA

Downwind distance [m]	Maximum incident radiation [kW/m2]	Lethality level [fraction]
-21.651	4.66461	5.40327E-07
-20.5448	5.57019	9.73529E-06
-19.4385	6.87467	0.000190593
-18.3323	8.90744	0.00380783
-17.226	12.4764	0.0644369
-16.1198	20.2378	0.552696
-15.0136	47.9797	0.998961
-13.9073	158.843	1
-12.8011	225.511	1
-11.6948	225.511	1
-10.5886	225.511	1
-9.48232	225.511	1
-8.37607	191.375	1
-7.26982	165.444	1
-6.16357	145.598	1
-5.05733	131.41	1
-3.95108	120.695	1
-2.84483	112.259	1
-1.73858	105.369	1
-0.632337	99.5034	1
0.473911	94.2203	1
1.58016	89.0275	1
2.68641	83.2188	1
3.79265	75.7289	0.999998
4.8989	65.2838	0.999982
6.00515	51.6615	0.999568
7.1114	36.8989	0.985467
8.21764	31.697	0.951933
9.32389	27.495	0.880696
10.4301	23.2872	0.729579
11.5364	19.5747	0.507489
12.6426	16.4725	0.284278
13.7489	13.9337	0.126831
14.8551	11.8677	0.0455833
15.9614	10.1841	0.0135008
17.0676	8.80816	0.00339564
18.1739	7.67092	0.000739579
19.2801	6.72661	0.000143319
20.3864	5.93707	2.52614E-05
21.4926	5.27184	4.12213E-06
22.5989	4.70732	6.32272E-07
23.7051	4.22511	9.23859E-08
24.8114	3.8105	1.29966E-08
25.9176	3.45185	0
27.0239	3.13983	0
28.1301	2.86693	0
29.2363	2.62705	0
30.3426	2.41519	0
31.4488	2.22725	0
32.5551	2.05984	0

Weather: Category 5/D

Wind speed [m/s]	5
Pasquill stability	D neutral - little sun and high wind or overcast/windy night
Atmospheric temperature [degC]	20
Relative humidity [fraction]	0.7
Solar radiation flux [kW/m2]	0.5

Jet fire model results

INPUT DATA

Scenario

Elevation	1 m
Release angle from horizontal	0 deg

Jet Fire Parameters

Jet fire method	Cone model
Wind orientation about the z-axis (anti-clockwise from the East)	0 deg
Rotation about the z-axis (anti-clockwise from the east)	0 deg
Rate modification factor	3

Calculated inputs

Mass flow rate	7.00647 kg/s
Temperature after atmospheric expansi	73.4827 degC

Liquid fraction	0	fraction
Velocity after atmospheric expansion (input)	419.027	m/s
Rainout fraction time averaged	0	fraction

OUTPUT DATA

Flame emissive power	215.25	kW/m2
Fraction of emissivity	0.164379	fraction
Jet velocity	419.027	m/s
Flame length	29.7622	m
Frustum length	21.5592	m
Frustum base width	1.91171	m
Frustum tip width	4.68043	m
Frustum lift-off distance	8.35802	m
Flame length in still air	34.4599	m
Hole to flame angle	13.0096	deg
Expanded diameter	0.10126	m
Plane angular rotation	0	deg

Radiation Intensity Ellipse Results

INPUT DATA

For ellipses 'observer direction' refers to whether inclination is 'fixed' or 'variable'. Orientation is always variable.

Observer direction	Variable	20 s
Exposure duration		
Height of interest		1 m

OUTPUT DATA

Radiation intensity

Incident radiation [kW/m2]	Lethality [%]	View factor	Probit	Dose [(W/m2)^ProbitN.s]	Ellipse half-length [m]	Ellipse half-width [m]	Ellipse centre downwind distance [m]	Effect downwind distance [m]	Ellipse area [m2]
3	0	0.0139373	-1.38321	865119	25.0051	34.3968	0	34.3968	2702.07
5	0.000174704	0.0232288	0.360367	1709491	21.0981	26.6403	0	26.6403	1765.76
7	0.02405	0.0325203	1.50883	2677313	19.0951	22.4049	0	22.4049	1344.05
12.5	6.52536	0.0580719	3.48789	5800162	16.398	16.2795	0	16.398	838.65

Radiation v Distance Results

INPUT DATA

Maximum distance	58.7277	m
Observer type radiation modelling flag	Planar	
Observer direction	Variable	
Height of interest	1	m

OUTPUT DATA

Downwind distance [m]	Maximum incident radiation [kW/m2]	Lethality level [fraction]
-22.5752	3.54312	0
-21.3767	4.37472	1.74098E-07
-20.1782	5.66352	1.25348E-05
-18.9796	7.89277	0.00103003
-17.7811	12.6612	0.0710017
-16.5826	27.1046	0.87069
-15.3841	82.1083	1
-14.1855	215.25	1
-12.987	215.25	1
-11.7885	215.25	1
-10.59	215.25	1
-9.39145	215.25	1
-8.19292	215.25	1
-6.9944	183.458	1
-5.79587	166.111	1
-4.59735	150.642	1
-3.39882	138.877	1
-2.2003	129.606	1
-1.00178	121.964	1
0.196749	115.571	1
1.39527	109.974	1
2.5938	104.7	1
3.79232	98.9288	1
4.99085	90.7413	1
6.18937	76.0192	0.999998
7.3879	51.933	0.999595
8.58642	40.2227	0.993375
9.78494	33.3286	0.966764
10.9835	26.4136	0.851182
12.182	20.8437	0.592185
13.3805	16.6055	0.293662
14.579	13.4058	0.101454
15.7776	10.9737	0.0251964
16.9761	9.10338	0.00473803
18.1746	7.64591	0.000711645
19.3731	6.4947	8.95435E-05
20.5717	5.57386	9.83392E-06



21.7702	4.82932	9.77924E-07
22.9687	4.21811	8.96065E-08
24.1672	3.71226	7.76467E-09
25.3658	3.28954	0
26.5643	2.93313	0
27.7628	2.63017	0
28.9613	2.3707	0
30.1599	2.14693	0
31.3584	1.95272	0
32.5569	1.78316	0
33.7554	1.63429	0
34.954	1.50298	0
36.1525	1.38657	0



Audit Number: 341
Date: 15/12/2023 Time: 09:01

Consequence Summary Report

Workspace: pm_rev1

Study: Study
Summary Basis

These tables will only report global values set in the parameters. Values that are modified in the study tree will not be reported.
The report is context sensitive, and filters up to the study level. You will need to generate multiple summary reports if you have multiple studies in your workspace.
The results in this report are from the non-CFD calculations only.

Discharge Results (after atmospheric expansion)

Path	Scenario	Weather	Peak Flowrate [kg/s]	Temperature [degC]	Liquid mass fraction in material [f]	Droplet diameter [um]	Expanded diameter [m]	Velocity [m/s]	End time of release [s]
Study\T3B	T3-2"leak vertical	Category 2/F	7.00647	73.4827	0	0	0.10126	419.027	62.8587
		Category 5/D	7.00647	73.4827	0	0	0.10126	419.027	62.8587

Dispersion Results

Input dispersion parameters

Core averaging time	18.75 s
Flammable averaging time	18.75 s
Toxic averaging time	600 s
Height of interest	1 m

Distance downwind to defined concentrations

The reported concentration of interest is defined at the scenario

Path	Scenario	Weather	Distance to UFL [m]	Distance to LFL [m]	Distance to LFL fraction [m]
Study\T3B	T3-2"leak vertical	Category 2/F	18.1132	62.855	87.8301
		Category 5/D	n/a	53.5652	76.9198

Jet Fire Results

Distance downwind to defined radiation levels

The reported radiations are defined in the parameters

Path	Scenario	Weather	Flame length [m]	Distance downwind to intensity level 1 (3 kW/m2) [m]	Distance downwind to intensity level 2 (5 kW/m2) [m]	Distance downwind to intensity level 3 (7 kW/m2) [m]	Distance downwind to intensity level 4 (12,5 kW/m2) [m]
Study\T3B	T3-2"leak vertical	Category 2/F	27.7962	34.6489	26.8633	22.6328	16.5581
		Category 5/D	29.7622	34.3968	26.6403	22.4049	16.398

Flash Fire Results

Distance downwind to defined concentrations

The reported LFL and LFL fraction are defined in the respective material property

Path	Scenario	Weather	Distance downwind to LFL [m]	Distance downwind to LFL Fraction [m]
Study\T3B	T3-2"leak vertical	Category 2/F	62.855	87.8301
		Category 5/D	53.5652	76.9198

Maximum distance to LFL fraction at any height

Path	Scenario	Weather	Max flash fire distance	Height of the max flash fire distance [m]	Time [s]
Study\T3B	T3-2"leak vertical	Category 2/F	93.9193	0	91.4635
		Category 5/D	80.8035	0	37.7152

Explosion Results

Explosion scenarios for worst-case maximum downwind distance to defined overpressures.

The reported overpressures are defined in the explosion parameters

Path	Scenario	Weather	Overpressure level [bar]	Maximum distance [m]	Diameter [m]
Study\T3B	T3-2"leak vertical	Category 2/F	0,02068	352,94	545,881
			0,1379	138,137	96,2737
			0,2068	126,091	72,1824
		Category 5/D	0,02068	231,096	302,192
			0,1379	109,366	58,733
			0,2068	102,018	44,0357

Supplementary data for worst-case explosion scenarios

Path	Scenario	Weather	Overpressure level [bar]	Explosion flammable mass [kg]	Ignition time [s]	Ignition source [m]	Cloud centre [m]	Explosion centre [m]
Study\T3B	T3-2"leak vertical	Category 2/F	0,02068	246,479	60,2941	80	41,4389	80
			0,1379	184,166	82,1174	90	52,0443	90
			0,2068	184,166	82,1174	90	52,0443	90
		Category 5/D	0,02068	41,8151	30,8659	80	32,441	80
			0,1379	41,8151	30,8659	80	32,441	80
			0,2068	41,8151	30,8659	80	32,441	80



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TOP EVENT 4



Audit Number: 290

Date: 27/12/2023 Time: 15:09

Discharge Report

Workspace: pm_rev0 - Copia

Study: Study

Equipment Item: T4A

pm_rev0 - Copia\Study\T4A

Material	ISOBUTANE	
East	0	m
North	0	m

Scenario (Leak) : T4-2''leak vertical

pm_rev0 - Copia\Study\T4A\T4-2''leak vertical

Weather: Category 2/F

INPUT DATA

Inventory data

Mass in vessel	2680	kg
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Stagnation Data (upstream end for long pipe)

Initial pressure (gauge)	28	bar
Initial temperature	80	degC
Fluid state	Non-saturated liquid	

Scenario data

Phase to be released	Liquid	
Tank head	0	m
Hole diameter	50.8	mm

OUTPUT DATA

Mass flow rate	66.8961	kg/s
Release duration	40.0621	s

Orifice or pipe exit data (before atmospheric expansion)

Pressure	1.01325	bar
Temperature	75.8823	degC
Liquid mass fraction	1	fraction
Velocity at vena contracta (at exit for pipe releases)	114.92	m/s
Discharge coefficient	0.6	



Final Data (after atmospheric expansion)

Temperature	-11.9098	degC
Liquid mass fraction	0.471676	fraction
Droplet diameter	67.7018	um
Expanded diameter	0.238851	m
Velocity	281.673	m/s

Weather: Category 5/D

INPUT DATA

Inventory data

Mass in vessel	2680	kg
----------------	-------------	----

Stagnation Data (upstream end for long pipe)

Initial pressure (gauge)	28	bar
Initial temperature	80	degC
Fluid state	Non-saturated liquid	

Scenario data

Phase to be released	Liquid	
Tank head	0	m
Hole diameter	50.8	mm

OUTPUT DATA

Mass flow rate	66.8961	kg/s
Release duration	40.0621	s

Orifice or pipe exit data (before atmospheric expansion)

Pressure	1.01325	bar
Temperature	75.8823	degC
Liquid mass fraction	1	fraction
Velocity at vena contracta (at exit for pipe releases)	114.92	m/s
Discharge coefficient	0.6	

Final Data (after atmospheric expansion)

Temperature	-11.9098	degC
Liquid mass fraction	0.471676	fraction
Droplet diameter	67.7018	um
Expanded diameter	0.238851	m
Velocity	281.673	m/s

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Audit Number: 290
Date: 27/12/2023 Time: 15:08

Explosion Report
Workspace: pm_rev0 - Copia
Study: Study
Equipment Item: T4A
pm_rev0 - Copia\Study\T4A

Material	ISOBUTANE	
East	0	m
North	0	m

Scenario (Leak) : T4-2''leak vertical
pm_rev0 - Copia\Study\T4A\T4-2''leak vertical
Weather: Category 2/F

Explosion location criterion	Cloud front (LFL fraction)	
Explosion height criterion	Centreline height	
Explosion method	Multi-Energy: Uniform confined	
Uniform confined method explosion efficiency	12.5	%
Uniform confined method explosion strength	10	

Time of explosion [s]	Distance to centre of mass [m]	Distance to explosion centre [m]	Distance to ignition point [m]	Flammable mass [kg]	Overpressures (input) [bar]	Distance to specified overpressures [m]
0.66141	9.50703	10	10	3.05242	0,02068 0,1379 0,2068	73,1475 22,2731 19,2019
0.66141	9.50703	20	20	3.05242	0,02068 0,1379 0,2068	83,1475 32,2731 29,2019
1.56839	13.8821	30	30	9.97343	0,02068 0,1379 0,2068	123,704 48,2119 43,6546
3.29074	18.8165	40	40	26.0641	0,02068 0,1379 0,2068	169,069 65,0854 58,8081
6.22198	25.2428	50	50	70.3479	0,02068 0,1379 0,2068	229,704 84,9267 76,1867
10.3341	29.8813	60	60	128.782	0,02068 0,1379 0,2068	279,833 102,726 92,0344
14.9944	34.0395	70	70	199.938	0,02068 0,1379 0,2068	324,55 119,474 107,093
19.8374	38.1165	80	80	276.233	0,02068 0,1379 0,2068	363,509 135,102 121,313
25.064	44.9062	90	90	429.481	0,02068 0,1379 0,2068	418,44 153,835 137,861
30.4416	49.0664	100	100	537.359	0,02068 0,1379 0,2068	453,913 168,785 151,573

36.0867	53.2209	110	110	647.139	0,02068 0,1379 0,2068	486,537 183,182 164,869
41.8653	55.9535	120	120	795.808	0,02068 0,1379 0,2068	523,408 198,405 178,785
47.8279	60.8454	130	130	888.957	0,02068 0,1379 0,2068	548,57 211,352 190,995
53.7778	67.3666	140	140	946.901	0,02068 0,1379 0,2068	567,474 223,082 202,292
67.7652	78.9133	150	150	919.42	0,02068 0,1379 0,2068	573,298 232,271 211,684
88.6722	94.7865	160	160	818.4	0,02068 0,1379 0,2068	567,189 239,14 219,336
109.579	110.66	170	170	717.379	0,02068 0,1379 0,2068	559,695 245,74 226,787

Weather: Category 5/D

Explosion location criterion	Cloud front (LFL fraction)	
Explosion height criterion	Centreline height	
Explosion method	Multi-Energy: Uniform confined	
Uniform confined method explosion efficien	12.5	%
Uniform confined method explosion strengt	10	

Time of explosion [s]	Distance to centre of mass [m]	Distance to explosion centre [m]	Distance to ignition point [m]	Flammable mass [kg]	Overpressures (input) [bar]	Distance to specified overpressures [m]
0.66141	11.5025	10	10	4.06018	0,02068 0,1379 0,2068	79,4475 23,4976 20,12
0.66141	11.5025	20	20	4.06018	0,02068 0,1379 0,2068	89,4475 33,4976 30,12
1.41085	16.8777	30	30	12.534	0,02068 0,1379 0,2068	131,12 49,6534 44,7354
2.52954	23.396	40	40	31.0187	0,02068 0,1379 0,2068	176,778 66,5837 59,9315
4.02966	30.2906	50	50	60.6413	0,02068 0,1379 0,2068	221,027 83,2402 74,9223
6.05592	36.6141	60	60	104.773	0,02068 0,1379 0,2068	265,222 99,8863 89,9052
8.64223	43.1405	70	70	172.742	0,02068 0,1379 0,2068	312,442 117,12 105,329
11.4442	49.745	80	80	249.889	0,02068 0,1379 0,2068	354,194 133,291 119,956
14.954	54.2125	90	90	311.332	0,02068 0,1379 0,2068	385,041 147,343 132,994
18.5225	58.503	100	100	371.472	0,02068 0,1379 0,2068	412,932 160,82 145,601



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					0,02068	434,608
					0,1379	173,09
22.4801	61.4271	110	110	414.623	0,2068	157,302
					0,02068	450,782
					0,1379	184,29
26.9153	62.102	120	120	438.734	0,2068	168,202
					0,02068	464,847
					0,1379	195,08
32.1922	62.135	130	130	455.108	0,2068	178,794
					0,02068	479,849
					0,1379	206,052
39.4809	62.4076	140	140	475.811	0,2068	189,523



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Jet Fire
Workspace: pm_rev0 - Copia
Study: Study
Equipment Item: T4A
pm_rev0 - Copia\Study\T4A

Material	ISOBUTANE	
East		0 m
North		0 m

Scenario (Leak) : T4-2"leak vertical

pm_rev0 - Copia\Study\T4A\T4-2"leak vertical

Weather: Category 2/F

Wind speed [m/s]	2
Pasquill stability	F stable - night with moderate clouds and light/moderate wind
Atmospheric temperature [degC]	20
Relative humidity [fraction]	0.7
Solar radiation flux [kW/m2]	0.5

Jet fire model results

INPUT DATA

Scenario

Elevation	1 m
Release angle from horizontal	0 deg

Jet Fire Parameters

Jet fire method	Cone model
Wind orientation about the z-axis (anti-clockwise from the East)	0 deg
Rotation about the z-axis (anti-clockwise from the east)	0 deg
Rate modification factor	3

Calculated inputs

Mass flow rate	66.8961 kg/s
Temperature after atmospheric expansion	-11.9098 degC
Liquid fraction	0.471676 fraction
Velocity after atmospheric expansion (input)	281.673 m/s
Rainout fraction time averaged	0.471676 fraction

OUTPUT DATA

Flame emissive power	317.684 kW/m2
Fraction of emissivity	0.323657 fraction
Jet velocity	281.673 m/s
Flame length	75.7704 m
Frustum length	74.6338 m
Frustum base width	0.440724 m
Frustum tip width	22.4281 m
Frustum lift-off distance	1.13656 m
Flame length in still air	68.1368 m
Hole to flame angle	0 deg
Expanded diameter	0.238851 m
Plane angular rotation	0 deg

Flame on ground impingement with partial truncation

Radiation Intensity Ellipse Results

INPUT DATA

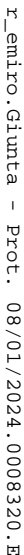
For ellipses 'observer direction' refers to whether inclination is 'fixed' or 'variable'. Orientation is always variable.

Observer direction	Variable
Exposure duration	20 s
Height of interest	1 m

OUTPUT DATA

Radiation intensity

Incident radiation [kW/m2]	Lethality [%]	View factor	Probit	Dose [(W/m2)^ProbitN]	Ellipse half-length [m]	Ellipse half-width [m]	Ellipse centre downwind distance [m]	Effect downwind distance [m]	Ellipse area [m2]
3	0	0.00944334	-1.38321	865119	95.4862	132.908	0	132.908	39869.6
5	0.000174704	0.0157389	0.360367	1709491	76.1875	102.768	0	102.768	24597.5



Radiation v Distance Results

Maximum distance	168.179 m
Observer type radiation modelling flag	Planar
Observer direction	Variable
Height of interest	1 m

Downwind distance [m]	Maximum incident radiation [kW/m ²]	Lethality level [fraction]
-67.6772	12.9975	0.0839647
-64.2449	317.684	1
-60.8127	317.684	1
-57.3805	317.684	1
-53.9482	317.684	1
-50.516	317.684	1
-47.0838	317.684	1
-43.6516	317.684	1
-40.2193	317.684	1
-36.7871	317.684	1
-33.3549	317.684	1
-29.9227	317.684	1
-26.4904	317.684	1
-23.0582	317.684	1
-19.626	317.684	1
-16.1937	317.684	1
-12.7615	317.684	1
-9.32929	317.684	1
-5.89706	317.684	1
-2.46484	317.684	1
0.967392	317.684	1
4.39962	317.684	1
7.83185	317.684	1
11.2641	163.222	1
14.6963	106.865	1
18.1285	80.8233	0.999999
21.5608	63.4583	0.999972
24.993	50.4131	0.999418
28.4252	40.5458	0.993865
31.8574	33.0271	0.964401
35.2897	27.2404	0.874252
38.7219	22.7357	0.701848
42.1541	19.1877	0.480303
45.5864	16.3594	0.276363
49.0186	14.0784	0.134316
52.4508	12.2196	0.05597
55.883	10.6886	0.020356
59.3153	9.41579	0.00658355
62.7475	8.34808	0.00192613
66.1797	7.44508	0.000517684
69.6119	6.67556	0.000129554
73.0442	6.0152	3.05426E-05
76.4764	5.4448	6.85119E-06
79.9086	4.94915	1.47484E-06
83.3409	4.51603	3.06913E-07
86.7731	4.13558	6.21277E-08
90.2053	3.79978	1.2299E-08
93.6375	3.50205	0
97.0698	3.23689	0
100.502	2.99993	0

Wind speed [m/s]	5
Pasquill stability	D neutral - little sun and high wind or overcast/windy night
Atmospheric temperature [degC]	20
Relative humidity [fraction]	0.7
Solar radiation flux [kW/m2]	0.5

Scenario		
Elevation	1	m
Release angle from horizontal	0	deg

Jet Fire Parameters

Jet fire method	Cone model	
Wind orientation about the z-axis (anti-clockwise from the East)		0 deg
Rotation about the z-axis (anti-clockwise from the east)		0 deg
Rate modification factor		3

Calculated inputs

Mass flow rate	66.8961	kg/s
Temperature after atmospheric expansion	-11.9098	degC
Liquid fraction	0.471676	fraction
Velocity after atmospheric expansion (input)	281.673	m/s
Rainout fraction time averaged	0.471676	fraction

OUTPUT DATA

Flame emissive power	350	kW/m2
Fraction of emissivity	0.323657	fraction
Jet velocity	281.673	m/s
Flame length	58.8984	m
Frustum length	58.0149	m
Frustum base width	0.727606	m
Frustum tip width	19.9627	m
Frustum lift-off distance	0.883476	m
Flame length in still air	68.1368	m
Hole to flame angle	0	deg
Expanded diameter	0.238851	m
Plane angular rotation	0	deg

Flame on ground impingement with partial truncation

Radiation Intensity Ellipse Results

INPUT DATA

For ellipses 'observer direction' refers to whether inclination is 'fixed' or 'variable'. Orientation is always variable.

Observer direction	Variable	
Exposure duration		20 s
Height of interest		1 m

OUTPUT DATA

Radiation intensity

Incident radiation [kW/m2]	Lethality [%]	View factor	Probit	Dose [(W/m2)^ProbitN]	Ellipse half-length [m]	Ellipse half-width [m]	Ellipse centre downwind distance [m]	Effect downwind distance [m]	Ellipse area [m2]
3	0	0.00857143	-1.38321	865119	89.0939	118.88	0	118.88	33274
5	0.000174704	0.0142857	0.360367	1709491	70.022	91.9326	0	91.9326	20223.4
7	0.02405	0.02	1.50883	2677313	60.6082	77.604	0	77.604	14776.3
12.5	6.52536	0.0357143	3.48789	5800162	50.816	58.9421	0	58.9421	9409.69

Radiation v Distance Results

INPUT DATA

Maximum distance	145.556	m
Observer type radiation modelling flag	Planar	
Observer direction	Variable	
Height of interest	1	m

OUTPUT DATA

Downwind distance [m]	Maximum incident radiation [kW/m2]	Lethality level [fraction]
-54.1081	48.5375	0.999091
-51.1376	350	1
-48.1671	350	1
-45.1965	350	1
-42.226	350	1
-39.2555	350	1
-36.2849	350	1
-33.3144	350	1
-30.3439	350	1
-27.3733	350	1
-24.4028	350	1
-21.4323	350	1
-18.4617	350	1
-15.4912	350	1
-12.5207	350	1
-9.55014	350	1
-6.57961	350	1
-3.60908	350	1
-0.638545	350	1
2.33199	350	1
5.30252	350	1
8.27305	167.736	1



11.2436	112.942	1
14.2141	86.1192	1
17.1847	68.4593	0.999991
20.1552	54.7058	0.99979
23.1257	44.2577	0.997471
26.0962	36.2546	0.9831
29.0668	30.06	0.93095
32.0373	25.2101	0.811204
35.0078	21.3692	0.624816
37.9784	18.2915	0.415799
40.9489	15.7972	0.237906
43.9194	13.7556	0.117931
46.89	12.0673	0.0513032
49.8605	10.6582	0.0198823
52.831	9.4722	0.00696956
55.8016	8.46602	0.00224067
58.7721	7.60612	0.000669011
61.7426	6.86622	0.000187573
64.7132	6.22557	4.98624E-05
67.6837	5.66762	1.26725E-05
70.6542	5.17904	3.10148E-06
73.6248	4.74905	7.35514E-07
76.5953	4.36884	1.69925E-07
79.5658	4.03116	3.84215E-08
82.5364	3.73003	8.53649E-09
85.5069	3.46039	0
88.4774	3.2182	0
91.448	2.99986	0



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Early Pool Fire Report
Workspace: pm_rev0 - Copia
Study: Study
Equipment Item: T4A
pm_rev0 - Copia\Study\T4A

Material	ISOBUTANE	
East		0 m
North		0 m

Scenario (Leak) : T4-2''leak vertical

pm_rev0 - Copia\Study\T4A\T4-2''leak vertical

Weather: Category 2/F

Wind speed [m/s]	2
Pasquill stability	F stable - night with moderate clouds and light/moderate wind
Atmospheric temperature [degC]	20
Relative humidity [fraction]	0.7
Solar radiation flux [kW/m2]	0.5

Pool fire model results

Early pool fires are assumed to occur at a time when the initial PVAP rainout rate equals the pool fire burn rate, unless the thus calculated pool fire radius exceeds the maximum PVAP pool radius. For the latter case the early pool fire radius is assumed to be the maximum PVAP pool radius. The pool fire centre is located at the rainout point.

INPUT DATA

Correlation Type: Thomas / Johnson

Surface type	Land	
Pool fire elevation		0 m
Maximum exposure duration		20 s
Downwind distance of liquid rainout		0 m
Use two zone pool fire model	Yes	

OUTPUT DATA

Pool fire diameter	18.2973	m
Downwind distance of pool fire centre	0	m
Pool fire flame length	38.8057	m
Angle between pool fire axis and vertical	30.4549	deg
Luminous flame emissive power	169.781	kW/m2
Smoky flame emissive power	0	kW/m2
Ratio of luminous flame length to the total flame length	1	fraction
Total burn rate	31.5533	kg/s
Radiative fraction	0.294493	fraction

Radiation Intensity Ellipse Results

INPUT DATA

For ellipses 'observer direction' refers to whether inclination is 'fixed' or 'variable'. Orientation is always variable.

Observer direction	Variable	
Exposure duration		20 s
Height of interest		1 m

OUTPUT DATA

Radiation intensity

Incident radiation [kW/m2]	Lethality [%]	View factor	Probit	Dose [(W/m2)^ProbitN.s]	Hazard information	Ellipse half-length [m]	Ellipse half-width [m]	Ellipse centre downwind distance [m]	Effect downwind distance [m]	Ellipse area [m2]
3	0	0.0176698	-1.38321	865119	-	90.2536	92.4574	13.7491	104.003	26215.4
5	0.000174704	0.0294497	0.360367	1709491	-	70.0348	71.6331	13.3616	83.3964	15760.8
7	0.02405	0.0412296	1.50883	2677313	-	59.3042	60.1247	13.3517	72.6558	11201.8
12.5	6.52536	0.0736243	3.48789	5800162	-	43.9166	43.4611	12.729	56.6456	5996.24

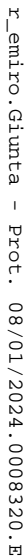
Radiation v Distance Results

INPUT DATA

Maximum distance	104.003	m
Angle from wind direction	0	deg
Observer direction	Variable	
Height of interest	1	m

OUTPUT DATA

Downwind distance [m]	Maximum incident radiation [kW/m2]	Lethality level [fraction]
0	169.781	1
2.1225	169.781	1
4.24501	169.781	1
6.36751	169.781	1
8.49002	169.781	1
10.6125	136.28	1
12.735	100.236	1
14.8575	82.2772	1
16.98	70.2554	0.999994
19.1025	61.7105	0.999959



Weather: Category 5/D

Pool fire model results

INPUT DATA

Correlation Type: Thomas / Johnson

OUTPUT DATA

Radiation Intensity Ellipse Results

INPUT DATA

For ellipses 'observer direction' refers to whether inclination is 'fixed' or 'variable'. Orientation is always variable.

OUTPUT DATA

OUTPUT DATA
Radiation intensity

Incident radiation [kW/m2]	Lethality [%]	View factor	Probit	Dose [(W/m2)^Probit]	Hazard information	Ellipse half-length [m]	Ellipse half-width [m]	Ellipse centre downwind distance [m]	Effect downwind distance [m]	Ellipse area [m2]
3	0	0.0176698	-1.38321	865119 -		85.8571	90.9927	19.9303	105.787	24543.3
5	0.000174704	0.0294497	0.360367	1709491 -		71.1568	67.6622	19.5432	87.2054	15125.6
7	0.02405	0.0412296	1.50883	2677313 -		57.7691	60.2451	19.097	76.8661	10933.7

12.5	6.52536	0.0736243	3.48789	5800162	-	43.7076	44.5328	17.6696	61.3772	6114.87
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Radiation v Distance Results

INPUT DATA

Maximum distance	105.787	m
Angle from wind direction	0	deg
Observer direction	Variable	
Height of interest	1	m

OUTPUT DATA

Downwind distance [m]	Maximum incident radiation [kW/m2]	Lethality level [fraction]
0	169.781	1
2.15893	169.781	1
4.31785	169.781	1
6.47678	169.781	1
8.6357	169.781	1
10.7946	134.492	1
12.9536	106.718	1
15.1125	91.2304	1
17.2714	80.5272	0.999999
19.4303	72.6803	0.999997
21.5893	65.6439	0.999983
23.7482	60.3957	0.999944
25.9071	55.3244	0.999818
28.066	51.2503	0.999523
30.225	48.0686	0.998983
32.3839	44.8937	0.997827
34.5428	42.2138	0.995878
36.7017	39.9055	0.992856
38.8607	37.3666	0.986978
41.0196	34.3039	0.973423
43.1785	31.1476	0.945667
45.3374	28.0921	0.894679
47.4964	25.224	0.811713
49.6553	22.5862	0.693995
51.8142	20.1958	0.549893
53.9731	18.0534	0.398441
56.1321	16.1484	0.26174
58.291	14.4641	0.1553
60.4499	12.9803	0.0832678
62.6088	11.9046	0.0466066
64.7678	10.9376	0.0245424
66.9267	10.0617	0.0121372
69.0856	9.26982	0.00566188
71.2445	8.55451	0.00250304
73.4035	7.90842	0.00105366
75.5624	7.32457	0.00042431
77.7213	6.79649	0.000164192
79.8802	6.31825	6.13099E-05
82.0392	5.88452	0.000022178
84.1981	5.49052	7.79996E-06
86.357	5.13198	2.67593E-06
88.5159	4.80512	8.98206E-07
90.6749	4.5066	2.95789E-07
92.8338	4.23345	9.57994E-08
94.9927	3.98306	3.05836E-08
97.1516	3.75309	9.64338E-09
99.3106	3.54152	0
101.469	3.34651	0
103.628	3.16647	0
105.787	2.99996	0



Audit Number: 290
Date: 27/12/2023 Time: 15:08

Consequence Summary Report

Workspace: pm_rev0 - Copia

Study: Study
Summary Basis

These tables will only report global values set in the parameters. Values that are modified in the study tree will not be reported.
The report is context sensitive, and filters up to the study level. You will need to generate multiple summary reports if you have multiple studies in your workspace.
The results in this report are from the non-CFD calculations only.

Discharge Results (after atmospheric expansion)

Path	Scenario	Weather	Peak Flowrate [kg/s]	Temperature [degC]	Liquid mass fraction in material [fraction]	Droplet diameter [m]	Expanded diameter [m]	Velocity [m/s]	End time of release [s]
Study\T4A	T4-2"leak vertical	Category 2/F	66.8961	-11.9098	0.471676	67.7018	0.238851	281.673	40.0621
		Category 5/D	66.8961	-11.9098	0.471676	67.7018	0.238851	281.673	40.0621

Dispersion Results

Input dispersion parameters

Core averaging time	18.75 s
Flammable averaging time	18.75 s
Toxic averaging time	600 s
Height of interest	1 m

Distance downwind to defined concentrations

The reported concentration of interest is defined at the scenario

Path	Scenario	Weather	Distance to UFL [m]	Distance to LFL [m]	Distance to LFL fraction [m]
Study\T4A	T4-2"leak vertical	Category 2/F	54.3168	131.367	159.635
		Category 5/D	43.7361	107.028	147.328

Jet Fire Results

Distance downwind to defined radiation levels

The reported radiations are defined in the parameters

Path	Scenario	Weather	Flame length [m]	Distance downwind to intensity level 1 (3 kW/m2) [m]	Distance downwind to intensity level 2 (5 kW/m2) [m]	Distance downwind to intensity level 3 (7 kW/m2) [m]	Distance downwind to intensity level 4 (12,5 kW/m2) [m]
Study\T4A	T4-2"leak vertical	Category 2/F	75.7704	132.908	102.768	87.346	67.1515
		Category 5/D	58.8984	118.88	91.9326	77.604	58.9421

Early Pool Fire Results

Distance downwind to defined radiation levels

The reported radiations are defined in the parameters

Path	Scenario	Weather	Pool diameter [m]	Distance downwind to intensity level 1 (3 kW/m2) [m]	Distance downwind to intensity level 2 (5 kW/m2) [m]	Distance downwind to intensity level 3 (7 kW/m2) [m]	Distance downwind to intensity level 4 (12,5 kW/m2) [m]
Study\T4A	T4-2"leak vertical	Category 2/F	18.2973	104.003	83.3964	72.6558	56.6456
		Category 5/D	18.2973	105.787	87.2054	76.8661	61.3772

Late Pool Fire Results

Distance downwind to defined radiation levels

The reported radiations are defined in the parameters

Path	Scenario	Weather	Pool diameter [m]	Distance downwind to intensity level 1 (3 kW/m2) [m]	Distance downwind to intensity level 2 (5 kW/m2) [m]	Distance downwind to intensity level 3 (7 kW/m2) [m]	Distance downwind to intensity level 4 (12,5 kW/m2) [m]
Study\T4A	T4-2"leak vertical	Category 2/F	21.5088	118.201	94.8487	82.5584	64.2618
		Category 5/D	21.3865	119.812	98.652	86.8724	69.2391

Flash Fire Results

Distance downwind to defined concentrations

The reported LFL and LFL fraction are defined in the respective material property

Path	Scenario	Weather	Distance downwind to LFL [m]	Distance downwind to LFL Fraction [m]
Study\T4A	T4-2"leak vertical	Category 2/F	131.367	159.635
		Category 5/D	107.028	147.328

Maximum distance to LFL fraction at any height

Path	Scenario	Weather	Max flash fire distance [m]	Height of the max flash fire distance [m]	Time [s]
Study\T4A	T4-2"leak vertical	Category 2/F	171.191	0	112.07
		Category 5/D	149.155	0	61.3675

Explosion Results

Explosion scenarios for worst-case maximum downwind distance to defined overpressures.

The reported overpressures are defined in the explosion parameters

Path	Scenario	Weather	Overpressure level [bar]	Maximum distance [m]	Diameter [m]
Study\T4A	T4-2"leak vertical	Category 2/F	0,02068	573,298	846,596
			0,1379	245,74	151,48
			0,2068	226,787	113,574
		Category 5/D	0,02068	479,849	679,698
			0,1379	206,052	132,104
			0,2068	189,523	99,0465

Supplementary data for worst-case explosion scenarios

Path	Scenario	Weather	Overpressure level [bar]	Explosion flammable mass [kg]	Ignition time [s]	Ignition source [m]	Cloud centre [m]	Explosion centre [m]
Study\T4A	T4-2"leak vertical	Category 2/F	0,02068	919,42	67,7652	150	78,9133	150
			0,1379	717,379	109,579	170	110,66	170
			0,2068	717,379	109,579	170	110,66	170
		Category 5/D	0,02068	475,811	39,4809	140	62,4076	140
			0,1379	475,811	39,4809	140	62,4076	140
			0,2068	475,811	39,4809	140	62,4076	140



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Discharge Report

Workspace: pm_rev0 - Copia

Study: Study

Equipment Item: T4B

pm_rev0 - Copia\Study\T4B

Material	ISOBUTANE	
East	0	m
North	0	m

Scenario (Leak) : T4-2"leak vertical

pm_rev0 - Copia\Study\T4B\T4-2"leak vertical

Weather: Category 2/F

INPUT DATA

Inventory data

Mass in vessel	371.687	kg
----------------	---------	----

Stagnation Data (upstream end for long pipe)

Initial pressure (gauge)	13.3	bar
Initial temperature	85	degC
Fluid state	Pressurized gas	

Scenario data

Phase to be released	Vapour	
Hole diameter	50.8	mm

OUTPUT DATA

Mass flow rate	7.71738	kg/s
Release duration	48.1623	s

Orifice or pipe exit data (before atmospheric expansion)

Pressure	8.84689	bar
Temperature	67.0043	degC
Liquid mass fraction	0	fraction
Velocity at vena contracta (at exit for pipe releases)	195.423	m/s
Discharge coefficient	0.893326	



Final Data (after atmospheric expansion)

Temperature	24.9833	degC
Liquid mass fraction	0	fraction
Droplet diameter	0	um
Expanded diameter	0.103138	m
Velocity	379.212	m/s

Weather: Category 5/D

INPUT DATA

Inventory data

Mass in vessel	371.687	kg
----------------	----------------	----

Stagnation Data (upstream end for long pipe)

Initial pressure (gauge)	13.3	bar
Initial temperature	85	degC
Fluid state	Pressurized gas	

Scenario data

Phase to be released	Vapour	
Hole diameter	50.8	mm

OUTPUT DATA

Mass flow rate	7.71738	kg/s
Release duration	48.1623	s

Orifice or pipe exit data (before atmospheric expansion)

Pressure	8.84689	bar
Temperature	67.0043	degC
Liquid mass fraction	0	fraction
Velocity at vena contracta (at exit for pipe releases)	195.423	m/s
Discharge coefficient	0.893326	

Final Data (after atmospheric expansion)

Temperature	24.9833	degC
Liquid mass fraction	0	fraction
Droplet diameter	0	um
Expanded diameter	0.103138	m
Velocity	379.212	m/s



Audit Number: 260
Date: 15/12/2023 Time: 09:35

Explosion Report
Workspace: pm_rev0 - Copia
Study: Study
Equipment Item: T4B
pm_rev0 - Copia\Study\T4B

Material	ISOBUTANE	
East		0 m
North		0 m

Scenario (Leak) : T4-2"leak vertical
pm_rev0 - Copia\Study\T4B\T4-2"leak vertical
Weather: Category 2/F

Explosion location criterion	Cloud front (LFL fraction)	
Explosion height criterion	Centreline height	
Explosion method	Multi-Energy: Uniform confined	
Uniform confined method explosion efficiency	12.5	%
Uniform confined method explosion strength	10	

Time of explosion [s]	Distance to centre of mass [m]	Distance to explosion centre [m]	Distance to ignition point [m]	Flammable mass [kg]	Overpressures (input) [bar]	Distance to specified overpressures [m]
0.7109	6.66686	10	10	1.16743	0,02068 0,1379 0,2068	55,8372 18,9088 16,6795
1.70874	10.1256	20	20	4.4222	0,02068 0,1379 0,2068	91,4531 33,8874 30,4122
5.27357	15.4999	30	30	16.839	0,02068 0,1379 0,2068	141,578 51,686 46,2593
11.4831	20.4034	40	40	40.3107	0,02068 0,1379 0,2068	189,262 69,01 61,7506
19.0689	25.8237	50	50	81.758	0,02068 0,1379 0,2068	238,937 86,7213 77,5322
27.1852	31.0533	60	60	128.529	0,02068 0,1379 0,2068	279,689 102,698 92,0134
40.243	35.0694	70	70	171.218	0,02068 0,1379 0,2068	311,726 116,981 105,225
60.134	46.1914	80	80	189.263	0,02068 0,1379 0,2068	329,937 128,577 116,421
84.0354	61.6616	90	90	126.125	0,02068 0,1379 0,2068	308,311 132,43 121,813

Weather: Category 5/D

Explosion location criterion	Cloud front (LFL fraction)	
Explosion height criterion	Centreline height	
Explosion method	Multi-Energy: Uniform confined	
Uniform confined method explosion efficiency	12.5	%
Uniform confined method explosion strength	10	



Time of explosion [s]	Distance to centre of mass [m]	Distance to explosion centre [m]	Distance to ignition point [m]	Flammable mass [kg]	Overpressures (input) [bar]	Distance to specified overpressures [m]
0.7109	9.27258	10	10	1.96884	0,02068 0,1379 0,2068	64,5605 20,6042 17,9506
1.26357	11.9661	20	20	4.40876	0,02068 0,1379 0,2068	91,3806 33,8733 30,4017
2.88424	18.4339	30	30	13.2746	0,02068 0,1379 0,2068	133,074 50,0331 45,0201
5.42793	24.846	40	40	26.8122	0,02068 0,1379 0,2068	170,292 65,3232 58,9864
8.88157	29.5353	50	50	38.4238	0,02068 0,1379 0,2068	196,895 78,5501 71,4058
13.1154	31.9449	60	60	43.9434	0,02068 0,1379 0,2068	213,617 89,8565 82,3853
19.8404	32.2801	70	70	44.6813	0,02068 0,1379 0,2068	224,472 100,023 92,5099



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Jet Fire
Workspace: pm_rev0 - Copia
Study: Study
Equipment Item: T4B
pm_rev0 - Copia\Study\T4B

Material	ISOBUTANE	
East		0 m
North		0 m

Scenario (Leak) : T4-2"leak vertical
pm_rev0 - Copia\Study\T4B\T4-2"leak vertical
Weather: Category 2/F
Wind speed [m/s] 2
Pasquill stability F stable - night with moderate clouds and light/moderate wind
Atmospheric temperature [degC] 20
Relative humidity [fraction] 0.7
Solar radiation flux [kW/m2] 0.5

Jet fire model results

INPUT DATA		
Scenario		
Elevation		1 m
Release angle from horizontal		0 deg

Jet Fire Parameters		
Jet fire method	Cone model	
Wind orientation about the z-axis (anti-clockwise from the East)		0 deg
Rotation about the z-axis (anti-clockwise from the east)		0 deg
Rate modification factor		3

Calculated inputs		
Mass flow rate	7.71738	kg/s
Temperature after atmospheric expansion	24.9833	degC
Liquid fraction	0	fraction
Velocity after atmospheric expansion (input)	379.212	m/s
Rainout fraction time averaged	0	fraction

OUTPUT DATA		
Flame emissive power	218.844	kW/m2
Fraction of emissivity	0.180364	fraction
Jet velocity	379.212	m/s
Flame length	29.425	m
Frustum length	21.4156	m
Frustum base width	2.13036	m
Frustum tip width	5.61617	m
Frustum lift-off distance	8.34466	m
Flame length in still air	36.6607	m
Hole to flame angle	19.1818	deg
Expanded diameter	0.103138	m
Plane angular rotation	0	deg

Flame on ground impingement with partial truncation
Radiation Intensity Ellipse Results
INPUT DATA
For ellipses 'observer direction' refers to whether inclination is 'fixed' or 'variable'. Orientation is always variable.

Observer direction	Variable	
Exposure duration	20	s
Height of interest	1	m

OUTPUT DATA									
Radiation intensity									
Incident radiation [kW/m2]	Lethality [%]	View factor	Probit	Dose [(W/m2)^ProbitN.s]	Ellipse half-length [m]	Ellipse half-width [m]	Ellipse centre downwind distance [m]	Effect downwind distance [m]	Ellipse area [m2]
3	0	0.0137084	-1.38321	865119	28.94	37.4838	0	37.4838	3407.94
5	0.000174704	0.0228473	0.360367	1709491	23.5971	29.059	0	29.059	2154.21
7	0.02405	0.0319862	1.50883	2677313	20.8607	24.4776	0	24.4776	1604.16
12.5	6.52536	0.0571183	3.48789	5800162	17.1884	17.891	0	17.891	966.095

Radiation v Distance Results
INPUT DATA



Maximum distance	57.1426	m
Observer type radiation modelling flag	Planar	
Observer direction	Variable	
Height of interest	1	m

OUTPUT DATA

Downwind distance [m]	Maximum incident radiation [kW/m2]	Lethality level [fraction]
-22.6917	5.34405	5.11351E-06
-21.5255	6.4519	8.18229E-05
-20.3593	8.09181	0.0013658
-19.1932	10.7463	0.0212763
-18.027	15.6868	0.230564
-16.8608	28.7345	0.908073
-15.6946	78.6679	0.999999
-14.5285	212.914	1
-13.3623	218.844	1
-12.1961	218.844	1
-11.0299	218.844	1
-9.86377	209.512	1
-8.69759	175.26	1
-7.53142	150.847	1
-6.36524	134.142	1
-5.19907	121.823	1
-4.03289	112.405	1
-2.86672	104.885	1
-1.70054	98.66	1
-0.53437	93.2882	1
0.631805	88.3754	1
1.79798	83.4801	1
2.96415	77.9918	0.999999
4.13033	71.0558	0.999995
5.2965	61.7481	0.999959
6.46268	49.9573	0.999352
7.62885	37.1267	0.986223
8.79503	30.4097	0.936043
9.9612	26.756	0.861144
11.1274	23.1932	0.72499
12.2936	19.7803	0.521708
13.4597	16.8417	0.310468
14.6259	14.3822	0.150719
15.7921	12.3458	0.0600351
16.9583	10.663	0.0199576
18.1244	9.27219	0.005676
19.2906	8.11202	0.00140443
20.4568	7.14122	0.000309727
21.623	6.32364	0.00006204
22.7891	5.63107	1.14896E-05
23.9553	5.04049	1.99514E-06
25.1215	4.53378	3.289E-07
26.2877	4.09646	5.2009E-08
27.4538	3.71696	7.96225E-09
28.62	3.38585	0
29.7862	3.09552	0
30.9524	2.83973	0
32.1185	2.61337	0
33.2847	2.4122	0
34.4509	2.23272	0

Weather: Category 5/D

Wind speed [m/s]	5
Pasquill stability	D
Atmospheric temperature [degC]	20
Relative humidity [fraction]	0.7
Solar radiation flux [kW/m2]	0.5

D neutral - little sun and high wind or overcast/windy night

Jet fire model results

INPUT DATA

Scenario	1
Elevation	1 m
Release angle from horizontal	0 deg

Jet Fire Parameters

Jet fire method	Cone model
Wind orientation about the z-axis (anti-clockwise from the East)	0 deg
Rotation about the z-axis (anti-clockwise from the east)	0 deg
Rate modification factor	3

Calculated inputs

Mass flow rate	7.71738 kg/s
Temperature after atmospheric expansion	24.9833 degC

Liquid fraction		0	fraction
Velocity after atmospheric expansion (input)		379.212	m/s
Rainout fraction time averaged		0	fraction

OUTPUT DATA

Flame emissive power		208.462	kW/m2
Fraction of emissivity		0.176639	fraction
Jet velocity		379.212	m/s
Flame length		31.8031	m
Frustum length		23.6161	m
Frustum base width		2.13036	m
Frustum tip width		5.21388	m
Frustum lift-off distance		8.34466	m
Flame length in still air		36.6607	m
Hole to flame angle		12.9704	deg
Expanded diameter		0.103138	m
Plane angular rotation		0	deg

Flame on ground impingement with partial truncation

Radiation Intensity Ellipse Results

INPUT DATA

For ellipses 'observer direction' refers to whether inclination is 'fixed' or 'variable'. Orientation is always variable.

Observer direction	Variable		
Exposure duration		20	s
Height of interest		1	m

OUTPUT DATA

Radiation intensity

Incident radiation [kW/m2]	Lethality [%]	View factor	Probit	Dose [(W/m2)^ProbitN.s]	Ellipse half-length [m]	Ellipse half-width [m]	Ellipse centre downwind distance [m]	Effect downwind distance [m]	Ellipse area [m2]
3	0	0.0143911	-1.38321	865119	27.2329	37.2485	0	37.2485	3186.79
5	0.000174704	0.0239852	0.360367	1709491	22.9986	28.854	0	28.854	2084.77
7	0.02405	0.035792	1.50883	2677313	20.8245	24.2626	0	24.2626	1587.31
12.5	6.52536	0.0599629	3.48789	5800162	17.9009	17.6143	0	17.9009	990.58

Radiation v Distance Results

INPUT DATA

Maximum distance		62.7165	m
Observer type radiation modelling flag	Planar		
Observer direction	Variable		
Height of interest		1	m

OUTPUT DATA

Downwind distance [m]	Maximum incident radiation [kW/m2]	Lethality level [fraction]
-23.8759	3.95984	2.73514E-08
-22.596	4.99415	1.71358E-06
-21.3161	6.67511	0.000129437
-20.0361	9.83899	0.00992547
-18.7562	17.9996	0.394516
-17.4763	44.0116	0.997317
-16.1963	147.005	1
-14.9164	208.462	1
-13.6365	208.462	1
-12.3566	208.462	1
-11.0766	208.462	1
-9.7967	208.462	1
-8.51677	195.213	1
-7.23684	174.174	1
-5.95692	159.421	1
-4.67699	145.485	1
-3.39706	134.726	1
-2.11713	126.116	1
-0.837199	119.034	1
0.44273	113.014	1
1.72266	107.954	1
3.00259	102.671	1
4.28252	97.1093	1
5.56245	89.1764	1
6.84238	74.9045	0.999998
8.12231	51.4849	0.999549
9.40223	39.833	0.992732
10.6822	33.2672	0.966295
11.9621	26.5252	0.854494
13.242	21.0387	0.604477
14.522	16.829	0.309563
15.8019	13.6314	0.111923
17.0818	11.1883	0.0293462
18.3617	9.3017	0.00585395
19.6417	7.82627	0.000934444
20.9216	6.6574	0.000124941
22.2015	5.7202	1.45636E-05



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23.4815	4.95959	1.52742E-06
24.7614	4.33654	1.48601E-07
26.0413	3.81901	1.35766E-08
27.3212	3.38602	0
28.6012	3.02057	0
29.8811	2.70965	0
31.161	2.44317	0
32.441	2.2132	0
33.7209	2.01349	0
35.0008	1.83905	0
36.2807	1.68586	0
37.5607	1.55063	0
38.8406	1.43074	0



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Date: 15/12/2023 Time: 09:35

Consequence Summary Report

Workspace: pm_rev0 - Copia

Study: Study

Summary Basis

These tables will only report global values set in the parameters. Values that are modified in the study tree will not be reported.
The report is context sensitive, and filters up to the study level. You will need to generate multiple summary reports if you have multiple studies in your workspace.
The results in this report are from the non-CFD calculations only.

Discharge Results (after atmospheric expansion)

Path	Scenario	Weather	Peak Flowrate [kg/s]	Temperature [degC]	Liquid mass fraction in material [fraction]	Droplet diameter [um]	Expanded diameter [m]	Velocity [m/s]	End time of release [s]
Study\T4B	T4-2"leak vertical	Category 2/F	7.71738	24.9833	0	0	0.103138	379.212	48.1623
		Category 5/D	7.71738	24.9833	0	0	0.103138	379.212	48.1623

Dispersion Results

Input dispersion parameters

Core averaging time	18.75 s
Flammable averaging time	18.75 s
Toxic averaging time	600 s
Height of interest	1 m

Distance downwind to defined concentrations

The reported concentration of interest is defined at the scenario

Path	Scenario	Weather	Distance to UFL [m]	Distance to LFL [m]	Distance to LFL fraction [m]
Study\T4B	T4-2"leak vertical	Category 2/F	15.5226	58.7531	86.629
		Category 5/D	n/a	51.9173	74.8254

Jet Fire Results

Distance downwind to defined radiation levels

The reported radiations are defined in the parameters

Path	Scenario	Weather	Flame length [m]	Distance downwind to intensity level 1 (3 kW/m2) [m]	Distance downwind to intensity level 2 (5 kW/m2) [m]	Distance downwind to intensity level 3 (7 kW/m2) [m]	Distance downwind to intensity level 4 (12,5 kW/m2) [m]
Study\T4B	T4-2"leak vertical	Category 2/F	29.425	37.4838	29.059	24.4776	17.891
		Category 5/D	31.8031	37.2485	28.854	24.2626	17.9009

Flash Fire Results

Distance downwind to defined concentrations

The reported LFL and LFL fraction are defined in the respective material property

Path	Scenario	Weather	Distance downwind to LFL [m]	Distance downwind to LFL Fraction [m]
Study\T4B	T4-2"leak vertical	Category 2/F	58.7531	86.629
		Category 5/D	51.9173	74.8254

Maximum distance to LFL fraction at any height

Path	Scenario	Weather	Max flash fire distance [m]	Height of the max flash fire distance [m]	Time [s]
Study\T4B	T4-2"leak vertical	Category 2/F	93.1774	0	113.607
		Category 5/D	78.8569	0	38.5298

Explosion Results

Explosion scenarios for worst-case maximum downwind distance to defined overpressures.

The reported overpressures are defined in the explosion parameters

Path	Scenario	Weather	Overpressure level [bar]	Maximum distance [m]	Diameter [m]
Study\T4B	T4-2"leak vertical	Category 2/F	0,02068	329,937	499,873
			0,1379	132,43	84,8603
		Category 5/D	0,2068	121,813	63,625
			0,02068	224,472	308,944
			0,1379	100,023	60,0454
			0,2068	92,5099	45,0197

Supplementary data for worst-case explosion scenarios

Path	Scenario	Weather	Overpressure level [bar]	Explosion flammable mass [kg]	Ignition time [s]	Ignition source [m]	Cloud centre [m]	Explosion centre [m]
Study\T4B	T4-2"leak vertical	Category 2/F	0,02068	189,263	60,134	80	46,1914	80
			0,1379	126,125	84,0354	90	61,6616	90
			0,2068	126,125	84,0354	90	61,6616	90
			0,02068	44,6813	19,8404	70	32,2801	70
		Category 5/D	0,1379	44,6813	19,8404	70	32,2801	70
			0,2068	44,6813	19,8404	70	32,2801	70



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TOP EVENT 7



Audit Number: 253

Date: 15/12/2023 Time: 09:28

Discharge Report

Workspace: pm_rev0 - Copia

Study: Study

Equipment Item: T7

pm_rev0 - Copia\Study\T7

Material	ISOBUTANE	
East	0	m
North	0	m

Scenario (Leak) : T7-2"leak vertical

pm_rev0 - Copia\Study\T7\T7-2"leak vertical

Weather: Category 2/F

INPUT DATA

Inventory data

Mass in vessel	2789.35	kg
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Stagnation Data (upstream end for long pipe)

Initial pressure (gauge)	5	bar
Initial temperature	20	degC
Fluid state	Non-saturated liquid	

Scenario data

Phase to be released	Liquid	
Tank head	0	m
Hole diameter	50.8	mm

OUTPUT DATA

Mass flow rate	29.7582	kg/s
Release duration	93.7338	s

Orifice or pipe exit data (before atmospheric expansion)

Pressure	1.01325	bar
Temperature	19.6932	degC
Liquid mass fraction	1	fraction
Velocity at vena contracta (at exit for pipe releases)	43.8343	m/s
Discharge coefficient	0.6	



Final Data (after atmospheric expansion)

Temperature	-11.9098	degC
Liquid mass fraction	0.813466	fraction
Droplet diameter	219.48	um
Expanded diameter	0.159731	m
Velocity	100.536	m/s

Weather: Category 5/D

INPUT DATA

Inventory data

Mass in vessel	2789.35	kg
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Stagnation Data (upstream end for long pipe)

Initial pressure (gauge)	5	bar
Initial temperature	20	degC
Fluid state	Non-saturated liquid	

Scenario data

Phase to be released	Liquid	
Tank head	0	m
Hole diameter	50.8	mm

OUTPUT DATA

Mass flow rate	29.7582	kg/s
Release duration	93.7338	s

Orifice or pipe exit data (before atmospheric expansion)

Pressure	1.01325	bar
Temperature	19.6932	degC
Liquid mass fraction	1	fraction
Velocity at vena contracta (at exit for pipe releases)	43.8343	m/s
Discharge coefficient	0.6	

Final Data (after atmospheric expansion)

Temperature	-11.9098	degC
Liquid mass fraction	0.813466	fraction
Droplet diameter	219.48	um
Expanded diameter	0.159731	m
Velocity	100.536	m/s



DNV

Audit Number: 253

Date: 15/12/2023 Time: 09:29

Explosion Report

Workspace: pm_rev0 - Copia

Study: Study

Equipment Item: T7

pm_rev0 - Copia\Study\T7

Material	ISOBUTANE	
East		0 m
North		0 m

Scenario (Leak) : T7-2"leak vertical
pm_rev0 - Copia\Study\T7\T7-2"leak vertical
Weather: Category 2/F

Explosion location criterion	Cloud front (LFL fraction)	
Explosion height criterion	Centreline height	
Explosion method	Multi-Energy: Uniform confined	
Uniform confined method explosion efficiency		12.5 %
Uniform confined method explosion strength		10

Time of explosion [s]	Distance to centre of mass [m]	Distance to explosion centre [m]	Distance to ignition point [m]	Flammable mass [kg]	Overpressures (input) [bar]	Distance to specified overpressures [m]
0.737821	4.48005	10	10	0.349771	0,02068 0,1379 0,2068	40,6716 15,9612 14,4695
3.66896	8.91774	20	20	3.42217	0,02068 0,1379 0,2068	85,6007 32,7499 29,5594
9.47355	12.8754	30	30	12.3798	0,02068 0,1379 0,2068	130,704 49,5725 44,6747
16.608	16.7586	40	40	27.4324	0,02068 0,1379 0,2068	171,289 65,517 59,1316
26.8486	20.256	50	50	46.0919	0,02068 0,1379 0,2068	206,081 80,3354 72,7443
41.9322	24.9709	60	60	90.9086	0,02068 0,1379 0,2068	255,739 98,0431 88,5233
57.0266	29.762	70	70	141.719	0,02068 0,1379 0,2068	296,961 114,111 103,073
71.5964	35.0268	80	80	206.134	0,02068 0,1379 0,2068	337,153 129,979 117,473
84.1815	38.3835	90	90	265.087	0,02068 0,1379 0,2068	369,643 144,351 130,75
94.3817	43.5928	100	100	348.969	0,02068 0,1379 0,2068	406,481 159,567 144,661
105.941	44.7931	110	110	459.215	0,02068 0,1379 0,2068	445,851 175,275 158,941
117.975	48.3274	120	120	556.204	0,02068 0,1379 0,2068	478,003 189,58 172,169
130.009	51.8617	130	130	653.193	0,02068 0,1379 0,2068	507,707 203,41 185,04

Weather: Category 5/D

Explosion location criterion	Cloud front (LFL fraction)	
Explosion height criterion	Centreline height	
Explosion method	Multi-Energy: Uniform confined	
Uniform confined method explosion efficiency		12.5 %
Uniform confined method explosion strength		10

Time of explosion [s]	Distance to centre of mass [m]	Distance to explosion centre [m]	Distance to ignition point [m]	Flammable mass [kg]	Overpressures (input) [bar]	Distance to specified overpressures [m]
0.670581	5.27606	10	10	0.419946	0,02068 0,1379 0,2068	42,5991 16,3359 14,7504
2.50182	11.5386	20	20	3.98019	0,02068 0,1379 0,2068	88,9884 33,4084 30,0531
5.54954	18.4273	30	30	16.7152	0,02068 0,1379 0,2068	141,304 51,6327 46,2194
9.56973	22.5946	40	40	30.7923	0,02068 0,1379 0,2068	176,444 66,5189 59,8828
14.8342	23.3069	50	50	38.9649	0,02068 0,1379 0,2068	197,582 78,6835 71,5058
24.7413	23.0157	60	60	51.1354	0,02068 0,1379 0,2068	221,578 91,4038 83,5453
77.7046	21.6788	70	70	109.097	0,02068 0,1379 0,2068	278,007 110,428 100,311



Audit Number: 253
Date: 15/12/2023 Time: 09:29

Jet Fire
Workspace: pm_rev0 - Copia
Study: Study
Equipment Item: T7
pm_rev0 - Copia\Study\T7

Material	ISOBUTANE	
East		0 m
North		0 m

Scenario (Leak) : T7-2"leak vertical
pm_rev0 - Copia\Study\T7\T7-2"leak vertical

Weather: Category 2/F	
Wind speed [m/s]	2
Pasquill stability	F stable - night with moderate clouds and light/moderate wind
Atmospheric temperature [degC]	20
Relative humidity [fraction]	0.7
Solar radiation flux [kW/m2]	0.5

Jet fire model results

INPUT DATA

Scenario		1 m
Release angle from horizontal		0 deg

Jet Fire Parameters

Jet fire method	Cone model	
Wind orientation about the z-axis (anti-clockwise from the East)		0 deg
Rotation about the z-axis (anti-clockwise from the east)		0 deg
Rate modification factor		3

Calculated inputs

Mass flow rate	16.6528	kg/s
Temperature after atmospheric expansion	-11.9098	degC
Liquid fraction	0.813466	fraction
Velocity after atmospheric expansion (input)	100.536	m/s
Rainout fraction time averaged	0.813466	fraction

OUTPUT DATA

Flame emissive power	215.19	kW/m2
Fraction of emissivity	0.435495	fraction
Jet velocity	100.536	m/s
Flame length	48.2863	m
Frustum length	47.562	m
Frustum base width	0.650005	m
Frustum tip width	16.715	m
Frustum lift-off distance	0.724295	m
Flame length in still air	43.4216	m
Hole to flame angle		0 deg
Expanded diameter	0.119489	m
Plane angular rotation		0 deg

Flame on ground impingement with partial truncation

Radiation Intensity Ellipse Results

INPUT DATA

For ellipses 'observer direction' refers to whether inclination is 'fixed' or 'variable'. Orientation is always variable.

Observer direction	Variable	
Exposure duration		20 s
Height of interest		1 m

OUTPUT DATA

Radiation intensity

Incident radiation [kW/m2]	Lethality [%]	View factor	Probit	Dose [(W/m2)^ProbitN.s]	Ellipse half-length [m]	Ellipse half-width [m]	Ellipse centre downwind distance [m]	Effect downwind distance [m]	Ellipse area [m2]
3	0	0.0139412	-1.38321	865119	59.7203	78.0803	0	78.0803	14649.2
5	0.000174704	0.0232353	0.360367	1709491	48.084	60.3774	0	60.3774	9120.63
7	0.02405	0.0325294	1.50883	2677313	43.4012	51.3253	0	51.3253	6998.16
12.5	6.52536	0.0580882	3.48789	5800162	37.6629	39.5803	0	39.5803	4683.21

Radiation v Distance Results

INPUT DATA

Maximum distance	105.738	m
Observer type radiation modelling flag	Planar	

Observer direction	Variable	
Height of interest		1 m

OUTPUT DATA

Downwind distance [m]	Maximum incident radiat	Lethality level [fraction]
-42.2703	34.8157	0.976384
-40.1123	215.19	1
-37.9544	215.19	1
-35.7965	215.19	1
-33.6386	215.19	1
-31.4806	215.19	1
-29.3227	215.19	1
-27.1648	215.19	1
-25.0069	215.19	1
-22.8489	215.19	1
-20.691	215.19	1
-18.5331	215.19	1
-16.3751	215.19	1
-14.2172	215.19	1
-12.0593	215.19	1
-9.90135	215.19	1
-7.74343	215.19	1
-5.5855	215.19	1
-3.42757	215.19	1
-1.26964	215.19	1
0.888287	215.19	1
3.04622	215.19	1
5.20414	215.19	1
7.36207	177.441	1
9.52	97.6997	1
11.6779	70.6768	0.999995
13.8359	54.7816	0.999793
15.9938	44.8623	0.997811
18.1517	36.8072	0.985151
20.3096	30.478	0.936997
22.4676	25.4783	0.820814
24.6255	21.5006	0.632724
26.7834	18.3096	0.417115
28.9414	15.7269	0.233222
31.0993	13.6182	0.111295
33.2572	11.8809	0.0459472
35.4151	10.4369	0.0166769
37.5731	9.22783	0.00541648
39.731	8.20709	0.00159841
41.8889	7.33896	0.000434649
44.0469	6.5958	0.000110331
46.2048	5.95545	2.64257E-05
48.3627	5.40038	6.02904E-06
50.5206	4.91654	1.32102E-06
52.6786	4.4926	2.79936E-07
54.8365	4.11931	5.77192E-08
56.9944	3.78913	1.16398E-08
59.1524	3.49582	0
61.3103	3.23421	0
63.4682	3	0

Weather: Category 5/D

Wind speed [m/s]	5
Pasquill stability	D neutral - little sun and high wind or overcast/windy night
Atmospheric temperature [degC]	20
Relative humidity [fraction]	0.7
Solar radiation flux [kW/m2]	0.5

Jet fire model results

INPUT DATA

Scenario

Elevation	1 m
Release angle from horizontal	0 deg

Jet Fire Parameters

Jet fire method	Cone model
Wind orientation about the z-axis (anti-clockwise from the East)	0 deg
Rotation about the z-axis (anti-clockwise from the east)	0 deg
Rate modification factor	3

Calculated inputs

Mass flow rate	16.6528 kg/s
Temperature after atmospheric expansion	-11.9098 degC
Liquid fraction	0.813466 fraction
Velocity after atmospheric expansion (input)	100.536 m/s
Rainout fraction time averaged	0.813466 fraction

OUTPUT DATA

Flame emissive power	282.751	kW/m2
Fraction of emissivity	0.435495	fraction
Jet velocity	100.536	m/s
Flame length	37.5343	m
Frustum length	36.9713	m
Frustum base width	1.0764	m
Frustum tip width	15.4788	m
Frustum lift-off distance	0.563014	m
Flame length in still air	43.4216	m
Hole to flame angle	0	deg
Expanded diameter	0.119489	m
Plane angular rotation	0	deg

Flame on ground impingement with partial truncation

Radiation Intensity Ellipse Results

INPUT DATA

For ellipses 'observer direction' refers to whether inclination is 'fixed' or 'variable'. Orientation is always variable.

Observer direction	Variable	
Exposure duration	20	s
Height of interest	1	m

OUTPUT DATA

Radiation intensity

Incident radiation [kW/m2]	Lethality [%]	View factor	Probit	Dose [(W/m2) ^ProbitN.s]	Ellipse half-length [m]	Ellipse half-width [m]	Ellipse centre downwind distance [m]	Effect downwind distance [m]	Ellipse area [m2]
3	0	0.01061	-1.38321	865119	62.8871	78.3908	0	78.3908	15487.3
5	0.000174704	0.0176834	0.360367	1709491	49.2685	60.6153	0	60.6153	9382.13
7	0.02405	0.0247567	1.50883	2677313	42.3064	51.1086	0	51.1086	6792.81
12.5	6.52536	0.0442085	3.48789	5800162	34.413	38.4939	0	38.4939	4161.63

Radiation v Distance Results

INPUT DATA

Maximum distance	98.5742	m
Observer type radiation modelling flag	Planar	
Observer direction	Variable	
Height of interest	1	m

OUTPUT DATA

Downwind distance [m]	Maximum incident radiation [kW/m2]	Lethality level [fraction]
-34.3701	132.742	1
-32.3583	282.751	1
-30.3466	282.751	1
-28.3349	282.751	1
-26.3232	282.751	1
-24.3115	282.751	1
-22.2998	282.751	1
-20.288	282.751	1
-18.2763	282.751	1
-16.2646	282.751	1
-14.2529	282.751	1
-12.2412	282.751	1
-10.2295	282.751	1
-8.21773	282.751	1
-6.20602	282.751	1
-4.1943	282.751	1
-2.18258	282.751	1
-0.170864	282.751	1
1.84085	282.751	1
3.85257	282.751	1
5.86429	151.304	1
7.87601	101.503	1
9.88772	74.6315	0.999998
11.8994	62.3611	0.999965
13.9112	50.8269	0.999473
15.9229	41.8561	0.99551
17.9346	34.8227	0.976422
19.9463	29.2642	0.917936
21.958	24.8308	0.796899
23.9697	21.261	0.618229
25.9815	18.3589	0.420701
27.9932	15.9778	0.250073
30.0049	14.0062	0.130553
32.0166	12.3592	0.060479
34.0283	10.9734	0.0251908
36.04	9.79779	0.00955245
38.0518	8.79342	0.00333763
40.0635	7.92989	0.00108682
42.0752	7.18274	0.00033305
44.0869	6.53257	9.68919E-05
46.0986	5.96374	2.69662E-05
48.1104	5.46359	7.22784E-06
50.1221	5.02175	1.87663E-06
52.1338	4.62971	4.74385E-07
54.1455	4.28043	1.17266E-07



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56.1572	3.96804	2.84558E-08
58.1689	3.68763	0
60.1807	3.43506	0
62.1924	3.20684	0
64.2041	2.99999	0



Audit Number: 253
Date: 15/12/2023 Time: 09:29

Early Pool Fire Report
Workspace: pm_rev0 - Copia
Study: Study
Equipment Item: T7
pm_rev0 - Copia\Study\T7

Material	ISOBUTANE
East	0 m
North	0 m

Scenario (Leak) : T7-2''leak vertical
pm_rev0 - Copia\Study\T7\T7-2''leak vertical
Weather: Category 2/F

Wind speed [m/s]	2
Pasquill stability	F stable - night with moderate clouds and light/moderate wind
Atmospheric temperature [degC]	20
Relative humidity [fraction]	0.7
Solar radiation flux [kW/m2]	0.5

Pool fire model results

Early pool fires are assumed to occur at a time when the initial PVAP rainout rate equals the pool fire burn rate, unless the thus calculated pool fire radius exceeds the maximum PVAP pool radius. For the latter case the early pool fire radius is assumed to be the maximum PVAP pool radius. The pool fire centre is located at the rainout point.

INPUT DATA

Correlation Type: Thomas / Johnson

Surface type	Land
Pool fire elevation	0 m
Maximum exposure duration	20 s
Downwind distance of liquid rainout	0 m
Use two zone pool fire model	Yes

OUTPUT DATA

Pool fire diameter	16.0265 m
Downwind distance of pool fire centre	0 m
Pool fire flame length	35.3915 m
Angle between pool fire axis and vertical	31.2992 deg
Luminous flame emissive power	169.499 kW/m2
Smoky flame emissive power	0 kW/m2
Ratio of luminous flame length to the total flame length	1 fraction
Total burn rate	24.2073 kg/s
Radiative fraction	0.304852 fraction

Radiation Intensity Ellipse Results

INPUT DATA

For ellipses 'observer direction' refers to whether inclination is 'fixed' or 'variable'. Orientation is always variable.

Observer direction	Variable
Exposure duration	20 s
Height of interest	1 m

OUTPUT DATA

Radiation intensity

Incident radiation [kW/m2]	Lethality [%]	View factor	Probit	Dose [(W/m2)^ProbitN.s]	Hazard information	Ellipse half-length [m]	Ellipse half-width [m]	Ellipse centre downwind distance [m]	Effect downwind distance [m]	Ellipse area [m2]
3	0	0.0176992	-1.38321	865119	-	80.811	82.8592	12.799	93.61	21035.9
5	0.000174704	0.0294986	0.360367	1709491	-	62.6604	64.1476	12.3999	75.0604	12627.7
7	0.02405	0.0412981	1.50883	2677313	-	53.0469	53.8095	12.363	65.4099	8967.44
12.5	6.52536	0.0737466	3.48789	5800162	-	39.3083	38.8459	11.7654	51.0737	4797.11

Radiation v Distance Results

INPUT DATA

Maximum distance	93.61 m
Angle from wind direction	0 deg
Observer direction	Variable
Height of interest	1 m

OUTPUT DATA

Downwind distance [m]	Maximum incident radiation [kW/m2]	Lethality level
0	169.499	1
1.91041	169.499	1
3.82082	169.499	1
5.73122	169.499	1
7.64163	169.499	1
9.55204	132.737	1
11.4624	99.5712	1
13.3729	81.9616	1
15.2833	70.2167	0.999994



17.1937	61.5546	0.999957
19.1041	54.9959	0.999803
21.0145	49.5939	0.999293
22.9249	44.963	0.997863
24.8353	41.3416	0.994924
26.7457	38.1566	0.98919
28.6561	35.0243	0.977498
30.5665	32.0773	0.955866
32.4769	29.354	0.91951
34.3873	26.8505	0.863792
36.2978	24.5556	0.785982
38.2082	22.4567	0.687075
40.1186	20.5413	0.572711
42.029	18.7971	0.452407
43.9394	17.2121	0.337149
45.8498	15.7742	0.236373
47.7602	14.4716	0.155719
49.6706	13.2927	0.0964162
51.581	12.2264	0.0561832
53.4914	11.2622	0.0308798
55.4018	10.3903	0.0160541
57.3122	9.60149	0.00792057
59.2226	8.88735	0.00372133
61.1331	8.24023	0.00167099
63.0435	7.65319	0.000719683
64.9539	7.12	0.000298351
66.8643	6.63504	0.000119455
68.7747	6.19331	4.63414E-05
70.6851	5.79034	0.000017472
72.5955	5.42215	6.42034E-06
74.5059	5.08536	2.30673E-06
76.4163	4.79998	8.82022E-07
78.3267	4.53592	3.31642E-07
80.2371	4.29133	1.22836E-07
82.1475	4.06451	4.48902E-08
84.058	3.8539	1.62104E-08
85.9684	3.65813	0
87.8788	3.47593	0
89.7892	3.30615	0
91.6996	3.14777	0
93.61	2.99984	0

Weather: Category 5/D

Wind speed [m/s]	5
Pasquill stability	D neutral - little sun and high wind or overcast/windy night
Atmospheric temperature [degC]	20
Relative humidity [fraction]	0.7
Solar radiation flux [kW/m2]	0.5

Pool fire model results

Early pool fires are assumed to occur at a time when the initial PVAP rainout rate equals the pool fire burn rate, unless the thus calculated pool fire radius exceeds the maximum PVAP pool radius. For the latter case the early pool fire radius is assumed to be the maximum PVAP pool radius. The pool fire centre is located at the rainout point.

INPUT DATA

Correlation Type: Thomas / Johnson

Surface type	Land	
Pool fire elevation		0 m
Maximum exposure duration		20 s
Downwind distance of liquid rainout		0 m
Use two zone pool fire model	Yes	

OUTPUT DATA

Pool fire diameter	16.0265	m
Downwind distance of pool fire centre		0 m
Pool fire flame length	35.3915	m
Angle between pool fire axis and vertical	48.6796	deg
Luminous flame emissive power	169.499	kW/m2
Smoky flame emissive power		0 kW/m2
Ratio of luminous flame length to the total flame length		1 fraction
Total burn rate	24.2073	kg/s
Radiative fraction	0.304852	fraction

Radiation Intensity Ellipse Results

INPUT DATA

For ellipses 'observer direction' refers to whether inclination is 'fixed' or 'variable'. Orientation is always variable.

Observer direction	Variable
Exposure duration	20 s
Height of interest	1 m

OUTPUT DATA

Radiation intensity

Incident radiation [kW/m2]	Lethality [%]	View factor	Probit	Dose [(W/m2)^ProbitN.s]	Hazard information	Ellipse half-length [m]	Ellipse half-width [m]	Ellipse centre downwind distance [m]	Effect downwind distance [m]	Ellipse area [m2]
3	0	0.0176992	-1.38321	865119	-	76.8338	81.5	18.2982	95.1321	19672.5



5	0.000174704	0.0294986	0.360367	1709491	-	60.5741	63.6881	17.9293	78.5034	12119.8
7	0.02405	0.0412981	1.50883	2677313	-	51.7441	53.8921	17.5072	69.2513	8760.64
12.5	6.52536	0.0737466	3.48789	5800162	-	39.2134	39.7942	16.1774	55.3908	4902.35

Radiation v Distance Results

INPUT DATA

Maximum distance	95.1321	m
Angle from wind direction	0	deg
Observer direction	Variable	
Height of interest	1	m

OUTPUT DATA

Downwind distance [m]	Maximum incident radiation [kW/m2]	Lethality level
0	169.499	1
1.94147	169.499	1
3.88294	169.499	1
5.82441	169.499	1
7.76588	169.499	1
9.70735	132.687	1
11.6488	106.441	1
13.5903	91.2927	1
15.5318	80.6863	0.999999
17.4732	72.7719	0.999997
19.4147	65.7385	0.999984
21.3562	60.2145	0.999942
23.2976	55.6986	0.999833
25.2391	51.6004	0.999561
27.1806	48.2268	0.999021
29.1221	44.9941	0.997879
31.0635	42.2377	0.995901
33.005	39.83	0.992727
34.9465	37.563	0.987566
36.8879	34.6281	0.975338
38.8294	31.4934	0.949695
40.7709	28.4242	0.901807
42.7124	25.5255	0.822461
44.6538	22.8495	0.707733
46.5953	20.4189	0.564694
48.5368	18.2373	0.411854
50.4782	16.2965	0.271977
52.4197	14.5803	0.161906
54.3612	13.0843	0.0875239
56.3026	12.0058	0.0494921
58.2441	11.0253	0.0261545
60.1856	10.1372	0.0129655
62.1271	9.33436	0.006056
64.0685	8.60938	0.00267788
66.01	7.95484	0.00112644
67.9515	7.36366	0.000452896
69.8929	6.82925	0.000174843
71.8344	6.34556	6.50924E-05
73.7759	5.90716	0.000023463
75.7174	5.50915	8.21886E-06
77.6588	5.14718	2.80728E-06
79.6003	4.81739	9.37867E-07
81.5418	4.51637	3.0732E-07
83.4832	4.24108	9.90219E-08
85.4247	3.98886	3.14448E-08
87.3662	3.75735	9.86132E-09
89.3076	3.54445	0
91.2491	3.34831	0
93.1906	3.16731	0
95.1321	2.99998	0



Audit Number: 253
Date: 15/12/2023 Time: 09:28

Consequence Summary Report

Workspace: pm_rev0 - Copia

Study: Study
Summary Basis

These tables will only report global values set in the parameters. Values that are modified in the study tree will not be reported.
The report is context sensitive, and filters up to the study level. You will need to generate multiple summary reports if you have multiple studies in your workspace.
The results in this report are from the non-CFD calculations only.

Discharge Results (after atmospheric expansion)

Path	Scenario	Weather	Peak Flowrate [kg/s]	Temperature [degC]	Liquid mass fraction in material [fraction]	Droplet diameter [um]	Expanded diameter [m]	Velocity [m/s]	End time of release [s]
Study\T7	T7-2"leak vertical	Category 2/F	29.7582	-11.9098	0.813466	219.48		0.159731	100.536
		Category 5/D	29.7582	-11.9098	0.813466	219.48		0.159731	100.536

Dispersion Results

Input dispersion parameters

Core averaging time	18.75	s
Flammable averaging time	18.75	s
Toxic averaging time	600	s
Height of interest	1	m

Distance downwind to defined concentrations

The reported concentration of interest is defined at the scenario

Path	Scenario	Weather	Distance to UFL [m]	Distance to LFL [m]	Distance to LFL fraction [m]
Study\T7	T7-2"leak vertical	Category 2/F	n/a	112.299	158.635
		Category 5/D	n/a	43.8971	70.5233

Jet Fire Results

Distance downwind to defined radiation levels

The reported radiations are defined in the parameters

Path	Scenario	Weather	Flame length [m]	Distance downwind to intensity level 1 (3 kW/m2) [m]	Distance downwind to intensity level 2 (5 kW/m2) [m]	Distance downwind to intensity level 3 (7 kW/m2) [m]	Distance downwind to intensity level 4 (12,5 kW/m2) [m]
Study\T7	T7-2"leak vertical	Category 2/F	48.2863	78.0803	60.3774	51.3253	39.5803
		Category 5/D	37.5343	78.3908	60.6153	51.1086	38.4939

Early Pool Fire Results

Distance downwind to defined radiation levels

The reported radiations are defined in the parameters

Path	Scenario	Weather	Pool diameter [m]	Distance downwind to intensity level 1 (3 kW/m2) [m]	Distance downwind to intensity level 2 (5 kW/m2) [m]	Distance downwind to intensity level 3 (7 kW/m2) [m]	Distance downwind to intensity level 4 (12,5 kW/m2) [m]
Study\T7	T7-2"leak vertical	Category 2/F	16.0265	93.61	75.0604	65.4099	51.0737
		Category 5/D	16.0265	95.1321	78.5034	69.2513	55.3908

Late Pool Fire Results

Distance downwind to defined radiation levels

The reported radiations are defined in the parameters

Path	Scenario	Weather	Pool diameter [m]	Distance downwind to intensity level 1 (3 kW/m2) [m]	Distance downwind to intensity level 2 (5 kW/m2) [m]	Distance downwind to intensity level 3 (7 kW/m2) [m]	Distance downwind to intensity level 4 (12,5 kW/m2) [m]
Study\T7	T7-2"leak vertical	Category 2/F	27.6131	143.959	115.646	100.531	78.0806
		Category 5/D	26.5209	142.184	116.904	102.822	81.8801

Flash Fire Results

Distance downwind to defined concentrations

The reported LFL and LFL fraction are defined in the respective material property

Path	Scenario	Weather	Distance downwind to LFL [m]	Distance downwind to LFL Fraction [m]
Study\T7	T7-2"leak vertical	Category 2/F	112.299	158.635
		Category 5/D	43.8971	70.5233

Maximum distance to LFL fraction at any height

Path	Scenario	Weather	Max flash fire distance [m]	Height of the max flash fire distance [m]	Time [s]
Study\T7	T7-2"leak vertical	Category 2/F	137.936	0	139.56
		Category 5/D	73.295	0	103.237

Explosion Results

Explosion scenarios for worst-case maximum downwind distance to defined overpressures.

The reported overpressures are defined in the explosion parameters

Path	Scenario	Weather	Overpressure level [bar]	Maximum distance [m]	Diameter [m]
Study\T7	T7-2"leak vertical	Category 2/F	0,02068	507,707	755,414
			0,1379	203,41	146,82
			0,2068	185,04	110,08
		Category 5/D	0,02068	278,007	416,015
			0,1379	110,428	80,8553
			0,2068	100,311	60,6222

Supplementary data for worst-case explosion scenarios



Path	Scenario	Weather	Overpressure level [bar]	Explosion flammable mass [kg]	Ignition time [s]	Ignition source [m]	Cloud centre [m]	Explosion centre [m]
Study\T7	T7-2"leak vertical	Category 2/F	0,02068	653,193	130,009	130	51,8617	130
			0,1379	653,193	130,009	130	51,8617	130
			0,2068	653,193	130,009	130	51,8617	130
		Category 5/D	0,02068	109,097	77,7046	70	21,6788	70
			0,1379	109,097	77,7046	70	21,6788	70
			0,2068	109,097	77,7046	70	21,6788	70



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TOP EVENT 8



Audit Number: 256

Date: 15/12/2023 Time: 09:31

Discharge Report

Workspace: pm_rev0 - Copia

Study: Study

Equipment Item: T8

pm_rev0 - Copia\Study\T8

Material	ISOBUTANE	
East	0	m
North	0	m

Scenario (Leak) : T8-2"leak vertical

pm_rev0 - Copia\Study\T8\T8-2"leak vertical

Weather: Category 2/F

INPUT DATA

Inventory data

Mass in vessel	1115.74	kg
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Stagnation Data (upstream end for long pipe)

Initial pressure (gauge)	5	bar
Initial temperature	20	degC
Fluid state	Non-saturated liquid	

Scenario data

Phase to be released	Liquid	
Tank head	0	m
Hole diameter	50.8	mm

OUTPUT DATA

Mass flow rate	29.7582	kg/s
Release duration	37.4935	s

Orifice or pipe exit data (before atmospheric expansion)

Pressure	1.01325	bar
Temperature	19.6932	degC
Liquid mass fraction	1	fraction
Velocity at vena contracta (at exit for pipe releases)	43.8343	m/s
Discharge coefficient	0.6	

**Final Data (after atmospheric expansion)**

Temperature	-11.9098	degC
Liquid mass fraction	0.813466	fraction
Droplet diameter	219.48	um
Expanded diameter	0.159731	m
Velocity	100.536	m/s

Weather: Category 5/D**INPUT DATA****Inventory data**

Mass in vessel	1115.74	kg
----------------	----------------	----

Stagnation Data (upstream end for long pipe)

Initial pressure (gauge)	5	bar
Initial temperature	20	degC
Fluid state	Non-saturated liquid	

Scenario data

Phase to be released	Liquid	
Tank head	0	m
Hole diameter	50.8	mm

OUTPUT DATA

Mass flow rate	29.7582	kg/s
Release duration	37.4935	s

Orifice or pipe exit data (before atmospheric expansion)

Pressure	1.01325	bar
Temperature	19.6932	degC
Liquid mass fraction	1	fraction
Velocity at vena contracta (at exit for pipe releases)	43.8343	m/s
Discharge coefficient	0.6	

Final Data (after atmospheric expansion)

Temperature	-11.9098	degC
Liquid mass fraction	0.813466	fraction
Droplet diameter	219.48	um
Expanded diameter	0.159731	m
Velocity	100.536	m/s



Explosion Report
Workspace: pm_rev0 - Copia
Study: Study
Equipment Item: T8

Material	ISOBUTANE	
East		0 m
North		0 m

Explosion location criterion	Cloud front (LFL fraction)	
Explosion height criterion	Centreline height	
Explosion method	Multi-Energy: Uniform confined	
Uniform confined method explosion efficiency		12.5 %
Uniform confined method explosion strength		10

Time of explosion [s]	Distance to centre of mass [m]	Distance to explosion centre [m]	Distance to ignition point [m]	Flammable mass [kg]	Overpressures (input) [bar]	Distance to specified overpressures [m]
0.81593	4.43537	10	10	0.343852	0,02068	40,4976
					0,1379	15,9274
					0,2068	14,4441
3.75944	9.0171	20	20	3.39597	0,02068	85,4329
					0,1379	32,7173
					0,2068	29,535
9.46335	13.3814	30	30	12.8539	0,02068	131,973
					0,1379	49,8192
					0,2068	44,8597
16.1498	16.3695	40	40	25.3982	0,02068	157,795
					0,1379	64,57
					0,2068	58,6466
26.367	19.3779	50	50	40.4979	0,02068	199,492
					0,1379	79,0549
					0,2068	71,7842
40.5411	23.1461	60	60	90.6601	0,02068	255,56
					0,1379	98,0084
					0,2068	88,4973
56.509	24.179	70	70	191.831	0,02068	321,062
					0,1379	118,796
					0,2068	106,585
75.7879	34.2995	80	80	192.389	0,02068	331,305
					0,1379	128,843
					0,2068	116,62
95.0667	44.4199	90	90	192.946	0,02068	341,547
					0,1379	138,89
					0,2068	126,656

Explosion location criterion	Cloud front (LFL fraction)	
Explosion height criterion	Centreline height	
Explosion method	Multi-Energy: Uniform confined	
Uniform confined method explosion efficiency		12.5 %
Uniform confined method explosion strength		10

Time of explosion [s]	Distance to centre of mass [m]	Distance to explosion centre [m]	Distance to ignition point [m]	Flammable mass [kg]	Overpressures (input) [bar]	Distance to specified overpressures [m]
0.663346	5.00843	10	10	0.409728	0,02068	42,3326
					0,1379	16,2841
					0,2068	14,7115
2.45127	11.9117	20	20	3.76839	0,02068	87,7423
					0,1379	33,1662
					0,2068	29,8715
5.59808	18.2957	30	30	16.1246	0,02068	139,978
					0,1379	51,2749
					0,2068	46,0261
9.64903	22.6059	40	40	30.3097	0,02068	175,728
					0,1379	66,3796
					0,2068	59,7794
14.8906	23.5839	50	50	39.2454	0,02068	197,935
					0,1379	78,7522
					0,2068	71,5573
22.5606	23.3341	60	60	48.435	0,02068	218,682
					0,1379	90,8409
					0,2068	83,1234



Audit Number: 256
Date: 15/12/2023 Time: 09:31

Jet Fire
Workspace: pm_rev0 - Copia
Study: Study
Equipment Item: T8

pm_rev0 - Copia\Study\T8		
Material	ISOBUTANE	
East		0 m
North		0 m

Scenario (Leak) : T8-2"leak vertical		
pm_rev0 - Copia\Study\T8\T8-2"leak vertical		
Weather: Category 2/F		
Wind speed [m/s]	2	
Pasquill stability	F	stable - night with moderate clouds and light/moderate wind
Atmospheric temperature [d	20	
Relative humidity [fraction]	0.7	
Solar radiation flux [kW/m2]	0.5	

Jet fire model results		
INPUT DATA		
Scenario		
Elevation	1	m
Release angle from horizontal	0	deg

Jet Fire Parameters		
Jet fire method	Cone model	
Wind orientation about the z-axis (anti-clockwise from the East)	0	deg
Rotation about the z-axis (anti-clockwise from the east)	0	deg
Rate modification factor	3	

Calculated inputs		
Mass flow rate	16.6528	kg/s
Temperature after atmospheric expansion	-11.9098	degC
Liquid fraction	0.813466	fraction
Velocity after atmospheric expansion (input)	100.536	m/s
Rainout fraction time averaged	0.813466	fraction

OUTPUT DATA	
Flame emissive power	215.19 kW/m2
Fraction of emissivity	0.435495 fraction
Jet velocity	100.536 m/s
Flame length	48.2863 m
Frustum length	47.562 m
Frustum base width	0.650005 m
Frustum tip width	16.715 m
Frustum lift-off distance	0.724295 m
Flame length in still air	43.4216 m
Hole to flame angle	0 deg
Expanded diameter	0.119489 m
Plane angular rotation	0 deg

Flame on ground impingement with partial truncation	
Radiation Intensity Ellipse Results	
INPUT DATA	
For ellipses 'observer direction' refers to whether inclination is 'fixed' or 'variable'. Orientation is always variable.	
Observer direction	Variable
Exposure duration	20 s
Height of interest	1 m

OUTPUT DATA									
Radiation intensity									
Incident radiation [kW/m2]	Lethality [%]	View factor	Probit	Dose [(W/m2)^ProbitN.s]	Ellipse half-length [m]	Ellipse half-width [m]	Ellipse centre downwind distance [m]	Effect downwind distance [m]	Ellipse area [m2]
3	0	0.0139412	-1.38321	865119	59.7203	78.0803	0	78.0803	14649.2



5	0.000174704	0.0232353	0.360367	1709491	48.084	60.3774	0	60.3774	9120.63
7	0.02405	0.0325294	1.50883	2677313	43.4012	51.3253	0	51.3253	6998.16
12.5	6.52536	0.0580882	3.48789	5800162	37.6629	39.5803	0	39.5803	4683.21

Radiation v Distance Results

INPUT DATA

Maximum distance	105.738	m
Observer type radiation modelling	Planar	
Observer direction	Variable	
Height of interest	1	m

OUTPUT DATA

Downwind distance [m]	Maximum incident radiation [kW/m2]	Lethality level [fr
-42.2703	34.8157	0.976384
-40.1123	215.19	1
-37.9544	215.19	1
-35.7965	215.19	1
-33.6386	215.19	1
-31.4806	215.19	1
-29.3227	215.19	1
-27.1648	215.19	1
-25.0069	215.19	1
-22.8489	215.19	1
-20.691	215.19	1
-18.5331	215.19	1
-16.3751	215.19	1
-14.2172	215.19	1
-12.0593	215.19	1
-9.90135	215.19	1
-7.74343	215.19	1
-5.5855	215.19	1
-3.42757	215.19	1
-1.26964	215.19	1
0.888287	215.19	1
3.04622	215.19	1
5.20414	215.19	1
7.36207	177.441	1
9.52	97.6997	1
11.6779	70.6768	0.999995
13.8359	54.7816	0.999793
15.9938	44.8623	0.997811
18.1517	36.8072	0.985151
20.3096	30.478	0.936997
22.4676	25.4783	0.820814
24.6255	21.5006	0.632724
26.7834	18.3096	0.417115
28.9414	15.7269	0.233222
31.0993	13.6182	0.111295
33.2572	11.8809	0.0459472
35.4151	10.4369	0.0166769
37.5731	9.22783	0.00541648
39.731	8.20709	0.00159841
41.8889	7.33896	0.000434649
44.0469	6.5958	0.000110331
46.2048	5.95545	2.64257E-05
48.3627	5.40038	6.02904E-06
50.5206	4.91654	1.32102E-06
52.6786	4.4926	2.79936E-07
54.8365	4.11931	5.77192E-08
56.9944	3.78913	1.16398E-08
59.1524	3.49582	0
61.3103	3.23421	0
63.4682	3	0

Weather: Category 5/D

Wind speed [m/s]	5
Pasquill stability	D neutral - little sun and high wind or overcast/windy night
Atmospheric temperature [d	20
Relative humidity [fraction]	0.7
Solar radiation flux [kW/m2]	0.5

Jet fire model results

INPUT DATA

Scenario

Elevation	1	m
Release angle from horizontal	0	deg

Jet Fire Parameters

Jet fire method	Cone model	
Wind orientation about the z-axis (anti-clockwise from the East)		0 deg
Rotation about the z-axis (anti-clockwise from the east)		0 deg
Rate modification factor		3

Calculated inputs

Mass flow rate	16.6528	kg/s
Temperature after atmospheric expansion	-11.9098	degC
Liquid fraction	0.813466	fraction
Velocity after atmospheric expansion (input)	100.536	m/s
Rainout fraction time averaged	0.813466	fraction

OUTPUT DATA

Flame emissive power	282.751	kW/m2
Fraction of emissivity	0.435495	fraction
Jet velocity	100.536	m/s
Flame length	37.5343	m
Frustum length	36.9713	m
Frustum base width	1.0764	m
Frustum tip width	15.4788	m
Frustum lift-off distance	0.563014	m
Flame length in still air	43.4216	m
Hole to flame angle	0	deg
Expanded diameter	0.119489	m
Plane angular rotation	0	deg

Flame on ground impingement with partial truncation

Radiation Intensity Ellipse Results

INPUT DATA

For ellipses 'observer direction' refers to whether inclination is 'fixed' or 'variable'. Orientation is always variable.

Observer direction	Variable
Exposure duration	20 s
Height of interest	1 m

OUTPUT DATA

Radiation intensity

Incident radiation [kW/m2]	Lethality [%]	View factor	Probit	Dose [(W/m2)^ProbitN.s]	Ellipse half-length [m]	Ellipse half-width [m]	Ellipse centre downwind distance [m]	Effect downwind distance [m]	Ellipse area [m2]
3	0	0.01061	-1.38321	865119	62.8871	78.3908	0	78.3908	15487.3
5	0.000174704	0.0176834	0.360367	1709491	49.2685	60.6153	0	60.6153	9382.13
7	0.02405	0.0247567	1.50883	2677313	42.3064	51.1086	0	51.1086	6792.81
12.5	6.52536	0.0442085	3.48789	5800162	34.413	38.4939	0	38.4939	4161.63

Radiation v Distance Results

INPUT DATA

Maximum distance	98.5742	m
Observer type radiation modelling	Planar	
Observer direction	Variable	
Height of interest	1	m

OUTPUT DATA

Downwind distance [m]	Maximum incident radiation [kW/m2]	Lethality level [fr
-34.3701	132.742	1
-32.3583	282.751	1
-30.3466	282.751	1
-28.3349	282.751	1
-26.3232	282.751	1
-24.3115	282.751	1
-22.2998	282.751	1
-20.288	282.751	1
-18.2763	282.751	1
-16.2646	282.751	1
-14.2529	282.751	1
-12.2412	282.751	1
-10.2295	282.751	1
-8.21773	282.751	1
-6.20602	282.751	1
-4.1943	282.751	1
-2.18258	282.751	1
-0.170864	282.751	1
1.84085	282.751	1



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3.85257	282.751	1
5.86429	151.304	1
7.87601	101.503	1
9.88772	74.6315	0.999998
11.8994	62.3611	0.999965
13.9112	50.8269	0.999473
15.9229	41.8561	0.99551
17.9346	34.8227	0.976422
19.9463	29.2642	0.917936
21.958	24.8308	0.796899
23.9697	21.261	0.618229
25.9815	18.3589	0.420701
27.9932	15.9778	0.250073
30.0049	14.0062	0.130553
32.0166	12.3592	0.060479
34.0283	10.9734	0.0251908
36.04	9.79779	0.00955245
38.0518	8.79342	0.00333763
40.0635	7.92989	0.00108682
42.0752	7.18274	0.00033305
44.0869	6.53257	9.68919E-05
46.0986	5.96374	2.69662E-05
48.1104	5.46359	7.22784E-06
50.1221	5.02175	1.87663E-06
52.1338	4.62971	4.74385E-07
54.1455	4.28043	1.17266E-07
56.1572	3.96804	2.84558E-08
58.1689	3.68763	0
60.1807	3.43506	0
62.1924	3.20684	0
64.2041	2.99999	0



Audit Number: 256
Date: 15/12/2023 Time: 09:31

Consequence Summary Report

Workspace: pm_rev0 - Copia

Study: Study

Summary Basis

These tables will only report global values set in the parameters. Values that are modified in the study tree will not be reported.
The report is context sensitive, and filters only to the study level. You will need to generate multiple summary reports if you have multiple studies in your workspace.
The results in this report are from the non-CFD calculations only.

Discharge Results (after atmospheric expansion)

Path	Scenario	Weather	Peak Flowrate [kg/s]	Temperature [degC]	Liquid mass fraction in material [fraction]	Droplet diameter [um]	Expanded diameter [m]	Velocity [m/s]	End time of release [s]
Study\T8	T8-2"leak vertical	Category 2/F	29.7582	-11.9098	0.813466	219.48	0.159731	100.536	37.4935
		Category 5/D	29.7582	-11.9098	0.813466	219.48	0.159731	100.536	37.4935

Dispersion Results

Input dispersion parameters

Core averaging time	18.75 s
Flammable averaging time	18.75 s
Toxic averaging time	600 s
Height of interest	1 m

Distance downwind to defined concentrations

The reported concentration of interest is defined at the scenario

Path	Scenario	Weather	Distance to UFL [m]	Distance to LFL [m]	Distance to LFL fraction [m]
Study\T8	T8-2"leak vertical	Category 2/F	n/a	17.6422	94.1619
		Category 5/D	n/a	41.524	64.2303

Jet Fire Results

Distance downwind to defined radiation levels

The reported radiations are defined in the parameters

Path	Scenario	Weather	Flame length [m]	Distance downwind to intensity level 1 (3 kW/m2) [m]	Distance downwind to intensity level 2 (5 kW/m2) [m]	Distance downwind to intensity level 3 (7 kW/m2) [m]	Distance downwind to intensity level 4 (12,5 kW/m2) [m]
Study\T8	T8-2"leak vertical	Category 2/F	48.2863	78.0803	60.3774	51.3253	39.5803
		Category 5/D	37.5343	78.3908	60.6153	51.1086	38.4939

Early Pool Fire Results

Distance downwind to defined radiation levels

The reported radiations are defined in the parameters

Path	Scenario	Weather	Pool diameter [m]	Distance downwind to intensity level 1 (3 kW/m2) [m]	Distance downwind to intensity level 2 (5 kW/m2) [m]	Distance downwind to intensity level 3 (7 kW/m2) [m]	Distance downwind to intensity level 4 (12,5 kW/m2) [m]
Study\T8	T8-2"leak vertical	Category 2/F	16.0265	93.61	75.0604	65.4099	51.0737
		Category 5/D	16.0265	95.1321	78.5034	69.2513	55.3908

Late Pool Fire Results

Distance downwind to defined radiation levels

The reported radiations are defined in the parameters

Path	Scenario	Weather	Pool diameter [m]	Distance downwind to intensity level 1 (3 kW/m2) [m]	Distance downwind to intensity level 2 (5 kW/m2) [m]	Distance downwind to intensity level 3 (7 kW/m2) [m]	Distance downwind to intensity level 4 (12,5 kW/m2) [m]
Study\T8	T8-2"leak vertical	Category 2/F	18.2972	104.002	83.396	72.6555	56.6453
		Category 5/D	18.1698	105.198	86.7239	76.4448	61.0462

Flash Fire Results

Distance downwind to defined concentrations

The reported LFL and LFL fraction are defined in the respective material property

Path	Scenario	Weather	Distance downwind to LFL	Distance downwind to LFL Fraction [m]
Study\T8	T8-2"leak vertical	Category 2/F	17.6422	94.1619
		Category 5/D	41.524	64.2303

Maximum distance to LFL fraction at any height

Path	Scenario	Weather	Max flash fire distance [m]	Height of the max flash fire distance [m]	Time [s]
Study\T8	T8-2"leak vertical	Category 2/F	97.2996	0	109.14
		Category 5/D	65.4825	0	41.2005

Explosion Results

Explosion scenarios for worst-case maximum downwind distance to defined overpressures.

The reported overpressures are defined in the explosion parameters

Path	Scenario	Weather	Overpressure level [bar]	Maximum distance [m]	Diameter [m]
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Study\T8	T8-2"leak vertical	Category 2/F	0,02068	341,547	503,095
			0,1379	138,89	97,7798
			0,2068	126,656	73,3116
		Category 5/D	0,02068	218,682	317,364
			0,1379	90,8409	61,6819
			0,2068	83,1234	46,2467

Supplementary data for worst-case explosion scenarios

Path	Scenario	Weather	Overpressure level [bar]	Explosion flammable mass [kg]	Ignition time [s]	Ignition source [m]	Cloud centre [m]	Explosion centre [m]
Study\T8	T8-2"leak vertical	Category 2/F	0,02068	192,946	95,0667	90	44,4199	90
			0,1379	192,946	95,0667	90	44,4199	90
			0,2068	192,946	95,0667	90	44,4199	90
		Category 5/D	0,02068	48,435	22,5606	60	23,3341	60
			0,1379	48,435	22,5606	60	23,3341	60
			0,2068	48,435	22,5606	60	23,3341	60

r_eniro.Giunta - Prot. 08/01/2024.0008320.E



Audit Number: 256
Date: 15/12/2023 Time: 09:32

Early Pool Fire Report
Workspace: pm_rev0 - Copia
Study: Study
Equipment Item: T8
pm_rev0 - Copia\Study\T8

Material	ISOBUTANE	
East		0 m
North		0 m

Scenario (Leak) : T8-2"leak vertical

pm_rev0 - Copia\Study\T8\T8-2"leak vertical

Weather: Category 2/F

Wind speed [m/s]	2
Pasquill stability	F stable - night with moderate clouds and light/moderate wind
Atmospheric temperature [degC]	20
Relative humidity [fraction]	0.7
Solar radiation flux [kW/m2]	0.5

Pool fire model results

Early pool fires are assumed to occur at a time when the initial PVAP rainout rate equals the pool fire burn rate, unless the thus calculated pool fire radius exceeds the maximum PVAP pool radius. For the latter case the early pool fire radius is assumed to be the maximum PVAP pool radius. The pool fire

INPUT DATA

Correlation Type: Thomas / Johnson

Surface type	Land	
Pool fire elevation		0 m
Maximum exposure duration		20 s
Downwind distance of liquid rainout		0 m
Use two zone pool fire model	Yes	

OUTPUT DATA

Pool fire diameter	16.0265 m
Downwind distance of pool fire centre	0 m
Pool fire flame length	35.3915 m
Angle between pool fire axis and vertical	31.2992 deg
Luminous flame emissive power	169.499 kW/m2
Smoky flame emissive power	0 kW/m2
Ratio of luminous flame length to the total flame length	1 fraction
Total burn rate	24.2073 kg/s
Radiative fraction	0.304852 fraction

Radiation Intensity Ellipse Results

INPUT DATA

For ellipses 'observer direction' refers to whether inclination is 'fixed' or 'variable'. Orientation is always variable.

Observer direction	Variable	
Exposure duration		20 s
Height of interest		1 m

OUTPUT DATA

Radiation intensity

Incident radiation [kW/m2]	Lethality [%]	View factor	Probit	Dose [(W/m2)^ProbitN.s]	Hazard information	Ellipse half-length [m]	Ellipse half-width [m]	Ellipse centre downwind distance [m]	Effect downwind distance [m]	Ellipse area [m2]
3	0	0.0176992	-1.38321	865119	-	80.811	82.8592	12.799	93.61	21035.9
5	0.000174704	0.0294986	0.360367	1709491	-	62.6604	64.1476	12.3999	75.0604	12627.7
7	0.02405	0.0412981	1.50883	2677313	-	53.0469	53.8095	12.363	65.4099	8967.44
12.5	6.52536	0.0737466	3.48789	5800162	-	39.3083	38.8459	11.7654	51.0737	4797.11

Radiation v Distance Results

INPUT DATA

Maximum distance	93.61	m
Angle from wind direction	0	deg
Observer direction	Variable	
Height of interest	1	m

OUTPUT DATA

Downwind distance [m]	Maximum Incident	Lethality level
0	169.499	1
1.91041	169.499	1
3.82082	169.499	1



5.73122	169.499	1
7.64163	169.499	1
9.55204	132.737	1
11.4624	99.5712	1
13.3729	81.9616	1
15.2833	70.2167	0.999994
17.1937	61.5546	0.999957
19.1041	54.9959	0.999803
21.0145	49.5939	0.999293
22.9249	44.963	0.997863
24.8353	41.3416	0.994924
26.7457	38.1566	0.98919
28.6561	35.0243	0.977498
30.5665	32.0773	0.955866
32.4769	29.354	0.91951
34.3873	26.8505	0.863792
36.2978	24.5556	0.785982
38.2082	22.4567	0.687075
40.1186	20.5413	0.572711
42.029	18.7971	0.452407
43.9394	17.2121	0.337149
45.8498	15.7742	0.236373
47.7602	14.4716	0.155719
49.6706	13.2927	0.0964162
51.581	12.2264	0.0561832
53.4914	11.2622	0.0308798
55.4018	10.3903	0.0160541
57.3122	9.60149	0.00792057
59.2226	8.88735	0.00372133
61.1331	8.24023	0.00167099
63.0435	7.65319	0.000719683
64.9539	7.12	0.000298351
66.8643	6.63504	0.000119455
68.7747	6.19331	4.63414E-05
70.6851	5.79034	0.000017472
72.5955	5.42215	6.42034E-06
74.5059	5.08536	2.30673E-06
76.4163	4.79998	8.82022E-07
78.3267	4.53592	3.31642E-07
80.2371	4.29133	1.22836E-07
82.1475	4.06451	4.48902E-08
84.058	3.8539	1.62104E-08
85.9684	3.65813	0
87.8788	3.47593	0
89.7892	3.30615	0
91.6996	3.14777	0
93.61	2.99984	0

Weather: Category 5/D

Wind speed [m/s]

Pasquill stability

Atmospheric temperature [degC]

Relative humidity [fraction]

Solar radiation flux [kW/m2]

5

D

neutral - little sun and high wind or overcast/windy night

20

0.7

0.5

Pool fire model results

Early pool fires are assumed to occur at a time when the initial PVAP rainout rate equals the pool fire burn rate, unless the thus calculated pool fire radius exceeds the maximum PVAP pool radius. For the latter case the early pool fire radius is assumed to be the maximum PVAP pool radius. The pool fire

INPUT DATA

Correlation Type: Thomas / Johnson

Surface type	Land	
Pool fire elevation	0	m
Maximum exposure duration	20	s
Downwind distance of liquid rainout	0	m
Use two zone pool fire model	Yes	

OUTPUT DATA

Pool fire diameter	16.0265	m
Downwind distance of pool fire centre	0	m
Pool fire flame length	35.3915	m
Angle between pool fire axis and vertical	48.6796	deg
Luminous flame emissive power	169.499	kW/m2
Smoky flame emissive power	0	kW/m2
Ratio of luminous flame length to the total flame length	1	fraction
Total burn rate	24.2073	kg/s
Radiative fraction	0.304852	fraction

Radiation Intensity Ellipse Results

INPUT DATA

For ellipses 'observer direction' refers to whether inclination is 'fixed' or 'variable'. Orientation is always variable.

Observer direction	Variable
Exposure duration	20 s
Height of interest	1 m

OUTPUT DATA

Radiation intensity

Incident radiation [kW/m2]	Lethality [%]	View factor	Probit	Dose [(W/m2)^ProbitN.s]	Hazard information	Ellipse half-length [m]	Ellipse half-width [m]	Ellipse centre downwind distance [m]	Effect downwind distance [m]	Ellipse area [m2]
3	0	0.0176992	-1.38321	865119	-	76.8338	81.5	18.2982	95.1321	19672.5
5	0.000174704	0.0294986	0.360367	1709491	-	60.5741	63.6881	17.9293	78.5034	12119.8
7	0.02405	0.0412981	1.50883	2677313	-	51.7441	53.8921	17.5072	69.2513	8760.64
12.5	6.52536	0.0737466	3.48789	5800162	-	39.2134	39.7942	16.1774	55.3908	4902.35

Radiation v Distance Results

INPUT DATA

Maximum distance	95.1321 m
Angle from wind direction	0 deg
Observer direction	Variable
Height of interest	1 m

OUTPUT DATA

Downwind distance [m]	Maximum incident	Lethality lev
0	169.499	1
1.94147	169.499	1
3.88294	169.499	1
5.82441	169.499	1
7.76588	169.499	1
9.70735	132.687	1
11.6488	106.441	1
13.5903	91.2927	1
15.5318	80.6863	0.999999
17.4732	72.7719	0.999997
19.4147	65.7385	0.999984
21.3562	60.2145	0.999942
23.2976	55.6986	0.999833
25.2391	51.6004	0.999561
27.1806	48.2268	0.999021
29.1221	44.9941	0.997879
31.0635	42.2377	0.995901
33.005	39.83	0.992727
34.9465	37.563	0.987566
36.8879	34.6281	0.975338
38.8294	31.4934	0.949695
40.7709	28.4242	0.901807
42.7124	25.5255	0.822461
44.6538	22.8495	0.707733
46.5953	20.4189	0.564694
48.5368	18.2373	0.411854
50.4782	16.2965	0.271977
52.4197	14.5803	0.161906
54.3612	13.0843	0.0875239
56.3026	12.0058	0.0494921
58.2441	11.0253	0.0261545
60.1856	10.1372	0.0129655
62.1271	9.33436	0.006056
64.0685	8.60938	0.00267788
66.01	7.95484	0.00112644
67.9515	7.36366	0.000452896
69.8929	6.82925	0.000174843
71.8344	6.34556	6.50924E-05
73.7759	5.90716	0.000023463
75.7174	5.50915	8.21886E-06
77.6588	5.14718	2.80728E-06
79.6003	4.81739	9.37867E-07
81.5418	4.51637	3.0732E-07
83.4832	4.24108	9.90219E-08
85.4247	3.98886	3.14448E-08
87.3662	3.75735	9.86132E-09
89.3076	3.54445	0
91.2491	3.34831	0
93.1906	3.16731	0
95.1321	2.99998	0