

Appendix 9B

ESSO and CRPC Major LPG Failure Case Tables

ESSO	Failure Case Frequency Calculation				Esso	Release Frequency	
	Base Frequency	Factors					
Case A	1	LPG Import by ship; tank failure;				Rupture Full	
	Tank Rupture	Tanks per ship	Presence at Jetty	Fraction of time tank full			
	2.00E-06	2	0.038	0.2		3.0E-8	
Case A	2	LPG Import by ship; tank failure;				Rupture Half Full	
	Tank Rupture	Tanks per ship	Presence at Jetty	Fraction of time tank full			
	2.00E-06	2	0.038	0.8		1.2E-7	
Case A	3	LPG Import by ship; Collision tank leak;				Catastrophic	
	Freq of Impact	LPG Ships per year			Release Prob	Size Distribution	
	7.4E-5	30	1		1 0.001484	10%	3.3E-7
Case A	4	LPG Import by ship; Collision tank leak;				100 mm hole	
	Freq of Impact	LPG Ships per year			Release Prob	Size Distribution	
	7.4E-5	30	1		1 0.001484	90%	3.0E-6
Case B	1	Marine Loading Arms				Rupture Full bore	
	Base Frequency	Arms (each of 2)	Modifier		Release Prob	Size Distribution	
	3.8E-3	1	1		1 1	10%	3.8E-4
Case B	2	Marine Loading Arms				Leak 50mm	
	Base Frequency	Arms (each of 2)	Modifier		Release Prob	Size Distribution	
	3.8E-3	1	1		1 1	90%	3.4E-3
Case B	3	Jetty pipeline				Leak 150 mm	
	Base Frequency		Modifier		Release Prob	Size Distribution	
	4.3E-5		1	1	1 1	100%	4.3E-5
Case C	1	LPG Mounded Storage Tanks : Tank Leak				Catastrophic	
	Base Frequency	Tanks (each of 3)			Release Prob	Size Distribution	
	1.5E-4	1	1		1 0.4	4.5%	2.7E-6 100% full
					0.2		1.4E-6 50% full
					0.4		2.7E-6 20%full
Case C	2	LPG Storage spheres : Tank Leak				100mm hole	
	Base Frequency	Tanks (each of 3)			Release Prob	Size Distribution	
	1.5E-4	1	1		1 0.425	6.5%	4.1E-6 100% full
					0.15		1.5E-6 50% full
					0.425		4.1E-6 20%full

Case C	3	LPG Storage spheres : Tank Leak				25 mm hole		
	Base Frequency	Tanks (each of 3)			Release Prob	Size Distribution		
	4.4E-4	1	1		1	35.6%	1.6E-4	
Case C	4	LPG Storage spheres : Tank Leak				5 mm hole		
	Base Frequency	Tanks (each of 3)			Release Prob	Size Distribution		
	4.4E-4	1	1		1	0.535	2.4E-4	
Case D	1	Filling Pipeline				Leak 150 mm		
	Base Frequency		Modifier		Release Prob	Size Distribution		
	4.3E-5		1	1	1	100%	4.3E-5	
Case D	2	Cylinder Filling				Leak		
	Base Frequency	Number of cylinders	Modifier		Release Prob	Size Distribution		
	1.5E-5	18	1.8		1	100%	4.9E-4	
Case D	3	Road Tanker Filling				Leak 100 mmm		
	Base Frequency	Number of cylinders	Modifier		Release Prob	Size Distribution		
	8.5E-3	1	1.8		1	100%	1.5E-2	
Case D	4	Road Tanker on Road				Rupture		
	Base Frequency	Number of tankers/yr	release prob		Prob	Size Distribution		
	7.10E-07	1600	0.034		1	0.12	4.6E-6	
Case D	5	Road Tanker on Road				Leak 100 mm		
	Base Frequency	Number of tankers/yr	release prob		Prob	Size Distribution		
	7.10E-07	1600	0.034		1	0.29	1.1E-5	
Case D	6	Road Tanker on Road				Leak 5 mm		
	Base Frequency	Number of tankers/yr	release prob		Prob	Size Distribution		
	7.10E-07	1600	0.034		1	0.59	2.3E-5	
Case D	7	Road Tanker on Road				BLEVE		
	Base Frequency	Number of tankers/yr	release prob		Chartek modfactor	Size Distribution		
	7.10E-07	1600	7.20E-04		1	0.1	1	8.2E-8
Case D	8	Road Tanker loading				BLEVE		
	Base Frequency	Number of tankers/yr	release prob		Chartek modfactor	Size Distribution		
	1.30E-07	1600	1.00		1	0.1	1	2.1E-5

CRC	Failure Case Frequency Calculation							Release Frequency	
	Base Frequency			Factors					
Case A	1	LPG Import by ship; tank failure;					Rupture Full		
	Tank Rupture	Tanks per ship	Presence at Jetty	Fraction of time tank full					
	2.00E-06	2	0.086	0.2			6.9E-8		
Case A	2	LPG Import by ship; tank failure;					Rupture Half Full		
	Tank Rupture	Tanks per ship	Presence at Jetty	Fraction of time tank full					
	2.00E-06	2	0.086	0.8			2.8E-7		
Case A	3	LPG Import by ship; Collision tank leak;					Catastrophic		
	Striking / Passing	LPG Ships per year	Passing per visit	Tug assist Modifier	Release Prob	Size Distribution			
	4.0E-6	50	13	0.5	0.052	10%	6.8E-6		
Case A	4	LPG Import by ship; Collision tank leak;					100 mm hole		
	Striking / Passing	LPG Ships per year	Passing per visit	Tug assist Modifier	Release Prob	Size Distribution			
	4.0E-6	50	13	0.5	0.052	90%	6.1E-5		
Case B	1	Marine Loading Arms					Rupture Full bore		
	Base Frequency	Arms (each of 2)	Modifier			Release Prob	Size Distribution		
	3.8E-3	1	1.8			1	1	10% 6.8E-4	
Case B	2	Marine Loading Arms					Leak 50mm		
	Base Frequency	Arms (each of 2)	Modifier			Release Prob	Size Distribution		
	3.8E-3	1	1.8			1	1	90% 6.2E-3	
Case B	3	Jetty pipeline					Leak 150 mm		
	Base Frequency	Modifier				Release Prob	Size Distribution		
	4.3E-5	1	1.8			1	1	100% 7.7E-5	
Case C	1	LPG Mounded Storage : Tank Leak					Catastrophic		
	Base Frequency	Tanks (each of 3)			Release Prob	Size Distribution			
	4.4E-4	1	1			1	1	4.5% 2.0E-5	
Case C	2	LPG Mounded Storage : Tank Leak					100mm hole		
	Base Frequency	Tanks (each of 3)			Release Prob	Size Distribution			
	4.4E-4	1	1			1	1	6.5% 2.9E-5	
Case C	3	LPG Mounded Storage : Tank Leak					25 mm hole		

		Base Frequency	Tanks (each of 3)			Release Prob	Size Distribution	
		4.4E-4	1	1		1	35.6%	1.6E-4
Case C	4	LPG Mounded Storage : Tank Leak			5 mm hole			
		Base Frequency	Tanks (each of 3)			Release Prob	Size Distribution	
		4.4E-4	1	1		1	0.535	2.4E-4
Case D	1	Filling Pipeline			Leak 150 mm			
		Base Frequency		Modifier		Release Prob	Size Distribution	
		4.3E-5	1	1.8		1	100%	7.7E-5
Case D	2	Cylinder Filling			Leak			
		Base Frequency	Number of cylinders	Modifier		Release Prob	Size Distribution	
		1.5E-5	18	1.8		1	100%	4.9E-4
Case D	3	Road Tanker Filling			Leak 100 mmm			
		Base Frequency	Number of cylinders	Modifier		Release Prob	Size Distribution	
		8.5E-3	1	1.8		1	100%	1.5E-2
Case D	4	Road Tanker on Road			Rupture			
		Base Frequency	Number of release tankers/yr	Modifier prob		Release Prob	Size Distribution	
		7.10E-07	625	0.034		1.8	1	0.12
								3.3E-6
Case D	5	Road Tanker on Road			Leak 100 mm			
		Base Frequency	Number of release tankers/yr	Modifier prob		Release Prob	Size Distribution	
		7.10E-07	625	0.034		1.8	1	0.29
								7.9E-6
Case D	6	Road Tanker on Road			Leak 5 mm			
		Base Frequency	Number of release tankers/yr	Modifier prob		Release Prob	Size Distribution	
		7.10E-07	625	0.034		1.8	1	0.59
								1.6E-5
Case D	7	Road Tanker on Road			BLEVE			
		Base Frequency	Number of release tankers/yr	Modifier prob		Chartek modfactor	Size Distribution	
		7.10E-07	625	7.20E-04		1.8	0.1	1
								5.8E-8
Case D	8	Road Tanker loading			BLEVE			
		Base Frequency	Number of release tankers/yr	Modifier prob		Chartek modfactor	Size Distribution	
		1.30E-07	625	1.00		1.8	0.1	1
								1.5E-5