Route 9 Detailed Feasibility Study	Final Environmental Impact Assessment Report
App	endix 9A
Shell and Caltex Maj	or LPG Failure Case Tables

Risk Assessment Report

Route 9
RiskProf Inputs

		@35m @35m @35m @ground level @ground level	V V PLL Lists FN Curves
	Day Night Peak	Day Night Peak Day Night	
Pop Data *.pop	tyf-shed tyf-shen tyf-shep *.pop	tys@35md tys@35mn tys@35mp tys@g-sd tys@g-sn tys@g-sp	
	0.25 0.50 0.25	0.25 0.50 0.25 0.25 0.50 0.25	
Met Data *.met	tsingyid tsingyin tsingyip *nd.met	tsday_nd tsnighnd tspeaknd tsday_nd tsnighnd tspeaknd	
s Consequence Models < V Lethality *30_l.dat	4phicons.dat ffd430_1.dat ffb230_1.dat ffd130_1.dat fff130_1.dat	pfd430_l.dat pfb230_l.dat exnd30_l.dat fbnd30_l.dat	
Risk Data Spreadsheets V C Risk Data *.rdf	sh-ffrd2 *fb.rdf	shda35fb sh@35mfb shni35fb sh@35mfb shpe35fb sh@35mfb shda@gfb sh@grdfb shni@gfb sh@grdfb shpe@gfb sh@grdfb	
Concept *ff.cpt	shda9rff shni9rff shpe9rff *fb.cpt	shda35fb shni35fb shpe35fb shda@gfb shni@gfb shni@gfb	Itours
	0.25 0.50 0.25	0.25 0.50 0.25	V V Individual Risk Con
Met Data *.met	tsingyid tsingyin tsingyip	tsday_nd tsnighnd tspeaknd	Individua
ts Consequence Models < V Lethality *30_l.dat	4phicons.dat ffd430_1.dat ffb230_1.dat ffd130_1.dat fff130_1.dat		
Risk Data Spreadsheets V C Risk Data *.rdf	sh-ffrd2	sh@35mfb sh@35mfb sh@35mfb	Outputs
S Concept *.cpt	sha9rff shni9rff shpe9rff	shda35fb shni35fb shpe35fb	RiskProf Outputs

Shell		se Frequency Calculation uency Factors	Shell	Release Frequ	uency	
Case A	1	LPG Import by ship; tank failur	e;	Rupture Full		
		Fraction Tanks Presence of time per ship at Jetty tank full 2 0.050 0.2	!		4.0E-8	
Case A	2	LPG Import by ship; tank failur	e;	Rupture Half	Full	
		Tanks Presence of time per ship at Jetty tank full 2 0.050 0.8	3		1.6E-7	
Case A	3	LPG Import by ship; Collision	tank leak;	Catastrophic		
		LPG Ships Passing Tug assist per year per visit Modifier 60 1 1	Release Prob 2.20E-03	Size Distribution 10%	3.7E-6	
Case A	4	LPG Import by ship; Collision	tank leak;	100 mm hole		
		LPG Ships Passing Tug assist per year per visit Modifier 60 1		Size Distribution 90%	3.3E-5	
Case A	5	LPG Import by ship; Collision	tank leak;	Catastrophic		
	Striking / Passing 4.0E-6	LPG Ships Passing Tug assis per year per visit Modifier 60 2.52	t Release Prob I 5.20E-02	Size Distribution 10%	3.1E-6	
Case A	6	LPG Import by ship; Collision	tank leak;	100 mm hole		
	Striking / Passing 4.0E-6	LPG Ships Passing Tug assis per year per visit Modifier 60 2.52		Size Distribution 90%	2.8E-5	
Case B	1	Marine Loading Arms		Rupture Fu	II bore	
	Base Frequency 1.3E-4	Cargo Modifier unloadings 60 1 0.2	Release Prob 2 1	Size Distribution 10%	1.6E-4	
Case B	2	Marine Loading Arms		Leak 50	mm	
	Base Frequency 1.3E-4	Arms Modifier (each of 2)	Release Prob 1 1	Size Distribution 90%	1.2E-4	
Case B	3	Jetty pipeline		Leak 15	0 mm	
	Base Frequency 4.3E-5		Release Prob 1 1	Size Distribution 100%	4.3E-5	
Case C	1	LPG Mounded Storage : Tank	Leak	Catastrophic		D. Franks
	Base Frequency 1.4E-4	Tanks (each of 3) 1 1	Release Prob	Size Distribution 4.5%	Full half-full 6.5E-6 20% full	Pr Freq /yr 0.41 2.63E-6 0.19 1.23E-6 0.41 2.63E-6
Case C	2	LPG Mounded Storage : Tank	Leak	100mm hole		

Case C	Base Frequency 1.4E-4	Tanks (each of 3) 1 1 LPG Storage spheres		Distribution 6.5% 9.4E-6
	Base	Tanks	Release	_
	Frequency	(each of 3)	Prob	Distribution 35.6% 5.1E-5
Case C	4	LPG Storage spheres	: Tank Leak	5 mm hole
	Base Frequency 1.4E-4	Tanks (each of 3) 1 1	Release Prob 1 1	Size Distribution 0.535 7.7E-5
Case D	1	Filling Pipeline		Leak 150 mm
	Base Frequency 4.3E-5		Release Prob	Size Distribution 100% 4.3E-5
Case D	2	Cylinder Filling		Leak
		Number of Modifier cylinders 18 1.8	Release Prob 1 1	Distribution
Case D	3	Road Tanker Filling		Leak 100 mmm
	Base Frequency 8.5E-3	Number of Modifier cylinders 1 1.8	Release Prob 1 1	Size Distribution 100% 1.5E-2
Case D	4	Road Tanker on Road		Rupture
		Number of release tankers/yr prob 3000 0.034	Prob 1 1	Size Distribution 0.12 8.7E-6
Case D	5	Road Tanker on Road		Leak 100 mm
	Base Frequency 7.10E-07	Number of release tankers/yr prob 3000 0.034	Prob 1 1	Size Distribution 0.29 2.1E-5
Case D	6	Road Tanker on Road		Leak 5 mm
	Base Frequency 7.10E-07	Number of release tankers/yr prob 3000 0.034	Prob 1 1	Size Distribution 0.59 4.3E-5
Case D	7	Road Tanker on Road		BLEVE
	Base Frequency 7.10E-07	Number of release tankers/yr prob 3000 7.20E-04	Chartek modfactor 1 0.1	Size Distribution 1 1.5E-7
Case D	8	Road Tanker loading		BLEVE
	Base Frequency 1.30E-07	Number of release tankers/yr prob 3000 1.00	Chartek modfactor 1 0.1	Distribution

Case C

3

ie a Detailed	i casibility o	· tuu y							
Caltex	Failure Cas Base Frequ	se Frequenc uency	cy Calcula	tion Factors	(Caltex	Rel	ease Fred	quency
Case A	1	LPG Import		Fraction	e;		Rup	ture Full	
	Tank	Tanks	Presence	of time					
	Rupture	,	at Jetty	tank full	_				4.05.0
	2.00E-06	2	0.050	0.3	2				4.0E-8
Case A	2	LPG Impor	t by ship;	tank failur Fraction	re;	;	Rup	ture Half	Full
	Tank	Tanks	Presence	of time					
	Rupture	per ship	at Jetty	tank full					
	2.00E-06	2	0.050	0.	8				1.6E-7
Case A	3	LPG Impor	t by ship;	Collision	ta	nk leak;	Cat	astrophic	:
	Freq of	LPG Ships				Release	Size	Э	
	Impact	per year				Prob	Dis	tribution	
	7.4E-5	30	1		1	0.001484		10%	3.3E-7
Case A	4	LPG Impor	t by ship;	Collision	ta	nk leak;	100	mm hole	
	Freq of	LPG Ships				Release	Siz	е	
	Impact	per year				Prob	Dis	tribution	
	7.4E-5		1		1	0.001484		90%	3.0E-6
Case B	1	Marine Loa	ading Arm	s			R	upture F	ull bore
	Base	Arms	Modifier			Release	Siz	е	
		(each of 2)				Prob	Dis	tribution	
	3.8E-3		1	l	1	1		10%	3.8E-4
Case B	2	Marine Lo	ading Arm	ıs				Leak 5	0mm
	Base	Arms	Modifier			Release	Siz	е	
		(each of 2)				Prob		tribution	
	3.8E-3			1	1	1		90%	3.4E-3
	_	1 - 44 t t	!!					Leak 1	50 mm
Case B	3	Jetty pipel	iine						•••
	Base		Modifier			Release	Siz		
	Frequency					Prob		tribution	4.05.5
	4.3E-5	, 1	•	1	1	1		100%	4.3E-5
Case C	1	LPG Stora	ige sphere	es : Tank L	.ea	ak	Ca	tastrophi	C
	Base	Tanks				Release	Siz		
	Frequency	(each of 3))			Prob		stribution	
	4.4E-4	1		1	1			4.5%	2.0E-6 90% full
						0.6 0.3			1.2E-5 50% full 6.0E-6 20%
Case C	2	LPG Stora	ige sphere	es : Tank l	_e			0mm hole	e
						5 '	٠.		
	Base	Tanks				Release	Siz		
		(each of 3)				Prob		stribution	205 5
	4.4E-4	1		1	1	•	1	6.5%	2.9E-5
						_			

LPG Storage spheres : Tank Leak 25 mm hole

Case C 4 LPG Storage spheres : Tank Leak 5 mm hole Base Frequency (each of 3)
Frequency (each of 3)
Base
Frequency
Case D 2 Cylinder Filling Release Prob Size Distribution 1 100% 4.3E-5 Base Frequency cylinders 1.5E-5 18 1.8 1 100% 4.9E-4 Case D 3 Road Tanker Filling Release Prob 1 100% Size Distribution 1 100% Leak 100 mmm Base Frequency cylinders 8.5E-3 1 1.8 1 1 100% 1.5E-2 Case D 4 Road Tanker on Road Base Number of release Rupture Size
Case D 2 Cylinder Filling Leak Base Frequency cylinders 1.5E-5 Number of Modifier Frequency cylinders 1.5E-5 Release Prob Distribution 1 100% 4.9E-4 Case D 3 Road Tanker Filling Leak 100 mmm Base Frequency cylinders 8.5E-3 Release Prob Distribution 1 100% 1.5E-2 Case D 4 Road Tanker on Road Base Number of release Rupture Base Number of release Size
Base Number of Modifier Frequency cylinders 1.5E-5 18 1.8 1 1 100% 4.9E-4 Case D 3 Road Tanker Filling Leak 100 mmm Base Number of Modifier Frequency cylinders 2.5
Frequency cylinders
Case D 3 Road Tanker Filling Leak 100 mmm
Case D 3 Road Tanker Filling Leak 100 mmm Base Number of Modifier Frequency cylinders 8.5E-3 1 1.8 1 100% 1.5E-2 Case D 4 Road Tanker on Road Base Number of release Size Distribution 1 100% 1.5E-2
Base Number of Modifier Release Size Prob Distribution 1 100% 1.5E-2 Case D 4 Road Tanker on Road Rupture Base Number of release Size Prob Distribution 1 100% 1.5E-2
Frequency cylinders 8.5E-3 1 1.8 1 Distribution 1 100% 1.5E-2 Case D A Road Tanker on Road Base Number of release Size
8.5E-3 1 1.8 1 1 100% 1.5E-2 Case D 4 Road Tanker on Road Rupture Base Number of release Size
Case D 4 Road Tanker on Road Rupture Base Number of release Size
Base Number of release Size
Dado Hambol of Foldate
Fraguency tankers/yr, proh. Proh. Distribution
requestoy tarrectory: prob
7.10E-07 1600 0.034 1 1 0.12 4.6E-6
Case D 5 Road Tanker on Road Leak 100 mm
Base Number of release Size
Frequency tankers/yr prob Prob Distribution 7 10F-07 1600 0.034 1 1 0.29 1.1E-5
7.10E-07 1600 0.034 1 1 0.29 1.1E-5
Case D 6 Road Tanker on Road Leak 5 mm
Base Number of release Size
Frequency tankers/yr prob Prob Distribution 7.10E-07 1600 0.034 1 1 0.59 2.3E-5
Case D 7 Road Tanker on Road BLEVE
Base Number of release Chartek Size
Frequency tankers/yr prob modfactor Distribution 7.10E-07 1600 7.20E-04 1 0.1 1 8.2E-8
Case D 8 Road Tanker loading BLEVE
Base Number of release Chartek Size
Frequency tankers/yr prob modfactor Distribution 1.30E-07 1600 1.00 1 0.1 1 2.1E-5