

FREQUENCY ESTIMATION

Table 11 contains the base event frequencies used to derive the minimum cut set frequencies in *Table 12*. A total of five time periods are presented within a week: night, jammed peak, peak, weekend day and working day. The classification of the time periods is shown in *Table 13*. The frequency of events occurring at a certain time period is calculated by multiplying the time period percentage shown in *Table 13* and the event frequencies (list in *Table 7.5* of the Main Report) to give the event frequencies in *Table 14*. For events related to transport of chlorine, which does not take place at night, the frequency at any other time periods is calculated by doubling the corresponding time period percentages.

Note that the following tables have been copied from Annex I of ERM (2001). The revisions of these frequencies for the purpose of the present assessment are discussed in *Section 7.2.2.* of the main Report.

Table 11

Base Event Frequency Data

Base Event Tag	Parameter	units	Yau Kom Tau
NumTrucks_	Number of trucks	per year	198
NumDrums_	Number of drums	per truck	6
NumLifts_	Number of lifts	per drum	2
DrumsinStr	Number of drums in store	drums	64
GatetoStor	Length of road between gate and store	km	0.2
TimeonRoad	Time spent on road within site before entering store	years	4.57E-06
DroppedDrum	Probability of dropped drum	per lift	7.7E-06
CondiRuptu	Conditional probability of drum rupture		1.0E-04
Spontafail	Spontaneous drum failure/leak frequency	per year	1.5E-04
MediumLeak	Probability of medium leak		2.2E-01
LargeLeak_	Probability of large leak		8.1E-02
Rupture__	Probability of drum rupture		2.7E-02
LoadshedAc	Average frequency of load shedding accidents	per truck km	1.1E-07
RolloverAc	Average frequency of rollover accidents	per truck km	1.9E-07
VehimpctAc	Average frequency of vehicle impact accidents	per truck km	4.0E-07
ShedSMLeak	Probability of medium leak from single drum due to load shedding		6.3E-02
RollSMLeak	Probability of medium leak from single drum due to rollover		1.5E-01
RollMMLeak	Probability of medium leak from multiple drums due to rollover		1.1E-02
ImpactRupt	Probability of rupture of single drum due to impact		1.7E-02
Truckfire_	Average frequency of spontaneous truck fire	per truck km	4.0E-09
MixOldDrum	Probability of 2 or 3 ruptured drums being the old drums		6.1E-02
OneOldDrum	Probability of having 1 old drum among 3 ruptured drums		3.3E-01
NilOldDrum	Probability of having nil old drums among 3 ruptured drums		6.1E-01
EquakeLv1_	Earthquake 0.5g ground acceleration leading to roof collapse	per year	3.30E-07
EquakeLv2_	Earthquake 0.8g ground acceleration leading to roof collapse	per year	7.00E-08
ReleasCas1	Probability of having this release quantity due to roof collapse		1.00E+00

Table I2

MinimumCutSet (MCS) Frequency Data

MinimumCutSet Tag	Description	Event	Peak Hour*	Janetd Peak*	Night*	Working Day*	Weekend Day*	TotalTime #	Yau Kom Tau
NumTrucks_*NumDrums_*NumLifts_*DroppedDrum*CondiRuptu	Freq. of rupture due to dropped drum	IUJTSRU	1	1		1	1	0.5	1.83E-06
DrumsInStr*Spontafail*Rupture__	Freq. of rupture due to spontaneous failure	IUITSRU	1	1	1	1	1	1.0	2.59E-04
NumTrucks_*GateoStor*LoadshedAc*ShedSMLeak	Freq. of medium leak due to load shedding	RUIITSML	1	1		1	1	0.5	2.74E-07
NumTrucks_*GateoStor*RolloverAc*RollSMLeak	Freq. of medium leak due to roll over	RUIITSML	1	1		1	1	0.5	1.13E-06
NumDrums_*NumTrucks_*TimeonRoad*Spontafail*MediumLeak	Freq. of spontaneous medium leak on road	RUIITSML	1	1		1	1	0.5	1.79E-07
NumTrucks_*GateoStor*RolloverAc*RollMMLLeak	Freq. of medium leak (multiple) due to roll over	RUITMML	1	1		1	1	0.5	8.28E-08
NumTrucks_*GateoStor*Truckfire_*NilOldDrum	Freq. of medium leak (multiple) due to spontaneous truck fire	RUITMML	1	1		1	1	0.5	9.73E-08
NumTrucks_*GateoStor*Truckfire_*OneOldDrum	Freq. of single large leak or rupture due to spontaneous truck fire	RUIITSRU	1	1		1	1	0.5	5.15E-08
NumTrucks_*GateoStor*Truckfire_*MixOldDrum	Freq. of multiple large leak or rupture due to spontaneous truck fire	RUITMRU	1	1		1	1	0.5	9.62E-09
NumDrums_*NumTrucks_*TimeonRoad*Spontafail*LargeLeak_	Freq. of spontaneous large leak on road	RUIITSRU	1	1		1	1	0.5	6.59E-08
NumTrucks_*GateoStor*VehImpctAc*ImpactRupt	Freq. of rupture from single drum due to impact	RUIITSRU	1	1		1	1	0.5	2.69E-07
NumDrums_*NumTrucks_*TimeonRoad*Spontafail*Rupture__	Freq. of spontaneous large leak on road	RUIITSRU	1	1		1	1	0.5	2.20E-08
QuakeLv1_*ReleasCas1	Frequency of rupture of multiple drums due to roof collapse in Equake_Level1	EUITMRU	1	1	1	1	1	1.0	3.30E-07
QuakeLv2_*ReleasCas1	Frequency of rupture of multiple drums due to roof collapse in Equake_Level2	EUITMRUH	1	1	1	1	1	1.0	7.00E-08

* The notation '1' indicates that the event can occur during that time period.
 The notation '' indicates that the event cannot occur during that time period.
 eg dropped drum does not occur during night because of no delivery of drums.

The value '0.5' indicates that the event can occur 50% of the total time period
 The value '1.0' indicates that the event can occur 100% of the time period.

Table I3

Time Periods

From	To	Mon-Fri	Sat	Sun	
00:00	01:00	Night	Night	Night	
01:00	02:00	Night	Night	Night	
02:00	03:00	Night	Night	Night	
03:00	04:00	Night	Night	Night	
04:00	05:00	Night	Night	Night	
05:00	06:00	Night	Night	Night	
06:00	07:00	Night	Night	Night	
07:00	08:00	Peak	Peak	Weekend day	
08:00	08:15	Jammed Peak	Jammed Peak	Weekend day	
08:15	09:00	Peak	Peak	Weekend day	
09:00	10:00	Working day	Working day	Weekend day	
10:00	11:00	Working day	Working day	Weekend day	
11:00	12:00	Working day	Working day	Weekend day	
12:00	13:00	Working day	Working day	Weekend day	
13:00	15:00	Working day	Peak	Weekend day	
15:00	16:00	Working day	Weekend day	Weekend day	
16:00	17:00	Working day	Weekend day	Weekend day	
17:00	19:00	Peak	Weekend day	Weekend day	
19:00	20:00	Night	Night	Night	
20:00	21:00	Night	Night	Night	
21:00	22:00	Night	Night	Night	
22:00	23:00	Night	Night	Night	
23:00	00:00	Night	Night	Night	
Days		5	1	1	
Peak	(hours)	18.75	3.75	0	13.39%
Jammed Peak		1.25	0.25	0	0.89%
Working day		40	4	0	26.19%
Weekend day		0	4	12	9.52%
Night		60	12	12	50.00%

Table 14

Frequency Data

VFIV	Yau Kom Lau	Yau Kom Lau	Yau Kom Lau	Yau Kom Lau	Yau Kom Lau	Yau Kom Lau	Yau Kom Lau	Yau Kom Lau	Yau Kom Lau	Yau Kom Lau
Ryan	EUTMRU	EUTMRU	EUTMRU	EUTMRU	EUTMRU	EUTMRUH	EUTMRUH	EUTMRUH	EUTMRUH	EUTMRUH
Period	Peak Hour	Turned Peak	Night	Working Day	Weekend Day	Peak Hour	Turned Peak	Night	Working Day	Weekend Day
Num Trucks / Num Drums / Num Bags / 1 Dropped Drum / Condi Rupt										
Drums in C / Spont Fail / Rupture										
Num Trucks / Gate/Stor / Road Shed / AC / Shed / M Leak										
Num Trucks / Gate/Stor / Rollover / AC / Roll / M Leak										
Num Drums / Num Trucks / Time on Road / Spont Fail / Medium Leak										
Num Trucks / Gate/Stor / Rollover / AC / Roll / M Leak										
Num Trucks / Gate/Stor / Truck fire / Nil / Old Drum										
Num Trucks / Gate/Stor / Truck fire / One Old Drum										
Num Trucks / Gate/Stor / Truck fire / Nil / Old Drum										
Num Drums / Num Trucks / Time on Road / Spont Fail / Large Leak										
Num Trucks / Gate/Stor / Veh Impact / AC / Impact Rupt										
Num Drums / Num Trucks / Time on Road / Spont Fail / Rupture										
Eqn Arel Y1 / Releas Casl	4.42E-08	2.94E-09	1.65E-07	8.64E-08	3.14E-08					
Eqn Arel Y2 / Releas Casl						9.37E-09	6.23E-10	3.50E-08	1.83E-08	6.66E-09
ADUMCS	4.42E-08	2.94E-09	1.65E-07	8.64E-08	3.14E-08	9.37E-09	6.23E-10	3.50E-08	1.83E-08	6.66E-09

Table I4

Frequency Data

WTW	Yau Kom Tau	Yau Kom Tau	Yau Kom Tau	Yau Kom Tau	Yau Kom Tau	Yau Kom Tau	Yau Kom Tau	Yau Kom Tau	Yau Kom Tau	Yau Kom Tau	Yau Kom Tau
Event	RUJTSRU	RUHSRU	RUHTRU	RUITSRU	RUITSRU	RUITMRU	RUITMRU	RUITMRU	RUITMRU	RUITMRU	RUITMRU
Period	Peak Hour	Jammed Peak	Night	Working Day	Weekend Day	Peak Hour	Jammed Peak	Night	Working Day	Weekend Day	Weekend Day
Num Trucks * Num Drums * Num bits * Dropped Drum * Condi Rupture											
Drums in St * Spontaneous Rupture											
Num Trucks * Gate to Stor * Loaded Shed * AC Shed * M Leak											
Num Trucks * Gate to Stor * Rollover * AC Roll * M Leak											
Num Drums * Num Trucks * Time on Road * Spontaneous * Medium Leak											
Num Trucks * Gate to Stor * Rollover * AC Roll * M Leak											
Num Trucks * Gate to Stor * Truck fire * Nil Old Drum											
Num Trucks * Gate to Stor * Truck fire * One Old Drum	1.38E-08	9.17E-10		2.70E-08	9.80E-09						
Num Trucks * Gate to Stor * Truck fire * Mix Old Drum						2.58E-09	1.71E-10		5.04E-09	1.83E-09	
Num Drums * Num Trucks * Time on Road * Spontaneous * Large Leak	1.77E-08	1.17E-09		3.45E-08	1.26E-08						
Num Trucks * Gate to Stor * Vehicle * AC Impact Rupture	7.21E-08	4.79E-09		1.41E-07	5.13E-08						
Num Drums * Num Trucks * Time on Road * Spontaneous * Rupture	5.88E-09	3.91E-10		1.15E-08	4.18E-09						
Equakely 1 * Release Gas 1											
Equakely 2 * Release Gas 1											
ALL MCS	1.09E-07	7.28E-09		2.14E-07	7.76E-08	2.58E-09	1.71E-10		5.04E-09	1.83E-09	

Table I4

Frequency Data

WTW	Yau Kom Tau	Yau Kom Tau	Yau Kom Tau	Yau Kom Tau	Yau Kom Tau	Yau Kom Tau	Yau Kom Tau	Yau Kom Tau	Yau Kom Tau	Yau Kom Tau
Event	RUIIMML	RUIIMML	RUIIMML	RUIIMML	RUIIMML	RUIISML	RUIISML	RUIISML	RUIISML	RUIISML
Period	Peak Hour	Jammed Peak	Night	Working Day	Weekend Day	Peak Hour	Jammed Peak	Night	Working Day	Weekend Day
Num Trucks * Num Drums * Num Biffs * 1 * Dropped Drum * Condi Ruptu										
Drums in air * Spont fail * Rupture										
Num Trucks * Gate/Stor Loadshed Acc Shed SML Leak						7.35E-08	4.89E-09		1.44E-07	5.23E-08
Num Trucks * Gate/Stor Rollover Acc Roll SML Leak						3.02E-07	2.01E-08		5.91E-07	2.15E-07
Num Drums * Num Trucks * Time on Road * Spont fail * Medium Leak						4.79E-08	3.19E-09		9.38E-08	3.41E-08
Num Trucks * Gate/Stor Rollover Acc Roll MML Leak	2.22E-08	1.47E-09		4.34E-08	1.58E-08					
Num Trucks * Gate/Stor Truck fire * Nil Old Drum	2.60E-08	1.73E-09		5.10E-08	1.85E-08					
Num Trucks * Gate/Stor Truck fire * One Old Drum										
Num Trucks * Gate/Stor Truck fire * Mix Old Blam										
Num Drums * Num Trucks * Time on Road * Spont fail * Large Leak										
Num Trucks * Gate/Stor Ven Impact Acc Impact Rupt										
Num Drums * Num Trucks * Time on Road * Spont fail * Rupture										
Equake Lvl 2 * Release Gas 1										
Equake Lvl 2 * Release Gas 1										
ABL/MCS	4.82E-08	3.20E-09		9.43E-08	3.43E-08	4.24E-07	2.82E-08		8.29E-07	3.01E-07

Table 14

Frequency Data

W/CW	Yau Kom Tau	Yau Kom Tau	Yau Kom Tau	Yau Kom Tau	Yau Kom Tau
Event	10/1/TSRU	10/1/TSRU	10/1/TSRU	10/1/TSRU	10/1/TSRU
Period	Peak Hour	Jammed Peak	Night	Working Day	Weekend Day
Num Trucks * Num Drums * Num Lifts * Dropped Drum * Condi Ruptu	4.90E-07	3.26E-08		9.58E-07	3.48E-07
Drums in Str * Spont fail * Rupture	3.47E-05	2.31E-06	1.30E-04	6.79E-05	2.47E-05
Num Trucks * Gate to Stor * Load shed Ac * Shed SM Leak					
Num Trucks * Gate to Stor * Rollover Ac * Roll SM Leak					
Num Drums * Num Trucks * Time on Road * Spont fail * Medium Leak					
Num Trucks * Gate to Stor * Rollover Ac * Roll MM Seal					
Num Trucks * Gate to Stor * Truck fire * Nil Old Drum					
Num Trucks * Gate to Stor * Truck fire * One Old Drum					
Num Trucks * Gate to Stor * Truck fire * Mix Old Drum					
Num Drums * Num Trucks * Time on Road * Spont fail * Large Leak					
Num Trucks * Gate to Stor * Veh impact Ac * Impact Rupt					
Num Drums * Num Trucks * Time on Road * Spont fail * Rupture					
Eqwake by 2 * Release Cas 1					
Eqwake by 2 * Release Cas 1					
ALL MCS	3.52E-05	2.34E-06	1.30E-04	6.88E-05	2.50E-05