Annex 1

Fault Trees for Tunnel

Blasting

loaded into holes

4.39E-06

2MIC

Higher vibration due to 2 MIC detonated at tha same time

MIC	Higher vibration due to 2 MIC detonated at the	a same time				
P.MIC]					
ligher vibration due to 2 MIC						
letonated at the same time						
2.90E-05	5					
DR						
2.1-WD	2.2-W-DETON	2.3-W-DETON-SC	2.4-W-SC	MD-DETON	MD-SC	OL-EMULSION
		One detonator of a sector			Manufacturer defect of one	
	1 detonator wrongly put into	connected wrongly to a		Manufacturer defect of one	surface connector such that	
Vrong design in time delay of		surface connector of another	Use of a wrong surface	detonator such that time delay	time delay corresponds to	Overcharge of emulsion more
one detonator	same time delay detonator	sector	connector	corresponds to another one	another one	than required
1.26E-09	9 1.68E-14	1.33E-09	4.80E-09	2.40E-05	6.00E-07	4.39E-0

зміс

Higher vibration due to 3 MIC detonated at the same time

3MIC
Higher vibration due to 3 MIC
detonated at the same time
2.46E-07

OR

3.1-WD

two detonators

Wrong design in time delay of

1.26E-11

3.2-W-DETON

Two detonators wrongly put into one sector which contains the same time delay detonator

1.68E-16

3.3-W-DETON-SC Two detonators of other sectors connected wrongly to a surface connector of another sector

1.33E-11

3.4-W-SC

Use of two wrong surface connector

4.80E-11

3MIC-P-AD-DETON

Incorrect time default of 2 detonators due to manufacturer defect

2.40E-07

3MIC-P-AD-SC

Surface connector fails to provide necessary delay due to manufacturer defect

6.00E-09

3MIC-ER-COMB

3 MIC detonated at the same time (Due to combination of two types of errors)

2.45E-10

4MIC

Higher than expected vibration due to 4 MIC detonated at the same time

4MIC

Higher than expected vibration due to 4 MIC detonated at the same time

2.57E-09

OR

4MIC-COMB-1

4 MIC detonated (due to same error occurred three times) at the same time

2.46E-09

4MIC-COMB-2

4 MIC detonated (due to same error occurred two times and one other error) at the same time

1.37E-12

4MIC-COMB-3

4 MIC detonated (due to three different errors occur at the same time) at the same time

3.84E-16

4MIC-COMB-4

4 MIC detonated (due to charge overload and one other error occur at the same time) at the same time

1.08E-10

Probability of blocked holes

0.07

not disposed of correctly

8.13E-03

OL-C-EMULSION Too much cartridged emulsion loaded into holes OL-C-EMULSION Too much cartridged emulsion loaded into holes 4.39E-06 4.2-WD 4.1-C3 Too many catridges are inserted in Wrong design in MIC holes and not realised 9.06E-08 4.29E-06 AND 4.2.1 4.2.2 4.1-C1 4.1-C2 Cartridges from blocked holes Failure to detect and correct design Too many cartridges are inserted in inserted in other holes and not Design error by the Blasting Engineer holes detected error 1.06E-03 4.28E-06 1.40E-08 AND AND 4.1.1 4.1.2-BH 4.1.3 4.1.3 Excess cartridges are loaded into Shotfirer does not realise holes are Cartridges from blocked holes Shotfirer does not realise holes holes overloaded inserted in othe holes are overloaded 1.77E-01 2.42E-05 5.80E-04 2.42E-05 AND 4.1.2 P-BH Cartridges from blocked holes are

4.1-WD

Wrong design in time delay of three detonators

4.1-WD		
Wrong design in time delay of three		
detonators		
1.26E-13		
AND		
AND		
3.1-WD		P-AD-DETON
Wrong design in time dealy of two		Wrong design in time delay of
detonators		additional detonator
1.26E-11		0.01
_		
AND	\neg	
2.1-WD	P-AD-DETON	
Wrong design in time delay of one	Wrong design in time delay of	
detonator	additional detonator	
1.26E-09		0.01

4.2-W-DETON

Three detonator wrongly put into one sector which contains the same time delay detonator

4.2-W-DETON

Three detonator wrongly put into one sector which contains the same time delay detonator

1.68E-18

AND

3.2-W-DETON

Two detonators wrongly put into one sector which contains the same time delay detonator

1.68E-16

P-AD-DETON

Additional detonator wrongly put into one sector which contains the same time delay detonator

0.01

AND

2.2-W-DETON

One detonator wrongly put into one sector which contains the same time delay detonator

1.68E-14

P-AD-DETON

Additional detonator wrongly put into one sector which contains the same time delay detonator

0.01

4.3-W-DETON-SC

Two detonators of othe sectors connected wrongly to a surface connector of another sector

4.3-W-DETON-SC

Three detonators of other sectors connected wrongly to a surface connector of another sector

1.33E-13

AND

3.3-W-DETON-SC

Two detonators of other sectors connected wrongly to a surface connector of another sector

1.33E-11

P-AD-SC

Additional detonator of a sector connected wrongly to a surface connector of another sector

0.01

AND

2.3-W-DETON-SC

One detonator of a sector connected wrongly to a surface conector of another sector

1.33E-09

P-AD-SC

Additional detonator of a sector connected wrongly to a surface connector of another sector

0.01

4.4-W-SC

Use of three wrong surface connector

4.4-W-SC		
Use of three wrong surface		
connector		
4.80E-13		
AND		
3.4-W-SC		P-AD-SC
		Additional use of wrong surface
Use of two wrong surface connector		connector
4.80E-11		0.01
AND		
7410		
2.4-W-SC	P-AD-SC	
	Additional use of wrong surface	
Use of a wrong surface connector	connector	
4.80E-09	0.01	

4MD-DETON

Incorrect time default of 3 detonators due to manufacturer defect

4MD-DETON
Incorrect time default of 3
detonators due to manufacturer
defect

2.40E-09

AND

3MD-DETON

Manufacturer defect of two detonator such that time delay corresponds to another one

2.40E-07

P-AD-DETON

Manufacturer defect of another detonator such that time delay corresponds to another one

0.01

AND

MD-DETON

Manufacturer defect of one detonator such that time delay corresponds to another one

2.40E-05

P-AD-DETON

Manufacturer defect of another detonator such that time delay corresponds to another one

0.01

4MD-SC

Surface connector fails to provide necessary delay due to manufacturer defect

4MD-SC
Surface connector fails to provide
necessary delay due to manufacturer

defect

6.00E-11

3MD-SC

Manufacturer defect of one surface connector such that time delay corresponds to another one

6.00E-09

P-AD-SC

Manufacturer defect of another surface connector such that time delay corresponds to another one

0.01

AND

MD-SC

Manufacturer defect of one surface connector such that time delay corresponds to another one

6.00E-07

P-AD-SC

Manufacturer defect of another surface connector such that time delay corresponds to another one

0.01

4-MIC-COMB-1

4 MIC detonated (due to same error occurred three times) at the same time

4-MIC-COMB-1
4 MIC detonated (due to same error
occurred three times) at the same
time

2.46E-09

OR

4.1-WD

Wrong design in time delay of three detonators

1.26E-13

4.2-W-DETON

Three detonator wrongly put into one sector which contains the same time delay detonator

1.68E-18

4.3-2-DETON

Three detonators of other sectors connected wrongly to a surface connector of another sector

1.33E-13

4.4-W-SC

Use of three wrong surface connector

4.80E-13

4MIC-P-AD-DETON

Incorrect time default of 3 detonators due to manufacturer defect

2.40E-09

4MIC-P-AD-SC

Surface connector fails to provide necessary delay due to manufacturer defect

6.00E-11

4.39E-06

4.1-WD+OTH Wrong design in time delay of two detonator plus one other type of errors 4.1-WD+OTH Wrong design in time delay of one detonator plus one other type of errors 3.65E-16 AND 4.1-WD 4.1-WD-OTH One error other than one Wrong design in time delay of wrong design in time delay of one detonator one detonator 1.26E-11 2.90E-05 AND 2.1-WD P-AD-DETON 2.2-W-DETON 2.3-W-DETON-SC 2.4-W-SC MD-DETON MD-SC OL-EMULSION Manufacturer defect of one Manufacturer defect of one One detonator wrongly put One detonator of a sector into one sector which contains connected wrongly to a detonator such that time surface connector such that Wrong design in time delay of Wrong design in time delay of the same time delay surface connector of another Use of a wrong surface delay corresponds to another time delay corresponds to Overcharge of emulsion more one detonator additional detonator detonator sector connector another one than required 1.26E-09 0.01 1.68E-14 1.33E-09 4.80E-09 2.40E-05 6.00E-07 4.39E-06 OL-C-EMULSION Too much cartridged emulsion loaded into holes

4.2-W-DETON+OTH

Two detonator wrongly put into one sector which contains the same time delay detonator plus one other type of error:

4.2-W-DETON+OTH
Two detonator wrongly put
into one sector which contains
tha same time delay
detonator plus one other type
of errors
4.86E-21

AND

····-
4.2-W-DETON
Two detonator wrongly put
into one sector which contains
the same time delay
detonator
1.68E-16

AND

2.2-W-DETON One detonator wrongly put into one sector which contains the same time delay detonator

1.68E-14

4.2-W-DETON-OTH One error other than one detonator wrongly put into a sector which contains the same time delay detonator 2.90E-05

P-AD-DETON One additional detonator wrongly put into one sector which contains the same time delay detonator 0.01

2.3-W-DETON-SC 2.1-WD Wrong design in time delay of one detonator sector 1.26E-09

One detonator of a sector connected wrongly to a surface connector of another 1.33E-09

2.4-W-SC Use of a wrong surface connector 4.80E-09 MD-DETON Manufacturer defect of one detonator such that time delay corresponds to another 2.40E-05

MD-SC Manufacturer defect of one surface connector such that time delay corresponds to another one 6.00E-07

OL-EMULSION

Overcharge of emulsion more than required 4.39E-06

OL-C-EMULSION Too much cartridged emulsion loaded into holes 4.39E-06

OL-C-EMULSION

loaded into holes

Too much cartridged emulsion

4.39E-06

4.3-W-DETON-SC+OTH One detonator for each of two sectors connected wrongly to a surface connector of another sector plus one other type of error 4.3-W-DETON-SC+OTH One detonator for each of two sectors connected wrongly to a surface connector of another sector plus one other type of errors 3.84E-16 AND 4.3-W-DETON-SC 4.3-W-DETON-SC-OTH One error other than one One detonator of each of two detonator of a sector connected wrongly to a sectors connected wrongly to surface connector of another a surface connector of another sector sector 1.33E-11 2.90E-05 AND 2.3-W-DETON-SC 2.2-W-DETON 2.4-W-SC OL-EMULSION P-AD-DETON 2.1-WD MD-DETON MD-SC One detonator of a sector One detonator of a sector One detonator wrongly put Manufacturer defect of one Manufacturer defect of one into one sector which contains detonator such that time surface connector such that connected wrongly to a connected wrongly to a surface connector of another Use of a wrong surface delay corresponds to another Overcharge of emulsion more surface connector of another Wrong design in time delay of the same time delay time delay corresponds to another one than required sector one detonator detonator connector sector 1.33E-09 1.26E-09 1.68E-14 4.80E-09 2.40E-05 6.00E-07 4.39E-06 0.01

loaded into holes

4.39E-06

4.4-W-SC+OTH Use of two wrong surface connector plus one other types of errors 4.4-W-SC+OTH Use of two wrong surface connector plus one other type of errors 1.39E-15 AND 4.4-W-SC 4.4-W-SC-OTH Use of two wrong surface One error other than use of a connector wrong surface connector 4.80E-11 2.90E-05 AND OR 2.2-W-DETON One detonator wrongly put 2.4-W-SC P-AD-SC 2.1-WD 2.3-W-DETON-SC MD-DETON MD-SC OL-EMULSION Manufacturer defect of one One detonator of a sector Manufacturer defect of one detonator such that time surface connector such that into one sector which contain connected wrongly to a Use of a wrong surface Use of a wrong surface Wrong design in time delay of the same time delay surface connector of another delay corresponds to another time delay corresponds to Overcharge of emulsion more connector connector one detonator detonator sector another one than required 4.80E-09 1.33E-09 2.40E-05 6.00E-07 0.01 1.26E-09 1.68E-14 4.39E-06 OL-C-EMULSION Too much cartridged emulsion

OL-C-EMULSION

loaded into holes

Too much cartridged emulsion

4.39E-06

4MD-DETON+OTH Incorrect time default of two detonator due to manufacturer defect plus one other type of errors 4MD-DETON+OTH Incorrect time default of two detonator due to manufacturer defect plus one other type of errors 1.20E-12 AND MD-DETON-OTH 4MD-DETON Incorrect time default of two One error other than incorrect detonator due to time default of one detonator manufacturer defect due to manufacturer defect 2.40E-07 4.99E-06 AND MD-DETON P-AD-DETON 2.1-WD 2.2-W-DETON 2.3-W-DETON-SC 2.4-W-SC MD-SC OL-EMULSION Manufacturer defect of one One additional detonator One detonator wrongly put One detonator of a sector Manufacturer defect of one detonator such that time wrongly put into one sector into one sector which contains connected wrongly to a surface connector such that delay corresponds to another which contains the same time the same time delay surface connector of another Use of a wrong surface time delay corresponds to Overcharge of emulsion more Wrong design in time delay of delay detonator one detonator another one than required detonator sector connector 2.40E-05 0.01 1.26E-09 1.68E-14 1.33E-09 4.80E-09 6.00E-07 4.39E-06

4MD-SC+OTH Two surface connector fail to provide necessary delay due to manufacturer defect plus one other type of errors

4MD-DETON+OTH Two surface connector fail to provide necessary delay due to manufacturer defect plus one other type of errors 1.70E-13 AND MD-DETON-OTH 4MD-SC Two surface connector fail to One error other than incorrect provide necessary delay due time default of one detonator to manufacturer defect due to manufacturer defect 2.84E-05 6.00E-09 MD-SC P-AD-SC 2.1-WD 2.2-W-DETON 2.3-W-DETON-SC 2.4-W-SC MD-DETON OL-EMULSION Manufacturer defect of one Manufacturer defect of one One detonator wrongly put One detonator of a sector Manufacturer defect of surface connector such that surface connector such that into one sector which contains connected wrongly to a oneDETONATOR such that time delay corresponds to time delay corresponds to Wrong design in time delay of the same time delay surface connector of another Use of a wrong surface time delay corresponds to Overcharge of emulsion more another one another one one detonator another one than required detonator sector connector 1.68E-14 6.00E-07 0.01 1.26E-09 1.33E-09 4.80E-09 2.40E-05 4.39E-06 OL-C-EMULSION Too much cartridged emulsion loaded into holes 4.39E-06

4MIC-COMB-2

4 MIC detonated (due to same error occurred two times and one other error) at the same time

4MIC-COMB-2
4 MIC detonated (due to same error
occurred two times and one other
error) at the same time
1 37F-1

4.1-WD+OTH

Wrong design in time delay of one detonator plus one other type of errors

3.65E-16

4.2-W-DETON+OTH

Two detonator wrongly put into one sector which contains tha same time delay detonator plus one other type of errors

4.86E-21

4.3-W-DETON-SC+OTH

One detonator for each of two sectors connected wrongly to a surface connector of another sector plus one other type of errors

3.84E-16

4.4-W-SC+OTH

Use of two wrong surface connector plus one other type of errors 1.39E-15

4MD-DETON+OTH

Incorrect time default of two detonator due to manufacturer defect plus one other type of errors 1.20E-12 4MD-SC+OTH

Two surface connector fail to provide necessary delay due to manufacturer defect plus one other type of errors

1.70E-13

4.2-(WD)-W-DETON+OTH

One detonator wrongly put into one sector which containes the same time delay detonator plus one other type of errors except wrong design in time delay

4.2-(WD)-W-DETON+OTH

One detonator wrongly put into one sector which contains the same time delay detonator plus one other type of errors except wrong design in time delay

4.86E-19

AND

2.2-W-DETON

One detonator wrongly put into one sector which contains the same time delay detonator

1.68E-14

4.2-W-DETON-OTH

One error other than one detonator wrongly put into a sector which contains the same time delay detonator

2.90E-05

OR

2.3-W-DETON-SC

One detonator of a sector connected wrongly to a surface connector of another sector

1.33E-09

2.4-W-SC

Use of a wrong surface connector 4.80E-09

MD-DETON

Manufacturer defect of one detonator such that time delay corresponds to another one

2.40E-05

MD-SC

Manufacturer defect of one surface connector such that time delay corresponds to another one

6.00E-07

OL-EMULSION

Overcharge of emulsion more than required

4.39E-06

OL-C-EMULSION

Too much cartridged emulsion loaded into holes

4.3-(WD)-W-DETON-SC+OTH

One detonator connected wrongly to a surface connector of another sector plus one other error except wrong design in time delay

	_									_		-	_		
Λ	2_	W	۸/	ח	۱_۱	۱٨	/ _	ח	FΤ	\cap	\I_9	C+	$\cap T$	Ή	

One detonator connected wrongly to a surface connector of another sector plus one other error except wrong design in time delay

3.84E-14

AND

2.3-W-DETON-SC

One detonator of a sector connected wrongly to a surface connector of another sector

1.33E-09

4.3-(WD)-W-DETON-OTH

One error other than one detonator for a sector connected wrongly to a surface connector of another sector

2.90E-05

OR

2.2-W-DETON

One detonator wrongly put into one sector which contains the same time delay detonator

1.68E-14

2.4-W-SC

Use of a wrong surface connector 4.80E-09

MD-DETON

Manufacturer defect of one detonator such that time delay corresponds to another one

2.40E-05

MD-SC

Manufacturer defect of one surface connector such that time delay corresponds to another one

6.00E-07

Overchar

Overcharge of emulsion more than required

4.39E-06

OL-C-EMULSION

OL-EMULSION

Too much cartridged emulsion loaded into holes

4.4(WD)-W-SC+OTH

Use of one wrong surface connector plus one other type of errors except wrong design in time delay

4.4-(WD)-W-SC+OTH	

Use of one wrong surface connector plus one other type of errors except wrong design in time delay

1.39E-13

AND

2.4-W-SC

Use of a wrong surface connector 4.80E-09

4.4-(WD)-W-SC-OTH

One error other than use of a wrong surface connector

2.90E-05

)R

2.2-W-DETON

One detonator wrongly put into one sector which contains the same time delay detonator

1.68E-14

2.3-W-DETON-SC

One detonator of a sector connected wrongly to a surface connector of another sector

1.33E-09

MD-DETON

Manufacturer defect of one detonator such that time delay corresponds to another one

2.40E-05

MD-SC

Manufacturer defect of one surface connector such that time delay corresponds to another one

6.00E-07

OL-EMULSION

Overcharge of emulsion more than required

4.39E-06

OL-C-EMULSION

Too much cartridged emulsion loaded into holes

Too much cartridged emulsion

4.39E-06

loaded into holes

4(WD)-MD-DETON+OTH

Incorrect time default of one detonator due to manufacuturer defect plus one other type of errors except wrong design in time delay

4(WD)-WD-DETON+OTH	incorrect time default of one detonator due to manu	diacuturer defect plus one other type of errors e.	xcept wrong design in time delay		
4MIC-(WD)-MD-DETON+OTH					
Incorrect time default of one					
detonator due to manufacuturer					
defect plus one other type of errors					
except wrong design in time delay					
1.20E-10					
AND					
4MD-DETON	4(WD)-MD-DETON-OTH				
THE BETON	One error other than incorrect time				
Incorrect time default of one	default of 1 detonator due to				
detonator due to maufacturer defect					
2.40E-05					
	<u> </u>				
	OR				
	1				0. 5.0
MD-DETON	2.2-W-DETON	2.3-W-DETON-SC	2.4-W-SC	MD-SC	OL-EMULSION
Manufacturer defect of one	One detonator wrongly put into one	One detonator of a sector connected		Manufacturer defect of one surface	
detonator such that time delay	sector which contains the same time	wrongly to a surface connector of		connector such that time delay	Overcharge of emulsion more than
corresponds to another one	delay detonator	another sector	Use of a wrong surface connector	corresponds to another one	required
2.40E-05	1.68E-14	1.33E-09	4.80E-09	6.00E-07	4.39E-06
					OL-C-EMULSION
					To a manuala control de cal a manulai a m

loaded into holes

4.39E-06

4(WD)-MD-SC+OTH

One surface connector fail to provide necessary delay due to manufacturer defect plus one other type of errors except wrong design in time delay

4(WD)-MD-3C+OTH One	surface connector fail to provide necessary dela	y due to manufacturer defect plus one other typ	e of errors except wrong design in time delay		
4(WD)-MD-SC+OTH					
One surface connector fail to provide					
necessary delay due to manufacturer					
defect plus one other type of errors					
except wrong design in time delay					
1.70E-11					
4115					
AND					
4MD-SC	4(WD)-MD-SC-OTH				
One surface connector fail to provide	One error other than incorrect time				
necessary delay due to manufacturer	default of one detonator due to				
defect	manufacturer defect				
6.00E-07	2.84E-05				
	OR				
					0. 5
MD-SC	2.2-W-DETON	2.3-W-DETON-SC	2.4-W-SC	MD-DETON	OL-EMULSION
Manufacturer defect of one surface	One detonator wrongly put into one	One detonator of a sector connected		Manufacturer defect of one	Overally and of anything are at the co
connector such that time delay	sector which contains the same time	wrongly to a surface connector of		detonator such that time delay	Overcharge of emulsion more than
corresponds to another one	delay detonator	another sector	Use of a wrong surface connector	corresponds to another one	required
6.00E-07	1.68E-14	1.33E-09	4.80E-09	2.40E-05	4.39E-06
					OL-C-EMULSION
					Too much cartridged emulsion
					I

4(WD)-OL-EMULSION+OTH

Overcharge of emulsion more than required plus one other type of error except wrong design in time delay of one detonator

4(WD)-OL-EMULSION+OTH
Overd	harge of emulsion more than
requi	red plus one other type of error
excep	t wrong design in time delay of
one d	etonator
	1 005 10
	1.08E-10
AND	1.081-10
	// JULSION
OL-EN	
OL-EN	NULSION harge of emulsion more than

SION
ge of emulsion more than

4(WD)-OL-EMULSION-OTH

One error other than hole overload

2.46E-05

OR

OL-C-EMULSION

Too much cartridged emulsion loaded into holes

4.39E-06

2.2-W-DETON

One detonator wrongly put into one sector which contains the same time delay detonator

1.68E-14

2.3-W-DETON-SC

One detonator of a sector wrongly to a surface connanother sector

2.3-W-DETON-SC

One detonator of a sector connected wrongly to a surface connector of another sector

1.33E-09

2.4-W-SC

MD-DETON

Manufacturer defect of one detonator such that time delay corresponds to another one

4.80E-09

ADD-DETON

Manufacturer defect of one detonator such that time delay corresponds to another one

2.40E-05

MD-SC
Manufacturer defect of one surface connector such that time delay corresponds to another one
6.00E-07

4(WD)+OTH+OTH

Wrong design in time delay of one detonator plus two other type of errors

4(WD)+OTH+OTH

Wrong design in time delay of one detonator plus two other type of errors

3.08E-19

AND

2.1-WD

Wrong design in time delay of one detonator

1.26E-09

4(WD)-OTH-OTH

Two errors other then wrong design in time delay of one detonator

2.45E-10

ΩR

4.2-(WD)-W-DETON+OTH

One detonator wrongly put into one sector which contains the same time delay detonator plus one other type of errors except wrong design in time delay

4.86E-19

4.3-(WD)-W-DETON-SC+OTH

One detonator connected wrongly to a surface connector of another sector plus one other error except wrong design in time delay

3.84E-14

4.4-(WD)-W-SC+OTH

Use of one wrong surface connector plus one other type of errors except wrong design in time delay

1.39E-13

4MIC-(WD)-MD-DETON+OTH

Incorrect time default of one detonator due to manufacuturer defect plus one other type of errors except wrong design in time delay

1.20E-10

4(WD)-MD-SC+OTH

One surface connector fail to provide necessary delay due to manufacturer defect plus one other type of errors except wrong design in time delay

1.70E-11

4(WD)-OL-EMULSION+OTH

Overcharge of emulsion more than required plus one other type of error except wrong design in time delay of one detonator

1.08E-10

loaded into holes

4.1-(W-DETON)-WD+OTH	Wrong design in time delay of one detonator plus one	other type of errors except one detonator wro	ngly put into one sector		
4.1-(W-DETON)-WD+OTH Wrong design in time delay of one					
detonator plus one other type of					
errors except one detonator wrongl	у				
put into one sector					
3.65E-1	14				
AND					
AND					
2.1-WD	4.1-(W-DETON)-WD-OTH				
Wrong design in time delay of one	One error other than one wrong				
detonator	design in time time of one detonator				
1.26E-0	09 2.90E-05				
	OR				
	2.3-W-DETON-SC	2.4-W-SC	MD-DETON	MD-SC	OL-EMULSION
	One detonator of a sector connected		Manufacturer defect of one	Manufacturer defect of one surface	
	wrongly to a surface connector of		detonator such that time delay	connector such that time delay	Overcharge of emulsion more than
	another sector	Use of a wrong surface connector	corresponds to another one	corresponds to another one	required
	1.33E-09	4.80E-09	2.40E-05	6.00E-07	4.39E-0
					OL-C-EMULSION
					Too much cartridged emulsion

4.3-(W-DETON)-W-DETON-SC+OTH One detonator connected wrongly to a surface connector of another sector plus one other error except one detonator wrongly put into one sector

4.2-(W-DETON)-W-DETON-SC+OTH
One detonator connected wrongly to
surface connector of another sector
plus one other error except one
detonator wrongly put into one
sector

3.84E-14

AND

2.3-W-DETON-SC

One detonator of a sector connected wrongly to a surface connector of another sector

1.33E-09

4.2-(W-DETON)-W-DETON-SC-OTH

One error other than one detonator for a sector connected wronglyh to a surface connector of another sector 2.90E-05

OR

2.1-WD

Wrong design in time delay of one detonator

1.26E-09

2.4-W-SC

Use of a wrong surface connector 4.80E-09

MD-DETON

Manufacturer defect of one detonator such that time delay corresponds to another one

2.40E-05

MD-SC

Maufacturer defect of one surface connector such that time delay corresponds to another one

6.00E-07

OL-EMULSION

Overcharge of emulsion more than required

4.39E-06

OL-C-EMULSION

Too much cartridged emulsion loaded into holes

loaded into holes

4.39E-06

4.4.(W.DETON).W-SC+OTH Lise of one wrong surface connector plus one other type of errors except one detonator wrongly put into

4.4-(W-DETON)-W-SC+OTH Use	of one wrong surface connector plus one other	type of errors except one detonator wrongly put	into one		
4.4-(W-DETON)-W-SC+OTH					
Use of one wrong surface connector					
plus one other type of errors except					
one detonator wrongly put into one					
1.39E-13					
1.331 13					
ND					
4-W-SC	4.4-(W-DETON)-W-SC-OTH				
	One error other than use of a wrong				
se of a wrong surface connector	surface connector				
4.80E-09	2.90E-05				
	OR				
	2.1-WD	2.3-W-DETON-SC	MD-DETON	MD-SC	OL-EMULSION
		One detonator of a sector connected	Manufacturer defect of one	Manufacturer defect of one surface	
	Wrong design in time delay od one	wrongly to a surface connector of	detonator such that time delauy	connector such that time delay	Overcharge of emulsion more than
	detonator	another sector	corresponds to another one	corresponds to another one	required
	1.26E-09	1.33E-09	2.40E-05	6.00E-07	4.39E-
					OL-C-EMULSION
					Too much cartridged emulsion
					Landad Saka India

4(W-DETON)-MD-DETON+OTH

2.40E-05

Incorrect time default of one detonator due to manufacturer defect plus one other type of errors except one detonator wrongly put into one sector

4(W-DETON)-MD-DETON				
Incorrect time default of one				
detonator due to manufacturer				
defect plus one other type of errors				
except one detonator wrongly put				
into one sector				
1.20E-10				
AND				
MD-DETON	4(W-DETON)-MD-DETON+OTH			
	One error other than incorrect time			
Incorrect time default of one	default of one detonator due to			
deonator due to manufacturer defect	manufacturer defect			
2.40E-05	4.99E-06			
	OR			
MD-DETON	2.1-WD	2.3-W-DETON-SC	2.4-W-SC	MD-SC
Manufacturer defect of one		One detonator of a sector connected		Manufacturer defect of one surface
detonator such that time delay	Wrong design in time delay of one	wrongly to a surface connector of		connector such that time delay
corresponds to another one	detonator	another sector	Use of a wrong surface connector	corresponds to another one

1.33E-09

4.80E-09

1.26E-09

OL-C-EMULSION
Too much cartridged emulsion
loaded into holes

Overcharge of emulsion more than

4.39E-06

4.39E-06

OL-EMULSION

required

6.00E-07

4(W-DETON)-MD-SC+OTH

One surface connector fail to provide necessay delay due to manufacturer defect plus one other type of errors except one detonator wrongly put into one sector

4(W-DETON)-MD-SC+OTH
One surface connector fail to provide
necessay delay due to manufacturer
defect plus one other type of errors
except one detonator wrongly put
into one sector
1.70E-11
AND

AND

MD-SC
One surface connector fail to provide
necessary delay due to manufacture
defect

6.00E-07

MD-SC

Manufacturer defect of one surface connector such that time delay corresponds to another one

6.00E-07

4(W-DETON)-MD-SC-OTH

One error other than incorrect time default of one detonator due to manufacturer defect

2.84E-05

OR

2.1-WD

Wrong design in time delay of one detonator 1.26E-09

2.3-W-DETON-SC
One detonator of a sector connected wrongly to a surface connector of another sector

1.33E-09

Use of a wrong surface connector
4.80E-09

MD-DETON

Manufacturer defect of one detonator suchh that time delay corresponds to another one

2.40E-05

OL-EMULSION

Overcharge of emulsion more than required

4.39E-06

OL-C-EMULSION

Too much cartridged emulsion loaded into holes

2.40E-05

4.39E-06

1.26E-09

4(W-DETON)-OL-EMULSION+OTH Overcharge of emulsion more than required plus one other type of error except 1 detonator wrongy put into one sector which contains the same time delay detonator

4(W-DETON)-OL-EMULSION+OTH					
Overcharge of emulsion more than					
required plus one other type of error					
except 1 detonator wrongly put into					
one sector which contains the same					
time delay detonator					
1.08E-10					
<u> </u>					
AND					
OL-EMULSION	4(W-DETON)-OL-EMULSION-OTH				
Overcharge of emulsion more than					
required	One error other than hole overload				
4.39E-06	2.46E-05				
<u>'</u>					
	OR				
OL-C-EMULSION	2.1-WD	2.3-W-DETON-SC	2.4-W-SC	MD-DETON	MD-SC
		One detonator of a sector connected		Manufacturer defect of one	Manufacturer defect of one surface
Too much cartridged emulsion	Wrong design in time delay of one	wrongly to a surface connector of		detonator such that time delay	connector such that time delay
loaded into hole	detonator	another sector	Use of a wrong surface connector	corresponds to another one	corresponds to another one

4.80E-09

1.33E-09

6.00E-07

4(W-DETON)+OTH+OTH

One detonator wronly put into one sector which contains the same time delay detonator plus two other type of errors

4(W-DETON)+OTH+OTH One detonator wronly put into one sector which contains the same time delay detonator plus two other type of errors

4.11E-24

AND

2.2-W-DETON

One detonator wrongly put into one sector which contains the same time delay detonator

1.68E-14

4(W-DETON)-OTH-OTH

Two errors other than one detonator wrongly put into one sector which contains the same time delay detonator

2.45E-10

4.1-(W-DETON)-WD+OTH

Wrong design in time delay of one detonator plus one other type of errors except one detonator wrongly put into one sector 3.65E-14 4.3-(W-DETON)-W-DETON-SC+OTH

One detonator connected wrongly to surface connector of another sector plus one other error except one detonator wrongly put into one sector 3.84E-14 4.4-(W-DETON)-W-SC+OTH

Use of one wrong surface connector plus one other type of errors except one detonator wrongly put into one 1.39E-13 4(W-DETON)-MD-DETON+OTH

Incorrect time default of one detonator due to manufacturer defect plus one other type of errors except one detonator wrongly put into one sector 1.20E-10 4(W-DETON)-MD-SC+OTH

One surface connector fail to provide necessary delay due to manufacturer defect plus one other type of errors except one detonator wrongly put into one sector 1.70E-11

Overcharge of emulsion more than

4(W-DETON)-OL-EMULSION+OTH

required plus one other type of error except 1 detonator wrongly put into one sector which contains the same time delay detonator

1.08E-10

loaded into hole

4.39E-06

4.1_(W_DETON_SC_WD+OTH Wrong design in time delay of one detonator plus of

4.1-(W-DETON-SC)-WD+OTH	Wrong design in time delay of one detonator plus on	e other type of errors except use of a wrong sur	face connector		
4.1-(W-DETON-SC)-WD+OTH					
Wrong design in time delay of one	7				
detonator plus one other type of					
errors except use of a wrong surface	2				
connector					
3.65E-1	4				
AND					
2.1-WD	4.1-(W-DETON-SC)-WD-OTH				
	One error other than one wrong				
Wrong design in time delay of one	design in time delay of one				
detonator	detonator				
1.26E-0	9 2.90E-05				
	OR				
	2.2-W-DETON	2.4-W-SC	MD-DETON	MD-SC	OL-EMULSION
	One detonator wrongly put into one		Manufacturer defect of one	Manufacturer defect of one surface	
	sector which contains the same time		detonator such that time delay	connector such that time delay	Overcharge of emulsion more than
	delay detonator	Use of a wrong surface connector	corresponds to another one	corresponds to another one	required
	1.68E-14	4.80E-09	2.40E-05	6.00E-07	4.39E-0
					OL-C-EMULSION
					Too much cartridged emulsion

loaded into holes

4.39E-06

4.2-(W-DETON-SC)-W-DETON+OTH One detonator wrongly put into the sector which contains the same time delay detonator plus one other yupe of errors except one detonator connected wrongly to a surface connector

4.2-(W-DETON-SC)-W-DETON+OTH One	detonator wrongly put into the sector which con	tains the same time delay detonator plus one o	ther yupe of errors except one detonator connec	ted wrongly to a surface connector	
4.2-(W-DETON-SC)-W-DETON+OTH					
One detonator wrongly put into the					
sector which contains the same time					
delay detonator plus one other yupe					
of errors except one detonator					
connected wrongly to a surface					
connector					
4.86E-19					
AND					
2.2-W-DETON	4.2-(W-DETON-SC)-W-DETON-OTH				
	One error other than one detonator				
One detonator wrongly put into one	wrongly put into a sector which				
sector which contains the same time	contains the same time delay				
delay detonator	detonator				
1.68E-14	2.90E-05				
	OR				
	2.1-WD	2.4-W-SC	MD-DETON	MD-SC	OL-EMULSION
			Manufacturer defect of one	Manufacturer defect of one surface	
	Wrong design in time delay of one		detonator such that time delay	connector such that time delay	Overcharge of emulsion more than
	detonator	Use of a wrong surface connector	corresponds to another one	corresponds to another one	required
	1.26E-09	4.80E-09	2.40E-05	6.00E-07	4.39E-06
					OL-C-EMULSION
					Too much cartridged emulsion
					l

Too much cartridged emulsion

4.39E-06

loaded into hole

4.4-(W-DETON-SC)-W-SC+OTH

4.4-(W-DETON-SC)-W-SC+OTH Use of	one wrong surface connector plus one other ty	ype of errors exceot one detonator connected w	vrongly to a surface connector		
4.4-(W-DETON-SC)-W-SC+OTH					
Use of one wrong surface connector					
plus one other type of errors exceot					
one detonator connected wrongly to					
a surface connector					
1.39E-13					
AND	<u></u>				
2.4-W-SC	4.4-(W-DETON-SC)-W-SC-OTH				
	One error other than use of a wrong				
Use of a wrong surface connector	surface connector				
4.80E-09	2.90E-05				
	OB				
	OR		1		
	2.1-WD	2.2-W-DETON	MD-DETON	MD-SC	OL-EMULSION
	2.1-440	One detonator wrongly put into one	Manufacturer defect of one	Manufacturer defect of one surface	OE-EIVIOESION
	Wrong design in time delay of one	sector which contains the same time	detonator such that time delay	connector such that time delay	Overcharge of emulsion more than
	detonator	delay detonator	corresponds to another one	corresponds to another one	required
	1.26E-09	1.68E-14	2.40E-05	6.00E-07	4.39E-0
	1,202 05	1.002 14	2.402 03	0.002 07	4.552 0

4(W-DETON-SC)-MD-DETON+OTH Incorrect time default of one detonator due to manufacturer defect plus one other type of errors except one detonator connected wrongly to a surface connector

4(W-DETON-SC)-MD-DETON+OTH Inco	orrect time default of one detonator due to manuf	acturer defect plus one other type of errors exce	ept one detonator connected wrongly to a surfa	ace connector	
4(W-DETON-SC)-MD-DETON+OTH					
Incorrect time default of one					
detonator due to manufacturer					
defect plus one other type of errors					
except one detonator connected					
wrongly to a surface connector					
1.20E-10					
AND					
MD-DETON	4(W-DETON-SC)-MD-DETON-OTH				
	One error other than incorrect time				
Incorrect time default of one	default of one detonator due to				
detonator due to maufacturer defect	manufacturer defect				
2.40E-05	4.99E-06				
	OR				
	ON .				
MD-DETON	2.1-WD	2.2-W-DETON	2.4-W-SC	MD-SC	OL-EMULSION
Manufacturer defect of one		One detonator wrongly put into one		Manufacturer defect of one surface	
detonator such that time delay	Wrong design in time delay of one	sector which contains the same time		connector such that time delay	Overcharge of emulsion more than
corresponds to another one	detonator	delay detonator	Use of a wrong surface connector	corresponds to another one	required
2.40E-05	1.26E-09	1.68E-14	4.80E-09	6.00E-07	4.39E-06
		<u> </u>			

4(W-DETON-SC)-MD-SC+OTH

One surface connector fail to provide necessary delay due to manufacturer defect plus one other type of errors except one detonator connected wrongly to a surface connector

1/11/	DETON	I CC\ N	1D-SC+OT	ш
41 VV -	-1) - 1()	V-5U.J-IV	リリーろしキしエ	н

One surface connector fail to provide necessary delay due to manufacturer defect plus one other type of errors except one detonator connected wrongly to a surface connector

1.70E-11

AND

MD-SC

One surface connector fail to provide necessary delay due to manufacturer defect

6.00E-07

MD-SC

Manufacturer defect of one surface connector such that time delay corresponds to another one

6.00E-07

4(W-DETON-SC)-MD-SC-OTH

One error other than incorrect time default of one detonator due to manufacturer defect

2.84E-05

1.26E-09

OR

2.1-WD

Wrong design in time delay of one detonator

One detonator wrongly put into one sector which contains the same time delay detonator

1.68E-14

2.2-W-DETON

2.3-W-DETON-SC

One detonator of a sector connected wrongly to a surface connector of another sector

1.33E-09

Manufacturer defect of one detonator suchh that time delay corresponds to another one

MD-DETON

2.40E-05

OL-EMULSION

Overcharge of emulsion more than required

4.39E-06

OL-C-EMULSION

Too much cartridged emulsion loaded into holes

4(W-DETON-SC)-OL-EMULSION+OTH	Overcharge of emulsion more than required plus one other	her type of error except one detonator of a sector	connected wrongly to a surface connector of a	nother sector	
4(W-DETON-SC)-OL-EMULSION+OTH					
Overcharge of emulsion more than required plus one other type of error except one detonator of a sector connected wrongly to a surface connector of another sector 1.08E-10					
AND OL-EMULSION Overcharge of emulsion more than required 4.39E-06	4(W-DETON-SC)-OL-EMULSION-OTH One error other than hole overload 2.46E-05				
OL-C-EMULSION	OR 2.1-WD	2.2-W-DETON	2.4-W-SC	MD-DETON	MD-SC
Too much cartridged emulsion loaded into hole 4.39E-06	Wrong design in time delay of one detonator 1.26E-09	One detonator wrongly put into one sector which contains the same time delay detonator 1.68E-14	Use of a wrong surface connector 4.80E-09	Manufacturer defect of one detonator such that time delay corresponds to another one 2.40E-05	Manufacturer defect of one surface connector such that time delay corresponds to another one 6.00E-07

4(W-DETON-SC)+OTH+OTH One detonator connected wrongly to a surface connector of another sector plus two other type of errors

4(W-DETON-SC)+OTH+OTH
One detonator connected
wrongly to a surface connector
of another sector plus two
other type of errors

3.24E-19

AND

2.3-W-DETON-SC

One detonator of a sector connected wrongly to a surface connector of another sector

1.33E-09

4(W-DETON-SC)-OTH-OTH Two errors other than one detonator of a sector

connected wrongly to a surface connector of another sector

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4.1-(W-DETON-SC)-WD+OTH

Wrong design in time delay of one detonator plus one other type of errors except use of a wrong surface connector

3.65E-14

2.45E-10

4.2-(W-DETON-SC)-W-DETON+OTH

One detonator wrongly put into the sector which contains the same time delay detonator plus one other yupe of errors except one detonator connected wrongly to a surface connector

4.86E-19

4.4-(W-DETON-SC)-W-SC+OTH

Use of one wrong surface connector plus one other type of errors exceot one detonator connected wrongly to a surface connector

1.39E-13

4(W-DETON-SC)-MD-DETON+OTH

Incorrect time default of one detonator due to manufacturer defect plus one other type of errors except one detonator connected wrongly to a surface connector

1.20E-10

4(W-DETON-SC)-MD-SC+OTH
One surface connector fail to
provide necessary delay due
to manufacturer defect plus
one other type of errors
except one detonator

except one detonator connected wrongly to a surface connector

1.70E-11

4(W-DETON-SC)-OL-EMULSION+OTH

Overcharge of emulsion more than required plus one other type of error except one detonator of a sector connected wrongly to a surface connector of another sector

1.08E-10

4.1-(W-SC)-WD+OTH

Wrong design in time delay of one detonator plus one other type of errors except use of a wrong surface connector

4.1-(W-	-SC)-W	D+	OTH	
1 A /		-I -	- :	•	41	

Wrong design in time delay of one detonator plus one other type of errors except use of a wrong surface connector

3.65E-14

AND

2.1-WD

Wrong design in time delay of one detonator

1.26E-09

4.1-(W-SC)-WD-OTH

One error other than one wrong design in time delay of one detonator

2.90E-05

ΩR

2.2-W-DETON

One detonator wrongly put into one sector which contains the same time delay detonator

1.68E-14

2.3-W-DETON-SC

One detonator of a sector connected wrongly to a surface connector of another sector

1.33E-09

MD-DETON

Manufacturer defect of one detonator such that time delay corresponds to another one

2.40E-05

MD-SC

Manufacturer defect of one surface connector such that time delay corresponds to another one

6.00E-07

OL-EMULSION

Overcharge of emulsion more than required

4.39E-06

OL-C-EMULSION

Too much cartridged emulsion loaded into holes

4.2-(W-SC)-W-DETON+OTH

One detonator wrongly put into one sector which contains the same time delay detonator plus one other type of errors except use of a wrong surface connector

4.2-(W-SC)-W-DETON+OTH

One detonator wrongly put into one sector which contains the same time delay detonator plus one other type of errors except use of a wrong surface connector

4.86E-19

AND

2.2-W-DETON

One detonator wrongly put into one sector which contains the same time delay detonator

1.68E-14

4.2-(W-SC)-W-DETON-OTH

One error other than one detonator wrongly put into a sector which contains the same time delay detonator

2.90E-05

1.26E-09

OR

2.1-WD

Wrong design in time delay of one detonator

2.3-W-DETON-SC

One detonator of a sector connected wrongly to a surface connector of another sector

1.33E-09

MD-DETON

Manufacturer defect of one detonator such that time delay corresponds to another one

2.40E-05

MD-SC

Manufacturer defect of one surface connector such that time delay corresponds to another one

6.00E-07

OL-EMULSION

Overcharge of emulsion more than required

4.39E-06

OL-C-EMULSION

Too much cartridged emulsion loaded into holes

4.3-(W-SC)-W-DETON-SC+OTH

One detonator connected wrongly to a surface connector of another sector plus one other error except use of a wrong surface connector

4.3-(W-SC)-W-DETON-SC+OTH

One detonator connected wrongly to a surface connector of another sector plus one other error except use of a wrong surface connector

3.84E-14

AND

2.3-W-DETON-SC

One detonator of a sector connected wrongly to a surface connector of another sector

1.33E-09

4.3-(W-SC)-W-DETON-SC-OTH

One error other than one detonator for a sector connected wrongly to a surface connector of another sector

2.90E-05

OR

2.1-WD

Wrong design in time delay of one detonator

1.26E-09

2.2-W-DETON

One detonator wrongly put into one sector which contains the same time delay detonator

1.68E-14

MD-DETON

Manufacturer defect of one detonator such that time delay corresponds to another one

2.40E-05

MD-SC

Manufacturer defect of one surface connector such that time delay corresponds to another one

6.00E-07

OL-EMULSION

Overcharge of emulsion more than required

4.39E-06

OL-C-EMULSION

Too much cartridged emulsion loaded into holes

4(W-SC)-MD-DETON+OTH

Incorrect time default of one detonator due to manufacturer defect plus one other type of errors except use of a wrong surface connector

+(W-3C)-WID-DETONTOTTI
4(W-SC)-MD-DETON+OTH
Incorrect time default of one
detonator due to manufacturer
defect plus one other type of errors
except use of a wrong surface
connector
1.20E-10
AND
MD-DETON
Incorrect time default of one
dotanator due to maufacturer defect

4(W-SC)-MD-DETON-OTH
One error other than incorrect time default of one detonator due to manufacturer defect
4.99E-06

OR

MD-DETON

Manufacturer defect of one detonator such that time delay corresponds to another one 2.40E-05

2.40E-05

2.1-WD

2.2-W-DETON

One detonator wrongly put into one sector which contains the same time delay detonator

1.26E-09

2.2-W-DETON

One detonator wrongly put into one sector which contains the same time delay detonator

2.3-W-DETON-SC

One detonator of a sector connected wrongly to a surface connector of another sector

1.68E-14

1.33E-09

MD-SC

Manufacturer defect of one surface connector such that time delay corresponds to another one

6.00E-07

OL-EMULSION

Overcharge of emulsion more than required

4.39E-06

OL-C-EMULSION
Too much cartridged emulsion
loaded into holes
4.39E-06

4(W-SC)-MD-SC+OTH

One surface connector fail to provide necessary delay due to manufacturer defect plus one other type of errors except use of a wrong surface connector

4(W-SC)-MD-SC+OTH
One surface connector fail to provide
necessary delay due to manufacturer
defect plus one other type of errors
except use of a wrong surface
connector
1.70E-11
AND

MD-SC
One surface connector fail to provide necessary delay due to manufacturer defect
6.00E-07

MD-SC
Manufacturer defect of one surface connector such that time delay corresponds to another one
6.00E-07

4(W-SC)-MD-SC-OTH

One error other than incorrect time default of one detonator due to manufacturer defect

2.84E-05

2.1-WD
Wrong design in time delay of one detonator

1.26E-09

OR

2.2-W-DETON

One detonator wrongly put into one sector which contains the same time delay detonator

1.68E-14

2.3-W-DETON-SC

One detonator of a sector connected wrongly to a surface connector of another sector

1.33E-09

MD-DETON

Manufacturer defect of one detonator such that time delay corresponds to another one

2.40E-05

Overcharge of emulsion more than required 4.39E-06

OL-EMULSION

OL-C-EMULSION
Too much cartridged emulsion
loaded into holes
4.39E-06

4(W-SC)-OL-EMULSION+OTH

Overcharge of emulsion more than required plus one other type of error except use of a wrong surface connector

4(W-SC)-OL-EMULSION+OTH
Overcharge of emulsion more than
required plus one other type of error
except use of a wrong surface
connector

1.08E-10

AND

OL-EMULSION
Overcharge of emulsion more than
required
4 39F-06

OL-C-EMULSION Too much cartridged emulsion loaded into hole 4.39E-06 4(W-SC)-OL-EMULSION-OTH

One hole other than hole overload 2.46E-05

OR

2.1-WD Wrong design in time delay of one detonator 1.26E-09

One detonator wrongly put into one sector which contains the same time delay detonator

2.2-W-DETON

1.68E-14

2.3-W-DETON-SC One detonator of a sector connected wrongly to a surface connector of another sector 1.33E-09 MD-DETON Manufacturer defect of one detonator such that time delay corresponds to another one 2.40E-05 MD-SC Manufacturer defect of one surface connector such that time delay corresponds to another one 6.00E-07

4(W-SC)+OTH+OTH

Use of a wrong surface connector plus two other type of errors

4(W-SC)+OTH+OTH
Use of a wrong surface
connector plus two other type
of errors
1.17E-18

AND

2.4-W-SC Use of a wrong surface connector 4.80E-09 4(W-SC)-OTH-OTH Two errors other than use of a wrong surface connector 2.45E-10

4.1-(W-SC)-WD+OTH

Wrong design in time delay of one detonator plus one other type of errors except use of a wrong surface connector 3.65E-14 4.2-(W-SC)-W-DETON+OTH One detonator wrongly put into one sector which contains the same time delay detonator plus one other type of errors except use of a wrong surface 4.86E-19

One detonator connected wrongly to a surface connector of another sector plus one other error except use of a wrong

surface connector

4.3-(W-SC)-W-DETON-SC+OTH

3.84E-14

4(W-SC)-MD-DETON+OTH

Incorrect time default of one detonator due to manufacturer defect plus one other type of errors except use of a wrong surface connector 1.20E-10 4(W-SC)-MD-SC+OTH

One surface connector fail to provide necessary delay due to manufacturer defect plus one other type of errors except use of a wrong surface connector 1.70E-11 4(W-SC)-OL-EMULSION+OTH

Overcharge of emulsion more than required plus one other type of error except use of a wrong surface connector

loaded into holes

4.39E-06

4.1-(MD-DETON)-WD+OTH

Wrong design in time delay of one detonator plus one other type of errors except manufacturer defect of one detonato

4.1-(MD-DETON)-WD+OTH	wrong design in time delay of one detonator plus on	le other type of errors except manufacturer dete	ect of one detonator		
4.1-(MD-DETON)-WD+OTH	\neg				
Wrong design in time delay of one	 				
detonator plus one other type of					
errors except manufacturer defect of	of				
one detonator					
6.29E-1	5				
AND					
2.1-WD	4.1-(MD-DETON)-WD-OTH				
	One error other than one wrong				
Wrong design in time delay of one	design in time delay of one				
detonator	detonator				
1.26E-0	9 4.99E-06				
	OR				
	2.2-W-DETON	2.3-W-DETON-SC	2.4-W-SC	MD-SC	OL-EMULSION
	One detonator wrongly put into one	One detonator of a sector connected		Manufacturer defect of one surface	
	sector which contains the same time	wrongly to a surface connector of		connector such that time delay	Overcharge of emulsion more than
	delay detonator	another sector	Use of a wrong surface connector	corresponds to another one	required
	1.68E-14	1.33E-09	4.80E-09	6.00E-07	4.39E-0
	•		-		
					OL-C-EMULSION
					Too much cartridged emulsion

4.2-(MD-DETON)-W-DETON+OTH One detonator wrongly put into the sector which contains the same time delay detonator plus one other type of errors except manufacturer defect of one detonator

4.2-(MD-DETON)-W-DETOI	N+OTH
------------------------	-------

One detonator wrongly put into the sector which contains the same time delay detonator plus one other type of errors except manufacturer defect of one detonator

8.37E-20

AND

2.2-W-DETON

One detonator wrongly put into one sector which contains the same time delay detonator

1.68E-14

4.2-(MD-DETON)-W-DETON-OTH One error other than one detonator wrongly put into a sector which

contains the same time delay

detonator

4.99E-06

OR

2.1-WD

Wrong design in time delay of one detonator

1.26E-09

2.3-W-DETON-SC

One detonator of a sector connected wrongly to a surface connector of another sector

1.33E-09

2.4-W-SC

Use of a wrong surface connector 4.80E-09 MD-SC

Manufacturer defect of one surface connector such that time delay corresponds to another one

6.00E-07

OL-EMULSION

Overcharge of emulsion more than required

4.39E-06

OL-C-EMULSION

Too much cartridged emulsion loaded into holes

4.3-(MD-DETON)-W-DETON-SC+OTH

One detonator connected wrongly to a surface connector of another sector plus one other error except manufacturer defect of one detonator

4.3-(MD-DETON)-W-DETON-SC+OTH
One detonator connected wrongly to a
surface connector of another sector plus
one other error except manufacturer
defect of one detonator

6.61E-15

AND

2.3-W-DETON-SC

One detonator of a sector connected wrongly to a surface connector of another sector

1.33E-09

4.3-(MD-DETON)-W-DETON-SC-OTH
One error other than one detonator for
a sector connected wrongly to a surface

connector of another sector 4.99E-06

OR

2.1-WD

Wrong design in time delay of one detonator

1.26E-09

2.2-W-DETON

One detonator wrongly put into one sector which contains the same time delay detonator

1.68E-14

2.4-W-SC

Use of a wrong surface connector 4.80E-09 MD-SC

Maufacturer defect of one surface connector such that time delay corresponds to another one

6.00E-07

OL-EMULSION

Overcharge of emulsion more than required

4.39E-06

OL-C-EMULSION

Too much cartridged emulsion loaded into holes

4 4-(MD-DFTON)-W-SC+OTH

Use of one wrong surface connector plus one other type of errors except manufacturer defect of one detonator

4.4-(MD-DETON)-W-SC+OTH	U
4.4-(MD-DETON)-W-SC+OTH	[
Use of one wrong surface connector	
plus one other type of errors except	
manufacturer defect of one	
detonator	
2.39E-14	
AND	
2.4-W-SC	
Use of a wrong surface connector	
4.80E-09	

4.4-(MD-DETON)-W-SC-OTH One error other than use of a wrong surface connector 4.99E-06

2.2-W-DETON 2.1-WD One detonator wrongly put into one Wrong design in time delay of one sector which contains the same time detonator delay detonator 1.26E-09

2.4-W-SC One detonator of a sector connected wrongly to a surface connector of another sector 1.33E-09

1.68E-14

MD-SC Manufacturer defect of one surface connector such that time delay corresponds to another one 6.00E-07 OL-EMULSION Overcharge of emulsion more than required 4.39E-06

OL-C-EMULSION Too much cartridged emulsion loaded into hole 4.39E-06

loaded into holes

4.39E-06

4(MD-DETON)-MD-SC+OTH

One surface connector fail to provide necessary delay due to manufacturer defect plus one other type of errors except manufacuturer defect of one detonator

4(MD-DETON)-MD-SC+OTH	One surface connector fail to provide necessary dela	y due to manufacturer defect plus one other typ	e of errors except manufacuturer defect of one of	detonator	
4(MD-DETON)-MD-SC+OTH]				
One surface connector fail to provide	2				
necessary delay due to manufacturer	r				
defect plus one other type of errors					
except manufacuturer defect of one					
detonator					
2.64E-12	2				
AND					
7.1.7.2					
MD-SC	4(MD-DETON)-MD-SC-OTH				
One surface connector fail to provide					
necessary delay due to manufacturer	1 1				
defect	manufacturer defect				
6.00E-07					
	OR				
	_				
MD-SC	2.1-WD	2.2-W-DETON	2.3-W-DETON-SC	2.4-W-SC	OL-EMULSION
Manufacturer defect of one surface		One detonator wrongly put into one	One detonator of a sector connected		
connector such that time delay	Wrong design in time delay of one	sector which contains the same time	wrongly to a surface connector of		Overcharge of emulsion more than
corresponds to another one	detonator	delay detonator	another sector	Use of a wrong surface connector	required
6.00E-07	7 1.26E-09	1.68E-14	1.33E-09	4.80E-09	4.39E-06
					OL-C-EMULSION
					Too much cartridged emulsion

4(MD-DETON)-OL-EMULSION+OTH Overcharge of emulsion more than required plus one other type of error except manufacturer defect of one detonator such that time delay corresponds to another one

4(MD-DETON)-OL-EMULSION+OTH Overcharge of emulsion more than required plus one other type of error except manufacturer defect of one					
detonator such that time delay corresponds to another one 2.66E-12					
AND					
OL-EMULSION	4(MD-DETON)-OL-EMULSION-OTH				
Overcharge of emulsion more than					
required	One hole other than overload				
4.39E-06	6.07E-07				
	OR				
OL C FMILLICION	2.4 WD	2.2 W DETON	2.2 W DETONICS	2.4.W.CC	MD CC
OL-C-EMULSION	2.1-WD	2.2-W-DETON	2.3-W-DETON-SC One detonator of a sector connected	2.4-W-SC	MD-SC Manufacturer defect of one surface
Too much cartridged emulsion	Wrong design in time delay of one	One detonator wrongly put into one sector which contains the same time	wrongly to a surface connector of		connector such that time delay
loaded into hole	detonator	delay detonator	another sector	Use of a wrong surface connector	corresponds to another one
4.39E-06	1.26E-09	1.68E-14	1.33E-09	4.80E-09	6.00E-07
4.531-00	1.201-09	1.00E-14	1.33E-09	4.60E-09	0.00E-07

4(MD-DETON)+OTH+OTH

Manufacturer defect of one detonator such that time delay corresponds to another one plus two other type of errors

4(MD-DETON)+OTH+OTH

Manufacturer defect of one detonator such that time delay corresponds to another one plus two other type of errors

1.28E-16

AND

MD-DETON

Incorrect time default of one detonator due to maufacturer defect

2.40E-05

MD-DETON

Manufacturer defect of one detonator such that time delay corresponds to another one

2.40E-05

4(MD-DETON)-OTH-OTH

Two errors other than manufacturer defect of one detonator such that time delay corresponds to another

5.34E-12

6.29E-15

4.1-(MD-DETON)-WD+OTH

Wrong design in time delay of one detonator plus one other type of errors except manufacturer defect of one detonator One detonator wrongly put into the sector which contains the same time delay detonator plus one other type of errors except manufacturer defect of one detonator

4.2-(MD-DETON)-W-DETON+OTH

8.37E-20

4.3-(MD-DETON)-W-DETON-SC+OTH

One detonator connected wrongly to a surface connector of another sector plus one other error except manufacturer defect of one detonator

6.61E-15

4.4-(MD-DETON)-W-SC+OTH

Use of one wrong surface connector plus one other type of errors except manufacturer defect of one detonator

2.39E-14

4(MD-DETON)-MD-SC+OTH
One surface connector fail to

provide necessary delay due
to manufacturer defect plus
one other type of errors
except manufacuturer defect
of one detonator

2.64E-12

4(MD-DETON)-OL-EMULSION+OTH

Overcharge of emulsion more than required plus one other type of error except manufacturer defect of one detonator such that time delay corresponds to another one

2.66E-12

4.1-(MD-SC)-WD+OTH

Wrong design in time delay of one detonator plus one other type of errors except manufacturer defect of one surface connector

4.1-(MD-SC)-\	WD+OTH
4.1-(MD-SC)-\	WD+OTH
Wrong design	in time delay of one
detonator plu	is one other type of
errors except	manufacturer defect of
one surface co	onnector
	3.58E-14
AND	
2.1-WD	
	in time delay of one
detonator	

1.26E-09

4.1-(MD-SC)-WD-OTH
One error other than one wrong design in time delay of one detonator

2.84E-05

OR

2.2-W-DETON

One detonator wrongly put into one sector which contains the same time delay detonator

1.68E-14

2.3-W-DETON-SC
One detonator of a sector connected wrongly to a surface connector of another sector

1.33E-09

Use of a wrong surface connector
4.80E-09

MD-DETON

Manufacturer defect of one detonator such that time delay corresponds to another one

2.40E-05

OL-EMULSION

Overcharge of emulsion more than required

4.39E-06

OL-C-EMULSION
Too much cartridged emulsion
loaded into holes
4.39E-06

4.2-(MD-SC)-W-DETON+OTH

One detonator wrongly put into one sector which contains the same time delay detonator plus one other type of errors except manufacturer defect of one surface connector

4.2-(MD-SC)-W-DETON+OTH

One detonator wrongly put into one sector which contains the same time delay detonator plus one other type of errors except manufacturer defect of one surface connector

4.76E-19

AND

2.2-W-DETON

One detonator wrongly put into one sector which contains the same time delay detonator

1.68E-14

4.2-(MD-SC)-W-DETON-OTH

One error other than one detonator wrongly put into a sector which contains the same time delay detonator

2.84E-05

OR

2.1-WD

Wrong design in time delay of one detonator

1.26E-09

2.3-W-DETON-SC

One detonator of a sector connected wrongly to a surface connector of another sector

1.33E-09

2.4-W-SC

Use of a wrong surface connector 4.80E-09

Manufacturer defect of one

detonator such that time delay corresponds to another one

MD-DETON

2.40E-05

OL-EMULSION

Overcharge of emulsion more than required

4.39E-06

OL-C-EMULSION

Too much cartridged emulsion loaded into holes

4.3-(MD-SC)-W-DETON-SC+OTH

One detonator connected wrongly to a surface connector of another sector plus one other error except manufacturer defect of one surface connector

4.3-	-(MD	-SC)-V	V-DET	ON-S	C+OTH	

One detonator connected wrongly to a surface connector of another sector plus one other error except manufacturer defect of one surface connector

3.76E-14

AND

2.3-W-DETON-SC

One detonator of a sector connected wrongly to a surface connector of another sector

1.33E-09

4.3-(MD-SC)-W-DETON-SC-OTH

One error other than one detonator for a sector connected wrongly to a surface connector of another sector

2.84E-05

OR

2.1-WD

Wrong design in time delay of one detonator 1.26E-09

2.2-W-DETON

One detonator wrongly put into one sector which contains the same time delay detonator

1.68E-14

2.4-W-SC

Use of a wrong surface connector 4.80E-09

MD-DETON

Manufacturer defect of one detonator such that time delay corresponds to another one

2.40E-05

OL-EMULSION

Overcharge of emulsion more than required

4.39E-06

OL-C-EMULSION

Too much cartridged emulsion loaded into holes

loaded into hole

4.39E-06

4.4-(MD-SC)-W-SC+OTH

Use of one wrong surface connector plus one other type of errors except manufacturer defect of one surface connector

4.4-(MD-SC)-W-SC+OTH	Use of one wrong surface connector plus one other	type of errors except manufacturer defect of one	e surface connector		
4.4-(MD-SC)-W-SC+OTH					
Use of one wrong surface connector	T				
plus one other type of errors except	:				
manufacturer defect of one surface					
connector					
1.36E-1	13				
AND					
AND					
2.4-W-SC	4.4-(MD-SC)-W-SC-OTH				
	One error other than use of a wrong				
Use of a wrong surface connector	surface connector				
4.80E-0	09 2.84E-05				
	OR				
	2.1-WD	2.2-W-DETON	2.3-W-DETON-SC	MD-DETON	OL-EMULSION
		One detonator wrongly put into one	One detonator of a sector connected	Manufacturer defect of one	
	Wrong design in time delay of one	sector which contains the same time	wrongly to a surface connector of	detonator such that time delay	Overcharge of emulsion more than
	detonator	delay detonator	another sector	corresponds to another one	required
	1.26E-09	1.68E-14	1.33E-09	2.40E-05	4.39E-06
					OL-C-EMULSION
					Too much cartridged emulsion
					landadista hala

4(MD-SC)-MD-DETON+OTH

Incorrect time default of one detonator due to manufacturer defect plus one other type of errors except manufacturer defect of one surface connector

4(MD-SC)-MD-DETON+OTH Incor	rect time default of one detonator due to manu	facturer defect plus one other type of errors exc	cept manufacturer defect of one surface connect	or	
4(MD-SC)-MD-DETON+OTH					
Incorrect time default of one					
detonator due to manufacturer					
defect plus one other type of errors					
except manufacturer defect of one					
surface connector					
1.05E-10					
AND					
MD-DETON	4(MD-SC)-MD-DETON-OTH				
	One error other than incorrect time				
ncorrect time default of one	default of one detonator due to				
detonator due to maufacturer defect	manufacturer defect				
2.40E-05	4.39E-06				
	OR				
AAD DETON	24 WD	2.2-W-DETON	2.2 W DETON CC	2.4.14.66	OL FAMILICION
MD-DETON Manufacturer defect of one	2.1-WD		2.3-W-DETON-SC One detonator of a sector connected	2.4-W-SC	OL-EMULSION
I	Wrong design in time delay of one	One detonator wrongly put into one sector which contains the same time	l l		Overcharge of emulsion more than
detonator such that time delay		1	wrongly to a surface connector of	Han of a company points and a second	
corresponds to another one	detonator	delay detonator	another sector 1.33E-09	Use of a wrong surface connector 4.80E-09	required 4.39E-0
2.40E-05	1.26E-09	1.68E-14	1.33E-09	4.80E-09	4.39E-0
					OL-C-EMULSION

4(MD-SC)-OL-EMULSION+OTH

Overcharge of emulsion more than required plus one other type of error except manufacturer defect of one surface connector such that time delay corresponds to another one

4(MD-SC)-OL-EMULSION+OTH					
4(IVID-3C)-OL-LIVIOL3IOIN+OTTI					
Overcharge of emulsion more than					
required plus one other type of error					
except manufacturer defect of one					
surface connector such that time					
delay corresponds to another one					
1.05E-10					
AND	\neg				
OL-EMULSION	4(MD-SC)-OL-EMULSION-OTH				
Overcharge of emulsion more than	4(IVID-3C)-OL-EIVIOL3ION-OTH				
required	One error other than hole overload				
4.39E-06	2.40E-05				
	5,000.00				
	OR				
OL-C-EMULSION	2.1-WD	2.2-W-DETON	2.3-W-DETON-SC	2.4-W-SC	MD-DETON
		One detonator wrongly put into one	One detonator of a sector connected		Manufacturer defect of one
Too much cartridged emulsion	Wrong design in time delay of one	sector which contains the same time	wrongly to a surface connector of		detonator such that time delay
loaded into hole	detonator	delay detonator	another sector	Use of a wrong surface connector	corresponds to another one
4.39E-06	1.26E-09	1.68E-14	1.33E-09	4.80E-09	2.40E-05

4(MD-SC)+OTH+OTH

Manufacturer defect of one surface connector such that time delay corresponds to another one plus two other type of error

4(MD-SC)+OTH+OTH

Manufacturer defect of one surface connector such that time delay corresponds to another one plus two other type of error

1.27E-16

AND

MD-SC

One surface connector fail to provide necessary delay due to manufacturer defect

6.00E-07

4(MD-SC)-OTH-OTH

Two errors other than manufacturer defect of one detonator such that time delay corresponds to another one

2.11E-10

3.58E-14

OR

MD-SC

Manufacturer defect of one surface connector such that time delay corresponds to another one 6.00E-07

4.1-(MD-SC)-WD+OTH

Wrong design in time delay of one detonator plus one other type of errors except manufacturer defect of one surface connector 4.2-(MD-SC)-W-DETON+OTH

One detonator wrongly put into one sector which contains the same time delay detonator plus one other type of errors except manufacturer defect of one surface connector

4.76E-19

4.3-(MD-SC)-W-DETON-SC+OTH

One detonator connected wrongly to a surface connector of another sector plus one other error except manufacturer defect of one surface connector

3.76E-14

4.4-(MD-SC)-W-SC+OTH

Use of one wrong surface connector plus one other type of errors except manufacturer defect of one surface connector 1.36E-13

4(MD-SC)-MD-DETON+OTH

Incorrect time default of one detonator due to manufacturer defect plus one other type of errors except manufacturer defect of one surface connector

1.05E-10

4(MD-SC)-OL-EMULSION+OTH

Overcharge of emulsion more than required plus one other type of error except manufacturer defect of one surface connector such that time delay corresponds to another one

1.05E-10

4.1-(OL-EMULSION)-WD+OTH

Wrong design in time delay of one detonator plus one other type of errors except overcharge

4.1-(OL-EMULSION)-WD+OTH
Wrong design in time delay of one
detonator plus one other type of
errors except overcharge

3.10E-14

AND

2.1-WD

Wrong design in time delay of one detonator

1.26E-09

4.1-(OL-EMULSION)-WD-OTH
One error other than one wrong design in time delay of one

2.46E-05

R

detonator

2.2-W-DETON

One detonator wrongly put into one sector which contains the same time delay detonator

1.68E-14

2.3-W-DETON-SC

One detonator of a sector connected wrongly to a surface connector of another sector

1.33E-09

2.4-W-SC

Use of a wrong surface connector 4.80E-09

MD-DETON

Manufacturer defect of one detonator such that time delay corresponds to another one

2.40E-05

MD-SC

Manufacturer defect of one surface connector such that time delay corresponds to another one

6.00E-07

4.2-(OL-EMULSION)-W-DETON+OTH One detonator wrongly put into one sector which contains the same time delay detonator plus one other type of errors except overcharge

4.2-(OL-EMULSION)-W-DETON+OTH

One detonator wrongly put into one sector which contains the same time delay detonator plus one other type of errors except overcharge

4.12E-19

AND

2.2-W-DETON

One detonator wrongly put into one sector which contains the same time delay detonator

1.68E-14

4.2-(OL-EMULSION)-W-DETON-OTH

One error other than one detonator wrongly put into a sector which contains the same time delay detonator

2.46E-05

OR

2.1-WD

Wrong design in time delay of one detonator

1.26E-09

2.3-W-DETON-SC

One detonator of a sector connected wrongly to a surface connector of another sector

1.33E-09

2.4-W-SC

Use of a wrong surface connector
4.80E-09

MD-DETON

Manufacturer defect of one detonator such that time delay corresponds to another one

2.40E-05

MD-SC

Manufacturer defect of one surface connector such that time delay corresponds to another one

6.00E-07

4.3-(OL-EMULSION)-W-DETON-SC+OTH One detonator connected wrongly to a surface connector of another sector plus one other error except overcharge

4.3-(OL-EMULSION)-W-DETON-SC+OTH					
0					
One detonator connected wrongly to a					
surface connector of another sector plus					
one other error except overcharge					
3.26E-14					
AND					
AND					
2.3-W-DETON-SC	4.3-(OL-EMULSION)-W-DETON-SC-OTH				
One detonator of a sector connected	One error other than one detonator for a				
wrongly to a surface connector of another	sector connected wrongly to a surface				
sector	connector of another sector				
1.33E-09	2.46E-05				
	<u> </u>				
	OR				
	2.1-WD	2.2-W-DETON	2.4-W-SC	MD-DETON	MD-SC
		One detonator wrongly put into one		Manufacturer defect of one	Manufacturer defect of one surface
	Wrong design in time delay of one	sector which contains the same time		detonator such that time delay	connector such that time delay
	detonator	delay detonator	Use of a wrong surface connector	corresponds to another one	corresponds to another one
	1.26E-09	1.68E-14	4.80E-09	2.40E-05	6.00E-07

4.4-(OL-EMULSION)-W-SC+OTH

Use of one wrong surface connector plus one other type of errors except overcharge

,
4.4-(OL-EMULSION)-W-SC+OTH
Use of one wrong surface connector
plus one other type of errors except
overcharge
1.18E-13
AND
2.4-W-SC

2.4-W-SC

4.4-(OL-EMULSION)-W-SC-OTH

One error other than use of a wrong surface connector

4.80E-09

2.46E-05

OR

2.1-WD
Wrong design in time delay of one detonator
1.26E-09

2.2-W-DETON

One detonator wrongly put into one sector which contains the same time delay detonator

1.68E-14

2.3-W-DETON-SC

One detonator of a sector connected wrongly to a surface connector of another sector

1.33E-09

MD-DETON

Manufacturer defect of one detonator such that time delay corresponds to another one

2.40E-05

MD-SC
Manufacturer defect of one surface connector such that time delay corresponds to another one
6.00E-07

4(OL-EMULSION)-MD-DETON+OTH Incorrect time default of one detonator due to manufacturer defect plus one other type of errorss except overcharge

4(OL-EMULSION)-MD-DETON+OTH					
Incorrect time default of one					
detonator due to manufacturer					
defect plus one other type of errorss					
except overcharge					
1.46E-11					
AND					
AND					
MD-DETON	4(OL-EMULSION)-MD-DETON-OTH				
IVID-DETON	One error other than incorrect time				
In an own at time and afairly affine					
Incorrect time default of one	default of one detonator due to				
detonator due to maufacturer defect	manufacturer defect				
2.40E-05	6.07E-07				
	OR				
MD-DETON	2.1-WD	2.2-W-DETON	2.3-W-DETON-SC	2.4-W-SC	MD-SC
Manufacturer defect of one		One detonator wrongly put into one	One detonator of a sector connected		Manufacturer defect of one surface
detonator such that time delay	Wrong design in time delay of one	sector which contains the same time	wrongly to a surface connector of		connector such that time delay
corresponds to another one	detonator	delay detonator	another sector	Use of a wrong surface connector	corresponds to another one
2.40E-05	1.26E-09	1.68E-14	1.33E-09	4.80E-09	6.00E-07
					

4.80E-09

4(OL-EMULSION)-MD-SC+OTH

6.00E-07

One surface connector fail to provide necessary delay due to manufacturer defect plus one other type of errors except overcharge

1.26E-09

4(OL-EMULSION)-MD-SC+OTH					
One surface connector fail to provide necessary delay due to manufacturer defect plus one other type of errors except overcharge 1.44E-11					
AND MD-SC	4(OL-EMULSION)-MD-SC-OTH				
One surface connector fail to provide	One error other than incorrect time				
necessary delay due to manufacturer	defult of one detonator due to				
defect	manufacturer defect				
6.00E-07	2.40E-05				
	OR				
MD-SC	2.1 WD	2.2-W-DETON	2.3-W-DETON-SC	2.4-W-SC	MD-DETON
	2.1-WD			2.4-VV-3C	
Manufacturer defect of one surface	Manage design in the endelse of an e	One detonator wrongly put into one	One detonator of a sector connected		Manufacturer defect of one
connector such that time delay	Wrong design in time delay of one	sector which contains the same time	wrongly to a surface connector of		detonator such that time delay
corresponds to another one	detonator	delay detonator	another sector	Use of a wrong surface connector	corresponds to another one

1.33E-09

1.68E-14

2.40E-05

(OL-EMULSION)+OTH+OTH Ove	ercharge of emulsion more than required an	nd two other errors occur at the same time				
1(OL-EMULSION)+OTH+OTH						
,						
vercharge of emulsion more						
an required and two other						
rors occur at the same time						
1.28E-16						
D						
-EMULSION	A/OL FAMILICIONI) OTIL OTIL					
ercharge of emulsion more	4(OL-EMULSION)-OTH-OTH Combination of two other					
nan required	different types of errors					
4.39E-06	2.92E-11					
1.552 00	2.522 11					
	OR					
-C-EMULSION	4.1-(OL-EMULSION)-WD+OTH	4.2-(OL-EMULSION)-W-DETON+OTH	4.3-(OL-EMULSION)-W-DETON-SC+OTH	4.4-(OL-EMULSION)-W-SC+OTH	4(OL-EMULSION)-MD-DETON+OTH	4(OL-EMULSION)-MD-DETON+O
	Wrong design in time delay of	One detonator wrongly put into one			Incorrect time default of one	Incorrect time default of one
	one detonator plus one other	sector which contains the same time	One detonator connected wrongly to a	Use of one wrong surface	detonator due to manufacturer	detonator due to manufacturer
oo much cartridged	type of errors except	delay detonator plus one other type of	surface connector of another sector plus	connector plus one other type	defect plus one other type of	defect plus one other type of
mulsion loaded into holes	overcharge	errors except overcharge	one other error except overcharge	of errors except overcharge	errorss except overcharge	errorss except overcharge
4.39E-06	3.10E-14	4.12E-19	3.26E-14	1.18E-13	1.46E-11	1.44

4MIC-COMB-3

4 MIC detonated (due to three different errors occur at the same time) at the same time

4MIC-COMB-3

4 MIC detonated (due to three different errors occur at the same time) at the same time 3.84E-16

4(WD)+OTH+OTH

Wrong design in time delay of one detonator plus two other type of errors

3.08E-19

4(W-DETON)+OTH+OTH

One detonator wronly put into one sector which contains the same time delay detonator plus two other type of errors 4.11E-24 4(W-DETON-SC)+OTH+OTH

One detonator connected wrongly to a surface connector of another sector plus two other type of errors 3.24E-19 4(W-SC)+OTH+OTH

Use of a wrong surface connector plus two other type of errors 1.17E-18 4(MD-DETON)+OTH+OTH

Manufacturer defect of one detonator such that time delay corresponds to another one plus two other type of errors 1.28E-16 4(MD-SC)+OTH+OTH

Manufacturer defect of one surface connector such that time delay corresponds to another one plus two other type of error 1.27E-16 4(OL-EMULSION)+OTH+OTH

Overcharge of emulsion more than required and two other errors occur at the same time

4MIC-COMB-4

4 MIC detonated (due to charge overload and one other error occur at the same time) at the same time

4MIC-COMB-4 4 MIC detonated (due to charge overload and one other						
error occur at the same time)						
at the same time						
1.08E-10						
AND						
OL FAMILICION	ANAIC OTH					
OL-EMULSION Overcharge of emulsion more	4MIC-OTH					
than required	One other type of errors					
4.39E-06	2.46E-05					
	2.100 00					
	OR					<u></u>
OL-C-EMULSION	2.1-WD	2.2-W-DETON	2.3-W-DETON-SC	2.4-W-SC	MD-DETON	MD-SC
			One detonator of a sector			Manufacturer defect of one
		1 detonator wrongly put into	connected wrongly to a		Manufacturer defect of one	surface connector such that
Too much cartridged emulsion	Wrong design in time delay of	one sector which containes the	surface connector of another	Use of a wrong surface	detonator such that time delay	time delay corresponds to
loaded into holes	one detonator	same time delay detonator	sector	connector	corresponds to another one	another one
4.39E-06	1.26E-09	1.68E-14	1.33E-09	4.80E-09	2.40E-05	6.00E-07

3.1-WD

Wrong design in time delay of two detonators

3.1-WD
Wrong design in time delay of two
detonators
1.26E-11

AND

2.1-WD	
Wrong design in time delay o	of one
detonator	
	1.26E-09

P-AD-DETON	
Wrong design in time delay o	f
additional detonator	
	1.00E-02

3.2-W-DETON

Two detonator wrongly put into one sector which contains the same time delay detonator

2-V			

Two detonator wrongly put into one sector which contains the same time delay detonator

1.68E-16

AND

2.2-W-DETON

One detonator wrongly put into one sector which contains the same time delay detonator

1.68E-14

P-AD-DETON

Additional detonator wrongly put into one sector which contains the same time delay detonator

0.01

3.3-W-DETON-SC

Two detonators of othe sectors connected wrongly to a surface connector of another sector

2	3.	٠١٨	/_	D	F٦	\cap	Ν	I-SC
J		- V I	_	ப	_	\mathbf{U}	I۷	-JC

Two detonators of other sectors connected wrongly to a surface connector of another sector

1.33E-11

AND

2.3-W-DETON-SC

One detonator of a sector connected wrongly to a surface conector of another sector

1.33E-09

P-AD-SC

Additional detonator of a sector connected wrongly to a surface connector of another sector

0.01

3.4-W-SC

Use of two wrong surface connector

3.4-W-SC	
Use of two wrong surface connector 4.80E-11	
AND	
2.4-W-SC	P-AD-SC
	Additional use of wrong surface
	raditional use of wrong surface
Use of wrong surface connector	connector

3MD-DETON

Incorrect time default of 2 detonators due to manufacturer defect

3MD-DETON
Incorrect time default of 2
detonators due to manufacturer
defect

2.40E-07

AND

MD-DETON

Manufacturer defect of one detonator such that time delay corresponds to another one

2.40E-05

P-AD-DETON

Manufacturer defect of another detonator such that time delay corresponds to another one

0.01

3MD-SC

Surface connector fails to provide necessary delay due to manufacturer defect

3MD-SC
Surface connector fails to provide
necessary delay due to manufacturer
defect
6.00E-09

AND

MD-SC

Manufacturer defect of one surface connector such that time delay corresponds to another one

6.00E-07

P-AD-SC

Manufacturer defect of another surface connector such that time delay corresponds to another one

0.01

3MIC-ER-COMB

3 MIC detonated at the same time (Due to combination of two types of errors)

3MIC-ER-COMB
3 MIC detonated at the same
time (Due to combination of
two types of errors)

2.45E-10

OR

2.1-WD+OTH

Wrong design in time delay of one detonator plus one other type of errors

3.65E-14

2.2-W-DETON+OTH

One detonator wrongly put into one sector which contains the same time delay detonator plus one other type of errors

4.86E-19

2.3-W-DETON+OTH

One detonator of a sector connected wrongly to a surface connector of another sector plus one other type of errors

3.84E-14

2.4-W-SC+OTH

Use of a wrong surface connector plus one other type of errors

1.39E-13

MD-DETON+OTH

Incorrect time default of one detonator due to manufacturer defect plus one other type of errors

1.20E-10

MD-SC+OTH

Surface connector fails to provide necessary delay due to manufacturer defect plus one other type of errors

1.70E-11

OL-EMULSION+OTH

Overcharge of emulsion more than required plus one other type of errors

1.08E-10

loaded into holes

3.1-WD+OTH	Wrong design in time delay of one detonator p	olus one other type of errors				
3.1-WD+OTH]					
Wrong design in time delay of						
one detonator plus one other						
type of errors						
3.65E-14						
AND						
AND						
2.1-WD	3.1-WD-OTH					
	One error other than one					
Vrong design in time delay of	wrong design in time delay of					
one detonator	one detonator					
1.26E-09	2.90E-05					
	OR					
	2.2-W-DETON	2.3-W-DETON-SC	2.4-W-SC	MD-DETON	MD-SC	OL-EMULSION
		One detonator of a sector			Manufacturer defect of one	
	One detonator wrongly put	connected wrongly to a		Manufacturer defect of one	surface connector such that	
	into one sector which contains	surface connector of another	Use of a wrong surface	detonator such that time delay	time delay corresponds to	Overcharge of emulsion more
	the same time delay detonator	sector	connector	corresponds to another one	another one	than required
	1.68E-14	1.33E-09	4.80E-09	2.40E-05	6.00E-07	4.39E-06
						OL-C-EMULSION
						Too much cartridged emulsion

3.2-W-DETON+OTH

One detonator wrongly put into one sector which contains the same time delay detonator plus one other type of errors

.2-V			

One detonator wrongly put into one sector which contains tha same time delay detonator plus one other type of errors

4.86E-19

AND

2.2-W-DETON

One detonator wrongly put into one sector which contains the same time delay detonator 1.68E-14

3.2-W-DETON-OTH One error other than one detonator wrongly put into a sector which contains the

same time delay detonator

2.90E-05

2.1-WD

Wrong design in time delay of one detonator 1.26E-09 2.3-W-DETON-SC One detonator of a sector connected wrongly to a surface connector of another

sector

1.33E-09

Use of a wrong surface connector

4.80E-09

2.4-W-SC

Manufacturer defect of one detonator such that time delay corresponds to another one 2.40E-05

MD-DETON

Manufacturer defect of one surface connector such that time delay corresponds to another one

6.00E-07

MD-SC

OL-EMULSION

Overcharge of emulsion more than required

4.39E-06

OL-C-EMULSION

Too much cartridged emulsion loaded into holes

loaded into holes

3.3-W-DETON-SC+OTH	One detonator of a sector connected wrongly to	a surface connector of another sector plu	us one other type of errors			
3.3-W-DETON-SC+OTH	1					
One detonator of a sector						
connected wrongly to a						
surface connector of another						
sector plus one other type of						
errors						
3.84E-14						
	•					
AND						
AND						
2.3-W-DETON-SC	3.3-W-DETON-OTH					
	One error other than one					
One detonator of a sector	detonator of a sector					
connected wrongly to a	connected wrongly to a					
surface connector of another	surface connector of another					
sector	sector					
1.33E-09	2.90E-05					
	OR	1				
	2.4.1112	221125721	2.4.11.60	LAD DETON	110.50	01.51411151011
	2.1-WD	2.2-W-DETON	2.4-W-SC	MD-DETON	MD-SC Manufacturer defect of one	OL-EMULSION
				Man fort and fort of an		
	Managadasian in time adalah af	One detonator wrongly put	lles of a surrous surface	Manufacturer defect of one	surface connector such that	Overale and of any dains are an
	Wrong design in time delay of one detonator	into one sector which contains the same time delay detonator	Use of a wrong surface	detonator such that time delay corresponds to another one	time delay corresponds to	Overcharge of emulsion more
	1.26E-09	1.68E-14	connector 4.80E-09	2.40E-05	another one 6.00E-07	than required 4.39E-06
	1.20E-09	1.00E-14	4.80E-09	2.40E-03	6.00E-07	4.59E-06
						OL-C-EMULSION
						Too much cartridged emulsion
						l

loaded into holes

4.39E-06

3.4-W-SC+OTH

Use of a wrong surface connector plus one other types of errors

	or a wrong surface connector plus one our	ici types of citors				
.4-W-SC+OTH						
se of one wrong surface						
nnector plus one other type						
errors						
1.39E-13						
)						
W-SC	3.4-W-SC-OTH					
of a wrong surface	One error other than use of a					
nector	wrong surface connector					
4.80E-09	2.90E-05					
	OR					
	OK .					
	2.1-WD	2.2-W-DETON	2.3-W-DETON-SC	MD-DETON	MD-SC	OL-EMULSION
			One detonator of a sector		Manufacturer defect of one	
		One detonator wrongly put	connected wrongly to a	Manufacturer defect of one	surface connector such that	
	Wrong design in time delay of	into one sector which contains	surface connector of another	detonator such that time delay	time delay corresponds to	Overcharge of emulsion mor
	one detonator	the same time delay detonator	sector	corresponds to another one	another one	than required
	1.26E-09	1.68E-14	1.33E-09	2.40E-05	6.00E-07	4.39E
						OL-C-EMULSION
						Too much cartridged emulsi

3MD-DETON+OTH

Incorrect time default of one detonator due to manufacturer defect plus one other type of errors

3MD-DETON+OTH Incorrect time default of one detonator due to manufacturer defect plus one other type of errors

1.20E-10

AND

3MD-DETON

Incorrect time default of one detonator due to manufacturer defect

2.40E-05

3MD-DETON-OTH

One error other than incorrect time default of one detonator due to manufacturer defect

4.99E-06

MD-DETON

Manufacturer defect of one detonator such that time delay corresponds to another one 2.40E-05 2.1-WD

Wrong design in time delay of one detonator

1.26E-09

2.2-W-DETON

One detonator wrongly put into one sector which contains the same time delay detonator

1.68E-14

2.3-W-DETON-SC

One detonator of a sector connected wrongly to a surface connector of another sector

1.33E-09

2.4-W-SC

Use of a wrong surface connector

4.80E-09

MD-SC

Manufacturer defect of one surface connector such that time delay corresponds to another one 6.00E-07 OL-EMULSION

Overcharge of emulsion more than required 4.39E-06

OL-C-EMULSION

Too much cartridged emulsion loaded into holes

3MD-SC+OTH

One surface connector fail to provide necessary delay due to manufacturer defect plus one other type of errors

_	D-DETON+OTH
One	surface connector fail to
prov	vide necessary delay due to
mar	ufacturer defect plus one
othe	er type of errors
	1.70E-11
AND	
3M[)-SC
One	surface connector fail to

3MD-SC

One surface connector fail to provide necessary delay due to manufacturer defect

6.00E-07

MD-DETON-OTH

One error other than incorrect time default of one detonator due to manufacturer defect

2.84E-05

2.1-WD

MD-SC
Manufacturer defect of one surface connector such that time delay corresponds to another one
6.00E-07

Wrong design in time delay of one detonator

1.26E-09

2.2-W-DETON

One detonator wrongly put into one sector which contains the same time delay detonator

1.68E-14

2.3-W-DETON-SC

One detonator of a sector connected wrongly to a surface connector of another sector

1.33E-09

Use of a wrong surface connector 4.80E-09

MD-DETON

Manufacturer defect of oneDETONATOR such that time delay corresponds to another one

2.40E-05

OL-EMULSION

Overcharge of emulsion more than required

4.39E-06

OL-C-EMULSION
Too much cartridged emulsion loaded into holes
4.39E-06

OL-EMULSION+OTH

Overcharge of emulsion more than required plus one other type of error

OL-EMULSION+OTH				
Overcharge of emulsion more				
than required plus one other				
type of error				
1.08E-1				

AND

OL-EMULSION
Overcharge of emulsion more
than required
4.39E-06

OL-EMULSION-OTH
One error other than hole overload
2.46E-05

2.1-WD

OL-C-EMULSION

Too much cartridged emulsion loaded into holes

4.39E-06

Wrong design in time delay of one detonator

1.26E-09

2.2-W-DETON

One detonator wrongly put into one sector which contains the same time delay detonator

1.68E-14

2.3-W-DETON-SC

One detonator of a sector connected wrongly to a surface connector of another sector

1.33E-09

Use of a wrong surface connector 4.80E-09

MD-DETON

Manufacturer defect of one detonator such that time delay corresponds to another one

2.40E-05

MD-SC
Manufacturer defect of one surface connector such that time delay corresponds to another one
6.00E-07

2.1.1 Design Error by Blasting Engineer and Failure of Design Check and Correction

2.1.1		
Design Error by Blasting Engineer and		
Failure of Design Check and		
Correction		
1.05E-03		
AND		
	21125	
2.1.1-1	2.1.1-BE	
	Failure to detect and correct error by	
Design error by Blasting Engineer	Blasting Engineer during modelling	
3.03E-02	3.48E-02	
	OR	
	2.1.1-2	2.1.1-3
	Failure to detect error by Blasting	Failure to correct error by Blasting
	Engineer during modelling	Engineer during modelling
	3.03E-02	4.54E-03

2.1.2 Failure to detect and correct error by Blasting Engineer, Mines Division, Shotfirer and Blasting Competent Supervisor

2.1.2 Failre to Detect and Correct error by Blasting Engineer, Mines Division, Shotfirer and Blasting Competent Supervisor 1.19E-06							
AND 2.1.2-RE Failure to detect and correct error by Resident Engineer 3.35E-02		2.1.2-MD Failure to detect and correct error by Mines Division 3.17E-02		2.1.2-SF Shotfirer fails to detect and correct error 3.35E-02		2.1.2-BCS Blasting Competent Supervisor fails to detect and 3.35E-02	
OR 2.1.2-1 Failure to detect error by Resident Engineer 2.92E-02	2.1.2-3 Failure to correct error by Resident Engineer 4.37E-03	OR 2.1.2-2 Failure to detect error by Mines Division 2.76E-02	2.1.2-4 Failure to correct error by Mines Division 4.14E-03	OR 2.1.2-5 Shotfirer fails to detect error 2.92E-02	2.1.2-6 Shotfirer fails to correct error 4.37E-03	OR 2.1.2-7 Blasting Competent Supervisor fails to detect error 2.92E-02	Blasting Competent Supervisor fails to correct error 4.37E-03

2.1-WD

Wrong design in time delay of one detonator

2.1-WD	
Wrong design in time delay	of one
detonator	
	1.26E-09

AND

2.1.1

Design Error by Blasting Engineer and Failure of Design Check and Correction

1.05E-03

2.1.2

Failure by Resident Engineer and Mines Division to detect and correct design error

1.19E-06

2.2.1-9

Blasting Competent Supervisor

4.42E-03

fails to correct error

2.2.1 Delivery of incorrect detonators from the magazine to the blast site 2.2.1 Delivery of incorrect detonators from the magazine to the blast site 7.11E-08 AND 2.2.1-1 2.2.1-F Detonators are picked incorrectly bu the shotfirer Failure to detect and correct selection error from the magazine site 2.01E-05 3.53E-03 2.2.1-REI 2.2.1-SF 2.2.1-CR 2.2.1-BCS Resident Engineer inspector fails to check correct Contractor's Representative Shotfirer fails to detect and detonators have been picked fails to check correct Blasting Competent Supervisor correct error and correct error detonators have been picked fails to detect and correct error 3.39E-02 1.36E-01 1.29E-01 3.39E-02

2.2.1-6

Resident Engineer's Inspector

4.39E-03

fails to correct error

2.2.1-4

Contractor's representative

detonators have been picked

1.25E-01

fails to check correct

2.2.1-7

Contractor;s representative

4.16E-03

fails to correct error

2.2.1-8

Blasting Competent Supervisor

2.94E-02

fails to detect error

2.2.1-5

Shotfirer fails to correct error

4.42E-03

2.2.1-3

Resident Engineer's Inspector

detonators have been picked

1.32E-01

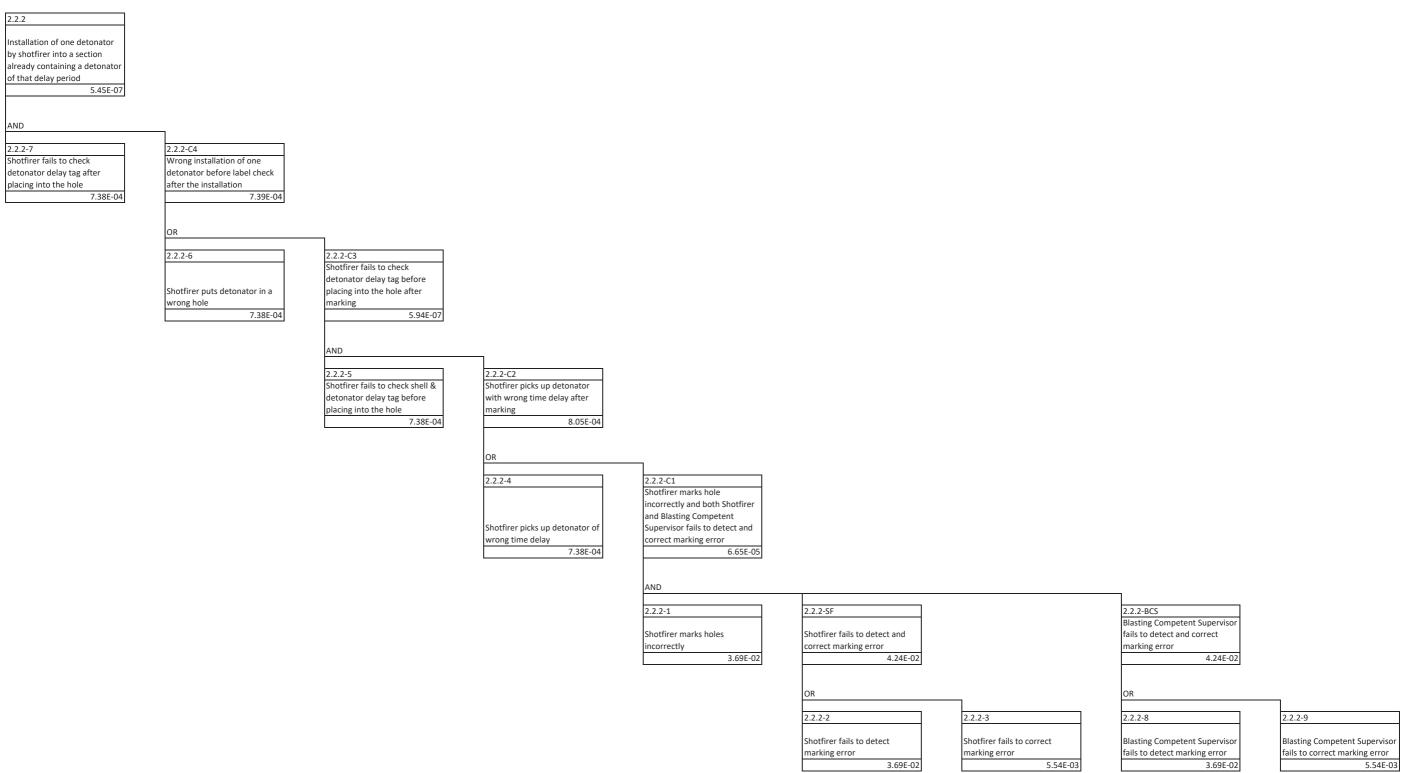
fails to check correct

2.2.1-2

Shotfirer fails to detect error

2.94E-02

2.2.2 Installation of one detonator by shotfirer into a section already containing a detonator of that delay period



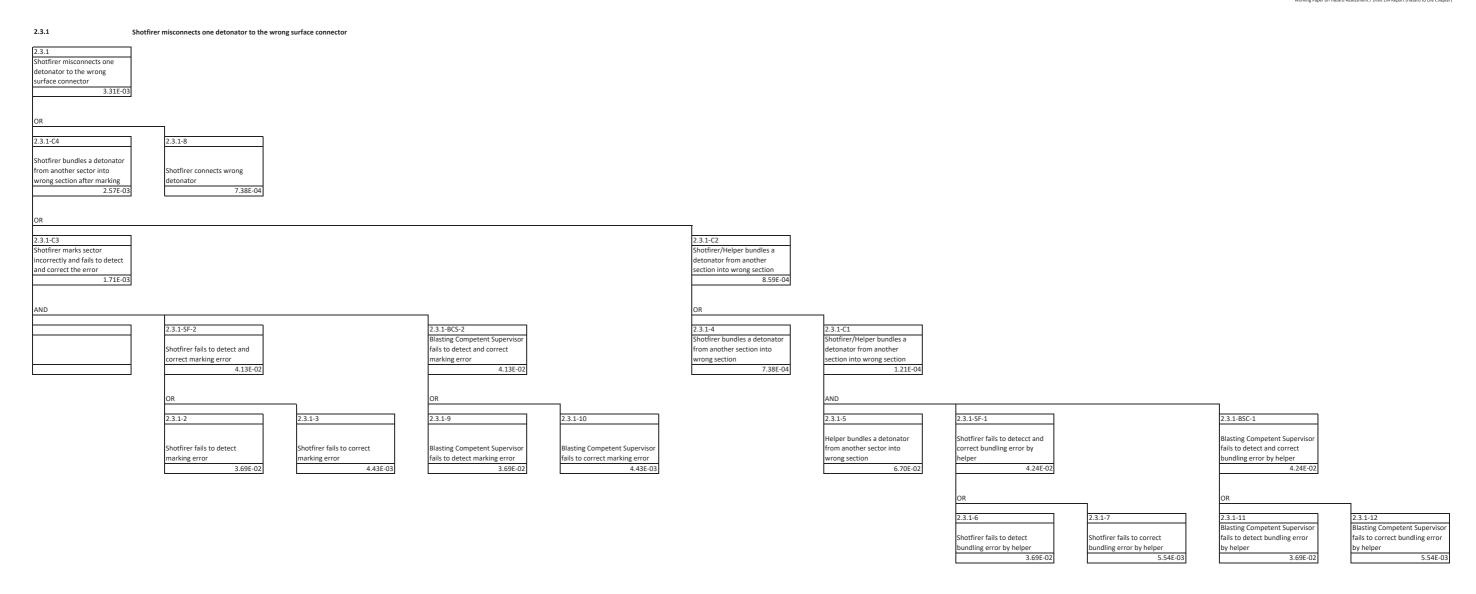
2.2.3 Shotfirer/Blasting Competent Supervisor fails to check and correct installation error

2.2.3			
Shotfirer/Blasting Competent			
Supervisor fails to check and correct			
installation error			
1.80E-03			
i			
AND			
2.2.3-SF		2.2.3-BCS	
		Blasting Competent Supervisor fails	
Shotfirer fails to detect and correct		to detect and correct installation	
installation error of detonator		error of detonator	
4.24E-02		4.24E-02	
•			
OR		OR	
2.2.3-1	2.2.3-2	2.2.3-3	2.2.3-4
Shotfirer leaves empty holes in the			
blast face due to not realising there	Shotfirer fails to fill empty holes	Blasting Competent Supervisor fails	Blasting Competent Supervisor fails
are detonators left over	before detonation	to detect installation error	to correct insallation error
3.69E-02	5.54E-03	3.69E-02	5.54E-03

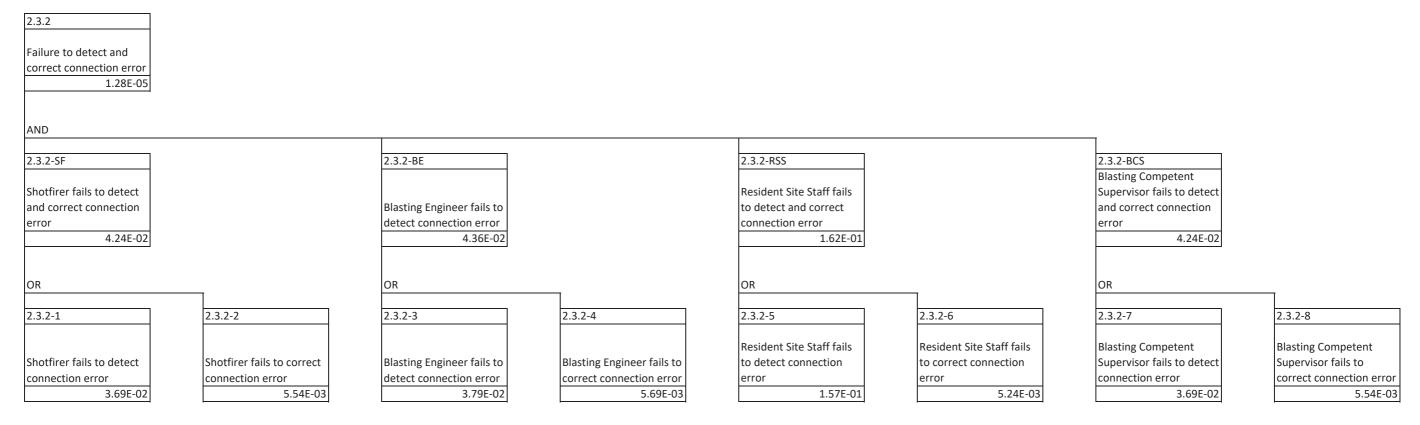
2.2-W-DETON

One detonator wrongly put into one sector which contains the same time delay detonator

2.2-W-DETON		
One detonator wrongly put into one		
sector which contains the same time		
delay detonator		
1.68E-14		
AND		
2.2.1	2.2.2	2.2.3
	Installation of One Detonator by	
	Shotfirer into a section already	Shotfirer /Blasting Competent
Delivery of incorrect detonators from	containing a detonator of that delay	Supervisor Fails to Check and Correct
the magazine to the blast site	period	Installation Error
7.11E-08	1.31E-04	1.80E-03



2.3.2 Failure to detect and correct connection error



2.3-W-DETON-SC

One detonator of a sector connected wrongly to a surface connector of another sector

2.3-W-DETON-SC		
One detonator of a sector connected		
wrongly to a surface connector of		
another sector		
1.33E-09		
AND		
2.3.1	2.3.2	2.2.2
		Installation of one detonator by
		Shotfirer into a section already
Shotfirer misconencts one detonator	Failure to detect and correct	containing a detonator of that delay
to the wrong surface connector	connection error	period
7.93E-01	1.28E-05	1.31E-04

installing

2.4.1 Incorrect Installation of Surface Connector

7.38E-04

2.4.1	
Incorrect installation of surface	
connector	
1.48E-03	
OR	
2.4.1-1	2.4.1-2
Shotfirer fails to check the colour of	
the surface connector before	Shotfirer connects wrong surface

connector

7.38E-04

2.4.2 Shotfirer/Blasting Competent Supervisor fails to detect and respond to error

2.4.2			
Shotfirer/Blasting Competent			
Supervisor fails to detect and			
respond to error			
1.80E-03			
AND			
2.4.2-SF		2.4.2-BCS	
Shortfirer fails to detect and correct		Blasting Competent Supervisor fails	
error		to detect and correct error	
4.24E-02		4.24E-02	
_			
OR		OR	
2.4.2-1	2.4.2-2	2.4.2-3	2.4.2-4
		Blasting Competent Supervisor fails	Blasting Competent Supervisor fails
Shotfirer fails to detect error	Shotfirer fails to correct error	to detect error	to correct error
3.69E-02	5.54E-03	3.69E-02	5.54E-03

2.4.3 Failure to detect and respond during final hook-up check

2.4.3 Failure to detect and respond during final hook-up check 3.01E-04					
AND					
2.4.3-BE Blasting Engineer fails to detect and		2.4.3-RSS Resident Site Staff fails to detect and		2.4.3-SF Shotfirer fails to detect and correct	
correct error 4.36E-02		correct error 1.62E-01		error 4.24E-02	
OR		OR		OR	
2.4.3-1	2.4.3-2	2.4.3-3	2.4.3-4	2.4.3-5	2.4.3-6
Blasting Engineer fails to detect error	Blasting Engineer fails to correct error	Resident Site Staff fails to detect error	Resident Site Staff fails to correct error	Shotfirer fails to detect error	Shotfirer fails to correct error
3.79E-02	5.69E-03	1.57E-01	5.24E-03	3.69E-02	5.54E-03

2.4-W-SC

Use of a wrong surface connector

2.4-W-SC		
Use of a wrong surface connector		
4.80E-09		
AND		
2.4.1	2.4.2	2.4.3
	Shotfirer/Blasting Competent	
Incorrect installation of surface	Supervisor Fails to Detect and	Failure to Detect and Respond during
connector	Respond to Error	Final Hook-up Check
8.86E-03	1.80E-03	3.01E-04

4.1.1

Excess cartridged are loaded into holes

Excess cartridges are loaded into
holes

7.38E-04

4.1.1-1

Shotfirer does not count number of cartridges picked up and loads too many

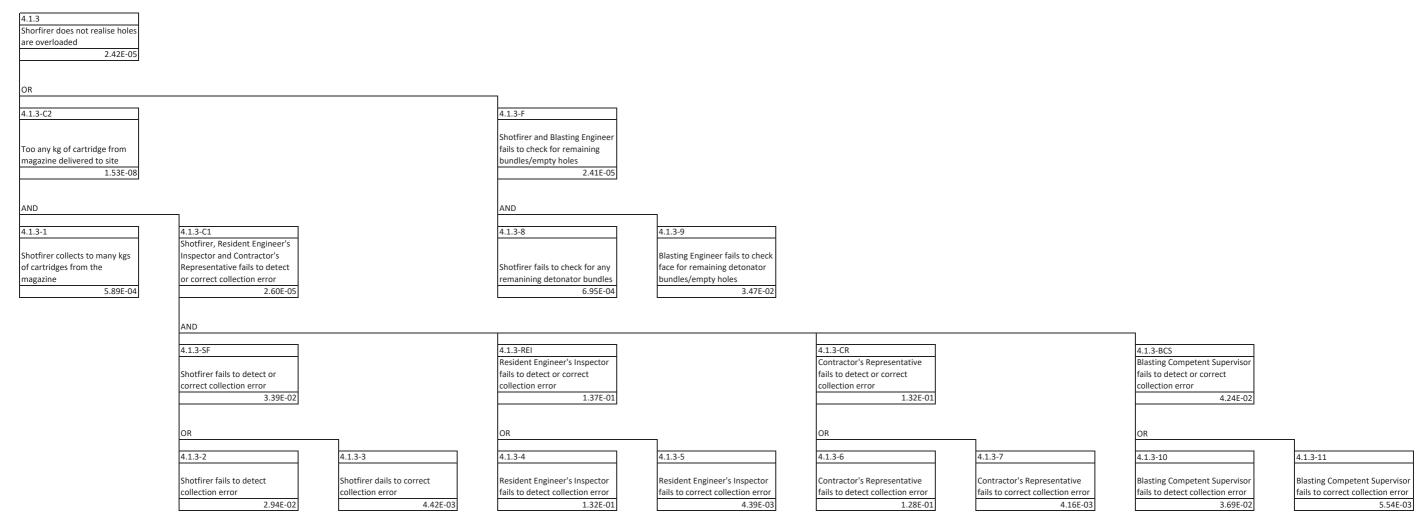
7.38E-04

4.1.2 Cartridges from blocked holes are not disposed of correctly

4.1.2
Cartridges from blocked holes are
not disposed of correctly
8.13E-03
4.1.2-1
Shotfirer intentionally overloads lifter
holes

8.13E-03

4.1.3 Shotfirer does not realise holes are overloaded



4.2.1 Design Error by the Blasting Engineer

4.2.1		
Design Error by the Blasting Engineer		
8.52E-05		
AND		
	434.05	
4.2.1-1	4.2.1-BE Blasting Engineer fails to detect and	
Design error by Blasting Engineer	correct error	
6.05E-04	1.41E-01	
	OR	
	4.2.1-2	4.2.1-3
	Blasting Engineer fails to detect error	Blasting Engineer fails to correct error
	1.36E-01	4.54E-03

4.2.2

Failure to detect and correct design error

4.2.2			
Failure to detect and correct design			
error			
1.06E-03			
AND			
			1
4.2.2-RE		4.2.2-MD	
Resident Engineer fails to detect and		Mines Division fails to detect and	
correct error		correct error	
3.35E-02		3.17E-02	
OR		OR	
1221	4222	4222	1
4.2.2-1	4.2.2-2	4.2.2-3	4.2.2-4
Residnent Engineer fails to detect	Resident Engineer fails to correct		
error	error	Mines Division fails to detect error	Mines Division fails to correct error
2.92E-02	4.37E-03	2.76E-02	4.14E-03

1.1.1

Design Error by Blasting Engineer and Failure of Design Check

1.1.1		
Design Error by Blasting Engineer and		
Failure of Design Check		
1.05E-03		
AND		
1.1.1-1	1.1.1-C1	
Design error by Blasting Engineer and	Failure to detect or correct error by	
Failure of Design Check	Blasting Engineer	
3.03E-02	3.48E-02	
	OR	
	1.1.1-2	1.1.1-3
	Failure to detect and correct error by	Failure to correct error by Blasting
	Resident Engineer and Mines Division	Engineer during modelling
	3.03E-02	4.54E-03

1.1.2 Failure to detect and correct error by Resident Engineer and Mines Division

1.1.2					
Failure to detect and correct error by					
Resident Engineer, Mines Division					
and Shotfirers					
3.56E-05					
-					
AND					
1.1.2-RE		1.1.2-MD		1.1.2-SF	
Failure to detect and correct error by		Failure to detect and correct error by		Failure to detect and correct error by	
Resident Engineer		Mines Division		Shotfirer	
3.35E-02		3.17E-02		3.35E-02	
		-			
OR		OR		OR	
	7				
1.1.2-1	1.1.2-3	1.1.2-2	1.1.2-4	1.1.2-5	1.1.2-6
Failure to detect error by Resident	Failure to correct error by Resident	Failure to detect error by Mines	Failure to correct error by Mines		
Engineer	Engineer	Division	Division	Failure to detect error by Shotfirer	Failure to correct error by Shotfirer
2.92E-02	4.37E-03	2.76E-02	4.14E-03	2.92E-02	4.37E-03

1.2.1

Failure by Blasting Engineer/Shotfirer to check and correct drilling error

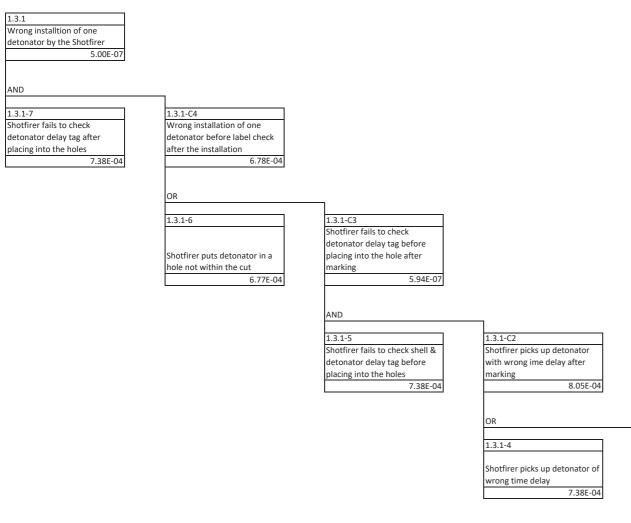
1.2.1		
Operator fails to drill correctly		
2.26E-02		
OR		
	L	
1.2.1-1	[1.2.1-2
Surveors calculate incorrect co-		
ordinates, leading to operator having	[Blasting Engineer inputs wrong
disc with incorrect information	ļi	information on to disc
2.20E-02		6.05E-04

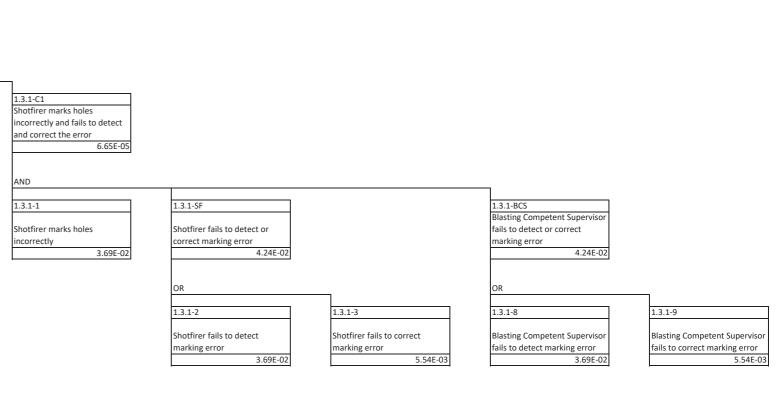
1.2.2 Failure by Blasting Engineer/Shotfirer to check and correct drilling error

are drilled correctly drilling error drilling error Shotfirer fails to correct drilling error to check holes are drilled correctly to check holes are drilled correctly	1.2.2					
to check and correct drilling error 7.61E-05 AND 1.2.2-BE Failure to detect or correct error by Blasting Engineer 4.32E-02 OR 0R 1.2.2-1 Blasting Engineer fails to check holes are drilled correctly 1.2.2-2 Shotfirer fails to correct drilling error 1.2.2-1 Shotfirer fails to correct drilling error 1.2.2-2 Shotfirer fails to correct drilling error 1.2.2-4 Blasting Engineer fails to correct drilling error 1.2.2-6 Blasting Competent Supervisor 1.2.2-6 Blasting Competent Supervisor fails Shotfirer fails to correct drilling error 1.2.2-6 Blasting Competent Supervisor fails Shotfirer fails to correct drilling error 1.2.2-6 Blasting Competent Supervisor fails Shotfirer fails to correct drilling error	Failure by Blasting Engineer/Shotfirer					
AND 1.2.2-BE Failure to detect or correct error by Blasting Engineer 4.32E-02 OR 1.2.2-1 Blasting Engineer fails to check holes are drilled correctly Blasting Engineer fails to correct drilling error 1.2.2-1 Blasting Engineer fails to correct drilling error 1.2.2-6 Blasting Competent Supervisor fails to correct drilling error 1.2.2-6 Blasting Competent Supervisor fails to correct drilling error 1.2.2-6 Blasting Competent Supervisor fails to correct drilling error						
AND 1.2.2-BE Failure to detect or correct error by Blasting Engineer 4.32E-02 OR 1.2.2-1 Blasting Engineer fails to check holes are drilled correctly Blasting Engineer fails to correct drilling error 1.2.2-1 Blasting Engineer fails to correct drilling error 1.2.2-6 Blasting Competent Supervisor fails to correct drilling error 1.2.2-6 Blasting Competent Supervisor fails to correct drilling error 1.2.2-6 Blasting Competent Supervisor fails to correct drilling error	7.61E-05					
1.2.2-BE Failure to detect or correct error by Blasting Engineer 4.32E-02 OR 1.2.2-BCS Failure to detect or correct error by Shotfirer 4.20E-02 OR 1.2.2-BCS Failure to detect or correct error by Blasting Competent Supervisor 4.20E-02 OR 1.2.2-1 Blasting Engineer fails to check holes are drilled correctly Blasting Engineer fails to correct drilling error 1.2.2-1 Blasting Engineer fails to check holes are drilled correctly Shotfirer fails to correct drilling error 1.2.2-6 Blasting Competent Supervisor fails blasting Comp						
1.2.2-BE Failure to detect or correct error by Blasting Engineer 4.32E-02 OR 1.2.2-BCS Failure to detect or correct error by Shotfirer 4.20E-02 OR 1.2.2-BCS Failure to detect or correct error by Blasting Competent Supervisor 4.20E-02 OR 1.2.2-1 Blasting Engineer fails to check holes are drilled correctly Blasting Engineer fails to correct drilling error 1.2.2-1 Blasting Engineer fails to check holes are drilled correctly Shotfirer fails to correct drilling error 1.2.2-6 Blasting Competent Supervisor fails blasting Comp						
Failure to detect or correct error by Blasting Engineer 4.32E-02 OR 1.2.2-1 Blasting Engineer fails to check holes are drilled correctly Failure to detect or correct error by Shotfirer 1.2.2-2 Shotfirer fails to check holes are drilled correctly Failure to detect or correct error by Blasting Competent Supervisor A.20E-02 Failure to detect or correct error by Blasting Competent Supervisor A.20E-02 Failure to detect or correct error by Blasting Competent Supervisor A.20E-02 Failure to detect or correct error by Blasting Competent Supervisor A.20E-02 OR 1.2.2-3 Blasting Engineer fails to check holes are drilled correctly Shotfirer fails to correct drilling error Shotfirer fails to correct drilling error	AND					
Failure to detect or correct error by Blasting Engineer 4.32E-02 OR 1.2.2-1 Blasting Engineer fails to check holes are drilled correctly Failure to detect or correct error by Shotfirer 1.2.2-2 Shotfirer fails to check holes are drilled correctly Failure to detect or correct error by Blasting Competent Supervisor A.20E-02 Failure to detect or correct error by Blasting Competent Supervisor A.20E-02 Failure to detect or correct error by Blasting Competent Supervisor A.20E-02 Failure to detect or correct error by Blasting Competent Supervisor A.20E-02 OR 1.2.2-3 Blasting Engineer fails to check holes are drilled correctly Shotfirer fails to correct drilling error Shotfirer fails to correct drilling error						
Blasting Engineer 4.32E-02 OR 1.2.2-1 Blasting Engineer fails to check holes are drilled correctly Blasting Engineer Supervisor 4.20E-02 OR 1.2.2-2 Shotfirer 1.2.2-4 Blasting Engineer fails to correct drilling error Blasting Competent Supervisor 4.20E-02 1.2.2-5 Blasting Competent Supervisor 1.2.2-6 Blasting Competent Supervisor fails to check holes are drilled correctly to check holes are drilled correctly	1.2.2-BE		1.2.2-SF		1.2.2-BCS	
A.32E-02 OR OR 1.2.2-1 Blasting Engineer fails to check holes are drilled correctly DR Shotfirer fails to correct drilling error A.20E-02 A.20E-02 A.20E-02 A.20E-02 A.20E-02 A.20E-02 A.20E-02 A.20E-02 A.20E-02 Blasting Corpetent Supervisor fails to check holes are drilled correctly to check holes are drilled correctly	Failure to detect or correct error by		Failure to detect or correct error by		Failure to detect or correct error by	
OR 1.2.2-1 Blasting Engineer fails to check holes are drilled correctly 1.2.2-3 Blasting Engineer fails to creect drilling error 1.2.2-5 Blasting Competent Supervisor fails to correct drilling error Shotfirer fails to correct drilling error OR 1.2.2-1 1.2.2-2 Shotfirer fails to check holes are drilled correctly Shotfirer fails to correct drilling error OR 1.2.2-5 Blasting Competent Supervisor fails to check holes are drilled correctly to check holes are drilled correctly	Blasting Engineer		Shotfirer		Blasting Competent Supervisor	
1.2.2-1 Blasting Engineer fails to check holes are drilled correctly 1.2.2-3 Blasting Engineer fails to creect drilling error 1.2.2-5 Blasting Competent Supervisor fails to check holes are drilled correctly to check holes are drilled correctly	4.32E-02		4.20E-02		4.20E-02	
1.2.2-1 Blasting Engineer fails to check holes are drilled correctly 1.2.2-3 Blasting Engineer fails to creect drilling error 1.2.2-5 Blasting Competent Supervisor fails to check holes are drilled correctly to check holes are drilled correctly	·					
1.2.2-1 Blasting Engineer fails to check holes are drilled correctly 1.2.2-3 Blasting Engineer fails to creect drilling error 1.2.2-5 Blasting Competent Supervisor fails to check holes are drilled correctly to check holes are drilled correctly						
Blasting Engineer fails to check holes are drilled correctly Blasting Engineer fails to correct drilling error Blasting Engineer fails to correct drilling error Shotfirer fails to check holes are drilled correctly Blasting Competent Supervisor fails to check holes are drilled correctly to check holes are drilled correctly	OR		OR		OR	
Blasting Engineer fails to check holes are drilled correctly Blasting Engineer fails to correct drilling error Blasting Engineer fails to correct drilling error Shotfirer fails to check holes are drilled correctly Blasting Competent Supervisor fails to check holes are drilled correctly to check holes are drilled correctly						
are drilled correctly drilling error drilling error Shotfirer fails to correct drilling error to check holes are drilled correctly to correct drilling error	1.2.2-1	1.2.2-3	1.2.2-2	1.2.2-4	1.2.2-5	1.2.2-6
	Blasting Engineer fails to check holes	Blasting Engineer fails to correct	Shotfirer fails to check holes are		Blasting Competent Supervisor fails	Blasting Competent Supervisor faile
3.79E-02 5.22E-03 3.69E-02 5.08E-03 5.08E-02 5.08E-03	are drilled correctly	drilling error	drilled correctly	Shotfirer fails to correct drilling error	to check holes are drilled correctly	to correct drilling error
	3.79E-02	5.22E-03	3.69E-02	5.08E-03	3.69E-02	5.08E-03

Major Works Project Management Office Highway Department of HKSAR

1.3.1 Wrong installation of one detonator by the Shotfirer





1.3.2

Shotfirer fails to detect and correct that there are holes without detonators left in the face

1.3.2
Shotfirer fails to detect and correct that there are holes without detonators left in the face

4.24E-02

OR

1.3.2-1
Shotfirer leaves empty holes in the blast face due to not realising that are detonators left over

3.69E-02

1.3.2-2

Shotfirer fails to fill empty holes before detonation

5.54E-03

CH-WHD

Wrong hole diameter or location for relief holes at cut

CH-WHD Wrong hole diameter or location for relief holes at cut 8.79E-07 CH-WHD-C1 CH-WHD-C2 Wrong location of drilling or incorrect frill size being used due to Wrong design in relief holes human error 1.88E-08 8.60E-07 AND AND 1.1.2 P-FF 1.2.2 P-FF 1.1.1 1.2.1 Design error signidicant enough to Design error by Blasting Engineer and Failure to detect and correct error by Failure by Blasting Engineer/Shotfirer Design error signidicant enough to Failure of design check Resident Engineer and Mines Division cause higher vibration Operator fails to drill correctly to check and correct drilling error cause higher vibration 1.05E-03 3.56E-05 0.5 0.5 2.26E-02 7.61E-05

CH-WD-TD

Wrong design of time delay of more than 2 production holes in cut

CH-WD-TD	
Wrong design of time delay of n	nore
than 2 production holes in cut	
1.2	6E-13
AND	

CH-WD-TD-C1

Wrong design of time delay of one production hole in cut

1.26E-09

P-AD-DETON

Wrong design of time delay of one additional production hole in cut

0.01

P-AD-DETON

Wrong design of time delay of one additional production hole in cut

0.01

AND

1.1.1

Design error by Blasting Engineer and Failure of design check

1.05E-03

1.1.2
Failure to detect and correct error by
Resident Engineer, Mines Division
and Shotfirers

1.19E-06

CH-WI-TD

Wrong installation of more than two detonators in cut (longer time delay from other sector put into the cut)

CH-WI-TD

Wrong installation of more than two detonators in cut (longer time delay from other sector put into the cut)

1.27E-11

AND

CH-WI-TD-C1

Wrong installation of one detonator in cut (longer time delay from other sector put into the cut)

1.27E-07

P-AD-DETON

Wrong installation of additional one detonator in cut (longer time delay from other sector put into the cut)

0.01

P-AD-DETON

Wrong installation of additional one detonator in cut (longer time delay from other sector put into the cut)

0.01

AND

1.3.1

Wrong installtion of one detonator by the Shotfirer

3.00E-06

1.3.2

Shotfirer fails to detect and correct that there are holes without detonators left in the face

4.24E-02

CH-TD-MD

Incorrect time default of more than two detonators due to manufacturer defect

CH-TD-MD
Incorrect time default of more than
two detonators due to manufacturer
defect

2.40E-09

AND

Incorrect time default of one detonator due to manufacturer defect

2.40E-05

P-AD-DETON

Incorrect time default of one additional detonator due to manufacturer defect

0.01

P-AD-DETON

Incorrect time default of one additional detonator due to manufacturer defect

0.01

CH Higher than expected vibration due to cut hole error

CH
Higher than expected vibration due to cut hole error

8.81E-07

OR

CH-WHD

Wrong hole diameter or location for relief holes at cut

8.79E-07

CH-C1

Wrong time delay at cut

2.41E-09

OR

CH-WD-TD

Wrong design of time delay of more than 2 production holes in cut

1.26E-13

CH-WI-TD

Wrong installation of more than two detonators in cut (longer time delay from other sector put into the cut)

1.27E-11

CH-TD-MD

Incorrect time default of more than two detonators due to manufacturer defect

2.40E-09

3.1.1 Excess emulsion is loaded due to wrong density

3.1.1		
Excess emulsion is loaded due to		
wrong density		
1.11E-12		
AND		
AND		
		3.1.1-C4
Truck Operator sets gassing flow		0.2.2 0.
meter or read density chart		Truck Operator reads scales or
· · · · · · · · · · · · · · · · · · ·		1 · ·
incorrectly		dentity incorrectly
3.03E-02		3.65E-11
OR		AND
3.1.1-1	3.1.1-2	3.1.1-C
		Truck Operator reaeds scales or
		density chart incorrectly and not
Truck Operator sets gassing flow	Truck Operator reads density chart	detected/corrected by Blasting
meter incorredtly	incorrectly	Engineer/Shotfirer (prior to loading)
3.95E-03	2.63E-02	3.32E-04
3.331-03	2.031-02	3.321-04

3.1.1-C

3.1.1-C

loading)

Truck Operator reaeds scales or density chart incorrectly and not

detected/corrected by Blasting

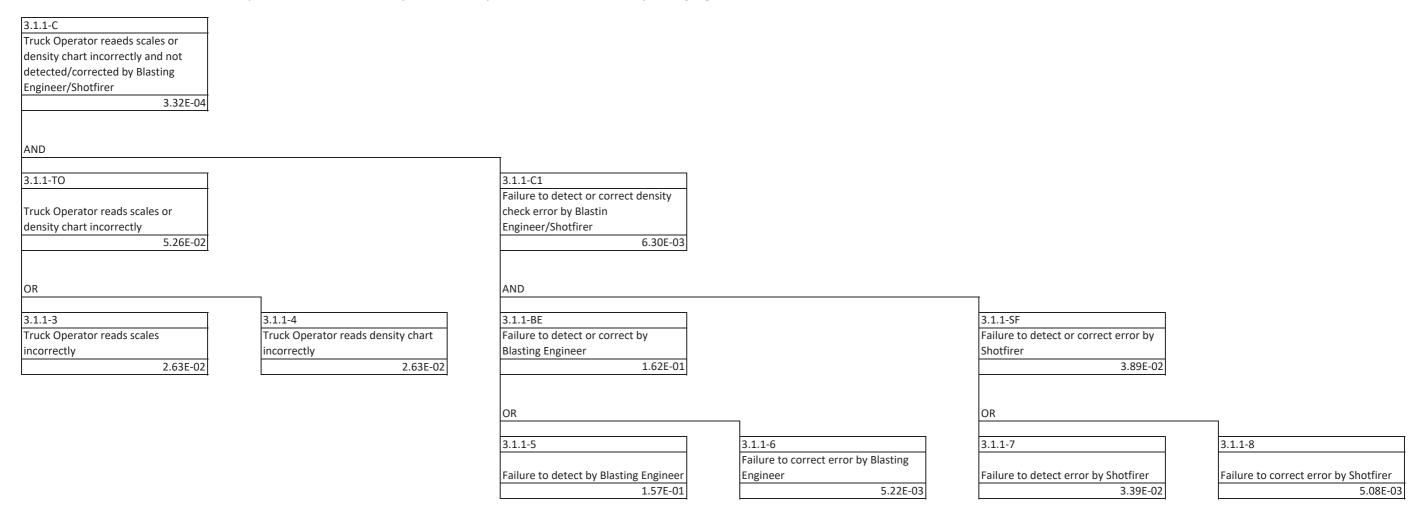
Engineer/Shotfirer (in the middle of

3.32E-04

Truck Operator reaeds scales or density chart incorrectly and not detected/corrected by Blasting Engineer/Shotfirer (towards end of loading)

3.32E-04

3.1.1-C Truck Operator reaeds scales or density chart incorrectly and not detected/corrected by Blasting Engineer/Shotfirer



3.1.2 Truck Operator, Shotfirer and Blasting Engineer do not realise hole is overloaded

3.1.2					
Truck Operator, Shotfirer and Blasting					
Engineeer do not realise hole is					
overloaded					
1.35E-06					
AND					
3.1.2-C3		3.1.2-C2			
		Shotfirer fails to detect or correct			
Truck Operator and Blasting Engineer		incorrect input of revolutions/weight			
fail to check		into PLC or hose marking error			
9.16E-04		1.47E-03			
AND		AND			
3.1.2-5	3.1.2-6	3.1.2-C1		3.1.2-SF	
		Truck Operator inputs incoorect			
		revolutions/weight into PLC or			
Truck Operator fails to check	Blasting Engineer fails to check	Shotfirer puts mark on hose in the		Shotfirer fails to detect or correct	
totaliser	totaliser	wrong place		error	
2.63E-02	3.48E-02	3.78E-02		3.89E-02	
5,002.02	3.102.02	311 32 32		3.002.02	
		OR		OR	
		3.1.2-1	3.1.2-2	3.1.2-3	3.1.2-4
		Truck Operator inputs incorrect	Shotfirer puts mark on hose in the	Shotfirer fails to detect hose marking	Shotfirer fails to correct hose
		revolutions/weight into PLC	wrong place	error	marking error
		3.95E-03	3.39E-02	3.39E-02	5.08E-03
		3.93E-03	5.39E-02	5.59E-02	5.06E-05

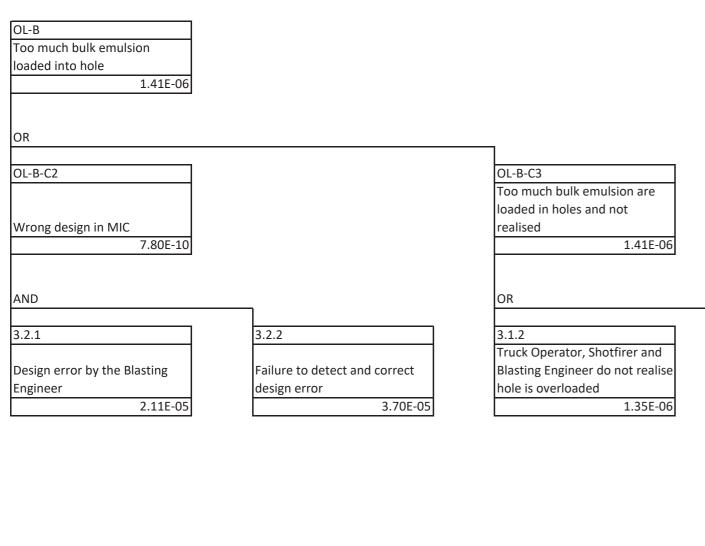
3.2.1 Design error by the Blasting Engineer

3.2.1		
Design error by the Blasting Engineer 2.11E-05		
AND		
3.2.1-1	3.2.1-BE	
Design away by Blacking Engineer	Failure to detect or correct error by	
Design error by Blasting Engineer 6.05E-04	Blasting Engineer 3.48E-02	
	OR	
	3.2.1-2	3.2.1-3
		Blasting Engineer fails to correct
	Blasting Engineer fails to detect error 3.03E-02	error 4.54E-03

3.2.2 Failure to detect and correct design error

3.2.2			
Failure to detect and correct design			
error			
3.70E-05			
AND			
3.2.2-RE		3.2.2-MD	
Failure to detect or correct error by		Failure to detect or correct error by	
Resident Engineer		Mines Division	
3.35E-02		1.10E-03	
OR		OR	
3.2.2-1	3.2.2-2	3.2.2-3	3.2.2-4
Resident Engineer fails to detect	Resident Engineer fails to correct		
error	error	Mines Division fails to detect error	Mines Division fails to correct error
2.92E-02	4.37E-03	5.52E-04	5.52E-04

OL-B Too much bulk emulsion loaded into hole

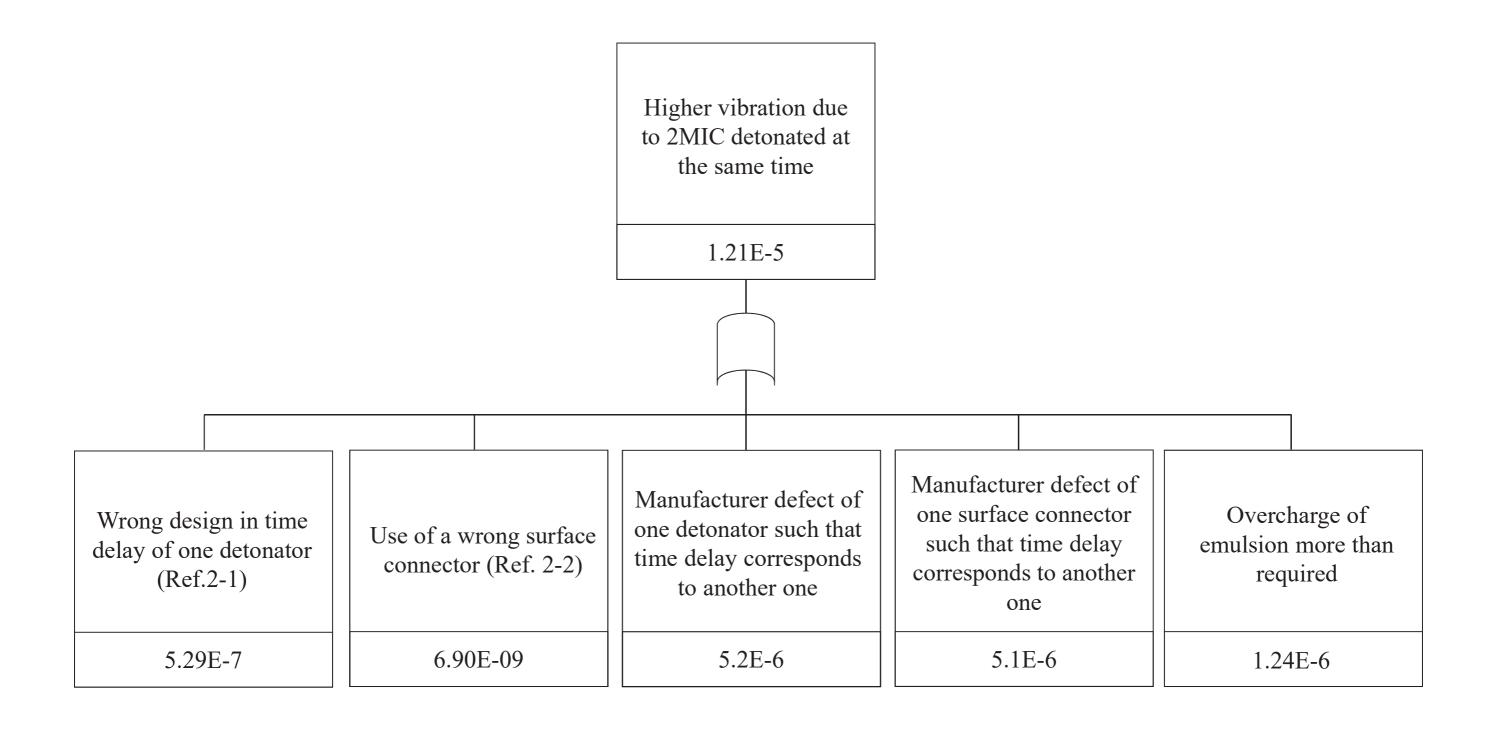


OL-B-C1 Incorrect density check 5.76E-08 3.1.1 P-MF-2 Excess emulsion is loaded due Wrong density check due to to wrong density mechanical failure 1.11E-12 5.76E-08 AND P-MF P-MF Scale out of Gassing flow meter calibration/malfunction malfunction 2.40E-04 2.40E-04

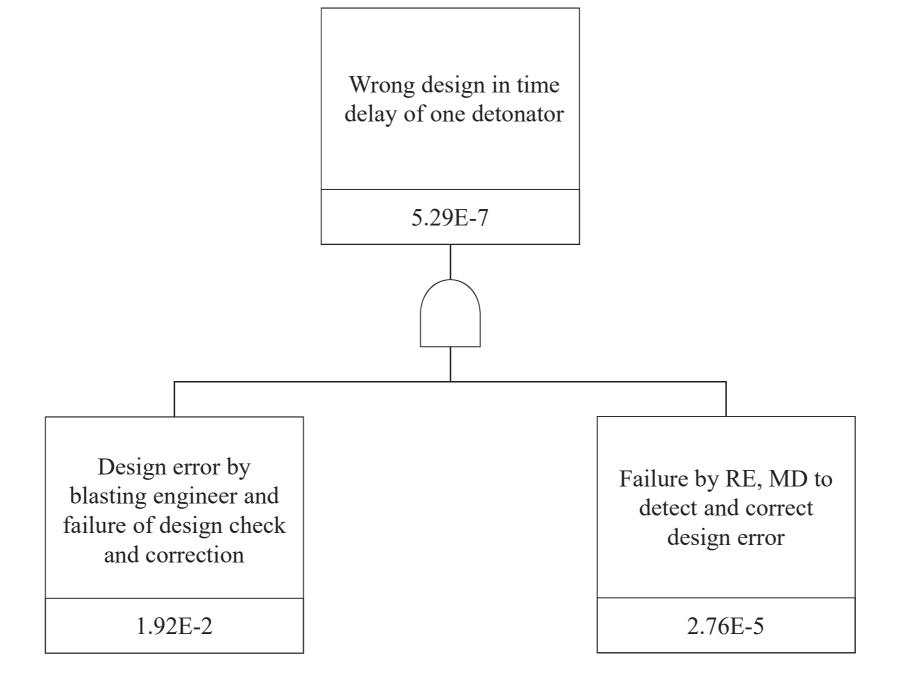
Annex 2

Fault Trees for Surface

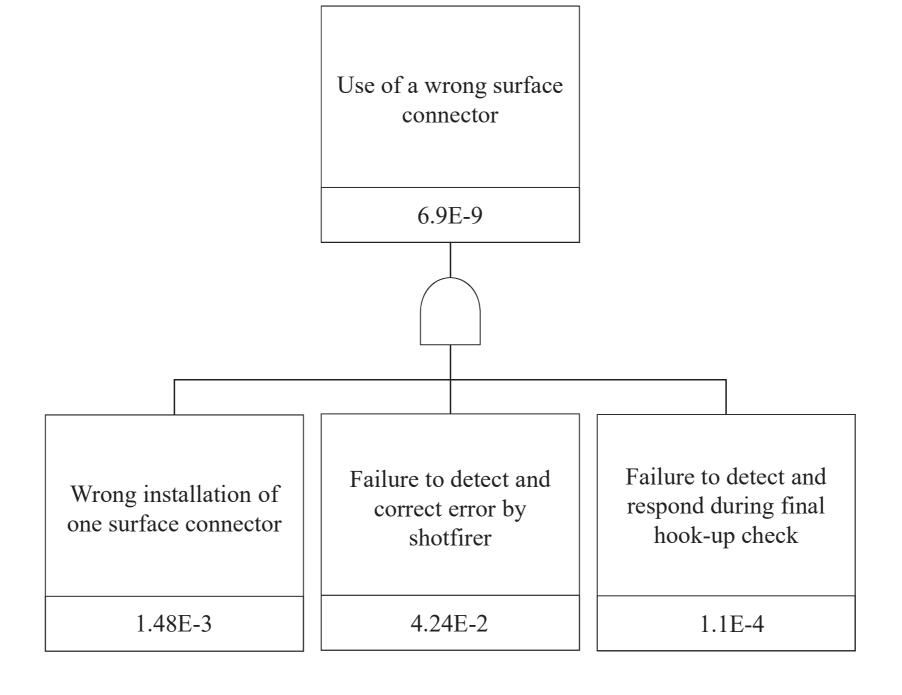
Blasting

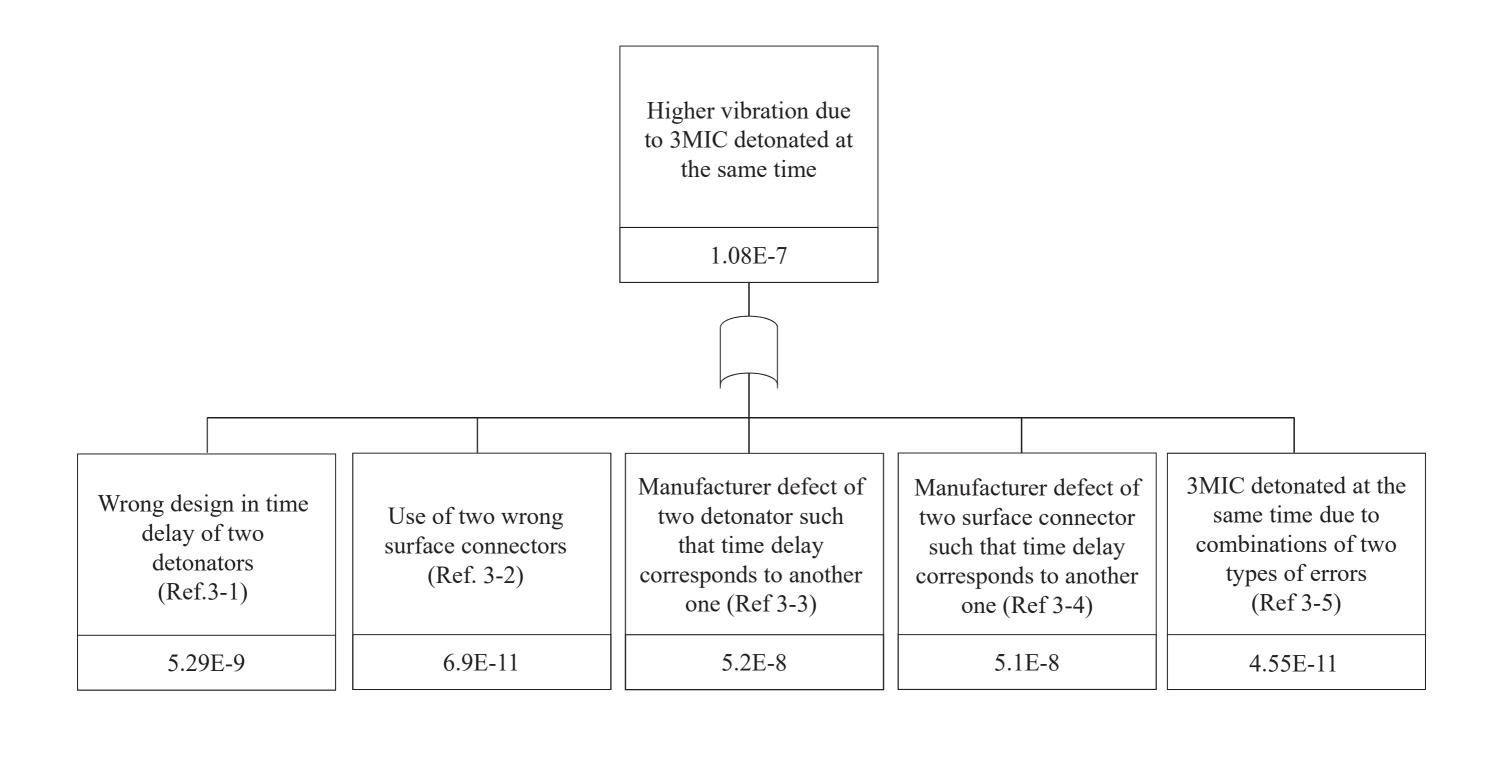


Ref. 2-1

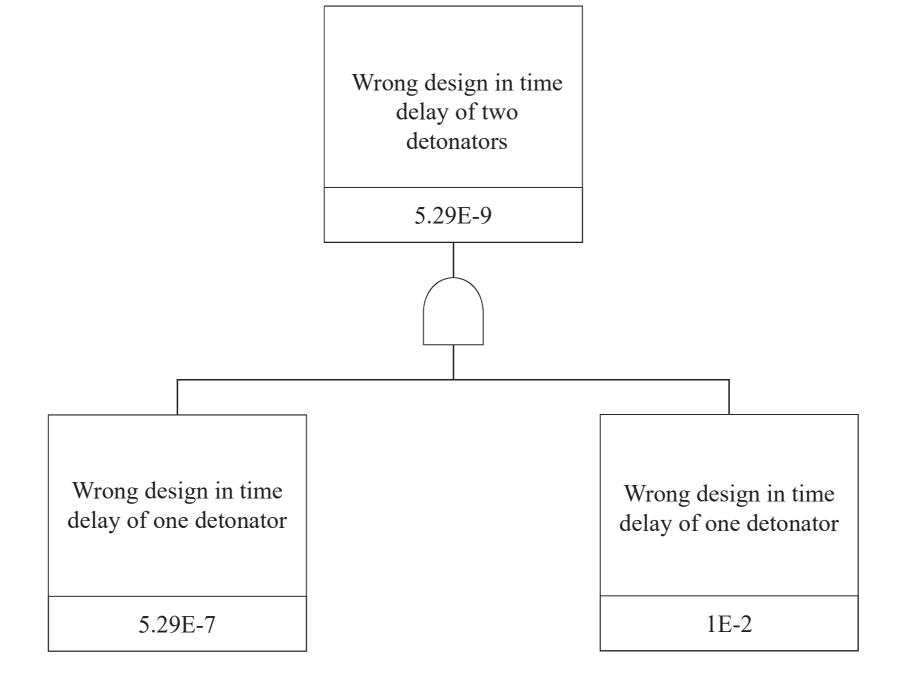


Ref. 2-2

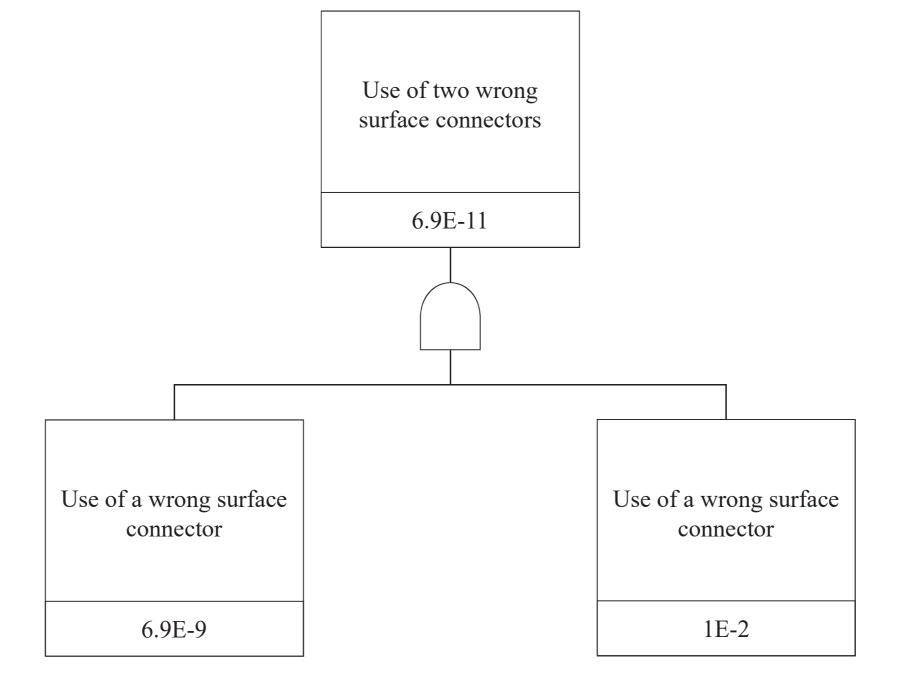




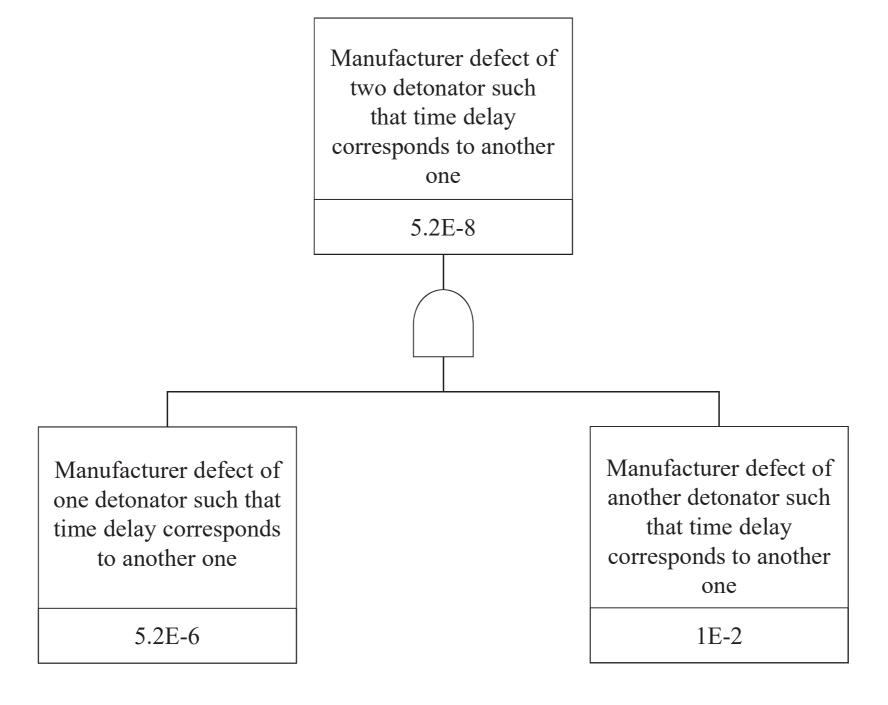
Ref. 3-1



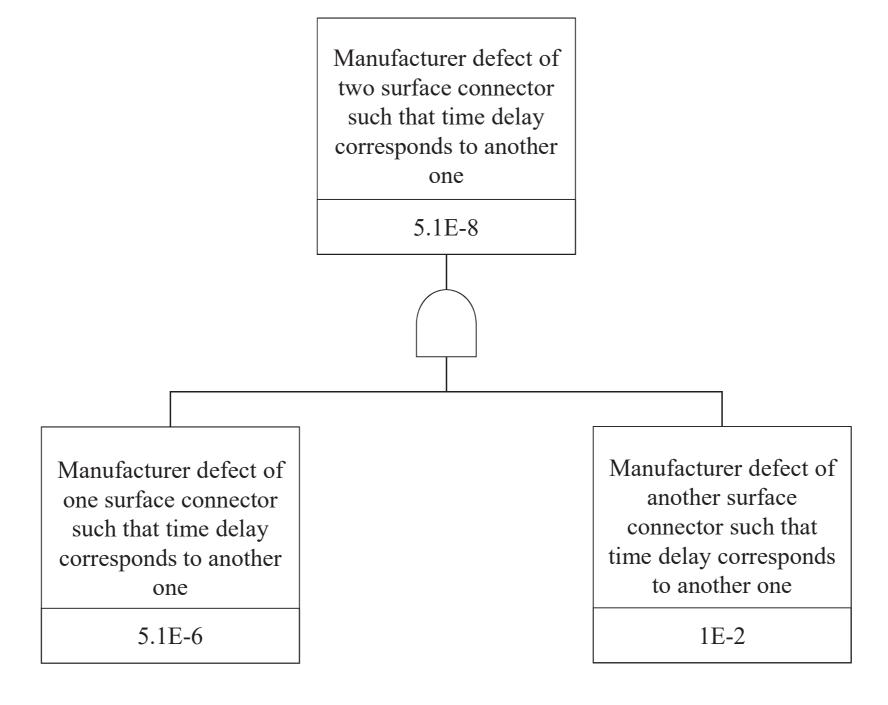
Ref. 3-2



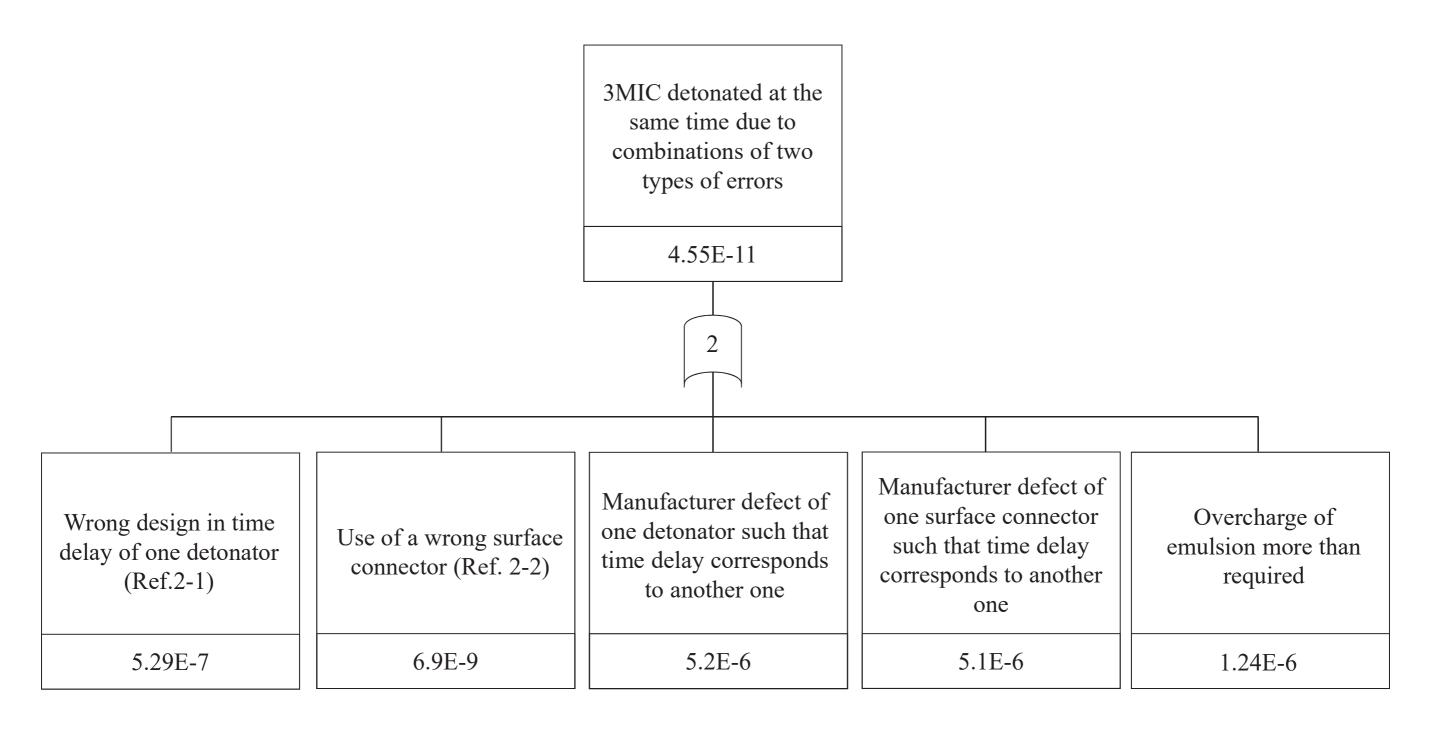
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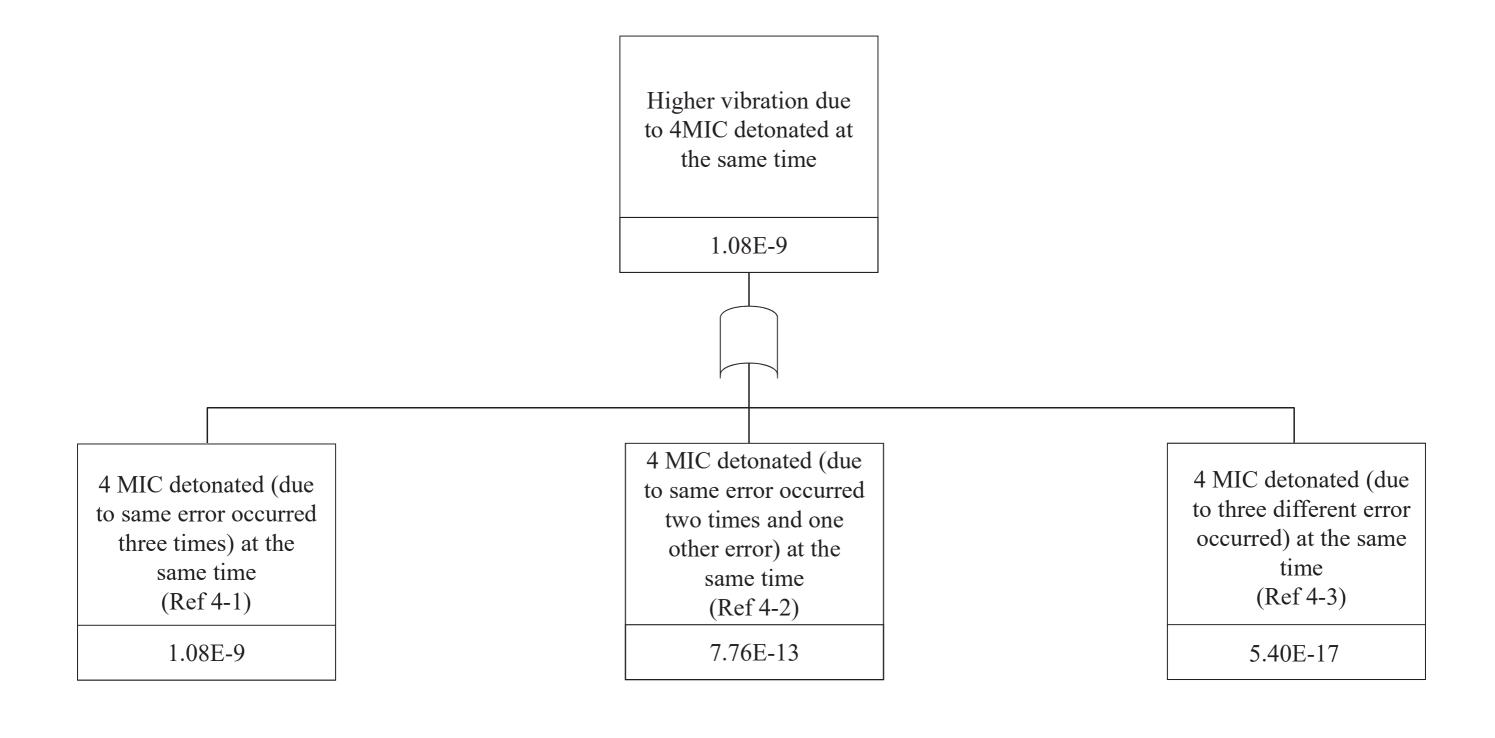


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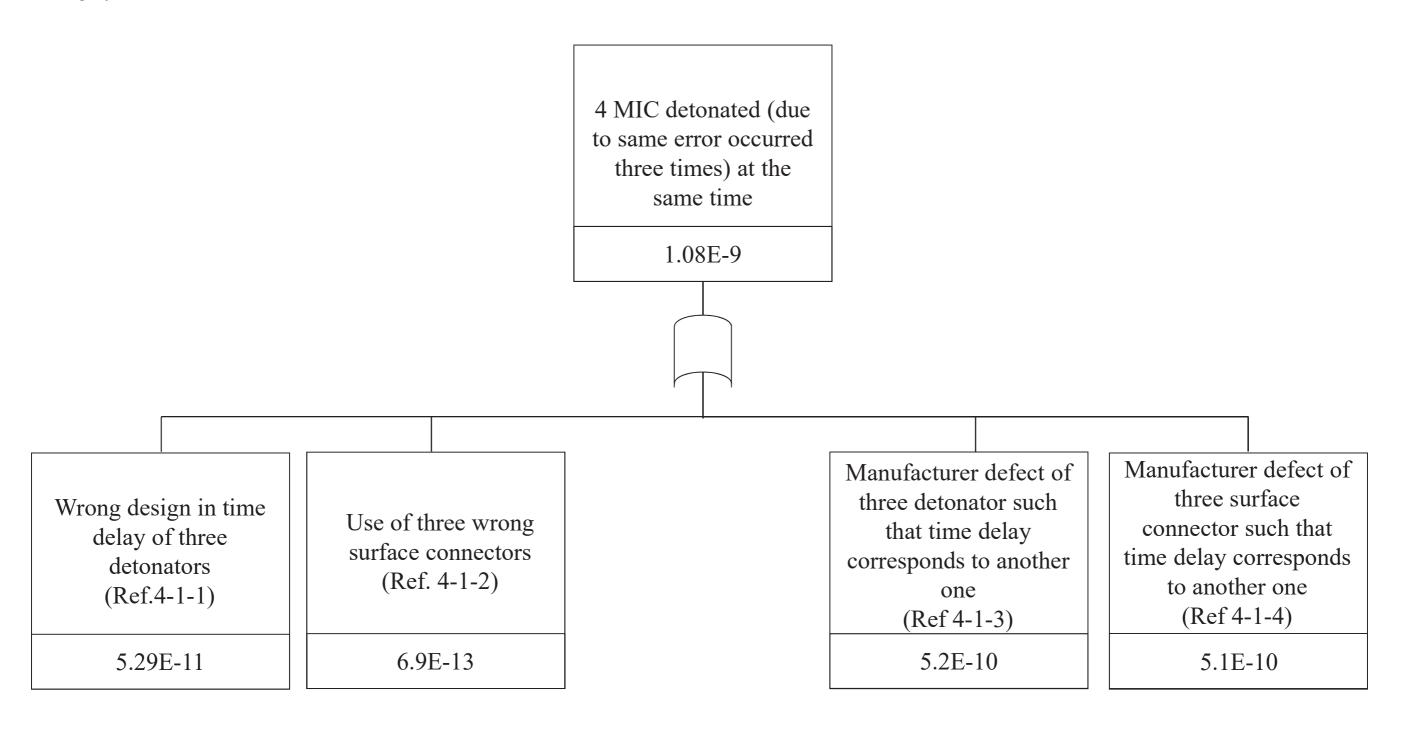


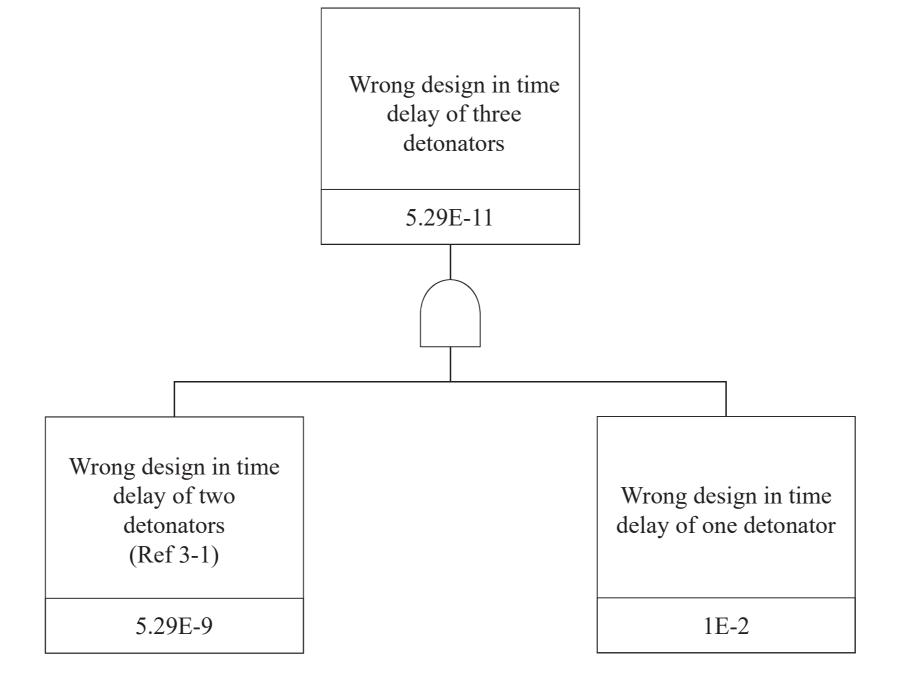
Ref. 3-5

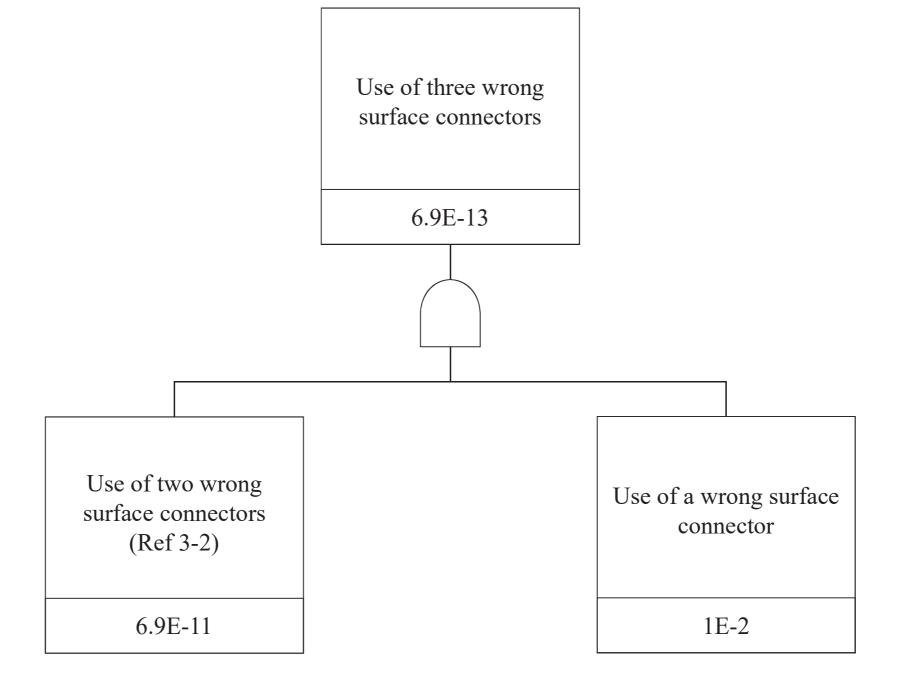


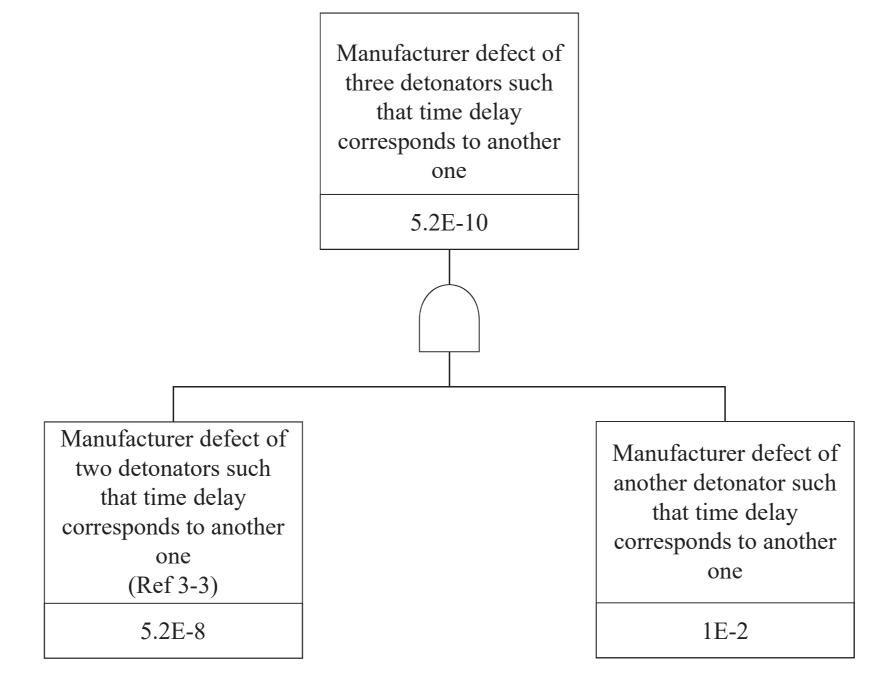


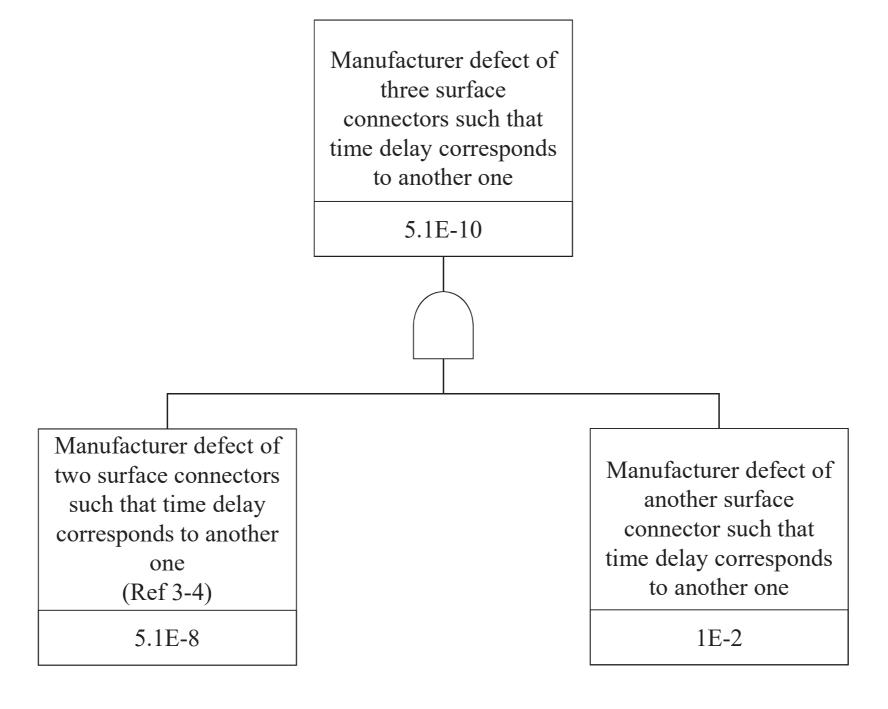
Ref. 4-1



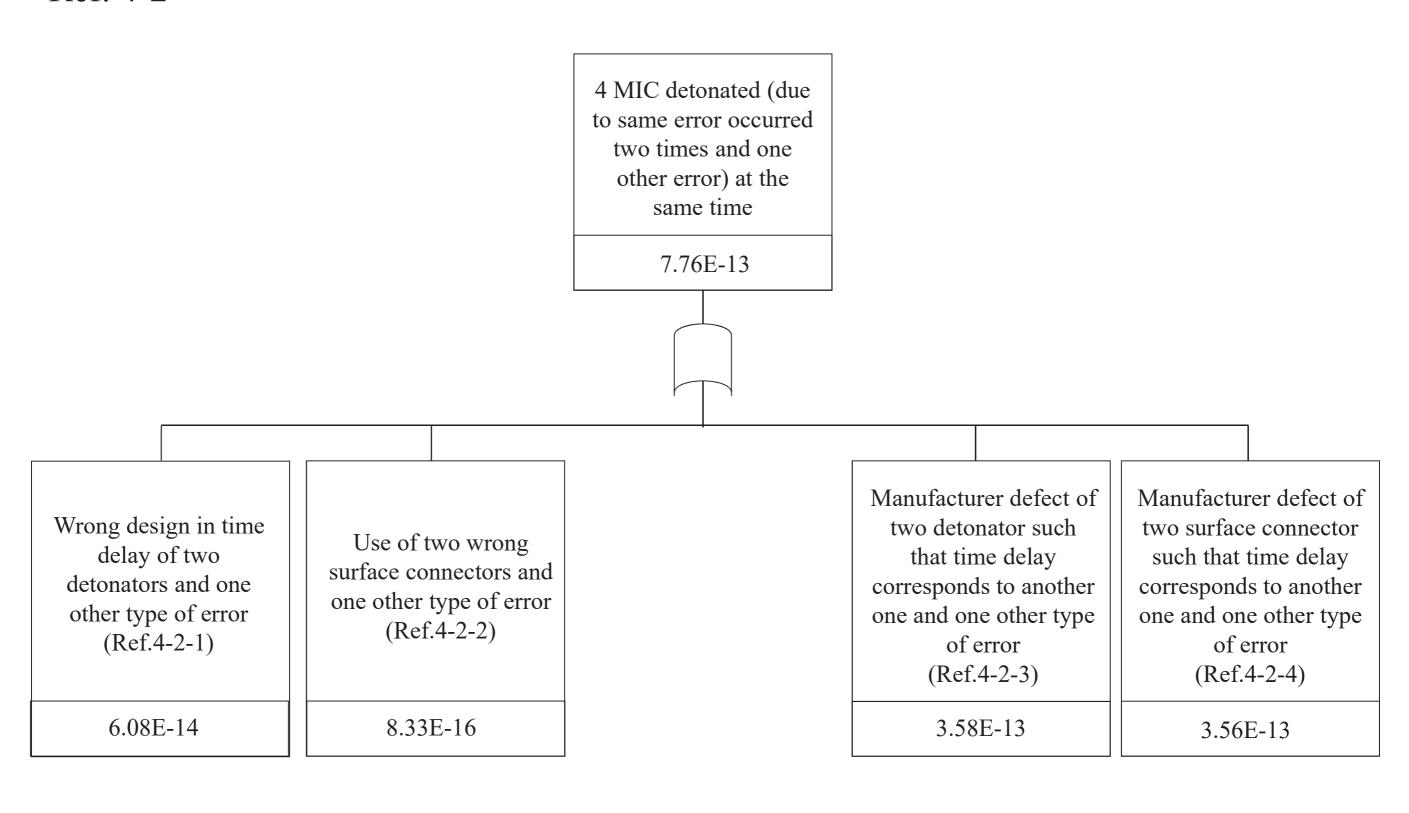


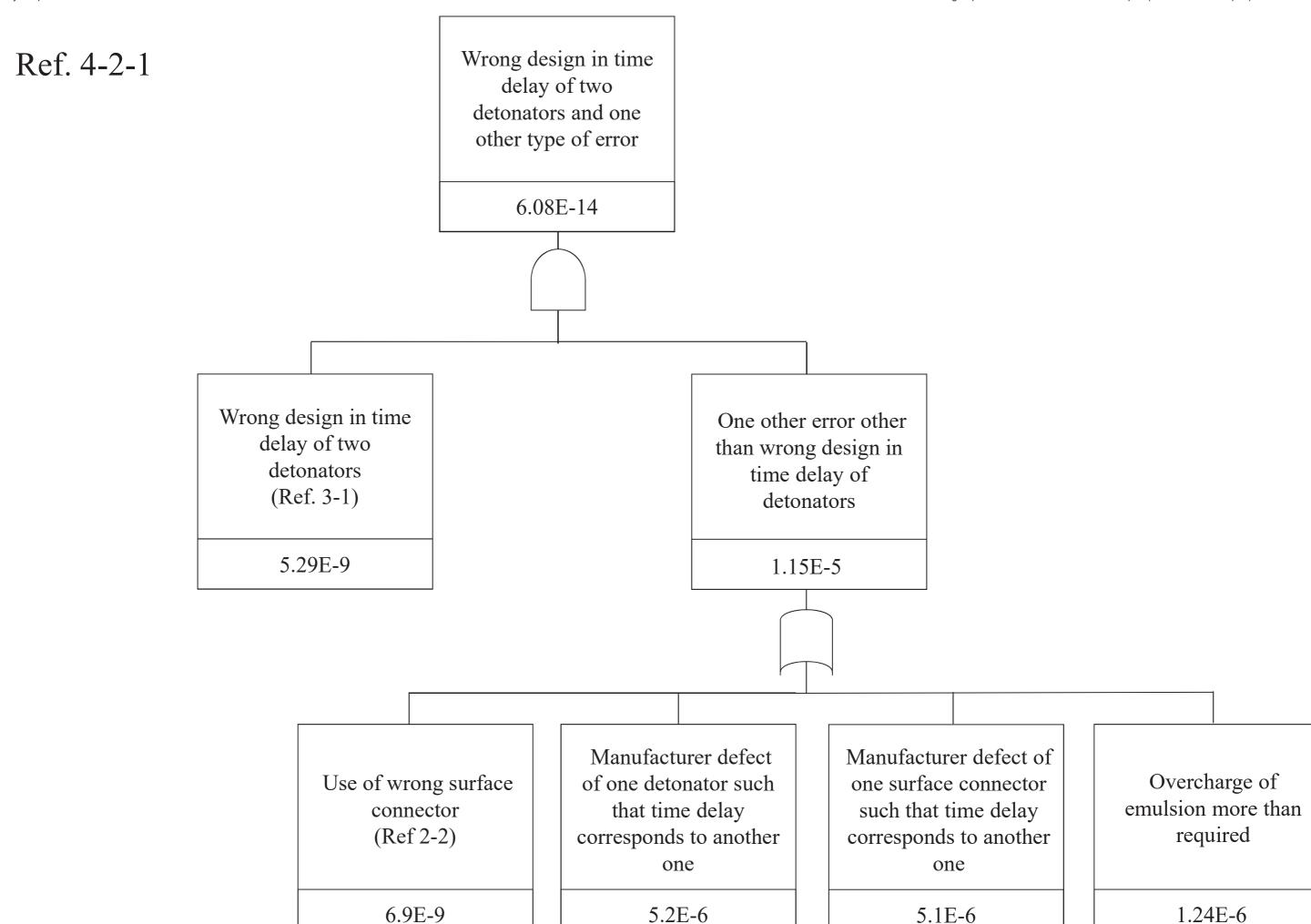


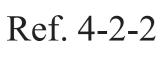


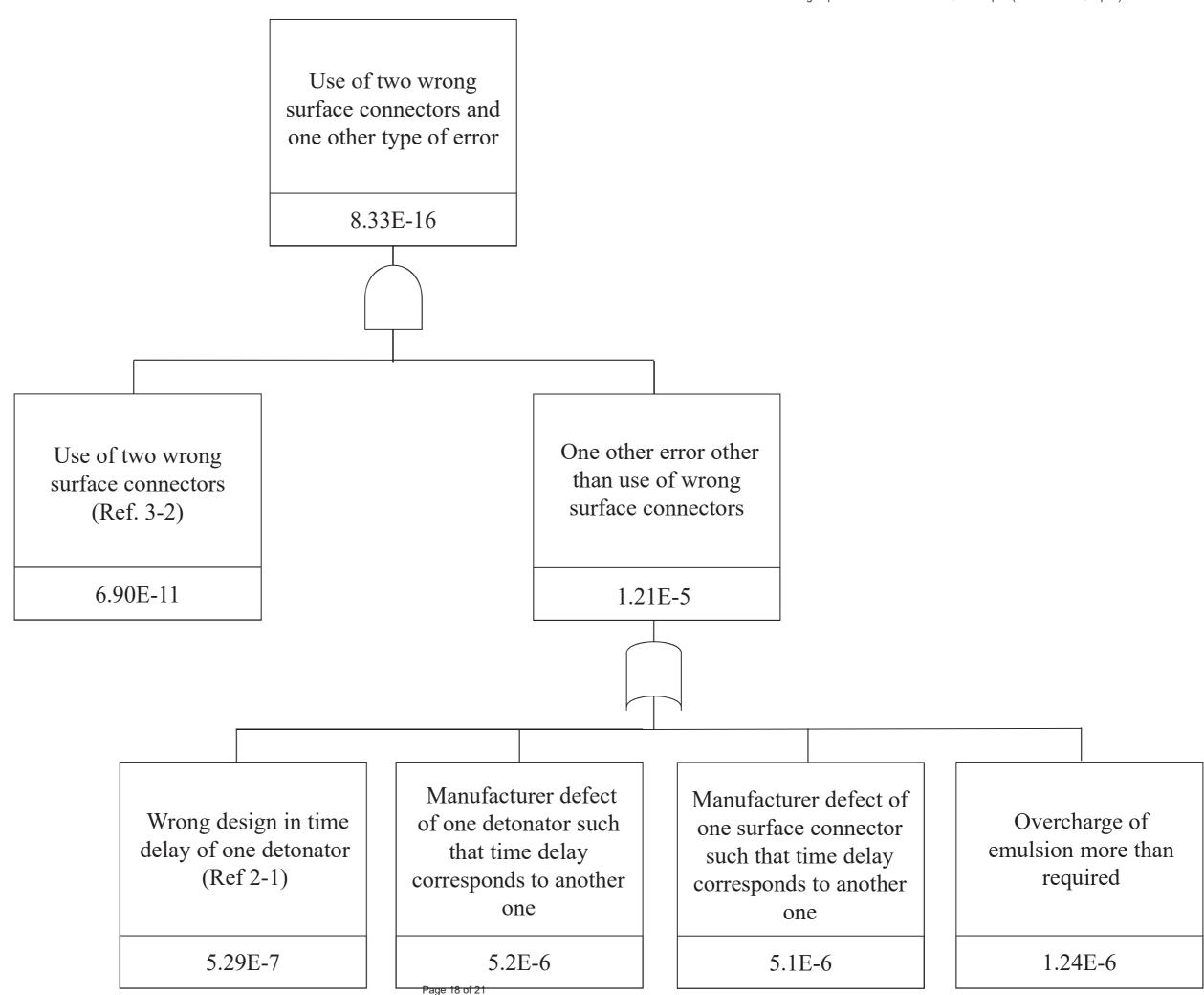


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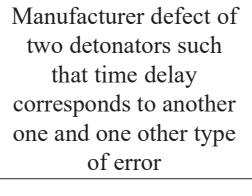








Ref. 4-2-3



3.58E-13

Manufacturer defect of two detonators such that time delay corresponds to another one (Ref 3-3)

5.2E-8

One other error other than manufacturer defect of detonator such that time delay corresponds to another one

6.88E-6

Wrong design in time delay of one detonator (Ref 2-1)

5.29E-7

Use of wrong surface connector (Ref 2-2)

6.9E-9

5.1E-6

Manufacturer defect of

one surface connector

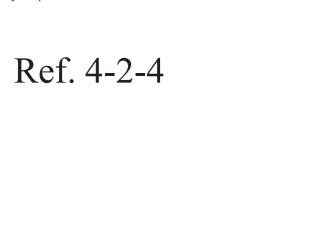
such that time delay

corresponds to another

one

Overcharge of emulsion more than required

1.24E-6



Manufacturer defect of two surface connector such that time delay corresponds to another one and one other type of error

3.56E-13

Manufacturer defect of two surface connector such that time delay corresponds to another

5.1E-8

one (Ref 3-4)

One other error other than manufacturer defect of one surface connector such that time delay corresponds to another one

6.98E-6

Wrong design in time delay of one detonator (Ref 2-1)

5.29E-7

Use of wrong surface connector (Ref 2-2)

6.9E-9

5.2E-6

Manufacturer defect of

one detonator such that

time delay corresponds

to another one

Overcharge of emulsion more than required

1.24E-6

Ref. 4-3

