Department of Planning & Environment

Responses to NSW Department of Planning & Environment Comments dated 14 March 2016

1. **Hazard Identification – Section 4.1**

a. We provide a copy of the Notes for HAZOP Report 11045 Rev 1 for the Stage 3 Development as a file: *"11045 Notes for HAZOP Report Stolthaven Newcastle Terminal Stage 3 Rev 1.docx"*

DP&E will appreciate that this is a "live" document. We recently updated this to reflect engineering development and will continue to update this as vendor selection is made and engineering design is fully developed. Preparation of the QRA as part of the EIS for Development Approval means that though major design decisions have been made, final engineering design cannot be completed until after approval, as tenders cannot be solicited and vendors approved for all equipment. The Stage 3 HAZOP will therefore be reviewed again prior to Stolthaven's application for a Major Hazard Facility licence.

b. Accidents related to pigging in fuels terminals are primarily OHS issues, rather than process safety. These OHS issues will be further explored on selection of a vendor for the final design of pig launchers and receivers. The main issue is for the potential of high pressure nitrogen to be present in the launcher or receiver when the door is opened. Inappropriate procedures and a lack of interlocks has historically resulted in operator fatalities by impact with the door or an ejected pig. These issues have been raised at design review meetings and the final design will be HAZOPed. Sophisticated designs for pig launcher/receiver doors are available and are being investigated as part of the detailed design. We note that there have been process safety issues with pig launchers and receivers in high pressure gas pipeline service in the past, particularly with sour gas, but in the terminalling industry the primary issue is OHS.

2. **Consequence Analysis**

a. Consequence modelling was carried out as part of the Stage 3 HAZOP to identify both internal and external scenarios leading to adverse effects.

This modelling identified two primary scenarios contributing to potential offsite risk in a fuels terminal: tank top fires and loss of containment scenarios which might then lead to flash fires, vapour cloud explosions and bund pool fires. With the addition of n-methylaniline additive, additional consequence analysis has been undertaken for toxic dispersion.

b. Tank Top Fires

For a tank-top fire, the impact is heat radiation. The presentation of heat radiation intensity for a consequence analysis is representative of a single wind speed and is therefore typical. In practice, for the QRA, the consequence is calculated for each of 84 different wind speed/direction and atmospheric stability combinations.

Figure 1 shows the 4.7 kW/m^2 heat radiation plot at 1.5m height for a single tank fire for a wind speed of 10 m/s (easterly). Figure 2 is a compilation of heat radiation contours for all tanks close to the railway line on the western boundary of the site, with a wind speed of 10 m/s and various wind directions.

The presentation of heat radiation intensity for a consequence analysis is representative of a single wind speed and is therefore typical. In practice, for the QRA, the consequence is calculated for each of 84 different wind speed/direction and atmospheric stability combinations.

Figure 1 Single Tank-top fire, ND16 – heat radiation of 4.7 kW/m² at 1.5m height

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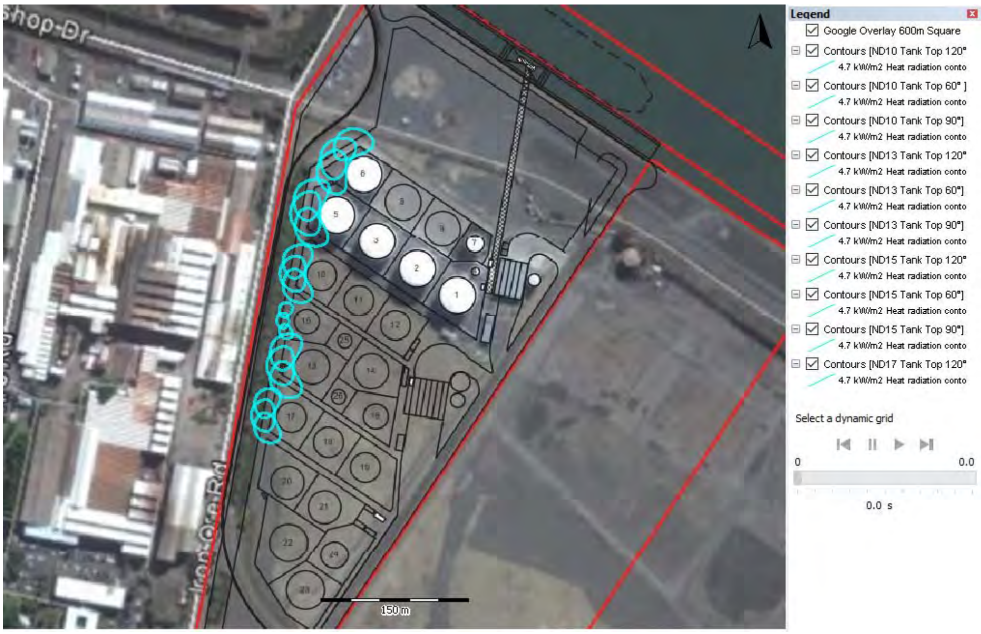
Figure 2 Tank-top fires on western perimeter – heat radiation at 4.7 kW/m² at 1.5m height



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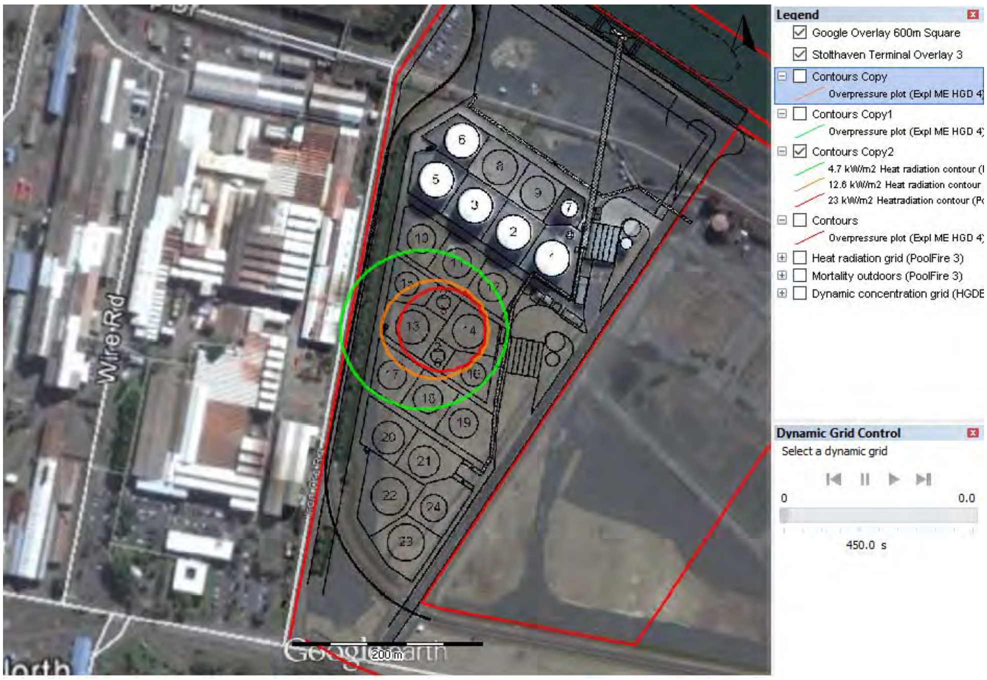
In the event of either a compound or a full bund spill, there are various possible consequences depending on both sources of ignition and weather conditions. If the spill is immediately ignited, the resultant pool fire will increase in area until the compound or bund is covered in fire.

c. Full Bund Fires

Figure 3 shows the extent of heat radiation contours (at 4.7, 12.6 and 23 kW/m^2) for a full bund fire in the largest petrol bund.

Figure 3 Full Bund Fire - Extent of Heat radiation contours



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d. Full Bund Spill – Flash Fires & Vapour Cloud Explosions

TNO Effects® and Riskcurves® programs allow defined mixtures to be used in consequence modelling. This is in contrast with less sophisticated programs that require “representative” materials to be used. Other PHAs in NSW have used n-hexane and n-octane as representative chemicals. These will not result in the prediction of flammable vapour clouds as the vapour pressure of these alkanes are low compared with petrol. The present QRA uses a multi-component definition for petrol, diesel and jet fuel. Results for petrol are similar to those using n-pentane, which TNO recommend if a representative chemical is used.

For some weather conditions, a dense flammable cloud is predicted using Effects® and this will disperse downwind. The extent of the cloud will depend on wind speed and atmospheric stability. As there are 11 separate full bund spill scenarios and 84 separate combinations of wind speed/direction and atmospheric stability, it would clearly be onerous to present the results of consequence analysis for all 9,240 instances.

Consequence analysis using EFFECTS® showed that flammable vapour clouds are only produced under Pasquill stability classes E and F. For the purpose of demonstration, various outputs are presented for the following conditions:

- Stability Class F
- Wind speed 2.0 m/s
- Wind direction (from) 90°

All scenarios and meteorological conditions are carried forward into RiskCurves®. RiskCurves® internally calculates effects for every combination of wind speed/direction and atmospheric stability, using the same models as EFFECTS®. If a flammable gas cloud is predicted, it will determine the area of the flammable cloud and for all grid points within the cloud, a fatality is assumed (flash fire). It will also calculate the effects of a vapour cloud explosion, and apply a probit to determine fatality for all grid points.

Figure 4 shows the extent of a flammable vapour cloud for a full bund petrol spill in the largest bund for F2.0 conditions (easterly wind). Figure 5 shows the overpressure contours (at 7 kPa, 15 kPa and 35 kPa) resulting in ignition of a vapour cloud for F2.0 conditions.

Figure 4 Extent of Flammable Cloud – F2.0 Easterly

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Figure 5 Incident Overpressure Contours – F2.0 Easterly

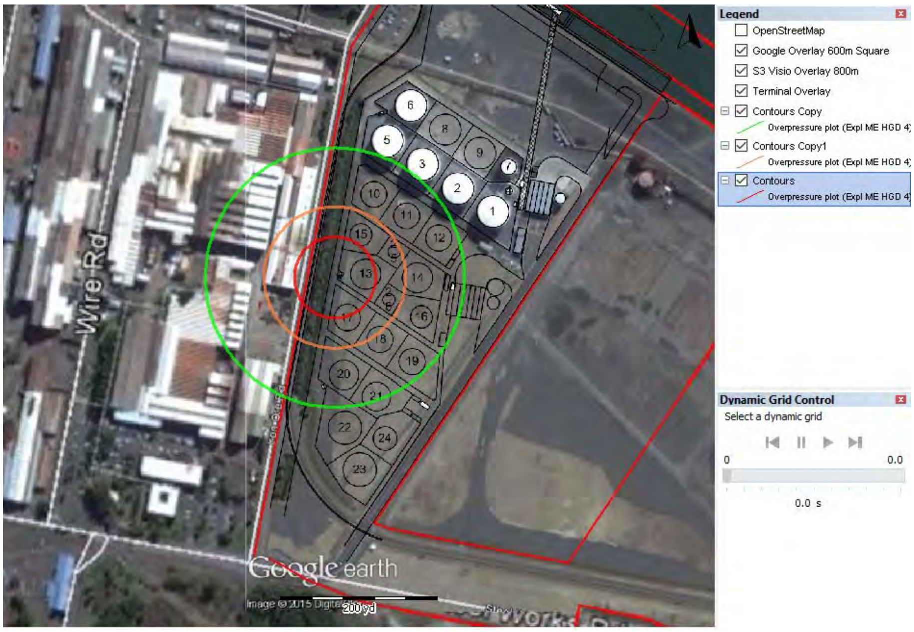

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Figure 6 shows the dynamic concentration grid at 180 s, at which time the flammable vapour cloud is well beyond the site boundary (the brown area represents the area at ground level with a concentration greater than the lower explosive limit). It is assumed that the vapour cloud will find a source of ignition as the fully formed vapour cloud moves beyond the site boundary.

Figure 6 Dynamic Concentration Grid at 400 s – F1.9 Easterly

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In all cases of ignition, whether by immediate ignition or as a result of a flash fire or vapour cloud explosion, a full bund fire will also occur, the effects of which are as shown in Figure 3, above.

As stated in Section A.6 of the PHA, the total ignition probability for Buncefield-type spills, including bund spills not due to overflow events, is taken as 1.0.

e. Toxic Dispersion

N-methylaniline (NMA), a petrol additive, will be stored in a 50m^3 additive tank. The bund design minimises the spill area to minimise evaporation and dispersion of toxic vapours.

Figure 7 shows the PAC-1 contours for average wind speeds for D, E and F stability classes for a full bund spill. PAC-1 (Protective Action Criterion, Level 1) which represents mid, transient effects, is 0.5 ppm NMA, is the same as the 8-hour TWA assigned by HSIS.

The extent of the PAC-1 contour is 398m from the source and 330 m from nearest sensitive land use.

Individual Fatality Risk and Individual Injury Risk are covered in 4.b below.

Figure 7 NMA Toxic Dispersion for D5.9, E3.5 and F1.9 atmospheric conditions

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3. Frequency Analysis

a. The statement in Appendix F is not a typographical error and is explained in Appendix A.6, Ignition Probability. The submitter is referred to Section 2.1 of the Ignition Probability Curves of the *OPG Risk Assessment Data Directory*:

"These curves represent "total" ignition probability. The method assumes that the immediate ignition probability is 0.001 and is independent of the release rate. As a result, all the curves start at a value of 0.001 relating to a release rate of 0.1 kg/s. Users of the data may wish to adopt this value and to obtain delayed ignition probabilities by subtracting 0.001 from the total ignition probability, e.g. an ignition probability value of 0.004 obtained from the look-up correlations can be considered as an immediate ignition probability of 0.001 and a delayed ignition probability of 0.003."

This is quite logical. The immediate ignition probability is a function of the availability of an ignition source at the point of loss of containment. The release rate is irrelevant. In the case of loss of containment of petrol, the effect of immediate ignition is either a jet fire or a spreading pool fire, depending on the release mechanism.

The delayed ignition probability is of more concern for loss of containment (petrol) scenarios. If ignition is delayed, the unignited pool will evaporate potentially producing a flammable vapour cloud. The larger the release rate, the larger the flammable cloud and the higher the chance that an ignition source is available. Hence the probability given in the OGP curves increases with discharge rate. Delayed ignition will result in a flash fire, a potential VCE and a pool fire.

It will also be noted that for large petrol loss of containment scenarios, the total ignition probability has been taken as 1.0 (i.e. an immediate ignition probability of 0.001 and a delayed ignition probability of 0.999) – see Appendix A.6. This is to account for Buncefield type scenarios where a large flammable vapour cloud extends beyond the controlled area of the terminal. Consideration of HOSL Buncefield, COPECO San Juan and IOC Jaipur incidents indicates that for these scenarios, a source of ignition is likely to be available.

b. The Probability Bow-Ties of Appendix B - B.6 LHS, B.6 RHS (large) and B.6 RHS (Moderate) - illustrate how we have modelled tank leaks and liquid spills outside of tanks.

Leaks to bunds are modelled for both operational and random failures. Operational failures during filling can lead to large tank overflow events, including Bunce-field-type events. Other specific tank failures are due to component failure, corrosion, meteorological events, impact and sabotage. Failure of piping and fittings also leads to loss of containment to compounds and bunds.

Operational failures during filling are directly proportional to the number of fills per year. Large failures due to impact are related to bund access for vehicles. The Stolthaven terminal has high bund walls and no drive-over access.

Unfortunately, historical data does not take account of specific design features nor the number of annual fill operations.

PBT B.6 (LHS) provides a calculation for potential overflow events based on terminal movements. These are assumed to be full bund spills.

For random failures, the basic leak rate is 2.5×10^{-3} pa per tank plus impact and sabotage contributions. It is assumed that 90% of all leaks are moderate (modelled as 50 mm hole size). The rest are modelled as full tank content leaks with a release rate based on emptying the tank in 10 minutes. Failures due to yard piping failure and meteorological events are also treated as major spill events.

The calculated total of tank overflow and failure rate for petrol tanks is 2.6×10^{-3} per tank (i.e. 2.6×10^{-2} total events for 10 petrol tanks) which may be compared with *OGP Storage Incident Frequencies Table 2.1* of 2.8×10^{-3} for “liquid spill outside tank”. Large loss of containment events are calculated as 1.3×10^{-4} per tank compared with “tank rupture” events of 3.0×10^{-6} in the OGP table. The largest contributor to these large events is tank overflow.

c. Stolthaven confirms that emergency release couplings and ranging alarms will be provided on the MLAs.

d. Pipeline failure rates

Table 1 below compares the QRA failure rate used for the wharf pipeline with other references.

A figure of 1.1×10^{-7} failures pa/m was used (being the sum of failure rates for all hole sizes greater than a pinhole) and all leaks are modelled as full bore. This was seen as being a conservative approach and less time consuming than modelling the various hole sizes. Based on the HSE numbers, full bore ruptures make up only 6% of the total failures above pinhole size.

There is no international data that fully reflects the wharf pipeline situation. The wharf pipelines are fully welded steel pipelines run above ground. When not in use, they rest on dry nitrogen, so are not subject to corrosive fluids. As you point out, the *UKHSE FR 3.1.2* reflects overland steel pipelines carrying gas. *Table FR 1.3* on the other hand represents process pipework, not pipelines. *OGP Risk assessment data directory – Process release frequencies (Process steel pipes)* specifically excludes inter-unit piping, so is not applicable to wharf lines. The *TNO Table 3.7* failure data includes flange failure in the piping failure frequency data and is limited in terms of pipe size.

The QRA models flanges separately – for the wharf there are 22 flanges associated with each wharfline at the wharf and each pump bay has flanged manifolds (with various numbers of flanges in each pump bay) for pump suction and discharge.

We have also included in the table data taken from the PHAs for Clyde Terminal Conversion project PHA and the Kurnell Product Terminal for comparison.

We believe that our selection of a failure frequency of 1 x 10^{-7} pa/m for all significant failures, the treatment of these failures all as full bore, and the separate identification of flanges (particularly at the wharf and pump bays) represents a consistent and conservative approach to available frequency data.

Table 1 Pipeline & Pipework Failure Frequencies (failures pa/m)

Line size (mm)	This QRA	UK HSE FR 3.1.2	UK HSE FR 1.3	TNO	OGP	CTCP	Kurnell
	Based on all sizes greater than a pinhole	Above ground Gas Pipeline	Process Pipework	Process pipes and inter-unit pipes. **Flanges included in frequency.**	Steel process pipes. **Inter-unit pipes excluded.**	Non-LPG Piping (p 65 of sherpa report)	Transfer Pipe (Table -6 of R4Risk Report)
	Full bore Rupture assumed		Full Bore		>150 mm	Full bore Rupture assumed	
150		0.007	0.2	0.1		0.2	0.18
200		0.007	0.2			0.2	
300	0.1	0.007	0.07		0.17	0.07	0.14
350	0.1	0.007	0.07			0.07	
400	0.1	0.007	0.07			0.07	
Leaks excluding full bore	All leaks assumed full bore.	>25mm	>25mm	>25mm	>25mm	All leaks assumed full bore.	>25mm
150		0.03	0.1	0.5			1.6
200		0.03	0.1				
300		0.03	0.1		0.37		1.2
350		0.03	0.1				
400		0.03	0.1		0.36		

4. Risk Assessment

a. Toxic Smoke Plumes

We have prepared some calculations of plume rise for bent-over, hot buoyant plumes using the methods of Briggs, as described in Beychok1. The results are provided in Tables 2 and 3 below for smoke plumes resulting from both a major petrol bund fire and a single petrol

[1] Fundamentals of Stack Gas Dispersion, Milton R Beychok, 1994

tank-top fire (ND13). It can be seen that for all average wind speed/atmospheric stability pairs, the plume rise exceeds the height of the mixing layer within 500-1,000m distance downwind of the fire.

A NASA EIS submission for a ground-based test rocket site[2] states that *"when pollutants are emitted above the mixing height, they are slowly dispersed and do not tend to mix with the air below"*.

No adverse impacts are anticipated in downwind residential areas.

Table 2 Plume Rise for large full bund spill (Mid Petrol Bund)

Stability Class	A	B	C	D	E	F
Wind Speed m/s	**1.3**	**2.7**	**4.3**	**7.7**	**3.5**	**1.9**
Mixing Height	**1,500**	**1,500**	**1,000**	**500**	**149**	**53**
Distance downwind m	**Vertical plume rise (m)**					
25	523	252	158	88	194	358
50	830	400	251	140	308	568
100	1,317	634	398	222	489	901
200	2,091	1,007	632	353	777	1,019
500	3,852	1,855	1,164	650	983	1,019
1,000	6,114	2,944	1,849	1,032	983	1,019
1,500	8,012	3,858	2,422	1,353	983	1,019
2,000	9,706	4,673	2,934	1,639	983	1,019
3,000	12,718	6,124	3,845	2,147	983	1,019
5,000	17,878	8,608	5,405	3,018	983	1,019

Table 3 Plume Rise for a single tank fire (ND13)

Stability Class	A	B	C	D	E	F
Wind Speed m/s	**1.3**	**2.7**	**4.3**	**7.7**	**3.5**	**1.9**
Mixing Height	**1,500**	**1,500**	**1,000**	**500**	**149**	**53**
Distance downwind m	**Vertical plume rise (m)**					
25	298	143	90	50	111	204
50	473	228	143	80	176	323
100	751	361	227	127	279	514
200	1,191	574	360	201	443	581
500	2,194	1,057	663	370	560	581
1,000	3,484	1,677	1,053	588	560	581
1,500	4,565	2,198	1,380	771	560	581
2,000	5,530	2,662	1,672	934	560	581
3,000	7,246	3,489	2,191	1,223	560	581
5,000	10,186	4,904	3,079	1,720	560	581

A review of photographs and video clips of major incidents involving petrol/diesel tank-top and full bund fires confirms that the intense heat of combustion results in a smoke plume that rises continuously in the downwind direction, dispersing at height.

[2] NASA Supplemental Final EIS Space Shuttle Advanced Solid Rocket Motor Program, August 1990, Appendix B-1

b. Exposure to N-methylaniline

Since submission of the PHA in March 2016, Stolthaven has introduced a new petrol additive at the request of one of its clients. The product is n-methylaniline (NMA) which is a Class 6.1 substance. Consequence analysis for a spill of n-methylaniline is included at 2.e above.

As NMA is a toxic substance, this has been included in the revised PHA submitted to the Department of Industry and the Environment on 30 June 2016. The product will be stored close to the petrol road tanker gantry in a 50m^3 steel storage tank.

The individual contribution to the Individual Fatality contour is shown as iso-probability contours in Figure 8, below. Iso-probabilities for mild, transient effects are presented in Figure 9.

N-methylaniline (NMA) has an Australian workplace TWA exposure limit of 0.5 ppm (2.2 mg/m3). This is the maximum allowable workplace concentration for exposure 8 hours per day, five days per week.

The US National Institute for Occupational Safety and Health (NIOSH) has assigned an IDLH value of 100 ppm. This value represents a concentration which would allow escape without loss of life or immediate irreversible effects with an exposure of 30 minutes.

To assess the effects of acute inhalation of toxic substances, "probit functions" describe the mathematical relationship between the concentration of a substance, the duration of exposure and the impact on the exposed population. Probit functions have been produced for 46 substances by the Dutch National Institute for Public Health and the Environment. These were originally based on using LC50 as the Point of Departure[i]. A more rigorous method is now in place for the revision of probit functions but this requires high quality inhalation toxicological data. NMA is not included in the Dutch list of toxic substances for which there is a probit. There is a paucity of high quality inhalation toxicity data for n-methylaniline.

For the purposes of the QRA, probit functions were derived using one tenth of the IDLH value for fatality (10 ppm, 30 minutes) and the PAC-1 (Protective Action Criterion Level 1) value for mild, transient effects (0.5 ppm for 30 minutes). The use of one tenth of the IDLH value is probably very conservative, as generally, the IDLH was previously taken as one tenth of the LC50 value, which was the normal Point of Departure used for constructing the probit function. The use of the PEL-1 value is also probably conservative, as this is the same as the maximum concentration to which workers may be exposed for forty hours per week, according to Australian and international criteria. Use of a concentration exponent of 1.0 is also a conservative assumption for concentrations below the Point of Departure.

The probit functions are (expressed in concentration units of kg/m3 and time units of seconds):

Lethality:

$$Pr = 7.52 + \ln (C1 \times t)$$

Mild, transient effects:

$$Pr = 10.507 + \ln (C1 \times t)$$

Figure 8 Individual Fatality Contours (Toxic Inhalation, NMA)

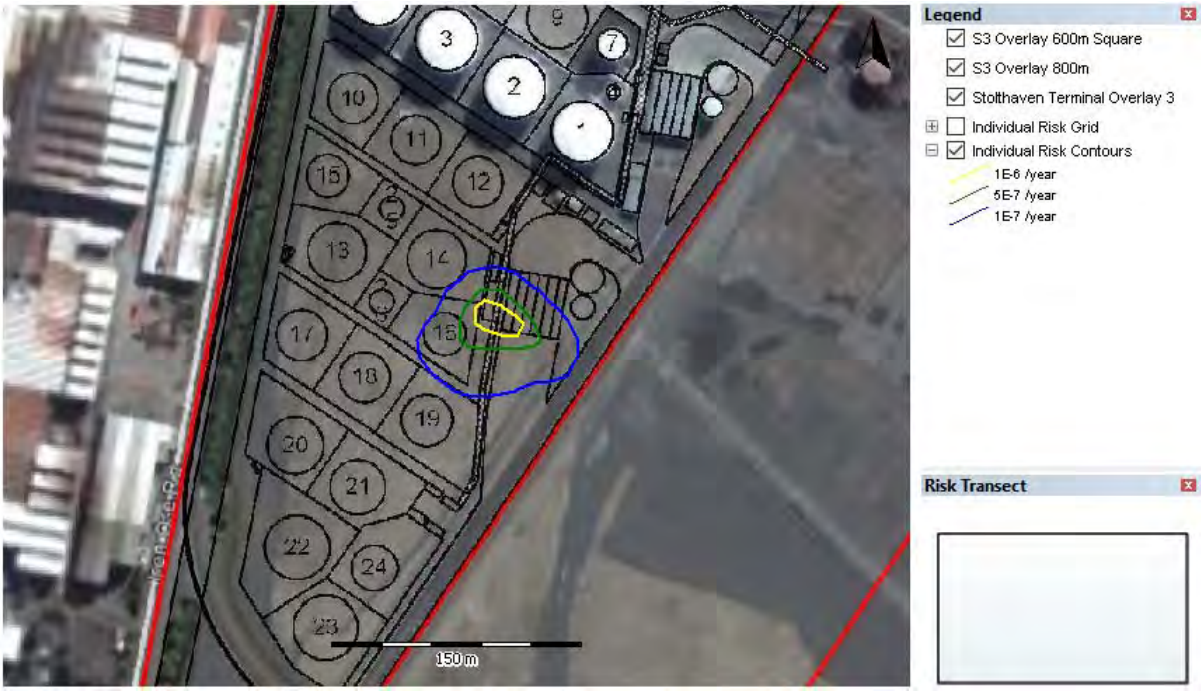

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Figure 9 Individual Injury Contours (Toxic Inhalation, Mild Transient Effects)

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Inspection of Figure 8 shows that the Individual Fatality Risk at a level of 1 x 10^{-7} pa is contained within the terminal site boundaries. Inspection of Figure 9 shows that the exposure equivalent to 30 minutes at the TWA level for personnel on the OneSteel site will be less than one in a million per year. The is negligible impact to residential and other sensitive land use areas.

c. Loss of both primary and secondary containment is modelled in the PBTs. Table 4 shows the predicted frequency of loss of secondary containment at the wharf.

Table 4 Probability of Wharf Loss of Containment to the Environment

Product	"Average" Facility	Facility with Advanced Controls
Petrol	5×10^{-6}	4×10^{-7}
Diesel	3×10^{-6}	3×10^{-7}
Jet Fuel	3×10^{-5}	5×10^{-7}
Ethanol	4×10^{-5}	5×10^{-7}

A number of control measures are included in the terminal design to minimise loss of containment to the environment at the wharf, including the use of modern loading arms for petrol and diesel products; provision of a large spill containment volume at the wharf operational area; procedural controls including securing the ship's scuppers, constant operator attendance and monitoring at the wharf with continuous communication to the ship's officer and control room, and established shut-down procedures.

The maximum anticipated loss of primary containment is approximately 50 tonnes of petrol or diesel, and 12 tonnes of either ethanol or jet fuel, which are discharged at lower rates. The quantity lost to the environment will depend on the exact nature and location of the release. The vulnerable area is the space between the ship and the berth. Actual loss to the marine environment is likely to be less than 10% of the primary loss of containment quantity.

We categorise the impact according to HIPAP 4 Table 3, Table of Environmental Consequences as Moderate: *Temporary alteration or disturbance beyond natural viability. Effects confined<5000 m2, not accumulating or impairment. Loss of resources but sustainability unaffected. Recovery temporarily affected. Recovery < 5 years*.

The environmental risk criteria suggested in HIPAP 4 are:

- *Industrial developments should not be sited in proximity to sensitive natural environmental areas where the effects (consequences) of the more likely accidental emissions may threaten the long-term viability of the ecosystem or any species within it.*
- *Industrial developments should not be sited in proximity to sensitive natural environmental areas where the likelihood (probability) of impacts that may threaten the long-term viability of the ecosystem or any species within it is not substantially lower than the background level of threat to the ecosystem.*

The port development essentially replaces previous heavy industrial development with a diverse range of cargo handling infrastructure within the context of the Mayfield Concept Plan. The Stolthaven development satisfies the HIPAP 4 criteria in that the development is not sited in proximity to sensitive natural environmental areas where the effects of accidental emissions would threaten the long-term viability of the eco-system or species within it and that the probability of impacts is low.

d. Analysis points have been reviewed as part of the standard output from RiskCurves®. Risk contributors for a typical analysis point (the Railway Line opposite OneSteel's main gate in Iron Ore Road) are shown as an attachment to this response. The total individual fatality risk at this point is 1.0×10^{-5} per year. The primary contributors are loss of containment scenarios associated with bund and compound spills on the western boundary of the site. The risk contributions provided with the analysis point are confirmatory of major risk contributors identified during HAZID/HAZOP risk identification, consequence analysis, initial risk assessments and the development of PBTs. Control measures have been developed progressively; in this instance, advanced control measures (including those suggested by the Buncefield recommendations) have been included in the terminal design.

5. Other

a. The total imported quantity of petrol for the Stolthaven Terminal at Stage 3 is 875,400 tpa. The Mayfield 7 Wharf is designed to accommodate additional discharge for the putative terminal (to be owned by others) to the east of the Stolthaven site. Additional infrastructure will not be built on the wharf topsides for Stage 3, but the potential additional throughput has been included in the risk analysis (with an estimate of 576,000 tpa being assumed at this stage as there are no definitive proposals in place with the PON).

b. Addressing Buncefield Requirements

The table has been completed below with Stolthaven Comments and is included in the updated PHA.

Table 5 Recommendations from the MIIB Design and operation report

MIIB Recommendation		PSLG Report Reference	Stolthaven Comments
Systematic assessment of safety integrity level requirements			
1.	The Competent Authority and operators of Buncefield-type sites should develop and agree a common methodology to determine safety integrity level (SIL) requirements for overfill prevention systems in line with the principles set out in Part 3 of BS EN 61511. This methodology should take account of: (a) the existence of nearby sensitive resources or populations; (b) the nature and intensity of depot operations; (c) realistic reliability expectations for tank gauging systems; and (d) the extent/rigour of operator monitoring. Application of the methodology should be clearly demonstrated in the COMAH safety report submitted to the Competent Authority for each applicable site. Existing safety reports will need to be reviewed to ensure this methodology is adopted.	Part 1, paragraphs 29–33 Overfill protection systems for storage tanks, paragraphs 34–38 Application of LOPA or similar techniques to the overflow of an atmospheric tank, paragraphs 39–40 Incorporating the findings of SIL assessments into COMAH safety reports, paragraph 41 Operator responsibilities and human factors, paragraphs 42-43	Stolthaven has used Probability Bow-Ties as described in the PHA. These represent complex chains of events and quantitatively reflect the risk reduction contributions of preventative and mitigate control measures. PBTs reflect the same considerations as LOPA in determining whether control measures are independent. These techniques have been applied to the overflow of atmospheric tanks. SIL and SFARP Studies will be completed for the final design of the terminal development as part of Stolthaven's Safety Case. The SIL methodology will be detailed in the Safety Case for the facility. The following points are emphasised in relation to the Stolthaven terminal compared with Buncefield: • Transfers are from a marine tanker (not pipeline) under the total control of the terminal; • Established protocols following ISGOTT are used in pre-discharge planning and management of ship discharge; • Discharges are continuously monitored in the control room; • Continuous communications are maintained with the ship; loss of communication will result in stopping the discharge as agreed in the ship/shore plan.

	MIIB Recommendation	PSLG Report Reference	Stolthaven Comments
Protecting against loss of primary containment using high integrity systems			
2.	Operators of Buncefield-type sites should, as a priority, review and amend as necessary their management systems for maintenance of equipment and systems to ensure their continuing integrity in operation. This should include, but not be limited to reviews of the following: (a) the arrangements and procedures for periodic proof testing of storage tank overfill prevention systems to minimise the likelihood of any failure that could result in loss of containment; any revisions identified pursuant to this review should be put into immediate effect; (b) the procedures for implementing changes to equipment and systems to ensure any such changes do not impair the effectiveness of equipment and systems in preventing loss of containment or in providing emergency response.	Part 2, paragraphs 44–46 Management of instrumented systems for fuel storage tank installations, paragraphs 47–68 Probabilistic preventative maintenance for atmospheric bulk storage tanks, paragraph 69	The normal level gauging instrumentation is checked for accuracy against physical tank dips for each discharge. All instrumentation has hand-shake fault detection. The independent level alarm (LSHH) and automatic tank valve closure safety instrumented function (SIF) will be tested regularly with a full physical test of each element as required by the final SIL life cycle management requirements. This testing will include level sensing element (removed and tested in liquid), the logic solver and the final element (tank inlet automated valve). Stolthaven has a Management of Change protocol which is part of the SMS. This will be detailed in the Safety Case to demonstrate how changes to systems are handled to ensure the ongoing integrity and effectiveness of equipment and systems to prevent loss of containment and in providing emergency response.

3.	Operators of Buncefield-type sites should protect against loss of containment of petrol and other highly flammable liquids by fitting a high integrity, automatic operating overfill prevention system (or a number of such systems, as appropriate) that is physically and electrically separate and independent from the tank gauging system. Such systems should meet the requirements of Part 1 of BS EN 61511 for the required safety integrity level, as determined by the agreed methodology (see Recommendation 1). Where independent automatic overfill prevention systems are already provided, their efficacy and reliability should be reappraised in line with the principles of Part 1 of BS EN 61511 and for the required safety integrity level, as determined by the agreed methodology (see Recommendation 1).	Automatic overfill protection systems for bulk gasoline storage tanks, paragraphs 70–72 Overfill protection standards, paragraphs 73–78 Tank overfill protection, paragraphs 79–103 Fire-safe shut-off valves, paragraphs 104–114 Remotely operated shut-off valves (ROSOVs) paragraphs 106–109	Independent, high integrity, automatic operating overfill protection systems will be fitted to all flammable tanks for the Stolthaven Terminal. These will be in appraised in accordance with IEC 61508 The overfill protection SIS will be at least SIL1 with the actual SIL determined during SIL/SFARP studies. Tank isolation valves will be fire-safe. Both tank inlet and outlet remote operated valves will be operable remotely from the control room. ROVs will also be fire-safe. Activation of the emergency shutdown system (ESD) results in closure of all ROVs all product pumps are stopped. Operation of a manual fire point will activate the ESD.

MIIB Recommendation		PSLG Report Reference	Stolthaven Comments
4.	The overfill prevention system (comprising means of level detection, logic/control equipment and independent means of flow control) should be engineered, operated and maintained to achieve and maintain an appropriate level of safety integrity in accordance with the requirements of the recognised industry standard for ‘SIS’, Part 1 of BS EN 61511.	Automatic overfill protection systems for bulk gasoline storage tanks, paragraphs 70–73 Overfill protection standards, paragraphs 73–78 Tank overfill protection, paragraphs 79–103 Fire-safe shut-off valves, paragraphs 104–114	Independent, high integrity, automatic operating overfill protection systems will be fitted to all flammable tanks for the Stolthaven Terminal. These will be appraised in accordance with IEC 61508 The overfill protection SIS will be at least SIL1 with the actual SIL determined during SIL/SFARP studies. Tank isolation valves will be fire-safe. Both tank inlet and outlet remote operated valves will be operable remotely from the control room. ROVs will also be fire-safe. Activation of the emergency shutdown system (ESD) results in closure of all ROVs all product pumps are stopped. Operation of a manual fire point will activate the ESD.
5.	All elements of an overfill prevention system should be proof tested in accordance with the validated arrangements and procedures sufficiently frequently to ensure the specified safety integrity level is maintained in practice in accordance with the requirements of Part 1 of BS EN 61511.	Automatic overfill protection systems for bulk gasoline storage tanks, paragraphs 70–72 Overfill protection standards, paragraphs 73–78 Tank overfill protection, paragraphs 79–103 Fire-safe shut-off valves, paragraphs 104–114	The inspection and testing regime will conform to IEC 61508 and will be documented in the Safety Case.

MIIB Recommendation		PSLG Report Reference	Stolthaven Comments
6.	The sector should put in place arrangements to ensure the receiving site (as opposed to the transmitting location) has ultimate control of tank filling. The receiving site should be able to safely terminate or divert a transfer (to prevent loss of containment or other dangerous conditions) without depending on the actions of a remote third party, or on the availability of communications to a remote location. These arrangements will need to consider upstream implications for the pipeline network, other facilities on the system and refineries.	Improving safety of fuel transfers, paragraph 115	The terminal will receive parcels of fuel to its Storage tanks from marine tankers. There is no pipeline transfer to Stolthaven Newcastle. The following points are emphasised in relation to the Stolthaven terminal compared with Buncefield: • Transfers are from a marine tanker (not pipeline) under the total control of the terminal; • Established protocols following ISGOTT are used in pre-discharge planning and management of ship discharge; • Discharges are continuously monitored in the control room; • Continuous communications are maintained with the ship; loss of communication will result in stopping the discharge as agreed in the ship/shore plan.
7.	In conjunction with Recommendation 6, the sector and the Competent Authority should undertake a review of the adequacy of existing safety arrangements, including communications, employed by those responsible for pipeline transfers of fuel. This work should be aligned with implementing Recommendations 19 and 20 on high reliability organisations to ensure major hazard risk controls address the management of critical organisational interfaces.	Improving safety of fuel transfers, paragraph 115	The terminal will receive parcels of fuel to its storage tanks from marine tankers. There is no pipeline transfer to Stolthaven Newcastle. Stolthaven rigorously adopts international regulations ISGOTT) for the management of marine discharges. Stolthaven would be pleased to work with the Competent Authority on any initiative with the sector.

	MIIB Recommendation	PSLG Report Reference	Stolthaven Comments
8.	The sector, including its supply chain of equipment manufacturers and suppliers, should review and report without delay on the scope to develop improved components and systems, including but not limited to the following: (a) Alternative means of ultimate high level detection for overfill prevention that do not rely on components internal to the storage tank, with the emphasis on ease of inspection, testing, reliability and maintenance. (b) Increased dependability of tank level gauging systems through improved validation of measurements and trends, allowing warning of faults and through using modern sensors with increased diagnostic capability. (c) Systems to control and log override actions.	Improved level instrumentation components and systems, paragraph 116 Overflow detection, paragraphs 117–121	The tank level gauging system will incorporate a non-contact radar system. A fixed tuning-fork system will be installed for the independent high-high alarm and shutdown system. Both systems have been employed elsewhere at Stolthaven terminals with high reliability. These systems have hand-shake fault detection systems. We question the requirement for components "that do not rely on components internal to the tank". All reliable level gauging or level switches have components within the tank. Levels of access to the control system software will be determined and detailed in the Safety Case. In principle, the LSHH position and LAH set point on the level gauging system are set on commissioning and are unchangeable without Management of Change procedures and high level access. The operator has available an additional level alarm on the tank gauging system which can be set for any discharge.

MIIB Recommendation		PSLG Report Reference	Stolthaven Comments
9.	Operators of Buncefield-type sites should introduce arrangements for the systematic maintenance of records to allow a review of all product movements together with the operation of the overfill prevention systems and any associated facilities. The arrangements should be fit for their design purpose and include, but not be limited to, the following factors: (a) The records should be in a form that is readily accessible by third parties without the need for specialist assistance. (b) The records should be available both on site and at a different location. (c) The records should be available to allow periodic review of the effectiveness of control measures by the operator and the Competent Authority, as well as for root cause analysis should there be an incident. (d) A minimum period of retention of one year.	Maintenance of records, paragraphs 122–123	Records are meticulously maintained for all product movements. These are available to the regulatory authority.
10.	The sector should agree with the Competent Authority on a system of leading and lagging performance indicators for process safety performance. This system should be in line with HSE's recently published guidance on *Developing process safety indicators* HSG254.	Process safety performance indicators, paragraphs 124– 125	This requirement relates to the UK terminalling industry and UK Competent Authority. Stolthaven has a process for operational performance monitoring. This process includes maintenance of mechanical integrity, action items follow up (Vault), management of change, process safety training/ competency and safety culture, which are all appropriate to monitoring the practical effectiveness of all control measures.

	MIIB Recommendation	PSLG Report Reference	Stolthaven Comments
Engineering against escalation of loss of primary containment			
11.	Operators of Buncefield-type sites should review the classification of places within COMAH sites where explosive atmospheres may occur and their selection of equipment and protective systems (as required by the Dangerous Substances and Explosive Atmospheres Regulations 2002). This review should take into account the likelihood of undetected loss of containment and the possible extent of an explosive atmosphere following such an undetected loss of containment. Operators in the wider fuel and chemicals industries should also consider such a review, to take account of events at Buncefield.	Part 3, paragraph 126 Review of area classifications, paragraph 127	The detailed design of the terminal will incorporate a full hazardous area classification based on all potential sources of release (AS/NZS 60079.10.1:2009). The hazardous area classification will govern the positions of key infrastructure and the rating of electrical equipment and wiring. Procedural and engineering preventative control measures are incorporated into the design, operation and maintenance of the terminal to reduce the possibility of loss of containment. Gas detectors will be provided in each compound to immediately detect loss of containment and remote-operated foam pourers are to be provided to blanket liquid spills and prevent the generation of flammable vapour clouds.
12.	Following on from Recommendation 11, operators of Buncefield-type sites should evaluate the siting and/or suitable protection of emergency response facilities such as firefighting pumps, lagoons or manual emergency switches.	Siting and protection of emergency response facilities, paragraph 128	The fire system comprises two geographically separated sets of fire water tanks and pumps which will provide a measure of redundancy. Details of the siting and protection of the emergency response facilities will be detailed in the Fire Safety Study.

	MIIB Recommendation	PSLG Report Reference	Stolthaven Comments
13.	Operators of Buncefield-type sites should employ measures to detect hazardous conditions arising from loss of primary containment, including the presence of high levels of flammable vapours in secondary containment. Operators should without delay undertake an evaluation to identify suitable and appropriate measures. This evaluation should include, but not be limited to, consideration of the following: (a) Installing flammable gas detection in bunds containing vessels or tanks into which large quantities of highly flammable liquids or vapour may be released. (b) The relationship between the gas detection system and the overfill prevention system detecting high levels of vapour in secondary containment is an early indication of loss of containment and so should initiate action, for example through the overfill prevention system, to limit the extent of any further loss. (c) Installing CCTV equipment to assist operators with early detection of abnormal conditions. Operators cannot routinely monitor large numbers of passive screens, but equipment is available that detects and responds to changes in conditions and alerts operators to these changes.	Detection of hazardous conditions, paragraph 129	During tank filling operations, the terminal control room is continuously manned with a supervisor being responsible for communications with other terminal personnel and the ship's officer. Flammable gas detectors are provided in each sub-compound at the compound sump as well as in the pump bays. These will provide an alarm in the control room. High quality CCTV coverage (plus communication with the line-walker in the terminal during marine discharge operations) will provide the control room operator information with which to evaluate any response. Foam pourers are provided to each compound so that any loss of containment can be dealt with to avoid the formation of a flammable vapour cloud and escalation.

	MIIB Recommendation	PSLG Report Reference	Stolthaven Comments
14.	Operators of **new** Buncefield-type sites or those making major modifications to existing sites (such as installing a new storage tank) should introduce further measures including, but not limited to, preventing the formation of flammable vapour in the event of tank overflow. Consideration should be given to modifications of tank top design and to the safe re-routing of overflowing liquids.	Prevention of the formation of flammable vapour clouds for new or substantially modified sites, paragraphs 130–135	Flammable gas detectors are provided in each sub-compound at the compound sump as well as in the pump bays. These will provide an alarm in the control room. High quality CCTV coverage (plus communication with the line-walker in the terminal during marine discharge operations) will provide the control room operator information with which to evaluate any response. Foam pourers are provided to each compound so that any loss of containment can be dealt with to avoid the formation of a flammable vapour cloud and escalation. Other feasible measures will be considered as part of the SFARP Studies to ensure that risks are reduced so far as is reasonably practicable.
15.	The sector should begin to develop guidance without delay to incorporate the latest knowledge on preventing loss of primary containment and on inhibiting escalation if loss occurs. This is likely to require the sector to collaborate with the professional institutions and trade associations.	Preventing loss of primary containment, paragraphs 136–138 Internal/out-of-service inspections, paragraphs 139– 146 External/in-service inspections, paragraphs 147– 149 Deferring internal examinations, paragraphs 150– 151 Competency, paragraphs 152–154 Remedial work, paragraphs 155-159	Where there is an opportunity to participate in sector or regulatory initiatives, Stolthaven are keen to participate.
16.	Operators of **existing** sites, if their risk assessments show it is not practicable to introduce measures to the same extent as for new ones, should introduce measures as close to those recommended by Recommendation 14 as is reasonably practicable. The outcomes of the assessment should be incorporated into the safety report submitted to the Competent Authority.	Prevention of the formation of flammable vapour clouds for existing sites, paragraphs 160–165	The Stolthaven site is a new Major Hazard Facility.

Engineering against loss of secondary and tertiary containment			
17.	The Competent Authority and the sector should jointly review existing standards for secondary and tertiary containment with a view to the Competent Authority producing revised guidance by the end of 2007. The review should include, but not be limited to the following: (a) Developing a minimum level of performance specification of secondary containment (typically this will be bunding). (b) Developing suitable means for assessing risk so as to prioritise the programme of engineering work in response to the new specification. (c) Formally specifying standards to be achieved so that they may be insisted upon in the event of lack of progress with improvements. (d) Improving firewater management and the installed capability to transfer contaminated liquids to a place where they present no environmental risk in the event of loss of secondary containment and fires. (e) Providing greater assurance of tertiary containment measures to prevent escape of liquids from site and threatening a major accident to the environment.	Part 4, paragraph 166–169 Bund lining systems, paragraphs 170–185 Pipe penetrations, paragraphs 186–208 Bund wall expansion and construction joints, paragraphs 209–217 Secondary containment systems under tanks, paragraphs 218–220 Basis for bund capacity based on tank capacity, paragraphs 221–232 Firewater management and control measures, paragraph 233 Tertiary containment, paragraphs 234–250	The design of bunds and bund penetrations are in accordance with the recommendations of the *UK HSE Safety and Environmental Standards for Fuel Storage Sites (Process Safety Leadership Group) Part 4.* Gravity drainage from the bunds has been replaced with a sump pump-out system with over-the-wall piping. Activation of the ESD will automatically stop any bund pumps that are being used to remove rainwater should a primary loss of containment occur. The infrastructure is available to provide for transfer of fire water. Stolthaven's design efforts have been focussed on primary and secondary containment as high integrity infrastructure. We will continuously monitor industry guidelines and practices and adopt those where reasonably practicable to do so.

18.	Revised standards should be applied in full to new build sites and to new partial installations. On existing sites, it may not be practicable to fully upgrade bunding and site drainage. Where this is so operators should develop and agree with the Competent Authority risk based plans for phased upgrading as close to new plant standards as is reasonably practicable.	Bund lining systems, paragraphs 170–185 Pipe penetrations, paragraphs 186–208 Bund wall expansion and construction joints, paragraphs 209–217 Secondary containment systems under tanks, paragraphs 218–220 Basis for bund capacity based on tank capacity, paragraphs 221–232 Firewater management and control measures, paragraph 233 Tertiary containment, paragraphs 234–250	See comments under Recommendation 17 above.

Operating with high reliability organisations			
19.	The sector should work with the Competent Authority to prepare guidance and/or standards on how to achieve a high reliability industry through placing emphasis on the assurance of human and organisational factors in design, operation, maintenance, and testing. Of particular importance are: (a) understanding and defining the role and responsibilities of the control room operators (including in automated systems) in ensuring safe transfer processes; (b) providing suitable information and system interfaces for front line staff to enable them to reliably detect, diagnose and respond to potential incidents; (c) training, experience and competence assurance of staff for safety critical and environmental protection activities; (d) defining appropriate workload, staffing levels and working conditions for front line personnel; (e) ensuring robust communications management within and between sites and contractors and with operators of distribution systems and transmitting sites (such as refineries); (f) prequalification auditing and operational monitoring of contractors' capabilities to supply, support and maintain high integrity equipment;	Part 5, paragraphs 251–258	Where there is an opportunity to participate in sector or regulatory initiatives to prepare guidance and/or standards, Stolthaven are keen to participate and to implement such standards and/or guidelines so far as is reasonably practicable

	(g) providing effective standardised procedures for key activities in maintenance, testing, and operations; (h) clarifying arrangements for monitoring and supervision of control room staff; and (i) effectively managing changes that impact on people, processes and equipment.		
20.	The sector should ensure that the resulting guidance and/or standards is/are implemented fully throughout the sector, including where necessary with the refining and distribution sectors. The Competent Authority should check that this is done.	Part 5, paragraphs 251–258	See comments re Recommendation 19 above.
21.	The sector should put in place arrangements to ensure that good practice in these areas, incorporating experience from other high hazard sectors, is shared openly between organisations.	Part 5, paragraphs 251–258	See comments re Recommendation 19 above.
22.	The Competent Authority should ensure that safety reports submitted under the COMAH Regulations contain information to demonstrate that good practice in human and organisational design, operation, maintenance and testing is implemented as rigorously as for control and environmental protection engineering systems.	Part 5, paragraphs 251–258	This is a recommendation to the Competent Authority.
Delivering high performance through culture and leadership			
23.	The sector should set up arrangements to collate incident data on high potential incidents including overfilling, equipment failure, spills and alarm system defects, evaluate trends, and communicate information on risks, their related solutions and control measures to the industry.	Part 6, paragraphs 259–265	Stolthaven is willing to share incident data and high potential incidents with the sector and to participate in analysis, the development of incident databases and collaboration with the workforce, its representatives, dutyholders and regulators to ensure that lessons are learned and best practice solutions are shared.

24.	The arrangements set up to meet Recommendation 24 should include, but not be limited to, the following: (a) Thorough investigation of root causes of failures and malfunctions of safety and environmental protection critical elements during testing or maintenance, or in service. (b) Developing incident databases that can be shared across the entire sector, subject to data protection and other legal requirements. Examples exist of effective voluntary systems that could provide suitable models. (c) Collaboration between the workforce and its representatives, dutyholders and regulators to ensure lessons are learned from incidents, and best practices are shared.	Part 6, paragraphs 259–265	See comment re Recommendation 23 above.
25.	In particular, the sector should draw together current knowledge of major hazard events, failure histories of safety and environmental protection critical elements, and developments in new knowledge and innovation to continuously improve the control of risks. This should take advantage of the experience of other high hazard sectors such as chemical processing, offshore oil and gas operations, nuclear processing and railways.	Part 6, paragraphs 259–265	See comment re Recommendation 23 above.

Photographs of Petrol Fire Smoke Plumes

Santos Brazil

COPECO

Ultracargo Santos near Sao Paulo 2015

National Oil Corporation Tripoli, Libya

Fuel Tank Fire Kansas City, Kansas (unleaded gasoline

Ultracargo Santos near Sao Paulo 2015

San Juan (COPECO) 2009

IOC Storage Tank Fire Gujarat, India 2013

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[i] Method for derivation of probit functions for acute inhalation toxicity RIVM Report 2015-0102

Analysis Point: Railway Line opposite OneSteel Main Gate Iron Ore Rd

Total Individual Risk at analysis point (X=1.68932E7,Y= -3.88079E6) is: 9.44E-06 /yr

Individual Risk Ranking

	Scenario	Contribution [%]	Value
1.	Liquid LOC scenario Leak VCE/Flash Fire (G3) (06.25 Petrol South Bund Buncefield)	92.7	8.75E-06
2.	Liquid LOC scenario Leak VCE/Flash Fire (G3) (06.11 Petrol Mld Bund Pool Spill Inst (L))	3.86	3.64E-07
3.	Liquid LOC scenario Leak VCE/Flash Fire (G3) (06.12 Associated Petrol S Bund Pool Spill)	2.42	2.29E-07
4.	Liquid LOC scenario Leak VCE/Flash Fire (G3) (06.08 Associated Petrol Mld Bund Pool Spill (L))	0.533	5.04E-08
5.	Liquid LOC scenario Leak VCE/Flash Fire (G3) (06.09 Associated Petrol S Bund Pool Spill)	0.336	3.17E-08
6.	Liquid LOC scenario Leak (G3) (06.46 Petrol ND17 Compound Spill (M))	0.163	1.54E-08
7.	Liquid LOC scenario Leak (G3) (06.20 Petrol ND17 Grad Compound Spill (L))	0.018	1.70E-09
8.	Liquid LOC scenario Leak (G3) (06.36 Petrol ND17 Assoc Compound Spill (M))	0.000362	3.42E-11
9.	Liquid LOC scenario Leak Pool Fire (G3) (06.09 Associated Petrol S Bund Pool Spill)	0	0.00E+00
10.	Pool fire (18.01 Diesel Fire RTFS ((N))	0	0.00E+00
11.	Pool fire (13.03 NN3 Tank Top Diesel)	0	0.00E+00
12.	Pool fire (10.04 ND13 Tank Top Petrol)	0	0.00E+00
13.	Liquid LOC scenario Leak (G3) (06.42 Petrol ND13 Compound Spill (M))	0	0.00E+00
14.	Pool fire (10.11 Petrol N Bund Fire)	0	0.00E+00
15.	Liquid LOC scenario Leak (G3) (06.06 Petrol Bund S Breach Grad (L))	0	0.00E+00
16.	Liquid LOC scenario Leak Pool Fire (G3) (06.12 Associated Petrol S Bund Pool Spill)	0	0.00E+00
17.	Gas LOC scenario Release in 10 min (G2) (14.03 Vapour Release RTFS)	0	0.00E+00
18.	Liquid LOC scenario Leak (G3) (08.03 Ethanol Compound Gradual Spill (M))	0	0.00E+00
19.	Pool fire (13.05 NN6 Tank Top Diesel)	0	0.00E+00
20.	Liquid LOC scenario Leak (G3) (22.05 Slops & Additives Bund: Minor Petrol Spill)	0	0.00E+00
21.	Liquid LOC scenario Leak (G3) (07.03 Ethanol Associated MultiCompound Spill (L))	0	0.00E+00
22.	Pool fire (13.11 NN23 Tank Top Diesel)	0	0.00E+00
23.	Pool fire (10.07 ND16 Tank Top Petrol)	0	0.00E+00
24.	Gas LOC scenario Release in 10 min (G2) (04.02 (2) Diesel Jet Fire Wharf)	0	0.00E+00
25.	Pool fire (13.13 Total Bund Fire Diesel Lot 37)	0	0.00E+00
26.	Liquid LOC scenario Leak (G3) (06.47 Petrol ND18 Compound Spill (M))	0	0.00E+00
27.	Liquid LOC scenario Leak (G3) (22.04 Slops & Additives Bund: Small Additive Spill (Flam)	0	0.00E+00
28.	Liquid LOC scenario Leak (G3) (06.33 Petrol ND14 Assoc Compound Spill (M))	0	0.00E+00
29.	Liquid LOC scenario Leak (G3) (4.02 Diesel Pipeline 1)	0	0.00E+00
30.	Liquid LOC scenario Leak (G3) (06.14 Petrol ND11 Grad Compound Spill (L))	0	0.00E+00
31.	Pool fire (13.01 NN Tank Top Diesel)	0	0.00E+00
32.	Liquid LOC scenario Leak (G3) (5.02 Hot Oil piping (1))	0	0.00E+00
33.	Gas LOC scenario Release in 10 min (G2) (01.02 (3) Petrol Jet Fire Wharf)	0	0.00E+00
34.	Liquid LOC scenario Leak (G3) (08.01 Ethanol Uncontained Gradual Spill (M))	0	0.00E+00
35.	Pool fire (10.08 ND17 Tank Top Petrol)	0	0.00E+00
36.	Pool fire (14.01 RTFS (S) Petrol Fire (RTFS))	0	0.00E+00
37.	Liquid LOC scenario Leak (G3) (02.01 Wharf Ethanol Spill & Ignition)	0	0.00E+00
38.	Liquid LOC scenario Leak (G3) (06.27 Petrol Mid Bund Breach)	0	0.00E+00
39.	Liquid LOC scenario Leak (G3) (21.03 Pump Bay 1 Petrol Spill)	0	0.00E+00
40.	Liquid LOC scenario Leak (G3) (21.05 Pump Bay 3 Petrol Spill)	0	0.00E+00
41.	Gas LOC scenario Release in 10 min (G2) (01.02 (1) Petrol Jet Fire Wharf)	0	0.00E+00
42.	Pool fire (10.05 ND14 Tank Top Petrol)	0	0.00E+00
43.	Liquid LOC scenario Leak (G3) (06.05 Petrol Bund Mid Breach Grad (L))	0	0.00E+00
44.	Pool fire (11.02 MultiCompound Ethanol Pool Fire)	0	0.00E+00
45.	Pool fire (11.01 ND25 Tank Top Ethanol)	0	0.00E+00
46.	Liquid LOC scenario Leak (G3) (07.05 Ethanol Compound Gradual Spill (L))	0	0.00E+00
47.	Liquid LOC scenario Leak (G3) (06.39 Petrol ND10 Assoc Compound Spill (M))	0	0.00E+00
48.	Gas LOC scenario Release in 10 min (G2) (17.03 Jet Fire RTFS (N))	0	0.00E+00
49.	Liquid LOC scenario Leak (G3) (22.06 Slops & Additives Bund: Small Petrol Spill)	0	0.00E+00
50.	Pool fire (12.01 ND26 Tank Top Jet Fuel)	0	0.00E+00
51.	Liquid LOC scenario Leak (G3) (04.01 Wharf Diesel Spill Ignition)	0	0.00E+00
52.	Pool fire (13.02 NN2 Tank Top Diesel)	0	0.00E+00
53.	Pool fire (18.02 Diesel Fire RTFS ((N) (RIB))	0	0.00E+00
54.	Gas LOC scenario Release in 10 min (G2) (19.02 Vapour Release RTFS (N))	0	0.00E+00
55.	Liquid LOC scenario Leak (G3) (06.19 Petrol ND16 Grad Compound Spill (L))	0	0.00E+00
56.	Liquid LOC scenario Leak (G3) (3.03 Jet Fuel Pipeline)	0	0.00E+00