City Pacific Limited

Townsville Ocean Terminal Explosive Overpressure at Townsville Port

Situational Analysis and Recommendations

Wednesday, 30 July 2008

Report no: AA001185-HRA04-080730

Hyder Consulting

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1 Introduction

The Environmental Impact Statement (EIS) for the Townsville Ocean Terminal (TOT) was submitted for public review from 1 December 2007 to 1 February 2008. Submissions on the EIS were received by the Coordinator General and were provided to the proponent to prepare a Supplementary EIS in response to issues raised in these submissions.

The consequences of overpressures resulting from an explosion at the Townsville Port were raised as an issue by several submissions on the EIS, including the submission from the Port Users Group.

Hyder Consulting has been engaged by the proponent to consider the current situation at Townsville Port and the potential adjustments required to accommodate the proposed Townsville Ocean Terminal development. Lloyd's Register has prepared a background report providing advice on the current Department of Mines and Energy (DME) guidelines and potential changes to berth limits.

The port explosives limits at Townsville Port have been recently reviewed by the Chief Inspector of Explosives and recommendations made in a letter from Queensland Government, Department of Mines and Energy to Port of Townsville dated 10 September 2007. Proposed port limits are described in section 2.3 of this report.

Port explosives limits are subject to review at any time by the Chief Inspector of Explosives as described in Information Bulletin 50 (version 2) from the Explosives Directorate dated 17 September 2007;

"The Chief Inspector of Explosives may vary the approved explosives limits if reasonably satisfied they are no longer appropriate (Section 64 of the Explosives Regulation 2003)."

This report outlines the consequences of explosive overpressure at the Townsville Port on surrounding areas and existing uses given the current situation, and makes comment and recommendations in regard to the port explosives limit.

2 Background to Current Situation

2.1 Explosive Overpressure

Explosive overpressure is simply the pressure generated by an explosion that is over and above the normal atmospheric pressure caused by the creation of a shock or blast wave. This overpressure may result in injury to people or damage to building structures within the explosive radius.

'In the case of explosions there is a well-established relationship between the quantity of material and the explosion overpressure from which lethal effects can be estimated', '*Lee's Loss Prevention in the Process Industries'*, Third Edition, Dr. Sam Mannam, 18/65. These effects are summarised in the table below in relation to the overpressure value.

Explosive Overpressure	Possible Effect
3.5 kPa	▪ 90% glass breakage. ▪ No fatality and very low probability of injury.
7 kPa	▪ Damage to internal partitions and joinery can be repaired. ▪ Probability of injury is 10%. No fatality.
14 kPa	▪ House uninhabitable and badly cracked.
21 kPa	▪ Reinforced structures distort. ▪ 20% chance of fatality to a person in a building.
35 kPa	▪ 50% chance of fatality for a person in a building and 15% chance of fatality for a person in the open.
70 kPa	▪ Threshold for lung damage. ▪ 100% chance of fatality for a person in a building or in the open. ▪ Complete demolition of house.

In conjunction with this information, aerial photography with explosive radius' regarding Security Sensitive Ammonium Nitrate (SSAN) at a 400t Limit and Class 1 Explosives of the port was submitted in order to carry out the investigation.

2.2 Minimum Standards

Australian Standard AS3846 '*The handling and transport of dangerous cargoes in port areas*' provides the minimum standards and limits that must be met in order to ensure the health and safety of people or property are not endangered.

The relevant sections used for the investigation include:

- Section 4 'Dangerous Cargoes of Explosives of Class 1'.In particular Table 4.2 ' Separation Distances from Ordinary Berths to Protected Places'.
- Section 6 'Additional Requirements for Ammonium Nitrate and Calcium Hypochlorite'.

2.3 Current Port Limits in Townsville

Lloyd's Register summarises the current ordinary berth limits for Class 1 explosives and SSAN in the following table:

Ordinary Berth Limits

Berth No.	Ammonium Nitrate (te)			Explosives (te NEQ)		
	AN	Emulsions	Additional Transit AN	Class 1.1, 1.2, 1.5, 1.6	Class 1.3	Class 1.4
1	400	25	1000	100	250	358
2	400	25	1000	58	250	265
3	400	25	1000	17	92	250
4	400	25	1000	6	5.4	250
7	400	25	1000	11	13.2	250
8	400	25	1000	11	5.2	250
9	400*	25*	1000*	6*	19.8*	250*
10	400*	25*	1000*	2.2*	19.8*	250*
11	400	25	1000	240	250	680

* Ammonium Nitrate, Oxidising Liquids Class 5.1, Calcium Hypochlorite and Dangerous Goods classified as packaging group 1 exceeding 500kgs will only be permitted to be transported or handled on Berths 9 and 10 during periods of inactivity at the Townsville Breakwater and Convention Centre. (Port Notices, November 2006)

2.4 Berths 1, 2 and 11

It is understood that that berths 1, 2 and 11 are not intended or suitable for use for either SSAN or Class 1 explosives. The Chief Inspector of Explosives has commented;

> *It is acknowledged that berths 1, 2 and 11 may not be utilised and have been included for reference purposes only. However by their inclusion it does provide the port authority with some flexibility in relation to port operations.*

(Letter from Queensland Government, Department of Mines and Energy to Port of Townsville dated 10 September 2007, Annex B, Comments on Port of Townsville Explosive Limits and Risk Assessment, point 9.)

Berths 1, 2 and 11 are described in the following table:

Berth No.	Operation
1	A dedicated bulk liquids wharf used exclusively by tankers for bulk oil/fuel, gas, and sulphuric acid discharge and by all types of vessels for bunkering. The berth pocket length is 250 metres and is a multi-user wharf.
2	Used for unloading nickel ore, two gantry cranes can be equipped to unload ore from the vessel into hoppers and feed a conveyor system, which carries the ore to the load site. The berth is leased to Xstrata who have licensed its use to Queensland Nickel Pty Ltd. The berth pocket length is 281 metres.
11	Known as the Outer Berth Mineral Concentrates Loading Facility. Lead and zinc concentrates are placed onto a conveyor system by front-end loader and transported to the 1350 tonnes/hour ship loader. BHP World Minerals lease the berth from Townsville Port Authority, and own the shiploading equipment at this berth. The berth pocket length is 240 metres.

Source: Townsville Port Authority website, accessed 4Jun08

Given the specialised use described above and the recent comment from the Chief Inspector of Explosives, it is extremely unlikely that berths 1, 2 or 11 are intended to be utilised, or would be suitable for, SSAN or Class 1 explosives in the current context.

It is a reasonable assumption that berths 1, 2 and 11 should be excluded from analysis of explosive overpressure limits at Townville Port.

2.5 Berths 3-4 and 7-10

The balance of berths in the Port of Townsville are described as follows:

Berth No.	Operation
3	Leased to Xstrata, and is operated by Northern Shipping and Stevedoring Pty Ltd. Typical cargoes handled over this wharf include lead ingots, refined copper, nickel, and zinc. It is also a general purpose wharf used for containerised cargo, fertilizer imports, and live cattle exports (by rail). The berth pocket length is 283.5 metres.
4	A multi-purpose wharf with a landing pad, supported by steel piling to service stern angle ramp RORO vessels. The berth handles bulk cement, imported from Gladstone by Cement Australia. The molasses pipeline to this berth is capable of loading up to 400 tonnes per hour. Motor vehicles are also imported over this wharf. The berth pocket length is 220 metres.
7	Licensed to Xstrata and supports a bulk ship loader for mineral concentrates and ores at the rate of 1,000 tonnes per hour and fertiliser at 1,200 tonnes per hour. Mineral concentrates mined in north-west Queensland are exported over this wharf. Southern Cross Fertilisers also export fertiliser over this wharf under an agreement with Xstrata. The berth pocket length is 183 metres.
8	A multi-user wharf that services the export frozen beef trade with cargoes drawn from freezer stores adjacent to the port. It also serves as a general-purpose berth, with scrap metal and fertiliser handled over this wharf. This wharf is also equipped with bunker pipelines. The berth pocket length is 213 metres.
9	Licensed to Queensland Sugar and is the raw sugar-loading berth. A bulk ship loader delivers sugar to carries at the rate of 2,000 tonnes per hour. The berth is equipped with bulk molasses and bunker pipelines. Fertiliser is also discharged at this berth. Cruise ships also use this wharf from time to time. The berth pocket length is 248 metres.
10	A general purpose berth leased to Patrick Stevedoring and is primarily used for containerised trade, general cargo, and livestock. A stern RORO ramp is also available which enables vehicles to be loaded onto or off a vessel. Live cattle are exported over this wharf (by road). Mining materials are exported to Papua New Guinea and Indonesia. The wharf is also used by the Australian Defence Forces from time to time. The berth pocket length is 160 metres.

Source: Townsville Port Authority website, accessed 4Jun08.

2.6 Wharf Restrictions at Berths 9 and 10

Port of Townsville, Port Notices, November 2006 states:

> **6.5 AMMONIUM NITRATE, OXIDISING LIQUIDS CLASS 5.1, CALCIUM HYPOCHLORITE AND DANGEROUS GOODS CLASSIFIED AS PACKAGING GROUP 1 EXCEEDING 500KGS**
> Under no circumstances are the above products to be bought into the Port without first obtaining written approval from the Authority. Whenever possible, ships that are discharging or loading these products must discharge or load the above products first. If this is not possible, written permission must be obtained from the Regional Harbour Master, Townsville, and the Authority.
>
> Ammonium Nitrate, Oxidising Liquids Class 5.1, Calcium Hypochlorite and Dangerous Goods classified as packaging group 1 exceeding 500kgs will only be permitted to be transported or handled on Berths 9 and 10 during periods of inactivity at the Townsville Breakwater and Convention Centre.
>
> It is an offence to fail to comply with these requirements.
>
> Maximum Penalty – 100 Penalty Units.

Port of Townsville, Port Notices, November 2006, p.21.

There is no access in the public domain to a specific standard operating procedure to identify "periods of inactivity at the Townsville Breakwater and Convention Centre" and no record of communication, log or convention in place with Townsville Entertainment Centre (TEC) to ensure inactivity. The penalty for a breach is equivalent to unauthorised mooring within the Port, defined by the Penalties and Sentences Act as $7500.

2.7 Facilities with Exposure to Explosive Overpressure

A comparison of the Port of Townsville overpressure limits against the Port Facilities Map produces the following lists of facilities at risk.

Facilities within 35kpa overpressure limits

Explosive Overpressure	Possible Effect
35 kPa	▪ 50% chance of fatality for a person in a building and 15% chance of fatality for a person in the open.

- **Townsville Entertainment Centre (10 permanent staff, regular event population of up to 5000)**
- Port Control Tower
- Svitzer Tugs

- Queensland Sugar (Bulk Sugar Sheds 1&2)
- Xstrata
- Australian Molasses Trading
- Chemtrans
- Origin Energy
- NSS Container Terminal
- Cement Australia
- S. Colbourne
- Queensland Terminals
- Recreational Boat Users on Ross Creek
- Visitors to local businesses / Port tours

Facilities within 21kpa overpressure limits

Explosive Overpressure	Possible Effect
21 kPa	▪ Reinforced structures distort. ▪ 20% chance of fatality to a person in a building.

Facilities within 35kpa overpressure limits and:

- **Jupiters Casino (staff of 450, entertainment complex and 194 room hotel)**
- Perkins Shipping
- Shell Company of Australia (Tank Farm)
- Incitec Pivot
- TPA Engineering Building
- Uncontrolled public vehicle access within overpressure limit

Facilities within 14kpa overpressure limits

Explosive Overpressure	Possible Effect
14 kPa	▪ House uninhabitable and badly cracked.

Facilities within 35kpa and 21kpa overpressure limits and:

- TPA Administration Building
- Northern Port Services
- Regional Harbour Master, Townsville
- Maritime Safety Queensland

3 Critical Issues

The following critical issues have been identified:

Ambiguity in the Australian Standard re: Transit Loads of SSAN

The Lloyd's Register report, *Supplementary Advice on Ammonium Nitrate and Class 1 Explosives in Townsville Port, 4 June 2008* has examined the in the Australian Standard AS3846 which leaves interpretation regarding the transit of SSAN:

> *The maximum permitted transit quantity[1] of SSAN is 1000 te. There is an uncertainty whether this quantity of SSAN includes or excludes the 400 te SSAN that may be loaded or unloaded at the port. In Gladstone Port, the interpretation has been that a maximum of 1400 te of SSAN may be on a ship at an ordinary berth, whether this comprises 1000 te transit and 400 te loaded/unloaded or comprises 1400 te transit.*

This is a critical issue given the current licence technically allows for 1400 te SSAN to be present at berths 7, 8, 9, and 10. The current DME overpressure map considers a quantity of 400 te. At 1400 te the distance to the recommended 14 kpa overpressure limit has been calculated by Lloyd's Register as 796m. Within this distance from berths 7-10 are the Townsville Entertainment Centre, Jupiters Casino and all or part of the Casino Peninsula residential precinct.

The 21 kpa overpressure limit would also be exceeded for berths 8-10 at Townsville Entertainment Centre, Jupiters Casino, for recreational boat users on Ross Creek and ferry passengers utilising Sunferry services. The risk to public safety is significant and unacceptable under the terms of AS3846.

Need for Review of Port Limits at Townsville

The current generic quantity guideline preferred by DMR of 400 te is also problematic considering the number of facilities identified in 2.7 above.

The 14 kpa overpressure limit is exceeded for 22 identified major facilities. It is reasonable to estimate 50 workplaces of various sizes fall within the 14 kpa overpressure limit. Some of the workplaces have less than 30 employees and are therefore not required to appoint a Workplace Health and Safety Officer under the Workplace Health and Safety Act 1995, which will exacerbate coordination and control issues. The total number of workers at risk is estimated at 700.

[1] at an ordinary berth. Otherwise a Special Berth will have to be declared.

The current situation, particularly in relation to berths 7-10, presents a significant and unacceptable risk to public safety, particularly the workforce within and adjacent to the Townsville Port. The Townsville City/Port Strategic Plan, Department of Infrastructure, June 2007, details the increase in residential, industrial and port-related development planned for the port area. This clearly signals an increased population falling within unacceptable overpressure limits from the port.

The limitations of berths 1, 2 and 11 are outlined in 2.4 above. The specialised use of berths 1, 2 and 11 and the comments from the Chief Inspector of Explosives, suggest it is unlikely that these berths are intended to be utilised, or would be suitable for, SSAN or Class 1 explosives.

Use of Berths 9 & 10 for Class 1 Explosives

The proximity of berths 9 and 10 to the Townsville Entertainment Centre (250m and 400m respectively) presents an additional layer of control and risk required to handle Class 1 explosives. There is a risk of the current controls failing to prevent the loading/unloading of Class 1 explosives at berths during public events and well as uncontrolled aspects of public access within the overpressure limits.

The allowable limits at these berths are modest, and it is clear that there are more efficient and safer alternatives available within the port.

Proposed Townsville Ocean Terminal Development

The proposed Townsville Ocean Terminal Development within the Townsville Future Development Area (FDA) includes residential houses and units which have similar distances from Townsville Port berths as existing workplaces and residences in the port area.

The resolution of overpressure issues for existing workplaces and residences in the port area will have the effect of resolving overpressure issues associated with the FDA.

4 Authority

Port explosives limits are subject to review by the Chief Inspector of Explosives as described in Information Bulletin 50 (version 2) from the Explosives Directorate dated 17 September 2007;

"The Chief Inspector of Explosives may vary the approved explosives limits if reasonably satisfied they are no longer appropriate (Section 64 of the Explosives Regulation 2003)."

5 Recommendations

Hyder Consulting recommends that:

1. The Chief Inspector of Explosives clarifies the current ambiguity in the Australian Standard as it applies to Townsville port to limit amounts of SSAN in transit through ports to 1000te, including amounts being discharged at the port;
2. The Chief Inspector of Explosives review the current proposed berth limits for SSAN and Class 1 explosives at Townsville Port to ensure the safety of existing and future workplaces and residences;
3. The Chief Inspector of Explosives amend the DME license for Townsville Port to exclude berths 1-2 and berths 7-11 from handling SSAN;
4. The Chief Inspector of Explosives amends the DME license for Townsville Port to exclude berths 9 and 10 from handling Class 1 explosives.

6 Conclusion

Should the Chief Inspector of Explosives review and amend the current berth limits for SSAN and Class 1 explosives for the Townsville Port as suggested in the recommendations above, the overpressure issues identified for existing and future workplaces and residences, and the Townsville FDA will be resolved.

7 References

- Australian Standard AS3846 'The handling and transport of dangerous cargoes in port areas'
- 'Lee's Loss Prevention in the Process Industries', Third Edition, Dr. Sam Mannam
- 'An Introductory Text', R2A Risk and Reliability, Richard M Robinson, Kevin Anderson
- Information Bulletin 50 (Version 2), Explosives Directorate, 17 Sep 2007
- Letter from Queensland Government, Department of Mines and Energy to Port of Townsville dated 10 September 2007
- Townsville Port Authority website viewed May/June 2008

- Supplementary Advice on Ammonium Nitrate and Class 1 Explosives in Townsville Port, Lloyd's Register, 4 June 2008
- Port of Townsville, Port Notices, November 2006
- Penalties and Sentences Act 1992
- Townsville City/Port Strategic Plan, Queensland Government Department of Infrastructure, June 2007

8 DME Response and Commentary

This section considers correspondence from the Chief Inspector of Explosives, Department of Mines and Energy in response to the above report.

8.1 DME Response

The Chief Inspector of Explosives has provided the following response:

> "Further to our discussion on Friday re the Hyder/Lloyds overpressure reports, we have had further advice from the DME Chief Inspector of Explosives. DME has confirmed that:
>
> - Hyder/Lloyds have incorrectly interpreted AS3846 for the handling of AN. The 400t limit is a threshold limit beyond which a risk assessment must be applied (ie to gain a "special berth" licence). In effect any ship may unload 400t onto any (licensed) "ordinary" berth at any time irrespective of what is located nearby.
>
> - Hyder/Lloyds are correct in their assessment of the overpressure consequences however the implication is that the likelihood is sufficiently small to assume an acceptable risk. This could be considered to be broadly similar to the transitory risk of transporting the same material through urban areas via truck or rail (note that the port is not licensed to store AN/explosives).
>
> - As part of its general duty of care, the Port may decide to go beyond the AS3846 requirements and limit operations. For this reason the current limits applicable to events at the TEC are imposed.
>
> - in terms of development within areas exposed to risk, generically, short term accommodation is treated the same as permanent residential. Workplaces (eg offices, port buildings), roads, carparks etc are given a higher tolerance.
>
> In terms of importing AN through the Port, the implications of the FDA proposal are:
>
> - in accordance with AS3846, the ordinary berth status of berth 10 would be unaffected

- the port may need to reconsider the risk profile at berth 10 in its general duty of care

- the port would be less likely to gain a "special berth" licence if there is a future proposal to import >400t of AN eg the distance from berth 2 shortens from approx 1200m to 714m. Likewise the distance from berth 11 shortens from approx 1600m to 819m

DME advise that significant quantities of AN are imported, primarily through Port Alma. Imports are critical to the mining industry (and therefore the Qld economy) and are likely to increase over the short to medium term to >500,000t/year.

(Extract from email received from Department of Infrastructure and Planning dated 7 July 2008)

8.2 Commentary

The authority of the Chief Inspector of Explosives to review port explosives limits is recognised, as described in Information Bulletin 50 (version 2) from the Explosives Directorate dated 17 September 2007.

The comments of the Chief Inspector regarding the interpretation of AS3846 are accepted.

The comments of the Chief Inspector regarding threshold requirements and acceptable risk are noted.

The comments of the Chief Inspector in regard to importation of AN through the port and the implications of the FDA proposal are noted.

8.3 Conclusion

The comments of the Chief Inspector of Explosives provide clarification of the impact of the FDA proposal on Port operations.

In summary, the major impacts identified by the Chief Inspector are:

- That the port may need to reconsider the risk profile at berth 10 in its general duty of care;

- That the port would be less likely to gain a "special berth" licence if there is a future proposal to import >400t of AN.

The clarification provided by the Chief Inspector of Explosives provides resolution for the overpressure issues identified for the Townsville FDA.