Opus Report For

ENVIRONMENTAL RISK MANAGEMENT AUTHORITY
NGĀ KAIWHAKATŪPATO WHAKARARU TAIAO

Study to Derive Limits for Handling Shipments of Explosives at Selected Ports in New Zealand

Final Summary Report
1 December 2008

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1 Executive Summary

Environmental Risk Management Authority New Zealand (ERMA) commissioned Opus International Consultants (Opus) to undertake a study of selected New Zealand ports. The objectives include ensuring consistency in approach and equivalent levels of protection of community safety, to provide clarity and certainty for the explosives and shipping industries, and to derive explosive quantity limits for each port.

The ports selected by ERMA are located at: Auckland & Onehunga, Tauranga, Napier, New Plymouth, Wellington, Lyttelton, and Port Chalmers.

Under the Hazardous Substances and New Organisms (HSNO) Act, ports wishing to accept vessels carrying explosives or to handle consignments of explosives, must comply with performance based regulations contained within the Hazardous Substances (Classes 1 to 5 Controls) Regulations 2001 (the Regulations). The Regulations provide minimum standards that must be met to ensure that the health and safety of people, and property, are not endangered.

Virtually all of the explosives entering New Zealand are understood to be packed in 20 foot ISO shipping containers. For this type of transportation the Regulations covering the transfer of Class 1.1 explosives in New Zealand ports *the NEQ and the boundaries of the DTZ are virtually solely determined by the factors associated with a 24kPa blast overpressure limit*. This model may be appropriate to ports that are isolated from large population centres and other port activities. However the universal application of a 24kPa limit model to ports in close proximity to population centres, oil and gas terminals, associated storage tanks, passenger/cruise ship terminals, and multiple other port activities, may result in high risk outcomes. As most New Zealand ports bear a closer resemblance to the second scenario than to the first, a number of additional considerations should be applied to the determination of NEQ and the boundaries of the DTZ to ensure acceptable risk to persons and facilities within and beyond the port boundaries.

Recommended NEQ limits were prepared for each port based on applying additional blast overpressure limits to protect certain features where these are considered necessary, and to establish an acceptable limit of hazard exposure and consistency between ports.

Our visits to each port included meeting port company staff and the Regional Harbour Master / their representative. We discussed current explosives handling practice, and asked port company staff to identify populated buildings, the port boundary, and other relevant features. Aerial photographs and scale drawings were used to clarify these discussions. In each case this was followed by a drive over to inspect the sites. We have relied on the information provided by the port companies to establish DTZ limits and to calculate their associated NEQs for each berth.

IMPORTANT NOTES

1. The designated transfer locations and their associated NEQ limits at explosives handling berths are based on information provided by the respective port company. Opus accepts no responsibility for the accuracy of this information.

2. Because virtually all explosives are packed in ISO containers we have based the DTZ on the 24 kPa limit. Where we considered it should be feasible to exclude other vessels from the DTZ we have based our calculations on this. In practice the recommended maximum NEQ may need to be altered to take into account other operational requirements and the port's assessment of risks to people and assets.

3. Recommended maximum NEQs generally relate to a specific location on each berth. They do not relate to the whole berth unless explicitly stated.

4. The vessel must be positioned so the hatch containing explosives (normally the bow hatch) is at the stipulated location.

Table 1. Recommended; Maximum NEQ for Each Port (packed in ISO Containers)

Port	Berth *At Specified Point*		Max Recommended NEQ in Kgs When Packed in ISO Containers.
Auckland	Fergusson	Outer	36,000
	Freyberg	West Outer	4,500
		East Outer	4,500
	Jellicoe	West Outer	20,000
		East Outer	5,000
	Bledisloe	West Outer	12,000
		East Outer	16,000
Onehunga	LOLO Berth		1,500
Tauranga	Sulphur Point	Berth 24	55,000
		Berth 23	55,000
	Berth 11		6,000
Napier	Cassidy Quay No1 (*Investigated at ERMA's request)*		150,000
	Kirkpatrick No5 Nth	Outer	59,000
New Plymouth	Blyde	Outer	7,000
Wellington	Thorndon	Outer	19,000
	Pacifica	Outer	160
Lyttelton	Cashin Quay 4	790m	36,000
	No 7 Wharf	East Outer	4,000
Port Chalmers	No 1 Berth	As specified	16,000

2 Requirements Noted During Port Assessments

2.1 Separation Distances Between Berthed Vessels

Previously the Chief Inspector of Explosives would generally stipulate a standard separation distance of 200 yards between a vessel berthed with explosives and another cargo vessel. It appears this separation was applied regardless of the NEQ. The current Regulations require crews of other vessels to be outside the DTZ.

However the (New Zealand) Regulations and the IMDG Code appear to be silent on the question of isolation distance between a vessel carrying explosives and:

- Vulnerable vessels such as cruise/passenger ships
- High risk vessels such as oil / LPG / methanol and other chemical tankers
- Oil / LPG / methanol / chemical terminals, and associated storage facilities.

Essentially vessels carrying large consignments of explosives should not be in port at the same time as cruise ships or high risk vessels unless they are well separated.

2.2 Transfer Between the Vessel and Shore Based Transport

Previously there was a requirement to transfer a container of explosives directly to truck or rail wagon without landing it on the wharf. A container crane provides a stable platform. Transfer using a ship's crane results in the ship rolling as the container is swung outboard. This instability increases the risk of injury, and damage to the container and truck/rail wagon on landing. The Regulations do not prohibit the process of landing a container on the wharf and then using a straddle, forklift or other cargo handling plant to complete the transfer to truck/rail wagon.

Where ships cranes are used to transfer explosive containers directly to truck/rail wagon, we recommend the practice be reviewed in light of safety, risk, and the degree of flexibility afforded by the Regulations. This is a matter that should be determined by each port.

2.3 Removing Transiting Consignments While a Vessel is in Port

This was not part of the original scope but the subject was raised during every port visit.

A transiting consignment of explosives is one which is already on a vessel when it arrives, and continues with the vessel for delivery to a subsequent port.

Most ports understand the Regulations require transiting consignments of explosives must be taken from the vessel to a temporary storage site, and brought back to the port to be re-stowed before the vessel sails. From a risk viewpoint there are definite pros and cons with the current requirements which are recorded in the Central Report.

The handling of transiting explosives consignments justifies review.

2.4 Exemption for Roll On Roll Off (RORO) Consignments

Under the Regulations, explosives being driven on/off RORO vessels are exempt from the requirement to establish a DTZ. The maximum NEQ is governed by marine regulations without direct reference to safety limitations on the land side.

Explosives consignments above quite small quantity limits may not be carried on passenger ferries including RORO ferries, and instead must be shipped on cargo only sailings.

We understand the RORO exemption comes about because the vessel is regarded as an extension of the road or rail network. In risk terms, freighting cargo on RORORs is treated as such. No transfer between different modes of transport takes place so the risks directly associated with transfer do not come into play. The truck or wagon is simply driven on before the vessels sails and off when it berths. However a distinction must be drawn between the situation that occurs when trucks and rail wagons are loaded before sailing, and the situation when they are taken off after berthing at the other end. No marshalling or waiting time should occur when a RORO discharges, and the truck or rail wagon should immediately resume its journey. However marshalling time before loading is potentially significant, particularly with rail, and particularly if the vessel is late berthing. While the direct transfer risks between modes of transport are absent, the aspect of dwell time before sailing and associated risks should be examined with a focus on minimising waiting time.

We note that the Rail ferries operate independently of the management systems and practices of the CentrePort organisation with respect to explosives.

2.5 Road and Rail Movements to/from Ports

For most ports, transporting the container to or from the port involves driving through congested city streets with the associated brief duration high consequence risks. Where the consignment is railed the route usually includes some densely populated areas.

Provided best practice is utilised, the level of risk for transport as it directly relates to the ports is one that has to be accepted. However the comments with regard to risks with transiting consignments, and with regard to RORO, should also be borne in mind.

2.6 NEQ Limits for Different Classes of Explosives

The different categories within Class 1 reflect differences in mass explosion and fragmentation hazards. The velocity of detonation (VOD) is a determinant of mass explosion potential vs. deflagration.

Blast overpressure is the predominant effect governing the limits of a Class 1.1 DTZ. Our investigations and comparisons have focussed on this class of explosive. Regulation 49 allows DTZ limits to be determined by the different explosives characteristics of the various categories. Given the practical difficulties in calculating heat radiation, and numbers of hazardous fragments per $60m^2$ of surface area, ERMA has provided NEQ/Distance tables that can be found at the back of this Report.

2.7 Assess Whether Blast Overpressure Limits are Sufficient

There are a number of examples where the universal application of a 24kPa blast overpressure limit may not offer adequate protection from a **Class 1.1** initiation.

High density high rise glass clad buildings, and high density roadways have sprung up just over the boundaries of some ports. High rise buildings have also been erected on port land adjacent to berths where explosives are handled. In most cases ports noted there has been significant urban encroachment even over the last 5 years. Given the damaging effects of blast overpressure on high rise glass clad buildings and the resulting hazards from falling glass on people below, there are concerns over urban encroachment and the sufficiency of a 24kPa limit to adequately limit the level of risk.

Vulnerable buildings as defined in the Regulations, protection for cruise ships and passenger ships, separation from marine terminals or the bulk storage of oil / LPG / methanol / and other hazardous substances, need to also be considered.

The universal application of a 24kPa limit model to ports in close proximity to population centres, oil and gas terminals, associated storage tanks, passenger/cruise ship terminals, and multiple other port activities, may result in unacceptably high risk outcomes.

We have applied a number of additional considerations in determining the recommended NEQs and the boundaries of the DTZs to ensure acceptable risk to persons and facilities within and beyond the port boundaries.

2.8 Thunderstorm Response

If a thunderstorm approaches, under section 48 of the Regulations the approved handler is required to ensure all persons within a radial distance equivalent to a 15kPa blast overpressure are evacuated. For a 24kPa DTZ this means the radial distance must be increased by 39%.

We understand the rationale to be: as likelihood of an unintended initiation is increased by a thunderstorm, the overall risk level is controlled by decreasing the consequences (increasing distance). In risk management terms we agree with the logic.

We note however that where the 24kPa DTZ meets e.g. the port boundary, it may be extremely difficult to establish a 15kPa DTZ in practice.

We offer for consideration several operational measures that may reduce likelihood of an unintended initiation caused by electrical impulse in a thunderstorm. At a berth the vessel; possibly a container crane sitting on crane rails, and possibly railway lines; may act as lightning interceptors and conduct electrical charge to the explosives container. In addition to the requirements in the Regulations, we suggest the container should be electrically isolated if possible by:

- Ensuring an explosives container is not in contact or close proximity to any container crane rails and railway lines.
- The ship or container crane spreader should be released from the container and raised.

(We note sections 28 & 29 of the Regulations deal with lightning interceptors at hazardous substances locations which are considered higher risk than transfer zones because transfer zones have short duration exposures).

2.9 Port Systems and Emergency Management Plans

In some ports the various responsibilities and systems did not appear to be clearly defined.

Except for coastal vessels, the port companies are generally responsible for allocating a berth, and piloting a vessel to the berth. However stevedoring the vessel is not always carried out by the port company. It may be stevedored by a

totally separate organisation. This is frequently the case when discharge or loading is carried out with the ship's own cranes as opposed to using container cranes.

Every port should review and upgrade systems and practices. Generally there are major potential gains in the areas of:

1. Systems for prior notification from the importer / exporter. This should include ERMA and NZ Customs and any other necessary approvals. Notification should include the Department of Labour to ensure the enforcement agency has advanced notice of explosives transfers.
2. The Approved Handler (often not the port company), and Person in Charge (usually but not always the port company), must establish the DTZ based on the NEQ. The process must be documented and should also involve the party responsible for berthing the vessel.
3. Have a Site Plan and an Emergency Management Plan. These should include a plan showing the location of other hazardous substances, action required in an emergency, material data safety sheets, compliant signage and its location at the entry points to the DNZ, fire fighting equipment, clearly define the responsibilities of all parties etc. We have made further comment on Emergency Management Plans below.
4. Systems that meet the tracking required by the Regulations for each consignment.

Emergency management planning is a requirement under Section 47 of the Regulations. All ports furnished written plans. Some were quite large documents.

The Emergency Management Plan (EMP) in each port was piecemeal and not necessarily focussed on explosives. In some cases EMPs were not readily available in locations where they could be accessed by those who need the information immediately in an emergency.

We recommend that each port compile an EMP that deals specifically with explosives.

We note ERMA has published the requirements for an EMP, and that this information is available on their website.

The nature of an accident involving explosives means it is unlikely there will be any warning. On that basis we offer the following general observations:

- Emergency planning should focus on minimising the post event consequences through ensuring swift medical aid will be available to casualties, and to prevent further casualties or more serious injuries.

- Planning should also aim to limit the consequential damage caused by fire and damage to buildings. To that end being able to immediately provide the Fire Service with a plan of the port showing the locations of all dangerous goods stores, and/or providing the local Fire Service with an updated dangerous goods stores plan of the port annually, is sound practice.

- Plans should also focus on immediate actions that may reduce business interruption and hasten recovery of normal operations.

3 DTZ Threshold Quantities & Quantity Distance Tables for Class 1 Substances

The following tables have been provided by ERMA for inclusion in this report.

Explosives Designated Transfer Zone Threshold Quantities

Hazard Classification	NEQ
1.1B, 1.2B and 1.4B	5 kg
1.1 (other than 1.1B or 1.1C), and 1.5	50 kg
1.2 (other than 1.2B)	50 kg
1.1C and 1.3 (other than 1.3G)	100 kg
1.3G and 1.4 (other than 1.4S and 1.4B)	200 kg
1.4S	1,000 kg
Retail Fireworks under the Hazardous Substances (Fireworks) Regulations 2001 (1.3G, 1.4G, 1.4S)	10,000 kg (gross weight)
Safety ammunition including pre-primed cartridges and primers of classification 1.4S	25,000 kg (gross weight)

Quantity/Distances for Explosives Designated Transfer Zones

Net Explosive Quantity	Classification 1.1		Classn. 1.2	Classn. 1.3	Classn. 1.4
	Containerised (24kPa)	Break Bulk (9kPa)		(a)	
(kg)	(m)	(m)	(m)	(m)	(m)
5	60	90	71		25
10	60	90	80		25
15	60	90	86		25
20	60	90	91		25
25	60	90	95		25
30	60	90	98		25
40	60	90	103		25
50	60	90	107		25
60	60	90	111		25
70	60	90	114		25
80	60	90	117		25
90	60	90	120		25
100	60	90	122	60	25
200	60	90	138	60	25
300	60	99	148	60	25
400	60	109	156	60	25
500	60	117	163	60	25
600	61	125	168	60	25
700	64	131	173	60	25
800	67	138	177	60	25
900	70	143	181	60	25
1,000	72	148	184	60	25
1,200	77	158	190	60	25
1,400	81	166	196	60	25
1,600	84	174	200	60	25
1,800	88	181	205	60	25
2,000	91	187	209	60	25
2,500	98	201	217	60	25
3,000	104	214	224	60	25
3,500	109	225	231	60	25
4,000	114	235	236	60	25
4,500	119	245	241	60	25
5,000	123	254	246	60	25
5,500	127	262	250	60	25
6,000	131	269	254	60	25
6,500	134	277	258	60	25
7,000	138	284	261	62	25
7,500	141	290	265	63	25
8,000	144	296	268	64	25

8,500	147	303	271	66	25
9,000	150	308	273	67	25
9,500	153	314	276	68	25

Note (a): Propellant powders in quantities greater than 500 kg are classified as 1.1C and not 1.3C

Net Explosive Quantity	Classification 1.1		Classn 1.2	Classn 1.3	Classn 1.4
	Containerised (24kPa)	Break Bulk (9kPa)			
(kg)	(m)	(m)	(m)	(m)	(m)
10,000	156	319	279	69	25
11,000	161	330	283	72	25
12,000	165	339	288	74	25
13,000	170	348	292	76	25
14,000	174	357	296	78	25
15,000	178	365	300	79	25
16,000	182	373	303	81	25
17,000	186	381	307	83	25
18,000	189	388	310	84	25
19,000	193	395	313	86	25
20,000	196	402	316	87	25
22,000	202	415	321	90	25
24,000	208	427	326	93	25
26,000	214	439	331	95	25
28,000	219	450	335	98	25
30,000	224	460	339	100	25
32,000	229	470	343	102	25
34,000	234	480	347	104	25
36,000	238	489	351	106	25
38,000	243	498	354	108	25
40,000	247	507	357	110	25
42,000	251	515	361	112	25
44,000	255	523	364	113	25
46,000	258	531	367	115	25
48,000	262	538	369	117	25
50,000	266	546	372	118	25
55,000	274	563	379	122	25
60,000	282	580	385	126	25
65,000	290	596	390	129	25
70,000	297	610	395	132	25
75,000	304	625	400	135	25
80,000	311	638	405	138	25

85,000	317	651	409	141	25
90,000	323	664	414	144	25
95,000	329	676	418	147	25
100,000	335	687	421	149	25
120,000	356	730	436	158	25
140,000	374	769	448	167	25
160,000	391	804	459	174	25
180,000	407	836	468	181	25
200,000	422	866	477	188	25