

Ship 'rumble': Rio Class low frequency noise mitigation

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Summary

The arrival of the Rio Class container ships at Port Otago resulted in a significant increase in community noise complaints. The issue was a loud, low frequency 'rumble' associated with the ships auxiliary generators. The solution was to replace traditional absorptive silencers with specialised reactive silencers. Residual noise emissions align with other typical container ships. Management protocols have been developed to minimise the community effects where a reactive silencer is not fitted. In the future, Ships entering New Zealand rotation should be fitted with a reactive silencer or achieve a standard noise emission specification to avoid this issue.

Keywords: Low frequency ship noise, community engagement, reactive silencers, noise mitigation

Rio Class Vessels arrived in 2018

Port Otago Limited operates a container terminal at Port Chalmers, on the east coast of the South Island of New Zealand. Like many ports, Port Otago have little control on the vessels that shipping lines choose to provide for various services.

Maersk operates the Southern Star service in New Zealand that visits Tauranga, Napier, Lyttelton, and Port Chalmers before returning to Malaysia. From 2011, Maersk serviced this route with the L-Class vessels without community noise complaints. However, from late 2018 onwards, Maersk began operating six Rio Class vessels (Rio's) on this service.

The Rio's were built in 2008, are 287m long by 40m wide and can carry up to 5900 containers/TEUs (Twenty-foot Equivalent Units). The Rio's have four generators that can provide auxiliary power to service the ship and operate onboard refrigerated container units (reefers). Usually, one or two generators will operate whilst in port to provide the vessel's power needs.

When the Rio's arrived they were significantly louder than the L-Class and were reminiscent of the same issue with the 4100 Class of vessels a decade earlier. This caused significant frustration within the community and saw Port Otago embark on a noise mitigation journey.

Community reaction was deafening

Port Otago traditionally received noise complaints about 'bangs and crashes.' The arrival of the Rio's saw a change to complaints about a loud 'rumble' that was keeping people awake from properties that were 5-7km away from the port. People described the noise like having a V8 car idling in their driveway keeping them awake at night [1]. Community meetings were held, and a petition signed by 140 residents was presented to the Dunedin City Council asking them to assist with addressing the issue [4].

Port Otago initially thought it was an isolated problem with only one of the six Rio's. However, community complaints were soon apparent with all six, and at all the New Zealand ports that the Rio's visited. Noise complaints increased dramatically; from 7 the year prior to 105 the year after.

Port Otago, led by Chief Executive Kevin Winders, engaged with Maersk. Several mitigation methods were trialled including berthing arrangements, generator configuration, duration and timing restrictions in port, and requiring the vessel to anchor at sea prior to entering, which had the potential to delay its arrival into Malaysia. This mitigation minimised the noise effects, but not enough to offset the impact on the community. A long-term solution needed to be found.

Rio's were significantly louder than typical container ships

Port Otago engaged Marshall Day Acoustics to measure the noise from the auxiliary engine exhaust for several Rio's under various generator combinations and load settings. The key findings in Table 1 were:

- Rio's were 10 – 15 decibels louder than a typical container ship (where a 10-decibel increase is usually perceived as twice as loud);
- Low frequency 'rumble' component was also disproportionately high; and
- The 'rumble' was audible at considerable distance due to low frequency propagation.

Table 1 Rio's were significantly louder than typical ships, but comparable once a reactive silencer was fitted [3]

Ship	Sound Power Level (dB L _{WA})	
	Overall (25 – 4kHz)	Low Frequency (25 – 160Hz)
Rio's (range)	115 – 122	113 – 119
Typical	105 – 115	95 – 105
Rio de Janeiro (pre mitigation)	119	119
Rio de Janeiro (post mitigation)	107	93

Low frequency noise effects are more prominent at night

Noise complaints are primarily received at night. The sound insulation performance of a typical dwelling is much less effective at low frequencies than mid and high frequencies. Therefore, the Rio's were perceived as significantly louder than other container ships inside the bedroom of a typical bungalow overlooking the port.

The 'rumble' was removed by installing a reactive silencer

Ongoing engagement between Port Otago and Maersk resulted in replacement of the Rio's traditional absorption silencers with reactive silencers. Installation of the silencers was a complex operation, taking place while the vessels were still at sea. Figure 1 shows that retro fitting of a reactive silencer dramatically reduced the low frequency noise component. This change can be experienced by watching and listening to a YouTube clip (with headphones) of before and after installation [2]. Residual noise emissions are now aligned with other typical container ships (Table 1).

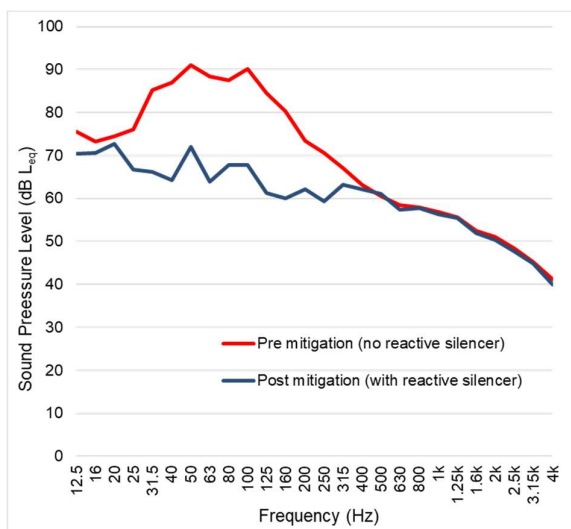


Figure 1 Rio de Janeiro auxiliary generator at 30m behind the exhaust stack [3]

Supplementary management protocols are used at Port Otago for ship generators with no reactive silencer

Where practicable, Rio's must only operate the generator fitted with a reactive silencer while at berth. However, the use of a second (unsilenced) generator is occasionally required for several legitimate reasons (e.g. operate bow thrusters while transiting the shipping channel or chill a high volume of refrigerated containers onboard, which often occurs during peak export season as the vessels are fully loaded). In such cases, the following management protocols are followed where practical

to minimise residual noise effects and raise community tolerance:

- Notice: Captain must provide advanced warning to Operations and Harbour Control;
- Location and orientation: Ship must be berthed on the multipurpose berth, bow out (Figure 2);
- Timing: Must arrive midweek (anchor outside the port if it is ahead of its scheduled window);
- Duration: One night (no weekend nights); and
- Communication: Community advised of scheduled timing and duration (e.g. Facebook posts).



Figure 2 Rio de Janeiro berthed on the multipurpose berth, bow out, to minimise the noise effects in the community.

Conclusions

- Low frequency 'rumble' from ships is avoidable when fitted with a reactive silencer.
- A New Zealand Ship Noise Register has been setup to collectively identify existing noisy ships.
- Ships entering New Zealand rotation should be fitted with a reactive silencer or achieve a standard noise emission specification (e.g. positive score using the NEPTUNES ESI scoring system [5]).
- Engagement with port communities builds trust and tolerance.

References

[1] Harwood, B. (14 April 2019). Steps to reduce port noise welcomed. Otago Daily Times.

[2] www.marshallday.com/news/2020/reactive-ship-silencers/

[3] Marshall Day Acoustics (21 January 2020), Rio Class Vessel Noise – Generator Silencer Measurements, Port Otago

[4] Miller, T. (11 June 2019). Muffler could be solution to port ship noise. Otago Daily Times

[5] <https://neptunes.pro/>