DRASLOVKA

Draslovka’s response to the EPA in support of our application to register EDN

For use in the fumigation of export log products

8/20/2018

Contents

1. Introduction

1.1 Background

This document has been prepared in response the EPA analyses and WorkSafe advice to the EPA regarding our application (APP202804) for the approval to import and use EDN containing 950g/kg ethanedinitrile as a phytosanitary treatment of forest products (including logs) to control a wide range of insects, nematodes and fungi.

The Stakeholders in Methyl Bromide Reduction (STIMBR) have identified EDN as a suitable alternative to methyl bromide in an extensive international review of potential alternative treatments. EDN has been shown to be an effective fumigant in controlling forest insects found in New Zealand.

The product will only be used by approved handlers in compliance with HSNOCOP31 - The Control and Safe Use of Fumigants. It is not an ozone depleting substance, is not a greenhouse gas, does not bio-accumulate, and it breaks down into naturally occurring substances.

The Staff Report and Science Memo provided by the EPA in response to our application are well written, well reviewed and robust in as far as they go towards assessing the risks, costs and benefits of approving EDN for phytosanitary use for forest product fumigation. We agree with their hazard classifications, and with much of the content within both reports.

WorkSafe has requested more information about scrubbing and recapture technology so that they can determine what requirements they will set for EDN. Any requirements for scrubbing affect the other controls set for EDN, such as the size of buffer zones, whether an end fumigation concentration requirement is set and if a permission control is needed. Here we provide that additional information to support our proposed buffer zones, end point fumigation concentrations, and the lack of requirement for a permission control.

1.2 Key Issues

The review document provided to the EPA by Dr Bruce Graham has some inherent problems and unjustifiable conclusions which have been adopted by WorkSafe in preparation of their advice to the EPA, and to some extent by the EPA in development of their proposed controls. In particular, we consider that Dr Graham has been overly cautious in his assessment of the Load Factors (LF), which he has calculated at 37%, significantly increasing the hypothesised concentration present at the end of fumigation. We present evidence that the industry load factor average is 58%[1]. To compensate for the reduced LF, Dr Graham applied an uncertainty factor of x7.4, which we demonstrate is not required.

Dr Graham has also overestimated the stack sizes of logs being fumigated, which has led him to overestimate the exposure rates of EDN left at ventilation. To counter this he has applied an uncertainty factor of x2, which we will demonstrate is not required. Following release of Dr Graham's report, we accessed industry data that shows that the stack size has in fact increased due

[1] 55% was used in the modelling we presented to the EPA in February.

to the high log volumes leaving the country. The national average stack size in 2017 was 1000 m^3. To clarify the effect this has on emissions, we have re-run our models using the 1000m^3 log stack size, the substantiated LF, and a range of application rates that cover all the possible application rates to be used commercially. This revised modelling is provided in association with this document . Table 1 summarises the changes that have been made to the input/output data in the revised modelling we have undertaken in response to EPA and WorkSafe comments.

Table 1 Input and output data used to inform the AERMOD modelling in February and August 2018. Differences in input and output are shown in red

	February	**August**
Input data	Brierley S, et al (2017)[2] Ajwa (2017)[3]	Brierley S, *et al* (2018) Addendum
Tarp volume	**750 m^3**	**1000 m^3**
Weather data	Weather Research and Forecasting 2012-2016 from the Tauranga fumigation site (GPS coordinates 37.65936 S 176.1825E)	Unchanged
Meteorological condition used in modelling	24 hours meteorological condition (worst case situation was included in the model)	Unchanged
Dose rates	50, 100 and 150 g/m^3	Unchanged
Treatment time	24 hours	Unchanged
Maximum fumigations /day	**30 fumigations (30 x 750 m^3 volume)**	**30 fumigations (30 x 1000 m^3 volume)**
Tarp height	**2.5 m**	**3.3 m**
Tarp fumigations over 1 yr[4]	1 tarp, 10 tarps and 30 tarps	Unchanged
Fumigant emission at end of the treatment period (ventilation period) / per stack	**1% of the initial dose rate** **For 150 g/m^3 dose rate the residual concentration at 24 hrs is 1.5 g/m^3 (669 ppm)**	**0.5% of the initial dose rate (to account for the change in loading from 50 to 55%)** **(357 ppm)**
Emission measurement	Reflects actual port activity fumigation and ventilation occurring between 7 am - 7 pm. The off gassing that occurs between 7 pm - 7 am was also included.	Unchanged
Number of ventilation per hour	2 stacks based on 10 fumigations 4 stacks based on 20 fumigations 6 stacks based on 30 fumigations	Unchanged
Output data	**Maximum Downwind EDN concentration (ppm) at 20 m from source for 50, 100 and 150 g/m3 application rate based on 90 and 95th percentile concentrations for 1 and 24 hours average**	**Only 95th percentile for 24 hours average. for multiple stacks This is the scenario that provides a larger buffer zone to protect bystanders.**

[2] Brierley S, Pal P, Hall A, Adlam A, Hall M (2017) Ethanedinitrile (EDN): A new fumigant for phytosanitary treatment of New Zealand export logs Plant and Food Research Report.
[3] Tarp permeability testing report.
[4] Number of log stacks treated each day and every day over the period of 1 year.

Our modelling has been deliberately conservative. Below are the parameters we created to ensure that the results have precaution built in:

- We used ~10 % permeability emissions during the treatment time which is based on the scenario of EDN fumigation without logs where no absorption occurs during treatment time. Hence a high level of EDN concentration remains in the treated space throughout the treatment period which has the ability to permeate through a tarpaulin. However in a commercial situation, EDN is absorbed by the logs, so the level available in the headspace decreases over 24 hours to 0.5% of the original level.
- EDN permeation data used in the AERMOD modelling to predict emission at 150 g/m^3 over 24 hours treatment time was calculated from the high dose rate 164 g/m^3 tested in the laboratory study.
- While the initial calculations in February 2018 were at the 90^{th} and 95% percentile, the current remodelling has been undertaken at the more conservative 95^{th} percentile.
- The modelling and the output results were based on a dose rate (i.e. 150 g/m^3) which was identified in the application as being the highest possible rate that may be needed. A caveat was placed on this advising that the treatment rates would be determined by the efficacy testing and the agreement of trading partners. The efficacy study results show that the proposed dose rate can be reduced from 150 g/m^3 to in the vicinity of 120 g/m^3 for 24 hours treatment time. Reducing the dose rate will significantly reduce the residual concentration at the end of the treatment time and the emission during the treatment time.
- Five years continuous weather data 24/7 for the port of Tauranga built from a number of meteorological records.

Using the numbers provided in our original model and applying these uncertainty factors, Dr Graham then suggested buffer zones of 50 m for workers and 120 m for the public. These buffer zones are both unnecessary and unworkable, and in this document, we provide evidence to support this. We maintain that a buffer zone of 20 m is sufficient to protect workers and the public, and we note also that the Ports have fences around them which prevent the public from entering controlled areas during and after fumigation. In most cases these fences are in excess of 20 m from the log stand area.

We want to reiterate that the information used by the APVMA in the 2013 approval of EDN in Australia is not up-to-date. We consider that some of the concerns expressed by WorkSafe in their report to the EPA, and their suggested controls, reflect the fact that they have used the Australian registration information to inform their consideration of our application. In this document, we highlight some of the insufficiencies of that APVMA approval, and remedy the conservatism that WorkSafe built into their report to the EPA as a consequence of recognising old information as equivalent to the more recent data.

In particular, WorkSafe have suggested that to address variability and uncertainty in the available information, scrubbing and/or recapture might be appropriate to ensure worker safety, and we herein demonstrate why scrubbing/recapture are not required.

Dr Graham noted that Ajwa Analytical Laboratories found a permeation of about 10% through the tarpaulin. On this basis he stated "*about 10% of the applied EDN was lost by permeation through the material over a 24 hour period*".

We agree that there is 10% permeation but loss means as levels of EDN fall under the tarpaulin there is a decrease in the actual quantity lost to the atmosphere over the fumigation time. The study undertaken by Ajwa Analytical Laboratories was conducted without logs i.e. the concentration of EDN could only decrease by loss through the tarpaulin. In this study an initial dose of 164 g/m^3 resulted in 151.4 g/m^3 remaining in the chamber after 24 hours.

A PFR study[5] conducted with logs showed that half of the initially applied dose (i.e. 150 g/m^3) was lost within six hours of application, and 1% (1.5 g/m^3) remained at the end of the treatment period. This loss is primarily due to the breakdown on EDN when it comes in contact with the wood. However, in the Ajwa Analytical study, 151.4 g/m^3 remained in the chamber at 24 hours. Therefore in a commercial condition with logs, we do not expect 10% of all the applied EDN to be permeated through the tarp.

We did not include fumigation in ships holds and in containers in our February application to the EPA. However, we understand that this use is of considerable importance to the industry. STIMBR in their submission have requested this use. We will be working with industry to clarify and include this use method in future.

1.3 Structure of Our Response

We have highlighted the key issues in the sections below, and provided relevant text from the EPA, Dr Bruce Graham, and WorkSafe, and our high level response to these issues. In the appendices of this document, we have included revised modelling or results for the Decision-Making Committee and all submitters to consider. We intend to speak at the hearing(s) to highlight our key concerns.

In section 13 of this document, we have quoted the controls proposed in the EPA Staff Report, and show using tracked changes where we consider the controls to be unnecessary after consideration of the material presented herein.

[5] Pranamornkith T, Hall MKD, Adlam AR, Somerfield KG, Page BBC, Hall AJ, Brash DW 2014a. Effect of fumigant dose, timber moisture content, end-grain sealing, and chamber load factor on sorption by sawn timber fumigated with ethanedinitrile. New Zealand Plant Protection 67: 66-74

2. Loading factors

Table 2 Loading Factors

Loading Factors	Comments
EPA staff report	
WorkSafe	
Bruce Graham	*The report by Brierley et al. contains extensive discussion and analysis of the effects of loading rates on the level of EDN uptake. The term loading refers to the proportion of 'air space' in the chamber (or under the tarpaulin) that is taken up by the logs. The absorption studies involved an average loading of 37% and it is argued by the authors that the data should be modified to reflect a loading of 50%, which they claim is the rate typically achieved in port operations. However, no data or factual information has been provided to support the 50% figure and, given the bulk log handling procedures used at the ports; it is hard to see how such a standardised rate could ever be achieved. This level of control would require careful selection and placement of individual logs on each pile, which just isn't done. The modification proposed by Brierley et al. is not insignificant; for the 150 g/m^3 treatment rate the residual EDN concentrations drop from 11.1 ± 8.9 g/m^3 to 1.4 ± 1.0 g/m3. This represents a 99% uptake of the applied EDN, rather than the ~90% figure noted above.*
Draslovka	Scientists and biostatisticians have tools available to them which allow the results determined in laboratory trials to be scaled with confidence to a load factor which better matches that found in commerce. These tools are commonly used and internationally accepted. Draslovka consider that Brierley et al's decay curves are well founded. The most recent annual industry data has been accessed to show the average stack size in New Zealand for 2017 is 1000m^3 with a load factor of 58%.

2.1 Rationale to support loading comments

Carrying out fumigation studies that use a similar load factor to that found in the commercial situation is considered ideal for experimental designs but is not always practicable for small-scale laboratory tests. Therefore, adjustments to the lethal fumigant concentrations determined by laboratory studies may be required to accommodate lesser or greater load factors that are commensurate with commercial operations, e.g., 37% load factor in laboratory EDN studies with logs in fumigation chambers compared with the conservative use of a 50% load factor for logs under tarpaulins.

Adjusting the concentration to the load factor is both common practice and important to ensure quarantine security and product quality. Ensuring quarantine security when adjusting fumigant concentrations is mathematically straight forward (based on gas laws, sorption rates and fumigation temperatures) and usually proved under commercial conditions by confirmatory testing with the commodity containing live insect infestations. Concentration adjustment where the commodity is fumigant-sensitive and where phytotoxicity may occur is much more difficult. The maintenance of product quality may require more in-depth laboratory studies to identify both the optimum concentration and load factor. Fortunately, product quality is not an issue for logs regardless of the fumigant that is used.

When the load factor is increased, the available air space around the commodity into which the fumigant is introduced is decreased. The result is that the initial concentration within the chamber or under the tarpaulin increases significantly in comparison to a lesser load factor. In some cases, the increased concentration may provide quicker insect mortality. The increased load factor also results in a greater area for sorption to occur. The impact of sorption and the speed and extent of toxicity to target pests will ultimately determine whether additional EDN is needed to ensure quarantine security. The increased load factor also results in less fumigant remaining in the free space in the closed chamber or under the tarpaulin at the end of the fumigation.

The response by Dr Graham that the Brierley et al. figures are "reduced figures" disregards the modelling process used by the authors. Furthermore, the statement that; "*…it would be more appropriate to work with the original, much higher, figures. This is easily accounted for by multiplying the modelling results by a factor of 7.4 (11.1 divided by 1.5)*" is considered by disinfestation scientists, to be overly simplistic. The mathematics suggested by Dr Graham does not consider sorption, especially that occurring in the presence of a greater load factor.

To a certain extent, reference to exact load factors don't need to be specified unless that knowledge is specifically required for insect kill or, especially in the case of sensitive plant products, to avoid phytotoxicity[6].

Taking these factors into account, we consider that with a load factor of 55% the end of fumigation concentration will reliably reach 0.5% of the initial concentration resulting in under the tarpaulin concentrations summarised in table 3.

Table 3 With a load factor of 55%, the end of fumigation concentration will reliably reach 0.5% of the initial concentration

Dose	**Unadjusted**		**Adjusted to 55%**	
	Data	Fitted	Data	Fitted
50	3.7±2.8	3.7±3	0.3±0.2	0.2±0.2
75	5.6±4.3	5.5±4.5	0.4±0.3	0.4±0.3
100	7.4±5.7	7.4±6	0.5±0.4	0.5±0.3
125	9.3±7.1	9.2±7.4	0.6±0.4	0.6±0.4
150	11.2±8.5	11.1±8.9	0.8±0.5	0.7±0.5
175	13±9.9	12.9±10.4	0.9±0.6	0.8±0.6
200	14.9±11.4	14.8±11.9	1±0.7	1±0.7
225	16.7±12.8	16.6±13.4	1.2±0.8	1.1±0.8

[6] Here we have used the advice from Jack Armstrong, Independent Science Advisor to STIMBR.

3. Stack Sizes

Table 4 Stack sizes

Stack Sizes	Comments
EPA staff report	
WorkSafe	
Bruce Graham	*For the purposes of this review, the modelling results were adjusted upwards by a factor of 2 to account for this possible difference in log pile volume.*
Draslovka	The most recent annual industry data has been accessed to show the average stack size in New Zealand for 2017 is 1000 m^3 with an average load factor of 58%. This data has been provided by New Zealand's largest fumigator.

3.1 Rationale to support stack size comments

A tarpaulin volume of 750 m^3 average was used in our initial modelling (July 2017 and updated for submission to the EPA in February 2018) because we had determined that this was the national average stack size at that time. Since submitting our application, we have revised the stack size to be the national average for the 2017 calendar year. The Genera database allowed us to determine an average stack size of 1000 m^3. Genera fumigates the vast majority of logs at all ports, and keeps complete records of every fumigation they undertake. Their database is therefore representative of the port practices in the three ports that currently allow fumigations: North Port, Port of Napier and Port of Tauranga.

On the Port the marshallers, not the fumigators, are responsible for the laying down of log stacks and so the stack size recorded by Genera will be representative of all stacks fumigated in New Zealand.

4. Monitoring

Table 5 Monitoring

Monitoring	Comments
EPA staff report	
WorkSafe	*The most feasible gas monitoring equipment for daily or regular use (MSA Ultima XA) has a limited range of measurement. It can read from 1ppm to 50ppm but note:* • *The error is +/-2 ppm, or 20% (whichever is greater). As such the lowest verifiable reading is 2ppm. This is equal to the proposed WES-TWA. That does not pose a problem as it the WES-TWA refers to an 8 hour average level, and we expect that workers who may be at risk of being exposed to ethanedinitrile would be protected.* • *Probably a more appropriate WES value for very short exposures would be the excursion limit of 5 ppm which is in effect a ceiling limit (a maximum*

	level not to be exceeded at any time). If correctly calibrated the meter could detect 5 ppm sufficiently, although because it has an error of 2 ppm, a value of 5 ppm should be considered a value of between 3-7 ppm. ***<u>Leak Detection</u>*** *When the meter reads a value above 50 ppm it shows 'failure'. The method proposed for leak detection is to assume that when the meter shows 'failure' there is a leak.* *This is a concern as:* • *if there is a reading above 50 ppm, the actual concentration wouldn't be known, and potentially complicates calculation of levels in excess of the IDLH), and* • *The 'failure' may be due to a malfunctioning gas meter rather than a leak.*
Bruce Graham	With regard to monitoring EDN levels on the ports the report states the proposed electrochemical monitor *"would only be marginal for monitoring against a workplace exposure standard of 2 ppm and it would definitely not be suitable for monitoring against any exposure limits lower than that"* and "*Most likely the only viable options for monitoring EDN would involve the collection of gas samples, either in gas containers or on absorption tubes, followed by analysis in a laboratory".*
Draslovka	We agree with the comments made by both WorkSafe and Bruce Graham regarding the usability of the *MSA Ultima XA*. However, with regards to the leak detection, we note that when a monitor reports 'failure', the operator moves to an area of lower concentration and unless the monitor has actually failed it will provide a reading within a guaranteed response time of 12 secs (typically 6 secs). In addition, we can now offer the use of the Riken FI-8000, which is suitable and accurate for the measurement of concentrations ranging from ~0.4 g/m^3 (185 ppm) to 300 g/m^3 (138,772 ppm).

4.1 Rationale to support modelling comments

4.1.1 Monitoring for less than 50ppm and leakage detection

Draslovka noted in its application that *MSA Ultima XA* is principally a hazard warning devices to protect staff. Operators are instructed when a monitor reports 'failure' that they must move to an area of lower concentration to check whether the machine is malfunctioning or continuing to indicate readings in excess of 50 ppm by reporting 'failure'. The monitor has a guaranteed response time of 12 secs (typically 6 secs). This short response time means that it should take <20 secs to ascertain whether the concentration has exceeded 50 ppm.

4.1.2 Monitoring under sheets during fumigation

Bruce Graham proposed that one way to reduce the levels given off during venting after fumigation would be to ensure gas levels should be below '*say 750 ppm*' prior to venting. "*However, as the meter only measures up to 50ppm this would require a system of dilution and testing*".

The MSA Ultima XA is suitable only as a personal protection device, measuring in the low concentrations from 1 – 50ppm.

To measure higher concentrations Draslovka has extensively tested the Riken FI-8000™. This machine is suitable and accurate for the measurement of EDN concentrations between 0.4 g/m^3 (185 ppm) and 300 g/m^3 (138,772 ppm). Being IP67 rated, it can be used outdoors in all weather conditions and has an in-built data logging capability to allow the fumigator to fully log the concentration versus time of the fumigation being undertaken.

This unit will allow fumigators to measure the concentration under the tarpaulin before its removal[7]. A tube is laid into the stack prior to fumigation and with the use of a small pump samples can be drawn from under the tarpaulin when required. Technical specifications, operating manuals etc. are available for the decision-making committee on request.

5. Measuring health impacts

Table 6 Tolerable Environmental Limits (TEL)

TEL	Comments
EPA	
WorkSafe	*"The EPA has proposed a TEL of 0.034ppm. However, as the lowest quantifiable level a meter can read is 2ppm, levels below the proposed TEL could only be measured by assuming that a zero reading on the meter is actually zero. This is not best practice because the meter has an error of 2ppm. Consequently, any level below 2ppm cannot contribute to the calculated TEL"*. **Health monitoring** *"The SWI should include health monitoring requirements. As EDN and hydrogen cyanide are known to be ototoxic (causing hearing loss even without noise exposure), we consider it reasonably practicable for PCBUs to ensure fumigation workers undergo audiometry health monitoring. We would also recommend respiratory function testing, given:* • *the irritant properties of ethanedinitrile, and* • *the reliance on RPE (hence the need to ensure workers using RPE do not have chronic respiratory disease that may preclude or affect the use of RPE)"*. **Biological exposure monitoring** *"In the body, EDN metabolises into cyanide compounds. Blood testing would be appropriate for acute high exposure (e.g. an unintended release or escape), and urine testing would be appropriate for chronic, low exposures (e.g. as an on-going assessment of regular exposure). Canterbury Health Laboratories in Christchurch can measure the levels of the cyanide metabolites in blood and urine samples. Other laboratories may also offer this test, however Canterbury Health Labs are widely used and samples can be easily transported to the lab from around the country. This ensures that it is reasonably practicable to provide regular and acute biological exposure monitoring"*.

[7] More detailed information on the Riken FI-8000 is provided in the appropriate section of the Draslovka field manual Available on request Additional information can be sourced from the Riken web site at https://www.rkiinstruments.com/pdf/FI-8000.pdf.

Bruce Graham	
Draslovka	We consider that the EPA's TEL is overly conservative and we provide a rationale for a TEL of 0.56 ppm We agree with WorkSafe's health monitoring recommendations.

5.1.1 The TEL value

The EPA has proposed a TEL of 0.034ppm and based on the modelling, we are confident that this TEL will not be exceeded beyond the proposed buffer zone. However it is critical to note that t if the EPA applies any additional uncertainty factors to the modelling this TEL may influence the distance of the buffer zones which in turn will affect port logistics and the space costs associated with fumigation. We consider that the TEL is overly conservative. We note that the most common worker safety exposure level across the world is still a time weighted average of 10 ppm for period of 8 hours. If this concentration is recalculated to whole week time it would result in TEL of 2.3 ppm.

During the assessment phase for our application we provided a paper to the EPA from Jonas[8] (2017) which outlined a number of alternative approaches for the calculation of the TEL. The following rationale is considered by Draslovka's toxicologist to be most appropriate for translating the results for EDN. It uses published uncertainty factors based on scientific data to calculate the TEL rather than the more conservative general approach.

The EPA has used a study undertaken by Lewis (1984)[9] to calculate its TEL value and used uncertainty factors that total 100. Specifically these uncertainty factors are:

- 10 for extra-species extrapolation from rats to humans, and,
- 10 for intra-species extrapolation to cover differences within humans.

This approach is standard when the sensitivity of species used for the calculation is unknown and sensitivity within humans is also unknown.

However, in the case of cyanide compounds the mode of action, the relative sensitivities of species as well as the interspecies variation are well known. Specifically:

- Rats are much more sensitive than humans (e.g. NCR 2001[10])
- The species used in the study were rhesus monkeys (Lewis 1984). Rhesus monkeys are physiologically more similar to humans and are known to be more sensitive to cyanides than humans (e.g. NCR 2001). In this test, no adverse effect was seen at the highest tested EDN level tested (25 ppm). The results from this species might be more appropriate for the risk assessment than the rats and would result in a higher TEL.

Due to the higher sensitivity of tested animals compared with humans, NCR (2001) uses an extra-species extrapolation factor of 2 for rats and 3 for monkeys. The NCR (2001) also uses an inter-species extrapolation factor of 3 to cover differences among humans because detoxification is not

[8] "Rationale for TEL, WES and NOAEC values for ethanedinitrile" (Jonas, 2017)

[9] TR Lewis; WK Anger 1984. "Toxicity of sub-chronic exposures to cyanogen in monkeys and Rats

[10] NCR, 2001, Acute exposure guideline levels for selected airborne chemicals, volume 2

dependent on age. These uncertainty factors are scientifically justified and already used by many regulators. They are in line with the calculation of worker exposure safety values (ACGIH, WorkSafe).

We also note that EDN does not bio-accumulate and that in other chronic tests with cyanide compounds, the resulting NOAELs were higher (NTP 1996, Howard, Hanzal 1955).

Using the uncertainty factors listed above, the following calculation will produce a realistic TEL which is still conservative:

- UF interspecies = 3
- UF extraspecies (rats/humans) = 2
- UF total = 2 x 3 = 6

TEL = NOAEL / UF total = 2.05 / 6 mg ethanedinitrile/kg bw day = 0.34 mg ethanedinitrile/kg bw day.

TEL mg/kg bw/day dose is converted to an atmospheric exposure level for humans by using ethanedinitrile mg/m^3 = TEL (mg/kg bw/day) x human bw (kg) / daily human ventilation rate (m^3/day) = [0.34 mg/kg bw/day x 70 kg bw] / 20 m^3/day = 1.19 mg/m^3 (0.56 ppm).

These calculations result in a TEL= 1.19 mg/m^3 (0.56 ppm).

5.1.2 Health Monitoring

We support the WorkSafe suggestion to have human health monitoring required to ensure that the health of workers is protected. We understand that Genera (and other fumigators) has a roster for staff working with fumigants to have health checks (including blood tests) at regular intervals.

6. SOPs for Removing Tarpaulins

Table 7 Removal of tarpaulins

Removal of tarpaulins	Comments
EPA staff report	
WorkSafe	
Bruce Graham	*Dispersion modelling is not really suitable for simulating the complex release patterns that are likely to occur during the ventilation phase of log pile fumigation. The main difficulty with assessing the releases from log piles is in adequately characterising the gas discharge rates and the geometry of their releases. For fumigations under tarpaulins the bulk of the releases will occur more or less instantaneously along the top and sides of the log piles as the tarpaulins are removed. On this basis it was recommended that reliability of results from modelling log fumigation should have an uncertainty factor of ±2.*
Draslovka	We note Dr Graham's concerns about potential complex release patterns during the ventilation phase. However tarpaulin removal in practise does not result in the bulk of the remaining fumigant being instantaneously released to the atmosphere. It is a controlled practise, described in an SOP, and is carefully managed to prevent

	atmospheric levels from exceeding established levels. We present evidence that negates the argument for the uncertainty factor of ±2.

6.1 Rationale to support comments on removal of tarpaulins

We note that in practise no tarpaulins are removed in a way that would allow the instantaneous release of all the EDN to the atmosphere. Tarpaulin removal is a very controlled process managed to ensure that the concentration of the fumigant does not exceed specific levels. For instance, in the case of methyl bromide, the speed of removal of tarpaulins is controlled so that the atmospheric level of methyl bromide does not exceed 25 ppm. The Genera SOP[11] below describes work practices that prevent an instantaneously lethal dose of EDN affecting workers on site:

"In order to manage its fumigation operations efficiently and safely Genera has a staff training programme. A health safety manager and trainers with designated responsibilities are tasked with ensuring that operations are carried out safely and efficiently. To guide staff the use of standard operating procedures is required. These are prepared and issued for all complex tasks to enable staff ensuring that tasks are preformed consistently to the same standard while reducing mishap. The use of SOP also reduces errors resulting from miscommunication and understanding. The use of SOP is particularly valuable to ensure that EPA and regional council regulations are understood and complied with.

During the uncovering and ventilation of log stacks supervisors are required to be in regular communication as they monitor the weather conditions, progress of the tarpaulin as it is removed, gas emissions and personnel working or passing close to the activities. As the cover is removed gas levels are constantly monitored and the boundaries of the managed safety zone are adjusted accordingly. In the event where gas levels are detected that is higher than the prescribed levels the removal of the tarpaulin is slowed or halted until such time as emission levels fall."

7. Buffer zones and Re-entry Intervals

Table 8 Buffer zones and REI

Buffer zones	Comments
EPA staff report	The use of appropriate Personal Protective Equipment (PPE), particularly Respiratory Protective Equipment (RPE), is recommended for anyone working closer than 10 metres to a single log stack being fumigated or 20 metres to the log stacks if there are multiple log stacks being fumigated. *For longer term exposure risks, the modelled exposure levels were evaluated in the context of the EPA staff-derived TEL of 0.034 ppm for ethanedinitrile. Under this exposure scenario, risks to bystanders are negligible from a single source log pile at a*

[11] An excerpt from the Genera Standard Operating Procedures (SOP) 7.2.3 Rolling the cover-up Work Instruction 2A: Fumigating Log Rows with methyl bromide under tarps Section E venting: Slowly draw the cover off the row, stopping occasionally to allow gas levels to dissipate.

	distance of 60 m as the estimated exposure level after all the uncertainty adjustments are included is 0.030 ppm. Risk to bystanders where there is a multiple log pile exposure source are ~8X above the TEL even at a distance of 120 m as the modelled exposure levels after all the uncertainty adjustment factors are included is 0.266 ppm. In order to bring exposure down to an acceptable level, controls would need to be set.
WorkSafe	WorkSafe is considering imposing a re-entry period.
Bruce Graham	*"...anyone standing closer than 10 m to the log piles ...has the potential to be exposed to instantaneous concentrations of 'say' 700 – 5200 ppm"* The loading effect factor of x7.4 combined with the worst case scenario for log pile size of x2 have been used to propose a buffer of 50m, and 120m if max log stack sizes are fumigated.
Draslovka	With the remodelling presented we consider that the buffer zones proposed in the application should be retained. These are: • A 10 m buffer zone to protect workers during fumigation when appropriate PPE is used • A 20 m buffer zone to protect the public.

7.1 Rationale to support comments on buffer zones and REI

7.1.1 Worker exposures

All of the 1-hour and 24-hour results at 95th percentile shown for single and multiple log piles in the modelling document provided to the EPA in February 2018 are well below the proposed workplace exposure standard (WES) of 3 ppm. Therefore, we accept the statement by Dr Bruce Graham that workers can safely operate at distances of >10 m from the log piles without needing respirators and other personal protective equipment.

7.1.2 Non-worker exposures based on EPA Science Memo

The acute exposure guideline level (AEGL) advised by WorkSafe is 3 ppm (1-hour average).

The Tolerable Exposure Limit (TEL) proposed by the EPA is 0.034 ppm as a 24-hour average[12].

All of the 1-hour averages shown for single and multiple log piles in the modelling document provided to the EPA in February are well below the AEGL proposed in the EPA Science Memo. The AEGL levels are also lower than the EPA science memo based on Bruce calculation with uncertainty factor. Therefore, 1-hour exposures comply with the non-worker exposures limit and are not a concern for non-workers at or above 20 m from the log piles (see Figure 1).

All of the 24-hour averages shown for single log piles in the modelling submitted to the EPA in February are below the TEL 0.034 proposed in the EPA Science Memo. Therefore, 24-hour exposures

[12] Note that this is 50x more conservative than the TEL recently set by the Australian regulators.

comply with the non-worker exposures limit and are not a concern for non-workers at or above 20 m from the log piles.

All of the 24-hour averages shown for the multiple log piles in the modelling submitted to the EPA in August 2018 with increase in loading factor and increase in fumigation volume are 0.016 ppm at 20 m. This is below the TEL 0.034 proposed in the EPA Science Memo. Therefore, 24-hour exposures comply with the non-worker exposures limit and are not a concern for non-workers at or above 20 m from the log piles. (Revised AERMOD modelling 2018)

Maximum Downwind EDN Concentrations (ppm) at 20 m from the source based on the 95th Percentile Concentrations

Application rates (g/m3)	Percentile	Multiple source 24 hours (ppm)
50	95^{th}	0.009
100	95^{th}	0.012
150	95^{th}	0.016

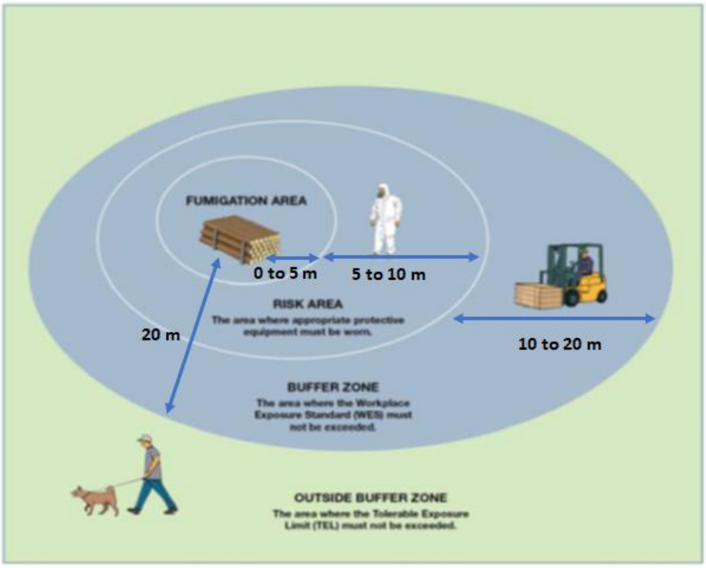

Figure 1 Schematic of the fumigation area, risk area, buffer zone, and outside the buffer zone. Our recommended distances for each of these zones are shown in table 9

Table 9 Recommended buffer zones to ensure worker and bystander safety

Zone	Distance
Fumigation area The area surrounding the log stack(s) being fumigated. It is expected that in this area the	5 m

WES will be exceeded, the prescribed PPE[13] will be worn, and monitoring will take place during fumigation and aeration	
Risk area Beyond the Fumigation area . It is expected that the WES will be exceeded at times, monitoring takes place and protective gear will be worn during the high risk times during fumigation and venting	5m-10 m
Buffer zone Beyond the Risk area where unprotected workers can safely work for an 8 hour work day[14]	10 m-20 m
Outside Buffer zone Beyond the Risk area where the public may be present 1 or 24 hours a day	>20 m

We have discussed port operations with Genera, and they report that buffer zones for methyl bromide of 20 m$^+$ for workers cause a slowing down of port operations and some additional internal on-wharf road closures, but they observe that these buffer zones are already in place and have a significant impact on existing port procedures. The ports currently manage with the buffer zones for methyl bromide 20 m for workers 50 m for the public[15].

Since the ports are a defined area (by the land area on the port with the boundary fences in place) the consequence is that if the boundary between the risk and buffer zone increase this has the effect of further restricting the area where fumigation can occur. This decreases the area available decreasing the posts ability to process

The WorkSafe Report states that "*WorkSafe is considering imposing a re-entry period. This would depend on any other requirements put in place, such as recapture. Given the time pressures and limitations of the ports, and the timeframes of MPI requirements (e.g. that logs are loaded on a ship within 36 hours in hot weather) this requires careful consideration.*

The APVMA states that fumigated timber cannot be handled for 24 hr unless appropriate PPE is worn. This will have implications for moving logs from the fumigated area onto the ships."

We have shown that post ventilation, the concentration of EDN in and around the stack itself will be able to be monitored until safe levels are reached. Current practice for methyl bromide is for a trained fumigator to stay with the stack once the tarpaulins have been lifted, and monitor levels until 5 ppm has been reached regardless of time needed. This is usually reached within 15 mins after ventilation. After safe levels are reached, re-entry is signalled with a flag taped to the stack to indicate that it is safe to be loaded onto ships for export.

We maintain that there is no desorption of EDN from treated wood because EDN is not adsorbed to the wood, but is fully broken down (see the Application Section 6.1 Appendix 6) This was supported by Hall et al. (2014)[16] in a series of laboratory tests simulating commercial fumigation of sawn timber

---

[13] Including SCBA as required.

[14] This is a standard work day and does not reflect the time at which is it *safe* to work. It may be safe to work longer, but people do not tend to work for longer than this.

[15] Note the EPA requires 100m when a log ship is being fumigated.

[16] 2014 MKD Hall, T Pranamornkith, AR Adlam, AJ Hall, DW Brash Simulated commercial fumigation of sawn timber and logs to verify the sorption desorption model of ethanedinitrile.

and logs undertaken to verify the sorption and desorption model of EDN. This trial showed that after 1.5 hours, no detectable concentrations of EDN were measurable.

We suggest 3 ppm as the safe re-entry level for unprotected workers, and suggest that the same SOP for re-entry be used as is currently used for methyl bromide.

8. Personal Protective Equipment (PPE) and Self-Contained Breathing Apparatus (SCBA)

Table 10 SCBA and PPE

SCBA and PPE	Comments
EPA staff report	SCBA is considered the only safe option to protect workers. However, WorkSafe is concerned that some PCBUs may allow workers to wear air purifying respirators as an alternative.
WorkSafe	*WorkSafe is concerned that due to the level of training and maintenance required for SCBA, and because some people cannot use it for medical reasons, PCBUs may allow workers to wear air purifying respirators as an alternative. This possibility further supports our case for reducing the gas concentration by means such as recapture before venting.* WorkSafe also mentions concerns with the proposed filters (see below).
Bruce Graham	
Draslovka	SCBA is a credible practice that is already in use and being applied to protect the safety of those involved in methyl bromide fumigations. We have also discussed the use of buffer zones to protect workers during fumigation, to protect against loss by permeation through the tarpaulins.

8.1 Rationale to support comments on PPE and SCBA

8.1.1 Appropriate Respiratory Protective Equipment (RPE)

WorkSafe commented that "*Bruce Graham's report stated that the modelling results are not suitable for making decisions about workers operating closer than 10 metres to the log piles, but that anyone standing close to the log piles when the tarpaulins are removed has the potential to be exposed to instantaneous concentrations of between 'say' 700 to 5200 ppm*" [17].

Fundamental to this concern is the expected level of EDN near the stacks. Our response to Dr Grahams report provides evidence supporting an end of fumigation under the tarpaulin

[17] This statement of 5200 ppm endpoint concentration was based on 37% loading factor. However, in commercial situations the end point concentration will be 0.5% of the applied dose rate (i.e. 360 ppm).

concentration of EDN of 0.5% of the 150 gm/m^3 applied i.e. 0.8 gm/m^3 or 360 ppm. In reality this level will be lower as EDN will be applied at treatment rates determined by the efficacy tests.

Efficacy research currently underway at Plant and Food Research (with just the final replicate to be completed) shows the highest commercial treatment rates will be in the vicinity of 120 g/m^3 at 5 and 10 ^oC and 60 g/m^3 at 20 ^oC. Where 100 gm/m^3 of EDN is applied, there will be 225 ppm at the end of 24 hours.

We recognise that pockets of EDN exceeding this level may be contained within the stack and that micro-eddies can occur as the tarpaulin is removed, resulting in short lived 'puffs' of EDN at higher levels. For this reason the modelling submitted with the application modelled a figure 24% higher than 530 ppm to accommodate these potential plumes, and to build conservatism into our results.

The modelling assumed that at the end of the treatment period, the residual EDN concentration will be slowly released over 1 hour (Table 11).

Table 11 Residual EDN at the end of treatment

Dose rate	Residual concentration after 24 hours (i.e. ventilation)	
	g/m3	PPM
50	0.3±0.2	134
100	0.5±0.4	268
150	0.8±0.5	357

The Riken FI-8000 can be used to ensure that the pre-determined concentration is not exceeded.

WorkSafe noted that:

Air purifying respirators (whether half face respirators, or the full face respirators discussed in the application) should never be used in situations where the IDLH[18] may be reached or exceeded (as per AS/NZS 1715, Dräger and 3M technical guides, and the APVMA approval). As the IDLH is 50ppm (based on cyanide), air purifying respirators should not be used for workers working near the sheets during fumigation and venting, and only air supplied or self-contained breathing apparatus could be used.

b) However, even if the IDLH wasn't an issue, an air purifying respirator could not be considered for use by workers near fumigation as:

- *based on the 8 hour WES-TWA of 3 ppm that WorkSafe will be adopting, the required minimum protection factor* would need to be between 233 and 1733 (700/3 and 5200/3) 530ppm / 3 of*
- *for short high exposures, based on the WES-excursion limit (ceiling) of 5 ppm that WorkSafe will be adopting, the required minimum protection factor would need to be between 140 (700/5) and 1040 (5200/5)*

[18] Immediately Dangerous to Health or Life.

- *AS/NZS 1715 (2009) Table 4.5 (on selection of filters for gases and vapours) states that a half face piece air purifying respirator (with cyanide appropriate filters) can only be used up to a concentration of 1000 ppm, and as such could not be considered a full pace piece P3 air purifying respirator (with cyanide appropriate filters) can be used up to a maximum of 10,000ppm, but only provides a protection factor up to 100 (as such wouldn't provide the range of protection factors that may arise).*

"*Considering the above points, the only option for workers near fumigation (e.g. applying fumigant, leak testing and venting) would be to use self-contained breathing apparatus (SCBA).*"

"*WorkSafe is concerned that due to the level of training and maintenance required for SCBA, and because some people cannot use it for medical reasons, PCBUs may allow workers to wear air purifying respirators as an alternative. This possibility further supports our case for reducing the gas concentration by means such as recapture before venting*".

We note that AS/NZS1715 does not specifically relate to protection against ethanedinitrile – it refers to cyanides. To determine the actual breakthrough time for air purifying filters, they must be tested for each individual substance, hence Draeger Germany conducted third party testing in 2017 on a number of different filters to determine categorically what the breakthrough time was for ethanedinitrile.

In Australia – and globally – the accepted filter for ethanedinitrile is an A2B2 filter providing excellent long term protection even at high concentrations. The trial tested the filters well above 1000 ppm – i.e. up to 5000 ppm – and the corresponding service lives are shown table 12.

Table 12 Filter testing and service lives

20 C **70% r.H.** **30 L/min**		**A2B2E2K1** **Hg P3 R D** **6738815**	**A2B2** **6738775**
	C_0 [ppm]	Service life to PEL (5ppm) (min)	
$(CN)_2$	5000	11	9
	2500	22	16
	1000	59	39
	500	124	76
	150	449	236
	100	693	348
	50	1453	674
	10	8106	3124

For applicators working in and around the log stacks during ventilation, air purifying filters should be changed every day to ensure the maximum protection limits. This is standard practice around filter management.

With regard to the use of SCBA

WorkSafe has expressed concern about the use of SCBA. We agree that all respiratory protective equipment has implications for people who have certain medical conditions, so any programme run by a company should have either:

- a doctors ticket to say they can wear it, or
- a declaration to say they know of no medical condition why they can't wear it.

The use of SCBA requires training and certification for the user, so that not just anyone can don the apparatus and begin fumigations. We know that fumigators are currently using breathing apparatus during fumigation and ventilation of stacks with methyl bromide. Industry sources have stated that although SCBA can be uncomfortable, particularly in summer, people understand the need for it and no one complains or tries to circumvent the use of the required personal protection equipment.

We note that fumigation companies have exemplary track records of using the appropriate PPE to protect workers during fumigation, and we support the use of their current SOPs in this area accompanied by regular health monitoring.

9. Scrubbing and recapture

Table 13 Scrubbing and recapture

Scrubbing and recapture	Comments
EPA staff report	PPE is recommended (esp. RPE) for anyone working closer than 10 m to a single log stack being fumigated, and 20 m when multiple stacks are being fumigated. **If WorkSafe set a requirement for scrubbing or recapture, there would be a potentially significant cost associated with the use of EDN**[19].
WorkSafe	Given the 700 – 5200 ppm levels of EDN estimated by Bruce Graham, WorkSafe is considering scrubbing/recapture. More information about recapture or scrubbing technology is required before WorkSafe can determine what will be required. Reported percentages of residual EDN released on venting vary considerably. For example, the APVMA indicates that residual EDN can be between 8-39%, meaning 8-39% could be available for release to atmosphere on venting. This differs from the application (and Bruce Graham's report), indicating residual EDN of between 1-10%.
Bruce Graham	
Draslovka	We recognise that APVMA requires scrubbing for fumigation of logs in Australia and that New Zealand Regulators would like to limit the potential for high levels of EDN being released to the atmosphere. We are confident that EDN released to the atmosphere during ventilation can be managed so that it does not exist at concentrations greater than 700ppm. This will be achieved by managing the time of the fumigation period and potentially validating the pre-release concentration using a Riken FI-8000. In addition, we consider scrubbing introduces additional risks into the workplace.

[19] Our accent added.

9.1 Rationale to support comments on scrubbing

We understand that WorkSafe is seeking to remove a potential source of risk, but we consider that with the information supplied on end-of-fumigation concentrations under the tarpaulin, and the availability of the Riken FI-8000, there is negligible risk and scrubbing is not required.

We have shown that when the overly precautious factors applied for the load factor, and the log pile size have been removed, a buffer zone of 20 m is appropriate to protect worker and bystander health and safety. In addition, we have discussed the use of appropriate PPE during fumigation, including the track record of using SCBA safely. We also note that the monitoring equipment in use at the Ports is available to detect EDN to within safe levels.

Therefore, we consider that the additional costs of scrubbing or recapture in the absence of evidence that demonstrates the need for such technologies are not justified. The imposition of recapture technologies would be an unnecessary burden on the industry, and does not provide sufficient additional mitigation to outweigh the substantial costs. Scrubbing increases the cost of fumigation and has other associated costs involved in disposing of the scrubbing effluent. Scrubbing solution and effluent increase the risk of exposure and human safety concerns, and damage the environment.

10. Permissions

Table 14 Permissions

Permissions	Comments
EPA staff report	While the modelling may be generally applicable to other ports, results may not be directly relevant to more constrained locations, such as Picton. This could be managed through a permission control, requiring site specific risk assessments. *Under s77A, no person may apply this substance unless that person first obtains permission from the Authority under s95A of the HSNO Act.*
WorkSafe	
Bruce Graham	Meteorological modelling appropriate for Tauranga but may not be suitable for Picton for example.
Draslovka	We consider that this is a redundant control, as the site specific risk assessment is covered by the 77A controls referring to Use Restriction (i.e. fumigation may not occur below specific wind conditions), and Labelling. We note that many Regional Councils through their resource consent process take

local conditions into account and at times place additional controls on fumigators.

Requiring permission adds an additional cost to the users/industry but does not create additional risk mitigation measures above those covered by other controls.

10.1 Rationale for comments on permissions

The EPA notes that "*meteorological inputs for the model were based on a data set for the Port of Tauranga. These modelling results may also be generally applicable to other large ports in New Zealand, with the caveat that the different weather conditions at different locations will affect the movement of EDN in the air".*

Dr Graham questioned the reliability of the meteorological data used in the modelling. We note that Sullivan Environmental used highly resolved Weather Research and Forecasting (WRF) data in our modelling. The modellers note that the WRF data set used considers all available regional data when producing wind fields, and in this case a pseudo tower. As Dr Graham pointed out, the use of the WRT data produced wind fields consistent with expectations, considering the complications resulting from the land-sea interface in that region. WRF data is generally accepted as a highly reliable source of meteorological data and is a suitable source of meteorological data for this model.

According to the Bulletin of the American Meteorological Society "*Since its initial public release in 2000, WRF has become arguably the world's most-used atmospheric model. This is evidenced in metrics of registered users and publications. For example, the cumulative number of WRF registrations is now over 36,000, distributed across 162 countries*." WRF data is considered an accurate representation of the meteorological conditions at the site of concern based on worldwide acceptance. Based on the same source cited above "*The number of unique institutions on peer-reviewed WRF publications is over 1,340, and the number of unique authors exceeds 11,700. To date, the number of citations to WRF papers is over 26,500, with an average of over 10 citations per publication." Another source for the basis of the meteorological data set and its applicability of this source of meteorological data to this assessment can be found in 'Aerosol and Air Quality Research': "The Weather Research and Forecasting (WRF) is a state-of-the-art mesoscale numerical weather prediction system designed to apply to both meteorological research and numerical weather prediction needs (Henmi et al., 2005). The model has the ability to simulate and forecast followed by producing a meteorological profile that reflects either real data or ideal data of the atmospheric condition. WRF has increasingly been used in both military and private meteorological fields and has also been adopted by the NOAA's National Weather Service (NCAR, 2012)2*". Based on abundant peer reviewed sources, this dataset presents an internationally respected source of meteorological data to accurately represent the meteorological conditions at the location of concern.

In addition to the reliability of our meteorological data source, we consider that controls that limit the use of EDN to conditions were there is some air movement mean that adding a permission control that requires site-specific risk assessments to be undertaken in addition to our modelling is redundant. In addition EDN is very volatile and will disperse and dilute quickly once the tarpaulin is removed from a stack. It is only during inversion conditions or when there is no air movement that there is any potential for EDN to "pond" in pockets or depressions.

The permissions control is also intended to protect sea bird colonies; however, ports are busy sites with a lot of machinery movement that can operate up to 24 hours a day. Consequently we consider that it is highly unlikely that any sea birds colonies occur proximal to the ports where fumigation will take place. The EPA Science Memo clearly states that the risks to birds flying over active fumigation operations are negligible. We therefore consider a permission assessing the location of sea bird colonies to be redundant.

Regional Councils determine the rules associated with agrichemicals and fumigants. Rules relating to fumigant use may deem the activity to be a permitted activity or they may require consent. In instances where a consent is required, the land/facility owner may hold the consent e.g. North Port or the service provider may be required to hold the consent e.g. Genera operating in Tauranga.

Essentially the EPA states that the controls associated with a registration are the bare minimum. Some Regional Councils use the EPAs decision and allow the chemical use as per the EPA’s controls. However, others place further controls and additional risk mitigating measures on the use of a fumigant. This often requires the fumigant to apply for resource consent for discharge of a fumigant to the atmosphere, and in granting that consent, the Regional Council may apply additional controls e.g. for methyl bromide, the Bay of Plenty Regional Council has extended the buffer zone from 50 m to 100 m.

In addition, individual Port authorities have policies that the fumigators must comply with. An example of North Port’s requirements was included in Appendix 5 of the February application.

11. Previous Application by BOC

Table 15 Previous application

Previous application	Comments
EPA staff report	This is the second application for approval of this substance in New Zealand. The first application, ERMA200203, was received in 2011 and subsequently withdrawn by the applicant.
WorkSafe	“*Reported percentages of residual EDN released on venting vary considerably. For example, the APVMA indicates that residual EDN can be between 8% and 39%, meaning 8-39% could be available for release to atmosphere on venting. This differs from the application (and Bruce Graham’s report), indicating residual EDN of between 1 and 10%. This variability is another reason to consider recapture*.”
Bruce Graham	
Draslovka	We note that the BOC application contained insufficient data to inform the decision making process. That application was withdrawn when we took over the license from BOC. This lack of data has been addressed in the new application.

11.1 Rationale for comments on the previous application

A fundamental concern about the advice provided in the WorkSafe document is the assumption that information presented in the 2013 Australian Pesticides and Veterinary Medicines Authority (APVMA) decision document is equivalent to the information submitted to the EPA by Draslovka.

The APVMA decision was based on paucity of data which was incomplete and in instances flawed. For example none of the recent toxicological or environmental data end-point concentration, permeability and modelling studies were available at the time.

The data to APVMA was provided by the applicant BOC (Aust) in an application to the APVMA in 2010. BOC also lodged a similar application with the EPA in New Zealand in 2011. That application was withdrawn by the EPA on request from Draslovka in 2016, after we took over the license from BOC. The EPA advised Draslovka in 2015 that," *based on the information currently held (submitted by BOC) and the significant data gaps about how to safely manage the substance, the staff advice report to decision makers would likely not support approval of the substance*".

Prior to the submission of the current application to the EPA, EPA staff indicated (in discussion with Draslovka) that there was no need to draw out the differences between the historic APVMA application and decision in the application Draslovka planned to submit because the EPA staff involved were well aware of the deficiencies of the information supplied by BOC to both regulators. Unfortunately, the WorkSafe advice document appears to consider the APVMA decision (and data) to be equivalent in all respects to the data provided by us in our 2017 application. This appears to have resulted in an overly cautious approach as WorkSafe has tried to account for apparent variability in the data.

11.2 APVMA reference to full scale log trials undertaken in Australia

For example the two Australian log trials undertaken by BOC produced data which differs significantly from the New Zealand results. This is primarily due to:

- A different approach to fumigating with EDN in Australia as compared to New Zealand. In Australia EDN was released under the tarpaulin and additional EDN was introduced to ensure a minimum level [high] was maintained for 6 hours after which ventilation commenced. There was no EDN standard available so BOC followed the methyl bromide standard. Subsequent evidence has shown that no topping up is required for EDN fumigation due to its excellent penetration into the timber.
- New Zealand fumigations consist of a single application of EDN at the beginning of a 24 hour fumigation [determined by efficacy trials] concluding by ventilation.
- The Australian trials were undertaken using debarked logs of an unknown species, whereas in New Zealand, the *Pinus radiata* logs used in the tests had bark on. Different species may influence the results i.e. the amount and rate of sorption, moisture content, etc. may vary.
- The first BOC test was conducted in a shipping container and was poorly run. Communication with one of the researchers has identified that the container was placed on uneven ground resulting in leakage from the unclosed doors. In addition, the

portable gas chromatograph that was used in the field was malfunctioning. These two factors resulted in significant and exaggerated atmospheric EDN readings outside of the container during the fumigation period.

11.3 End point concentrations and desorption

WorkSafe states "*the APVMA indicates that residual EDN can be between 8% and 39%, meaning 8-39% could be available for release to atmosphere on venting. This differs from the application (and Bruce Graham's report), indicating residual EDN of between 1 and 10%*".

In the more credible of the two field trials assessed by the APVMA, the EDN measured at the end of the 6 hour fumigation in Australia was ~13 % of the initially applied dose rate. This compares with the New Zealand laboratory work were 0.5% is consistently measured after 24 hour fumigation (Brierley et al. 2017). These results are in line with the decay curves and end points measured by Plant and Food in laboratory trials.

The APVMA states that EDN desorbs (i.e. is released from the wood) post fumigation and so 24 hours ventilation is required. This was based on an estimate provided on timber residues rather than a valid scientific desorption study. BOC did not submit desorption data, but rather relied on data from a grain residue study[20] which is not comparable.

In addition the New Zealand desorption studies show that less than 0.57 $g/m^3/h$ were released from pine logs during ventilation (Hall et al. 2014)[21] The same study also demonstrated that any post fumigation release occurs quickly: thirty minutes after venting commenced in these trials, EDN levels were too low to be measured accurately using GC.

[20] Smith *et al*. (2005) Devitalisation of imported feed grain by EDN fumigation. CSIRO Report

[21] 2014 MKD Hall, T Pranamornkith, AR Adlam, AJ Hall, DW Brash Simulated commercial fumigation of sawn timber and logs to verify the sorption desorption model of ethanedinitrile.

12. Revised Controls

The hazard classifications of EDN trigger a number of prescribed controls under the Act. In addition, controls under section 77A of the Act and in potential SWIs are proposed to mitigate the human health and environmental risks associated with EDN.

Exposure limits

WorkSafe New Zealand has proposed new Workplace Exposure Standard (WES) values for EDN of 3 ppm as a TWA and 5 ppm as a ceiling value.

Additional WorkSafe requirements

There is uncertainty regarding the amount of ammonia present at the end of fumigation and whether this poses a risk to workers or the environment. Depending on whether WorkSafe require scrubbing or recapture to occur, and the capability of the available systems, the presence of ammonia at the end of fumigations may not be an issue.

A Tolerable Exposure Limit (TEL) of ~~0.034~~ 0.56 ppm is proposed by the EPA staff. This is equivalent to 1.19 mg/m^3.

The EPA is required to set acceptable daily exposure (ADE) and potential daily exposure (PDE) values for new active ingredients that may become present in food, drinking water or other environmental media. This is to allow the EPA or other government departments to set standards or guideline values for food, drinking water or other media where necessary. However, as ethanedinitrile is not expected to become present in food or drinking water ADE and PDE values have not been proposed.

The prescribed controls allow for Environmental Exposure Limits (EELs) to be set for any component in a substance. With the proposed controls in place, the risks to the environment are expected to be negligible. Therefore, no EEL values are proposed at this time.

There are a number of requirements that fall under the jurisdiction of WorkSafe. Please see the WorkSafe assessment for these requirements. [It is noted that whether scrubbing or recapture is required will affect what the residual risks are and, therefore, whether the other controls are still needed to manage the risks]:

A number of provisions were identified in the EPA Science Memorandum as being required to adequately manage risks:

The WorkSafe report has identified a number of possible requirements, including

- ~~Scrubbing or recapture may be required~~
- Health monitoring
- Buffer zones ~~(the size of these depend on the other controls set)~~10 m and 20 m
- ~~Entry restrictions into the buffer zone and an REI~~
- Onsite monitoring will prevent entry to areas with high ppm

Additional controls and variations to prescribed controls

The following additional controls are proposed under section 77A of the Act to manage the risks of use of EDN:

- This substance must not be applied into or onto water
- Maximum application rate of 150 g EDN/m^3
- A use control limiting use to fumigation of timber and logs for export under tarpaulins
- Atmospheric conditions must be monitored and EDN must not be vented under very low wind speed conditions (less than 5 km/h) or under inversion conditions
- Fumigations must be undertaken only at locations where water bird colonies are not known to exist
- ~~A permission control~~
- The following limits are set for toxicologically relevant impurities in the active ingredient ethanedinitrile used to manufacture this substance: Hydrogen cyanide: 1 v/v maximum
- Label requirements that state the maximum application rate and the use controls
- Personal Protective Equipment must be worn by workers when they are within ~~20~~ 10 metres of log stacks being fumigated
- The concentration of EDN under the tarpaulin should be 700 ppm or lower before the removal of a tarpaulin from a fumigated log pile
- An air quality monitoring programme should be employed in the workplace.