IN THE MATTER	of the Hazardous Substances and New Organisms Act 1996 ("HSNO Act")
AND	
IN THE MATTER	of the Decision-Making Committee with delegated responsibility for powers and functions related to the hearing and deciding of applications under the HSNO Act to import EDN (Ethanedinitrile), a fumigant for use on timber/logs under commercial conditions (APP202804)
THE DECISION-MAKING COMMITTEE	John Taylor (Chair) Ngaire Phillips Kerry Laing

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EXPERT CONFERENCING JOINT WITNESS STATEMENT

TOPIC: AIR CONCENTRATION DISPERSION MODELLING

DATE: 15 OCTOBER 2018

PARTICIPANTS: Bruce Graham, Dennis Hlinka

DATE AND TIME OF CONFERENCING: 4 October 2018, 10am NZT

INTRODUCTION

A. This signed joint witness statement is provided in response to the Decision-Making Committee's Directions and Minutes dated 23 August 2018 and 14 September 2018.

B. This joint witness statement relates to the conferencing topic of **Air Concentration Dispersion Modelling**.

C. In preparing this statement, the experts have read and understood the Code of Conduct for Expert Witnesses as included in the Environment Court of New Zealand Practice Note 2014.

D. The experts identified Agenda items and then discussed them in turn, recording the following:

1. UNCERTAINTIES IN THE USE OF DISPERSION MODELLING

Issue: Is dispersion modelling an appropriate tool for assessing EDN releases from the fumigation of logs under tarpaulins?

Consideration: Atmospheric dispersion modelling has some inherent uncertainties but, in the absence of any reliable field monitoring data it is the only available option. The algorithms and dispersion parameters used in the modelling are generally based on conservative assumptions and this often results in an over-estimate of the potential downwind effects. However, that is not always the case. It is not possible to accurately quantify the uncertainties involved in most assessments.

The non-uniform and short-term nature of the releases from log fumigations will introduce additional uncertainties in the modelling results. This will only be of limited concern when considering 1-hour and 24-hour averages because of the ‘smoothing’ effect of the time-averaging. It would be more of a concern if the modelling was to be used for assessing potential exposures over periods of say 15 minutes.

Agreement/Disagreement: Dr Graham and Mr Hlinka agree that there will be uncertainties in the modelling results which cannot be quantified. Dr Graham believes that, on the basis of a precautionary approach, the modelling results should be evaluated using the typically applied uncertainty factor of ±2. However, Mr Hlinka’s view is that no additional reliability factor is required because the uncertainties are already covered by the inherent conservativism in the model itself and in the assumptions around specific input parameters, including the use of the Monte Carlo method for determining the fumigation start dates and times.

2. DISPERSION MODEL USED

Issue: Is AERMOD an appropriate model to use for the fumigation assessment?

Consideration: The use of AERMOD has been validated for a range of industrial source emissions and it is being routinely used for such assessments both within New Zealand and overseas. In addition, development work is currently under way in the USA to incorporate it into more specialised applications, such as in the model PERFUM, which is used for the assessment of field fumigation activities.

Agreement/Disagreement: Both experts agree that AERMOD should be accepted as a suitable model for use in the EDN assessment.

3. METEOROLOGICAL DATA

Issue: Was the modelling based on appropriate local meteorological data?

Consideration: The January 2018 version of the Sullivan modelling report indicated that they had difficulties in accessing suitable meteorological data for the Tauranga area and instead used a data file produced using the WRF modelling system. In his report, Dr Graham questioned what local data, if any, was used to produce the WRF files.

The following additional information has since been provided by Mr Hlinka: The data file produced by the WRF model can be described as a "pseudo station" of both surface and upper air data located directly at the log pile site in Tauranga based on 1-km gridded data. The gridded data is based on the geographically varying micro-physics of the atmospheric layers in response to the changes in heat and moisture fluxes over geographically varying surface features over both land and sea. This creates a reasonably site-specific meteorological definition of the atmosphere at the ground and through the various layers directly above the Tauranga site. The raw input data for the WRF model would have included that from two upper air monitoring stations located at Whenuapai and Paraparaumu, and any or all of the 7 fully automated surface weather observation stations operated by the NZ Meteorological Service, including the one at Tauranga airport.

Agreement/Disagreement: Both experts agree that the modelling was based on appropriate local meteorological data.

4. 1-HOUR VS 24-HOUR AVERAGE RESULTS

Issue: The reported 24-hour average results are higher than the 1-hour average results, which is the reverse of that usually observed with air modelling and monitoring data.

Consideration: When questioned on this, Dr Sullivan (Rotorua transcript, p233, lines 6 to 30) indicated that it was related to the high proportion of zero values in the hourly results. That explanation was confirmed by Mr Hlinka during the conferencing. However, Dr Graham is concerned that this suggests that the 95^{th} percentile values, as reported in the modelling, may not give a meaningful indication of the potential near-maximum 1-hour exposures. Mr Hlinka indicated that the 95^{th} percentile is the level typically reported in the USA, although the 98^{th} and 99^{th} percentiles are also considered in some instances. He has also produced a more detailed summary of the approach taken by the US EPA, which is appended to this statement as Attachment 1.

Dr Graham noted that a range of percentiles, up to and including the 99.9^{th} is recommended in the Good Practice Guide published by the NZ Ministry for the Environment. However, the latter is based on the use of a full year of meteorological data (ie 8760 hourly data points) which is not directly comparable to the randomized sampling approach used for the fumigation modelling. The actual modelling was conducted with a much larger data set consisting of a full 5-years of hourly meteorological data with randomized emissions. The 40 simulation runs over the 5-years is equivalent to 200-years of modelled randomized emissions. Dr Graham accepted that the 99.9^{th} percentile is likely to give an overly conservative assessment of the potential effects.

Agreement/Disagreement: Both experts agree that any future modelling should include reporting of the 98^{th} percentile for the hourly average result.

5. LOG PILE SIZES

Issue: What is the most appropriate log pile size for use in the modelling assessment?

Consideration: The modelling reported in the application was for a log pile size of 750 m^3, but Dr Graham suggested that a size of 1500 m^3 would be more appropriate. His figure was based on a review of methyl bromide fumigation data from a range of New Zealand ports, which he carried out for ERMA New Zealand in support of the reassessment of that fumigant in 2009. In response Draslovka arranged for a revised modelling assessment based on a pile size of 1000 m^3 (Sullivan report, August 2018). It was stated that this was based on Genera data for 2017, which showed a national average stack size of 1000 m^3. No actual data was submitted in support of that position and when questioned, Genera's Mr Self simply stated (Rotorua transcript, p353, line 16) that log stacks are currently up to 1000 m^3.

Agreement/Disagreement: Mr Hlinka was unable to comment on the most appropriate log pile size to be used in the modelling because he has no direct experience in that area. Dr Graham accepts that a 1000 m^3 limit may apply at the Port of Tauranga because of the space limitations at that site. However, that may not be the case at other locations, such as Picton, which is where the larger pile sizes were reported in 2009. He noted that this variation could possibly be addressed by requiring separate assessments for each port, such as would be required through the 'permission' provisions available under the HSNO Act.

The potential effects of the fumigant releases are directly related to the mass emission rate, so any increase in log pile size will result in a proportional increase in the potential effects, because of the increased quantities of fumigant being used. However, both experts agree that this would be best assessed through additional modelling, rather than by simple extrapolation, in order to account for any concomitant changes in the dimensions of the log piles, especially the height.

6. PILE SIZE TO BE USED IN MULTIPLE LOG PILE MODELLING

Issue: What log pile size should be used in modelling releases from multiple piles?

Consideration: Draslovka have questioned the use of the maximum pile size for all log piles in the modelling for multiple piles (eg. Wellington transcript, Gear, p50, lines 10 – 15). They argued that it was unlikely that all 30 log piles would be the same size and it may be more appropriate to use a lower average value. However, comparison of the modelling results for a single log pile and for multiple log piles shows that there is very little interaction between the releases from different piles. The results for multiple piles are approximately double those of the single pile, which is primarily due to having two adjacent piles ventilated within the same hour; ie. the hourly mass emission rate is doubled. Other than that, the contour lines show only minimal overlap between the three different groups of log piles.

Agreement/Disagreement: both experts agree that the modelling results for multiple log piles are not unduly affected by assumptions around the size of individual log piles, and no additional assessment of this aspect is required.

7. EDN RELEASE HEIGHT

Issue: What is the most appropriate release height for use in the modelling assessment?

Consideration: The modelling reported in the application documents was based on a log pile height of 2.5 metres but Dr Graham pointed out in his report that the piles could be much higher than that. In response to this Draslovka arranged for the revised modelling to be carried out using a pile height of 3.3 metres (August 2018 modelling report). From information presented at the hearing it appears that the practice used at the Port of Tauranga is to stack the logs up against a 6 metre high support at one end and the actual pile height will vary along the length of the pile (Rotorua transcript, McConville, p200, lines 18 – 21).

Agreement/Disagreement: Neither of the experts has access to detailed information on log pile heights and they are mainly reliant on the estimates provided by others. In reality the EDN releases will occur from ground level up to the top of the pile, but Mr Hlinka noted that this is addressed to some extent in the modelling, which automatically sets the release height at 50% of the log pile height. The full vertical extent of the emissions of the log piles was also addressed in the modelling by including a sigma-Z distribution centered at the modelled release height.

Both experts agree that the log pile height can have a significant influence on the modelling results, with increases in the EDN release height leading to lower overall effects. Given the possible range in pile sizes they believe it would be appropriate for any additional modelling to be carried out using two log pile height options of 2.5 and 5 metres.

8. EDN LOAD FACTOR

Issue: What load factor should be used in determining the probable end-point EDN concentration and the resulting mass of EDN released in the ventilation phase?

Consideration: As referred to in the application, the load factor is a measure of the proportion of space taken up by the logs underneath a tarpaulin. The stated load factor has varied from 40 to 50% (Hall, *et al*, October 2016[1]), 50% (Brierley *et al*, July 2017[2]), and then 55 to 58% (Draslovka response to the EPA Science Report). The latter figures were derived from discussions with Genera (eg. Rotorua transcript, Swaminathan, p208, lines 19 to 22) and a value of 55% was used for the August 2018 modelling. However, Dr Graham's understanding is that load factors are not routinely measured during fumigations and, in reality, would be extremely difficult to determine. When questioned on the matter Mr Self of Genera simply referred to a 'rule of thumb' factor of 1.7 (0.58 is the reciprocal of 1.72) which is used by the industry in estimating the quantity of logs that can be placed in the hold of a ship (Rotorua transcript, p 354, lines 14 to 31). This bears no relationship to any measured load factor for log piles under tarpaulins.

Agreement/Disagreement: Mr Hlinka was unable to comment on this matter because he has had no involvement in this aspect of the applicant's work. Dr Graham believes that, in the absence of any meaningful real-world data on load factors a value of 50% should be used simply on the basis that it represents an approximate mid-point of the available estimates.

9. EDN RELEASES DURING THE FUMIGATION PHASE

Issue: Are the EDN releases during the fumigation phase likely to cause any significant adverse effects?

Consideration: Small amounts of EDN may be released by permeation through the tarpaulin during the fumigation phase. The August 2018 modelling was based on an hourly release rate of less than 10 $\mu g/cm^2/sec$, which is considerably lower than the release rate of 333.3 $\mu g/cm^2/sec$ during the ventilation phase. In addition, Draslovka pointed out that the estimated permeation rate was conservative because it was based on steady state laboratory concentration data, rather than the reducing concentrations that would occur under a tarpaulin (eg. Rotorua transcript, Swaminathan, p206, line 34 – p207, line 14).

Agreement/Disagreement: Both experts agree that the EDN releases during the fumigation phase are unlikely to make any significant contribution to the potential adverse effects from the overall fumigation operation.

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1 Fumigation monitoring – Fumigas EDN commercial log trial to determine ethanedinitrile emissions. Hall. *et al*, Plant & Food Research, Auckland, October 2016.

2 Ethanedinitrile (EDN): A new fumigant for phytosanitary treatment of New Zealand export logs. Brierley, *et al*, Plant & Food Research, Auckland. July 2017.

10. EDN RELEASES DURING THE VENTILATION PHASE

Issue: What residual concentration should be used for the EDN releases during ventilation?

Consideration: The January 2018 modelling was based on a residual EDN concentration under the tarpaulin of 660 ppm, immediately prior to the start of the ventilation phase. This was challenged by Dr Graham on the basis that it was based on an artificial adjustment of laboratory results that was not supported by any real-world measurement data. In addition, it is highly dependent on the assumed load factor. Dr Graham noted in his report that the adjustment was not insignificant (5216 ppm reducing to 660 ppm) and the original experimental data had a high level of uncertainty (5216 ± 4182ppm). The August 2018 modelling report was based on an even lower residual concentration of 376 ppm. The residual EDN concentration is used in conjunction with the load factor to determine the EDN mass emission rate in the ventilation phase.

It should also be noted that this issue would become largely irrelevant if the EPA decides to specify a maximum EDN concentration limit that should be achieved prior to the start of ventilation. Dr Graham had suggested a limit of 700 ppm and Draslovka appear to have accepted that in their submissions.

Agreement/Disagreement: Mr Hlinka was unable to comment on this matter, while Dr Graham pointed out that the issue could be most easily addressed by using the HSNO controls to specify a maximum EDN concentration limit prior to ventilation. Any additional modelling should be based on the proposed limit.

11. OVERALL CHANGES TO THE MODELLING RESULTS

Issue: How will the modelling results be affected by the various changes in input parameters discussed above?

Consideration: Some of the changes discussed above will have an effect on the modelling results. This applies in particular to the values adopted for load factor, residual EDN concentration, and log pile size, and also the consideration of other percentiles of the results.

Agreement/Disagreement: The experts agree that additional modelling will be necessary if the Decision Making Committee wishes to consider the possible effects of changes to any of the input parameters discussed above.

12. APPLICABILITY TO OTHER TYPES OF FUMIGATION

Issue: Can the modelling results be used to predict the potential impacts from other forms of fumigation, including logs placed in ship holds or shipping containers, or fumigation of other commodities in fixed fumigation chambers.

Consideration: The dispersion characteristics for each of these sources would be totally different from those of the log piles.

Agreement/Disagreement: The experts agree that the modelling results for log piles under tarpaulins cannot be used to predict the potential impacts from other forms of fumigation because of the different dispersion characteristics of the EDN releases.

DATE: 15 OCTOBER 2018

[redacted]

Dennis Hlinka

[redacted]

Dr Bruce Graham

Attachment 1: *'Percentile Limits Currently used by the USEPA in their NAAQS and Risk Assessment Guidelines: Summary prepared by Dennis Hlinka'*