RESPONSES TO QUESTIONS FROM THE DMC ON EDN AIR CONCENTRATION DISPERSION MODELLING

On 18 December 2018, I took part in a teleconference with the Decision Making Committee to discuss a number of points that had been raised by members of the committee in relation to the EDN air concentration dispersion modelling. The discussion was based around a number of questions that had been circulated in advance of the meeting. These questions are reproduced below along with brief summaries of my responses.

1. In Bruce Graham's original comments he said that the modelling should have been done with a volume source. There is no comment on this in the Joint Witness Statement (JWS). Was it concluded this would not make a difference/was unnecessary or easier to do further work on the same basis as existing? Was there any discussion on alternative models that could have been used?

The expert caucusing did include some general discussions about possible variations to the modelling including changes to the source characteristics and the use of shorter time periods but these were not explored in any detail. Similarly, there was some discussion of the use of alternative models but it was agreed that AERMOD was a suitable choice for the assessment.

2. In (JWS) paragraph 6, it states that 'the results for multiple piles are approximately double those of a single pile, which is primarily due to having two adjacent piles ventilated within the same hour. Other than that the contours show only minimal overlap between the three different groups of log piles'. This indicates that the use of the term 'multiple piles' is potentially misleading as the ventilation from sets of piles at different locations are essentially independent and it is irrelevant if there are 10, 20 or 30 piles – the results are essentially for 2 piles. It also brings into question the random nature of start and thus ventilation times. Using the postulated scenario that there are 2, 4 or 6 fumigations/hour over 5 hours it means the first fumigation occurs between 7am and 2pm and the others are fixed by this. The random start times are for ventilation.

Should consideration be given to ventilation of more than 2 piles/hour within a particular set and whether the findings are also true at shorter time periods?

The above statements about the randomness of fumigation and ventilation start times are correct in that the possible range of fumigation times is limited by the operational window applied to the ventilation operations at the Port of Tauranga.

The time taken to remove a tarpaulin is typically 10 to 15 minutes, which means that about 4 to 5 piles can be uncovered in an hour. However, these can be distributed across multiple locations rather than all being adjacent to one another. Consideration could be given to ventilation of more than 2 adjacent piles in an hour, although it was argued by the applicant that this was very unlikely to occur at the Port.

The matter of using shorter time periods is addressed in the next question.

3. What is meant by a 1hr and 24hr average and how are they derived?

At the hearing and in the JWS (paragraph 4) the question was asked regarding why the 24hr average was higher than the 1hr average. In both instances the answer provided was that it was related to the high proportion of zero values in the hourly results. There is not a great difference between the 1hr averages and the 24hr averages so would have to conclude a fair proportion of zero values in the 24 hr average data set also. How do the zero values arise and why there are so many of them and what

effect do they have on the percentile calculations? This is borne out by Bruce Graham's concern that the 95th percentile may be an underestimate of exposure values. There is also a concern around shorter time intervals, which are particularly relevant for port workers. Why are there no modelling results for intervals less than 1 hour?

The modelling is based on 1-hour meteorological data which means, in very simple terms, that there is a single set of meteorological parameters (wind speed, wind direction, atmospheric stability, etc) applied to each hour of the day. As a result, the model calculates a single concentration value at each individual receptor point for each hour of the day. Thus, the so-called hourly averages are in fact single values in the raw modelling results. They only become averages (or percentiles) if the results from multiple modelling runs are combined.

The 24-hour averages are simply calculated by averaging the 1-hour values for a 24-hour period.

Most of the zero results are produced by receptor positions away from the wind line that applies in any hour. For example, if the wind direction was exactly from the north (ie. 0 or 360 degrees) all of the receptors outside of a narrow arc centred on the southerly direction (180 degrees) would have zero results for that particular hour. The width of the arc is determined by the extent of sideways dispersion applying in that hour.

When modelling is done for a full year of hourly meteorological data there will be 8760 individual results for any receptor location. However, if the wind only blows in the direction of that receptor for, say, 1% of the year, we would only expect to see about 88 positive results for that location, and about 8672 zeroes. On the other hand if the wind blew in that direction for 10% for the time, we would expect to see about 876 positive results. (Note: The wind rose given in Figure 4 of the August 2018 EDN modelling report shows wind frequencies varying between about 1 and 6% for each 10 degree wind sector.)

Percentile values are commonly used in the reporting of modelling results. In most cases the interest is in 'worst-case' values, but it is argued that the absolute maximum result (ie. 100 percentile) represents very rare dispersion conditions that are unlikely to be experienced in real life. The 99th percentile (ie. the 9th highest value out of 8760 results) is usually taken as giving a better indication of the potential 'worst-case' effect. The use of percentiles in reporting of the EDN modelling is discussed further in the next question.

The 1-hour time period used for reporting of the modelling results is determined by the time period of the meteorological data. A new meteorological data set would have to be developed if modelling results were required for shorter time periods, but this would involve significant time and cost.

4. Also in JWS (paragraph 4) -with 5 years of meteorological data available not able to follow why it was considered necessary to do 40 simulated runs. Why was this done and how (particularly relevant to multiple stacks and time of day for fumigation and ventilation) and how does it affect the results?

For the single stack scenario each modelling 'run' was effectively only concerned with a single 24-hour period chosen at random from within each year. The model may have been run for the full 5 years of meteorological data but there were no EDN releases for most of that time. For multiple stacks each 'run' would have extended over a slightly longer period to accommodate the up to 5 hours required for fumigation/ventilation of all of the log piles.

In both cases the 40 simulations were used to build up the number of results possibly available for each receptor point to allow for a statistical analysis of the data. The alternative approach would have been

to do separate simulations for a start time based on every hour across the entire 5 year period (apart from those times falling outside the permitted operational window). However, this would have required unreasonably long computing times.

The use of only 40 simulations raises the issue of percentile reporting because there can be far fewer positive results at individual receptors. For the single stack scenario the modelling runs will cover a total of 4800 individual hours (Forty 24-hour periods over each of 5 years). However, the EDN releases only occur in the final hour of each of these 24 hour periods, so the maximum number of positive results reduces to 200. Applying the wind frequency adjustments given for question 3 above reduces the number of possible positives to between 2 and 20, for a frequency range of 1 to 10%. Clearly this places significant limitations on the use of percentiles for data reporting.

5. In considering the array of receptors for the multiple pile fumigations is this a fixed set irrespective of which pile is being ventilated and what the wind direction may be? As an example, if the northern most pile in a set of 10 is being ventilated and the wind is blowing from the north, then the closest receptor downwind is more than 60m away. It is likely that not much of the dissipating EDN will move in a southerly direction due to the barriers in this direction but will flow in other directions. How is this determined?

It is easiest to think of the modelling as having been done using two sets of receptors. The first is a 10m by 10m grid across the entire modelling domain, which would have been needed to generate the contour plots given in Appendix B of the August 2018 modelling report. The second set is the individual receptors shown in Figure 5 of that report and these were most likely used to produce the individual maximum values quoted in Table 3 of the report.

6. The related question is how does the model deal with the fact that upon ventilation (an air/EDN mixture that is not buoyant and modelled as releasing at half the stack height) there is a wall 1m away and the wind direction may be directly towards the wall?

In very simple terms the model was based on a fixed rate of release from a flat surface suspended at 2.5 metres above a totally flat plain with no surrounding structures or landforms. It is possible to allow for these types of complications in the modelling but they were not considered here.

7. Modelling assumes all the EDN is vented within the first hour. How is this dealt with? Is there an assumption that there is a linear decrease in concentration from that assumed at the initiation of ventilation to zero after 1 hour, some other rate of decrease that assumes more rapid decrease at shorter times and a slowing decrease towards the 1 hour mark or something else?

The hour of release is not broken down into shorter intervals. This links back to the discussion under question 3 where it was noted that each one hour of meteorological data produces a single data point for each receptor.

Bruce W Graham

29 January 2019