Re: Peer review of Public Health Assessment for Ambient Air Quality in Claremont, Sullivan County, New Hampshire

August 26, 2009

To Whom It May Concern:

I have been asked to provide a peer review of the public health assessment addressing ambient air quality in Claremont, Sullivan County, New Hampshire (prepared by the New Hampshire Department of Environmental Services Environmental Health Program, under a cooperative agreement with the U.S. Department of Health and Human Services Agency for Toxic Substances and Disease Registry). I am an associate professor of environmental health and risk assessment at Harvard School of Public Health, with research expertise in air pollution risk assessment. This review should be considered as my personal opinions on the content of the report, rather than as an official evaluation from the Harvard School of Public Health. The review is also strictly on the scientific merits of the report from the perspective of risk assessment methods.

The version of the document that I reviewed was dated March 2, 2009. My review focused on two aspects of the report:

1) Does it reflect the best available scientific evidence regarding the health effects of environmental contaminants?
2) Does it provide the necessary insight to draw conclusions about nearby point sources, including the Wheelabrator, Claremont facility (which appears to be of greatest interest to the local community and within the report)?

As a general observation, the orientation of the report is largely around ambient air quality rather than any marginal contribution of the Wheelabrator facility (or other point sources). This is not a conventional form of risk assessment for a point source – more typically, fate and transport models would be used to determine the marginal[1] contribution of a point source to concentrations, which would then be used to quantify any health risks across a broad population base. However, this orientation is reasonable as part of a first-pass screening assessment, as if there were no health effects attributable to ambient air pollution from all sources, there would clearly not be any health effects attributable to an individual source. This orientation is more problematic for pollutants for which no population threshold is considered to exist (such as mutagenic carcinogens), or for criteria pollutants, for which National Ambient Air Quality Standards (NAAQS) generally act as putative population thresholds but where health effects are often observed below the NAAQS. These pollutants are generally handled by estimation of health risks and examination of those risks relative to comparison values, which was done to some extent in this report. However, as described in more detail below, the way in

[1] Note that "marginal" in this case refers to the incremental contribution of a single source above and beyond the contribution of other sources, not the colloquial use of the term.

which these pollutants were addressed in the report was at times non-standard, with some internal inconsistencies.

Focusing first on the health risk assessment methods proposed in Section 4.1, the analysis is framed by using health-based comparison values (CVs), which are described as concentrations considered to be "harmless". This includes reference dose/reference concentration (RfD/RfC [2]) values for non-cancer effects, as well as cancer risk evaluation guides (CREGs) that reflect the concentration estimated to result in one excess cancer per million people exposed over a lifetime. This is an appropriate and conventional risk assessment framework, but there are a few aspects of the methodology that are not appropriate or do not reflect the stated methods. First, for RfD/RfC assessments, one would conventionally consider all pollutants simultaneously with a similar mechanism of action, with a default assumption of additivity of hazard quotients (the ratio between the observed dose/concentration and the RfD/RfC). This was apparently not done in this report for non-cancer effects. For cancer, as described in more detail later, concentrations at times exceeded the CREGs but were dismissed nevertheless, which is inconsistent with the stated methodology. The direct use of LOAELs (lowest observed adverse effect levels) without adjustment is mentioned in this section but is not scientifically appropriate – LOAELs and NOAELs (no observed adverse effect levels) are used to derive RfD/RfC values, but are not used by themselves for human health risk assessment, as they ignore human heterogeneity in response and other standard uncertainty factors.

Considering the methodology for addressing the potential pollutants of interest (Section 4.4), to evaluate effects of mercury and dioxins/furans, the analysis uses atmospheric dispersion models to determine "worst-case" ambient air levels of these pollutants. There are two significant flaws with this approach. First, while detail is lacking, it appears that DES only modeled contributions from a handful of local facilities, which is not appropriate when considering non-cancer effects, as background concentrations matter. Second, and perhaps more significantly, both mercury and dioxin/furans have the vast majority of their exposure through non-inhalation pathways, with bioaccumulation in the food chain. In each case, even for air emissions, most of the exposure is through other pathways, and this has been ignored. Research by Tom McKone and colleagues [3] has shown that the population exposure per unit emissions to the air of dioxin is 3-4 orders of magnitude greater than for inhalation-only pollutants, because of the non-inhalation pathways, but this has been omitted from the analysis. While this is clearly complex to model reasonably, and conducting a full multi-media model would have been beyond the scope of the report, this approach significantly understates the possibility of health risk for these pollutants, a fact that is never mentioned in the report.

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[2] A reference dose/reference concentration is defined as a quantity that is likely to be without an appreciable risk of deleterious effects, including for sensitive subpopulations.

[3] M.J. MacLeod and T.E. McKone. Overall Multi-Media Persistence as an Indicator of Potential for Population-Level Intake of Environmental Contaminants. *Environmental Toxicology and Chemistry*, **23** (10): 2465-2472, 2004.

Turning to the results section, the use of the LOAEL to evaluate the likelihood of health risks from sulfur dioxide (Section 5.2.1) is inappropriate, as this ignores uncertainty factors (which in this case reflect human variability in response as well as the use of a LOAEL rather than a NOAEL (no observed adverse effects level)). The MRL is the minimum risk level derived from the LOAEL, which is actually applicable to the general human population. The presence of measurements above the MRL does not necessarily mean that there will be health effects from sulfur dioxide, but it is the appropriate comparison value. I agree that sulfur dioxide is not likely a significant contributor to health outcomes in Claremont, but the methodology used to reach this inference needs to be scientifically valid. Comparing sulfur dioxide levels between the Claremont monitor and Manchester/Portsmouth monitors is somewhat helpful in contextualizing the measured levels, but is being used to argue that air pollution levels are not problematic in Claremont given lower levels than Manchester/Portsmouth, which is not meaningful. It is possible for levels to be higher in Manchester/Portsmouth but for there still to be effects in Claremont. Finally, the ambient air comparison (Section 5.2.1.5) is essentially meaningless given the tiny number of hours when boilers were offline and the fact that atmospheric conditions (like temperature or precipitation) were not controlled in the analysis. This analysis is later used to rebut community concerns but has limited scientific validity.

For the other criteria pollutants (Section 5.3.2 – Section 5.3.4), similar comments apply as for sulfur dioxide – the comparison with Manchester and Portsmouth is largely irrelevant to the specific question of whether facilities in Claremont contribute to health risks.

As mentioned above, Table 5-14 illustrates that multiple air toxics are above their cancer comparison values, which by itself would indicate the need to proceed to an evaluation of the marginal contribution of the facilities of concern to ambient concentrations. However, this is not what was done. Similarly, as mentioned above, the non-cancer comparison values are not used appropriately, as the hazard quotients should be summed for pollutants with similar mechanisms of action. The importance of this is illustrated by the EPA National Air Toxics Assessment (NATA). According to the 2002 NATA, the respiratory hazard index for Sullivan County is approximately 2.7 [4], indicating that the combination of air toxics with respiratory effects exceeds the combined comparison value and that some health risks might be anticipated. While this is driven largely by pollutants such as acrolein, which may not be important for Wheelabrator and other point sources, it implies that a source that contributes to concentrations of air toxics with respiratory mechanisms of action would have some marginal contribution to health risk.

The inhalation-only approach for mercury and dioxin/furans (Section 5.2.5.2) is non-informative, since it ignores other exposure pathways for the air emissions and appears to ignore background concentrations for the non-cancer CVs. The inclusion of monitoring data for dioxins/furans is helpful, but still does not address the bioaccumulative nature of dioxins.

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[4] A hazard index greater than 1 is considered to indicate the possibility of health effects, whereas health effects are considered unlikely for a hazard index less than 1.

Turning to the public health implication (Section 6), the framing of the sulfur dioxide data remains problematic, as the MRL is presented as being conservative relative to the LOAEL (which is also presented as being conservative), whereas standard risk assessment practice would never use a LOAEL directly without consideration of human heterogeneity in response or other factors (if nothing else, the NOAEL is generally used as the point of departure when available, not the LOAEL). The summary of particulate matter evidence is thorough and appropriate, but does not reflect the fact that epidemiological evidence shows health effects below the NAAQS (and indeed, below the recommended standards by the Northeast States for Coordinated Air Use Management, mentioned in the report). This would imply that marginal contributions of individual facilities to particulate matter concentrations would have some marginal health implications – the impact may be small from any one facility, but it is not likely to be zero. The summary of ozone evidence is reasonable, but similarly doesn't acknowledge the possible health effects of marginal changes in exposures below the NAAQS.

For the air toxics evaluation (Section 6.1.5), there are logical inconsistencies with the stated framework of the report. For example, benzene is stated to have concentrations well in excess of its CV, with a cancer risk greater than 1 in one million, which would seem to indicate exposures of concern given the framework of Section 4.1. However, the criteria have seemingly changed by this section, and the risk is described as having "no detectable effect on cancer rates in the Claremont area now or in the future". Even if correct, this is not a relevant or appropriate criterion – for a population of approximately 15,000 people, a "detectable" impact would need to be many orders of magnitude above the common risk levels of concern. No regulatory mechanism or risk assessment approach would use this logic, which essentially would say that larger health risks are allowed for smaller populations (with essentially any health risk being OK for a very small community). For air toxics, the question is not whether effects could be detected, but whether they exceed CREGs, which they do in this case. That does not mean that the Wheelabrator facility by itself exceeds CREGs, but emphasizes the limitations of the framework of this report. The same issue exists for all air toxics, and the non-cancer comparisons are taken singly without consideration of background concentrations or additive effects for pollutants with similar mechanisms of action (e.g., formaldehye's and acetaldehyde's contributions to respiratory health effects). Parenthetically, it is also unclear how multiple pollutants are stated as having levels exceeding the cancer CV (risk of 1 per million) but are then described as having an excess cancer risk of less than 1 per million.

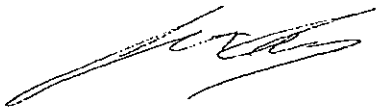
In summary, this DES/ATSDR report used a somewhat non-standard risk assessment approach, focusing on whether ambient air in Claremont had any health effects rather than on whether a facility of concern contributed significantly to health effects. While this would have been a good strategy had the report (and other evidence) concluded that there were no health risks, this was not as informative given the existence of health risks at baseline. Because previous assessments of air toxics risks (like the 2002 NATA) have clearly shown cancer and non-cancer risks at current ambient levels in Sullivan County, and because of the likelihood of health risks from particulate matter and ozone at current

levels of exposure, this framework proved problematic, and led the authors to use internally inconsistent logic (e.g., stating that the critical value for cancer is 1 per million, then stating that levels above 1 per million are not important if the increment could not be "detected"). The dismissal of effects from bioaccumulative compounds based on direct inhalation risks is also not appropriate.

To be clear, my critique of this report does not imply that the Wheelabrator facility contributes substantially to health risks in Claremont – this may or may not be the case. What it does imply is that the methodology used in the DES/ATSDR cannot answer this question readily, and a more appropriate methodology would have modeled the marginal contribution of Wheelabrator to levels of key pollutants and quantified health risks using standard risk assessment practices.

Thank you for your consideration of these comments.

Sincerely,



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