

May 5, 2006

**NESCAUM Response to April 21, 2006 Letter of Philip H. Gitlen, on Behalf of Central Boiler, Inc., re: Assessment of Outdoor Wood-fired Boilers**

The following are NESCAUM's responses to each comment raised in the letter of April 21, 2006 sent by Philip H. Gitlen of Whiteman Osterman & Hanna on behalf of Central Boiler, Inc. NESCAUM arranges the following responses according to the order the April 21 letter raises each issue.

Before addressing each comment given under the bold headings of the April 21 letter, we wish to correct the misunderstanding in the letter's second paragraph asserting that NESCAUM's report "was prepared to convince 'policymakers' that outdoor wood boilers ('OWBs') must be either banned or severely regulated." As the opening sentence of the report's Executive Summary states, the report "was undertaken by NESCAUM ... to provide policymakers with an assessment of concerns relating to the growing use of outdoor wood-fired boilers[.]" To this end, the Executive Summary concludes in its final sentence, "NESCAUM believes that states should take action immediately to control OWB emissions by establishing technology-forcing standards that will lead manufacturers to develop cleaner burning OWBs." The NESCAUM report lists a number of recommendations at the end of Section 7. These recommendations include setting emission limits, performing further studies, and developing additional tools for the states. None of these are outside the standard scope of approaches used with other types of air pollution sources. Banning OWBs is listed in Section 6.1 among the various control strategies available to regulatory agencies that the report provides for informational purposes. Banning OWBs, however, is not among the recommendations that NESCAUM makes in Section 7.

**Cover Photo**

The report contains no text stating the cover photo is of a Central Boiler product, nor does it make any description of its operating condition or the characteristics of its smoke. Regardless, the Michigan Department of Environmental Quality (MI DEQ) provided the photo to NESCAUM as showing primarily smoke and not steam. The photo also appears publicly on a MI DEQ website in a group of OWB photos under the heading "Outdoor Wood Boiler photos – the smoke is not uncommon."<sup>1</sup> The photo was taken by staff at MI DEQ certified in Method 9, the EPA test for visually determining the opacity of emissions from stationary sources. It is consistent with many similar photos of outdoor wood boilers (OWBs) obtained by enforcement staff throughout the country documenting smoke under normal operating conditions. For example, several such photos appear in the New York Attorney General's report on OWBs that NESCAUM cites in its report.

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<sup>1</sup> Michigan Department of Environmental Quality, *Outdoor Wood Boilers – the smoke is not uncommon*, [http://www.michigan.gov/documents/Outdoor\\_Wood\\_Boiler\\_photos\\_142274\\_7.pdf](http://www.michigan.gov/documents/Outdoor_Wood_Boiler_photos_142274_7.pdf).

### **Comparing Rates of Emissions**

The NESCAUM report makes comparisons on a grams per hour basis because it is the most appropriate approach for understanding various sources' impacts on ambient air quality in the context of public health. A rate in grams per hour better reflects the total pollutant loadings into the air over time to which the public is potentially exposed. Comparisons based on consumed fuel in residential settings do not adequately differentiate between smaller (e.g., residential stoves) and larger (e.g., outdoor wood boilers) air pollution sources from this public health point of view. While the April 21 letter expresses a preference that emissions be compared on the basis of "per unit of consumed fuel (i.e., kilogram of wood)," the NESCAUM report clearly explains on page viii the reasoning for making comparisons on the grams per hour basis (including comparisons to oil-fired and natural gas furnaces, not just residential wood stoves).

### **The NESCAUM Report's Statements Regarding PAHs**

The April 21 letter takes issue with the NESCAUM report's statement on p. vii, "There is a lack of information relating to air toxic emissions, such as polycyclic aromatic hydrocarbons (PAHs), polycyclic organic matter (POM) and dioxin." Based on the publicly available information accessible to NESCAUM at the time of writing the report, there was only one test on two units, which is consistent with the report's statement of a "lack of information." However, the combustion characteristics of OWBs, as described in the report, are of the type that can lead to formation of PAHs. The EPA data cited in the April 21 letter comparing PAHs between OWBs and wood stoves supports this statement.

With regard to the comparison of PAH emission rates between the OWB and the certified wood stoves, we note that the text accompanying Table 4-5 of the EPA study cited in the April 21 letter states:

The data presented in Table 4-5 were originally generated by different researchers using a variety of sampling and analytical methodologies. A number of assumptions had to be made to "normalize" the data for comparison. Consequently, only order of magnitude differences should be considered significant.<sup>2</sup>

### **Emission Rate Comparisons and EPA Method 28**

The NESCAUM report takes emission rates compiled and presented on the website <http://www.burningissues.org/comp-emmis-part-sources.htm> (as given in the accompanying footnote in this section of the NESCAUM report). As seen from the citations on this website, the rate for the certified wood stove comes from averaged field measurements. Because NESCAUM obtained its OWB emissions rate in a field measurement, it is appropriate to compare the NESCAUM field measurement with field measurements of wood stoves. Therefore, the emission rate comparison is not from the lab-based EPA certification Method 28, rather it is from actual field measurements.

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<sup>2</sup> Valenti JC, Clayton RK. Emissions from Outdoor Wood-Burning Residential Hot Water Furnaces. EPA Project Summary, EPA/600/SR-98/017. U.S. EPA, National Risk Management Research Laboratory: Cincinnati, OH 1998, p. 24.

### **Operation in Cycles**

A wood stove appliance's combustion air control is through manual operation by the user to regulate the appliance's heat output, which is based on the user's comfort requirements and space heating needs. EPA-certified appliances are designed to operate cleanly at the long burn time and low heat output setting in order to accommodate the user's needs during overnight burns, and to reduce pollution these operating conditions can generate. In the OWB case, however, the control and restriction of combustion air are engineered into the product's design and operate automatically without user control based upon the temperature of the water jacket or heat exchanger. The ability of the user to control or correct smoldering fires has therefore been intentionally eliminated from this type of appliance by design.

### **Stack Heights**

The April 21 letter, by citing the practices of one company, does not contradict the NESCAUM report's finding that "stacks from OWBs, as per manufacturer's installation instructions, *are usually* less than 12 feet from the ground ..." (italics added). This statement encompasses all manufacturers and is not specific to Central Boiler. This general statement is consistent with information from an EPA-sponsored study stating most outdoor wood boilers come with 8- to 10-foot stacks that are relatively low compared to conventional wood stove installations.<sup>3</sup> Even a stack height of 12 to 13 feet is relatively short when most wood stoves are required to have stacks 12 feet higher than the roofline.

### **Secondary Combustion Design**

The NESCAUM report states that *most* units do not have secondary combustion or control technologies. This is a general observation and not specific to any individual company. While Central Boiler OWBs may now have units with this feature, this does not represent the design of all manufacturers, nor include older models that are still in use. Furthermore, NESCAUM would appreciate any data Central Boiler has to show that its baffle design substantially reduces overall emissions.

### **Complaints in Vermont after Siting Regulations Adopted**

The April 21 letter misinterprets the *total number* of complaints since 1997 referred to in the report as an assertion on changes in the *annual rate* (number per year) of complaints registered. The statement properly read indicates that OWB complaints to the Vermont Air Pollution Control Division (APCD) continued even after Vermont established its 1997 OWB siting regulation. We note that even if looking at annual rates, the number of complaints that the letter indicates Vermont received in 2004 and 2005 is inaccurate. Specifically, the letter lists the number of complaints received during all of 2005 as three, but this number represents only part of the year. By the end of 2005, the Vermont APCD had received nine formal complaints

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<sup>3</sup> Valenti JC, Clayton RK. Emissions from Outdoor Wood-Burning Residential Hot Water Furnaces. EPA Project Summary, EPA/600/SR-98/017. U.S. EPA, National Risk Management Research Laboratory: Cincinnati, OH 1998, p. 1.

regarding outdoor wood boilers, all but one of which involved concerns about smoke. One of the 2005 complaints concerned the illegal installation of an OWB. Also, there were actually seven complaints received in 2004 regarding smoke from five different OWB units. In addition, the Vermont APCD received other “complaints” or inquiries from citizens who are reluctant to file formal complaints against their neighbors for various reasons but who are sometimes very concerned about the smoke and health impacts. The complaints mentioned above do not include the testimony by complainants at the two hearings conducted by the Vermont APCD in fall 2005 on its proposed rule on this subject.

### **Central Boiler’s Manufacturing Capacity**

The NESCAUM report presents estimates based upon available data drawn from statements made by Central Boiler in the printed media and in personal conversations with NESCAUM staff and state regulators. The report identifies the media sources in footnotes 14 and 15. The news article of footnote 14 quotes a co-owner of Central Boiler as saying in October 2005 that Central Boiler’s production capacity has doubled over its previous high. In the article cited in footnote 15, the same person states that Central Boiler’s peak production in 2004 was 200 units a week, and it has room to make 1,000 units a week. Because the weekly versus annual distinction and the difference in years has apparently caused confusion in how the report made its estimates, NESCAUM will re-phrase the text of the report to more clearly reflect the basis from which the report draws upon in making the estimates.

NESCAUM had asked for detailed manufacturer data that had been previously provided to the New York Attorney General’s Office and EPA, but Central Boiler and other manufacturers claimed confidential business information privileges and blocked NESCAUM from reviewing the data for its report. If this information were to become available, NESCAUM will review it and make appropriate revisions, if warranted.

### **EPA Test Data**

The April 21 letter identifies a typographical error in the NESCAUM report regarding an inadvertent reversal in the company names in the discussion of EPA’s test data on page 5-1. The EPA-sponsored study’s test results refer to the units as Furnace A and B and NESCAUM will change that sentence to reflect this and remove mention of the units’ manufacturers.

To date, there are no conclusive data that prove that the use of oak cordwood (as used in the EPA OWB test) over Method 28’s use of Douglas fir in its dimensional lumber form yields widely different results. It is the belief of several state testing experts, based on their experience, that Method 28’s use of dimensional Douglas fir may yield higher emission rates compared to oak cordwood due to the higher resin content of softwood, which tends to volatilize faster.

With regard to the use of the air damper, it is our understanding that the testing facilities use the air damper to control the burn rate for each of Method 28’s four burn categories to mimic different heating demands, in the same manner that the heat exchanger is used to maintain the heat draw in the OWB test. Method 28 does allow for the use of an air damper under certain

operating conditions, however, according to John Voorhoes of Omni Testing, this use has never been required in any wood stove test they have conducted. Furthermore, Method 28's use of four burn rate categories ensures wood stove performance at a variety of burn rates. The EPA OWB study conducted testing at two burn categories and therefore does not give the depth of data provided by Method 28. Based on this information, NESCAUM does not believe that the use of the air damper favorably biases Method 28 results.

With regard to the comparison of OWB and wood stove PM rates, whether with or without an XAD-2 cartridge accompanying Method 5G, we simply note that the numbers presented in the NESCAUM report are taken directly from Table 4-5 of the EPA OWB study, which itself makes the comparison. We will modify the text of the NESCAUM report to make that clear.

With regard to representative testing, at this point in time there is no definitive data set to determine the actual "in-use" emissions profile of OWBs. Therefore, it would be inappropriate to assume that the EPA OWB test represents actual in-use conditions or that this test is a reproducible test method until additional studies are completed using a similar method. In contrast to the OWB situation, EPA has deemed Method 28 as an appropriate surrogate for in-use emissions of wood stoves. We therefore disagree with the letter's contention the EPA OWB study represents actual in-use conditions, while wood stove certification methods represent ideal conditions.

The April 21 letter correctly identifies typographical errors in the numbers and attribution for the OWB PAH hourly rates relative to certified wood stoves. NESCAUM will change this and include a listing of the mg/MJ rates cited in Table 4-5 of the EPA OWB report. While rates based on g/hr would change the relative comparison in terms of total PAH amounts emitted, we cannot convert the wood stove mg/MJ rates to our preferred g/hr rates because we do not have sufficient information on the wood stove inputs to do this. To do the g/hr comparison, we will use PAH rates derived from a separate field study of wood stoves in home use. This comparison is conservative with regard to the OWB rates because of the in-use condition of the wood stoves in the field study compared to the OWB tests in the laboratory.

The April 21 letter states that Table 5-1 of the NESCAUM report did not include the New York table in its entirety. NESCAUM did not include in Table 5-1 the EPA test results for the Central Boiler and Taylor units because, as indicated by Table 5-1's heading, the table only includes *unevaluated* OWB emissions data from the New York AG's report. As stated in the NESCAUM report's text, the manufacturers of these units did not make the test reports and procedures available to NESCAUM for its review and evaluation. In contrast, the Central Boiler and the Taylor units' test results and protocols were available to NESCAUM for review, hence they were not included among the unevaluated results in Table 5-1.

### **Presentation of Near-Source Emission Monitoring**

The April 21 letter incorrectly implies that the NESCAUM study described in section 5.2 of the report used only green wood cut four months earlier in its near-source emission monitoring study. As noted in the text of section 5-2:

Fuel usage during monitoring was a mix of green oak logged 11/01/04 and split 12/04 (stored dry) and maple/cherry/other hardwood seasoned about one-year (stored dry). [Monitoring was conducted March 2005, also noted in text.]

The April 21 letter also characterizes the NESCAUM study by saying “sections of the plume are down-washed to the ground by air circulation up and over the adjacent house.” The NESCAUM study did not suggest or say that such plume dynamics occurred, nor did the text provide information about a house or its location or whether such a location could cause this outcome. Furthermore, during the study period, down-washing was not observed.

The April 21 letter states that the NESCAUM report failed to disclose that a certified wood stove under similar testing conditions would have led to measurement of the same concentration peaks. NESCAUM is unaware of such a study.

The April 21 letter states that NESCAM failed to disclose that if the tested unit had “a proper stack height,” then ground level PM concentrations would have been substantially reduced. Unfortunately, most OWBs in current use have stack heights similar to the unit measured. NESCAUM did not choose to measure ambient emissions from an OWB with a higher stack because these stack heights are less common. NESCAUM is also unaware of any study that has compared the unit it measured with an identical unit with a higher stack.

With regard to the lack of mention of PM10 modeling results by Central Boiler, the focus of the study described in the NESCAUM report was PM2.5, therefore PM10 was not a parameter in this particular analysis. Even so, we note that the collective impacts of a group of distributed pollution sources is often more relevant to violations of a NAAQS than the impact from an individual source.

### **“In Use” Stack Test Method**

With regard to the assumptions behind the DataRAM 4000 measurements, the test method used the default settings for the instrument’s calibration and relative humidity (RH) correction. The actual density of the stack wood smoke aerosol is unknown, but given that it is a mix of elemental and organic carbon, the measurement error due to density is not likely to be large. The NESCAUM report states in the second paragraph of section 3.1 that the DataRAM 4000 uses “light scattering to *estimate* PM2.5 concentrations” (italics added). The report makes no claim that the PM measurements from the DataRAM are as accurate as true gravimetric methods such as EPA Method 5G.

With regard to possible water interference with the DataRAM 4000 measurements, we see no basis for a significant water interference with these measurements. The sample was diluted in the stack with ambient air by a factor of 10 to 20 times, as stated in the report. This resulted in a moderate RH within the DataRAM 4000 measurement chamber. The DataRAM chamber RH is reported along with the other data; it ranged from 40 to 60% on the first day of measurements, and from 38 to 73% on the second day. The nearly continuous 3.5 hour run in the afternoon of test day two used to generate the emission rate of 161 g/m<sup>3</sup> was during a period where the RH was between 40 and 60% for the majority of that sample period. In addition, the RH correction function in the DataRAM 4000 was turned on; this approximately compensates for water associated with the aerosol, reducing the reported mass concentration when RH is high. Page 50 of the December 2003 DataRAM DR-4000 manual states:

It is of interest to note that if the DataRAM 4 is used in conjunction with an in-line sample stream heater (e.g., MIE model DR-TCH), and the resultant measurements are compared with the humidity corrected measurements mentioned above (without the heater), it is possible to assess the loss of particle mass due to evaporation of semi-volatile particles. Alternatively, if there were no difference between measurements obtained with and without the inlet heater, it would indicate that there is no humidity induced particle growth and thus, the humidity correction should not be enabled.

This statement makes it clear that if the RH correction is used, the DR-TCH heater is not necessary, and may actually result in degraded measurements of semi-volatile aerosol. Fresh wood smoke has a substantial fraction of semi-volatile organic carbon aerosol, and heating as a method of water control would be inappropriate.

The April 21 letter's assertion that the DR-4000 sample inlet probe clogged because of water problems is not correct. The sample probe was *inside* the stack, at stack temperatures. The probe was cleaned frequently during the two testing days, and the clogging was from excess particulate matter. There was no sign of liquid water in or on the probe at any time.

During "idle fire" (damper closed) burn testing sample periods, the stack temperature was relatively low. Under these low combustion temperature conditions, the modified Method 17 gravimetric glass fiber filter sample method used would be expected to work reasonably well, and be much more accurate than the same method under the full fire (damper open) test periods when the stack temperature (and thus the filter temperature) was much hotter. The latter filter test conditions would be expected to lose much or most of the condensable fraction of the PM, as noted in the NESCAUM report. It is a conservative approach that underestimates PM emissions from OWBs during full fire operation.

The comparisons between the continuous DataRAM measurements and the filter measurements under these two test conditions (hot and cooler stack temperatures) are consistent with the assumptions above. Figure 5-5 (cooler stack temperatures) shows relatively good numeric agreement and correlation between the gravimetric filter samples and the continuous PM data. This gives us confidence that the continuous nephelometry PM measurements made during

these tests are reasonably accurate for this use, even though they are a surrogate (indirect) measurement of PM2.5.

**NESCAUM will not withdraw the report**

NESCAUM has made minor edits to the report as noted above, but stands by the overall substance and conclusions of its report.