

performing turbine, we determined that the method had a minimum detection level (MDL) of between 2 and 3 ppb formaldehyde. We expect the MDL to vary somewhat in actual practice and, thus, do not assume that the MDL would be the same if the method were run by another person or at another laboratory. We have no information regarding the distribution of the CARB Method 430 MDL actually achieved by other testers. We want to ensure that the MACT floor reflects the variability in the limit of detection determined by different, competent testers throughout the U.S. using the same method, *i.e.*, CARB Method 430. We only have one test, the test conducted on the best performing turbine, to try to determine a limit of detection for this method, and this is not enough information to determine the variability in the limit of detection among different testers. If we had sufficient information on the limit of detection determined by different competent testers using Method 430, under similar conditions, we would analyze the results to determine the average limit of detection and its standard deviation. To establish a limit of detection that would be achievable by approximately 99 percent of all the testers, we would add three times the standard deviation to the average limit of detection. Since we do not have this information, we can attempt to estimate it. We believe that it is reasonable to assume that the standard deviation of the limit of detection is no greater than the single estimate of the limit that we have. If we multiply the single value of the limit of detection by three and add it to itself, the result is an estimate of the upper bound for the limit of detection that is four times the single measured value that we have. Based on the considerations above, the lowest MACT floor that we believe would take into account the variability in the MDL is 12 ppb. This level provides a safety factor of four to account for uncertainty in whether testers could routinely achieve a limit of detection of 2 to 3 ppb formaldehyde.

The combustion turbine MACT would be a national standard, and therefore, the MACT limit should reflect variations in the performance of the best performing turbine that could occur. There are two major sources of variability that together produce the total variability observed in the emissions sample results. These sources of variability are: the actual variability in the emissions, and the variability associated with procedures for sampling and analyzing the emissions samples. We believe there is substantial basis to

conclude that sources of variability unrelated to turbine performance account for the differences in formaldehyde emissions concentrations between the five turbines. We discuss these sources of variability in more detail below.

When we began investigating the possible sources of the actual (non-sampling, non-analytical) variability in lean premix combustion turbine emissions, we realized that turbine performance was only one of several possible sources of that variability, and that turbine emissions also could vary widely due to environmental and operational factors that are unrelated to turbine performance and that are beyond an operator's control.

Specifically, formaldehyde concentrations are expected to vary temporally (*e.g.*, seasonally) and spatially (*e.g.*, geographically) due to environmental and operational factors such as temperature, humidity, atmospheric pressure, fuel quality, and the concentrations of formaldehyde present in the ambient air. It is our judgement that if the turbines were tested at various times during the year and at various locations throughout the U.S., the concentration of formaldehyde emitted by a given turbine could vary by a factor of seven or more, solely due to geographic and temporal differences in temperature, humidity, atmospheric pressure, fuel quality, and formaldehyde concentration in the ambient air. This factor is based not only on the short term variability of the data for the turbine with the lowest reported formaldehyde emissions, but also on the test data from all five turbines.

Variations in temperature, humidity, atmospheric pressure, and fuel quality are known to have resulted in fluctuations in criteria pollutant stack concentrations (*e.g.*, NO<sub>x</sub>, VOC, and CO), and we anticipate that they also would cause variations in formaldehyde concentrations in the combustion turbine stack. An owner or operator cannot control the variability of environmental parameters such as ambient temperature, humidity, or atmospheric pressure. With regard to fuel quality, an owner or operator cannot control the quality of the natural gas delivered through a pipeline, or the nature and concentration of natural gas additives or contaminants. The five turbines for which we have formaldehyde emissions data operate at four locations in the Western U.S. that are at considerably different altitudes. Moreover, each of the five turbines was sampled over only a 3-hour period, and the five sampling events occurred in four different months of the year: April,

May, June (two turbines), and December. Therefore, we believe that the variability in formaldehyde concentration of the turbine emissions will be greater than the variability reflected in the 3-hour sampling period.

Furthermore, we believe that the variability observed in the available turbine emissions data may reflect the variability of formaldehyde concentrations in ambient air—much of which is due to natural causes. The average concentration of formaldehyde in ambient air varies between 2 and 25 ppb within the U.S., with a U.S. annual average urban concentration of 5.17 ug/m<sup>3</sup> (4.2 ppb).<sup>1</sup> The difference between hourly maximum and minimum formaldehyde concentrations across the U.S. would be even greater than the average annual 23 ppb range in U.S. formaldehyde concentrations. We do not have information that specifically shows that the ambient concentration of formaldehyde affects the stack outlet concentration of formaldehyde. We expect that some formaldehyde, especially the portion that goes through the combustors, would be destroyed. However, about two-thirds of the inlet combustion turbine air bypasses the combustors. We are not sure that all of the ambient formaldehyde that enters with the combustion air is destroyed and, therefore, ambient formaldehyde may affect the formaldehyde concentration in the outlet stack of the combustion turbine. For example, if half of the ambient formaldehyde passes through to the outlet stack, the annual average contribution of ambient formaldehyde to the stack formaldehyde concentration may be in the 10 ppb range in some parts of the U.S. This means that hourly formaldehyde emissions from the outlet stack of a given turbine could differ by over 10 ppb based solely on the region of the country where the turbine is located.

Sampling variability is a result of the fact that it is impossible to collect two samples in exactly the same way. Sampling variability occurs both when an individual intends to collect replicate samples of the same emissions stream, and when sampling is conducted by different personnel using different procedures and different equipment under different physical conditions. If the same sampling personnel collect a suite of samples using the same equipment and procedures, the variability of the sampling results will be reduced. However, a given individual or a given piece of equipment may impart bias, a

<sup>1</sup> 1998 National Air Quality and Emission Trends Report, Table 5-2 and Figure 5-1a.