# MEMORANDUM

## State of Alaska

**Department of Environmental Conservation**
Division of Air & Water Quality
Air Permits Program

TO: File 15.05

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FILE: 15.05 Model Approval/Issues

THRU: Jim Baumgartner, Supervisor
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SUBJECT: Rounding of Modeled Impacts

This memorandum addresses whether New Source Review (NSR) applicants, including applicants subject to the State's Prevention of Significant Deterioration (PSD) program, may round the values obtained through ambient air quality dispersion modeling. The Department has been inconsistent on this issue, partly due to the lack of readily available guidance from the U.S. Environmental Protection Agency (EPA). At times, the Department has allowed applicants to round modeled impacts to the same number of significant digits as shown in the State regulations for the particular standard or threshold.

The Department has recently found guidance from EPA indicating ambient air quality standards and increments are absolute limits and therefore, applicants should not round modeled results. The Department notes however, that the most common NSR air quality model, ISCST3, reports values to the fifth decimal. Constantly repeating values of this size in an application can be burdensome, and frequently provides no benefits. However, EPA's point about the standards and increments being absolute limits is well taken. Therefore, applicants may no longer use rounding for purposes of demonstrating compliance with an ambient air quality standard listed in 18 AAC 50.010, a maximum allowable increase (PSD increment) listed in 18 AAC 50.020, a significant concentration listed in 18 AAC 50.310(d)(2), or a monitoring threshold listed in 18 AAC 50.310(e). Applicants may still round modeled concentrations for reporting purposes, but never to the level where the remaining digits could alter the findings of the compliance demonstration.

## Discussion

Calculated values are only as accurate as the data used in the calculation. Calculations based on highly accurate data are more reliable than calculations based on approximations. Therefore, it is common engineering practice to round the result of the final calculation to a level that reflects the basic degree of accuracy.

The data used in modeling is no different than any other data, in that it too has limited accuracy, which limits the accuracy of the modeling analysis. The accuracy of the modeled emission rate is dependent on whether the value comes from a generic emission factor, such as AP-42, or from a source test of the specific unit. Approximations may be used to determine the stack temperature and flow rate of a point source. All of these parameters (emissions, temperature, and flow rate) may also vary with ambient temperature, humidity, and pressure. Parameters can also vary with age and maintenance practices. In addition to the limited accuracy of the model input data, the mathematical algorithms used by the dispersion model are also approximations, which further limits the accuracy of the modeling results.

In contrast to the limited accuracy of input data and modeling algorithms, computers are capable of reporting an extremely large number of digits for each calculated value. Computer programmers typically limit the number of reported digits through use of format statements, in order to provide manageable printouts. At that point, the computer either rounds or truncates the extra digits. *Therefore, the issue at hand is not really whether rounding/truncating should be allowed, but to what digit (level) should rounding or truncating be accepted.*

The most common NSR dispersion model (ISCST3) reports values to the fifth decimal, which typically results in numbers with a total of six to eight digits. This provides nice looking tables in the output file and more importantly, allows for non-zero values to be reported when modeling extremely small emission rates or impacts at distant receptors. However, modeled results are never accurate to six to eight significant digits.

For these reasons, the Department has allowed permit applicants to round the modeled impacts to the same number of significant digits as is used for the applicable standard or increment. This approach does not reflect a rigorous assessment of modeling accuracy, but rather *assumes* all modeling results have the same level of accuracy as the methods used to develop the standards and increments. The Department applied rounding regardless of whether the extraneous digits were numerically above or below the standard/increment. For example, a modeled nitrogen dioxide ($NO_2$) increment impact of 24.89762 micrograms per cubic meter ($\mu g/m^3$) would be rounded up to 25 $\mu g/m^3$, while a modeled impact of 25.10023 $\mu g/m^3$ would be rounded down to 25 $\mu g/m^3$. The Department allowed rounding out of an acknowledgement that the values reported by dispersion models are based on an internal format statement, rather than an assessment of data accuracy or reliance.

The Department has since found EPA guidance indicating that modeled values should not be rounded further. In the preamble to EPA's Final Rule regarding the $NO_2$ increment (October 17, 1988 Federal Register, page 40657), EPA states:

> *It should be noted that these increments, like those for particulate matter and sulfur dioxide, are absolute limits. This means, for example, that a modeled impact of 25.1 $\mu g/m^3$ for a proposed new source would result in an exceedance of the Class II*

> *increment of 25 $\mathbf{m}g/m^3$, while a modeled impact of 24.9 $\mathbf{m}g/m^3$ would not. In neither*
> *case is the result "rounded off" to 25 $\mathbf{m}g/m^3$.*

It is interesting to note that EPA used a three-digit value in their example instead of a seven-digit value. EPA likely used a three-digit value for simplicity in getting their point across. It is an example, so they can use whatever number they want and as many digits as they need to get the point across. In reality, the reporting of a three-digit value could only occur by additional rounding or truncating of the modeled output.

EPA's Model Clearinghouse Summary Report for FY-93 (October 1993) provides additional support that additional rounding should not be used. In Section 3.3 "Rounding of Model Estimates in Ozone Attainment Demonstrations," EPA discusses their response to a question regarding the rounding of a modeled ozone value provided in a SIP demonstration. EPA's response included the following comments:

More specifically, the Clearinghouse's review of prior work addressing this issue for ozone and other criteria pollutants included:

1. *...*
2. *past correspondence from [Air Quality Management Division] concerning interpretations of control targets for carbon monoxide and lead; model estimates for comparison to the target value should not be rounded.*
3. *a survey of Regional Office Modeling contacts in which the most common practice, with regard to rounding of model estimates, appears to interpret values like 0.121 ppm of ozone as not meeting the target concentration level. [Note: the ozone standard at the time was 0.12 ppm.]*

Based on the information gleaned, it appears in the majority of situations involving various criteria pollutants, for NAAQS demonstrations the numerical value of the standard is the "target" level to which model estimates should be reduced. For ozone, this implies that for the application of a model that estimates concentrations to three significant figures, the target level is actually 0.120 ppm.

EPA's guidance indicates that additional rounding should not be used when demonstrating compliance with a standard/increment. While EPA discusses rounding up as well as rounding down, the main concern appears to be with rounding down. This is especially true in situations where the reported value would be greater than the standard/increment if the standard/increment was also reported with the same number of digits as the modeled value. For example, a modeled $NO_2$ increment concentration of 25.00001 $\mu g/m^3$ would be compared to a Class II $NO_2$ increment standard of 25.00000 $\mu g/m^3$ rather than the 25 $\mu g/m^3$ value provided in regulation. In essence, EPA is treating standards/increments as if they have a floating number of significant digits for purposes of comparing to modeled impacts. They are also implying that

modeled impacts should not be rounded further than what is already done internally by the model.  This approach provides a slight level of conservatism to the ambient analysis.

The Department did not find any EPA guidance regarding the use of rounding in a significant impact analysis or demonstration regarding the need for pre-construction monitoring.  However, we assume that EPA would apply the same approach as used in a standard/increment analysis.

It would be easy at this point to say that applicants should include all digits provided in the output files in their modeling reports.  However, repeating all six to eight digits every time a number is used in a report becomes burdensome and pointless.  There are situations where additional rounding is warranted.  Even EPA indirectly implied this by using three digits instead of seven digits in their $NO_2$ increment example.  Most people do not want to read extraneous verbiage (including digits) if the point can clearly be made with less.

The Department sees no need to require applicants to always repeat all digits from a modeled output.  If a value rounded to four digits provides the same assurance of compliance as the original seven-digit value, then there is no reason why the four-digit value could not be used.  However, additional rounding or truncating may not be used if it changes the conclusion of the compliance demonstration.  For example, an $NO_2$ increment impact of 25.00001 $\mu g/m^3$ will now be considered as an exceedance of the 25 $\mu g/m^3$ Class II $NO_2$ increment standard, and therefore, this seven-digit value should not be rounded.  However, a 24.89762 modeled $NO_2$ increment impact could be rounded to 24.9 $\mu g/m^3$.  In a similar manner, a 5.11161 modeled $NO_2$ increment impact could be rounded to 5 $\mu g/m^3$.

### Summary
NSR permit applicants may only round modeled results as long as the level of rounding does not alter the compliance demonstration.  Rounding may never be used to eliminate a modeled exceedance of a standard, increment, or threshold.  All standards, increments, and thresholds are absolute limits.

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cc:   Bill Walker, ADEC/APP, Juneau