

Bureaus of Air Pollution Control & Air Quality Planning

Modeling Guidance for Intermittent Sources and the 1-hr NO₂ Standard

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Introduction

The Environmental Protection Agency (EPA) promulgated a new 1-hour National Ambient Air Quality Standard (NAAQS) for Nitrogen Dioxide (NO₂) on February 9, 2010 that became effective April 12, 2010. The 1-hour NO₂ standard is 100 parts per billion (ppb) or 188 micrograms per cubic meter (µg/m³) at standard conditions (25° Celsius (C) and 760 millimeters of mercury (mm Hg)).

The 1-hour NO₂ NAAQS is a “probabilistic” standard, unlike the annual NO₂ NAAQS, which is a “deterministic” standard. As such, the 1-hour probabilistic form is explicitly intended to, “provide a more stable metric for characterizing air quality levels by mitigating the impact that outliers in the [annual] distribution [of daily maximum 1-hour concentrations] might have on the design value.”¹ The 1-hour NO₂ NAAQS is based on the three-year average of the 98th percentile of the annual distribution of maximum daily 1-hour concentrations.

The EPA has stated they believe, “the most appropriate data to use for compliance demonstrations for the 1-hour NO₂ NAAQS are those based on emissions scenarios that are continuous enough or frequent enough to *contribute significantly to the annual distribution of daily maximum 1-hour concentrations*” [emphasis added].¹ This perspective is fundamental in their technical argument for modeling intermittent sources. The EPA does not discuss what constitutes a significant impact; however, the EPA does allow NDEP discretion to exempt intermittent sources from model requirements under appropriate circumstances.

Modeling Considerations for Intermittent Sources

For intermittent sources, there are two questions for a facility to consider: (1) is modeling required for the intermittent source; and (2) if modeling is required, then at what emission rate?

Is Modeling Required?

For the first question, we look at EPA’s memo from March 1, 2011, that discusses modeling for the 1-hr standard. On page 2 of that memo, EPA recommends compliance demonstrations address emission scenarios that, “can logically be assumed to be relatively continuous or which occur frequently enough to contribute significantly to the annual distribution of daily maximum 1-hour concentrations based on existing modeling guidelines...” As such, NDEP reviewed this recommendation from a statistical perspective and developed several scenarios to assist facilities with determining whether modeling would be required for intermittent sources to demonstrate compliance with the 1-hr NO₂ standard.

Specifically, when we consider the annual distribution of daily maximum 1-hr concentrations, we have a total of 365 data points. NDEP has established the 1% and 2% thresholds as levels of significance for the following two scenarios:

Scenario 1 - Intermittent sources are the only source of NO₂ emissions at the facility

The 2% threshold for 365 data points corresponds to eight (8) data points ($365 \times 0.02 = 7.3$, rounded up to 8). Therefore, for this scenario, we shall consider seven (7) days or less of intermittent activity as not being significant; by considering less than eight (8) days, we remain below the 2% threshold of significance. As such, a facility will not be required to model emissions from intermittent sources (sole sources of NO₂ for this scenario) if the following conditions are met:

- Engines are started-up and tested seven (7) or fewer times each calendar year; there is no restriction on the hours of testing per day, AND
- If the facility has multiple engines, all engines will be tested the same day.

Scenario 2 - Intermittent sources are the NOT the only source of NO₂ emissions at the facility

For this scenario, we acknowledge the existence of sources (other than intermittent) that contribute to ambient NO₂ emissions. We shall consider the 1% threshold for a data set of 365 data points, i.e., four (4) data points ($365 \times 0.01 = 3.65$, rounded up to 4). As such, we shall consider four (4) days or less of intermittent activity as not being significant. A facility will not be required to model emissions from intermittent sources (sole sources of NO₂ for this scenario) if the following conditions are met:

- Engines are started-up and tested no more frequently than once every three (3) months; there is no restriction on the hours of testing per day; AND,
- If the facility has multiple engines, all engines will be tested the same day; AND,
- Engines are rated at less than 300 horsepower, or less than 845 horsepower if they are EPA-certified Tier II or greater; AND,
- Engine exhaust is greater than 100 feet from the model plant boundary of the facility.

NDEP added the additional conditions for the following reasons:

- For small engines, the AP-42 diesel engine emission factor for NO_x is 0.031 lb/hp-hr. An unrated, i.e., no EPA Tier rating, 300-hp engine would yield 9.3 lb-NO_x/hr. That value corresponds to a PTE of approximately 40 tons/year. Therefore, remaining below this power size also keeps the source below the NAAQS modeling assignment criteria.
- EPA-certified Tier II (or greater) are limited to no more than 0.011 lb-NMHC+NO_x / hp-hr. At 845 hp, that emission rate is 9.3 lbs-NMHC+NO_x / hr. That value corresponds to a PTE of approximately 40 tons/year. Therefore, remaining below this power size for EPA Tier 2 or higher-rated engines also keeps the source below the NAAQS modeling assignment criteria.

Due to the variability in engine sizes and operational scenarios for intermittent sources, consultation with NDEP is recommended to determine whether the proposed intermittent sources are exempted from the 1-hour NO₂ NAAQS modeling requirement.

Finally, for both scenarios, if the NDEP determines that an intermittent source is exempt from the 1-hour NO₂ modeling requirement, the permit holder will be required to verify, through additional monitoring and recordkeeping, that the intermittent source will not violate the conditions that allowed the exemption. As such, relevant permit conditions (per 445B.305) will be added to operating permits that identify necessary monitoring and/or recordkeeping.

If modeling is required, what emission rate and dispersion modeling settings?

With respect to emission rates for 1-hour NO₂ NAAQS modeling, NDEP concurs with EPA that using the average hourly emission rate represents “a simple approach to account for the probability of the emergency generator [intermittent source] actually operating for a given hour.”¹ This approach accounts for potential worst-case meteorological conditions associated with intermittent source emissions by assuming continuous operation. For example, in cases where the operational frequency of the intermittent source is uncertain, we would assume continuous operation and model impacts based on annualized hourly emission rate rather than the maximum hourly emission rate. That is, if a proposed intermittent source had a limit of 500 hour/year or less, a modeling analysis could be based on assuming continuous operation at the average hourly rate, i.e., the maximum hour rate times 500 / 8,760.

EPA has proposed a three-tiered evaluation process for quantifying NO₂ mass emission rates for air dispersion modeling. Tier 1 assumes full conversion of NO_x to NO₂. That is, the applicant assumes all NO_x is emitted in the form of NO₂. Tier 2 employs an empirically-derived conversion ratio (NO₂/ NO_x), whereby the result from the Tier 1 value is multiplied by 0.80 for the ambient air (known as the ‘Ambient Ratio Method’). This tier is available to a source when low-level releases occur with limited plume rise and ozone concentrations are likely to be relatively low. When using a ratio value other than 0.80, the analysis would be considered a Tier 3 evaluation. Tier 3 represents a general category of “detailed screening methods” which may be considered on a case-by-case basis. Tier 1 factors may be used for all permit applications without additional support documentation with default AERMOD settings. Tier 2 conversion factors will require additional support documentation for all applications. Documentation would include acknowledgement of source-surrounding characteristics that meet applicable assumptions. Tier 3 approaches will require substantial background information, and pre-approval via a model protocol is required.

References

1 – EPA Guidance Memo of Appendix W Modeling Guidance for 1-hr NO₂ NAAQS, dated March 11, 2011