ATMOSPHERIC DYNAMICS, INC
Meteorological & Air Quality Modeling

Memorandum

To: Phil Allen/ Kristin Martin: ODEQ
From: Greg Darvin: Atmospheric Dynamics, Inc.
Date: October 31, 2023

Subject: 1-Hour NO_2 Intermittent Source Modeling Approach for Standby Diesel Generator Engine Operations During Plant Power Emergencies Amendment

Two separate and distinct methods will be used to assess the 1-hour NO_2 concentrations from the intermittent operations of diesel emergency engines during an emergency plant power outage. The first method will utilize the approach outlined in the USEPA guidance document (March 1, 2011, USEPA memorandum "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard"). The second method will utilize a Monte Carlo simulation as recommended by the Oregon Department of Environmental Quality (ODEQ). Since emergency operations can be speculative, both modeling methods will rely on historical operations of diesel emergency engines that have occurred from 2016 to present. Historical operations reflect the fact that the electrical service to the Intel campuses is intentionally structured in such a way that it is highly unlikely that loss of electrical service would have a plant-wide impact. Instead, as past events document, Intel's electrical service design is intentionally structured to maintain electrical service across most of the plant even if one source of electrical service is lost. A table listing these past events was provided to ODEQ on September 11th, 2023, and it was agreed that they form the best basis for identifying reasonably likely future diesel emergency engine operating scenarios at the Aloha and Ronler Acres campuses.

Based on actual past occurrences, the event with the longest run time at the Ronler campus and with the utilization of the most diesel emergency engines occurred over two (2) days on May 6th and May 7th, 2022. Here, five (5) diesel emergency engines associated with operations at the D1D operations ran for roughly 23 hours for each engine. For the Aloha campus, five (5) diesel emergency engines (EFG15_01 through EGF15_03 and EGF5_01 and EGF5_02) were utilized for 8 hours on April 18th, 2021. Based on input from the ODEQ, the emergency operations modeling will utilize the D1D group of diesel emergency engines but will modify the number of diesel emergency engines on the Ronler case to reflect six (6) engines (EGDD_01 through EGDD_06) in place of five (5) that ran during the emergency. It will also modify the number of hours of emergency operation to reflect 24 hours of emergency operation for the Ronler diesel emergency engines for each of the five (5) year periods in the analysis. Both types of modeling approaches will also include the non-emergency operations (e.g., maintenance and readiness testing) along with the steady state source (non-emergency sources).[1]

EPA 1-Hour NO_2 Methodology

The diesel emergency engines can run up to 25 hours per year for non-emergency operations. As noted above, emergency operations will include 24 additional hours of operations for the Ronler sources. The approach suggested by EPA is to model impacts from intermittent sources based on an annualized hourly

[1] Intel does not participate in the Portland General Electric Dispatchable Standby Generation program and so non-emergency operation of the diesel emergency engines is limited to training and maintenance and readiness testing.

emission rate, rather than the maximum hourly emissions. This approach would account for potential worst-case meteorological conditions combined with essentially continuous operation of the diesel emergency engines (both regular testing and emergency operation) at an average hourly emission rate. Non-emergency steady state sources will be included in the EPA methodology. All modeling results will be based on the use of the Ambient Ratio Method Version 2 (ARM2). There will be no daytime limitations to the operating hours for emergency operations. Background sources of NO_2 (cumulative source inventory) will also be included in the modeling results.

Monte Carlo 1-Hour Methodology

The second method for assessing emergency operations on the 1-hr NO_2 standard will utilize a Monte Carlo Simulation to estimate the NO_2 impacts. Here the maximum 1-hour NO_2 emission rates on the diesel emergency engines will be used and include both non-emergency (testing and maintenance) and emergency hours. As before, the non-emergency hours of operation will be limited to daytime conditions while the emergency operations will not have any hour of day restrictions. Additionally, the steady state sources will be included in the Monte Carlo analyses.

The Monte Carlo simulation will be used to model the probability of different outcomes in a process that cannot easily be predicted due to the intervention of random variables. For example, the specific hour/day of an emergency event that a set of diesel emergency engines will run is generally unknown. The operation of the diesel emergency engines may or may not correspond to a poor dispersion period, as the occurrence of these events is essentially random. The Monte Carlo approach can account for the random nature of both the diesel emergency engine operation and the underlaying meteorological conditions. The Monte Carlo modeling will utilize the following three (3) separate AERMOD runs to create output files of hourly (1-hr) NO_2 concentrations for each receptor across all five (5) years of meteorology. To minimize output file size, the receptor group will be broken out into three individual groups of roughly 800 receptors each, the total of which include the entire high resolution downwash grid to identify and determine the maximum concentrations:

1. Continuous sources with ARM2 and seasonal hour by day background NO_2 background
2. M&R testing for the 20 emergency generator source groups with hours limited to daylight hours only and utilizing PVMRM as previously described in the modeling protocol and the July 7th permit application. Each group will have its own 1-hour hourly concentration files.
3. Emergency operations for 24-hour single one-hour events for each of the five years with no day or nighttime limitations and utilizing PVMRM. The ODEQ has recommended that the maximum number of annual emergency operation hours in the recent historical record (24 hours) be used in the analysis. Since this maximum could possibly occur in any year, the 24 hours will be used in all years of the simulation. Since the length of operation cannot be predicted, the most conservative option is to treat all emergency hours as single hour events that could occur on any day of the year in the Monte Carlo simulation. The 24 occurrences will then be spread out over 12 months with two (2) random occurrences each month for each of the one-year meteorological data periods.

The receptor-by-receptor hourly files from the three AERMOD runs above will then be used in the Monte Carlo analysis. The hourly files will be split into individual daily files, each with 24 hours of concentration for each receptor. These files will then be grouped by month. For each iteration, 365 days will be randomly selected from the five-year dataset to form a simulation year. Any particular day will only be used once in the simulation year. The hourly continuous source concentrations will be loaded into the simulation year concentration arrays. Two days in each month will be assigned to the emergency runs. On those days, one hour will be randomly selected for the emergency runs. For this hour, the concentration from the emergency runs will be added to the continuous source concentration. For the M&R source, 15 days in a month will be identified for which the 20 groups of generators will be evaluated. For each generator group, a random hour between hours 9 and 18 will be selected. For this hour, the concentration from the M&R group run will be added to the continuous source concentration. If two M&R groups are run on the same day, they will run on different hours. Once this step is completed, the highest 1-hr concentration on each day will be calculated (on a receptor-by-receptor basis) from which the highest eighth highest concentration at each receptor will be found. This process will be repeated two more times to generate a three-year simulation data set. Once the three simulation years are assembled, the high-eighth-high concentrations from each year will be determined and then averaged to produce a final high-eighth-high concentration for that iteration. The process will then be repeated 1000 more times and a median concentration will be calculated from the 1001 simulations. If this median value is less than the standard, then compliance is demonstrated.

The advantage of this approach over the original submittal of paring results based on receptor location only is that concentrations of continuous, M&R, and emergency operations are paired both in space and time, and the 98th percentile calculation for each receptor and hour is done as a last step.