**ILLINOIS ENVIRONMENTAL PROTECTION AGENCY**
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**JB PRITZKER**, GOVERNOR **JAMES JENNINGS**, ACTING DIRECTOR

**MEMORANDUM**

**Date:** June 4, 2025

**To:** Joseph Odele State/FESOPs Unit, Permits/BOA

**From:** Mohammad Sweid, Modeling Unit, Permits/BOA

**Subject**: Prime Data Centers (ID# 031440AWZ) Construction Permit (#24090003)

Prime Data Centers (Prime) submitted a construction permit application (#24090003) on September 3rd, 2024, requesting authorization to construct 39 new emergency generators to support a new data center building in Elk Grove Village, Illinois. The proposed facility would include thirty-nine 3,250 kW emergency generators, fired exclusively on ultra-low sulfur distillate (ULSD) fuel oil. These generators would provide backup power during power outages ensuring the facility's operational reliability. The facility would be located at 1600 East Higgins Road in Elk Grove Village, Illinois. Centering coordinates for this facility are UTM Zone 16 coordinates 420375 meters (m) Easting and 4652820 meters (m) Northing.

As of the date of this permitting decision, Prime's new facility would be located in an area of Environmental Justice (EJ) concern as identified using Illinois EPA EJ Start. The issued permit would provide for increases in permitted emissions of nitrogen oxides (NOx), carbon monoxide (CO), sulfur dioxide ($SO_2$), particulate matter, volatile organic materials (VOMs), and hazardous air pollutants (HAPs). Consequently, the Illinois EPA requested Prime submit an air quality analysis as part of its permit application to ensure the project would not threaten or compromise existing National Ambient Air Quality Standards (NAAQS) for any pollutant with an increase in permitted emissions.

In response to Illinois EPA's request, Prime had Atmospheric Dynamics Inc (Atmospheric) conduct an air quality review for emissions of nitrogen dioxide ($NO_2$), CO, particulate matter ($PM_{10}$ and $PM_{2.5}$), $SO_2$, VOMs and HAPs.

## Modeling Unit Analysis

The air quality analysis performed by Atmospheric was submitted on January 9, 2025. The following dot point entries identify key aspects of the modeling methodology used in this analysis:

- Atmospheric used AERMOD (AMS/USEPA Regulatory Model), Version 23132.[1] AERMOD is a federally approved regulatory model appropriate for use in an air quality analysis of this nature. The audit runs conducted by the Modeling Unit of the Illinois EPA used the same version of AERMOD.

- Modeling inputs utilized Illinois EPA- and USEPA-recommended default regulatory options, which simulate phenomena such as atmospheric stability, plume rise, and downwash. Five years of locally representative meteorology were applied to the modeling. National Weather Service's meteorological data file for years 2019 through 2023 were obtained from the National Centers for Environmental Information (NCEI) and consisted of surface data collected at the Chicago O'Hare Airport in Chicago, Illinois, and upper air data collected at the Davenport National Weather Service Office in Davenport, Iowa. Surface and upper air stations were selected because of their proximity to the proposed project site in Cook County. The combination of this surface and upper air station data provides representative meteorology for the project site. The applicant's meteorological data was processed with AERMET, version 23132.[2] The Modeling Unit's audit runs used the same meteorological data processed with the same version of AERMET.

- Atmospheric processed National Elevation Data (NED) terrain elevations from USGS using AERMAP, version 18081.[3] to develop the receptor terrain elevations and hill height scales required by AERMOD. The site elevation at the Elk Grove Village facility is approximately 212 m above mean sea level.

- Atmospheric used a Cartesian grid in their distribution of 8182 receptors. The following receptor grid densities were used:
  - 10 m spacing of receptors along fence line.
  - 20 m spacing of receptors from fence line to 500 meters.
  - 50 m spacing of receptors from 500 meters to 1,000 meters.
  - 100 m spacing of receptors from 1,000 meters to 2,000 meters.
  - 500 m spacing of receptors from 2,000 meters to 10,000 meters

- Atmospheric selected the urban modeling option in their analysis. The Modeling Unit conducted an Auer's Analysis as part of its review to characterize the area surrounding Prime to determine whether the AERMOD rural option should be implemented. The Modeling Unit developed its Auer's Analysis using 2021 National Land Cover Data (NLCD) within a 3-km radius of the facility. Results of the analysis showed that the surrounding area is 32% rural and 68% urban. The Modeling Unit audit also utilized the urban modeling option.

[1] A new version of AERMOD, AERMAP, and AERMET (v. 24142) has been released, but it is not expected to impact the results of this modeling analysis. Therefore, the use of AERMOD (v. 23132), AERMET (v. 23132), and AERMAP (v. 18081) was approved for this analysis

[2] See, footnote 1.

[3] See, footnote 1.

- Atmospheric used USEPA's Building Profile Input Program (BPIP PRIME) to account for downwash effects of on-site structures. All on-site nearby buildings were included in the modeling analysis.

- $NO_2$ modeling options consist of multiple tiers. Tier 1 assumes that all NOx emitted from emission units at the source converts to $NO_2$. Tier 2 is based upon a representative atmospheric equilibrium default value that was developed using conversion ratios generated from monitored concentrations of NOx and $NO_2$. Tier 3 allows the user to perform a detailed analysis using either Ozone Limiting Method (OLM) or the Plume Volume Molar Ratio Method (PVMRM) regulatory screening options in AERMOD. These options consider the chemical mechanism of ozone titration and the resulting $NO_2$ concentrations. Based on the submitted modeling files, Atmospheric used a Tier 2 approach to model $NO_2$. Atmospheric selected the regulatory default Ambient Ratio Method (ARM2) option in AERMOD which uses a range of ambient $NO_2$/NOx ratios, with 0.5 as the lower limit and 0.9 as the upper limit.

- Atmospheric used the EMISFACT option in AERMOD to model emissions based on Prime's proposed operating schedule. EMISFACT allows the user to apply and model variable emission rate factors for individual sources by hour-of-day and day-of-week. The EMISFACT settings used in AERMOD reflect the operating schedules proposed by Prime. **Table 1** summarizes the proposed operating hours at the facility.

**Table 1**
**Operating Hours**

| Permit Description | Stack ID | Daily Operating Schedule | Hours |
|---|---|---|---|
| 39 Tier 2 Emergency Diesel Engines | GEN01 – GEN39 | 8am-6pm | 10 |

## Source Impact Analysis

Atmospheric performed a source impact analysis to determine if more detailed modeling would be required for any $NO_2$, $SO_2$, CO, $PM_{2.5}$, or $PM_{10}$ averaging period. The results of this analysis were compared against significant impact levels for each pollutant and averaging period. The results of this analysis can be found in **Table 2** below.

**Table 2**
**Source Impact Analysis Results**

| Pollutant | Averaging Period | Maximum Modeled Impact (µg/m$^3$) | Significant Impact Level (µg/m$^3$) |
|---|---|---|---|
| $PM_{10}$ | 24-hour | 9.6 | 5 |
| $PM_{2.5}$ | 24-hour | 7.56$^{(1)}$ | 1.2 |
| | Annual | 0.12 | 0.13 |
| CO | 1-hour | 997 | 2000 |
| | 8-hour | 381 | 500 |
| $SO_2$ | 1-hour | 1.91 | 7.85 |
| | 3-hour | 1.24 | 25 |
| $NO_2$ | 1-hour | 13.7 | 7.52 |
| | Annual | 5 | 1 |

(1) The maximum modeled impact also included secondary $PM_{2.5}$ impacts.

The Modeling Unit audit runs confirmed the source impact analysis results presented in **Table 2**. Both Atmospheric's modeling analysis and the Modeling Unit's audit found that impacts for 1-hour and annual $NO_2$, 24-hour $PM_{10}$, and 24-hour $PM_{2.5}$ would be above their respective SILs and required further analysis.

Based on the results of the modeling analyses, the project will be required to incorporate diesel particulate filters (DPF) on 20 of the 39 engines which would limit diesel PM to 0.02 grams/bhp-hr. The Modeling Unit conducted comparative analyses with and without DPFs. The results showed that incorporating DPFs would reduce annual $PM_{2.5}$ concentrations and would bring modeled impacts below the SIL.

The results for 24-hour $PM_{2.5}$ included secondary $PM_{2.5}$ emissions from the project's increases of NOx and $SO_2$ emissions. Annual $PM_{2.5}$ concentrations were below the applicable SIL, and therefore did not require inclusion of secondary $PM_{2.5}$ contributions. The Modeling Unit also evaluated the project's impact on ozone ($O_3$) formation from emissions of NOx and VOM. These analyses are discussed in detail in the following section.

***Ozone and Secondary $PM_{2.5}$ Formation***

Atmospheric did not evaluate the project's increase of NOx and VOM emissions to assess the potential impact of secondary $O_3$ formation on the NAAQS. $O_3$ formation is a complex process that depends on meteorological conditions as well as the presence of precursor emissions such as VOM and NOx.

Separately, the Modeling Unit independently assessed the project's potential for secondary pollutant formation, including both $O_3$ and secondary $PM_{2.5}$, due to increases in VOM, NOx, and $SO_2$ emissions. While primary $PM_{2.5}$ is directly emitted from a source, secondary $PM_{2.5}$ forms through atmospheric chemical reactions involving precursor emissions, with NOx and $SO_2$ being key contributors.

To estimate the $O_3$ and secondary $PM_{2.5}$ formation, a Tier 1 demonstration was performed following guidance from USEPA on modeled emission rates for precursors (MERPs).[4,5,6] This approach utilizes air quality modeling results from hypothetical sources with precursor emission estimates to evaluate the project's impacts on $O_3$ and secondary $PM_{2.5}$.

For the analysis, the Modeling Unit used the closest hypothetical source located in Porter County, Indiana with values for a 500 tpy, 10 m high stack taken from USEPA's MERPs View Qlik tool.[7] The Modeling Unit used this source to estimate the secondary formation impacts for both $O_3$ and $PM_{2.5}$. The Modeling Unit's evaluation confirmed that the project's impacts were below the SILs for all averaging periods of $PM_{2.5}$ and $O_3$. The results of the MERPs analysis are summarized in **Table 3** and **Table 4**.

**Table 3**
**MERPs Analysis for Secondary $PM_{2.5}$**

| Pollutant | Averaging Period | Concentration (ppb) | SIL (ppb) |
|---|---|---|---|
| $PM_{2.5}$ | 24-hour | 0.027 | 1.2 |

**Table 4**
**MERPs Analysis for Ozone**

| Pollutant | Averaging Period | Concentration (ppb) | SIL (ppb) |
|---|---|---|---|
| $O_3$ | 8-hour | 0.181 | 1.0 |

The project is not significantly impacting concentrations of $O_3$ or $PM_{2.5}$ from secondary formation as reflected in the tables presented above. The secondary $PM_{2.5}$ concentrations were

[4] USEPA (2024). *Clarification on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for Ozone and $PM_{2.5}$ under the PSD Permitting Program*. Office of Air Quality Planning and Standards, Research Triangle Park, NC.
[5] USEPA (2019). *Guidance on the Use of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for Ozone and $PM_{2.5}$ under the PSD Permitting Program*. Publication No. EPA 454/R–19–003. Office of Air Quality Planning and Standards, Research Triangle Park, NC.
[6] USEPA (2022). *Guidance for Ozone and Fine Particulate Matter Permit Modeling*. Publication No. EPA 454/R–22–005. Office of Air Quality Planning and Standards, Research Triangle Park, NC.
[7] https://www.epa.gov/scram/merps-view-qlik#Modeled_Impacts

negligible when added to primary $PM_{2.5}$ concentrations found in **Table 2**, further confirming that the project would not have a significant impact on the SIL for 24-hour $PM_{2.5}$.

## NAAQS Analysis

Based on the results from the source impact analysis, Atmospheric conducted a NAAQS analysis for $NO_2$ (both 1-hour and annual averaging periods), $PM_{10}$ (24-hour averaging period), and $PM_{2.5}$ (24-hour averaging period). Atmospheric developed a cumulative modeling analysis that incorporated background concentrations based on nearby monitoring data as well as nearby emission inventory sources not represented by the background monitor concentration.

Atmospheric utilized representative background data collected from the Illinois EPA monitors located in Schiller Park, Illinois (AQS ID: 17-031-3103) for $NO_2$, Northbrook, Illinois (AQS ID: 17-031-4201) for $PM_{10}$ and Des Plaines, Illinois (AQS ID: 17-031-4007) for $PM_{2.5}$. These monitors were chosen based on the relative proximity to the Prime facility. These were the closest monitors and are in an urban region where concentrations are expected to be a conservative representation of background for the Elk Grove Village area facility location.

The Modeling Unit provided Atmospheric with an inventory of sources located within a 10 km radius of the facility's center. In the 1-hour $NO_2$ analysis, intermittent sources were excluded from the nearby source inventory in accordance with USEPA's guidance memorandum,[8] which permits the exclusion of nearby intermittent sources when modeling for the 1-hour $NO_2$ standard.

The modeled concentrations included impacts from the facility and nearby emissions inventory sources. The total concentrations are the summation of the modeled concentrations and background concentrations, and these impacts are compared to the respective NAAQS, as shown in **Table 5.** The results shown in the following table display the $NO_2$, $PM_{10}$ and $PM_{2.5}$ modeling results provided by Atmospheric. The results of the modeling analysis indicated that annual $NO_2$, 24-hour $PM_{10}$ and 24-hour $PM_{2.5}$ emissions would be below their respective NAAQS values.

**Table 5**

**NAAQS Modeling Results**

| Pollutant | Averaging Period | Modeled Concentration ($\mu g/m^3$) | Background Concentration ($\mu g/m^3$) | Total Concentration ($\mu g/m^3$) | NAAQS ($\mu g/m^3$) |
|---|---|---|---|---|---|
| $NO_2$ | 1-Hour | 264.2(1) | 99.70(a) | 363.90 | 188.68 |
| | Annual | 12.90(2) | 32.40(b) | 45.30 | 100 |
| $PM_{10}$ | 24-Hour | 12.6(4) | 59(c) | 71.6 | 150 |
| $PM_{2.5}$ | 24-Hour | 8.6(1) | 20.40(d) | 29.90 | 35 |

(1) Average of the 8th highs over five years.
(2) Highest annual high value over five years.
(3) Highest 2nd high value over 5 years.
(4) Highest 6th high over five years.
(a) Three-year average of the 98th percentile daily max 1-hour values.
(b) Highest annual concentration over three years of monitoring data.
(c) Highest 2nd high concentration over 3 years of monitoring data.
(d) Average of the 99th percentile concentration per year over 3 years.

[8] USEPA (2011). *Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour $NO_2$ National Ambient Air Quality Standard.*

As **Table 5** indicates, Atmospheric reported modeled exceedances of the 1-hour $NO_2$ NAAQS. An analysis was performed to determine if Prime would cause or contribute to these modeled exceedances of the NAAQS by comparing Prime's contribution to modeled exceedances to their respective SILs.

For the 1-hour $NO_2$ analysis, the maximum 1-hour $NO_2$ contribution from Prime to a modeled exceedance was 0.16 $\mu g/m^3$. This value, which was also modeled and confirmed by the Modeling Unit, is less than the 1-hour $NO_2$ SIL of 7.52 $\mu g/m^3$ which indicates that Prime would not cause or contribute to an exceedance the 1-hour $NO_2$ NAAQS.

**<u>Air Toxics Analysis</u>**

As part of the air quality analysis for Prime, the Modeling Unit requested the facility evaluate the impacts of toxic air pollutant emissions from the facility. Atmospheric provided the Modeling Unit with emission calculations for potential HAP emissions from the facility. The Modeling Unit performed a screening analysis using the Air Emissions Risk Analysis (AERA) Guidance.[9] It was determined from the use of the MPCA Risk Assessment Screening Spreadsheet (RASS) that further analysis was necessary for emissions of Naphthalene, Acetaldehyde, Acrolein, Benzene, Formaldehyde, Toluene, and Xylenes.

The Modeling Unit modeled the Organic Process HAP potential emissions and compared modeled concentrations against reference concentration levels for each pollutant from California's Office of Environmental Health Hazard Assessment (OEHHA). The results of the Modeling Unit's analysis are displayed in and **Table 7** below. All modeled concentrations were below their respective reference concentrations.

**Table 7**

**Organic HAPs Analysis**

| Pollutant | CAS Number | Averaging Period | Maximum Modeled Impact ($\mu g/m^3$) | Threshold ($\mu g/m^3$) | References |
|---|---|---|---|---|---|
| Naphthalene | 91-20-3 | 1-Hour | .02337 | 200 | OEHHA REL(1) |
| | | Annual | 0.00034 | 9 | |
| Acetaldehyde | 75-07-0 | 1-Hour | .0043 | 470 | OEHHA REL(1) |
| | | Annual | 0.00007 | 140 | |
| Acrolein | 107-02-8 | 1-Hour | 0.00142 | 2.5 | OEHHA REL(1) |
| | | Annual | 0.00002 | .35 | |
| Benzene | 71-43-2 | 1-Hour | 0.139 | 27 | OEHHA REL(1) |
| | | Annual | 0.00187 | 3 | |
| Formaldehyde | 50-00-0 | 1-Hour | 0.01416 | 55 | OEHHA REL(1) |
| | | Annual | 0.00021 | 9 | |
| Toluene | 108-88-3 | 1-Hour | 0.05048 | 5000 | OEHHA REL(1) |
| | | Annual | 0.00074 | 420 | |

[9] Minnesota Pollution Control Agency (2024). Air Emissions Risk Analysis (AERA) Guidance. Retrieved from https://www.pca.state.mn.us/sites/default/files/aq9-18.pdf.

| | | | | | |
|---|---|---|---|---|---|
| Xylenes | 1330-20-7 | 1-Hour | 0.03462 | 22000 | OEHHA REL[(1)] |
| | | Annual | 0.00051 | 700 | |

(1) OEHHA Reference Exposure Levels (REL) are established for pollutants based on exposure durations.

**Summary**

The Modeling Unit has reviewed the air quality analysis submitted by Atmospheric on behalf of Prime and has completed an audit of the modeling results. This audit confirms that the project proposed in Prime's construction permit application would not significantly impact air quality for any CO, $SO_2$, $PM_{2.5}$, or $PM_{10}$ averaging period. Additionally, modeled concentrations of $NO_2$ from the proposed project would not exceed the NAAQS for any relevant averaging period. These conclusions are based on the operational schedule provided in **Table 1**, which would include 39 Tier 2 generators operating no more than 10 hours per day. Each engine, rated at 4,656 BHP (3,250 kWe) at 100% load, would be restricted to no more than 35 hours of operation per year for maintenance and readiness testing and would exclusively use ULSD fuel with a sulfur content of no more than 15 ppmw. Furthermore, 20 of the 39 engines would be equipped with diesel particulate filters (DPFs) which would limit diesel particulate matter to 0.02 g/bhp-hr. Provided that the Permittee operates within these permit restrictions, the proposed project should not exceed the NAAQS for all criteria pollutants, including $NO_2$. In addition, HAP emissions from the proposed project are projected to remain within safe limits.

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