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MEMORANDUM

Date: January 06, 2025

Revision Date: May 15, 2025

To: Muhammad Huq, FESOP/State Permits/BOA

From: Mohammad Sweid, Modeling Unit, Permits/BOA

Subject: CyrusOne LLC (ID# 043120AEZ) Construction Permit (#24060010)

CyrusOne, LLC (CyrusOne) submitted a construction permit application (#24060010) on June 6th, 2024, requesting authorization to construct 44 new emergency generators equipped with integral diesel fuel belly tanks to support two new data center buildings in Wood Dale, Illinois. The proposed facility would include forty-two 2,250 kW emergency generators, each with an integral 6,800-gallon diesel fuel tank base, and two 1,250 kW emergency generators, each with an integral 3,800-gallon diesel fuel tank base. These generators would provide backup power during power outages, ensuring the facility's operational reliability. The facility would be located at 460 and 480 Bryn Mawr Ave, Wood Dale, IL. Centering coordinates for this facility are UTM Zone 16 coordinates 420,340 meters (m) Easting and 4,646,780 meters (m) Northing.

As of the date of this permitting decision, CyrusOne is in an area of Environmental Justice (EJ) concern as identified using Illinois EPA Start. The issued permit would provide for increases in permitted emissions of nitrogen oxides (NOx), carbon monoxide (CO), volatile organic materials (VOMs), particulate matter (PM) and sulfur dioxide (SO_2). Consequently, the Illinois EPA requested CyrusOne 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, CyrusOne had Ramboll Americas Engineering Solutions, Inc (Ramboll) conduct an air quality review of NO_2, CO, PM_{10}, $PM_{2.5}$, SO_2, and ozone (O_3) emissions.

Modeling Unit Analysis

Ramboll submitted an initial air quality analysis summary on September 20, 2024. Modeling files were transmitted electronically to the Modeling Unit on September 20, 2024. Ramboll submitted an addendum to the initial modeling report and electronic modeling files on March 25, 2025. The updated modeling report provided revised modeled emission rates. The following main dot entries identify key aspects of the modeling methodology used in this analysis:

- Ramboll used AERMOD (v. 23132)[1] the AMS/USEPA Regulatory Model. 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 also used this version.

- Modeling inputs utilized Illinois EPA- and USEPA-recommended default regulatory options, which simulate phenomena such as atmospheric stability, plume rise, and downwash. The modeling analysis incorporated five years of locally representative meteorology. The Modeling Unit obtained National Weather Service (NWS) meteorological data files for years 2019 through 2023 from the National Centers for Environmental Information (NCEI) which consisted of surface data collected at the O'Hare International Airport in Chicago, Illinois, and upper air data collected at the Davenport Municipal Airport in Davenport, Iowa. Surface and upper air stations were selected because of their proximity and representativeness to the project site in Cook County. The Modeling Unit provided the applicant with meteorology data processed with AERMET (v. 23132). The Modeling Unit used 2019 through 2023 files processed with AERMET (v. 23132) in its review.

- Ramboll processed National Elevation Data (NED) terrain elevations from USGS using the most recent version of AERMAP (v. 18081) to develop the receptor terrain elevations and hill height scales required by AERMOD. The site elevation at the CyrusOne facility is approximately 205.2 meters above mean sea level.

- Ramboll used a Cartesian grid in their distribution of 3,171 receptors. The following receptor grid densities were used:
    - 25 m spacing of receptors along fence line.
    - 50 m spacing of receptors from fence line to 500 meters.
    - 100 m spacing of receptors from 500 meters to 1,500 meters.
    - 250 m spacing of receptors from 1,500 meters to 3,000 meters.
    - 500 m spacing of receptors from 3,000 meters to 5,000 meters.
    - 1,000 m spacing of receptors from 5,000 meters to 10,000 meters.

- Ramboll 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 CyrusOne and to determine whether the AERMOD urban 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

[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 since the modeling was submitted before the release of the new versions.
Tillerson, Clint (2024, November 20) *Release of the regulatory AERMOD Modeling System (AERMOD, AERMET, and AERMAP), AERSURFACE, and AERPLOT (Version 24142), and MMIF (Version 4.1.1).* USEPA https://gaftp.epa.gov/air/aqmg/scram/models/preferred/aermod/AERMOD_24142_transmittal_memo.pdf

surrounding area is 32% rural and 68% urban. The Modeling Unit audit also utilized the urban modeling option.

- Ramboll used USEPA's Building Profile Input Program (BPIPPRM) 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, Ramboll used a Tier 2 approach to model NO_2. Ramboll 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.

Significant Impact Analysis

Ramboll performed a source impact analysis to determine if more detailed modeling would be required for any NOx, SO_2, $PM_{2.5}$, PM_{10} or CO averaging period. The analysis modeled allowable emission increases, the difference between the proposed permitted emissions and the current actual emissions of existing units at the facility. Ramboll initially submitted the modeling analysis on September 20, 2024. Since that submission, Ramboll updated the modeled emission rates and submitted an addendum to the original modeling analysis on March 25, 2025. The results of the original modeling analysis are presented in **Table 1**, while the updated results from the March 2025 addendum are presented in **Table 1A**. Each table includes a comparison of modeled concentrations against the significant impact levels (SILs) for each pollutant and averaging period.

Table 1

Original Source Impact Analysis Results

Pollutant	Averaging Period	Maximum Modeled Impact ($\mu g/m^3$)	Significant Impact Level ($\mu g/m^3$)
NO_2	1-hour	51.02	7.52
	Annual	7.67	1
SO_2	1-hour	6.34	7.85

	3-hour	6.25	25
$PM_{2.5}$	24-hour	8.48 (1)	1.2
	Annual	0.12 (1)	0.13
PM_{10}	24-hour	10.25	5
CO	1-hour	1372.70	2000
	8-hour	1053.89	500

(1) The maximum model impact also includes secondary $PM_{2.5}$ concentrations.

Table 1A

Updated Source Impact Analysis Results

Pollutant	**Averaging Period**	**Maximum Modeled Impact** ($\mu g/m^3$)	**Significant Impact Level** ($\mu g/m^3$)
NO_2	1-hour	37.61	7.52
	Annual	5.51	1
SO_2	1-hour	6.15	7.85
	3-hour	5.77	25
$PM_{2.5}$	24-hour	3.88 (2)	1.2
	Annual	0.0326 (2)	0.13
PM_{10}	24-hour	4.38	5
CO	1-hour	1523.61	2000
	8-hour	1169.244	500

(2) The maximum model impact also includes secondary $PM_{2.5}$ concentrations.

The $PM_{2.5}$ results presented in **Table 1** and **Table 1A** account for both primary and secondary impacts. A detailed explanation of the secondary $PM_{2.5}$ and Ozone (O_3) analysis is provided in the subsequent section. In both the original modeling analysis and the updated modeling analysis, emissions of CO (1-hour averaging period), SO_2 (both1-hour and 3-hour averaging periods) and $PM_{2.5}$ (annual averaging period) from the proposed project were projected to be below their respective SIL values and, as such, no further evaluation was required for these pollutants and averaging times. In the original modeling analysis, the 24-hour PM_{10} modeled concentration exceed the SIL, which triggered a NAAQS analysis for that pollutant and averaging period. However, in the updated modeling analysis, the revised 24-hour PM_{10} modeled concentration is below the SIL and did not trigger a NAAQS analysis for that pollutant and averaging period.

Ozone and Secondary $PM_{2.5}$ Formation[2]

Ramboll considered the precursor emission increases of NOx, SO_2, and VOM to evaluate the impact on the NAAQS from secondarily formed O_3 and $PM_{2.5}$. Results from the analysis were compared against SILs for O_3 and $PM_{2.5}$ to determine if further analysis should be completed.

Additionally, the Modeling Unit independently evaluated the project's formation of secondary $PM_{2.5}$ due to the project's increases of NOx and SO_2 emissions. While primary $PM_{2.5}$ is emitted directly from the source, secondary $PM_{2.5}$ is formed in the atmosphere from chemical reactions involving precursor emissions. Emissions of NOx and SO_2 are precursors to the secondary $PM_{2.5}$ formation.

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).[3,4,5] This approach utilizes air quality modeling results from hypothetical sources with precursor emission estimates to evaluate the project's impacts against SILs for O_3 and $PM_{2.5}$.

Ramboll utilized MERP values from the nearest hypothetical source located in Porter, Indiana, based on a 500 tpy emission rate with a 10 m high stack. These values were obtained from the USEPA's MERPs Qlik tool.[6] Ramboll's results were based upon facility emissions of 88.63 tpy of NO_x, 0.06 tpy of SO_2, and 6.22 tpy of VOM.

Illinois EPA elected to use the same hypothetical source to calculate secondary $PM_{2.5}$ impacts. The Illinois EPA's analysis concluded Ramboll's MERPs approach was accurate. Both the Illinois EPA analysis and Ramboll's analysis concluded that impacts were less than significant for all averaging periods of $PM_{2.5}$ and O_3. The results of the MERPs analysis are provided in **Table 2** and **Table 3**.

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[2] The results of the formation of Ozone and Secondary $PM_{2.5}$ emissions remained the same in both the original modeling report and the addendum

[3] 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.

[4] 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.

[5] 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.

[6] USEPA (2019). MERPs View Qlik. *Support Center for Regulatory Atmospheric Modeling (SCRAM).* Retrieved from: https://www.epa.gov/scram/merps-view-qlik

Table 2
MERPs Analysis for Secondary $PM_{2.5}$

Pollutant	Averaging Period	Concentration ($\mu g/m^3$)	SIL ($\mu g/m^3$)
$PM_{2.5}$	24-hour	0.042	1.2
	Annual	0.00195	0.13

Table 3

MERPs Analysis for Ozone

Pollutant	Averaging Period	Concentration (ppb)	SIL (ppb)
O_3	8-hour	0.109	1.0

The project is not significantly impacting concentrations of O_3 or $PM_{2.5}$ from secondary formation, as estimated in the MERPs analysis tables above, which further reflects that the emissions of NO_x and VOM will not impact the O_3 NAAQS.

NAAQS Analysis

Based on the results from the source impact analysis in the original modeling analysis, Ramboll conducted a NAAQS analysis for NO_2 (both 1-hour and annual averaging periods), CO (8-hour averaging period), PM_{10} (24-hour averaging period), and $PM_{2.5}$ (24-hour averaging period). Ramboll developed a cumulative modeling analysis that incorporated background concentrations based on nearby monitoring data as well as nearby emissions of sources not represented by the background monitor concentrations. In the updated modeling analysis, Ramboll conducted a NAAQS analysis for the same pollutants and averaging periods as the original modeling analysis, with the exception of 24-hour PM_{10}. Given the revised 24-hour PM_{10} concentration modeled below the SIL in the updated modeling analysis, it did not trigger further modeling for this pollutant and averaging period.

Ramboll utilized representative background data collected from Illinois's air monitoring network. NO_2 design values for 2020 to 2022 were obtained from the monitor located in Schiller Park, Illinois (AQS ID: 17-031-3103), while CO, PM_{10}, and $PM_{2.5}$ design values for 2020 to 2022 were obtained from the monitor located in Northbrook, Illinois (AQS ID: 17-031-4201). These monitors were chosen based on the relative proximity to the CyrusOne facility at approximately 20 km for the Northbrook monitor and 8 km for the Schiller Park monitor. These were the closest monitors and are in an urban region where concentrations are expected to be a conservative representation of background for the Wood Dale area facility location.

Ramboll was provided an inventory of sources from the Modeling Unit that included sources located within a 10 km radius from the center of the facility.

For the 1-hour NO_2 analysis, intermittent sources were excluded from the nearby source inventory based on USEPA guidance[7] that allows for 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 4 and Table 4A.** The results shown in the following table display the NO_2, CO, PM_{10} and $PM_{2.5}$ modeling results provided by Ramboll. The analysis indicated that, for both the original and updated modeling analyses, all modeled pollutant concentrations were below their respective NAAQS values.

Table 4

Original NAAQS Modeling Results

Pollutant	Averaging Period	Modeled Concentration (µg/m³)	Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)
NO_2	1-Hour	49.85[(1)]	97.76[(a)]	147.61	188.68
	Annual	12.70[(2)]	32.35[(b)]	45.06	100
CO	8-Hour	3,070.73[(3)]	1,035[(c)]	4,105.73	10,000
PM_{10}	24-Hour	18.92[(4)]	30[(c)]	48.92	150
$PM_{2.5}$	24-Hour	11[(1)]	18.90[(d)]	29.92	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.

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

Table 4A

Updated 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	36.98$^{(1)}$	97.76$^{(a)}$	134.74	188.68
	Annual	23.43$^{(2)}$	32.35$^{(b)}$	55.78	100
CO	8-Hour	3,070.74$^{(3)}$	1,035$^{(c)}$	4,105.74	10,000
$PM_{2.5}$	24-Hour	3.41$^{(1)}$	18.90$^{(d)}$	22.31	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.

Air Toxic Analysis

The Modeling Unit performed a HAPs screening analysis using the Air Emissions Risk Analysis (AERA) Guidance.[8] After inputting the HAP emissions from the proposed facility and corresponding dispersion values (e.g. stack heights and distance to the fence line) into the Minnesota Pollution Control Agency (MPCA) Risk Assessment Screening Spreadsheet (RASS), the Modeling Unit calculated the risks from HAP emissions from the proposed facility. Any calculated risks above 1 would require additional modeling. In this instance, values were calculated to be below 1. As such, no further HAPs modeling was required.

Summary

The Modeling Unit has reviewed the air quality analyses provided by Ramboll on behalf of CyrusOne. In the January 6, 2025, modeling memorandum, the modeling assessment assumed that all generators would be equipped with diesel particulate filters (DPFs) with a minimum control efficiency of 85%.

The modeling assessment also assumed that all generators would operate up to 80 hours per year (consuming 358,935 gallons/year of diesel fuel for all engines combined) and would operate 8 hours per day at full load (consuming 53,662 gallons/day of diesel fuel for all engines combined) for regularly scheduled maintenance and testing. Unplanned maintenance, testing, and emergencies are anticipated to occur infrequently and irregularly such that emissions from these events are not anticipated to impact the NAAQS. Accordingly, the applicant proposed that the modeled limitations apply only to regularly scheduled maintenance and testing as follows:

[8] 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.

- Annual consumption of diesel fuel for regularly-scheduled maintenance and testing not to exceed 358,935 gallons/year for all engines combined.
- Daily consumption of diesel fuel for regularly-scheduled maintenance and testing not to exceed 53,662 gallons/day for all engines combined.

The Modeling Unit's audit of this analysis confirmed that CyrusOne's proposed operation based on the noted emissions would not exceed the NAAQS for any NO_2, SO_2, CO, PM_{10} and $PM_{2.5}$ averaging times. The audit also confirms that emissions of NOx, SO_2, and VOM would not have significant impacts on $PM_{2.5}$ and ozone formation.

Following the analysis described above, Ramboll and CyrusOne submitted updated emissions data and control efficiencies on March 25, 2025. These updates—provided by the engine and control system manufacturer—include a control efficiency of 83.1% for the 2,250 kW generators and 72.5% for the 1,250 kW generators (both equipped with diesel particulate filters). Updated fuel limits were also provided, as follows:

- Proposed model limitations as follows, to account for the updated control efficiencies and emissions specifications, and recent redesignation of the Chicago area to serious nonattainment. Proposed revised fuel limits, reflecting the updated emissions and the recent redesignation of the Chicago area to serious nonattainment:
    - Annual consumption of diesel fuel for regularly-scheduled maintenance and testing not to exceed 264,492 gallons/year for all engines combined.
    - Daily consumption of diesel fuel for regularly-scheduled maintenance and testing not to exceed 19,000 gallons/day for all engines combined.

The Modeling Unit's review of the updated analysis confirms that the revised fuel limits and emissions data would not result in exceed the NAAQS for NO_2, SO_2, CO, $PM_{2.5}$, and PM_{10} averaging times. The audit also confirms that emissions of NO_2, SO_2, and VOM would not have significant impacts on $PM_{2.5}$ and ozone formation. Based upon the applicant's submittal and the IEPA's review of the modeling results, the air quality analysis demonstrates the proposed operations will comply with all NAAQS so long as the operations are restricted in the permit as outlined in this memorandum.

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