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MEMORANDUM

DATE: March 27, 2020

TO: File, Construction Permit No. 19020013

FROM: Steven King, Modeler, Bureau of Air

SUBJECT: Follow-up Modeling Post Capture and Control and Compliance Testing - Medline Industries, Inc. (ID No. 097190AFG)

Background

Medline Industries Inc. (Medline) owns and operates a commercial ethylene oxide sterilization source in northeastern Lake County. The facility operates at 1160 South Northpoint Boulevard, within the Waukegan city limits. At this facility, Medline primarily sterilizes medical devices, surgical kits, pharmaceutical, and laboratory equipment using ethylene oxide as the means of sterilization.

In April 2019, Medline submitted an air quality modeling impact analysis in support of construction permit application #19020013. Illinois EPA's review of the modeling, including background on the project and assessment of potential air quality impacts are described in an August 2, 2019 memorandum, publicly available as part of the issued construction permit at the following link:

https://www2.illinois.gov/epa/topics/community-relations/sites/ethylene-oxide/Documents/MEMORANDUM_IEPA%20Review_Medline%20EtO%20Dispersion%20Modeling%20Analysis_Permit%20Application%2019020013.FINAL.pdf.

This memorandum serves as a review of the follow-up modeling required as part of Illinois Public Act 101-0022.

This follow-up modeling demonstration differs from the modeling analysis submitted in the construction permit application. This modeling is required by the Illinois Public Act 101-0022 for the applicant to submit an air quality dispersion modeling analysis based on stack test data. This data represents an "as built" scenario representative of actual operating conditions. This follow up review is necessary to ensure that the impacts remain within USEPA's acceptable cancer risk levels.

This updated modeling was submitted by Montrose Air Quality Services, Inc (Montrose) on behalf of Medline based on the exhaust parameters and emission rates derived from the March 10-12, 2020 stack test. For other model parameters, the modeling adheres to the same procedures and settings utilized in Medline's April 2019 dispersion modeling analysis to support the construction permit application unless otherwise noted below. Please refer to the previous

Illinois EPA memorandum for additional details on the model setup and background on the project.

In December 2016, the United States Environmental Protection Agency (U.S. EPA) issued a summary report which supported EPA's Integrated Risk and Assessment System (IRIS) upgrade of ethylene oxide from "probably carcinogenic to humans" to "carcinogenic to humans". The adult-based inhalation cancer risk estimate for ethylene oxide, called the "unit risk estimate", was changed from 0.0001 per microgram per cubic meter (µg/m^3) to 0.003 per µg/m^3, which equates to a 30-fold cancer potency increase. Per the 2016 report, "*When using the adult-based unit risk estimates to estimate extra cancer risks for a given exposure scenario, the standard age-dependent adjustment factors (ADAFs) should be applied, in accordance with the EPA's Supplemental Guidance (U.S. EPA, 2005b). Applying the ADAFs to obtain a full lifetime total cancer unit risk estimate yields 5.0 × 10^{-3} per µg/m^3.*" For the modeling demonstration submitted for Medline, the 0.005 per µg/m^3 lifetime unit risk estimate is the appropriate metric to apply to the dispersion modeling results for residential areas. In commercial, industrial, or off-site adult worker areas, a 0.003 per µg/m^3 unit risk estimate consistent U.S. EPA's assumption of an 8.5-hour workday, 250 days a year, for 25 years, and an 0.087 exposure factor, is the appropriate method for estimating risk.

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For comparison purposes, Table 1 presents the original design for the stack emissions and parameters, followed by the parameters determined by the recent stack test.

Table 1
Comparison of Stack Parameters: As Designed vs. As Built/As Tested

Scenario	Emission Rate	Stack Height	Stack Temperature	Stack Diameter	Stack Exit Velocity
	lbs/year (lbs/hour)	Feet (Meters)	deg. F (deg K)	Feet (Meters)	Feet per Second (m/s)
As Designed	150.9 (0.0172)	60 (18.29)	89.3 (305.0)	4.6 (1.41)	60.0 (18.3)
As Built/As Tested*	96.4 (0.011)	60 (18.29)	79.1 (299.3)	5.0 (1.52)	44.4 (13.5)

* Stack emissions and parameters based on March 10 – 12, 2020 stack test.

In addition to the stack parameter updates noted on Table 1, these are the following updates to the model inputs.

- The U.S. EPA released a new version of AERMOD in July 2019 (version 19191) to replace the previous version (dated 18081). This new AERMOD version was utilized in this modeling analysis. AERMOD is a state and federally approved regulatory model appropriate for use in an air quality analysis of this nature.

- The U.S. EPA released a new version of AERMET, the meteorological processor for AERMOD, in July 2019 (version 19191) to replace the previous version (dated 18081). This new AERMET program was used by Illinois EPA to update the meteorological dataset. The data source location and procedures used to update the hourly meteorology was identical to the original submittal. This new dataset was provided to Medline to use in this modeling analysis.
- The location of the new common stack is approximately 36 feet north-northeast of the originally proposed location. It remains situated between the two Medline buildings (chamber process building, and the larger office building to the east).
- A new 27 foot tall and approximately 25 by 35 foot structure was constructed just north of the stack to house emission control equipment. Since this structure can affect the stack plume via building induced downwash, it was digitized into the model inputs. The U.S. EPA's Building Profile Input Program with PRIME algorithm (BPIPPRM, version 04274) was rerun (including the new stack location) to account for downwash and wake effects.
- AERMAP (version 18081), the terrain elevation processor program, was rerun to incorporate the elevation height for the new common stack location and additional building structure.

Stack parameters and hourly emissions derived from the stack test, and updated inputs, models, and model settings were utilized to predict the five-year average concentrations at each of 750 receptor points within 1-kilometer of Medline. Illinois EPA considers this areal extent and timeframe appropriate to determine and represent maximum long-term (lifetime/70-year) exposures and impacts.

Table 2 presents a summary of Medline's modeling. The maximum predicted five-year average ethylene oxide concentration for the as built scenario (based on the March 2020 stack test data). Illinois EPA has audited the results and verified that the correct model inputs and procedures were used in the modeling exercise. Illinois EPA also confirmed that the area of maximum impact is adequately determined in the modeling demonstration.

Table 2
Maximum Predicted 5-Year Average Ethylene Oxide Concentration

Location	Stack Height	Receptor Location of Domain Maximum		Maximum Predicted 5-year Average Concentration ($\mu g/m^3$)		
		UTM Easting (m)	UTM Northing (m)	Entire Domain	Off-Property	Entire Domain Highest Residential
5-years	60'	426835.00	4687645.00	0.00910	0.00814	0.00284

The maximum predicted five-year average ethylene oxide concentration in the entire modeling domain is **0.0091** µg/m^3. This predicted maximum is approximately 90 meters north-northeast of the stack and this impact occurs on the Medline property. This maximum concentration represents a *non-residential* lifetime risk of **2 in a million** for off-site workers. The maximum predicted five-year average ethylene oxide concentration off-property is **0.00814 µg/m^3**. This predicted maximum occurs approximately 215 meters east of the stack and on a vacant strip of land near the on-ramp to Route 41. This represents a highest off-property *non-residential* lifetime risk of approximately **2 in a million** for off-site workers. The maximum predicted *residential* concentration is approximately **0.00284 µg/m^3**, located about 265 meters southwest of the stack. This impact represents a *residential* lifetime risk of **14 in a million.** Table 3 presents a summary of the predicted lifetime cancer risk.

Table 3
Maximum Predicted Lifetime Cancer Risk in a Million

Stack Height	Maximum Predicted Lifetime Risk (in a million)		
	Entire Domain Non-Residential	Off-Property Non-Residential	Entire Domain Highest Residential
60’	2.4	2.1	14.2

The emission rate in this follow-up modeling is based upon the stack test rate of 0.011 lb/hour, or annually, 96.4 lbs/year. The permit allows up to 150 lbs/year, thus Illinois EPA asked Medline to provide impacts at 150 lb/year (0.0171 lb/hour) to fully assess the potential impacts at the maximum permitted rate. Because the emission rate is the only data point that changes in the model, impacts can be linearly scaled from the stack test emission rate. This interpolation, at 150 lbs/year, results in expected maximum impacts (risk) of **0.01417** µg/m^3 (3.7 in a million), **0.01267** µg/m^3 (3.3 in a million), and **0.00442** µg/m^3 (22.1 in a million), for maximum domain, maximum off-property, and maximum residential concentrations, respectively.

Recommendation

The area of maximum predicted impact in the follow-up modeling is sufficiently determined. The maximum impact, whether at the stack test emission rate or maximum permitted rate, at a non-residential or residential location, predict risk that is considerably below U.S. EPA’s upper limit of acceptable lifetime cancer risk for the most exposed person of 100 in a million. For all other receptor locations modeled within one-square kilometer of the facility, impacts, and thus risk, decreased.

The topography beyond one-kilometer of the facility is generally flat to gently rolling. Consequently, standard dispersion principles intrinsic in the model gaussian - plume equation will calculate decreasing concentrations and risk beyond the one-kilometer extent of the

modeling domain. Based upon my review and audit of the dispersion modeling, including associated emission rates, updated stack configuration based on stack test results, modeling procedures, and modeled impacts, I consider the ethylene oxide air quality dispersion modeling analysis acceptable and find it appropriately fulfills the requirements of Illinois Public Act 101-0022.