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JB PRITZKER, GOVERNOR **JAMES JENNINGS**, ACTING DIRECTOR

MEMORANDUM

Date: November 25, 2024

To: Mohamad Otry, State/FESOPs Unit, Permits/BOA

From: Mohammad Sweid, Modeling Unit, Permits/BOA

Subject: Arnold Magnetic Technologies Corporation (ID# 111095AIR) Construction Permit (#24070027)

Arnold Magnetic Technologies Corporation (Arnold) submitted a construction permit application (#24070027) on July 19th, 2024, where Arnold is planning to cease operations at its current facility in Marengo, Illinois, and relocate some operations to a new site in Woodstock, Illinois. The existing Marengo facility is comprised of various emission units operating four distinct processes; these processes include the Arkomax department, Cast Alnico department, Sintered Alnico department, and Precision Thin Metals department.

The Woodstock facility would produce various magnetic alloys with the process equipment and the nature of operations would be the same as Arnold's existing Marengo facility with a few exceptions. The address for the new facility is 1005 Courtalds Drive in Woodstock, IL and the centering coordinates for the facility are 382.97 km East and 4,684.3 km North (UTM Zone 16).

As of the date of this permitting decision, Arnold's new facility is in in an area of Environmental Justice (EJ) concern as identified using Illinois EPA EJ Start. The issued permit would facilitate the relocation and operation of Arnold's emission units and process, including the Arkomax, Cast Alnico, and Precision Thin Metals departments, to the new Woodstock, Illinois site. To ensure that emissions from these relocated operations, which may include nitrogen oxides (NOx), carbon monoxide (CO), volatile organic material (VOM), particulate matter (PM), and sulfur dioxide (SO_2), do not compromise National Ambient Air Quality Standards (NAAQS), the Illinois EPA has requested Arnold conduct a comprehensive air quality analysis as part of its application for this permit.

In response to Illinois EPA's request, Arnold had Trinity Consultants (Trinity), conduct an air quality review of CO, NOx, $PM_{2.5}$, PM_{10}, and SO_2 emissions. Trinity also provided emission estimates of Hazardous Air Pollutant (HAP) emissions from the facility.

Modeling Unit Review

The air quality analysis performed by Trinity was submitted on July 31, 2024. The following dot point entries identify key aspects of the modeling methodology used in this analysis:

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- Trinity used AERMOD (AMS/EPA 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 IEPA- 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 Waukegan Regional Airport in Waukegan, 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 McHenry 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.[1] The Modeling Unit's audit runs used the same meteorological data processed with the same version of AERMET.

- Trinity processed National Elevation Data (NED) terrain elevations from USGS using AERMAP, version 18081[1], to develop the receptor terrain elevations and hill height scales required by AERMOD. The site elevation at the Woodstock facility is approximately 294 m above mean sea level.

- Trinity used a Cartesian grid in their distribution of 665 receptors. Receptors were modeled along the ambient air boundary at a spacing of 50-meters, with 100-meter spacing out to one kilometer from the ambient air boundary.

- Trinity selected the rural modeling option in their analysis. The Modeling Unit conducted an Auer's Analysis as part of its review to characterize the area surrounding Arnold 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 92% rural and 8% urban. The Modeling Unit audit also utilized the rural modeling option.

- Trinity 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.

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[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.
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

- 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 the Ozone Limiting Method (OLM) or the Plume Volume Molar Ratio Method (PVMRM) regulatory screening options in AERMOD. These options consider the chemical mechanisms of ozone titration and the resulting NO_2 concentrations. Based on the submitted modeling files, Trinity used a Tier 3 approach to model NO_2. Trinity used the OLM using Ozone data for 2019-2023 obtained for the closest available seasonal monitor (~17 km SE), Cary Grove HS (17-111-0001), and closest available full year monitor (~55 km SE), Northbrook Water Plant (17-031-4201). OLM also requires selection of the NO_2/NOx in-stack ratio (ISR) for each source. Trinity used an ISR of 0.5 for the Arnold sources and for all inventory within 3 km of the Arnold facility. All other sources utilized an ISR of 0.2 as recommended by the USEPA.

- Trinity used the EMISFACT option in AERMOD to model emissions based on Arnold'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 Arnold. **Table 1** summarizes the proposed operating hours at the facility.

Table 1

Operating Hours

Permit Description	Stack ID	Daily Operating Schedule	Hours
Arkomax Induction Furnace/Melt Deck	1	7am-3pm	8
Arkomax Pouring/Casting (aka Chill Boxes)	1	7am-5pm	10
Arkomax Core Curing Oven	2	7am-3pm	8
Alnico Melt Induction Furnace (300-lb) Arnokrome Melt Induction Furnace (200-lb)	CAST	7am-3pm	8
Cast Alnico Pouring/Casting (aka Smoke Tunnel)	CAST	7am-5pm	10
Cast Alnico Oven	4	7am-3pm	8
Shakeout/Shotblasting/Grinding/Machine Operations (Cast Alnico and Arkomax)	19	7am-3pm	8
	18	7am-3pm	8
Alnico Exogas Gen for Heat Treat	12	7am-7am	24
Alnico Heat Treat	13	7am-7am	24
Cast Alnico Dipping Furnace	14	7am-7am	24
Alnico Core Making Silos	SILO	7am-3pm	8
PTM Coat Line Annealing Furnaces	5	7am-7am	24
PTM Cold Degreaser and Distiller	10 11	7am-12pm 7am-3pm	5 8
PTM Sergeant & Wilbur	16	7am-3pm	8

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Source Impact Analysis

Trinity performed a source impact analysis to determine if more detailed modeling would be required for any NOx, SO_2, CO, $PM_{2.5}$, or PM_{10} averaging period. The results of this analysis are 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	0.65	5
$PM_{2.5}$	24-hour	0.62(1)	1.2
	Annual	0.10(1)	0.13
CO	1-hour	51.41	2000
	8-hour	26.07	500
SO_2	1-hour	0.30	7.85
	3-hour	0.25	25
NO_2	1-hour	45.37	7.52
	Annual	4.33	1

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

Modeling Unit audit runs confirmed Trinity’s modeling analysis. The results from both Trinity’s analysis and the Modeling Unit’s audit found that impacts for 1-hour and annual NO_2 would be above their respective SILs and require further analysis.

The results for 24-hour and annual $PM_{2.5}$ also included secondary $PM_{2.5}$ emissions from the project’s increases of NOx and SO_2 emissions. Trinity 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

Trinity considered the precursor emission increases of NOx and VOM to evaluate the impact of secondary formation of O_3 on the NAAQS. O_3 formation is a complex, process that is dependent on meteorological conditions as well as concentrations of VOM and NOx. Emissions of VOM and NOx are precursors to O_3 formation.

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

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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).[2.3.4] 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 $PM_{2.5}$.

Trinity used the closest hypothetical source located in Stephenson County, Illinois with values for a 500 tpy, 10 m high stack taken from USEPA's MERPs View Qlik tool.[5] The Illinois EPA used the same hypothetical source to calculate secondary $PM_{2.5}$ impacts. The Illinois EPA's review confirmed that Trinity's approach was accurate, with both Trinity and the Illinois EPA concluding that impacts were below SILs across all averaging periods for $PM_{2.5}$ and O_3. The results of the MERPs analysis are provided in **Table 3** and **Table 4**.

Table 3
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	0.00081	1.2
	Annual	0.000047	0.13

Table 4
MERPs Analysis for Ozone

Pollutant	Averaging Period	Concentration (ppb)	SIL (ppb)
O_3	8-hour	0.014	1.0

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

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2 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.

3 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.

4 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.

5 https://www.epa.gov/scram/merps-view-qlik#Modeled_Impacts

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NAAQS Analysis

Based on the results from the source impact analysis, Arnold conducted a NAAQS analysis for NO_2 (both 1-hour and annual averaging periods). Arnold 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.

Arnold utilized representative background data collected from the IEPA monitor located in Nilwood, Illinois (AQS ID: 17-117-0002). This monitor was chosen as a representative background source as it is a rural monitor similar to the area surrounding Arnold's facility in Woodstock, Illinois. The closest ambient NO_2 monitors are surrounded by urban communities and would give very conservative estimates of the background concentrations near the Arnold facility. For 1-hour NO_2, Trinity utilized seasonal and hourly varying data. For annual NO_2, Trinity utilized a background value of 2.13 ppb.

The Modeling Unit provided Trinity with an inventory of sources located within a 20 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,[6] which permits the exclusion of nearby intermittent sources when modeling for the 1-hour NO_2 standard.

The modeled concentrations account for impacts from both the facility and nearby emission inventory sources. Total concentrations were calculated by summing the modeled and background concentrations, with these values compared to the respective NAAQS standards, as presented in **Table 5.** Trinity incorporated the background monitor concentrations into the modeling files, so the concentrations presented in **Table 5** include background monitor impacts. The results in **Table 5** display Trinity's NO_2 modeling outcomes, indicating that both hourly and annual NO_2 emissions remain below their respective NAAQS thresholds.

Table 5
NAAQS Modeling Results

Pollutant	Averaging Period	Maximum Modeled Impact ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
NO_2	1-Hour	115.94	188
	Annual	9.28	100

Air Toxics Analysis

As part of the air quality analysis for Arnold, the Modeling Unit requested the facility evaluate the impacts of toxic air pollutant emissions from the facility. Trinity 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.[7] It

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

[7] 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.

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was determined from the use of the MPCA Risk Assessment Screening Spreadsheet (RASS) that further analysis was necessary for emissions of Cobalt, Chromium, Manganese, Nickel, Naphthalene, MDI, and Phenol.

The Modeling Unit modeled the Metallic HAP potential emissions and Organic Process HAP potential emissions and compared modeled concentrations against reference concentration levels for each pollutant from USEPA's Integrated Risk Information System (IRIS), California's Office of Environmental Health Hazard Assessment (OEHHA), and the Agency for Toxic Substances and Disease Registry (ATSDR). The results of the Modeling Unit's analysis are displayed in **Table 6** and **Table 7** below. All modeled concentrations were below their respective reference concentrations.

Table 6

Metallic HAPs Analysis

Pollutant	CAS Number	Averaging Period	Maximum Modeled Impact (µg/m^3)	Threshold (µg/m^3)	References
Cobalt	7440-48-4	Annual	0.00077	0.1	ATDSR MRL(1)
Chromium	7440-47-3	Annual	0.00007	0.0003	ATDSR MRL(1)
Manganese	7439-96-5	8-Hour	0.00006	0.17	OEHHA REL (2)
		Annual	0.00000	0.09	
Nickel	7440-02-0	1-Hour	0.01122	0.2	OEHHA REL(2)
		8-Hour	0.00731	0.06	
		Annual	0.00039	0.014	

(1) ATDSR Minimum Risk Levels (MRL) are established for pollutants based on exposure durations.
(2) OEHHA Reference Exposure Levels (REL) are established for pollutants based on exposure durations.

Table 7

Organic HAPs Analysis

Pollutant	CAS Number	Averaging Period	Maximum Modeled Impact (µg/m^3)	Threshold (µg/m^3)	References
Naphthalene	91-20-3	1-Hour	1.84	200	OEHHA REL(1)
		Annual	0.10	9	
MDI	9016-87-9	1-Hour	2.77	12	OEHHA REL(1)
		Annual	0.14	0.6	IRIS RfC(2)
Phenol	108-95	1-Hour	0.46	5800	OEHHA REL(1)
		Annual	0.02	200	

(1) OEHHA Reference Exposure Levels (REL) are established for pollutants based on exposure durations.
(2) IRIS reference concentrations for inhalation exposure (RfCs) provide an estimate of concentrations that human populations could inhale over a lifetime without an appreciable risk of negative health outcomes.

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Summary

The Modeling Unit has reviewed the air quality analysis provided by Trinity on behalf of Arnold. The Modeling Unit audit of this analysis confirms that the operations proposed in Arnold’s construction permit application would not significantly impact the air quality for any CO, SO_2, $PM_{2.5}$, or PM_{10} averaging period, and additionally, the concentrations of NO_2 resulting from the proposed operation would not exceed the NAAQS for any NO_2 averaging period. The audit confirms that the proposed operations comply with the NAAQS for all relevant pollutants, include NO_2, and the HAP emissions would remain within safe limits, provided the operations adhere to the permit restrictions outlined in this memorandum.

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