MICHIGAN POTASH COMPANY
600 17th Street, Suite 2300 | Denver, CO 80203 | info@mipotash.com

Mr. Nicholas Carlson
Environmental Engineer
EGLE – Air Quality Division
525 West Allegan Street
Lansing, MI 48933-1502

April 30, 2021

RE: Revised Ambient Impact Analysis Including Natural Gas-fired Space Heaters
Permit to Install Application No. 165-15A
Michigan Potash Operating, LLC

Dear Mr. Carlson:

On March 23, 2021, Michigan Potash Operating, LLC (MPO) submitted PTI Application No. 165-15A to Michigan Department of Environment, Great Lakes, and Energy (EGLE) for an amendment to PTI No. 165-15 to incorporate updated plant design, layout, and equipment for its proposed salt and potash manufacturing facility. In accordance with EGLE Policy and Procedure No. AQD-022, the application included an ambient impact analysis utilizing dispersion modeling for emissions of nitrogen oxides (NO_x (as NO_2)), particulate matter less than 10 and 2.5 microns (PM_{10} and $PM_{2.5}$), sulfur dioxide (SO_2) and toxic air contaminants (TACs).

On April 2, 2021, EGLE requested that MPO provide an updated ambient impact analysis to include various small natural gas-fired space heaters that are anticipated to be installed throughout multiple buildings at the proposed plant.

Revised Ambient Impact Analysis Including Natural Gas-Fired Space Heaters

The natural gas-fired space heaters will be used for facility heating, ventilation, and cooling (HVAC) systems, to provide comfort heating where personnel will be working, and will be similar to forced-air heating systems found in homes and traditional office spaces. Further, the space heaters vent to the in-plant (or office) environment, are not for production, and will operate on a limited basis (i.e., seasonally) during periods of cool weather, operating intermittently to raise the temperature of certain spaces. If not for inclusion with this project and "activity" as outlined in R 336.1278, the space heaters would otherwise be exempt from air permitting (even when considering aggregate heat input) pursuant to Michigan Air Pollution Control Rule R 336.1282(2)(b)(i) for natural gas fuel burning equipment with a rated heat input capacity of not more than 50 million British thermal units per hour (MMBtu/hr).

Inclusion of the space heaters in the modeling demonstration assuming maximum potential operation is a conservative measure as the units may only operate for a portion of the year and are insignificant sources to the overall plant emissions profile. Regardless, the ambient impact analysis has been updated at EGLE's request. Consistent with the original ambient impact analysis submitted with PTI Application No. 165-15A, the updated ambient impact analysis indicates that impacts of NO_x (as NO_2), PM_{10}, $PM_{2.5}$ and SO_2 remain less than the applicable National Ambient Air Quality Standards (NAAQS) and Prevention of Significant Deterioration (PSD) Increment standards. Additionally, impacts of TACs remain within respective health-based screening levels in accordance with R 336.1225.

We have enclosed an updated facility diagram depicting locations of the various space heaters as Attachment A (Note: there have not been other changes to the physical layout; the only additional information is the locations of the space heaters).

Attachment B includes the following updated tables from the PTI Support Document that include:

- Section 1, Tables 1-2 and 1-3 showing change in facility potential emissions and maximum ambient impacts with inclusion of the space heaters
- Section 2, Table 2-2, showing proposed facility emissions with inclusion of the space heaters
- Section 3, showing proposed facility updated potential emissions with major source thresholds
- Section 4, showing updated allowable emissions compared to AQD-22 requirements
- Section 5, Tables 5-2, 5-3, and 5-4, containing updated dispersion modeling results with inclusion of the space heaters (as volume sources)
- Appendix B: Tables B-7 and B-9, containing updated potential emission estimates for the space heaters along with updated maximum estimated heat input capacities
- Appendix C: Tables C-1 and C-3, containing updated TAC analyses with inclusion of the space heaters
- Appendix D: Table D-1b, containing updated modeled inputs with inclusion of the space heaters modeled as volume sources

Updated modeling files will be provided electronically via EGLE's File Transfer Protocol (FTP) site.

Should you have questions regarding this analysis, please contact me at (231) 577-9616 or Ms. Mary Mello of NTH at (248) 662-2033.

Sincerely,

Theodore Pagano, P.E., P.G.
Chief Executive Officer

Attachments

cc: Mr. Andrew Drury, EGLE – AQD
Ms. Rhiana C. Dornbos, P.E., NTH
Ms. Mary Mello, NTH
Mr. Eric Marko, NTH

ATTACHMENT A

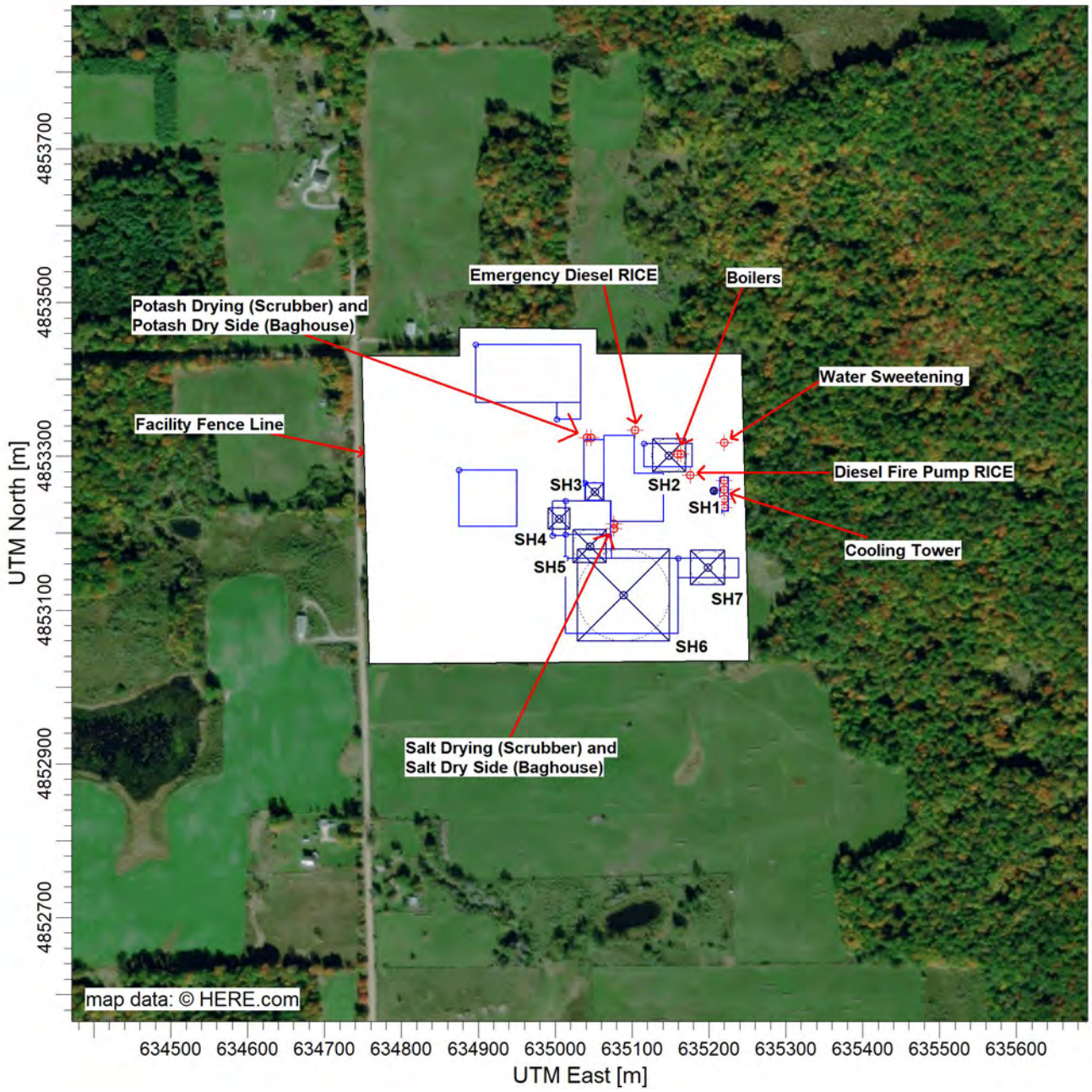
// FACILITY SITE LAYOUT

(Revised: April 2021)

Attachment A
Facility Site Layout (Revised April 2021)

PROJECT TITLE:

Michigan Potash Operating, LLC
Salt and Potash Manufacturing Facility



COMMENTS:
Space Heater Locations:
SH1 = Cooling Tower Electrical Room (one heater)
SH2 = Utility Building & Wet Side Electrical Room (two heaters)
SH3 = Dry Side Electrical Room & Operator/ Networking/Control Room (two heaters)
SH4 = Control Room Loadout #1 (one heater)
SH5 = Packaging/Shipping Office (one heater)
SH6 = Warehouse Building & Admin Office (two heaters)
SH7 = Maintenance Office & Maintenance Building (two heaters)

SOURCES: **21**

RECEPTORS: **5416**

OUTPUT TYPE:

MAX:

COMPANY NAME: **NTH Consultants, Ltd.**

SCALE: 1:8,311
0 0.3 km

DATE: **5/3/2021**

PROJECT NO.: **74-200230-02**

AERMOD View - Lakes Environmental Software

ATTACHMENT B

// UPDATED TABLES FROM PTI

APPLICATION NO. 165-15A

(Revised: April 2021)

ATTACHMENT B
Updated Tables from PTI Application No. 165-15A

Table 1-2: Change in Facility PTE (*Revised April 2021*)

Pollutant	PTI No. 165-15 Facility PTE (tpy)	Proposed Amendment Facility PTE (tpy)	Summary of Change in PTE
PM_{10}	89.9	88	Reduction in potential emissions due to enhanced control technology design and updated vendor guarantees.
$PM_{2.5}$	89.9	88	
NO_x	54	75	No change or a slight increase in potential emissions due to update in natural gas boiler heat input capacity and inclusion of ancillary equipment. Emissions remain less than major source thresholds and in line with PTI No. 165-15.
CO	57	66	
PM	83	96	
SO_2	12	12	
Pb	6.2E-04	6.8E-04	
VOC	6.8	8.5	
Maximum Individual HAP	2.2	2.5	
Aggregate HAPs	2.3	2.6	

Table 1-3: Change in Maximum Ambient Impacts (*Revised April 2021*)

Modeled Pollutant	PTI No. 165-15 % of NAAQS	Proposed Amendment % of NAAQS	PTI No. 165-15 % of PSD Increment	Proposed Amendment % of PSD Increment	Summary of Change in Impact
NO_2 (1-hr)	37%	58%	NA	NA	Reduction in PM impacts from original permit by up to 21%
NO_2 (Annual)	4%	12%	6%	38%	
$PM_{2.5}$ (24-hr)	79%	58%	99%	91%	
$PM_{2.5}$ (Annual)	68%	64%	38%	39%	
PM_{10} (24-hr)	27%	29%	30%	27%	
PM_{10} (Annual)	NA	NA	9%	9%	

Table 2-2: Proposed Potash and Salt Manufacturing Facility Emissions (*Revised April 2021*)

Pollutant	Water Sweetening (tpy)	Manufacturing		Natural Gas-fired Boilers (tpy)	Diesel Emg. RICE (tpy)	Diesel Fire Pump (tpy)	Cooling Tower (tpy)	Space Heaters (tpy)	Total PTE (tpy)
		Salt (tpy)	Potash (tpy)						
NO_x	2.4	17	18	9.6	16	0.14	-	12.0	75
CO	2.0	14	15	16	8.6	0.14	-	10.1	66
PM	4.5E-02	44	50	1.6	0.49	1.2E-02	-	0.23	96
PM_{10}	0.18	34	45	6.5	0.66	3.9E-02	1.6	0.91	88
$PM_{2.5}$	0.18	34	45	6.5	0.66	3.9E-02	1.6	0.91	88
SO_2	11	0.10	0.11	0.51	1.8E-02	3.6E-02	-	7.2E-02	12
Pb	1.2E-05	8.5E-05	9.0E-05	4.3E-04	-	-	-	6.0E-05	6.8E-04
VOC	0.13	0.94	1.0	4.7	1.1	4.4E-02	-	0.66	8.5
H_2S	7.7	-	-	-	-	-	-	-	7.7
H_2SO_4	1.1	-	-	-	-	-	-	-	1.1
Max Single HAP (Hexane)	4.3E-02	3.2E-01	3.4E-01	1.5	-	-	-	2.2E-01	2.5
Aggregate HAPs	4.5E-02	3.4E-01	3.6E-01	1.6	1.5E-02	9.7E-04	-	2.3E-01	2.6

ATTACHMENT B
Updated Tables from PTI Application No. 165-15A

Table 3-3: Proposed Facility PTE and Major Stationary Source Thresholds (*Revised April 2021*)

Pollutant	Proposed Facility PTE (tpy)	ROP Major Source Threshold (tpy)	PSD Major Source Threshold (tpy)
NO_x	75	100	250
CO	66	100	250
PM (filterable)	96	N/A	250
PM_{10} (filterable and condensable)	88	100	250
$PM_{2.5}$ (filterable and condensable)	88	100	250
SO_2	12	100	250
Pb	6.8E-04	100	250
VOC	8.5	100	250
H_2S	7.7	N/A	250
H_2SO_4	1.1	N/A	250
Individual HAP (Hexane)	2.5	10	N/A
Aggregate HAPs	2.6	25	N/A

Table 4-1: Allowable Emissions Comparison to AQD-22 Requirements *(Revised April 2021)*

Pollutant	Proposed Project PTE (tpy)	Significant Emission Rate (tpy)	Percent of Significant Emission Rate (%)	AQD-22 Tables 1, 2 and 3 Requirements
NO_x	75	40	> 100%	Demonstration required
CO	66	100	66%	None
PM_{10} (filterable and condensable)	88	15	> 100%	Demonstration required
$PM_{2.5}$ (filterable and condensable)	88	10	> 100%	Demonstration required
SO_2	12	40	30%	Meet stack height requirements or demonstration required

Table 5-2: SILs and Modeling Results for the Proposed Project (*Revised April 2021*)

Pollutant	Averaging Time Period	SIL (µg/m³)	Maximum Impact [1] (µg/m³)	Maximum Impact as % of SIL (µg/m³)
NO_2	1-hour	7.5	105	1,403%
	Annual	1	9.0	897%
$PM_{2.5}$	24-hour	1.2	8.4	702%
	Annual	0.2	1.5	754%
PM_{10}	24-hour	5	10.0	200%
	Annual	1	1.5	151%
SO_2	1-hour	7.8	39.8	510%
	3-hour	25	31.0	124%
	24-hour	5	13.1	262%
	Annual	1	1.8	180%

[1] Impacts are based on the highest of the first high (H1H) impacts directly from proposed project source emissions.

ATTACHMENT B
Updated Tables from PTI Application No. 165-15A

Table 5-3: PSD Increment Standards and Modeling Results (*Revised April 2021*)

Pollutant	Averaging Time Period	PSD Increment (µg/m^3)	Maximum Impact [1,2] (µg/m^3)	Maximum Impact as % of PSD Increment (µg/m^3)
NO_2	Annual	25	9.5	37.9%
$PM_{2.5}$	24-hour	9	8.2	91.5%
	Annual	4	1.6	39.2%
PM_{10}	24-hour	30	8.2	27.5%
	Annual	17	1.6	9.2%
SO_2	3-hour	512	28.4	5.5%
	24-hour	91	11.4	12.5%
	Annual	20	2.0	9.8%

[1] Annual impacts are based on the maximum H1H impact from any year of the 5-year meteorology data period.
[2] The 24-hour impacts for PM_{10} and $PM_{2.5}$ and the 24-hour and 3-hour impacts for SO_2 are based on the maximum highest of the second high (H2H) impact from any year of the 5-year meteorology data period.

Table 5-4: NAAQS Levels and Modeling Results (*Revised April 2021*)

Pollutant	Averaging Time Period	NAAQS (µg/m^3)	Maximum Impact [1,2,3,4,5] (µg/m^3)	Background Concentration (µg/m^3)	Total Impact (µg/m^3)	Maximum Impact as % of NAAQS (µg/m^3)
NO_2	1-hour	188	96.3	13.2	110	58.3%
	Annual	100	9.5	2.6	12.1	12.1%
$PM_{2.5}$	24-hour	35	5.9	14.5	20.4	58.3%
	Annual	12	1.5	6.2	7.7	64.2%
PM_{10}	24-hour	150	8.1	35.0	43.1	28.7%
SO_2	1-hour	196	36.7	11.5	48.2	24.6%
	3-hour	1,300	28.4	14.4	42.8	3.3%

[1] The annual NO_2 impact is based on the maximum H1H impact from any year of the 5-year meteorology data period.
[2] The 1-hour impact for NO_2 and the 24-hour impact for $PM_{2.5}$ are based on the 98th Percentile (equivalent to the highest of the eighth high (H8H) impact over 5 years).
[3] The 24-hour impact for PM_{10} is based on the highest of the sixth high (H6H) impact over the 5-year meteorology data period.
[4] The annual $PM_{2.5}$ impact is based on the average H1H impact over the 5-year meteorology data period.
[5] The 1-hour impact for SO_2 is based on the 99th Percentile (equivalent to the highest of the fourth high (H4H) impact over 5 years). The 3-hour impact for SO_2 is based on the maximum H2H impact from any year of the 5-year meteorology data period.

Table B-5. Emergency Diesel RICE Potential Emissions

Specifications					
Hourly heat input (MMBtu/hr)	38				
Annual Hours of Operation (hr/yr)	500				
Engine Rating, kW (mechanical)	4,474				
Brake Horsepower (hp)	6,000				
Pollutant	**Emission Factor**	**Emission Factor Units**	**Emission Factor Basis**	**Emissions (lb/hr)**	**Emissions (tpy)**
NO_x + NMHC	6.4	g/kW-hr	NSPS Subpart IIII	63	16
CO	3.5	g/kW-hr	NSPS Subpart IIII	35	8.6
PM, filterable	0.20	g/kW-hr	NSPS Subpart IIII	2.0	0.49
PM_{10}, filterable & condensable	6.97E-02	lb/MMBtu	AP-42 Ch. 3.4, Table 3.4-2	2.6	0.66
$PM_{2.5}$, filterable & condensable	6.97E-02	lb/MMBtu	AP-42 Ch. 3.4, Table 3.4-2	2.6	0.66
SO_2	1.21E-05	lb/hp-hr	AP-42 Ch. 3.4, Table 3.4-1, 0.0015% sulfur	7.3E-02	1.8E-02
VOC	7.05E-04	lb/hp-hr	AP-42 Ch. 3.4, Table 3.4-1	4.2	1.1

Table B-6. Diesel Fire Pump RICE Potential Emissions

Specifications					
Hourly heat input (MMBtu/hr)	1.0				
Annual Hours of Operation (hr/yr)	500				
Brake horsepower (hp)	71				
Pollutant	**Emission Factor**	**Emission Factor Units**	**Emission Factor Basis**	**Emissions (lb/hr)**	**Emissions (tpy)**
NO_x + NMHC	3.5	g/hp-hr	NSPS Subpart IIII, Table 4	0.54	0.14
CO	3.7	g/hp-hr	NSPS Subpart IIII, Table 4	0.58	0.14
PM, filterable	0.30	g/hp-hr	NSPS Subpart IIII, Table 4	4.7E-02	1.2E-02
PM_{10}, filterable & condensable	2.20E-03	lb/hp-hr	AP-42 Ch. 3.3, Table 3.3-1	0.16	3.9E-02
$PM_{2.5}$, filterable & condensable	2.20E-03	lb/hp-hr	AP-42 Ch. 3.3, Table 3.3-1	0.16	3.9E-02
SO_2	2.05E-03	lb/hp-hr	AP-42 Ch. 3.3, Table 3.3-1	0.14	3.6E-02
VOC (as TOC)	2.47E-03	lb/hp-hr	AP-42 Ch. 3.3, Table 3.3-1	0.17	4.4E-02

Table B-7. Aggregate Space Heater Potential Emissions*(Revised April 2021)*

Specifications						**Cooling Tower Elec Room (1050)**	**Wet Side Elec Room (350)**	**Utility Building Heater (350)**	**Dry Side Elec Room (750)**	**Operator/ Networking/ Control Room**	**Control Rm for Loadout #1**	**Packaging/ Shipping Office Heater (740)**	**Warehouse Building Heater (900)**	**Admin Office RTU (900)**	**Maintenance Building heater (900)**	**Maintenance Office**
Aggregate Hourly heat input (MMBtu/hr)	28					1	1	3	1	1	1	2	13.5	1	2.5	1
Annual Hours of Operation (hr/yr)	8,760															
Natural Gas Heating Value (Btu/scf)	1,020															
Pollutant	**Emission Factor**	**Emission Factor Units**	**Emission Factor Basis**	**Emissions (lb/hr)**	**Emissions (tpy)**	**Volume Source 1 (lb/hr)**	**Volume Source 2 (lb/hr)**		**Volume Source 3 (lb/hr)**		**Volume Source 4 (lb/hr)**	**Volume Source 5 (lb/hr)**	**Volume Source 6 (lb/hr)**		**Volume Source 7 (lb/hr)**	
NO_x	100	lb/MMscf	AP-42 Ch. 1.4, Table 1.4-1	2.7	12.0	0.098	0.392		0.196		0.098	0.196	1.422		0.343	
CO	84	lb/MMscf	AP-42 Ch. 1.4, Table 1.4-1	2.3	10.1	0.082	0.329		0.165		0.082	0.165	1.194		0.288	
PM, filterable	1.9	lb/MMscf	AP-42 Ch.1.4, Table 1.4-2	5.2E-02	0.23	0.0019	0.0075		0.0037		0.0019	0.0037	0.027		0.0065	
PM_{10}, filterable & condensable	7.6	lb/MMscf	AP-42 Ch.1.4, Table 1.4-2	2.1E-01	0.91	0.0075	0.03		0.015		0.0075	0.015	0.108		0.026	
$PM_{2.5}$, filterable & condensable	7.6	lb/MMscf	AP-42 Ch.1.4, Table 1.4-2	2.1E-01	0.91	0.0075	0.03		0.015		0.0075	0.015	0.108		0.026	
SO_2	0.6	lb/MMscf	AP-42 Ch.1.4, Table 1.4-2	1.6E-02	7.2E-02	0.0006	0.0024		0.0012		0.0006	0.0012	0.0085		0.0021	
Pb	0.0005	lb/MMscf	AP-42 Ch.1.4, Table 1.4-2	1.4E-05	6.0E-05	4.9E-07	2.0E-06		9.8E-07		4.9E-07	9.8E-07	7.1E-06		1.7E-06	
VOC	5.5	lb/MMscf	AP-42 Ch. 1.4, Table 1.4-2	0.15	0.66	0.0054	0.022		0.011		0.0054	0.011	0.078		0.019	

Table B-9. HAP/TAC Potential Emission Factors and Emission Rates for Natural Gas Combustion *(Revised April 2021)*

Pollutant	CAS	Emission Factor AP-42 Table 1.4-3 & Table 1.4-4	Natural Gas Boilers		H_2S Abatement System	Salt Dryer	Potash Dryer	Space Heaters	Total Natural Gas Emission Rates	
		(lb/MMscf)	Per Boiler (lb/hr) [1]	Total 2 Boilers (lb/hr) [2]	(lb/hr) [1]	(lb/hr) [1]	(lb/hr) [1]	(lb/hr) [1]	(lb/hr) [1]	(tpy) [3]
Hazardous Air Pollutant (HAP)										
Arsenic	7440382	2.0E-04	2.0E-05	3.9E-05	1.1E-06	8.2E-06	8.7E-06	5.5E-06	6.3E-05	2.7E-04
Benzene	71432	2.1E-03	2.1E-04	4.1E-04	1.1E-05	8.6E-05	9.1E-05	5.8E-05	6.6E-04	2.9E-03
Beryllium	7440417	1.2E-05	1.2E-06	2.4E-06	6.5E-08	4.9E-07	5.2E-07	3.3E-07	3.8E-06	1.6E-05
Cadmium	7440439	1.1E-03	1.1E-04	2.2E-04	5.9E-06	4.5E-05	4.8E-05	3.0E-05	3.4E-04	1.5E-03
Chromium	7440473	1.4E-03	1.4E-04	2.7E-04	7.5E-06	5.7E-05	6.1E-05	3.8E-05	4.4E-04	1.9E-03
Cobalt	7440484	8.4E-05	8.2E-06	1.6E-05	4.5E-07	3.4E-06	3.6E-06	2.3E-06	2.6E-05	1.2E-04
Dichlorobenzene	106467	1.2E-03	1.2E-04	2.4E-04	6.5E-06	4.9E-05	5.2E-05	3.3E-05	3.8E-04	1.6E-03
Formaldehyde	50000	7.5E-02	7.3E-03	1.5E-02	4.0E-04	3.1E-03	3.3E-03	2.1E-03	2.3E-02	1.0E-01
n-Hexane	110543	1.8E+00	1.8E-01	3.5E-01	9.7E-03	7.3E-02	7.8E-02	4.9E-02	5.6E-01	2.5
Manganese	7439965	3.8E-04	3.7E-05	7.4E-05	2.0E-06	1.5E-05	1.6E-05	1.0E-05	1.2E-04	5.2E-04
Mercury	7439976	2.6E-04	2.5E-05	5.1E-05	1.4E-06	1.1E-05	1.1E-05	7.1E-06	8.1E-05	3.6E-04
Nickel	7440020	2.1E-03	2.1E-04	4.1E-04	1.1E-05	8.6E-05	9.1E-05	5.8E-05	6.6E-04	2.9E-03
Selenium	7782492	2.4E-05	2.4E-06	4.7E-06	1.3E-07	9.8E-07	1.0E-06	6.6E-07	7.5E-06	3.3E-05
Toluene	108883	3.4E-03	3.3E-04	6.7E-04	1.8E-05	1.4E-04	1.5E-04	9.3E-05	1.1E-03	4.7E-03
Polycyclic Organic Matter (POMs)										
2-Methylnaphthalene	91576	2.4E-05	2.4E-06	4.7E-06	1.3E-07	9.8E-07	1.0E-06	6.6E-07	7.5E-06	3.3E-05
3-Methylcholanthrene	56495	1.8E-06	1.8E-07	3.5E-07	9.7E-09	7.3E-08	7.8E-08	4.9E-08	5.6E-07	2.5E-06
7,12-Dimethylbenz(a)anthracene	57976	1.6E-05	1.6E-06	3.1E-06	8.6E-08	6.5E-07	6.9E-07	4.4E-07	5.0E-06	2.2E-05
Acenaphthene	83329	1.8E-06	1.8E-07	3.5E-07	9.7E-09	7.3E-08	7.8E-08	4.9E-08	5.6E-07	2.5E-06
Acenaphthylene	208968	1.8E-06	1.8E-07	3.5E-07	9.7E-09	7.3E-08	7.8E-08	4.9E-08	5.6E-07	2.5E-06
Anthracene	120127	2.4E-06	2.4E-07	4.7E-07	1.3E-08	9.8E-08	1.0E-07	6.6E-08	7.5E-07	3.3E-06
Benz(a)anthracene	56553	1.8E-06	1.8E-07	3.5E-07	9.7E-09	7.3E-08	7.8E-08	4.9E-08	5.6E-07	2.5E-06
Benzo(a)pyrene	50328	1.2E-06	1.2E-07	2.4E-07	6.5E-09	4.9E-08	5.2E-08	3.3E-08	3.8E-07	1.6E-06
Benzo(b)fluoranthene	205992	1.8E-06	1.8E-07	3.5E-07	9.7E-09	7.3E-08	7.8E-08	4.9E-08	5.6E-07	2.5E-06
Benzo(g,h,i)perylene	191242	1.2E-06	1.2E-07	2.4E-07	6.5E-09	4.9E-08	5.2E-08	3.3E-08	3.8E-07	1.6E-06
Benzo(k)fluoranthene	207089	1.8E-06	1.8E-07	3.5E-07	9.7E-09	7.3E-08	7.8E-08	4.9E-08	5.6E-07	2.5E-06
Chrysene	218019	1.8E-06	1.8E-07	3.5E-07	9.7E-09	7.3E-08	7.8E-08	4.9E-08	5.6E-07	2.5E-06
Dibenzo(a,h)anthracene	53703	1.2E-06	1.2E-07	2.4E-07	6.5E-09	4.9E-08	5.2E-08	3.3E-08	3.8E-07	1.6E-06
Fluoranthene	206440	3.0E-06	2.9E-07	5.9E-07	1.6E-08	1.2E-07	1.3E-07	8.2E-08	9.4E-07	4.1E-06
Fluorene	86737	2.8E-06	2.7E-07	5.5E-07	1.5E-08	1.1E-07	1.2E-07	7.7E-08	8.8E-07	3.8E-06
Indeno(1,2,3,c,d)pyrene	193395	1.8E-06	1.8E-07	3.5E-07	9.7E-09	7.3E-08	7.8E-08	4.9E-08	5.6E-07	2.5E-06
Naphthalene	91203	6.1E-04	6.0E-05	1.2E-04	3.3E-06	2.5E-05	2.6E-05	1.7E-05	1.9E-04	8.4E-04
Phenanthrene	85018	1.7E-05	1.7E-06	3.3E-06	9.2E-08	6.9E-07	7.4E-07	4.7E-07	5.3E-06	2.3E-05
Pyrene	129000	5.0E-06	4.9E-07	9.8E-07	2.7E-08	2.0E-07	2.2E-07	1.4E-07	1.6E-06	6.9E-06
								Maximum Single HAP (Hexane)		**2.5**
								Aggregate HAPs		**2.6**
Non-HAP Toxic Air Contaminants										
Barium	7440393	4.4E-03	4.3E-04	8.6E-04	2.4E-05	1.8E-04	1.9E-04	1.2E-04	1.3E-03	5.5E-03
Butane	106978	2.1E+00	2.1E-01	4.1E-01	1.1E-02	8.6E-02	9.1E-02	5.8E-02	6.0E-01	2.6
Copper	7440508	8.5E-04	8.3E-05	1.7E-04	4.6E-06	3.5E-05	3.7E-05	2.3E-05	2.4E-04	1.1E-03
Molybdenum	7439987	1.1E-03	1.1E-04	2.2E-04	5.9E-06	4.5E-05	4.8E-05	3.0E-05	3.1E-04	1.4E-03
Pentane	109660	2.6E+00	2.5E-01	5.1E-01	1.4E-02	1.1E-01	1.1E-01	7.1E-02	7.4E-01	3.3E+00
Vanadium	7440622	2.3E-03	2.3E-04	4.5E-04	1.2E-05	9.4E-05	1.0E-04	6.3E-05	6.6E-04	2.9E-03
Zinc	7440666	2.9E-02	2.8E-03	5.7E-03	1.6E-04	1.2E-03	1.3E-03	8.0E-04	8.3E-03	3.6E-02

[1] The lb/hr emission rates for the equipment are based upon the natural gas heating value of 1,020 Btu/scf and the maximum rated capacity of equipment.

[2] The total lb/hr emission rate is based on the hourly emissions from two (2) boilers.

[3] The tpy emission rates are based on maximum operation of 8,760 hrs/yr (Note, the salt and potash dryers will be limited to 8,340 hrs/yr; therefore, this is conservative).

TOXIC AIR CONTAMINANTS
Allowable Emission Rate Methodology - Rule 227(1)(a) ***(Revised 2/20/2020)***

Table C-1. Allowable Emission Rate Compliance Demonstration with Health Based Screening Levels (*Revised April 2021*)

Facility Name:	Michigan Potash Operating, LLC							**Facility Address:**	Schofield Rd. & 120th Avenue, Evart Township, Osceola County, Michigan																						
		Screening Level						**Allowable Emission Rate (AER)**						**Maximum Emission Rate**					**Proposed Emission Rate (ER)**							**Is Proposed Emission Rate less than AER?**					
								1st ITSL		**2nd ITSL**		**IRSL / SRSL**																			
Chemical Name [1]	**CAS No.**	**1st ITSL µg/m³**	**1st ITSL Avg Time**	**2nd ITSL µg/m³**	**2nd ITSL Avg Time**	**IRSL / SRSL µg/m³ (annual Avg)**	**AQD Footnote(s)**	**Max lbs per hour**	**lbs per month, 24-hr, 8-hr or 1-hr**	**Max lbs per hour**	**lbs per month, 24-hr, 8-hr or 1-hr**	**Max lbs per hour**	**lbs per month**	**Two (2) Natural Gas-fired Boiler Emissions (lb/hr)**	**Water Sweetening (lb/hr)**	**Diesel-fired Emergency Engine (lb/hr)**	**Diesel-fired Fire Pump Emergency Engine (lb/hr)**	**Space Heaters (lb/hr)**	**Max Hourly ER lbs/hour**	**Rate (1st ITSL)**	**1st ITSL Rate Units**	**Rate (2nd ITSL)**	**2nd ITSL Rate Units**	**Rate (IRSL)**	**IRSL / SRSL Rate Units**	**1st ITSL Max Hourly Rate**	**1st ITSL ER**	**2nd ITSL Max Hourly Rate**	**2nd ITSL ER**	**IRSL Max Hourly Rate**	**IRSL ER**
1,2-dichlorobenzene	95501	300	annual					162	12000					2.4E-04				3.3E-05	2.7E-04	0.19564	lbs/month					yes	yes				
1,3-dichlorobenzene	541731	3	annual					1.62	120					2.4E-04				3.3E-05	2.7E-04	0.19564	lbs/month					yes	yes				
1,4-dichlorobenzene	106467	800	annual			0.25		432	32000			0.135	10	2.4E-04				3.3E-05	2.7E-04	0.19564	lbs/month			0.19564	lbs/month	yes	yes			yes	yes
1,3-butadiene	106990	33	annual			0.03		17.82	1320			0.0162	1.2				3.9E-05		3.9E-05	0.0285	lbs/month			0.02854	lbs/month	yes	yes			yes	yes
2-methylnaphthalene	91576	10	annual					5.4	400					4.7E-06				6.6E-07	5.4E-06	0.003913	lbs/month					yes	yes				
acenaphthene	83329	210	annual					113.4	8400					3.5E-07		1.8E-04	1.4E-06	4.9E-08	1.8E-04	0.13107	lbs/month					yes	yes				
acenaphthylene	208968	35	annual					18.9	1400					3.5E-07		3.5E-04	5.1E-06	4.9E-08	3.6E-04	0.259863	lbs/month					yes	yes				
acetaldehyde	75070	9	annual			0.5		4.86	360			0.27	20			9.6E-04	7.7E-04		1.7E-03	1.258509	lbs/month			1.25851	lbs/month	yes	yes			yes	yes
acrolein	107028	0.16	annual	5	1 hr		13	0.0864	6.4	0.005	0.005					3.0E-04	9.3E-05		3.9E-04	0.285976	lbs/month	0.000392	lbs/hr			yes	yes	yes	yes		
anthracene	120127	1000	annual					540	40000					4.7E-07		4.7E-05	1.9E-06	6.6E-08	4.9E-05	0.035855	lbs/month					yes	yes				
arsenic	7440382					0.0002						0.0001	0.008	3.9E-05				5.5E-06	4.5E-05					0.03261	lbs/month					yes	**no**
barium and soluble barium compounds	7440393	5	8 hr				35	0.1	0.1					8.6E-04				1.2E-04	9.8E-04	0.007861	lbs/8-hr					yes	yes				
benzene	71432	30	annual	30	24 hr	0.1		16.2	1200	1.5	3.6	0.054	4	4.1E-04		2.9E-02	9.3E-04	5.8E-05	3.1E-02	22.53588	lbs/month	0.740906	lbs/24-h	22.5359	lbs/month	yes	yes	yes	yes	yes	**no**
benzo(a)pyrene	50328	0.002	24 hr			0.001	5	0.0001	0.00024			0.0005	0.04	2.4E-07		9.8E-06	1.9E-07	3.3E-08	1.0E-05	0.000245	lbs/24-hr			0.00746	lbs/month	yes	**no**			yes	yes
benzo(g,h,i)perylene	191242	13	annual					7.02	520					2.4E-07		2.1E-05	4.9E-07	3.3E-08	2.2E-05	0.015966	lbs/month					yes	yes				
beryllium	7440417	0.02	24 hr			0.0004		0.001	0.0024			0.0002	0.016	2.4E-06				3.3E-07	2.7E-06	6.43E-05	lbs/24-hr			0.00196	lbs/month	yes	yes			yes	yes
butane	106978	23800	8 hr				22	476	476					4.1E-01				5.8E-02	4.7E-01	3.752	lbs/8-hr					yes	yes				
cadmium	7440439					0.0006						0.0003	0.024	2.2E-04				3.0E-05	2.5E-04					0.17934	lbs/month					yes	**no**
cobalt and cobalt compounds that release cobalt ions	7440484	0.2	8 hr			0.00013	42	0.004	0.004			7E-05	0.0052	1.6E-05				2.3E-06	1.9E-05	0.00015	lbs/8-hr			0.01369	lbs/month	yes	yes			yes	**no**
copper	7440508	2	8 hr					0.04	0.04					1.7E-04				2.3E-05	1.9E-04	0.001519	lbs/8-hr					yes	yes				
fluoranthene	206440	140	annual					75.6	5600					5.9E-07		1.5E-04	7.6E-06	8.2E-08	1.6E-04	0.117765	lbs/month					yes	yes				
fluorene	86737	140	annual					75.6	5600					5.5E-07		4.9E-04	2.9E-05	7.7E-08	5.2E-04	0.376617	lbs/month					yes	yes				
formaldehyde	50000	30	24 hr			0.08		1.5	3.6			0.0432	3.2	1.5E-02		3.0E-03	1.2E-03	2.1E-03	2.1E-02	0.502231	lbs/24-hr			15.2762	lbs/month	yes	yes			yes	**no**
hydrogen sulfide	7783064	10	annual	100	24 hr			5.4	400	5	12				3.3E+00				3.3E+00	2435.153	lbs/month	80.05982	lbs/24-h			yes	**no**	yes	**no**		
manganese and manganese compounds	7439965	0.3	annual				29	0.162	12					7.4E-05				1.0E-05	8.5E-05	0.061953	lbs/month					yes	yes				
mercury and mercury compounds	7439976	0.3	annual	1	24 hr		7	0.162	12	0.05	0.12			5.1E-05				7.1E-06	5.8E-05	0.042389	lbs/month	0.001394	lbs/24-h			yes	yes	yes	yes		
mixed xylenes	1330207	390	annual				2	210.6	15600							7.3E-03	2.9E-04		7.6E-03	5.558433	lbs/month					yes	yes				
molybdenum	7439987	30	8 hr					0.6	0.6					2.2E-04				3.0E-05	2.5E-04	0.001965	lbs/8-hr					yes	yes				
naphthalene	91203	3	annual	520	8 hr	0.08		1.62	120	10.4	10.4	0.0432	3.2	1.2E-04		4.9E-03	8.5E-05	1.7E-05	5.2E-03	3.765239	lbs/month	0.041263	lbs/8-hr	3.76524	lbs/month	yes	yes	yes	yes	yes	**no**
n-hexane	110543	700	annual					378	28000					3.5E-01				4.9E-02	4.0E-01	293.46	lbs/month					yes	yes				
nickel	7440020					0.006						0.0032	0.24	4.1E-04				5.8E-05	4.7E-04					0.34237	lbs/month					yes	**no**
pentane	109660	17700	8 hr					354	354					5.1E-01				7.1E-02	5.8E-01	4.645333	lbs/8-hr					yes	yes				
phenanthrene	85018	0.1	annual					0.054	4					3.3E-06		1.5E-03	2.9E-05	4.7E-07	1.6E-03	1.155299	lbs/month					yes	yes				
propylene	115071	8600	8 hr					172	172							1.1E-01	6.5E-03		1.1E-01	0.919099	lbs/8-hr					yes	yes				
pyrene	129000	100	annual					54	4000					9.8E-07		1.4E-04	4.8E-06	1.4E-07	1.5E-04	0.107154	lbs/month					yes	yes				
selenium and inorganic selenium compounds	7782492	2	8 hr				34	0.04	0.04					4.7E-06				6.6E-07	5.4E-06	4.29E-05	lbs/8-hr					yes	yes				
sulfuric acid	7664939	1	annual	120	1 hr		9,13	0.54	40	0.12	0.12				1.6E+00				1.6E+00	1177.336	lbs/month	1.612789	lbs/hr			**no**	**no**	**no**	**no**		
toluene	108883	5000	24 hr					250	600					6.7E-04		1.1E-02	4.1E-04	9.3E-05	1.2E-02	0.284147	lbs/24-hr					yes	yes				
PAHs as benzo(a)pyrene . (IRSL only)	50328					0.001	5					0.0005	0.04						8.6E-03					6.26163	lbs/month					**no**	**no**

[1] AP-42 contains emission factors for chromium, vanadium, and zinc as shown in Table B-9; however, there are not applicable screening levels for these TACs.

Michigan Potash Operating, LLC
TAC Analysis - PAHs

Table C-2. PAH Potency Equivalency Factors (PEFs) ***(Revised April 2021)***

CHEMICAL NAME	CAS NO.	PEF	Two (2) Natural Gas-fired Boilers (lb/hr)	Salt Dryer (lb/hr)	Potash Dryer (lb/hr)	Space Heaters (lb/hr)	Emergency Diesel RICE (lb/hr)	Diesel-fired Fire Pump Engine (lb/hr)	Emission Rate (lb/hr)
3-Methylcholanthrene	56495	5.7	3.5E-07	7.3E-08	7.8E-08	4.9E-08			5.5E-07
7,12-Dimethylbenz(a)anthracene	57976	65	3.1E-06	6.5E-07	6.9E-07	4.4E-07			4.9E-06
Benzo(a)anthracene	56553	0.1	3.5E-07	7.3E-08	7.8E-08	4.9E-08	2.4E-05	1.7E-06	2.6E-05
Benzo(b)fluoranthene	205992	0.1	3.5E-07	7.3E-08	7.8E-08	4.9E-08	4.2E-05	9.9E-08	4.3E-05
Benzo(k)fluoranthene	207089	0.1	3.5E-07	7.3E-08	7.8E-08	4.9E-08	8.3E-06	1.6E-07	9.0E-06
Benzo(a)pyrene	50328	1	2.4E-07	4.9E-08	5.2E-08	3.3E-08	9.8E-06	1.9E-07	1.0E-05
Chrysene	218019	0.01	3.5E-07	7.3E-08	7.8E-08	4.9E-08	5.8E-05	3.5E-07	5.9E-05
Dibenz(a,h)anthracene	53703	1.1	2.4E-07	4.9E-08	5.2E-08	3.3E-08	1.3E-05	5.8E-07	1.4E-05
Indeno(1,2,3-cd)pyrene	193395	0.1	3.5E-07	7.3E-08	7.8E-08	4.9E-08	1.6E-05	3.8E-07	1.7E-05
PAHs	several isomers	1					8.1E-03	1.7E-04	8.2E-03
Equivalent Emission Rate of benzo(a)pyrene (lb/hr)			2.1E-04	4.3E-05	4.6E-05	2.9E-05	8.1E-03	1.7E-04	**8.6E-03**

Table C-3. HAP/TAC Modeling Results
1.0 Pound/Hour Maximum Modeled Impacts ***(Revised April 2021)***

Averaging Period	Total Boiler Impact ($\mu g/m^3$/1 lb/hr)	Water Sweetening Impact (H_2S Abatement) ($\mu g/m^3$/1 lb/hr)	Total Space Heaters Impact ($\mu g/m^3$/1 lb/hr)	Diesel-fired Emergency Engine ($\mu g/m^3$/1 lb/hr)	Diesel-fired Fire Pump Engine ($\mu g/m^3$/1 lb/hr)
1 hour	15.04	14.46	38.40	5.63	185.41
8 Hour	9.74	6.16	23.28	3.57	102.71
24 Hour	5.28	3.61	16.54	2.04	53.54
Annual	0.58	0.66	3.05	0.21	11.47

Pollutant	CAS	Boiler Emission Rate (per unit) (lb/hr)	Water Sweetening Emission Rate (H_2S Abatement) (lb/hr)	Space Heaters (Total) (lb/hr)	Diesel-fired Emergency Engine (lb/hr)	Diesel-fired Fire Pump Engine (lb/hr)	ITSL ($\mu g/m^3$)	Averaging Period	Total Ambient Impact ($\mu g/m^3$)	% of ITSL	IRSL ($\mu g/m^3$)	Total Ambient Impact ($\mu g/m^3$)	% of IRSL
Hazardous Air Pollutants													
Arsenic	7440382	1.96E-05		5.49E-06							0.0002	2.81E-05	14.0%
Benzene	71432	2.06E-04		5.76E-05	2.95E-02	9.33E-04	30	annual	1.71E-02	0.06%	0.1	1.71E-02	17%
Benzene (secondary ITSL)	71432	2.06E-04		5.76E-05	2.95E-02	9.33E-04	30	24 hr	1.12E-01	0.37%			
Cadmium	7440439	1.08E-04		3.02E-05							0.0006	1.54E-04	26%
Cobalt and cobalt compounds	7440484	8.23E-06		2.31E-06			0.2	8 hr	1.34E-04	0.07%	0.00013	1.18E-05	9.1%
Formaldehyde	50000	7.35E-03		2.06E-03	3.00E-03	1.18E-03	30	24 hr	1.42E-01	0.47%	0.08	2.47E-02	31%
Nickel	7440020	2.06E-04		5.76E-05							0.006	2.95E-04	4.9%
Polycyclic Organic Matter (POM)													
Benzo(a)pyrene	50328	1.18E-07		3.29E-08	9.76E-06	1.88E-07	0.002	24 hr	3.11E-05	1.6%	0.001	4.34E-06	0.43%
Naphthalene	91203	5.97E-05		1.67E-05	4.94E-03	8.48E-05	3	annual	2.08E-03	0.07%	0.08	2.08E-03	2.6%
Naphthalene (secondary ITSL)	91203	5.97E-05		1.67E-05	4.94E-03	8.48E-05	520	8 hr	2.73E-02	0.01%			
PAHs (as benzo(a)pyrene) (EGLE Toxics Database, Footnote 5) [1]	50328	1.03E-04		2.89E-05	4.61E-04	9.65E-06					0.001	3.54E-04	35%
Non-HAP Toxic Air Contaminants													
Hydrogen sulfide [2]	7783064		1.8E+00				10	annual	1.17E+00	12%			
Hydrogen sulfide (secondary ITSL)	7783064		3.3E+00				100	24 hr	1.20E+01	12%			
Sulfuric acid [2]	7664939		2.4E-01				1	annual	1.60E-01	16%			
Sulfuric acid (secondary ITSL)	7664939		1.6E+00				120	1 hr	2.33E+01	19%			

[1] PAHs (as benzo(a)pyrene) emissions from the emergency engine and fire pump are annualized, based upon the proposed 500 hr/yr restriction.

[2] Emissions of hydrogen sulfide (H_2S) and sulfuric acid (H_2SO_4), for demonstrating compliance with the annual ITSLs, are calculated based on the anticipated concentration of H_2S within the brine entering the water sweetening process over an annual period.

Table D-1a. Dispersion Modeling Parameters (Stack/Point Sources)

Stack	Model Source ID	Emission Rate (lb/hr)					Stack Parameters					
		PM_{10} 24-hr & Annual Avg. Periods	$PM_{2.5}$ 24-hr & Annual Avg. Periods	NO_x 1-hr & Annual Avg. Periods	SO_2 1-hr & Annual Avg. Periods	SO_2 3-hr & 24-hr Avg. Periods	Flow Rate (acfm)	Exhaust Velocity (ft/s)	Height (ft)	Diameter (in)	Diameter (ft)	Temperature (^oF)
Boiler 1	BOILER1	0.74	0.74	1.09	0.06		32,292	56	50	42	3.5	300
Boiler 2	BOILER2	0.74	0.74	1.09	0.06		32,292	56	50	42	3.5	300
PotDrying	POTDRY	4.63	4.63	4.33	0.03		39,390	42	225	54	4.5	134
Pot Dry Side	PDRYSIDE	6.07	6.07	--	--		99,754	42	225	86	7.1	186
SaltDrying	SALTDRY	4.30	4.30	4.08	0.024		39,830	42	225	54	4.5	143
Salt Dry Side	SDRYSIDE	3.77	3.77	--	--		51,150	42	225	61	5.1	100
Water Sweetening (H_2S Abatement)	H2STRT	0.04	0.04	0.54	2.6		2,800	26	75	18	1.5	120
Emergency Engine [1,2]	EMERGEN	0.44	0.44	3.60	0.0042	0.073	42,897	82	45	40	3.3	802
Fire Pump Engine [1,2]	FIREPUMP	0.03	0.03	0.03	0.0083	0.145	357	68	10	4	0.3	900
Cooling Tower (per cell)	COOL1 - COOL4	0.094	0.094	--	--		767,500	26.1	35	300	25	71

[1] NO_x and SO_2 emission rates for the emergency engine and fire pump engine have been annualized to represent intermittent emissions over 500 hours during the year for the 1-hour and annual averaging periods.

[2] PM_{10} and $PM_{2.5}$ emission rates for the emergency and fire pump engines are based on a daily operational restrictions of 4 hrs/day, excluding emergency and stack test operation, for the 24-hour and annual averaging periods. The PM_{10} and $PM_{2.5}$ annual averaging period is conservatively modeled with the 24-hour emission rate (annualized emission rates would be lower).

Table D-1b. Space Heater Dispersion Modeling Parameters (Volume Sources) (*Added April 2021*) [1]

Source	Model Source ID	Emission Rate (lb/hr)						Source Parameters				
		PM_{10} 24-hr & Annual Avg. Periods	$PM_{2.5}$ 24-hr & Annual Avg. Periods	NO_x 1-hr & Annual Avg. Periods	SO_2 1-hr & Annual Avg. Periods	SO_2 3-hr & 24-hr Avg. Periods	TACs 1-hr, 8-hr, 24-hr and Annual Avg. Periods [2]	Building Height (feet)	Vent Midpoint/ Release Height [3] (feet)	Avg. Bldg. Width (feet)	Initial Lateral Dimension (feet)	Initial Vertical Dimension (feet)
Cooling Tower Electrical Room (Area 1050)	SH1	0.0075	0.0075	0.098	0.0006		0.036	12	10.00	21.21	4.93	5.58
Utility Building (Area 1000) and Wet Side Electrical Room (Area 350)	SH2	0.03	0.03	0.392	0.0024		0.143	38	31.67	141.74	32.96	17.67
Dry Side Electrical Room and Operator/Networking/Control Room (Area 750)	SH3	0.015	0.015	0.196	0.0012		0.071	33	27.50	76.97	17.90	15.35
Control Rm Loadout #1 (NaCl Loadout Area 710)	SH4	0.0075	0.0075	0.098	0.0006		0.036	42	35.00	91.04	21.17	19.53
Packaging/Shipping Office (Area 740)	SH5	0.015	0.015	0.196	0.0012		0.071	36	30.00	141.04	32.80	16.74
Warehouse Building and Admin Offices (Area 900)	SH6	0.108	0.108	1.422	0.0085		0.518	41	34.17	391.92	91.14	19.07
Maint Office and Maintenance Building (Area 900)	SH7	0.026	0.026	0.343	0.0021		0.125	34	28.33	146.62	34.10	15.81

[1] Pursuant to EGLE's modeling guidance dated September 2009, building roof/side vents (used to model space heater emissions) are modeled as volume sources. The initial lateral and vertical dimensions of the volume sources are calculated based on the modeling guidance.

[2] For modeling purposes, emission rates for TACs, presented in Table C-3 are not incorporated into the model run. Rather, the modeled emission rate for each space heater (as a volume source) is determined based on the ratio of the emission rates from the individual space heater to the total emission rate for the space heaters combined. The total combined modeled emission rate for the space heaters is 1 lb/hr.

[3] The building space heater vents are estimated to extend from 2/3 the roof height up to the roof line. Based on EGLE's modeling guidance, the release height of emissions from a volume source is the height of the vent midpoint. Therefore, the release height of the space heaters are assumed to be 5/6 the building height.