Compass Minerals

Via Federal Express: 7792-1725-5911

May 25, 2017

Martin D. Gray, Manager
New Source Review Section
Utah Division of Air Quality
195 North 1950 West
P.O. Box 144820
Salt Lake City, Utah 84114-4820

Re: Serious Non-Attainment Area State Implementation Plan Control Strategy
Compass Minerals Ogden Inc.
Source ID # 5700001003

Dear Mr. Gray:

In response to your letter dated January 23, 2017 concerning the Serious Non-Attainment (NAA) State Implementation Plan (SIP) Control strategy, Compass Minerals Ogden Inc. is pleased to submit the enclosed site-wide BACT analysis for PM2.5 and PM2.5 precursors.

In response to your request, this document includes a BACT analysis for each significant point and fugitive source known at the site that emits PM2.5 or precursors, proposed appropriate emission limits and monitoring requirements for each emitting unit, and an assessment of when potential measures could be implemented.

If you should have any questions regarding this submittal or require additional information, feel free to contact Chris Freeman, Environmental Engineer, at (801) 732-3251.

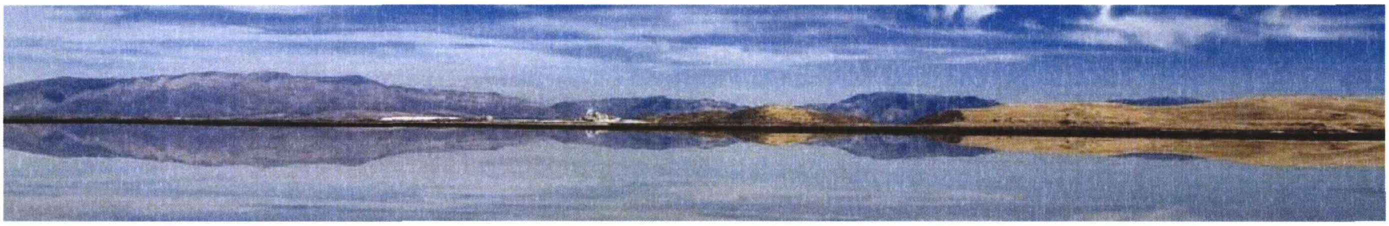
Sincerely,

Barbara Menard
VP EHSS For:

Denise L. Hubbard, V.P. Operations-Ogden
Compass Minerals Ogden Inc.

5/25/17

Date



Compass Minerals

Compass Minerals Ogden Inc.

765 North 10500 West, Ogden, UT 84404

Title V Permit Number 5700001003

Site-Wide BACT Analyses for PM2.5 and Precursors

Prepared by Strata, LLC

May 22, 2017

STRATA LLC

Table of Contents

4. **Proposed Limits, Monitoring, Recordkeeping, and Schedule for Selected BACT**
    a. **Proposed Limits**
        i. **Table 4.1 Proposed Limits**
    b. **Measurement concerns for wet streams and condensables**
    c. **Adjustment of boiler NOx limits**
    d. **Proposed Monitoring Requirements**
    e. **Implementation Schedule**

5. **Attachments**

Attachment 1	**Summary of Allowable Emissions of PM2.5/PM2.5 Precursors (tpy)**
Attachment 2	**Summary of Actual Emissions of PM2.5/PM 2.5 Precursors (tpy) (2015)**
Attachment 3	**Summary of Emission Estimating Methods**
Attachment 4	**Summary of Existing BACT Limits for PM2.5 & Precursors**
Attachment 5	**Relevant Site-Wide Limits**
Attachment 6	**Description of Control Technologies**
Attachment 7	**BACT Backup Documentation**
Attachment 8	**Condensable Measurement**
Attachment 9	**References**
Attachment 10	**Acronyms**

1. Overview

Compass Minerals, International owns and operates a facility, Compass Minerals Ogden Inc. (Compass), located at 765 North 10500 West, Ogden, UT 84404 (Title V permit number 5700001003, dated July 11, 2016).

In a letter dated January 23, 2017, the Utah Department of Environmental Quality, Division of Air Quality (DAQ) notified Compass of its work on a serious area attainment control plan in accordance with 40 CFR 51 Subpart Z. The rule requires DAQ to identify, adopt and implement Best Available Control Measures (BACM) on major sources of PM2.5 and PM2.5 precursors. The major source threshold is 70 tons per year (tpy) in an area of serious non-attainment for PM2.5. The operating permit issued to Compass allows emissions of more than 70 tpy for PM2.5 and/or PM2.5 precursors, therefore the Compass facility emission units will be included in the serious attainment area control plan.

PM2.5 and/or PM2.5 precursors are defined as follows:

- Particulate Matter (PM) less than 2.5 microns in diameter (PM2.5), and
- PM2.5 Precursors:
  - Nitrogen Oxides (NOx)
  - Sulfur Oxides (SOx)
  - Volatile Organic Compounds (VOC), and
  - Ammonia (NH3).

The letter also outlined a request that Compass assist in the development of the control plan as follows:

1) Conduct a BACT analysis of each emitting unit of PM2.5/PM2.5 precursors - Identify and evaluate all applicable control measures to include a detailed, written justification of each available control strategy, considering technological and economic feasibility, and including documentation to justify the elimination of any controls.
2) Propose appropriate emission limits and monitoring requirements for each emitting unit, along with a justification of the adequacy of the suggested measures.
3) Provide an assessment of when a potential measure could be implemented.

The purpose of this document is to respond to the DAQ site-wide BACT request. This document includes a BACT analysis for all significant point and fugitive sources known at the site that emit PM2.5 or precursors listed above.

The contact person for this BACT report is:

Chris Freeman, Environmental Engineer
Compass Minerals Ogden, Inc.
801-388-9754
FreemanC@compassminerals.com

2. Description of Source

Compass Minerals operates a mineral recovery facility on the eastern shore of the Great Salt Lake near Ogden, Utah in Weber County. This facility produces sodium chloride ($NaCl$), sulfate of potash (SOP) (K_2SO_4), and magnesium chloride ($MgCl_2$).

The process uses crystallized salts, including halite (sodium chloride) and a mixed salt containing potassium sulfate and magnesium sulfate from solar evaporation ponds. The raw halite is washed, wet-screened, dried, cooled, dry-screened, packaged, and shipped as sodium chloride.

The mixed salt is washed, slurried, thickened, crystallized, and converted to shoenite which is then filtered, dried, screened, granulated/compacted, and shipped as sulfate of potash.

The remaining brine slurry is primarily magnesium chloride with organic impurities. This slurry is further concentrated in evaporators, and either shipped out as liquid magnesium chloride or bleached, dried, bagged, and shipped as flaked magnesium chloride.

This document includes a BACT analysis for 38 sources identified on Table 2.1. Sources scheduled to be permanently shut down before the serious attainment date of December 31, 2019 are not included. The shut-down requirements for these sources are outlined in the current facility Title V operating permit.

Table 2.1. Summary of Existing Emitting Equipment/Processes

Item #	Permit ID	Area	EU ID	EU Description	Control ID	Control Description	Comment	*P or F
1.01	II.A.3	SALT	AH-500	Salt Cooler Circuit	AH-500	Cyclonic wet scrubber	Salt pellet cooler and salt cube cooler	P
1.02	II.A.4	SALT	AH-502	Salt Plant Circuit	AH-502	Cyclonic wet scrubber	Salt material handling: bins/hoppers, conveyors, crushers/grinder, elevators, feeders/baggers, mixer, presses, screens, railcar loading	P
1.03	II.A.6	SALT	D-501	Salt Dryer 501	AH-513	Wet cyclone and cyclonic wet scrubber; Low NOx burners; Permit Cond. II.B.1.c. (nat gas fuel)	Combustion emissions and process PM emissions	P
1.04	II.A.19	SALT	F-506	Salt Cooler	BH-501	Baghouse	Controls salt cooler feeder emissions; BH-501 exhausts to building, or D-501 combustion air, or salt cooler fluidized cooler air.	P
1.05	II.A.27	SALT	BH-502	Salt bulk load-out	BH-502	Cartridge filter dust collector	Product loading; elevators, bins/hoppers, feeders, drop points associated with salt load-out.	P
1.06	II.A.5	SALT	BH-505	Salt Special Products Circuit	BH-505	Baghouse that exhausts back into the building	Mineral feeder assembly and super sack bagger, Since the baghouse exhausts back to the building, emissions are addressed in Item 1.08	P
1.07	II.A.1	SALT	SALT FOUMH	SALT Fugitive outdoor uncaptured material handling	Permit Cond. II.B.1.g	Permit Cond. II.B.1.g regarding limitations on visible emissions caused by fugitive dust.	Material handling equipment such as conveyors and elevators.	F/P
1.08	II.A.1	SALT	SALT FBMH	SALT fugitive material handling from building doors/windows/vents	BL500	Inside a building; Permit Cond. II.B.1.g regarding limitations on visible emissions caused by fugitive dust.		F/P
1.09	II.A.1	SALT	SALT FPILES	SALT Fugitive salt pile and road dust emissions	Permit Cond. II.B.1.g	Permit Cond. II.B.1.g regarding limitations on visible emissions caused by fugitive dust.	Salt material piles and salt upaved road vehicle traffic.	F
2.01	II.A.9	SOP	D-1545	SOP Dryer D-1545	AH-1547	Wet scrubber & LNB; Permit Cond. II.B.1.c. (nat gas fuel)	Combustion emissions and process PM emissions; Includes dry feed conveyor line 2.	P

Item #	Permit ID	Area	EU ID	EU Description	Control ID	Control Description	Comment	*P or F
2.02	II.A.10	SOP	AH-1555	SOP Plant Compaction Building	AH-1555	Wet scrubber	SOP material handling: Conveyors, screens, elevators, crushers/grinders, bins/hoppers, feeders/baggers, presses, drop points, pugmills	P
2.03	II.A.11	SOP	B-1520	Nat gas process heater (<5 mmBtuh)	AH-1555	Wet scrubber; Permit Cond. II.B.1.c. (nat gas fuel)		P
2.04	II.A.14	SOP	BH-001	SOP Bulk Loadout Circuit	BH-001	Baghouse	SOP material handling: Conveyors, screens, bins/hoppers associated with SOP product load-out	P
2.05	II.A.15	SOP	BH-002	SOP Silo Storage Circuit	BH-002	Baghouse	SOP material handling: Conveyors, screens, bins/hoppers, feeders/baggers	P
2.06	Unknown	SOP	BH-1565	SOP Compaction Recycle Hopper Bin Vent	BH-1565	Fabric Filter	SOP bin/hopper	P
2.07	II.A.7	SOP	D-1400	SOP Dryer 1400 (51.0 mmBtuh)	BH-1400	Cyclone and Baghouse for PM; ULNB for NOx; Permit Cond. II.B.1.c. (nat gas fuel)	Combustion emissions and process PM emissions	P
2.08	II.A.7 or II.A.9	SOP	DeFoam	SOP Defoamer	No Control	None	Potential emission source due to evaporation of VOCs from Wet SOP defoamer	P
2.09	II.A.16	SOP	SUB	SOP Submerged Combustion, 90 mmBtuh	Permit Cond. II.B.1.c	Permit Cond. II.B.1.c. (nat gas fuel)		P
2.10	II.A.26	SOP	SOP CT	Cooling Towers (SOP)	DE	Drift eliminators		F
2.11	II.A.1	SOP	SOP FOUMH	SOP Fugitive outdoor uncaptured material handling	Permit Cond. II.B.1.g	Permit Cond. II.B.1.g regarding limitations on visible emissions caused by fugitive dust.	Material handling equipment such as conveyors and elevators.	F/P
2.12	II.A.1	SOP	SOP FBMH	SOP Fugitive material handling from building doors/windows/vents	BL003 BL004 BL006 NCB	Inside a building; Permit Cond. II.B.1.g regarding limitations on visible emissions caused by fugitive dust.		F/P

Item #	Permit ID	Area	EU ID	EU Description	Control ID	Control Description	Comment	*P or F
2.13	II.A.1	SOP	SOP FPILES	SOP Fugitive haul road, evaporation pond windrowing and activity, SOP pile, and road dust emissions	Permit Cond. II.B.1.g	Permit Cond. II.B.1.g regarding limitations on visible emissions caused by fugitive dust.	Evaporation pond activity and SOP material piles and SOP pile vehicle traffic	F
3.01	II.A.23	MAG	MP WS	MgCl2 plant process streams from cooling belt, packaging, and handling	AH-692	High energy venturi wet scrubber		P
3.02	NOI anticipated 5/2017	MAG	EVAP	MgCl2 plant evaporators venting through 4 stacks	No Control	None	NOI expected in May 2017	P
3.03	II.A.24	MAG	MAG CT	MgCl2 plant cooling tower	DE	Drift eliminators		F
3.04	II.A.1	MAG	MAG FBMH	MAG fugitive material handling from building doors/windows/vents	BL600	Permit Cond. II.B.1.g regarding limitations on visible emissions caused by fugitive dust.	Material handling equipment such as conveyors and pin breakers.	F/P
4.01	II.A.28	MISC	NGB-1	Natural Gas Boiler 1 - 108.11 mmBtuh	ULNB	ULNB, FGR, and continuous oxygen trim system; Permit Cond. II.B.1.c. (nat gas fuel)	Control is Inherent to design	P
4.02	II.A.28	MISC	NGB-2	Natural Gas Boiler 2 - 108.11 mmBtuh	ULNB	ULNB, FGR, and continuous oxygen trim system; Permit Cond. II.B.1.c. (nat gas fuel)	Control is Inherent to design	P
5.01	II.A.29	MISC	BU GEN OGN200	25 kW (estimated) emergency generator, Propane	Eng Controls	NSPS engine controls, as applicable	Substation	P
5.02	Unknown	MISC	BU GEN OGN300	25 kW (estimated) emergency generator, Propane	Eng Controls	NSPS engine controls, as applicable	Near the AT&T tower	P
5.03	AO 3/9/2017	SOP	SOP EMGen	100 KW emergency generator; Diesel	Eng Controls	NSPS engine controls, as applicable, including ULSD.	Installed for the new SOP compaction plant	P
5.04	II.A.21	MISC	MIS	175 kW emergency generator engine, diesel	Eng Controls	MACT engine controls, as applicable, including ULSD.	OGN007; Generator at admin; diesel fired	P

Item #	Permit ID	Area	EU ID	EU Description	Control ID	Control Description	Comment	*P or F
5.05	II.A.21	MISC	THICK	300 kW emergency generator engine diesel	Eng Controls	NSPS engine controls, as applicable, including ULSD.	OGN1200 Generator; diesel fired	P
5.06	II.A.21	MISC	Fire Water Backup	450 kW emergency FW pump engine, diesel	Eng Controls	NSPS engine controls, as applicable, including ULSD.	OGN100 Emergency fire water pump engine; diesel fired;	P
6.01	II.A.25	MISC	3	Gasoline Storage Tank - 6,000 gal	Tank Color	White/reflective exterior	RVP 11	P
6.02	II.A.25	MISC	4-5	Diesel Storage Tanks - one 10,000 gal tank and four 12,000 gal tanks	Tank Color	White/reflective exterior	Very low vapor pressure material stored	P
6.03	II.A.17	MISC	BLAST	Abrasive Blast Machine	Permit Cond. II.B.16.a	Permit Cond. II.B.16.a regarding limitations on visible emissions.	Outdoor Station	F
6.04	II.A.22	MISC	ROADS	Various roads and disturbed, unpaved areas	FDCP	Fugitive Dust Control Plan		F

** P = point source; F = fugitive source; F/P = emissions could reasonably pass through a stack and be controlled, depending on technical, economic, and impacts analyses.*

Emission Estimates

Particulate matter 2.5 micrometers in aerodynamic diameter and smaller (PM2.5) are primarily generated from point sources for material handling, material dryers, and combustion. Additionally, PM2.5 fugitives are generated from material storage piles, unpaved roads, cooling towers, etc. PM 2.5 precursors are emitted from the combustion sources (PM2.5, NOx, SOx, VOC), evaporators (VOC), and defoaming process (VOC).

Most particulate matter from the material handling operations and dryers are controlled by cyclones, baghouses and/or wet scrubbers, as applicable. The Title V operating permit outlines stack testing requirements for each control device. Emissions for the site can be determined from the stack testing records. To supplement the existing stack testing data, Compass also relied on appropriate emission factors. Where PM2.5-specific stack testing data or emission factors were unavailable, Compass followed the methods utilized in the 2015 EI, in which PM2.5 emissions are estimated based on the application of the ration of particle size factors from AP-42 Chapter 13.2.4 on Aggregate Handling and Storage Piles to the PM10 emission data or factor, respectively. Specifically, from the table entitled "Aerodynamic Particle Size Multiplier (k) For Equation 1", a multiplier of 0.053 is utilized for PM2.5 and 0.35 for PM10. A ratio of 0.053/0.35 is subsequently multiplied by the PM10 emission data or factor.

For new sources related to the SOP compaction plant expansion (AH-1547 and AH-1555), historical emissions are unavailable and permit limits are assumed to be the controlled actual emissions for these sources.

For sources without associated stack test data or numerical emission limits, AP-42 emission factors or other established emission factors have been utilized to estimate emissions.

Literature reference pertaining to the control efficiency of PM provided by building enclosures is typically not specific to PM2.5. Reference documents reviewed by Compass identified a variety of control efficiencies from enclosures stated for PM10, with many documents stating a combined capture and control efficiency of 90%. Due to the nature of PM2.5, which acts more like a gas than a physical, suspended particle, a control efficiency as high as 90% may not always be appropriate for PM2.5. Furthermore, it is well documented that the effectiveness of air pollution control devices decreases for smaller particle sizes. Taking into consideration a review of available documentation, Compass has conservatively estimated the control efficiency of PM2.5 by building enclosures to be approximately 75%. Emissions from full enclosures occur at building windows, vents, doors, etc. Based on the same reasoning expressed for full enclosures, Compass has estimated a 35% PM2.5 control efficiency from partial enclosures. Based on site observations, it is known that the capture efficiency of the hoods and ductwork at the Plant are <100%. For estimating emissions, Compass has estimated that capture efficiency of ductwork across the site is approximately 90%.

Where salt is present in a liquid slurry, no emissions are expected. Salt hauled from evaporation ponds is approximately 10-20% moisture by weight. It is assumed that such moisture inherently provides 90% control due to site observations, best engineering judgement, and the hygroscopic nature of salt.

Condensable particulate matter (CPM) is only recently subject to regulation and therefore the existing PM2.5 BACT limits do not contemplate the condensable fraction and stack tests that distinguish between the condensable and filterable fraction of PM2.5 have only recently been performed at the Plant. In addition, fractionation of CPM is not technologically feasible and methods are less refined than accepted filterable particulate matter measurement methods. Compass has included CPM where data is available, and requests adjustable CPM limits until more reliable data can be obtained by the Plant to ensure that BACT limits are achievable.

Where available, 2015 EI emissions have been utilized to estimate an incremental increase in emission control (and subsequent incremental decrease in emissions) achieved by the application of improved emission controls. A site-wide summary of Allowable and Actual (2015) emission estimates for PM2.5 and PM2.5 precursors are shown on Table 2.2.

Allowable and Actual (2015) emission estimates are shown by emission unit in Attachments 1 and 2, respectively. Detailed emission estimating methodologies are shown in Attachment 3.

Existing Permit Limits are shown in Attachment 4. Site-wide conditions that serve to limit emissions are shown in Attachment 5.

Table 2.2. Summary of Allowable and Actual Emissions (TPY)
PM2.5 and PM2.5 Precursors

	PM2.5	PM2.5 - F	PM2.5 - C	SOX	NOX	VOC	NH3
Allowable Point Source (PTE)	166.882	184.196	97.244	2.926	49.361	45.456	6.128
Allowable Fugitive Source (PTE)	25.090	25.090	-	-	-	-	-
Actual (2015)	96.215	90.148	27.611	1.231	38.001	41.376	3.812

This summary shows all known emissions other than mobile sources and insignificant or trivial emissions such as main office boiler, laboratory fume hoods, comfort heaters, pallet plant operations, degreasing stations air ventilation systems, etc.

Recent Permitting Analyses

There have been several permitting actions during recent years that included BACT analyses. These are described in Table 2.3.

Table 2.3. **Summary of Recent Permitting Actions**

Approval or NOI ID	Date Issued/Submitted	Adds	BACT	Removes
DAQE-AN109170036-17	March 9, 2017	D-501 Retrofit	Low NOx Burners	
		100 kW Em Generator, Tier III	NSPS Engine Controls, as applicable	
DAQE-AN109170035-16	January 15, 2016	2 Em Generators (Substation and Thickner Locations); Replacement of Fire Pump Engine	NSPS Engine Controls, as applicable	D-005/BH-006 D-003/AH-013
		SOP D-1545/AH-1547	0.01 grains/dscf PM2.5	
DAQE-AN109170033-15 had previously added D-1400 and BH-1400		New SOP Plant Compaction Bldg/AH-1555	0.01 grains/dscf PM2.5	
		SC-460 (SUB)		
		B-1520/AH-1555	0.01 grains/dscf PM2.5	
		D-1400/BH 1400	0.01 grains/dscf PM2.5 Low NOx Burners	
DAQE-AN109170030A-12	August 21, 2012 and July 30, 2012	Boiler 1 rated 108 mmBtuh (nat gas)	9.0 ppm NOx	SALT AH-505
		Boiler 2 rated 108 mmBtuh (nat gas)	9.0 ppm NOx	
		SALT BH-505		
DAQE-AN0109170028-10	September 15, 2010	BH 502	0.0053 grains/dscf	

3. BACT ANALYSIS

The United States Environmental Protection Agency (EPA) set forth the BACT process in 40 CFR 52.21(j) and further clarified the required methodology known as the "Top-Down" approach. (Ref. New Source Review Workshop Manual). Utah has incorporated the BACT process described in 40 CFR 52.21(j) by reference into Utah Administrative Code R307-405-11. The "Top-Down" approach was used in this BACT report, and is summarized below.

- **Step 1**—Identify Possible Control Technology Options. Information sources include EPA's RACT / BACT / LAER Clearinghouse (RBLC); permits as applicable and available; recent information from control technology vendors; and other sources. Although only demonstrated BACT controls (those that have actually been implemented at a similar source type) are required to be considered, the BACT analysis can also consider theoretical or innovative controls as well.

- **Step 2**—Eliminate Technically Infeasible Control Options. A technically feasible option means that the technology is available, has been demonstrated, and could be successfully applied to the emission unit being reviewed. The basis for eliminating a potential control option due to technical infeasibility should be clearly explained.

- **Step 3**—Rank Remaining Control Options by Effectiveness. This ranking should include control efficiencies, projected emissions rates after the control option, estimates of ton/yr reductions, and economic impact. Other impacts (i.e. other pollutants, water use, waste water, hazardous/solid waste, safety, impact on local energy suppliers, etc.), should be identified qualitatively.

- **Step 4**—Evaluate the Most Effective Control Options. Based on the analyses in Step 3, consider all of the impacts identified: control efficiency, tons of pollutant reduced, economic, environmental, energy, and other impacts. If the top control option is not selected as BACT, document why it was not selected, and evaluate the next most effective control option. When a control option is selected as BACT, the less effective control options need not be considered further.

- **Step 5**—Clearly Identify and Document BACT.

BACT Analyses

Identification of possible control options are shown in tables below by source and by pollutant. (Source identification corresponds to sources shown on Table 2.1.)

Descriptions of potential control options that are repetitively considered are shown in Attachment 6. If a control option is unique to a specific source, it is described in the tables below.

BACT impact analyses (by sources shown on Table 2.1) and by pollutant (PM2.5 and PM2.5 precursors) are shown below. Cost estimates range from "Study" to "Order of Magnitude" levels of accuracy. (Ref. page 2-3 of Cost Control Manual).

Existing controls that have already been implemented pursuant to previous BACT analyses are considered as available controls in tStep 2 of the BACT analysis. To review the effectiveness of applying different control technologies, Step 3 of the BACT analysis relies on actual, controlled emissions taking into consideration previously installed control technologies, as opposed to uncontrolled potential to emit. This approach, which is consistent with guidance from EPA and DAQ, considers the cost/ton and incremental cost/ton based on the potential for additional reductions from a baseline of past actual emissions.

BACT OPTIONS TABLE 1.01 PM2.5

STEPS 1-2

Item # 1.01 **SALT Cooler Circuit AH-500** **PM 2.5 Control Possibilities**

Control Option	Percent Control		GR/DSCF		Comment	Efficiency Rank
	Min	Max	Min	Max		
Baghouse/Fabric Filter/Cartridge Filter	90	99.99	0.0003	0.04	Gr/dscf outlet loading is assumed for filterables-only, since baghouses do not control condensables. May be technically infeasible or less efficient due to high moisture content.	1
Wet Scrubber	85	99.7	0.0025	0.096	Typically less efficient than Baghouse; may result in artifact (created) PM; controls filterable and condensable PM. ***Cyclonic wet scrubber is the existing control for the source.***	2
Cyclone	10	70	0.026	0.13	Not effective for PM2.5 unless coupled with Baghouse, ESP, or Scrubber; will not control condensables very effectively.	3
Wet ESP	99	99.9	0.01	0.021	There are considerable safety factors due to high voltage and the potential generation of HAPs. Technically infeasible because ESPs have reduced collection efficiency for materials that have high electrical resistivity such as sodium chloride. ESP is not demonstrated for highly resistive particulate matter such as those produced by CM processes.	NA
Dry ESP	96	99.2	NA	NA	There are considerable safety factors due to high voltage and the potential generation of HAPs. Technically infeasible because ESPs have reduced collection efficiency for materials that have high electrical resistivity such as sodium chloride. ESP is not demonstrated for highly resistive particulate matter such as those produced by CM processes.	NA

1.01 PM2.5 BACT Analysis for Technically Feasible Control Options

Information for Economic Analysis		Description
EU ID	AH-500	Salt Cooler Circuit
Existing Control	AH-500	Cyclonic wet scrubber, 7.65 lb/hr and 0.020 grains/dscf.
Interest Rate	0.07	Interest rate at which the company can borrow money. Enter 0.07, or 0.10, for example.
Useful Life	20	Estimated useful life of the new control equipment being considered.

STEP 3:

POLLUTANTS TO BE CONTROLLED	PM2.5	SOx	NOx	VOC	NH3
Actual 2015 Tons Per Year	0.010				
Estimated Uncontrolled TPY	0.1				
Existing Control Efficiency	90%				
Existing Outlet Concentration (g/dscf)	N/A				

ECONOMIC ANALYSIS

Option	Demon-strated?	Technically Feasible Control Options	Total Capital Cost	Pollutant	New Control Efficiency	Difference	Additional Tons Controlled	Annualized Capital $	Annualized Operating $	BACT ($/ton)
1	Yes	Baghouse	$ 869,000	PM2.5	99%	9%	0.009	$ 82,027	$ 81,479	$ 18,167,339
2	Yes	Wet scrubber Venturi	$ 689,000	PM2.5	99%	9%	0.009	$ 65,037	$ 337,865	$ 44,766,813
3	Yes	Cartridge filter	$ 275,000	PM2.5	99%	9%	0.009	$ 25,958	$ 92,342	$ 13,144,496

Notes: More refined cost estimates would be done during the engineering phase of a project.
Recovered material was accounted in the Annualized Operating Cost, if applicable.
See Attachment 7 for more detail on cost estimates for Options 1-3.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:
Option 2 consumes fresh water and generates wastewater. Options 1 and 3 would likely have a neutral effect on solid waste generation.

STEP 4: All of the technically feasible control options ranked above or near current controls were evaluated, and found to be economically infeasible.

STEP 5: Compass believes the estimated costs are exceptionally high in comparison to costs being borne by other sources of the same type to control the pollutant, indicating that the use of the above listed control options are not economically feasible. BACT is selected as the existing cyclonic wet scrubber. See Section 4 of this report for proposed limits.

BACT OPTIONS TABLE 1.02 PM2.5 STEPS 1-2

Item # 1.02 **SALT Plant Circuit AH-502** **PM 2.5 Control Possibilities**

Control Option	Percent Control		GR/DSCF		Comment	Efficiency Rank
	Min	Max	Min	Max		
Baghouse/Fabric Filter/Cartridge Filter	90	99.99	0.0003	0.04	Gr/dscf outlet loading is assumed for filterables-only, since baghouses do not control condensables. May be technically infeasible or less efficient due to high moisture content.	1
Wet Scrubber	85	99.7	0.0025	0.096	Typically less efficient than Baghouse; may result in artifact (created) PM; controls filterable and condensable PM. ***Cyclonic wet scrubber is the existing control for the source.***	2
Cyclone	10	70	0.026	0.13	Not effective for PM2.5 unless coupled with Baghouse, ESP, or Scrubber; will not control condensables very effectively.	3
Wet ESP	99	99.9	0.01	0.021	There are considerable safety factors due to high voltage and the potential generation of HAPs. Technically infeasible because ESPs have reduced collection efficiency for materials that have high electrical resistivity such as sodium chloride. ESP is not demonstrated for highly resistive particulate matter such as those produced by CM processes.	NA
Dry ESP	96	99.2	NA	NA	There are considerable safety factors due to high voltage and the potential generation of HAPs. Technically infeasible because ESPs have reduced collection efficiency for materials that have high electrical resistivity such as sodium chloride. ESP is not demonstrated for highly resistive particulate matter such as those produced by CM processes.	NA

BACT IMPACTS TABLE 1.02 PM2.5 STEPS 3-5 AH-502

1.02 PM2.5 BACT Analysis for Technically Feasible Control Options

Information for Economic Analysis		Description
EU ID	AH-502	Salt Plant Circuit
Existing Control	AH-502	Cyclonic wet scrubber, 5.24 lb/hr and 0.040 grains/dscf.
Interest Rate	0.07	Interest rate at which the company can borrow money. Enter 0.07, or 0.10, for example.
Useful Life	20	Estimated useful life of the new control equipment being considered.

STEP 3:

POLLUTANTS TO BE CONTROLLED	PM2.5	SOx	NOx	VOC	NH3
Actual 2015 Tons Per Year	0.006				
Estimated Uncontrolled TPY	0.06				
Existing Control Efficiency	90%				
Existing Outlet Concentration (g/dscf)	N/A				

ECONOMIC ANALYSIS

Option	Demon-strated?	Technically Feasible Control Options	Total Capital Cost	Pollutant	New Control Efficiency	Difference	Additional Tons Controlled	Annualized Capital $	Annualized Operating $	BACT ($/ton)
1	Yes	Baghouse	$ 494,000	PM2.5	99%	9%	0.005	$ 46,630	$ 81,479	$ 23,723,834
2	Yes	Wet scrubber Venturi	$ 326,000	PM2.5	99%	9%	0.005	$ 30,772	$ 337,865	$ 68,266,053
3	Yes	Cartridge filter	$ 136,000	PM2.5	99%	9%	0.005	$ 12,837	$ 92,342	$ 19,477,750

Notes: More refined cost estimates would be done during the engineering phase of a project.
Recovered material was accounted in the Annualized Operating Cost, if applicable.
See Attachment 7 for more detail on cost estimates for Options 1-3.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

Option 2 consumes fresh water and generates wastewater. Options 1 and 3 would likely have a neutral effect on solid waste generation.

STEP 4: All of the technically feasible control options ranked above or near current controls were evaluated, and found to be economically infeasible.

STEP 5: Compass believes the estimated costs are exceptionally high in comparison to costs being borne by other sources of the same type to control the pollutant, indicating that the use of the above listed control options are not economically feasible. BACT is selected as the existing cyclonic wet scrubber. See Section 4 of this report for proposed limits.

Item # 1.03 **SALT Dryer D-501 / AH-513** **PM 2.5 Control Possibilities**

Control Option	Percent Control		GR/DSCF		Comment	Efficiency Rank
	Min	Max	Min	Max		
Baghouse/Fabric Filter/Cartridge Filter	90	99.99	0.0003	0.04	Gr/dscf outlet loading is assumed for filterables-only, since baghouses do not control condensables. May be technically infeasible or less efficient due to high moisture content.	1
Wet Scrubber	85	99.7	0.0025	0.096	Typically less efficient than Baghouse; may result in artifact (created) PM; controls filterable and condensable PM. ***Cyclonic wet scrubber is the existing control for the source.***	2
Cyclone	10	70	0.026	0.13	Already have a cyclone with wet scrubber. Cyclone alone is not effective for PM2.5, cyclone alone will not control condensables very effectively.	3
Wet ESP	99	99.9	0.01	0.021	There are considerable safety factors due to high voltage and the potential generation of HAPs. Technically infeasible because ESPs have reduced collection efficiency for materials that have high electrical resistivity such as sodium chloride. ESP is not demonstrated for highly resistive particulate matter such as those produced by CM processes.	NA
Dry ESP	96	99.2	NA	NA	Dry ESPs are not recommended for removing sticky or moist particles. Dryer exhaust generally has 20%+ moisture. Organic condensables plug a dry ESP. There are considerable safety factors due to high voltage and the potential generation of HAPs. Technically infeasible because ESPs have reduced collection efficiency for materials that have high electrical resistivity such as sodium chloride. ESP is not demonstrated for highly resistive particulate matter such as those produced by CM processes.	NA

BACT IMPACTS TABLE 1.03 PM2.5 STEPS 3-5 AH-513

1.03 PM2.5 BACT Analysis for Technically Feasible Control Options

Information for Economic Analysis		Description
EU ID	D-501	Salt Dryer D-501
Existing Control	AH-513	Wet cyclone and cyclonic wet scrubber, 1.45 lb/hr and 0.0114 grains/dscf.
Interest Rate	0.07	Interest rate at which the company can borrow money. Enter 0.07, or 0.10, for example.
Useful Life	20	Estimated useful life of the new control equipment being considered.

STEP 3:

POLLUTANTS TO BE CONTROLLED	PM2.5	SOx	NOx	VOC	NH3
Actual 2015 Tons Per Year	0.595				
Estimated Uncontrolled TPY	5.95				
Existing Control Efficiency	90%				
Existing Outlet Concentration (g/dscf)	N/A				

ECONOMIC ANALYSIS

Option	Demon-strated?	Technically Feasible Control Options	Total Capital Cost	Pollutant	New Control Efficiency	Difference	Additional Tons Controlled	Annualized Capital $	Annualized Operating $	BACT ($/ton)
1	Yes	Baghouse	$ 1,097,000	PM2.5	99%	9%	0.535	$ 103,549	$ 81,479	$ 345,599
2	Yes	Wet scrubber Venturi	$ 689,000	PM2.5	99%	9%	0.535	$ 65,037	$ 337,865	$ 752,548
3	Yes	Cartridge filter	$ 275,000	PM2.5	99%	9%	0.535	$ 25,958	$ 92,342	$ 220,964

Notes:
More refined cost estimates would be done during the engineering phase of a project.
Recovered material was accounted in the Annualized Operating Cost, if applicable.
See Attachment 7 for more detail on cost estimates for Options 1-3.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

Option 2 consumes fresh water and generates wastewater. Options 1 and 3 would likely have a neutral effect on solid waste generation.

STEP 4: All of the technically feasible control options ranked above or near current controls were evaluated, and found to be economically infeasible.

STEP 5: Compass believes the estimated costs are exceptionally high in comparison to costs being borne by other sources of the same type to control the pollutant, indicating that the use of the above listed control options are not economically feasible. BACT is selected as the existing cyclonic wet scrubber. See Section 4 of this report for proposed limits.

BACT OPTIONS TABLE 1.03 SOx STEPS 1-5

Item # 1.03 **SALT Dryer D-501 / AH-513** **SOx Control Possibilities STEPS 1 and 2:**

Control Option	Percent Control		LB/MMBTU		Comment	Efficiency Rank
	Min	Max	Min	Max		
Pipeline Quality Natural Gas Fuel (low sulfur fuel)	NA	NA	0.0009	0.0065	Natural gas sold to consumers has the lowest sulfur content of any of the fossil fuels, and constitutes BACT for SOx. ***CM uses only pipeline quality natural gas fuel in external combustion units, per permit condition II.B.1.c (BACT).***	1
Good Combustion Practices	NA	NA	NA	NA	***CM follows good combustion practices per permit condition II.B.1.d (BACT).***	2
Limestone Injection (CFB)	NA	NA	0.06	0.2	Used for solid fuel only. In RBLC, applications were for solid fuel (coal, pet coke, lignite, biomass). Not demonstrated for natural gas-only combustion.	NA
Dry Sorbent Injection	NA	NA	NA	0.06	Creates particulate sulfate from the SO2. My require a baghouse on exhaust. In RBLC, applications were for solid fuel (coal, pet coke, biomass). Not demonstrated for natural gas-only combustion.	NA
Wet flue gas desulfurization	NA	NA	0.065	0.107	***Wet scrubber control is currently used for this source.*** In RBLC, applications demonstrated were for solid fuel (coal, corn fiber).	NA

STEP 3: The existing controls of exhausting through a wet scrubber, combusting pipeline quality natural gas and good combustion practices have been determined to be BACT and there are no additional technically feasible options.

STEP 4: There are no other technically feasible options to evaluate, therefore BACT remains the use of natural gas and combustion practices.

STEP 5: The existing use of pipeline quality natural gas, good combustion practices, and wet scrubber control is considered BACT for SOx emissions from this source.

BACT OPTIONS TABLE **1.03 NOx** **STEPS 1-5**

Item # 1.03 **SALT Dryer D-501 / AH-513** **NOx Control Possibilities STEPS 1 and 2:**

Control Option	Percent Control Min	Percent Control Max	LB/MMBTU Min	LB/MMBTU Max	Comment	Efficiency Rank
Ultra Low NOx Burners (ULNB)	NA	NA	0.0125	0.072	There is no widely accepted definition for Ultra Low NOx Burners (ULNB). For this BACT analysis it is assumed ≤ 20 ppm @ 3% O2 is ULNB. FGR and/or staged combustion principles are usually included in ULNB. ***Existing control for this source is ULNB with FGR and staged combustion principles, plus pipeline quality natural gas.***	1
Selective Catalytic Reduction (SCR)	70	90	0.02	0.1	Catalyst and ammonia required. Ammonia emissions in range of 10-20 ppm. Effective in streams >20 ppm NOx. Rarely demonstrated for natural gas-only combustion units.	2
Low NOx Burners (LNB)	50	55	0.035	0.35	Low NOx burners often use FGR and/or staged combustion principles.	3
Natural Gas Fuel	NA	NA	NA	NA	***CM uses natural gas fuel per permit condition II.B.1.c (BACT). Natural gas has little or no fuel bound nitrogen.***	4
Good Combustion Practices	NA	NA	NA	NA	***CM follows good combustion practices per permit condition II.B.1.d (BACT).***	5
FGR (Flue Gas Recirculation)	NA	NA	NA	NA	FGR is a pollution prevention technique used to achieve low ppm in LNB and ULNB by limiting excess oxygen. **See the ULNB and LNB categories.**	6
Staged Combustion/Over Fire Air and Air/Fuel Ratio	NA	NA	0.08	0.22	Staged combustion/over fire air are pollution prevention techniques that allow for the reduction of thermal NOx formation by modifying the primary combustion zone stoichiometry or air/fuel ratio. Staged combustion can mean staged air or staged fuel. It often helps achieve low ppm in LNB and ULNB by keeping the temperature lower. **See the ULNB and LNB categories.**	7
Selective Noncatalytic Reduction (SNCR)	60	70	0.07	0.25	Requires ammonia or urea injection as a reducing agent. SNCR tends to be less effective at low NOx concentrations. Typical NOx inlet loadings vary from 200 to 400 ppm. (Ref. EPA SNCR Fact Sheet) Rarely demonstrated for natural gas-only combustion units.	NA
Steam/Water Injection	NA	NA	NA	NA	Steam/Water Injection reduces thermal NOx formation by lowering temperature. Not demonstrated for natural gas-only combustion.	NA
NSCR (Nonselective catalytic reduction)	NA	NA	NA	NA	NSCR (Nonselective catalytic reduction) controls are not shown in RBLC for chemical, wood, minerals, or agricultural industries. This technology is typically used for mobile sources. Not demonstrated for natural gas-only combustion.	NA

STEP 3: The existing controls of ULNB (< 20 ppm @ 3% O2, based on vendor data and adjusting for local ambient conditions) with FGR and staged combustion practices, combusting pipeline quality natural gas have been determined to be BACT and there are no additional technically feasible options.

STEP 4: There are no other technically feasible options to evaluate, therefore BACT remains the use of ULNB, FGR, natural gas and combustion practices.

STEP 5: BACT is selected as the existing ULNB with FGR and staged combustion principles, plus pipeline quality natural gas, plus good combustion practices. See Section 4 of this report for proposed limits.

BACT OPTIONS TABLE 1.03 VOC STEPS 1-5

Item # 1.03 **SALT Dryer D-501 / AH-513** **VOC Control Possibilities STEPS 1 and 2:**

Control Option	Percent Control		LB/MMBTU		Comment	Efficiency Rank
	Min	Max	Min	Max		
Pipeline Quality Natural Gas Fuel	NA	NA	0.004	0.0054	***CM uses pipeline quality natural gas fuel for its dryers, boilers, and process heaters, per permit condition II.B.1.c (BACT).***	1
Good Combustion Practices	NA	NA	0.0054	0.01	***CM follows good combustion practices per permit condition II.B.1.d (BACT).***	2
Oxidation catalyst	95	99	NA	NA	Controls VOC and CO. Oxidation catalyst is most effective in high excess oxygen sources such as turbines (12-15% excess oxygen) compared to external natural gas combustion (2-6% excess oxygen). It requires high temperature (600-800 °F) and particulate often must first be removed. Only two determinations were found in RBLC for a natural gas-only boiler, specified for CO control. Most oxidation catalyst determinations in RBLC were for engines, turbines, or solid/liquid/mixed fuels. Technically infeasible because particulate often must first be removed. By the time the particulate has been removed, the air stream is too cool.	NA
Thermal Oxidizers (TO, RTO)	NA	NA	NA	NA	Controls CO, VOC, and PM. Not demonstrated for natural gas-only combustion.	NA

STEP 3: The existing controls of combusting pipeline quality natural gas and good combustion practices have been determined to be BACT and there are no additional technically feasible options.

STEP 4: There are no other technically feasible options to evaluate, therefore BACT remains the use of natural gas and combustion practices.

STEP 5: BACT is selected as pipeline quality natural gas fuel and good combustion practices. See Section 4 of this report for proposed limits.

Item # 1.03 **SALT Dryer D-501 / AH-513** **VOC Control Possibilities STEPS 1 and 2:**

Control Option	Percent Control		LB/MMBTU		Comment	Efficiency Rank
	Min	Max	Min	Max		
Limit on ammonia slip in SCR controlled process heater.	NA	NA	NA	NA	Ammonia is only included in RBLC as a pollutant to be controlled if the unit is controlled for NOx with SCR or SNCR. These controls are normally used for engines, turbines, and external combustion sources fired on liquid, solid, or mixed fuels or fuel gas. In this case, ammonia slip may be controlled to prevent ammonia emissions. Ammonia controls are not demonstrated in RBLC for natural gas-only boilers or dryers, boilers or process heaters.	NA

STEP 3: No impacts analysis per Step 3 is needed, because there are no technically feasible options.

STEP 4: There are no other technically feasible options to evaluate for natural gas-only combustion units.

STEP 5: BACT is selected as pipeline quality natural gas fuel and good combustion practices. See Section 4 of this report for proposed limits.

BACT OPTIONS TABLE 1.04 PM2.5 STEPS 1-2

Item # 1.04 **SALT Cooler BH-501** **PM 2.5 Control Possibilities**

Control Option	Percent Control		GR/DSCF		Comment	Efficiency Rank
	Min	Max	Min	Max		
Baghouse/Fabric Filter/Cartridge Filter	90	99.99	0.0003	0.04	Gr/dscf outlet loading is assumed for filterables-only, since baghouses do not control condensables. ***Baghouse is the existing control for the source.***	1
Wet Scrubber	85	99.7	0.0025	0.096	Typically less efficient than Baghouse; may result in artifact (created) PM; controls filterable and condensable PM. Technically feasible if there is room at the site.	2
Cyclone	10	70	0.026	0.13	Not effective for PM2.5 unless coupled with Baghouse, ESP, or Scrubber; will not control condensables very effectively.	3
Wet ESP	99	99.9	0.01	0.021	There are considerable safety factors due to high voltage and the potential generation of HAPs. Technically infeasible because ESPs have reduced collection efficiency for materials that have high electrical resistivity such as sodium chloride. ESP is not demonstrated for highly resistive particulate matter such as those produced by CM processes.	NA
Dry ESP	96	99.2	NA	NA	There are considerable safety factors due to high voltage and the potential generation of HAPs. Technically infeasible because ESPs have reduced collection efficiency for materials that have high electrical resistivity such as sodium chloride. ESP is not demonstrated for highly resistive particulate matter such as those produced by CM processes.	NA

1.04 PM2.5 BACT Analysis for Technically Feasible Control Options

Information for Economic Analysis		Description
EU ID	F-506	Salt Cooler
Existing Control	BH-501	Baghouse, 0.9 lb/hr and 0.01 grains/dscf.
Interest Rate	0.07	Interest rate at which the company can borrow money. Enter 0.07, or 0.10, for example.
Useful Life	20	Estimated useful life of the new control equipment being considered.

STEP 3:

POLLUTANTS TO BE CONTROLLED	PM2.5	SOx	NOx	VOC	NH3
Actual 2015 Tons Per Year	0.003				
Estimated Uncontrolled TPY	0.3				
Existing Control Efficiency	99%				
Existing Outlet Concentration (g/dscf)	N/A				

ECONOMIC ANALYSIS

Option	Demon-strated?	Technically Feasible Control Options	Total Capital Cost	Pollutant	New Control Efficiency	Difference	Additional Tons Controlled	Annualized Capital $	Annualized Operating $	BACT ($/ton)
1	Yes	Baghouse	$ 914,000	PM2.5	99.9%	0.9%	0.003	$ 86,275	$ 81,479	$ 62,131,012
2	Yes	Wet scrubber Venturi	$ 617,000	PM2.5	99.9%	0.9%	0.003	$ 58,240	$ 337,865	$ 146,705,565
3	Yes	Cartridge filter	$ 236,000	PM2.5	99.9%	0.9%	0.003	$ 22,277	$ 92,342	$ 42,451,534

Notes: More refined cost estimates would be done during the engineering phase of a project.
Recovered material was accounted in the Annualized Operating Cost, if applicable.
See Attachment 7 for more detail on cost estimates for Options 1-3.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

Option 2 consumes fresh water and generates wastewater. Options 1 and 3 would likely have a neutral effect on solid waste generation.

STEP 4: All of the technically feasible control options ranked above or near current controls were evaluated, and found to be economically infeasible.

STEP 5: Compass believes the estimated costs are exceptionally high in comparison to costs being borne by other sources of the same type to control the pollutant, indicating that the use of the above listed control options are not economically feasible. BACT is selected as the existing baghouse. See Section 4 of this report for proposed limits.

BACT OPTIONS TABLE 1.05 PM2.5

STEPS 1-2

Item # 1.05 **SALT Bulk Load-out BH-502** **PM 2.5 Control Possibilities**

Control Option	Percent Control		GR/DSCF		Comment	Efficiency Rank
	Min	Max	Min	Max		
Baghouse/Fabric Filter/Cartridge Filter	90	99.99	0.0003	0.04	Gr/dscf outlet loading is assumed for filterables-only, since baghouses do not control condensables. ***A cartridge filter dust collector is the existing control for the source.***	1
Wet Scrubber	85	99.7	0.0025	0.096	Typically less efficient than Baghouse; may result in artifact (created) PM; controls filterable and condensable PM. Technically feasible if there is room at the site.	2
Cyclone	10	70	0.026	0.13	Not effective for PM2.5 unless coupled with Baghouse, ESP, or Scrubber; will not control condensables very effectively.	3
Wet ESP	99	99.9	0.01	0.021	There are considerable safety factors due to high voltage and the potential generation of HAPs. Technically infeasible because ESPs have reduced collection efficiency for materials that have high electrical resistivity such as sodium chloride. ESP is not demonstrated for highly resistive particulate matter such as those produced by CM processes.	NA
Dry ESP	96	99.2	NA	NA	There are considerable safety factors due to high voltage and the potential generation of HAPs. Technically infeasible because ESPs have reduced collection efficiency for materials that have high electrical resistivity such as sodium chloride. ESP is not demonstrated for highly resistive particulate matter such as those produced by CM processes.	NA

BACT IMPACTS TABLE 1.05 PM2.5 STEPS 3-5 BH-502

1.05 PM2.5 BACT Analysis for Technically Feasible Control Options

Information for Economic Analysis		Description
EU ID	BH-502	Salt bulk load-out
Existing Control	BH-502	Cartridge filter dust collector, 0.17 lb/hr and 0.0053 grains/dscf.
Interest Rate	0.07	Interest rate at which the company can borrow money. Enter 0.07, or 0.10, for example.
Useful Life	20	Estimated useful life of the new control equipment being considered.

STEP 3:

POLLUTANTS TO BE CONTROLLED	PM2.5	SOx	NOx	VOC	NH3
Actual 2015 Tons Per Year	0.113				
Estimated Uncontrolled TPY	2.26				
Existing Control Efficiency	95%				
Existing Outlet Concentration (g/dscf)	N/A				

ECONOMIC ANALYSIS

Option	Demon-strated?	Technically Feasible Control Options	Total Capital Cost	Pollutant	New Control Efficiency	Difference	Additional Tons Controlled	Annualized Capital $	Annualized Operating $	BACT ($/ton)
1	Yes	Baghouse	$ 216,000	PM2.5	99.0%	4.0%	0.090	$ 20,389	$ 81,479	$ 1,129,314
2	Yes	Wet scrubber Venturi	$ 373,000	PM2.5	99.0%	4.0%	0.090	$ 35,209	$ 337,865	$ 4,135,930
3	Yes	Cartridge filter	$ 139,000	PM2.5	99.0%	4.0%	0.090	$ 13,121	$ 92,342	$ 1,169,175

Notes: More refined cost estimates would be done during the engineering phase of a project.
Recovered material was accounted in the Annualized Operating Cost, if applicable.
See Attachment 7 for more detail on cost estimates for Options 1-3.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

Option 2 consumes fresh water and generates wastewater. Options 1 and 3 would likely have a neutral effect on solid waste generation.

STEP 4: All of the technically feasible control options ranked above or near current controls were evaluated, and found to be economically infeasible.

STEP 5: Compass believes the estimated costs are exceptionally high in comparison to costs being borne by other sources of the same type to control the pollutant, indicating that the use of the above listed control options are not economically feasible. BACT is selected as the existing cartridge filter dust collector. See Section 4 of this report for proposed limits.

BACT OPTIONS TABLE 1.06 PM2.5 STEPS 1-2

Item # 1.06 **SALT Special Products Circuit BH-505** **PM 2.5 Control Possibilities**

Control Option	Percent Control		GR/DSCF		Comment	Efficiency Rank
	Min	Max	Min	Max		
Baghouse/Fabric Filter/Cartridge Filter	90	99.99	0.0003	0.04	Gr/dscf outlet loading is assumed for filterables-only, since baghouses do not control condensables. ***A baghouse is the existing control for the source.***	1
Wet Scrubber	85	99.7	0.0025	0.096	Typically less efficient than Baghouse; may result in artifact (created) PM; controls filterable and condensable PM. Technically feasible if there is room at the site.	2
Cyclone	10	70	0.026	0.13	Not effective for PM2.5 unless coupled with Baghouse, ESP, or Scrubber; will not control condensables very effectively.	3
Wet ESP	99	99.9	0.01	0.021	There are considerable safety factors due to high voltage and the potential generation of HAPs. Technically infeasible because ESPs have reduced collection efficiency for materials that have high electrical resistivity such as sodium chloride. ESP is not demonstrated for highly resistive particulate matter such as those produced by CM processes.	NA
Dry ESP	96	99.2	NA	NA	There are considerable safety factors due to high voltage and the potential generation of HAPs. Technically infeasible because ESPs have reduced collection efficiency for materials that have high electrical resistivity such as sodium chloride. ESP is not demonstrated for highly resistive particulate matter such as those produced by CM processes.	NA

BACT IMPACTS TABLE 1.06 PM2.5 STEPS 3-5 BH-505

1.06 PM2.5 BACT Analysis for Technically Feasible Control Options

Information for Economic Analysis		Description
EU ID	BH-505	Salt Special Products Circuit
Existing Control	BH-505	Baghouse that exhausts back into the building, no unit specific limits.
Interest Rate	0.07	Interest rate at which the company can borrow money. Enter 0.07, or 0.10, for example.
Useful Life	20	Estimated useful life of the new control equipment being considered.

STEP 3:

POLLUTANTS TO BE CONTROLLED	PM2.5	SOx	NOx	VOC	NH3
Actual 2015 Tons Per Year	0.000014				
Estimated Uncontrolled TPY	0.0028				
Existing Control Efficiency	99.5%				
Existing Outlet Concentration (g/dscf)	N/A				

ECONOMIC ANALYSIS

Option	Demon-strated?	Technically Feasible Control Options	Total Capital Cost	Pollutant	New Control Efficiency	Difference	Additional Tons Controlled	Annualized Capital $	Annualized Operating $	BACT ($/ton)
1	Yes	Baghouse	$ 267,000	PM2.5	99.9%	0.4%	0.000011	$ 25,203	$ 81,479	$ 9,457,580,709
2	Yes	Wet scrubber Venturi	$ 452,000	PM2.5	99.9%	0.4%	0.000011	$ 42,666	$ 337,865	$ 33,734,946,266
3	Yes	Cartridge filter	$ 173,000	PM2.5	99.9%	0.4%	0.000011	$ 16,330	$ 92,342	$ 9,634,077,004

Notes: More refined cost estimates would be done during the engineering phase of a project.
Recovered material was accounted in the Annualized Operating Cost, if applicable.
See Attachment 7 for more detail on cost estimates for Options 1-3.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

Option 2 consumes fresh water and generates wastewater. Options 1 and 3 would likely have a neutral effect on solid waste generation.

STEP 4: All of the technically feasible control options ranked above or near current controls were evaluated, and found to be economically infeasible.

STEP 5: Compass believes the estimated costs are exceptionally high in comparison to costs being borne by other sources of the same type to control the pollutant, indicating that the use of the above listed control options are not economically feasible. BACT is selected as the existing baghouse. See Section 4 of this report for proposed limits.

Item # 1.07 **SALT Fugitive outdoor uncaptured material handling** **PM 2.5 Control Possibilities**

Control Option	Percent Control		GR/DSCF		Comment	Efficiency Rank
	Min	Max	Min	Max		
Control Devices	10	99.99	0.0003	0.13	RBLC included: fabric filter, baghouse, cartridge filter, cyclone, scrubber.	1
Conveyance: Pneumatic	10	99.99	0.0003	0.13	Must be coupled with a cyclone, baghouse, and or scrubber type of control.	1
Conveyors: Enclosed	NA	NA	NA	NA	Enclosed conveyors can be fully or partially enclosed to prevent wind erosion and spillage.	NA
Drop Height Reduction	NA	NA	NA	NA	Drop height reduction can include enclosures or not.	NA
Enclosure	NA	NA	NA	NA	A building, silo, shroud, etc. around transfer points, drop points, load/unload areas, conveyors, etc.	NA

BACT IMPACTS TABLE 1.07a PM2.5 STEPS 3-5 SALT FOUMH

1.07a PM2.5 BACT Analysis for Technically Feasible Control Options

Information for Economic Analysis		Description
EU ID	SALT FOUMH	SALT Fugitive outdoor uncaptured material handling; Emissions Group 1
Existing Control	None	N/A
Interest Rate	0.07	Interest rate at which the company can borrow money. Enter 0.07, or 0.10, for example.
Useful Life	20	Estimated useful life of the new control equipment being considered.

STEP 3:

POLLUTANTS TO BE CONTROLLED	PM2.5	SOx	NOx	VOC	NH3
Estimated Uncontrolled PTE (TPY)	0.0089				
Existing Control Efficiency	0.00				
Existing Outlet Concentration (g/dscf)	N/A				

ECONOMIC ANALYSIS

Option	Demon-strated?	Technically Feasible Control Options	Total Capital Cost	Pollutant	New Control Efficiency	Difference	Additional Tons Controlled	Annualized Capital $	Annualized Operating $	BACT ($/ton)
1	Yes	Full Enclosure and Ducting to Existing APCE	$ 150,000	PM2.5	99%	99.0%	0.008821	$ 14,159	$ -	$ 1,605,158
2	Yes	Full Enclosure	$ 53,000	PM2.5	75.0%	75.0%	0.006683	$ 5,003	$ -	$ 748,646

Notes:
More refined cost estimates would be done during the engineering phase of a project.
Recovered material was accounted in the Annualized Operating Cost, if applicable.
See Attachment 7 for more detail on cost estimates for Options 1-2.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

STEP 4: All of the technically feasible control options ranked above or near current controls were evaluated, and found to be economically infeasible.

STEP 5: Compass believes the estimated costs are exceptionally high in comparison to costs being borne by other sources of the same type to control the pollutant, indicating that the use of the above listed control options are not economically feasible.

BACT IMPACTS TABLE 1.07b PM2.5 STEPS 3-5 SALT FOUMH

1.07b PM2.5 BACT Analysis for Technically Feasible Control Options

Information for Economic Analysis		Description
EU ID	SALT FOUMH	SALT Fugitive outdoor uncaptured material handling; Emissions Group 2
Existing Control	None	N/A
Interest Rate	0.07	Interest rate at which the company can borrow money. Enter 0.07, or 0.10, for example.
Useful Life	20	Estimated useful life of the new control equipment being considered.

STEP 3:

POLLUTANTS TO BE CONTROLLED	PM2.5	SOx	NOx	VOC	NH3
Estimated Uncontrolled PTE (TPY)	0.027				
Existing Control Efficiency	0.00				
Existing Outlet Concentration (g/dscf)	N/A				

ECONOMIC ANALYSIS

Option	Demon-strated?	Technically Feasible Control Options	Total Capital Cost	Pollutant	New Control Efficiency	Difference	Additional Tons Controlled	Annualized Capital $	Annualized Operating $	BACT ($/ton)
1	Yes	Enclosure	$ 248,000	PM2.5	99%	99.0%	0.027027	$ 23,409	$ -	$ 866,150

Notes:
More refined cost estimates would be done during the engineering phase of a project.
Recovered material was accounted in the Annualized Operating Cost, if applicable.
See Attachment 7 for more detail on cost estimates for Options 1.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

STEP 4: All of the technically feasible control options ranked above or near current controls were evaluated, and found to be economically infeasible.

STEP 5: Compass believes the estimated costs are exceptionally high in comparison to costs being borne by other sources of the same type to control the pollutant, indicating that the use of the above listed control options are not economically feasible.

1.07c PM2.5 BACT Analysis for Technically Feasible Control Options

Information for Economic Analysis		Description
EU ID	SALT FOUMH	SALT Fugitive outdoor uncaptured material handling; Emissions Group 3
Existing Control	None	N/A
Interest Rate	0.07	Interest rate at which the company can borrow money. Enter 0.07, or 0.10, for example.
Useful Life	20	Estimated useful life of the new control equipment being considered.

STEP 3:

POLLUTANTS TO BE CONTROLLED	PM2.5	SOx	NOx	VOC	NH3
Estimated Uncontrolled PTE (TPY)	0.47				
Existing Control Efficiency	0.00				
Existing Outlet Concentration (g/dscf)	N/A				

ECONOMIC ANALYSIS										
Option	Demon-strated?	Technically Feasible Control Options	Total Capital Cost	Pollutant	New Control Efficiency	Difference	Additional Tons Controlled	Annualized Capital $	Annualized Operating $	BACT ($/ton)
1	Yes	Full Enclosure and Ducting to Existing APCE	$ 167,000	PM2.5	99%	99.0%	0.469260	$ 15,764	$ -	$ 33,593
2	Yes	Full Enclosure	$ 156,000	PM2.5	75.0%	75.0%	0.355500	$ 14,725	$ -	$ 41,421

Notes: More refined cost estimates would be done during the engineering phase of a project.
Recovered material was accounted in the Annualized Operating Cost, if applicable.
See Attachment 7 for more detail on cost estimates for Options 1-2.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

STEP 4: All of the technically feasible control options ranked above or near current controls were evaluated, and found to be economically infeasible.

STEP 5: Compass believes the estimated costs are exceptionally high in comparison to costs being borne by other sources of the same type to control the pollutant, indicating that the use of the above listed control options are not economically feasible.

Item # 1.08 **SALT fugitive material handling from building doors/windows/vents** **PM 2.5 Control Possibilities**

Control Option	Percent Control		GR/DSCF		Comment	Efficiency Rank
	Min	Max	Min	Max		
Control Devices	10	99.99	0.0003	0.13	RBLC included: fabric filter, baghouse, cartridge filter, cyclone, scrubber.	NA
Conveyance: Pneumatic	10	99.99	0.0003	0.13	Must be coupled with a cyclone, baghouse, and or scrubber type of control.	NA
Conveyors: Enclosed	NA	NA	NA	NA	Enclosed conveyors can be fully or partially enclosed to prevent wind erosion and spillage.	NA
Drop Height Reduction	NA	NA	NA	NA	Drop height reduction can include enclosures or not.	NA
Enclosure	NA	NA	NA	NA	A building, silo, shroud, etc. around transfer points, drop points, load/unload areas, conveyors, etc.	NA

BACT IMPACTS TABLE 1.08 PM2.5 STEPS 3-5 SALT FBMH

1.08 PM2.5 BACT Analysis for Technically Feasible Control Options

Information for Economic Analysis		Description
EU ID	SALT FBMH	SALT Fugitive indoor uncaptured material handling; Emissions
Existing Control	None	N/A
Interest Rate	0.07	Interest rate at which the company can borrow money. Enter 0.07, or 0.10, for example.
Useful Life	20	Estimated useful life of the new control equipment being considered.

STEP 3:

POLLUTANTS TO BE CONTROLLED	PM2.5	SOx	NOx	VOC	NH3
Estimated Uncontrolled PTE (TPY)	0.08				
Existing Control Efficiency	0.00				
Existing Outlet Concentration (g/dscf)	N/A				

ECONOMIC ANALYSIS

Option	Demon-strated?	Technically Feasible Control Options	Total Capital Cost	Pollutant	New Control Efficiency	Difference	Additional Tons Controlled	Annualized Capital $	Annualized Operating $	BACT ($/ton)
1	Yes	Ducting to Existing APCE	$ 1,028,000	PM2.5	99%	99.0%	0.078354	$ 97,036	$ -	$ 1,238,437

Notes: More refined cost estimates would be done during the engineering phase of a project.
Recovered material was accounted in the Annualized Operating Cost, if applicable.
See Attachment 7 for more detail on cost estimates for Options 1.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

STEP 4: All of the technically feasible control options ranked above or near current controls were evaluated, and found to be economically infeasible.

STEP 5: Compass believes the estimated costs are exceptionally high in comparison to costs being borne by other sources of the same type to control the pollutant, indicating that the use of the above listed control options are not economically feasible.

BACT OPTIONS TABLE **1.09 PM2.5** **STEPS 1-5**

Items # 1.09 **SALT Fugitive salt pile and road dust emissions**

PM 2.5 Control Possibilities

Control Option	Percent Control		GR/DSCF		Comment	Efficiency Rank
	Min	Max	Min	Max		
Fugitive Dust Control Plan	NA	NA	NA	NA	Developing, Implementing, and Maintaining a Fugitive Dust Control Plan (FDCP) is a recognized control technology in EPA's RBLC. It is also a requirement of Utah Rule 307-309	NA
Inherent Moisture Content	NA	NA	NA	NA	Some materials have inherent moisture content, which helps to minimize emissions.	NA
Stabilization: Chemical	NA	NA	NA	NA	Chemicals dust suppressants include salts, lignin sulfonate, wetting agents, latexes, plastics, and petroleum derivatives.	NA
Stabilization: Physical	NA	NA	NA	NA	Water spraying, paving, sweeping, tarping piles, etc.	NA
Stabilization: Vegetative Cover	NA	NA	NA	NA	Vegetative cover can be used to stabilize soil, but is technically infeasible for salt piles, and is not an option for Compass Minerals.	NA
Speed Limit	NA	NA	NA	NA	Slowing down the vehicle speeds on site can minimize road dust.	NA
Wind Screens	NA	NA	NA	NA	Wind screens are porous wind fences, that help prevent fugitive emissions, and can be moved depending on wind conditions and work planning.	NA
Work Practices / Housekeeping	NA	NA	NA	NA	Work practices (or best operating practices) include several strategies, such as avoiding dusty work on windy days, keeping dusty materials vacuumed up, etc.	NA

STEP 3: Salt pile and fugitive road dust is not a candidate for add on controls, but rather is best managed through measures identified above.

STEP 4: The following site-wide permit conditions establish the requirement for a Fugitive Dust Control Plan:

State-Only	II.B.1.g	Unless otherwise specified in this permit, visible emissions caused by fugitive dust shall not exceed 10% at the property boundary, and 20% onsite. Opacity shall not apply when the wind speed exceeds 25 miles per hour if the permittee has implemented, and continues to implement, the accepted fugitive dust control plan and administers at least one of the following contingency measures: 1 Pre-event watering; 2 Hourly watering; 3 Additional chemical stabilization; 4 Cease or reduce fugitive dust producing operations; 5 Other contingency measure approved by the director. [Origin: R307-309]. [R307-309-5, R307-309-6]
State-Only	II.B.1.h	The permittee shall submit a fugitive dust control plan to the Director in accordance with R307-309-6. Activities regulated by R307-309 shall not commence before the fugitive dust control plan is approved by the director. If site modifications result in emission changes, the permittee shall submit an updated fugitive dust control plan. At a minimum, the fugitive dust control plan shall include the requirements in R307-309-6(4) as applicable. The fugitive dust control plan shall include contact information, site address, total area of disturbance, expected start and completion dates, identification of dust suppressant and plan certification by signature of a responsible person. [Origin: R307-309]. [R307-309-5(2), R307-309-6]
State-Only	II.B.1.i	Condition: If the permittee owns, operates or maintains a new or existing material storage, handling or hauling operation, the permittee shall prevent, to the maximum extent possible, material from being deposited onto any paved road other than a designated deposit site. If materials are deposited that may create fugitive dust on a public or private paved road, the permittee shall clean the road promptly. [Origin: R307-309]. [R307-309-7]

STEP 5: BACT is selected as continued adherence to the facility's Fugitive Dust Control Plan. Specifically, CM will review it to ensure that fugitive emissions from SALT operations are addressed.

Item # 2.01 **SOP Dryer D-1545 / AH-1547** **PM 2.5 Control Possibilities**

Control Option	Percent Control		GR/DSCF		Comment	Efficiency Rank
	Min	Max	Min	Max		
Wet Scrubber	85	99.7	0.0025	0.096	May result in artifact (created) PM.Controls filterable and condensable PM. ***Existing control is a wet scrubber.***	1
Cyclone	10	70	0.026	0.13	Not effective for PM2.5 unless coupled with Baghouse, ESP, or Scrubber; will not control condensables very effectively.	2
Baghouse/Fabric Filter/Cartridge Filter	90	99.99	0.0003	0.04	Gr/dscf outlet loading is assumed for filterables-only, since baghouses do not control condensables. Not technically feasible due to steam and binder in the air stream.	NA
Wet ESP	99	99.9	0.01	0.021	There are considerable safety factors due to high voltage and the potential generation of HAPs. Technically infeasible because ESPs have reduced collection efficiency for materials that have high electrical resistivity such as sodium chloride. ESP is not demonstrated for highly resistive particulate matter such as those produced by CM processes.	NA
Dry ESP	96	99.2	NA	NA	Dry ESPs are not recommended for removing sticky or moist particles. Dryer exhaust generally has 20%+ moisture and this dryer has binder as well.. Organic condensables plug a dry ESP. There are considerable safety factors due to high voltage and the potential generation of HAPs. Technically infeasible because ESPs have reduced collection efficiency for materials that have high electrical resistivity such as sodium chloride. ESP is not demonstrated for highly resistive particulate matter such as those produced by CM processes..	NA

STEP 3: The existing controls of exhausting through a wet scrubber have been determined to be BACT and there are no additional technically feasible options.

STEP 4: There are no other technically feasible options to evaluate, therefore BACT remains the use of a wet scrubber.

STEP 5: BACT is selected as the existing wet scrubber.

BACT OPTIONS TABLE 2.01 SOx STEPS 1-5

Item # 2.01 **SOP Dryer D-1545 / AH-1547** **SOx Control Possibilities**

Control Option	Percent Control Min	Percent Control Max	LB/MMBTU Min	LB/MMBTU Max	Comment	Efficiency Rank
Pipeline Quality Natural Gas Fuel (low sulfur fuel)	NA	NA	0.0009	0.0065	Natural gas sold to consumers has the lowest sulfur content of any of the fossil fuels, and constitutes BACT for SOx. ***CM uses only pipeline quality natural gas fuel in external combustion units, per permit condition II.B.1.c (BACT).***	1
Good Combustion Practices	NA	NA	NA	NA	***CM follows good combustion practices per permit condition II.B.1.d (BACT).***	2
Limestone Injection (CFB)	NA	NA	0.06	0.2	Used for solid fuel only. In RBLC, applications were for solid fuel (coal, pet coke, lignite, biomass). Not demonstrated for natural gas-only combustion.	NA
Dry Sorbent Injection	NA	NA	NA	0.06	Creates particulate sulfate from the SO2. My require a baghouse on exhaust. In RBLC, applications were for solid fuel (coal, pet coke, biomass). Not demonstrated for natural gas-only combustion.	NA
Wet flue gas desulfurization	NA	NA	0.065	0.107	***Wet scrubber control is currently used for this source.*** In RBLC, applications demonstrated were for solid fuel (coal, corn fiber).	NA

STEP 3: The existing controls of exhausting through a wet scrubber, combusting pipeline quality natural gas and good combustion practices have been determined to be BACT and there are no additional technically feasible options.

STEP 4: There are no other technically feasible options to evaluate, therefore BACT remains the use of natural gas and combustion practices.

STEP 5: The existing use of pipeline quality natural gas, good combustion practices, and wet scrubber control is considered BACT for SOx emissions from this source.

BACT OPTIONS TABLE 2.01 NOx STEPS 1-5

Item # 2.01 **SOP Dryer D-1545 / AH-1547** **NOx Control Possibilities**

Control Option	Percent Control		LB/MMBTU		Comment	Efficiency Rank
	Min	Max	Min	Max		
Ultra Low NOx Burners (ULNB)	NA	NA	0.0125	0.072	There is no widely accepted definition for Ultra Low NOx Burners (ULNB). For this BACT analysis it is assumed $\leq$ 20 ppm @ 3% O2 is ULNB. FGR and/or staged combustion principles are usually included in ULNB. ***Existing control for this source is ULNB with FGR and staged combustion principles, plus pipeline quality natural gas.***	1
Selective Catalytic Reduction (SCR)	70	90	0.02	0.1	Catalyst and ammonia required. Ammonia emissions in range of 10-20 ppm. Effective in streams >20 ppm NOx. Rarely demonstrated for natural gas-only combustion units.	2
Low NOx Burners (LNB)	50	55	0.035	0.35	Low NOx burners often use FGR and/or staged combustion principles.	3
Natural Gas Fuel	NA	NA	NA	NA	***CM uses natural gas fuel per permit condition II.B.1.c (BACT). Natural gas has little or no fuel bound nitrogen.***	4
Good Combustion Practices	NA	NA	NA	NA	***CM follows good combustion practices per permit condition II.B.1.d (BACT).***	5
FGR (Flue Gas Recirculation)	NA	NA	NA	NA	FGR is a pollution prevention technique used to achieve low ppm in LNB and ULNB by limiting excess oxygen. **See the ULNB and LNB categories.**	6
Staged Combustion/Over Fire Air and Air/Fuel Ratio	NA	NA	0.08	0.22	Staged combustion/over fire air are pollution prevention techniques that allow for the reduction of thermal NOx formation by modifying the primary combustion zone stoichiometry or air/fuel ratio. Staged combustion can mean staged air or staged fuel. It often helps achieve low ppm in LNB and ULNB by keeping the temperature lower. **See the ULNB and LNB categories.**	7
Selective Noncatalytic Reduction (SNCR)	60	70	0.07	0.25	Requires ammonia or urea injection as a reducing agent. SNCR tends to be less effective at low NOx concentrations. Typical NOx inlet loadings vary from 200 to 400 ppm. (Ref. EPA SNCR Fact Sheet) Rarely demonstrated for natural gas-only combustion units.	NA
Steam/Water Injection	NA	NA	NA	NA	Steam/Water Injection reduces thermal NOx formation by lowering temperature. Not demonstrated for natural gas-only combustion.	NA
NSCR (Nonselective catalytic reduction)	NA	NA	NA	NA	NSCR (Nonselective catalytic reduction) controls are not shown in RBLC for chemical, wood, minerals, or agricultural industries. This technology is typically used for mobile sources. Not demonstrated for natural gas-only combustion.	NA

STEP 3: The existing controls of ULNB (< 20 ppm @ 3% O2, based on vendor data and adjusting for local ambient conditions) with FGR and staged combustion practices, combusting pipeline quality natural gas have been determined to be BACT and there are no additional technically feasible options.

STEP 4: There are no other technically feasible options to evaluate, therefore BACT remains the use of ULNB, FGR, natural gas and combustion practices.

STEP 5: BACT is selected as the existing ULNB with FGR and staged combustion principles, plus pipeline quality natural gas, plus good combustion practices. See Section 4 of this report for proposed limits.

BACT OPTIONS TABLE 2.01 VOC STEPS 1-5

Item # 2.01 **SOP Dryer D-1545 / AH-1547** **VOC Control Possibilities**

Control Option	Percent Control		LB/MMBTU		Comment	Efficiency Rank
	Min	Max	Min	Max		
Pipeline Quality Natural Gas Fuel	NA	NA	0.004	0.0054	***CM uses pipeline quality natural gas fuel for its dryers, boilers, and process heaters, per permit condition II.B.1.c (BACT).***	1
Good Combustion Practices	NA	NA	0.0054	0.01	***CM follows good combustion practices per permit condition II.B.1.d (BACT).***	2
Oxidation catalyst	95	99	NA	NA	Controls VOC and CO. Oxidation catalyst is most effective in high excess oxygen sources such as turbines (12-15% excess oxygen) compared to external natural gas combustion (2-6% excess oxygen). It requires high temperature (600-800 °F) and particulate often must first be removed. Only two determinations were found in RBLC for a natural gas-only boiler, specified for CO control. Most oxidation catalyst determinations in RBLC were for engines, turbines, or solid/liquid/mixed fuels. Technically infeasible because particulate often must first be removed. By the time the particulate has been removed, the air stream is too cool.	NA
Thermal Oxidizers (TO, RTO)	NA	NA	NA	NA	Controls CO, VOC, and PM. Not demonstrated for natural gas-only combustion.	NA

STEP 3: The existing controls of combusting pipeline quality natural gas and good combustion practices have been determined to be BACT and there are no additional technically feasible options.

STEP 4: There are no other technically feasible options to evaluate, therefore BACT remains the use of natural gas and combustion practices.

STEP 5: BACT is selected as pipeline quality natural gas fuel and good combustion practices.

BACT OPTIONS TABLE 2.01 NH3 STEPS 1-5

Item # 2.01 **SOP Dryer D-1545 / AH-1547** **Ammonia Control Possibilities**

Control Option	Percent Control		LB/MMBTU		Comment	Efficiency Rank
	Min	Max	Min	Max		
Limit on ammonia slip in SCR controlled process heater.	NA	NA	NA	NA	Ammonia is only included in RBLC as a pollutant to be controlled if the unit is controlled for NOx with SCR or SNCR. These controls are normally used for engines, turbines, and external combustion sources fired on liquid, solid, or mixed fuels or fuel gas. In this case, ammonia slip may be controlled to prevent ammonia emissions. Ammonia controls are not demonstrated in RBLC for natural gas-only boilers or dryers, boilers or process heaters.	NA

STEP 3: No impacts analysis per Step 3 is needed, because there are no technically feasible options.

STEP 4: There are no other technically feasible options to evaluate for natural gas-only combustion units.

STEP 5: BACT is selected as pipeline quality natural gas fuel and good combustion practices. See Section 4 of this report for proposed limits.

BACT OPTIONS TABLE 2.02 PM2.5 STEPS 1-5

Item # 2.02 **SOP Plant Compaction Building AH-1555** **PM 2.5 Control Possibilities**

Control Option	Percent Control		GR/DSCF		Comment	Efficiency Rank
	Min	Max	Min	Max		
Wet Scrubber	85	99.7	0.0025	0.096	May result in artifact (created) PM.Controls filterable and condensable PM. ***Existing control is a wet scrubber.***	1
Cyclone	10	70	0.026	0.13	Not effective for PM2.5 unless coupled with Baghouse, ESP, or Scrubber; will not control condensables very effectively.	2
Baghouse/Fabric Filter/Cartridge Filter	90	99.99	0.0003	0.04	Gr/dscf outlet loading is assumed for filterables-only, since baghouses do not control condensables. Not technically feasible due to steam and binder in the air stream.	NA
Wet ESP	99	99.9	0.01	0.021	There are considerable safety factors due to high voltage and the potential generation of HAPs. Technically infeasible because ESPs have reduced collection efficiency for materials that have high electrical resistivity such as sodium chloride. ESP is not demonstrated for highly resistive particulate matter such as those produced by CM processes.	NA
Dry ESP	96	99.2	NA	NA	Dry ESPs are not recommended for removing sticky or moist particles. Dryer exhaust generally has 20%+ moisture and this dryer has binder as well.. Organic condensables plug a dry ESP. There are considerable safety factors due to high voltage and the potential generation of HAPs. Technically infeasible because ESPs have reduced collection efficiency for materials that have high electrical resistivity such as sodium chloride. ESP is not demonstrated for highly resistive particulate matter such as those produced by CM processes.	NA

STEP 3: The existing controls of exhausting through a wet scrubber have been determined to be BACT and there are no additional technically feasible options.

STEP 4: There are no other technically feasible options to evaluate, therefore BACT remains the use of a wet scrubber.

STEP 5: BACT is selected as the existing wet scrubber.

BACT OPTIONS TABLE 2.03 PM2.5 and Precursors STEPS 1-5

Item # 2.03 **SOP Process Heater B-1520 / AH-1555** **PM 2.5 and Precursor Control Possibilities**

Pollutant	Percent Control		GR/DSCF		Comment	Efficiency Rank
	Min	Max	Min	Max		
PM2.5	NA	NA	NA	NA	There are no demonstrated control options for PM2.5 for a heater of this small size (5 mmBtuh), other than pipeline quality natural gas fuel selection and good combustion practices.	NA
SOx, VOC, NH3	NA	NA	NA	NA	There are no demonstrated control options for these combustion products for a heater of this small size (5 mmBtuh), other than pipeline quality natural gas fuel selection and good combustion practices.	NA
NOx	NA	NA	NA	NA	There are no demonstrated control options for these combustion products for a heater of this small size (5 mmBtuh), other than low NOx design, pipeline quality natural gas fuel selection and good combustion practices.	NA
Overall Comment:	***CM uses natural gas fuel per permit condition II.B.1.c (BACT). Natural gas has little or no fuel bound nitrogen. New burners were selected based on low-NOx design. CM follows good combustion practices per permit condition II.B.1.d (BACT).***					NA

STEP 3: The existing controls of low NOx burners with good combustion practices and combusting pipeline quality natural gas have been determined to be BACT and there are no additional technically feasible options.

STEP 4: There are no other technically feasible options to evaluate, therefore BACT remains as the existing controls of low NOx burners with good combustion practices and combusting pipeline quality natural gas.

STEP 5: BACT is selected as the existing LNB, plus pipeline quality natural gas, plus good combustion practices.

BACT OPTIONS TABLE 2.04 PM2.5 STEPS 1-2

Item # 2.04 **SOP Bulk Load-out Circuit BH-001** **PM 2.5 Control Possibilities**

Control Option	Percent Control		GR/DSCF		Comment	Efficiency
	Min	Max	Min	Max		Rank
Baghouse/Fabric Filter/Cartridge Filter	90	99.99	0.0003	0.04	Gr/dscf outlet loading is assumed for filterables-only, since baghouses do not control condensables. ***Baghouse is the existing control for this source.***	1
Wet Scrubber	85	99.7	0.0025	0.096	Typically less efficient than Baghouse; may result in artifact (created) PM; controls filterable and condensable PM. Technically feasible if there is room at the site.	2
Cyclone	10	70	0.026	0.13	Not effective for PM2.5 unless coupled with Baghouse, ESP, or Scrubber; will not control condensables very effectively.	3
Wet ESP	99	99.9	0.01	0.021	There are considerable safety factors due to high voltage and the potential generation of HAPs. Technically infeasible because ESPs have reduced collection efficiency for materials that have high electrical resistivity such as sodium chloride. ESP is not demonstrated for highly resistive particulate matter such as those produced by CM processes.	NA
Dry ESP	96	99.2	NA	NA	There are considerable safety factors due to high voltage and the potential generation of HAPs. Technically infeasible because ESPs have reduced collection efficiency for materials that have high electrical resistivity such as sodium chloride. ESP is not demonstrated for highly resistive particulate matter such as those produced by CM processes.	NA

2.04 PM2.5 BACT Analysis for Technically Feasible Control Options

Information for Economic Analysis		Description
EU ID	BH-001	SOP Bulk Loadout Circuit
Existing Control	BH-001	Baghouse, 1.64 pounds per hour and 0.01 grains/dscf.
Interest Rate	0.07	Interest rate at which the company can borrow money. Enter 0.07, or 0.10, for example.
Useful Life	20	Estimated useful life of the new control equipment being considered.

POLLUTANTS TO BE CONTROLLED	PM2.5	SOx	NOx	VOC	NH3
Actual 2015 Tons Per Year	0.077				
Estimated Uncontrolled TPY	7.70				
Existing Control Efficiency	99%				
Existing Outlet Concentration (g/dscf)	N/A				

ECONOMIC ANALYSIS

Option	Demon-strated?	Technically Feasible Control Options	Total Capital Cost	Pollutant	New Control Efficiency	Difference	Additional Tons Controlled	Annualized Capital $	Annualized Operating $	BACT ($/ton)
1	Yes	Baghouse	$ 905,000	PM2.5	99.9%	0.9%	0.069300	$ 85,426	$ 81,479	$ 2,408,430
2	Yes	Wet scrubber Venturi	$ 569,000	PM2.5	99.9%	0.9%	0.069300	$ 53,710	$ 337,865	$ 5,650,421
3	Yes	Cartridge filter	$ 228,000	PM2.5	99.9%	0.9%	0.069300	$ 21,522	$ 92,342	$ 1,643,059

Notes: More refined cost estimates would be done during the engineering phase of a project.
Recovered material was accounted in the Annualized Operating Cost, if applicable.
See Attachment 7 for more detail on cost estimates for Options 1-3.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

Option 2 consumes fresh water and generates wastewater. Options 1 and 3 would likely have a neutral effect on solid waste generation.

STEP 4: There are no other technically feasible options to evaluate, therefore BACT remains the use of a baghouse.

STEP 5: BACT is selected as the existing baghouse.

Item # 2.05 **SOP Bulk Load-out Circuit BH-002** **PM 2.5 Control Possibilities**

Control Option	Percent Control		GR/DSCF		Comment	Efficiency Rank
	Min	Max	Min	Max		
Baghouse/Fabric Filter/Cartridge Filter	90	99.99	0.0003	0.04	Gr/dscf outlet loading is assumed for filterables-only, since baghouses do not control condensables. ***Baghouse is the existing control for this source.***	1
Wet Scrubber	85	99.7	0.0025	0.096	Typically less efficient than Baghouse; may result in artifact (created) PM; controls filterable and condensable PM. Technically feasible if there is room at the site.	2
Cyclone	10	70	0.026	0.13	Not effective for PM2.5 unless coupled with Baghouse, ESP, or Scrubber; will not control condensables very effectively.	3
Wet ESP	99	99.9	0.01	0.021	There are considerable safety factors due to high voltage and the potential generation of HAPs. Technically infeasible because ESPs have reduced collection efficiency for materials that have high electrical resistivity such as sodium chloride. ESP is not demonstrated for highly resistive particulate matter such as those produced by CM processes.	NA
Dry ESP	96	99.2	NA	NA	There are considerable safety factors due to high voltage and the potential generation of HAPs. Technically infeasible because ESPs have reduced collection efficiency for materials that have high electrical resistivity such as sodium chloride. ESP is not demonstrated for highly resistive particulate matter such as those produced by CM processes.	NA

BACT IMPACTS TABLE 2.05 PM2.5 STEPS 3-5 BH-002

2.05 PM2.5 BACT Analysis for Technically Feasible Control Options

Information for Economic Analysis		Description
EU ID	BH-002	SOP Silo Storage Circuit
Existing Control	BH-002	Baghouse, 1.37 pounds per hour and 0.01 grains/dscf.
Interest Rate	0.07	Interest rate at which the company can borrow money. Enter 0.07, or 0.10, for example.
Useful Life	20	Estimated useful life of the new control equipment being considered.

STEP 3:

POLLUTANTS TO BE CONTROLLED	PM2.5	SOx	NOx	VOC	NH3
Potential Emissions	0.447				
Estimated Uncontrolled TPY	8.94				
Existing Control Efficiency	95%				
Existing Outlet Concentration (g/dscf)	N/A				

ECONOMIC ANALYSIS

Option	Demon-strated?	Technically Feasible Control Options	Total Capital Cost	Pollutant	New Control Efficiency	Difference	Additional Tons Controlled	Annualized Capital $	Annualized Operating $	BACT ($/ton)
1	Yes	Baghouse	$ 777,000	PM2.5	99%	4.0%	0.358	$ 73,343	$ 81,479	$ 432,947
2	Yes	Wet scrubber Venturi	$ 512,000	PM2.5	99%	4.0%	0.358	$ 48,329	$ 337,865	$ 1,079,960
3	Yes	Cartridge filter	$ 200,000	PM2.5	99%	4.0%	0.358	$ 18,879	$ 92,342	$ 311,021

Notes:
More refined cost estimates would be done during the engineering phase of a project
A baghouse may be technically infeasible in this area due to moisture content of the material being handled. Moisture would be added by binder.
Recovered material was accounted in the Annualized Operating Cost, if applicable.
See Attachment 7 for more detail on cost estimates for Options 1-3.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

Option 2 will consume fresh water and generate wastewater. Options 1 and 3 will likely have a neutral effect on solid waste generation.

STEP 4: There are no other technically feasible options to evaluate, therefore BACT remains the use of a baghouse.

STEP 5: BACT is selected as the existing baghouse.

BACT OPTIONS TABLE 2.06 PM2.5 STEPS 1-5

Item # 2.06 **SOP Compaction Recycle Hopper Bin Vent Filter** **PM 2.5 Control Possibilities**

Control Option	Percent Control		GR/DSCF		Comment	Efficiency Rank
	Min	Max	Min	Max		
Baghouse/Fabric Filter/Cartridge Filter	90	99.99	0.0003	0.04	Gr/dscf outlet loading is assumed for filterables-only, since baghouses do not control condensables. ***Emissions vented from bin 1565 are currently controlled by an integrated fabric filter.***	1
Wet Scrubber	85	99.7	0.0025	0.096	Typically less efficient than Baghouse; may result in artifact (created) PM; controls filterable and condensable PM. Technically feasible if there is room at the site.	2
Cyclone	10	70	0.026	0.13	Not effective for PM2.5 unless coupled with Baghouse, ESP, or Scrubber; will not control condensables very effectively.	3
Wet ESP	99	99.9	0.01	0.021	There are considerable safety factors due to high voltage and the potential generation of HAPs. Technically infeasible because ESPs have reduced collection efficiency for materials that have high electrical resistivity such as sodium chloride. ESP is not demonstrated for highly resistive particulate matter such as those produced by CM processes.	NA
Dry ESP	96	99.2	NA	NA	Dry ESPs are not recommended for removing sticky or moist particles. Dryer exhaust generally has 20%+ moisture and this dryer has binder as well.. Organic condensables plug a dry ESP. There are considerable safety factors due to high voltage and the potential generation of HAPs. Technically infeasible because ESPs have reduced collection efficiency for materials that have high electrical resistivity such as sodium chloride. ESP is not demonstrated for highly resistive particulate matter such as those produced by CM processes.	NA

STEP 3: The existing controls of exhausting through a a fabric filter have been determined to be BACT and there are no additional technically feasible options.

STEP 4: There are no other technically feasible options to evaluate, therefore BACT remains the use of a fabric filter.

STEP 5: BACT is selected as the existing bin vent fabric filter.

BACT OPTIONS TABLE 2.07 PM2.5 STEPS 1-5

Item # 2.07 **SOP Dryer D-1400 / BH-1400** **PM 2.5 Control Possibilities**

Control Option	Percent Control		GR/DSCF		Comment	Efficiency Rank
	Min	Max	Min	Max		
Baghouse/Fabric Filter/Cartridge Filter	90	99.99	0.0003	0.04	***This unit currently has a new cyclone/baghouse system that started up in 2016.*** Gr/dscf outlet loading is assumed for filterables-only, since baghouses do not control condensables.	1
Wet Scrubber	85	99.7	0.0025	0.096	Typically less efficient than Baghouse; may result in artifact (created) PM; controls filterable and condensable PM. Technically feasible if there is room at the site. Does not allow for the recovery of high-value product captured.	2
Cyclone	10	70	0.026	0.13	This unit currently has a new cyclone/baghouse system that started up in 2016. Cyclones are not effective for PM2.5 unless coupled with Baghouse, ESP, or Scrubber.	3
Baghouse/Fabric Filter	90	99.99	0.0003	0.04	Gr/dscf outlet loading is assumed for filterables-only, since baghouses do not control condensables. Not technically feasible due to steam and binder in the air stream.	NA
Wet ESP	99	99.9	0.01	0.021	There are considerable safety factors due to high voltage and the potential generation of HAPs. Technically infeasible because ESPs have reduced collection efficiency for materials that have high electrical resistivity such as sodium chloride. ESP is not demonstrated for highly resistive particulate matter such as those produced by CM processes.	NA
Dry ESP	96	99.2	NA	NA	Dry ESPs are not recommended for removing sticky or moist particles. Dryer exhaust generally has 20%+ moisture and this dryer has binder as well.. Organic condensables plug a dry ESP. There are considerable safety factors due to high voltage and the potential generation of HAPs. Technically infeasible because ESPs have reduced collection efficiency for materials that have high electrical resistivity such as sodium chloride. ESP is not demonstrated for highly resistive particulate matter such as those produced by CM processes.	NA

STEP 3: The existing baghouse control has been determined to be BACT. Wet scrubbers, although effective at capturing fine particulate, produce a water discharge that requires permitting under the National Pollution Discharge Elimination System. Also, wet scrubbers have lower removal efficiencies than fabric filters.

STEP 4: There are no other technically feasible options to evaluate, therefore BACT remains the use of a baghouse.

STEP 5: BACT is selected as the existing cyclone/baghouse system.

Item # 2.07 **SOP Dryer D-1400 / BH-1400** **SOx Control Possibilities**

Control Option	Percent Control Min	Percent Control Max	LB/MMBTU Min	LB/MMBTU Max	Comment	Efficiency Rank
Pipeline Quality Natural Gas Fuel (low sulfur fuel)	NA	NA	0.0009	0.0065	Natural gas sold to consumers has the lowest sulfur content of any of the fossil fuels, and constitutes BACT for SOx. ***CM uses only pipeline quality natural gas fuel in external combustion units, per permit condition II.B.1.c (BACT).***	1
Wet flue gas desulfurization	90%	95%	0.065	0.107	Similar to wet scrubber. In RBLC, demonstrated applications were for solid fuel (coal, corn fiber).	NA
Good Combustion Practices	NA	NA	NA	NA	**CM follows good combustion practices per permit condition II.B.1.d (BACT).**	2
Limestone Injection (CFB)	NA	NA	0.06	0.2	Used for solid fuel only. In RBLC, applications were for solid fuel (coal, pet coke, lignite, biomass). Not demonstrated for natural gas-only combustion.	NA
Dry Sorbent Injection	NA	NA	NA	0.06	Creates particulate sulfate from the SO2. My require a baghouse on exhaust. In RBLC, applications were for solid fuel (coal, pet coke, biomass). Not demonstrated for natural gas-only combustion.	NA

BACT IMPACTS TABLE 2.07 SOx STEPS 3-5 D-1400

2.07 SOx BACT Analysis for Technically Feasible Control Options

Information for Economic Analysis		Description
EU ID	D-1400	SOP Dryer 1400 (51.0 mmBtuh)
Existing Control	None	N/A
Interest Rate	0.07	Interest rate at which the company can borrow money. Enter 0.07, or 0.10, for example.
Useful Life	20	Estimated useful life of the new control equipment being considered.

STEP 3:

POLLUTANTS TO BE CONTROLLED	PM2.5	SOx	NOx	VOC	NH3
Potential Emissions	11.607	0.329			
Estimated Uncontrolled TPY	11.607	0.329			
Existing Control Efficiency	0%	0%			
Existing Outlet Concentration (g/dscf)	N/A	N/A			

ECONOMIC ANALYSIS

Option	Demon-strated?	Technically Feasible Control Options	Total Capital Cost	Pollutant	New Control Efficiency	Difference	Additional Tons Controlled	Annualized Capital $	Annualized Operating $	BACT ($/ton)
1	Yes	Wet flue gas desulfurization	$ 966,000	PM2.5 + SOx	95.0%	95.0%	11.339	$ 91,184	$ 248,800	$ 29,983

Notes: More refined cost estimates would be done during the engineering phase of a project.
Control of both SOx and PM2.5 (post existing baghouse) are considered as part of this analysis as control of both pollutants would be achieved.
The cost per ton indicated above is greatly influenced by the addition of a second PM2.5 control technology downstream of the existing baghouse considered as BACT for D-1400. It is not CM's intent to install concurrent control technologies as BACT.
Recovered material was accounted in the Annualized Operating Cost, if applicable.
See Attachment 7 for more detail on cost estimates for Options 1.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

The production area where a wet scrubber would be installed downstream of D-1400 has limited space and lies within a congested processing area. Installation of additional equipment will require complicated engineering, design, and installation of structures to accomodate the addition. While technically feasible, the costs of such installation are being estimated at this time and are expected by CM to increase upon further evaluation.

STEP 4: All of the technically feasible control options ranked above or near current controls were evaluated, and found to be economically infeasible.

STEP 5: The continued use of pipeline quality natural gas and good combustion practices are considered BACT for this source.

Item # 2.07 **SOP Dryer D-1400 / BH-1400** **NOx Control Possibilities**

Control Option	Percent Control		LB/MMBTU		Comment	Efficiency Rank
	Min	Max	Min	Max		
Ultra Low NOx Burners (ULNB)	NA	NA	0.0125	0.072	There is no widely accepted definition for Ultra Low NOx Burners (ULNB). For this BACT analysis it is assumed ≤ 20 ppm @ 3% O2 is ULNB. FGR and/or staged combustion principles are usually included in ULNB. ***Existing control for this source is ULNB with FGR and staged combustion principles, plus pipeline quality natural gas.***	1
Selective Catalytic Reduction (SCR)	70	90	0.02	0.1	Catalyst and ammonia required. Ammonia emissions in range of 10-20 ppm. Effective in streams >20 ppm NOx. Rarely demonstrated for natural gas-only combustion units.	2
Low NOx Burners (LNB)	50	55	0.035	0.35	Low NOx burners often use FGR and/or staged combustion principles.	3
Natural Gas Fuel	NA	NA	NA	NA	***CM uses natural gas fuel per permit condition II.B.1.c (BACT). Natural gas has little or no fuel bound nitrogen.***	4
Good Combustion Practices	NA	NA	NA	NA	***CM follows good combustion practices per permit condition II.B.1.d (BACT).***	5
FGR (Flue Gas Recirculation)	NA	NA	NA	NA	FGR is a pollution prevention technique used to achieve low ppm in LNB and ULNB by limiting excess oxygen. **See the ULNB and LNB categories.**	6
Staged Combustion/Over Fire Air and Air/Fuel Ratio	NA	NA	0.08	0.22	Staged combustion/over fire air are pollution prevention techniques that allow for the reduction of thermal NOx formation by modifying the primary combustion zone stoichiometry or air/fuel ratio. Staged combustion can mean staged air or staged fuel. It often helps achieve low ppm in LNB and ULNB by keeping the temperature lower. **See the ULNB and LNB categories.**	7
Selective Noncatalytic Reduction (SNCR)	60	70	0.07	0.25	Requires ammonia or urea injection as a reducing agent. SNCR tends to be less effective at low NOx concentrations. Typical NOx inlet loadings vary from 200 to 400 ppm. (Ref. EPA SNCR Fact Sheet) Rarely demonstrated for natural gas-only combustion units.	NA
Steam/Water Injection	NA	NA	NA	NA	Steam/Water Injection reduces thermal NOx formation by lowering temperature. Not demonstrated for natural gas-only combustion.	NA
NSCR (Nonselective catalytic reduction)	NA	NA	NA	NA	NSCR (Nonselective catalytic reduction) controls are not shown in RBLC for chemical, wood, minerals, or agricultural industries. This technology is typically used for mobile sources. Not demonstrated for natural gas-only combustion.	NA

STEP 3: The existing controls of ULNB (< 20 ppm @ 3% O2, based on vendor data and adjusting for local ambient conditions) with FGR and staged combustion practices, combusting pipeline quality natural gas have been determined to be BACT and there are no additional technically feasible options.

STEP 4: There are no other technically feasible options to evaluate, therefore BACT remains the use of ULNB, FGR, natural gas and combustion practices.

STEP 5: BACT is selected as the existing ULNB with FGR and staged combustion principles, plus pipeline quality natural gas, plus good combustion practices. See Section 4 of this report for proposed limits.

BACT OPTIONS TABLE 2.07 VOC STEPS 1-5

Item # 2.07 **SOP Dryer D-1400 / BH-1400** **VOC Control Possibilities**

Control Option	Percent Control		LB/MMBTU		Comment	Efficiency Rank
	Min	Max	Min	Max		
Pipeline Quality Natural Gas Fuel	NA	NA	0.004	0.0054	***CM uses pipeline quality natural gas fuel for its dryers, boilers, and process heaters, per permit condition II.B.1.c (BACT).***	1
Good Combustion Practices	NA	NA	0.0054	0.01	***CM follows good combustion practices per permit condition II.B.1.d (BACT).***	2
Oxidation catalyst	95	99	NA	NA	Controls VOC and CO. Oxidation catalyst is most effective in high excess oxygen sources such as turbines (12-15% excess oxygen) compared to external natural gas combustion (2-6% excess oxygen). It requires high temperature (600-800 °F) and particulate often must first be removed. Only two determinations were found in RBLC for a natural gas-only boiler, specified for CO control. Most oxidation catalyst determinations in RBLC were for engines, turbines, or solid/liquid/mixed fuels. Technically infeasible because particulate often must first be removed. By the time the particulate has been removed, the air stream is too cool.	NA
Thermal Oxidizers (TO, RTO)	NA	NA	NA	NA	Controls CO, VOC, and PM. Not demonstrated for natural gas-only combustion.	NA

STEP 3: The existing controls of combusting pipeline quality natural gas and good combustion practices have been determined to be BACT and there are no additional technically feasible options.

STEP 4: There are no other technically feasible options to evaluate, therefore BACT remains the use of natural gas and combustion practices.

STEP 5: BACT is selected as pipeline quality natural gas fuel and good combustion practices.

BACT OPTIONS TABLE 2.07 NH3 STEPS 1-5

Item # 2.07 **SOP Dryer D-1400 / BH-1400** **Ammonia Control Possibilities**

Control Option	Percent Control		LB/MMBTU		Comment	Efficiency Rank
	Min	Max	Min	Max		
Limit on ammonia slip in SCR controlled process heater.	NA	NA	NA	NA	Ammonia is only included in RBLC as a pollutant to be controlled if the unit is controlled for NOx with SCR or SNCR. These controls are normally used for engines, turbines, and external combustion sources fired on liquid, solid, or mixed fuels or fuel gas. In this case, ammonia slip may be controlled to prevent ammonia emissions. Ammonia controls are not demonstrated in RBLC for natural gas-only boilers or dryers, boilers or process heaters.	NA

STEP 3: No impacts analysis per Step 3 is needed, because there are no technically feasible options.

STEP 4: There are no other technically feasible options to evaluate for natural gas-only combustion units.

STEP 5: BACT is selected as pipeline quality natural gas fuel and good combustion practices.

BACT OPTIONS TABLE 2.08 VOC STEPS 1-5

Item # 2.08 **SOP Defoamer** **VOC Control Possibilities**

Control Option	Percent Control		Comment	Efficiency Rank
	Min	Max		
Defoaming agent selection	TBD	100%	Defoaming agents are available which do not contain VOCs. However, affects of the use of such chemicals in the SOP process has not yet been determined and will require processing testing prior to implementing.	1
VOC capture and control	NA	NA	VOCs are emitted at various points of the SOP process as fugitive emissions and through process vents. A majority of emissions occur at ambient conditions in the plant thickeners. The thickener consists of an open top tank where material is continuously added. It is technically infeasible to capture fugitive VOC emissions from the open tops of the thickener vessels and direct emissions to a control device.	N/A

STEP 3: CM needs more time to complete Steps 3-5. Currently CM is not aware of a suitable defoamer replacement, but will evaluate this further.

STEP 4: The economic feasibility and impacts associated with a change in defoamer utilized in the SOP floatation plant cannot be assessed at this time.

STEP 5: CM intends on conducting preliminary testing of alternative defoamer chemicals and will provide additional information to the UDAQ regarding those results no later than December 31, 2018.

Item # 2.09 **Submerged Combustion SUB** **PM 2.5 Control Possibilities**

Control Option	Percent Control		GR/DSCF		Comment	Efficiency Rank
	Min	Max	Min	Max		
Natural Gas Combustion	NA	NA	NA	NA	***CM uses only natural gas in SUB per permit condition II.B.1.c (BACT).***	NA
Good Combustion Practices	NA	NA	NA	NA	***CM follows good combustion practices per permit condition II.B.1.d (BACT).***	NA
Add on Control Devices	NA	NA	NA	NA	Natural gas and good combustion practices constitute BACT. RBLC did not show any add on control devices for particulate matter for natural gas-only combustion.	NA

STEP 3: The existing controls of low NOx burners with good combustion practices and combusting pipeline quality natural gas have been determined to be BACT and there are no additional technically feasible options.

STEP 4: There are no other technically feasible options to evaluate, therefore BACT remains as the existing controls of low NOx burners with good combustion practices and combusting pipeline quality natural gas.

STEP 5: BACT is selected as the existing LNB, plus pipeline quality natural gas, plus good combustion practices.

BACT OPTIONS TABLE 2.09 NOx STEPS 1-5

Item # 2.09 **Submerged Combustion SUB** **NOx Control Possibilities**

Control Option	Percent Control Min	Percent Control Max	LB/MMBTU Min	LB/MMBTU Max	Comment	Efficiency Rank
Low NOx Burners (LNB)	50	55	0.035	0.35	Low NOx burners often use FGR or staged combustion or air/fuel ratio principles. ***For the submerged combustion unit, the technology employed is well controlled fuel/air ratio with high excess oxygen and thorough air/fuel mixing.*** This keeps the flame temperature low and prevents thermal NOx formation.	1
Natural Gas Fuel	NA	NA	NA	NA	***CM uses natural gas fuel per permit condition II.B.1.c (BACT). Natural gas has little or no fuel bound nitrogen.***	2
Good Combustion Practices	NA	NA	NA	NA	***CM follows good combustion practices per permit condition II.B.1.d (BACT).***	3
Staged Combustion/Over Fire Air and Air/Fuel Ratio	NA	NA	0.08	0.22	Staged combustion/over fire air are pollution prevention techniques that allow for the reduction of thermal NOx formation by modifying the primary combustion zone stoichiometry or air/fuel ratio. Staged combustion can mean staged air or staged fuel. It often helps achieve low ppm in LNB and ULNB by keeping the temperature lower. ***This unit employs air/fuel ratio management and vigorous mixing to minimize NOx.***	4
Ultra Low NOx Burners (ULNB)	NA	NA	0.0125	0.072	There is no widely accepted definition for Ultra Low NOx Burners (ULNB). For this BACT analysis it is assumed ≤ 20 ppm @ 3% O2 is ULNB. FGR and/or staged combustion principles are usually included in ULNB. For this unit, ULNB is technically infeasible due to space limitations.	NA
Selective Catalytic Reduction (SCR)	70	90	0.02	0.1	Catalyst and ammonia required. Ammonia emissions in range of 10-20 ppm. Effective in streams >20 ppm NOx. Rarely demonstrated for natural gas-only combustion units. For this unit, SCR is technically infeasible due to space limitations.	NA
FGR (Flue Gas Recirculation)	NA	NA	NA	NA	FGR is a pollution prevention technique used to achieve low ppm in LNB and ULNB by limiting excess oxygen. For this unit, FGR is technically infeasible due to space limitations.	NA
Selective Noncatalytic Reduction (SNCR)	60	70	0.07	0.25	Requires ammonia or urea injection as a reducing agent. SNCR tends to be less effective at low NOx concentrations. Typical NOx inlet loadings vary from 200 to 400 ppm. (Ref. EPA SNCR Fact Sheet) Rarely demonstrated for natural gas-only combustion units. For this unit, SNCR is technically infeasible due to space limitations.	NA
Steam/Water Injection	NA	NA	NA	NA	Steam/Water Injection reduces thermal NOx formation by lowering temperature. Not demonstrated for natural gas-only combustion.	NA
NSCR (Nonselective catalytic reduction)	NA	NA	NA	NA	NSCR (Nonselective catalytic reduction) controls are not shown in RBLC for chemical, wood, minerals, or agricultural industries. This technology is typically used for mobile sources. Not demonstrated for natural gas-only combustion.	NA

STEP 3: The existing controls of low NOx burners with air/fuel ratio management and vigorous mixing to minimize Nox and combusting pipeline quality natural gas have been determined to be BACT and there are no additional technically feasible options.

STEP 4: There are no other technically feasible options to evaluate, and this unit already has BACT. Additionally this unit is 95% efficient compared to typical boilers which achieve 80-85% efficiency. Therefore, this unit produces more useable heat with less fuel than typical boilers.

STEP 5: BACT is selected as the existing LNB with air/fuel mixing principles, plus pipeline quality natural gas, plus good combustion practices.

BACT OPTIONS TABLE 2.09 SOx STEPS 1-5

Item # 2.09 **Submerged Combustion SUB** **SOx Control Possibilities**

Control Option	Percent Control Min	Percent Control Max	LB/MMBTU Min	LB/MMBTU Max	Comment	Efficiency Rank
Pipeline Quality Natural Gas Fuel (low sulfur fuel)	NA	NA	0.0009	0.0065	Natural gas sold to consumers has the lowest sulfur content of any of the fossil fuels, and constitutes BACT for SOx. ***CM uses only pipeline quality natural gas fuel in external combustion units, per permit condition II.B.1.c (BACT).***	1
Good Combustion Practices	NA	NA	NA	NA	***CM follows good combustion practices per permit condition II.B.1.d (BACT).***	2
Limestone Injection (CFB)	NA	NA	0.06	0.2	Used for solid fuel only. In RBLC, applications were for solid fuel (coal, pet coke, lignite, biomass). Not demonstrated for natural gas-only combustion.	NA
Dry Sorbent Injection	NA	NA	NA	0.06	Creates particulate sulfate from the SO2. My require a baghouse on exhaust. In RBLC, applications were for solid fuel (coal, pet coke, biomass). Not demonstrated for natural gas-only combustion.	NA
Wet flue gas desulfurization	NA	NA	0.065	0.107	Similar to wet scrubber. In RBLC, demonstrated applications were for solid fuel (coal, corn fiber). For this unit, wet flue gas desulfurization is technically infeasible due to space limitations.	NA

STEP 3: The existing controls of combusting pipeline quality natural gas and good combustion practices have been determined to be BACT and there are no additional technically feasible options.

STEP 4: There are no other technically feasible options to evaluate, therefore BACT remains the use of natural gas and combustion practices.

STEP 5: BACT is selected as pipeline quality natural gas fuel and good combustion practices.

BACT OPTIONS TABLE 2.09 VOC STEPS 1-5

Item # 2.09 **Submerged Combustion SUB** **VOC Control Possibilities**

Control Option	Percent Control Min	Percent Control Max	LB/MMBTU Min	LB/MMBTU Max	Comment	Efficiency Rank
Pipeline Quality Natural Gas Fuel	NA	NA	0.004	0.0054	***CM uses pipeline quality natural gas fuel for its dryers, boilers, and process heaters, per permit condition II.B.1.c (BACT).***	1
Good Combustion Practices	NA	NA	0.0054	0.01	***CM follows good combustion practices per permit condition II.B.1.d (BACT).***	2
Oxidation catalyst	95	99	NA	NA	Controls VOC and CO. Oxidation catalyst is most effective in high excess oxygen sources such as turbines (12-15% excess oxygen) compared to external natural gas combustion (2-6% excess oxygen). It requires high temperature (600-800 °F) and particulate often must first be removed. Only two determinations were found in RBLC for a natural gas-only boiler, specified for CO control. Most oxidation catalyst determinations in RBLC were for engines, turbines, or solid/liquid/mixed fuels. Technically infeasible because particulate often must first be removed. By the time the particulate has been removed, the air stream is too cool.	NA
Thermal Oxidizers (TO, RTO)	NA	NA	NA	NA	Controls CO, VOC, and PM. Not demonstrated for natural gas-only combustion.	NA

STEP 3: The existing controls of combusting pipeline quality natural gas and good combustion practices have been determined to be BACT and there are no additional technically feasible options.

STEP 4: There are no other technically feasible options to evaluate, therefore BACT remains the use of natural gas and combustion practices.

STEP 5: BACT is selected as pipeline quality natural gas fuel and good combustion practices.

BACT OPTIONS TABLE 2.09 NH3 STEPS 1-5

Item # 2.09 **Submerged Combustion SUB** **Ammonia Control Possibilities**

Control Option	Percent Control		LB/MMBTU		Comment	Efficiency Rank
	Min	Max	Min	Max		
Limit on ammonia slip in SCR controlled process heater.	NA	NA	NA	NA	Ammonia is only included in RBLC as a pollutant to be controlled if the unit is controlled for NOx with SCR or SNCR. These controls are normally used for engines, turbines, and external combustion sources fired on liquid, solid, or mixed fuels or fuel gas. In this case, ammonia slip may be controlled to prevent ammonia emissions. Ammonia controls are not demonstrated in RBLC for natural gas-only boilers or dryers, boilers or process heaters.	NA

STEP 3: No impacts analysis per Step 3 is needed, because there are no technically feasible options.

STEP 4: There are no other technically feasible options to evaluate for natural gas-only combustion units.

STEP 5: BACT is selected as pipeline quality natural gas fuel and good combustion practices.

BACT OPTIONS TABLE 2.10 PM2.5

STEPS 1-2

Item # 2.10 **SOP Cooling Towers** **PM 2.5 Control Possibilities**

Control Option	Percent Control		Drift		Comment	Efficiency
	Min	Max	Min Control	Max Control		Rank
Drift Eliminators	99.9	99.995	0.02% Drift	0.0005 % Drift	Drift eliminators are typically considered high efficiency if they have lower drift percent.	1
Limiting Total Dissolved Solids (TDS)	NA	NA	1,000 ppm TDS	6000 ppm TDS	Limiting TDS (by using more fresh makeup water or other means) can help reduce PM formation.	2

BACT IMPACTS TABLE 2.10 PM2.5 STEPS 3-5 SOP CT

2.10 PM2.5 BACT Analysis for Technically Feasible Control Options

Information for Economic Analysis		Description
EU ID	SOP CT	SOP Cooling Tower
Existing Control	DE	Drift Eliminators
Interest Rate	0.07	Interest rate at which the company can borrow money. Enter 0.07, or 0.10, for example.
Useful Life	20	Estimated useful life of the new control equipment being considered.

STEP 3:

POLLUTANTS TO BE CONTROLLED	PM2.5	SOx	NOx	VOC	NH3
Actual 2015 Tons Per Year	0.254				
Estimated Uncontrolled TPY	0.508				
Existing Control Efficiency	50%				
Existing Drift percent	0.2				

ECONOMIC ANALYSIS

Option	Demon-strated?	Technically Feasible Control Options	Total Capital Cost	Pollutant	New Control Efficiency	Diff-erence	Additional Tons Controlled	Annualized Capital $	Annualized Operating $	BACT ($/ton)
1	Yes	HE Drift Eliminator and TDS Limit of 4,000 ppm	$ 143,820	PM2.5	99%	49.0%	0.25	$ 13,576	$ -	$ 54,538

Notes: More refined cost estimates would be done during the engineering phase of a project
See Attachment 7 for more detail on cost estimate.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

The drift eliminator will conserve fresh water, but this will be more than offset by the extra fresh water to maintain a lower TDS.

STEP 4: All of the technically feasible control options were evaluated, and found to be economically infeasible.

STEP 5: Compass believes the estimated costs are exceptionally high in comparison to costs being borne by other sources of the same type to control the pollutant, indicating that the use of the above listed control options are not economically feasible. BACT is selected as the existing mist eliminator and TDS level.

Items # 2.11 **SOP Fugitive Emissions SOP FOUMH, SOP FBMH, SOP FPILES**

Control Option	Percent Control Min	Percent Control Max	GR/DSCF Min	GR/DSCF Max	Comment	Efficiency Rank
Control Devices	10	99.99	0.0003	0.13	RBLC included: fabric filter, baghouse, cartridge filter, cyclone, scrubber.	NA
Conveyance: Pneumatic	10	99.99	0.0003	0.13	Must be coupled with a cyclone, baghouse, and or scrubber type of control.	NA
Conveyors: Enclosed	NA	NA	NA	NA	Enclosed conveyors can be fully or partially enclosed to prevent wind erosion and spillage.	NA
Drop Height Reduction	NA	NA	NA	NA	Drop height reduction can include enclosures or not.	NA
Enclosure	NA	NA	NA	NA	A building, silo, shroud, etc. around transfer points, drop points, load/unload areas, conveyors, etc.	NA
Fugitive Dust Control Plan	NA	NA	NA	NA	Developing, Implementing, and Maintaining a Fugitive Dust Control Plan (FDCP) is a recognized control technology in EPA's RBLC. It is also a requirement of Utah Rule 307-309	NA
Inherent Moisture Content	NA	NA	NA	NA	Some materials have inherent moisture content, which helps to minimize emissions.	NA
Stabilization: Chemical	NA	NA	NA	NA	Chemicals dust suppressants include salts, lignin sulfonate, wetting agents, latexes, plastics, and petroleum derivatives.	NA
Stabilization: Physical	NA	NA	NA	NA	Water spraying, paving, sweeping, tarping piles, etc.	NA
Stabilization: Vegetative Cover	NA	NA	NA	NA	Vegetative cover can be used to stabilize soil, but is technically infeasible for salt piles, and is not an option for Compass Minerals.	NA
Telescopic Chutes	NA	NA	NA	NA	Telescopic chutes are used for rapid and efficient loading of dry bulk solids to ships, tankers, railcars, and open trucks, while minimizing dust emissions.	NA
Wind Screens	NA	NA	NA	NA	Wind screens are porous wind fences, that help prevent fugitive emissions, and can be moved depending on wind conditions and work planning.	NA
Work Practices / Housekeeping	NA	NA	NA	NA	Work practices (or best operating practices) include several strategies, such as avoiding dusty work on windy days, keeping dusty materials vacuumed up, etc.	NA

BACT IMPACTS TABLE 2.11 PM2.5 STEPS 3-5 SOP FOUMH

2.11 a PM2.5 BACT Analysis for Technically Feasible Control Options

Information for Economic Analysis		Description
EU ID	SOP FOUMH	SOP outdoor uncaptured material handling Emissions Group 1
Existing Control	None	N/A
Interest Rate	0.07	Interest rate at which the company can borrow money. Enter 0.07, or 0.10, for example.
Useful Life	20	Estimated useful life of the new control equipment being considered.

STEP 3:

POLLUTANTS TO BE CONTROLLED	PM2.5	SOx	NOx	VOC	NH3
Potential Emissions	6.410				
Estimated Uncontrolled TPY	0.00				
Existing Control Efficiency	N/A				
Existing Outlet Concentration (g/dscf)	N/A				

ECONOMIC ANALYSIS

Option	Demon-strated?	Technically Feasible Control Options	Total Capital Cost	Pollutant	New Control Efficiency	Difference	Additional Tons Controlled	Annualized Capital $	Annualized Operating $	BACT ($/ton)
1	Yes	Baghouse	$ 583,000	PM2.5	99%	99.0%	6.35	$ 55,031	$ 81,479	$ 21,511
2	Yes	Wet scrubber Venturi	$ 431,000	PM2.5	99%	99.0%	6.35	$ 40,683	$ 337,865	$ 59,652
3	Yes	Cartridge filter	$ 206,000	PM2.5	99%	99.0%	6.35	$ 19,445	$ 92,342	$ 17,616

Notes: More refined cost estimates would be done during the engineering phase of a project.
Recovered material was accounted in the Annualized Operating Cost, if applicable.
See Attachment 7 for more detail on cost estimates for Options.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

Option 2 will consume fresh water and generate wastewater. Options 1 and 3 will likely have a neutral effect on solid waste generation.

STEP 4: All of the technically feasible control options ranked above or near current controls were evaluated, and found to be economically infeasible.

STEP 5: Due to the location of this operating equipment in relation to existing control equipment, routing emissions from these sources would result in excessive frictional losses, therefore, new APCE must be considered. Compass believes the estimated costs are exceptionally high in comparison to costs being borne by other sources of the same type to control the pollutant, indicating that the use of the above listed control options are not economically feasible.

BACT IMPACTS TABLE 2.11 PM2.5 STEPS 3-5 SOP FOUMH

2.11 b PM2.5 BACT Analysis for Technically Feasible Control Options

Information for Economic Analysis		Description
EU ID	SOP FOUMH	SOP outdoor uncaptured material handling Emissions Group 2
Existing Control	None	N/A
Interest Rate	0.07	Interest rate at which the company can borrow money. Enter 0.07, or 0.10, for example.
Useful Life	20	Estimated useful life of the new control equipment being considered.

STEP 3:

POLLUTANTS TO BE CONTROLLED	PM2.5	SOx	NOx	VOC	NH3
Potential Emissions	1.02				
Estimated Uncontrolled TPY	0%				
Existing Control Efficiency	N/A				
Existing Outlet Concentration (g/dscf)	N/A				

ECONOMIC ANALYSIS

Option	Demon-strated?	Technically Feasible Control Options	Total Capital Cost	Pollutant	New Control Efficiency	Difference	Additional Tons Controlled	Annualized Capital $	Annualized Operating $	BACT ($/ton)
1	Yes	Baghouse	$ 893,000	PM2.5	99%	99%	1.01	$ 56,541	$ 81,479	$ 136,147
2	Yes	Wet scrubber Venturi	$ 643,000	PM2.5	99%	99%	1.01	$ 58,052	$ 337,865	$ 390,542
3	Yes	Cartridge filter	$ 442,000	PM2.5	99%	99%	1.01	$ 17,274	$ 92,342	$ 108,128

Notes: More refined cost estimates would be done during the engineering phase of a project.
Recovered material was accounted in the Annualized Operating Cost, if applicable.
See Attachment 7 for more detail on cost estimates for Options.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

Option 2 will consume fresh water and generate wastewater. Options 1 and 3 will likely have a neutral effect on solid waste generation.

STEP 4: All of the technically feasible control options ranked above or near current controls were evaluated, and found to be economically infeasible.

STEP 5: Due to the location of this operating equipment in relation to existing control equipment, routing emissions from these sources would result in excessive frictional losses, therefore, new APCE must be considered. Compass believes the estimated costs are exceptionally high in comparison to costs being borne by other sources of the same type to control the pollutant, indicating that the use of the above listed control options are not economically feasible.

BACT IMPACTS TABLE 2.11 PM2.5 STEPS 3-5 SOP FOUMH

2.11 d PM2.5 BACT Analysis for Technically Feasible Control Options

Information for Economic Analysis		Description
EU ID	SOP FOUMH	SOP outdoor uncaptured material handling Emissions Group 4
Existing Control	None	N/A
Interest Rate	0.07	Interest rate at which the company can borrow money. Enter 0.07, or 0.10, for example.
Useful Life	20	Estimated useful life of the new control equipment being considered.

POLLUTANTS TO BE CONTROLLED	PM2.5	SOx	NOx	VOC	NH3
Estimated Uncontrolled PTE (TPY)	1.80				
Existing Control Efficiency	0%				
Existing Outlet Concentration (g/dscf)	N/A				

ECONOMIC ANALYSIS

Option	Demon-strated?	Technically Feasible Control Options	Total Capital Cost	Pollutant	New Control Efficiency	Difference	Additional Tons Controlled	Annualized Capital $	Annualized Operating $	BACT ($/ton)
1	Yes	Baghouse	$ 961,000	PM2.5	99%	99%	1.78	$ 90,712	$ 81,479	$ 96,789
2	Yes	Wet scrubber Venturi	$ 669,000	PM2.5	99%	99%	1.78	$ 63,149	$ 337,865	$ 225,411
3	Yes	Cartridge filter	$ 555,000	PM2.5	99%	99%	1.78	$ 52,388	$ 92,342	$ 81,354
4	Yes	Full Enclosure	$ 297,000	PM2.5	75%	75%	1.35	$ 28,035	$ -	$ 20,801

Notes: More refined cost estimates would be done during the engineering phase of a project.
Recovered material was accounted in the Annualized Operating Cost, if applicable.
See Attachment 7 for more detail on cost estimates for Options.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

Option 2 will consume fresh water and generate wastewater. Options 1 and 3 will likely have a neutral effect on solid waste generation.

STEP 4: All of the technically feasible control options ranked above or near current controls were evaluated, and found to be economically infeasible.

STEP 5: Due to the location of this operating equipment in relation to existing control equipment, routing emissions from these sources would result in excessive frictional losses, therefore, new APCE must be considered. Compass believes the estimated costs are exceptionally high in comparison to costs being borne by other sources of the same type to control the pollutant, indicating that the use of the above listed control options are not economically feasible.

BACT IMPACTS TABLE 2.11 PM2.5 STEPS 3-5 SOP FOUMH

2.11 e PM2.5 BACT Analysis for Technically Feasible Control Options

Information for Economic Analysis		Description
EU ID	SOP FOUMH	SOP outdoor uncaptured material handling Emissions Group 5
Existing Control	None	N/A
Interest Rate	0.07	Interest rate at which the company can borrow money. Enter 0.07, or 0.10, for example.
Useful Life	20	Estimated useful life of the new control equipment being considered.

POLLUTANTS TO BE CONTROLLED	PM2.5	SOx	NOx	VOC	NH3
Estimated Uncontrolled PTE (TPY)	1.33				
Existing Control Efficiency	0%				
Existing Outlet Concentration (g/dscf)	N/A				

ECONOMIC ANALYSIS

Option	Demon-strated?	Technically Feasible Control Options	Total Capital Cost	Pollutant	New Control Efficiency	Difference	Additional Tons Controlled	Annualized Capital $	Annualized Operating $	BACT ($/ton)
1	Yes	Enclosure	$ 592,000	PM2.5	75%	75%	0.99	$ 55,881	$ -	$ 56,190

Notes: More refined cost estimates would be done during the engineering phase of a project.
Recovered material was accounted in the Annualized Operating Cost, if applicable.
See Attachment 7 for more detail on cost estimates for Options.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

STEP 4: All of the technically feasible control options ranked above or near current controls were evaluated, and found to be economically infeasible.

STEP 5: Additional APCE is not feasible. Compass believes the estimated costs are exceptionally high in comparison to costs being borne by other sources of the same type to control the pollutant, indicating that the use of the above listed control options are not economically feasible.

BACT IMPACTS TABLE 2.11 PM2.5 STEPS 3-5 SOP FOUMH

2.11 f PM2.5 BACT Analysis for Technically Feasible Control Options

Information for Economic Analysis		Description
EU ID	SOP FOUMH	SOP outdoor uncaptured material handling Emissions Group 6
Existing Control	None	N/A
Interest Rate	0.07	Interest rate at which the company can borrow money. Enter 0.07, or 0.10, for example.
Useful Life	20	Estimated useful life of the new control equipment being considered.

POLLUTANTS TO BE CONTROLLED	PM2.5	SOx	NOx	VOC	NH3
Estimated Uncontrolled PTE (TPY)	0.09				
Existing Control Efficiency	0%				
Existing Outlet Concentration (g/dscf)	N/A				

ECONOMIC ANALYSIS

Option	Demon-strated?	Technically Feasible Control Options	Total Capital Cost	Pollutant	New Control Efficiency	Difference	Additional Tons Controlled	Annualized Capital $	Annualized Operating $	BACT ($/ton)
1	Yes	Enclosure	$ 156,000	PM2.5	75%	75%	0.07	$ 14,725	$ -	$ 225,675

Notes: More refined cost estimates would be done during the engineering phase of a project.
Recovered material was accounted in the Annualized Operating Cost, if applicable.
See Attachment 7 for more detail on cost estimates for Options.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

STEP 4: All of the technically feasible control options ranked above or near current controls were evaluated, and found to be economically infeasible.

STEP 5: Additional APCE is not feasible. Compass believes the estimated costs are exceptionally high in comparison to costs being borne by other sources of the same type to control the pollutant, indicating that the use of the above listed control options are not economically feasible.

BACT IMPACTS TABLE 2.11 PM2.5 STEPS 3-5 SOP FOUMH

2.11 g PM2.5 BACT Analysis for Technically Feasible Control Options

Information for Economic Analysis		Description
EU ID	SOP FOUMH	SOP outdoor uncaptured material handling Emissions Group 7
Existing Control	None	N/A
Interest Rate	0.07	Interest rate at which the company can borrow money. Enter 0.07, or 0.10, for example.
Useful Life	20	Estimated useful life of the new control equipment being considered.

POLLUTANTS TO BE CONTROLLED	PM2.5	SOx	NOx	VOC	NH3
Estimated Uncontrolled PTE (TPY)	1.59				
Existing Control Efficiency	0%				
Existing Outlet Concentration (g/dscf)	N/A				

ECONOMIC ANALYSIS

Option	Demon-strated?	Technically Feasible Control Options	Total Capital Cost	Pollutant	New Control Efficiency	Difference	Additional Tons Controlled	Annualized Capital $	Annualized Operating $	BACT ($/ton)
1	Yes	Enclosure	$ 237,000	PM2.5	35%	35%	0.56	$ 22,371	$ -	$ 40,151

Notes: More refined cost estimates would be done during the engineering phase of a project.
Recovered material was accounted in the Annualized Operating Cost, if applicable.
See Attachment 7 for more detail on cost estimates for Options.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

None

STEP 4: All of the technically feasible control options ranked above or near current controls were evaluated, and found to be economically infeasible.

STEP 5: Additional APCE is not feasible. Compass believes the estimated costs are exceptionally high in comparison to costs being borne by other sources of the same type to control the pollutant, indicating that the use of the above listed control options are not economically feasible.

2.11 h PM2.5 BACT Analysis for Technically Feasible Control Options

Information for Economic Analysis		Description
EU ID	SOP FOUMH	SOP outdoor uncaptured material handling Emissions Group 8
Existing Control	None	N/A
Interest Rate	0.07	Interest rate at which the company can borrow money. Enter 0.07, or 0.10, for example.
Useful Life	20	Estimated useful life of the new control equipment being considered.

POLLUTANTS TO BE CONTROLLED	PM2.5	SOx	NOx	VOC	NH3
Estimated Uncontrolled PTE (TPY)	0.79				
Existing Control Efficiency	0%				
Existing Outlet Concentration (g/dscf)	N/A				

ECONOMIC ANALYSIS										
Option	Demon-strated?	Technically Feasible Control Options	Total Capital Cost	Pollutant	New Control Efficiency	Difference	Additional Tons Controlled	Annualized Capital $	Annualized Operating $	BACT ($/ton)
1	Yes	Enclosure	$ 189,000	PM2.5	75%	75%	0.59	$ 17,840	$ -	$ 30,034

Notes: More refined cost estimates would be done during the engineering phase of a project.
Recovered material was accounted in the Annualized Operating Cost, if applicable.
See Attachment 7 for more detail on cost estimates for Options.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

STEP 4: All of the technically feasible control options ranked above or near current controls were evaluated, and found to be economically infeasible.

STEP 5: Additional APCE is not feasible. Compass believes the estimated costs are exceptionally high in comparison to costs being borne by other sources of the same type to control the pollutant, indicating that the use of the above listed control options are not economically feasible.

BACT IMPACTS TABLE 2.12a PM2.5 STEPS 3-5 SOP FBMH

2.12a BACT Analysis for Technically Feasible Control Options

Information for Economic Analysis		Description
EU ID	SOP FBMH	SOP fugitive point source emissions that can be routed to existing BH-001
Existing Control	None	N/A
Interest Rate	0.07	Interest rate at which the company can borrow money. Enter 0.07, or 0.10, for example.
Useful Life	20	Estimated useful life of the new control equipment being considered.

POLLUTANTS TO BE CONTROLLED	PM2.5	SOx	NOx	VOC	NH3
Estimated Uncontrolled PTE (TPY)	0.0306				
Existing Control Efficiency	0%				
Existing Outlet Concentration (g/dscf)	N/A				

ECONOMIC ANALYSIS

Option	Demon-strated?	Technically Feasible Control Options	Total Capital Cost	Pollutant	New Control Efficiency	Difference	Additional Tons Controlled	Annualized Capital $	Annualized Operating $	BACT ($/ton)
1	Yes	Route to BH-001	$ 126,000	PM2.5	99%	99%	0.030336	$ 11,894	$ -	$ 392,059

Notes: More refined cost estimates would be done during the engineering phase of a project.
Recovered material was accounted in the Annualized Operating Cost, if applicable.
See Attachment 7 for more detail on cost estimates for Options.

Recovered material was accounted in the Annualized Operating Cost, as applicable.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

STEP 4: The addition of ductwork and routing of source emissions to BH-001 is economically infeasible.

STEP 5: Compass believes the estimated costs are exceptionally high in comparison to costs being borne by other sources of the same type to control the pollutant, indicating that the use of the above listed control options are not economically feasible.

BACT IMPACTS TABLE 2.12b PM2.5 STEPS 3-5 SOP FBMH

2.12b BACT Analysis for Technically Feasible Control Options

Information for Economic Analysis		Description
EU ID	SOP FBMH	SOP fugitive point source emissions that can be routed to existing BH-1400
Existing Control	None	N/A
Interest Rate	0.07	Interest rate at which the company can borrow money. Enter 0.07, or 0.10, for example.
Useful Life	20	Estimated useful life of the new control equipment being considered.

POLLUTANTS TO BE CONTROLLED	PM2.5	SOx	NOx	VOC	NH3
Estimated Uncontrolled PTE (TPY)	1.17				
Existing Control Efficiency	0%				
Existing Outlet Concentration (g/dscf)	N/A				

ECONOMIC ANALYSIS

Option	Demon-strated?	Technically Feasible Control Options	Total Capital Cost	Pollutant	New Control Efficiency	Difference	Additional Tons Controlled	Annualized Capital $	Annualized Operating $	BACT ($/ton)
1	Yes	Route to BH-1400	$ 134,000	PM2.5	99%	99.0%	1.16	$ 12,649	$ -	$ 10,933

Notes: More refined cost estimates would be done during the engineering phase of a project.
Recovered material was accounted in the Annualized Operating Cost, if applicable.
See Attachment 7 for more detail on cost estimates for Options.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

STEP 4: The addition of ductwork and routing of emissions to BH-1400 is economically feasible.

STEP 5: BACT is selected as ducting to the existing baghouse.

BACT IMPACTS TABLE 2.12c PM2.5 STEPS 3-5 SOP FBMH

2.12c BACT Analysis for Technically Feasible Control Options

Information for Economic Analysis		Description
EU ID	SOP FBMH	SOP fugitive point source emissions that can be routed to existing AH-1547
Existing Control	None	N/A
Interest Rate	0.07	Interest rate at which the company can borrow money. Enter 0.07, or 0.10, for example.
Useful Life	20	Estimated useful life of the new control equipment being considered.

POLLUTANTS TO BE CONTROLLED	PM2.5	SOx	NOx	VOC	NH3
Estimated Uncontrolled PTE (TPY)	0.0730				
Existing Control Efficiency	0%				
Existing Outlet Concentration (g/dscf)	N/A				

ECONOMIC ANALYSIS

Option	Demon-strated?	Technically Feasible Control Options	Total Capital Cost	Pollutant	New Control Efficiency	Difference	Additional Tons Controlled	Annualized Capital $	Annualized Operating $	BACT ($/ton)
1	Yes	Route to AH-1547	$ 30,000	PM2.5	95%	95.0%	0.069310	$ 2,832	$ -	$ 40,857

Notes: More refined cost estimates would be done during the engineering phase of a project.
Recovered material was accounted in the Annualized Operating Cost, if applicable.
See Attachment 7 for more detail on cost estimates for Options.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

STEP 4: The addition of ductwork and routing of emissions to AH-1547 is economically infeasible.

STEP 5: Additional APCE is not feasible. Compass believes the estimated costs are exceptionally high in comparison to costs being borne by other sources of the same type to control the pollutant, indicating that the use of the above listed control options are not economically feasible.

Items # 2.13 **SOP Fugitive haul road, evaporation pond windrowing and activity, SOP pile, and road dust emissions**

PM 2.5 Control Possibilities

Control Option	Percent Control		GR/DSCF		Comment	Efficiency Rank
	Min	Max	Min	Max		
Fugitive Dust	NA	NA	NA	NA	Developing, Implementing, and Maintaining a Fugitive Dust Control Plan (FDCP) is a	NA
Inherent Moisture Content	NA	NA	NA	NA	Some materials have inherent moisture content, which helps to minimize emissions.	NA
Stabilization: Chemical	NA	NA	NA	NA	Chemicals dust suppressants include salts, lignin sulfonate, wetting agents, latexes, plastics, and petroleum derivatives.	NA
Stabilization: Physical	NA	NA	NA	NA	Water spraying, paving, sweeping, tarping piles, etc.	NA
Stabilization: Vegetative Cover	NA	NA	NA	NA	Vegetative cover can be used to stabilize soil, but is technically infeasible for salt piles, and is not an option for Compass Minerals.	NA
Speed Limit	NA	NA	NA	NA	Slowing down the vehicle speeds on site can minimize road dust.	NA
Wind Screens	NA	NA	NA	NA	Wind screens are porous wind fences, that help prevent fugitive emissions, and can be moved depending on wind conditions and work planning.	NA
Work Practices / Housekeeping	NA	NA	NA	NA	Work practices (or best operating practices) include several strategies, such as avoiding dusty work on windy days, keeping dusty materials vacuumed up, etc.	NA

STEP 3: SOP haul road, evaporation pond windrowing and activity, SOP pile, and road dust emissions is not a candidate for add on controls, but rather is best managed through measures identified above.

STEP 4: The following site-wide permit conditions establish the requirement for a Fugitive Dust Control Plan:

State-Only	II.B.1.g	Unless otherwise specified in this permit, visible emissions caused by fugitive dust shall not exceed 10% at the property boundary, and 20% onsite. Opacity shall not apply when the wind speed exceeds 25 miles per hour if the permittee has implemented, and continues to implement, the accepted fugitive dust control plan and administers at least one of the following contingency measures: 1 Pre-event watering; 2 Hourly watering; 3 Additional chemical stabilization; 4 Cease or reduce fugitive dust producing operations; 5 Other contingency measure approved by the director. [Origin: R307-309]. [R307-309-5, R307-309-6]
State-Only	II.B.1.h	The permittee shall submit a fugitive dust control plan to the Director in accordance with R307-309-6. Activities regulated by R307-309 shall not commence before the fugitive dust control plan is approved by the director. If site modifications result in emission changes, the permittee shall submit an updated fugitive dust control plan. At a minimum, the fugitive dust control plan shall include the requirements in R307-309-6(4) as applicable. The fugitive dust control plan shall include contact information, site address, total area of disturbance, expected start and completion dates, identification of dust suppressant and plan certification by signature of a responsible person. [Origin: R307-309]. [R307-309-5(2), R307-309-6]
State-Only	II.B.1.i	Condition: If the permittee owns, operates or maintains a new or existing material storage, handling or hauling operation, the permittee shall prevent, to the maximum extent possible, material from being deposited onto any paved road other than a designated deposit site. If materials are deposited that may create fugitive dust on a public or private paved road, the permittee shall clean the road promptly. [Origin: R307-309]. [R307-309-7]

STEP 5: BACT is selected as continued adherence to the facility's Fugitive Dust Control Plan. Specifically, CM will review it to ensure that fugitive emissions from SOP operations are addressed.

BACT OPTIONS TABLE 3.01 PM2.5 STEPS 1-5

Item # 3.01 **MgCl2 plant process streams from cooling belt, packaging, and handling** **PM2.5 Control Possibilities**

Control Option	Percent Control Min	Percent Control Max	GR/DSCF Min	GR/DSCF Max	Comment	Efficiency Rank
Wet Scrubber	85	99.7	0.0025	0.096	May result in artifact (created) PM.Controls filterable and condensable PM. ***Existing control is a wet scrubber.***	1
Cyclone	10	70	0.026	0.13	Not effective for PM2.5 unless coupled with Baghouse, ESP, or Scrubber; will not control condensables very effectively.	2
Baghouse/Fabric Filter/Cartridge Filter	90	99.99	0.0003	0.04	Gr/dscf outlet loading is assumed for filterables-only, since baghouses do not control condensables. Not technically feasible due to hygroscopic nature of MgCl2	NA
Wet ESP	99	99.9	0.01	0.021	Technically infeasible due to space limitations. There are considerable safety factors due to high voltage and the potential generation of HAPs. Technically infeasible because ESPs have reduced collection efficiency for materials that have high electrical resistivity such as sodium chloride. ESP is not demonstrated for highly resistive particulate matter such as those produced by CM processes.	NA
Dry ESP	96	99.2	NA	NA	Dry ESPs are not recommended for removing sticky or moist particles. Organic condensables plug a dry ESP. Technically in feasible due to hygroscopic nature of MgCl2 (moist and sticky). There are considerable safety factors due to high voltage and the potential generation of HAPs. Technically infeasible because ESPs have reduced collection efficiency for materials that have high electrical resistivity such as sodium chloride. ESP is not demonstrated for highly resistive particulate matter such as those produced by CM processes.	NA

STEP 3: The existing controls of exhausting through a wet scrubber have been determined to be BACT and there are no additional technically feasible options.

STEP 4: There are no other technically feasible options to evaluate, therefore BACT remains the use of a wet scrubber.

STEP 5: BACT is selected as the existing wet scrubber.

BACT OPTIONS TABLE 3.02 PM2.5

STEPS 1-2

Item # 3.02 **MgCl2 plant evaporators venting through 4 stacks** **VOC Control Possibilities**

Control Option	Percent Control		GR/DSCF		Comment	Efficiency Rank
	Min	Max	Min	Max		
Multi-effect evaporator	95	100	NA	NA	Generally, in a multiple-effect evaporator, water is boiled in a sequence of vessels, each held at a lower pressure than the last. In this case, the water in the brine slurry would evaporate at lower temperature under a vacuum, compared to the current configuration. Current evaporator temperature is about 320 °F. Testing shows that organic VOC compounds chloroform, formaldehyde, and methanol form at temperatures above approximately 270 °F. The multi-effect evaporator would operate below 270 °F, thereby preventing the formation of organic vapors.	1
Microfiltration	90	90	NA	NA	Microfiltration utilizes a 0.02 micron filter to reduce the amount of organic matter in the brine slurry, prior to evaporation. Some bleach would still required but much less.	2
Condenser/ scrubber system	0	90	NA	NA	Condenser/scrubber system, with acid neutralization, carbon absorption, and 19-acre evap pond. Estimated control efficiencies: Chloroform control = 0%, Formaldehyde control = 90%, Methanol Control = 25%.	3
Substitute oxidizing agent	NA	NA	NA	NA	Use of ozone or hydrogen peroxide as oxidizing agent instead of bleach. Testing showed that it was the temperature of the evaporators that caused organics to form from the organic matter in the brine, regardless of the bleach/brine ratio. Excess bleach addition was not correlated to organic vapor formation. Technically infeasible because it does not solve the problem of organic vapor formation at temperatures over ~270 °F.	NA
Lower the bleach/brine ratio	NA	NA	NA	NA	Limit the amount of excess bleach. Testing showed that it was the temperature of the evaporators that caused organics to form from the organic matter in the brine, not the bleach/brine ratio. Excess bleach addition was not correlated to organic vapor formation. Technically infeasible because it does not solve the problem of organic vapor formation at temperatures over ~270 °F.	NA

BACT IMPACTS TABLE 3.02 VOC STEPS 3-5 MAG EVAP

3.02 VOC BACT Analysis for Technically Feasible Control Options

Information for Economic Analysis		Description
EU ID	EVAP	MgCl2 Evaporator Stacks
Existing Control	None	
Interest Rate	0.07	Interest rate at which the company can borrow money. Enter 0.07, or 0.10, for example.
Useful Life	7	Estimated useful life of the new control equipment being considered.

STEP 3:

POLLUTANTS TO BE CONTROLLED	PM2.5	SOx	NOx	VOC	NH3
Tons Per Year	0.000	0.000	0.000	5.7	0.000

ECONOMIC ANALYSIS

Option	Demon-strated?	Technically Feasible Control Options	Capital Cost	Chemical	Control Efficiency	Tons Controlled	Annualized Capital $	Annualized Operating $	BACT ($/ton)
1	No	Multi-Effect Evaporator	$2,544,792	Chloroform	100%	2.85			
		Electrical	$1,425,083	Formaldehyde	100%	0.88			
		Mechanical	$4,936,896	Methanol	100%	1.97			
		Total	**$8,906,771**	**Tons Controlled**		**5.70**	**$ 1,652,680**	**$ 1,000,000**	**$ 465,382**
2	No	Microfiltration	$4,071,667	Chloroform	90%	2.57			
				Formaldehyde	90%	0.79			
				Methanol	90%	1.77			
		Total	**$4,071,667**	**Tons Controlled**		**5.13**	**$ 755,511**	**$ 100,000**	**$ 166,766**
3	No	Condenser/Scrubber Sys.	$5,089,583	Chloroform	0%	-			
		Acid Neutralization Sys.	$101,792	Formaldehyde	90%	0.79			
		Carbon Absorption	$2,035,833	Methanol	25%	0.49			
		19 Acre Lined Evap Pond	$2,137,625						
		Total	**$9,364,833**	**Tons Controlled**		**1.28**	**$ 1,737,675**	**$ 3,000,000**	**$ 3,688,342**

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

Option 2 will generate biomass waste. Option 3 will create solid waste and wastewater and will consume fresh water and 19 acres of land.

STEP 4: All of the technically feasible control options ranked above or near current controls were evaluated, and found to be economically infeasible.

STEP 5: Compass believes the estimated costs are exceptionally high in comparison to costs being borne by other sources of the same type to control the pollutant, indicating that the use of the above listed control options are not economically feasible.

Item # 3.03 **MgCl2 plant cooling tower** **PM 2.5 Control Possibilities**

Control Option	Percent Control		GR/DSCF		Comment	Efficiency Rank
	Min	Max	Min	Max		
Drift Eliminators	99.9	99.995	0.02% Drift	0.0005% Drift	Drift eliminators are typically considered high efficiency if they have lower drift percent.	1
Limiting Total Dissolved Solids	NA	NA	1,000 ppm TDS	6000 ppm TDS	Limiting TDS (by using more fresh makeup water or other means) can help reduce PM formation.	2

3.03 PM2.5 BACT Analysis for Technically Feasible Control Options

Information for Economic Analysis		Description
EU ID	MAG CT	MgCl2 plant cooling tower
Existing Control	DE	Drift Eliminators
Interest Rate	0.07	Interest rate at which the company can borrow money. Enter 0.07, or 0.10, for example.
Useful Life	20	Estimated useful life of the new control equipment being considered.

STEP 3:

POLLUTANTS TO BE CONTROLLED	PM2.5	SOx	NOx	VOC	NH3
Actual 2015 Tons Per Year	0.018				
Estimated Uncontrolled TPY	0.036				
Existing Control Efficiency	50%				
Existing Outlet Concentration (g/dscf)	0.2				

ECONOMIC ANALYSIS

Option	Demon-strated?	Technically Feasible Control Options	Total Capital Cost	Pollutant	New Control Efficiency	Difference	Additional Tons Controlled	Annualized Capital $	Annualized Operating $	BACT ($/ton)
1	Yes	HE Drift Eliminator and TDS Limit of 4,000 ppm	$ 3,525	PM2.5	99%	49%	0.018	$ 333		$ 18,942

Notes: More refined cost estimates would be done during the engineering phase of a project.
See Attachment 7 for more detail on cost estimate.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:
The drift eliminator will conserve fresh water, but this will be more than offset by the extra fresh water to maintain a lower TDS.

STEP 4: All of the technically feasible control options ranked above or near current controls were evaluated, and found to be economically infeasible.

STEP 5: Compass believes the estimated costs are exceptionally high in comparison to costs being borne by other sources of the same type to control the pollutant, indicating that the use of the above listed control options are not economically feasible. BACT is selected as the existing mist eliminator and TDS level.

Item # 3.04 **MAG fugitive material handling from building doors/windows/vents** **PM 2.5 Control Possibilities**

Control Option	Percent Control		GR/DSCF		Comment	Efficiency Rank
	Min	Max	Min	Max		
Control Devices	10	99.99	0.0003	0.13	RBLC included: fabric filter, baghouse, cartridge filter, cyclone, scrubber.	NA
Conveyance: Pneumatic	10	99.99	0.0003	0.13	Must be coupled with a cyclone, baghouse, and or scrubber type of control.	NA

BACT IMPACTS TABLE 3.04 PM2.5 STEPS 3-5 MAG FBMH

3.04 PM2.5 BACT Analysis for Technically Feasible Control Options

Information for Economic Analysis		Description
EU ID	MAG FOUMH	MAG fugitive material handling from building doors/windows/vents
Existing Control	None	N/A
Interest Rate	0.07	Interest rate at which the company can borrow money. Enter 0.07, or 0.10, for example.
Useful Life	20	Estimated useful life of the new control equipment being considered.

STEP 3:

POLLUTANTS TO BE CONTROLLED	PM2.5	SOx	NOx	VOC	NH3
Estimated Uncontrolled PTE (TPY)	0.141				
Existing Control Efficiency	0%				
Existing Outlet Concentration (g/dscf)	N/A				

ECONOMIC ANALYSIS

Option	Demon-strated?	Technically Feasible Control Options	Total Capital Cost	Pollutant	New Control Efficiency	Difference	Additional Tons Controlled	Annualized Capital $	Annualized Operating $	BACT ($/ton)
1	Yes	Ducting to existing scrubber (MP WS)	$ 120,000	PM2.5	99%	99%	0.140	$ 11,327	$ -	$ 81,144

Notes: More refined cost estimates would be done during the engineering phase of a project.
Recovered material was accounted in the Annualized Operating Cost, if applicable.
See Attachment 7 for more detail on cost estimates for Options 1.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

STEP 4: The routing of emissions from uncontrolled equipment in MAG to MP WS is not economically feasible.

STEP 5: Compass believes the estimated costs are exceptionally high in comparison to costs being borne by other sources of the same type to control the pollutant, indicating that the use of the above listed control options are not economically feasible.

BACT OPTIONS TABLE 4.01 PM2.5 STEPS 1-5

Item # 4.01 **Natural Gas Boiler 1** **PM 2.5 Control Possibilities**

Control Option	Percent Control		GR/DSCF		Comment	Efficiency Rank
	Min	Max	Min	Max		
Natural Gas Combustion	NA	NA	NA	NA	***CM uses only natural gas in this Boiler per permit condition II.B.1.c (BACT).***	NA
Good Combustion Practices	NA	NA	NA	NA	***CM follows good combustion practices per permit condition II.B.1.d (BACT).***	NA
Add on Control Devices	NA	NA	NA	NA	Natural gas and good combustion practices constitute BACT. RBLC did not show any add on control devices for particulate matter for natural gas-only combustion.	NA

STEP 3: The existing controls of combusting pipeline quality natural gas and good combustion practices have been determined to be BACT and there are no additional technically feasible options.

STEP 4: There are no other technically feasible options to evaluate, therefore BACT remains the use of natural gas and combustion practices.

STEP 5: BACT is selected as pipeline quality natural gas fuel and good combustion practices.

BACT OPTIONS TABLE 4.01 SOx STEPS 1-2

Item # 4.01 **Natural Gas Boiler 1** **SOx Control Possibilities**

Control Option	Percent Control		LB/MMBTU		Comment	Efficiency Rank
	Min	Max	Min	Max		
Pipeline Quality Natural Gas Fuel (low sulfur fuel)	NA	NA	0.0009	0.0065	Natural gas sold to consumers has the lowest sulfur content of any of the fossil fuels, and constitutes BACT for SOx. ***CM uses only pipeline quality natural gas fuel in external combustion units, per permit condition II.B.1.c (BACT).***	1
Wet flue gas desulfurization	90%	95%	0.065	0.107	Similar to wet scrubber. In RBLC, demonstrated applications were for solid fuel (coal, corn fiber).	NA
Good Combustion Practices	NA	NA	NA	NA	**CM follows good combustion practices per permit condition II.B.1.d (BACT).**	2
Limestone Injection (CFB)	NA	NA	0.06	0.2	Used for solid fuel only. In RBLC, applications were for solid fuel (coal, pet coke, lignite, biomass). Not demonstrated for natural gas-only combustion.	NA
Dry Sorbent Injection	NA	NA	NA	0.06	Creates particulate sulfate from the SO2. My require a baghouse on exhaust. In RBLC, applications were for solid fuel (coal, pet coke, biomass). Not demonstrated for natural gas-only combustion.	NA

BACT IMPACTS TABLE 4.01 SOx STEPS 3-5 NGB-1

4.01 SOx BACT Analysis for Technically Feasible Control Options

Information for Economic Analysis		Description
EU ID	NGB-1	Natural Gas Boiler 1 - 108.11 mmBtuh
Existing Control	None	N/A
Interest Rate	0.07	Interest rate at which the company can borrow money. Enter 0.07, or 0.10, for example.
Useful Life	20	Estimated useful life of the new control equipment being considered.

STEP 3:

POLLUTANTS TO BE CONTROLLED	PM2.5	SOx	NOx	VOC	NH3
Potential Emissions		0.165			
Estimated Uncontrolled TPY		0.165			
Existing Control Efficiency		0%			
Existing Outlet Concentration (g/dscf)		N/A			

ECONOMIC ANALYSIS

Option	Demon-strated?	Technically Feasible Control Options	Total Capital Cost	Pollutant	New Control Efficiency	Difference	Additional Tons Controlled	Annualized Capital $	Annualized Operating $	BACT ($/ton)
1	Yes	Wet flue gas desulfurization	$ 492,000	SOx	95%	95%	0.157	$ 46,441	$ 248,800	$ 1,885,372

Notes: More refined cost estimates would be done during the engineering phase of a project.
Recovered material was accounted in the Annualized Operating Cost, if applicable.
See Attachment 7 for more detail on cost estimates for Options 1.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

STEP 4: All of the technically feasible control options ranked above or near current controls were evaluated, and found to be economically infeasible.

STEP 5: The continued use of pipeline quality natural gas and good combustion practices are considered BACT for this source.

Item # 4.01 **Natural Gas Boiler 1** **NOx Control Possibilities**

Control Option	Percent Control		LB/MMBTU		Comment	Efficiency Rank
	Min	Max	Min	Max		
Ultra Low NOx Burners (ULNB)	NA	NA	0.0125	0.072	This Boiler has ULNB, FGR, and continuous oxygen trim system. There is no widely accepted definition for Ultra Low NOx Burners (ULNB). For this BACT analysis it is assumed $\leq$ 20 ppm @ 3% O2 is ULNB. FGR and/or staged combustion principles are usually included in ULNB. ***This unit has low NOx burners and achieves NOx control through controlled air/fuel ratio and vigorous mixing, resulting in lower temperatures in the combustion zone, thereby preventing thermal NOx formation.***	1
Selective Catalytic Reduction (SCR)	70	90	0.02	0.1	Catalyst and ammonia required. Ammonia emissions in range of 10-20 ppm. Effective in streams >20 ppm NOx. Rarely demonstrated for natural gas-only combustion units.	2
Low NOx Burners (LNB)	50	55	0.035	0.35	Low NOx burners often use FGR and/or staged combustion principles.	3
Natural Gas Fuel	NA	NA	NA	NA	***CM uses natural gas fuel per permit condition II.B.1.c (BACT).*** Natural gas has little or no fuel bound nitrogen.	4
Good Combustion Practices	NA	NA	NA	NA	***CM follows good combustion practices per permit condition II.B.1.d (BACT).***	5
FGR (Flue Gas Recirculation)	NA	NA	NA	NA	FGR is a pollution prevention technique used to achieve low ppm in LNB and ULNB by limiting excess oxygen. **See the ULNB and LNB categories.**	6
Staged Combustion/Over Fire Air and Air/Fuel Ratio	NA	NA	0.08	0.22	Staged combustion/over fire air are pollution prevention techniques that allow for the reduction of thermal NOx formation by modifying the primary combustion zone stoichiometry or air/fuel ratio. Staged combustion can mean staged air or staged fuel. It often helps achieve low ppm in LNB and ULNB by keeping the temperature lower. **See the ULNB and LNB categories.**	7
Selective Noncatalytic Reduction (SNCR)	60	70	0.07	0.25	Requires ammonia or urea injection as a reducing agent SNCR tends to be less effective at low NOx concentrations. Typical NOx inlet loadings vary from 200 to 400 ppm. (Ref. EPA SNCR Fact Sheet) Rarely demonstrated for natural gas-only combustion units.	NA
Steam/Water Injection	NA	NA	NA	NA	Steam/Water Injection reduces thermal NOx formation by lowering temperature. Not demonstrated for natural gas-only combustion.	NA
NSCR (Nonselective catalytic reduction)	NA	NA	NA	NA	NSCR (Nonselective catalytic reduction) controls are not shown in RBLC for chemical, wood, minerals, or agricultural industries. This technology is typically used for mobile sources. Not demonstrated for natural gas-only combustion.	NA

STEP 3: The existing controls of low NOx burnersachieves NOx control through controlled air/fuel ratio and vigorous mixing, resulting in lower temperatures in the combustion zone, thereby preventing thermal NOx formation and combusting pipeline quality natural gas have been determined to be BACT and there are no additional technically feasible options

STEP 4: There are no other technically feasible options to evaluate, and this unit already has BACT. Additionally this unit is 95% efficient compared to typical boilers which achieve 80-85% efficiency. Therefore, this unit produces more useable heat with less fuel than typical boilers.

STEP 5: BACT is selected as the existing ULNB with FGR and continuous oxygen trim system., plus pipeline quality natural gas, plus good combustion practices.

BACT OPTIONS TABLE 4.01 VOC STEPS 1-5

Item # 4.01 **Natural Gas Boiler 1** **VOC Control Possibilities**

Control Option	Percent Control		LB/MMBTU		Comment	Efficiency Rank
	Min	Max	Min	Max		
Pipeline Quality Natural Gas Fuel	NA	NA	0.004	0.0054	***CM uses pipeline quality natural gas fuel for its dryers, boilers, and process heaters, per permit condition II.B.1.c (BACT).***	1
Good Combustion Practices	NA	NA	0.0054	0.01	***CM follows good combustion practices per permit condition II.B.1.d (BACT).***	2
Oxidation catalyst	95	99	NA	NA	Controls CO, and VOC. Oxidation catalyst is most effective in high excess oxygen sources such as turbines (12-15% excess oxygen) compared to external natural gas combustion (3-6% excess oxygen). Most oxidation catalyst determinations in RBLC were for engines, turbines, or solid/liquid/mixed fuels.Rarely demonstrated for natural gas-only external combustion sources. Not technically feasible because exhaust temperature is less than 300 °F.	NA
Thermal Oxidizers (TO, RTO)	NA	NA	NA	NA	Controls CO, VOC, and PM. Not demonstrated for natural gas-only combustion.	NA

STEP 3: The existing controls of combusting pipeline quality natural gas and good combustion practices have been determined to be BACT and there are no additional technically feasible options.

STEP 4: There are no other technically feasible options to evaluate, therefore BACT remains the use of natural gas and combustion practices.

STEP 5: BACT is selected as pipeline quality natural gas fuel and good combustion practices.

BACT OPTIONS TABLE 4.01 NH3 STEPS 1-5

Item # 4.01 **Natural Gas Boiler 1** **Ammonia Control Possibilities**

Control Option	Percent Control		LB/MMBTU		Comment	Efficiency Rank
	Min	Max	Min	Max		
Limit on ammonia slip in SCR controlled process heater.	NA	NA	NA	NA	Ammonia is only included in RBLC as a pollutant to be controlled if the unit is controlled for NOx with SCR or SNCR. These controls are normally used for engines, turbines, and external combustion sources fired on liquid, solid, or mixed fuels or fuel gas. In this case, ammonia slip may be controlled to prevent ammonia emissions. <u>Ammonia controls are not demonstrated in RBLC for natural gas-only boilers or dryers, boilers or process heaters.</u>	NA

STEP 3: No impacts analysis per Step 3 is needed, because there are no technically feasible options.

STEP 4: There are no other technically feasible options to evaluate for natural gas-only combustion units.

STEP 5: BACT is selected as pipeline quality natural gas fuel and good combustion practices.

Item # 4.02 **Natural Gas Boiler 2** **PM 2.5 Control Possibilities**

Control Option	Percent Control		GR/DSCF		Comment	Efficiency Rank
	Min	Max	Min	Max		
Natural Gas Combustion	NA	NA	NA	NA	***CM uses only natural gas in this Boiler per permit condition II.B.1.c (BACT).***	NA
Good Combustion Practices	NA	NA	NA	NA	***CM follows good combustion practices per permit condition II.B.1.d (BACT).***	NA
Add on Control Devices	NA	NA	NA	NA	Natural gas and good combustion practices constitute BACT. RBLC did not show any add on control devices for particulate matter for natural gas-only combustion.	NA

STEP 3: The existing controls of combusting pipeline quality natural gas and good combustion practices have been determined to be BACT and there are no additional technically feasible options.

STEP 4: There are no other technically feasible options to evaluate, therefore BACT remains the use of natural gas and combustion practices.

STEP 5: BACT is selected as pipeline quality natural gas fuel and good combustion practices.

BACT OPTIONS TABLE 4.02 SOx STEPS 1-2

Item # 4.02 **Natural Gas Boiler 2** **SOx Control Possibilities**

Control Option	Percent Control Min	Percent Control Max	LB/MMBTU Min	LB/MMBTU Max	Comment	Efficiency Rank
Pipeline Quality Natural Gas Fuel (low sulfur fuel)	NA	NA	0.0009	0.0065	Natural gas sold to consumers has the lowest sulfur content of any of the fossil fuels, and constitutes BACT for SOx. ***CM uses only pipeline quality natural gas fuel in external combustion units, per permit condition II.B.1.c (BACT).***	1
Wet flue gas desulfurization	90%	95%	0.065	0.107	Similar to wet scrubber. In RBLC, demonstrated applications were for solid fuel (coal, corn fiber).	NA
Good Combustion Practices	NA	NA	NA	NA	**CM follows good combustion practices per permit condition II.B.1.d (BACT).**	2
Limestone Injection (CFB)	NA	NA	0.06	0.2	Used for solid fuel only. In RBLC, applications were for solid fuel (coal, pet coke, lignite, biomass). Not demonstrated for natural gas-only combustion.	NA
Dry Sorbent Injection	NA	NA	NA	0.06	Creates particulate sulfate from the SO2. My require a baghouse on exhaust. In RBLC, applications were for solid fuel (coal, pet coke, biomass). Not demonstrated for natural gas-only combustion.	NA

BACT IMPACTS TABLE 4.02 SOx STEPS 3-5 NGB-2

4.02 SOx BACT Analysis for Technically Feasible Control Options

Information for Economic Analysis		Description
EU ID	NGB-2	Natural Gas Boiler 2 - 108.11 mmBtuh
Existing Control	None	N/A
Interest Rate	0.07	Interest rate at which the company can borrow money. Enter 0.07, or 0.10, for example.
Useful Life	20	Estimated useful life of the new control equipment being considered.

STEP 3:

POLLUTANTS TO BE CONTROLLED	PM2.5	SOx	NOx	VOC	NH3
Potential Emissions		0.165			
Estimated Uncontrolled TPY		0.165			
Existing Control Efficiency		0%			
Existing Outlet Concentration (g/dscf)		N/A			

ECONOMIC ANALYSIS

Option	Demon-strated?	Technically Feasible Control Options	Total Capital Cost	Pollutant	New Control Efficiency	Difference	Additional Tons Controlled	Annualized Capital $	Annualized Operating $	BACT ($/ton)
1	Yes	Wet flue gas desulfurization	$ 492,000	SOx	95%	95%	0.157	$ 46,441	$ 248,800	$ 1,885,372

Notes: More refined cost estimates would be done during the engineering phase of a project.
Recovered material was accounted in the Annualized Operating Cost, if applicable.
See Attachment 7 for more detail on cost estimates for Options 1.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

STEP 4: All of the technically feasible control options ranked above or near current controls were evaluated, and found to be economically infeasible.

STEP 5: The continued use of pipeline quality natural gas and good combustion practices are considered BACT for this source.

Item # 4.02 **Natural Gas Boiler 2** **NOx Control Possibilities**

Control Option	Percent Control Min	Percent Control Max	LB/MMBTU Min	LB/MMBTU Max	Comment	Efficiency Rank
Ultra Low NOx Burners (ULNB)	NA	NA	0.0125	0.072	This Boiler has ULNB, FGR, and continuous oxygen trim system. There is no widely accepted definition for Ultra Low NOx Burners (ULNB). For this BACT analysis it is assumed ≤ 20 ppm @ 3% O2 is ULNB. FGR and/or staged combustion principles are usually included in ULNB. ***This unit has low NOx burners and achieves NOx control through controlled air/fuel ratio and vigorous mixing, resulting in lower temperatures in the combustion zone.***	1
Selective Catalytic Reduction (SCR)	70	90	0.02	0.1	Catalyst and ammonia required. Ammonia emissions in range of 10-20 ppm. Effective in streams >20 ppm NOx. Rarely demonstrated for natural gas-only combustion units.	2
Low NOx Burners (LNB)	50	55	0.035	0.35	Low NOx burners often use FGR and/or staged combustion principles.	3
Natural Gas Fuel	NA	NA	NA	NA	***CM uses natural gas fuel per permit condition II.B.1.c (BACT).*** Natural gas has little or no fuel bound nitrogen.	4
Good Combustion Practices	NA	NA	NA	NA	***CM follows good combustion practices per permit condition II.B.1.d (BACT).***	5
FGR (Flue Gas Recirculation)	NA	NA	NA	NA	FGR is a pollution prevention technique used to achieve low ppm in LNB and ULNB by limiting excess oxygen. **See the ULNB and LNB categories.**	6
Staged Combustion/Over Fire Air and Air/Fuel Ratio	NA	NA	0.08	0.22	Staged combustion/over fire air are pollution prevention techniques that allow for the reduction of thermal NOx formation by modifying the primary combustion zone stoichiometry or air/fuel ratio. Staged combustion can mean staged air or staged fuel. It often helps achieve low ppm in LNB and ULNB by keeping the temperature lower. **See the ULNB and LNB categories.**	7
Selective Noncatalytic Reduction (SNCR)	60	70	0.07	0.25	Requires ammonia or urea injection as a reducing agent. SNCR tends to be less effective at low NOx concentrations. Typical NOx inlet loadings vary from 200 to 400 ppm. (Ref. EPA SNCR Fact Sheet) Rarely demonstrated for natural gas-only combustion units.	NA
Steam/Water Injection	NA	NA	NA	NA	Steam/Water Injection reduces thermal NOx formation by lowering temperature. Not demonstrated for natural gas-only combustion.	NA
NSCR (Nonselective catalytic reduction)	NA	NA	NA	NA	NSCR (Nonselective catalytic reduction) controls are not shown in RBLC for chemical, wood, minerals, or agricultural industries. This technology is typically used for mobile sources. Not demonstrated for natural gas-only combustion.	NA

STEP 3: The existing controls of low NOx burnersachieves NOx control through controlled air/fuel ratio and vigorous mixing, resulting in lower temperatures in the combustion zone, thereby preventing thermal NOx formation and combusting pipeline quality natural gas have been determined to be BACT and there are no additional technically feasible options.

STEP 4: There are no other technically feasible options to evaluate, and this unit already has BACT. Additionally this unit is 95% efficient compared to typical boilers which achieve 80-85% efficiency. Therefore, this unit produces more useable heat with less fuel than typical boilers.

STEP 5: BACT is selected as the existing ULNB with FGR and continuous oxygen trim system., plus pipeline quality natural gas, plus good combustion practices.

BACT OPTIONS TABLE 4.02 VOC STEPS 1-5

Item # 4.02 **Natural Gas Boiler 2** **VOC Control Possibilities**

Control Option	Percent Control Min	Percent Control Max	LB/MMBTU Min	LB/MMBTU Max	Comment	Efficiency Rank
Pipeline Quality Natural Gas Fuel	NA	NA	0.004	0.0054	***CM uses pipeline quality natural gas fuel for its dryers, boilers, and process heaters, per permit condition II.B.1.c (BACT).***	1
Good Combustion Practices	NA	NA	0.0054	0.01	***CM follows good combustion practices per permit condition II.B.1.d (BACT).***	2
Oxidation catalyst	95	99	NA	NA	Controls CO, and VOC. Oxidation catalyst is most effective in high excess oxygen sources such as turbines (12-15% excess oxygen) compared to external natural gas combustion (3-6% excess oxygen). Most oxidation catalyst determinations in RBLC were for engines, turbines, or solid/liquid/mixed fuels.Rarely demonstrated for natural gas-only external combustion sources. Not technically feasible because exhaust temperature is less than 300 °F.	NA
Thermal Oxidizers (TO, RTO)	NA	NA	NA	NA	Controls CO, VOC, and PM. Not demonstrated for natural gas-only combustion.	NA

STEP 3: The existing controls of combusting pipeline quality natural gas and good combustion practices have been determined to be BACT and there are no additional technically feasible options.

STEP 4: There are no other technically feasible options to evaluate, therefore BACT remains the use of natural gas and combustion practices.

STEP 5: BACT is selected as pipeline quality natural gas fuel and good combustion practices.

BACT OPTIONS TABLE 4.02 NH3 STEPS 1-5

Item # 4.02 **Natural Gas Boiler 2** **Ammonia Control Possibilities**

Control Option	Percent Control		LB/MMBTU		Comment	Efficiency Rank
	Min	Max	Min	Max		
Limit on ammonia slip in SCR controlled process heater.	NA	NA	NA	NA	Ammonia is only included in RBLC as a pollutant to be controlled if the unit is controlled for NOx with SCR or SNCR. These controls are normally used for engines, turbines, and external combustion sources fired on liquid, solid, or mixed fuels or fuel gas. In this case, ammonia slip may be controlled to prevent ammonia emissions. Ammonia controls are not demonstrated in RBLC for natural gas-only boilers or dryers, boilers or process heaters.	NA

STEP 3: No impacts analysis per Step 3 is needed, because there are no technically feasible options.

STEP 4: There are no other technically feasible options to evaluate for natural gas-only combustion units.

STEP 5: BACT is selected as pipeline quality natural gas fuel and good combustion practices.

BACT OPTIONS TABLE   Items 5.01 - 5.06   Engine Data

5.01 - 5.06   Emergency Engines

Item #	0.7457 kW per HP			Comment	Efficiency
	kW	HP	EPA Tier		Rank
5.01	25	33.5	Tier 4 or Tier 4 Interim	25 kW propane emergency generator engine (substation), mfg date 1/21/2014. ***Presumptive BACT due to Tier 4 status.***	NA
5.02	25	33.5	Tier 4 or Tier 4 Interim	25 kW propane emergency generator engine (AT&T tower), mfg date approximately 2014. ***Presumptive BACT due to Tier 4 status.***	NA
5.03	100	134.1	Tier 3	100 kW diesel emergency generator engine. Tier 3. ***Presumptive BACT due to Tier 4 status.***	NA
5.04	175	234.7	NA	175 kW diesel emergency generator engine. Mfg before April 2006. See BACT analysis.	NA
5.05	300	402.3	Tier 3	300 kW diesel generator Engine: NOI date 7/2015. ***Presumptive BACT due to Tier 3 status.***	NA
5.06	455	610.2	Tier 4 Interim	455 kW emergency diesel fire water pump engine. Tier 4 interim. ***Presumptive BACT due to Tier 4 status.***	NA

Note: For Tier 3 and Tier 4 Emergency Engines, BACT is presumed.

BACT IMPACTS TABLE 5.04 STEPS 3-5 MIS

5.04 PM2.5 BACT Analysis for Technically Feasible Control Options

Information for Economic Analysis		Description
EU ID	MISC MIS	175 kW diesel emergency generator engine. Mfg before April 2006.
Existing Control	None	
Interest Rate	0.07	Interest rate at which the company can borrow money. Enter 0.07, or 0.10, for example.
Useful Life	20	Estimated useful life of the new control equipment being considered.

STEP 3:

POLLUTANTS TO BE CONTROLLED	PM2.5	SOx	NOx	VOC	NH3
Actual 2015 Tons Per Year	0.003	0.007	0.079	0.003	0.000
Estimated Uncontrolled TPY	0.123	0.001	1.408	0.041	0.006
Existing Control Efficiency	0%	0%	0%	0%	0%

ECONOMIC ANALYSIS

Option	Demon-strated?	Technically Feasible Control Options	Total Capital Cost	Pollutant	New Control Efficiency	Diff-erence	Additional Tons Controlled	Annualized Capital $	Annualized Operating $	BACT ($/ton)
1	Yes	Purchase Tier 3 or Tier 4 emergency engine add-on controls (SCR/NSCR)	$ 21,200	NOx	95%	95%	0.08	$ 2,001	$ 1	$ 26,679

Notes: More refined cost estimates would be done during the engineering phase of a project

Engine replacement would be substantially more expensive than add-on control and would achieve comparable decreases in emissions. Because add-on controls are not economically feasible, further evaluation of engine replacement is not necessary.

Control Efficiency = 1 - (0.298/6.6)g/hp-hr

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

STEP 4: All of the technically feasible control options were evaluated, and found to be economically infeasible.

STEP 5: Additional APCE or engine replacement is not feasible. Compass believes the estimated costs are exceptionally high in comparison to costs being borne by other sources of the same type to control the pollutant, indicating that the use of the above listed control options are not economically feasible.

Item # 6.01 **Gasoline Storage Tank - 6,000 gallons** **VOC Control Possibilities**

Control Option	Percent Control		Lb/Hr		Comment	Efficiency Rank
	Min	Max	Min	Max		
Design Control - Floating Roof IFR or EFR	NA	NA	0.48	1.08	Floating roof to minimize head space. White or aluminum surface to minimize internal temperature. Proper and regular maintenance checks are necessary to ensure this design control is adequately implemented. In RBLC and in relevant rules, floating roofs are not required or practical on 6,000 gallon tanks. <u>Not demonstrated for 6,000 gallon tanks.</u>	NA
Vent to flare, carbon canister, condenser, wet scrubber, TO, or other device	98	99			These generally relate to larger tanks. Due to the low amount of emissions from a small, shop-built tank, CM considers existing State regulations as BACT.	NA
Submerged Fill Pipes					***Submerged fill pipe per (state rule). Required by R307-328.***	NA
Tank color / maintenance					White or aluminum surface to minimize head space and internal temperature. Good maintenance practices to keep the surface reflective. ***This source has a white surface that is well maintained.***	NA
NSPS Compliance Requirements					Some RBLC determinations require emissions of VOC from the storage tanks to be controlled by the proper construction of the tanks per an applicable rule. The smallest size tank regulated by NSPS K, Ka, or Kb is 19,812 gallons. The gasoline storage tank at CM is 6,000 gallons. <u>Not applicable.</u>	NA
Vapor return line to gasoline cargo tank					***Required by R307-328 (or other means of controlling vapors during tank filling).***	NA

STEP 3: The existing controls of controlling vapors during tank filling and maintaining a white reflective tank surface have been determined to be BACT and there are no additional technically feasible options.

STEP 4: There are no other technically feasible options to evaluate, therefore BACT remains the use of controlled filling practices and a white, reflective tank surface.

STEP 5: BACT is selected as controlled filling practices and maintaining a white reflective tank surface.

BACT OPTIONS TABLE 6.02 VOC

STEPS 1-5

Item # 6.02 **Diesel Storage Tanks (2) - 1,000 and 12,000 gallon** **VOC Control Possibilities**

Control Option	Percent Control		GR/DSCF		Comment	Efficiency
	Min	Max	Min	Max		Rank
Tank color / maintenance	NA	NA	NA	NA	White or aluminum surface to minimize head space and internal temperature. Good maintenance practices to keep the surface reflective. ***This source has a white surface that is well maintained.***	NA
Low vapor pressure of tank contents	NA	NA	NA	NA	Should not need any other controls due to very low vapor pressure (total emissions from diesel storage tanks in 2015 were 0.02 tons). ***Diesel fuel has very low vapor pressure (0.0074 psia @ 60 F; 0.02 psia @ 100 F).***	NA

STEP 3: The existing controls of maintaining a white reflective tank surface have been determined to be BACT and there are no additional technically feasible options.

STEP 4: There are no other technically feasible options to evaluate, therefore BACT remains the maintaining a white, reflective tank surface.

STEP 5: BACT is selected as white or reflective exterior color, good maintenance, and low vapor pressure of contents.

BACT OPTIONS TABLE 6.03 PM2.5 STEPS 1-2

Items # 6.03 **Abrasive Blast Machine**

PM 2.5 Control Possibilities

Control Option	Percent Control		GR/DSCF		Comment	Efficiency Rank
	Min	Max	Min	Max		
Fugitive Dust Control Plan	NA	NA	NA	NA	Developing, Implementing, and Maintaining a Fugitive Dust Control Plan (FDCP) is a recognized control technology in EPA's RBLC. It is also a requirement of Utah Rule 307-309	NA
Enclosure	NA	NA	NA	NA	The sandblasting station can be enclosed in a building to capture dust emissions and provide some control.	NA
Wind Screens	NA	NA	NA	NA	Wind screens are porous wind fences, that help prevent fugitive emissions, and can be moved depending on wind conditions and work planning.	NA
Work Practices / Housekeeping	NA	NA	NA	NA	Work practices (or best operating practices) include several strategies, such as avoiding dusty work on windy days, keeping dusty materials vacuumed up, etc.	NA

6.03 PM2.5 BACT Analysis for Technically Feasible Control Options

Information for Economic Analysis		Description
EU ID	BLAST	Abrasive Blast Machine
Existing Control	None	N/A
Interest Rate	0.07	Interest rate at which the company can borrow money. Enter 0.07, or 0.10, for example.
Useful Life	20	Estimated useful life of the new control equipment being considered.

STEP 3:

POLLUTANTS TO BE CONTROLLED	PM2.5	SOx	NOx	VOC	NH3
Estimated Uncontrolled PTE (TPY)	0.09				
Existing Control Efficiency	0%				
Existing Outlet Concentration (g/dscf)	N/A				

ECONOMIC ANALYSIS

Option	Demon-strated?	Technically Feasible Control Options	Total Capital Cost	Pollutant	New Control Efficiency	Difference	Additional Tons Controlled	Annualized Capital $	Annualized Operating $	BACT ($/ton)
1	Yes	Enclosure	$ 108,000	$0	75%	75%	0.06	$ 10,194	$ -	$ 159,913

Notes: More refined cost estimates would be done during the engineering phase of a project.

STEP 4: All of the technically feasible control options ranked above were evaluated, and found to be economically infeasible.

STEP 5: Compass believes the estimated costs are exceptionally high in comparison to costs being borne by other sources of the same type to control the pollutant, indicating that the use of the above listed control options are not economically feasible.

Items # 6.04 **Fugitive Road Dust**

PM 2.5 Control Possibilities

Control Option	Percent Control		GR/DSCF		Comment	Efficiency Rank
	Min	Max	Min	Max		
Fugitive Dust Control Plan	NA	NA	NA	NA	Developing, Implementing, and Maintaining a Fugitive Dust Control Plan (FDCP) is a recognized control technology in EPA's RBLC. It is also a requirement of Utah Rule 307-309	NA
Inherent Moisture Content	NA	NA	NA	NA	Some materials have inherent moisture content, which helps to minimize emissions.	NA
Stabilization: Chemical	NA	NA	NA	NA	Chemicals dust suppressants include salts, lignin sulfonate, wetting agents, latexes, plastics, and petroleum derivatives.	NA
Stabilization: Physical	NA	NA	NA	NA	Water spraying, paving, sweeping, tarping piles, etc.	NA
Stabilization: Vegetative Cover	NA	NA	NA	NA	Vegetative cover can be used to stabilize soil, but is technically infeasible for salt piles, and is not an option for Compass Minerals.	NA
Speed Limit	NA	NA	NA	NA	Slowing down the vehicle speeds on site can minimize road dust.	NA
Wind Screens	NA	NA	NA	NA	Wind screens are porous wind fences, that help prevent fugitive emissions, and can be moved depending on wind conditions and work planning.	NA
Work Practices / Housekeeping	NA	NA	NA	NA	Work practices (or best operating practices) include several strategies, such as avoiding dusty work on windy days, keeping dusty materials vacuumed up, etc.	NA

STEP 3: Fugitive road dust is not a candidate for add on controls, but rather is best managed through measures identified above.

STEP 4: The following site-wide permit conditions establish the requirement for a Fugitive Dust Control Plan:

State-Only	II.B.1.g	Unless otherwise specified in this permit, visible emissions caused by fugitive dust shall not exceed 10% at the property boundary, and 20% onsite. Opacity shall not apply when the wind speed exceeds 25 miles per hour if the permittee has implemented, and continues to implement, the accepted fugitive dust control plan and administers at least one of the following contingency measures: 1 Pre-event watering; 2 Hourly watering; 3 Additional chemical stabilization; 4 Cease or reduce fugitive dust producing operations; 5 Other contingency measure approved by the director. [Origin: R307-309]. [R307-309-5, R307-309-6]
State-Only	II.B.1.h	The permittee shall submit a fugitive dust control plan to the Director in accordance with R307-309-6. Activities regulated by R307-309 shall not commence before the fugitive dust control plan is approved by the director. If site modifications result in emission changes, the permittee shall submit an updated fugitive dust control plan. At a minimum, the fugitive dust control plan shall include the requirements in R307-309-6(4) as applicable. The fugitive dust control plan shall include contact information, site address, total area of disturbance, expected start and completion dates, identification of dust suppressant and plan certification by signature of a responsible person. [Origin: R307-309]. [R307-309-5(2), R307-309-6]
State-Only	II.B.1.i	Condition: If the permittee owns, operates or maintains a new or existing material storage, handling or hauling operation, the permittee shall prevent, to the maximum extent possible, material from being deposited onto any paved road other than a designated deposit site. If materials are deposited that may create fugitive dust on a public or private paved road, the permittee shall clean the road promptly. [Origin: R307-309]. [R307-309-7]

STEP 5: BACT is selected as continued adherence to the facility's Fugitive Dust Control Plan. Specifically, CM will review it to ensure that fugitive emissions from road dust are addressed.

4. PROPOSED LIMITS, MONITORING, RECORDKEEPING, AND SCHEDULE

Table 4.1 shows the proposed lb/hr BACT limits for each source, as applicable. This section outlines the basis for proposed emission limits for PM2.5 and PM2.5 precursors listed in Table 4.1. Compass is proposing lb/hr limits, rather than concentration based limits (gr/dscf) because flow rate in multiple processes at Ogden is not constant. Monitoring and recordkeeping conditions are also proposed, as well as a BACT implementation schedule.

Condensable PM2.5

As a result of the recent inclusion of CPM in the regulatory definition of PM2.5, adequate reliable data does not exist for PM2.5, including condensable PM (CPM), for all sources. In addition, Compass does not have test data for VOC emissions from all sources. Under similar circumstances, EPA and the Environmental Appeals Board (EAB) have affirmed the use of a variable emission limit, or adjustable BACT limit, to ensure that the BACT limit is achievable.

Specifically, the EAB has upheld the use of worst-case adjustable limits subject to revision after subsequent stack testing where "the permit issuer had very little information on actual emissions of the targeted pollutants." *In re Steel Dynamics*, 9 E.A.D. 16 (EAB 2000) (providing adjustable limit for PM limits because of lack of data on condensable fraction). Consistent with this precedent, Compass would propose setting a worst-case emission limit for condensable PM while, as discussed below, setting a filterable limit based on available data. Upon further emission testing, the condensable limit would be reduced to a limit that is consistently achievable. *See in re Hadson Power 14-Buena Vista*, 4 E.A.D. 258 (EAB 1992) (upholding permit language authorizing downward adjustment of NOx emission rate); *In re Prairie State Generating Company*, 13 E.A.D. 1, 83 (EAB 2006) (adjustable limit appropriate where "there is an uncertain state of scientific knowledge about [the emissions], and their control.").

In keeping with this strategy approved by EPA, Compass is proposing the CPM emission limits presented in Table 4.1. These CPM limits may be adjusted downward, if appropriate, based on sufficient stack test data as it becomes available for each emission unit.

As background, the problems with measuring CPM have long been studied, and to a large extent are still not resolved. Partitioning of CPM is not technologically feasible and methods are less refined than accepted filterable particulate matter measurement methods. Therefore, Compass suggests the following categories of permit limits.

- A limit on PM2.5 filterable emissions. Compliance demonstration will use EPA accepted PM2.5 filterable measurements.
- A limit on PM10 filterable emissions. Compliance demonstration will use EPA accepted PM10 filterable measurements.
- A limit on PM condensable emissions. Condensables are a gas when they exit the stack. They condense (when they cool off) into an aerosol, particle, or globule of unknown size. Condensables cannot currently be described in terms of 2.5 or 10 or greater than 10 microns as they exit the stack. They currently can be partitioned into size categories (2.5 or 10 or greater than 10 microns) using ambient monitoring methods.

In this case, BACT would be assessed for PM2.5, but the permit limits for PM10, filterable PM2.5 and CPM would be set separately. Separating the permit limits as described above will serve the purpose of ensuring that BACT is achievable and that the condensable fraction is properly considered when setting a BACT limit. For example, Compass may have adequate test data to be able to set a PM10 or PM2.5 filterable limit, but little or no data on CPM, making a determination of an overall PM2.5 limit difficult. Such conditions do exist and confound Compass's ability to establish or request emission limits for CPM that are both achievable and measurable. Such decoupling of filterable and condensable PM2.5 will also allow Compass to appropriately establish filterable-only limits, without CPM confounding an overall PM2.5 limit.

For Compass Minerals, the precise origin of the CPM in any particular operating condition for certain processes is currently undetermined. The source could be inorganic condensables (product contamination), combustion condensables (although not likely for natural gas fuel), organic matter in brine from the Great Salt Lake, or other organic condensables. Alternatively, it's possible that testing results are anomalous. Isolating the permit limits of filterable PM from condensable PM enable a higher confidence in compliance, allow for improved understanding of the sources of condensable PM, and ultimately result in improved potential for control techniques for these emissions in the future.

Compass needs sufficient time to characterize CPM in order to determine an achievable BACT limit for PM2.5. In the meantime, separate and distinct emissions limits for filterable PM2.5 and condensable PM2.5 are appropriate.

Filterable PM2.5 in wet gas streams

Currently, there are no promulgated methods available for the measurement of filterable PM2.5 from sources with entrained water droplets (See Method 201A Section 1.5) (Attachment 9). Therefore, in wet streams such as scrubber exhaust, only total PM can be measured and the sizing of the PM will not be known. As such Compass requests that for scrubbers, the particulate limit be expressed as total PM rather than PM10 or PM2.5 to align with current measurement technology. A limit on Total PM will serve to limit PM2.5 also, because PM2.5 is a sub-set of Total PM.

Adjustment of boiler NOx limits

The previous BACT limits are based on the use of ultra-low NOx burners are BACT, which generally reduce NOx emissions to between 9 ppm and 20 ppm. Based on vendor guarantees for the ultra-low NOx burners installed on each of the 108.11 mmBtuh boilers (NGB-1 and NGB-2), NOx emission limits for Compass's boilers are currently set at 9 ppmdv at 3% oxygen. As stated in an NOI submitted by Compass for D-501 dated August 10, 2016, however, manufacturer guarantees provided to Compass do not appear to have adequately taken into consideration all ambient conditions experienced in the Ogden, Utah area. This includes ambient temperature and elevation, which affect burner operation and often result in greater NOx emissions that would be experienced at lower elevations. In addition, the permit limit does not include any compliance margin, which is likely to lead to long-term issues with achievability. To address these issues, Compass proposes an adjustment of the NOx limit for the ultra-low NOx burners on NGB-1 and NGB-2 from 9 ppmvd at 3% oxygen to 12 ppmvd at 3% oxygen; taking into account the experienced difficulties in operating ultra-low NOx burners during periods of high ambient temperature.

Table 4.1. Summary of Proposed Limits (lb/hr)

Item #	Permit ID	Area	EU ID	EU Description	Control ID	Control Description	PMTotal	PM2.5 - F	PM2.5 - C	SOX	NOX	VOC	NH3
1.01	II.A.3	SALT	AH-500	Salt Cooler Circuit	AH-500	Cyclonic wet scrubber	3.00		4.50				
1.02	II.A.4	SALT	AH-502	Salt Plant Circuit	AH-502	Cyclonic wet scrubber	3.00		4.50				
1.03	II.A.6	SALT	D-501	Salt Dryer 501	AH-513	Wet cyclone and cyclonic wet scrubber; Low NOx burners; Permit Cond. II.B.1.c. (nat gas fuel)	1.45		2.18				
1.04	II.A.19	SALT	F-506	Salt Cooler	BH-501	Baghouse		0.90	1.35				
1.05	II.A.27	SALT	BH-502	Salt bulk load-out	BH-502	Cartridge filter dust collector		0.17	0.26				
1.06	II.A.5	SALT	BH-505	Salt Special Products Circuit	BH-505	Baghouse that exhausts back into the building							
1.07	II.A.1	SALT	SALT FOUMH	SALT Fugitive outdoor uncaptured material handling	Permit Cond. II.B.1.g	Permit Cond. II.B.1.g regarding limitations on visible emissions caused by fugitive dust.							
1.08	II.A.1	SALT	SALT FBMH	SALT fugitive material handling from building doors/windows/vents	BL500	Inside a building; Permit Cond. II.B.1.g regarding limitations on visible emissions caused by fugitive dust.							
1.09	II.A.1	SALT	SALT FPILES	SALT Fugitive material handling not elsewhere addressed	Permit Cond. II.B.1.g	Permit Cond. II.B.1.g regarding limitations on visible emissions caused by fugitive dust.							
2.01	II.A.9	SOP	D-1545	SOP Dryer D-1545	AH-1547	Wet scrubber & LNB; Permit Cond. II.B.1.c. (nat gas fuel)	2.57		3.86				
2.02	II.A.10	SOP	AH-1555	SOP Plant Compaction Building	AH-1555	Wet scrubber	2.57		3.86				
2.03	II.A.11	SOP	B-1520	Nat gas process heater (<5 mmBtuh)	AH-1555	Wet scrubber; Permit Cond. II.B.1.c. (nat gas fuel)							
2.04	II.A.14	SOP	BH-001	SOP Bulk Loadout Circuit	BH-001	Baghouse		1.64	2.46				
2.05	II.A.15	SOP	BH-002	SOP Silo Storage Circuit	BH-002	Baghouse		1.37	2.06				
2.06	Unknown	SOP	BH-1565	SOP Compaction Recycle Hopper Bin Vent Filter	BH-1565	Fabric filter							
2.07	II.A.7	SOP	D-1400	SOP Dryer 1400 (51.0 mmBtuh)	BH-1400	Cyclone and Baghouse for PM; ULNB for NOx; Permit Cond. II.B.1.c. (nat gas fuel)		2.65	3.98				
2.08	II.A.7 or II.A.9	SOP	DeFoam	SOP Defoamer	No Control	None							
2.09	II.A.16	SOP	SUB	SOP Submerged Combustion, 90 mmBtuh	Permit Cond. II.B.1.c	Permit Cond. II.B.1.c. (nat gas fuel)							
2.10	II.A.26	SOP	SOP CT	Cooling Towers (SOP)	DE	Drift eliminators							
2.11	II.A.1	SOP	SOP FOUMH	SOP Fugitive outdoor uncaptured material handling	Permit Cond. II.B.1.g	Permit Cond. II.B.1.g regarding limitations on visible emissions caused by fugitive dust.							

Item #	Permit ID	Area	EU ID	EU Description	Control ID	Control Description	PMTotal	PM2.5 - F	PM2.5 - C	SOX	NOX	VOC	NH3
2.12	II.A.1	SOP	SOP FBMH	SOP Fugitive material handling from building doors/windows/vents	BL003 BL004 BL006 NCB	Inside a building; Permit Cond. II.B.1.g regarding limitations on visible emissions caused by fugitive dust.							
2.13	II.A.1	SOP	SOP FPILES	SOP Fugitive material handling not elsewhere addressed	Permit Cond. II.B.1.g	Permit Cond. II.B.1.g regarding limitations on visible emissions caused by fugitive dust.							
3.01	II.A.23	MAG	MP WS	MgCl2 plant process streams from cooling belt, packaging, and handling	AH-692	High energy venturi wet scrubber	0.50		0.75				
3.02	NOI anticipated 5/2017	MAG	EVAP	MgCl2 plant evaporators venting through 4 stacks	No Control	None						3.09	
3.03	II.A.24	MAG	MAG CT	MgCl2 plant cooling tower	DE	Drift eliminators							
3.04	II.A.1	MAG	MAG FBMH	MAG fugitive material handling from building doors/windows/vents	BL600	Permit Cond. II.B.1.g regarding limitations on visible emissions caused by fugitive dust.							
4.01	II.A.28	MISC	NGB-1	Natural Gas Boiler 1 - 108.11 mmBtuh	ULNB	ULNB, FGR, and continuous oxygen trim system; Permit Cond. II.B.1.c. (nat gas fuel)					1.60		
4.02	II.A.28	MISC	NGB-2	Natural Gas Boiler 2 - 108.11 mmBtuh	ULNB	ULNB, FGR, and continuous oxygen trim system; Permit Cond. II.B.1.c. (nat gas fuel)					1.60		
5.01	II.A.29	MISC	BU GEN OGN200	25 kW (estimated) emergency generator, Propane	Eng Controls	NSPS engine controls, as applicable							
5.02	Unknown	MISC	BU GEN OGN300	25 kW (estimated) emergency generator, Propane	Eng Controls	NSPS engine controls, as applicable							
5.03	AO 3/9/2017	SOP	SOP EMGen	100 KW emergency generator; Diesel	Eng Controls	NSPS engine controls, as applicable, including ULSD.							
5.04	II.A.21	MISC	MIS	175 kW emergency generator engine, diesel	Eng Controls	MACT engine controls, as applicable, including ULSD.							
5.05	II.A.21	MISC	THICK	300 kW emergency generator engine diesel	Eng Controls	NSPS engine controls, as applicable, including ULSD.							

Item #	Permit ID	Area	EU ID	EU Description	Control ID	Control Description	PMTotal	PM2.5 - F	PM2.5 - C	SOX	NOX	VOC	NH3
5.06	II.A.21	MISC	Fire Water Backup	450 kW emergency FW pump engine, diesel	Eng Controls	NSPS engine controls, as applicable, including ULSD.							
6.01	II.A.25	MISC	3	Gasoline Storage Tank - 6,000 gal	Tank Color	White/reflective exterior							
6.02	II.A.25	MISC	4-5	Diesel Storage Tanks - one 10,000 gal tank and four 12,000 gal tanks	Tank Color	White/reflective exterior							
6.03	II.A.17	MISC	BLAST	Abrasive Blast Machine	Permit Cond. II.B.16.a	Permit Cond. II.B.16.a regarding limitations on visible emissions.							
6.04	II.A.22	MISC	ROADS	Various roads and disturbed, unpaved areas	FDCP	Fugitive Dust Control Plan							

** P = point source; F = fugitive source; F/P = emissions could reasonably pass through a stack and be controlled, depending on technical, economic, and impacts analyses.*

Proposed Monitoring Requirements

Compass proposes the following in order to monitor compliance with the 24-hour PM2.5 air quality standard. Generally, the proposed monitoring requirements incorporate hourly parametric monitoring and/or periodic stack tests as appropriate.

For the baghouse sources with limits outlined in Table 4.1, Compass proposes to continuously monitor the bag leak detection system (BLDS) via analog signal. An average BLDS signal shall be calculated during each hour of operation. Analog signal limits will be established by corresponding to PM levels during the most recent stack test. Stack tests should be conducted at a frequency of once every three years.

For the scrubbers with limits outlined in Table 4.1, Compass proposes continuous monitoring of the scrubber liquid flow rate with an average flow rate calculated each hour. Parameter limits should be based on the most recent stack test. Stack tests should be conducted at a frequency of once every three years.

For the Magnesium Chloride Evaporators, Compass proposes that emissions will be determined based on an hourly emission rate determined during the most recent stack test multiplied by the hours of operation each month. Stack tests should be conducted at a frequency of once every three years.

For the facility boilers, Compass proposes to continuously monitor NOx emissions in accordance with the requirement outlined 40 CFR Part 60, Subpart Db. Stack tests should be conducted at a freqquency of once every three years.

Implementation Schedule

As a result of the BACT analyses presented in Section 3, Compass identified measures that may lead to improved control of PM2.5 and precursors. The cost of these measures, based on a dollars/ton of reduction of each pollutant controlled ranges from approximately $10,000 per ton to $9,000,000,000 per ton.

Compass has assessed the feasibility and implementation effort necessary for these measures and proposes the following.

1. Compass intends to route the SOP fugitive point source emissions identified in BACT analysis table 2.12b to the existing baghouse BH-1400 at an estimated cost of $10,933/ton no later than December 31, 2018.
2. Compass intends on conducting preliminary testing of alternative SOP defoamer chemicals (see BACT table 2.08) and will provide additional information to the UDAQ regarding those results no later than December 31, 2018.
3. Compass intends to thoroughly review its Fugitive Dust Control Plan and revise, if appropriate, to improve control of fugitive PM2.5 emissions for sources that cannot be feasibly controlled via air pollution control equipment, no later than December 31, 2018.
4. Compass intends to implement the proposed emission limits and monitoring schedule outlined above, no later than December 31, 2019.

5. ATTACHMENTS

Attachment 1	Summary of Allowable Emissions of PM2.5/PM2.5 Precursors (tpy)
Attachment 2	Summary of Actual Emissions of PM2.5/PM 2.5 Precursors (tpy) (2015)
Attachment 3	Summary of Emission Estimating Methods
Attachment 4	Summary of Existing BACT Limits for PM2.5 & Precursors
Attachment 5	Relevant Site-Wide Limits
Attachment 6	Description of Control Technologies Attachment
Attachment 7	BACT Backup Documentation
Attachment 8	Condensable Measurement
Attachment 9	References
Attachment 10	Acronyms

Att. 1 Summary of Allowable Emissions of PM2.5 and PM2.5 Precursors (tpy)

Item #	Permit ID	Area	EU ID	EU Description	Control ID	PM2.5	PM2.5 - F	PM2.5 - C	SOX	NOX	VOC	NH3
1.01	II.A.3	SALT	AH-500	Salt Cooler Circuit	AH-500	33.507	33.507	33.507	-	-	-	-
1.02	II.A.4	SALT	AH-502	Salt Plant Circuit	AH-502	22.951	22.951	22.951	-	-	-	-
1.03	II.A.6	SALT	D-501	Salt Dryer 501	AH-513	6.351	6.351	6.351	0.329	5.426	1.205	0.701
1.04	II.A.19	SALT	F-506	Salt Cooler	BH-501	3.942	3.942	3.942	-	-	-	-
1.05	II.A.27	SALT	BH-502	Salt bulk load-out	BH-502	0.113	0.113	0.113	-	-	-	-
1.06	II.A.5	SALT	BH-505	Salt Special Products Circuit	BH-505	0.000	0.000	-	-	-	-	-
1.07	II.A.1	SALT	SALT FOUMH	SALT Fugitive outdoor uncaptured material handling	Permit Cond. II.B.1.g	12.887	12.887	-	-	-	-	-
1.08	II.A.1	SALT	SALT FBMH	SALT fugitive material handling from building doors/windows/vents	BL500	0.068	0.068	-	-	-	-	-
1.09	II.A.1	SALT	SALT FPILES	SALT Fugitive material handling not elsewhere addressed	Permit Cond. II.B.1.g	3.455	3.455	-	-	-	-	-
2.01	II.A.9	SOP	D-1545	SOP Dryer D-1545	AH-1547	11.257	11.257	11.257	0.193	3.192	0.709	0.412
2.02	II.A.10	SOP	AH-1555	SOP Plant Compaction Building	AH-1555	11.257	11.257	11.257	0.032	1.074	0.118	0.069
2.03	II.A.11	SOP	B-1520	Nat gas process heater (<5 mmBtuh)	AH-1555	Accounted for in AH-1555 emissions.						
2.04	II.A.14	SOP	BH-001	SOP Bulk Loadout Circuit	BH-001	7.183	7.183	-	-	-	-	-
2.05	II.A.15	SOP	BH-002	SOP Silo Storage Circuit	BH-002	6.001	6.001	-	-	-	-	-
2.06	Unknown	SOP	BH-1565	SOP Compaction Recycle Hopper Bin Vent	BH-1565	0.005	0.005	-	-	-	-	-
2.07	II.A.7	SOP	D-1400	SOP Dryer 1400 (51.0 mmBtuh)	BH-1400	11.607	11.607	-	0.329	5.426	1.205	0.701
2.08	II.A.7 or II.A.9	SOP	DeFoam	SOP Defoamer	No Control	-	-	-	-	-	27.370	-
2.09	II.A.16	SOP	SUB	SOP Submerged Combustion, 90 mmBtuh	Permit Cond. II.B.1.c	2.937	0.734	2.203	0.580	19.324	2.126	1.237
2.10	II.A.26	SOP	SOP CT	Cooling Towers (SOP)	DE	0.254	-	0.254	-	-	-	-
2.11	II.A.1	SOP	SOP FOUMH	SOP Fugitive outdoor uncaptured material handling	Permit Cond. II.B.1.g	24.748	24.748	-	-	-	-	-
2.12	II.A.1	SOP	SOP FBMH	SOP Fugitive material handling from building doors/windows/vents	BL003 BL004 BL006 NCB	1.415	1.414	0.012	-	-	-	-
2.13	II.A.1	SOP	SOP FPILES	SOP Fugitive material handling not elsewhere addressed	Permit Cond. II.B.1.g	7.986	7.986	-	-	-	-	-

Item #	Permit ID	Area	EU ID	EU Description	Control ID	PM2.5	PM2.5 - F	PM2.5 - C	SOX	NOX	VOC	NH3
3.01	II.A.23	MAG	MP WS	MgCl2 plant process streams from cooling belt, packaging, and handling	AH-692	3.005	3.005	-	-	-	-	-
3.02	NOI anticipated 5/2017	MAG	EVAP	MgCl2 plant evaporators venting through 4 stacks	No Control	-	-	-	-	-	5.782	-
3.03	II.A.24	MAG	MAG CT	MgCl2 plant cooling tower	DE	0.018	-	0.018	-	-	-	-
3.04	II.A.1	MAG	MAG FBMH	MAG fugitive material handling from building doors/windows/vents	BL600	0.141	0.141	-	-	-	-	-
4.01	II.A.28	MISC	NGB-1	Natural Gas Boiler 1 - 108.11 mmBtuh	ULNB	3.528	0.882	2.646	0.696	5.694	2.553	1.486
4.02	II.A.28	MISC	NGB-2	Natural Gas Boiler 2 - 108.11 mmBtuh	ULNB	3.528	0.882	2.646	0.696	5.694	2.553	1.486
5.01	II.A.29	MISC	BU GEN OGN200	25 kW (estimated) emergency generator, Propane	Eng Controls	0.000	0.000	0.000	0.032	0.091	0.018	0.000
5.02	Unknown	MISC	BU GEN OGN300	25 kW (estimated) emergency generator, Propane	Eng Controls	0.000	0.000	0.000	0.032	0.091	0.018	0.000
5.03	AO 3/9/2017	SOP	SOP EMGen	100 KW emergency generator; Diesel	Eng Controls	0.013	0.007	0.007	0.001	0.199	0.199	0.005
5.04	II.A.21	MISC	MIS	175 kW emergency generator engine, diesel	Eng Controls	0.041	0.041	0.041	0.001	1.408	0.041	0.006
5.05	II.A.21	MISC	THICK	300 kW emergency generator engine diesel	Eng Controls	0.014	0.014	0.014	0.002	0.875	0.013	0.011
5.06	II.A.21	MISC	Fire Water Backup	450 kW emergency FW pump engine, diesel	Eng Controls	0.025	0.025	0.025	0.004	0.869	0.100	0.016
6.01	II.A.25	MISC	3	Gasoline Storage Tank - 6,000 gal	Tank Color	-	-	-	-	-	1.427	-
6.02	II.A.25	MISC	4-5	Diesel Storage Tanks - one 10,000 gal tank and four 12,000 gal tanks	Tank Color	-	-	-	-	-	0.020	-
6.03	II.A.17	MISC	BLAST	Abrasive Blast Machine	Permit Cond. II.B.16.a	0.085	0.085	-	-	-	-	-
6.04	II.A.22	MISC	ROADS	Various roads and disturbed, unpaved areas	FDCP	13.649	13.649	-	-	-	-	-
Total						**191.971**	**184.196**	**97.244**	**2.926**	**49.361**	**45.456**	**6.128**

Att. 2 Summary of Actual Emissions of PM2.5 and PM 2.5 Precursors (tpy) (2015)

Italics indicates PTE values rather than Actual Emissions.

Item #	Permit ID	Area	EU ID	EU Description	Control ID	PM2.5	PM2.5 - F	PM2.5 - C	SOX	NOX	VOC	NH3
1.01	II.A.3	SALT	AH-500	Salt Cooler Circuit	AH-500	0.010	0.005	0.005	-	-	-	-
1.02	II.A.4	SALT	AH-502	Salt Plant Circuit	AH-502	0.006	0.003	0.003	-	-	-	-
1.03	II.A.6	SALT	D-501	Salt Dryer 501	AH-513	0.595	0.154	0.441	0.045	5.426	0.414	0.241
1.04	II.A.19	SALT	F-506	Salt Cooler	BH-501	*0.003*	*0.002*	*0.002*	-	-	-	-
1.05	II.A.27	SALT	BH-502	Salt bulk load-out	BH-502	0.113	0.113	0.113	-	-	-	-
1.06	II.A.5	SALT	BH-505	Salt Special Products Circuit	BH-505	0.000	0.000	-	-	-	-	-
1.07	II.A.1	SALT	SALT FOUMH	SALT Fugitive outdoor uncaptured material handling	Permit Cond. II.B.1.g	*12.887*	*12.887*	-	-	-	-	-
1.08	II.A.1	SALT	SALT FBMH	SALT fugitive material handling from building doors/windows/vents	BL500	*0.068*	*0.068*	-	-	-	-	-
1.09	II.A.1	SALT	SALT FPILES	SALT Fugitive material handling not elsewhere addressed	Permit Cond. II.B.1.g	*3.455*	*3.455*	-	-	-	-	-
2.01	II.A.9	SOP	D-1545	SOP Dryer D-1545	AH-1547	*11.257*	*11.257*	*11.257*	*0.193*	*3.192*	*0.709*	*0.412*
2.02	II.A.10	SOP	AH-1555	SOP Plant Compaction Building	AH-1555	*11.257*	*11.257*	*11.257*	*0.032*	*1.074*	*0.118*	*0.069*
2.03	II.A.11	SOP	B-1520	Nat gas process heater (<5 mmBtuh)	AH-1555	Accounted for in AH-1555 emissions.						
2.04	II.A.14	SOP	BH-001	SOP Bulk Loadout Circuit	BH-001	0.077	0.077	-	-	-	-	-
2.05	II.A.15	SOP	BH-002	SOP Silo Storage Circuit	BH-002	0.447	0.447	-	-	-	-	-
2.06	Unknown	SOP	BH-1565	SOP Compaction Recycle Hopper Bin Vent	BH-1565	0.005	0.005	-	-	-	-	-
2.07	II.A.7	SOP	D-1400	SOP Dryer 1400 (51.0 mmBtuh)	BH-1400	*11.607*	*11.607*	-	*0.329*	*5.426*	*1.205*	*0.701*
2.08	II.A.7 or II.A.9	SOP	DeFoam	SOP Defoamer	No Control	-	-	-	-	-	*27.370*	-
2.09	II.A.16	SOP	SUB	SOP Submerged Combustion, 90 mmBtuh	Permit Cond. II.B.1.c	1.462	0.366	1.096	0.231	12.794	1.058	0.616
2.10	II.A.26	SOP	SOP CT	Cooling Towers (SOP)	DE	*0.254*	-	*0.254*	-	-	-	-

Item #	Permit ID	Area	EU ID	EU Description	Control ID	PM2.5	PM2.5 - F	PM2.5 - C	SOX	NOX	VOC	NH3
2.11	II.A.1	SOP	SOP FOUMH	SOP Fugitive outdoor uncaptured material handling	Permit Cond. II.B.1.g	*24.748*	*24.748*	-	-	-	-	-
2.12	II.A.1	SOP	SOP FBMH	SOP Fugitive material handling from building doors/windows/vents	BL003 BL004 BL006 NCB	*1.415*	*1.414*	*0.012*	-	-	-	-
2.13	II.A.1	SOP	SOP FPILES	SOP Fugitive material handling not elsewhere addressed	Permit Cond. II.B.1.g	*7.986*	*7.986*	-	-	-	-	-
3.01	II.A.23	MAG	MP WS	MgCl2 plant process streams from cooling belt, packaging, and handling	AH-692	*3.005*	*3.005*	-	-	-	-	-
3.02	NOI anticipated 5/2017	MAG	EVAP	MgCl2 plant evaporators venting through 4 stacks	No Control	-	-	-	-	-	*5.782*	-
3.03	II.A.24	MAG	MAG CT	MgCl2 plant cooling tower	DE	*0.018*	-	*0.018*	-	-	-	-
3.04	II.A.1	MAG	MAG FBMH	MAG fugitive material handling from building doors/windows/vents	BL600	*0.141*	*0.141*	-	-	-	-	-
4.01	II.A.28	MISC	NGB-1	Natural Gas Boiler 1 - 108.11 mmBtuh	ULNB	2.088	0.522	1.566	0.165	4.412	1.511	0.879
4.02	II.A.28	MISC	NGB-2	Natural Gas Boiler 2 - 108.11 mmBtuh	ULNB	2.088	0.522	1.566	0.165	4.305	1.511	0.879

Item #	Permit ID	Area	EU ID	EU Description	Control ID	PM2.5	PM2.5 - F	PM2.5 - C	SOX	NOX	VOC	NH3
5.01	II.A.29	MISC	BU GEN OGN200	25 kW (estimated) emergency generator, Propane	Eng Controls	*0.000*	*0.000*	*0.000*	*0.032*	*0.091*	*0.018*	*0.000*
5.02	Unknown	MISC	BU GEN OGN300	25 kW (estimated) emergency generator, Propane	Eng Controls	*0.000*	*0.000*	*0.000*	*0.032*	*0.091*	*0.018*	*0.000*
5.03	AO 3/9/2017	SOP	SOP EMGen	100 KW emergency generator; Diesel	Eng Controls	*0.013*	*0.007*	*0.007*	*0.001*	*0.199*	*0.199*	*0.005*
5.04	II.A.21	MISC	MIS	175 kW emergency generator engine, diesel	Eng Controls	0.003	0.001	0.001	0.001	0.079	0.003	-
5.05	II.A.21	MISC	THICK	300 kW emergency generator engine diesel	Eng Controls	*0.014*	*0.014*	*0.014*	*0.002*	*0.875*	*0.013*	*0.011*
5.06	II.A.21	MISC	Fire Water Backup	450 kW emergency FW pump engine, diesel	Eng Controls	0.001	0.001	0.001	0.004	0.039	0.001	-
6.01	II.A.25	MISC	3	Gasoline Storage Tank - 6,000 gal	Tank Color	-	-	-	-	-	1.427	-
6.02	II.A.25	MISC	4-5	Diesel Storage Tanks - one 10,000 gal tank and four 12,000 gal tanks	Tank Color	-	-	-	-	-	0.020	-
6.03	II.A.17	MISC	BLAST	Abrasive Blast Machine	Permit Cond. II.B.16.a	*0.085*	*0.085*	-	-	-	-	-
6.04	II.A.22	MISC	ROADS	Various roads and disturbed, unpaved areas	FDCP	1.107	-	-	-	-	-	-
Total						**96.215**	**90.148**	**27.611**	**1.231**	**38.001**	**41.376**	**3.812**

Att. 3 Summary of Emission Estimating Methods

Item #	Permit ID	Area	EU ID	EU Description	Control ID	Allowable Emissions Basis	Allowable Emissions Estimate Description	Actual Emissions Basis	Actual Emissions Estimate Description
1.01	II.A.3	SALT	AH-500	Salt Cooler Circuit	AH-500	Emission Limitations of Permit Number 5700001003	Allowable Emissions (tons/yr) = Emission Limit (lb/hr) x 8,760 (hr/yr) / 2,000 (lb/ton)	2015 Emission Inventory	Actual PM2.5 emissions for the 2015 EI are based on the most recent stack test results for PM10 multiplied by the number of operating hours, converted to tons, and multiplied by a ratio of the PM2.5 and PM10 particle size multipliers from AP-42 Chapter 13.2.4 (0.053 and 0.35, respectively).
1.02	II.A.4	SALT	AH-502	Salt Plant Circuit	AH-502	Emission Limitations of Permit Number 5700001003	Allowable Emissions (tons/yr) = Emission Limit (lb/hr) x 8,760 (hr/yr) / 2,000 (lb/ton)	2015 Emission Inventory	Actual PM2.5 emissions for the 2015 EI are based on the most recent stack test results for PM10 multiplied by the number of operating hours, converted to tons, and multiplied by a ratio of the PM2.5 and PM10 particle size multipliers from AP-42 Chapter 13.2.4 (0.053 and 0.35, respectively).
1.03	II.A.6	SALT	D-501	Salt Dryer 501	AH-513	Emission Limitations of Permit Number 5700001003	Allowable Emissions (tons/yr) = Emission Limit (lb/hr) x 8,760 (hr/yr) / 2,000 (lb/ton) NOx emissions are based on a vendor guarantee of 20 ppmvd @ 3% O2.	2015 Emission Inventory	Actual PM2.5 emissions for the 2015 EI are based on the most recent stack test results for PM10 multiplied by the number of operating hours, converted to tons, and multiplied by a ratio of the PM2.5 and PM10 particle size multipliers from AP-42 Chapter 13.2.4 (0.053 and 0.35, respectively). NOx emissions are based on a vendor guarantee of 20 ppmvd @ 3% O2.
1.04	II.A.19	SALT	F-506	Salt Cooler	BH-501	Emission Limitations of Permit Number 5700001003	Allowable Emissions (tons/yr) = Emission Limit (lb/hr) x 8,760 (hr/yr) / 2,000 (lb/ton)	2015 Emission Inventory	Actual PM2.5 emissions for the 2015 EI are based on the most recent stack test results for PM10 multiplied by the number of operating hours, converted to tons, and multiplied by a ratio of the PM2.5 and PM10 particle size multipliers from AP-42 Chapter 13.2.4 (0.053 and 0.35, respectively).

Item #	Permit ID	Area	EU ID	EU Description	Control ID	Allowable Emissions Basis	Allowable Emissions Estimate Description	Actual Emissions Basis	Actual Emissions Estimate Description
1.05	II.A.27	SALT	BH-502	Salt bulk load-out	BH-502	Emission Limitations of Permit Number 5700001003	Allowable Emissions (tons/yr) = Emission Limit (lb/hr) x 8,760 (hr/yr) / 2,000 (lb/ton)	Stack Test Data	Actual PM2.5 emissions for this source were estimated using the 2015 EI methodology. Specifically, the most recent stack test results for PM10 were multiplied by 8,760 operating hours, converted to tons, and multiplied by a ratio of the PM2.5 and PM10 particle size multipliers from AP-42 Chapter 13.2.4 (0.053 and 0.35, respectively).
1.06	II.A.5	SALT	BH-505	Salt Special Products Circuit	BH-505	AP-42 Emission Factors and Best Engineering Judgement	BH-505 controls salt material handling emissions and exhausts inside the salt mill building (BL500). As a result, emissions controlled by BH-505 are also controlled by BL500. Uncontrolled emissions captured and directed to BH-505 have been estimated using appropriate AP-42 emission factors. A PM2.5 capture efficiency of 90% and a PM2.5 control efficiency of 99% have been assumed based on best engineering judgement, site observations, and Table B.2-3. A PM2.5 capture and control efficiency of 75% is estimated to be provided by BL500 based on best engineering judgement and site observations. The resulting emissions have been added to the emissions estimated for BL500.	AP-42 Emission Factors and Best Engineering Judgement	BH-505 controls salt material handling emissions and exhausts inside the salt mill building (BL500). As a result, emissions controlled by BH-505 are also controlled by BL500. Uncontrolled emissions captured and directed to BH-505 have been estimated using appropriate AP-42 emission factors. A PM2.5 capture efficiency of 90% and a PM2.5 control efficiency of 99% have been assumed based on best engineering judgement, site observations, and Table B.2-3. A PM2.5 capture and control efficiency of 75% is estimated to be provided by BL500 based on best engineering judgement and site observations. The resulting emissions have been added to the emissions estimated for BL500.
1.07	II.A.1	SALT	SALT FOUMH	SALT Fugitive outdoor uncaptured material handling	Permit Cond. II.B.1.g	AP-42 Emission Factors and Best Engineering Judgement	Emissions from outdoor salt handling operations have been estimated using appropriate AP-42 emission factors. Where PM2.5-specific emission factors were unavailable, particle size multipliers from Chapter 13.2.4 of AP-42 were utilized to adjust from Total PM or PM10 to PM2.5. Due to the hygroscopic nature of salt, moist salt (i.e., salt hauled from evaporation ponds handled prior to drying) is assumed to have reduced emissions equivalent to 90% control efficiency when compared to dry salt emission factors.	AP-42 Emission Factors and Best Engineering Judgement	Emissions from outdoor salt handling operations have been estimated using appropriate AP-42 emission factors. Where PM2.5-specific emission factors were unavailable, particle size multipliers from Chapter 13.2.4 of AP-42 were utilized to adjust from Total PM or PM10 to PM2.5. Due to the hygroscopic nature of salt, moist salt (i.e., salt hauled from evaporation ponds handled prior to drying) is assumed to have reduced emissions equivalent to 90% control efficiency when compared to dry salt emission factors.

Item #	Permit ID	Area	EU ID	EU Description	Control ID	Allowable Emissions Basis	Allowable Emissions Estimate Description	Actual Emissions Basis	Actual Emissions Estimate Description
1.08	II.A.1	SALT	SALT FBMH	SALT fugitive material handling from building doors/windows/vents	BL500	AP-42 Emission Factors and Best Engineering Judgement	Emissions from salt material handling sources that are not controlled by emission control equipment are exhausted to the atmosphere via vents, windows, doors, etc. in BL500. Appropriate AP-42 emission factors have been used to estimate uncaptured and uncontrolled PM2.5 emissions from such sources. Where PM2.5-specific emission factors were unavailable, particle size multipliers from Chapter 13.2.4 of AP-42 were utilized to adjust from Total PM or PM10 to PM2.5. A PM2.5 capture and control efficiency of 75% is estimated to be provided by BL500 based on best engineering judgement and site observations.	AP-42 Emission Factors and Best Engineering Judgement	Emissions from salt material handling sources that are not controlled by emission control equipment are exhausted to the atmosphere via vents, windows, doors, etc. in BL500. Appropriate AP-42 emission factors have been used to estimate uncaptured and uncontrolled PM2.5 emissions from such sources. Where PM2.5-specific emission factors were unavailable, particle size multipliers from Chapter 13.2.4 of AP-42 were utilized to adjust from Total PM or PM10 to PM2.5. A PM2.5 capture and control efficiency of 75% is estimated to be provided by BL500 based on best engineering judgement and site observations.
1.09	II.A.1	SALT	SALT FPILES	SALT Fugitive material handling not elsewhere addressed	Permit Cond. II.B.1.g	AP-42 Emission Factors and Best Engineering Judgement	Emissions from salt piles and unpaved salts roads have been estimated using appropriate AP-42 emission factors. Where PM2.5-specific emission factors were unavailable, particle size multipliers from Chapter 13.2.4 of AP-42 were utilized to adjust from Total PM or PM10 to PM2.5. Due to the hygroscopic nature of salt, moist salt (i.e., salt hauled from evaporation ponds handled prior to drying) is assumed to have reduced emissions equivalent to 90% control efficiency when compared to dry salt emission factors. Road silt content is assumed to comparable to sand and gravel processing.	AP-42 Emission Factors and Best Engineering Judgement	Emissions from salt piles and unpaved salts roads have been estimated using appropriate AP-42 emission factors. Where PM2.5-specific emission factors were unavailable, particle size multipliers from Chapter 13.2.4 of AP-42 were utilized to adjust from Total PM or PM10 to PM2.5. Due to the hygroscopic nature of salt, moist salt (i.e., salt hauled from evaporation ponds handled prior to drying) is assumed to have reduced emissions equivalent to 90% control efficiency when compared to dry salt emission factors. Road silt content is assumed to comparable to sand and gravel processing.
2.01	II.A.9	SOP	D-1545	SOP Dryer D-1545	AH-1547	Emission Limitations of Permit Number 5700001003	Allowable Emissions (tons/yr) = Emission Limit (lb/hr) x 8,760 (hr/yr) / 2,000 (lb/ton) NOx emissions are based on a vendor guarantee of 20 ppmvd @ 3% O2.	Emission Limitations of Permit Number 5700001003	AH-1547 is a new piece of equipment related to the ongoing SOP compaction plant expansion. Initial performance testing for this source has not yet been conducted. NOx emissions are based on a vendor guarantee of 20 ppmvd @ 3% O2. Allowable Emissions (tons/yr) = Emission Limit (lb/hr) x 8,760 (hr/yr) / 2,000 (lb/ton)

Item #	Permit ID	Area	EU ID	EU Description	Control ID	Allowable Emissions Basis	Allowable Emissions Estimate Description	Actual Emissions Basis	Actual Emissions Estimate Description
2.02	II.A.10	SOP	AH-1555	SOP Plant Compaction Building	AH-1555	Emission Limitations of Permit Number 5700001003	Allowable Emissions (tons/yr) = Emission Limit (lb/hr) x 8,760 (hr/yr) / 2,000 (lb/ton) Combustion emissions are based on	Emission Limitations of Permit Number 5700001003	AH-1555 is a new piece of equipment related to the ongoing SOP compaction plant expansion. Initial performance testing for this source has not yet been conducted. Allowable Emissions (tons/yr) = Emission Limit (lb/hr) x 8,760 (hr/yr) / 2,000 (lb/ton)
2.03	II.A.11	SOP	B-1520	Nat gas process heater (<5 mmBtuh)	AH-1555	Emission Limitations of Permit Number 5700001003	Emissions from this source are included in the emission estimates for AH-1555. Allowable Emissions (tons/yr) = Emission Limit (lb/hr) x 8,760 (hr/yr) / 2,000 (lb/ton) Natural gas combustion emissions have been estimated using AP-42 emission factors from Table 1.4-2. NOx emissions are based on a vendor guarantee of 20 ppmvd @ 3% O2.	Emission Limitations of Permit Number 5700001003	Emissions from this source are included in the emission estimates for AH-1555. AH-1555 is a new piece of equipment related to the ongoing SOP compaction plant expansion. Initial performance testing for this source has not yet been conducted. Allowable Emissions (tons/yr) = Emission Limit (lb/hr) x 8,760 (hr/yr) / 2,000 (lb/ton) Natural gas combustion emissions have been estimated using AP-42 emission factors from Table 1.4-2. NOx emissions are based on a vendor guarantee of 20 ppmvd @ 3% O2.
2.04	II.A.14	SOP	BH-001	SOP Bulk Loadout Circuit	BH-001	Emission Limitations of Permit Number 5700001003	Allowable Emissions (tons/yr) = Emission Limit (lb/hr) x 8,760 (hr/yr) / 2,000 (lb/ton)	2015 Emission Inventory	Actual PM2.5 emissions for the 2015 EI are based on the most recent stack test results for PM10 multiplied by the number of operating hours, converted to tons, and multiplied by a ratio of the PM2.5 and PM10 particle size multipliers from AP-42 Chapter 13.2.4 (0.053 and 0.35, respectively).
2.05	II.A.15	SOP	BH-002	SOP Silo Storage Circuit	BH-002	Emission Limitations of Permit Number 5700001003	Allowable Emissions (tons/yr) = Emission Limit (lb/hr) x 8,760 (hr/yr) / 2,000 (lb/ton)	2015 Emission Inventory	Actual PM2.5 emissions for the 2015 EI are based on the most recent stack test results for PM10 multiplied by the number of operating hours, converted to tons, and multiplied by a ratio of the PM2.5 and PM10 particle size multipliers from AP-42 Chapter 13.2.4 (0.053 and 0.35, respectively).

Item #	Permit ID	Area	EU ID	EU Description	Control ID	Allowable Emissions Basis	Allowable Emissions Estimate Description	Actual Emissions Basis	Actual Emissions Estimate Description
2.06	Unknown	SOP	BH-1565	SOP Compaction Recycle Hopper Bin Vent	BH-1565	AP-42 Emission Factors	Bin vent emissions are based on AP42 Table 11.19.2-4 with 95.9% Control Efficiency Removed. Control Efficiency that was removed is based on Conveyor Transfer Point Calculation in 11.19.2.	AP-42 Emission Factors	Bin vent emissions are based on AP42 Table 11.19.2-4 with 95.9% Control Efficiency Removed. Control Efficiency that was removed is based on Conveyor Transfer Point Calculation in 11.19.2.
2.07	II.A.7	SOP	D-1400	SOP Dryer 1400 (51.0 mmBtuh)	BH-1400	Emission Limitations of Permit Number 5700001003	Allowable Emissions (tons/yr) = Emission Limit (lb/hr) x 8,760 (hr/yr) / 2,000 (lb/ton) NOx emissions are based on a vendor guarantee of 20 ppmvd @ 3% O2.	Emission Limitations of Permit Number 5700001003	BH-1400 is a new piece of equipment related to the ongoing SOP compaction plant expansion. Initial performance testing for this source has not yet been conducted. NOx emissions are based on a vendor guarantee of 20 ppmvd @ 3% O2. Allowable Emissions (tons/yr) = Emission Limit (lb/hr) x 8,760 (hr/yr) / 2,000 (lb/ton)
2.08	II.A.7 or II.A.9	SOP	DeFoam	SOP Defoamer	No Control	Mass Balance	Defoamer utilized in the SOP process is 60% VOC based on the manufacturer's SDS. The addition rate of defoamer is 90 mL/min and has a density of 7.3 lb/gal.	Mass Balance	Defoamer utilized in the SOP process is 60% VOC based on the manufacturer's SDS. The addition rate of defoamer is 90 mL/min and has a density of 7.3 lb/gal.
2.09	II.A.16	SOP	SUB	SOP Submerged Combustion, 90 mmBtuh	Permit Cond. II.B.1.c	AP-42 Emission Factors	Natural gas combustion emissions from the submerged combustion source have been estimated using AP-42 emission factors from Table 1.4-2.	2015 Emission Inventory and AP-42 Emission Factors	Emissions reported for "SUB" in the 2015 EI were utilized to account for emissions from the 30 mmBtu/hr burners present at that time. Natural gas combustion emissions from the additional 60 mmBtu/hr of submerged combustion burners have been estimated using AP-42 emission factors from Table 1.4-2 and added to the 2015 EI estimates.
2.10	II.A.26	SOP	SOP CT	Cooling Towers (SOP)	DE	Mass Balance	Cooling tower emissions have been estimated based on the cooling tower circulation rate, drift loss, and typical total dissolved solids. Additionally, a particle size distribution has been used to estimate the amount of PM2.5 emissions in pounds based on droplet size distributions, droplet mass, solid particle volume, and solid particle mass.	Mass Balance	Cooling tower emissions have been estimated based on the cooling tower circulation rate, drift loss, and typical total dissolved solids. Additionally, a particle size distribution has been used to estimate the amount of PM2.5 emissions in pounds based on droplet size distributions, droplet mass, solid particle volume, and solid particle mass.

Item #	Permit ID	Area	EU ID	EU Description	Control ID	Allowable Emissions Basis	Allowable Emissions Estimate Description	Actual Emissions Basis	Actual Emissions Estimate Description
2.11	II.A.1	SOP	SOP FOUMH	SOP Fugitive outdoor uncaptured material handling	Permit Cond. II.B.1.g	AP-42 Emission Factors and Best Engineering Judgement	Emissions from outdoor SOP handling operations have been estimated using appropriate AP-42 emission factors. Where PM2.5-specific emission factors were unavailable, particle size multipliers from Chapter 13.2.4 of AP-42 were utilized to adjust from Total PM or PM10 to PM2.5. Due to the hygroscopic nature of SOP, moist SOP (i.e., SOP hauled from evaporation ponds handled prior to drying and SOP in the wet section of the production process) is assumed to have reduced emissions equivalent to 90% control efficiency when compared to dry SOP emission factors.	AP-42 Emission Factors and Best Engineering Judgement	Emissions from outdoor SOP handling operations have been estimated using appropriate AP-42 emission factors. Where PM2.5-specific emission factors were unavailable, particle size multipliers from Chapter 13.2.4 of AP-42 were utilized to adjust from Total PM or PM10 to PM2.5. Due to the hygroscopic nature of SOP, moist SOP (i.e., SOP hauled from evaporation ponds handled prior to drying and SOP in the wet section of the production process) is assumed to have reduced emissions equivalent to 90% control efficiency when compared to dry SOP emission factors.
2.12	II.A.1	SOP	SOP FBMH	SOP Fugitive material handling from building doors/windows/vents	BL003 BL004 BL006 NCB	AP-42 Emission Factors and Best Engineering Judgement	Emissions from SOP material handling sources that are not controlled by emission control equipment are exhausted to the atmosphere via vents, windows, doors, etc. in BL003, BL004, BL006, and NCB. Appropriate AP-42 emission factors have been used to estimate uncaptured and uncontrolled PM2.5 emissions from such sources. Where PM2.5-specific emission factors were unavailable, particle size multipliers from Chapter 13.2.4 of AP-42 were utilized to adjust from Total PM or PM10 to PM2.5. A PM2.5 capture and control efficiency of 75% is estimated to be provided by BL003, BL004, BL006 based on best engineering judgement and site observations.	AP-42 Emission Factors and Best Engineering Judgement	Emissions from SOP material handling sources that are not controlled by emission control equipment are exhausted to the atmosphere via vents, windows, doors, etc. in BL003, BL004, BL006, and NCB. Appropriate AP-42 emission factors have been used to estimate uncaptured and uncontrolled PM2.5 emissions from such sources. Where PM2.5-specific emission factors were unavailable, particle size multipliers from Chapter 13.2.4 of AP-42 were utilized to adjust from Total PM or PM10 to PM2.5. A PM2.5 capture and control efficiency of 75% is estimated to be provided by BL003, BL004, BL006 based on best engineering judgement and site observations.

Item #	Permit ID	Area	EU ID	EU Description	Control ID	Allowable Emissions Basis	Allowable Emissions Estimate Description	Actual Emissions Basis	Actual Emissions Estimate Description
2.13	II.A.1	SOP	SOP FPILES	SOP Fugitive material handling not elsewhere addressed	Permit Cond. II.B.1.g	AP-42 Emission Factors and Best Engineering Judgement	Emissions from SOP piles and unpaved SOP roads have been estimated using appropriate AP-42 emission factors. Where PM2.5-specific emission factors were unavailable, particle size multipliers from Chapter 13.2.4 of AP-42 were utilized to adjust from Total PM or PM10 to PM2.5. Due to the hygroscopic nature of salt, moist salt (i.e., SOP hauled from evaporation ponds handled prior to drying and SOP in the wet section of the production process) is assumed to have reduced emissions equivalent to 90% control efficiency when compared to dry SOP emission factors. Road silt content is assumed to comparable to sand and gravel processing.	AP-42 Emission Factors and Best Engineering Judgement	Emissions from SOP piles and unpaved SOP roads have been estimated using appropriate AP-42 emission factors. Where PM2.5-specific emission factors were unavailable, particle size multipliers from Chapter 13.2.4 of AP-42 were utilized to adjust from Total PM or PM10 to PM2.5. Due to the hygroscopic nature of salt, moist salt (i.e., SOP hauled from evaporation ponds handled prior to drying and SOP in the wet section of the production process) is assumed to have reduced emissions equivalent to 90% control efficiency when compared to dry SOP emission factors. Road silt content is assumed to comparable to sand and gravel processing.
3.01	II.A.23	MAG	MP WS	MgCl2 plant process streams from cooling belt, packaging, and handling	AH-692	Emission Limitations of Permit Number 5700001003	Allowable Emissions (tons/yr) = Emission Limit (gr/dscf) x Flow (dscf) / 7,000 (gr/lb) x 8,760 (hr/yr) / 2,000 (lb/ton)	Emission Limitations of Permit Number 5700001003	Allowable Emissions (tons/yr) = Emission Limit (gr/dscf) x Flow (dscf) / 7,000 (gr/lb) x 8,760 (hr/yr) / 2,000 (lb/ton)
3.02	NOI anticipated 5/2017	MAG	EVAP	MgCl2 plant evaporators venting through 4 stacks	No Control	Stack Test Data	VOC emission data obtained during the most recent stack test in lb/hr was multiplied by 8,760 tons/yr to estimate evaporator emissions.	Stack Test Data	VOC emission data obtained during the most recent stack test in lb/hr was multiplied by 8,760 tons/yr to estimate evaporator emissions.
3.03	II.A.24	MAG	MAG CT	MgCl2 plant cooling tower	DE	Mass Balance	Cooling tower emissions have been estimated based on the cooling tower circulation rate, drift loss, and typical total dissolved solids. Additionally, a particle size distribution has been used to estimate the amount of PM2.5 emissions in pounds based on droplet size distributions, droplet mass, solid particle volume, and solid particle mass.	Mass Balance	Cooling tower emissions have been estimated based on the cooling tower circulation rate, drift loss, and typical total dissolved solids. Additionally, a particle size distribution has been used to estimate the amount of PM2.5 emissions in pounds based on droplet size distributions, droplet mass, solid particle volume, and solid particle mass.

Item #	Permit ID	Area	EU ID	EU Description	Control ID	Allowable Emissions Basis	Allowable Emissions Estimate Description	Actual Emissions Basis	Actual Emissions Estimate Description
3.04	II.A.1	MAG	MAG FBMH	MAG fugitive material handling from building doors/windows/vents	BL600	AP-42 Emission Factors and Best Engineering Judgement	Emissions from MAG material handling sources that are not controlled by emission control equipment are exhausted to the atmosphere via vents, windows, doors, etc. in BL600. Appropriate AP-42 emission factors have been used to estimate uncaptured and uncontrolled PM2.5 emissions from such sources. Where PM2.5-specific emission factors were unavailable, particle size multipliers from Chapter 13.2.4 of AP-42 were utilized to adjust from Total PM or PM10 to PM2.5. A PM2.5 capture and control efficiency of 75% is estimated to be provided by BL600 based on best engineering judgement and site observations.	AP-42 Emission Factors and Best Engineering Judgement	Emissions from MAG material handling sources that are not controlled by emission control equipment are exhausted to the atmosphere via vents, windows, doors, etc. in BL600. Appropriate AP-42 emission factors have been used to estimate uncaptured and uncontrolled PM2.5 emissions from such sources. Where PM2.5-specific emission factors were unavailable, particle size multipliers from Chapter 13.2.4 of AP-42 were utilized to adjust from Total PM or PM10 to PM2.5. A PM2.5 capture and control efficiency of 75% is estimated to be provided by BL600 based on best engineering judgement and site observations.
4.01	II.A.28	MISC	NGB-1	Natural Gas Boiler 1 - 108.11 mmBtuh	ULNB	Emission Limitations of Permit Number 5700001003 and AP-42 Emission Factors	Allowable Emissions (tons/yr) = Emission Limit (lb/hr) x 8,760 (hr/yr) / 2,000 (lb/ton) OR Emission Factor (lb/mmscf) x Capacity (mmBtu/hr) / 1,020 (Btu/scf) x 8,760 (hr/yr) / 2,000 (lb/ton)	2015 Emission Inventory	2015 EI emissions are based on actual fuel usage along with emission factors from the most recent stack test and, when stack test data is not available, AP-42 emission factors for natural gas-fired external combustion equipment.
4.02	II.A.28	MISC	NGB-2	Natural Gas Boiler 2 - 108.11 mmBtuh	ULNB	Emission Limitations of Permit Number 5700001003 and AP-42 Emission Factors	Allowable Emissions (tons/yr) = Emission Limit (lb/hr) x 8,760 (hr/yr) / 2,000 (lb/ton) OR Emission Factor (lb/mmscf) x Capacity (mmBtu/hr) / 1,020 (Btu/scf) x 8,760 (hr/yr) / 2,000 (lb/ton)	2015 Emission Inventory	2015 EI emissions are based on actual fuel usage along with emission factors from the most recent stack test and, when stack test data is not available, AP-42 emission factors for natural gas-fired external combustion equipment.
5.01	II.A.29	MISC	BU GEN OGN200	25 kW (estimated) emergency generator, Propane	Eng Controls	Manufacturer Data and AP-42 Emission Factors	Where available, manufacturer data for internal combustion engines was utilized. Otherwise, the most appropriate AP-42 emission factor was used with the assumption that PM10 and PM2.5 are equivalent if separate factors were not specified. Run hours were assumed to be 500 hours based on the engine being categorized as an emergency engine.	Manufacturer Data and AP-42 Emission Factors	Where available, manufacturer data for internal combustion engines was utilized. Otherwise, the most appropriate AP-42 emission factor was used with the assumption that PM10 and PM2.5 are equivalent if separate factors were not specified. Run hours were assumed to be 500 hours based on the engine being categorized as an emergency engine.

Item #	Permit ID	Area	EU ID	EU Description	Control ID	Allowable Emissions Basis	Allowable Emissions Estimate Description	Actual Emissions Basis	Actual Emissions Estimate Description
5.02	Unknown	MISC	BU GEN OGN300	25 kW (estimated) emergency generator, Propane	Eng Controls	Manufacturer Data and AP-42 Emission Factors	Where available, manufacturer data for internal combustion engines was utilized. Otherwise, the most appropriate AP-42 emission factor was used with the assumption that PM10 and PM2.5 are equivalent if separate factors were not specified. Run hours were assumed to be 500 hours based on the engine being categorized as an emergency engine.	Manufacturer Data and AP-42 Emission Factors	Where available, manufacturer data for internal combustion engines was utilized. Otherwise, the most appropriate AP-42 emission factor was used with the assumption that PM10 and PM2.5 are equivalent if separate factors were not specified. Run hours were assumed to be 500 hours based on the engine being categorized as an emergency engine.
5.03	AO 3/9/2017	SOP	SOP EMGen	100 KW emergency generator; Diesel	Eng Controls	Manufacturer Data and AP-42 Emission Factors	Where available, manufacturer data for internal combustion engines was utilized. Otherwise, the most appropriate AP-42 emission factor was used with the assumption that PM10 and PM2.5 are equivalent if separate factors were not specified. Run hours were assumed to be 500 hours based on the engine being categorized as an emergency engine.	Manufacturer Data and AP-42 Emission Factors	Where available, manufacturer data for internal combustion engines was utilized. Otherwise, the most appropriate AP-42 emission factor was used with the assumption that PM10 and PM2.5 are equivalent if separate factors were not specified. Run hours were assumed to be 500 hours based on the engine being categorized as an emergency engine.
5.04	II.A.21	MISC	MIS	175 kW emergency generator engine, diesel	Eng Controls	Manufacturer Data and AP-42 Emission Factors	Where available, manufacturer data for internal combustion engines was utilized. Otherwise, the most appropriate AP-42 emission factor was used with the assumption that PM10 and PM2.5 are equivalent if separate factors were not specified. Run hours were assumed to be 500 hours based on the engine being categorized as an emergency engine.	Manufacturer Data and AP-42 Emission Factors	Where available, manufacturer data for internal combustion engines was utilized. Otherwise, the most appropriate AP-42 emission factor was used with the assumption that PM10 and PM2.5 are equivalent if separate factors were not specified. Run hours were based on actual 2015 usage.
5.05	II.A.21	MISC	THICK	300 kW emergency generator engine diesel	Eng Controls	Manufacturer Data and AP-42 Emission Factors	Where available, manufacturer data for internal combustion engines was utilized. Otherwise, the most appropriate AP-42 emission factor was used with the assumption that PM10 and PM2.5 are equivalent if separate factors were not specified. Run hours were assumed to be 500 hours based on the engine being categorized as an emergency engine.	Manufacturer Data and AP-42 Emission Factors	Where available, manufacturer data for internal combustion engines was utilized. Otherwise, the most appropriate AP-42 emission factor was used with the assumption that PM10 and PM2.5 are equivalent if separate factors were not specified. Run hours were assumed to be 500 hours based on the engine being categorized as an emergency engine.

Item #	Permit ID	Area	EU ID	EU Description	Control ID	Allowable Emissions Basis	Allowable Emissions Estimate Description	Actual Emissions Basis	Actual Emissions Estimate Description
5.06	II.A.21	MISC	Fire Water Backup	450 kW emergency FW pump engine, diesel	Eng Controls	Manufacturer Data and AP-42 Emission Factors	Where available, manufacturer data for internal combustion engines was utilized. Otherwise, the most appropriate AP-42 emission factor was used with the assumption that PM10 and PM2.5 are equivalent if separate factors were not specified. Run hours were assumed to be 500 hours based on the engine being categorized as an emergency engine.	Manufacturer Data and AP-42 Emission Factors	Where available, manufacturer data for internal combustion engines was utilized. Otherwise, the most appropriate AP-42 emission factor was used with the assumption that PM10 and PM2.5 are equivalent if separate factors were not specified. Run hours were based on actual 2015 usage.
6.01	II.A.25	MISC	3	Gasoline Storage Tank - 6,000 gal	Tank Color	Tanks 4.09d	Tanks 4.09d emission estimation software developed by EPA was utilized to estimate VOC emissions based on gasoline tank characteristics and the chemical and physical characteristics of RVP 11 gasoline.	Tanks 4.09d	Tanks 4.09d emission estimation software developed by EPA was utilized to estimate VOC emissions based on gasoline tank characteristics and the chemical and physical characteristics of RVP 11 gasoline.
6.02	II.A.25	MISC	4-5	Diesel Storage Tanks - one 10,000 gal tank and four 12,000 gal tanks	Tank Color	Tanks 4.09d	Tanks 4.09d emission estimation software developed by EPA was utilized to estimate VOC emissions based on diesel tank characteristics and the chemical and physical characteristics of Distillate Fuel No. 2.	Tanks 4.09d	Tanks 4.09d emission estimation software developed by EPA was utilized to estimate VOC emissions based on diesel tank characteristics and the chemical and physical characteristics of Distillate Fuel No. 2.
6.03	II.A.17	MISC	BLAST	Abrasive Blast Machine	Permit Cond. II.B.16.a	AP-42 Emission Factors and Best Engineering Judgement	AP-42 Table 13.2.6-1 provides PM emission factors for abrasive blasting in lb/1,000 lbs of abrasive utilized. Based on historical plant information, it takes approximately 50 lbs of abrasive and 20 minutes to sandblast a part. Additionally, sandblasting is only conducted during daylight hours due to the outdoor nature of the blast pad. The resulting estimate is: 50 lbs abrasive/part / 20 minutes/part x 60 minutes/hr x 4,380 hrs/yr / 1,000 x EF lb/1,000 lbs of abrasive x 0.053/0.35 = PM2.5 TPY	AP-42 Emission Factors and Best Engineering Judgement	No sandblasting emissions were reported in the 2015 EI. Therefore, actual emissions are assumed to be no more than allowable emissions. AP-42 Table 13.2.6-1 provides PM emission factors for abrasive blasting in lb/1,000 lbs of abrasive utilized. Based on historical plant information, it takes approximately 50 lbs of abrasive and 20 minutes to sandblast a part. Additionally, sandblasting is only conducted during daylight hours due to the outdoor nature of the blast pad. The resulting estimate is: 50 lbs abrasive/part / 20 minutes/part x 60 minutes/hr x 4,380 hrs/yr / 1,000 x EF lb/1,000 lbs of abrasive x 0.053/0.35 = PM2.5 TPY

Item #	Permit ID	Area	EU ID	EU Description	Control ID	Allowable Emissions Basis	Allowable Emissions Estimate Description	Actual Emissions Basis	Actual Emissions Estimate Description
6.04	II.A.22	MISC	ROADS	Various roads and disturbed, unpaved areas	FDCP	AP-42 Emission Factors and Best Engineering Judgement	Emissions from pave and unpaved roads have been estimated using appropriate AP-42 emission factors. Where PM2.5-specific emission factors were unavailable, particle size multipliers from Chapter 13.2.4 of AP-42 were utilized to adjust from Total PM or PM10 to PM2.5. Road silt content is assumed to comparable to sand and gravel processing. Vehicle traffic was estimated based on average vehicle weight and travel distance and the maximum amount of material hauling and shipping.	AP-42 Emission Factors and Best Engineering Judgement	Emissions from pave and unpaved roads have been estimated using appropriate AP-42 emission factors. Where PM2.5-specific emission factors were unavailable, particle size multipliers from Chapter 13.2.4 of AP-42 were utilized to adjust from Total PM or PM10 to PM2.5. Road silt content is assumed to comparable to sand and gravel processing. Vehicle traffic was based on actual material hauling and shipping during 2015.

Attachment 4. Summary of Existing BACT Limits for PM2.5 & Precursors

Item #	Permit ID	Area	EU ID	EU Description	Control ID	Pollutant	BACT Limit for PM2.5 and PM2.5 Precursors
NA	II.B.2.a	SALT	Salt Plant	Salt Plant	Admin Limit	PM 2.5	Production of dried salt shall be no greater than 960,000 tons per 12-month rolling total.
1.01	II.B.3.a	SALT	AH-500	Salt Cooler Circuit	AH-500	PM 2.5	7.65 lb/hr and 0.020 grains/dscf.
1.02	II.B.4.a	SALT	AH-502	Salt Plant Circuit	AH-502	PM2.5	5.24 lb/hr and 0.040 grains/dscf.
1.03	II.B.5.a	SALT	D-501	Salt Dryer 501	AH-513	NA	Production of dried salt shall be no greater than 120 tons per hour.
1.03	II.B.5.c	SALT	D-501	Salt Dryer 501	AH-513	PM2.5	1.45 lb/hr and 0.0114 grains/dscf.
1.03	II.B.1.c.	SALT	D-501	Salt Dryer 501	AH-513	PM2.5, SOx, NOx, VOC	The permittee shall use only pipeline quality natural gas for fuel for all boilers and burners. 20 ppm has been requested for NOx.
1.04	II.B.17.b	SALT	F-506	Salt Cooler	BH-501	PM2.5	0.9 lb/hr and 0.01 grains/dscf.
1.05	II.B.21.b	SALT	BH-502	Salt bulk load-out	BH-502	PM2.5	0.17 lb/hr and 0.0053 grains/dscf.
1.06	II.A.5	SALT	BH-505	Salt Special Products Circuit	BH-505	PM2.5	None. BH exhausts back to the building, and is addressed in Item 1.08.
2.01	II.B.8.a	SOP	D-1545	SOP Dryer D-1545	AH-1547	PM2.5	2.57 lb/hr and 0.01 grains/dscf.
2.01	II.B.1.c.	SOP	D-1545	SOP Dryer D-1545	AH-1547	PM2.5, SOx, NOx, VOC	The permittee shall use only pipeline quality natural gas for fuel for all boilers and burners.
2.02	II.B.9.a	SOP	AH-1555	SOP Plant Compaction Building	AH-1555	PM2.5	2.57 lb/hr and 0.01 grains/dscf.
2.03	II.B.1.c	SOP	B-1520	Nat gas process heater (<5 mmBtuh)	AH-1555	PM2.5, SOx, NOx, VOC	The permittee shall use only pipeline quality natural gas for fuel for all boilers and burners.
2.04	II.B.13.a	SOP	BH-001	SOP Bulk Loadout Circuit	BH-001	PM2.5	1.64 pounds per hour and 0.01 grains/dscf.
2.04	II.B.13.c	SOP	BH-001	SOP Bulk Loadout Circuit	BH-001	PM2.5	Sulfate of Potash loading rate shall be no greater than 300 tons per hour and no greater than 5,600 hours per rolling 12-month total for potash silos loadout.
2.05	II.B.14.a	SOP	BH-002	SOP Silo Storage Circuit	BH-002	PM2.5	1.37 pounds per hour and 0.01 grains/dscf.

Item #	Permit ID	Area	EU ID	EU Description	Control ID	Pollutant	BACT Limit for PM2.5 and PM2.5 Precursors
2.07	II.B.6.c	SOP	D-1400	SOP Dryer 1400 (51.0 mmBtuh)	BH-1400	PM2.5	2.65 pounds per hour and 0.01 grains/dscf.
2.07	II.B.1.c.	SOP	D-1400	SOP Dryer 1400 (51.0 mmBtuh)	BH-1400	PM2.5, SOx, NOx, VOC	The permittee shall use only pipeline quality natural gas for fuel for all boilers and burners.
2.09	II.B.1.c	SOP	SUB	SOP Submerged Combustion, 90 mmBtuh	Permit Cond. II.B.1.c	PM2.5, SOx, NOx, VOC	Permit II.B.1.c. The permittee shall use only pipeline quality natural gas for fuel for all boilers and burners.
4.01	II.B.22.a	MISC	NGB-1	Natural Gas Boiler 1 - 108.11 mmBtuh	ULNB	NOx	1.30 lb/hr and 9.0 ppm.
4.01	II.B.1.c.	MISC	NGB-1	Natural Gas Boiler 1 - 108.11 mmBtuh	Permit Cond. II.B.1.c	PM2.5, SOx, VOC	The permittee shall use only pipeline quality natural gas for fuel for all boilers and burners.
4.02	II.B.22.a	MISC	NGB-2	Natural Gas Boiler 2 - 108.11 mmBtuh	ULNB	NOx	1.30 lb/hr and 9.0 ppm.
4.02	Permit II.B.1.c.	MISC	NGB-2	Natural Gas Boiler 2 - 108.11 mmBtuh	Permit Cond. II.B.1.c	PM2.5, SOx, VOC	The permittee shall use only pipeline quality natural gas for fuel for all boilers and burners.
6.04	II.B.19.a	MISC	ROADS	Various roads and disturbed, unpaved areas	FDCP	PM2.5	Visible emissions shall be no greater than 20 percent opacity.

Attachment 5. Relevant Site-Wide Limits

BACT	II.B.1.c	The permittee shall use only pipeline quality natural gas for fuel for all boilers and burners. [Origin: DAQE-AN109170035-16]. [R307-401-8(1)(a)(BACT)]
BACT	II.B.1.d	Unless otherwise specified, at all times, including periods of startup, shutdown, and malfunction, the permittee shall, to the extent practicable, maintain and operate any affected emission units, including associated air pollution control equipment, in a manner consistent with good air pollution control practice for minimizing emissions. Determination of whether acceptable operating and maintenance procedures are being used will be based on information available to the Director which may include, but is not limited to, monitoring results, opacity observations, review of operating and maintenance procedures, and inspection of the source. [Origin: DAQE-AN109170035-16]. [40 CFR 60.11(d), R307-401-8(1)(a)(BACT), R307-401-8(2)]
BACT	II.B.1.e	Visible emissions shall be no greater than 15 percent opacity, unless otherwise specified in this permit. This includes, but is not limited to, all scrubbers and all conveyor drop and transfer points. [Origin: DAQE-AN109170035-16]. [R307-305-3, R307-401-8(1)(a)(BACT)]
BACT	II.B.1.f	Sulfur content of any fuel oil or diesel burned shall be no greater than 0.0015 percent by weight. [Origin: DAQE-AN109170035-16]. [R307-401-8(1)(a)(BACT)]
State-Only	II.B.1.g	Unless otherwise specified in this permit, visible emissions caused by fugitive dust shall not exceed 10% at the property boundary, and 20% onsite. Opacity shall not apply when the wind speed exceeds 25 miles per hour if the permittee has implemented, and continues to implement, the accepted fugitive dust control plan and administers at least one of the following contingency measures: 1. Pre-event watering; 2. Hourly watering; 3. Additional chemical stabilization; 4. Cease or reduce fugitive dust producing operations; 5. Other contingency measure approved by the director. [Origin: R307-309]. [R307-309-5, R307-309-6]
State-Only	II.B.1.h	The permittee shall submit a fugitive dust control plan to the Director in accordance with R307-309-6. Activities regulated by R307-309 shall not commence before the fugitive dust control plan is approved by the director. If site modifications result in emission changes, the permittee shall submit an updated fugitive dust control plan. At a minimum, the fugitive dust control plan shall include the requirements in R307-309-6(4) as applicable. The fugitive dust control plan shall include contact information, site address, total area of disturbance, expected start and completion dates, identification of dust suppressant and plan certification by signature of a responsible person. [Origin: R307-309]. [R307-309-5(2), R307-309-6]
State-Only	II.B.1.i	Condition: If the permittee owns, operates or maintains a new or existing material storage, handling or hauling operation, the permittee shall prevent, to the maximum extent possible, material from being deposited onto any paved road other than a designated deposit site. If materials are deposited that may create fugitive dust on a public or private paved road, the permittee shall clean the road promptly. [Origin: R307-309]. [R307-309-7]

Att. 6 Description of Control Technologies

This Attachment provides a description of the control technologies that are used repetitively in the report.

Description	Ref.

Particulate Matter Control Descriptions (Point Sources)

Particulate Matter Control Descriptions (Point Sources)		Ref.
Baghouse / Fabric Filter (Several Types)	**Mechanical Shaker Cleaned Type** **Pulse-Jet Cleaned Type** **Reverse-Air Cleaned Type** **Reverse-Jet Cleaned Type** **Sonic Horn Enhancement** Typical efficiencies are 99 to 99.9%. Inlet concentrations are 0.5 to 10 grains per cubic foot (gr/ft3), 0.05 to 100+ gr/ft3 in the extreme. Outlet is typically 0.010 gr/ft3, (0.001 gr/ft3 extreme). Baghouse outlet is nearly constant, overall efficiency varies with loading. Flue gas is passed through a tightly woven or felted fabric, causing PM to collect on the fabric. Fabric filters may be sheets, or cartridges, but bags are the most common. Some materials can be used to high temperatures. Large fabric to flue gas ratios are used to minimize pressure drop and dust cake thickness. Cleaning type, intensity, and frequency are important variables. Cleaning types include: mechanical shaking, vibration, sonic horn, reverse-air flow, and pulse jet. Advantages: High collection efficiencies on both coarse and submicron particulates Insensitive to fluctuations in gas stream conditions Outlet loading and pressure drop are unaffected by changes in inlet loading Outlet air is usually clean enough to recirculate within the plant Material is collected dry for subsequent processing or disposal Corrosion and rusting are usually not problems Operation is relatively simple Do not require the use of high voltage Maintenance is simple High collection efficiency of submicron smokes and gaseous contaminants Physical configuration can be customized for location restraints Disadvantages: Temperatures above 550°F require special refractory mineral or metallic fabrics Fabric filters have relatively high maintenance requirements Not useful in moist environments or with hygroscopic or sticky materials Respiratory protection may be required for maintenance Medium pressure drop is required, (4" to 10" of water column)	EPA Fact Sheets
Cyclones (wet or dry)	Cyclones operate by creating a double vortex inside the cyclone body. The incoming gas is forced into circular motion down the cyclone near the inner surface of the cyclone tube. At the bottom of the cyclone, the gas turns and spirals up through the center of the tube and out of the top of the cyclone. Particles in the gas stream are forced toward the cyclone walls. Large particles reach the cyclone walls and are collected. Small particles leave the cyclone with the exiting gas.	EPA Fact Sheet

	Description	Ref.
	Control efficiency varies by type: conventional, high-throughput, high-efficiency single, and high-efficiency multi-cyclones. Conventional: 70 to 90% for TSP, 30 to 90% for PM10, and 0 to 40% for PM2.5. High throughput: 80 to 99% for TSP, 10 to 40% for PM10, and 0 to 10% for PM2.5. High efficiency single: 80 to 99% for TSP, 60 to 95% for PM10, and 20 to 70% for PM2.5. Multi-cyclones: 80 to 95% collection efficiency for PM5. Typical gas flow rates for a single cyclone unit are 1,060 to 25,400 scfm. Cyclones operate up to 1000°F. Inlet gas loading is typically 1.0 to 100 gr/scf. No pretreatment is necessary for cyclones. Higher control efficiencies occur at higher inlet velocities (higher pressure drops). Pressure drops are: 2" to 4" H2O for low-efficiency units; 4" to 6" H2O for medium-efficiency units; 8" to 10" H2O for high-efficiency units. Multi-cyclones can achieve high efficiency with high flow rate. Wet cyclones can also achieve high efficiency. Advantages: Low capital cost Low operating cost Low maintenance requirements Low pressure drop (2"-4"and 4"-6" H2O), for low and medium efficiency cyclone Wide temperature and pressure ranges Dry collection and disposal (dry only) Relatively small space requirements. Disadvantages: Unable to handle sticky or tacky materials Single cyclones have low PM10/PM2.5 collection efficiencies High efficiency cyclones have high pressure drops (8" to 10" H2O)	
Dry Electrostatic Precipitator (Dry ESP) (Wire Plate Type or Wire-Pipe Type)	Uses pulsating DC voltage (20,000 to 100,000 volts) in charging wires to move particles in an exhaust stream onto collector plates or pipes. Collector plates in wire-plate ESPs are "rapped" by mechanical means to dislodge the particulate which slides downward into a hopper. Wire-pipe ESPs are cleaned acoustically using sonic horns powered by compressed air. From 97.1% to 99.4% efficient for PM10 and 96.0% to 99.2% efficient for PM2.5 depending on gas velocity through the unit, electric field strength, particulate chemical composition and resistivity, and gas temperature. Dust resistivity above 2 x 1011 ohm-cm reduces collection efficiency. Dust resistivity below 108 ohm-cm increases re-entrainment and reduces collection efficiency. Resistivity is a function of temperature, moisture, gas composition, particle composition, and surface characteristics. Advantages: Very low pressure drops Energy requirements and operating costs are low Capable of very high efficiencies for very small particles Can handle temperatures up to 1300°F Dry collection and disposal allows for easier handling Capable of large gas flow rates Disadvantages: High capital costs. Wires are high-maintenance items Not suited for highly variable processes (gas flow rate, gas temperature, particulate composition and loading) Difficult to install in sites with limited space Particulates with extremely high or low resistivity are difficult to collect Requires relatively sophisticated maintenance personnel Needs special safety precautions for high voltage Not recommended for sticky or moist particles Produces ozone	EPA Fact Sheet

	Description	Ref.
Wet Electrostatic Precipitator (ESP) (Wire-Plate Type or Wire-Pipe Type)	Typical efficiencies: 99 to 99.9%. Residence time inside the ESP is the most important design parameter. Wet ESPs are used when dry ESPs effective: material is wet, sticky, or highly resistivity. Limited to operating below 190°F. Typical inlet loading 1 to 50 gr/scf. Small particles can be efficiently collected by wet ESPs. A wet ESP uses DC voltage (20,000 to 100,000 volts) to move particles in an exhaust stream onto collection plate or pipes which are washed by a spray of liquid, usually water, into collection hoppers. This wash system replaces the rapping mechanisms used by dry ESPs. Advantages: Low pressure drops (less than 0.5" H2O) Low energy requirements Low operating costs Very high efficiencies, even for very small particles Can collect sticky particles and highly resistive dusts. Condenses some pollutants Collects liquid particles and aerosols Disadvantages: High capital costs High-maintenance items; need highly skilled workers High voltage - Safety Not suited for highly variable processes Large space requirements Produce ozone Limited to less than 190°F	EPA Fact Sheet
Wet Scrubber	Liquid or solid particles are removed from a gas stream by transferring them to a liquid (usually water). A pressure drop of more than 5" water is needed to remove particles smaller than 5 microns. Spray tower scrubbers, with either countercurrent or cross-current flow, are most effective on particulate greater than 5 microns. A medium pressure-drop venturi will remove particulate above one micron. Other wet systems include: condensation scrubbers, impingement plate scrubbers, mechanically-aided scrubbers, and orifice scrubbers. All wet scrubbers are susceptible to operating problems: inadequate liquid flow, liquid re-entrainment, poor gas-liquid contact, corrosion, and plugged nozzles, beds, or mist eliminators. Advantages: Low pressure drops (less than 0.5" H2O) Can be designed to remove particles above 1 micron Can be designed to remove some condensable PM Can be used on sticky or wet streams that would clog a Baghouse Disadvantages: High capital costs High water use Wastewater treatment disposal issues Susceptible to operating problems	EPA Fact Sheet

Particulate Matter Control Descriptions (Fugitive Sources)		Ref.
Fugitive particulate emissions are generated in a building from processes, and escape to atmosphere through doors, windows, and building vents OR are generated outdoors by wind, road traffic, or material handling processes. There are many potential options for controlling fugitive particulate matter.		EPA 1986
Control Devices	RBLC included the following control devices for reducing fugitive material handling emissions: fabric filter, baghouse, cartridge filter, cyclone, scrubber.	RBLC

	Description	Ref.
Conveyance: Pneumatic	Pneumatic conveyance (transport of material using an air stream through a pipe) can have 100% capture efficiency and must be coupled with a cyclone, baghouse, and or scrubber type of control	EPA 1992
Conveyors: Enclosed	Enclosed conveyors can be fully enclosed or partially enclosed to prevent wind erosion and spillage. If they are controlled by a baghouse or similar device, the control efficiency will normally be even greater than enclosure alone.	
Drop Height Reduction	Drop height reduction through the use of hinged-boom conveyors, rock ladders, lower wells, etc. Rock ladder - 50% control efficiency. Lowering well - 80% control efficiency. Telescoping chutes - 75%+ efficiency (depending if chute is flanged into loading area). Drop height reduction alone will yield lower control efficiency	EPA 1998
Enclosure	A building or other enclosure (such as a silo) around a fugitive dust source of emissions (transfer points, drop points, load/unload areas, conveyors, etc.) can help prevent wind from picking up the particulates and spreading them into the atmosphere. Additionally, the building can act as a settling chamber for total suspended particulates (TSP), although the settling is less efficient for PM10 and very much less for PM2.5. If enclosed, a fugitive dust source can be captured and vented to a control device (such as a baghouse, cartridge filter, scrubber, etc.), thus it would typically become a controlled point source. An enclosure can be partial (such as a three sided shroud around a truck loading area) or complete (such as a building). Control Efficiency for enclosures varies considerably with design and capture efficiency.	EPA 1986 and EPA Fact Sheet
Fugitive Dust Control Plan	Developing, Implementing, and Maintaining a Fugitive Dust Control Plan (FDCP) is a recognized control technology in EPA's RBLC. It is also a requirement of Utah Rule 307-309 (Nonattainment and Maintenance Areas for PM10 and PM2.5: Fugitive Emissions and Fugitive Dust). The FDCP requires permittees to evaluate sources of fugitive PM emissions and take measures to reduce them and monitor conditions such as visible emissions, wind, and moisture to minimize fugitive PM emissions.	RBLC and R307-309
Inherent Moisture Content	Some materials have inherent moisture content, which helps to minimize emissions.	RBLC
Stabilization: Chemical	Chemicals dust suppressants (salts, lignin sulfonate, wetting agents, latexes, plastics, and petroleum derivatives) can be used to help prevent fugitive particulate emissions. Salts provide dust control by absorbing and retaining moisture in the surface material. Wetting agents enhance the mitigative effects of watering by lowering the surface tension of the water. The other dust suppressants function by binding the fines to larger aggregates in the surface material. Chemical suppressants can be applied by spray or fog.	EPA 1986
Stabilization: Physical	Water spraying, paving, sweeping, tarping piles, or other physical means to help prevent fugitive dust being generated from road traffic and wind erosion. Keeping a high moisture content in dusty materials is an effective form of control. For coal and cement, moisture content of about 5% is effective. Water can be sprayed into a plume as plume aftertreatment.	EPA 1986
Stabilization: Vegetative Cover	Vegetative cover can be used to stabilize soil, but is technically infeasible for salt piles, and is not an option for Compass Minerals.	EPA 1986
Telescopic Chutes	Telescopic chutes are also known as loading bellow and loading spout. Telescopic chutes are used for rapid and efficient loading of dry bulk solids to ships, tankers, railcars, and open trucks, while minimizing dust emissions. The lower discharge cone of the telescopic chute can be placed on the inlet flange of the tanker. The product in powder or granule form is automatically discharged into the tank. When the tank is full a sensor generates a signal to stop the product flow. Free flowing bulk solids in powder and granule form are easily transferred from silos, hoppers, containers, screw feeder to tankers, open trucks, or stockpiles. Telescoping chutes can achieve 75% or greater control efficiency.	EPA 1998

	Description	Ref.
Wind Screens	Wind screens are porous wind fences, that help prevent fugitive emissions, and can be moved depending on wind conditions and work planning. Wind screens have been shown to significantly reduce emissions from active storage piles and exposed ground areas. The principle employed by wind screens is to provide a sheltered region behind the fenceline where the mechanical turbulence generated by ambient winds is significantly reduced. The downwind extent of the protected area is many times the physical height of the fence. The application of wind screens along the leading edge of active storage piles seems to be one of the few good control options available for active storage piles and exposed ground areas. (Ref. EPA 1986, page 36)	EPA 1986
Work Practices / Housekeeping	Work practices (or best operating practices) include several strategies, such as avoiding dusty work on windy days, keeping dusty materials vacuumed up, washing equipment regularly if it tends to cake up with dusty material, etc. These practices would be included in a Fugitive Dust Control Plan, if applicable.	RBLC

Particulate Matter Control Descriptions (Cooling Towers)

Mist/Drift Eliminators	Mist / Drift Eliminators are panels of wood, plastic, fiberglass, or metal arranged in a herringbone (blade-type), wave form, or cellular (or honeycomb) pattern, acting as a surface to collect water droplets which then drip back into the cooling tower basin. Originally designed to preserve water by preventing some of the water droplets from drifting away, they are now recognized as a control technology because the particulate matter constituent of the drift droplets is classified as an emission. Droplets that are smaller than PM 2.5 may in fact escape the drift eliminator, however, the capture of droplets of any size may help reduce PM2.5 formation, depending on the nature and concentration of the total dissolved solids in the water droplet. According to the California Air Resources Board's CEIDARS database, PM2.5 is 60% of PM10 from cooling towers.	AP-42 Ch. 13.4
Limit on TDS	Using AP-42 methodology, particulate emissions are correlated in part to the concentration of total dissolved solids (TDS) in the cooling tower water. Limiting TDS (by using more fresh makeup water or other means) can help reduce PM formation.	

NOx Control Descriptions for External Combustion

Flue Gas Recirculation (FGR)	Flue gas recirculation (FGR) is based on recycling 15 to 30 percent of the products of combustion (flue gas) to the primary combustion zone. This dilutes the combustion air and reduces the peak flame temperature, thereby reducing thermal NOx formation. If combustion temperature is held below 1,400°F, the formation of thermal NOx is negligible. Advantages Can be used on conventional burners Disadvantages High capital costs Can only be used in high-temperature applications Can only be used with mechanical draft heaters Ineffective with oil-fired heaters	EPA Fact Sheet
Good Combustion Practices	"Good combustion practices" is a general term use to describe optimized variables to promote clean, efficient, and complete combustion of the fuel. Following the manufacturer's installation, operating, and maintenance instructions will ensure that a well-designed combustion unit will burn efficiently and completely, thus minimizing emissions to the atmosphere.	

	Description	Ref.
Low NOx Burners (LNB)	There are many designs for Low NOx Burners (LNB). Staged-air LNBs bypass a fraction of the combustion air around the primary combustion zone and supply it to the secondary combustion zone. The primary zone is therefore a fuel-rich reducing environment which inhibits fuel-NOx formation. The secondary combustion zone is fuel- lean and cooled by the secondary air; this inhibits thermal-NOx formation. Staged-air, gas-fired burners may also supply tertiary air around the outside of the secondary combustion zone to ensure complete combustion at relatively low combustion temperatures. Staged-air combustion can be used for either gaseous or oil fuel. Staged-fuel LNBs bypass a fraction of the fuel around the primary combustion zone and supply it to the secondary combustion zone. The primary zone is fuel-lean and relatively cool, which inhibits thermal NOx formation. The secondary zone is fuel-rich with limited oxygen; this further inhibits NOx formation. A third zone can be the final combustion in low excess air to limit the temperature. Advantages Low cost for significant NOx reduction Designed for natural draft and mechanical draft burners Can use natural gas, refinery gas, or fuel oil Disadvantages May require increased maintenance of burner	EPA Fact Sheet
Nonselective Catalytic Reduction (NSCR)	Nonselective catalytic reduction uses a catalyst to reduce NOx, CO, and hydrocarbon to water, carbon dioxide, and nitrogen. The catalyst is usually a noble metal. One type of NSCR system injects a reducing agent into the exhaust gas stream prior to the catalyst reactor to reduce the NOx. Another type of NSCR system has an afterburner and two catalytic reactors (one reduction catalyst and one oxidation catalyst). Advantages Removes NOx, CO, and hydrocarbon Operating temperatures from 700° to 1500°F Disadvantages Oxygen must be less than 0.5%	EPA Fact Sheet
Selective Catalytic Reduction (SCR)	SCR is capable of 70% to 90% NOx reduction. Ammonia or urea is injected downstream the combustion and the mixture passes through a catalyst module. The process has a higher control than SNCR and occurs at lower temperatures. However, the capital and operating costs are higher. It is very cost-effective for natural gas fired units. Catalyst can be damaged by poisoning sintering, blinding/plugging/fouling, erosion. Ammonia slip increases with catalyst damage. Advantages: Higher NOx reductions than low-NOx burners and SNCR Applicable to sources with low NOx concentrations Reactions occur within a lower and broader temperature range than SNCR. Does not require modifications to the combustion unit Disadvantages: Significantly higher capital and operating costs than low-NOx burners and SNCR Retrofit of SCR on industrial boilers is difficult and costly Large volume of reagent and catalyst required May require downstream equipment cleaning Can result in ammonia in the waste gas	EPA Fact Sheet
Selective Non -Catalytic Reduction (SNCR)	NOX reduction ranges from 30% to 50%. In conjunction with low NOX burners, 65% to 75%. A nitrogen-based reducing agent (ammonia or urea) is injected into exhaust gas where the temperature is between 1600°F and 2100°F. Advantages: Capital and operating costs are low SNCR retrofit is simple	EPA Fact Sheet

	Description	Ref.
	Cost effective for seasonal or variable load applications. Can be used in exhaust streams with high PM levels Can be combined with other NOX controls Disadvantages: The waste gas temperature must stay in range Not applicable exhaust with low NOX (such as gas turbines) Not as effective as Selective Catalytic Reduction (SCR). May require downstream equipment cleaning May result in ammonia in exhaust or recovered product	
Staged Combustion / Over Fire Air	Staged-air, oil-fired burners have at least two combustion zones designed to reduce NOx emissions. Initial combustion is fuel-rich and fuel-bound nitrogen forms N2 rather than NOx. Flame temperature is high due to the low combustion air/fuel ratio, but thermal NOx formation is limited by low O2. Staged-air designs often use a tertiary air combustion zone containing the "excess" portion (10 to 20 percent) of combustion air introduced around the outside of the secondary combustion zone. This allows unburned fuel and O2 to mix/react more by diffusion than by turbulent mixing. Staged-air maximizes the time that fuel burns in sub-stoichiometric conditions. Advantages Works with gas and oil fuel Reduces NOx from fuel-bound nitrogen Disadvantages Altered flame shape may cause problems Retrofit may be difficult	EPA Fact Sheet
Ultra Low NOx Burners (ULNB)	Ultra-low-NOx burners (ULNB) use a relatively cool fuel-lean primary combustion zone, fuel-rich secondary combustion zone, and internal flue gas recirculation (IFGR). IFGR returns a portion of the inert exhaust gas to the combustion zone to reduce flame temperature and dilute combustion air. Other techniques are sometimes added. Advantages Lowest levels of NOx emissions Can use natural gas or refinery gas Disadvantages Burners are larger and require larger air plenums Retrofit often requires modification to burner mounts	EPA Fact Sheet

VOC Control Descriptions for External Combustion

Catalytic Oxidation	In a catalytic incinerator, the gas stream is introduced into a mixing chamber where it is also heated. The waste gas usually passes through a recuperative heat exchanger where it is preheated by post combustion The heated gas then passes through the catalyst bed. Oxygen and VOC migrate to the catalyst surface where oxidation then occurs. Catalytic oxidation is most suited to systems with lower exhaust volumes, when there is little variation in the type and concentration of VOC, and where catalyst poisons or other fouling contaminants such as the type and concentration of VOC, and where catalyst poisons or other fouling contaminants such as silicone, sulfur, heavy hydrocarbons and particulates are not present. Particulate matter can rapidly coat the catalyst so that the catalyst active sites are prevented from aiding in the oxidation of pollutants in the gas stream. This effect of PM on the catalyst will deactivate the catalyst over time. Catalytic oxidation requires air stream temperature 600-800 °F.	EPA Fact Sheet

	Description	Ref.
	Catalytic oxidation control efficiency for VOC is 95% with a standard package. Higher efficiency can be achieved with custom engineering and special catalyst.	

Att. 7 BACT Backup Documentation

Cost Backup Table Item 1.01 Option 1

Purchased Equipment Costs				Notes
Baghouse	=	$	196,000.00	Estimated based on Figure 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed 6,000 acfm per source to achieve minimum threshold velocity.
Bags	=	$	38,000.00	Estimated based on Table 1.8 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed bags of ryton with diameter of 4-1/2 to 5-1/8 inches
Auxiliary Equipment				
Hoods and Ductwork	=	$	-	Existing
Cyclones	=	$	30,000.00	Estimated 15% of baghouse cost based on plant data
Stack	=	$	6,000.00	Estimated based on Table 1.12 of Sect. 2 Ch. 1 of EPA Cost Manual; Estimated diameter of 33 in. and stack height of 30 ft.; Material assumed to be Sheet-galv CS
Dust removal	=	$	30,000.00	Estimated 15% of baghouse cost based on plant data
Equipment Costs (A)	=	$	*299,000.00*	
Instrumentation	=	$	30,000.00	0.01A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Sales Tax	=	$	-	Sales tax is not paid on process equipment
Freight	=	$	15,000.00	0.05A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
PEC (B)	=	**$**	**344,000.00**	

Direct Installation Costs (DC)				
Foundations & Supports	=	$	14,000.00	0.04B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Handling & Erection	=	$	172,000.00	0.50B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Electrical	=	$	28,000.00	0.08B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Piping	=	$	18,000.00	0.05B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual with additional cost added for assumed distances
Insulation for ductwork	=	$	-	Unnecessary for this service
Painting	=	$	35,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Building or Enclosure	=	$	-	Existing
Total Direct Costs (DC)	=	**$**	**267,000.00**	

Indirect Costs (IC)				
Engineering	=	$	61,000.00	0.10(B+DC) based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and site engineering, design, and construction records
Construction and field expenses	=	$	69,000.00	0.20B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contractor fees	=	$	35,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Start-up	=	$	28,000.00	0.08B based on site engineering, design, and construction records
Performance Testing	=	$	4,000.00	0.01B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contingencies	=	$	61,000.00	0.10(B+DC) based on site engineering, design, and construction records
Total Indirect Costs (IC)	=	**$**	**258,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 869,000.00

Cost Backup Table — Item 1.01 — Option 2

Purchased Equipment Costs

			Notes
Scrubber	= $	148,000.00	Estimated based on Figure 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed 6,000 acfm per source to achieve minimum threshold velocity.
Fan and pump	= $	60,000.00	Estimated to be 40% of scrubber cost
Auxiliary Equipment			
Hoods and Ductwork	= $	-	Existing
Cyclones	= $	23,000.00	Estimated 15% of baghouse cost based on plant data
Stack	= $	6,000.00	Estimated based on Table 1.12 of Sect. 2 Ch. 1 of EPA Cost Manual; Estimated diameter of 33 in. and stack height of 30 ft.; Material assumed to be Sheet-galv CS
Equipment Costs (A)	= $	*236,000.00*	
Instrumentation	= $	24,000.00	0.01A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Sales Tax	= $	-	Sales tax is not paid on process equipment
Freight	= $	12,000.00	0.05A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
PEC (B)	**= $**	**272,000.00**	

Direct Installation Costs (DC)

Foundations & Supports	= $	11,000.00	0.04B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Handling & Erection	= $	136,000.00	0.50B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Electrical	= $	22,000.00	0.08B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Piping	= $	14,000.00	0.05B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual with additional cost added for assumed distances
Insulation for ductwork	= $	-	Unnecessary for this service
Painting	= $	28,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Building or Enclosure	= $	-	Existing
Total Direct Costs (DC)	**= $**	**211,000.00**	

Indirect Costs (IC)

Engineering	= $	49,000.00	0.10(B+DC) based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and site engineering, design, and construction records
Construction and field expenses	= $	55,000.00	0.20B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contractor fees	= $	28,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Start-up	= $	22,000.00	0.08B based on site engineering, design, and construction records
Performance Testing	= $	3,000.00	0.01B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contingencies	= $	49,000.00	0.10(B+DC) based on site engineering, design, and construction records
Total Indirect Costs (IC)	**= $**	**206,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 689,000.00

Cost Backup Table **Item 1.01** **Option 3**

Purchased Equipment Costs				Notes
Baghouse	=	$	28,000.00	Estimated based on Figure 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed 6,000 acfm per source to achieve minimum threshold velocity.
Filters	=	$	51,000.00	Estimated based on Table 1.8 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed filters of polyethylene with diameter of 4-7/8 inches
Auxiliary Equipment				
Hoods and Ductwork	=	$	-	Existing
Cyclones	=	$	5,000.00	Estimated 15% of baghouse cost based on plant data
Stack	=	$	6,000.00	Estimated based on Table 1.12 of Sect. 2 Ch. 1 of EPA Cost Manual; Estimated diameter of 33 in. and stack height of 30 ft.; Material assumed to be Sheet-galv CS
Dust removal	=	$	5,000.00	Estimated 15% of baghouse cost based on plant data
Equipment Costs (A)	=	*$*	*93,000.00*	
Instrumentation	=	$	10,000.00	0.01A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Sales Tax	=	$	-	Sales tax is not paid on process equipment
Freight	=	$	5,000.00	0.05A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
PEC (B)	=	**$**	**108,000.00**	

Direct Installation Costs (DC)				
Foundations & Supports	=	$	5,000.00	0.04B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Handling & Erection	=	$	54,000.00	0.50B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Electrical	=	$	9,000.00	0.08B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Piping	=	$	6,000.00	0.05B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual with additional cost added for assumed distances
Insulation for ductwork	=	$	-	Unnecessary for this service
Painting	=	$	11,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Building or Enclosure	=	$	-	Existing
Total Direct Costs (DC)	=	**$**	**85,000.00**	

Indirect Costs (IC)				
Engineering	=	$	19,000.00	0.10(B+DC) based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and site engineering, design, and construction records
Construction and field expenses	=	$	22,000.00	0.20B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contractor fees	=	$	11,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Start-up	=	$	9,000.00	0.08B based on site engineering, design, and construction records
Performance Testing	=	$	2,000.00	0.01B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contingencies	=	$	19,000.00	0.10(B+DC) based on site engineering, design, and construction records
Total Indirect Costs (IC)	=	**$**	**82,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 275,000.00

Cost Backup Table Item 1.02 Option 1

Purchased Equipment Costs			Notes
Baghouse	=	$ 110,000.00	Estimated based on Figure 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed 6,000 acfm per source to achieve minimum threshold velocity.
Bags	=	$ 20,000.00	Estimated based on Table 1.8 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed bags of ryton with diameter of 4-1/2 to 5-1/8 inches
Auxiliary Equipment			
Hoods and Ductwork	=	$ -	Existing
Cyclones	=	$ 17,000.00	Estimated 15% of baghouse cost based on plant data
Stack	=	$ 6,000.00	Estimated based on Table 1.12 of Sect. 2 Ch. 1 of EPA Cost Manual; Estimated diameter of 33 in. and stack height of 30 ft.; Material assumed to be Sheet-galv CS
Dust removal	=	$ 17,000.00	Estimated 15% of baghouse cost based on plant data
Equipment Costs (A)	=	*$ 169,000.00*	

Instrumentation	=	$ 17,000.00	0.01A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Sales Tax	=	$ -	Sales tax is not paid on process equipment
Freight	=	$ 9,000.00	0.05A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
PEC (B)	=	**$ 195,000.00**	

Direct Installation Costs (DC)			
Foundations & Supports	=	$ 8,000.00	0.04B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Handling & Erection	=	$ 98,000.00	0.50B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Electrical	=	$ 16,000.00	0.08B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Piping	=	$ 10,000.00	0.05B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual with additional cost added for assumed distances
Insulation for ductwork	=	$ -	Unnecessary for this service
Painting	=	$ 20,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Building or Enclosure	=	$ -	Existing
Total Direct Costs (DC)	=	**$ 152,000.00**	

Indirect Costs (IC)			
Engineering	=	$ 35,000.00	0.10(B+DC) based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and site engineering, design, and construction records
Construction and field expenses	=	$ 39,000.00	0.20B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contractor fees	=	$ 20,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Start-up	=	$ 16,000.00	0.08B based on site engineering, design, and construction records
Performance Testing	=	$ 2,000.00	0.01B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contingencies	=	$ 35,000.00	0.10(B+DC) based on site engineering, design, and construction records
Total Indirect Costs (IC)	=	**$ 147,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 494,000.00

Cost Backup Table — Item 1.02 — Option 2

Purchased Equipment Costs

			Notes
Scrubber	=	$ 67,000.00	Estimated based on Figure 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed 6,000 acfm per source to achieve minimum threshold velocity.
Fan and pump	=	$ 27,000.00	Estimated to be 40% of scrubber cost
Auxiliary Equipment			
Hoods and Ductwork	=	$ -	Existing
Cyclones	=	$ 11,000.00	Estimated 15% of baghouse cost based on plant data
Stack	=	$ 6,000.00	Estimated based on Table 1.12 of Sect. 2 Ch. 1 of EPA Cost Manual; Estimated diameter of 33 in. and stack height of 30 ft.; Material assumed to be Sheet-galv CS
Equipment Costs (A)	=	*$ 110,000.00*	
Instrumentation	=	$ 11,000.00	0.01A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Sales Tax	=	$ -	Sales tax is not paid on process equipment
Freight	=	$ 6,000.00	0.05A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
PEC (B)	=	**$ 127,000.00**	

Direct Installation Costs (DC)

Foundations & Supports	=	$ 6,000.00	0.04B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Handling & Erection	=	$ 64,000.00	0.50B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Electrical	=	$ 11,000.00	0.08B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Piping	=	$ 7,000.00	0.05B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual with additional cost added for assumed distances
Insulation for ductwork	=	$ -	Unnecessary for this service
Painting	=	$ 13,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Building or Enclosure	=	$ -	Existing
Total Direct Costs (DC)	=	**$ 101,000.00**	

Indirect Costs (IC)

Engineering	=	$ 23,000.00	0.10(B+DC) based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and site engineering, design, and construction records
Construction and field expenses	=	$ 26,000.00	0.20B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contractor fees	=	$ 13,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Start-up	=	$ 11,000.00	0.08B based on site engineering, design, and construction records
Performance Testing	=	$ 2,000.00	0.01B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contingencies	=	$ 23,000.00	0.10(B+DC) based on site engineering, design, and construction records
Total Indirect Costs (IC)	=	**$ 98,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 326,000.00

Cost Backup Table   Item 1.02   Option 3

Purchased Equipment Costs			Notes
Baghouse	= $	14,000.00	Estimated based on Figure 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed 6,000 acfm per source to achieve minimum threshold velocity.
Filters	= $	20,000.00	Estimated based on Table 1.8 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed filters of polyethylene with diameter of 4-7/8 inches
Auxiliary Equipment			
Hoods and Ductwork	= $	-	Existing
Cyclones	= $	3,000.00	Estimated 15% of baghouse cost based on plant data
Stack	= $	6,000.00	Estimated based on Table 1.12 of Sect. 2 Ch. 1 of EPA Cost Manual; Estimated diameter of 33 in. and stack height of 30 ft.; Material assumed to be Sheet-galv CS
Dust removal	= $	3,000.00	Estimated 15% of baghouse cost based on plant data
Equipment Costs (A)	= $	*44,000.00*	
Instrumentation	= $	5,000.00	0.01A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Sales Tax	= $	-	Sales tax is not paid on process equipment
Freight	= $	3,000.00	0.05A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
PEC (B)	**= $**	**52,000.00**	

Direct Installation Costs (DC)			
Foundations & Supports	= $	3,000.00	0.04B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Handling & Erection	= $	26,000.00	0.50B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Electrical	= $	5,000.00	0.08B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Piping	= $	3,000.00	0.05B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual with additional cost added for assumed distances
Insulation for ductwork	= $	-	Unnecessary for this service
Painting	= $	6,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Building or Enclosure	= $	-	Existing
Total Direct Costs (DC)	**= $**	**43,000.00**	

Indirect Costs (IC)			
Engineering	= $	9,000.00	0.10(B+DC) based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and site engineering, design, and construction records
Construction and field expenses	= $	11,000.00	0.20B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contractor fees	= $	6,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Start-up	= $	5,000.00	0.08B based on site engineering, design, and construction records
Performance Testing	= $	1,000.00	0.01B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contingencies	= $	9,000.00	0.10(B+DC) based on site engineering, design, and construction records
Total Indirect Costs (IC)	**= $**	**41,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 136,000.00

Cost Backup Table **Item 1.03** **Option 1**

Purchased Equipment Costs				Notes
Baghouse	=	$	248,000.00	Estimated based on Figure 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed 6,000 acfm per source to achieve minimum threshold velocity.
Bags	=	$	50,000.00	Estimated based on Table 1.8 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed bags of ryton with diameter of 4-1/2 to 5-1/8 inches
Auxiliary Equipment				
Hoods and Ductwork	=	$	-	Existing
Cyclones	=	$	38,000.00	Estimated 15% of baghouse cost based on plant data
Stack	=	$	6,000.00	Estimated based on Table 1.12 of Sect. 2 Ch. 1 of EPA Cost Manual; Estimated diameter of 33 in. and stack height of 30 ft.; Material assumed to be Sheet-galv CS
Dust removal	=	$	38,000.00	Estimated 15% of baghouse cost based on plant data
Equipment Costs (A)	=	*$*	*378,000.00*	
Instrumentation	=	$	38,000.00	0.01A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Sales Tax	=	$	-	Sales tax is not paid on process equipment
Freight	=	$	19,000.00	0.05A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
PEC (B)	**=**	**$**	**435,000.00**	

Direct Installation Costs (DC)				
Foundations & Supports	=	$	18,000.00	0.04B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Handling & Erection	=	$	218,000.00	0.50B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Electrical	=	$	35,000.00	0.08B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Piping	=	$	22,000.00	0.05B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual with additional cost added for assumed distances
Insulation for ductwork	=	$	-	Unnecessary for this service
Painting	=	$	44,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Building or Enclosure	=	$	-	Existing
Total Direct Costs (DC)	**=**	**$**	**337,000.00**	

Indirect Costs (IC)				
Engineering	=	$	77,000.00	0.10(B+DC) based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and site engineering, design, and construction records
Construction and field expenses	=	$	87,000.00	0.20B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contractor fees	=	$	44,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Start-up	=	$	35,000.00	0.08B based on site engineering, design, and construction records
Performance Testing	=	$	5,000.00	0.01B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contingencies	=	$	77,000.00	0.10(B+DC) based on site engineering, design, and construction records
Total Indirect Costs (IC)	**=**	**$**	**325,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 1,097,000.00

Cost Backup Table   Item 1.03   Option 2

Purchased Equipment Costs				Notes
Scrubber	=	$	148,000.00	Estimated based on Figure 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed 6,000 acfm per source to achieve minimum threshold velocity.
Fan and pump	=	$	60,000.00	Estimated to be 40% of scrubber cost
Auxiliary Equipment				
Hoods and Ductwork	=	$	-	Existing
Cyclones	=	$	23,000.00	Estimated 15% of baghouse cost based on plant data
Stack	=	$	6,000.00	Estimated based on Table 1.12 of Sect. 2 Ch. 1 of EPA Cost Manual; Estimated diameter of 33 in. and stack height of 30 ft.; Material assumed to be Sheet-galv CS
Equipment Costs (A)	=	*$*	*236,000.00*	
Instrumentation	=	$	24,000.00	0.01A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Sales Tax	=	$	-	Sales tax is not paid on process equipment
Freight	=	$	12,000.00	0.05A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
PEC (B)	=	**$**	**272,000.00**	

Direct Installation Costs (DC)				
Foundations & Supports	=	$	11,000.00	0.04B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Handling & Erection	=	$	136,000.00	0.50B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Electrical	=	$	22,000.00	0.08B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Piping	=	$	14,000.00	0.05B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual with additional cost added for assumed distances
Insulation for ductwork	=	$	-	Unnecessary for this service
Painting	=	$	28,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Building or Enclosure	=	$	-	Existing
Total Direct Costs (DC)	=	**$**	**211,000.00**	

Indirect Costs (IC)				
Engineering	=	$	49,000.00	0.10(B+DC) based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and site engineering, design, and construction records
Construction and field expenses	=	$	55,000.00	0.20B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contractor fees	=	$	28,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Start-up	=	$	22,000.00	0.08B based on site engineering, design, and construction records
Performance Testing	=	$	3,000.00	0.01B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contingencies	=	$	49,000.00	0.10(B+DC) based on site engineering, design, and construction records
Total Indirect Costs (IC)	=	**$**	**206,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 689,000.00

Cost Backup Table **Item 1.03** **Option 3**

Purchased Equipment Costs

			Notes
Baghouse	=	$ 28,000.00	Estimated based on Figure 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed 6,000 acfm per source to achieve minimum threshold velocity.
Filters	=	$ 51,000.00	Estimated based on Table 1.8 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed filters of polyethylene with diameter of 4-7/8 inches
Auxiliary Equipment			
Hoods and Ductwork	=	$ -	Existing
Cyclones	=	$ 5,000.00	Estimated 15% of baghouse cost based on plant data
Stack	=	$ 6,000.00	Estimated based on Table 1.12 of Sect. 2 Ch. 1 of EPA Cost Manual; Estimated diameter of 33 in. and stack height of 30 ft.; Material assumed to be Sheet-galv CS
Dust removal	=	$ 5,000.00	Estimated 15% of baghouse cost based on plant data
Equipment Costs (A)	=	*$ 93,000.00*	
Instrumentation	=	$ 10,000.00	0.01A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Sales Tax	=	$ -	Sales tax is not paid on process equipment
Freight	=	$ 5,000.00	0.05A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
PEC (B)	=	**$ 108,000.00**	

Direct Installation Costs (DC)

Foundations & Supports	=	$ 5,000.00	0.04B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Handling & Erection	=	$ 54,000.00	0.50B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Electrical	=	$ 9,000.00	0.08B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Piping	=	$ 6,000.00	0.05B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual with additional cost added for assumed distances
Insulation for ductwork	=	$ -	Unnecessary for this service
Painting	=	$ 11,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Building or Enclosure	=	$ -	Existing
Total Direct Costs (DC)	=	**$ 85,000.00**	

Indirect Costs (IC)

Engineering	=	$ 19,000.00	0.10(B+DC) based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and site engineering, design, and construction records
Construction and field expenses	=	$ 22,000.00	0.20B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contractor fees	=	$ 11,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Start-up	=	$ 9,000.00	0.08B based on site engineering, design, and construction records
Performance Testing	=	$ 2,000.00	0.01B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contingencies	=	$ 19,000.00	0.10(B+DC) based on site engineering, design, and construction records
Total Indirect Costs (IC)	=	**$ 82,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 275,000.00

Cost Backup Table **Item 1.04** **Option 1**

Purchased Equipment Costs				Notes
Baghouse	=	$	206,000.00	Estimated based on Figure 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed 6,000 acfm per source to achieve minimum threshold velocity.
Bags	=	$	41,000.00	Estimated based on Table 1.8 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed bags of ryton with diameter of 4-1/2 to 5-1/8 inches
Auxiliary Equipment				
Hoods and Ductwork	=	$	-	Existing
Cyclones	=	$	31,000.00	Estimated 15% of baghouse cost based on plant data
Stack	=	$	6,000.00	Estimated based on Table 1.12 of Sect. 2 Ch. 1 of EPA Cost Manual; Estimated diameter of 33 in. and stack height of 30 ft.; Material assumed to be Sheet-galv CS
Dust removal	=	$	31,000.00	Estimated 15% of baghouse cost based on plant data
Equipment Costs (A)	=	$	*314,000.00*	
Instrumentation	=	$	32,000.00	0.01A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Sales Tax	=	$	-	Sales tax is not paid on process equipment
Freight	=	$	16,000.00	0.05A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
PEC (B)	=	**$**	**362,000.00**	

Direct Installation Costs (DC)				
Foundations & Supports	=	$	15,000.00	0.04B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Handling & Erection	=	$	181,000.00	0.50B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Electrical	=	$	29,000.00	0.08B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Piping	=	$	19,000.00	0.05B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual with additional cost added for assumed distances
Insulation for ductwork	=	$	-	Unnecessary for this service
Painting	=	$	37,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Building or Enclosure	=	$	-	Existing
Total Direct Costs (DC)	=	**$**	**281,000.00**	

Indirect Costs (IC)				
Engineering	=	$	64,000.00	0.10(B+DC) based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and site engineering, design, and construction records
Construction and field expenses	=	$	73,000.00	0.20B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contractor fees	=	$	37,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Start-up	=	$	29,000.00	0.08B based on site engineering, design, and construction records
Performance Testing	=	$	4,000.00	0.01B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contingencies	=	$	64,000.00	0.10(B+DC) based on site engineering, design, and construction records
Total Indirect Costs (IC)	=	**$**	**271,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 914,000.00

Cost Backup Table   Item 1.04   Option 2

Purchased Equipment Costs

			Notes
Scrubber	= $	132,000.00	Estimated based on Figure 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed 6,000 acfm per source to achieve minimum threshold velocity.
Fan and pump	= $	53,000.00	Estimated to be 40% of scrubber cost
Auxiliary Equipment			
Hoods and Ductwork	= $	-	Existing
Cyclones	= $	20,000.00	Estimated 15% of baghouse cost based on plant data
Stack	= $	6,000.00	Estimated based on Table 1.12 of Sect. 2 Ch. 1 of EPA Cost Manual; Estimated diameter of 33 in. and stack height of 30 ft.; Material assumed to be Sheet-galv CS
Equipment Costs (A)	*= $*	*211,000.00*	
Instrumentation	= $	22,000.00	0.01A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Sales Tax	= $	-	Sales tax is not paid on process equipment
Freight	= $	11,000.00	0.05A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
PEC (B)	**= $**	**244,000.00**	

Direct Installation Costs (DC)

Foundations & Supports	= $	10,000.00	0.04B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Handling & Erection	= $	122,000.00	0.50B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Electrical	= $	20,000.00	0.08B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Piping	= $	13,000.00	0.05B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual with additional cost added for assumed distances
Insulation for ductwork	= $	-	Unnecessary for this service
Painting	= $	25,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Building or Enclosure	= $	-	Existing
Total Direct Costs (DC)	**= $**	**190,000.00**	

Indirect Costs (IC)

Engineering	= $	43,000.00	0.10(B+DC) based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and site engineering, design, and construction records
Construction and field expenses	= $	49,000.00	0.20B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contractor fees	= $	25,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Start-up	= $	20,000.00	0.08B based on site engineering, design, and construction records
Performance Testing	= $	3,000.00	0.01B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contingencies	= $	43,000.00	0.10(B+DC) based on site engineering, design, and construction records
Total Indirect Costs (IC)	**= $**	**183,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 617,000.00

Cost Backup Table **Item 1.04** **Option 3**

Purchased Equipment Costs			Notes
Baghouse	= $	24,000.00	Estimated based on Figure 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed 6,000 acfm per source to achieve minimum threshold velocity.
Filters	= $	42,000.00	Estimated based on Table 1.8 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed filters of polyethylene with diameter of 4-7/8 inches
Auxiliary Equipment			
Hoods and Ductwork	= $	-	Existing
Cyclones	= $	4,000.00	Estimated 15% of baghouse cost based on plant data
Stack	= $	6,000.00	Estimated based on Table 1.12 of Sect. 2 Ch. 1 of EPA Cost Manual; Estimated diameter of 33 in. and stack height of 30 ft.; Material assumed to be Sheet-galv CS
Dust removal	= $	4,000.00	Estimated 15% of baghouse cost based on plant data
Equipment Costs (A)	= $	*79,000.00*	
Instrumentation	= $	8,000.00	0.01A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Sales Tax	= $	-	Sales tax is not paid on process equipment
Freight	= $	4,000.00	0.05A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
PEC (B)	**= $**	**91,000.00**	

Direct Installation Costs (DC)			
Foundations & Supports	= $	4,000.00	0.04B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Handling & Erection	= $	46,000.00	0.50B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Electrical	= $	8,000.00	0.08B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Piping	= $	5,000.00	0.05B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual with additional cost added for assumed distances
Insulation for ductwork	= $	-	Unnecessary for this service
Painting	= $	10,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Building or Enclosure	= $	-	Existing
Total Direct Costs (DC)	**= $**	**73,000.00**	

Indirect Costs (IC)			
Engineering	= $	17,000.00	0.10(B+DC) based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and site engineering, design, and construction records
Construction and field expenses	= $	19,000.00	0.20B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contractor fees	= $	10,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Start-up	= $	8,000.00	0.08B based on site engineering, design, and construction records
Performance Testing	= $	1,000.00	0.01B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contingencies	= $	17,000.00	0.10(B+DC) based on site engineering, design, and construction records
Total Indirect Costs (IC)	**= $**	**72,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 236,000.00

Cost Backup Table **Item 1.05** **Option 1**

Purchased Equipment Costs

				Notes
Baghouse	=	$	47,000.00	Estimated based on Figure 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed 6,000 acfm per source to achieve minimum threshold velocity.
Bags	=	$	6,000.00	Estimated based on Table 1.8 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed bags of ryton with diameter of 4-1/2 to 5-1/8 inches
Auxiliary Equipment				
Hoods and Ductwork	=	$	-	Existing
Cyclones	=	$	8,000.00	Estimated 15% of baghouse cost based on plant data
Stack	=	$	6,000.00	Estimated based on Table 1.12 of Sect. 2 Ch. 1 of EPA Cost Manual; Estimated diameter of 33 in. and stack height of 30 ft.; Material assumed to be Sheet-galv CS
Dust removal	=	$	8,000.00	Estimated 15% of baghouse cost based on plant data
Equipment Costs (A)	=	*$*	*73,000.00*	
Instrumentation	=	$	8,000.00	0.01A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Sales Tax	=	$	-	Sales tax is not paid on process equipment
Freight	=	$	4,000.00	0.05A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
PEC (B)	=	**$**	**85,000.00**	

Direct Installation Costs (DC)

Foundations & Supports	=	$	4,000.00	0.04B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Handling & Erection	=	$	42,000.00	0.50B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Electrical	=	$	7,000.00	0.08B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Piping	=	$	5,000.00	0.05B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual with additional cost added for assumed distances
Insulation for ductwork	=	$	-	Unnecessary for this service
Painting	=	$	9,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Building or Enclosure	=	$	-	Existing
Total Direct Costs (DC)	=	**$**	**67,000.00**	

Indirect Costs (IC)

Engineering	=	$	15,000.00	0.10(B+DC) based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and site engineering, design, and construction records
Construction and field expenses	=	$	17,000.00	0.20B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contractor fees	=	$	9,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Start-up	=	$	7,000.00	0.08B based on site engineering, design, and construction records
Performance Testing	=	$	1,000.00	0.01B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contingencies	=	$	15,000.00	0.10(B+DC) based on site engineering, design, and construction records
Total Indirect Costs (IC)	=	**$**	**64,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 216,000.00

Cost Backup Table　　Item 1.05　　Option 2

Purchased Equipment Costs			Notes
Scrubber	= $	78,000.00	Estimated based on Figure 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed 6,000 acfm per source to achieve minimum threshold velocity.
Fan and pump	= $	32,000.00	Estimated to be 40% of scrubber cost
Auxiliary Equipment			
Hoods and Ductwork	= $	-	Existing
Cyclones	= $	12,000.00	Estimated 15% of baghouse cost based on plant data
Stack	= $	6,000.00	Estimated based on Table 1.12 of Sect. 2 Ch. 1 of EPA Cost Manual; Estimated diameter of 33 in. and stack height of 30 ft.; Material assumed to be Sheet-galv CS
Equipment Costs (A)	= $	*127,000.00*	
Instrumentation	= $	13,000.00	0.01A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Sales Tax	= $	-	Sales tax is not paid on process equipment
Freight	= $	7,000.00	0.05A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
PEC (B)	**= $**	**147,000.00**	

Direct Installation Costs (DC)			
Foundations & Supports	= $	6,000.00	0.04B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Handling & Erection	= $	74,000.00	0.50B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Electrical	= $	12,000.00	0.08B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Piping	= $	8,000.00	0.05B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual with additional cost added for assumed distances
Insulation for ductwork	= $	-	Unnecessary for this service
Painting	= $	15,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Building or Enclosure	= $	-	Existing
Total Direct Costs (DC)	**= $**	**115,000.00**	

Indirect Costs (IC)			
Engineering	= $	26,000.00	0.10(B+DC) based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and site engineering, design, and construction records
Construction and field expenses	= $	30,000.00	0.20B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contractor fees	= $	15,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Start-up	= $	12,000.00	0.08B based on site engineering, design, and construction records
Performance Testing	= $	2,000.00	0.01B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contingencies	= $	26,000.00	0.10(B+DC) based on site engineering, design, and construction records
Total Indirect Costs (IC)	**= $**	**111,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 373,000.00

Cost Backup Table **Item 1.05** **Option 3**

Purchased Equipment Costs				Notes
Baghouse	=	$	25,000.00	Estimated based on Figure 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed 6,000 acfm per source to achieve minimum threshold velocity.
Filters	=	$	6,000.00	Estimated based on Table 1.8 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed filters of polyethylene with diameter of 4-7/8 inches
Auxiliary Equipment				
Hoods and Ductwork	=	$	-	Existing
Cyclones	=	$	4,000.00	Estimated 15% of baghouse cost based on plant data
Stack	=	$	6,000.00	Estimated based on Table 1.12 of Sect. 2 Ch. 1 of EPA Cost Manual; Estimated diameter of 33 in. and stack height of 30 ft.; Material assumed to be Sheet-galv CS
Dust removal	=	$	4,000.00	Estimated 15% of baghouse cost based on plant data
Equipment Costs (A)	=	*$*	*45,000.00*	
Instrumentation	=	$	5,000.00	0.01A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Sales Tax	=	$	-	Sales tax is not paid on process equipment
Freight	=	$	3,000.00	0.05A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
PEC (B)	=	**$**	**53,000.00**	

Direct Installation Costs (DC)				
Foundations & Supports	=	$	3,000.00	0.04B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Handling & Erection	=	$	26,000.00	0.50B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Electrical	=	$	5,000.00	0.08B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Piping	=	$	3,000.00	0.05B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual with additional cost added for assumed distances
Insulation for ductwork	=	$	-	Unnecessary for this service
Painting	=	$	6,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Building or Enclosure	=	$	-	Existing
Total Direct Costs (DC)	=	**$**	**43,000.00**	

Indirect Costs (IC)				
Engineering	=	$	10,000.00	0.10(B+DC) based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and site engineering, design, and construction records
Construction and field expenses	=	$	11,000.00	0.20B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contractor fees	=	$	6,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Start-up	=	$	5,000.00	0.08B based on site engineering, design, and construction records
Performance Testing	=	$	1,000.00	0.01B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contingencies	=	$	10,000.00	0.10(B+DC) based on site engineering, design, and construction records
Total Indirect Costs (IC)	=	**$**	**43,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 139,000.00

Cost Backup Table **Item 1.06** **Option 1**

Purchased Equipment Costs				Notes
Baghouse	=	$	57,000.00	Estimated based on Figure 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed 6,000 acfm per source to achieve minimum threshold velocity.
Bags	=	$	8,000.00	Estimated based on Table 1.8 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed bags of ryton with diameter of 4-1/2 to 5-1/8 inches
Auxiliary Equipment				
Hoods and Ductwork	=	$	-	Existing
Cyclones	=	$	9,000.00	Estimated 15% of baghouse cost based on plant data
Stack	=	$	6,000.00	Estimated based on Table 1.12 of Sect. 2 Ch. 1 of EPA Cost Manual; Estimated diameter of 33 in. and stack height of 30 ft.; Material assumed to be Sheet-galv CS
Dust removal	=	$	9,000.00	Estimated 15% of baghouse cost based on plant data
Equipment Costs (A)	=	$	*89,000.00*	
Instrumentation	=	$	9,000.00	0.01A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Sales Tax	=	$	-	Sales tax is not paid on process equipment
Freight	=	$	5,000.00	0.05A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
PEC (B)	=	**$**	**103,000.00**	

Direct Installation Costs (DC)				
Foundations & Supports	=	$	5,000.00	0.04B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Handling & Erection	=	$	52,000.00	0.50B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Electrical	=	$	9,000.00	0.08B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Piping	=	$	6,000.00	0.05B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual with additional cost added for assumed distances
Insulation for ductwork	=	$	-	Unnecessary for this service
Painting	=	$	11,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Building or Enclosure	=	$	-	Existing
Total Direct Costs (DC)	=	**$**	**83,000.00**	

Indirect Costs (IC)				
Engineering	=	$	19,000.00	0.10(B+DC) based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and site engineering, design, and construction records
Construction and field expenses	=	$	21,000.00	0.20B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contractor fees	=	$	11,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Start-up	=	$	9,000.00	0.08B based on site engineering, design, and construction records
Performance Testing	=	$	2,000.00	0.01B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contingencies	=	$	19,000.00	0.10(B+DC) based on site engineering, design, and construction records
Total Indirect Costs (IC)	=	**$**	**81,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 267,000.00

Cost Backup Table   Item 1.06   Option 2

Purchased Equipment Costs			Notes
Scrubber	=	$ 95,000.00	Estimated based on Figure 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed 6,000 acfm per source to achieve minimum threshold velocity.
Fan and pump	=	$ 38,000.00	Estimated to be 40% of scrubber cost
Auxiliary Equipment			
Hoods and Ductwork	=	$ -	Existing
Cyclones	=	$ 15,000.00	Estimated 15% of baghouse cost based on plant data
Stack	=	$ 6,000.00	Estimated based on Table 1.12 of Sect. 2 Ch. 1 of EPA Cost Manual; Estimated diameter of 33 in. and stack height of 30 ft.; Material assumed to be Sheet-galv CS
Equipment Costs (A)	=	*$ 154,000.00*	
Instrumentation	=	$ 16,000.00	0.01A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Sales Tax	=	$ -	Sales tax is not paid on process equipment
Freight	=	$ 8,000.00	0.05A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
PEC (B)	=	**$ 178,000.00**	

Direct Installation Costs (DC)			
Foundations & Supports	=	$ 8,000.00	0.04B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Handling & Erection	=	$ 89,000.00	0.50B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Electrical	=	$ 15,000.00	0.08B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Piping	=	$ 9,000.00	0.05B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual with additional cost added for assumed distances
Insulation for ductwork	=	$ -	Unnecessary for this service
Painting	=	$ 18,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Building or Enclosure	=	$ -	Existing
Total Direct Costs (DC)	=	**$ 139,000.00**	

Indirect Costs (IC)			
Engineering	=	$ 32,000.00	0.10(B+DC) based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and site engineering, design, and construction records
Construction and field expenses	=	$ 36,000.00	0.20B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contractor fees	=	$ 18,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Start-up	=	$ 15,000.00	0.08B based on site engineering, design, and construction records
Performance Testing	=	$ 2,000.00	0.01B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contingencies	=	$ 32,000.00	0.10(B+DC) based on site engineering, design, and construction records
Total Indirect Costs (IC)	=	**$ 135,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 452,000.00

Cost Backup Table Item 1.06 Option 3

Purchased Equipment Costs			Notes
Baghouse	= $	33,000.00	Estimated based on Figure 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed 6,000 acfm per source to achieve minimum threshold velocity.
Filters	= $	9,000.00	Estimated based on Table 1.8 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed filters of polyethylene with diameter of 4-7/8 inches
Auxiliary Equipment			
Hoods and Ductwork	= $	-	Existing
Cyclones	= $	5,000.00	Estimated 15% of baghouse cost based on plant data
Stack	= $	6,000.00	Estimated based on Table 1.12 of Sect. 2 Ch. 1 of EPA Cost Manual; Estimated diameter of 33 in. and stack height of 30 ft.; Material assumed to be Sheet-galv CS
Dust removal	= $	5,000.00	Estimated 15% of baghouse cost based on plant data
Equipment Costs (A)	= $	*58,000.00*	
Instrumentation	= $	6,000.00	0.01A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Sales Tax	= $	-	Sales tax is not paid on process equipment
Freight	= $	3,000.00	0.05A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
PEC (B)	**= $**	**67,000.00**	

Direct Installation Costs (DC)			
Foundations & Supports	= $	3,000.00	0.04B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Handling & Erection	= $	34,000.00	0.50B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Electrical	= $	6,000.00	0.08B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Piping	= $	4,000.00	0.05B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual with additional cost added for assumed distances
Insulation for ductwork	= $	-	Unnecessary for this service
Painting	= $	7,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Building or Enclosure	= $	-	Existing
Total Direct Costs (DC)	**= $**	**54,000.00**	

Indirect Costs (IC)			
Engineering	= $	12,000.00	0.10(B+DC) based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and site engineering, design, and construction records
Construction and field expenses	= $	14,000.00	0.20B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contractor fees	= $	7,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Start-up	= $	6,000.00	0.08B based on site engineering, design, and construction records
Performance Testing	= $	1,000.00	0.01B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contingencies	= $	12,000.00	0.10(B+DC) based on site engineering, design, and construction records
Total Indirect Costs (IC)	**= $**	**52,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 173,000.00

Salt Plant Enclosed and Unenclosed Sources Routed to Existing APCE

(Groups established based on source location proximity and technical feasibility to address emissions with a single piece of control equipment.)

Emissions Group	Source ID	Source Description	Equipment Category	Area		Estimated Uncontrolled Emissions (TPY)
1	OC503	F506 DISCHARGE CONVEYOR	Conveyor		6.41	0.009
2	Salt Rail Load-Out	Bulk Loading of Salt Railcars		Salt Loading	1.024	0.0273
3	GA503	Drop to ground after C503 and before C506	Drop Points		1.024	0.474
4	OC513	STORAGE BIN FEED Conveyor 30 X 32	Conveyor		0.009	0.079
	OC576	BAG STAGE 4 FEED CONVEYOR	Conveyor		0.002	
	OC577	BAG STAGE 5 FEED CONVEYOR	Conveyor		0.002	
	OC578	BAG STAGE 1 FEED CONVEYOR	Conveyor		0.002	
	OC579	FEED CONVEYOR, BAG STAGE 3	Conveyor		0.002	
	OC580	SOUTH RAIL LOADOUT CONV 30" WI	Conveyor		0.007	
	OC581	NORTH RAIL LOADOUT CONV 30' WI	Conveyor		0.007	
	OC582	SOUTH RAIL COLLECTOR CONVEYOR	Conveyor		0.007	
	OC583	NORTH RAIL COLLECTOR CONV 30"	Conveyor		0.007	
	OC584	SO. TRUCK COLLECTOR CONV 30"	Conveyor		0.007	
	OC585	NO. TRUCK COLLETOR CONV 30" WI	Conveyor		0.007	
	OC586	TRUCK LOADOUT BELT CONV 30" WI	Conveyor		0.007	
	OC595	ASPEN FEED SCREW 6" STAINLESS	Conveyor		0.00007	
	OBA505C3	TIP CONVEYOR	Conveyor		0.0046	
	OF505	PELLET PRESS SP501 FORCE FEED	Feeders/Baggers		0.003	
	OF507	PELLET PRESS SP502 FORCE FEED	Feeders/Baggers		0.003	
	OF508	ADDITIVE HOPPER TO MIN BAGGER	Feeders/Baggers		0.0004	
	OF515	ADDITIVES HOPPER TO C581	Feeders/Baggers		0.000005	
	OF518A	DSP FEEDER TO C575 SCREW	Feeders/Baggers		0.002	
	OF518B	SP503 ADDITIVES HOPPER FEEDER	Feeders/Baggers		0.00007	

Cost Backup Table   Item 1.07a   Option 1

Purchased Equipment Costs

				Notes
Galvanized sheet metal enclosure	=	$	11,000.00	Estimated based on Table 3.3 of Sect. 2 Ch. 3 of EPA Cost Manual with a multiplier of 1.25 for galvanized sheet metal
Hoods and ductwork	=	$	10,000.00	Based on $10,000 per pickup point
PEC (B) =		**$**	**21,000.00**	

Installation Costs (DC)

Painting	=	$	3,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Foundations & Supports	=	$	126,000.00	Estimated based on Table 3.10 of Sect. 2 Ch. 3 of EPA Cost Manual. A multiplier of 2.0 has been added due to the complexity of construction.
Installation Costs (DC+IC) =		**$**	**129,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 150,000.00

Cost Backup Table   Item 1.07a   Option 2

Purchased Equipment Costs				Notes
Galvanized sheet metal enclosure	=	$	4,000.00	Estimated based on Table 3.3 of Sect. 2 Ch. 3 of EPA Cost Manual with a multiplier of 1.25 for galvanized sheet metal
PEC (B) =		**$**	**4,000.00**	

Installation Costs (DC)				
Painting	=	$	1,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Foundations & Supports	=	$	48,000.00	Estimated based on Table 3.10 of Sect. 2 Ch. 3 of EPA Cost Manual. A multiplier of 2.0 has been added due to the complexity of construction.
Installation Costs (DC+IC) =		**$**	**49,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 53,000.00

Cost Backup Table   Item 1.07b   Option 1

Purchased Equipment Costs

				Notes
Galvanized sheet metal enclosure	=	$	18,000.00	Estimated based on Table 3.3 of Sect. 2 Ch. 3 of EPA Cost Manual with a multiplier of 1.25 for galvanized sheet metal
Hoods and ductwork	=	$	10,000.00	Based on $10,000 per pickup point
PEC (B) =		**$**	**28,000.00**	

Installation Costs (DC)

Painting	=	$	3,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Foundations & Supports	=	$	217,000.00	Estimated based on Table 3.10 of Sect. 2 Ch. 3 of EPA Cost Manual. A multiplier of 2.0 has been added due to the complexity of construction.
Installation Costs (DC+IC) =		**$**	**220,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 248,000.00

Cost Backup Table **Item 1.07c** **Option 1**

Purchased Equipment Costs

				Notes
Galvanized sheet metal enclosure	=	$	12,000.00	Estimated based on Table 3.3 of Sect. 2 Ch. 3 of EPA Cost Manual with a multiplier of 1.25 for galvanized sheet metal
Hoods and ductwork	=	$	10,000.00	Based on $10,000 per pickup point
PEC (B) =		**$**	**22,000.00**	

Installation Costs (DC)

Painting	=	$	3,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Foundations & Supports	=	$	142,000.00	Estimated based on Table 3.10 of Sect. 2 Ch. 3 of EPA Cost Manual. A multiplier of 2.0 has been added due to the complexity of construction.
Installation Costs (DC+IC) =		**$**	**145,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 167,000.00

Cost Backup Table   Item 1.07c   Option 2

Purchased Equipment Costs				Notes
Galvanized sheet metal enclosure	=	$	12,000.00	Estimated based on Table 3.3 of Sect. 2 Ch. 3 of EPA Cost Manual with a multiplier of 1.25 for galvanized sheet metal
PEC (B) =		**$**	**12,000.00**	

Installation Costs (DC)				
Painting	=	$	2,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Foundations & Supports	=	$	142,000.00	Estimated based on Table 3.10 of Sect. 2 Ch. 3 of EPA Cost Manual. A multiplier of 2.0 has been added due to the complexity of construction.
Installation Costs (DC+IC) =		**$**	**144,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 156,000.00

Cost Backup Table Item 1.08 Option 1

Purchased Equipment Costs

				Notes
Galvanized sheet metal enclosure	=	$	76,000.00	Estimated based on Table 3.3 of Sect. 2 Ch. 3 of EPA Cost Manual with a multiplier of 1.25 for galvanized sheet metal
PEC (B) =		**$**	**76,000.00**	

Installation Costs (DC)

Painting	=	$	8,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Foundations & Supports	=	$	944,000.00	Estimated based on Table 3.10 of Sect. 2 Ch. 3 of EPA Cost Manual. A multiplier of 2.0 has been added due to the complexity of construction.
Installation Costs (DC+IC) =		**$**	**952,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 1,028,000.00

Cost Backup Table **Item 2.04** **Option 1**

Purchased Equipment Costs

				Notes
Baghouse	=	$	204,000.00	Estimated based on Figure 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed 6,000 acfm per source to achieve minimum threshold velocity.
Bags	=	$	40,000.00	Estimated based on Table 1.8 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed bags of ryton with diameter of 4-1/2 to 5-1/8 inches
Auxiliary Equipment				
Hoods and Ductwork	=	$	-	Existing
Cyclones	=	$	31,000.00	Estimated 15% of baghouse cost based on plant data
Stack	=	$	6,000.00	Estimated based on Table 1.12 of Sect. 2 Ch. 1 of EPA Cost Manual; Estimated diameter of 33 in. and stack height of 30 ft.; Material assumed to be Sheet-galv CS
Dust removal	=	$	31,000.00	Estimated 15% of baghouse cost based on plant data
Equipment Costs (A)	=	$	*311,000.00*	
Instrumentation	=	$	32,000.00	0.01A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Sales Tax	=	$	-	Sales tax is not paid on process equipment
Freight	=	$	16,000.00	0.05A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
PEC (B)	=	**$**	**359,000.00**	

Direct Installation Costs (DC)

Foundations & Supports	=	$	15,000.00	0.04B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Handling & Erection	=	$	179,000.00	0.50B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Electrical	=	$	29,000.00	0.08B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Piping	=	$	18,000.00	0.05B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual with additional cost added for assumed distances
Insulation for ductwork	=	$	-	Unnecessary for this service
Painting	=	$	36,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Building or Enclosure	=	$	-	Existing
Total Direct Costs (DC)	=	**$**	**277,000.00**	

Indirect Costs (IC)

Engineering	=	$	64,000.00	0.10(B+DC) based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and site engineering, design, and construction records
Construction and field expenses	=	$	72,000.00	0.20B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contractor fees	=	$	36,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Start-up	=	$	29,000.00	0.08B based on site engineering, design, and construction records
Performance Testing	=	$	4,000.00	0.01B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contingencies	=	$	64,000.00	0.10(B+DC) based on site engineering, design, and construction records
Total Indirect Costs (IC)	=	**$**	**269,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 905,000.00

Cost Backup Table Item 2.04 Option 2

Purchased Equipment Costs			Notes
Scrubber	= $	132,000.00	Estimated based on Figure 2.16 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed 6,000 acfm per source to achieve minimum threshold velocity.
Fan and pump	= $	53,000.00	Estimated to be 40% of scrubber cost
Auxiliary Equipment			
Hoods and Ductwork	= $	-	Existing
Cyclones	= $	20,000.00	Estimated 15% of scrubber cost based on plant data
Stack	= $	6,000.00	Estimated based on Table 1.12 of Sect. 2 Ch. 1 of EPA Cost Manual; Estimated diameter of 33 in. and stack height of 30 ft.; Material assumed to be Sheet-galv CS
Equipment Costs (A)	= $	*211,000.00*	
Instrumentation	= $	22,000.00	0.01A based on Table 2.8 of Sect. 6 Ch. 2 of EPA Cost Manual
Sales Tax	= $	-	Sales tax is not paid on process equipment
Freight	= $	11,000.00	0.05A based on Table Table 2.8 of Sect. 6 Ch. 2 of EPA Cost Manual
PEC (B)	**= $**	**244,000.00**	

Direct Installation Costs (DC)			
Foundations & Supports	= $	15,000.00	0.06B based on Table Table 2.8 of Sect. 6 Ch. 2 of EPA Cost Manual
Handling & Erection	= $	122,000.00	0.50B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Electrical	= $	3,000.00	0.01B based on Table Table 2.8 of Sect. 6 Ch. 2 of EPA Cost Manual
Piping	= $	13,000.00	0.05B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual with additional cost added for assumed distances
Insulation for ductwork	= $	-	Unnecessary for this service
Painting	= $	25,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Building or Enclosure	= $	-	Existing
Total Direct Costs (DC)	**= $**	**178,000.00**	

Indirect Costs (IC)			
Engineering	= $	25,000.00	0.10(B+DC) based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and site engineering, design, and construction records
Construction and field expenses	= $	49,000.00	0.20B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contractor fees	= $	25,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Start-up	= $	20,000.00	0.08B based on site engineering, design, and construction records
Performance Testing	= $	3,000.00	0.01B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contingencies	= $	25,000.00	0.10(B+DC) based on site engineering, design, and construction records
Total Indirect Costs (IC)	**= $**	**147,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 569,000.00

Cost Backup Table   Item 2.04   Option 3

Purchased Equipment Costs			Notes
Baghouse	= $	23,000.00	Estimated based on Figure 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed 6,000 acfm per source to achieve minimum threshold velocity.
Filters	= $	41,000.00	Estimated based on Table 1.8 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed filters of polyethylene with diameter of 4-7/8 inches
Auxiliary Equipment			
Hoods and Ductwork	= $	-	Existing
Cyclones	= $	4,000.00	Estimated 15% of baghouse cost based on plant data
Stack	= $	6,000.00	Estimated based on Table 1.12 of Sect. 2 Ch. 1 of EPA Cost Manual; Estimated diameter of 33 in. and stack height of 30 ft.; Material assumed to be Sheet-galv CS
Dust removal	= $	4,000.00	Estimated 15% of baghouse cost based on plant data
Equipment Costs (A)	= $	*77,000.00*	
Instrumentation	= $	8,000.00	0.01A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Sales Tax	= $	-	Sales tax is not paid on process equipment
Freight	= $	4,000.00	0.05A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
PEC (B)	**= $**	**89,000.00**	

Direct Installation Costs (DC)			
Foundations & Supports	= $	4,000.00	0.04B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Handling & Erection	= $	45,000.00	0.50B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Electrical	= $	8,000.00	0.08B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Piping	= $	5,000.00	0.05B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual with additional cost added for assumed distances
Insulation for ductwork	= $	-	Unnecessary for this service
Painting	= $	9,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Building or Enclosure	= $	-	Existing
Total Direct Costs (DC)	**= $**	**71,000.00**	

Indirect Costs (IC)			
Engineering	= $	16,000.00	0.10(B+DC) based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and site engineering, design, and construction records
Construction and field expenses	= $	18,000.00	0.20B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contractor fees	= $	9,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Start-up	= $	8,000.00	0.08B based on site engineering, design, and construction records
Performance Testing	= $	1,000.00	0.01B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contingencies	= $	16,000.00	0.10(B+DC) based on site engineering, design, and construction records
Total Indirect Costs (IC)	**= $**	**68,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 228,000.00

Cost Backup Table Item 2.05 Option 1

Purchased Equipment Costs				Notes
Baghouse	=	$	174,000.00	Estimated based on Figure 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed 6,000 acfm per source to achieve minimum threshold velocity.
Bags	=	$	34,000.00	Estimated based on Table 1.8 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed bags of ryton with diameter of 4-1/2 to 5-1/8 inches
Auxiliary Equipment				
Hoods and Ductwork	=	$	-	Existing
Cyclones	=	$	27,000.00	Estimated 15% of baghouse cost based on plant data
Stack	=	$	6,000.00	Estimated based on Table 1.12 of Sect. 2 Ch. 1 of EPA Cost Manual; Estimated diameter of 33 in. and stack height of 30 ft.; Material assumed to be Sheet-galv CS
Dust removal	=	$	27,000.00	Estimated 15% of baghouse cost based on plant data
Equipment Costs (A)	=	$	*266,000.00*	
Instrumentation	=	$	27,000.00	0.01A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Sales Tax	=	$	-	Sales tax is not paid on process equipment
Freight	=	$	14,000.00	0.05A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
PEC (B)	=	**$**	**307,000.00**	

Direct Installation Costs (DC)				
Foundations & Supports	=	$	13,000.00	0.04B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Handling & Erection	=	$	153,000.00	0.50B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Electrical	=	$	25,000.00	0.08B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Piping	=	$	16,000.00	0.05B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual with additional cost added for assumed distances
Insulation for ductwork	=	$	-	Unnecessary for this service
Painting	=	$	31,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Building or Enclosure	=	$	-	Existing
Total Direct Costs (DC)	=	**$**	**238,000.00**	

Indirect Costs (IC)				
Engineering	=	$	55,000.00	0.10(B+DC) based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and site engineering, design, and construction records
Construction and field expenses	=	$	62,000.00	0.20B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contractor fees	=	$	31,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Start-up	=	$	25,000.00	0.08B based on site engineering, design, and construction records
Performance Testing	=	$	4,000.00	0.01B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contingencies	=	$	55,000.00	0.10(B+DC) based on site engineering, design, and construction records
Total Indirect Costs (IC)	=	**$**	**232,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 777,000.00

Cost Backup Table   Item 2.05   Option 2

Purchased Equipment Costs			Notes
Scrubber	= $	119,000.00	Estimated based on Figure 2.16 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed 6,000 acfm per source to achieve minimum threshold velocity.
Fan and pump	= $	48,000.00	Estimated to be 40% of scrubber cost
Auxiliary Equipment			
Hoods and Ductwork	= $	-	Existing
Cyclones	= $	18,000.00	Estimated 15% of scrubber cost based on plant data
Stack	= $	6,000.00	Estimated based on Table 1.12 of Sect. 2 Ch. 1 of EPA Cost Manual; Estimated diameter of 33 in. and stack height of 30 ft.; Material assumed to be Sheet-galv CS
Equipment Costs (A)	= $	*191,000.00*	
Instrumentation	= $	20,000.00	0.01A based on Table 2.8 of Sect. 6 Ch. 2 of EPA Cost Manual
Sales Tax	= $	-	Sales tax is not paid on process equipment
Freight	= $	10,000.00	0.05A based on Table Table 2.8 of Sect. 6 Ch. 2 of EPA Cost Manual
PEC (B)	= **$**	**221,000.00**	

Direct Installation Costs (DC)			
Foundations & Supports	= $	14,000.00	0.06B based on Table Table 2.8 of Sect. 6 Ch. 2 of EPA Cost Manual
Handling & Erection	= $	110,000.00	0.50B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Electrical	= $	3,000.00	0.01B based on Table Table 2.8 of Sect. 6 Ch. 2 of EPA Cost Manual
Piping	= $	11,000.00	0.05B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual with additional cost added for assumed distances
Insulation for ductwork	= $	-	Unnecessary for this service
Painting	= $	22,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Building or Enclosure	= $	-	Existing
Total Direct Costs (DC)	= **$**	**160,000.00**	

Indirect Costs (IC)			
Engineering	= $	22,000.00	0.10(B+DC) based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and site engineering, design, and construction records
Construction and field expenses	= $	44,000.00	0.20B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contractor fees	= $	22,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Start-up	= $	18,000.00	0.08B based on site engineering, design, and construction records
Performance Testing	= $	3,000.00	0.01B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contingencies	= $	22,000.00	0.10(B+DC) based on site engineering, design, and construction records
Total Indirect Costs (IC)	= **$**	**131,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 512,000.00

Cost Backup Table Item 2.05 Option 3

Purchased Equipment Costs				Notes
Baghouse	=	$	20,000.00	Estimated based on Figure 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed 6,000 acfm per source to achieve minimum threshold velocity.
Filters	=	$	35,000.00	Estimated based on Table 1.8 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed filters of polyethylene with diameter of 4-7/8 inches
Auxiliary Equipment				
Hoods and Ductwork	=	$	-	Existing
Cyclones	=	$	3,000.00	Estimated 15% of baghouse cost based on plant data
Stack	=	$	6,000.00	Estimated based on Table 1.12 of Sect. 2 Ch. 1 of EPA Cost Manual; Estimated diameter of 33 in. and stack height of 30 ft.; Material assumed to be Sheet-galv CS
Dust removal	=	$	3,000.00	Estimated 15% of baghouse cost based on plant data
Equipment Costs (A)	=	$	*67,000.00*	
Instrumentation	=	$	7,000.00	0.01A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Sales Tax	=	$	-	Sales tax is not paid on process equipment
Freight	=	$	4,000.00	0.05A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
PEC (B)	=	**$**	**78,000.00**	
Direct Installation Costs (DC)				
Foundations & Supports	=	$	4,000.00	0.04B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Handling & Erection	=	$	39,000.00	0.50B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Electrical	=	$	7,000.00	0.08B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Piping	=	$	4,000.00	0.05B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual with additional cost added for assumed distances
Insulation for ductwork	=	$	-	Unnecessary for this service
Painting	=	$	8,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Building or Enclosure	=	$	-	Existing
Total Direct Costs (DC)	=	**$**	**62,000.00**	
Indirect Costs (IC)				
Engineering	=	$	14,000.00	0.10(B+DC) based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and site engineering, design, and construction records
Construction and field expenses	=	$	16,000.00	0.20B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contractor fees	=	$	8,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Start-up	=	$	7,000.00	0.08B based on site engineering, design, and construction records
Performance Testing	=	$	1,000.00	0.01B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contingencies	=	$	14,000.00	0.10(B+DC) based on site engineering, design, and construction records
Total Indirect Costs (IC)	=	**$**	**60,000.00**	
Total Capital Cost (PEC + DC + IC)	=	**$**	**200,000.00**	

Cost Backup Table — Item 2.07 — Option 1

Purchased Equipment Costs

				Notes
Scrubber	=	$ 113,000.00	$ 113,000.00	Estimated based on Figure 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed 6,000 acfm per source to achieve minimum threshold velocity.
Fan and pump	=	$ 45,200.00	$ 46,000.00	Estimated to be 40% of scrubber cost
Auxiliary Equipment				
Hoods and Ductwork	=	$ -	$ -	Existing
Cyclones	=	$ 17,000.00	$ 17,000.00	Estimated 15% of baghouse cost based on plant data
Stack	=	$ 6,000.00	$ 6,000.00	Estimated based on Table 1.12 of Sect. 2 Ch. 1 of EPA Cost Manual; Estimated diameter of 33 in. and stack height of 30 ft.; Material assumed to be Sheet-galv CS
Equipment Costs (A)	=	*$ 182,000.00*	*$ 182,000.00*	
Instrumentation	=	$ 18,200.00	$ 19,000.00	0.01A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Sales Tax	=	$ -	$ -	Sales tax is not paid on process equipment
Freight	=	$ 9,100.00	$ 10,000.00	0.05A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
PEC (B)	=	**$ 209,300.00**	**$ 211,000.00**	

Direct Installation Costs (DC)

Foundations & Supports	=	$ 104,650.00	$ 105,000.00	0.50B based on complexity of construction in a congested plant area
Handling & Erection	=	$ 313,950.00	$ 314,000.00	1.5B based on complexity of construction in a congested plant area
Electrical	=	$ 16,744.00	$ 17,000.00	0.08B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Piping	=	$ 10,465.00	$ 11,000.00	0.05B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual with additional cost added for assumed distances
Insulation for ductwork	=	$ -	$ -	Unnecessary for this service
Painting	=	$ 20,930.00	$ 21,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Building or Enclosure	=	$ -	$ -	Existing
Total Direct Costs (DC)	=	**$ 466,739.00**	**$ 468,000.00**	

Indirect Costs (IC)

Engineering	=	$ 135,207.80	$ 136,000.00	0.20(B+DC) based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and site engineering, design, and construction records
Construction and field expenses	=	$ 41,860.00	$ 42,000.00	0.20B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contractor fees	=	$ 20,930.00	$ 21,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Start-up	=	$ 16,744.00	$ 17,000.00	0.08B based on site engineering, design, and construction records
Performance Testing	=	$ 2,093.00	$ 3,000.00	0.01B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contingencies	=	$ 67,603.90	$ 68,000.00	0.10(B+DC) based on site engineering, design, and construction records
Total Indirect Costs (IC)	=		**$ 287,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 966,000.00

EMISSION CALCULATIONS FOR COOLING TOWERS # Cost Backup for Item 2.10

Compass Minerals **Ogden Utah**

Equipment Designation: CT003 - SOP

Equipment Description: Cooling Tower Blowdown is controlled by conductivity. When the tower conductivity reaches the set point an automatic blowdown opens reducing it to below setpoint.

Model Forced draft counterflow

Operating Parameters	90,000	gallons per hour
Annual Operating Hours	8,760	hours
Annual Water Use	788,400	Thousand Gallons
Recirculation Rate (RR, gpm)	1,500	Data provided by CM
Drift Loss (% of RR)	0.20%	Based on standard engineering design*
TDS, ppm (average)	10,700	As provided by Compass Ogden staff
Drift, gpm (calculated)	3	Drift Loss x RR
Emissions		
PM, lb/hr	16.063	Drift x TDS / 1E-6 x 8.34 x 60
PM, lb/gal	1.785E-04	PM lb/hr / gallons per hour
PM, lb/1000 gal	1.785E-01	PM lb/gal / 1,000
PM, tpy	70.355	lb/hr x 8,760 / 2000
PM_{10}, lb/hr	0.92	PM lb/hr x Particle Size Ratio %
PM_{10}, tpy	4.03	lb/hr x 8,760 / 2000
$PM_{2.5}$, lb/hr	2.90E-02	PM lb/hr x Particle Size Ratio %
$PM_{2.5}$, tpy	1.27E-01	lb/hr x 8,760 / 2000

Equipment Designation: CT003 - SOP

Equipment Description: Cooling Tower Blowdown is controlled by conductivity. When the tower conductivity reaches the set point an automatic blowdown opens reducing it to below setpoint.

Model Forced draft counterflow

Operating Parameters	90,000	gallons per hour
Annual Operating Hours	8,760	hours
Annual Water Use	788,400	Thousand Gallons
Recirculation Rate (RR, gpm)	1,500	Data provided by CM
Drift Loss (% of RR)	0.0005%	Based on standard engineering design*
TDS, ppm (average)	4,000	As provided by Compass Ogden staff
Drift, gpm (calculated)	0.0075	Drift Loss x RR
Emissions		
PM, lb/hr	0.015	Drift x TDS / 1E-6 x 8.34 x 60
PM, lb/gal	1.668E-07	PM lb/hr / gallons per hour
PM, lb/1000 gal	1.668E-04	PM lb/gal / 1,000
PM, tpy	0.066	lb/hr x 8,760 / 2000
PM_{10}, lb/hr	0.0009	PM lb/hr x Particle Size Ratio %
PM_{10}, tpy	0.004	lb/hr x 8,760 / 2000
$PM_{2.5}$, lb/hr	2.71E-05	PM lb/hr x Particle Size Ratio %
$PM_{2.5}$, tpy	1.19E-04	lb/hr x 8,760 / 2000

Additional Tons Controlled CT003
1.26708E-01 tpy

Equipment Designation:	CT004 - SOP
Equipment Description:	Cooling Tower Blowdown is controlled by conductivity. When the tower conductivity
Model	Forced draft counterflow

Operating Parameters	90,000	gallons per hour
Annual Operating Hours	8,760	hours
Annual Water Use	788,400	Thousand Gallons
Recirculation Rate (RR, gpm)	1,500	Data provided by CM
Drift Loss (% of RR)	0.20%	Based on standard engineering design*
TDS, ppm (average)	10,700	As provided by Compass Ogden staff
Drift, gpm (calculated)	3	Drift Loss x RR
Emissions		
PM, lb/hr	16.063	Drift x TDS / 1E-6 x 8.34 x 60
PM, lb/gal	1.785E-04	PM lb/hr / gallons per hour
PM, lb/1000 gal	1.785E-01	PM lb/gal / 1,000
PM, tpy	70.355	lb/hr x 8,760 / 2000
PM_{10}, lb/hr	9.19E-01	PM lb/hr x Particle Size Ratio %
PM_{10}, tpy	4.03	lb/hr x 8,760 / 2000
$PM_{2.5}$, lb/hr	2.90E-02	PM lb/hr x Particle Size Ratio %
$PM_{2.5}$, tpy	1.27E-01	lb/hr x 8,760 / 2000

Equipment Designation:	CT004 - SOP
Equipment Description:	Cooling Tower Blowdown is controlled by conductivity. When the tower conductivity
Model	Forced draft counterflow

Operating Parameters	90,000	gallons per hour
Annual Operating Hours	8,760	hours
Annual Water Use	788,400	Thousand Gallons
Recirculation Rate (RR, gpm)	1,500	Data provided by CM
Drift Loss (% of RR)	0.0005%	Based on standard engineering design*
TDS, ppm (average)	4,000	As provided by Compass Ogden staff
Drift, gpm (calculated)	0.0075	Drift Loss x RR
Emissions		
PM, lb/hr	0.015	Drift x TDS / 1E-6 x 8.34 x 60
PM, lb/gal	1.668E-07	PM lb/hr / gallons per hour
PM, lb/1000 gal	1.668E-04	PM lb/gal / 1,000
PM, tpy	0.066	lb/hr x 8,760 / 2000
PM_{10}, lb/hr	8.59E-04	PM lb/hr x Particle Size Ratio %
PM_{10}, tpy	0.004	lb/hr x 8,760 / 2000
$PM_{2.5}$, lb/hr	2.71E-05	PM lb/hr x Particle Size Ratio %
$PM_{2.5}$, tpy	1.19E-04	lb/hr x 8,760 / 2000

Additional Tons Controlled CT003 and CT004
2.53417E-01 tpy

Additional Tons Controlled CT004
1.26708E-01 tpy

Information from Brian Fuqua, Cooling Tower Depot, phone call 5/4/2017
www.Coolingtowerdepot.com
816-331-5536

	Feet	Feet	Sq Ft Ref	0.0005%D $/Sq Ft	Direct cost 2017$ Installed Cost
SOP-N	36	72	2592 CTD	23.5	$ 60,912
SOP-S	42	84	3528 CTD	23.5	$ 82,908
MAG	10	15	150 G Earth	23.5	$ 3,525

Sulfate of Potash Plant Enclosed and Unenclosed Sources Routed to New APCE

(Groups established based on source location proximity and technical feasibility to address emissions with a single piece of control equipment.)

Emissions Group	Source ID	Source Description	Equipment Category	Area		Estimated Uncontrolled Emissions (TPY)
2.11a	OST012	DOME SILO #12	Bins/Hoppers	SOP Plant Discharge	6.41	6.41
2.11b	OST013	DOME SILO #13	Bins/Hoppers	KCl Storage	1.024	1.024
2.11c	OST014	KCL STORAGE FABRIC DOME	Bins/Hoppers	KCl Storage	1.024	1.024
2.11d	OC276	KCL CAMBELT INCLINE UNLOADING	Conveyor	KCl Transfer	0.219	1.797
	OC277	KCL TRANSFER BELT TO ST014	Conveyor		0.219	
	OC281	KCL XFER CONV C276 TO ST013	Conveyor		0.219	
	GA276	Drop to ground after C276 and before C214/C277	Drop Points		1.14	
2.11e	OC246	TEMP RECLAIM SYSTEM	Conveyor	SOP Plant Discharge	0.073	1.326
	OC246A	RECLAIM CONVEYOR BELT #1	Conveyor		0.073	
	OC246B	RECLAIM MAGNET BELT	Conveyor		0.073	
	OC246C	RECLAIM CONVEYOR BELT #2	Conveyor		0.073	
	OC246D	RECLAIM CONVEYOR BELT #3	Conveyor		0.073	
	OC246E	RECLAIM CONVEYOR BELT #4	Conveyor		0.073	
	OC246F	RECLAIM SCREW CONVEYOR	Conveyor		0.073	
	GA009	Drop to ground after C009 and before C165	Drop Points		0.379	
	GA040	Drop to ground after C040 and before C010	Drop Points		0.379	
	OC010	K2S04 PRODUCT BUCKET ELEVATOR	Elevators		0.0285	
	OC236	BUCKET ELEVATOR	Elevators		0.0285	
2.11f	OC278	KCL RECLAIM TUNNEL CONVEYOR	Conveyor	KCl Reclaim	0.029	0.087
	OC279	KCL CAMBELT INCLINE RECLAIM	Conveyor		0.029	
	OC280	KCL RECLAIM TRANSFER CONVEYOR	Conveyor		0.029	
2.11g	OC213	KCL UNLOADING SCREW CONVEYOR	Conveyor	KCl Rail Receiving	0.219	1.59
	N/A	KCL RAIL UNLOADING	Unloading		1.37	
2.11h	OC041	COMPACTION BUCKET ELEVATOR	Elevators	SOP Compaction	0.171	0.792
	OS1565	RECYCLE ROTEX SCALPER SCREEN	Screens		0.577	
	OSH042	SHUTTLE-TRIPPER, CONVEYOR C042	Conveyor		0.044	

Cost Backup Table Item 2.11a Option 1

Purchased Equipment Costs			Notes
Baghouse	= $	138,000.00	Estimated based on Figure 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed 6,000 acfm per source to achieve minimum threshold velocity.
Bags	= $	26,000.00	Estimated based on Table 1.8 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed bags of ryton with diameter of 4-1/2 to 5-1/8 inches
Auxiliary Equipment			
Hoods and Ductwork	= $	-	Direct control of roof vent
Cyclones	= $	-	Direct control of roof vent
Stack	= $	-	Direct control of roof vent
Dust removal	= $	-	Return of dust into dome
Equipment Costs (A)	= $	*164,000.00*	
Instrumentation	= $	17,000.00	0.01A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Sales Tax	= $	-	Sales tax is not paid on process equipment
Freight	= $	9,000.00	0.05A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
PEC (B)	**= $**	**190,000.00**	

Direct Installation Costs (DC)			
Foundations & Supports	= $	8,000.00	0.04B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Handling & Erection	= $	95,000.00	0.50B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Electrical	= $	16,000.00	0.08B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Piping	= $	10,000.00	0.05B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual with additional cost added for assumed distances
Insulation for ductwork	= $	-	Unnecessary for this service
Painting	= $	19,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Building or Enclosure	= $	86,000.00	Based on historical plant data on cost of total source enclosure
Total Direct Costs (DC)	**= $**	**234,000.00**	

Indirect Costs (IC)			
Engineering	= $	42,000.00	0.10(B+DC) based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and site engineering, design, and construction records
Construction and field expenses	= $	38,000.00	0.20B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contractor fees	= $	19,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Start-up	= $	16,000.00	0.08B based on site engineering, design, and construction records
Performance Testing	= $	2,000.00	0.01B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contingencies	= $	42,000.00	0.10(B+DC) based on site engineering, design, and construction records
Total Indirect Costs (IC)	**= $**	**159,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 583,000.00

Cost Backup Table Item 2.11a Option 2

Purchased Equipment Costs				Notes
Scrubber	=	$	91,000.00	Estimated based on Figure 2.16 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed 6,000 acfm per source to achieve minimum threshold velocity.
Fan and pump	=	$	37,000.00	Estimated to be 40% of scrubber cost
Auxiliary Equipment				
Hoods and Ductwork	=	$	-	Direct control of roof vent
Cyclones	=	$	-	Direct control of roof vent
Stack	=	$	-	Direct control of roof vent
Equipment Costs (A)	=	*$*	*128,000.00*	
Instrumentation	=	$	13,000.00	0.01A based on Table 2.8 of Sect. 6 Ch. 2 of EPA Cost Manual
Sales Tax	=	$	-	Sales tax is not paid on process equipment
Freight	=	$	7,000.00	0.05A based on Table Table 2.8 of Sect. 6 Ch. 2 of EPA Cost Manual
PEC (B)	**=**	**$**	**148,000.00**	

Direct Installation Costs (DC)				
Foundations & Supports	=	$	9,000.00	0.06B based on Table Table 2.8 of Sect. 6 Ch. 2 of EPA Cost Manual
Handling & Erection	=	$	74,000.00	0.50B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Electrical	=	$	2,000.00	0.01B based on Table Table 2.8 of Sect. 6 Ch. 2 of EPA Cost Manual
Piping	=	$	8,000.00	0.05B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual with additional cost added for assumed distances
Insulation for ductwork	=	$	-	Unnecessary for this service
Painting	=	$	15,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Building or Enclosure	=	$	86,000.00	Based on historical plant data on cost of total source enclosure
Total Direct Costs (DC)	**=**	**$**	**194,000.00**	

Indirect Costs (IC)				
Engineering	=	$	15,000.00	0.10(B+DC) based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and site engineering, design, and construction records
Construction and field expenses	=	$	30,000.00	0.20B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contractor fees	=	$	15,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Start-up	=	$	12,000.00	0.08B based on site engineering, design, and construction records
Performance Testing	=	$	2,000.00	0.01B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contingencies	=	$	15,000.00	0.10(B+DC) based on site engineering, design, and construction records
Total Indirect Costs (IC)	**=**	**$**	**89,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 431,000.00

Cost Backup Table Item 2.11a Option 3

Purchased Equipment Costs			Notes
Baghouse	= $	17,000.00	Estimated based on Figure 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed 6,000 acfm per source to achieve minimum threshold velocity.
Filters	= $	26,000.00	Estimated based on Table 1.8 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed filters of polyethylene with diameter of 4-7/8 inches
Auxiliary Equipment			
Hoods and Ductwork	= $	-	Direct control of roof vent
Cyclones	= $	-	Direct control of roof vent
Stack	= $	-	Direct control of roof vent
Dust removal	= $	-	Return of dust into dome
Equipment Costs (A)	= $	*43,000.00*	
Instrumentation	= $	5,000.00	0.01A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Sales Tax	= $	-	Sales tax is not paid on process equipment
Freight	= $	3,000.00	0.05A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
PEC (B)	**= $**	**51,000.00**	

Direct Installation Costs (DC)

Foundations & Supports	= $	2,000.00	0.04B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Handling & Erection	= $	25,000.00	0.50B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Electrical	= $	4,000.00	0.08B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Piping	= $	3,000.00	0.05B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual with additional cost added for assumed distances
Insulation for ductwork	= $	-	Unnecessary for this service
Painting	= $	5,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Building or Enclosure	= $	86,000.00	Based on historical plant data on cost of total source enclosure
Total Direct Costs (DC)	**= $**	**125,000.00**	

Indirect Costs (IC)

Engineering	= $	5,000.00	0.10(B+DC) based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and site engineering, design, and construction records
Construction and field expenses	= $	10,000.00	0.20B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contractor fees	= $	5,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Start-up	= $	4,000.00	0.08B based on site engineering, design, and construction records
Performance Testing	= $	1,000.00	0.01B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contingencies	= $	5,000.00	0.10(B+DC) based on site engineering, design, and construction records
Total Indirect Costs (IC)	**= $**	**30,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 206,000.00

Cost Backup Table Item 2.11b Option 1

Purchased Equipment Costs			Notes
Baghouse	=	$ 138,000.00	Estimated based on Figure 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed 6,000 acfm per source to achieve minimum threshold velocity.
Bags	=	$ 26,000.00	Estimated based on Table 1.8 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed bags of ryton with diameter of 4-1/2 to 5-1/8 inches
Auxiliary Equipment			
Hoods and Ductwork	=	$ 60,000.00	$10,000 per pickup point based on plant data
Cyclones	=	$ 21,000.00	Estimated 15% of baghouse cost based on plant data
Stack	=	$ 6,000.00	Estimated based on Table 1.12 of Sect. 2 Ch. 1 of EPA Cost Manual; Estimated diameter of 33 in. and stack height of 30 ft.; Material assumed to be Sheet-galv CS
Dust removal	=	$ 21,000.00	Estimated 15% of baghouse cost based on plant data
Equipment Costs (A)	=	*$ 271,000.00*	
Instrumentation	=	$ 28,000.00	0.01A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Sales Tax	=	$ -	Sales tax is not paid on process equipment
Freight	=	$ 14,000.00	0.05A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
PEC (B)	=	**$ 313,000.00**	

Direct Installation Costs (DC)			
Foundations & Supports	=	$ 13,000.00	0.04B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Handling & Erection	=	$ 156,000.00	0.50B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Electrical	=	$ 25,000.00	0.08B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Piping	=	$ 16,000.00	0.05B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual with additional cost added for assumed distances
Insulation for ductwork	=	$ -	Unnecessary for this service
Painting	=	$ 32,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Building or Enclosure	=	$ 86,000.00	Based on historical plant data on cost of total source enclosure
Total Direct Costs (DC)	=	**$ 328,000.00**	

Indirect Costs (IC)			
Engineering	=	$ 64,000.00	0.10(B+DC) based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and site engineering, design, and construction records
Construction and field expenses	=	$ 63,000.00	0.20B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contractor fees	=	$ 32,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Start-up	=	$ 25,000.00	0.08B based on site engineering, design, and construction records
Performance Testing	=	$ 4,000.00	0.01B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contingencies	=	$ 64,000.00	0.10(B+DC) based on site engineering, design, and construction records
Total Indirect Costs (IC)	=	**$ 252,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 893,000.00

Cost Backup Table Item 2.11b Option 2

Purchased Equipment Costs				Notes
Scrubber	=	$	91,000.00	Estimated based on Figure 2.16 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed 6,000 acfm per source to achieve minimum threshold velocity.
Fan and pump	=	$	37,000.00	Estimated to be 40% of scrubber cost
Auxiliary Equipment				
Hoods and Ductwork	=	$	60,000.00	$10,000 per pickup point based on plant data
Cyclones	=	$	14,000.00	Estimated 15% of scrubber cost based on plant data
Stack	=	$	6,000.00	Estimated based on Table 1.12 of Sect. 2 Ch. 1 of EPA Cost Manual; Estimated diameter of 33 in. and stack height of 30 ft.; Material assumed to be Sheet-galv CS
Equipment Costs (A)	=	*$*	*208,000.00*	
Instrumentation	=	$	21,000.00	0.01A based on Table 2.8 of Sect. 6 Ch. 2 of EPA Cost Manual
Sales Tax	=	$	-	Sales tax is not paid on process equipment
Freight	=	$	11,000.00	0.05A based on Table Table 2.8 of Sect. 6 Ch. 2 of EPA Cost Manual
PEC (B)	=	**$**	**240,000.00**	
Direct Installation Costs (DC)				
Foundations & Supports	=	$	15,000.00	0.06B based on Table Table 2.8 of Sect. 6 Ch. 2 of EPA Cost Manual
Handling & Erection	=	$	120,000.00	0.50B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Electrical	=	$	3,000.00	0.01B based on Table Table 2.8 of Sect. 6 Ch. 2 of EPA Cost Manual
Piping	=	$	12,000.00	0.05B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual with additional cost added for assumed distances
Insulation for ductwork	=	$	-	Unnecessary for this service
Painting	=	$	24,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Building or Enclosure	=	$	86,000.00	Based on historical plant data on cost of total source enclosure
Total Direct Costs (DC)	=	**$**	**260,000.00**	
Indirect Costs (IC)				
Engineering	=	$	24,000.00	0.10(B+DC) based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and site engineering, design, and construction records
Construction and field expenses	=	$	48,000.00	0.20B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contractor fees	=	$	24,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Start-up	=	$	20,000.00	0.08B based on site engineering, design, and construction records
Performance Testing	=	$	3,000.00	0.01B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contingencies	=	$	24,000.00	0.10(B+DC) based on site engineering, design, and construction records
Total Indirect Costs (IC)	=	**$**	**143,000.00**	
Total Capital Cost (PEC + DC + IC)	=	**$**	**643,000.00**	

Cost Backup Table   Item 2.11b   Option 3

Purchased Equipment Costs			Notes
Baghouse	= $	17,000.00	Estimated based on Figure 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed 6,000 acfm per source to achieve minimum threshold velocity.
Filters	= $	26,000.00	Estimated based on Table 1.8 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed filters of polyethylene with diameter of 4-7/8 inches
Auxiliary Equipment			
Hoods and Ductwork	= $	60,000.00	$10,000 per pickup point based on plant data
Cyclones	= $	3,000.00	Estimated 15% of baghouse cost based on plant data
Stack	= $	6,000.00	Estimated based on Table 1.12 of Sect. 2 Ch. 1 of EPA Cost Manual; Estimated diameter of 33 in. and stack height of 30 ft.; Material assumed to be Sheet-galv CS
Dust removal	= $	3,000.00	Estimated 15% of baghouse cost based on plant data
Equipment Costs (A)	*= $*	*115,000.00*	
Instrumentation	= $	12,000.00	0.01A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Sales Tax	= $	-	Sales tax is not paid on process equipment
Freight	= $	6,000.00	0.05A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
PEC (B)	**= $**	**133,000.00**	

Direct Installation Costs (DC)			
Foundations & Supports	= $	6,000.00	0.04B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Handling & Erection	= $	67,000.00	0.50B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Electrical	= $	11,000.00	0.08B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Piping	= $	7,000.00	0.05B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual with additional cost added for assumed distances
Insulation for ductwork	= $	-	Unnecessary for this service
Painting	= $	14,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Building or Enclosure	= $	86,000.00	Based on historical plant data on cost of total source enclosure
Total Direct Costs (DC)	**= $**	**191,000.00**	

Indirect Costs (IC)			
Engineering	= $	32,000.00	0.10(B+DC) based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and site engineering, design, and construction records
Construction and field expenses	= $	27,000.00	0.20B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contractor fees	= $	14,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Start-up	= $	11,000.00	0.08B based on site engineering, design, and construction records
Performance Testing	= $	2,000.00	0.01B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contingencies	= $	32,000.00	0.10(B+DC) based on site engineering, design, and construction records
Total Indirect Costs (IC)	**= $**	**118,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 442,000.00

Cost Backup Table Item 2.11d Option 1

Purchased Equipment Costs				Notes
Baghouse	=	$	125,000.00	Estimated based on Figure 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed 6,000 acfm per source to achieve minimum threshold velocity.
Bags	=	$	23,000.00	Estimated based on Table 1.8 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed bags of ryton with diameter of 4-1/2 to 5-1/8 inches
Auxiliary Equipment				
Hoods and Ductwork	=	$	40,000.00	$10,000 per pickup point based on plant data
Cyclones	=	$	19,000.00	Estimated 15% of baghouse cost based on plant data
Stack	=	$	6,000.00	Estimated based on Table 1.12 of Sect. 2 Ch. 1 of EPA Cost Manual; Estimated diameter of 33 in. and stack height of 30 ft.; Material assumed to be Sheet-galv CS
Dust removal	=	$	19,000.00	Estimated 15% of baghouse cost based on plant data
Equipment Costs (A)	=	*$*	*231,000.00*	
Instrumentation	=	$	24,000.00	0.01A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Sales Tax	=	$	-	Sales tax is not paid on process equipment
Freight	=	$	12,000.00	0.05A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
PEC (B)	**=**	**$**	**267,000.00**	

Direct Installation Costs (DC)				
Foundations & Supports	=	$	11,000.00	0.04B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Handling & Erection	=	$	133,000.00	0.50B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Electrical	=	$	22,000.00	0.08B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Piping	=	$	14,000.00	0.05B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual with additional cost added for assumed distances
Insulation for ductwork	=	$	-	Unnecessary for this service
Painting	=	$	27,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Building or Enclosure	=	$	239,000.00	Based on historical plant data on cost of total source enclosure
Total Direct Costs (DC)	**=**	**$**	**446,000.00**	

Indirect Costs (IC)				
Engineering	=	$	71,000.00	0.10(B+DC) based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and site engineering, design, and construction records
Construction and field expenses	=	$	54,000.00	0.20B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contractor fees	=	$	27,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Start-up	=	$	22,000.00	0.08B based on site engineering, design, and construction records
Performance Testing	=	$	3,000.00	0.01B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contingencies	=	$	71,000.00	0.10(B+DC) based on site engineering, design, and construction records
Total Indirect Costs (IC)	**=**	**$**	**248,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 961,000.00

Cost Backup Table　　Item 2.11d　　Option 2

Purchased Equipment Costs				Notes
Scrubber	=	$	73,000.00	Estimated based on Figure 2.16 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed 6,000 acfm per source to achieve minimum threshold velocity.
Fan and pump	=	$	30,000.00	Estimated to be 40% of scrubber cost
Auxiliary Equipment				
Hoods and Ductwork	=	$	40,000.00	$10,000 per pickup point based on plant data
Cyclones	=	$	11,000.00	Estimated 15% of scrubber cost based on plant data
Stack	=	$	6,000.00	Estimated based on Table 1.12 of Sect. 2 Ch. 1 of EPA Cost Manual; Estimated diameter of 33 in. and stack height of 30 ft.; Material assumed to be Sheet-galv CS
Equipment Costs (A)	=	*$*	*160,000.00*	
Instrumentation	=	$	16,000.00	0.01A based on Table 2.8 of Sect. 6 Ch. 2 of EPA Cost Manual
Sales Tax	=	$	-	Sales tax is not paid on process equipment
Freight	=	$	8,000.00	0.05A based on Table Table 2.8 of Sect. 6 Ch. 2 of EPA Cost Manual
PEC (B)	=	**$**	**184,000.00**	

Direct Installation Costs (DC)				
Foundations & Supports	=	$	12,000.00	0.06B based on Table Table 2.8 of Sect. 6 Ch. 2 of EPA Cost Manual
Handling & Erection	=	$	92,000.00	0.50B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Electrical	=	$	2,000.00	0.01B based on Table Table 2.8 of Sect. 6 Ch. 2 of EPA Cost Manual
Piping	=	$	10,000.00	0.05B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual with additional cost added for assumed distances
Insulation for ductwork	=	$	-	Unnecessary for this service
Painting	=	$	19,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Building or Enclosure	=	$	239,000.00	Based on historical plant data on cost of total source enclosure
Total Direct Costs (DC)	=	**$**	**374,000.00**	

Indirect Costs (IC)				
Engineering	=	$	19,000.00	0.10(B+DC) based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and site engineering, design, and construction records
Construction and field expenses	=	$	37,000.00	0.20B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contractor fees	=	$	19,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Start-up	=	$	15,000.00	0.08B based on site engineering, design, and construction records
Performance Testing	=	$	2,000.00	0.01B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contingencies	=	$	19,000.00	0.10(B+DC) based on site engineering, design, and construction records
Total Indirect Costs (IC)	=	**$**	**111,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 669,000.00

Cost Backup Table Item 2.11d Option 3

Purchased Equipment Costs			Notes
Baghouse	= $	16,000.00	Estimated based on Figure 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed 6,000 acfm per source to achieve minimum threshold velocity.
Filters	= $	24,000.00	Estimated based on Table 1.8 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed filters of polyethylene with diameter of 4-7/8 inches
Auxiliary Equipment			
Hoods and Ductwork	= $	40,000.00	$10,000 per pickup point based on plant data
Cyclones	= $	3,000.00	Estimated 15% of baghouse cost based on plant data
Stack	= $	6,000.00	Estimated based on Table 1.12 of Sect. 2 Ch. 1 of EPA Cost Manual; Estimated diameter of 33 in. and stack height of 30 ft.; Material assumed to be Sheet-galv CS
Dust removal	= $	3,000.00	Estimated 15% of baghouse cost based on plant data
Equipment Costs (A)	= $	*90,000.00*	
Instrumentation	= $	9,000.00	0.01A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Sales Tax	= $	-	Sales tax is not paid on process equipment
Freight	= $	5,000.00	0.05A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
PEC (B)	**= $**	**104,000.00**	

Direct Installation Costs (DC)			
Foundations & Supports	= $	5,000.00	0.04B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Handling & Erection	= $	52,000.00	0.50B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Electrical	= $	9,000.00	0.08B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Piping	= $	6,000.00	0.05B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual with additional cost added for assumed distances
Insulation for ductwork	= $	-	Unnecessary for this service
Painting	= $	11,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Building or Enclosure	= $	239,000.00	Based on historical plant data on cost of total source enclosure
Total Direct Costs (DC)	**= $**	**322,000.00**	

Indirect Costs (IC)			
Engineering	= $	43,000.00	0.10(B+DC) based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and site engineering, design, and construction records
Construction and field expenses	= $	21,000.00	0.20B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contractor fees	= $	11,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Start-up	= $	9,000.00	0.08B based on site engineering, design, and construction records
Performance Testing	= $	2,000.00	0.01B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contingencies	= $	43,000.00	0.10(B+DC) based on site engineering, design, and construction records
Total Indirect Costs (IC)	**= $**	**129,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 555,000.00

Cost Backup Table Item 2.11d Option 4

Purchased Equipment Costs					Notes
Galvanized sheet metal enclosure	=	$ 21,846.49	$	22,000.00	Estimated based on Table 3.3 of Sect. 2 Ch. 3 of EPA Cost Manual with a multiplier of 1.25 for galvanized sheet metal
PEC (B) =		**$ 21,846.49**	**$**	**22,000.00**	

Installation Costs (DC)					
Painting	=	$ 2,184.65	$	3,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Foundations & Supports	=	$ 271,177.57	$	272,000.00	Estimated based on Table 3.10 of Sect. 2 Ch. 3 of EPA Cost Manual. A multiplier of 2.0 has been added due to the complexity of construction.
Installation Costs (DC+IC) =			**$**	**275,000.00**	
Total Capital Cost (PEC + DC + IC) =			**$**	**297,000.00**	

Cost Backup Table Item 2.11e Option 1

Purchased Equipment Costs				Notes
Galvanized sheet metal enclosure	=	$	44,000.00	Estimated based on Table 3.3 of Sect. 2 Ch. 3 of EPA Cost Manual with a multiplier of 1.25 for galvanized sheet metal
PEC (B) =		**$**	**44,000.00**	

Installation Costs (DC)				
Painting	=	$	5,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Foundations & Supports	=	$	543,000.00	Estimated based on Table 3.10 of Sect. 2 Ch. 3 of EPA Cost Manual. A multiplier of 2.0 has been added due to the complexity of construction.
Installation Costs (DC+IC) =		**$**	**548,000.00**	

Cost Backup Table Item 2.11f Option 1

Purchased Equipment Costs

Purchased Equipment Costs				Notes
Galvanized sheet metal enclosure	=	$	12,000.00	Estimated based on Table 3.3 of Sect. 2 Ch. 3 of EPA Cost Manual with a multiplier of 1.25 for galvanized sheet metal
PEC (B) =		**$**	**12,000.00**	

Installation Costs (DC)

Painting	=	$	2,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Foundations & Supports	=	$	142,000.00	Estimated based on Table 3.10 of Sect. 2 Ch. 3 of EPA Cost Manual. A multiplier of 2.0 has been added due to the complexity of construction.
Installation Costs (DC+IC) =		**$**	**144,000.00**	

Cost Backup Table   Item 2.11g   Option 1

Purchased Equipment Costs

			Notes
Galvanized sheet metal enclosure	=	$ 18,000.00	Estimated based on Table 3.3 of Sect. 2 Ch. 3 of EPA Cost Manual with a multiplier of 1.25 for galvanized sheet metal
PEC (B) =		**$ 18,000.00**	

Installation Costs (DC)

Painting	=	$ 2,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Foundations & Supports	=	$ 217,000.00	Estimated based on Table 3.10 of Sect. 2 Ch. 3 of EPA Cost Manual. A multiplier of 2.0 has been added due to the complexity of construction.
Installation Costs (DC+IC) =		**$ 219,000.00**	

Cost Backup Table Item 2.11h Option 1

Purchased Equipment Costs				Notes
Galvanized sheet metal enclosure	=	$	14,000.00	Estimated based on Table 3.3 of Sect. 2 Ch. 3 of EPA Cost Manual with a multiplier of 1.25 for galvanized sheet metal
PEC (B) =		**$**	**14,000.00**	

Installation Costs (DC)				
Painting	=	$	2,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Foundations & Supports	=	$	173,000.00	Estimated based on Table 3.10 of Sect. 2 Ch. 3 of EPA Cost Manual. A multiplier of 2.0 has been added due to the complexity of construction.
Installation Costs (DC+IC) =		**$**	**175,000.00**	

Sulfate of Potash Plant Enclosed and Unenclosed Sources Routed to Existing APCE

(Groups established based on routing to existing APCE due to differences in APCE control efficiency.)

Emissions Group	Source ID	Source Description	Equipment Category	Area	Estimated Uncontrolled Emissions (TPY)
2.12a	OSH035	LOADOUT SHUTTLE CONVEYOR NORTH	Conveyor	SOP Loading	0.031
	OSH040	LOADOUT SHUTTLE CONVEYOR SOUTH	Conveyor	SOP Loading	
2.12b	OC1405	Baghouse dust to C1406	Conveyor	SOP Plant Discharge	1.17
	OC1406	DRAG CONVEYOR DISCHARGE D1400	Conveyor	SOP Plant Discharge	
	OC1407	RECLAIM CONVEYOR BELT	Conveyor	SOP Plant Discharge	
	OC1408	RECLAIM CAM BELT	Conveyor	SOP Plant Discharge	
	OC1500	FRESH FEED BUCKET ELAVATOR	Elevators	SOP Compaction	
	OS1500	METAL REMOVAL SCREEN	Screens	SOP Compaction	
2.12c	OC1540	DRY FEED CONVEYOR for D1545	Conveyor	SOP Compaction	0.073

Cost Backup Table   Item 2.12a   Option 1

Purchased Equipment Costs				Notes
Galvanized sheet metal enclosure	=	$	8,000.00	Estimated based on Table 3.3 of Sect. 2 Ch. 3 of EPA Cost Manual with a multiplier of 1.25 for galvanized sheet metal
Hoods and ductwork	=	$	20,000.00	Based on $10,000 per pickup point
PEC (B) =		**$**	**28,000.00**	

Installation Costs (DC)				
Painting	=	$	3,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Foundations & Supports	=	$	95,000.00	Estimated based on Table 3.10 of Sect. 2 Ch. 3 of EPA Cost Manual. A multiplier of 2.0 has been added due to the complexity of construction.
Installation Costs (DC+IC) =		**$**	**98,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 126,000.00

Cost Backup Table Item 2.12b Option 1

Purchased Equipment Costs / **Notes**

				Notes
Galvanized sheet metal enclosure	=	$	11,000.00	Estimated based on Table 3.3 of Sect. 2 Ch. 3 of EPA Cost Manual with a multiplier of 1.25 for galvanized sheet metal
Hoods and ductwork	=	$	60,000.00	Based on $10,000 per pickup point
PEC (B) =		**$**	**71,000.00**	

Installation Costs (DC)

Painting	=	$	8,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Foundations & Supports	=	$	126,000.00	Estimated based on Table 3.10 of Sect. 2 Ch. 3 of EPA Cost Manual. A multiplier of 2.0 has been added due to the complexity of construction.
Installation Costs (DC+IC) =		**$**	**134,000.00**	

Cost Backup Table Item 2.12c Option 1

Purchased Equipment Costs				Notes
Hoods and ductwork	=	$	10,000.00	$10,000 per pickup point based on plant data
PEC (B) =		**$**	**10,000.00**	

Installation Costs (DC)				
Foundations & Supports	=	$	20,000.00	2.0B based on complexity of installation around existing equipment.
Installation Costs (DC+IC) =		**$**	**20,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 30,000.00

Cost Backup Table   Item 3.04   Option 1

Purchased Equipment Costs				Notes
Hoods and ductwork	=	$	40,000.00	$10,000 per pickup point based on plant data
	PEC (B) =	**$**	**40,000.00**	

Installation Costs (DC)				
Foundations & Supports	=	$	80,000.00	2.0B based on complexity of installation around existing equipment.
	Installation Costs (DC+IC) =	**$**	**80,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 120,000.00

Cost Backup Table　　Item 4.01　　Option 1

Purchased Equipment Costs

			Notes
Scrubber	=	$ 104,000.00	Estimated based on Figure 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed 6,000 acfm per source to achieve minimum threshold velocity.
Fan and pump	=	$ 42,000.00	Estimated to be 40% of scrubber cost
Auxiliary Equipment			
Hoods and Ductwork	=	$ -	Existing
Cyclones	=	$ 16,000.00	Estimated 15% of baghouse cost based on plant data
Stack	=	$ -	Existing
Equipment Costs (A)	=	*$ 162,000.00*	
Instrumentation	=	$ 17,000.00	0.01A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Sales Tax	=	$ -	Sales tax is not paid on process equipment
Freight	=	$ 9,000.00	0.05A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
PEC (B)	=	**$ 188,000.00**	

Direct Installation Costs (DC)

Foundations & Supports	=	$ 8,000.00	0.04B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Handling & Erection	=	$ 94,000.00	0.50B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Electrical	=	$ 15,000.00	0.08B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Piping	=	$ 10,000.00	0.05B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual with additional cost added for assumed distances
Insulation for ductwork	=	$ -	Unnecessary for this service
Painting	=	$ 19,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Building or Enclosure	=	$ -	Existing
Total Direct Costs (DC)	=	**$ 146,000.00**	

Indirect Costs (IC)

Engineering	=	$ 33,000.00	0.10(B+DC) based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and site engineering, design, and construction records
Construction and field expenses	=	$ 38,000.00	0.20B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contractor fees	=	$ 19,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Start-up	=	$ 15,000.00	0.08B based on site engineering, design, and construction records
Performance Testing	=	$ 2,000.00	0.01B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contingencies	=	$ 33,000.00	0.10(B+DC) based on site engineering, design, and construction records
Total Indirect Costs (IC)	=	**$ 140,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 474,000.00

Cost Backup Table — Item 4.01 — Option 1

Purchased Equipment Costs		Notes
Scrubber =	$ 104,000.00	Estimated based on Figure 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual; Assumed 6,000 acfm per source to achieve minimum threshold velocity.
Fan and pump =	$ 42,000.00	Estimated to be 40% of scrubber cost
Auxiliary Equipment		
Hoods and Ductwork =	$ -	Existing
Cyclones =	$ 16,000.00	Estimated 15% of baghouse cost based on plant data
Stack =	$ -	Existing
Equipment Costs (A) =	*$ 162,000.00*	
Instrumentation =	$ 17,000.00	0.01A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Sales Tax =	$ -	Sales tax is not paid on process equipment
Freight =	$ 9,000.00	0.05A based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
PEC (B) =	**$ 188,000.00**	

Direct Installation Costs (DC)		
Foundations & Supports =	$ 8,000.00	0.04B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Handling & Erection =	$ 94,000.00	0.50B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Electrical =	$ 15,000.00	0.08B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Piping =	$ 10,000.00	0.05B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual with additional cost added for assumed distances
Insulation for ductwork =	$ -	Unnecessary for this service
Painting =	$ 19,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and taking into account site paint specs to prevent corrosion
Building or Enclosure =	$ -	Existing
Total Direct Costs (DC) =	**$ 146,000.00**	

Indirect Costs (IC)		
Engineering =	$ 33,000.00	0.10(B+DC) based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual and site engineering, design, and construction records
Construction and field expenses =	$ 38,000.00	0.20B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contractor fees =	$ 19,000.00	0.10B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Start-up =	$ 15,000.00	0.08B based on site engineering, design, and construction records
Performance Testing =	$ 2,000.00	0.01B based on Table 1.9 of Sect. 6 Ch. 1 of EPA Cost Manual
Contingencies =	$ 33,000.00	0.10(B+DC) based on site engineering, design, and construction records
Total Indirect Costs (IC) =	**$ 140,000.00**	

Total Capital Cost (PEC + DC + IC) = $ 474,000.00

COMPLIANCE WITH REQUIREMENT FOR PIPELINE QUALITY NATURAL GAS

40 CFR 72.2

Natural gas means a naturally occurring fluid mixture of hydrocarbons (e.g., methane, ethane, or propane) produced in geological formations beneath the Earth's surface that maintains a gaseous state at standard atmospheric temperature and pressure under ordinary conditions. Natural gas contains 20.0 grains or less of total sulfur per 100 standard cubic feet. Additionally, natural gas must either be composed of at least 70 percent methane by volume or have a gross calorific value between 950 and 1100 Btu per standard cubic foot. Natural gas does not include the following gaseous fuels: landfill gas, digester gas, refinery gas, sour gas, blast furnace gas, coal-derived gas, producer gas, coke oven gas, or any gaseous fuel produced in a process which might result in highly variable sulfur content or heating value.

Pipeline natural gas means a naturally occurring fluid mixture of hydrocarbons (e.g., methane, ethane, or propane) produced in geological formations beneath the Earth's surface that maintains a gaseous state at standard atmospheric temperature and pressure under ordinary conditions, and which is provided by a supplier through a pipeline. Pipeline natural gas contains 0.5 grains or less of total sulfur per 100 standard cubic feet. Additionally, pipeline natural gas must either be composed of at least 70 percent methane by volume or have a gross calorific value between 950 and 1100 Btu per standard cubic foot.

Title V Operating Permit

PERMIT NUMBER: 5700001003
DATE OF PERMIT: July 11, 2016
Date of Last Revision: July 11, 2016

II.B.1.c **Condition:** The permittee shall use only pipeline quality natural gas for fuel for all boilers and burners. [Origin: DAQE-AN109170035-16]. [R307-401-8(1)(a)(BACT)]

II.B.22.d **Condition:** Only pipeline quality natural gas with a potential SO_2 emission rate of 0.32 lb/MMBtu (140 ng/J) heat input or less shall be used as fuel for the boilers. [Origin: 40 CFR 60 Subpart Db]. [40 CFR 60.42b(k)(2)]

QUESTAR GAS COMPANY UTAH NATURAL GAS TARIFF PSCU 400

GAS QUALITY SPECIFICATIONS

Questar Gas may refuse to accept gas that does not conform to the specifications listed below and other requirements set forth in this Tariff:

8. Total Sulfur. The gas shall not contain more than 5 grains of total sulfur per 1,000 standard cubic feet (MSCF) or 8.4 parts per million by volume (ppmv), of which not more than 2 grains shall be mercaptan sulfur. (p. 7-11)

REF.: www.questargas.com/Tariffs/uttariff.pdf

	Ave. ppm	Min. ppm	Max. ppm
QUESTAR TOTAL SULFUR RECORD FOR 2016			
Lakeside 1724	2.081	0.188	5.567
Lakeside 1725	3.154	0.962	5.636
SLC #445	2.662	1.800	4.903
	2.632	**0.188**	**5.636**

REF.: www.questargas.com/ServicesBus/ProductServices/ISPrices/IndMarket/SulfurContent.php

Average Btu (2/5/2017 through 5/6/2017) = 1042.8

Calculation 1: Pipeline Natural Gas Maximum

	(gr. to lbs)	(lbs to moles)	(moles to scf)	(100 scf to 1 scf)	(scf to ppmv)
	1/7000	1/32	1 x 385	(1/100)	1 x 1,000,000
grains / 100 scf PNG ⇨	pounds / 100 scf PNG ⇨	moles / 100 scf PNG ⇨	scf / 100 scf PNG ⇨	scf / 1 scf PNG ⇨	parts / million
	1/7000	1/32	1 x 385	(1/100)	1 x 1,000,000
0.5 / 100 scf PNG =	0.0000714 / 100 scf PNG =	0.0000022 / 100 scf PNG =	0.00086 / 100 scf PNG =	0.0000086 / 1 scf PNG =	**8.6 ppmv MAX**

Calculation 2: SO2 Emissions (lb/mmBtu) from Questar 2016 Maximum

	(ppmv to scf)	(scf S to scf SO2)	(scf PNG to 1 Btu)	(1 Btu to mmBtu)	(scf to moles)	(moles to lbs)
	1/1,000,000	1 x 1	1/1042.3	1 x 1,000,000	1/385	1 X 64
ppmv / scf PNG ⇨	scf S / scf PNG ⇨	scf SO2 / scf PNG ⇨	scf SO2 / Btu ⇨	scf SO2 / mmBtu ⇨	moles / mmBtu ⇨	lbs SO2 / mmBtu
	1/1,000,000	1 x 1	1/1042.3	1 x 1,000,000	1/385	1 X 64
5.64 / scf PNG =	0.000 005 64 / scf PNG =	0.000 005 64 / scf PNG =	0.0000 000 05 / Btu =	0.00541 / mmBtu =	0.0000141 / mmBtu =	**0.0009 lbs SO2 / mmBtu**

COMPLIANCE WITH REQUIREMENT FOR PIPELINE QUALITY NATURAL GAS

40 CFR Part 80

§80.510 What are the standards and marker requirements for refiners and importers for NRLM (nonroad, locomotive, and marine) diesel fuel and ECA marine fuel?

(c) *Beginning June 1, 2012.* Except as otherwise specifically provided in this subpart, all NRLM diesel fuel is subject to the following per-gallon standards:

(1) Sulfur content. 15 ppm maximum.

(2) Cetane index or aromatic content, as follows:

(i) A minimum cetane index of 40; or

(ii) A maximum aromatic content of 35 volume percent.

Compass Minerals

Compass Minerals uses Ultra Low Sulfur Diesel (ULSD) in all of its diesel fired engines. ULSD complies with 40 CFR 80.510 and minimizes SO2 emissions. ULSD is BACT for diesel fuel.

Attachment 8. Condensable Measurement

This attachment is to show the difficulty in condensable measurement, a technical matter that has not fully been resolved.

Particulate Emissions-
Combustion Source Emissions Dependent on Test Method

Robynn Andracsek, and David Gaige Burns & McDonnell

Particulate emissions from combustion sources can be quantified by type and size: filterable, condensible, PM, and PM_{10}. Permit limits for both pulverized coal boilers (PC) and circulating fluidized bed boilers (CFB) do not always provide adequate clarification regarding what type of particulate is addressed by the limits. Critical to this issue is the prescribed test method, and the potential for error introduced by the test method that can misreport compounds such as ammonium bisulfate and sulfur dioxide as particulate emissions (Methods 5, 201, 202, etc.). This paper will summarize recently established PM_{10} permit limits, describe the inherent problems of PM_{10} test methods, and provide considerations for emission inventories.

Summary of Recent PM_{10} BACT Determinations

Through numerous Freedom of Information Act (FOIA) requests, the PM_{10} permit limits were found for several recently permitted coal-fired boilers across the country. As shown in Figure 1 and Table 1, the limits for both filterable and condensible are often the same or lower than the limits for filterable only.

Figure 1. Recent PM10 BACT Limits

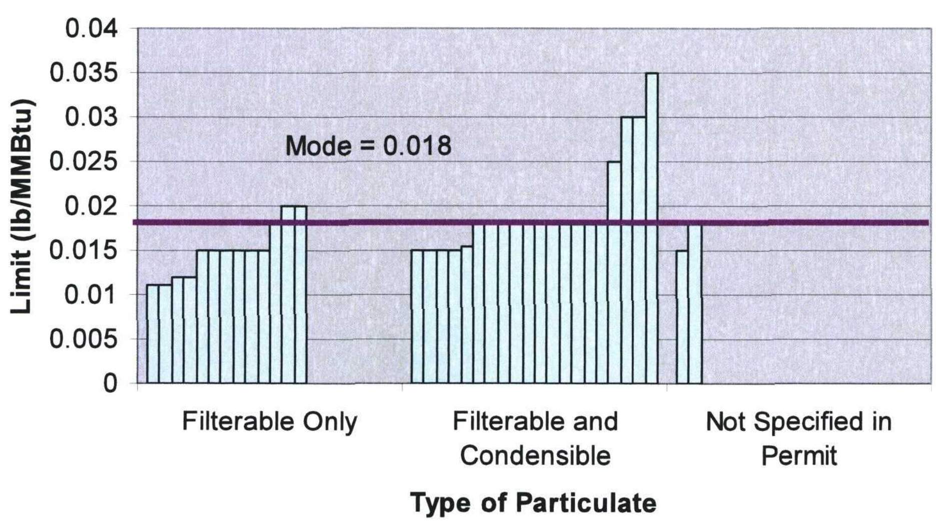


Table 1. Particulate Limits for Recently Permitted Coal-Fired Boilers.

Facility	Particulate Type	Year Issued	Boiler Type	Operational?	Permit Limit (lb/mmBTU)
AES Puerto Rico #1	f/c	1998	CFB	yes (& tested)	0.03
AES Puerto Rico #2	f/c	1998	CFB	yes (& tested)	0.03
Corn Belt Energy	f only	2002	PC	no	0.02
Council Bluffs (Mid America)	f/c	2003	PC	no	0.025
Elm Road Generating Station #1 (WE-Energies)	f/c	2004	PC	no	0.018
Elm Road Generating Station #2 (WE-Energies)	f/c	2004	PC	no	0.018
EnviroPower IL - Benton #1	f/c	2001	CFB	no	0.015
EnviroPower IL - Benton #2	f/c	2001	CFB	no	0.015
Hawthorn 5 (KCP&L)	f/c	1999	PC	yes (& tested)	0.018
Holcomb Unit #2 (Sand Sage Power, LLC)	f/c	2002	PC	no	0.018
Indeck-Elwood LLC #1	f/c	2003	CFB	no	0.015
Indeck-Elwood LLC #2	f/c	2003	CFB	no	0.015
Intermountain Power Unit #3	f only	2004	PC	no	0.012
JEA Northside #1	f only	1999	CFB	yes (& tested)	0.011
JEA Northside #2	f only	1999	CFB	yes (& tested)	0.011
Kentucky Mountain Power, LLC (EnviroPower)	Not Specified	2001	CFB	no	0.015
Longview Power (GenPower)	f/c	2004	PC	no	0.018
Plum Point Power Station	f/c	2003	PC	no	0.018
Prairie State	f/c	2005	PC	No	0.035
Red Hills #1 (Choctaw Generation)	f only	1998	CFB	yes (initial testing waived)	0.015
Red Hills #2 (Choctaw Generation)	f only	1998	CFB	yes (initial testing waived)	0.015
Rocky Mountain Power (Hardin Generator Project)	f only	2002	PC	no	0.015
Roundup #1 (Bull Mountain)	f only	2003	PC	no	0.015
Roundup #2 (Bull Mountain)	f only	2003	PC	no	0.015
Santee Cooper/Cross Unit 3	f/c	2004	PC	no	0.018
Santee Cooper/Cross Unit 4	f/c	2004	PC	no	0.018
Sevier Power (Nevco Energy)	f/c	2004	CFB	no	0.0154
Spurlock (E. KY Power Coop)	f only	2002	CFB	no	0.015
Thoroughbred #1	f/c	2002	PC	no, Permit under litigation	0.018
Thoroughbred #2	f/c	2002	PC	no, Permit under litigation	0.018
Two Elk	f only	2003	PC	no	0.018
Whelan Energy Center Unit 2-Hastings	Not Specified	2004	PC	no	0.018
Wisconsin Public Service - Weston 4	f/c	2004	PC	no	0.018
WYGEN I (Black Hills)	f only	1996	PC	yes (& tested)	0.02
WYGEN II (Black Hills)	f only	2002	PC	no	0.012

Inherent Problems of Particulate Test Methods

Initial testing for PM_{10} is required of coal-fired boilers to confirm that they meet their permit limits. The permit usually specifies which test method is required. EPA standard reference methods are usually called out and are briefly discussed in Table 2 along with some alternate methods.

Table 2. EPA Reference Methods for Testing

Method	Particulate Size	Particulate Fraction	Method Notes
Method 5[1]	Any size	Filterable	Measures all particulate matter that is collected on a glass fiber filter at a temperature of approximately 120 °C; combustion products that are in the vapor phase at this temperature, although they may contribute to ambient particulate matter concentrations, are not measured.
Method 201A[2]	PM_{10} or smaller	Filterable	Measures all particulate matter having an aerodynamic diameter equal to or less than nominally 10 micrometers (PM_{10}) that is collected on a glass fiber filter at the stack temperature. Method 201A excludes particles having an aerodynamic diameter nominally 10 micrometers or greater and therefore generally yields a slightly smaller result than Method 5.
Method 202[3]	PM_{10} or smaller	Condensible	Measures particulate matter that condenses at a temperature of approximately 20 °C after passing through a filter such as that used in Method 5 or 201A. The total PM_{10}, which is the combined result of performing Method 201A and Method 202 simultaneously, may be substantially different than the PM measured by Method 5, or thePM10 measured by method 201A.

Compliance issues can arise when testing to verify compliance with a limit that includes both filterable and condensible emissions. For coal-fired boilers (or any sources with sulfur in the exhaust gas), Method 202 can provide an erroneously high result due to the creation of "artifacts". These artifacts consist of ammonia and sulfate compounds created in the sampling system:

- Oxidation of SO_2 to SO_3 in the "back half" impinger

---

1 http://www.epa.gov/ttn/emc/methods/method5.html
2 http://www.epa.gov/ttn/emc/methods/method201a.html
3 http://www.epa.gov/ttn/emc/methods/method202.html

- NH_3 slip from SNCR or SCR reacts in the impinger to form ammonium bisulfate NH_4HSO_4
- Absorption of soluble NO_x components (e.g., N_2O_5)

Artifacts and are a known quantitative error in Method 202. This artificial particulate is formed by the measurement technique itself and would not form particulate matter in the atmosphere when the flue gas is cooled to atmospheric temperature. Several studies have been performed and reported similar results. (Mega symposium, 2004)

This is a serious developing issue within the utility industry. As the permit limits for particulate are tightened, and as technology advances related to the control of filterable particulate, the relative contribution of condensable particulate increases. This may be partly due to the fact that less filterable particulate is available to serve as a condensation nucleus, resulting in less particle growth and a resultant increase to the amount of fine particulate . This issue has come to the forefront recently because current PSD BACT limits are becoming increasingly restrictive. For utility boilers, a large portion of the filterable particulate is removed from the flue gas stream, resulting in a significant portion of the PM_{10} emissions consisting of condensable particulate matter. It has been shown that determining the condensable PM_{10} emissions using Method 202 may over-state that actual emissions, or quantity of particulate that would be created from ambient mixing and cooling of the gas stream.

Possible Corrections

Nitrogen Purge in Method 202

Method 202 allows for a nitrogen gas purge to correct for these artifacts by removing the dissolved SO_2:

> The one hour purge with dry nitrogen should be performed immediately following the final leak check of the system. Even low concentrations of SO_2 in the exhaust gas will dissolve into the impinger solution and if not removed by nitrogen purging will result in a positive bias.
>
> Neutralizing the inorganic portion to a pH of 7.0 determines the un-neutralized sulfuric acid content of the sample without over correcting the amount of neutralized sulfate in the inorganic portion. These neutralized sulfates (such as $(NH_4)_2SO_4$ or NH_4SO_4) would be created in the exhaust gas upon dilution cooling in the ambient air and result in fine particulate formation. Ion chromatography, for SO_4 measures both the amount of neutralized and un-neutralized SO_4 contained in the impinger solution prior to the addition of NH_4OH and therefore introduces a negative bias.
>
> The presence of free ammonia and HCl in the exhaust gas will form Ammonium Chloride that produces fine particulate upon dilution and cooling in the ambient air.[4]

[4] http://www.epa.gov/ttn/emc/methods/method202.html

However, the nitrogen purge may not eliminate the artifacts completely. Some SO_3 and SO_4 remain as well as ammonium chlorides, and even a small quantity of artifacts can affect the test results.

New Methods (Controlled Condensate)

The problems measuring condensable particulate emissions from combustion sources have been identified for combustion turbines as well, and EPRI and others have developed and proposed alternative test methods that attempt to simulate atmospheric condensation. One alternative that has been suggested because it was once an approved test method is Method 8A. This test method was originally developed for the pulp and paper industry, and is no longer an approved EPA standard test method. The intent of this test method is to cool the sample to 150°F by passing it though a glass coil. The intended result is that the H_2SO_4 and SO_3 acids will condense and be measured as condensible particulate. Most of the artifacts, including the artificial SO_2 byproducts will not be created. Although EPA has not approved an alternate method to simulate atmospheric condensation, the results from a test of this type can be helpful in quantifying the effect of artifacts or pseudo-particulate created in Method 202.

Precedents

AES Puerto Rico recently experienced problems complying with their original particulate limits. The draft permit established a permit limit (for a CFB unit) of 0.015 lb/mmBTU, and specified Methods 201 and 202 for the compliance test. The applicant commented that tying this low emission rate to a test method that includes condensable emissions is inappropriate. EPA responded by setting a second limit of 0.05 lb/mmBTU if the limit of 0.015 lb/mmBTU could not be achieved. Initial testing of the unit showed levels approximately double the limit of 0.015 lb/mmBTU. Subsequently, their permit limit was modified to 0.03 lb/mmBTU. The complete decision can be found at http://www.epa.gov/eab/disk11/aespur.pdf.

The recently issued permit (1/14/05) for Prairie State in Illinois (pulverized coal boilers) established a limit of 0.035 lb/mmBTU for PM_{10} filterable and condensible with a stipulation that the limit may be lowered to 0.018 lb/mmBTU after initial testing.

Typically, one would expect that particulate matter (PM) would include particulate smaller than 10 microns (PM_{10}) as a subset of the total. But at the Tucson Electric Springerville Unit the PM limit is almost one fourth (1/4) of the limit for PM10. The difference is that the condensable portion is not included in PM. The agency established a limit of 0.055 lb/mmBTU for PM10, and specified method 202 which includes condensable. For PM, the permit limit is only 0.015 lb/mm, and specifies Method 5, or filterable only.

Emission Inventory Considerations

Using an emission limit for particulate must be qualified with type of particulate. For combustion sources, this is best defined by identifying the test method used to determine the emission rate. Method 5 particulate is PM filterable only. Method 201 particulate is filterable particulate less than 10 microns, etc. The following are recommendations for pro-active steps that can be taken to try to minimize the problems related to the determination of particulate from combustion sources:

- Particulate emission estimates for airborne particulate with a potential to affect ambient concentrations, should include filterable and condensable particulate less than 10 microns only.
- All emission estimates for particulate resulting from combustion sources should include both filterable and condensible emissions, and specify the compliance test method.
- Particulate emissions are only equivalent if the same test method is used.
- Factors to adjust a filterable only estimate to a filterable and condensable estimate need to consider the relevant test method.
- Method 202 results may have a potential to overestimate emissions from sources with SO2 emissions because of the creation of pseudo-particulate within the sampling train.
- Consideration should to be given to the development of test methods that provide consistent results.

Attachment 9. References

1. AP 42, "Fifth Edition Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources", EPA, January, 1995, as amended.

2. Control Cost Manual: "EPA Air Pollution Control Cost Manual, Sixth Edition", EPA/452/B-02-001, January, 2002 (or select chapter of Seventh Edition, where available and applicable).

3. Draft Workshop Manual: "New Source Review Workshop Manual Prevention of Significant Deterioration and Nonattainment Area Permitting", EPA, DRAFT October, 1990.

4. EPA Fact Sheets: These are a series of Air Pollution Control Technology Fact Sheets published by EPA at: https://www3.epa.gov/ttncatc1/cica/atech_e.html#111

5. EPA 1975: "Fugitive Emissions and Fugitive Dust Emissions", EPA, July 1995.

6. EPA 1986:" Identification, Assessment, and Control of Fugitive Particulate Emissions", EPA-600/8-86-023, August 1986.

7. EPA 1998: Stationary Source Control Techniques Document for Fine Particulate Matter, EPA CONTRACT NO. 68-D-98-026, Prepared by EC/R Incorporated, October 1998.

8. EPA 2016. "Other Test Method-36 (OTM-036)". Measurement Technology Group, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency (Mail Code E143-02), Research Triangle Park, NC 27711, April 11, 2016.

Attachment 10. Acronyms

acfm	actual cubic feet per minute
BACT	Best Available Control Technology
Btu	British thermal unit
cf	cubic feet
cfm	cubic feet per minute
CH3OH	Methanol
CHCl3	Chloroform
CM	Compass Minerals Ogden Inc.
DAQ	Division of Air Quality, Utah Department of Environmental Quality
dscfm	Dry standard cubic feet per minute
EPA	United States Environmental Protection Agency
g	gram
gal	Gallon
gr	grain
HCHO	Formaldehyde
HP	Horsepower
HP-h	Horsepower per hour
K2SO4	Potassium Sulfate
KCl	Potassium Chloride
kW	Kilowatt
kW-h	Kilowatts per hour
l	liter
LAER	Lowest Achievable Emission Rate
LNB	Low NOx Burner
MgCl2	Magnesium Chloride
mmBtu	Million British thermal units
mmBtuh	Million British thermal units per hour
NaCl	Sodium Chloride
NH3	Ammonia
NOx	Nitrogen Oxides
PM	Particulate Matter of unspecified size
PM10	Particulate Matter less than or equal to 10 microns aerodynamic diameter PM2.5 Particulate Matter less than or equal to 2.5 microns aerodynamic diameter PMTotal Total Particulate Matter (of any size, from sub-micron to 30+ microns)
ppm	parts per million
ppmdv	parts per million dry volume
PTE	Potential to Emit
SOP	Sulfate of Potash
SOx	Sulfur Oxides
ULNB	Ultra Low NOx Burner
ULSD	Ultra-Low Sulfur Diesel fuel (15 ppm S)
VOC	Volatile Organic Compounds