PM$_{2.5}$ SIP Evaluation Report: Compass Minerals – Compass Minerals Ogden Inc.

Salt Lake City PM$_{2.5}$ Serious Nonattainment Area

Utah Division of Air Quality

Major New Source Review Section

July 1, 2018

DAQ-2018-007703

$PM_{2.5}$ SERIOUS SIP EVALUATION REPORT
Compass Minerals – Compass Minerals Ogden Inc.

1.0 Introduction

The following is part of the Technical Support Documentation for Section IX, Part H.12 of the Utah SIP; to address the Salt Lake City $PM_{2.5}$ Nonattainment Area. This document specifically serves as an evaluation of the Compass Minerals operated Ogden Minerals Processing Plant.

1.1 Facility Identification

Name: Compass Minerals Ogden Inc.
Address : 765 North 10500 West Ogden, Utah 84404-1190
Owner/Operator: Compass Minerals
UTM coordinates: 396,869 M Easting; 4,570,651 M Northing; UTM 12

1.2 Facility Process Summary

The Compass Minerals Ogden Inc. (Compass) mineral recovery facility produces sodium chloride (NaCl), sulfate of potash (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. The mixed salt is washed, slurried, thickened, crystallized, and converted to schoenite which is then filtered, dried, screened, half granulated/compacted, and shipped as sulfate of potash.

1.3 Facility Criteria Air Pollutant Emissions Sources

The source consists of the following emission units:

AH500 – Salt plant compaction/loading wet scrubber
AH502 – Salt plant screening wet scrubber
AH513 – Salt dryer 501 wet scrubber and cyclonic wet scrubber
AH1555 – SOP plant compaction bldg. / B1520 process heater wet scrubber
MP WS / AH-692 – $MgCL_2$ plant venturi wet scrubber
BH001 – SOP bulk loadout circuit baghouse
BH002 – SOP silo storage circuit baghouse
BH501 – Salt cooler baghouse
BH502 – Salt bulk loadout baghouse
BH503 – Salt special products baghouse
BH505 – Salt special products circuits baghouse
BH1400 – SOP dryer 1400 baghouse
BH1505 – Bins and hoppers binvent
BH1510 – Bins and hoppers binvent
BH1545 – D1545 SOP dryer baghouse
BH1565 – SOP Compaction Recycle Hopper Bin Vent fabric filter
BHNEW – new SOP compaction bldg. baghouse
Dust Torits – Individual cartridge filter control devices on material handling operations
SOP, SALT, and MAG fugitives

Indoor and outdoor material handling operations
NGB-1 – 108.11 mmBtu/hr natural gas-fired boiler with low-NO_x burners (boiler #1)
NGB-2 – 108.11 mmBtu/hr natural gas-fired boiler with low-NO_x burners (boiler #2)
SC450, SC460 – 30 MMBtu/hr submerged combustion water heaters
SC461, SC462 – 60 MMBtu/hr submerged combustion water heaters
MAG Evaps – $MgCL_2$ brine evaporators
Defoamer – Evaporation of VOCs from SOP defoaming additive.
CT003 – SOP plant cooling tower
CT004 – SOP plant cooling tower
CT639 – $MgCL_2$ plant cooling tower
BLAST – Abrasive blasting operations
Emergency generators: GN100, GN200, GN300, GN1200, GN1300, Admin, CS Gen
Horizontal storage tanks: Tank 3, Tank 4, Tank 5
Four (4) natural gas-fired dryers: D501, D1400, D1545, B1520

1.4 Facility 2016 Baseline Actual Emissions and Current PTE

In 2016, Compass' baseline actual emissions were determined to be the following (in tons per year)[1]:

Table 1: Actual Emissions

Pollutant	Actual Emissions (Tons/Year)
$PM_{2.5}$	80.5
SO_2	9.81
NO_x	134.5
VOC	72.82
NH_3	3.61

2.0 Modeled Emission Values

A full explanation of how the modeling inputs are determined can be found elsewhere. However, a shortened explanation is provided here for context.

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The base year for all modeling was set as 2016, as this is the most recent year in which a complete annual emissions inventory was submitted from each source. Each source's submission was then verified (QA-QC) – checking for condensable particulates, ammonia (NH_3) emissions, and calculation methodologies. Once the quality-checked 2016 inventory had been prepared, a set of projection year inventories was generated. Individual inventories were generated for each projection year: 2017, 2019, 2020, 2023, 2024, and 2026. If necessary, the first projection year, 2017, was adjusted to account for any changes in equipment between 2016 and 2017. For new equipment not previously listed or included in the source's inventory, actual emissions were assumed to be 90% of its individual PTE.

While some facilities were adjusted by "growing" the 2016 inventory by REMI growth factors; most facilities were held to zero growth. This decision was largely based on source type, and

1 see References: Item #17

how each source type operates. The refineries have reported to UDAQ as a production group that they are operating at capacity and are not planning any production or major emission increases in the time frame covered by the SIP BACT analysis. In addition, each of the refineries has previously agreed to accept SIP allowable CAPs on emissions of $PM_{2.5}$ and $PM_{2.5}$ precursors in the moderate $PM_{2.5}$ SIP previously issued by UDAQ. For these reasons, UDAQ used zero growth for all projection years beyond the 2016 baseline inventory.

For Compass, between the years of 2016 and 2017, the only permitting actions that took place were the addition of some emergency engines. These changes are included in the 2017 emission rows; and a summary of the modified emission totals for 2017 are shown below in Table 2-1.

Table 3: Modeled Emission Values (Plant-Wide)

Pollutant	2017 Projected Actual Emissions (Tons/Year)
$PM_{2.5}$	80.5
SO_2	9.81
NO_x	134.5
VOC	72.82
NH_3	3.61

Finally, the effects of BACT were then applied during the appropriate projection year. Any controls applied between 2016 and 2017 (such as any RACT or RACM required as a result of the moderate $PM_{2.5}$ SIP), was previously taken into account during the 2017 adjustment performed earlier. Future BACT, meaning those items expected to be coming online between today and the regulatory attainment date (December 31, 2019), would be applied during the 2019 projection year. Notations in the appropriate table of emission inventory model input spreadsheet indicate the changes made and the source of those changes. Similarly, Additional Feasible Measures (AFM) or Most Stringent Measures (MSM), which might be applied in future projection years beyond 2019 are similarly marked on the spreadsheet. The effects of those controls are applied on the projection year subsequent to the installation of each control – e.g. controls coming online in 2021 would be applied in the 2023 projection year, while controls installed in 2023 would be shown only in 2024.

3.0 BACT Selection Methodology

The general procedure for identifying and selecting BACT is through use of a process commonly referred to as the "top-down" BACT analysis. The top-down process consists of five steps which consecutively identify control measures, and gradually eliminate less effective or infeasible options until only the best option remains. This process is performed for each emission unit and each pollutant of concern. The five steps are as follows:

1. Identify All Existing and Potential Emission Control Technologies: UDAQ evaluated various resources to identify the various controls and emission rates. These include, but are not limited to: federal regulations, Utah regulations, regulations of other states, the RBLC, recently issued permits, and emission unit vendors.

2. Eliminate Technically Infeasible Options: Any control options determined to be technically infeasible are eliminated in this step. This includes eliminating those options with physical or technological problems that cannot be overcome, as well as eliminating those options that cannot be installed in the projected attainment timeframe.

3. Evaluate Control Effectiveness of Remaining Control Technologies: The remaining control options are ranked in the third step of the BACT analysis. Combinations of various controls are also included.

4. Evaluate Most Effective Controls and Document Results: The fourth step of the BACT analysis evaluates the economic feasibility of the highest ranked options. This evaluation includes energy, environmental, and economic impacts of the control option.

5. Selection of BACT: The fifth step in the BACT analysis selects the "best" option. This step also includes the necessary justification to support the UDAQ's decision.

Should a particular step reduce the available options to zero (0), no additional analysis is required. Similarly, if the most effective control option is already installed, no further analysis is needed.

4.0 BACT for the Natural Gas-fired Dryers

Some of the primary sources of emissions at the Compass facility are the various dryers used to reduce the water content of the various materials being processed. The dryers are fired on pipeline quality natural gas and function similarly to rotary kilns.

4.1 $PM_{2.5}$

There are two sources of particulate emissions from the dryers. Combustion of natural gas results in combustion products containing filterable and condensable particulate – primarily $PM_{2.5}$. The material being dried – NaCl, K_2SO_4, and $MgCl_2$ – are all generally friable and can easily break down into fine dusts under heat and excessive mechanical action. This also releases particulates that can become entrained in the exhaust air. While the majority of these particulates are larger than $PM_{2.5}$, some fraction will fall below the $PM_{2.5}$ threshold.

4.1.1 Available Control Technology

Controls for particulate emissions from the dryers primarily fall into the post combustion control category. Pre-combustion controls involve: inlet air filters, which are only available for enclosed combustion sources such as turbines or IC engines; good combustion practices, which apply generally in any combustion BACT analysis; and the use of clean burning fuels, with natural gas being the primary example. Post combustion controls cover: fabric filtration; wet scrubbers, either packed bed towers or venturi-type; and electrostatic precipitation, or ESPs.

The identified controls are as follows:

Inlet air filters: primarily used to filter out small particulate matter in the inlet air. These filters are not particularly useful on material dryers. While they can provide some aid in reducing plugging and associated wear on the LNB; material dryers, unlike boilers, are fired with an open flame used to heat a large volume of inlet air that is then passed over the material to be dried. Any inlet air filtering would be negated by the much larger volume of unfiltered air being heated. Typically, burner plugging and other wear/damage is related to fuel contaminants, and not to the combustion air. The chance of burner plugging, or other damage to internal components is essentially zero in this circumstance.

Good combustion practice: this is nothing but properly operating the dryers with the correct ratio of air to fuel in order to maximize combustion and minimize unburned fuel.

Clean burning fuels: includes the use of inherently low emitting fuels like natural gas.

Specific burner and/or combustion chamber design: the more efficiently the dryer is able to operate, the less pollution it will generate for a given amount of fuel combusted. Primarily this includes low-NO_x and ultra-low-NO_x burners. Other forms of combustion-based control: like staged fuel combustion or overfire air injection are not physically possible in this type of dryer configuration. For particulate control in natural gas combustion, there is little to no difference between the various burner designs or configurations as the degree of complete combustion is the ultimate deciding factor in particulate control.

Add-on particulate controls: this final option includes traditional "add-on" control systems such as baghouses or electrostatic precipitators. These types of controls would be installed in the exhaust gas stream exiting the dryer combustion chamber, but prior to the emissions exiting the stack.

4.1.2 Evaluation of Technical Feasibility of Available Controls

With the low risk of damage to the dryers by firing exclusively on pipeline quality natural gas, the use of inlet particulate filters is not technically feasible. While some filtration of inlet air would occur, these filters would result in essentially zero reduction in particulate emissions given the low inlet flow rates to the dryer burners. Filtering of the drying air would involve considerable redesign of the dryer airflow, as currently these units are simply open to maximize airflow. Additional ductwork, fans and control equipment would also be required.

The use of clean burning fuels, good combustion controls, and proper burner design are all technically feasible, and already in place and operational.

The use of add-on post-combustion particulate controls – such as baghouse filtration, or wet scrubbers – is technically feasible. The use of ESPs is not considered technically feasible due to the high electrical resistance of the material being dried. NaCl, $K2SO_4$ and $MgCl_2$ are all highly electrically resistive and extremely difficult to control with ESPs. Add-on controls are designed primarily to control the filterable fraction of particulate emissions, and do very little to control the condensable fraction, although wet scrubbers do control the condensable fraction.

4.1.3 Evaluation and Ranking of Technically Feasible Controls

The various particulate controls can be used in conjunction, although fabric filtration and wet scrubbing cannot be used together. The extra water content from the wet scrubber tends to plug and blind fabric filter bags, leading to blown bags and greatly elevated operating costs – plus increased emissions during periods of malfunction. Running with fabric filtration in front of wet scrubbing makes the wet scrubber mostly redundant – it would serve only as a very expensive condensable particulate filter.

4.1.4 Further Evaluation of Most Effective Controls

Fabric filtration has one added benefit over wet scrubbing for control of these materials. As the materials are highly water soluble, fabric filtration allows for product recovery, while wet scrubbing will simply re-dissolve the materials and return them to the liquid phase. Wet scrubbing controls the condensable particulates, which cannot be removed by fabric filtration.

Compass has a combination of both types of controls, although it has been slowly replacing most wet scrubbers with fabric filters in order to improve product recovery.

Fabric filters are also typically less expensive to operate, and less prone to malfunction in Compass' physical environment. For control of filterable particulates the two types of controls are approximately equal.

4.1.5 Selection of BACT

Retention of the existing particulate controls should remain as BACT. Although Compass has been replacing wet scrubbers with baghouses, UDAQ recommends that the existing controls remain as is – where baghouses are currently installed, they should remain, and where wet scrubbers are currently installed, those should remain. The existing limits from the moderate $PM_{2.5}$ SIP should also be retained, as no change in equipment or processes is taking place:

Emission Unit	Filterable+Condensable $PM_{2.5}$ Emission Rate (lb/hr)
AH-500	2.52
AH-502	5.49
AH-513	2.32
BH-501	3.77
BH-1545	13.55
AH-1555	1.92
BH-1400	8.42
AH-692	0.44

Emission Unit	Filterable $PM_{2.5}$ Emission Rate (lb/hr)
SOP Plant Compaction Building Baghouse	0.21
BH-001	0.27
BH-002	0.6
BH-502	0.15

4.2 NO_x

NO_x, or oxides of nitrogen, are formed from the combustion of fuel. There are three mechanisms for the formation of NO_x: fuel NO_x, which is the oxidation of the nitrogen bound in the fuel; thermal NO_x, or the oxidation of the nitrogen (N_2) present in the combustion air itself; and prompt NO_x, which is formed from the combination of combustion air nitrogen (N_2) with various partially-combusted intermediary products derived from the fuel. For combustion within the material dryers, thermal NO_x is the major contributor. Prompt NO_x contributes slightly only in the initial stages of combustion. As the dryers are fueled with pipeline quality natural gas, which is inherently low in nitrogen content, fuel NO_x is not a major contributor. All three processes are temperature dependent – combustion temperatures below 2700ºF greatly inhibit NO_x formation.

4.2.1 Available Controls

For control of NO_x emissions from the material dryers there are both pre- and post-combustion options available. Beside the two inherent options of clean burning fuels and good combustion practices, there are five different combustion techniques: low-NO_x burners, ultra-low-NO_x burners with internal flue gas recirculation, staged air/fuel combustion (aka overfire air injection), low excess air firing, and external flue gas recirculation. The source also identified three post-combustion controls, specifically: SNCR, SCR, and EMx™. UDAQ also identified four other options: Xonon Cool Combustion®, LoTOx™, Pahlmann™, and NO_xOUT™, as available control options that could be applied to the dryers.

Combustion techniques:

Clean Burning Fuels: The use of natural gas rather than fuel oil or coal is the most commonly cited example of using clean burning fuels. This is the default case for all of the material dryers at the Compass facility.

Good Combustion Practices: This is nothing more than proper operation of the dryers to minimize emissions, minimize fuel use, and maximize heating efficiency. It includes regular maintenance as well as periodic testing and monitoring. This is also part of the default case at the Compass plant.

Low-NO_x Burners (LNB): Typically thought of as an advanced version of a standard burner, the LNB reduces NO_x formation through the restriction of oxygen, flame temperature, and/or residence time. There are two main types of LNB: staged fuel and staged air burners. Staged fuel burners divide the combustion zone into two regions, limiting the amount of fuel supplied in the first zone with the standard amount of combustion air, and then supplying the remainder of the fuel in the second zone to combust with the un-combusted oxygen from the first zone. Staged air burners reverse this, limiting the combustion air in the first zone then supplying the remainder of the combustion air in the second zone to combust the remaining fuel. Staged air LNBs are more suited to the dryers as they do not restrict flame temperature as much as stage fuel burners.

Ultra-Low-NO_x Burners (ULNB): Most commonly a combination of LNB technology with some internal flue gas recirculation. The burner recirculates some of the hot flue gases from the flame or firebox back into the combustion zone. Since these high temperature flue gases are oxygen depleted, the burner lowers the speed at which fuel can be combusted without reducing the flame temperature below the level needed for optimum combustion efficiency. Reducing oxygen concentrations in the firebox most directly impacts fuel NO_x generation.

Flue Gas Recirculation (FGR): External FGR involves recycling of flue gas back into the firebox as part of the fuel-air mixture at the burner. Although similar to the concept of ULNB, rather than using burner design features to recirculate gases from within the firebox, FGR uses external ductwork to route a portion of the exhaust stream back to the inlet side of the dryer.

Xonon Cool Combustion®: Catalytica Energy Systems' Xonon Cool Combustion® System is a specific type of catalytic combustion process, and often mentioned independently in control technology reviews. In practical application, however, it functions similarly to other catalytic combustors. These combustors use a flameless catalytic combustion module to initiate the combustion process, followed by a more traditional combustion process downstream of the catalyst. This two-stage process lowers the overall combustion temperature.

Staged Air/Fuel Combustion (Over-fire Air Injection): Over-fire air (OFA) is a combustion staging practice typically used in combination with LNB, but not with ULNB or FGR. In OFA designs, a portion of the combustion air is injected separately from the LNBs to a higher elevation in the firebox. This lowers the flame temperature by reducing the oxygen concentration in the area of the firebox where the fuel is being injected. This oxygen–reduced section would then be followed by the second "over-fire air" section that would act as an oxidation zone to complete combustion. This splits the firebox into two zones in the same way as the staged-air LNB.

Low Excess Air Firing: One factor that might influence the formation of NO_x is the amount of excess combustion air. The additional oxygen and nitrogen present in the excess combustion air can combine and form thermal NO_x. Limiting excess air can be accomplished with proper burner design and through oxygen trim controls.

Post Combustion Controls:

Selective Catalytic Reduction (SCR): In the SCR process, a reducing agent, such as aqueous ammonia, is introduced into the dryer's exhaust; just past the firebox (sometimes within the final stages of the firebox), and upstream of a metal or ceramic catalyst. As the exhaust gas/reducing agent mixture passes through the catalyst bed, the reducing agent selectively reduces the nitrogen oxide compounds present in the exhaust to produce elemental nitrogen (N_2) and water (H_2O). Ammonia is the most commonly used reducing agent. Adequate mixing of ammonia in the exhaust gas and control of the amount of ammonia injected (based on the inlet NO_x concentration) are critical to obtaining the required reduction. For the SCR system to operate properly, the exhaust gas must maintain minimum O_2 concentrations and remain within a specified temperature range (typically between 480ºF and 800ºF with the most effective range being between 580°F and 650°F), with the range dictated by the type of catalyst. Exhaust gas temperatures greater than the upper limit (850°F) will pass the NO_x and unreacted ammonia through the catalyst. The most widely used catalysts are vanadium, platinum, titanium, or zeolite compounds impregnated on metallic or ceramic substrates in a plate or honeycomb configuration. The catalyst life expectancy is typically 3 to 6 years, at which time the vendor can recycle the catalyst to minimize waste.

Selective Non-catalytic Reduction (SNCR): Very similar to SCR, only without the use of a catalyst bed. SNCR simply uses the application of ammonia or (more commonly in this case) urea to achieve NO_x control. And rather than injection into the exhaust stream, the reducing agent is usually injected directly into the upper end of the firebox. This lowers the flame temperature and helps to ensure adequate mixing of the exhaust gases and the reducing agent. Fuel Tech's NO_xOUT™ process is a subset of SNCR designed to operate at higher temperatures by using stabilized urea liquor injected directly into the firebox.

The EMx™ system uses a coated oxidation catalyst installed in the flue gas to remove both NO_x and CO without the need of a reagent such as ammonia. The NO emissions are oxidized to NO_2 and then absorbed onto the catalyst. A dilute hydrogen gas is passed through the catalyst periodically to de-absorb the NO_2 from the catalyst and reduce it to N_2 prior to exit from the stack. EMx™ prefers an operating temperature range between 500°F and 700°F. The catalyst uses a potassium carbonate coating that reacts to form potassium nitrates and nitrites on the surface of the catalyst. When all of the carbonate absorber coating on the surface of the catalyst has reacted to form nitrogen compounds, NO_2 is no longer absorbed, and the catalyst must be regenerated. Dampers are used to isolate a portion of the catalyst for regeneration. The regeneration gas consists of steam, carbon dioxide, and a dilute concentration of hydrogen. The regeneration gas is passed through the isolated portion of the catalyst while the remaining catalyst stays in contact with the flue gas. After the isolated portion has been regenerated, the next set of dampers close to isolate and regenerate the next portion of the catalyst. This cycle repeats continuously. At any one time, four oxidation/absorption cycles are occurring and one regeneration cycle is occurring.

Linde's LoTOx™ technology uses ozone injection to oxidize NO and NO_2 to N_2O which is highly soluble and easier to remove through the use of another control device such as a wet scrubber. UDAQ has seen and permitted the application of this technology in combination with a wet gas scrubber for emission control at a petroleum refinery.

Enviroscrub's Pahlmann™ Process is a sorbent-based control system which functions similarly to a dry scrubber. In this system, Pahlmanite (a manganese dioxide sorbent) is injected into the exhaust stream for NO_x removal and then collected in a particulate control device like a baghouse. The sorbent is then regenerated in an aqueous process, filtered and dried, and is then ready for reinjection. The wastewater is sent offsite for disposal.

4.2.2 Evaluation of Technical Feasibility of Available Controls

Both default case options of clean burning fuels and good combustion practices are technically feasible. The Compass plant has been using pipeline quality natural gas as fuel. Good combustion practices are a standard requirement of UDAQ's NSR permits.

Of the available combustion techniques, only Xonon® is not technically feasible. The Xonon combustor is specifically designed for use in combustion turbines and not for material dryers. The current owner of the technology, Catalytica Energy Systems, is only marketing Xonon technology for gas turbines within the 1 to 15 MW size range. At this time, there is no information available on the transferability of the technology to other combustion processes.

Most of the post-combustion controls that have been identified are technically feasible in a general sense. These controls are widely used and have been demonstrated to control NO_x emissions from similar combustion sources. However, some feasibility concerns do exist.

The EMx™ system has not been demonstrated in practice on material dryers. The catalyst system operates best in a gas temperature range of 500-700ºF, well above the expected 250ºF exhaust temperature of the dryers.

LoTOx™ still requires the use of another pollutant control system such as a wet gas scrubber to remove the N_2O. This other control imposes additional infrastructure for little additional pollutant removal.

The Pahlmann™ system also requires the addition of a baghouse or other particulate control system, an aqueous sorbent regeneration system, and wastewater treatment and disposal. The system has not been demonstrated in practice on natural gas-fired equipment.

SCR and SNCR both require ammonia or urea injection as a reducing agent. The aqueous solution will raise the water content, requiring additional fuel burned to complete the drying process. Compass also reports[2] that the addition of ammonia or urea can cause contamination with the material being dried.

Based on the many feasibility issues listed above, only LNB, ULNB, and FGR in combination with GCP and natural gas are technically feasible.

4.2.3 Evaluation and Ranking of Technically Feasible Controls

For the remaining control options the following table shows the expected ranking and degree of emission control:

Table 4-1: NO_x Control Options

2 see References: Item #15

Control Technology	Rate of Control
ULNB	50-80%
LNB + FGR	55-75%
LNB	35-55%
FGR	30-50%
Low excess air	5-10%

One combination not listed in the table above was the use of ULNB and FGR; likely because this makes use of redundant control technology. Both control techniques rely on some degree of recirculation of the flue gases to reduce the oxygen concentration in the inlet air stream. Combining the two processes would lessen the benefits each would provide if used individually, such that they would work antagonistically rather than synergistically. The use of ULNB+FGR will not be evaluated further.

4.2.4 Further Evaluation of Most Effective Controls

Compass provided an analysis[3] of the various control options for each of the material dryers at its facility. Compass' analysis seemed to suggest that the use of ULNB and FGR in combination would serve as BACT. UDAQ looked into this particular combination based on entries in the RBLC which also referenced this combination. UDAQ investigated each listing individually to identify the "use" of both ULNB and FGR. The first entry was for an Indiana Gasification Plant in Rockport, IN (with a listed NO_x emission rate of 0.0123 lb/MMBtu on a 24-hr basis). For this plant, UDAQ retrieved the original BACT analysis. Rather than showing that both technologies had been installed, the permit reviewer was expressing that the ULNB being installed used FGR – as in "ULNB = LNB+FGR". Only ULNB were ever installed, and the entry on the RBLC was merely in error. The second entry was for the ADM Corn Processing Plant in Cedar Rapids, Iowa (with a listed emission rate of 0.02 lb/MMBtu on a 30-day rolling average). For this plant, the situation was the same. After finding the original engineering review, UDAQ was able to learn that the BACT determination was for LNB with FGR, and that the RBLC entry for this permit was also in error. The use of ULNB+FGR will not be evaluated further.

4.2.5 Selection of BACT

UDAQ recommends the use of ULNB for control of NO_x emissions from the material dryers at Compass. There are no existing NO_x limitations in the $PM_{2.5}$ moderate SIP for the material dryers. It is recommended that this remain the case in the $PM_{2.5}$ serious SIP as no specific control equipment is being installed that requires monitoring. Good combustion practices can remain a condition of the AO and Title V permits without requiring SIP-level monitoring, given the low level of NO_x emissions expected from the material dryers.

4.3 VOC

As with any combustion source, VOC emissions from the dryers are the result of unburned hydrocarbons formed during incomplete combustion. The formation of VOCs is dependent on combustion system design, choice of fuel, combustion temperature, and operating practices.

4.3.1 Available Control Technology

3 see References: Item #15

The available control techniques for VOC emissions can be sorted into three categories: pre-combustion controls, thermal oxidation and oxidation catalysts.

Pre-combustion controls include those items such as equipment design (proper burners), good combustion practices, the use of pipeline quality natural gas as fuel, maintaining high combustion efficiencies, maintaining proper air-to-fuel ratios, and conducting proper maintenance. These items have all been previously discussed under the particulate and NO_x control sections (4.1.1 and 4.2.1) above.

Thermal oxidation is the use of a secondary combustion process to burn off the remaining unburned VOCs (oxidize) into CO_2 and water vapor. This process also oxidizes CO as a secondary benefit. The oxidation process typically requires a separate combustion chamber, burner, and heat exchanger; and in some/most cases, additional fuel input.

Most oxidation catalysts are designed to control both VOCs and CO. The exhaust gas stream is sent through the catalyst "bed", which consists of a honeycomb shaped substrate material that is coated with the catalyst. The gas stream needs to be relatively particulate-free to prevent fouling of the catalyst. Oxidation catalysts do not use additional reagent chemicals like SCR systems.

One specific oxidation catalyst, EMx^{TM}, has been used to oxidize and remove both NO_x and VOC. The system uses a platinum-based catalyst coated with potassium carbonate (K_2CO_3) – see the section on NO_x control, Section 4.2, for additional information.

4.3.2 Evaluation of Technical Feasibility of Available Controls

Combustion controls, proper design and operation, are the most common means of controlling VOC emissions from material dryers. Controlling VOC emissions through operational and design elements is far easier and cost efficient than the application of add-on control techniques.

Although available, no applications of thermal oxidation have been applied to material dryers. Thermal oxidation requires a higher concentration of VOCs and CO than is typically present in material dryer exhaust. The average exhaust gas temperature of 200-250ºF is quite low and would require a high degree of supplemental heat input to be added in the thermal combustor to raise the exhaust gas above the thermal oxidation temperature of 1500ºF. In addition, the large volume of drying air passing through the dryer drives down the total concentration of VOCs.

Oxidation catalysts have the same problem as thermal oxidizers with available concentration. The exhaust gas temperature is less of a concern with a catalytic based control, but without sufficient concentration to allow the technique to be operationally functional, the technique is ultimately infeasible.

Therefore, only pre-combustion controls will be evaluated further as BACT.

4.3.3 Evaluation and Ranking of Technically Feasible Controls

Good combustion practices for the material dryers are the continued use of pipeline quality natural gas as fuel, adjustment of combustion flame temperature and combustion residence time, proper fuel-air mixing and adequate turbulence in the flue gas. As none of these practices are contradictory, there is no need to rank these controls. All can be performed in concert and will be viewed as single control option; "combustion controls."

4.3.4 Further Evaluation of Most Effective Controls

The technically feasible controls are all installed and operational on the material dryers at Compass. No additional evaluation is required.

4.3.5 Selection of BACT

Retention of the existing control systems (good combustion practices and proper equipment design) for control of VOC emissions is recommended as BACT. There are no existing VOC limitations in the $PM_{2.5}$ moderate SIP for the material dryers. It is recommended that this remain the case in the $PM_{2.5}$ serious SIP as no specific control equipment is being installed that requires monitoring. Good combustion practices can remain a condition of the AO and Title V permits without requiring SIP-level monitoring, given the low level of VOC emissions expected from the material dryers.

4.4 SO_2

Sulfur dioxide emissions from combustion are directly related to the amount of sulfur present in the fuel. The material dryers are fired on pipeline-quality natural gas, which is inherently low in sulfur.

4.4.1 Available Control Technology

To reduce SO_2 emissions, a source can either reduce the amount of sulfur present in the fuel or apply post-combustion controls such as flue gas desulfurization. The use of pipeline quality natural gas is considered a control technique for fuel-sulfur minimization.

As for post-combustion controls, primarily only flue gas desulfurization systems exist. These are wet or dry scrubbing systems which remove SO_2 through absorption with a scrubbing reagent. Wet scrubbers typically mix the reagent with water and use one of a variety of contacting chambers or "towers" to allow the exhaust stream and scrubbing liquid to contact. Dry scrubbers use dry injection, spray drying or a combination of the two to inject the scrubbing reagent (typically a lime-slurry) directly into the exhaust stream. The reacted slurry is then removed in a particulate control device.

4.4.2 Evaluation of Technical Feasibility of Available Controls

No post-combustion SO_2 controls have been found to be technically feasible for use on natural gas fired material dryers of this size or type. The SO_2 concentrations are considered too low for scrubbing technologies to be effective. The extra pressure drop associated with the scrubbing system and added particulate capture system (typically a baghouse), plus the cost of the scrubber and baghouse have led to these systems not being applied in practice and they are not considered commercially available for natural gas-fired material dryers. The injection of desulfurization chemicals will contaminate the product being dried and render it unsellable.

The use of low sulfur fuels, such as natural gas and ULSD, is considered technically feasible and is already in use at Compass.

4.4.3 Evaluation and Ranking of Technically Feasible Controls

With the elimination of all post-combustion SO_2 controls, there is no need to rank the single remaining control of fuel sulfur limiting. The use of inherently low-sulfur fuels such as pipeline-quality natural gas and ULSD is the only technically viable control option. It is also the existing base-case already in use at the Compass plant. No ranking of controls is required

4.4.4 Further Evaluation of Most Effective Controls

N/A, no further analysis is required.

4.4.5 Selection of BACT

The use of pipeline-quality natural gas is the only feasible SO_2 control technology for the material dryers and is considered BACT. There are no specific SO_2 emission limitations on the utility boilers in the NSR permit or the $PM_{2.5}$ moderate SIP. It is recommended that this remain the case in the serious SIP as there is no control equipment necessary to artificially restrict SO_2 emissions.

5.0 BACT for Natural Gas-Fired Boilers: 108.11 MMBtu/hr Natural Gas-Fired Boilers – Boilers #1 and #2

UDAQ has separated the analysis of process heaters and boilers into two groups. For those heaters and boilers with heat input ratings less than 30 MMBtu/hr; UDAQ has included its analysis in a separate document which addresses similar emission units which are common to many sources such as small heaters and boilers. Please refer to the $PM_{2.5}$ Serious SIP - BACT for Small Sources – Section 5 for details of the analysis for these smaller units. The remaining larger items are covered below.

Compass operates two large boilers with heat input capacities in excess of 100 MMBtu/hr. The boilers were installed in partial fulfillment of the RACT requirements of the moderate $PM_{2.5}$ SIP on July 30, 2012 (DAQE-AN109170030-12). These boilers are equipped with ULNB.

5.1 $PM_{2.5}$

No add-on controls for particulates were considered for these boilers. Given that these emission units are fired on gaseous fuels, with inherently low particulate formation, no controls are expected to be cost effective. Compass' own analysis[4] did not provide any additional information. Low sulfur fuels such as pipeline quality natural gas and GCP remain BACM.

5.2 SO_2

Sulfur dioxide emissions from combustion are directly related to the amount of sulfur present in the fuel. The utility boilers are primarily fired on pipeline-quality natural gas, which is inherently low in sulfur.

5.2.1 Available Control Technology

To reduce SO_2 emissions, a source can either reduce the amount of sulfur present in the fuel or apply post-combustion controls such as flue gas desulfurization. The use of pipeline quality natural gas is considered a control technique for fuel-sulfur minimization

4 see References: Item #15

As for post-combustion controls, primarily only flue gas desulfurization systems exist. These are wet or dry scrubbing systems which remove SO_2 through absorption with a scrubbing reagent. Wet scrubbers typically mix the reagent with water and use one of a variety of contacting chambers or “towers” to allow the exhaust stream and scrubbing liquid to contact. Dry scrubbers use dry injection, spray drying or a combination of the two to inject the scrubbing reagent (typically a lime-slurry) directly into the exhaust stream. The reacted slurry is then removed in a particulate control device.

5.2.2 Evaluation of Technical Feasibility of Available Controls

No post-combustion SO_2 controls have been found to be technically feasible for use on natural gas fired boilers of this size or type. The SO_2 concentrations are considered too low for scrubbing technologies to be effective. The extra pressure drop associated with the scrubbing system and added particulate capture system (typically a baghouse), plus the cost of the scrubber and baghouse have led to these systems not being applied in practice and they are not considered commercially available for natural gas-fired utility boilers.

The use of low sulfur fuels, such as natural gas, is considered technically feasible and is already in use at Compass.

5.2.3 Evaluation and Ranking of Technically Feasible Controls

With the elimination of all post-combustion SO_2 controls, there is no need to rank the single remaining control of fuel sulfur limiting. The use of inherently low-sulfur fuels such as pipeline-quality natural gas is the only technically viable control option. It is also the existing base-case already in use at the Compass plant.

5.2.4 Further Evaluation of Most Effective Controls

N/A, no additional evaluation is required, as Compass has chosen the top remaining control option.

5.2.5 Selection of BACT

The use of low sulfur fuels such as pipeline-quality natural gas is the only feasible SO_2 control technology for these two boilers and is considered BACT. There are no specific SO_2 emission limitations on the utility boilers in the NSR permit or the $PM_{2.5}$ moderate SIP. It is recommended that this remain the case in the serious SIP as there is no control equipment necessary to artificially restrict SO_2 emissions

5.3 NO_x

NO_x, or oxides of nitrogen, are formed from the combustion of fuel in a boiler’s firebox. There are three mechanisms for the formation of NO_x: fuel NO_x, which is the oxidation of the nitrogen bound in the fuel; thermal NO_x, or the oxidation of the nitrogen (N_2) present in the combustion air itself; and prompt NO_x, which is formed from the combination of combustion air nitrogen (N_2) with various partially-combusted intermediary products derived from the fuel. For combustion within these boilers, thermal NO_x is the major contributor. Prompt NO_x contributes slightly only in the initial stages of combustion, while fuel NO_x is not a major contributor (natural gas is inherently low in nitrogen content). All three processes are temperature dependent – combustion temperatures below 2700ºF greatly inhibit NO_x formation.

5.3.1 Available Controls

For control of NO_x emissions from these boilers there are both pre- and post-combustion options available. Controls include:

- clean burning fuels and good combustion practices,
- LNB,
- ULNB,
- staged air/fuel combustion (overfire air injection),
- low excess air firing,
- external FGR
- SNCR,
- SCR,
- EMx™,
- Xonon Cool Combustion®,
- LoTOx™
- Pahlmann™
- NO_xOUT

5.3.2 Evaluation of Technical Feasibility of Available Controls

Both default case options of clean burning fuels and good combustion practices are technically feasible. The Compass plant has been using pipeline quality natural gas as fuel in the boilers since their installation.

Xonon® is not technically feasible. The Xonon combustor is specifically designed for use in combustion turbines and not for industrial boilers. At this time, there is no information available on the transferability of the technology to other combustion processes.

The EMx™ system has not been demonstrated in practice on large industrial boilers. The catalyst system operates best in a gas temperature range of 500-700ºF, well above the expected 250ºF exhaust temperature of the two boilers.

LoTOx™ requires the use of another pollutant control system such as a wet gas scrubber to remove the N_2O. This other control imposes additional infrastructure for little additional pollutant removal.

The Pahlmann™ system also requires the addition of a baghouse or other particulate control system, an aqueous sorbent regeneration system, and wastewater treatment and disposal. The system has not been demonstrated in practice on natural gas-fired equipment, especially on industrial boilers.

Given these concerns, Xonon®, EMx™, LoTOx™, and Pahlmann™ were all eliminated from further consideration. All other identified control options (combustion technique or post-combustion controls) remain as technically feasible options.

5.3.3 Evaluation and Ranking of Technically Feasible Controls

For the remaining control options the following table shows the expected ranking and degree of emission control:

Table 4-1: NO_x Control Options

Control Technology	Rate of Control
ULNB + SCR	85-99%
LNB + SCR	85-95%
ULNB + SNCR	80-90%
SCR	80-90%
LNB + SNCR	55-75%
ULNB	50-80%
LNB + FGR	55-75%
LNB	35-55%
SNCR	30-50%
FGR	30-50%
Low excess air	5-10%

The top control option identified is ULNB in conjunction with SCR. A review of recent permitting actions for large industrial and utility boilers yielded limited results. The lowest emission limits found were for utility boilers permitted in 2014 and 2015 using either LNB with SCR or ULNB alone. No recently permitted large boilers were found using both ULNB and SCR in combination – even though this appears to be the most effective control mechanism.

5.3.4 Further Evaluation of Most Effective Controls

There are few energy related impacts with installation or operation of SCR or SNCR. There are no energy or environmental impacts associated with the potential installation of FGR, although as discussed in sections 4.2.3 and 4.2.4, external FGR and ULNB cannot be used in conjunction as the technologies are counterproductive when used in series.

One potential source of concern with operation of either SCR or SNCR is the generation of ammonia slip. Unreacted ammonia, meaning any ammonia which does not react with the NO_x present in the exhaust stream, may react with HCl to form ammonium chloride, or with SO_3 to form ammonium sulfate/sulfite. This can occur either in the exhaust stream or in the ambient air. The unreacted ammonia is referred to as “ammonia slip.” Ammonia slip itself often requires permit limitations as a precursor pollutant.

Installation of either SCR or SNCR does not appear to be cost effective for either of the two boilers. The lowest $/ton value for any SCR or SNCR unit UDAQ has investigated has been calculated at nearly $32K per ton of NO_x removed. Although BACT economic infeasibility ranges vary from location to location, the most expansive of these (San Joaquin Valley Air Pollution Control District – SJVAPCD), tops out at $25K/ton.

Similarly, the installation of FGR is equally economically infeasible, as it would require the removal of the existing ULNB and replacement of these with new LNB. This is counterproductive, as the total amount of NO_x reduced would be less than the existing reductions achieved with ULNB.

Compass had an existing limit of 9 ppm NO_x for both boilers in the moderate $PM_{2.5}$ SIP, but this has been shown in practice as difficult to achieve at the elevated altitude where Compass is located. The source is able to attain this limit but only with continual adjustment of the operating parameters of the boilers – steam generation is not consistent, and breakdowns are more frequent than is typical for boilers of this size or type. UDAQ has considered this problem and agreed that a relaxation of the concentration-based limit while also imposing a mass-based limit would allow Compass more flexibility in operating the boilers while also minimizing emissions. UDAQ's recommendation is included in the next section.

5.3.5 Selection of BACT

Currently, BACT for NO_x control at the two large boilers is the use of the existing ULNB control systems. UDAQ recommends a limit for both Boiler #1 and #2 of 12 ppm NO_x and 1.6 lb of NO_x/hr.

5.4 VOC

5.4.1 Available Controls

Compass identified[5] the following controls for mitigation of VOC emissions from Boilers #1 and #2:

- Use of pipeline quality natural gas as fuel
- Good combustion practices (GCP)
- Use of an oxidation catalyst
- Use of thermal oxidation, either afterburner (flare) or regenerative thermal oxidation (RTO)

5.4.2 Evaluation of Technical Feasibility of Available Controls

Both the use of natural gas as fuel and GCP are technically feasible and represent the baseline case for the two boilers.

The use of oxidation catalysts have been shown as technically feasible in reducing VOC emissions, but are less effective on boilers than on turbines and IC engines. Oxidation catalysts are most effective for sources with high excess oxygen exhaust flows such as turbines (12-15% excess oxygen) compared to external natural gas combustion sources such as boilers (3-6% excess oxygen).

Neither type of thermal oxidation has been shown effective for natural gas combustion sources as the concentration of VOCs in the exhaust gas is very low. A large quantity of additional heat in the form of supplemental fuel is often required to achieve any reduction in VOC emissions – and this supplemental fuel burning negates any positive benefits gained from the VOC reduction.

5.4.3 Evaluation and Ranking of Technically Feasible Controls

The use of natural gas as fuel and GCP can be used in conjunction and are both technically feasible. There is no need to further evaluate these options.

5.4.4 Further Evaluation of Most Effective Controls

5 see References: Item #15

N/A, the two technically feasible options are both already in use on the two boilers.

5.4.5 Selection of BACT

UDAQ recommends that Compass continue to operate the two boilers in keeping with good combustion practices and using only natural gas as fuel. As this is a work practice standard, there is no need for specific limitations to appear in the SIP.

5.5 Consideration of Ammonia

There are few emissions of ammonia from the boilers naturally (some minor amounts of ammonia may be generated as part of the combustion process). Ammonia emissions would be more of a concern if SCR or SNCR had been chosen as a viable control option. However, as no ammonia injection is being used, no ammonia slip can result. UDAQ does not recommend ammonia controls on the heaters and boilers at this time.

6.0 BACT for Submerged Combustion Sources

The submerged combustion sources are functionally equivalent to the natural gas-fired material dryers, save that the fuel burning equipment is designed to operate beneath a fluid surface level. These units provide additional heat to aid in the salt separation process – where different sodium, potassium and magnesium salts precipitate from the brine feedstock.

As these burners function similarly to the natural gas-fired material dryers discussed in section 4.0 above, please refer to that section for the complete BACT analysis.

7.0 BACT for Storage Silos

The storage silos at the Compass facility store dried product ready to be shipped out to various customers. The product can be sold in a variety of sizes – compressed into larger brick sizes, left in granule form, or in pelletized form. The products are then loaded into trucks, railcars, or bagged and placed on pallets for shipping. The product/material storage silos are similar to grain silos. They are pneumatically loaded, gravity unloaded, and controlled with bin vent or fabric filtration during loading/unloading operations. Emissions at all other times are essentially zero.

A review of available controls for particulate emissions from storage silos shows only fabric filtration or bin vent-type controls are viable and available as BACT. While other types of particulate controls such as wet scrubbing do exist, such controls are far too expensive to be economically feasible considering the low level of expected emissions – 2016 actuals show less than 5 tons per year of particulates.

8.0 BACT for Emergency Engines

Compass operates a number of small natural gas and diesel-fired emergency engines at its Ogden facility. These engines supply power to the control rooms and control & emergency equipment if there is a loss of line power or other emergency.

UDAQ has completed a separate analysis of specific similar emission units which are common to many sources such as emergency generators. Refer to the $PM_{2.5}$ Serious SIP - BACT for Small Sources – Section 8A for details of that analysis.

Compass' own analysis[6] was similar to UDAQ's and arrived at the same conclusion – replacement of existing emergency equipment already subject to the emission standards of NSPS Subpart IIII or Subpart JJJJ was cost prohibitive. Similarly, retrofitting these engines with new controls, such as diesel particulate filters (DPFs), SCR, or oxidation catalysts, was similarly cost prohibitive. These engines are run rarely – periodically for testing and routine maintenance, and are already subject to the emission standards of NSPS Subpart IIII or JJJJ. They are also required to burn only ULSD or pipeline quality natural gas. These limitations and requirements are adequate to serve as BACM for these engines.

9.0 BACT for Fuel Storage Tanks

Compass makes use of three horizontal sealed storage tanks for fuel. One tank hold gasoline for plant trucks and other on-highway vehicles requiring regular gasoline. The other two store ULSD for material handling vehicles and for fuel in the emergency generators.

UDAQ has completed a separate analysis of specific similar emission units which are common to many sources such as storage tanks. Refer to the $PM_{2.5}$ Serious SIP - BACT for Small Sources – Section 13 for details of that analysis.

10.0 BACT for Abrasive Blasting

Compass performs a limited amount of abrasive blasting to clean parts prior to painting or performing other maintenance. These operations take place inside a dedicated booth. UDAQ has performed a separate analysis of abrasive cleaning/blasting which can be found in the $PM_{2.5}$ Serious SIP - BACT for Small Sources – Section 1. Please refer to that analysis for specific details. The results of that analysis are that abrasive blasting operations should be conducted in an enclosed booth and controlled with a baghouse or similar particulate control device. Unconfined abrasive blasting operations may only be conducted if the item to be blasted exceeds 8 feet in any dimension or the surface being blasted is situated at its permanent location. Unconfined abrasive blasting must be conducted using wet abrasive blasting, blasting with reclaim systems, or the abrasives defined in R307-306-6(2). The Compass facility is subject to these restrictions by rule, so additional requirements or limitations are not necessary.

11.0 BACT for Material Handling and Fugitive Particulates

Compass operates as a mineral extraction facility, removing various mineral salts from solar evaporated brine using precipitation evaporation/concentration and general mineral processing operations (screening, washing, compression, grinding, bagging, etc. As the various salts are collected, material handling operations involving both mobile equipment (e.g., trucks, loaders, bulldozers), and stationary equipment (conveyors, screens, feed hoppers, pile drop points, etc.). UDAQ has conducted a separate analysis of both types of equipment. For all material handling operations, please refer to the $PM_{2.5}$ Serious SIP - BACT for Small Sources – Section 12.

12.0 BACT for Cooling Towers

Compass has three cooling towers, two located in the K_2SO_4 plant and one located in the $MgCl_2$ plant. These cooling towers cool the processing water used during mineral extraction and cleaning operations. Cooling towers are a source of particulate emissions as the evaporation of water in the tower leads to the release of suspended and dissolved solids. UDAQ has completed a

6 see References: Item #15

separate analysis of cooling towers which can be found in the $PM_{2.5}$ Serious SIP - BACT for Small Sources – Section 6 for details of that analysis.

13.0 BACT for $MgCl_2$ Plant Evaporators

The Compass facility is the only known domestic producer of magnesium chloride hexahydrate. A search of the RBLC database or any other state permitting database will yield no control options for this process. Globally, the only other known producer of magnesium chloride hexahydrate harvests its product from the waters of the Dead Sea. The Dead Sea brine does not contain significant levels of organics and the harvested minerals are naturally white. Compass adds bleach to the process to achieve this same whiteness artificially. Unfortunately, the addition of chlorine bleach releases VOCs and organic HAPs.

13.1 Available Controls

Although there are no demonstrated controls, Compass examined[7] inherently lower-emitting processes and practices as well as add-on controls that are not yet demonstrated as part of the Step 1 process:

1. Installation of a multi-effect evaporator to lower the boiling point of the desired concentration brine below the temperatures at which HCl and the organics form.
2. Utilize microfiltration (<0.02 micron) to remove organics from the feed brine before heating.
3. condensation of the exhaust plume, treatment via a scrubber system to neutralize the pH, carbon absorption to remove the organics from the collected waste stream, and then disposal of the waste water.
4. Use of chlorine alternatives as an oxidizing agent instead of bleach.
5. Limit the amount of excess bleach.

13.2 Evaluation of Technical Feasibility of Available Controls

In evaluating the technical feasibility of the available controls, UDAQ needed to defer to Compass' expertise, as no other sources with similar processes are located in the US, and limited information is available for the only other source located overseas.

For those items identified as available in the previous step, Compass provided the following additional information[8]:

1. 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, in which the brine is heated concurrently in two evaporators at higher temperatures. 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. The Dead Sea process utilizes a multi-effect evaporator, but it is not for the purpose of controlling HCl and/or organic emissions. Compass has tested a bench scale version of this process, but it has not yet been demonstrated in practice and is not considered commercially available or technically feasible at this time.

7 see References: Item #15
8 see References: Item #15

2. This would substantially reduce the amount of chloroform, formaldehyde, and methanol emitted, but would have no impact upon HCl emissions. Some bleach would still be required, but much less. Although HCl is not a VOC and thus not addressed by the $PM_{2.5}$ SIP (as HAP emissions are not a precursor), Compass does not wish to pursue a process that does not solve both the VOC and HAP issues, as ultimately the HAP issue will still remain as an NSR permitting concern.
3. Because federal water quality standards prohibit the discharge of wastewater from saline brine processing, the wastewater would need to be disposed using a lined, permitted, evaporation pond. Based on engineering calculations, this would require a disposal pond of approximately 19 acres, which Compass currently does not have the space to construct. The process has also not been demonstrated in practice, and is not considered technically feasible at this time.
4. Alternatives to chlorine bleach (peroxides, percarbonates, persulfates, ozone) would produce unwanted byproducts and dark flake. The naturally "dark" flake has been proven in the consumer marketplace as unacceptable and rejected by consumers. Several non-chlorine bleaches were evaluated. Some were eliminated due to increased employee safety risks or because they added an unacceptable level of complexity to the process. None of the remaining non-chlorine bleach options produced white flake. This option was eliminated by Compass due to its inability to result in an acceptable product.
5. Testing has demonstrated that this option is not effective in limiting the amount of VOCs or HAPs generated during the process. This option is also eliminated from further consideration.

13.3 Evaluation and Ranking of Technically Feasible Controls

N/A, all available control options have been eliminated from consideration as none are technically feasible.

13.4 Further Evaluation of Most Effective Controls

Technically, N/A. Compass is still evaluating technical options and investigating mechanisms for potentially controlling VOC and HAP emissions from this process. Currently, emissions remain uncontrolled.

13.5 Selection of BACT

None, no control options remain viable. UDAQ recommends a limit on VOC emissions from the MgCL2 evaporators while VOC mitigation investigations are ongoing. This recommended limit is as follows:

Emissions of VOC from all Magnesium Chloride Evaporators (four stacks total) shall not exceed 9.27 lb/hr

14.0 BACT for Defoaming Operations

Foam occurs in the K_2SO_4 process due to natural sources in the feed salt, process water and reagents in the flotation process. Foam inhibits the SOP production process by causing filtration issues and solid-liquid separation issues in the thickeners. To mitigate foaming, a specially formulated liquid which contains up to 60% volatile organic compounds (VOCs) is dosed into slurry and brine streams. The process slurries are introduced to a series of thickeners, ranging from 60 ft. to 230 ft. in diameter, in order to separate the solids from the liquor, in each thickener step. The center "well" of the thickener is connected to four large rake structures that rotate and scrape settled solids off the thickener floor to the center where they are pumped to the next process stage. A majority of the fugitive VOCs generated by the defoamer additive are released at the thickener process.

14.1 Available Controls

As with the bleaching process discussed in section 13.1, there are no processes similar to this to be found in a search of the RBLC or other state agency databases. Compass again needed to investigate[9] inherently lower-emitting processes and practices as well as not yet demonstrated add-on controls in this step.

1. Replacement of the currently used defoaming agent with commercially available defoaming agents which do not contain VOCs.
2. VOC capture and control.

14.2 Evaluation of Technical Feasibility of Available Controls

For those items identified as available in the previous step, Compass provided the following additional information[10]:

1. The effects of the use of such chemicals in the SOP process are unknown and would require process testing prior to implementation to ensure that use of an alternative defoaming agent is technically feasible as part of the Compass process. This process is potentially feasible.
2. The defoamer is primarily fed to control foam at Thickener #1 and the liquor and slurries travel from this thickener throughout the plant. VOCs are emitted at various points of the SOP process as fugitive emissions. Initial emissions occur at ambient conditions in the plant thickeners, primarily thickener #1 which is 230 ft. diameter. Currently this option is not technically feasible, given the size of Thickener #1.

14.3 Evaluation and Ranking of Technically Feasible Controls

Option #1 is technically feasible; however, it is not yet demonstrated in practice. Compass is currently evaluating commercially available low-VOC defoaming agents. None have been bench tested for the SOP process, nor demonstrated on a SOP production scale. Effectiveness of alternative defoaming agents must be tested in consideration of the plant chemistry, liquor temperature, ambient temperature, etc. Therefore, Option 1 is excluded from further BACT review at this time.

14.4 Further Evaluation of Most Effective Controls

Technically, N/A. Compass is still evaluating technical options and investigating mechanisms for potentially controlling VOC emissions from this process. Currently, emissions remain uncontrolled.

14.5 Selection of BACT

None, no control options remain viable.

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9 see References: Item #15
10 see References: Item #15

15.0 Additional Feasible Measures and Most Stringent Measures

15.1 Extension of SIP Analysis Timeframe

As outlined in 40 CFR 51.1003(b)(2)(iii):

If the state(s) submits to the EPA a request for a Serious area attainment date extension simultaneous with the Serious area attainment plan due under paragraph (b)(1) of this section, such a plan shall meet the most stringent measure (MSM) requirements set forth at § 51.1010(b) in addition to the BACM and BACT and additional feasible measure requirements set forth at § 51.1010(a).

Thus, with the potential for an extension of the SIP regulatory attainment date from December 31, 2019 to December 31, 2024, the SIP must consider the application of both Additional Feasible Measures (AFM) and Most Stringent Measures (MSM).

15.2 Additional Feasible Measures at Compass

As defined in Subpart Z, AFM is any control measure that otherwise meets the definition of "best available control measure" (BACM) but can only be implemented in whole or in part beginning 4 years after the date of reclassification of an area as Serious and no later than the statutory attainment date for the area. The Salt Lake City Nonattainment Area was reclassified as Serious on June 9, 2017. Therefore, any viable control measures that could only be implemented in whole or in part beginning 6/9/2021 (4 years after the date of reclassification) are classified as AFM.

After a review of the available control measures described throughout this evaluation report, UDAQ was unable to identify any additional control measures that were eliminated from BACT consideration due to extended construction or implementation periods. Although there are some instances where technologies or control systems were removed from further consideration based on a lack of commercial or technological development, such as EMx™ or NO_x absorber systems, there is no evidence to suggest that these systems will become viable for application merely by waiting 4 years. In addition, existing BACT controls on the emitting units where these alternative controls might have been applied will achieve the same or potentially greater levels of emission reduction; thus rendering the hypothetical discussion moot.

Compass is investigating potential VOC controls at the $MgCl_2$ Extraction Plant and at Defoaming Operations, but the fate of these investigations is unknown at this time. It is possible that a solution will be found allowing for mitigation of VOC emissions from these operations, but the likelihood of this occurring before the regulatory attainment date is slim. Should the attainment date be extended (see Most Stringent Measures in Section 15.3 below) these investigations may be of more importance.

15.3 Most Stringent Measures at Compass

As defined in Subpart Z, MSM is defined as:

… any permanent and enforceable control measure that achieves the most stringent emissions reductions in direct $PM_{2.5}$ emissions and/or emissions of $PM_{2.5}$ plan precursors from among those control measures which are either included in the SIP for any other NAAQS, or have been

achieved in practice in any state, and that can feasibly be implemented in the relevant $PM_{2.5}$ NAAQS nonattainment area.

This is further refined and clarified in 40 CFR 51.1010(b), to include the following Steps:

Step 1) The state shall identify the most stringent measures for reducing direct $PM_{2.5}$ and $PM_{2.5}$ plan precursors adopted into any SIP or used in practice to control emissions in any state.
Step 2) The state shall reconsider and reassess any measures previously rejected by the state during the development of any previous Moderate area or Serious area attainment plan control strategy for the area.
Step 3) The state may make a demonstration that a measure identified is not technologically or economically feasible to implement in whole or in part by 5 years after the applicable attainment date for the area, and may eliminate such whole or partial measure from further consideration.
Step 4) Except as provided in Step 3), the state shall adopt and implement all control measures identified under Steps 1) and 2) that collectively shall achieve attainment as expeditiously as practicable, but no later than 5 years after the applicable attainment date for the area.

15.3.1 Step 1 – Identification of MSM

For purposes of this evaluation report UDAQ has identified for consideration the most stringent methods of control for each emission unit and pollutant of concern ($PM_{2.5}$ or $PM_{2.5}$ precursor). A summary is provided in the following table:

Table 15-1: Most Stringent Controls by Emission Unit

Emission Unit	Pollutant	Most Stringent Control Method
Material Dryers	$PM_{2.5}$	fabric filtration, wet scrubbers
	SO_2	use of natural gas
	NO_x	SCR
	VOC	use of natural gas
Boilers #1 and #2	$PM_{2.5}$	GCP, proper burner design, natural gas
	SO_2	use of natural gas
	NO_x	SCR
	VOC	oxidation catalysts

The above listed controls represent the most stringent level of control identified from all other state SIPs or permitting actions, but do not necessarily represent the final choice of MSM. That is determined in Step 4. Those smaller source primarily covered by UDAQ's $PM_{2.5}$ Serious SIP - BACT for Small Sources are not included in the above table. Also not included are the $MgCl_2$ Evaporation Plant or the Defoaming Operations, as neither process resulted in viable controls, and no viable controls were discovered for any similar process in any other database, either federal or state.

15.3.2 Step 2 – Reconsideration of Previous SIP Measures

Utah has previously issued a SIP to address the moderate $PM_{2.5}$ nonattainment areas of Logan, Salt Lake City, and Provo. The SIP was issued in parts: with the section devoted to the Logan nonattainment area being found at SIP Section IX.A.23, Salt Lake City at Section IX.A.21, and Provo/Orem at Section IX.A.22. Finally, the Emission Limits and Operating Practices for Large Stationary Sources, which includes the application of RACT at those sources, can be found in the

SIP at Section IX Part H. Limits and practices specific to $PM_{2.5}$ may be found in subsections 11, 12, and 13 of Part H.

Accompanying Section IX Part H was a Technical Support Document (TSD) that included multiple evaluation reports similar to this document for each large stationary source identified and listed in each nonattainment area. UDAQ conducted a review of those measures included in each previous evaluation report which contained emitting units which were at all similar to those installed and operating at the LSPP.

There were several technologies that had been eliminated from further consideration at some point during many of the previous reviews. Some emitting units were considered too small, or emissions too insignificant to merit further consideration at that time. The cost effectiveness considerations may have been set at too low a threshold (a question of cost in RACT versus BACT). And many cases of technology being technically infeasible for application – such as applying catalyst controls to infrequently used emitting units which may never reach an operating temperature where use of the catalyst becomes viable and effective.

In all but one case, these rejected control technologies were already brought forward and re-evaluated using updated information (more recent permits, emission rates and cost information) by the Compass plant in its BACT analysis report. The one case which was not reconsidered was the deferment of VOC controls for the wastewater treatment systems at four Salt Lake City area refineries. This issue does not apply at Compass. Although some amount of water treatment does take place, this is for pre-treatment of the water used in the boilers, and cooling towers and not wastewater treatment in the traditional sense. Thus, there are no additional technologies identified in Step 2.

15.3.3 Step 3 – Demonstration of Feasibility

A control technology or control strategy can be eliminated as MSM if the state demonstrates that it is either technically or economically infeasible.

This demonstration of infeasibility must adhere to the criteria outlined under §51.1010(b)(3), in summary:

1) When evaluating technological feasibility, the state may consider factors including but not limited to a source's processes and operating procedures, raw materials, plant layout, and potential environmental or energy impacts
2) When evaluating the economic feasibility of a potential control measure, the state may consider capital costs, operating and maintenance costs, and cost effectiveness of the measure.
3) The SIP shall include a detailed written justification for the elimination of any potential control measure on the basis of technological or economic infeasibility.

This evaluation report serves as written justification of technological or economic feasibility/infeasibility for each control measure outlined herein. Where applicable, the most effective control option was selected, unless specifically eliminated for technological or economical infeasibility. Expanding on the previous table, the following additional information is provided:

Table 15-2: Feasibility Determination

Emission Unit*	Pollutant	MSM Previously Identified	Is Method Feasible?

Material Dryers	$PM_{2.5}$	fabric filtration, wet scrubbers	Yes
	SO_2	use of natural gas	Yes
	NO_x	SCR	No, chemical issues
	VOC	use of natural gas	No, high cost
Boilers #1 and #2	$PM_{2.5}$	GCP, proper burner design, natural gas	Yes
	SO_2	use of natural gas	Yes
	NO_x	SCR	No, chemical issues
	VOC	oxidation catalysts	Yes

Many of the entries in the above table were determined to be feasible on both a technological and economic basis. In each of those cases, the control technique listed represents BACT/BACM as well as MSM, so no changes need to take place if implementation of MSM becomes a requirement. For the remaining entries, a more detailed analysis is required.

Boilers #1 and #2 VOC control: The installation of oxidation catalysts was determined to be infeasible for boilers of this size and emission rate. While some VOC reductions can be achieved from the installation of catalytic control, such control has been shown to come with a control cost of over $200,000/ton of VOC reduced. This is well outside of standard BACT economic feasibility. The existing BACT evaluation should also serve as MSM. Should the installation of MSM be required at a future date due to monitored nonattainment concerns, this issue can be revisited.

16.0 New $PM_{2.5}$ SIP – General Requirements

The general requirements for all listed sources are found in SIP Subsection IX.H.11. These serve as a means of consolidating all commonly used and often repeated requirements into a central location for consistency and ease of reference. As specifically stated in subsection IX.H.11.a below, these general requirements apply to all sources subsequently listed in either IX.H.12 (Salt Lake City) or IX.H.13 (Provo), and are in addition to (and in most cases supplemental to) any source-specific requirements found within those two subsections.

16.1 Monitoring, Recordkeeping and Reporting

As stated above, the general requirements IX.H.11.a through IX.H.11.f primarily serve as declaratory or clarifying conditions, and do not impose compliance provisions themselves. Rather, they outline the scope of the conditions which follow in the source specific requirements of IX.H.12 and IX.H.13.

For example, most of the conditions in those subsections include some form of short-term emission limit. This limitation also includes a compliance demonstration methodology – stack test, CEM, visible opacity reading, etc. In order to ensure consistency in compliance demonstrations and avoid unnecessary repetition, all common monitoring language has been consolidated under IX.H.11.e and IX.H.11.f. Similarly, all common recordkeeping and reporting provisions have been consolidated under IX.H.11.c.

17.0 New $PM_{2.5}$ SIP – Compass Specific Requirements

The Compass specific conditions in Section IX.H.12 address those limitations and requirements that apply only to the Compass Minerals Ogden facility in particular.

IX.H.12.e.i This condition lists the specific requirements applicable to Boilers #1 and #2.

The new concentration limits of 12 ppm and mass limits of 1.6 lb/hr are listed in this section. A paragraph explaining that compliance shall be determined by stack test once every three years as outlined in IX.H.11.e. is also included.

IX.H.12.e.ii This condition lists the filterable and condensable $PM_{2.5}$ limits that apply to sources able to be tested for condensable $PM_{2.5}$.

Those sources with baghouse (fabric filtration) controls can be tested for both filterable and condensable $PM_{2.5}$. The limits are given as lb of $PM_{2.5}$ hr, with compliance to be determined by stack test once every three years. The sources are listed by unit number as the generic name has caused confusion in the past.

IX.H.12.e.iii This condition lists the filterable $PM_{2.5}$ limits that apply to those sources that cannot be tested for condensable $PM_{2.5}$.

Those sources with wet scrubber controls cannot be tested for condensable $PM_{2.5}$, as the wet stack makes use of Method 202 impossible. Instead the source must use Method 5, which captures only filterable particulate. The limits are given as lb of $PM_{2.5}$ hr, with compliance to be determined by stack test once every three years. The sources are listed by unit number as the generic name has caused confusion in the past.

IX.H.12.e.iv Emissions of VOC from all Magnesium Chloride Evaporators (four stacks total) shall not exceed 9.27 lb/hr

This is the recommended limit from Section 13 of this review. Compliance is outlined in subparagraphs A and B as follows:

A. Compliance shall be determined by stack test as outlined in Section IX Part H.11.e of this SIP. Compliance testing shall be performed at least once every three years.

B. Process emissions shall be routed through operating controls prior to being emitted to the atmosphere.

17.1 Monitoring, Recordkeeping and Reporting

Monitoring for IX.H.12.e.i. is specifically outlined in IX.H.12.e.i.; IX.H.12.e.ii. is addressed in IX.H.12.e.ii.; etc. All stack testing requirements are found in IX.H.11.e. Recordkeeping is subject to the requirements of IX.H.11.c.

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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.

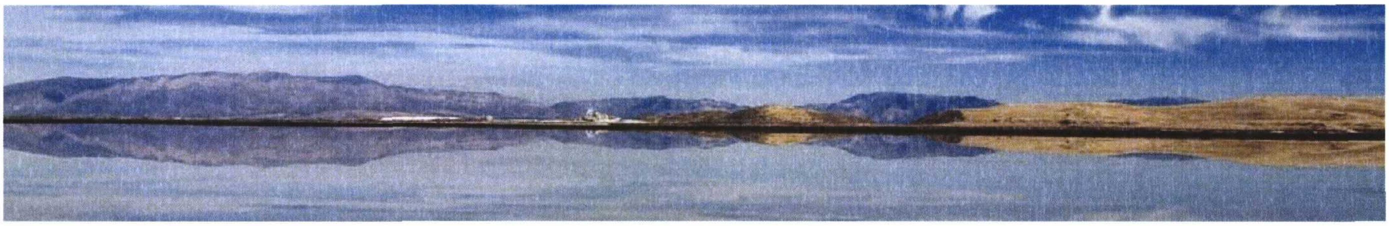
If you should have any questions regarding this submittal or require additional information, feel free to contact Chris Freeman, Environmental Engineer, at (801) 732-3251.

Sincerely,

Barbara Hazard
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

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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**
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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.

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.

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

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 **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.

BACT OPTIONS TABLE 1.03 NH3 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		
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.

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.

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.

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

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.

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.

Item # 2.01 **SOP Dryer D-1545 / AH-1547** **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
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.

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.

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 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

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

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.

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.

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.

BACT OPTIONS TABLE 2.07 SOx STEPS 1-5

Item # 2.07 **SOP Dryer D-1400 / BH-1400** **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

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.

BACT OPTIONS TABLE 2.07 NOx STEPS 1-5

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 $\leq$ 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 2.07 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.

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.

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

Control Option	Percent Control		LB/MMBTU		Comment	Efficiency Rank
	Min	Max	Min	Max		
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.

Item # 2.09 **Submerged Combustion SUB** **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
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.

Item # 2.09 **Submerged Combustion SUB** **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 2.09 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

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		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
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.

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.

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.

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.

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

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.

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

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.

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.

BACT OPTIONS TABLE 4.01 NOx STEPS 1-5

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 ≤ 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 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 4.01 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. 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 4.02 PM2.5 STEPS 1-5

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		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 4.02 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.

BACT OPTIONS TABLE 4.02 NOx STEPS 1-5

Item # 4.02 **Natural Gas Boiler 2** **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 ≤ 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		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 4.02 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.

5.01 - 5.06 **Emergency Engines**

	0.7457 kW per HP				Efficiency
Item #	kW	HP	EPA Tier	Comment	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. Not demonstrated for 6,000 gallon tanks.	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. Not applicable.	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.

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 frequency 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)		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

Item			Amount	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

Item			Amount	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)

Item			Amount	Notes
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)

Item			Amount	Notes
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

Item			Amount	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)

Item			Amount	Notes
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)

Item			Amount	Notes
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

Item			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)

Item			Notes
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)

Item			Notes
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

Item		Cost	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)

Item		Cost	Notes
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)

Item		Cost	Notes
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

Item			Cost	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)

Item			Cost	Notes
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)

Item			Cost	Notes
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

Item			Amount	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)

Item			Amount	Notes
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

Item			Amount	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)

Item			Amount	Notes
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)

Item			Amount	Notes
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

Item			Amount	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)

Item			Amount	Notes
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)

Item			Amount	Notes
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				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

Item			Amount	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)

Item			Amount	Notes
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
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

	QUESTAR TOTAL SULFUR RECORD FOR 2016		
	Ave. ppm	Min. ppm	Max. ppm
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

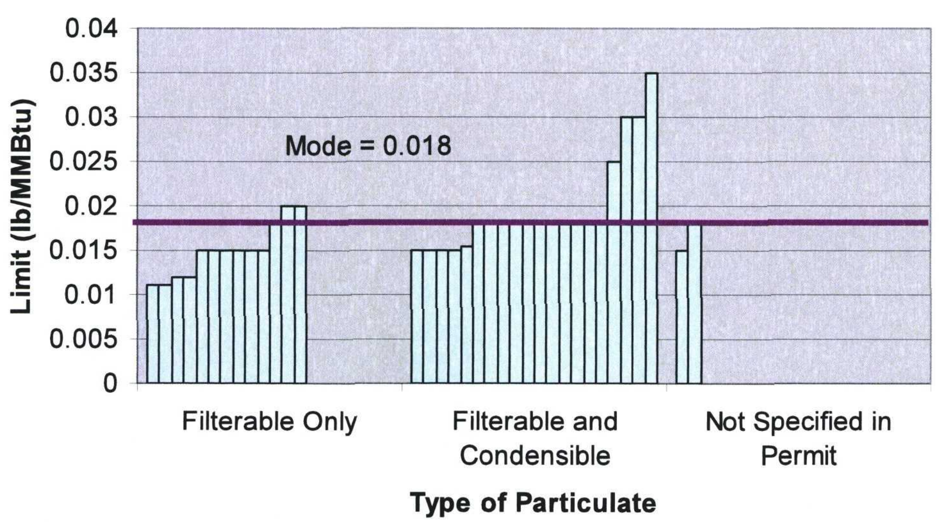

Table 1. Particulate Limits for Recently Permitted Coal-Fired Boilers.

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

Compass Minerals Ogden Inc.

765 North 10500 West, Ogden, UT 84404

Title V Permit Number 5700001003

Response to Comments
Site-Wide BACT Analyses for PM2.5 and Precursors

Prepared by Strata, LLC

May 9, 2018

Contents

1. Overview

Compass Minerals Ogden Inc. (Compass Minerals) owns and operates a facility 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 Minerals 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 Minerals allows emissions of more than 70 tpy for PM2.5 and/or PM2.5 precursors, therefore the Compass Minerals 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 Minerals 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.

Compass Minerals submitted the above information, per the DAQ site-wide BACT request in May 2017. The document included a BACT analysis for all significant point and fugitive sources known at the site to emit PM2.5 or precursors.

On June 30, 2017, Compass Minerals received correspondence (via e-mail) from DAQ requesting additional information in some areas to bolster the depth of the technical support documentation prior to inclusion of that information in the State Implementation Plan (SIP). Based on this correspondence Compass Minerals revised and resubmitted in March 2018, the relevant sections of its previous submittal. Since that time DAQ has provided further input and clarifications, requiring further revisions to the previous submittals. Compass Minerals provides the following to describe its response to the request for additional information.

1) The revised BACT analysis follows the "Top-Down" approach as described in Section 3. Existing controls are included in Step 1 of each analysis. Where the existing control is identified as the only technically feasible control option in Step 2 or the highest ranked control option in Step 3, then the existing control is determined as BACT.
2) If a technically feasible, more effective (compared to the existing technology) control option is identified in Step 3, an economic analysis is provided in Step 4. The economic analysis uses the potential PM2.5 and PM2.5 precursor emissions reduction and the cost of the more effective and technically feasible control option. The economic analysis is presented to reflect the cost per ton of **additional** control gained over the existing control of potential emissions.
3) Where an add-on control is capable of controlling two or more pollutants (PM2.5/PM2.5 precursors) at once, the cost to control the aggregated pollutants are analyzed instead of individual pollutant emissions.

4) Compass Minerals is planning process improvements to its sulfate of potash (SOP) compaction process. Modifications related to that project are included in this site-wide BACT analysis, and will be detailed in a future notice of intent to be submitted to DAQ.

The contact person for this BACT:

Barbara J. Menard, VP Environmental, Health, Safety & Security
Compass Minerals Ogden, Inc.
913-344-9236
MenardB@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 or 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 schoenite 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 the 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. Pending modifications to the Compass Minerals facility, as well as pending permit actions aimed at updating and clarifying emissions at Compass Minerals, are included in this BACT analysis.

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 material handling and 2/3 of exhaust flow from the fluidized bed cooler with cyclone	P
1.02	II.A.4	SALT	AH-502	Salt Plant Circuit	AH-502	Cyclonic wet scrubber	Salt material handling and screening operations	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)	Salt dryer D501 material handling and D501 burner natural gas combustion emissions	P
1.04	II.A.19	SALT	F-506	Salt Cooler	BH-501	Baghouse	Approx. 1/3 of fluidized bed salt cooler exhaust flow (other 2/3 routed to AH502)	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	Pending NOI	SALT	SALT OMH	SALT outdoor uncaptured, unenclosed, and uncontrolled 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 identified in July NOI and amendments.	F/P
1.07	Pending NOI	SALT	SALT EMH	SALT material handling sources controlled by full enclosures, partial enclosures, and/or building enclosures.			Material handling equipment identified in July NOI and amendments.	F/P
1.08	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
1.09	Pending NOI	SALT	BH-503	Salt Special Products Circuit	BH-503	Baghouse	Mineral feeder assembly and super sack bagger	P
1.10	Pending NOI	SALT	BH-505	Salt Packaging Circuit	BH-505	Baghouse that exhausts back into the building	Controls specific hoppers, baggers, feeders	P

Item #	Permit ID	Area	EU ID	EU Description	Control ID	Control Description	Comment	*P or F
2.01	Pending NOI	SOP	D-1545	SOP Dryer D-1545	BH-1545	Baghouse w/ Cyclone & LNB; Permit Cond. II.B.1.c. (nat gas fuel)	SOP dryer D1545 material handling and burner natural gas combustion emissions	P
2.02	II.A.10; Pending NOI	SOP	AH-1555	SOP Plant Compaction Building (Wet)	AH-1555	Wet scrubber	Wet SOP material handling; Emission sources with high moisture content that may blind baghouse bags. As part of pending NOI, sources routed to this control device to be reduced.	P
2.03	II.A.11	SOP	B-1520	Nat gas process heater (7 mmBtuh; limited to 5 mmBtuh)	AH-1555	Wet scrubber; Permit Cond. II.B.1.c. (nat gas fuel)	Curing belt heater	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	Pending NOI	SOP	BH-019	Bin 19 vent cartridge filter	BH-019	Fabric Filter	SOP bins/hoppers	P
2.07	Pending NOI	SOP	BH-1505	Bin 1505 vent cartridge filter	BH-1505	Fabric Filter	SOP bins/hoppers	P
2.08	Pending NOI	SOP	BH-1510	Bin 1510 vent cartridge filter	BH-1510	Fabric Filter	SOP bins/hoppers	P
2.09	Pending NOI	SOP	BH-1565	SOP Compaction Recycle Hopper Bin Vent	BH-1565	Fabric Filter	SOP bins/hoppers	P
2.10	II.A.7; Pending NOI	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)	SOP dryer D1400 material handling and burner natural gas combustion emissions. As part of pending NOI, additional material handling emissions to be routed to BH-1400.	P

Item #	Permit ID	Area	EU ID	EU Description	Control ID	Control Description	Comment	*P or F
2.11	Pending NOI	SOP	BH-NEW	SOP Plant Compaction Building (Dry)	BH-NEW	Cyclone and Baghouse for PM	Dry SOP material handling re-routed from AH-1555	P
2.12	Pending NOI	SOP	Dust Torits	SOP Enclosed Material Handling Sources	Dust Torits	Source-specific Cartridge Filter Vents for PM	Individually controlled, enclosed SOP material handling sources vented through cartridge filters	P
2.13	Pending NOI	SOP	DeFoam	SOP Defoamer	No Control	None	Potential emission source due to evaporation of VOCs from Wet SOP defoamer	P
2.14	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)	SC-450, 450 and SC-461, 462	P
2.15	II.A.26	SOP	SOP CT	Cooling Towers (SOP)	DE	Drift eliminators		F
2.16	Pending NOI	SOP	SOP OMH	SOP outdoor uncaptured, unenclosed, and uncontrolled 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 identified in July NOI and amendments.	F/P
2.17	Pending NOI	SOP	SOP EMH	SOP material handling sources controlled by full enclosures, partial enclosures, and/or building enclosures.	BL003 BL004 BL006 NCB	Inside a building; Permit Cond. II.B.1.g regarding limitations on visible emissions caused by fugitive dust.	Material handling equipment identified in July NOI and amendments.	F/P
2.18	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

Item #	Permit ID	Area	EU ID	EU Description	Control ID	Control Description	Comment	*P or 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	Pending NOI	MAG	EVAP	MgCl2 plant evaporators venting through 4 stacks	No Control	None	MgCl2 evaporators identified in July NOI.	P
3.03	II.A.24	MAG	MAG CT	MgCl2 plant cooling tower	DE	Drift eliminators		F
3.04	Pending NOI	MAG	MAG EMH	MAG material handling sources controlled by full enclosures, partial enclosures, and/or building enclosures.	BL600	Permit Cond. II.B.1.g regarding limitations on visible emissions caused by fugitive dust.	Material handling equipment identified in July NOI.	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

Item #	Permit ID	Area	EU ID	EU Description	Control ID	Control Description	Comment	*P or F
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	July 2017 NOI	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
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
5.07	Pending NOI	MISC	CS Gen	20 kW emergency generator, Propane	Eng Controls	NSPS engine controls, as applicable	Near Customer Service Center	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.*

3. Emission Estimates (PTE)

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.

Where PM2.5-specific emission factors were unavailable, Compass Minerals estimated emissions 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. Compass Minerals utilized source-specific particle size distribution data if available in AP-42 or its appendices.

Literature reference pertaining to the control efficiency of PM provided by full enclosures is typically not specific to PM2.5. Reference documents reviewed by Compass Minerals 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 Minerals has conservatively estimated the control efficiency of PM2.5 by full enclosures to be approximately 75%. Based on the same reasoning expressed for full enclosures, Compass Minerals has estimated a 25% PM2.5 control efficiency from partial enclosures and a 40% PM2.5 control efficiency for buildings.

Where material is present in a liquid slurry, no emissions are expected. Material hauled from evaporation ponds is approximately 10-20% moisture by weight. It is assumed that such moisture inherently provides 99% control due to site observations, best engineering judgement, and the hygroscopic nature of salts.

Emergency engines and process upset chutes were assumed to operate no more than 500 hours per year.

4. Recent Permitting Analyses

There have been several permitting actions during recent years that included BACT analyses. These are described in Table 4.1.

Table 4.1. 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 Thickener 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	
Pending NOI	Pending NOI Submittal	Mag Chloride Plant Evaporators; Uncontrolled Material Handling Sources; PTE Corrections; Modified Emission Limits for D-1400/BH-1400; Add BH-1545, BH-NEW, BH-019, BH-1505, BH-1510, BH-1565, Dust Torits, emergency generators; Isolation of wet SOP sources to AH-1555; Re-route BH-503 and BH-505 to atmosphere; Add SOP Fresh Feed System; Replace Cam Belts; Add SOP Recycle System	Included in this site-wide BACT analysis	AH-1547

5. BACT Analysis Methodology

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.

6. 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.) Where an add-on control is capable of controlling two or more pollutants (PM2.5/PM2.5 precursors) at once, the cost to control the aggregated pollutants are analyzed instead of individual pollutant emissions.

Existing controls that have already been implemented pursuant to previous BACT analyses are considered as available controls in Step 1 and 2 of the BACT analysis. If the existing control is identified, in Step 3, as the highest ranking technically feasible control, then the existing control is determined as BACT. Otherwise, to review the cost effectiveness of applying a more effective technology, Step 4 of the BACT analysis relies on potential emissions reduction between the existing control and the more effective control option, calculating the cost per ton of reductions beyond the existing control.

General presumptions:

1) Where the most effective control technology, in regard to efficiency and cost was determined to not be economically feasible (most often a fabric filter baghouse or cartridge filter control device), additional control technology that were equally or less efficient, but more expensive, were not evaluated.
2) Tier 3 or 4 internal combustion engine technology is presumed to be BACT.
3) Due to the hygroscopic nature of salts, where sodium chloride, magnesium chloride, and/or SOP is wet or

contains moisture, further control is not considered because PM2.5 emissions from these processes are de minimis and meaningful further reductions would be precluded by difficulties associated collecting and controlling this wet material.

4) Groupings of equipment under the EMH and OMH categories are based on spatial relationship and proximity. It is conservatively assumed that these groupings are close enough spatially to allow for one common control device to collect and control emissions from the group.
5) Screw conveyors in the EMH category located in baghouse chambers for the purpose of removing controlled particulate from baghouse hoppers were not included in EMH groups due to the inherent design and purpose of the screws. Attempts to “control” emissions from such screws will cause air-flow imbalance in the baghouse chamber and likely re-entrainment of controlled particulate.
6) Total capital investment figures are not based on detailed engineering designs. Costs were estimated based on similarly constructed controls at the facility, factoring increases in costs of structural steel, capacity assumptions, etc. Direct cost increases (operation and maintenance) of proposed controls vs. existing controls were similarly estimated, as applicable. Total capital investment and annualized costs will be adjusted, as necessary, as detailed engineering designs are completed for those projects that may require additional control according to the BACT evaluations.

Table 6.1.1. SALT BACT Analyses

STEPS 1-5 PM 2.5 Control Possibilities

Item # 1.01 AH-500 Salt Cooler Circuit

Control Option	Percent Control		GR/DSCF		Comment	Typical Efficiency for this Application	Efficiency Rank
	Min	Max	Min	Max			
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 and is more effective due to high condensibles.***	90	1
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 due to high moisture content. Less efficient than a wet scrubber due to high condensibles.	<90	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. Used in conjunction with above listed controls if necessary to reduce loading.	N/A	NA
Wet ESP	99	99.9	0.01	`	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.	N/A	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.	N/A	NA

STEP 4 and 5:	Cyclonic wet scrubber is the existing control for the source and is more effective due to high condensibles. No further economic analysis is necessary. BACT is selected as the existing wet scrubber system.

STEPS 1-3 PM 2.5 Control Possibilities

Item # 1.02 AH-502 Salt Plant Circuit

Control Option	Percent Control		GR/DSCF		Comment	Typical Efficiency for this Application	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.	99	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.***	90	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. Used in conjunction with above listed controls if necessary to reduce loading.	N/A	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.	N/A	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.	N/A	NA

Information for Economic Analysis		Description
EU ID	AH-502	Salt Plant Circuit
Existing Control	AH-502	Wet Scrubber (Venturi)
Alternate Control		Cyclone w/ Baghouse or Cartridge Filter
Interest Rate (i)	7.0%	Interest rate at which the company can borrow money.
Useful Life (n)	20	Estimated useful life of the new control equipment being considered.

POLLUTANTS TO BE CONTROLLED	Uncontrolled PTE	Existing Capture Efficiency	Existing Control Efficiency	New Capture Efficiency	New Control Efficiency	Existing PTE	New PTE
PM2.5 (Filterable)	5.04			100%	99%	0.49	0.05
PM2.5 (Condensible)							
Total PM2.5	5.04					0.49	0.05
SOx							
NOx							
VOC							
NH3							
Total Pollutants	5.04					0.49	0.05

Total Capital Investment (TCI)	Capital Recovery Factor (CRF) [i*(1+i)^n]/[(1+i)^n - 1]	Annual Capital Recovery Cost (CRC) (TCI x CRF)	Increased Annual O&M (DC)*	Other Indirct Costs (ID) (4% x TCI)	Total Annual Cost (TAC) (CRC+DC+ID)	Emission Reduction - TPY (ER)	Cost Per Ton (TAC/ER)
$ 568,000.00	0.0944	$ 53,615.18	$ -	$ 22,720.00	$ 76,335.18	0.43	$ 175,644.69

*DC only considered if there is an increase in direct costs (raw material, maintenance, labor, energy, etc.) compared to existing controls.

Total Capital Investment (TCI)	Capital Recovery Factor (CRF) [i*(1+i)^n]/[(1+i)^n - 1]	Annual Capital Recovery Cost (CRC) (TCI x CRF)	Increased Annual O&M (DC)*	Other Indirct Costs (ID) (4% x TCI)	Total Annual Cost (TAC) (CRC+DC+ID)	Emission Reduction - TPY (ER)	Cost Per Ton (TAC/ER)
$ 156,000.00	0.0944	$ 14,725.30	$ -	$ 6,240.00	$ 20,965.30	0.43	$ 48,240.44

*DC only considered if there is an increase in direct costs (raw material, maintenance, labor, energy, etc.) compared to existing controls.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

The existing wet scrubber control consumes fresh water and generates wastewater. Replacement with a baghouse would reduce the fresh water resource use and decrease wastwater generation.

STEP 4: The cyclone with baghouse or cartridge filter is the most efficient control for this source and is evaluated to be economically infeasible.

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

STEPS 1-5 PM 2.5 Control Possibilities

Item # 1.03 D-501 Salt Dryer

Control Option	Percent Control		GR/DSCF		Comment	Typical Efficiency for this Application	Efficiency Rank
	Min	Max	Min	Max			
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 and is more effective due to high condensibles.***	90	1
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 due to high moisture content. Less efficient than a wet scrubber due to high condensibles.	<90	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. Used in conjunction with above listed controls if necessary to reduce loading.	N/A	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.	N/A	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.	N/A	NA

STEP 4 and 5:	Cyclonic wet scrubber is the existing control for the source and is more effective due to high condensibles. No further economic analysis is necessary. BACT is selected as the existing wet scrubber system.

STEPS 1-5 SOx Control Possibilities

Item # 1.03 D-501 Salt Dryer

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

STEPS 1-5 NOx Control Possibilities

Item # 1.03 D-501 Salt Dryer

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 4 and 5:	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. BACT is selected as the existing ULNB with FGR and staged combustion principles, plus pipeline quality natural gas, plus good combustion practices.

STEPS 1-5 VOC Control Possibilities

Item # 1.03 D-501 Salt Dryer

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

STEPS 1-5 NH3 Control Possibilities

Item # 1.03 D-501 Salt Dryer

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

STEPS 1-5 PM 2.5 Control Possibilities

Item # 1.04 BH-501 Salt Cooler

Control Option	Percent Control Min	Percent Control Max	GR/DSCF Min	GR/DSCF Max	Comment	Typical Efficiency for this Application	Efficiency 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 the source.***	99	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.	90	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. Used in conjunction with above listed controls if necessary to reduce loading.	N/A	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.	N/A	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.	N/A	NA

STEP 4 and 5:	Baghouse is the existing control for the source and is the most effective demonstrated control. No further economic analysis is necessary. BACT is selected as the existing baghouse system.

STEPS 1-5 PM 2.5 Control Possibilities

Item # 1.05 BH-502 Salt Bulk Loadout

Control Option	Percent Control		GR/DSCF		Comment	Typical Efficiency for this Application	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. ***Cartridge Filter Dust Collector is the existing control for the source.***	99	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.	90	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. Used in conjunction with above listed controls if necessary to reduce loading.	N/A	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.	N/A	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.	N/A	NA

STEP 4 and 5:	Cartridge Filter Dust Collector is the existing control for the source and is the most effective demonstrated control. No further economic analysis is necessary. BACT is selected as the existing Cartridge Filter Dust Collection system.

STEPS 1-3 PM 2.5 Control Possibilities

Item # 1.06 SALT outdoor uncaptured, unenclosed, and uncontrolled

Control Option	Percent Control		GR/DSCF		Comment	Typical Efficiency for this Application	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.	99	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.	90	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. Used in conjunction with above listed controls if necessary to reduce loading.	N/A	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.	N/A	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.	N/A	NA
Drop Height Reduction	NA	NA	NA	NA	Drop height reduction can include enclosures or not.	NA	NA
Enclosure	NA	NA	NA	NA	A building, silo, shroud, etc. around transfer points, drop points, load/unload areas, conveyors, etc.	NA	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	NA
Inherent Moisture Content	NA	NA	NA	NA	Some materials have inherent moisture content, which helps to minimize emissions.	NA	NA
Stabilization: Chemical	NA	NA	NA	NA	Chemicals dust suppressants include salts, lignin sulfonate, wetting agents, latexes, plastics, and petroleum derivatives.	NA	NA
Stabilization: Physical	NA	NA	NA	NA	Water spraying, paving, sweeping, tarping piles, etc.	NA	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	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	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	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	NA

Information for Economic Analysis		Description
EU ID	Salt OMH	SALT Fugitive outdoor uncaptured material handling; Includes Drop to ground between C503 and C506
Existing Control	None	
Alternate Control		Full Enclosure and Ducting to Existing APCE
Interest Rate (i)	7.0%	Interest rate at which the company can borrow money.
Useful Life (n)	20	Estimated useful life of the new control equipment being considered.

POLLUTANTS TO BE CONTROLLED	Uncontrolled PTE	Existing Capture Efficiency	Existing Control Efficiency	New Capture Efficiency	New Control Efficiency	Existing PTE	New PTE
PM2.5 (Filterable)	1.19	0%	0%	100%	99%	1.19	0.01
PM2.5 (Condensible)						0.00	0.00
Total PM2.5	1.19					1.19	0.01
SOx						0.00	0.00
NOx						1.19	1.19
VOC						0.00	0.00
NH3						0.00	0.00
Total Pollutants	1.19					1.19	0.01

Total Capital Investment (TCI)	Capital Recovery Factor (CRF) [i*(1+i)^n]/[(1+i)^n - 1]	Annual Capital Recovery Cost (CRC) (TCI x CRF)	Increased Annual O&M (DC)*	Other Indirct Costs (ID) (4% x TCI)	Total Annual Cost (TAC) (CRC+DC+ID)	Emission Reduction - TPY (ER)	Cost Per Ton (TAC/ER)
$ 250,000.00	0.0944	$ 23,598.23	$ -	$ 10,000.00	$ 33,598.23	1.18	$ 28,519.00

*DC only considered if there is an increase in direct costs (raw material, maintenance, labor, energy, etc.) compared to existing controls.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

STEP 4:	An enclosure with ducting to existing APCE is the most efficient control for this source and is evaluated to be 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.

STEPS 1-3 PM 2.5 Control Possibilities

Item # 1.07 **SALT material handling sources controlled by full enclosures, partial enclosures, and/or building enclosures.**

Control Option	Percent Control		GR/DSCF		Comment	Typical Efficiency for this Application	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.	99	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.	90	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. Used in conjunction with above listed controls if necessary to reduce loading.	N/A	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.	N/A	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.	N/A	NA
Drop Height Reduction	NA	NA	NA	NA	Drop height reduction can include enclosures or not.	NA	NA
Enclosure	NA	NA	NA	NA	A building, silo, shroud, etc. around transfer points, drop points, load/unload areas, conveyors, etc.	NA	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	NA
Inherent Moisture Content	NA	NA	NA	NA	Some materials have inherent moisture content, which helps to minimize emissions.	NA	NA
Stabilization: Chemical	NA	NA	NA	NA	Chemicals dust suppressants include salts, lignin sulfonate, wetting agents, latexes, plastics, and petroleum derivatives.	NA	NA
Stabilization: Physical	NA	NA	NA	NA	Water spraying, paving, sweeping, tarping piles, etc.	NA	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	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	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	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	NA

Information for Economic Analysis		Description
EU ID	Salt EMH	SALT EMH Group 1
Existing Control	Enclosure	Full enclosure, partial enclosure, or building enclosure
Alternate Control		Route to AH500
Interest Rate (i)	7.0%	Interest rate at which the company can borrow money.
Useful Life (n)	20	Estimated useful life of the new control equipment being considered.

POLLUTANTS TO BE CONTROLLED	Uncontrolled PTE	Existing Capture Efficiency	Existing Control Efficiency	New Capture Efficiency	New Control Efficiency	Existing PTE	New PTE
PM2.5 (Filterable)	0.90	100%	25-75%	100%	90%	0.29	0.09
PM2.5 (Condensible)						0.00	0.00
Total PM2.5	0.90					0.29	0.090
SOx							
NOx							
VOC							
NH3							
Total Pollutants	0.90					0.287	0.090

Total Capital Investment (TCI)	Capital Recovery Factor (CRF) [i*(1+i)^n]/[(1+i)^n - 1]	Annual Capital Recovery Cost (CRC) (TCI x CRF)	Increased Annual O&M (DC)*	Other Indirct Costs (ID) (4% x TCI)	Total Annual Cost (TAC) (CRC+DC+ID)	Emission Reduction - TPY (ER)	Cost Per Ton (TAC/ER)
$ 750,000.00	0.0944	$ 70,794.69	$ -	$ 30,000.00	$ 100,794.69	0.20	$ 511,648.19

*DC only considered if there is an increase in direct costs (raw material, maintenance, labor, energy, etc.) compared to existing controls.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

STEP 4:	An enclosure with ducting to existing APCE is the most efficient control for this source and is evaluated 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.

Information for Economic Analysis		Description
EU ID	Salt EMH	SALT EMH Group 2
Existing Control	None	
Alternate Control		Route to BH505
Interest Rate (i)	7.0%	Interest rate at which the company can borrow money.
Useful Life (n)	20	Estimated useful life of the new control equipment being considered.

POLLUTANTS TO BE CONTROLLED	Uncontrolled PTE	Existing Capture Efficiency	Existing Control Efficiency	New Capture Efficiency	New Control Efficiency	Existing PTE	New PTE
PM2.5 (Filterable)	0.02	100%	25-75%	100%	99%	2.85E-04	0.00
PM2.5 (Condensible)						0.00	0.00
Total PM2.5	0.02					0.00	0.000
SOx							
NOx							
VOC							
NH3							
Total Pollutants	0.02					0.000	0.000

Total Capital Investment (TCI)	Capital Recovery Factor (CRF) [i*(1+i)^n]/[(1+i)^n - 1]	Annual Capital Recovery Cost (CRC) (TCI x CRF)	Increased Annual O&M (DC)*	Other Indirct Costs (ID) (4% x TCI)	Total Annual Cost (TAC) (CRC+DC+ID)	Emission Reduction - TPY (ER)	Cost Per Ton (TAC/ER)
$ 184,800.00	0.0944	$ 17,443.81	$ -	$ 7,392.00	$ 24,835.81	0.000	$ 261,429,607.13

*DC only considered if there is an increase in direct costs (raw material, maintenance, labor, energy, etc.) compared to existing controls.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

STEP 4:	An enclosure with ducting to existing APCE is the most efficient control for this source and is evaluated 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.

Information for Economic Analysis		Description
EU ID	Salt EMH	SALT EMH Group 3
Existing Control	None	
Alternate Control		Route to AH502
Interest Rate (i)	7.0%	Interest rate at which the company can borrow money.
Useful Life (n)	20	Estimated useful life of the new control equipment being considered.

POLLUTANTS TO BE CONTROLLED	Uncontrolled PTE	Existing Capture Efficiency	Existing Control Efficiency	New Capture Efficiency	New Control Efficiency	Existing PTE	New PTE
PM2.5 (Filterable)	0.11	100%	25-75%	100%	90%	1.70E-02	0.01
PM2.5 (Condensible)						0.00	0.00
Total PM2.5	0.11					0.02	0.011
SOx							
NOx							
VOC							
NH3							
Total Pollutants	0.11					0.017	0.011

Total Capital Investment (TCI)	Capital Recovery Factor (CRF) [i*(1+i)^n]/[(1+i)^n - 1]	Annual Capital Recovery Cost (CRC) (TCI x CRF)	Increased Annual O&M (DC)*	Other Indirct Costs (ID) (4% x TCI)	Total Annual Cost (TAC) (CRC+DC+ID)	Emission Reduction - TPY (ER)	Cost Per Ton (TAC/ER)
$ 200,000.00	0.0944	$ 18,878.59	$ -	$ 8,000.00	$ 26,878.59	0.006	$ 4,715,541.25

*DC only considered if there is an increase in direct costs (raw material, maintenance, labor, energy, etc.) compared to existing controls.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

STEP 4:	An enclosure with ducting to existing APCE is the most efficient control for this source and is evaluated 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.

Information for Economic Analysis		Description
EU ID	Salt EMH	SALT EMH Group 4
Existing Control	None	
Alternate Control		Route to BH503
Interest Rate (i)	7.0%	Interest rate at which the company can borrow money.
Useful Life (n)	20	Estimated useful life of the new control equipment being considered.

POLLUTANTS TO BE CONTROLLED	Uncontrolled PTE	Existing Capture Efficiency	Existing Control Efficiency	New Capture Efficiency	New Control Efficiency	Existing PTE	New PTE
PM2.5 (Filterable)	0.16	100%	25-75%	100%	99%	0.06	0.00
PM2.5 (Condensible)						0.00	0.00
Total PM2.5	0.16					0.056	0.002
SOx							
NOx							
VOC							
NH3							
Total Pollutants	0.16					0.056	0.002

Total Capital Investment (TCI)	Capital Recovery Factor (CRF) [i*(1+i)^n]/[(1+i)^n - 1]	Annual Capital Recovery Cost (CRC) (TCI x CRF)	Increased Annual O&M (DC)*	Other Indirct Costs (ID) (4% x TCI)	Total Annual Cost (TAC) (CRC+DC+ID)	Emission Reduction - TPY (ER)	Cost Per Ton (TAC/ER)
$ 150,000.00	0.0944	$ 14,158.94	$ -	$ 6,000.00	$ 20,158.94	0.054	$ 372,417.12

*DC only considered if there is an increase in direct costs (raw material, maintenance, labor, energy, etc.) compared to existing controls.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

STEP 4:	An enclosure with ducting to existing APCE is the most efficient control for this source and is evaluated 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.

Information for Economic Analysis		Description
EU ID	Salt EMH	SALT EMH Group 3
Existing Control	None	
Alternate Control		Route to BH503
Interest Rate (i)	7.0%	Interest rate at which the company can borrow money.
Useful Life (n)	20	Estimated useful life of the new control equipment being considered.

POLLUTANTS TO BE CONTROLLED	Uncontrolled PTE	Existing Capture Efficiency	Existing Control Efficiency	New Capture Efficiency	New Control Efficiency	Existing PTE	New PTE
PM2.5 (Filterable)	0.38	100%	25-75%	100%	99%	0.11	0.00
PM2.5 (Condensible)						0.00	0.00
Total PM2.5	0.38					0.11	0.004
SOx							
NOx							
VOC							
NH3							
Total Pollutants	0.38					0.110	0.004

Total Capital Investment (TCI)	Capital Recovery Factor (CRF) [i*(1+i)^n]/[(1+i)^n - 1]	Annual Capital Recovery Cost (CRC) (TCI x CRF)	Increased Annual O&M (DC)*	Other Indirct Costs (ID) (4% x TCI)	Total Annual Cost (TAC) (CRC+DC+ID)	Emission Reduction - TPY (ER)	Cost Per Ton (TAC/ER)
$ 287,500.00	0.0944	$ 27,137.97	$ -	$ 11,500.00	$ 38,637.97	0.106	$ 364,509.11

*DC only considered if there is an increase in direct costs (raw material, maintenance, labor, energy, etc.) compared to existing controls.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

STEP 4:	An enclosure with ducting to existing APCE is the most efficient control for this source and is evaluated 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.

Information for Economic Analysis		Description
EU ID	Salt EMH	SALT EMH Group 4
Existing Control	None	
Alternate Control		Route to BH501
Interest Rate (i)	7.0%	Interest rate at which the company can borrow money.
Useful Life (n)	20	Estimated useful life of the new control equipment being considered.

POLLUTANTS TO BE CONTROLLED	Uncontrolled PTE	Existing Capture Efficiency	Existing Control Efficiency	New Capture Efficiency	New Control Efficiency	Existing PTE	New PTE
PM2.5 (Filterable)	0.15	100%	25-75%	100%	99%	0.09	0.00
PM2.5 (Condensible)						0.00	0.00
Total PM2.5	0.15					0.088	0.001
SOx							
NOx							
VOC							
NH3							
Total Pollutants	0.15					0.088	0.001

Total Capital Investment (TCI)	Capital Recovery Factor (CRF) [i*(1+i)^n]/[(1+i)^n - 1]	Annual Capital Recovery Cost (CRC) (TCI x CRF)	Increased Annual O&M (DC)*	Other Indirct Costs (ID) (4% x TCI)	Total Annual Cost (TAC) (CRC+DC+ID)	Emission Reduction - TPY (ER)	Cost Per Ton (TAC/ER)
$ 100,000.00	0.0944	$ 9,439.29	$ -	$ 4,000.00	$ 13,439.29	0.086	$ 156,198.19

*DC only considered if there is an increase in direct costs (raw material, maintenance, labor, energy, etc.) compared to existing controls.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

STEP 4:	An enclosure with ducting to existing APCE is the most efficient control for this source and is evaluated 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.

STEPS 1-5 PM 2.5 Control Possibilities

Item # 1.08 SALT Fugitive salt pile and road dust emissions

Control Option	Percent Control Min	Percent Control Max	GR/DSCF Min	GR/DSCF Max	Comment	Efficiency Rank
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

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

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 4 and 5:	Salt pile and fugitive road dust is not a candidate for add on controls, but rather is best managed through measures identified above. 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.

STEPS 1-5 PM 2.5 Control Possibilities

Item # 1.09 BH-503 Salt Screening Circuit

Control Option	Percent Control Min	Percent Control Max	GR/DSCF Min	GR/DSCF Max	Comment	Typical Efficiency for this Application	Efficiency 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 the source.***	99	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.	90	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. Used in conjunction with above listed controls if necessary to reduce loading.	N/A	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.	N/A	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.	N/A	NA

STEP 4 and 5:	Baghouse is the existing control for the source and is the most effective demonstrated control. No further economic analysis is necessary. BACT is selected as the existing baghouse system.

STEPS 1-5 PM 2.5 Control Possibilities

Item # 1.10 BH-505 Salt Special Products Circuit

Control Option	Percent Control Min	Percent Control Max	GR/DSCF Min	GR/DSCF Max	Comment	Typical Efficiency for this Application	Efficiency 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 the source.***	99	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.	90	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. Used in conjunction with above listed controls if necessary to reduce loading.	N/A	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.	N/A	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.	N/A	NA

STEP 4 and 5:	Baghouse is the existing control for the source and is the most effective demonstrated control. No further economic analysis is necessary. BACT is selected as the existing baghouse system.

Table 6.1.2. SOP BACT Analyses

STEPS 1-3 PM 2.5 Control Possibilities

Item # 2.01 D-1545 SOP Dryer

Control Option	Percent Control		GR/DSCF		Comment	Typical Efficiency for this Application	Efficiency Rank
	Min	Max	Min	Max			
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.	90	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. May be technically infeasible due to high moisture content.	99	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. Used in conjunction with above listed controls if necessary to reduce loading.	N/A	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.	N/A	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.	N/A	NA

Information for Economic Analysis		Description
EU ID	D-1545	SOP Dryer D-1545
Existing Control	AH-1547	Wet scrubber - to be replaced under pending NOI
Alternate Control	BH1545	Cyclone w/ Baghouse or Cartridge Filter
Interest Rate (i)	7.0%	Interest rate at which the company can borrow money.
Useful Life (n)	20	Estimated useful life of the new control equipment being considered.

POLLUTANTS TO BE CONTROLLED	Uncontrolled PTE	Existing Capture Efficiency	Existing Control Efficiency	New Capture Efficiency	New Control Efficiency	Existing PTE	New PTE
PM2.5 (Filterable)	1009.40	0%	0%	100%	99%	1009.40	10.09
PM2.5 (Condensible)	7.742294118	0%	0%	100%	0%	7.74	7.74
Total PM2.5	1017.14					1017.14	17.84
SOx	0.193235294	0%	0%	100%	0%	0.19	0.19
NOx	3.191639498	0%	0%	100%	0%	3.19	3.19
VOC	0.708529412	0%	0%	100%	0%	0.71	0.71
NH3	0.412235294	0%	0%	100%	0%	0.41	0.41
Total Pollutants	1021.64					1021.64	22.34

Total Capital Investment (TCI)	Capital Recovery Factor (CRF) [i*(1+i)^n]/[(1+i)^n - 1]	Annual Capital Recovery Cost (CRC) (TCI x CRF)	Increased Annual O&M (DC)*	Other Indirct Costs (ID) (4% x TCI)	Total Annual Cost (TAC) (CRC+DC+ID)	Emission Reduction - TPY (ER)	Cost Per Ton (TAC/ER)
$ 1,000,000.00	0.0944	$ 94,392.93	$ -	$ 40,000.00	$ 134,392.93	999.30	$ 134.49

*DC only considered if there is an increase in direct costs (raw material, maintenance, labor, energy, etc.) compared to existing controls.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

The existing wet scrubber control consumes fresh water and generates wastewater. Replacement with a baghouse would reduce the fresh water resource use and decrease wastwater generation.

STEP 4: The cyclone with baghouse or cartridge filter is the most efficient control for this source and is evaluated to be economically feasible.

STEP 5: BACT is selected asreplacement of the existing wet scrubber system with a cyclone and baghouse or cartridge filter.

STEPS 1-5 SOx Control Possibilities

Item # 2.01 D-1545 SOP Dryer

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	In RBLC, applications demonstrated were for solid fuel (coal, corn fiber).	NA

STEP 4 and 5: 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. The existing use of pipeline quality natural gas and good combustion practices is considered BACT for SOx.

STEPS 1-5 NOx Control Possibilities

Item # 2.01 D-1545 SOP Dryer

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 4 and 5:	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. BACT is selected as the existing ULNB with FGR and staged combustion principles, plus pipeline quality natural gas, plus good combustion practices.

STEPS 1-5 VOC Control Possibilities

Item # 2.01 D-1545 SOP Dryer

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

STEPS 1-5 NH3 Control Possibilities

Item # 2.01 D-1545 SOP Dryer

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

STEPS 1-5 PM 2.5 Control Possibilities

Item # 2.02 AH-1555 SOP Plant Compaction Building (Wet)

Control Option	Percent Control		GR/DSCF		Comment	Typical Efficiency for this Application	Efficiency Rank
	Min	Max	Min	Max			
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 and is more effective due to high condensibles.***	90	1
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 due to high moisture content. Less efficient than a wet scrubber due to high condensibles.	<90	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. Used in conjunction with above listed controls if necessary to reduce loading.	N/A	NA
Wet ESP	99	99.9	0.01	`	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.	N/A	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.	N/A	NA

STEP 4 and 5:	Cyclonic wet scrubber is the existing control for the source and is more effective due to high condensibles. No further economic analysis is necessary. BACT is selected as the existing wet scrubber system.

STEPS 1-5 PM 2.5/PM2.5 Precursors Control Possibilities

Item # 2.03 B-1520 Natural Gas Fired Process Heater (Curing Belt)

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 (7 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 (7 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 (7 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). Exhausting through scrubber AH-1555 provides further control for PM2.5 and SOx emissions.***					NA

STEP 4 and 5:	The existing controls of exhausting through a wet scrubber and 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.

STEPS 1-5 PM 2.5 Control Possibilities

Item # 2.04 BH-001 SOP Bulk Loadout Circuit

Control Option	Percent Control		GR/DSCF		Comment	Typical Efficiency for this Application	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.***	99	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.	90	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. Used in conjunction with above listed controls if necessary to reduce loading.	N/A	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.	N/A	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.	N/A	NA

STEP 4 and 5:	Baghouse is the existing control for the source and is the most effective demonstrated control. No further economic analysis is necessary. BACT is selected as the existing baghouse system.

STEPS 1-5 PM 2.5 Control Possibilities

Item # 2.05 BH-002 SOP Silo Storage Circuit

Control Option	Percent Control		GR/DSCF		Comment	Typical Efficiency for this Application	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.***	99	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.	90	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. Used in conjunction with above listed controls if necessary to reduce loading.	N/A	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.	N/A	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.	N/A	NA

STEP 4 and 5:	Baghouse is the existing control for the source and is the most effective demonstrated control. No further economic analysis is necessary. BACT is selected as the existing baghouse system.

STEPS 1-5 PM 2.5 Control Possibilities

Item # 2.06 BH-019 Bin Vent 19

Control Option	Percent Control		GR/DSCF		Comment	Typical Efficiency for this Application	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. ***Cartridge Filter Dust Collector is the existing control for the source.***	99	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.	90	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. Used in conjunction with above listed controls if necessary to reduce loading.	N/A	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.	N/A	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.	N/A	NA

STEP 4 and 5:	Cartridge Filter Dust Collector is the existing control for the source and is the most effective demonstrated control. No further economic analysis is necessary. BACT is selected as the existing Cartridge Filter Dust Collection system.

STEPS 1-5 PM 2.5 Control Possibilities

Item # 2.07 BH-1505 Bin Vent 1505

Control Option	Percent Control		GR/DSCF		Comment	Typical Efficiency for this Application	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. ***Cartridge Filter Dust Collector is the existing control for the source.***	99	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.	90	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. Used in conjunction with above listed controls if necessary to reduce loading.	N/A	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.	N/A	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.	N/A	NA

STEP 4 and 5:	Cartridge Filter Dust Collector is the existing control for the source and is the most effective demonstrated control. No further economic analysis is necessary. BACT is selected as the existing Cartridge Filter Dust Collection system.

STEPS 1-5 PM 2.5 Control Possibilities

Item # 2.08 BH-1510 Bin Vent 1510

Control Option	Percent Control		GR/DSCF		Comment	Typical Efficiency for this Application	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. ***Cartridge Filter Dust Collector is the existing control for the source.***	99	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.	90	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. Used in conjunction with above listed controls if necessary to reduce loading.	N/A	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.	N/A	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.	N/A	NA

STEP 4 and 5:	Cartridge Filter Dust Collector is the existing control for the source and is the most effective demonstrated control. No further economic analysis is necessary. BACT is selected as the existing Cartridge Filter Dust Collection system.

STEPS 1-5 PM 2.5 Control Possibilities

Item # 2.09 BH-1565 SOP Compaction Recycle Hopper Bin Vent

Control Option	Percent Control		GR/DSCF		Comment	Typical Efficiency for this Application	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. ***Cartridge Filter Dust Collector is the existing control for the source.***	99	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.	90	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. Used in conjunction with above listed controls if necessary to reduce loading.	N/A	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.	N/A	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.	N/A	NA

STEP 4 and 5:	Cartridge Filter Dust Collector is the existing control for the source and is the most effective demonstrated control. No further economic analysis is necessary. BACT is selected as the existing Cartridge Filter Dust Collection system.

STEPS 1-5 PM 2.5 Control Possibilities

Item # 2.10 D-1400 SOP Dryer 1400

Control Option	Percent Control		GR/DSCF		Comment	Typical Efficiency for this Application	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. Proven to be technically feasible.	99	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.	90	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. Used in conjunction with above listed controls if necessary to reduce loading.	N/A	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.	N/A	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.	N/A	NA

STEP 4 and 5:	Cyclone and baghouse is the existing control for the source and is ranked as the most effective control. No further economic analysis is necessary. BACT is selected as the existing baghouse system.

STEPS 1-5 SOx Control Possibilities

Item # 2.10 D-1400 SOP Dryer 1400

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	In RBLC, applications demonstrated were for solid fuel (coal, corn fiber).	NA

STEP 4 and 5: 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. The existing use of pipeline quality natural gas and good combustion practices is considered BACT for SOx.

STEPS 1-5 NOx Control Possibilities

Item # 2.10 D-1400 SOP Dryer 1400

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 4 and 5:	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. BACT is selected as the existing ULNB with FGR and staged combustion principles, plus pipeline quality natural gas, plus good combustion practices.

STEPS 1-5 **VOC Control Possibilities**

Item # 2.10 **D-1400 SOP Dryer 1400**

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

STEPS 1-5 NH3 Control Possibilities

Item # 2.10 D-1400 SOP Dryer 1400

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

STEPS 1-3 PM 2.5 Control Possibilities

Item # 2.11 BH-NEW SOP Plant Compaction Building (Dry)

Control Option	Percent Control		GR/DSCF		Comment	Typical Efficiency for this Application	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.	99	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.	90	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. Used in conjunction with above listed controls if necessary to reduce loading.	N/A	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.	N/A	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.	N/A	NA

Information for Economic Analysis		Description
EU ID	BH-NEW	Dry SOP material handling re-routed from AH-1555 to a new cyclone and baghouse
Existing Control	AH-1555	Wet scrubber - to be re-routed under pending NOI
Alternate Control	BH-NEW	Cyclone w/ Baghouse
Interest Rate (i)	7.0%	Interest rate at which the company can borrow money.
Useful Life (n)	20	Estimated useful life of the new control equipment being considered.

POLLUTANTS TO BE CONTROLLED	Uncontrolled PTE	Existing Capture Efficiency	Existing Control Efficiency	New Capture Efficiency	New Control Efficiency	Existing PTE	New PTE
PM2.5 (Filterable)	287.87	0%	0%	100%	99.2%	287.87	2.30
PM2.5 (Condensible)						0.00	0.00
Total PM2.5	287.87					287.87	2.30
SOx						0.00	0.00
NOx						0.00	0.00
VOC						0.00	0.00
NH3						0.00	0.00
Total Pollutants	287.87					287.87	2.30

Total Capital Investment (TCI)	Capital Recovery Factor (CRF) [i*(1+i)^n]/[(1+i)^n - 1]	Annual Capital Recovery Cost (CRC) (TCI x CRF)	Increased Annual O&M (DC)*	Other Indirct Costs (ID) (4% x TCI)	Total Annual Cost (TAC) (CRC+DC+ID)	Emission Reduction - TPY (ER)	Cost Per Ton (TAC/ER)
$ 1,200,000.00	0.0944	$ 113,271.51	$ -	$ 48,000.00	$ 161,271.51	285.57	$ 564.74

*DC only considered if there is an increase in direct costs (raw material, maintenance, labor, energy, etc.) compared to existing controls.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:
The existing wet scrubber control consumes fresh water and generates wastewater. Replacement with a baghouse would reduce the fresh water resource use and decrease wastwater generation.

STEP 4:	The cyclone with baghouse or cartridge filter is the most efficient control for this source and is evaluated to be economically feasible.

STEP 5:	BACT is selected as replacement of the existing wet scrubber system with a cyclone and baghouse or cartridge filter.

STEPS 1-5 **PM 2.5 Control Possibilities**

Item # 2.12 Dust Torits **Individually controlled, enclosed SOP material handling sources vented through cartridge filters (15 in total)**

Control Option	Percent Control		GR/DSCF		Comment	Typical Efficiency for this Application	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. ***Cartridge Filter Dust Collector is the existing control for the source.***	99	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.	90	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. Used in conjunction with above listed controls if necessary to reduce loading.	N/A	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.	N/A	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.	N/A	NA

STEP 4 and 5:	Cartridge Filter Dust Collector is the existing control for individually controlled material handling sources vented through cartridge filters and is the most effective demonstrated control. No further economic analysis is necessary. BACT is selected as the existing Cartridge Filter Dust Collection system.

Steps 1-5 **VOC Control Possibilities**

Item # 2.13 **SOP Defoamer**

Foam occurs in the SOP process due to natural sources in the feed salt, process water and reagents in the flotation process. Foam inhibits the SOP production process by causing filtration issues and solid-liquid separation issues in the thickeners. To mitigate foaming, a specially formulated liquid which contains up to 60% volatile organic compounds (VOCs) is dosed into slurry and brine streams. The process slurries are introduced to a series of thickeners, ranging from 60 ft. to 230 ft. in diameter, in order to separate the solids from the liquor, in each thickener step. The center "well" of the thickener is connected to four large rake structures that rotate and scrape settled solids off the thickener floor to the center where they are pumped to the next process stage. A majority of the fugitive VOCs generated by the defoamer additive are released at the thickener process.

Step 1 – Identify Available Control Technology Options

EPA's RBLC search yielded no control options for this process. Although there are no demonstrated controls, Compass examined both inherently lower-emitting processes and practices as well as add-on controls that are not yet demonstrated as part of the Step 1 process.

Option 1 – considers replacement of the currently used defoaming agent with commercially available defoaming agents which do not contain VOCs. The effects of the use of such chemicals in the SOP process are unknown and would require process testing prior to implementing to ensure that use of an alternative defoaming agent is technically feasible as part of the Compass process.

Option 2 – considers VOC capture and control. The defoamer is primarily fed to control foam at Thickener #1 and the liquor and slurries travel from this thickener throughout the plant. VOCs are emitted at various points of the SOP process as fugitive emissions. Compass believes initial emissions occur at ambient conditions in the plant thickeners, primarily thickener #1 which is 230 ft. diameter. The fate of additional VOCs from the defoaming agent are not certain, and may not be emitted at a point that would allow for capture and control.

Step 2 – Eliminate Technically Infeasible Control Options

Step 2 requires an analysis of whether a technology is "available," which means "it can be obtained by the applicant through commercial channels or is otherwise available with the common sense meaning of the term," and is "applicable," which means it "can be reasonably installed and operated on the source type under consideration."[1] Moreover, "technologies in the pilot scale testing stages of development would not be considered for BACT review…"[2] None of the options described above have been demonstrated to control VOC emissions from a sulfate of potash or similar process on a production scale basis. Each option is evaluated below.

Option 1 – Compass is currently evaluating commercially available low-VOC defoaming agents. However, none have been bench tested for the SOP process, nor demonstrated on a SOP production scale. Effectiveness of alternative defoaming agents must be tested in consideration of the plant chemistry, liquor temperature, ambient temperature, etc. Therefore, Option 1 is excluded from further BACT review at this time. Compass is planning to undertake an evaluation of alternative defoaming agents, which Compass expects to complete no later than December 31, 2018. Compass will update UDAQ at that time if a feasible low-VOC defoaming agent is identified.

Option 2 – The thickener consists of an open top tank where material is continuously added. The 1st thickener (Thickener #1), where a majority of the defoamer is fed, is 230 ft. in diameter. The center "well" is connected to four large rake structures that rotate and scrape settled solids off the thickener floor to the center where they are pumped to the next process stage. The sidewalls of Thickener #1 are not strong enough to support a tank roof, cover or lid and must be kept clear to collect the Plant End Liquor that is collected and eventually returned to the ponds. There is insufficient structure to support a tank roof on Thickener #1.

Additionally, a roof would interfere with visual observation of operation, service of the tank and service of the rake mechanism. A floating lid would interfere with the rotating rake structure. Therefore, it is technically infeasible to capture fugitive VOC emissions from the open tops of the thickener vessels and direct emissions to a control device.

Step 3-5 – Rank and Evaluate Remaining Control Options. Identify BACT.

After eliminating the technologically infeasible control options, there are no further options to consider for Steps 3 through 5.

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[1] New Source Review Workshop Manual at B.7, cited in *re Cardinal FG Company*, 12 E.A.D. 153, 163 (EAB 2005).

[2] *Id*.

STEPS 1-5 PM 2.5 Control Possibilities

Item # 2.14 SUB Natural Gas Fired Process Heater (Submerged Combustion)

Control Option	Percent Control Min	Percent Control Max	GR/DSCF Min	GR/DSCF Max	Comment	Efficiency Rank
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 4 and 5:	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.

STEPS 1-5 SOx Control Possibilities

Item # 2.14 SUB Natural Gas Fired Process Heater (Submerged Combustion)

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 4 and 5: 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.

STEPS 1-5

NOx Control Possibilities

Item # 2.14 SUB Natural Gas Fired Process Heater (Submerged Combustion)

Control Option	Percent Control		LB/MMBTU		Comment	Efficiency Rank
	Min	Max	Min	Max		
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 4 and 5:	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.

STEPS 1-5 VOC Control Possibilities

Item # 2.14 SUB Natural Gas Fired Process Heater (Submerged Combustion)

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 4 and 5:	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.

STEPS 1-5 NH3 Control Possibilities

Item # 2.14 SUB Natural Gas Fired Process Heater (Submerged Combustion)

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 4 and 5:	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.

STEPS 1-3

PM 2.5 Control Possibilities

Item # 2.15 **SOP CT SOP Cooling Towers**

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

Information for Economic Analysis		Description
EU ID	SOP CT	SOP Cooling Towers
Existing Control	DE	Drift Eliminators (0.01% Drift)
Alternate Control		Hi Efficiency Drift Eliminators (0.0005% Drift)
Interest Rate (i)	7.0%	Interest rate at which the company can borrow money.
Useful Life (n)	20	Estimated useful life of the new control equipment being considered.

POLLUTANTS TO BE CONTROLLED	Uncontrolled PTE	Existing Capture Efficiency	Existing Control Efficiency	New Capture Efficiency	New Control Efficiency	Existing PTE	New PTE
PM2.5 (Filterable)	0.00					0.00	0.00
PM2.5 (Condensible)	0.3					0.30	0.02
Total PM2.5	0.30					0.30	0.02
SOx							
NOx							
VOC							
NH3							
Total Pollutants	0.30					0.30	0.02

Total Capital Investment (TCI)	Capital Recovery Factor (CRF) [i*(1+i)^n]/[(1+i)^n - 1]	Annual Capital Recovery Cost (CRC) (TCI x CRF)	Increased Annual O&M (DC)*	Other Indirct Costs (ID) (4% x TCI)	Total Annual Cost (TAC) (CRC+DC+ID)	Emission Reduction - TPY (ER)	Cost Per Ton (TAC/ER)
$ 143,820.00	0.0944	$ 13,575.59	$ -	$ 5,752.80	$ 19,328.39	0.29	$ 67,818.91

*DC only considered if there is an increase in direct costs (raw material, maintenance, labor, energy, etc.) compared to existing controls.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

STEP 4:	The high efficiency drift eliminator is the most efficient control for this source and is evaluated to be economically infeasible.

STEP 5:	BACT is selected as the existing drift eliminator.

STEPS 1-3 PM 2.5 Control Possibilities

Item # 2.16 SOP outdoor, unenclosed, and uncontrolled material handling

Control Option	Percent Control		GR/DSCF			Typical Efficiency for this Application	Efficiency Rank
	Min	Max	Min	Max	Comment		
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.	99	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.	90	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. Used in conjunction with above listed controls if necessary to reduce loading.	N/A	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.	N/A	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.	N/A	NA
Drop Height Reduction	NA	NA	NA	NA	Drop height reduction can include enclosures or not.	NA	NA
Enclosure	NA	NA	NA	NA	A building, silo, shroud, etc. around transfer points, drop points, load/unload areas, conveyors, etc.	NA	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	NA
Inherent Moisture Content	NA	NA	NA	NA	Some materials have inherent moisture content, which helps to minimize emissions.	NA	NA
Stabilization: Chemical	NA	NA	NA	NA	Chemicals dust suppressants include salts, lignin sulfonate, wetting agents, latexes, plastics, and petroleum derivatives.	NA	NA
Stabilization: Physical	NA	NA	NA	NA	Water spraying, paving, sweeping, tarping piles, etc.	NA	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	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	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	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	NA

Information for Economic Analysis		Description
EU ID	SOP OMH	Group 1 - SOP outdoor, unenclosed, and uncontrolled material handling
Existing Control	None	
Alternate Control		Bin Vent Cartridge Filter
Interest Rate (i)	7.0%	Interest rate at which the company can borrow money.
Useful Life (n)	20	Estimated useful life of the new control equipment being considered.

POLLUTANTS TO BE CONTROLLED	Uncontrolled PTE	Existing Capture Efficiency	Existing Control Efficiency	New Capture Efficiency	New Control Efficiency	Existing PTE	New PTE
PM2.5 (Filterable)	0.56	0%	0%	100%	99%	0.56	0.01
PM2.5 (Condensible)	0					0.00	0.00
Total PM2.5	0.56					0.56	0.01
SOx							
NOx							
VOC							
NH3							
Total Pollutants	0.56					0.56	0.01

Total Capital Investment (TCI)	Capital Recovery Factor (CRF) [i*(1+i)^n]/[(1+i)^n - 1]	Annual Capital Recovery Cost (CRC) (TCI x CRF)	Increased Annual O&M (DC)*	Other Indirct Costs (ID) (4% x TCI)	Total Annual Cost (TAC) (CRC+DC+ID)	Emission Reduction - TPY (ER)	Cost Per Ton (TAC/ER)
$ 638,250.00	0.0944	$ 60,246.28	$ -	$ 25,530.00	$ 85,776.28	0.55	$ 155,514.47

*DC only considered if there is an increase in direct costs (raw material, maintenance, labor, energy, etc.) compared to existing controls.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

STEP 4:	A cartridge filter is the most efficient control for this source and is evaluated 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.

Information for Economic Analysis		Description
EU ID	SOP OMH	Group 2 - SOP outdoor, unenclosed, and uncontrolled material handling
Existing Control	None	
Alternate Control		New Baghouse or Cartridge Filter or Full Enclosure
Interest Rate (i)	7.0%	Interest rate at which the company can borrow money.
Useful Life (n)	20	Estimated useful life of the new control equipment being considered.

POLLUTANTS TO BE CONTROLLED	Uncontrolled PTE	Existing Capture Efficiency	Existing Control Efficiency	New Capture Efficiency	New Control Efficiency	Existing PTE	New PTE
PM2.5 (Filterable)	2.50	0%	0%	100%	99%	2.50	0.03
PM2.5 (Condensible)	0					0.00	0.00
Total PM2.5	2.50					2.50	0.03
SOx							
NOx							
VOC							
NH3							
Total Pollutants	2.50					2.50	0.03

Cartridge Filter Total Capital Investment (TCI)	Capital Recovery Factor (CRF) [i*(1+i)^n]/[(1+i)^n - 1]	Annual Capital Recovery Cost (CRC) (TCI x CRF)	Increased Annual O&M (DC)*	Other Indirct Costs (ID) (4% x TCI)	Total Annual Cost (TAC) (CRC+DC+ID)	Emission Reduction - TPY (ER)	Cost Per Ton (TAC/ER)
$ 1,577,800.00	0.0944	$ 148,933.16	$ -	$ 63,112.00	$ 212,045.16	2.48	$ 85,674.81

*DC only considered if there is an increase in direct costs (raw material, maintenance, labor, energy, etc.) compared to existing controls.

Full Enclosure Total Capital Investment (TCI)	Capital Recovery Factor (CRF) [i*(1+i)^n]/[(1+i)^n - 1]	Annual Capital Recovery Cost (CRC) (TCI x CRF)	Increased Annual O&M (DC)*	Other Indirct Costs (ID) (4% x TCI)	Total Annual Cost (TAC) (CRC+DC+ID)	Emission Reduction - TPY (ER) **	Cost Per Ton (TAC/ER)
$ 638,250.00	0.0944	$ 60,246.28	$ -	$ 25,530.00	$ 85,776.28	1.88	$ 45,747.35

*DC only considered if there is an increase in direct costs (raw material, maintenance, labor, energy, etc.) compared to existing controls.

**Full Enclosure provides a lower emission reduction than a baghouse or cartridge filter.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:
The existing wet scrubber control consumes fresh water and generates wastewater. Replacement with a baghouse would reduce the fresh water resource use and decrease wastwater generation.

STEP 4:	The cyclone with baghouse or cartridge filter is the most efficient control for this source and is evaluated to be economically infeasible. The next option of a full enclosure is also 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.

Information for Economic Analysis		Description
EU ID	SOP OMH	Group 3 - SOP outdoor, unenclosed, and uncontrolled material handling
Existing Control	None	
Alternate Control		New Baghouse or Cartridge Filter
Interest Rate (i)	7.0%	Interest rate at which the company can borrow money.
Useful Life (n)	20	Estimated useful life of the new control equipment being considered.

POLLUTANTS TO BE CONTROLLED	Uncontrolled PTE	Existing Capture Efficiency	Existing Control Efficiency	New Capture Efficiency	New Control Efficiency	Existing PTE	New PTE
PM2.5 (Filterable)	1.22	0%	0%	100%	99%	1.22	0.01
PM2.5 (Condensible)	0					0.00	0.00
Total PM2.5	1.22					1.22	0.01
SOx							
NOx							
VOC							
NH3							
Total Pollutants	1.22					1.22	0.01

Cartridge Filter Total Capital Investment (TCI)	Capital Recovery Factor (CRF) [i*(1+i)^n]/[(1+i)^n - 1]	Annual Capital Recovery Cost (CRC) (TCI x CRF)	Increased Annual O&M (DC)*	Other Indirct Costs (ID) (4% x TCI)	Total Annual Cost (TAC) (CRC+DC+ID)	Emission Reduction - TPY (ER)	Cost Per Ton (TAC/ER)
$ 638,250.00	0.0944	$ 60,246.28	$ -	$ 25,530.00	$ 85,776.28	1.21	$ 71,018.62

*DC only considered if there is an increase in direct costs (raw material, maintenance, labor, energy, etc.) compared to existing controls.

Full Enclosure Total Capital Investment (TCI)	Capital Recovery Factor (CRF) [i*(1+i)^n]/[(1+i)^n - 1]	Annual Capital Recovery Cost (CRC) (TCI x CRF)	Increased Annual O&M (DC)*	Other Indirct Costs (ID) (4% x TCI)	Total Annual Cost (TAC) (CRC+DC+ID)	Emission Reduction - TPY (ER) **	Cost Per Ton (TAC/ER)
$ 272,550.00	0.0944	$ 25,726.79	$ -	$ 10,902.00	$ 36,628.79	0.92	$ 40,031.47

*DC only considered if there is an increase in direct costs (raw material, maintenance, labor, energy, etc.) compared to existing controls.

**Full Enclosure provides a lower emission reduction than a baghouse or cartridge filter.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

STEP 4:	The cyclone with baghouse or cartridge filter is the most efficient control for this source and is evaluated to be economically infeasible. The next option of a full enclosure is also 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.

STEPS 1-3 **PM 2.5 Control Possibilities**

Item # 2.17 **SOP material handling sources controlled by full enclosures, partial enclosures, and/or building enclosures.**

Control Option	Percent Control		GR/DSCF		Comment	Typical Efficiency for this Application	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.	99	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.	90	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. Used in conjunction with above listed controls if necessary to reduce loading.	N/A	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.	N/A	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.	N/A	NA
Drop Height Reduction	NA	NA	NA	NA	Drop height reduction can include enclosures or not.	NA	NA
Enclosure	NA	NA	NA	NA	A building, silo, shroud, etc. around transfer points, drop points, load/unload areas, conveyors, etc.	NA	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	NA
Inherent Moisture Content	NA	NA	NA	NA	Some materials have inherent moisture content, which helps to minimize emissions.	NA	NA
Stabilization: Chemical	NA	NA	NA	NA	Chemicals dust suppressants include salts, lignin sulfonate, wetting agents, latexes, plastics, and petroleum derivatives.	NA	NA
Stabilization: Physical	NA	NA	NA	NA	Water spraying, paving, sweeping, tarping piles, etc.	NA	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	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	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	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	NA

Information for Economic Analysis		Description
EU ID	SOP EMH	Group 1 - SOP material handling sources controlled by full enclosures, partial enclosures, and/or building enclosures.
Existing Control	Enclosure	Full enclosure, partial enclosure, or building enclosure
Alternate Control	BH001	Route to BH001
Interest Rate (i)	7.0%	Interest rate at which the company can borrow money.
Useful Life (n)	20	Estimated useful life of the new control equipment being considered.

POLLUTANTS TO BE CONTROLLED	Uncontrolled PTE	Existing Capture Efficiency	Existing Control Efficiency	New Capture Efficiency	New Control Efficiency	Existing PTE	New PTE
PM2.5 (Filterable)	1.95	100%	25-75%	100%	99%	1.04	0.02
PM2.5 (Condensible)						0.00	0.00
Total PM2.5	1.95					1.04	0.02
SOx							
NOx							
VOC							
NH3							
Total Pollutants	1.95					1.04	0.02

Total Capital Investment (TCI)	Capital Recovery Factor (CRF) [i*(1+i)^n]/[(1+i)^n - 1]	Annual Capital Recovery Cost (CRC) (TCI x CRF)	Increased Annual O&M (DC)*	Other Indirct Costs (ID) (4% x TCI)	Total Annual Cost (TAC) (CRC+DC+ID)	Emission Reduction - TPY (ER)	Cost Per Ton (TAC/ER)
$ 289,800.00	0.0944	$ 27,355.07	$ -	$ 11,592.00	$ 38,947.07	1.02	$ 38,164.69

*DC only considered if there is an increase in direct costs (raw material, maintenance, labor, energy, etc.) compared to existing controls.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

STEP 4:	The cyclone with baghouse or cartridge filter is the most efficient control for this source and is evaluated 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.

Information for Economic Analysis		Description
EU ID	SOP EMH	Group 2 - SOP material handling sources controlled by full enclosures, partial enclosures, and/or building enclosures.
Existing Control	Enclosure	Full enclosure, partial enclosure, or building enclosure
Alternate Control	BH1400	Route to BH1400
Interest Rate (i)	7.0%	Interest rate at which the company can borrow money.
Useful Life (n)	20	Estimated useful life of the new control equipment being considered.

POLLUTANTS TO BE CONTROLLED	Uncontrolled PTE	Existing Capture Efficiency	Existing Control Efficiency	New Capture Efficiency	New Control Efficiency	Existing PTE	New PTE
PM2.5 (Filterable)	12.96	100%	25-75%	100%	99%	1.30	0.13
PM2.5 (Condensible)						0.00	0.00
Total PM2.5	12.96					1.30	0.13
SOx							
NOx							
VOC							
NH3							
Total Pollutants	12.96					1.30	0.13

Total Capital Investment (TCI)	Capital Recovery Factor (CRF) [i*(1+i)^n]/[(1+i)^n - 1]	Annual Capital Recovery Cost (CRC) (TCI x CRF)	Increased Annual O&M (DC)*	Other Indirct Costs (ID) (4% x TCI)	Total Annual Cost (TAC) (CRC+DC+ID)	Emission Reduction - TPY (ER)	Cost Per Ton (TAC/ER)
$ 500,000.00	0.0944	$ 47,196.46	$ -	$ 20,000.00	$ 67,196.46	1.17	$ 57,413.25

*DC only considered if there is an increase in direct costs (raw material, maintenance, labor, energy, etc.) compared to existing controls.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

STEP 4:	The cyclone with baghouse or cartridge filter is the most efficient control for this source and is evaluated 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.

Information for Economic Analysis		Description
EU ID	SOP EMH	Group 3 - SOP material handling sources controlled by full enclosures, partial enclosures, and/or building enclosures.
Existing Control	Enclosure	Full enclosure, partial enclosure, or building enclosure
Alternate Control		New Baghouse or Cartridge Filter
Interest Rate (i)	7.0%	Interest rate at which the company can borrow money.
Useful Life (n)	20	Estimated useful life of the new control equipment being considered.

POLLUTANTS TO BE CONTROLLED	Uncontrolled PTE	Existing Capture Efficiency	Existing Control Efficiency	New Capture Efficiency	New Control Efficiency	Existing PTE	New PTE
PM2.5 (Filterable)	4.77	100%	25-75%	100%	99%	1.19	0.05
PM2.5 (Condensible)						0.00	0.00
Total PM2.5	4.77					1.19	0.05
SOx							
NOx							
VOC							
NH3							
Total Pollutants	4.77					1.19	0.05

Total Capital Investment (TCI)	Capital Recovery Factor (CRF) [i*(1+i)^n]/[(1+i)^n - 1]	Annual Capital Recovery Cost (CRC) (TCI x CRF)	Increased Annual O&M (DC)*	Other Indirct Costs (ID) (4% x TCI)	Total Annual Cost (TAC) (CRC+DC+ID)	Emission Reduction - TPY (ER)	Cost Per Ton (TAC/ER)
$ 236,900.00	0.0944	$ 22,361.68	$ 40,000.00	$ 9,476.00	$ 71,837.68	1.14	$ 62,888.63

*DC only considered if there is an increase in direct costs (raw material, maintenance, labor, energy, etc.) compared to existing controls.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

STEP 4:	The cyclone with baghouse or cartridge filter is the most efficient control for this source and is evaluated 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.

Information for Economic Analysis		Description
EU ID	SOP EMH	Group 4 - SOP material handling sources controlled by full enclosures, partial enclosures, and/or building enclosures.
Existing Control	Enclosure	Full enclosure, partial enclosure, or building enclosure
Alternate Control		New KCl Unloading Baghouse or Cartridge Filter
Interest Rate (i)	7.0%	Interest rate at which the company can borrow money.
Useful Life (n)	20	Estimated useful life of the new control equipment being considered.

POLLUTANTS TO BE CONTROLLED	Uncontrolled PTE	Existing Capture Efficiency	Existing Control Efficiency	New Capture Efficiency	New Control Efficiency	Existing PTE	New PTE
PM2.5 (Filterable)	0.09	100%	25-75%	100%	99%	0.02	0.00
PM2.5 (Condensible)						0.00	0.00
Total PM2.5	0.09					0.02	0.00
SOx							
NOx							
VOC							
NH3							
Total Pollutants	0.09					0.02	0.00

Total Capital Investment (TCI)	Capital Recovery Factor (CRF) [i*(1+i)^n]/[(1+i)^n - 1]	Annual Capital Recovery Cost (CRC) (TCI x CRF)	Increased Annual O&M (DC)*	Other Indirct Costs (ID) (4% x TCI)	Total Annual Cost (TAC) (CRC+DC+ID)	Emission Reduction - TPY (ER)	Cost Per Ton (TAC/ER)
$ 142,600.00	0.0944	$ 13,460.43	$ -	$ 5,704.00	$ 19,164.43	0.02	$ 1,117,459.55

*DC only considered if there is an increase in direct costs (raw material, maintenance, labor, energy, etc.) compared to existing controls.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

STEP 4:	The cyclone with baghouse or cartridge filter is the most efficient control for this source and is evaluated 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.

Information for Economic Analysis		Description
EU ID	SOP EMH	Group 5 - SOP material handling sources controlled by full enclosures, partial enclosures, and/or building enclosures
Existing Control	Enclosure	Full enclosure, partial enclosure, or building enclosure
Alternate Control		New Top of Silos Baghouse or Cartridge Filter
Interest Rate (i)	7.0%	Interest rate at which the company can borrow money.
Useful Life (n)	20	Estimated useful life of the new control equipment being considered.

POLLUTANTS TO BE CONTROLLED	Uncontrolled PTE	Existing Capture Efficiency	Existing Control Efficiency	New Capture Efficiency	New Control Efficiency	Existing PTE	New PTE
PM2.5 (Filterable)	12.40	100%	25-75%	100%	99%	0.87	0.12
PM2.5 (Condensible)						0.00	0.00
Total PM2.5	12.40					0.87	0.12
SOx							
NOx							
VOC							
NH3							
Total Pollutants	12.40					0.87	0.12

Total Capital Investment (TCI)	Capital Recovery Factor (CRF) [i*(1+i)^n]/[(1+i)^n - 1]	Annual Capital Recovery Cost (CRC) (TCI x CRF)	Increased Annual O&M (DC)*	Other Indirct Costs (ID) (4% x TCI)	Total Annual Cost (TAC) (CRC+DC+ID)	Emission Reduction - TPY (ER)	Cost Per Ton (TAC/ER)
$ 711,850.00	0.0944	$ 67,193.60	$ -	$ 28,474.00	$ 95,667.60	0.75	$ 128,240.76

*DC only considered if there is an increase in direct costs (raw material, maintenance, labor, energy, etc.) compared to existing controls.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

STEP 4:	The cyclone with baghouse or cartridge filter is the most efficient control for this source and is evaluated 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.

Information for Economic Analysis		Description
EU ID	SOP EMH	Group 6 - SOP material handling sources controlled by full enclosures, partial enclosures, and/or building enclosures
Existing Control	Enclosure	Full enclosure, partial enclosure, or building enclosure
Alternate Control		New Recycle Baghouse or Cartridge Filter
Interest Rate (i)	7.0%	Interest rate at which the company can borrow money.
Useful Life (n)	20	Estimated useful life of the new control equipment being considered.

POLLUTANTS TO BE CONTROLLED	Uncontrolled PTE	Existing Capture Efficiency	Existing Control Efficiency	New Capture Efficiency	New Control Efficiency	Existing PTE	New PTE
PM2.5 (Filterable)	8.32	100%	25-75%	100%	99%	0.83	0.08
PM2.5 (Condensible)						0.00	0.00
Total PM2.5	8.32					0.83	0.08
SOx							
NOx							
VOC							
NH3							
Total Pollutants	8.32					0.83	0.08

Total Capital Investment (TCI)	Capital Recovery Factor (CRF) [i*(1+i)^n]/[(1+i)^n - 1]	Annual Capital Recovery Cost (CRC) (TCI x CRF)	Increased Annual O&M (DC)*	Other Indirct Costs (ID) (4% x TCI)	Total Annual Cost (TAC) (CRC+DC+ID)	Emission Reduction - TPY (ER)	Cost Per Ton (TAC/ER)
$ 285,200.00	0.0944	$ 26,920.86	$ -	$ 11,408.00	$ 38,328.86	0.75	$ 51,324.13

*DC only considered if there is an increase in direct costs (raw material, maintenance, labor, energy, etc.) compared to existing controls.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

STEP 4:	The cyclone with baghouse or cartridge filter is the most efficient control for this source and is evaluated 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.

Information for Economic Analysis		Description
EU ID	SOP EMH	Group 7 - SOP material handling sources controlled by full enclosures, partial enclosures, and/or building enclosures.
Existing Control	Enclosure	Full enclosure, partial enclosure, or building enclosure
Alternate Control		Route to BH-NEW
Interest Rate (i)	7.0%	Interest rate at which the company can borrow money.
Useful Life (n)	20	Estimated useful life of the new control equipment being considered.

POLLUTANTS TO BE CONTROLLED	Uncontrolled PTE	Existing Capture Efficiency	Existing Control Efficiency	New Capture Efficiency	New Control Efficiency	Existing PTE	New PTE
PM2.5 (Filterable)	2.97	100%	25-75%	100%	99%	0.30	0.03
PM2.5 (Condensible)						0.00	0.00
Total PM2.5	2.97					0.30	0.03
SOx							
NOx							
VOC							
NH3							
Total Pollutants	2.97					0.30	0.03

Total Capital Investment (TCI)	Capital Recovery Factor (CRF) [i*(1+i)^n]/[(1+i)^n - 1]	Annual Capital Recovery Cost (CRC) (TCI x CRF)	Increased Annual O&M (DC)*	Other Indirct Costs (ID) (4% x TCI)	Total Annual Cost (TAC) (CRC+DC+ID)	Emission Reduction - TPY (ER)	Cost Per Ton (TAC/ER)
$ 25,000.00	0.0944	$ 2,359.82	$ -	$ 1,000.00	$ 3,359.82	0.27	$ 12,569.48

*DC only considered if there is an increase in direct costs (raw material, maintenance, labor, energy, etc.) compared to existing controls.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

STEP 4:	The cyclone with baghouse or cartridge filter is the most efficient control for this source and is evaluated to be economically feasible.

STEP 5:	BACT is selected as routing the source to the baghouse system designated BH-NEW.

Information for Economic Analysis		Description
EU ID	SOP EMH	Group 8 - SOP dome silo 12
Existing Control	Enclosure	Full enclosure, partial enclosure, or building enclosure
Alternate Control		Silo 12 baghouse or cartridge filter
Interest Rate (i)	7.0%	Interest rate at which the company can borrow money.
Useful Life (n)	20	Estimated useful life of the new control equipment being considered.

POLLUTANTS TO BE CONTROLLED	Uncontrolled PTE	Existing Capture Efficiency	Existing Control Efficiency	New Capture Efficiency	New Control Efficiency	Existing PTE	New PTE
PM2.5 (Filterable)	0.46	100%	25-75%	100%	99%	0.28	0.00
PM2.5 (Condensible)						0.00	0.00
Total PM2.5	0.46					0.28	0.00
SOx							
NOx							
VOC							
NH3							
Total Pollutants	0.46					0.28	0.00

Total Capital Investment (TCI)	Capital Recovery Factor (CRF) [i*(1+i)^n]/[(1+i)^n - 1]	Annual Capital Recovery Cost (CRC) (TCI x CRF)	Increased Annual O&M (DC)*	Other Indirct Costs (ID) (4% x TCI)	Total Annual Cost (TAC) (CRC+DC+ID)	Emission Reduction - TPY (ER)	Cost Per Ton (TAC/ER)
$ 711,850.00	0.0944	$ 67,193.60	$ -	$ 28,474.00	$ 95,667.60	0.28	$ 347,427.38

*DC only considered if there is an increase in direct costs (raw material, maintenance, labor, energy, etc.) compared to existing controls.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

STEP 4:	The cyclone with baghouse or cartridge filter is the most efficient control for this source and is evaluated 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.

Information for Economic Analysis		Description
EU ID	SOP EMH	Group 9 - SOP dome silo 13
Existing Control	Enclosure	Full enclosure, partial enclosure, or building enclosure
Alternate Control		Silo 13 baghouse or cartridge filter
Interest Rate (i)	7.0%	Interest rate at which the company can borrow money.
Useful Life (n)	20	Estimated useful life of the new control equipment being considered.

POLLUTANTS TO BE CONTROLLED	Uncontrolled PTE	Existing Capture Efficiency	Existing Control Efficiency	New Capture Efficiency	New Control Efficiency	Existing PTE	New PTE
PM2.5 (Filterable)	0.11	100%	25-75%	100%	99%	0.07	0.00
PM2.5 (Condensible)						0.00	0.00
Total PM2.5	0.11					0.07	0.00
SOx							
NOx							
VOC							
NH3							
Total Pollutants	0.11					0.07	0.00

Total Capital Investment (TCI)	Capital Recovery Factor (CRF) [i*(1+i)^n]/[(1+i)^n - 1]	Annual Capital Recovery Cost (CRC) (TCI x CRF)	Increased Annual O&M (DC)*	Other Indirct Costs (ID) (4% x TCI)	Total Annual Cost (TAC) (CRC+DC+ID)	Emission Reduction - TPY (ER)	Cost Per Ton (TAC/ER)
$ 711,850.00	0.0944	$ 67,193.60	$ -	$ 28,474.00	$ 95,667.60	0.07	$ 1,409,779.02

*DC only considered if there is an increase in direct costs (raw material, maintenance, labor, energy, etc.) compared to existing controls.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

STEP 4:	The cyclone with baghouse or cartridge filter is the most efficient control for this source and is evaluated 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.

Information for Economic Analysis		Description
EU ID	SOP EMH	Group 10 - SOP dome silo 14
Existing Control	Enclosure	Full enclosure, partial enclosure, or building enclosure
Alternate Control		Silo 14 baghouse or cartridge filter
Interest Rate (i)	7.0%	Interest rate at which the company can borrow money.
Useful Life (n)	20	Estimated useful life of the new control equipment being considered.

POLLUTANTS TO BE CONTROLLED	Uncontrolled PTE	Existing Capture Efficiency	Existing Control Efficiency	New Capture Efficiency	New Control Efficiency	Existing PTE	New PTE
PM2.5 (Filterable)	0.11	100%	25-75%	100%	99%	0.07	0.00
PM2.5 (Condensible)						0.00	0.00
Total PM2.5	0.11					0.07	0.00
SOx							
NOx							
VOC							
NH3							
Total Pollutants	0.11					0.07	0.00

Total Capital Investment (TCI)	Capital Recovery Factor (CRF) [i*(1+i)^n]/[(1+i)^n - 1]	Annual Capital Recovery Cost (CRC) (TCI x CRF)	Increased Annual O&M (DC)*	Other Indirct Costs (ID) (4% x TCI)	Total Annual Cost (TAC) (CRC+DC+ID)	Emission Reduction - TPY (ER)	Cost Per Ton (TAC/ER)
$ 711,850.00	0.0944	$ 67,193.60	$ -	$ 28,474.00	$ 95,667.60	0.07	$ 1,409,779.02

*DC only considered if there is an increase in direct costs (raw material, maintenance, labor, energy, etc.) compared to existing controls.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:
The existing wet scrubber control consumes fresh water and generates wastewater. Replacement with a baghouse would reduce the fresh water resource use and decrease wastwater generation.

STEP 4:	The cyclone with baghouse or cartridge filter is the most efficient control for this source and is evaluated 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.

Information for Economic Analysis		Description
EU ID	SOP EMH	Group 11 - SOP compactors
Existing Control	Enclosure	Full enclosure, partial enclosure, or building enclosure
Alternate Control		New Wet Scrubber System (Baghouse not feasible due to high moisture)
Interest Rate (i)	7.0%	Interest rate at which the company can borrow money.
Useful Life (n)	20	Estimated useful life of the new control equipment being considered.

POLLUTANTS TO BE CONTROLLED	Uncontrolled PTE	Existing Capture Efficiency	Existing Control Efficiency	New Capture Efficiency	New Control Efficiency	Existing PTE	New PTE
PM2.5 (Filterable)	0.32	100%	25-75%	100%	90%	0.19	0.03
PM2.5 (Condensible)						0.00	0.00
Total PM2.5	0.32					0.19	0.03
SOx							
NOx							
VOC							
NH3							
Total Pollutants	0.32					0.19	0.03

Total Capital Investment (TCI)	Capital Recovery Factor (CRF) [i*(1+i)^n]/[(1+i)^n - 1]	Annual Capital Recovery Cost (CRC) (TCI x CRF)	Increased Annual O&M (DC)*	Other Indirct Costs (ID) (4% x TCI)	Total Annual Cost (TAC) (CRC+DC+ID)	Emission Reduction - TPY (ER)	Cost Per Ton (TAC/ER)
$ 500,000.00	0.0944	$ 47,196.46	$ 100,000.00	$ 20,000.00	$ 167,196.46	0.16	$ 1,050,229.04

*DC only considered if there is an increase in direct costs (raw material, maintenance, labor, energy, etc.) compared to existing controls.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:
A wet scrubber control consumes fresh water and generates wastewater.

STEP 4:	The cyclone with wet scrubber is the most efficient and only technically feasible control for this source. The control option is evaluated 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 remains the existing enclosure.

STEPS 1-5 **PM 2.5 Control Possibilities**

Item # 2.18 **SOP Fugitive haul road, evaporation pond windrowing and activity, SOP pile, and road dust emissions**

Control Option	Percent Control Min	Percent Control Max	GR/DSCF Min	GR/DSCF Max	Comment	Efficiency Rank
Fugitive Dust	NA	NA	NA	NA	Developing, Implementing, and Maintaining a Fugitive Dust Control Plan (FDCP)	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

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.

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 4 - 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.

Table 6.1.3. MAG BACT Analyses

STEPS 1-5 PM 2.5 Control Possibilities

Item # 3.01 MgCl2 plant process streams from packaging and handling

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 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 4 and 5:	The existing controls of exhausting through a wet scrubber have been determined to be BACT and there are no additional technically feasible options. BACT is selected as the existing wet scrubber.

Steps 1-5 **VOC Control Possibilities**
Item # 3.02 MgCl2 Plant Evaporators

The Compass Ogden facility is the only known domestic producer of the magnesium chloride hexahydrate. It is not surprising, therefore, that EPA's RBLC search yielded no control options for this process. Globally, the only other known producer of magnesium chloride hexahydrate harvests its product from the waters of the Dead Sea. The Dead Sea brine does not contain significant levels of organics and the harvested minerals are naturally white. Therefore, it is not necessary to add bleach to the process.

Due to the unique nature of the Compass Ogden magnesium chloride hexahydrate process, there are no commercially available technologies for controlling VOC and organic HAP. Although there are no demonstrated controls, Compass examined both inherently lower-emitting processes and practices as well as add-on controls that are not yet demonstrated as part of the Step 1 process:

Step 1 – Identify Available Control Technology Options
EPA's RBLC search yielded no control options for this process. Although there are no demonstrated controls, Compass examined both inherently lower-emitting processes and practices as well as add-on controls that are not yet demonstrated as part of the Step 1 process.

Option 1 – includes installation of a multi-effect evaporator to lower the boiling point of the desired concentration brine below the temperatures at which HCl and the organics form.

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, in which the brine is heated concurrently in two evaporators at higher temperatures. 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.

The Dead Sea process utilizes a multi-effect evaporator, but it is not for the purpose of controlling HCl and/or organic emissions.

Option 2 – utilizes microfiltration (<0.02 micron) to remove organics from the feed brine before heating. This would substantially reduce the amount of chloroform, formaldehyde, and methanol emitted, but would have no impact upon HCl emissions. Some bleach would still be required, but much less.

Option 3 – includes condensation of the exhaust plume, treatment via a scrubber system to neutralize the pH, carbon absorption to remove the organics from the collected waste stream, and then disposal of the waste water. Because federal water quality standards prohibit the discharge of wastewater from saline brine processing, the wastewater would need to be disposed using a lined, permitted, evaporation pond.

Option 4 - Use of chlorine alternatives as an oxidizing agent instead of bleach. However, alternatives to Chlorine bleach (peroxides, percarbonates, persulfates, ozone) would produce unwanted byproducts and dark flake. The basic purpose and design of Compass's magnesium chloride hexahydrate process is to produce white flake. White flake product is used in blends of consumer products used to melt snow and ice. The naturally "dark" flake has been proven in the consumer marketplace as unacceptable and rejected by consumers. If compass could not produce white flake, their market share would be replaced by imported material. Several non-chlorine bleaches were evaluated. Some were eliminated due to increased employee safety risks or because they added an unacceptable level of complexity to the process. None of the remaining non-chlorine bleach options produced white flake. Because the objective of the magnesium chloride hexahydrate plant is to produce a white flake for sale, and the use of bleach is inherent to that purpose, it is not appropriate to include in the BACT analysis an option that would result in a different product (i.e. a dark flake).[3]

Option 5 - Limit the amount of excess bleach.

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[3] *See In re Prairie State Generating Company LLC*, 13 E.A.D. 1, 23 (EAB 2006) ("[T]he permit issuer must be mindful that BACT, in most cases, should not be applied to regulate the applicant's objective or purpose for the proposed facility, and therefore, the permit issuer must discern which design elements are inherent to that purpose, articulated for reasons independent of air quality permitting, and which design elements may be changed to achieve pollutant emissions reductions without disrupting the applicant's basic business purpose…").

Step 2 – Eliminate Technically Infeasible Control Options

Step 2 requires an analysis of whether a technology is "available," which means "it can be obtained by the applicant through commercial channels or is otherwise available within the common sense meaning of the term," and is "applicable," which means it "can be reasonably installed and operated on the source type under consideration."[4] Moreover, "technologies in the pilot scale testing stages of development would not be considered for BACT review…"[5] None of the options described above have been demonstrated to control HCl and organic emissions from a magnesium chloride hexahydrate or similar process on production scale basis. However, two stand out as theoretically possible. Each option is evaluated below.

Option 1 – The multi-effect evaporator has been modeled and a bench scale design was tested by Compass. An evaluation of the bench scale test results shows that this option theoretically could be effective; however, it has not been demonstrated on a production scale. Therefore, Option 1 is excluded from further BACT review.

Option 2 – Compass has conducted a successful pilot scale test of microfiltration of the brine, but it has has not been demonstrated on a production scale basis, Compass has conducted a bench scale test. Although an evaluation of the bench scale test results shows that this option theoretically would be effective to reduce the amount of VOC and organic HAP emissions, this option would not reduce HCl emissions. Because this option has only been developed on a pilot scale, and given that HCl comprises the highest fraction of the evaporator HAP emissions, this option is technologically infeasible and is excluded from further BACT review.

Option 3 – This option, which includes carbon absorption and scrubber neutralization of the condensed exhaust plume, is only theoretically effective. It has not been demonstrated on a production scale basis and a bench scale test has not been conducted. Furthermore, because federal water quality standards prohibit the discharge of wastewater from saline brine processing, the wastewater would need to be disposed using a lined, permitted, evaporation pond. Based on engineering calculations, the size of such a pond would occupy approximately 19 acres. Because this option is only theoretical and has not been demonstrated to be either "available" or "applicable" on Compass's production of magnesium chloride hexahydrate, the option is technologically infeasible and is excluded from further BACT review.

Option 4 - Eliminated

Option 5 – Limiting the amount of excess bleach will not be effective in reducing VOC/organic HAP emissions. Diagnostic 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. This is option is technically infeasible because it does not solve the problem of organic vapor formation at temperatures over ~270 °F.

Step 3-5 – Rank and Evaluate Remaining Control Options. Identify BACT.

After eliminating the technologically infeasible control options, there are no further options to consider for Steps 3 through 5.

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[4] New Source Review Workshop Manual at B.7, cited in *In re Cardinal FG Company*, 12 E.A.D. 153, 163 (EAB 2005).

[5] *Id.*

STEPS 1-3 PM 2.5 Control Possibilities

Item # 3.03 MAG CT Mag Plant Cooling Towers

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

Information for Economic Analysis		Description
EU ID	MAG Evaporators	Mag Plant Cooling Towers
Existing Control	DE	Drift Eliminators (0.1% Drift)
Alternate Control		Hi Efficiency Drift Eliminators (0.0005% Drift)
Interest Rate (i)	7.0%	Interest rate at which the company can borrow money.
Useful Life (n)	20	Estimated useful life of the new control equipment being considered.

POLLUTANTS TO BE CONTROLLED	Uncontrolled PTE	Existing Capture Efficiency	Existing Control Efficiency	New Capture Efficiency	New Control Efficiency	Existing PTE	New PTE
PM2.5 (Filterable)	0.00					0.00	0.00
PM2.5 (Condensible)	0.424					0.424	0.002
Total PM2.5	0.424					0.424	0.002
SOx							
NOx							
VOC							
NH3							
Total Pollutants	0.424					0.424	0.002

Total Capital Investment (TCI)	Capital Recovery Factor (CRF) [i*(1+i)^n]/[(1+i)^n - 1]	Annual Capital Recovery Cost (CRC) (TCI x CRF)	Increased Annual O&M (DC)*	Other Indirct Costs (ID) (4% x TCI)	Total Annual Cost (TAC) (CRC+DC+ID)	Emission Reduction - TPY (ER)	Cost Per Ton (TAC/ER)
$ 3,525.00	0.0944	$ 332.74	$ -	$ 141.00	$ 473.74	0.422	$ 1,122.91

*DC only considered if there is an increase in direct costs (raw material, maintenance, labor, energy, etc.) compared to existing controls.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

STEP 4:	The high efficiency drift eliminator is the most efficient control for this source and is evaluated to be economically feasible.

STEP 5:	BACT is selected as a high efficiency drift eliminator.

STEPS 1-3 **PM 2.5 Control Possibilities**

Item # 3.04 **Magnesium chloride material handling sources controlled by full enclosures, partial enclosures, and/or building enclosures.**

Control Option	Percent Control		GR/DSCF		Comment	Typical Efficiency for this Application	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.	99	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.	90	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. Used in conjunction with above listed controls if necessary to reduce loading.	N/A	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.	N/A	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.	N/A	NA
Drop Height Reduction	NA	NA	NA	NA	Drop height reduction can include enclosures or not.	NA	NA
Enclosure	NA	NA	NA	NA	A building, silo, shroud, etc. around transfer points, drop points, load/unload areas, conveyors, etc.	NA	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	NA
Inherent Moisture Content	NA	NA	NA	NA	Some materials have inherent moisture content, which helps to minimize emissions.	NA	NA
Stabilization: Chemical	NA	NA	NA	NA	Chemicals dust suppressants include salts, lignin sulfonate, wetting agents, latexes, plastics, and petroleum derivatives.	NA	NA
Stabilization: Physical	NA	NA	NA	NA	Water spraying, paving, sweeping, tarping piles, etc.	NA	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	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	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	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	NA

Information for Economic Analysis		Description
EU ID	MAG EMH	Group 1 - Magnesium chloride material handling sources controlled by full enclosures, partial enclosures, and/or building enclosures.
Existing Control	Enclosure	Full enclosure, partial enclosure, or building enclosure
Alternate Control		Route to MP WS
Interest Rate (i)	7.0%	Interest rate at which the company can borrow money.
Useful Life (n)	20	Estimated useful life of the new control equipment being considered.

POLLUTANTS TO BE CONTROLLED	Uncontrolled PTE	Existing Capture Efficiency	Existing Control Efficiency	New Capture Efficiency	New Control Efficiency	Existing PTE	New PTE
PM2.5 (Filterable)	0.03	100%	25-75%	100%	99%	2.80E-03	3.20E-04
PM2.5 (Condensible)	0					0.00	0.00
Total PM2.5	0.03					0.00	0.00
SOx							
NOx							
VOC							
NH3							
Total Pollutants	0.03					2.80E-03	3.20E-04

Total Capital Investment (TCI)	Capital Recovery Factor (CRF) [i*(1+i)^n]/[(1+i)^n - 1]	Annual Capital Recovery Cost (CRC) (TCI x CRF)	Increased Annual O&M (DC)*	Other Indirct Costs (ID) (4% x TCI)	Total Annual Cost (TAC) (CRC+DC+ID)	Emission Reduction - TPY (ER)	Cost Per Ton (TAC/ER)
$ 138,000.00	0.0944	$ 13,026.22	$ -	$ 5,520.00	$ 18,546.22	0.002	$ 7,478,316.03

*DC only considered if there is an increase in direct costs (raw material, maintenance, labor, energy, etc.) compared to existing controls.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:
The existing wet scrubber control consumes fresh water and generates wastewater.

STEP 4:	The Wet Scrubber is the most efficient control for this source and is evaluated 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.

Table 6.1.4. Natural Gas-Fired Industrial Boiler BACT Analyses

STEPS 1-5 PM 2.5 Control Possibilities

Item # 4.01 - 4.02 Natural Gas Boiler 1 and Boiler 2

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 4 and 5:	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.

STEPS 1-5 SOx Control Possibilities

Item # 4.01 - 4.02 Natural Gas Boiler 1 and Boiler 2

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
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
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

STEP 4 and 5:	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.

STEPS 1-5 NOx Control Possibilities

Item # 4.01 - 4.02 Natural Gas Boiler 1 and Boiler 2

Control Option	Percent Control		LB/MMBTU			Efficiency
	Min	Max	Min	Max	Comment	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 $\leq$ 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 4 and 5:	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. 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. BACT is selected as the existing ULNB with FGR and continuous oxygen trim system., plus pipeline quality natural gas, plus good combustion practices.

STEPS 1-5 VOC Control Possibilities

Item # 4.01 - 4.02 Natural Gas Boiler 1 and Boiler 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 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 4 and 5:	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.

STEPS 1-5 NH3 Control Possibilities

Item # 4.01 - 4.02 Natural Gas Boiler 1 and Boiler 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 4 and 5:	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.

Table 6.1.5. Internal Combustion Engine BACT Analyses

Items 5.01 - 5.07 **Emergency Engines** **Engine Data**

	0.7457 kW per HP				Efficiency
Item #	**kW**	**HP**	**EPA Tier**	**Comment**	**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. Pre-NSPS manufacture date. 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
5.07	20	26.8	NA	20 kW Natural Gas fired emergency generator engine (near Customer Service Area). 2018manufacture date. ***Presumptive BACT due to Tier 4 status.***	NA

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

Information for Economic Analysis		Description
EU ID	OGN007	175 KW Diesel Fired Emergency Engine
Existing Control	None	
Alternate Control		Replace with NSPS Compliant Engine or purchase add-on controls
Interest Rate (i)	7.0%	Interest rate at which the company can borrow money.
Useful Life (n)	20	Estimated useful life of the new control equipment being considered.

POLLUTANTS TO BE CONTROLLED	Uncontrolled PTE	Existing Capture Efficiency	Existing Control Efficiency	New Capture Efficiency	New Control Efficiency	Existing PTE	New PTE
PM2.5 (Filterable)							
PM2.5 (Condensible)							
Total PM2.5	0.008					0.008	0.0003
SOx	0.000					0.000	0.0000
NOx	0.282					0.282	0.0080
VOC	0.008					0.008	0.0080
NH3	0.002					0.002	0.0002
Total Pollutants	0.300					0.300	0.017

Engine Replacement Total Capital Investment (TCI)	Capital Recovery Factor (CRF) [i*(1+i)^n]/[(1+i)^n - 1]	Annual Capital Recovery Cost (CRC) (TCI x CRF)	Increased Annual O&M (DC)*	Other Indirct Costs (ID) (4% x TCI)	Total Annual Cost (TAC) (CRC+DC+ID)	Emission Reduction - TPY (ER)	Cost Per Ton (TAC/ER)
$ 106,000.00	0.0944	$ 10,005.65	$ -	$ 4,240.00	$ 14,245.65	0.284	$ 50,199.73

*DC only considered if there is an increase in direct costs (raw material, maintenance, labor, energy, etc.) compared to existing controls.

Engine Add-on Controls Total Capital Investment (TCI)	Capital Recovery Factor (CRF) [i*(1+i)^n]/[(1+i)^n - 1]	Annual Capital Recovery Cost (CRC) (TCI x CRF)	Increased Annual O&M (DC)*	Other Indirct Costs (ID) (4% x TCI)	Total Annual Cost (TAC) (CRC+DC+ID)	Emission Reduction - TPY (ER)	Cost Per Ton (TAC/ER)
$ 21,200.00	0.0944	$ 2,001.13	$ -	$ 848.00	$ 2,849.13	0.284	$ 10,039.95

*DC only considered if there is an increase in direct costs (raw material, maintenance, labor, energy, etc.) compared to existing controls.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

STEP 4 and 5:	Engine replacement is not economically feasible. Add-on controls (SCR or NSCR) is chosen as BACT .

Table 6.1.6. Miscellaneous BACT Analyses

STEPS 1-5 VOC Control Possibilities

Item # 6.01 Gasoline Storage Tank - 6,000 gallons

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. Not demonstrated for 6,000 gallon tanks.	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. Not applicable.	NA
Vapor return line to gasoline cargo tank					***Required by R307-328 (or other means of controlling vapors during tank fi***	NA

STEP 4 and 5:	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. BACT is selected as controlled filling practices and maintaining a white

STEPS 1-5 VOC Control Possibilities

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

Control Option	Percent Control		GR/DSCF		Comment	Efficiency Rank
	Min	Max	Min	Max		
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 4 and 5: The existing controls of maintaining a white reflective tank surface have been determined to be BACT and there are no additional technically feasible options. BACT is selected as white or reflective exterior color, good maintenance, and low vapor pressure of contents.

STEPS 1-3 PM 2.5 Control Possibilities

Items # 6.03 Abrasive Blast Machine

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

Information for Economic Analysis		Description
EU ID	BLAST	Abrasive Blast Machine
Existing Control	None	
Alternate Control		Enclosure
Interest Rate (i)	7.0%	Interest rate at which the company can borrow money.
Useful Life (n)	20	Estimated useful life of the new control equipment being considered.

POLLUTANTS TO BE CONTROLLED	Uncontrolled PTE	Existing Capture Efficiency	Existing Control Efficiency	New Capture Efficiency	New Control Efficiency	Existing PTE	New PTE
PM2.5 (Filterable)	0.090	0%	0%	0%	75%	0.09	0.02
PM2.5 (Condensible)							
Total PM2.5	0.090					0.090	0.0225
SOx							
NOx							
VOC							
NH3							
Total Pollutants	0.090					0.090	0.023

Engine Replacement Total Capital Investment (TCI)	Capital Recovery Factor (CRF) [i*(1+i)^n]/[(1+i)^n - 1]	Annual Capital Recovery Cost (CRC) (TCI x CRF)	Increased Annual O&M (DC)*	Other Indirct Costs (ID) (4% x TCI)	Total Annual Cost (TAC) (CRC+DC+ID)	Emission Reduction - TPY (ER)	Cost Per Ton (TAC/ER)
$ 108,000.00	0.0944	$ 10,194.44	$ -	$ 4,320.00	$ 14,514.44	0.068	$ 215,028.68

*DC only considered if there is an increase in direct costs (raw material, maintenance, labor, energy, etc.) compared to existing controls.

ENVIRONMENTAL & OTHER IMPACTS ANALYSIS:

STEP 4 and 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.

7. Proposed Limits, Monitoring, Recordkeeping, and Schedule

Table 7.1 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 7.1. 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 many sources at Compass Minerals. 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 total PM10 based on available filterable PM data. Total PM10 being the sum of filterable and condensable PM10. Upon further emission testing, separate emission limits for CPM and filterable PM can be established, with an overall reduction in emission limit. 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 particulate emission limits presented in Table 7.1.

1. For "dry" emission sources which do not have appreciable exhaust moisture: A limit on Total PM2.5 emissions. Compliance demonstration will use EPA-accepted PM2.5 filterable measurements.
2. For "wet" emission sources such as scrubbers and dryers: Separate limits for PM2.5 filterable and CPM emissions. Compliance demonstration will use EPA-accepted PM10 filterable measurement with particle size fractioning and CPM measurements.

CPM-specific limits may be established 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. Condensable particulates are a gas when they exit the stack. They condense when cooled into an aerosol, particle, or globule of unknown size. Condensable particulate cannot currently be described in terms of 2.5, 10, or greater than 10 microns as it exits the stack. Condensable particulate 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 Total PM2.5 (being a sum of PM2.5 filterable and CPM), and filterable PM2.5 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.

For Compass Minerals, the precise origin of the CPM in any particular operating condition for certain processes is variable depending on the emission source. The genesis of CPM could be inorganic condensable particulate (product contamination), combustion condensable particulate (although not likely for natural gas fuel), organic matter in brine from the Great Salt Lake, or other organic condensable particulate. 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 75 Fed. Reg. 80108, 80121 (Dec. 21, 2010)*]. 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 all scrubbers and filter baghouses or cartridge filter baghouses controlling moist exhaust from sources such as dryers and product coolers, the particulate limit be expressed as total PM filterable rather than separate limits for PM filterable, fractionated by size and CPM to align with current measurement technology. A limit on Total PM filterable will serve to limit PM2.5 also, because PM2.5 is a sub-set of PM10 and 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 did not 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; this limit account for the difficulties that Compass has experienced in operating ultra-low NOx burners during periods of high ambient temperature.

Table 7.1. Summary of Proposed Limits (lb/hr)

Item #	Permit ID	Area	EU ID	EU Description	Control ID	Control Description	PM Total - Fil	PM2.5 - Fil	PM2.5 - Con	SOx	NOx	VOC	NH3
1.01	II.A3	SALT	AH-500	Salt Cooler Circuit	AH-500	Cyclonic wet scrubber	1.01		1.51				
1.02	II.A4	SALT	AH-502	Salt Plant Circuit	AH-502	Cyclonic wet scrubber	2.20		3.29				
1.03	II.A6	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)	0.93		1.39				
1.04	II.A19	SALT	F-506	Salt Cooler	BH-501	Baghouse	1.51		2.26				
1.05	II.A27	SALT	BH-502	Salt bulk load-out	BH-502	Cartridge filter dust collector		0.15					
1.06	Pending NOI	SALT	SALT OMH	SALT outdoor uncaptured, unenclosed, and uncontrolled material handling	Permit Cond. II.B.1.g	Permit Cond. II.B.1.g regarding limitations on visible emissions caused by fugitive dust.							
1.07	Pending NOI	SALT	SALT EMH	SALT material handling sources controlled by full enclosures, partial enclosures, and/or building enclosures.	Permit Cond. II.B.1.g	Permit Cond. II.B.1.g regarding limitations on visible emissions caused by fugitive dust.							
1.08	II.A1	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.							
1.09	Pending NOI	SALT	BH-503	Salt Screening Circuit	BH-503	Baghouse that exhausts back into the building to be routed to ambient							
1.10	Pending NOI	SALT	BH-505	Salt Special Products Circuit	BH-505	Baghouse that exhausts back into the building to be routed to ambient							

Item #	Permit ID	Area	EU ID	EU Description	Control ID	Control Description	PM Total - Fil	PM2.5 - Fil	PM2.5 - Con	SOx	NOx	VOC	NH3
2.01	Pending NOI	SOP	D-1545	SOP Dryer D-1545	BH-1545	Baghouse w/ Cyclone & LNB; Permit Cond. II.B.1.c. (nat gas fuel)	5.42		8.13				
2.02	II.A.10; Pending NOI	SOP	AH-1555	SOP Plant Compaction Building (Wet)	AH-1555	Wet scrubber	0.77		1.15				
2.03	II.A.11	SOP	B-1520	Nat gas process heater (7 mmBtuh; limited to 5 mmBtuh)	AH-1555	Wet scrubber; Permit Cond. II.B.1.c. (nat gas fuel)	Emissions included in Item No. 2.02.						
2.04	II.A.14	SOP	BH-001	SOP Bulk Loadout Circuit	BH-001	Baghouse		0.27					
2.05	II.A.15	SOP	BH-002	SOP Silo Storage Circuit	BH-002	Baghouse		0.60					
2.06	Pending NOI	SOP	BH-019	Bin 19 vent cartridge filter	BH-019	Fabric Filter							
2.07	Pending NOI	SOP	BH-1505	Bin 1505 vent cartridge filter	BH-1505	Fabric Filter							
2.08	Pending NOI	SOP	BH-1510	Bin 1510 vent cartridge filter	BH-1510	Fabric Filter							
2.09	Pending NOI	SOP	BH-1565	SOP Compaction Recycle Hopper Bin Vent	BH-1565	Fabric Filter							
2.10	II.A.7; Pending NOI	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)	3.37		5.05				
2.11	Pending NOI	SOP	BH-NEW	SOP Plant Compaction Building (Dry)	BH-NEW	Cyclone and Baghouse for PM		0.21					
2.12	Pending NOI	SOP	Dust Torits	SOP Enclosed Material Handling Sources	Dust Torits	Source-specific Cartridge Filter Vents for PM							
2.13	Pending NOI	SOP	DeFoam	SOP Defoamer	No Control	None							
2.14	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)							
2.15	II.A.26	SOP	SOP CT	Cooling Towers (SOP)	DE	Drift eliminators							

Item #	Permit ID	Area	EU ID	EU Description	Control ID	Control Description	PM Total - Fil	PM2.5 - Fil	PM2.5 - Con	SOx	NOx	VOC	NH3
2.16	Pending NOI	SOP	SOP OMH	SOP outdoor uncaptured, unenclosed, and uncontrolled material handling	Permit Cond. II.B.1.g	Permit Cond. II.B.1.g regarding limitations on visible emissions caused by fugitive dust.							
2.17	Pending NOI	SOP	SOP EMH	SOP material handling sources controlled by full enclosures, partial enclosures, and/or	BL003 BL004 BL006 NCB	Inside a building; Permit Cond. II.B.1.g regarding limitations on visible emissions caused by fugitive dust.							
2.18	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.							
3.01	II.A.23	MAG	MP WS	MgCl2 plant process streams from packaging and handling	AH-692	High energy venturi wet scrubber	0.18		0.26				
3.02	NOI anticipated 5/2017	MAG	EVAP	MgCl2 plant evaporators venting through 4 stacks	No Control	None						9.27	
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		

Item #	Permit ID	Area	EU ID	EU Description	Control ID	Control Description	PM Total - Fil	PM2.5 - Fil	PM2.5 - Con	SOx	NOx	VOC	NH3
5.01	II.A29	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.A21	MISC	MIS	175 kW emergency generator engine, diesel	Eng Controls	MACT engine controls, as applicable, including ULSD.							
5.05	II.A21	MISC	THICK	300 kW emergency generator engine diesel	Eng Controls	NSPS engine controls, as applicable, including ULSD.							
5.06	II.A21	MISC	Fire Water Backup	450 kW emergency FW pump engine, diesel	Eng Controls	NSPS engine controls, as applicable, including ULSD.							
5.07	Pending NOI	MISC	CS Gen	20 kW emergency generator, Propane	Eng Controls	NSPS engine controls, as applicable							
6.01	II.A25	MISC	3	Gasoline Storage Tank - 6,000 gal	Tank Color	White/reflective exterior							
6.02	II.A25	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.A17	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.A22	MISC	ROADS	Various roads and disturbed, unpaved areas	FDCP	Fugitive Dust Control Plan							

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 frequency of once every three years.

Implementation Schedule

As a result of the BACT analyses presented in Section 6, 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 covers a wide range.

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

1. Compass intends to route dry SOP material handling sources, currently routed to wet scrubber AH-1555 to a new baghouse system, as identified in the BACT analysis Table 6.12 Item 2.11, no later than December 31, 2019. The SOP EMH group 7 source identified in Table 6.12 Item 2.17 will also be routed to the new baghouse.
2. Compass intends to replace the AH-1547 wet scrubber, which currently controls SOP dryer D-1545, with a new control device. Compass intends to replace the scrubber with a new baghouse system, if technically feasible. Due to the high moisture content of the D-1545 exhaust, the bags may become blinded, in which case, an appropriately designed scrubber will become a more effective option. Compass will conduct pilot tests to determine the technical feasibility of the baghouse control. Based on the pilot test results, Compass intends to replace AH-1547 no later than December 31, 2019.
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, 2019.
4. Compass intends to implement the proposed emission limits and monitoring schedule outlined above, no later than December 31, 2019.

Source Name	PM10-Pri	PM10 - Fil	PM10 - Con	PM2.5-Pri	PM2.5 - Fil	PM2.5 - Con
AH500	3.46	3.46	0.00	3.05	3.05	0.00
AH502	8.72	7.94	0.78	8.17	7.39	0.78
AH513	7.71	6.08	1.64	7.71	6.08	1.64
AH1555	2.90	2.06	0.84	2.90	2.06	0.84
MP WS	0.99	0.99	0.00	0.99	0.99	0.00
BH001	0.29	0.29	0.00	0.18	0.18	0.00
BH002	0.59	0.59	0.00	0.08	0.08	0.00
BH501	9.90	1.21	8.69	8.87	0.18	8.69
BH502	0.38	0.38	0.00	0.27	0.27	0.00
BH503	0.12	0.12	0.00	0.08	0.08	0.00
BH505	0.10	0.10	0.00	0.04	0.04	0.00
BH1400	14.09	1.61	12.48	13.78	1.30	12.48
BH1505	0.07	0.07	0.00	0.01	0.01	0.00
BH1510	0.16	0.16	0.00	0.12	0.12	0.00
BH1545	23.37	12.12	11.25	23.37	12.12	11.25
BH1565	0.15	0.15	0.00	0.12	0.12	0.00
BHNEW	2.01	2.01	0.00	0.32	0.32	0.00
Dust Torits	1.01	1.01	0.00	0.45	0.45	0.00
SOP Uncaptured	14.71	14.34	0.37	3.84	3.47	0.37
SALT Uncaptured	9.91	9.91	0.00	4.44	4.44	0.00
MAG Uncaptured	0.64	0.64	0.00	0.44	0.44	0.00
SOP OMH	75.83	75.83	0.00	20.65	20.65	0.00
SALT OMH	7.67	7.67	0.00	1.16	1.16	0.00
SOP EMH	67.84	67.84	0.00	13.94	13.94	0.00
SALT EMH	2.54	2.54	0.00	1.24	1.24	0.00
MAG EMH	0.01	0.01	0.00	0.01	0.01	0.00
NGB-1	3.53	0.88	2.65	3.53	0.88	2.65
NGB-2	3.53	0.88	2.65	3.53	0.88	2.65
SC450, SC460	0.98	0.24	0.73	0.98	0.24	0.73
SC461, SC462	1.96	0.49	1.47	1.96	0.49	1.47
MAG Evaps	0	0	0	0	0	0
Defoamer	0	0	0	0	0	0
CT003	1.32	0.00	1.32	1.32	0.00	1.32
CT004	1.32	0.00	1.32	1.32	0.00	1.32
CT639	1.86	0.00	1.86	1.86	0.00	1.86
BLAST	4.27	4.27	0.00	0.43	0.43	0.00
GN100	0.03	0.03	0.03	0.03	0.03	0.03
GN200	0.00	0.00	0.00	0.00	0.00	0.00
GN300	0.00	0.00	0.00	0.00	0.00	0.00
GN1200	0.01	0.01	0.01	0.01	0.01	0.01
GN1300	0.01	0.01	0.01	0.01	0.01	0.01
Admin Gen	0.04	0.04	0.04	0.04	0.04	0.04
CS Gen	0.00	0.00	0.00	0.11	0.00	0.00
Tank 3	0	0	0	0	0	0

Tank 4	0	0	0	0	0	0
Tank 5	0	0	0	0	0	0
Total	**274.00**	**225.97**	**48.12**	**131.33**	**83.19**	**48.12**

Emissions (tons per year)

SOx	NOX	VOC	CO	Lead	CH4	CO2	N2O
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0.33	5.43	1.20	18.40	0.00	0.50	26280.00	0.14
0.03	0.53	0.12	1.80	0.00	0.05	2576.47	0.01
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0.33	5.43	1.20	18.40	0.00	0.50	26280.00	0.14
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0.19	3.19	0.71	10.82	0.00	0.30	15458.82	0.08
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0.70	5.69	2.55	39.00	0.00	1.04	55348.97	0.10
0.70	5.69	2.55	39.00	0.00	1.04	55348.97	0.10
0.19	3.19	0.71	10.82	0.00	0.30	15458.82	0.08
0.39	6.38	1.42	21.64	0.00	0.59	30917.65	0.16
0	0	27.07	0	0	0	0	0
0	0	27.37	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0.00	0.87	0.10	0.87	0	0.10	176.94	0
0.03	0.09	0.02	0.98	0	0.02	2.35	0
0.03	0.09	0.02	0.98	0	0.02	2.35	0
0.00	0.88	0.01	0.05	0	0.01	115.66	0
0.00	0.20	0.20	0.05	0	0.20	38.89	0
0.00	1.41	0.04	0.32	0	0.04	68.06	0
0.00	0.03	0.03	0.01	0	0.03	1.88	0
0	0	0.915635	0	0	0	0	0

0	0	0.00455	0	0	0	0	0
0	0	0.00455	0	0	0	0	0
2.93	**39.10**	**66.25**	**163.13**	**0.00**	**4.75**	**228075.81**	**0.83**

NH3
0
0
0.70
0.07
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0.70
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6.13