DRAFT ENGINEERING EVALUATION

Plant 17456: Peet's Coffee & Tea, Inc.
2001 Harbor Bay Parkway, Alameda, CA, 94502

Applications 28552 and 30019: New Coffee Roaster-Cooler-Destoner Systems and Modification of Existing Roasting Systems

BACKGROUND

Peet's Coffee & Tea, Inc (Peet's) has applied to obtain an Authority to Construct (AC) and/or a Permit to Operate (PO) for the following equipment at its facility in Alameda, CA under AN 28552:

S-3 **Batch Coffee Roaster, Probat R1000, 2200 lbs of green beans/hour capacity; 2.15 MMBtu/hr natural gas-fired burner, Maxon Ovenpak MDL#400 Size 422M; Abated by A-3 cyclone and A-4 Direct Flame Afterburner in series; Emission Point P-3**

A-3: Roaster Cyclone; Probat, 900 mm diameter

A-4: Direct Flame Afterburner, Conversion Products TA34/50V-1700EC-NB equipped with 20 MMBTU/hour Eclipse TJ2000 natural gas-fired burner

Maximum exhaust air flow rate: 2,416 dscfm; Outlet PM10 grain loading: 0.01 grains/dscf

S-4 **Batch Coffee Cooler and Destoner, Probat R1000, 2200 lbs of green beans/hour capacity; Cooler abated by A-5 cyclone and intermittently by A-4 afterburner in series; Emission Points P-3 (when abated by A-4) and P-4 (when not abated by A-4)**

A-5: Cooler Cyclone; Probat, 1200 mm diameter; Maximum exhaust air flow rate: 5,108 dscfm; Outlet PM10 grain loading: 0.0045 grains/dscf

A-4: Direct Flame Afterburner, Conversion Products TA34/50V-1700EC-NB equipped with 20 MMBTU/hour Eclipse TJ2000 natural gas-fired burner

Destoner abated by A-32 cyclone; Emission Point P-25
A-32: Destoner Cyclone; Probat, 1200 mm diameter; Maximum destoner exhaust air flow rate: 4,864 dscfm; Outlet PM10 grain loading: 0.01 grains/dscf

---

S-5 **Batch Coffee Roaster, Probat R1000, 2200 lbs of green beans/hour capacity; 2.15 MMBtu/hr natural gas-fired burner, Maxon Ovenpak MDL#400 Size 422M; Abated by A-6 cyclone and A-7 Direct Flame Afterburner in series; Emission Point P-5**

A-6: Roaster Cyclone; Probat, 900 mm diameter

A-7: Direct Flame Afterburner, Conversion Products TA34/50V-1700EC-NB equipped with 20 MMBTU/hour Eclipse TJ2000 natural gas-fired burner

Maximum exhaust air flow rate: 2,416 dscfm; Outlet PM10 grain loading: 0.01 grains/dscf

S-6 **Batch Coffee Cooler and Destoner, Probat R1000, 2200 lbs of green beans/hour capacity; Cooler abated by A-8 cyclone and intermittently by A-7 afterburner in series; Emission Points P-5 (when abated by A-7) and P-6 (when not abated by A-7)**

A-8: Cooler Cyclone; Probat, 1200 mm diameter; Maximum exhaust air flow rate: 5,108 dscfm; Outlet PM10 grain loading: 0.0045 grains/dscf

A-7: Direct Flame Afterburner, Conversion Products TA34/50V-1700EC-NB equipped with 20 MMBTU/hour Eclipse TJ2000 natural gas-fired burner

Destoner abated by A-33 cyclone; Emission Point P-26

A-33: Destoner Cyclone; Probat, 1200 mm diameter; Maximum exhaust air flow rate: 4,864 dscfm; Outlet PM10 grain loading: 0.01 grains/dscf when abating destoner exhaust

---

S-7 **Batch Coffee Roaster, Probat R1500, 3300 lbs of green beans/hour capacity;**

3.5 MMBtu/hr natural gas-fired burner, Maxon Ovenpak II MDL#400 Model 435 op2;
Abated by A-9 cyclone and A-10 Direct Flame Afterburner in series; Emission Point P-7

A-9: Roaster Cyclone; Probat, 1200 mm diameter

A-10: Direct Flame Afterburner, Conversion Products TA48/66V-3700EC-NB equipped with two 20 MMBTU/hour Eclipse TJ2000 natural gas-fired burners; Total 40 MMBtu/hr
Maximum exhaust air flow rate: 3,300 dscfm; Outlet PM10 grain loading: 0.01 grains/dscf

S-8 **Batch Coffee Cooler, Probat R1500, 3300 lbs of green beans/hour capacity;**
Abated by A-11 cyclone and intermittently by A-10 Afterburner in series; Emission Points P-7 (when abated by A-10) and P-8 (when not abated by A-10)

A-11: Cooler Cyclone; Probat, 1500 mm diameter; Maximum exhaust air flow rate: 9,500 dscfm; Outlet PM10 grain loading: 0.0045 grains/dscf

A-10: Direct Flame Afterburner, Conversion Products TA48/66V-3700EC-NB equipped with two 20 MMBTU/hour Eclipse TJ2000 natural gas-fired burners; Total 40 MMBtu/hr

S-9 **Batch Coffee Destoner, Probat R1500, 3300 lbs of green beans/hour capacity;**
Abated by A-12 cyclone; Emission Point P-9

A-12: Destoner Cyclone; Probat, 1200 mm diameter; Maximum exhaust air flow rate: 5,108 dscfm; Outlet PM10 grain loading: 0.01 grains/dscf

---

S-10 **Batch Coffee Roaster, Probat R1500, 3300 lbs of green beans/hour capacity;**
3.5 MMBtu/hr natural gas-fired burner Maxon Ovenpak II MDL#400 Model 435 op2;
Abated by A-13 cyclone and A-14 Direct Flame Afterburner in series; Emission Point P-10

A-13: Roaster Cyclone; Probat, 1200 mm diameter

A-14: Direct Flame Afterburner, Conversion Products TA48/66V-3700EC-NB equipped with two 20 MMBTU/hour Eclipse TJ2000 natural gas-fired burners; Total 40 MMBtu/hr
Maximum exhaust air flow rate: 3,300 dscfm; Outlet PM10 grain loading: 0.01 grains/dscf

S-11 **Batch Coffee Cooler, Probat R1500, 3300 lbs of green beans/hour capacity;**
Abated by A-15 cyclone and intermittently by A-14 Afterburner in series; Emission Points P-10 (when abated by A-14) and P-11 (when not abated by A-14)

A-15: Cooler Cyclone; Probat, 1500 mm diameter; Maximum exhaust air flow rate: 9,500 dscfm; Outlet PM10 grain loading: 0.0045 grains/dscf

A-14: Direct Flame Afterburner, Conversion Products TA48/66V-3700EC-NB equipped with two 20 MMBTU/hour Eclipse TJ2000 natural gas-fired burners; Total 40 MMBtu/hr

S-12 **Batch Coffee Destoner, Probat R1500, 3300 lbs of green beans/hour capacity;**
Abated by A-16 cyclone; Emission Point P-12

A-16: Destoner Cyclone; Probat, 1200 mm diameter; Maximum exhaust air flow rate: 5,108 dscfm; Outlet PM10 grain loading: 0.01 grains/dscf

---

S-16 **Batch Coffee Roaster, Probat R1500, 3300 lbs of green beans/hour capacity;**
3.5 MMBtu/hr natural gas-fired burner, Maxon Ovenpak II Model 235;
Abated by A-22 cyclone and A-23 Regenerative Thermal Oxidizer (RTO) in series; Emission Point P-17

A-22: Roaster Cyclone; Probat, 1200 mm diameter

A-23: Regenerative Thermal Oxidizer, B&W Megtec, Model Millennium-1040-95 equipped with 2.78 MMBTU/hour Maxon Kinedizer LE 3" natural gas-fired burner

Maximum exhaust air flow rate: 25,400 dscfm; Outlet PM10 grain loading: 0.01 grains/dscf

S-17 **Batch Coffee Cooler, Probat R1500, 3300 lbs of green beans/hour capacity;**

Abated by A-24 cyclone and intermittently by A-23 RTO in series; Emission Points P-17 (when abated by A-23) and P-18 (when not abated by A-23)

A-24: Cooler Cyclone; Probat, 1500 mm diameter; Maximum exhaust air flow rate: 9,500 dscfm; Outlet PM10 grain loading: 0.0045 grains/dscf

A-23: Regenerative Thermal Oxidizer, B&W Megtec, Model Millennium-1040-95 equipped with 2.78 MMBTU/hour Maxon Kinedizer LE 3" natural gas-fired burner

S-18 Batch Coffee Destoner, Probat R1500, 3300 lbs of green beans/hour capacity; Abated by A-25 cyclone; Emission Point P-19

A-25: Destoner Cyclone; Probat, 1200 mm diameter; Maximum exhaust air flow rate: 10,370 dscfm; Outlet PM10 grain loading: 0.01 grains/dscf

---

S-19 Batch Coffee Roaster, Probat P60, 600 lbs of green bean/hr capacity, with 410,000 Btu/hr Maxon, natural gas-fired burner;
abated by A-26 cyclone and A-23 RTO in series; Emission Point P-17
A-26: Roaster Cyclone, Probat, 550 mm diameter; Maximum exhaust air flow rate: 1,098 dscfm; Outlet PM10 grain loading: 0.01 grains/dscf

A-23: Regenerative Thermal Oxidizer, B&W Megtec, Model Millennium-1040-95 equipped with 2.78 MMBTU/hour Maxon Kinedizer LE 3" natural gas-fired burner

S-20 Batch Coffee Cooler, Probat P60, 600 lbs of green bean/hr capacity; abated by A-27 cyclone and intermittently by A-23 RTO in series; Emission Points P-17 (when abated by A-23) and P-20 (when not abated by A-23)

A-27: Cooler and Destoner Cyclone, Probat, 700 mm diameter; Maximum cooler exhaust air flow rate: 2,014 dscfm; Outlet PM10 grain loading: 0.0045 grains/dscf

A-23: Regenerative Thermal Oxidizer, B&W Megtec, Model Millennium-1040-95 equipped with 2.78 MMBTU/hour Maxon Kinedizer LE 3" natural gas-fired burner

S-21 Batch Coffee Destoner, Probat P60, 600 lbs of green bean/hr capacity; abated by A-27 cyclone; Emission Point P-20
A-27: Cooler and Destoner Cyclone, Probat, 700 mm diameter; Maximum destoner exhaust air flow rate: 2,014 dscfm; Outlet PM10 grain loading: 0.01 grains/dscf

---

Peet's Coffee & Tea, Inc (Peet's) has applied to obtain an Authority to Construct (AC) and/or a Permit to Operate (PO) for the following equipment at its facility in Alameda, CA under AN 30019:

S-22 Batch Coffee Roaster, Probat N1500, 3300 lbs of green beans/hour capacity;
3.15 MMBtu/hr natural gas-fired burner, Maxon Ovenpak EB-3;
Abated by A-28 cyclone and A-29 Regenerative Thermal Oxidizer (RTO) in series; Emission Point P-22

A-28: Roaster Cyclone; Probat, 1050 mm diameter

A-29: Regenerative Thermal Oxidizer, Megtec, Model CleanSwitch-300 equipped with 7.5 MMBTU/hour Maxon Kinedizer LE natural gas-fired burner

Maximum exhaust air flow rate: 6,757 dscfm; Outlet PM10 grain loading: 0.01 grains/dscf

S-23 Batch Coffee Cooler, Probat N1500, 3300 lbs of green beans/hour capacity;
Abated by A-30 cyclone and intermittently by A-29 RTO in series; Emission Points P-22 (when abated by A-29) and P-23 (when not abated by A-29)

A-30: Cooler Cyclone; Probat, 1500 mm diameter; Maximum exhaust air flow rate: 8,453 dscfm; Outlet PM10 grain loading: 0.0045 grains/dscf

A-29: Regenerative Thermal Oxidizer, Megtec, Model CleanSwitch-300 equipped with 7.5 MMBTU/hour Maxon Kinedizer LE natural gas-fired burner

S-24 Batch Coffee Destoner, Probat N1500, 3300 lbs of green beans/hour capacity; Abated by A-31 cyclone; Emission Point P-24

A-31: Destoner Cyclone; Probat, 1200 mm diameter; Maximum exhaust air flow rate: 6,658 dscfm; Outlet PM10 grain loading: 0.01 grains/dscf

Source S-3 through S-12, S-16, S-17, and S-18 are existing sources. Under application AN 28552, the permitted facility-wide annual operating time grouped limit will increase from 21,390 hours/year to 35,290 hours/year for the existing sources. The permitted facility-wide green bean throughput grouped limit will increase from 35,300 tons/year to 50,466 tons/year for the existing sources. The annual permitted operating time at each source will increase from an average of 4,278 hours per year to 7,058 hours/year. Annual permitted green bean throughput will increase from an average of 7,060 tons/year at each source to 7,764 tons/year at S-3 through S-6 and to 11,646 tons/year at S-7 through S-12, S-16, S-17, and S-18. The facility has not made any physical changes to these existing sources or upgraded the abatement equipment to reduce the hourly emission rate and compensate for the increased operating time and production. Therefore, source S-3 through S-12, S-16, S-17, and S-18 are modified per Regulation 2-1-234.1 because the annual potential to emit (PTE) of these sources is increasing due to the increase in annual operating time and green bean throughput at each source.

Sources S-19 through S-24 are new sources.

Process Description

The coffee roasting process consists of cleaning, roasting, cooling, destoning, grinding, and packaging operations. Bags of green coffee beans are hand- or machine-opened, dumped into a hopper, and screened to remove debris. The green beans are then weighed and transferred by belt or pneumatic conveyors to storage hoppers. From the storage hoppers the green beans are conveyed to the roasters. This operation at the facility is performed by sources S-1 and S-2 and abated by baghouse A-1. The roasters at the facility (existing S-3, S-5, S-7, S-10, and S-16 and new S-19 and S-22) are indirect fired, drum roasters. The coffee beans are turned in an inclined drum, while hot air for roasting is supplied by an indirect, natural-gas fired burner. The roasting cycle is typically 8 to16 minutes in duration, depending upon the type of beans and quality of roast desired. For some types of roast, water sprays are used to quench the beans within the roaster at the end of the roasting cycle. Following roasting and quenching the beans are cooled in an open, down-draft air cooler with sieve and rotating arms (existing S-4, S-6, S-8, S-11, and S-17 and new S-20 and S-23) and then run through a destoner (existing S-4, S-6, S-9, S-12, and S-18 and new S-21 and S-24). Destoners are air classifiers that remove stones, metal fragments, and other waste not removed from the beans during initial screening. Exhaust from the roasters during the entire roasting cycle is controlled by a cyclone (existing A-3, A-6, A-9, A-13, and A-22 and new A-26 and A-28), followed by an afterburner/ regenerative thermal oxidizer (existing A-4, A-7, A-10, A-14, and A-23 and new A-29). The cooling cycle is typically 6 minutes in duration. The exhaust during the initial two to three minutes of the cooling cycle is controlled by a cyclone (existing A-5, A-8, A-11, A-15 and A-24, and new A-27 and A-30), followed by the afterburner (existing A-4, A-7, A-10, A-14, and A-23 and new A-29) to reduce odor and visible emissions. The exhaust during the rest of the cooling cycle is controlled only by a cyclone (existing A-5, A-8, A-11, A-15 and A-24, and new A-27 and A-30) only. The exhaust from the destoner is controlled by a cyclone (existing A-5, A-8, A-12, A-16, and A-25 and new A-27 and A-31).

The emissions train for existing and new sources is described in the source descriptions above.

The exhaust from the new roaster S-19 will be abated by a dedicated cyclone A-26, prior to venting into existing regenerative thermal oxidizer (RTO) A-23, which is also abating existing roaster S-16. The exhaust from the new cooler S-20 and new destoner S-21 will be abated by same cyclone A-27.

The exhaust from the new roaster S-22 will be abated by a dedicated cyclone A-28, prior to venting into new RTO A-29. The exhaust from the new cooler S-23 will be abated by a dedicated cyclone A-30 and new destoner S-24 will be abated by a dedicated cyclone A-31.

EMISSIONS SUMMARY

Coffee roasting process generates criteria air pollutant and toxic air contaminant (TAC) emissions. These emissions are often attributed to natural gas combustion in the roasters and afterburners/RTO. However, the results of source tests conducted at various facilities, including Peet's, show that oxides of nitrogen (NOx), carbon monoxide (CO), precursor organic compounds (POC) and TAC emissions are higher than what would be expected from only natural gas combustion. It is now well established through engineering studies performed by roaster manufacturers and academic research that in addition to natural gas combustion in roaster and oxidizer burners, the high temperature roasting and thermal/ catalytic oxidation processes also generate criteria air pollutants and TACs e.g. particulate matter less than 10 micrometer aerodynamic diameter (PM10) emissions are generated from coffee bean chaff during roasting and NOx emissions are generated from oxidation of nitrogenous compounds, such as caffeine, in the roaster and thermal/ catalytic oxidizer. Oils/ organic gases released from coffee beans and combusted/ oxidized in the roaster and oxidizer are comingled with natural gas combustion products. Roasting of oils/organic matter in the coffee beans generates gaseous organic pollutants, including alcohols and aldehydes. Particulate matter (PM) emissions also occur due to material handling in roaster, cooler, and destoner. There are many factors that can potentially affect the emission levels from coffee roasting operations including the firing rate of the burners, type and quality of beans, type of roast, time-temperature profile during a roasting cycle, and type and efficiency of abatement equipment.

Emissions of NOx, CO, and POC are based on the hourly permit limits requested by the applicant. To reduce the NOx offset burden, the applicant has requested a lower hourly emission limit for NOx than the hourly PTE estimated by prorating the source tested emission factors on a pounds per ton green bean basis by the maximum hourly green bean roasting capacity of the equipment. To avoid being a Title V Major Facility, the applicant has requested lower hourly emission limit for CO than the hourly PTE estimated by prorating the source tested emission factors on a pounds per ton green bean basis by the maximum hourly green bean roasting capacity of the equipment.

Emissions of PM10 are based on the outlet particulate grain loading rates guaranteed by the equipment manufacturer and the maximum design exhaust air flow rate of the equipment. Sulfur dioxide (SO2) emissions have never been source tested from coffee roasting operations. Therefore, Staff has assumed that SO2 emission occur from natural gas combustion only and have used the emission factor from AP-42 Chapter 1.4, Natural Gas Combustion, to estimate SO2 emissions. Peet's is the largest coffee roasting operation in the Air District. Therefore, staff recommends requiring source tests for SO2 to accurately characterize the emissions.

Table 1 summarizes the emission factors used to estimate the post-project PTE of criteria air pollutants and TACs.

Table 1 – Post-Project Emissions Factors

Pollutant	Emissions Factor	Source
NOx	2.6 lb/hr for S-3 and S-5 2.1 lb/hr for S-7, S-10, S-16, and S-22 0.4 lb/hr for S-19	Permit limit requested by applicant
CO	4.5 lb/hr for S-3 and S-5 5.6 lb/hr for S-7 and S-10 0.2 lb/hr for S-16, S-19, and S-22	
POC	0.1 lb/hr for all roasters	
PM10	0.01 gr/dscf for all roasters and destoners 0.0045 gr/dscf for all coolers	Manufacturer guaranteed outlet grain loading is 0.01 gr/dscf for all equipment. Applicant has accepted a lower grain loading limit for coolers in order to avoid triggering ambient air quality modeling under Regulation 2-2-308
SO2	0.6 lb/MMscf for all roasters + compliance margin = 0.41 lb/hr for all roasters	AP-42 Chapter 1.4, Natural Gas Combustion
Acetaldehyde	0.0032 lb/ton green beans	Maximum of all source tests conducted at Peet's
Formaldehyde	0.0072 lb/ton green beans	
Benzene	2.06E-07 lb/therm	BAAQMD Policy: Emission Factors for Toxic Air Contaminants from Miscellaneous Natural Gas Combustion Sources, dated 2/28/2008
Toluene	3.33E-07 lb/therm	

Emission factors used to estimate the adjusted 3-year baseline emissions are summarized in Table 2. For pollutants and sources that have been source tested, these factors are based on the average of source-specific emission rates derived from compliant source tests conducted during the 3-year baseline period. Per Regulation 2-2-603, the 3-year baseline period used in this application is from July 1, 2016 through June 30, 2019.

Table 2 – Actual Emissions Factors During Baseline Period

Pollutant	Emissions Factor	Source
NOx	1.17 lb/hr for S-3 1.52 lb/hr for S-5 0.76 lb/hr for S-7 0.98 lb/hr for S-10 1.37 lb/hr for S-16	Average of source-specific emission rates derived from compliant source tests conducted during the baseline period - July 1, 2016 through June 30, 2019
CO	3.11 lb/hr for S-3 3.48 lb/hr for S-5 2.20 lb/hr for S-7 1.87 lb/hr for S-10 0.09 lb/hr for S-16	
POC	0.008 lb/hr for S-3 0.015 lb/hr for S-5 0.069 lb/hr for S-7 0.022 lb/hr for S-10 0.01 lb/hr for S-16	
PM10	0.01 gr/dscf for all sources, except 0.0067 gr/dscf for S-16 0.0016 gr/dscf for S-17 0.006 gr/dscf for S-18	Manufacturer guaranteed outlet grain loading for all sources, except for S-16, S-17, S-18 because other sources have never been source tested for PM10
SO2	0.6 lb/MMscf for all roasters	AP-42 Chapter 1.4, Natural Gas Combustion

Post project process rates and operating times and the actual 3-year average baseline process rates and operating times used to estimate post project PTE and actual adjusted baseline emissions are summarized in Appendix A, Table A-1.

Maximum design exhaust flow rates are summarized in Appendix A Table A-2.

Post-project hourly PTE and average 3-year adjusted baseline emissions are summarized in Appendix A Tables A-3 and A-4, respectively.

Tables 3 and 4 summarize the post-project daily PTE and post-project annual PTE, respectively.

Tables 5 and 6 summarize the hourly and annual TAC emissions, respectively.

Table 3 – Post-Project Daily Potential to Emit (Pounds/Day)

Source #	NOx	CO	POC	PM10	SO2	PM2.5
3	59.8	103.5	2.3	4.8	9.50	4.8
4	0.0	0.0	0.0	4.5 (cooler) + 9.6 (destoner) = 14.1	0.00	14.1
5	59.8	103.5	2.3	4.8	9.50	4.8
6	0.0	0.0	0.0	4.5 (cooler) + 9.6 (destoner) = 14.1	0.00	14.1
7	48.3	128.8	2.3	6.6	9.50	6.6
8	0.0	0.0	0.0	8.4	0.00	8.4
9	0.0	0.0	0.0	10.1	0.00	10.1
10	48.3	128.8	2.3	6.6	9.50	6.6
11	0.0	0.0	0.0	8.4	0.00	8.4
12	0.0	0.0	0.0	10.1	0.00	10.1
16	48.3	4.6	2.3	6.6	9.50	6.6
17	0.0	0.0	0.0	8.4	0.00	8.4
18	0.0	0.0	0.0	10.3	0.00	10.3
19	6.4	3.2	1.6	1.5	6.61	1.5
20	0.0	0.0	0.0	1.2	0.00	1.2
21	0.0	0.0	0.0	2.8	0.00	2.8
22	48.3	4.6	2.3	13.3	9.50	13.3
23	0.0	0.0	0.0	7.5	0.00	7.5
24	0.0	0.0	0.0	13.1	0.00	13.1
Total	**319**	**477**	**15**	**153**	**63.60**	**153**

Sample calculation for emissions summarized in Table 3:

Maximum Daily PM10 Emissions for S-17:

$$Post-project\ Daily\ PM10\ PTE = \left(\frac{0.0045\ grains\ PM10}{dscf} \times \frac{9{,}500\ dscf}{min} \times \frac{60\ min}{hour} \times \frac{1\ lb}{7{,}000\ grains} \times \frac{23\ hours}{day}\right) = \frac{8.4\ lb\ PM10}{day}$$

Table 4 – Post-Project Annual Potential to Emit (Tons/Year)

Source #	NOx	CO	POC	PM10	SO2	PM2.5
3	9.175	15.881	0.353	0.731	1.457	0.731
4	0.000	0.000	0.000	2.167	0.000	2.167
5	9.175	15.881	0.353	0.731	1.457	0.731
6	0.000	0.000	0.000	2.167	0.000	2.167
7	7.411	19.762	0.353	1.007	1.457	1.007
8	0.000	0.000	0.000	1.293	0.000	1.293
9	0.000	0.000	0.000	1.545	0.000	1.545
10	7.411	19.762	0.353	1.007	1.457	1.007
11	0.000	0.000	0.000	1.293	0.000	1.293
12	0.000	0.000	0.000	1.545	0.000	1.545
16	7.411	0.706	0.353	1.007	1.457	1.007
17	0.000	0.000	0.000	1.293	0.000	1.293
18	0.000	0.000	0.000	1.577	0.000	1.577
19	0.807	0.403	0.202	0.190	0.833	0.190
20	0.000	0.000	0.000	0.157	0.000	0.157
21	0.000	0.000	0.000	0.348	0.000	0.348
22	7.411	0.706	0.353	2.044	1.457	2.044
23	0.000	0.000	0.000	1.151	0.000	1.151
24	0.000	0.000	0.000	2.014	0.000	2.014
Total	**48.801**	**73.101**	**2.319**	**23.267**	**9.578**	**23.267**

Sample calculation for emissions summarized in Table 4:

Annual NOx Emissions for S-3:

$$Post-project\ Annual\ NOx\ PTE = \left(\frac{2.6\ lb\ NOx}{hour} \times \frac{7{,}058\ hr}{yr} \times \frac{1\ ton}{2{,}000\ lb}\right) = \frac{9.175\ tons\ NOx}{yr}$$

Table 5 – Hourly TAC Emissions

Source #	Acetaldehyde	Benzene	Formaldehyde	Toluene
S-3	3.52E-03	4.56E-05	7.92E-03	7.38E-05
S-5	3.52E-03	4.56E-05	7.92E-03	7.38E-05
S-7	5.28E-03	8.96E-05	1.19E-02	1.45E-04
S-10	5.28E-03	8.96E-05	1.19E-02	1.45E-04
S-16	5.28E-03	1.29E-05	1.19E-02	2.09E-05
S-19	9.60E-04	8.43E-07	2.16E-03	1.36E-06
S-22	5.28E-03	2.19E-05	1.19E-02	3.55E-05
Project Total	2.91E-02	3.06E-04	6.55E-02	4.95E-04
Reg 2-5 Acute Trigger Level	1.0E+00	6.0E-02	1.2E-01	8.2E+01

Sample Calculation for Table 5:

Maximum Hourly Benzene Emissions for S-3:

$$Maximum\ hourly\ benzene\ emissions = \left(\frac{2.065E-07\ lb\ Benzene}{therm} \times \frac{22.15\ MMBtu}{hr} \times \frac{10\ therms}{MMBtu}\right) = \frac{4.56E-05\ lb\ benzene}{hr}$$

Table 6 – Annual TAC Emissions

Source #	Acetaldehyde	Benzene	Formaldehyde	Toluene
S-3	2.48E+01	3.22E-01	5.59E+01	5.21E-01
S-5	2.48E+01	3.22E-01	5.59E+01	5.21E-01
S-7	3.73E+01	6.32E-01	8.38E+01	1.02E+00
S-10	3.73E+01	6.32E-01	8.38E+01	1.02E+00
S-16	3.73E+01	9.13E-02	8.38E+01	1.48E-01
S-19	3.87E+00	3.40E-03	8.71E+00	5.50E-03
S-22	3.73E+01	1.55E-01	8.38E+01	2.50E-01
Project Total	2.03E+02	2.16E+00	4.56E+02	3.49E+00
Reg 2-5 Chronic Trigger Level	2.9E+01	2.9E+00	1.4E+01	1.2E+04

Sample Calculation for Table 6:

Maximum Annual Formaldehyde Emissions for S-3:

$$Maximum\ annual\ formaldehyde\ emissions = \left(\frac{0.0072\ lb\ formaldehyde}{ton\ green\ beans} \times \frac{1.1\ tons\ green\ beans}{hr} \times \frac{7058\ hours}{year}\right) = \frac{55.9\ lb\ formaldehyde}{year}$$

Note: Shaded cells indicate emissions that equal or exceed respective acute or chronic trigger level.

PLANT CUMULATIVE INCREASE

Table 7 summarizes the cumulative increase in criteria pollutant emissions that will result from this project.

Table 7 Cumulative Increase

Pollutant	Permitted Emissions (since Reg 2-2-209 Baseline Date)	Offsets Previously Provided, including from SFB (Reg 2-2-608.2.2)	Adjusted Actual Baseline (Reg 2-2-603)	Post Project PTE	Project Emissions Increase (Reg 2-2-606)	Contemporaneous Onsite Emissions Reduction (Reg. 2-2-605)	Project Cumulative Emissions Increase (Reg. 2-2-607)
	(TPY)	(TPY)	(TPY)	(TPY)	(TPY)	(TPY)	(TPY)
NOx	34.240	34.240	11.910	48.801	14.561	0.000	14.561
CO	51.300	51.300*	21.024	73.101	21.801	0.000	21.801
POC	1.140	0.000	0.274	2.319	2.045	0.000	2.045
PM10	32.511	0.000	13.480	23.267	9.787	0.000	9.787
SO2	0.086	0.000	0.048	9.578	9.530	0.000	9.530
PM2.5	16.613	0.000	13.480	23.267	9.787	0.000	9.787

*CO is not under the offset program. Therefore, emissions increase of CO is always considered offset.

TOXIC HEALTH RISK ASSESSMENT (HRA)

A new source or a modified source of TAC requiring an AC and/or PO is subject to Regulation 2-5. Pursuant to Regulation 2-5, all TAC emissions from new and modified sources are subject to HRA, if the emissions of any individual TAC exceed either the acute or chronic emission thresholds defined in Regulation 2-5, Table 2-5-1.

TAC emissions are generated from natural gas combustion in the roaster and RTO burners. Also, roasting of oils/organic matter in the coffee beans generates aldehyde, ketone, and alcohol emissions. As summarized in Tables 5 and 6, annual emissions of acetaldehyde exceed the chronic trigger level for S-7, S-10, S-16, and S-22 and annual emissions of formaldehyde exceed the chronic trigger level for S-3, S-5, S-7, S-10, S-16, and S-22. TAC emissions from S-19 don’t exceed the respective trigger levels. But S-19 is part of the Project per Regulation 2-5-216. Therefore, an HRA is required for the whole project.

The cancer risk from the project to the maximally exposed receptor resident (MEIR) is 0.29 in a million and the chronic hazard index at MEIR is 0.0019. The cancer risk to the maximally exposed receptor worker (MEIW) is 0.2 in a million and the chronic hazard index at MEIW of 0.016. The acute hazard index at point of maximum impact (PMI) is 0.032. The cancer risk for students attending the Harbor Bay KinderCare school is 0.074 in a million and the chronic hazard index is 0.0015. The cancer risk for students attending the Bright Horizons school is 0.038 in a million and the chronic hazard index is 0.00076.

Since the total project cancer risk is below 1 in a million and chronic hazard index is below 0.2, individual sources’ cancer risk and chronic hazard index will be well below these Regulation 2-5-301 standards. Therefore, per Regulation 2-5-301, none of the sources is subject to Best Available Control Technology for toxics (TBACT) and the project complies with the risk requirements in Regulation 2-5-302. Nonetheless, all roasters equipped with TBACT, which is thermal oxidation for organic TACs.

In addition to formaldehyde and acetaldehyde, other TACs such as methanol, isopropyl alcohol, methyl ethyl ketone, propylene, carbon disulfide, and hydrogen sulfide were detected at a coffee roasting facility in Oxnard, CA. The coolers are a known source of odorous pollutants, which are likely organic and/or sulfur compounds. The sources at Peet’s have never been tested for these compounds. Therefore, revised permit condition 22877 requires testing of additional TACs during the start-up period to accurately characterize the TAC emissions from the facility. If warranted, the HRA will be revised prior to issuance of the PO.

BEST AVAILABLE CONTROL TECHNOLOGY (BACT)

Per Regulation 2-2-301.1, BACT is triggered for a District BACT pollutant if a new source has a potential to emit 10.0 or more pounds per day of that pollutant. Per Regulation 2-2-301.2, BACT is triggered for a District BACT pollutant for which the source is “modified”, per Regulation 2-1-234, the post-project PTE of the source equals or exceeds 10 pounds per day and whose modification results in an increase in emissions of that pollutant above the actual adjusted baseline emissions.

Because all source tests on all roasters permitted at Peet’s have been conducted at the stack (downstream of the abatement equipment), there isn’t enough information available to apportion the emissions measured at the stack to the roaster (primary) and oxidizer (secondary). Therefore, under AN 27373, the District decided to consider the thermal oxidizer an integral part of the roaster and consider the combined roaster and thermal oxidizer one source. Therefore, the BACT threshold of 10 lb/day and any BACT determinations would apply to total emissions downstream of the thermal oxidizer.

As shown in Tables 3, 4, and A-4, BACT is triggered for the following pollutants and sources:

1. NOx: S-3, S-5, S-7, S-10, S-16, and S-22
2. CO: S-3, S-5, S-7, and S-10
3. PM10 and PM2.5: S-4, S-6, S-9, S-12, S-18, S-22, and S-24

A top-down BACT assessment was performed for NOx, CO, and PM10 emissions, which is provided in Appendix B to this report. BACT-1 for NOx, which is a selective catalytic reduction (SCR) system, was determined to be technologically feasible if one SCR system is used to abate combined exhaust streams from all roasters. As shown in Appendix B, Table B-1, the cost effectiveness of an SCR was estimated to be $18,118 per ton of NOx abated in 2018 dollars. The District’s cost effectiveness threshold is $17,500 per ton of NOx abated. Therefore, an SCR system to abate combined NOx emissions from all roasters is not cost-effective in BAAQMD. As discussed in Appendix B, the District determined BACT2 for NOx to be the hourly mass emissions limit requested by Peet’s and summarized in Table 1 for the specific sources.

BACT-1 for CO is oxidation catalyst with good combustion practices, which is technologically feasible. There is no cost effectiveness threshold for CO. Therefore, the District considers an oxidation catalyst not cost effective. As discussed in Appendix B, the District determined BACT-2 for CO to be good combustion practice with the hourly mass emissions limit requested by Peet’s and summarized in Table 1 for the specific sources.

BACT-1 for PM10, which is a either a fabric filter, a wet venturi scrubber, or an electrostatic precipitator with greater than 95% abatement efficiency, was determined to be technologically feasible, if one abatement device is used to abate combined exhaust stream from all sources that trigger BACT. The cost effectiveness of one fabric filter system to abate combined exhaust stream from all sources that trigger BACT was estimated to be $5,622 per ton of PM10 abated in 2018 dollars. The cost effectiveness of one wet venturi scrubber system to abate combined exhaust stream from all sources that trigger BACT was estimated to be $5,503 per ton of PM10 abated in 2018 dollars. The cost effectiveness of one electrostatic precipitator system to abate combined exhaust stream from all sources that trigger BACT was estimated to be $6,486 per ton of PM10 abated in 2018 dollars. The District’s cost effectiveness threshold is $5,300 per ton of PM10 abated. Therefore, none of the systems to abate combined PM10 emissions are cost-effective in BAAQMD. As discussed in Appendix B, BAAQMD determined BACT-2 for PM10 to be an outlet grain loading of 0.01 grains/dscf for all destoners and roasters. BACT-2 for coolers may be reduced to 0.0045 grains/dscf as a result of this application, if it is demonstrated to be achieved-in-practice through source test.

Because BACT-2 for NOx and CO is the mass emission limits requested by Peet’s and BACT-2 for PM10 are outlet grain loading rates guaranteed by equipment manufacturer, the sources are expected to comply with these BACT-2 standards.

OFFSETS

Regulation 2-2-302 requires offsets for NOx and POC emission increases from any new or modified source if the post-project, facility-wide PTE of that pollutant will be more than 10 tons/year. Regulation 2-2-303 requires offsets for PM2.5, PM10, and SO2 emission increases from any new or modified source if the post-project, facility-wide PTE of that pollutant will be 100 tons/year or more and if the un-offset cumulative increase in emissions of that pollutant at the facility and any related sources since the baseline date exceeds 1 ton per year.

As shown in Table 8, the post-project facility-wide PTE for POC will be less than 10 TPY. Therefore, offsets are not required for POC emissions increases. The post-project facility-wide PTE for PM2.5, PM10, and SO2 will be less than 100 tpy. Therefore, offsets are not required for PM2.5, PM10, and SO2 emission increases.

Because the post-project, facility-wide PTE for NOx will exceed 10 tpy, the NOx emissions increases from this project and any prior un-offset cumulative increase must be offset. Because the post-project, facility-wide PTE for NOx will exceed 35 tpy, Peet's will have to provide offsets at a ratio of 1.15:1 for all un-offset cumulative increase. In addition, Peet's will also need to reimburse the Small Facility Bank for 34.24 tpy NOx offsets that it availed to offset previous cumulative increases. Table 8 summarizes the offset requirements.

Table 8: Total Facility Emissions and Offset Requirement

Pollutant	Facility-Wide Post Project PTE (TPY))	Regulation 2-2-302 and 2-2-303 Offset Triggers (TPY)	Offsets Required (TPY)
NOx	48.801	Post-project Facility-wide PTE > 10	34.24 + 14.561*1.15=50.985
CO	73.101	NA	NA
POC	2.319	Post-project Facility-wide PTE < 10	0
PM10	26.077	> 1.0 CI and ≥100 tpy post-project facility-wide PTE	0
SO2	9.578	> 1.0 CI and ≥100 tpy post-project facility-wide PTE	0
PM2.5	26.077	> 1.0 CI and ≥100 tpy post-project facility-wide PTE	0

STATEMENT OF COMPLIANCE

New Source Performance Standards (NSPS)

There are no New Source Performance Standards that apply to the coffee roasters, coolers, or destoners.

National Emission Standards for Hazardous Air Pollutants (NESHAP)

There are no National Emission Standards for Hazardous Air Pollutants that apply to the coffee roasters, coolers, or destoners.

District Regulations

BAAQMD Regulation 1-301 "General Provisions and Definitions" prohibits discharging emissions in quantities that cause injury, detriment, nuisance or annoyance. Odor and visible emissions from coffee coolers are the predominant cause of public nuisance. To prevent public nuisance, Peet's routes the cooler exhaust for the initial 2-3 minutes of the cooling cycle through afterburners/ RTOs to combust all odorous and particulate emissions. Therefore, the sources are expected to comply with this requirement.

All proposed sources are subject to Regulation 6, Rule 1 ("Particulate Matter"). Regulation 6-1-301 limits visible emissions from any source to Ringelmann No. 1. Regulation 6-1-302 limits emissions from any source to 20% opacity. Regulation 6-1-305 prohibits emissions of visible particles on real property other than that of the person responsible for the emission. The proposed sources are also subject to the outlet grain loading limit of 0.15 grains per dscf of exhaust gas volume in Regulation 6-1-310.1. The manufacturer guaranteed grain loading rate for each source is 0.01 grains per dscf of exhaust gas volume. Therefore, each source is expected to comply with this rule. Future compliance with this rule will be determined through periodic source tests. The proposed sources are also subject to the TSP weight limits in Regulation 6-1-311. As seen below, each source will comply with the limits in Table 6-1-311.1. Future compliance with this rule will be determined through periodic source tests.

Process Weight Limits in Regulation 6-1-311.1

Source	P Process weight rate (lb/hr)	E Allowable emission rate (lb/hr)	Guaranteed emission rate from Table A-3 of all the sources with same process weight rate (lb/hr)
Each source S-3 through S-6	2,200	4.52	S-3, S-5: 0.21 lb/hr S-4, S-6: 0.61 lb/hr
Each source S-7 through S-12, S-16, S-17, S-18, S-22, S-23, and S-24	3,300	6.70	S-7, S-10, S-16: 0.29 lb/hr S-8, S-11, S-17: 0.37 lb/hr S-9, S-12: 0.44 lb/hr S-18: 0.45 lb/hr S-22: 0.58 lb/hr S-23: 0.33 lb/hr S-24: 0.57 lb/hr
Each source S-19, S-20, and S-21	600	2.02	S-19: 0.09 lb/hr S-20: 0.08 lb/hr S-21: 0.17 lb/hr

Regulation 6-1-401 requires the operator to have the means to know the appearance of emissions from the operations at all times. Majority of the emissions from the proposed sources will occur during active, manned operation of the source, so the emissions will be visible to equipment operators and shall be addressed by them as and when they occur.

The facility is expected to comply with the standards in Regulation 7, "Odorous Substances", if the standards in this regulation become applicable.

Per Regulation 8-2-111 "Exemption, Preparation of Food", the proposed sources are not subject to the requirements in Regulation 8-2 if Best Management Practices (BMPs) are used. The proposed emission controls at the sources and compliance with the proposed permit conditions constitute BMPs. The coolers are a known source of odorous pollutants, which are likely organic compounds. However, the coolers have not been tested for volatile organic compound (VOCs) emissions. The revised permit condition 22877 will require Peet's to source test the coolers for VOC emissions.

The roasters S-3, S-5, S-7, S-10, S-16, S-19 and S-22 are subject to the SO2 limitations of Regulations 9-1-301 (ground-level concentration) and 9-1-302 (general emission limitation). The coolers S-4, S-6, S-8, S-11, S-17, S-20 and S-23 may also be subject to Regulation 9-1, if they are a source of SO2 emission due to off gassing/ air scrubbing. The roasters and coolers have not been source tested for SO2. The assessment in this report assumes that the SO2 emissions are generated only from natural gas combustion in roasters plus some compliance margin. However, like nitrogen, sulfur is known to be present in all plant-based materials, including coffee beans[1]. Like nitrogen, the sulfur in the coffee beans can potentially oxidize to SO2. Additionally, recent testing at a coffee roasting facility in Oxnard, CA detected sulfur-based TACs. Permit condition 22877 will require Peet's to source test the roasters and coolers for SO2 emissions.

There is no District rule that specifically addresses coffee roasters. For the purposes of rule applicability, it is reasonable to assume the roasters to be a kiln, oven, or furnace used for drying, baking, heat treating or cooking. Therefore, per the exemption in Regulation 9-7-110.6, the roasters are not subject to the requirements in Regulation 9-7. The coolers at Peet's have also not been source tested for NOx and CO. The coolers S-4, S-6, S-8, S-11, S-17,

[1] https://www.slac.stanford.edu/econf/C060709/papers/247_TUPO51.PDF

S-20 and S-23 may be potential sources of NOx and CO emissions due to off gassing/ air scrubbing. Since the facility-wide PTE of NOx is above the offset threshold and CO emissions have been limited to avoid being Title V Major Facility, source testing the coolers for NOx and CO is warranted to get an accurate characterization of the facility's NOx and CO emissions. The revised permit condition 22877 will require Peet's to source test the coolers for NOx and CO emissions.

Based on the results of the source tests, required pursuant to revised permit condition 22877, the emissions of all pollutants will be reassessed, compliance status of all sources with respect to the respective applicable regulations will be confirmed, and if warranted, a permit application may be required to address emissions from these sources.

<u>California Environmental Quality Act (CEQA)</u>

Although there is a permit handbook chapter (Chapter 11.3) for coffee roasting operations, the project/ sources that trigger BACT cannot be considered ministerial for CEQA. The proposed project is exempt from CEQA review per the categorical exemption in Regulation 2-1-312.11, sub-sections 11.2 and 11.4, because it satisfies the "No Net Emission Increase" provisions of District Regulation 2, Rule 2. The NOx emissions increase from new and modified sources has been fully offset. The toxic emissions increase from the project does not result in a cancer risk greater than 1 in a million and a chronic hazard index greater than 0.2. The District has reviewed Appendix H Environmental Information Form submitted by Peet's and concurs there is no possibility that the project may have any significant environmental effect in connection with any environmental media or resources other than air quality.

<u>School Notification (Regulation 2-1-412)</u>

The proposed sources are located less than 1,000 feet from a kindergarten school, with more than 12 students enrolled in it. Therefore, the proposed sources are subject to the public notification requirements of Regulation 2-1-412. A public notice will be prepared and sent to all addresses within 1,000 feet of the proposed sources and parents and guardians of students of the following school(s):

Bright Horizons
2275 N Loop Road, Alameda, CA, 94502

All comments received shall be summarized in final evaluation report.

The proposed project will not trigger a PSD review because the facility is not a major facility per Regulation 2-2-304.

Major Facility Review per Regulation 2-6 is also not triggered.

<u>Notes:</u>

The following permit condition does not include the typical "Allowable Temperature Excursions" condition for thermal oxidizers because the proposed process is a batch operation with maximum duration of 15 minutes per batch. According to the Permit Handbook, the template permit condition for "Allowable Temperature Excursions of Thermal Oxidizers" is not intended for catalytic units or cyclic or batch operations, where the duration of the source operation may not exceed 15 minutes. According to Peet's, the thermal oxidizers will maintain the set point temperature at all times when the roasters are operating. When the roasters are not operating, the thermal oxidizers will idle to a lower temperature between batches, mainly to reduce energy consumption, operating costs, and combustion emissions. However, when the roasters will roast back-to-back batches there will be negligible idling time between batches.

<u>PERMIT CONDITIONS</u>

COND# 22877 --------------------------------------

Applies to S-1 through S-12 and S-16 through S-24

1. The owner/operator of sources S-3 through S-12 and S-16 through S-24 shall ensure that the sources do not exceed any of the following limits indicated below in any consecutive, rolling 12-month period:

    a. Operating Time: The owner/operator shall limit the operating time of the sources indicated below in any consecutive, rolling 12-month period to the following:

Source	Operating Time per Consecutive, Rolling 12 Months
S-3	7,058 hours per source

S-5	7,058 hours per source
S-7	7,058 hours per source
S-10	7,058 hours per source
S-16	7,058 hours per source
S-19	4,034 hours per source
S-22	7,058 hours per source

The owner/operator shall not operate the cooler and destoner associated with each roaster for a longer time period than the corresponding roaster.

The owner/operator of S-3 through S-12, S-16 through S-18 and S-22 through S-24 shall each not exceed a daily operating time of 23 hours in a calendar day. The owner/operator of S-19, S-20 and S-21 shall not exceed a daily operating time of 16 hours in a calendar day for each S-19, S-20 and S-21.

b. Green Coffee Bean Throughput: The owner/operator shall limit the green bean throughput of the sources indicated below in any consecutive, rolling 12-month period to the following:

Source	Green Beans Throughput per Consecutive, Rolling 12 Months
S-3 and S-4	7,764 tons green beans per source
S-5 and S-6	7,764 tons green beans per source
S-7, S-8, and S-9	11,646 tons green beans per source
S-10, S-11, and S-12	11,646 tons green beans per source
S-16, S-17, and S-18	11,646 tons green beans per source
S-19, S-20, and S-21	1,210 tons green beans per source
S-22, S-23, and S-24	11,646 tons green beans per source

c. Natural Gas Usage: The owner/operator shall limit the facility-wide natural gas usage to 1,047,860 MMBtu in any consecutive, rolling 12-month period

[Basis: Cumulative Increase]

2. The owner/operator of roasters (S-3, S-5, S-7, S-10, S-16, S-19, and S-22) and coolers (S-4, S-6, S-8, S-11, S-17, S-20, and S-23) shall limit the hourly mass emissions rates at the exhaust points or stacks of the sources indicated below to the following:

Source #	NOx lb/hour	CO lb/hour	POC lb/hour	SO2 lb/hour
S-3/A-4/P-3	2.60	4.50	0.10	0.41
S-5/A-7/P-5	2.60	4.50	0.10	0.41
S-7/A-10/P-7	2.10	5.60	0.10	0.41
S-10/A-14/P-10	2.10	5.60	0.10	0.41
S-16/A-23/P-17*	2.10	0.20	0.10	0.41
S-19/A-23/P-17*	0.40	0.20	0.10	0.41
S-22-A-29/P-22	2.10	0.20	0.10	0.41

*When S-16 and S-19 are operating simultaneously, the sum of the individual emissions limits specified above shall apply.

Daily emissions limits for source is equal to the product of the respective source's hourly emissions limit in this part of the permit condition and the respective daily operating time limit in part 1.a. of this permit condition.

Annual emissions limits foreach source listed above is equal to the product of the respective source's hourly emissions limit in this part of the permit condition and the respective annual operating time limit in part 1.a. of this permit condition.

[Basis: Cumulative Increase, BACT, and Regulation 9-1]

3. The owner/operator of sources S-1 through S-12 and S-16 through S-24 shall limit the outlet grain loading rates of Total PM10 emissions, including filterable PM10 and condensable PM10 to the following at standard temperature of 70 °F:

a. 0.01 grains per dry standard cubic feet at each source S-1, S-2, S-3, S-4 (destoner), S-5, S-6 (destoner), S-7, S-9, S-10, S-12, S-16, S-18, S-19, S-21, S-22, and S-24.
b. 0.0045 grains per dry standard cubic feet at each source S-4 (cooler), S-6 (cooler), S-8, S-11, S-17, S-20, and S-23.
If any of the emissions from the above destoners and coolers are combined in the stack, the emissions limit shall be 0.0045 grains per dry standard cubic feet per Regulation 1-107.
[Basis: Cumulative Increase, BACT]

4. The owner/operator of sources S-1 through S-12 and S-16 through S-24 is subject to Regulation 1-301, Standard for Public Nuisance, and Regulation 7, Odorous Substances. Upon receipt of a violation notice for either of these statutes, the Air Pollution Control Officer may require the owner/operator to curtail operations until either the operation can be modified, or the meteorological conditions change, such that the community is no longer adversely impacted.
[Basis: Regulations 1-301, 7-301, 7-302, and 7-303]

5. The owner/operator of sources S-1 through S-12 and S-16 through S-24 shall limit from any source for a period or periods aggregating more than three minutes in any hour, a visible emission which is as dark or darker than No. 0.5 on the Ringelmann Chart or of such opacity as to obscure an observer's view to an equivalent or greater degree.
[Basis: BACT]

6. Except where indicated with an asterisk, the owner/operator of sources S-1 through S-12 and S-16 through S-24 shall abate the following sources at all times the respective source operates with the following abatement devices that shall be properly maintained and properly operated per manufacturer's specifications:

Source #	Abatement Device	Abatement Device
S-1	A-1 (baghouse)	
S-2	A-1 (baghouse)	
S-3	A-3 (cyclone)	A-4 (afterburner) [in series]
S-4	A-5 (cyclone)	A-4 (afterburner)*
S-5	A-6 (cyclone)	A-7 (afterburner) [in series]
S-6	A-8 (cyclone)	A-7 (afterburner)*
S-7	A-9 (cyclone)	A-10 (afterburner) [in series]
S-8	A-11 (cyclone)	A-10 (afterburner)*
S-9	A-12 (cyclone)	
S-10	A-13 (cyclone)	A-14 (afterburner) [in series]
S-11	A-15 (cyclone)	A-14 (afterburner)*
S-12	A-16 (cyclone)	
S-16	A-22 (cyclone)	A-23 (regenerative thermal oxidizer) [in series]
S-17	A-24 (cyclone)	A-23 (regenerative thermal oxidizer)*
S-18	A-25 (cyclone)	
S-19	A-26 (cyclone)	A-23 (regenerative thermal oxidizer) [in series]
S-20	A-27 (cyclone)	A-23 (regenerative thermal oxidizer)*
S-21	A-27 (cyclone)	
S-22	A-28(cyclone)	A-29 (regenerative thermal oxidizer) [in series]
S-23	A-30 (cyclone)	A-29 (regenerative thermal oxidizer)*
S-24	A-31 (cyclone)	

NOTE: Where indicated by an "*", the afterburner/ regenerative thermal oxidizer (RTO) shall be used as needed to comply with parts 4 and 5 of this permit condition.

[Basis: Cumulative Increase, BACT, Regulations 1-301, 6-1, and 7]

7. The owner/operator of roasters (S-3, S-5, S-7, S-10, S-16, S-19, and S-22) and coolers (S-4, S-6, S-8, S-11, S-17, S-20, and S-23) shall maintain a minimum furnace temperature at 1400° F and maintain a residence time of at least 0.3 seconds in direct afterburners A-4, A-7, A-10, and A-14 at all times of operation of the corresponding roasters and coolers. The owner/operator shall maintain a minimum chamber temperature at 1600° F and maintain a residence time of at least 0.42 seconds in RTOs A-23 and A-29 at all times of operation of the corresponding roasters and coolers. The owner/operator may petition for a lower furnace temperature after start-up but prior to permit issuance if the owner/operator can demonstrate based upon source test results that all pollutants' emissions meet the required emissions levels as specified in parts 2, 3, 4, and 5 of this permit condition.
[Basis: Regulation 2-1-403]

8. The owner/operator of roasters (S-3, S-5, S-7, S-10, S-16, S-19, and S-22) and coolers (S-4, S-6, S-8, S-11, S-17, S-20, and S-23) shall install, calibrate, maintain, and operate the following:
   a. A temperature-measuring device capable of continuously measuring and recording the chamber temperature in each afterburner A-4, A-7, A-10, and A-14 and each RTO A-23 and A-29. These devices shall be accurate to within 10 degrees Fahrenheit (° F) and shall be maintained and calibrated in accordance with manufacturer's recommendations. These temperature monitors shall be used to determine compliance with the temperature requirements in part 7 of this permit condition.
   b. A District-approved high accuracy, low pressure transducer with a 0 to 3" H_2O range (available on-site) so that stack flow may be monitored simultaneously with concentration data.
   c. Within 180 days of issuance of an Authority to Construct under AN 28552 and 30019, a District-approved Continuous Emissions Monitoring System (CEMS) or an alternative District-approved, enforceable emissions monitoring system and recorder to monitor and record the hourly mass emissions rates of NOx from the exhaust point or stack of each roaster S-3, S-5, S-7, S-10, S-16, S-19, and S-22 and its corresponding afterburner/ RTO A-4, A-7, A-10, A-14, A-23, and A-29 to demonstrate compliance with part 2 of this permit condition including the daily and/or annual limits. Within 90 days of issuance of an Authority to Construct under AN 28552 and 30019, the owner/operator shall submit plans and specifications for CEMS or alternative District-approved, enforceable emissions monitoring system selection and placement to the District's Source Test Section for prior approval. The owner/operator shall comply with the all the applicable emissions monitoring and recordkeeping procedures in Regulation 1-522 and any additional procedures required by the District's Source Test Section. If the District determines that the alternative emissions monitoring system does not provide adequate, reliable, and enforceable emissions data to demonstrate compliance with part 2 including both daily and/or annual emissions limits , then the owner/operator of S-3, S-5, S-7, S-10, S-16, S-19, and S-22 shall install a District-approved CEMS.

   [Basis: Regulations 1-420, 1-521, and 1-522]

9. The owner/operator of S-1 and S-2 shall properly maintain and properly operate per manufacturer's specifications the baghouse (A-1) such that it is kept in good operating condition at all times. The owner/operator shall ensure that baghouse (A-1) be equipped with a device for measuring the pressure drop across the baghouse.
[Basis: Regulations 2-1-403 and 6-1]

10. The owner/operator of Baghouse, A-1 shall perform all of the following:
    a. Check and record the pressure drop across A-1 on a weekly basis. The pressure drop shall be no lower than 0.5 inches of water and no greater than 5 inches of water.
    b. Check exhaust from A-1 weekly for evidence of particulate breakthrough. If breakthrough is evident from plume observations, dust buildup near the stack outlet, or abnormal pressure drops, the filter bags shall be checked for any tears, holes, abrasions, and scuffs, and replaced as needed.
    c. Discharge all hoppers in a timely manner to maintain compliance with 10(a) above.
    d. Maintain and operate A-1 in accordance with manufacturer's recommendations to maintain compliance with parts 3 and 5 of this permit condition.

    [Basis: Regulations 2-1-403 and 6-1]

11. The owner/operator of sources S-1 through S-12 and S-16 through S-24 shall provide appropriate District-approved source testing facilities such as sampling ports and platforms and safe access to such facilities at the

outlet of every abatement device. The owner/operator shall consult with the District's Source Test Section to identify the appropriate source testing facilities and their locations to allow sampling and testing using District- or EPA-promulgated sampling and analytical methods.
[Basis: Regulation 1-501]

12. Initial Source Test: Within 60 days of commencement of operation of roasters and coolers for which an Authority to Construct or Permit to Operate is issued under AN 28552 and 30019, the owner/operator shall conduct a District-approved source test at each roaster's (S-3, S-5, S-7, S-10, S-16, S-19, and S-22) and cooler's (S-4, S-6, S-8, S-11, S-17, S-20, and S-23) exhaust stack to determine the emissions of the following pollutants in the units specified:

    a. Nitrogen Oxides [lb/hr and lb/ton green coffee beans]
    b. Carbon Monoxide [lb/hr and lb/ton green coffee beans]
    c. Total Organics [lb/hr and lb/ton green coffee beans]- For the purposes of this permit condition total organics are considered equal to NMOC and shall be determined using District-approved methods for NMOC
    d. Total PM10 - Filterable and Condensable PM10 [lb/hr, lb/ton green coffee beans, and gr/dscf]
    e. Sulfur Dioxide [lb/hr and lb/ton green coffee beans]
    f. Formaldehyde [lb/hr and lb/ton green coffee beans]
    g. Acetaldehyde [lb/hr and lb/ton green coffee beans]
    h. Hydrogen Sulfide [lb/hr and lb/ton green coffee beans]
    i. Isopropyl Alcohol [lb/hr and lb/ton green coffee beans]
    j. Naphthalene [lb/hr and lb/ton green coffee beans]
    k. Propylene [lb/hr and lb/ton green coffee beans] and
    l. All compounds listed in EPA Method TO-15 that are not listed above [lb/hr and lb/ton green coffee beans]

    [Basis: Cumulative Increase, BACT, and Regulations 2-1-403, 2-5, 6-1, 8-2, and 9-1]

13. Initial Source Test: Within 60 days of commencement of operation of destoners for which an Authority to Construct or Permit to Operate is issued under AN 28552 and 30019, the owner/operator shall conduct a District-approved source test at each destoner's (S-4, S-6, S-9, S-12, S-18, S-21, and S-24) exhaust stack in order to determine the Total PM10 emissions, including Filterable and Condensable PM10 on lb/hr, lb/ton green coffee beans, and grains/dscf basis to determine compliance with part 3 of this permit condition.
    [Basis: Cumulative Increase, BACT, and Regulations 2-1-403 and 6-1]

14. Periodic Source Test: After the initial source test, the owner/operator shall conduct a District-approved source test once every three years at each roaster S-3, S-5, S-7, S-10, S-16, S-19, and S-22 and each cooler S-4, S-6, S-8, S-11, S-17, S-20, and S-23 to determine the emissions of following pollutants, in the units specified below:
    a. Nitrogen Oxides [lb/hr and lb/ton green coffee beans] – For sources equipped with CEMS or an alternate District-approved emissions monitoring system, annual testing conducted under Relative Accuracy Test Audit (RATA), shall be considered towards the triennial testing requirement for that source. All other sources shall be tested at least once every three years for NOx.
    b. Carbon Monoxide [lb/hr and lb/ton green coffee beans]
    c. Total Organics [lb/hr and lb/ton green coffee beans] - For the purposes of this permit condition total organics are considered equal to NMOC and shall be determined using District-approved methods for NMOC
    d. Total PM10 - Filterable and Condensable PM10 [lb/hr, lb/ton green coffee beans and gr/dscf]
    e. Sulfur Dioxide [lb/hr and lb/ton green coffee beans]

    After the initial source test, the owner/operator shall conduct a District-approved source test once every three years at sources S-1 and S-2 and at each destoner S-4, S-6, S-9, S-12, S-18, S-21, and S-24, for Total PM10 emissions, including Filterable and Condensable PM10.

    [Basis: Cumulative Increase, BACT, Regulation 2-1-403]

15. The owner/operator of S-1 through S-12 and S-16 through S-24 shall monitor and record the following process parameters for each source test run and submit them along with the comprehensive source test report required by part 16 of this permit condition:
    a. Number of batches processed during each test run
    b. Batch start and end time and duration of each batch during each test run
    c. Quantity of green beans roasted in each batch during each test run
    d. Type of green beans roasted in each batch during each test run
    e. Type of roast for each batch during each test run
    f. Afterburner/RTO chamber temperature during each test run
    g. Pressure drop across abatement devices during each test run

    [Basis: Cumulative Increase, Regulation 2-1-403]

16. At least 30 days prior to conducting the source tests required by parts 12, 13, and 14 of this permit conditions, the owner/operator shall submit a source test protocol for approval to the District's Source Test Section. Within 60 days of test completion, the owner/operator shall submit a comprehensive report of the test results to the Manager of the District's Source Test Section for review and disposition. The owner/operator shall retain records of the source test results and any related correspondence with the District's Source Test Section on the site for a minimum of 2 years from the date of the document and shall make the records available to District staff upon request.
    [Basis: Cumulative Increase, Regulation 2-1-403]

17. The owner/operator may conduct a source test for the purpose of lowering the minimum temperature requirement in the afterburners/ RTOs provided that the following has occurred:

    a. The afterburners/ RTOs are equipped with the devices required by parts 8a and 8b of this permit condition.
    b. The Source Test Section and the Compliance and Enforcement Division were notified at least seven days prior to testing and the test protocol was deemed acceptable.

    The District may change the temperature limits in part 7, if the District approves and concurs with the results derived from the source tests and if the results of the source tests at the lower operating temperature demonstrate that the roasters and associated abatement devices tested are capable of meeting the POC emission limit in part 2 and the toxic air contaminant emission rates are not higher than the emission rates that would comply with Regulation 2-5.
    [Basis: Regulation 2-1-403]

18. To demonstrate compliance with the above conditions, the owner/operator of S-1 through S-12 and S-16 through S-24 shall maintain and provide the following records:
    a. Daily quantity of green coffee beans roasted at each roaster S-3, S-5, S-7, S-10, S-16, S-19, and S-22.
    b. Daily operating hours of each source
    c. Monthly facility-wide natural gas usage for all roasters and afterburners/RTOs.
    d. Records of continuous temperature measurements in A-4, A-7, A-10, and A-14 Afterburners and A-23 and A-29 RTOs whenever their respective coffee roasters are in operation.
    e. Records of weekly pressure drop measurements across A-1 and dates when the filters are replaced and/or the baghouse repaired.
    f. Source test reports.
    g. Daily operating hours of each source shall be totaled on a monthly and rolling, consecutive 12-month period basis.
    h. Daily green coffee beans throughput at each source shall be totaled on a monthly and rolling, consecutive 12-month period basis.
    i. Monthly facility-wide natural gas consumption for all roasters and afterburner/RTOs shall be totaled on rolling, consecutive 12-month period basis.
    j. Raw NOx concentration and flow rate data for each source equipped with CEMS or alternate District-approved emissions monitoring stsrem and hourly NOx mass emissions rate for each source.

k. Records of any work conducted per manufacturer's recommendation on sources S-1 through S-12 and S-16 through S-24 and their abatement devices A-1, A-3 through A-16, and A-22 through A-31.

All records shall be retained onsite for at least two years from the date of entry and shall be made available for inspection to District staff upon request. These record-keeping requirements shall not replace the record keeping requirements contained in any applicable District Regulations.
[Basis: Cumulative Increase, Regulation 2-1-403]

End of Conditions

RECOMMENDATION

The District has reviewed the material contained in the permit application for the proposed project and has made a preliminary determination that the project is expected to comply with all applicable requirements of District, state, and federal air quality-related regulations. The preliminary recommendation is to issue an Authority to Construct for the equipment listed below. However, the proposed sources will be located within 1,000 feet of at least one school, which triggers the public notification requirements of Regulation 2-1-412. After the comments are received and reviewed, the District will make a final determination on the permit.

I recommend that the District initiate a public notice and consider any comments received prior to taking any final action on issuance of an Authority to Construct and/or a Permit to Operate for the following equipment:

S-3 **Batch Coffee Roaster, Probat R1000, 2200 lbs of green beans/hour capacity;**
2.15 MMBtu/hr natural gas-fired burner, Maxon Ovenpak MDL#400 Size 422M;
Abated by A-3 cyclone and A-4 Direct Flame Afterburner in series; Emission Point P-3

A-3: Roaster Cyclone; Probat, 900 mm diameter

A-4: Direct Flame Afterburner, Conversion Products TA34/50V-1700EC-NB equipped with 20 MMBTU/hour Eclipse TJ2000 natural gas-fired burner

Maximum exhaust air flow rate: 2,416 dscfm; Outlet PM10 grain loading: 0.01 grains/dscf

S-4 **Batch Coffee Cooler and Destoner, Probat R1000, 2200 lbs of green beans/hour capacity;**
Cooler abated by A-5 cyclone and intermittently by A-4 afterburner in series; Emission Points P-3 (when abated by A-4) and P-4 (when not abated by A-4)

A-5: Cooler Cyclone; Probat, 1200 mm diameter; Maximum exhaust air flow rate: 5,108 dscfm; Outlet PM10 grain loading: 0.0045 grains/dscf

A-4: Direct Flame Afterburner, Conversion Products TA34/50V-1700EC-NB equipped with 20 MMBTU/hour Eclipse TJ2000 natural gas-fired burner

Destoner abated by A-32 cyclone; Emission Point P-25
A-32: Destoner Cyclone; Probat, 1200 mm diameter; Maximum destoner exhaust air flow rate: 4,864 dscfm; Outlet PM10 grain loading: 0.01 grains/dscf

---

S-5 **Batch Coffee Roaster, Probat R1000, 2200 lbs of green beans/hour capacity;**
2.15 MMBtu/hr natural gas-fired burner, Maxon Ovenpak MDL#400 Size 422M;
Abated by A-6 cyclone and A-7 Direct Flame Afterburner in series; Emission Point P-5

A-6: Roaster Cyclone; Probat, 900 mm diameter

A-7: Direct Flame Afterburner, Conversion Products TA34/50V-1700EC-NB equipped with 20 MMBTU/hour Eclipse TJ2000 natural gas-fired burner

Maximum exhaust air flow rate: 2,416 dscfm; Outlet PM10 grain loading: 0.01 grains/dscf

S-6 **Batch Coffee Cooler and Destoner, Probat R1000, 2200 lbs of green beans/hour capacity;**

Cooler abated by A-8 cyclone and intermittently by A-7 afterburner in series; Emission Points P-5 (when abated by A-7) and P-6 (when not abated by A-7)

A-8: Cooler Cyclone; Probat, 1200 mm diameter; Maximum exhaust air flow rate: 5,108 dscfm; Outlet PM10 grain loading: 0.0045 grains/dscf

A-7: Direct Flame Afterburner, Conversion Products TA34/50V-1700EC-NB equipped with 20 MMBTU/hour Eclipse TJ2000 natural gas-fired burner

Destoner abated by A-33 cyclone; Emission Point P-26

A-33: Destoner Cyclone; Probat, 1200 mm diameter; Maximum exhaust air flow rate: 4,864 dscfm; Outlet PM10 grain loading: 0.01 grains/dscf when abating destoner exhaust

---

S-7 **Batch Coffee Roaster, Probat R1500, 3300 lbs of green beans/hour capacity;**
3.5 MMBtu/hr natural gas-fired burner, Maxon Ovenpak II MDL#400 Model 435 op2;
Abated by A-9 cyclone and A-10 Direct Flame Afterburner in series; Emission Point P-7

A-9: Roaster Cyclone; Probat, 1200 mm diameter

A-10: Direct Flame Afterburner, Conversion Products TA48/66V-3700EC-NB equipped with two 20 MMBTU/hour Eclipse TJ2000 natural gas-fired burners; Total 40 MMBtu/hr
Maximum exhaust air flow rate: 3,300 dscfm; Outlet PM10 grain loading: 0.01 grains/dscf

S-8 **Batch Coffee Cooler, Probat R1500, 3300 lbs of green beans/hour capacity;**
Abated by A-11 cyclone and intermittently by A-10 Afterburner in series; Emission Points P-7 (when abated by A-10) and P-8 (when not abated by A-10)

A-11: Cooler Cyclone; Probat, 1500 mm diameter; Maximum exhaust air flow rate: 9,500 dscfm; Outlet PM10 grain loading: 0.0045 grains/dscf

A-10: Direct Flame Afterburner, Conversion Products TA48/66V-3700EC-NB equipped with two 20 MMBTU/hour Eclipse TJ2000 natural gas-fired burners; Total 40 MMBtu/hr

S-9 **Batch Coffee Destoner, Probat R1500, 3300 lbs of green beans/hour capacity;**
Abated by A-12 cyclone; Emission Point P-9

A-12: Destoner Cyclone; Probat, 1200 mm diameter; Maximum exhaust air flow rate: 5,108 dscfm; Outlet PM10 grain loading: 0.01 grains/dscf

---

S-10 **Batch Coffee Roaster, Probat R1500, 3300 lbs of green beans/hour capacity;**
3.5 MMBtu/hr natural gas-fired burner Maxon Ovenpak II MDL#400 Model 435 op2;
Abated by A-13 cyclone and A-14 Direct Flame Afterburner in series; Emission Point P-10

A-13: Roaster Cyclone; Probat, 1200 mm diameter

A-14: Direct Flame Afterburner, Conversion Products TA48/66V-3700EC-NB equipped with two 20 MMBTU/hour Eclipse TJ2000 natural gas-fired burners; Total 40 MMBtu/hr
Maximum exhaust air flow rate: 3,300 dscfm; Outlet PM10 grain loading: 0.01 grains/dscf

S-11 **Batch Coffee Cooler, Probat R1500, 3300 lbs of green beans/hour capacity;**
Abated by A-15 cyclone and intermittently by A-14 Afterburner in series; Emission Points P-10 (when abated by A-14) and P-11 (when not abated by A-14)

A-15: Cooler Cyclone; Probat, 1500 mm diameter; Maximum exhaust air flow rate: 9,500 dscfm; Outlet PM10 grain loading: 0.0045 grains/dscf

A-14: Direct Flame Afterburner, Conversion Products TA48/66V-3700EC-NB equipped with two 20 MMBTU/hour Eclipse TJ2000 natural gas-fired burners; Total 40 MMBtu/hr

S-12 **Batch Coffee Destoner, Probat R1500, 3300 lbs of green beans/hour capacity;**
Abated by A-16 cyclone; Emission Point P-12

A-16: Destoner Cyclone; Probat, 1200 mm diameter; Maximum exhaust air flow rate: 5,108 dscfm; Outlet PM10 grain loading: 0.01 grains/dscf

S-16 Batch Coffee Roaster, Probat R1500, 3300 lbs of green beans/hour capacity; 3.5 MMBtu/hr natural gas-fired burner, Maxon Ovenpak II Model 235; Abated by A-22 cyclone and A-23 Regenerative Thermal Oxidizer (RTO) in series; Emission Point P-17

A-22: Roaster Cyclone; Probat, 1200 mm diameter

A-23: Regenerative Thermal Oxidizer, B&W Megtec, Model Millennium-1040-95 equipped with 2.78 MMBTU/hour Maxon Kinedizer LE 3" natural gas-fired burner

Maximum exhaust air flow rate: 25,400 dscfm; Outlet PM10 grain loading: 0.01 grains/dscf

S-17 Batch Coffee Cooler, Probat R1500, 3300 lbs of green beans/hour capacity; Abated by A-24 cyclone and intermittently by A-23 RTO in series; Emission Points P-17 (when abated by A-23) and P-18 (when not abated by A-23)

A-24: Cooler Cyclone; Probat, 1500 mm diameter; Maximum exhaust air flow rate: 9,500 dscfm; Outlet PM10 grain loading: 0.0045 grains/dscf

A-23: Regenerative Thermal Oxidizer, B&W Megtec, Model Millennium-1040-95 equipped with 2.78 MMBTU/hour Maxon Kinedizer LE 3" natural gas-fired burner

S-18 Batch Coffee Destoner, Probat R1500, 3300 lbs of green beans/hour capacity; Abated by A-25 cyclone; Emission Point P-19

A-25: Destoner Cyclone; Probat, 1200 mm diameter; Maximum exhaust air flow rate: 10,370 dscfm; Outlet PM10 grain loading: 0.01 grains/dscf

---

S-19 Batch Coffee Roaster, Probat P60, 600 lbs of green bean/hr capacity, with 410,000 Btu/hr Maxon, natural gas-fired burner; abated by A-26 cyclone and A-23 RTO in series; Emission Point P-17
A-26: Roaster Cyclone, Probat, 550 mm diameter; Maximum exhaust air flow rate: 1,098 dscfm; Outlet PM10 grain loading: 0.01 grains/dscf

A-23: Regenerative Thermal Oxidizer, B&W Megtec, Model Millennium-1040-95 equipped with 2.78 MMBTU/hour Maxon Kinedizer LE 3" natural gas-fired burner

S-20 Batch Coffee Cooler, Probat P60, 600 lbs of green bean/hr capacity; abated by A-27 cyclone and intermittently by A-23 RTO in series; Emission Points P-17 (when abated by A-23) and P-20 (when not abated by A-23)

A-27: Cooler and Destoner Cyclone, Probat, 700 mm diameter; Maximum cooler exhaust air flow rate: 2,014 dscfm; Outlet PM10 grain loading: 0.0045 grains/dscf

A-23: Regenerative Thermal Oxidizer, B&W Megtec, Model Millennium-1040-95 equipped with 2.78 MMBTU/hour Maxon Kinedizer LE 3" natural gas-fired burner

S-21 Batch Coffee Destoner, Probat P60, 600 lbs of green bean/hr capacity; abated by A-27 cyclone; Emission Point P-20
A-27: Cooler and Destoner Cyclone, Probat, 700 mm diameter; Maximum destoner exhaust air flow rate: 2,014 dscfm; Outlet PM10 grain loading: 0.01 grains/dscf

---

S-22 Batch Coffee Roaster, Probat N1500, 3300 lbs of green beans/hour capacity; 3.15 MMBtu/hr natural gas-fired burner, Maxon Ovenpak EB-3; Abated by A-28 cyclone and A-29 Regenerative Thermal Oxidizer (RTO) in series; Emission Point P-22

A-28: Roaster Cyclone; Probat, 1050 mm diameter

A-29: Regenerative Thermal Oxidizer, Megtec, Model CleanSwitch-300 equipped with

7.5 MMBTU/hour Maxon Kinedizer LE natural gas-fired burner

Maximum exhaust air flow rate: 6,757 dscfm; Outlet PM10 grain loading: 0.01 grains/dscf

S-23 Batch Coffee Cooler, Probat N1500, 3300 lbs of green beans/hour capacity;
Abated by A-30 cyclone and intermittently by A-29 RTO in series; Emission Points P-22 (when abated by A-29) and P-23 (when not abated by A-29)

A-30: Cooler Cyclone; Probat, 1500 mm diameter; Maximum exhaust air flow rate: 8,453 dscfm; Outlet PM10 grain loading: 0.0045 grains/dscf

A-29: Regenerative Thermal Oxidizer, Megtec, Model CleanSwitch-300 equipped with
7.5 MMBTU/hour Maxon Kinedizer LE natural gas-fired burner

S-24 Batch Coffee Destoner, Probat N1500, 3300 lbs of green beans/hour capacity;
Abated by A-31 cyclone; Emission Point P-24

A-31: Destoner Cyclone; Probat, 1200 mm diameter; Maximum exhaust air flow rate: 6,658 dscfm; Outlet PM10 grain loading: 0.01 grains/dscf

APPENDIX A
EMISSIONS CALCULATION

Table A-1 – Process Rates and Operating Time

Roaster line	Roaster Burner Capacity	Afterburner/ RTO Capacity	Total Maximum Burner Capacity	Current and Future Maximum Hourly Processing Capacity*	3-Year Average Baseline Operating Hours	3-Year Average Baseline Throughput	3-year Baseline Average Natural Gas Combustion	Post-Project Annual Operating Time	Post-Project Annual Green Bean Throughput	Post-Project Maximum Daily Operating Hours
	MMBtu/hr	MMBtu/hr	MMBtu/hr	lb/hr of Green Beans	hr/year	tpy Green Beans	MMBtu/year	Hours/year	tpy Green Beans	hours/day
S-3	2.15	20	22.15	2,200	3,253	3,333	20,427	7058	7764	23
S-5	2.15	20	22.15	2,200	3,731	3,614	23,433	7058	7764	23
S-7	3.5	40	43.5	3,300	4,660	7,886	57,477	7058	11646	23
S-10	3.5	40	43.5	3,300	4,426	7,768	54,585	7058	11646	23
S-16	3.5	2.78	6.28	3,300	4,717	7,768	8,399	7058	11646	23
S-19	0.41		0.41	600	0	0	0	4034	1210	16
S-22	3.15	7.5	10.65	3,300	0	0	0	7058	11646	23
Total				18,200	20,788	30,369	164,327	46,382	63,322	

*All roasters are batch roasters. The maximum hourly roasting capacity is based on the assumption that there are 4 roasting cycles or batches of 15 minutes each per hour. As the roasting duration of a batch can vary between 8 to 16 minutes the number of batches roasted per hour can also vary from 3 to 7 batches. Therefore, shorter roasting cycles can accommodate more than 4 batches/ hour and the hourly roasting capacity can potentially be more than that specified above.

Table A-2 – Exhaust Gas Flow Rate

Source	Description	Actual Flow Rate	Actual Temperature	% Moisture	Wet flowrate	Dry Std. Flow Rate
Units	--	acfm	°F	%	wscfm	dscfm
S-3	Roaster	8,488	1216	10%	2,684	2,416
S-4	Cooler	5,376	70	5%	5,376	5,108
S-4	Destoner	5,120	70	5%	5,120	4,864
S-5	Roaster	9,642	1444	10%	2,684	2,416
S-6	Cooler	5,376	70	5%	5,376	5,108
S-6	Destoner	5,120	70	5%	5,120	4,864
S-7	Roaster	9,459	895	10%	3,700	3,330
S-8	Cooler	10,000	70	5%	10,000	9,500
S-9	Destoner	5,376	70	5%	5,376	5,108
S-10	Roaster	9,459	895	10%	3,700	3,330
S-11	Cooler	10,000	70	5%	10,000	9,500
S-12	Destoner	5,376	70	5%	5,376	5,108
S-16	Roaster	5,362	308	10%	3,700	3,330
S-17	Cooler	10,000	70	5%	10,000	9,500
S-18	Destoner	5,376	70	3%	5,376	5,215
S-19	Roaster	1,766	308	10%	1,219	1,098
S-20	Cooler	2,119	70	5%	2,119	2,014
S-21	Destoner	2,119	70	5%	2,119	2,014
S-22	Roaster	13,889	515	10.5%	7,550	6,757
S-23	Cooler	9,770	122	5%	8,897	8,453
S-24	Destoner	7,220	86	5%	7,008	6,658

acfm = actual cubic feet per minute at actual exhaust temperature and including moisture
wscfm = wet standard cubic feet per minute at standard conditions of 70 °F and 1 atm and including moisture
dscfm = dry standard cubic feet per minute at standard conditions of 70 °F and 1 atm and excluding moisture

Table A-3 – Post-Project Hourly Potential to Emit (Pounds/Hour)

Source #	NOx	CO	POC	PM10	SO2	PM2.5
3	2.60	4.50	0.10	0.21	0.413	0.21
4	0.00	0.00	0.00	0.61	0.000	0.61
5	2.60	4.50	0.10	0.21	0.413	0.21
6	0.00	0.00	0.00	0.61	0.000	0.61
7	2.10	5.60	0.10	0.29	0.413	0.29
8	0.00	0.00	0.00	0.37	0.000	0.37
9	0.00	0.00	0.00	0.44	0.000	0.44
10	2.10	5.60	0.10	0.29	0.413	0.29
11	0.00	0.00	0.00	0.37	0.000	0.37
12	0.00	0.00	0.00	0.44	0.000	0.44
16	2.10	0.20	0.10	0.29	0.413	0.29
17	0.00	0.00	0.00	0.37	0.000	0.37
18	0.00	0.00	0.00	0.45	0.000	0.45
19	0.40	0.20	0.10	0.09	0.413	0.09
20	0.00	0.00	0.00	0.08	0.000	0.08
21	0.00	0.00	0.00	0.17	0.000	0.17
22	2.10	0.20	0.10	0.58	0.413	0.58
23	0.00	0.00	0.00	0.33	0.000	0.33
24	0.00	0.00	0.00	0.57	0.000	0.57
Total	**14.00**	**20.80**	**0.70**	**6.74**	**2.891**	**6.74**

Sample calculation for emissions summarized in Table A-3:

Maximum Hourly SO2 Emissions for S-3 and A-4:

$$Post - project\ Hourly\ SO2\ Emissions = \frac{9.5\ lb\ SO2}{day} \times \frac{1\ day}{23\ hours} = \frac{0.413\ lb\ SO2}{hr}$$

Table A-4 – Actual Adjusted 3-year Average Baseline Emissions (Tons/Year)

Source #	NOx	CO	POC	PM10	SO2	PM2.5
3	1.903	5.058	0.013	0.568	0.006	0.568
4	0.000	0.000	0.000	1.390	0.000	1.390
5	2.836	6.493	0.028	0.699	0.007	0.699
6	0.000	0.000	0.000	1.595	0.000	1.595
7	1.771	5.131	0.161	0.712	0.017	0.712
8	0.000	0.000	0.000	1.897	0.000	1.897
9	0.000	0.000	0.000	1.020	0.000	1.020
10	2.169	4.127	0.049	0.893	0.016	0.893
11	0.000	0.000	0.000	1.802	0.000	1.802
12	0.000	0.000	0.000	0.969	0.000	0.969
16	3.231	0.215	0.024	0.995	0.002	0.995
17	0.000	0.000	0.000	0.307	0.000	0.307
18	0.000	0.000	0.000	0.633	0.000	0.633
19	0.000	0.000	0.000	0.000	0.000	0.000
20	0.000	0.000	0.000	0.000	0.000	0.000
21	0.000	0.000	0.000	0.000	0.000	0.000
22	0.000	0.000	0.000	0.000	0.000	0.000
23	0.000	0.000	0.000	0.000	0.000	0.000
24	0.000	0.000	0.000	0.000	0.000	0.000
Total	**11.910**	**21.024**	**0.274**	**13.480**	**0.048**	**13.480**

Sample calculation for emissions summarized in Table A-4:

3-year Average Annual Baseline NOx Emissions for S-3:

$$3 - Year\ Average\ Annual\ Baseline\ NOx\ Emissions = \left(\frac{1.17\ lb\ NOx}{hour} \times \frac{3{,}253\ hr}{yr} \times \frac{1\ ton}{2{,}000\ lb}\right) = \frac{1.903\ tons\ NOx}{yr}$$

APPENDIX B
TOP-DOWN BACT ASSESSMENT

1. BACT Analysis Methodology

District Regulation 2-2-202 defines BACT as an emission limitation, control device, or control technique applied at a source that is the most stringent of:

1. The most effective emission control device or technique that has been successfully utilized for the type of equipment comprising such a source; or
2. The most stringent emission limitation achieved by an emission control device or technique for the type of equipment comprising such a source; or
3. The most effective control device or technique or most stringent emission limitation that the APCO has determined to be technologically feasible for a source, taking into consideration cost-effectiveness, any ancillary health and environmental impacts, and energy requirements; or
4. The most effective emission control limitation for the type of equipment comprising such a source that is contained in an approved implementation plan of any state, unless the applicant demonstrates to the satisfaction of the APCO that such limitation is not achievable.

The first two definitions are "achieved in practice" or BACT 2 and the third definition is "technologically feasible and cost effective" or BACT 1 in the District's BACT/TBACT workbook.

The prevailing BACT2 determination for NOx and CO in District BACT Guideline, Document # 47.3.1 (dated April 2, 2008) are based on start-up source tests conducted on Peet's roasters S-3, S-5, and S-7. The same roasters failed to meet these BACT2 emission limitation in subsequent source tests. Therefore, the District staff had recommended, in the addendum to AN 13807, that the BACT2 emission limitation be raised from 0.2 lb/MMBtu to 0.3 lb/MMBtu for NOx and from 0.4 lb/MMBtu to 0.45 lb/MMBtu for CO. The BACT guidelines were not updated to reflect these recommendations.

The prevailing BACT2 emission limitation in District BACT Guideline, Document # 47.3.1 (dated April 2, 2008) and the above recommended BACT2 emission limitation are expressed on lb/MMBtu basis. These emission limitations were derived from source tests, which measured NOx and CO concentration on ppmv basis. The NOx and CO concentration were converted to lb/MMBtu basis using the equation shown below and default natural gas stoichiometric fuel factor (Fd) of 8710 dscf/MMBtu in EPA Method 19. The Fd factor is fuel specific. It is well established through engineering studies performed by roaster manufacturers and research that in addition to natural gas combustion in roaster and oxidizer burners, the high temperature roasting and thermal/ catalytic oxidation processes also generate criteria air pollutants and TACs e.g. PM10 emissions are generated from coffee bean chaff during roasting and NOx emissions are generated from oxidation of nitrogenous compounds, such as caffeine, in the roaster and thermal/ catalytic oxidizer. Oils/ organic gases released from coffee beans and combusted/ oxidized in the roaster and oxidizer are comingled with natural gas combustion products. In other words, the overall "fuel" or gas that is combusted in roaster and oxidizer is not exclusively natural gas (it is a mixture of natural gas and organic gases from coffee beans). Therefore, it is inappropriate to use natural gas-specific Fd factor to convert concentration from ppmv basis to lb/MMBtu basis for this type of "fuel" or source.

In addition, Peet's old roasters S-3, S-5, S-7, and S-10 are equipped with direct afterburners. New roasters S-16, S-19, and S-22 will be equipped with an RTO. RTO typically operates at higher % excess air than a direct afterburner, resulting in higher %O2 content in exhaust than that from a direct afterburner. The stack %O2 correction applied when converting emissions from ppmv to lb/MMBtu artificially inflates the emissions from a roaster-RTO combination compared to those from a roaster-afterburner combination, even though emissions on mass basis (lb/hour) from a roaster-RTO combination are lower than those from a roaster-afterburner combination due to less natural gas combustion. Therefore, lb/MMBtu is not an appropriate metric for expressing BACT emission limitation for coffee roasters. Staff recommends expressing BACT emission limitation on lb/ ton green bean basis.

$$EF\left(\frac{lb}{MMBtu}\right) = \frac{ppm}{10^6} \times F_d \times \left(\frac{20.9}{20.9 - \%O_2}\right) \times \frac{MW}{M_v}$$

EPA guidance for a "top-down" BACT analysis requires reviewing the possible control options starting with the best control efficiency. In the course of the BACT analysis, one or more options may be eliminated from consideration because they are demonstrated to be technically infeasible or have unacceptable energy, economic, or environmental impacts on a case-by-case (site-specific) basis. The steps required for a "top-down" BACT review are:

1. Identify available control technologies;
2. Eliminate technically infeasible options;
3. Rank remaining technologies;
4. Evaluate remaining technologies in terms of economic, energy, and environmental impacts; and
5. Select BACT (the most efficient technology that cannot be rejected for economic, energy, or environmental impact reasons is BACT).

Publicly available information on emission control technologies was reviewed for step one of this analysis. The SCAQMD Major and Non-Major Source BACT Guidelines, BAAQMD BACT Guidelines, SJVAPCD BACT database, California Air Resources Board (CARB) BACT database, EPA's RACT/BACT/LAER Clearinghouse (RBLC) and Puget Sound Clean Air Agency's requirements were reviewed to determine BACT for the proposed source. These guidelines are examples of past determinations that help in determining BACT for new permit applications.

The following sections discuss the BACT determinations for NOx, CO, and PM10 for coffee roaster and thermal oxidizer combination as source.

NOx – Roasters & Thermal Oxidizers

Step 1: Identify Available Control Technologies

The technologies that can be employed for NOx emissions reductions at roasters and their thermal oxidizers are listed below in descending order of effectiveness:

- Post-combustion technologies
  - Selective Catalytic Reduction (SCR)
  - Selective Non-catalytic Reduction (SNCR)
- Pre-combustion technologies
  - Low or ultra-low-NOx Burners (LNB/ ULNB)
  - Water or Steam Injection (W/SI)
  - Flue Gas Recirculation (FGR)
  - Less Excess Air (LEA), Over Fire Air (OFA), Fuel reburning (FR), etc.

Step 2: Eliminate Technically Infeasible Options

BACT is source specific and must be determined on a case-by-case basis. Although pre-combustion technologies, such as LNB, ULNB, W/SI, and FGR, may be feasible for any other roaster, these pre-combustion technologies may not be feasible for roasters at Peet's, as explained below.

The quality of roasted coffee, in terms of its taste and aroma, is unique to each coffee manufacturer. The quality of each batch of roasted coffee depends on the roasting environment (or condition of roasting air) during the roasting period. The condition of roasting air is characterized by its temperature profile over the roasting period and its oxygen and moisture content. The desired type of roast (light, medium, or dark) and the quality of green beans also dictate the roasting environment. Peet's typically roasts coffee at high O2 and low moisture conditions. To yield a consistent quality of product that is unique to Peet's, it must tightly control the roasting environment across all batches and roasters.

Thermal NOx is the predominant pathway for NOx formation in natural gas combustors. All the pre-combustion technologies listed above control thermal NOx formation by reducing peak flame and combustion temperatures. The peak flame and combustion temperatures are reduced by avoiding combustion at ideal stoichiometric air-to-fuel ratio, which is in turn achieved by staging injection of air or fuel as in the LNB or injecting water/ steam or recirculating cooled oxygen-depleted flue gas. All these pre-combustion NOx control technologies have a potential to change the roasting environment inside the roasters, thereby affecting the quality of roasted coffee. For example, LNB have slower response time for temperature control, especially on the 30 ppm NOx burners. The slower response time could potentially cause problems by changing the temperature of the roasting air over the roasting period - specifically the ramp up time to high heat in the beginning of the roast could be much slower as the discharge temperature of the burner is lower, and the reaction time of the burner is slower.

The roasters at Peet's are not equipped with any of the pre-combustion NOx control technologies listed above. To what extent these pre-combustion NOx control technologies would impact the quality of coffee is unknown. Furthermore, NOx emissions formed in the roaster drum from oxidation of nitrogenous compounds in the coffee will not be reduced by these pre-combustion control technologies, which are installed in the fire-box. Because of this uncertainty and the cost that Peet's might have to incur if retrofitting the roasters with pre-combustion NOx control technologies does not work as intended, the District deems these pre-combustion NOx control technologies infeasible for the roasters at Peet's.

Step 3: Rank Remaining Technologies

SCR and SNCR are post-combustion, add-on control technologies, that will not affect the roasting environment inside the roasters. Both technologies are feasible.

The temperature of the exhaust air post-RTO ranges between 230 °F and 400 °F. The temperature of the exhaust air post direct afterburners ranges between 750 °F and 1500 °F. The minimum exhaust air temperature required for SCR is 500 °F and the minimum exhaust air temperature required for SNCR is 1600 °F. The optimum exhaust temperature for an SCR system is 700 to 800 °F and that for an SNCR is 1700 to 1800 °F. If all the exhaust streams from all roasters are combined and co-abated by one abatement system, then a dilution fan would be needed to lower the temperature of the combined exhaust stream to the SCR's optimum temperature range. On the other hand, the combined exhaust stream will need to be reheated to raise its temperature to the SNCR's optimum temperature range. The latter option will result in additional energy cost and combustion emissions to operate an SNCR.

On a continuous steady process, SCR can achieve a NOx destruction efficiency of greater than 95%, with less than 5 ppmv ammonia slip. On the other hand, the destruction efficiency of SNCR on a continuous steady process is between 50% and 60% with an ammonia slip of greater than 10 ppmv. Therefore, SCR is the top ranked technology, followed by SNCR.

Step 4: Evaluate Remaining Technologies

Coffee roasting is a batch and unsteady process. NOx emissions not only vary from batch to batch depending on the quality and quantity of beans and the type of roast but also vary within each batch depending on the temperature profile during each batch. Due to this variability in NOx loading, a dedicated SCR for each roaster is not feasible because the amount of reagent injected will need to be continuously adjusted to account for the changing NOx concentration during the cycle. The lag in the feedback control loop which determines the quantity of reagent to be injected could either reduce the NOx abatement efficiency or increase the ammonia slip. Therefore, the District evaluated the feasibility and cost of using one SCR system to abate the combined exhaust from all roasters. Because the roasters will operate at different stages of roasting cycle, the variability in NOx loading and any peaks and valleys of NOx concentrations should average or even out and become steady if the exhaust streams are combined. Furthermore, Peet's intends to operate the roasters practically continuously for 23 hours/day. Therefore, with an operating duration of 23 hours/day and combined exhaust stream the NOx loading is almost continuous and steady.

District reached out to SCR vendors to evaluate the technological feasibility and cost effectiveness of abating all roasters with one SCR system. Although SCR systems can typically achieve a NOx destruction efficiency of greater than 95% and the turn-key installation cost is 1.8 times the equipment cost, the vendor guaranteed a conservative destruction efficiency of 70% and quoted a turn-key installation cost of 2 times the equipment cost because of the variability in NOx loading, complexity of the installation and also because it would have been the very first application of SCR to coffee roasters. The vendor quoted the equipment cost at $1.9 Million and the turn-key installation cost at $3.8 Million, resulting in Total Capital Investment of $5.7 Million. District also used the EPA's SCR cost calculation spreadsheet, version June 2019. The EPA calculator estimated a Total Capital Investment of $6.1 Million in 2018 dollars, including the highest recommended retrofit factor of 1.5 for installing SCR on existing equipment compared to installing SCR on a new equipment (50% cost escalation for retrofit versus new construction).

Using the default EPA cost factors build-into the calculator, the cost effectiveness of an SCR with a Total Capital Investment of $6.1 Million was determined to be $15,842 per ton of NOx abated in 2018 dollars. However, the default factors such as the catalyst cost, reagent cost, and electricity cost are US averages. The cost effectiveness using the local electricity cost and the regent and catalyst cost provided by the vendor was estimated to be $18,118 per ton of NOx abated in 2018 dollars.

Step 5: Select BACT

Because the NOx control technologies discussed above have not been demonstrated to be achieved-in-practice on similar type of source and are not cost effective, staff recommends establishing BACT2 as an emission limitation.

Under AN 27373 staff determined BACT2 for NOx to be an emission limitation of 1.94 lb NOx/ ton of green beans, which was based on the highest source tested emission factor for R1500 roasters S-7, S-10, and S-16. When prorated by the hourly capacity of the S-7, S-10, S-16, and S-22 roasters, this emission factor translates to an hourly emission rate of 3.20 lb/hour. The highest source tested emission factor for R1000 roasters S-3 and S-5 is 2.39 lb/ton of green beans. When prorated by the hourly capacity of the R1000 roasters, this emission factor translates to an hourly emission rate of 2.63 lb/hour for S-3 and S-5 roasters. Peet's has requested a mass emission limit of 2.10 lb/hr for S-7, S-10, S-16, and S-22 roasters, which is lower than the hourly mass emissions rate of 3.20 lb/hr derived from the previously established BACT2 emission factor under AN 27373. Similarly, Peet's has requested a mass emission limit of 2.60 lb/hr for roasters S-3 and S-5, which is slightly lower than the hourly rate of 2.63 lb/hr derived from the highest tested emission factor of 2.39 lb/ton of green beans. Therefore, staff determines the lower hourly emission limits requested by Peet's as BACT2 for these specific sources.

2. CO – Roasters & Thermal Oxidizers

Step 1: Identify Available Control Technologies

The technologies that can be employed for CO emissions reductions at the roasters and their thermal oxidizers are listed below in descending order of effectiveness:

- Combination of technologies, i.e. oxidation catalyst with good combustion practice
- Oxidation catalyst
- Good combustion practices

Step 2: Eliminate Technically Infeasible Options

BACT is source specific and must be determined on a case-by-case basis. All the above listed technologies are feasible. CO oxidation catalyst is a post-combustion, add-on control technologies, that will not affect the roasting environment inside the roasters. The combined exhaust's temperature is within the acceptable range for a CO oxidation catalyst (500 °F to 1200 °F). Peet's already employs good combustion practices, to the extent practicable, in its roasters.

Step 3: Rank Remaining Technologies

The technologies are ranked as shown above.

Step 4: Evaluate Remaining Technologies

There is no cost-effectiveness threshold for CO. Therefore, the District considers an oxidation catalyst not cost effective.

Step 5: Select BACT

Staff recommends establishing BACT2 as good combustion practices with the most stringent emission limitation.

Under AN 27373 staff determined BACT2 for CO to be good combustion practices with an emission limitation of 4.20 lb CO/ ton of green beans, which was based on the highest source tested emission factor for all roasters. When prorated by the hourly capacity of the S-7, S-10, S-16, and S-22 roasters, this emission factor translates to an hourly emission rate of 6.93 lb/hour. When prorated by the hourly capacity of the R1000 roasters S-3 and S-5, this emission factor translates to an hourly emission rate of 4.62 lb/hour. Peet's has requested mass emission limits of 5.6 lb/hr for S-7 and S-10 and 0.2 lb/hr for S-16 and S-22, which are lower than the hourly mass emissions rate of 6.93 lb/hr derived from the previously established BACT2 emission factor under AN 27373. Similarly, Peet's has requested a mass emission limit of 4.5 lb/hr for roasters S-3 and S-5, which is slightly lower than the hourly rate of 4.62 lb/hr derived from the highest tested emission factor of 4.2 lb/ton of green beans (also the previously established BACT2 emission factor under AN 27373). Therefore, staff determines the respective lower hourly emission limits requested by Peet's as BACT2 for these specific sources.

3. PM10 – S-4, S-6, S-9, S-12, S-18, S-22 and S-24

Step 1: Identify Available Control Technologies

The technologies that can be employed for PM10 emissions reductions are listed below:

- Fabric Filter
- Wet Venturi Scrubber
- Electrostatic Precipitator (ESP)
- Cyclone

Step 2: Eliminate Technically Infeasible Options

BACT is source specific and must be determined on a case-by-case basis. All the above listed technologies are feasible and can be installed downstream of the cooler and/or destoners. A fabric filter that can meet the desired control efficiency cannot be installed downstream of Roaster S-22 because the post-RTO exhaust temperature, which is in the range of 230 °F and 400 °F, is too high for the fabric to withstand. However, exhaust from Roaster S-22 can be abated with a fabric filter if the S-22 exhaust stream is combined with the lower temperature exhaust streams from the cooler and/or destoners.

<u>Step 3: Rank Remaining Technologies</u>

All technologies can provide a control efficiency of more than 95%. However, sufficient information about the exhaust streams, such as particle size distribution, quality of particles (sticky or non-sticky), quality of air stream (corrosive or non-corrosive), is not available to definitively rank these technologies in terms of their collection efficiency.

<u>Step 4: Evaluate Remaining Technologies</u>

PM10 emissions from roasters and cooler and/or destoners are already abated by cyclones. Therefore, only fabric filter, wet venturi scrubber, and ESP were evaluated for cost effectiveness. The District evaluated the cost effectiveness of abating the combined exhaust stream from S-22 roaster and all destoners that trigger BACT with one abatement system.

For the fabric filter, the District obtained a quote for this specific project from a vendor. The fabric filter was originally sized and quoted to abate the exhaust from all coolers, all destoners, and S-22 roaster because all these sources triggered BACT at the originally proposed outlet grain loading of 0.01 grains/dscf. However, the applicant has accepted a lower grain loading limit of 0.0045 grains/dscf at the coolers in order to avoid triggering ambient air quality modeling per Regulation 2-2-308. With the lower grain loading limits, the coolers no longer trigger BACT. The District adjusted the originally quoted cost of fabric filter by the ratio of the sum of exhaust flow rate to be abated for the sources that trigger BACT after the change in grain loading to the sum of exhaust flow rate to be abated for all sources that originally triggered BACT for which the original quote was obtained. For wet venturi scrubber, the District used a quote, obtained from a vendor in 2017 for another project of similar size, and escalated the cost by the ratio of 2018 CEPCI to 2017 CEPCI[1]. The District also adjusted the quote for wet scrubber by the ratio of the sum of exhaust flow rate to be abated for the sources that trigger BACT after the change in grain loading to the sum of exhaust flow rate to be abated for all sources that originally triggered BACT for which the original quote was obtained. For ESP, the District estimated the equipment cost using the methodology described in *EPA Air Pollution Control Cost Manual, 6th Edition, January 2002* and escalated the cost by the ratio of 2018 CEPCI to 1987 CEPCI. In all three cases, the District estimated the cost effectiveness using the methodology described in *EPA Air Pollution Control Cost Manual, 6th Edition, January 2002* and *BAAQMD BACT Workbook*.

The cost effectiveness calculations are summarized in Table B-2 through B-4. The cost effectiveness for fabric filter was determined to be $5,622 per ton of PM10 abated. The cost effectiveness for wet venturi scrubber was determined to be $5,503 per ton of PM10 abated. The cost effectiveness for ESP was determined to be $6,486 per ton of PM10 abated. The District's cost effectiveness threshold is $5,300 per ton of PM10 abated. Therefore, none of these technologies are cost effective.

<u>Step 5: Select BACT</u>

As discussed above, BACT1 is not cost effective. Therefore, the "achieved in practice" BACT2 applies and will be required for Roaster S-22 and all destoners that trigger BACT. The prevailing BACT2 emission limitation for PM10 in District BACT Guideline, Document # 47.3.1 (dated April 2, 2008) is 0.01 grains/dscf for coffee roasters. The

[1] CEPCI – Chemical Engineering Plant Cost Index

manufacturer guarantees an outlet grain loading of 0.01 grains/dscf for the roaster S-22. Therefore S-22 meets BACT2 standard.

Per District BACT Guideline, Document # 47A.2.1 dated 10/04/1991 for destoners, BACT1 is a baghouse and afterburner with a retention time greater than or equal to 3 seconds at 1400 °F. BACT2 is a high efficiency cyclone and afterburner with a retention time greater than or equal to 3 seconds at 1400 °F. All destoners are equipped with cyclones with a manufacturer guaranteed grain loading of 0.01 grains/dscf. Exhaust from destoners is not abated by a thermal oxidizer. Using a thermal oxidizer downstream of cyclone on destoners will result in marginal reduction in PM10 emissions, at significantly high capital and operating costs and with additional criteria pollutant and GHG emissions from natural gas combustion in thermal oxidizers. Furthermore, BACT2 emission limitation in District BACT Guideline, Document # 47.3.1 for PM10 is an outlet grain loading of 0.01 grains/dscf for the corresponding control technology with cyclone and afterburner. The cyclones on destoners are guaranteed to achieve a grain loading than 0.01 gr/dscf without thermal oxidizer. Therefore, District determines BACT2 from destoning operations to be an outlet grain loading of 0.01 grains/dscf. All destoners meet BACT2 standard.

Data Inputs

Enter the following data for your combustion unit:

Is the combustion unit a utility or industrial boiler? Industrial

What type of fuel does the unit burn? Natural Gas

Is the SCR for a new boiler or retrofit of an existing boiler? Retrofit

Please enter a retrofit factor between 0.8 and 1.5 based on the level of difficulty. Enter 1 for projects of average retrofit difficulty. 1.5

* NOTE: You must document why a retrofit factor of 1.5 is appropriate for the proposed project.

Complete all of the highlighted data fields:

What is the maximum heat input rate (QB)? 150 MMBtu/hour

What is the higher heating value (HHV) of the fuel? 1,033 Btu/scf

*HHV value of 1033 Btu/scf is a default value. See below for data source. Enter actual HHV for fuel burned, if known.

What is the estimated actual annual fuel consumption? 1,024,878,993 scf/Year

Enter the net plant heat input rate (NPHR) 8.2 MMBtu/MW

If the NPHR is not known, use the default NPHR value:

Fuel Type	Default NPHR
Coal	10 MMBtu/MW
Fuel Oil	11 MMBtu/MW
Natural Gas	8.2 MMBtu/MW

Plant Elevation 250 Feet above sea level

Not applicable to units burning fuel oil or natural gas

Type of coal burned: Not Applicable

Enter the sulfur content (%S) = percent by weight

Not applicable to units buring fuel oil or natural gas

Note: The table below is pre-populated with default values for HHV and %S. Please enter the actual values for these parameters in the table below. If the actual value for any parameter is not known, you may use the default values provided.

Coal Type	Fraction in Coal Blend	%S	HHV (Btu/lb)
Bituminous	0	1.84	11,841
Sub-Bituminous	0	0.41	8,826
Lignite	0	0.82	6,685

Please click the calculate button to calculate weighted average values based on the data in the table above.

For coal-fired boilers, you may use either Method 1 or Method 2 to calculate the catalyst replacement cost. The equations for both methods are shown on rows 85 and 86 on the ***Cost Estimate*** tab. Please select your preferred method:

- ○ Method 1
- ○ Method 2
- ◉ Not applicable

Enter the following design parameters for the proposed SCR:

Number of days the SCR operates (t_{SCR})	307 days	Number of SCR reactor chambers (n_{scr})	1
Number of days the boiler operates (t_{plant})	307 days	Number of catalyst layers (R_{layer})	3
Inlet NO_x Emissions (NOx_{in}) to SCR	0.093 lb/MMBtu	Number of empty catalyst layers (R_{empty})	1
Outlet NO_x Emissions (NOx_{out}) from SCR	0.028 lb/MMBtu	Ammonia Slip (Slip) provided by vendor	10 ppm
Stoichiometric Ratio Factor (SRF)	0.525	Volume of the catalyst layers ($Vol_{catalyst}$) (Enter "UNK" if value is not known)	UNK Cubic feet
		Flue gas flow rate ($Q_{fluegas}$) (Enter "UNK" if value is not known)	180000 acfm

*The SRF value of 0.525 is a default value. User should enter actual value, if known.

Estimated operating life of the catalyst ($H_{catalyst}$)	24,000 hours	Gas temperature at the SCR inlet (T)	800 °F
Estimated SCR equipment life	25 Years*	Base case fuel gas volumetric flow rate factor (Q_{fuel})	1200 ft^3/min-MMBtu/hour

* For industrial boilers, the typical equipment life is between 20 and 25 years.

Concentration of reagent as stored (C_{stored})	32 percent
Density of reagent as stored (ρ_{stored})	68 lb/cubic feet
Number of days reagent is stored ($t_{storage}$)	14 days

Densities of typical SCR reagents:	
50% urea solution	71 lbs/ft^3
29.4% aqueous NH_3	56 lbs/ft^3
32% Urea Solution*	68 lbs/ft^3

*Provided by vendor

Select the reagent used: Urea

Enter the cost data for the proposed SCR:

Desired dollar-year	2018 https://www.chemengonline.com/2019-cepci-updates-january-prelim-and-december-2018-final/	
CEPCI for 2018	603.1 Enter the CEPCI value for 2018 / 541.7 2016 CEPCI	CEPCI = Chemical Engineering Plant Cost Index
Annual Interest Rate (i)	5 Percent	IF(C54=5.5,"* 5.5 percent is the default bank prime rate. User should enter current bank prime rate (available at https://www.federalreserve.gov/releases/h15/.)"," ")
Reagent ($Cost_{reag}$)	4.000 $/gallon for 50% urea	IF(AND(P46=1,C55=0.293),"* $0.293/gallon is a default value for 29% ammonia. User should enter actual value, if known.",(IF(AND(P46=2,C55=1.66),"* $1.66/gallon is a default value for 50% urea. User should enter actual value, if known."," ")))
Electricity ($Cost_{elect}$)	0.1516 $/kWh	IF(C56=0.0361,"* $0.0361/kWh is a default value for electicity cost. User should enter actual value, if known.",(IF(C56=0.0676,"* $0.0676/kWh is a default value for electrity cost. User should enter actual value, if known."," ")))
Catalyst cost ($CC_{replace}$)	396.44 $/cubic foot (includes removal and disposal/regeneration of existing catalyst and installation of new catalyst	IF(C57=227, "* $227/cf is a default value for the catalyst cost based on 2016 prices. User should enter actual value, if known.", " ")
Operator Labor Rate	60.00 $/hour (including benefits)*	* $60/hour is a default value for the operator labor rate. User should enter actual value, if known.
Operator Hours/Day	4.00 hours/day*	* 4 hours/day is a default value for the operator labor. User should enter actual value, if known.

Note: The use of CEPCI in this spreadsheet is not an endorsement of the index, but is there merely to allow for availability of a well-known cost index to spreadsheet users. Use of other well-known cost indexes (e.g., M&S) is acceptable.

Maintenance and Administrative Charges Cost Factors:

Maintenance Cost Factor (MCF) =	0.005
Administrative Charges Factor (ACF) =	0.03

Data Sources for Default Values Used in Calculations:

Data Element	Default Value	Sources for Default Value	If you used your own site-specific values, please enter the value used and the reference source . . .
Reagent Cost ($/gallon)	$1.66/gallon 50% urea solution	U.S. Environmental Protection Agency (EPA). Documentation for EPA's Power Sector Modeling Platform v6 Using the Integrated Planning Model, Updates to the Cost and Performance for APC Technologies, SCR Cost Development Methodology, Chapter 5, Attachment 5-3, January 2017. Available at: https://www.epa.gov/sites/production/files/2018-05/documents/attachment_5-	$4/ gallon for 32% urea from SCR vendor: Nation-wide Boiler
Electricity Cost ($/kWh)	0.0676	U.S. Energy Information Administration. Electric Power Monthly. Table 5.3. Published December 2017. Available at: https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_5_6_a.	$0.1516/kWH from https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t =epmt_5_6_a
Percent sulfur content for Coal (% weight)		Not applicable to units burning fuel oil or natural gas	
Higher Heating Value (HHV) (Btu/lb)	1,033	2016 natural gas data compiled by the Office of Oil, Gas, and Coal Supply Statistics, U.S. Energy Information Administration (EIA) from data reported on EIA Form EIA-923, Power Plant Operations Report. Available at http://www.eia.gov/electricity/data/eia923/.	
Catalyst Cost ($/cubic foot)	227	U.S. Environmental Protection Agency (EPA). Documentation for EPA's Power Sector Modeling Platform v6 Using the Integrated Planning Model. Office of Air and Radiation. May 2018. Available at: https://www.epa.gov/airmarkets/documentation-epas-power-sector-modeling-platform-v6.	$14,000/cubic meter from SCR vendor - Nation-Wide Boiler
Operator Labor Rate ($/hour)	$60.00	U.S. Environmental Protection Agency (EPA). Documentation for EPA's Power Sector Modeling Platform v6 Using the Integrated Planning Model. Office of Air and Radiation. May 2018. Available at: https://www.epa.gov/airmarkets/documentation-epas-power-sector-modeling-platform-v6.	
Interest Rate (Percent)	5.5	Default bank prime rate	5% available at https://www.federalreserve.gov/releases/h15/.

SCR Design Parameters

The following design parameters for the SCR were calculated based on the values entered on the *Data Inputs* tab. These values were used to prepare the costs shown on the *Cost Estimate* tab.

Parameter	Equation	Calculated Value	Units	
Maximum Annual Heat Input Rate (Q_B) =	HHV x Max. Fuel Rate =	150	MMBtu/hour	
Maximum Annual fuel consumption (mfuel) =	(QB x 1.0E6 x 8760)/HHV =	1,272,023,233	scf/Year	
Actual Annual fuel consumption (Mactual) =		1,024,878,993	scf/Year	
Heat Rate Factor (HRF) =	NPHR/10 =	0.82		
Total System Capacity Factor (CF_{total}) =	(Mactual/Mfuel) x (tscr/tplant) =	0.806	fraction	
Total operating time for the SCR (t_{op}) =	CF_{total} x 8760 =	7058	hours	
NOx Removal Efficiency (EF) =	(NOx_{in} - NOx_{out})/NOx_{in} =	70.0	percent	
NOx removed per hour =	NOx_{in} x EF x Q_B =	9.80	lb/hour	
Total NO_x removed per year =	(NOx_{in} x EF x Q_B x t_{op})/2000 =	34.58	tons/year	
NO_x removal factor (NRF) =	EF/80 =	0.88		
Volumetric flue gas flow rate ($q_{flue\ gas}$) =	Q_{fuel} x QB x (460 + T)/(460 + 700)n_{scr} =	180,000	acfm	
Space velocity (V_{space}) =	$q_{flue\ gas}$/$Vol_{catalyst}$ =	568.54	/hour	
Residence Time	1/V_{space}	0.00	hour	
Coal Factor (CoalF) =	1 for oil and natural gas; 1 for bituminous; 1.05 for sub-bituminous; 1.07 for lignite (weighted average is used for coal blends)	1.00		
SO_2 Emission rate =	(%S/100)x(64/32)*1x10^6)/HHV =			Not applicable; factor applies only to coal-fired boilers
Elevation Factor (ELEVF) =	14.7 psia/P =			Not applicable; elevation factor does not apply to plants located at elevations below 500 feet.
Atmospheric pressure at sea level (P) =	2116 x [(59-(0.00356xh)+459.7)/518.6]$^{5.256}$ x (1/144)* =	14.6	psia	
Retrofit Factor (RF)	Retrofit to existing boiler	1.50		

* Equation is from the National Aeronautics and Space Administration (NASA), Earth Atmosphere Model. Available at https://spaceflightsystems.grc.nasa.gov/education/rocket/atmos.html.

Catalyst Data:

Parameter	Equation	Calculated Value	Units
Future worth factor (FWF) =	(interest rate)(1/((1+ interest rate)^{Y} -1), where Y = $H_{catalyts}$/(t_{SCR} x 24 hours) rounded to the nearest integer	0.3172	Fraction
Catalyst volume ($Vol_{catalyst}$) =	2.81 x Q_B x EF $_{adj}$ x Slipadj x NOx_{adj} x S_{adj} x (T_{adj}/N_{scr})	316.60	Cubic feet
Cross sectional area of the catalyst ($A_{catalyst}$) =	$q_{flue\ gas}$ /(16ft/sec x 60 sec/min)	188	ft^2
Height of each catalyst layer (H_{layer}) =	($Vol_{catalyst}$/(R_{layer} x $A_{catalyst}$)) + 1 (rounded to next highest integer)	2	feet

SCR Reactor Data:

Parameter	Equation	Calculated Value	Units
Cross sectional area of the reactor (A_{SCR}) =	1.15 x $A_{catalyst}$	216	ft^2
Reactor length and width dimensions for a square reactor =	$(A_{SCR})^{0.5}$	14.7	feet
Reactor height =	(R_{layer} + R_{empty}) x (7ft + h_{layer}) + 9ft	43	feet

Reagent Data:

Type of reagent used Urea

Molecular Weight of Reagent (MW) = 60.06 g/mole

Density = 68 lb/ft^3

Parameter	Equation	Calculated Value	Units
Reagent consumption rate ($m_{reagent}$) =	(NOx_{in} x Q_B x EF x SRF x MW_R)/MW_{NOx} =	7	lb/hour
Reagent Usage Rate (m_{sol}) =	$m_{reagent}$/Csol =	21	lb/hour
	(m_{sol} x 7.4805)/Reagent Density	2	gal/hour
Estimated tank volume for reagent storage =	(m_{sol} x 7.4805 x $t_{storage}$ x 24)/Reagent Density =	800	gallons (storage needed to store a 14 day reagent supply rounded to t

Capital Recovery Factor:

Parameter	Equation	Calculated Value
Capital Recovery Factor (CRF) =	i (1+ i)^{n}/(1+ i)^{n} - 1 = Where n = Equipment Life and i= Interest Rate	0.0710

Other parameters	Equation	Calculated Value	Units
Electricity Usage: Electricity Consumption (P) =	A x 1,000 x 0.0056 x (CoalF x HRF)$^{0.43}$ = where A = (0.1 x QB) for industrial boilers.	77.13	kW

Cost Estimate

Total Capital Investment (TCI)

TCI for Oil and Natural Gas Boilers

For Oil and Natural Gas-Fired Utility Boilers between 25MW and 500 MW:

$$TCI = 86,380 \times (200/B_{MW})^{0.35} \times B_{MW} \times ELEVF \times RF$$

For Oil and Natural Gas-Fired Utility Boilers >500 MW:

$$TCI = 62,680 \times B_{MW} \times ELEVF \times RF$$

For Oil-Fired Industrial Boilers between 275 and 5,500 MMBTU/hour :

$$TCI = 7,850 \times (2,200/Q_B)^{0.35} \times Q_B \times ELEVF \times RF$$

For Natural Gas-Fired Industrial Boilers between 205 and 4,100 MMBTU/hour :

$$TCI = 10,530 \times (1,640/Q_B)^{0.35} \times Q_B \times ELEVF \times RF$$

For Oil-Fired Industrial Boilers >5,500 MMBtu/hour:

$$TCI = 5,700 \times Q_B \times ELEVF \times RF$$

For Natural Gas-Fired Industrial Boilers >4,100 MMBtu/hour:

$$TCI = 7,640 \times Q_B \times ELEVF \times RF$$

Total Capital Investment (TCI) =	$6,092,630	in 2018 dollars

Annual Costs

Total Annual Cost (TAC)

TAC = Direct Annual Costs + Indirect Annual Costs

Direct Annual Costs (DAC) =	$191,444 in 2018 dollars
Indirect Annual Costs (IDAC) =	$435,153 in 2018 dollars
Total annual costs (TAC) = DAC + IDAC	$626,597 in 2018 dollars

Direct Annual Costs (DAC)

DAC = (Annual Maintenance Cost) + (Annual Reagent Cost) + (Annual Electricity Cost) + (Annual Catalyst Cost)

Annual Maintenance Cost =	0.005 x TCI =	$30,463 in 2018 dollars
Annual Reagent Cost =	m_{sol} x $Cost_{reag}$ x t_{op} =	$65,183 in 2018 dollars
Annual Electricity Cost =	P x $Cost_{elect}$ x t_{op} =	$82,528 in 2018 dollars
Annual Catalyst Replacement Cost =	n_{scr} x Vol_{cat} x $(CC_{replace}/R_{layer})$ x FWF	$13,271 in 2018 dollars
Direct Annual Cost =		$191,444 in 2018 dollars

Indirect Annual Cost (IDAC)

IDAC = Administrative Charges + Capital Recovery Costs

Administrative Charges (AC) =	0.03 x (Operator Cost + 0.4 x Annual Maintenance Cost) =	$2,576 in 2018 dollars
Capital Recovery Costs (CR)=	CRF x TCI =	$432,577 in 2018 dollars
Indirect Annual Cost (IDAC) =	AC + CR =	$435,153 in 2018 dollars

Cost Effectiveness

Cost Effectiveness = Total Annual Cost/ NOx Removed/year

Total Annual Cost (TAC) =	$626,597 per year in 2018 dollars
NOx Removed =	35 tons/year
Cost Effectiveness =	$18,118 per ton of NOx removed in 2018 dollars

Table B-2: Cost Effectiveness for Fabric Filter

Overall PM10 Control Efficiency	95.0%	
PM10 Outlet Grain Loading (gr/dscf)	0.0100	
Exhaust Flow Rate (dscfm)	85743	With other coolers' exhaust
Exhaust Flow Rate (dscfm)	48790	Without other coolers' exhaust
PM10 Emissions (tpy)	13.06	
PM10 Abated (tpy)	12.41	

Vendor				
Type of System				
Model Name				
	Cost Rate		**Reference**	**Cost**
Direct Capital Cost (DC)				
Purchased Equipment Cost (PEC)				
Basic and Auxiliary Equipment Cost (EC)				
Instruments and Controls	0.1	of EC in OAQPS		
Sales Tax	0.03	of EC in OAQPS		
Freight	0.05	of EC in OAQPS		
Total PEC			Vendor Quote	$240,975
Is the Control Device Packaged	Yes/ No			yes
Direct Installation Costs (DI)				
Foundation & Supports	0.04	of PEC	OAQPS	$9,639.00
Handling & Erection	0.5	of PEC	OAQPS	$120,487.45
Electrical	0.08	of PEC	OAQPS	$19,277.99
Piping	0.01	of PEC	OAQPS	$2,409.75
Insulation for Ductwork	0.07	of PEC	OAQPS	$16,868.24
Painting	0.04	of PEC	OAQPS	$9,639.00
Total DI				$60,244
Site Preparation (SP)	as required		Assumed	$0
Building (Bldg)	as required		Assumed	$0
Total Direct Cost (DC)	DC = PEC + DI + SP + Bldg		OAQPS	$301,219
Indirect Cost (IC)				
Indirect Installation Costs				
Engineering	0.10	of PEC	OAQPS	$24,097
Construction and field expenses	0.20	of PEC	OAQPS	$48,195
Contractor fees	0.10	of PEC	OAQPS	$24,097
Start-up	0.01	of PEC	OAQPS	$2,410
Performance Test	0.01	of PEC	OAQPS	$2,410
Contingencies	0.03	of PEC	OAQPS	$7,229
Total IC				$108,439
Total Capital Investment (TCI)*	**TCI = DC+IC**		**OAQPS**	**$409,657**
Annualized Cost				
Capital Recovery Factor CRF	0.080	of TCI	BAAQMD BACT Workbook	$32,872
Property Tax	0.01	of TCI	BAAQMD BACT Workbook	$4,097
Insurance	0.01	of TCI	BAAQMD BACT Workbook	$4,097
General and Administrative	0.02	of TCI	BAAQMD BACT Workbook	$8,193
Operation & Maintenance*	0.05	of TCI	BAAQMD BACT Workbook	$20,483
Total Annualized Cost ($/yr)				$69,741
Cost Effectiveness ($/Ton)				**5,622**
BAAQMD Maximum Cost Effectiveness				
PM10 ($/Ton)	5,300		BAAQMD BACT Workbook	Not Cost Effective

Life of abatement equipment	20	years
Interest rate	5%	April 25, 2019 through September 24, 2019 Average
CRF	0.080	

Table B-3: Cost Effectiveness for Wet Venturi Scrubber

Overall Fil-PM10 Control Efficiency	95.0%	
PM10 Outlet Grain Loading (gr/dscf)	0.0100	
Exhaust Flow Rate (dscfm)	85743	With other coolers' exhaust
Exhaust Flow Rate (dscfm)	48790	Without other coolers' exhaust
PM10 Emissions (tpy)	13.06	
PM10 Abated (tpy)	12.41	
2017 CEPCI	567.5	
2018 CEPCI	603.1	

Vendor				
Type of System				
Model Name				
	Cost Rate		**Reference**	**Cost**
Direct Capital Cost (DC)				
Purchased Equipment Cost (PEC)				
Basic and Auxiliary Equipment Cost (EC)			Vendor Quote for MicroMist Scrubber for Another Project in 2017	$169,322
Instruments and Controls	0.1	of EC	OAQPS	$16,932.21
Sales Tax	0.09	of EC	Average 9% sales tax in Bay Area	$15,238.99
Freight	0.05	of EC	OAQPS	$8,466.10
Total PEC				$209,959
Direct Installation Costs (DI)				
Foundation & Supports	0.06	of PEC	OAQPS	$12,597.56
Handling & Erection	0.4	of PEC	OAQPS	$83,983.76
Electrical	0.01	of PEC	OAQPS	$2,099.59
Piping	0.05	of PEC	OAQPS	$10,497.97
Insulation for Ductwork	0.03	of PEC	OAQPS	$6,298.78
Painting	0.01	of PEC	OAQPS	$2,099.59
Total DI				$117,577
Site Preparation (SP)	as required		Assumed	$0
Building (Bldg)	as required		Assumed	$0
Total Direct Cost (DC)	DC = DI + SP + Bldg		OAQPS	$117,577
Indirect Cost (IC)				
Indirect Installation Costs				
Engineering	0.10	of PEC	OAQPS	$20,996
Construction and field expenses	0.10	of PEC	OAQPS	$20,996
Contractor fees	0.10	of PEC	OAQPS	$20,996
Start-up	0.01	of PEC	OAQPS	$2,100
Performance Test	0.01	of PEC	OAQPS	$2,100
Contingencies	0.03	of PEC	OAQPS	$6,299
Total IC				$73,486
Total Capital Investment (TCI)*	TCI = PEC+DC+IC		OAQPS	$401,022
Annualized Cost				
Capital Recovery Factor CRF	0.080	of TCI	BAAQMD BACT Workbook	$32,179
Property Tax	0.01	of TCI	BAAQMD BACT Workbook	$4,010
Insurance	0.01	of TCI	BAAQMD BACT Workbook	$4,010
General and Administrative	0.02	of TCI	BAAQMD BACT Workbook	$8,020
Operation & Maintenance	0.05	of TCI	BAAQMD BACT Workbook	$20,051
Total Annualized Cost ($/yr)				$68,271
Cost Effectiveness ($/Ton)				**5,503**
BAAQMD Maximum Cost Effectiveness				
PM10 ($/Ton)	5,300		BAAQMD BACT Workbook	**Not Cost Effective**

Life of abatement equipment	20	years
Interest rate	5%	April 25, 2019 through September 24, 2019 Average
CRF	0.080	

Table B-4: Cost Effectiveness for ESP

Overall PM10 Control Efficiency	95.0%
PM10 Outlet Grain Loading (gr/dscf)	0.0100
Exhaust Flow Rate (dscfm)	48790
Exhaust Flow Rate (acfm)	58229
Controlled PM10 Emissions (tpy)	13.06
PM10 Abated (tpy)	12.41
1987 CEPCI	323.8
2018 CEPCI	603.1

Vendor				
Type of System				
Model Name				
	Cost Rate		**Reference**	**Cost**
Direct Capital Cost (DC)				
Purchased Equipment Cost (PEC)				
Basic and Auxiliary Equipment Cost (EC)			From Figure 3.6	$209,445
Instruments and Controls	0.1	of EC	OAQPS	$20,944.55
Sales Tax	0.09	of EC	Average 9% sales tax in Bay Area	$18,850.09
Freight	0.05	of EC	OAQPS	$10,472.27
Total PEC				$259,712
Is the Control Device a Two-Stage ESP	Yes/ No			yes
Direct Installation Costs (DI)				
Foundation & Supports	0.04	of PEC	OAQPS	$10,388.50
Handling & Erection	0.5	of PEC	OAQPS	$129,856.19
Electrical	0.08	of PEC	OAQPS	$20,776.99
Piping	0.01	of PEC	OAQPS	$2,597.12
Insulation for Ductwork	0.02	of PEC	OAQPS	$5,194.25
Painting	0.02	of PEC	OAQPS	$5,194.25
Total DI				$64,928
Site Preparation (SP)	as required		Assumed	$0
Building (Bldg)	as required		Assumed	$0
Total Direct Cost (DC)	DC = PEC+ DI + SP + Bldg		OAQPS	$324,640
Indirect Cost (IC)				
Indirect Installation Costs				
Engineering	0.20	of PEC	OAQPS	$51,942
Construction and field expenses	0.20	of PEC	OAQPS	$51,942
Contractor fees	0.10	of PEC	OAQPS	$25,971
Start-up	0.01	of PEC	OAQPS	$2,597
Performance Test	0.01	of PEC	OAQPS	$2,597
Model Study	0.02	of PEC	OAQPS	$5,194
Contingencies	0.03	of PEC	OAQPS	$7,791
Total IC				$148,036

Total Capital Investment (TCI)*	**TCI = DC+IC**		**OAQPS**	**$472,677**
Annualized Cost				
Capital Recovery Factor CRF	0.080	of TCI	BAAQMD BACT Workbook	$37,929
Property Tax	0.01	of TCI	BAAQMD BACT Workbook	$4,727
Insurance	0.01	of TCI	BAAQMD BACT Workbook	$4,727
General and Administrative	0.02	of TCI	BAAQMD BACT Workbook	$9,454
Operation & Maintenance*	0.05	of TCI	BAAQMD BACT Workbook	$23,634
Total Annualized Cost ($/yr)				$80,470
Cost Effectiveness ($/Ton)				**6,486**
BAAQMD Maximum Cost Effectiveness				
PM10 ($/Ton)	5,300		BAAQMD BACT Workbook	Not Cost Effective

Life of abatement equipment	20 years
Interest rate	5% April 25, 2019 through September 24, 2019 Average
CRF	0.080

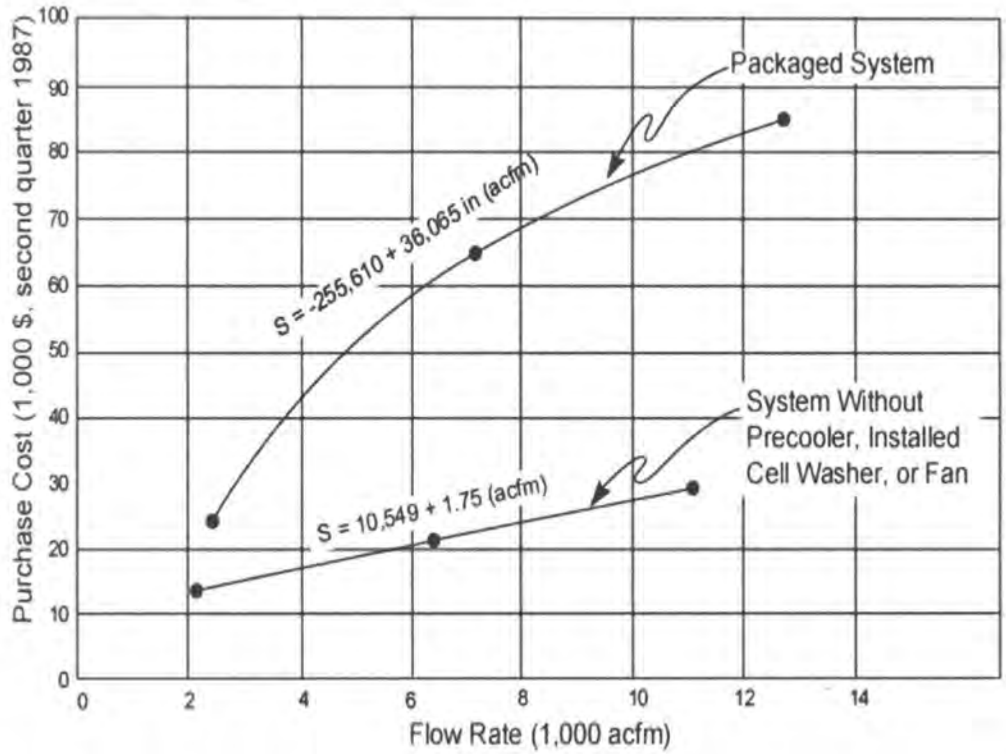

Figure 3.6: Purchase Costs for Two-stage, Two-cell Precipitators [40]