Draft Engineering Evaluation
San Mateo Water Quality Control Plant
2050 Detroit Drive, San Mateo, CA 94404
Plant No. 861
Application No. 27505
Project Description: New Dual-Fueled Digester Gas/Natural Gas Hot Water Boiler

BACKGROUND

San Mateo Water Quality Control Plant (facility) has applied to obtain an Authority to Construct (ATC) and/or Permit to Operate (PTO) for the following equipment:

S-27 Dual-Fueled Natural Gas/Digester Gas Fired Hot Water Boiler
Burnham, Model V1116H, 3.9 MMBtu/Hr Rated Capacity
With S.T. Johnson Company, Model DHF100G4GM-LN, Low NO_X Burner

The dual-fueled natural gas/digester gas hot water boiler (boiler) will be situated at the wastewater treatment plant located on 2050 Detroit Drive in San Mateo, CA 94404. The boiler will be fired with Public Utilities Commission (PUC) regulated natural gas and/or digester gas generated by the anaerobic digesters located at the publicly owned treatment works (POTW). The boiler will supply hot water to the digesters to maintain the ideal temperature for the anaerobic microorganisms. In the process, digester gas generated from the anaerobic system will supplement the overall fuel consumed, thereby lowering the facility's natural gas consumption.

The proposed boiler is expected to comply with the nitrogen oxides (NO_X) and carbon monoxide (CO) emission standards of Regulation 9-7. Furthermore, the daily potential to emit (PTE) increase in emissions are estimated to be below the Best Available Control Technology (BACT) limit pursuant to Regulation 2-2-301.

The criteria pollutants associated with the source are NO_X, CO, precursor organic compounds (POC), sulfur dioxide (SO_2), and particulate matter (PM).

The facility will be provided a fuel sulfur content limit (as H_2S) to ensure that the facility does not exceed any regulatory requirements that pertain to SO_2. The operation of the boiler should not pose any health threat to the surrounding community or the public at large.

EMISSIONS CALCULATIONS

The applicant has provided the following information, which was supplied by the vendor.

Table 1. Boiler Specifications and Emission Factors	
Boiler Manufacturer	Burnham
Boiler Model	V1116H
Burner Manufacturer	S.T. Johnson
Burner Model	DHF100G4GM-LN
Rated Capacity, MMBtu/hr	3.9
NO_X, Natural Gas Fired, ppmv[1]	30
NO_X, Digester Gas Fired, ppmv[1]	30
CO, Natural Gas Fired, ppmv (lb/MMBtu)[1]	140 (0.102)
CO, Digester Gas Fired, ppmv (lb/MMBtu)[1]	125 (0.104)

Table 1. Boiler Specifications and Emission Factors (Continued)	
PM, Natural Gas Fired, lb/MMBtu[2,3]	0.007
PM, Digester Gas Fired, lb/MMBtu[2,3]	0.010
VOC, Natural Gas Fired, lb/MMBtu[2,4]	0.02
VOC, Digester Gas Fired, lb/MMBtu[2,4]	0.05
Digester Gas Typical Heat Content, MMBtu/MMscf[5]	569

[1]The emission factors were supplied by the manufacturer (S.T. Johnson Company) in an email correspondence dated January 21, 2016. S.T. Johnson Company is willing to guarantee stack concentrations of less than 30 ppmv NO_X, 140 ppmv CO firing natural gas, and 125 ppmv CO firing digester (referenced at 3% O_2, dry).

[2]The emission factors for PM and POC were obtained from a correspondence between San Mateo Water Quality Control Plant and S.T. Johnson Company dated January 15, 2016.

[3]PM is assumed to be in the form of PM with a diameter of less than 10 µm (PM_{10}). In addition, the correspondence between San Mateo Water Quality Control Plant and S.T. Johnson Company dated January 15, 2016, identifies PM and PM_{10} as having the same emission factor.

[4]It is assumed that all volatile organic compounds (VOC) emitted will be in the form of POC.

[5]The typical heat content of the digester gas was provided by the applicant.

Estimating The F_d Factor For Digester Gas

Using the information provided by the vendor, the volume of combustion components per unit heat content (F_d factor) for digester gas was estimated. In addition, the F_d factor for natural gas is assumed to be 8,710 dscf/MMBtu in accordance with the *"Permit Handbook – Section 2.1 Boilers, Steam Generators & Process Heaters"* (Permit Handbook). The following equations provide the methodology for estimating the F_d factor for digester gas.

$$E.F. = \frac{ppm_{measured} \cdot \left(\frac{21}{21 - \%O_{2_{measured}}}\right) \cdot MW \cdot F_d}{V_m} \qquad (\textbf{Equation 1})$$

Where: E.F. is the emission factor in lb/MMBtu;
ppm is the volume concentration of a pollutant at the measured $\%O_2$;
$\%O_2$ is the percent measured oxygen concentration;
MW is the molecular weight of the pollutant in lb/mol_{lb};
F_d is the volume of combustion components per unit heat content in dscf/MMBtu; and,
V_m is the molecular volume of a gas, which is 385.3 $dscf/mol_{lb}$ at 1 atm and 68°F.

Rearranging Equation 1, the F_d factor may be solved in terms of the emission factor, the molecular volume, the volume concentration of a pollutant, the percent measured oxygen concentration, and the molecular weight of a pollutant.

$$F_d = \frac{E.F. \cdot V_m}{ppm_{measured} \cdot \left(\frac{21}{21 - \%O_{2_{measured}}}\right) \cdot MW} \quad (\textbf{Equation 2})$$

Inputting the values provided by the vendor, the F_d factor for digester gas was calculated.

$$F_{d_{Digester\ Gas}} = \frac{\left(\frac{\mathbf{0.104\ \cancel{lbs\ CO}}}{\mathbf{MMBtu}}\right) \cdot \left(\frac{\mathbf{385.3\ \cancel{dscf\ CO}}}{\mathbf{\cancel{mol_{lb}\ CO}}}\right)}{\left(\frac{\mathbf{125\ \cancel{dscf\ CO}}}{\mathbf{10^6\ dscf\ Flue\ Gas}}\right) \cdot \left(\frac{\mathbf{21}}{\mathbf{21-3}}\right) \cdot \left(\frac{\mathbf{28.01\ \cancel{lbs\ CO}}}{\mathbf{\cancel{mol_{lb}\ CO}}}\right)}$$

$$\boxed{\mathbf{F_{d_{Digester\ Gas}} = 9{,}810\ dscf\ Flue\ Gas/MMBtu}}$$

Comparing the F_d factors of natural gas and digester gas, the aforementioned F_d factor for digester gas will be an acceptable estimate, as a combustion source will need to burn more of a low grade gas, such as digester gas, to output the same heat generated for a higher grade gas, such as natural gas. The combustion of more fuel will lead to a higher volume of flue gas. Furthermore, the F_d factor for gas generated from municipal solid waste, obtained from the Environmental Protection Agency's (EPA) *"Method 19 – Determination of Sulfur Dioxide Removal Efficiency and Particulate Matter, Sulfur Dioxide, and Nitrogen Oxide Emission Rates,"* (Method 19) is estimated to be 9,570 dscf/MMBtu. The volume of combustion generated from municipal solid waste gas demonstrates the same trend as volume of combustion generated from digester gas, thereby providing more evidence that the F_d factor for a low grade gas should be higher than a higher grade gas.

Converting NO_X Emission Factor For The Firing of Digester Gas

In order to determine the mass emission rate of NO_X from digester gas combustion, for regulatory review purposes, Equation 1 was utilized. Assuming that NO_X is in the form of NO_2, the following mass emission rate was calculated.

$$E.F. = \frac{ppm_{measured} \cdot \left(\frac{21}{21 - \%O_{2_{measured}}}\right) \cdot MW \cdot F_d}{V_m}$$

$$E.F._{NO_X} = \frac{\left(\frac{\mathbf{30\ \cancel{dscf\ NO_x}}}{\mathbf{10^6\ \cancel{dscf\ Flue\ Gas}}}\right) \cdot \left(\frac{\mathbf{21}}{\mathbf{21-3}}\right) \cdot \left(\frac{\mathbf{46.005\ lbs\ NO_X}}{\mathbf{\cancel{mol_{lb}\ NO_x}}}\right) \cdot \left(\frac{\mathbf{9{,}810\ \cancel{dscf\ Flue\ Gas}}}{\mathbf{MMBtu}}\right)}{\left(\frac{\mathbf{385.3\ \cancel{dscf\ NO_x}}}{\mathbf{\cancel{mol_{lb}\ NO_x}}}\right)}$$

$$\boxed{\mathbf{E.F._{NO_X} = 0.041\ lbs\ NO_X/MMBtu\ (Digester\ Gas\ Fired)}}$$

Converting NO_X and CO Emission Factors For The Firing of Natural Gas

In order to determine the mass emission rates of NO_X and CO from natural gas combustion, for regulatory review purposes, Equation 1 was utilized. Assuming that NO_X is in the form of NO_2 and the F_d factor for natural gas is 8,710 dscf/MMBtu, the following mass emission rates were calculated.

$$E.F. = \frac{ppm_{measured} \cdot \left(\frac{21}{21 - \%O_{2measured}}\right) \cdot MW \cdot F_d}{V_m}$$

$$E.F._{NO_X} = \frac{\left(\frac{\mathbf{30}\ \cancel{dscf\ NO_x}}{\mathbf{10^6}\ \cancel{dscf\ Flue\ Gas}}\right) \cdot \left(\frac{\mathbf{21}}{\mathbf{21-3}}\right) \cdot \left(\frac{\mathbf{46.005\ lbs\ NO_X}}{\cancel{mol_{lb}\ NO_x}}\right) \cdot \left(\frac{\mathbf{8,710}\ \cancel{dscf\ Flue\ Gas}}{\mathbf{MMBtu}}\right)}{\left(\frac{\mathbf{385.3}\ \cancel{dscf\ NO_x}}{\cancel{mol_{lb}\ NO_x}}\right)}$$

$$\boxed{\boldsymbol{E.F._{NO_X} = 0.036\ lbs\ NO_X/MMBtu\ (Natural\ Gas\ Fired)}}$$

$$E.F._{CO} = \frac{\left(\frac{\mathbf{140}\ \cancel{dscf\ CO}}{\mathbf{10^6}\ \cancel{dscf\ Flue\ Gas}}\right) \cdot \left(\frac{\mathbf{21}}{\mathbf{21-3}}\right) \cdot \left(\frac{\mathbf{28.01\ lbs\ CO}}{\cancel{mol_{lb}\ CO}}\right) \cdot \left(\frac{\mathbf{8,710}\ \cancel{dscf\ Flue\ Gas}}{\mathbf{MMBtu}}\right)}{\left(\frac{\mathbf{385.3}\ \cancel{dscf\ CO}}{\cancel{mol_{lb}\ CO}}\right)}$$

$$\boxed{\boldsymbol{E.F._{CO} = 0.103\ lbs\ CO/MMBtu\ (Natural\ Gas\ Fired)}}$$

Although the manufacturer has provided the equivalent mass emission rate for CO, which is 0.102 lbs/MMBtu, using the assumed natural gas F_d factor yields a larger CO mass emission rate. For regulatory review purposes, the larger CO mass emission rate will be used to evaluate the source.

Determining SO_X BACT Emission Limit

Pursuant to a correspondence from S.T. Johnson Company dated January 15, 2016, the estimated SO_X (as SO_2) mass emission rate for the combustion of digester gas is 0.07 lbs/MMBtu. Using the provided emission factor and the maximum heat input rating of the boiler, the following daily mass emission rate was calculated.

$$\frac{\mathbf{0.07\ lbs\ SO_X}}{\cancel{MMBtu}} \times \frac{\mathbf{3.9}\ \cancel{MMBtu}}{\cancel{hr}} \times \frac{\mathbf{24}\ \cancel{hr}}{\mathbf{day}} = \mathbf{6.6\ lbs\ SO_X/day}$$

Although, the manufacturer's daily mass emission rate is below the BACT limit of 10 lbs of SO_X, due to the unpredictable nature of digester gas, a sulfur limit will be calculated and included as a permit condition.

It is assumed that the digester gas will contain sulfur in the form of hydrogen sulfide (H_2S). Limiting the source to the SO_X BACT limit and using the following stoichiometric equation for the complete combustion of H_2S, the necessary concentration of H_2S, in the digester gas before combustion, which will approach the SO_X BACT limit, may be determined.

$$2\ H_2S + 3\ O_2 \rightarrow 2\ SO_2 + 2\ H_2O \quad (\textbf{Equation 3})$$

$$\frac{\mathbf{10}\ \cancel{lbs\ SO_x}}{\mathbf{day}} \times \frac{\cancel{mol_{lb}\ SO_x}}{\mathbf{64.058}\ \cancel{lbs\ SO_x}} \times \frac{\mathbf{2}\ \mathbf{mol_{lb}\ H_2S}}{\mathbf{2}\ \cancel{mol_{lb}\ SO_x}} = \mathbf{0.156}\ \mathbf{mol_{lb}\ H_2S/day}$$

Using the ideal gas law (Equation 4), the volume of H_2S in the digester gas, which will approach the SO_X BACT limit, may be determined.

$$PV = nRT \quad (\textbf{Equation 4})$$

Where: P is the pressure of a gaseous compound, which is assumed to be at 1 atm;
V is the volume of a gaseous compound in dscf;
n is the amount of a gaseous compound in mol_{lb};
R is a gas constant, which is 0.730241 (atm·scf)/(mol_{lb}·°R); and,
T is the temperature of a gaseous compound in °R, which is assumed to be 527.67°R (68°F).

Rearranging the ideal gas law, the volume of H_2S in the digester gas may be determined.

$$V = \frac{nRT}{P}$$

$$\frac{\mathbf{0.156}\ \cancel{mol_{lb}}\ \mathbf{H_2S}}{\mathbf{day}} \times \frac{\mathbf{0.730241}\ \cancel{atm} \cdot \mathbf{scf}}{\cancel{^\circ R} \cdot \cancel{mol_{lb}}} \times \mathbf{527.67}\cancel{^\circ R}}{\mathbf{1}\ \cancel{atm}} = \mathbf{60.111}\ \mathbf{scf\ H_2S/day}$$

Using a common heating value content for digester gas, the maximum digester gas fuel flowrate may be estimated.

$$\frac{\mathbf{3,900,000}\ \cancel{Btu}}{\cancel{hr}} \times \frac{\mathbf{scf\ Digester\ Gas}}{\mathbf{550}\ \cancel{Btu}} \times \frac{\mathbf{24}\ \cancel{hr}}{\mathbf{day}} = \mathbf{170,181.818}\ \mathbf{scf\ Digester\ Gas/day}$$

Using the calculated volume of H_2S in the digester gas that would approach the BACT limit and the estimated maximum digester gas fuel flowrate, the volumetric concentration of sulfur in the digester gas may be calculated.

$$\frac{\frac{\mathbf{60.111}\ \mathbf{scf\ H_2S}}{\cancel{day}}}{\frac{\mathbf{170,181.818}\ \cancel{scf}\ \mathbf{Digester\ Gas}}{\cancel{day}}} \times \frac{\mathbf{10^6}\ \cancel{scf}}{\mathbf{MMscf}} = \mathbf{353}\ \mathbf{scf\ H_2S/Digester\ Gas\ MMscf}$$

$$353\ scf\ H_2S/Digester\ Gas\ MMscf = 353\ ppmv\ H_2S$$

Source and Facility-Wide PTE Emission Calculations

The following table provides the PTE emission rate calculations for digester gas fired, natural gas fired, and maximum emissions.

Table 2. Source Daily and Annual PTE Emission Calculations (Digester Gas)							
Pollutant	**Emission Factor (lb/MMBtu)**	**Maximum Input Heat Rating (MMBtu/hr)**	**PTE Daily Operating Hours[1] (hr/day)**	**PTE Daily Emissions (lb/day)**	**PTE Annual Operation[2] (day/yr)**	**PTE Annual Emissions (lb/yr)**	**PTE Annual Emissions (ton/yr)**
POC	0.050	3.9	24	4.68	365	1,708.20	0.854
NO_X	0.041	3.9	24	3.84	365	1,401.60	0.701
CO	0.104	3.9	24	9.73	365	3,551.45	1.776
PM[3]	0.010	3.9	24	0.94	365	343.10	0.172
SO_2[4]	-	-	-	9.99	365	3,646.35	1.823

Table 3. Source Daily and Annual PTE Emission Calculations (Natural Gas)							
Pollutant	**Emission Factor (lb/MMBtu)**	**Maximum Input Heat Rating (MMBtu/hr)**	**PTE Daily Operating Hours[1] (hr/day)**	**PTE Daily Emissions (lb/day)**	**PTE Annual Operation[2] (day/yr)**	**PTE Annual Emissions (lb/yr)**	**PTE Annual Emissions (ton/yr)**
POC	0.020	3.9	24	1.87	365	682.55	0.341
NO_X	0.036	3.9	24	3.37	365	1,230.05	0.615
CO	0.103	3.9	24	9.64	365	3,518.60	1.759
PM[3]	0.007	3.9	24	0.66	365	240.90	0.120
SO_2[4]	-	-	-	9.99	365	3,646.35	1.823

Table 4. Source Maximum Daily and Annual PTE Emission Rates		
Pollutant	**PTE Daily Emissions (lb/day)**	**PTE Annual Emissions (ton/yr)**
POC	4.68	0.854
NO_X	3.84	0.701
CO	9.73	1.776
PM[3]	0.94	0.172
SO_2[4]	9.99	1.823

[1]Maximum daily operation is assumed to be 24 hours.

[2]Maximum annual operation is assumed to be 365 days.

[3]PM is assumed to be in the form of PM_{10}.

[4]A permit condition will be included, which will limit the sulfur content of the fuel to prevent the exceedance of a BACT limit.

Furthermore, utilizing information accumulated from the facility for each source, the following table provides the potential to emit for the facility.

Table 5. Facility Source PTE Emission Review			
Pollutant	**Existing[1] (ton/yr)**	**New (ton/yr)**	**Total (ton/yr)**
POC	12.562	0.854	13.416
NO_X	12.922	0.700	13.622
SO_2	12.359	1.825	14.184
PM_{10}	0.611	0.171	0.782
CO	22.150	1.777	23.927

[1]The existing facility source PTE emissions were obtained from the attached detailed spreadsheet *"Appendix A – Potential to Emit Review."*

TOXIC RISK SCREENING ANALYSIS

The boiler has the ability to combust natural gas and digester gas. Using toxic air contaminant (TAC) emission factors for digester gas, obtained from EPA Web Fire for the following search criteria, and TAC emission factors for natural gas, obtained from *"District Policy: Emission Factors for Toxic Air Contaminants from Miscellaneous Natural Gas Combustion Sources,"* the hourly and annual maximum TAC emission rates were calculated.

Table 6. EPA Web Fire Detailed Emission Factor Search[1]	
Detailed Search Criteria	**Search Criteria Choice**
Level 1	External Combustion Boilers
Level 2	Commercial/Institutional
Level 3	Process Gas
Level 4	POTW Digester Gas-Fired Boiler

[1]The aforementioned parameters were used in the following website to obtain emission factors for TACs listed in Table 7.

http://cfpub.epa.gov/webfire/index.cfm?action=fire.detailedSearch

Table 7. Regulation 2-5 Review – Digester Gas TAC Emission Rates						
Pollutant	**Emission Factor (lb/MMBtu)**	**Maximum Input Heat Rating (MMBtu/hr)**	**Maximum Hourly Emission Rate (lb/hr)**	**Reg. 2-5 Acute Trigger Level (lb/hr)**	**Maximum Annual Emission Rate[1] (lb/yr)**	**Reg. 2-5 Chronic Trigger Level (lb/yr)**
Acetaldehyde (75-07-0)	1.30E-04	3.9	5.07E-04	1.0E+00	4.44E+00	3.8E+01
Acrolein (107-02-8)	7.80E-05	3.9	3.04E-04	5.5E-03	2.66E+00	1.4E+01
Dichloromethane (75-09-2)	1.37E-04	3.9	5.34E-04	N/A	4.68E+00	N/A

Table 7. Regulation 2-5 Review – Digester Gas TAC Emission Rates (Continued)						
Pollutant	**Emission Factor (lb/MMBtu)**	**Maximum Input Heat Rating (MMBtu/hr)**	**Maximum Hourly Emission Rate (lb/hr)**	**Reg. 2-5 Acute Trigger Level (lb/hr)**	**Maximum Annual Emission Rate[1] (lb/yr)**	**Reg. 2-5 Chronic Trigger Level (lb/yr)**
Xylene (1330-20-7)	3.68E-05	3.9	1.44E-04	4.9E+01	1.26E+00	2.7E+04
Styrene (100-42-5)	7.64E-05	3.9	2.98E-04	4.6E+01	2.61E+00	3.5E+04
1,1,1-Trichloroethane (71-55-6)	1.25E-04	3.9	4.88E-04	1.5E+02	4.27E+00	3.9E+04

[1]It is assumed that the source will operate 8,760 hours per year (based on 24 hours per day, 365 days per year operation).

Table 8. Regulation 2-5 Review – Natural Gas TAC Emission Rates						
Pollutant	**Emission Factor (lb/Mscf)**	**Maximum Fuel Usage Rate[1] (Mscf/hr)**	**Maximum Hourly Emission Rate (lb/hr)**	**Reg. 2-5 Acute Trigger Level (lb/hr)**	**Maximum Annual Emission Rate[2] (lb/yr)**	**Reg. 2-5 Chronic Trigger Level (lb/yr)**
Benzene (71-43-2)	2.1E-06	3.8	7.9E-06	2.9E+00	7.00E-02	3.8E+00
Formaldehyde (50-00-0)	7.5E-05	3.8	2.85E-04	1.2E-01	2.50E+00	1.8E+01
Toluene (108-88-3)	3.4E-06	3.8	1.29E-05	8.2E+01	1.13E-01	1.2E+04

[1]The maximum fuel usage rate was derived from the maximum input heat rating and a conversion factor of 1,020 Btu per scf of natural gas.

$$\frac{3.9 \times 10^6 \ \cancel{Btu}}{hr} \times \frac{\cancel{scf}\ Natural\ Gas}{1,020\ \cancel{Btu}} \times \frac{Mscf}{10^3\ \cancel{scf}} = 3.8\ Mscf\ Natural\ Gas/hr$$

[2]It is assumed that the source will operate 8,760 hours per year (based on 24 hours per day, 365 days per year operation).

Although there are digester gas combustion emission factors for benzene, formaldehyde, and toluene listed in EPA Web Fire, pursuant to previous source tests performed on dual fueled boilers (natural gas/digester gas), digester gas combustion emits less non-methane organic compound concentrations than natural gas combustion. Therefore, the emission rates from natural gas combustion will be maximum PTE.

The boiler is not expected to exceed the trigger threshold levels of Regulation 2-5. According to Regulation 2-5-110, the source is not subject to the provisions of this rule.

PLANT CUMULATIVE EMISSIONS

2050 Detroit Drive, San Mateo, CA 94404 is an existing facility. Table 9 summarizes the cumulative increase in criteria pollutant emissions that will result from the operation of S-27.

Table 9. Facility Cumulative Increase Review

Pollutant	Existing (ton/yr)	New (ton/yr)	Total (ton/yr)
POC	7.464	0.854	8.318
NO_X	7.464	0.701	8.165
SO_2	2.239	1.823	4.062
PM_{10}	0.597	0.172	0.769
CO	20.520	1.776	22.296

BEST AVAILABLE CONTROL TECHNOLOGY

Pursuant to Table 4, the source is not expected to exceed a 10 lb daily emission rate of any criteria pollutant. The source is not subject to the BACT requirements.

OFFSETS

Pursuant to Regulation 2-2-302, offsets must be provided for any new or modified source at a facility that emits, or is permitted to emit, more than 10 tons per year of POC or NO_X. Furthermore, pursuant to Regulation 2-2-303 offsets must be provided for any new or modified source at a major facility with a cumulative increase that exceeds 1.0 ton per year of PM_{10} or SO_2. Pursuant to the definition of a "Major Facility" as defined in Regulation 2-6-212 and based upon Table 5, the facility is not defined as a major source. According to Table 5, offsets must be provided for the NO_X and POC cumulative emission increases. The offsets will be provided from the District's Small Facilities Bank.

STATEMENT OF COMPLIANCE

Regulation 1

The boiler is subject to and expected to be in compliance with the requirements of Regulation 1-301 (Public Nuisance).

Regulation 2, Rule 1

Pursuant to Regulation 2-1-114.1.1, boilers, which are not exclusively fired by natural gas or liquefied petroleum gas, which are greater than 1 MMBtu/hr, are subject to the requirements of Regulation 2-1. According to Regulation 2-1-301, prior to the installation of the equipment, an ATC must be obtained. The facility has submitted an application and is expected to be in compliance with Regulation 2-1.

Furthermore, the facility has certified that the source will be located within 1,000 feet of the outer boundary of any K-12 school site. Therefore, the requirements of the California Health & Safety Code §42301.6 are applicable at this time. The facility will have to perform a public notification in accordance with California Health & Safety Code §42301.6.

Regulation 2, Rule 2
Pursuant to Regulation 2-2-301, BACT is required for a new source with potential to emit emission increases that equal 10.0 lbs or greater of POC, NPOC, NO_X, SO_2, PM_{10}, or CO.

The boiler is not expected to exceed any of the BACT thresholds. Therefore the source is not subject to the BACT requirements.

Furthermore, pursuant to Regulation 2-2-302, a facility that emits more than 10 tons of POC or NO_X per year is subject to offsets. The facility is expected to emit more than 10 tons and less than 35 tons of POC and NO_X per year and will require the provision of offsets. The offsets will be provided from the District's Small Facilities Bank.

Lastly, the facility is not expected to emit greater than 100 tons per year or more of any air pollutant subject to regulation under the Clean Air Act or 10 tons of a single hazardous air pollutant (HAP) or 25 tons of a combination of HAPs per year. The facility is not a major facility and is not required to meet the requirements of Regulation 2-2-303 (Offsets for PM_{10} and SO_X), 2-2-304 (Prevention of Significant Deterioration (PSD)), and 2-2-405 (Publication and Public Comment).

Regulation 2, Rule 5
Pursuant to Regulation 2-5-110, the provisions of this rule are not subject to sources with an increase in emissions less than the trigger levels listed in Table 2-5-1. The boiler is not expected to exceed the trigger levels listed in Table 2-5-1 and is not required to meet the requirements of Regulation 2-5.

Regulation 6, Rule 1
Pursuant to Regulations 6-1-301, a person shall not emit 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. 1 on the Ringelmann Chart, or of such opacity as to obscure an observer's view to an equivalent or greater degree. In addition, pursuant to Regulation 6-1-302, a person shall not emit from any source for a period or periods aggregating more than three minutes in any hour an emission equal to or greater than 20% opacity as perceived by an opacity sensing device, where such device is required by District regulations.

The boiler is expected to meet the requirements of Regulations 6-1-301 and 6-1-302.

Regulation 9, Rule 1
According to Regulation 9-1-302, a person shall not emit from any source, other than a ship, a gas stream containing sulfur dioxide in excess of 300 ppm (dry). Using the 10 lb of SO_2 limit and the estimated F_d factor, the volumetric concentration of SO_2 may be calculated.

$$\boldsymbol{V_{flue\ gas} = \frac{3.9\ \cancel{MMBtu}}{\cancel{hr}} \times \frac{9{,}810\ dscf\ flue\ gas}{\cancel{MMBtu}} \times \frac{24\ \cancel{hr}}{day} = 918{,}216\ dscf\ flue\ gas/day}$$

$$V_{SO_2} = \frac{10\ \cancel{lb\ SO_2}}{day} \times \frac{\cancel{mol}\ SO_2}{64.058\ \cancel{lb\ SO_2}} \times \frac{385.3\ scf}{\cancel{mol}} = 60.15\ scf\ SO_2/day$$

$$\frac{V_{SO_2}}{V_{flue\ gas}} = \frac{60.15\ scf\ SO_2}{918{,}216\ \cancel{scf}\ flue\ gas} \times \frac{10^6\ \cancel{scf}}{MMscf} = 66\ scf\ SO_2/MMscf\ flue\ gas = 66\ ppmv\ SO_2$$

The boiler is not expected to exceed the limitation of Regulation 9-1-302.

Regulation 9, Rule 7
This rule limits the emissions of NO_X and CO from industrial, institutional, and commercial boilers, steam generators, and process heaters with a rated heat input of 1 MMBtu/ hr or more, when fired with fuels other than natural gas or liquefied petroleum gas.

Pursuant to Regulation 9-7-307, the boiler will need to meet the following emission limits of Sections 307.1, 307.7, and 307.9.

Table 10. Regulation 9-7 Emission Limits Review

Description	Heat Input Rating (MMBtu/hr)	Fuel	NO_X Limit Dry @ 3% O_2 (ppmv)	CO Limit Dry @ 3% O_2 (ppmv)
Regulation 9-7	***≥ 1.0***	***Multiple***	***30***[1]	***400***
Manufacturer	3.9	Multiple (Natural Gas)	30	140
Manufacturer	3.9	Multiple (Digester Gas)	30	125

[1]The emission limit is based on a heat-input weighted average of the fuels. However, since natural gas and digester gas have the same NO_X limits, the heat input weighted average emission limit will remain the same.

Pursuant to an email correspondence dated January 21, 2016, S.T. Johnson Company is willing to guarantee stack concentrations of less than 30 ppmv NO_X, 140 ppmv CO firing natural gas, and 125 ppmv CO firing digester (referenced at 3% O_2, dry). The boiler is expected to meet the emission limits of Regulation 9-7-307.

In addition, pursuant to Regulation 9-7-312, no person shall operate a boiler or steam generator with a stack temperature that exceeds the following.

Table 11. Regulation 9-7 Stack Gas Temperature Limits Review

Heater Design	Maximum Temperature (°F), Highest Limit
Fire-Tube	100°F over saturated steam temperature (steam boiler); 100°F over hot water temperature (water boiler); or, 250°F greater than combustion air temperature.
Water-Tube	150°F over saturated steam temperature (steam boiler); 150°F over hot water temperature (water boiler); or, 250°F greater than combustion air temperature.

However, the aforementioned gas temperature requirements do not apply to devices certified by the Air-Conditioning, Heating and Refrigeration Institute (AHRI) as having a thermal efficiency of 80% or more. The boiler is certified and expected to have a thermal efficiency of 82.3%. The gas temperature limits do not apply to the boiler.

In accordance with Regulation 9-7-501, boilers firing multiple fuels must be equipped with a non-resettable totalizing fuel meter for each fuel line. Regulation 9-7-503 requires the following records to be kept for at least 24 months from the date of entry, which are to be made available to District staff upon request.

- Documentation verifying the hours of equipment testing using non-gaseous fuel, and of total operating hours using non-gaseous fuel during each calendar month;
- Results of any testing required by Regulation 9-7-506; and,
- Total operating hours and operating hours firing or co-firing digester gas.

The boiler is expected to meet the aforementioned requirements and will need to demonstrate compliance prior to the issuance of a PTO.

California Environmental Quality Act (CEQA) and Regulation 2-1
Pursuant to Regulation 2-1-311, an application for a proposed new or modified source will be classified as ministerial and will accordingly be exempt from the CEQA requirement of Regulation 2-1-310 if the District's engineering evaluation and basis for approval or denial of the permit application for the project is limited to the criteria set forth in Regulation 2-1-428 and to the specific procedures, fixed standards, and objective measurements set forth in the District's Permit Handbook and BACT/TBACT Workbook. The application was reviewed under the guidelines of *"Chapter 2.1 – Boilers, Steam Generators & Process Heaters"* of the Permit Handbook. The application is considered to be ministerial and is not subject to CEQA review.

California Health & Safety Code §42301.6 and Regulation 2-1-412
Pursuant to California Health & Safety Code §42301.6(a), prior to approving an application for a permit to construct or modification of a source, which is located within 1,000 feet from the outer boundary of a school site, the District shall prepare a public notice as detailed in §42301.6. §42301.9(a) defines a "school" as any public or private school used for the purposes of the education of more than 12 children in kindergarten or any grades 1 to 12, inclusive, but does not include any private school in which education is primarily conducted in private homes.

The applicant has proposed to install a source within 1,000 feet from the outer boundary of the following school sites identified in the following table.

Table 12. School Sites Located Within 1,000 Feet of the Source

School Name	School Location	Grades	Description
Bayside Middle School (Bayside STEM Academy)	2025 Kehoe Avenue San Mateo, CA 94403	6-8	Public

The District will be required to prepare a public notice as detailed in §42301.6. The public notice will be distributed to the addresses within 1,000 feet of the source and to the parents or guardians of children attending schools within a quarter (¼) mile of the source. The following schools are within a quarter mile of the source.

Table 13. School Sites Located Within ¼ Mile of the Source			
School Name	**School Location**	**Grades**	**Description**
Bayside Middle School (Bayside STEM Academy)	2025 Kehoe Avenue San Mateo, CA 94403	6-8	Public
LEAD Elementary School	949 Ocean View Avenue San Mateo, CA 94401	K-5	Public

PERMIT CONDITIONS

Permit Condition #26210

1. The owner/operator of S-27 shall only operate this source on digester gas generated from S-180 (Anaerobic Digester #1 & #2) and/or Public Utilities Commission regulated natural gas.
   [Basis: Cumulative Increase]

2. The owner/operator of S-27 shall operate this source only when a non-resettable totalizing fuel meter is installed in each fuel line.
   [Basis: Regulation 9-7-501]

3. The owner/operator shall ensure that the following pollutant concentrations, in the combustion gas exhausting from S-27, are less than the following limits:

   a. 30 ppmv NO_X @ 3% O_2, on a dry basis, when firing natural gas, digester gas, and/or a combination thereof;
   b. 140 ppmv CO @ 3% O_2, on a dry basis, when firing natural gas exclusively;
   c. 125 ppmv CO @ 3% O_2, on a dry basis, when firing digester gas exclusively; and,
   d. A weighted average of the emission limits of Part 3(b) and 3(c) of this condition, when firing a combination of digester gas supplemented with natural gas.

   [Basis: Cumulative Increase and Regulation 9-7-307]

4. The owner/operator shall perform the following monitoring, maintenance, and record keeping requirements, at the specified time intervals, to ensure on-going compliance with the NO_X and CO limits outlined in Part 3 of this permit condition:

   a. Measure the NO_X and CO concentrations from S-27, once every quarter, using a hand-held portable monitor;
   b. Maintain and calibrate the hand-held portable monitor in accordance with manufacturer recommendations; and,
   c. Maintain records of NO_X and CO concentration measurements. At a minimum, the records should include the following:

i) Name of the staff/contractor, which performed the concentration measurements;
ii) Date and time when the concentration measurements were taken;
iii) Raw concentration measurements, in ppmv, using a hand-held monitor;
iv) Calibration records for the hand-held monitor used during the concentration measurements (calibration gas used, etc.);
v) Conditions during the concentration measurements (type of fuel burned, $\%O_2$, etc.);
vi) Corrected concentration measurements, in ppmv @ 3% O_2, on a dry basis; and,
vii) Any other information, which is deemed useful in demonstrating compliance with the limitations set forth in Part 3 of this permit condition.

After 4 quarters of monitoring for NO_X and CO, the owner/operator may petition the District to lower the frequency of monitoring to once per year. The District will lower the frequency if the margin of compliance is adequate. If the District lowers the frequency, the change will be made administratively without requiring a permit application.
[Basis: Cumulative Increase and Regulation 2-1-403]

5. The owner/operator shall ensure that the digester gas fired in S-27 does not exceed a total sulfur content of 350 ppmv.
[Basis: Cumulative Increase]

6. To demonstrate compliance with the standard in Part 5 of this condition, the owner/operator shall monitor and record the sulfur content of the digester gas at least once every calendar week. If the owner/operator can demonstrate 3 months of digester sulfur results lower than 175 ppmv, the monitoring frequency for sulfur analysis may be reduced to at least once every calendar month. If any subsequent results, from monthly monitoring, are above the 175 ppmv, the owner/operator shall monitor every week until the owner/operator can demonstrate 3 months of digester sulfur results lower than 175 ppmv, at which time the monitoring frequency for sulfur analysis may return to at least once every calendar month.
[Basis: Cumulative Increase]

7. The owner/operator shall conduct the monitoring required by Part 6 of this condition in accordance with any of the following methodologies:

   a. Draeger Tube Test Method: A Draeger Tube test or a meter using a Draeger H_2S sensor, Part No 680910, or equivalent, demonstrating an H_2S level up to 200 ppmv shall demonstrate compliance with the above limit. An H_2S measurement by Draeger Tube exceeding 200 ppmv shall not be deemed a violation but shall trigger a requirement to demonstrate compliance using either methods of Part 7(b) and (c) of this condition.

b. Portable Instrument Method: A Draeger PAC-III (or equivalent) portable meter with an H_2S sensor capable of measuring over 800 ppmv H_2S. In the event that H_2S levels exceed 800 ppmv, the owner/operator shall commence to perform a source test using the method of Part 7(c) of this condition.
c. Chromatographic Method: The owner/operator may sample and test for sulfides according to BAAQMD Lab Method 44A (Manual of Procedures, Volume III), or by ASTM Method 5504, or by any other equivalent method, approved in advance by the District.

[Basis: Cumulative Increase]

8. The owner/operator of S-27 shall maintain the following records for a minimum of 2 years and be made available to the District upon request:

a. Total operating hours and operating hours firing or co-firing digester gas;
b. Monthly records of digester gas and natural gas consumed;
c. Records required by Part 4 of this condition; and,
d. Records to substantiate compliance with Part 5 and 6 of this condition.

[Basis: Cumulative Increase and Regulation 9-7-503]

9. Within 60 days of startup, the owner/operator shall verify compliance with the following emission limitations of S-27:

a. 30 ppmv NO_X @ 3% O_2, on a dry basis, when firing natural gas, digester gas, and/or a combination thereof, using a hand-held monitor;
b. 140 ppmv CO @ 3% O_2, on a dry basis, when firing natural gas exclusively, using a hand-held monitor;
c. 125 ppmv CO @ 3% O_2, on a dry basis, when firing digester gas exclusively, using a hand-held monitor. If there is not a sufficient amount of digester gas to fully operate S-27, a weighted average of the emission limits of Part 3(b) and 3(c) of this condition shall be used, when firing a combination of digester gas supplemented with natural gas; and,
d. Demonstrate compliance with the limit of Part 5 of this condition in accordance with any of the following methodologies:

i) Draeger Tube Test Method: A Draeger Tube test or a meter using a Draeger H_2S sensor, Part No 680910, or equivalent, demonstrating an H_2S level up to 200 ppmv shall demonstrate compliance with the above limit. An H_2S measurement by Draeger Tube exceeding 200 ppmv shall not be deemed a violation but shall trigger a requirement to demonstrate compliance using either methods of Part 9(d)(ii) and 9(d)(iii) of this condition.
ii) Portable Instrument Method: A Draeger PAC-III (or equivalent) portable meter with an H_2S sensor capable of measuring over 800 ppmv H_2S. In the event that H_2S levels exceed 800 ppmv, the owner/operator shall commence to perform a source test using the method of Part 9(d)(iii) of this condition.

iii) Chromatographic Method: The owner/operator may sample and test for sulfides according to BAAQMD Lab Method 44A (Manual of Procedures, Volume III), or by ASTM Method 5504, or by any other equivalent method, approved in advance by the District.

[Basis: Cumulative Increase]

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 source will be located within 1,000 feet of a school, which triggers the public notification requirement of District 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 the issuance of an Authority to Construct for the following source:

S-27 Dual-Fueled Natural Gas/Digester Gas Fired Hot Water Boiler
Burnham, Model V1116H, 3.9 MMBtu/Hr Rated Capacity
With S.T. Johnson Company, Model DHF100G4GM-LN, Low NO_X Burner

By: _____ Date: _____

Alfonso Borja
Air Quality Engineer