

**Draft Engineering Evaluation  
City of Fairfield  
Plant No. 3719  
Application No. 32158  
420 Gregory Lane, Fairfield, CA 94533**

**BACKGROUND**

The City of Fairfield is applying for an Authority to Construct and Permit to Operate a Prime Generator Set, fueled by liquefied petroleum gas (LPG).

**S-4 Prime Propane Engine Generator Set  
Make: Power Solutions International, EPA Family: LPSIB21.9NGP, Model 21.9L,  
Model Year 2020, Burn Type: Rich, Rated 582 BHP.**

S-4 will be installed at a municipal bus depot located at 420 Gregory Lane in Fairfield, CA. The project will reduce air pollution within a disadvantaged community by providing charging capability for electric buses and allow the diesel buses serving this area to be retired.

The primary pollutants from LPG engines are the products of combustion, including nitrogen oxides (NO<sub>x</sub>), carbon monoxide (CO), hydrocarbon and other organic compounds (precursor organic compounds, POCs), sulfur dioxide (SO<sub>2</sub>), and particulate matter (PM<sub>10</sub> and PM<sub>2.5</sub>). Various toxic air contaminants (TACs) are also emitted during the combustion of LPG.

The new source is located within an overburdened community, and the project required a Health Risk Assessment (HRA); therefore, this application is subject to the public notice requirements of BAAQMD Regulation 2-1-412.

**EMISSION CALCULATIONS**

**Basis and Assumptions:**

- Maximum output rating of 582 brake horsepower (BHP), per EPA certification rating data
- Liquefied propane density of 4.23 lb/gallon
- Maximum fuel consumption of 162 lb/hr, per manufacturer
- Maximum volumetric fuel consumption of 38.30 gallons/hr (162 lb/hr / 4.23 lb/gallon)
- Maximum operation: 1053 hours (40,328 gallons propane) per year, up to 9 hours (344.7 gallons propane) per day
- Heat Conversion: 8063 British thermal units (Btus) per BHP for LPG fuel
- For the US Environmental Protection Agency (EPA) Certification Emission Rate for "HC+NO<sub>x</sub>", the portions may be considered 95% NO<sub>x</sub> and 5% hydrocarbons (HC). For the purposes of this evaluation, HC = POC.
- For the purposes of this evaluation, toxic air contaminant (TAC) emissions from this engine can be estimated using TAC emission factors from natural gas.

**Annual Emissions and Daily Maximum Emissions:**

The following EPA Certification Emission Rates for HC+NO<sub>x</sub>, and CO emissions from the engine were used for the emission calculations:

HC+NO<sub>x</sub> = 0.4 g/kW-hr (0.30 g/bhp-hr)

CO = 0.6 g/kW-hr (0.45 g/bhp-hr)

NO<sub>x</sub> and POC emissions rates were calculated as follows:

NO<sub>x</sub> = (0.30 g/bhp-hr) \* (95%) = 0.28 g/bhp-hr

POC = (0.30 g/bhp-hr) \* (5%) = 0.015 g/bhp-hr

The particulate matter (PM) and SO<sub>2</sub> emissions were calculated using emission factors from AP-42 Chapter 3.2 Natural Gas-fired Reciprocating Engines, Table 3.2-3 (Uncontrolled Emission Factors For 4-Stroke Rich-Burn Engines). The total PM emission factor consists of the sum of filterable plus condensable emission factors in AP-42.

The daily maximum emissions were calculated assuming 9-hr/day of operation.

The annual and daily maximum emissions from S-4 are summarized below in Table 1.

<b>Table 1 – Daily and Annual Maximum Emissions for S-4</b>					
<b>Pollutant</b>	<b>Emission Factor</b>	<b>Emission Factor Unit</b>	<b>Emissions</b>		
			<b>Daily (lbs/day)</b>	<b>Annual (lbs/yr)</b>	<b>Annual (TPY)</b>
NO <sub>x</sub>	0.28	g/bhp-hr	3.272	382.80	0.191
CO	0.45	g/bhp-hr	5.166	604.42	0.302
POC	0.015	g/bhp-hr	0.172	20.15	0.010
PM <sub>10</sub>	1.94E-02	lb/MMBtu	0.820	95.91	0.048
PM <sub>2.5</sub>	1.94E-02	lb/MMBtu	0.820	95.91	0.048
SO <sub>2</sub>	5.88E-04	lb/MMBtu	0.025	2.91	0.001

<sup>a</sup> Emission factors for NO<sub>x</sub>, CO, and POC per EPA certification.

<sup>b</sup> Emission factors for PM<sub>10</sub> and SO<sub>2</sub> were retrieved from AP-42 Chapter 3.2 Natural Gas-fired Reciprocating Engines, Table 3.2-3. PM emission factors consist of filterable plus condensable fractions. These numbers are uncontrolled (unabated) emissions.

#### **Plant Cumulative Increase:**

Table 2 summarizes the cumulative increase in criteria pollutant emissions resulting from the operation of S-4.

<b>Table 2 – Plant Cumulative Emissions</b>			
<b>Pollutant</b>	<b>Emissions (TPY)</b>		
	<b>Existing</b>	<b>New</b>	<b>Total</b>
NO <sub>x</sub>	0.000	0.191	0.191
CO	0.000	0.302	0.302
POC	0.000	0.010	0.010
PM <sub>10</sub>	0.000	0.048	0.048
PM <sub>2.5</sub>	0.000	0.048	0.048
SO <sub>2</sub>	0.000	0.001	0.001

#### **TOXIC HEALTH RISK ASSESSMENT**

Toxic air contaminant (TAC) emission factors from California Air Toxics Emission Factors (CATEF) are generally preferred over those found in AP-42. When available, TAC emission factors were therefore retrieved from CATEF for Natural Gas-fired Rich Burn Engines rated < 650 hp. When CATEF factors were unavailable, values from AP-42, Table 3.2-3 were used. The TAC emission estimates are based on uncontrolled emission factors for natural gas engines, and a factor of 1020 btu/cubic foot was used to convert CATEF factors to units of lb/MMBtu.

TACs were calculated assuming an operating schedule of 9 hours per day, 5 days per week, and 52 weeks per year (2,340 hours per year).

Table 3 - TAC Emission Estimates

Compound	Emission Factor [lb/MMBtu]	Basis	Hourly Emissions [lb/hr]	Acute Trigger Level [lb/hr]	HRA Triggered? (Acute)	Annual Emissions [lb/yr]	Chronic Trigger Level [lb/yr]	HRA Triggered? (Chronic)
1,1,2,2-Tetrachloroethane	2.53E-05	AP-42	1.2E-04	None	None	2.8E-01	1.40E+00	No
1,1,2-Trichloroethane	1.53E-05	AP-42	7.2E-05	None	None	1.7E-01	5.00E+00	No
1,1-Dichloroethane	1.13E-05	AP-42	5.3E-05	None	None	1.2E-01	5.00E+01	No
1,3-Butadiene	1.02E-04	CATEF	4.8E-04	2.90E-01	No	1.1E+00	4.80E-01	YES
Acetaldehyde	8.66E-04	CATEF	4.1E-03	2.10E-01	No	9.5E+00	2.90E+01	No
Acrolein	5.36E-04	CATEF	2.5E-03	1.10E-03	YES	5.9E+00	1.40E+01	No
Benzene (no control)	1.87E-03	CATEF	8.8E-03	1.20E-02	No	2.1E+01	2.90E+00	YES
Carbon Tetrachloride	1.77E-05	AP-42	8.3E-05	8.40E-01	No	1.9E-01	1.90E+00	No
Chlorobenzene	1.29E-05	AP-42	6.1E-05	None	None	1.4E-01	3.90E+04	No
Chloroform	1.37E-05	AP-42	6.4E-05	6.60E-02	No	1.5E-01	1.50E+01	No
Ethylbenzene	1.14E-05	CATEF	5.3E-05	None	None	1.3E-01	3.30E+01	No
Ethylene Dibromide	2.13E-05	AP-42	1.0E-04	None	None	2.3E-01	1.10E+00	No
Formaldehyde (no control)	2.30E-03	CATEF	1.1E-02	2.40E-02	No	2.5E+01	1.40E+01	No
Methanol	3.06E-03	AP-42	1.4E-02	1.20E+01	No	3.4E+01	1.50E+05	No
Methylene Chloride	4.12E-05	AP-42	1.9E-04	6.20E+00	No	4.5E-01	8.20E+01	No
Naphthalene	7.50E-05	CATEF	3.5E-04	None	None	8.2E-01	2.40E+00	No
PAH Equivalent as Benzo(a)pyrene	1.78E-07	CATEF	8.4E-07	None	None	2.0E-03	3.30E-03	No
Propylene	1.57E-02	CATEF	7.4E-02	None	None	1.7E+02	1.20E+05	No
Styrene	1.19E-05	AP-42	5.6E-05	9.30E+00	No	1.3E-01	3.50E+04	No
Toluene	1.05E-03	CATEF	4.9E-03	2.20E+00	No	1.2E+01	1.60E+04	No
Vinyl Chloride	7.18E-06	AP-42	3.4E-05	8.00E+01	No	7.9E-02	1.10E+00	No
Xylene (total)	6.45E-04	CATEF	3.0E-03	9.70E+00	No	7.1E+00	2.70E+04	No

<sup>1</sup> CATEFs are used when AP-42 EFs are less conservative than CATEFs. Reported mean emission factor values are used in accordance with District procedures.

Based on the calculations in Table 3 below, some TACs exceed the District's Risk Screening trigger levels set forth in Table 1 of Reg. 2-5 (New Source Review for Toxic Air Contaminants). Therefore, a Health Risk Assessment (HRA) is required.

The BAAQMD therefore undertook an HRA to evaluate the potential acute, chronic, carcinogenic and non-carcinogenic health risks from emissions from this project. The HRA evaluated risks to workers and to residents in the vicinity of the project.

Results from the HRA indicate that the maximum project cancer risk is **2.2 in a million**, the project maximum chronic hazard index is **0.017**, and the project maximum acute hazard index is **0.057**. In accordance with the District's Regulation 2-5-301, this source requires TBACT because the cancer risk exceeds 1.0 in a million. Rather than apply TBACT, the applicant instead chose to accept a reduction in permitted usage of the new engine. By reducing annual usage from 2,340 hours per year to 1,053 hours per year, the project cancer risk no longer exceeds 1.0 in a million.

This project is located in an overburdened community (OBC), as defined by Regulation 2-1-243; therefore, the project must comply with the project cancer risk limit of 6 in a million. Since the estimated project cancer risk does not exceed 6 in a million and project hazard indices do not exceed 1.0, this project complies with the District's Regulation 2-5-302 project risk requirements.

Compliance with Regulation 2-5 is therefore satisfied.

#### **GRAIN LOADING RATE**

The grain loading rate calculation is required for determining the compliance of this application with BAAQMD Regulation 6, Rule 1 (refer to "Statement of Compliance" section, below).

$$[0.091 \text{ lb PM}_{10}/\text{hr} * 7000 \text{ grain/lb}] / [60 \text{ min/hr} * 817.2 \text{ DSCFM}] = 0.01 \text{ grain/dscf}$$

#### *Assumptions:*

- $1.94\text{E-}02 \text{ lb PM}_{10}/\text{MMBtu} * 4.69 \text{ MMBtu/hr} = 0.091 \text{ lb PM}_{10}/\text{hr}$
- 7000 grain/lb standard conversion factor (AP-42 Appendix A, Page A-19)
- Per applicant, S-4 has maximum flow of 2333 acfm at 1053°F dry exhaust; this is equivalent to 817.2 DSCFM:

$$\text{DSCFM} = \text{ACFM} \times [(460^\circ\text{R} + 70^\circ\text{F}) / (460^\circ\text{R} + \text{temp})] \times (\text{Actual P} / 14.7 \text{ psi}) \times (1 - B_w)$$

Where: ACFM = 2333 cfm, temp = 1053°F, Actual P = 14.7 psi,  $B_w = 0$  (fraction of water vapor)

#### **STATEMENT OF COMPLIANCE**

The owner/operator of S-4 shall comply with Reg. 6-1 (Particulate Matter and Visible Emissions Standards), Reg. 9-1-301 (Inorganic Gaseous Pollutants: Sulfur Dioxide for Limitations on Ground Level Concentrations), and Reg. 9-8 (Nitrogen Oxides and Carbon Monoxide from Stationary ICE).

The owner/operator is expected to comply with Reg. 6-1 since the unit is fueled with LPG. Because the S-4 engine has displacement of 21.9L (1336.4 cubic inch), the Ringelmann No. 2 Limitation applies per Section 6-1-303 (ICE engine of less than 25 L or 1500 cubic inch displacement). Thus, for any period aggregating more than three minutes in any hour, there should be no visible emission as dark or darker than No. 2 on the Ringelmann Chart or be equal to or greater than 40% opacity. S-4 is expected to comply with this requirement, as well as the visible particles requirement of Section 6-1-305. The emission rate from S-4 results in an outlet grain loading of 0.01 grains/dscf, which is less than the limit 0.15 grains/dscf and therefore complies with Regulation 6-1-310.1. The TSP limits in 6-1-310.2 does not apply because the potential to emit TSP is below 1,000 kg per year.

The owner/operator is expected to comply with Regulation 9-1 by restricting fuel to LPG only. Combustion of LPG is expected to produce a SO<sub>2</sub> concentration of no more than 1 ppmv. Therefore, the source is expected to comply with Section 9-1-301 (Limitations on Ground Level Concentrations) and 9-1-304 (Fuel Burning).

S-4 is expected to comply with the limits identified in Regulation 9-8-301, as shown below.

<b>Table 4: Regulation 9-8-301 Limits</b>			
Pollutant	Standard (ppmvd @ 15% O2)	Standard (lb/hr)	S-4 Emissions Rate (lb/hr)
NOx	56	1.0	0.4
CO	2000	21.0	0.6

Assumptions:

$$\text{lb/hr} = \text{ppm} * 10^{-6} * (1/\text{molar volume}) * (\text{molar mass}) * \text{Fd} * 20.9/(20.9-\%O_2) * \text{HHV} * 10^{-6} * \text{bhp}$$

where molar volume = 385.3 dscf/lb-mol, Fd = 8710 dscf/MMBtu, %O<sub>2</sub> = 15, HHV = 8063, and bhp = 582

#### NOx

$$56 \text{ ppm} * 10^{-6} * (1/385.3 \text{ dscf/lb-mol}) * (46 \text{ lb/lb-mol}) * (8710 \text{ dscf/MMBtu}) * (20.9)/(20.9-15) * (8063 \text{ Btu/bhp-hr}) * 10^{-6} * 582 \text{ bhp} = 1.0 \text{ lb/hr}$$

#### CO

$$2000 \text{ ppm} * 10^{-6} * (1/385.3 \text{ dscf/lb-mol}) * (28 \text{ lb/lb-mol}) * (8710 \text{ dscf/MMBtu}) * (20.9)/(20.9-15) * (8063 \text{ Btu/bhp-hr}) * 10^{-6} * 582 \text{ bhp} = 21.0 \text{ lb/hr}$$

#### **California Environmental Quality Act (CEQA):**

The project is ministerial, under the District's CEQA Reg. 2-1-311, and therefore is not subject to CEQA review. The engineering review for this project requires only the application of standard permit conditions and standard emissions factors as specified in District permit handbook chapter 2.3.2 (Stationary Natural Gas Engines) and therefore is not discretionary as defined by CEQA.

#### **Public Notification (Regulation 2-1-412)**

The project is not within 1,000 feet from the nearest school; however, the project is located within an overburdened community and required an HRA. Therefore, a public notice will be distributed and a thirty-day public comment period will be initiated.

#### **Best Available Control Technology (BACT)**

In accordance with Reg. 2-2-301 (Best Available Control Technology Requirement), BACT is triggered for any new or modified source with the potential to emit 10 pounds or more per highest day of POC, NPOC, NO<sub>x</sub>, CO, SO<sub>2</sub>, PM<sub>10</sub>, or PM<sub>2.5</sub>. Based on the emission calculations in Table 1, BACT is not triggered since the maximum daily emission for all the criteria pollutants are less than 10 pounds per day.

#### **Offsets**

Offsets must be provided for any new or modified source at a facility that emits more than 10 tons per year of POC or NO<sub>x</sub>. Based on the emission calculations in Table 1, offsets are not required for this application per Reg 2-2-302 (Offset Requirements, Precursor Organic Compounds and Nitrogen Oxides).

#### **New Source Performance Standards (NSPS)**

S-4 is subject to 40 CFR 60, Subpart JJJJ, Standards of Performance for Stationary Spark Ignition (SI) Internal Combustion Engines (ICEs), per §60.4230(a)(4)(i) because the owner/operator will commence construction after June 12, 2006, and the source is an engine which was manufactured after July 1, 2007 and has a maximum power greater than 500 hp.

The engine will comply with the limits in (40 CFR 60 Subpart JJJJ) Table 1 for emergency spark-ignited engines greater than 130 hp.

**Table 5. NSPS Emission Standards vs. S-4 Engine Family Emission Rates**

<b>Pollutant</b>	<b>NSPS Emission Standard*</b>	<b>S-4 Emission Rate</b>
NOx	2.0 g/bhp-hr	0.3 g/bhp-hr
CO	4.0 g/bhp-hr	0.4 g/bhp-hr
VOC	1.0 g/bhp-hr	0.01 g/bhp-hr

\*[https://www.law.cornell.edu/cfr/text/40/appendix-Table 1 to subpart JJJJ of part 60](https://www.law.cornell.edu/cfr/text/40/appendix-Table_1_to_subpart_JJJJ_of_part_60)

Based on the EPA Annual Emission Certification Data, S-4 complies with NSPS requirements.

#### **National Emission Standards for Hazardous Air Pollutants (NESHAP)**

S-4 is subject to 40 CFR 63, Subpart ZZZZ, National Emission Standards for Hazardous Air Pollutants for Reciprocating Internal Combustion Engines (RICE). Per 40 CFR 63.6590(c)(1), a new or reconstructed stationary RICE located at an area source must meet the requirements of NSPS (40 CFR 60, Subpart JJJJ) for spark ignition engines. As stated above in the NSPS section, S-4 meets the emissions requirements of NSPS.

#### **Prevention of Significant Deterioration (PSD)**

Regulation 2-2-224 defines a PSD project as one at a facility that has the potential to emit 100 tons or more per year of any PSD pollutant. This facility will not have the potential to emit 100 tons or more of any PSD pollutant therefore, this project is not a PSD project.

#### **PERMIT CONDITIONS**

##### Permit Condition # 100266 (applicable to S-4)

1. The owner/operator of S-4 shall operate this source on propane gas fuel exclusively. (Basis: Cumulative Increase; Regulation 2-5)
2. The owner/operator of S-4 shall not exceed 1,053 hours of operation or 40,328 gallons of propane fuel usage in any 12-month period. (Basis: Cumulative Increase, Regulation 2-5)
3. The owner/operator of S-4 shall not exceed 9 hours of operation or 344.7 gallons of propane fuel usage in any day. (Basis: BACT)
4. To determine compliance with the above parts, the owner/operator of S-4 shall maintain the following records:
  - a. Gallons of propane used in each day.
  - b. Gallons of propane used in each month.
  - c. Gallons of propane used in each rolling 12-month period.

The owner/operator shall record all records in a District-approved log. The owner/operator shall retain the records with the equipment for two years, from the date of entry, and make them available for inspection by District staff upon request. These record-keeping requirements shall not replace the record-keeping requirements contained in any applicable District Regulations. (Basis: Recordkeeping)

**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 an overburdened community and an HRA was required, which triggers the public notification requirements of Regulation 2-1-412. After the comments are received from the public 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-4 Prime Propane Engine Generator Set**  
**Make: Power Solutions International, EPA Family: LPSIB21.9NGP, Model 21.9L,**  
**Model Year 2020, Burn Type: Rich, Rated 582 BHP.**

**Prepared by:** \_\_\_\_\_ **Date:** \_\_\_\_\_  
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