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REVISED EMISSIONS TABLES

Tier 4 Compliant Generators

Revised to Include Ammonia Corrections and Calculations

Generator Ammonia Emissions
Cyrus One
Santa Clara, CA

Parameter	Value	Unit
Outlet Concentration Limit[1]	10	ppmv
Outlet Gas Oxygen Content[1]	3	% O_2
Molecular Weight of NH3	17.031	lb/lb-mol
NH_3 Emission Factor[1]	0.0047	lb/MMBtu
Diesel Heat Content[2]	19300	Btu/lb
Diesel Fuel Density[2]	7.1	lb/gal
Generator Fuel Flow[3]	317	gal/hr
Annual Operating Hours[4]	50	hr/year
Number of Generators at Full Buildout	54	--
Emissions per generator	**10.3**	**lb/year**
	0.21	**lb/hr**
Emissions at Full Buildout	**556**	**lb/year**

Notes:

1. NH_3 Emission factor is calculated assuming an F factor of 9190 dscf/MMBtu, using an expected permit limit of 10 ppmv ammonia exhaust concentration at 3% O_2.
2. Heat content and fuel density of diesel fuel are assumed from U.S. EPA AP-42 Emission Factor Guidance for Large Stationary Diesel And All Stationary Dual-fuel Engines, Table 3.4-1, footnote (a).
3. Generator fuel flow is assumed based on engine application data for MTU standby generator model 16V4000DS2250.
4. Annual generator emissions assume 50 hours per year of generator maintenance and testing.

Abbreviations:

Btu - British thermal units
dscf - dry standard cubic feet
gal - gallon
hr - hour
lb - pound
MMBtu - million British thermal units
mol - mole
NH_3 - ammonia
ppmv - parts per million volume

References:

U.S. EPA. 1996. Air Emissions Factors and Quantification, Chapter 3.4: Large Stationary Diesel And All Stationary Dual-fuel Engines. Available online at: https://www3.epa.gov/ttnchie1/ap42/ch03/final/c03s04.pdf

The following table provides a comparison of the annual NOx emissions of the proposed Tier 4 compliant generators to the original Tier 2 generators.

NOx Emissions Comparison	***Units***	***Tier 2***	***Tier 4***
Emission Factor	g/kW-hr	5.37	0.67
Emissions per Generator (Testing and Maintenance)	ton/yr	0.67	0.08
Emissions Phase 1 (Testing and Maintenance)	ton/yr	18.65	2.33
Emissions Full Buildout (Testing and Maintenance)	ton/yr	35.96	4.49
Emissions Full Buildout (Testing and Maintenance and emergency operation required by BAAQMD emissions offsets screening rules)	ton/yr	107.88	13.46

The following tables from the SPPE Application have been revised for the Revised Project Description modification to Tier 4 compliant generators.

Table 4.3-6 Criteria Pollutant Emissions from All Backup Generators for Maintenance and Testing (tons per year)

Evaluation Period	Pollutant	Emissions	BAAQMD Thresholds	Exceeds Threshold?
Maximum Annual Emissions (tons per year)[a]	NOx[b]	~~364~~.5	10	~~Yes~~No
	VOCs	0.5	10	No
	CO[c]	2.7	--	N/A
	PM_{10}	0.16	15	No
	$PM_{2.5}$	0.16	10	No

Source: Ramboll, 2019

[a] The maximum annual emissions were estimated assuming that all 54 backup generators would operate 50 hours per year even though this estimate is extremely conservative as C1 estimates normal maintenance and testing would be on the order of less than 11 hours per year.

[b] NO_X emissions from maintenance and testing would be fully offset through the air permitting process with the BAAQMD.

[c] In the absence of a mass-based threshold, CO impacts were evaluated through air dispersion modeling

-- = No mass-based threshold has been adopted for this pollutant

N/A = Not applicable because no mass-based threshold is available

Table 4.3-7 Criteria Pollutant Emissions from All Backup Generators for Emergency and Maintenance and Testing (tons per year)

Evaluation Period	Pollutant	Emissions (Includes Emergency Periods)
Maximum Annual Emissions (tons per year)[a]	NOx[b]	~~108~~13
	VOCs	1.6
	CO[c]	8.0
	PM_{10}	0.48
	$PM_{2.5}$	0.48

Source: Ramboll, 2019

[a] The maximum annual emissions for emergency use and maintenance and testing were estimated assuming that all 54 backup generators would operate 150 hours per year (100 hours of emergency use and 50 hours of maintenance and testing). This estimate is extremely conservative as C1 estimates normal maintenance and testing would be on the order of less than 11 hours per year and SVP power outages are very rare.

[b] NO_X emissions from maintenance and testing would be fully offset through the air permitting process with the BAAQMD.

Table 4.3-8 Maximum Daily Criteria Pollutant Emissions from a Single Backup Generator

Pollutant	Emissions (lb/day)	BAAQMD BACT Thresholds (lb/day)	Exceeds Threshold?
NOx	~~639~~80	10	Yes
VOCs	9.55	10	No
CO	47.6	10	Yes
SO_2	0.35	10	No
PM_{10}	2.86	10	No
$PM_{2.5}$	2.86	10	No

Source: Ramboll, 2019

Notes: The maximum daily emissions were derived assuming 24 hours of operation in one day.

Table 4.3-9 Toxic Air Contaminant Emissions from All Backup Generators

Pollutant	Pollutant is a Federal HAP?	Hourly Emissions (lb/hr)[a]	Annual Emissions (tons/year)[b]
Diesel PM[c]	No	2.94	0.537
1,3-Butadiene	Yes	0.00560	0.00102
Acetaldehyde	Yes	0.216	0.0395
Benzene	Yes	0.0589	0.0107
Ethylbenzene	Yes	0.00913	0.00167
Formaldehyde	Yes	0.433	0.0791
n-Hexane	Yes	0.00471	0.000860
Methanol	Yes	0.00088	0.00016
Methyl Ethyl Ketone	No	0.0436	0.00795
Naphthalene	Yes	0.00265	0.00048
Propylene	No	0.0766	0.0140
Styrene	Yes	0.00177	0.000322
Toluene	Yes	0.0433	0.00790
m-Xylene	Yes	0.0180	0.00328
o-Xylene	Yes	0.0100	0.00183
p-Xylene	Yes	0.00294	0.000537
Ammonia	No	0.21	0.278
Total HAP Emissions			**0.147**

Source: Ramboll, 2019

[a] Hourly emissions were estimated assuming that all 54 backup generators could be operated concurrently. However, C1 commits to standard operating procedures that would limit testing to one backup generator at a time. Ammonia emissions are calculated as one generator operating at a time, consistent with how the generators will be operated.

[b] The annual emissions were estimated assuming that all 54 backup generators would operate 50 hours per year.

[c] Diesel particulate matter (DPM) emissions were assumed equal to exhaust PM10 emissions.

[d] Emissions of ammonia do not exceed trigger levels in BAAQMD Rule 2-5, so additional health risk assessments are not necessary. lb/hr = pound(s) per hour PAH = Polycyclic Aromatic Hydrocarbons