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SUPPLEMENTAL RESPONSES TO CEC STAFF DATA REQUEST SET 1 (1-59)

Mission College Backup Generating Facility (19-SPPE-05)

SUBMITTED TO: CALIFORNIA ENERGY COMMISSION
SUBMITTED BY: **Oppidan Investment Company**

February 2020

INTRODUCTION

Attached are Oppidan Investment Company's (Oppidan) supplemental responses to California Energy Commission (CEC) Staff Data Request Set No. 1 (1-59) for the Mission College Backup Generation Facility (MCBGF) Application for Small Power Plant Exemption (SPPE) (19-SPPE-05). Specifically, Oppidan updates its Initial Data Responses docketed on February 6, 2020, with supplemental responses to Data Requests 5, 6, 8, 9, 10, 18, 21 and 45.

GENERAL OBJECTIONS

Oppidan objects to all data requests that require analysis beyond which is necessary to comply with the California Environmental Quality Act (CEQA) or which requires Oppidan to provide data that is in the control of third parties and not reasonably available to Oppidan. Notwithstanding this objection, Oppidan has worked diligently to provide these responses swiftly to allow the CEC Staff to prepare the Initial Study/Mitigated Negative Declaration (IS/MND).

AIR QUALITY

BACKGROUND: DISPERSION MODELING FOR CONSTRUCTION IMPACTS

The SPPE application indicates that ambient air quality impacts were not evaluated for the construction phase of the project (p.74). As such, the application does not quantify public health impacts or demonstrate compliance with National Ambient Air Quality Standards (NAAOS) and California Ambient Air Quality Standards (CAAQS) during construction for the different averaging times of the standards. Staff needs ground-level impacts analysis using dispersion modeling to evaluate public health impacts and to determine compliance with NAAQS and CAAQS during construction of the project.

DATA REQUESTS

5. Please provide ground-level impacts analysis using dispersion modeling to show public health impacts and compliance with NAAQS and CAAQS of the criteria pollutants during construction of the project.

RESPONSE TO DATA REQUEST 5

In addition to Oppidan's response to Data Request 5 provided on February 6, 2020, Oppidan is providing criteria pollutant air dispersion modeling results for the Project construction phase in comparison to the NAAQS and CAAQS. AERMOD model (version 19191) is used with Trinity Consultants' (Trinity's) *BREEZE™ AERMOD Suite* software to calculate concentrations using the regulatory default parameters. Assumptions regarding the coordinate system, terrain elevations, meteorological data, building downwash, receptors, and background concentration data are consistent with the assumptions stated in Section 4.3 and Section 4.5.3 of the Air Quality Impact Assessment (AQIA) submitted as Appendix A to the MCBGF SPPE Application. A detailed summary of the results and the comparison to NAAQS and CAAQS is included in Table 1 below. The total concentration of PM_{10} including both background concentration and Project construction emissions exceed the 24-hour CAAQS and the annual CAAQS. The total concentration of $PM_{2.5}$ including both background concentration and Project construction emissions exceed the 24-hour NAAQS and the annual CAAQS. However, for each of these exceedances, the pollutant concentrations resulting from the Project construction phase are below the applicable Class II Significant Impact Levels (SIL) thresholds which represent the concentrations of criteria pollutants in the ambient air that are considered inconsequential in comparison to the

NAAQS.[1] As stated in the AQIA, the background concentration data for each of these cases alone exceeds the AAQS, and thus, despite the comparably minimal Project construction emissions, the AAQS are exceeded. Additionally, as demonstrated in Table 4-4 of the AQIA, the construction PM_{10} and $PM_{2.5}$ emissions from the proposed Project are well under the BAAQMD CEQA thresholds of significance. Due to these circumstances, Oppidan does not consider Project construction emissions as significantly impacting the state or federal air quality plans. Please find all related electronic modeling files included in the USB provided as part of this response.

[1] U.S. EPA, 2018. US EPA Memorandum: Guidance on Significant Impact Levels for Ozone and Fine Particles in the Prevention of Significant Deterioration Permitting Program, April 17, 2018. Available at https://www.epa.gov/sites/production/files/2018-04/documents/sils_guidance_2018.pdf. Accessed February 2020.

TABLE 1: Construction Phase Ambient Air Quality Dispersion Model Results and Comparison to AAQS

Pollutant	Averaging Period	Ambient Air Quality Standards (AAQS) CAAQS[a] (μg/m³)	Ambient Air Quality Standards (AAQS) NAAQS[b] (μg/m³)	Standardized Concentration (μg/m³)	Background Concentration (μg/m³)	Total Concentration (μg/m³)	Comparison to Ambient Air Quality Standards CAAQS Below Threshold?	Comparison to Ambient Air Quality Standards NAAQS Below Threshold?
NO_2	1-hour	339	--	110	162	271	Yes	--
		--	188	90.8	94	185.1	--	Yes
	Annual	57	--	3	24	27	Yes	--
		--	100	2.7	22	25	--	Yes
CO	1-hour	23,000	--	157	2864	3021	Yes	--
		--	40,000	152	2838	2990	--	Yes
	8-hour	10,000	--	47	2406	2453	Yes	--
		--	10,000	35	2406	2441	--	Yes
SO_2	1-hour	655	--	0.24	7.9	8.1	Yes	--
		--	196	0.21	6.9	7.1	--	Yes
	3-hour	--	1,300	0.15	7.3	7.5	--	Yes
	24-hour	105	--	0.38	2.9	2.9	Yes	--
	Annual	--	80	0.006	18	18	--	Yes
PM_{10}	24-hour	50	--	2.32	122	124	No	--
		--	150	1.94	71	71	--	Yes
	Annual	20	--	0.40	23	23	No	--
$PM_{2.5}$	24-hour	--	35	0.60	42	42	--	No
	Annual	--	12	0.16	10	10	--	Yes
		12	--	0.19	13	13	No	--

a. The CAAQS are codified in the California Code of Regulations Title 17 § 70200 Table of Standards and accessed February 2020 here: https://govt.westlaw.com/calregs/Document/I020618D0D60811DE88AEDDE29ED1DC0A?viewType=FullText&originationContext=

b. The NAAQS are codified in 40 CFR Part 50, National Primary and Secondary Ambient Air Quality Standards and accessed February 2020 here: https://www.ecfr.gov/cgi-bin/text-idx?SID=f455d98eb15c432be5a7b38a03257511&mc=true&node=pt40.2.50&rgn=div5

6. Please describe the assumptions of the source parameters (e.g., initial dimension and release height of area/volume sources, or stack height, diameter, temperature, and velocity of point sources) used in the dispersion modeling for construction impacts.

RESPONSE TO DATA REQUEST 6

In addition to Oppidan's response to Data Request 6 provided on February 6, 2020, Oppidan is providing source parameter assumptions associated with the Project construction phase air dispersion modeling analysis as provided in Table 2 below.

Table 2: Project Construction Air Dispersion Modeling Source Input Parameters

Source Description	Model ID	Release Height (m)	Initial Lateral Dimension (m)	Initial Vertical Dimension (m)
Volume Source: Construction Equipment Tailpipe Emissions	EXHAUST	1.532	44.19	0.356
Volume Source: Material Handling (Soil Dumping or Moving)	MATHAND	1.532	44.19	0.356
Volume Source: Fugitive Dust from Soil Disturbance (Roads and Surfaces)	ROADUST	2.61	44.19	1.212

All volume sources are located over the proposed facility buildings to represent the general area construction would occur. The volume source type is representative of the construction emission sources as they are fugitive in nature and may occur above ground level or with a vertical plume rise. The release heights of EXHAUST and MATHAND are based on the midpoint height of the weighted average height of the construction equipment. The weighted average height is developed using dimensions of the equipment type and the anticipated quantity of the equipment type. Construction equipment types include, but not limited to, concrete saws, crushers, excavators, dozers, tractors, graders, scrapers, and cranes. The initial lateral and vertical dimensions for the EXHAUST and MATHAND sources are estimated using the area encompassing the two proposed phases and dividing by a factor of 4.3 as consistent with AERMOD user guidance.[2] The release height of the ROADUST source is based on the weighted average height of the construction equipment and a factor of 1.7 and 0.5 per Haul Road Workgroup guidance.[3] The initial lateral and vertical dimensions of the ROADUST source are estimated using the area encompassing the two proposed phases and dividing by a factor of 2.15 as consistent with Haul Road Workgroup guidance.

Emission rates for the above emission sources reflect the maximum annual and daily mitigated CalEEMod outputs are further refined to exclude offsite emissions beyond 1,000 feet of the Project boundary, as consistent with BAAQMD guidance.[4] Emission rates were ratioed for the applicable emissions using the vehicle miles travelled onsite and up to 1,000 feet past the Project boundary with the total vehicle miles travelled. The dispersion modeling assumes construction activities will be limited to 7:00am and 6:00pm on weekdays. Construction equipment tailpipe emissions include NO_x, CO, SO_2, Exhaust PM_{10}, and Exhaust $PM_{2.5}$ ratioed from Table 4-4 of the AQIA.[5] Construction equipment material handling fugitive particulate emissions (i.e. scooping/dumping of soil) represent the ratioed particulate matter emissions from construction equipment only while fugitive road dust emissions represent the ratioed particulate matter emissions from mobile equipment only as represented in AQ-4 of the AQIA.

Please find all related electronic modeling files included in the USB provided as part of this response which contains all source input parameters.

BACKGROUND: CONSTRUCTION HEALTH RISK ASSESSMENT (HRA)

On page 70 of the application, the applicant stated that the 2018 MND adopted for the previously proposed data center facility on the site includes construction period emissions for PM, NOx, and ROG. Comparison of the 2018 MND construction emissions to those shown in Table 4.3-7 of the application shows that the construction emissions of PM10 and PM2.5 from the proposed Project are less than those of the 2018 MND. Therefore, due to construction time period changes between the projects as evaluated in the 2018 MND and also due to

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[2] Per Table 3-2 of "User's Guide for the AMS/EPA Regulatory Model (AERMOD)" dated August 2019 available online here: https://www3.epa.gov/ttn/scram/models/aermod/aermod_userguide.pdf
[3] Per EPA memorandum "Haul Road Workgroup Final Report Submission to EPA-OAQPS" dated March 2, 2012 available online here: https://www3.epa.gov/scram001/reports/Haul_Road_Workgroup-Final_Report_Package-20120302.pdf
[4] Per e-mail correspondence with Areana Flores (BAAQMD) and Emily Wen (Trinity) on January 7, 2020.

project modifications, the proposed Project results in similar or lower construction emissions. It is reasonable to assume that a construction HRA for the proposed Project would result in similar conclusions as the 2018 MND's construction HRA, which was accepted by the City of Santa Clara. Further, it is reasonable to estimate that the HRA results would be lower for the proposed Project due to the reduction in annual PM2.5 construction emissions resulting from these changes.

DATA REQUESTS

8. Please complete a short-term screening level HRA for construction-phase DPM emissions. The Applicant should use a duration starting in the 3rd trimester of pregnancy to determine a maximum cancer risk to the most sensitive receptor. Then, if the risk is still above a significance threshold (10 x 10-6) the applicant should refine the modeling beyond a screening level of analysis.

RESPONSE TO DATA REQUEST 8

Please see response to Data Request 10 below. Oppidan has conservatively developed the full HRA in lieu of a screening level HRA.

9. Please provide a quantitative health risk impact assessment (including cancer risk, chronic non-cancer health index, and UTM coordinates) for both construction phases. These impacts should include the following receptors at point of maximum impact (PMI), maximally exposed individual sensitive receptor (MEISR), maximally exposed individual resident (MEIR), and maximally exposed individual worker (MEIW). Please also provide the HRA files.

RESPONSE TO DATA REQUEST 9

Please see response to Data Request 10 below. Per the CEC's request in Data Request 10 below, Oppidan is providing an HRA for both the Project construction and operation together. The results in response to Data Request 10 include the PMI, MEISR, MEIR, and MEIW for cancer risk and chronic non-cancer health index with UTM coordinates for such results. Note that modeling the overlapping period of Phase 1 operation and Phase 2 construction together provide a conservative estimate of Project construction emissions which would have higher and more impactful results than modeling the Phase 1 or Phase 2 construction periods independently.

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[5] Note that exhaust particulate matter is represented as total particulate less fugitive particulate

10. Please update the project's HRA to include construction and operation together, not separately, particularly since the risk driver is diesel particulate matter (DPM) for both.

RESPONSE TO DATA REQUEST 10

Oppidan is providing the HRA results for the overlapping period of Phase 1 operation and Phase 2 construction of the Project. Per Oppidan's construction schedule, there will be seven critical backup generators in operation while Phase 2 construction is ongoing. One life safety generator is conservatively assumed to be in operation as well. As such, the HRA included herein represents maximum annual diesel particulate matter (DPM) construction emissions in conjunction with maximum annual DPM emissions from the seven critical backup generators and one life safety generator. The locations of the seven critical backup generators were selected based on the seven worst-case locations for the Phase 1 building determined in the load-screening analysis presented in Section 4.4 the AQIA (submitted as Appendix A to the MCBGF SPPE Application).

AERMOD dispersion modeling and the Hotspots Analysis and Reporting Program (HARP) Air Dispersion Modeling and Risk Tool (ADMRT) (version 19121) are used to estimate carcinogenic and chronic health risks at residential and worker receptors as a result of the emissions from the overlapping Phase 1 operation and Phase 2 construction of the Project.

Assumptions regarding the coordinate system, terrain elevations, meteorological data, building downwash, receptors, and exposure pathways are consistent with the assumptions stated in Section 4.3, Section 4.6.1, and Section 4.6.4 of the AQIA.

The emission sources for the Phase 1 operation and Phase 2 construction of the Project are modeled as follows:

- One volume source representative of construction equipment tailpipe emissions. The volume source type was selected because tailpipe emissions will occur over a large spatial area at a slight elevation above ground due to equipment tailpipe placement.

- Eight point sources representative of the seven critical backup generators and one life safety generator that will be installed as part of the Phase 1 operation while Phase 2 construction is ongoing.

The AERMOD dispersion model is run using an emission rate of 1 g/s for "Other" pollutant for the area and point sources to represent DPM. The AERMOD results are scaled by the source-specific emission rates for input into HARP. The emission rates used to represent the construction volume source described above are based on the maximum annual exhaust particulate matter emission rates across the two phases of construction as presented in Table 4-4 of the AQIA.[6] The emission rates used to represent the critical backup generator and life safety generator point sources described above are based on the annual operational emissions of particulate matter, as represented in Table 4-5 of the AQIA.

A detailed summary of the HRA results and the comparison to the BAAQMD CEQA thresholds of significance are presented in Table 3 below. The analysis concludes that the health risk is below BAAQMD's CEQA thresholds of significance. The increased risk is evaluated on a per-receptor basis using the results from HRAs conducted for the proposed emissions scenario. The results support a finding of a less than significant air quality impact due to air toxic pollutant emissions. Please find all related electronic modeling files included in the USB provided as part of this response.

Table 3: Phase 1 Operation and Phase 2 Construction HRA Results

Receptor	Receptor ID	Location (UTM Zone 10)	Cancer risk (in 1 million)		Chronic Hazard Index		Significant Impact?
			Project Risk	Significance Threshold	Project Hazard Index	Significance Threshold	
MEIR	10093	591380 m E, 4138819.5 m N	6.56	10.0	3.44E-03	1.0	No
MEIW	3202	591676 m E, 4138561.4 m N	1.19	10.0	7.30E-03	1.0	No
MEISR	1181	591696 m E, 4138501.4 m N	0.674	10.0	3.54E-04	1.0	No
PMI	10105	591579.3 m E, 4138527.7 m N	27.7	-	1.46E-02	-	N/A[a]

a. As similarly described in Oppidan's February 6, 2020 response to data request, the PMI in this evaluation is not located in a MEI location and is not appropriate to compare to the significance thresholds of the health risk evaluation.

BACKGROUND: HEALTH RISK ASSESSMENT (HRA) FOR OPERATION PHASE IMPACTS

In Table 4.3-12 on page 82 of the application, the applicant said "additional HRA analyses are being prepared at the time of filing of this application to represent more reasonable case operation profiles and will be submitted under separate cover." Also, the PMI in Table 4.3-12 is 51.39 in one million, higher than the threshold of 10 in a million.

DATA REQUESTS

18. Please update the project's HRA to include construction and operation together, not separately, particularly since the risk driver is DPM for both.

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[6] Note that exhaust particulate matter is represented as total PM_{10} less fugitive dust PM_{10}.

RESPONSE TO DATA REQUEST 18

Please see Response to Data Request 10.

BACKGROUND: MODELING FOR NITROGEN DIOXIDE

The modeling files for the 1-hour nitrogen dioxide (NO2) concentrations appear to under-represent the potential impact of the maximum short-term NOx emission rate of approximately 42.6 lb/hr (based on the emission factor of 5.32 grams per brake- horsepower-hour and 3,633 horsepower per engine) as in the applicant's AQIA Appendix AQ-2.

The modeling files for 1-hour NO2 impacts assume single-hour emissions at the "annualized" NOx emission rate, as disclosed in a footnote in the AQIA (footnote 'f', the applicant's AQIA Table 4-7). However, the maximum potential hourly NOx emissions should be used in the evaluation of whether CAAQS would be exceeded. This means that the 1-hour NO2 impacts in SPPE application Table 4.3-11 appear to be underestimated by modeling an "annualized" emission rate rather than the actual potential short-term emissions that could occur during any hour. For example, the applicant's AQIA Table 4-7 shows the short-term emissions rate for NOx of 5.369 grams per second, which contrasts with the modeling for source name: GEN42A, at the emission rate of: 0.03064 grams/second (in modeling file "1hr_NO2_CAAQS_2013- 2017.aml"). If the basis for this approach is the March 1, 2011 memorandum from Tyler Fox of the US EPA with the subject line "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO2 NAAQS," CEC staff notes that this document says on page 9 that "the guideline is not a strict modeling 'cookbook'" and that "case-by-case analysis and judgment are frequently required." The memorandum also says on page 10 that "case-specific issues and factors may arise that affect the application of this guidance" and that "additional discretion may need to be exercised in such cases to ensure that public health is protected." Staff's review of the single-engine scenarios indicate that many scenarios could exceed the 1-hour NO2 CAAQS (based on results in the applicant's AQIA Appendix AQ-6: Load Screening Analysis Model Total Output).

DATA REQUEST

21. Please update the modeling for NO2 impacts and re-evaluate compliance with the 1-hour NO2 CAAQS by analyzing the potential NOx emissions that could occur during any single-hour scenario.

RESPONSE TO DATA REQUEST 21

In addition to Oppidan's response to Data Request 6 provided on February 6, 2020, Oppidan is providing the requested refined NO_2 modeling analysis for comparison to the 1-hour NO_2 CAAQS. The AERMOD model (version 19191) is used with Trinity's *BREEZE™ AERMOD Suite* software to calculate concentrations using the regulatory default parameters. Assumptions regarding the coordinate system, terrain elevations, meteorological data, building downwash, receptors, and background concentration data are consistent with the assumptions stated in Section 4.3 and Section 4.5.3 of AQIA submitted as Appendix A to the MCBGF SPPE Application. The refined NO_2 modeling analysis assumes one generator is operating at a time during any given hour for routine testing and maintenance purposes. The worst-case generator location and load are determined consistent with the load screening analysis described in Section 4.4 of the AQIA. For the purposes of the refined analysis, NO_2 emissions are not annualized on an annual basis and instead are converted directly from a worst-case lb/hr scenario to g/s emission rate.

The refined analysis utilizes the Plume Molar Volume Molar Ratio Method (PVMRM) per the US EPA's guidelines.[7] The in-stack ratio (ISR) of NO_2 to NO_x is set at 0.1 based on data presented in the US EPA's NO_2/NO_x ISR database for diesel/kerosene-fired reciprocating internal combustion engines.[8] As part of the PVMRM technique, hourly ozone data collected from the Jackson Street, San Jose monitor was uploaded to the AERMOD model using the ozone file editor tool.[9] Missing hourly ozone data was substituted as follows: for one to two consecutive hours of missing values, the missing value was replaced by the greatest preceding or succeeding value. For three or more consecutive hours of missing hourly values, the maximum value occurring from the same month and hour across the five years of ozone data was used.

Results from the refined NO_2 analysis are presented in Table 4 below and are below the CAAQS. As such, the Project will not result in a significant impact on air quality. Please

[7] Per 40 CFR Part 51, Appendix W.
[8] US EPA NO2/NOx ISR Database available online here: https://www3.epa.gov/ttn/scram/no2_isr_database.htm
[9] Ozone monitoring data collected from 158 East Jackson Street, San Jose, CA, the nearest BAAQMD monitoring site.

find all related electronic modeling files included in the USB provided as part of this response.

TABLE 4: Refined 1-hr NO_2 Air Quality Dispersion Model Results and Comparison to CAAQS

Pollutant	Averaging Period	CAAQS ($\mu g/m^3$)	Standardized Concentration ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	Total Concentration ($\mu g/m^3$)	Below CAAQS Threshold?
NO_2	1-hour	339	137	162	299	Yes

BACKGROUND: THERMAL PLUMES

The project site is located approximately 1.7 miles from the Norman Y. Mineta San Jose International Airport. According to the application, the project would have emergency generators and roof-mounted up-blast fans. This equipment would emit high-velocity thermal plumes.

DATA REQUEST

45. In order to evaluate the potential plume hazards to aviation, please model (using the Spillane methodology) and provide analysis of the plumes' velocities for the project's emergency generators and up-blast fans.

RESPONSE TO DATA REQUEST 45

Oppidan evaluated potential thermal plume hazards to aircraft from the proposed up-blast fans and emergency generators using the Spillane methodology. Per Oppidan's design, there will be a maximum of 56 up-blast fans operating between the Phase 1 and Phase 2 buildings. For the purposes of the thermal plume hazard analysis, it is assumed that all 56 up-blast fans and one emergency generator would operate simultaneously. This assumption is based on typical operation of the Project within a short time-period when an aircraft may be overhead, where all up-blast fans would be operating for routine building operational purposes and one emergency generator may be operating for routine testing or maintenance.

The thermal plume hazard analysis is based on models presented in the 2003 "Aviation Safety and Buoyant Plumes" paper prepared by Best, et al.[10] Per the 2003 Australian Manual of Aviation Meteorology, a vertical plume velocity of 10.6 meters per second is

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[10] Best, Peter, et. al. (2003). *Aviation Safety and Buoyant Plumes.* Available online here: http://www.ctcombustion.com/oxc/sources/23-Katestone.pdf

the starting velocity at which aircraft will experience severe turbulence. As such, Oppidan used the 10.6 meters per second velocity as the threshold at which thermal plumes from the Project would interfere with aircraft. Oppidan's analysis demonstrates that of the combined thermal plume from the 56 up-blast fans and the thermal plume from one emergency generator, the highest elevation above grade that 10.6 meters per second velocity is met is at a maximum height of 53.4 meters (175 ft) above grade. As aircraft are not expected to be within 175 feet of the Project, the impact from thermal plumes is considered less than significant. Details of the thermal plume hazard calculations utilizing the Spillane method are included as Attachment 1 to this response. The electronic spreadsheet file of these calculations is also included in the USB included as part of this submittal.

ATTACHMENT 1: Thermal Plume Hazard Analysis Calculations

Table 1. Spillane Method Calculation Inputs

Parameter	Value		Units	Reference
Constants				
Gravity, g	9.81		m/s^2	--
Worst-Case Ambient Conditions	**Upblast Fan**	**Emergency Generator**		
Ambient Potential Temperature, θ_a	272	305	K	1
Plume Exit Conditions	**Upblast Fan**	**Emergency Generator**		
Stack Height, h_s	29.0	11.7	m	2
Stack Length, L	1.746	--	m	3
Stack Equivalent Diameter, D	1.909	0.508	m	4
Stack Flow Rate, Q	60919	19578.8	CFM	3
Stack Velocity, V_{exit}	14.30	45.59	m/s	3
Stack Potential Temp, θ_s	328	764	K	5
Initial Stack Buoyancy Flux, F_o	21.7	18.6	m^4/s^3	6
Number of stacks, N	56	1	stacks	7
Spillane Methodology - Analytical Solution for Calm Conditions for Plume Heights above Jet Phase	**Upblast Fan**	**Emergency Generator**		
Virtual Source Height, z_v	1.059	1.167	m*	8
Virtual Source Height above ground, $z_v + h_s$	30.08	12.88	m	
Single Plume top-hat radius, a	3.74	0.71	m	9
Initial Plume Velocity and top-hat radius product, $(Va)_o$	12.43	7.32	m^2/s	10
Single Plume Velocity at the height at which the Merged Plume Velocity meets the Plume Velocity Screening Threshold, V	3.87	10.6	m/s	11
Merged Plume Velocity for N Plumes, V_m	10.6	10.6	m/s	12
Plume Velocity Screening Threshold	10.6		m/s	13
Height above stacktop at which Plume Velocity Screening Threshold is met, z	24.4	5.6	m*	14
Height above grade level, $z+h_s$	53.4	17.3	m	15
Minimum safe altitude for aircraft in congested areas	304.8		m	16
Significant Impact?	**No**			17

1. Upblast fan assumes a worst-case condition of 30°F ambient temperature.
   Emergency generator assumes a worst-case condition of 90°F ambient temperature.
2. Upblast fan stack height is the sum of the building height and height of upblast fan stack. Building height of 87' per site plans submitted as Figure 2-2 in MCBGF SPPE Application, TN#230848. Height of upblast fan opening of 98.50" per manufacturer specifications.
   Emergency generator stack height per the electronic modeling files submitted as part of MCBGF SPPE Application, TN#230848. Represents the height of the stacked configuration.
3. Upblast fan parameters per manufacturer specifications.
   Emergency generator parameters for worst case condition of 100% load per manufacturer specifications submitted as part of MCBGF SPPE Application, TN#230848.
4. Upblast Fan Equivalent Diameter = $1.30\ (L^2)^{0.625} / (2L)^{0.25}$
   Emergency generator diameter per the electronic modeling files submitted as part of MCBGF SPPE Application, TN#230848.
5. Assumes maximum operating temperature of 130°F for the upblast fans. Actual operating temperature anticipated closer to 70°F.
   Assumes 100% load operation and thus maximum temperature of 915.2°F per the manufacturer specifications in MCBGF SPPE Application, TN#230848.
6. $F_o = g * V_{exit} * D^2 * (1 - \theta_a/\theta_s)/4$, Section 2, paragraph 1 of Best et al, 2003, "Aviation Safety and Buoyant Plumes." (Best et al, 2003)
7. Number of stacks of upblast fans per site plan specifications.
   Only one generator will operate at a time for routine maintenance and testing purposes.
8. $z_v = 6.25 * D * [1 - (\theta_e/\theta_s)^{0.5}]$, assuming $\theta_e = \theta_a$ (Section 2, Eq. 6; Best et al, 2003).
   Note m* refers to meters above stacktop whereas m refers to meters from grade level.
9. $a = 0.16\ (z-z_v)$ (Section 2, paragraph 3; Best et al, 2003).
10. $(Va)_o = V_{exit} * D / 2\ (\theta_a/\theta_s)^{0.5}$ (Section 2.1 Eq. 6; Best et al, 2003).
11. $V = \{(Va)_o^{\ 3} + 0.12F_o\ [(z-z_v)^2 - (6.25D-z_v)^2]\}^{1/3} / a$ (Section 2.1 Eq. 6; Best et al, 2003).
12. $V_m = V * N^{0.25}$ (Section 3, paragraph 4; Best et al, 2003).
13. Per the Australian *Manual of Aviation Meteorology*, 2003, a vertical velocity of 10.6 m/s is the starting velocity at which aircraft will experience severe turbulence.
14. Height above stacktop at which the Merged Plume Velocity equals the Plume Velocity Screening Threshold. Note m* refers to meters above stacktop whereas m refers to meters from grade level.
    Height is solved for using Excel Goalseek for the height at which the Merged Plume Velocity will equal the Plume Velocity Screening Threshold.
15. Height above ground elevation at which Merged Plume Velocity equals the Plume Velocity Screening Threshold.
16. Unless necessary for takeoff or landing, minimum safe altitudes for aircraft are 1,000 feet above grade level for congested areas, per Title 14, Section 91.119 of the Code of Federal Regulations.
17. The Height above grade level at which the Plume Velocity Screening Threshold is met is less than the minimum safe altitude for aircraft in congested areas, such as the area around the Mission College Data Center. As such, impacts to aircraft from thermal plumes are expected to be less than significant.