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Response to CEC Staff Data Request Set No.1 (1-34)

McLaren Backup Generating Facility (17-SPPE-01)

SUBMITTED TO: CALIFORNIA ENERGY COMMISSION
SUBMITTED BY: **Vantage Data Centers**

February 2018

DAYZEN LLC

INTRODUCTION

Attached are Vantage Data Centers' (Vantage) responses to California Energy Commission (CEC) Staff Data Request Set No. 1 (1-34) for the McLaren Backup Generation Facility (MBGF) Application for Small Power Plant Exemption (SPPE) (17-SPPE-01). Staff issued Data Request Set No. 1 (1-34) on January 25, 2018.

The Data Responses are grouped by individual discipline or topic area. Within each discipline area, the responses are presented in the same order as Staff presented them and are keyed to the Data Request numbers (1-34). Additional tables, figures, or documents submitted in response to a data request (e.g., supporting data, stand-alone documents such as plans, folding graphics, etc.) are found at the end each data response and are not sequentially page-numbered consistently with the remainder of the document, although they may have their own internal page numbering system.

For context the text of the Background and Data Request precede each Data Response.

GENERAL OBJECTIONS

Vantage objects to all data requests that require additional analysis of the McLaren Data Center (MDC) which is not subject to the Commission's jurisdiction because it is not a thermal power plant. The MDC has already been approved by the City of Santa Clara (City) pursuant to an Initial Study/Mitigated Negative Declaration (IS/MND). Staff should rely on the IS/MND as directed by Commission Regulation 20 CCR 1943. While the Commission is the lead agency for California Environmental Quality Act (CEQA) purposes, the project before the Commission is the generating facility and the lead agency status does not extend to the MDC.

The City is currently processing a request by Vantage for minor modification to the previously approved MDC. These changes include increasing the square footage of the buildings which in turn increased the backup generating facility capacity. All of the changes to the MDC are within the previously approved site. The City intends to prepare an Addendum to the IS/MND for the MDC to document the changes to the MDC and, if the Commission grants the SPPE for the MBGF, incorporate the Commission's environmental analysis into its overall approval of the MDC and the MBGF.

Therefore, the information about the MDC and potential environmental impacts that are associated solely with the MDC should not be part of the scope of the Commission's analysis. We acknowledge that where a potential environmental impact of the MBGF contributes to an environmental impact caused by the MDC, Staff should evaluate the potential cumulative effect and MBGF's contribution to such cumulative effect. Therefore, Vantage objects to data requests 1, 28 through 32 and 34.

DATA REQUESTS AND RESPONSES

AESTHETICS

BACKGROUND: Elevation Drawings

The city of Santa Clara's Initial Study/Mitigated Negative Declaration (IS/MND) published in February 2017 for the McLaren Data Center (MDC) was submitted with the Small Power Plant Exemption (SPPE) application as Appendix B Part 1. On pages 20 through 22 in the Project Description discussion, Figures 3.0-7 through 3.0-9 of the city's IS/MND provide elevation drawings for the original project configuration. There are no elevation drawings provided for the new project configuration as described in the SPPE application.

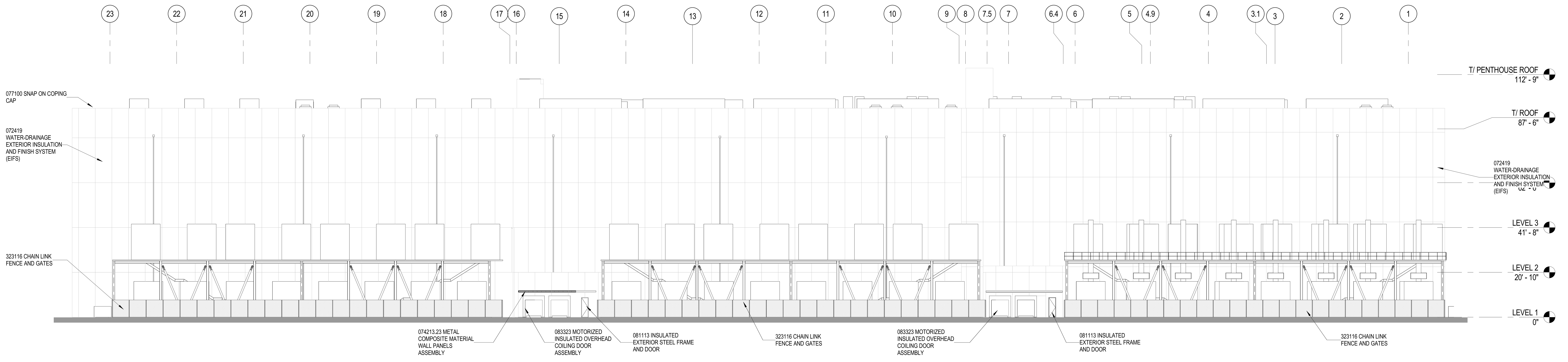
DATA REQUEST

1. Please provide elevation drawings, in similar detail as provided in the city's IS/MND, for the new project configuration.

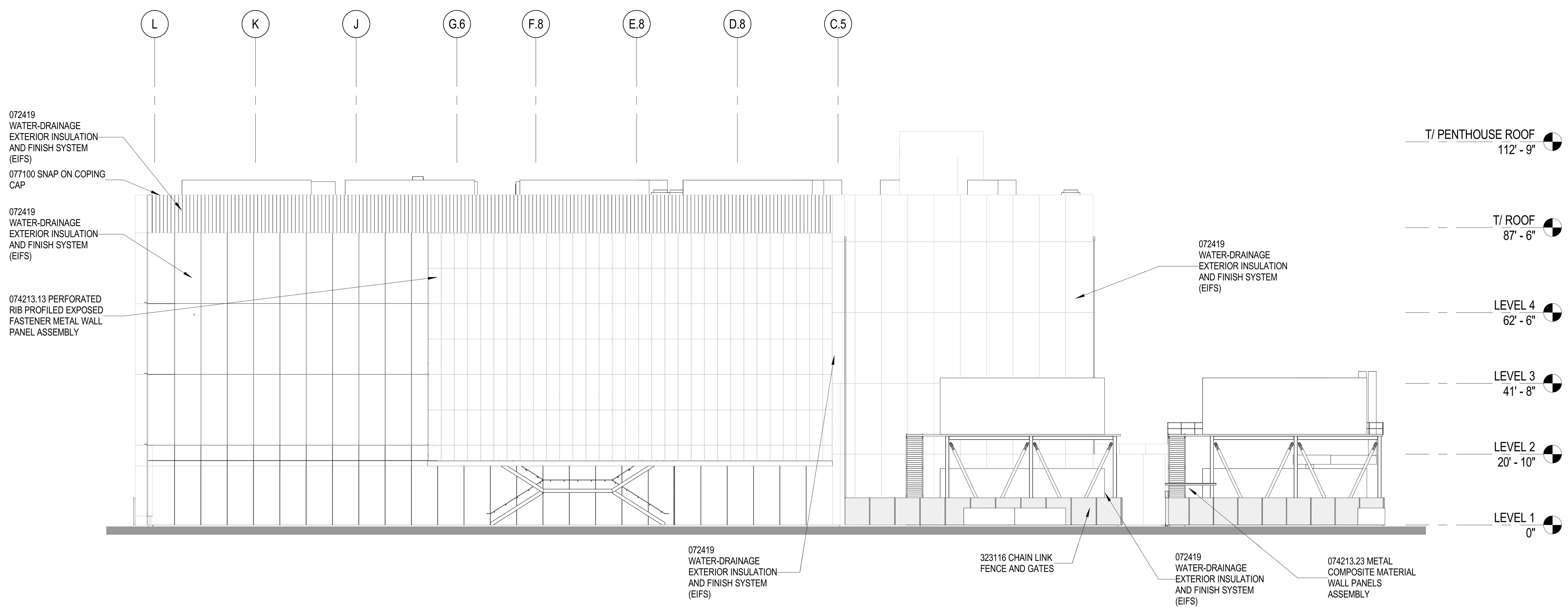
RESPONSE TO DATA REQUEST 1

Notwithstanding the general objection to this data request, please see Attachment DR-1, Figures A211.01 and A211.02.

DR-1 – Architectural Drawings



2 (diagram) OVERALL NORTH ELEVATION - CAMPUS
3/64" = 1'-0"



1 (diagram) OVERALL EAST ELEVATION - CAMPUS
3/64" = 1'-0"

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LANDSCAPE ARCHITECT
REED ASSOCIATES
LANDSCAPE ARCHITECTURE

NO.	DESCRIPTION	DATE

DRAWING ISSUES

PROGRESS SET
NOT FOR CONSTRUCTION

PROJECT:

VANTAGE - MCLAREN

Project Status

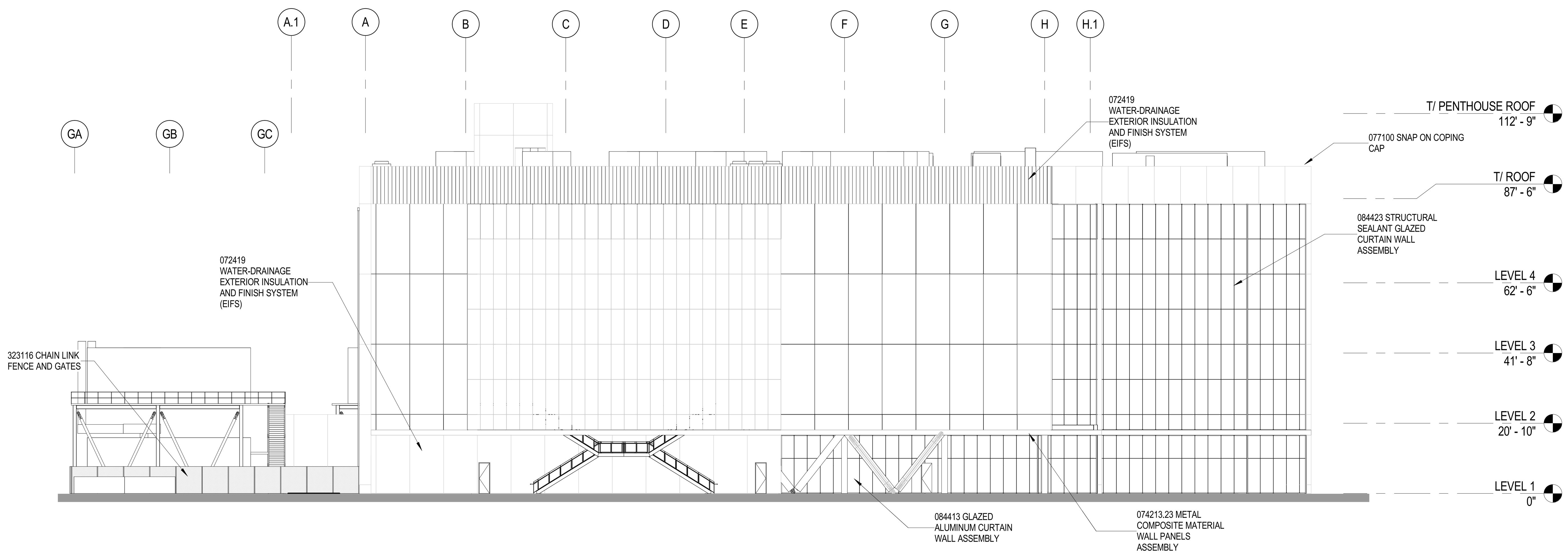
625, 725 MATHEW STREET
SANTA CLARA, CA

DWG. TITLE

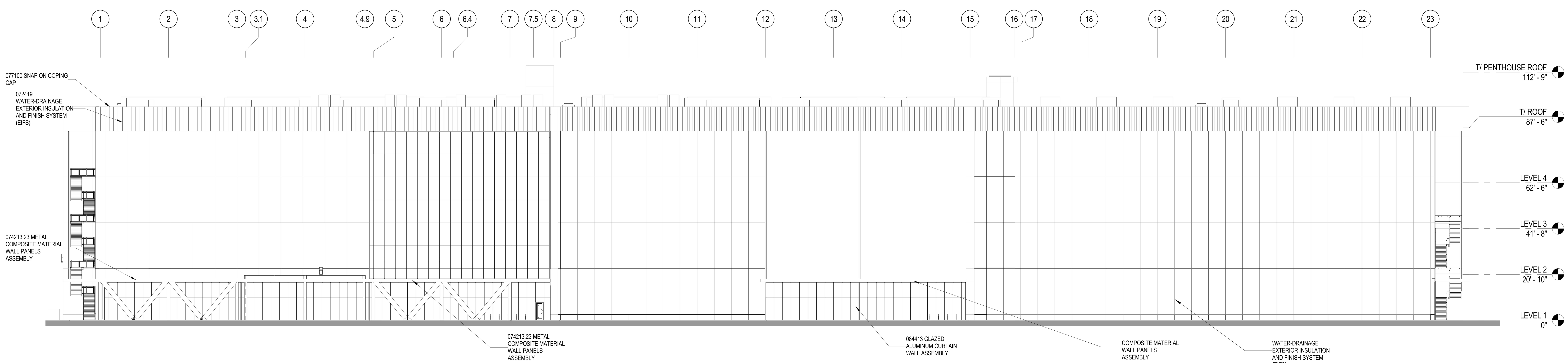
CAMPUS ELEVATIONS

PROJECT NO: Project Number
DATE: Issue Date
SCALE: AS NOTED

DWG. NO:
A211.01



2 (diagram) OVERALL WEST ELEVATION - CAMPUS
3/64" = 1'-0"



1 (diagram) OVERALL SOUTH ELEVATION - CAMPUS
3/64" = 1'-0"

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LANDSCAPE ARCHITECT

REED ASSOCIATES
LANDSCAPE ARCHITECTURE

NO.	DESCRIPTION	DATE

DRAWING ISSUES

PROGRESS SET
NOT FOR CONSTRUCTION

PROJECT:

VANTAGE - MCLAREN

Project Status

625, 725 MATHEW STREET
SANTA CLARA, CA

DWG. TITLE

CAMPUS ELEVATIONS

PROJECT NO: Project Number
DATE: Issue Date
SCALE: AS NOTED

DWG. NO: A211.02

AIR QUALITY

BACKGROUND: CONSTRUCTION RELATED EMISSIONS AND IMPACTS

Staff has reviewed the construction related emissions that were analyzed by the city of Santa Clara in its IS/MND. However, the project has now changed to a larger facility with a different configuration and layout, requiring updated construction-related emission information for the new configuration of the McLaren Backup Generating Facility (MBGF).

DATA REQUEST

2. Please provide emission estimates and impacts analysis for both criteria pollutants and toxic air contaminants for the construction phase of the modified configuration of MBGF.

RESPONSE TO DATA REQUEST 2

Ramboll is currently developing the emission estimates, which will be submitted on February 6, 2018.

BACKGROUND: EMERGENCY GENERATOR ENGINE TESTING PROFILE

The applicant states in Appendix E-1, Air Dispersion Modeling Report, section 3.2.1, on page 5 of 7 that the annual engine-testing profile required to ensure availability will be with the first hour at 50 percent load, the next hour at 75 percent load, and the third and fourth hours at 100 percent load. For the oxidation catalyst and the diesel particulate filter, staff needs to understand whether or not the control efficiency drops at lower loads during these relatively short periods of testing, how emissions would change at lower loads and how control efficiencies are maintained with intermittent operations. These effects were not quantified in the application submitted to the Energy Commission.

Pages 43 and 44 of 273 in the Attachment C Manufacturer Performance Data Sheets in Appendix E (TN# 222041-11) show emission rates at different loads. Staff needs to understand whether the control efficiency during intermittent operations was considered in the emission rates shown in Attachment C. Staff also noticed that pages 43 and 44 in Attachment C showed two sets of emission rates: one with potential site variation and the other was shown as nominal data. The applicant used emission rates from nominal data in the application, which are lower than the data with potential site variation. Staff needs to understand how the applicant decided which set of data is more representative of the project site.

DATA REQUESTS

3. Please describe how post-combustion control efficiencies are maintained during intermittent operations and testing.

4. Please explain whether the control efficiency during intermittent operations was considered in the emission rates shown in Attachment C.

RESPONSE TO DATA REQUESTS 3 and 4

Control efficiencies are maintained and changes in control efficiency or emission rates do not require consideration. The manufacturer of the DPF, Johnson Matthey, has assured that the % load or intermittency of emissions does not affect the DPF performance. Johnson Matthey stated: "*Our DPF(s) have absolute filters inside, so load doesn't affect the amount of PM reduction. At any engine load the filters act in the same manner of removing PM, just like a piece of filter paper will filter out what it can, as long as it doesn't break apart. Same with our ceramic filters, they will filter PM material out at any engine load as long as they don't physically break. Thus, across all loads the product will deliver 85%+ total PM reduction. One technical paper that might be of some help is one I've attached. It was performed and reported by EPA, and compared the Johnson Matthey DPF to the Rypos DPF. In the attached paper the Johnson Matthey DPF (referred to as the P-DPF) is just like the ones we sell to Peterson Power. The Rypos DPF is referred to as the A-DPF in the pape*r."

The vendor has stated that there are no requirements for regeneration during loaded conditions: "*The DPF has 85% reduction in PM at all times as it is trapping the particulate and gradually clogging.*" When the generators are being run at an unloaded condition (0% load), the DPF is "*sized to handle 24 cold starts with 30 minutes of operation at 0% load or 12 hours of continuous operation at 0% load, before regeneration.*" Vantage runs the generators at 0% load for 5 minutes monthly, so control efficiencies are maintained. The paper provided by Johnson Matthey (Paper DR4 – Yelverton) and the emails from Johnson Matthey (Emails DR4-01 and DR4-02 and DR4-03) are attached.

5. Please justify the use of the nominal data instead of the data with potential site variation.

RESPONSE TO DATA REQUEST 5

The engine manufacturer, Caterpillar, has verified that the "nominal" data is the appropriate data to use. Caterpillar stated: "*The nominal data follows ISO8178 conditions for testing where as the "potential site variation" data is not to be used for permitting and is very much representative of "worst case scenario" type data. I've*

Attachment DR4-Yelverton

Attachment Emails DR4-01, DR4-02 and DR4-03

Clean Techn Environ Policy
DOI 10.1007/s10098-015-0900-6

ORIGINAL PAPER

Emissions removal efficiency from diesel gensets using aftermarket PM controls

Tiffany L. B. Yelverton · Amara L. Holder · Jelica Pavlovic

Received: 27 October 2014 / Accepted: 6 January 2015

Abstract Diesel particulate matter (PM) has been associated with adverse health effects in humans and is classified as a human carcinogen. Additionally, the strongly light absorbing fraction, black carbon (BC), has been identified as an important climate forcer. For these reasons, the effectiveness of aftermarket controls on reducing PM and BC from three stationary diesel gensets (230, 400, and 600 kW) of varying engine displacement (from 8.8 to 27 L) and physical size was investigated. Uncontrolled emissions were compared with emissions controlled with a passive (P-DPF) and active diesel particulate filter (A-DPF) and a diesel oxidation catalyst (DOC). Overall, the DPFs resulted in significant PM mass removal (~80–99 %), while the DOC resulted in statistically insignificant reductions (~0–25 %). Both BC and elemental carbon (EC) removal followed a similar trend, but EC/PM ratios varied from 0 to 0.79 over all test conditions, indicating changes in PM composition with the addition of aftermarket controls or changes in load. Further, the single scattering albedo of PM was slightly decreased from the DPFs compared to the uncontrolled case. Particle number concentrations were also significantly reduced when using DPFs, with a greater than 97 % reduction in particle concentrations with the P-DPF and greater than 82 % reduction with the A-DPF. The DOC exhibited much lower particle reductions, reducing the particle concentration by only 5–35 %, depending upon the genset or load. These results demonstrate that while DPFs are effective at reducing PM and BC emissions, the particle characteristics are altered from those of uncontrolled emissions.

Keywords Diesel genset · Emissions factors · PM control

Introduction and background

As early as 1970, when the United States Congress first passed the Clean Air Act, finding ways to mitigate or eliminate particulate matter (PM) emissions from combustion sources has been a focus of research and regulatory communities in an effort to improve human and environmental health, visibility, and more recently global climate. Epidemiological evidence has linked ambient $PM_{2.5}$ with adverse human health effects (Pope and Dockery 2006; Brito et al. 2010), and more specifically the World Health Organization (WHO) has determined that diesel emissions are a human carcinogen (IARC 2012). Diesel emissions in the U.S. at one point were estimated to contribute up to 75 % of visibility degradation in urban areas (Eldering and Cass 1996), but more recent diesel engine emission regulations in the U.S. and other nations have led to an overall

Jelica Pavlovic was a ORISE postdoctoral fellow at the U.S. Environmental Protection Agency Research Triangle Park, NC at the time the research and analysis were completed.

Electronic supplementary material The online version of this article (doi:10.1007/s10098-015-0900-6) contains supplementary material, which is available to authorized users.

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increase in visibility by requiring decreased PM and NO_x emissions (40 CFR part 89 and 1039).[1]

Black carbon (BC), a subset of PM found in diesel emissions, is an important contributor to global climate change as it directly warms the atmosphere by absorbing solar radiation and reduces the surface albedo when deposited on snow and ice covered surfaces (Bond et al. 2013). It is estimated from climate models as second only to CO_2 as the largest climate warming agent (Jacobson 2002; Ramanathan and Carmichael 2008; Bond et al. 2013). As BC has a much shorter residence time (~1 week) in the atmosphere than CO_2 (~150 years), it is possible that a reduction in BC emissions could lessen the effects of global climate change in the near-term (Ramanathan and Carmichael 2008). However, the impact of BC on climate is dependent upon its optical properties. Particularly, the ratio of the scattering coefficient to the extinction coefficient (single scatter albedo, SSA) determines whether BC will warm or cool the surrounding atmosphere (Bond et al. 2013). Also, of importance is the variation of the absorbance with wavelength, which is quantified with the absorption angstrom exponent (a) and can indicate the presence of coatings or light absorbing organic compounds (Lack and Cappa 2010). How these optical properties vary with engine load and control technology has not been characterized.

While it is possible to achieve emissions reductions from diesel combustion through engine modifications, post-combustion control technologies such as diesel particulate filters (DPFs) and diesel oxidation catalysts (DOC) offer an array of options for mitigation or elimination of gaseous and particulate emissions, and can be utilized for both on- and off-road applications (Shah et al. 2007; Wien et al. 2004; Konstandopoulos 2000; Mayer et al. 1995, 1996). Due to regulations, predominately stemming from on-road use, in the U.S. and the European Union (EU), these technologies have become more sophisticated and more capable over the past few decades. Use of fuel-borne catalysts such as platinum or iron (Nash et al. 2013; Lee et al. 2006) or ultra-low sulfur diesel (ULSD) fuel (U.S. DOE 2000) can also alter the emissions from diesel combustion. ULSD must contain less than 15 ppm of sulfur, and is required for on- and off-road use in the U.S. However, studies have shown that even lower levels of sulfur (<10 ppm) optimize the PM removal efficiency of DPFs (Allansson et al., 2000; U.S. DOE 2000), as less sulfate PM is formed.

Post-combustion control technologies vary a great deal for on- and off-road vehicles and equipment, but ultimately accomplish emission reductions in a similar manner. DPFs are often used to control PM emissions, and can be used with or without selective catalytic reduction (SCR) or DOC technologies depending on the nature of the diesel engine and its use. DPFs can operate under a passive or active approach, with passive technologies using the heat from the engine exhaust and active technologies using an external heat or electrical source to clean or "burn off" PM collected on the filter substrate. A review and further discussion of DPFs for comparison to on-road applications can be found in the literature (Resitoglu et al. 2014; Bauner et al. 2009). DOCs are typically used to control gaseous emissions such as hydrocarbons or CO. However, possible co-benefits of PM reduction up to 40 % with the use of this technology (U.S. Environmental Protection Agency 2010) have been discussed. This (EPA report 2010) suggests PM removed by the DOC is likely in the soluble organic fraction rather than the elemental carbon (EC) fraction. While other post-combustion control technologies and combinations of these technologies do exist (i.e., SCR, and NO_x adsorbers), the active and passive DPF and the DOC were used here, as particle removal was the focus of this investigation.

The U.S. EPA's Reciprocating Internal Combustion Engine (RICE) Rule (40 CFR part 63)[2] regulates the emissions from stationary diesels. Non-road diesel gensets often fall under this regulation as a trailer-mounted diesel genset can be deemed stationary if it is in the same location for more than 12 months. It is also common for manufacturers to use the same engine in both the trailer-mounted, non-road gensets as they do in the stationary diesel gensets, thus certifying the same engine for both applications. While extensive studies have been completed for investigating the emissions of diesel engines on dynamometers for on-road applications with and without DPFs (Fontaras et al. 2014; Kittelson et al. 2004), few studies have focused on non-road or stationary diesel gensets (Shah et al. 2004; U.S. DOE 2000; Ryan et al. 2002), and even fewer with the application of post-combustion PM controls (Shah et al. 2007; Wien et al. 2004). Further, comparisons of particle size distributions with and without PM controls are limited in the literature for large-scale gensets (Shah et al. 2007), while much more common for on-road diesel engines (Liu et al. 2007; Kittelson et al. 2004). A better understanding of how the implementation of aftermarket PM controls for non-road applications affects the particle EC composition, number count, and size distribution of these emissions is needed. Therefore, the current study focused on taking both gaseous and particulate emissions measurements to assess the particle characteristics and PM emission reduction (including EC and BC) potential for these aftermarket controls.

[1] 40 CFR part 89 and 40 CFR part 1039. Control of Emissions from New and In-Use Nonroad Compression Ignition Engines

[2] 40 CFR part 63, subpart ZZZZ. National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines (RICE)

Table 1 Genset specifications

Genset model	Genset model year	EPA tier rating	Maximum power output (kW)	Engine model	Engine displacement (L)
XQ230	2009	3	230	CAT C9 ATAAC I-6, 4-stroke, water-cooled	8.8
XQ400	2005	3	400	CAT C15 ATAAC 1-6, 4-stroke, water-cooled	15.2
XQ600	2006	2	600	CAT 3412, V-12, 4-stroke, water-cooled	27

Experimental approach

Equipment

Three four-stroke diesel gensets manufactured by Caterpillar (XQ230, XQ400, and XQ600) were rented spanning a range of power outputs. Each genset, described further in Table 1, was trailer mounted and EPA certified for non-road mobile applications at varying tier levels and operated using ULSD (analysis shown in Table S1). A resistive load bank (Avtron model K580) was used to apply the load during steady-state testing. This load bank was capable of exceeding the 540 kW load needed to achieve a 90 % loading on the largest genset.

Three aftermarket control technologies were tested on each of the three gensets: an active DPF (A-DPF), a passive DPF (P-DPF), and a DOC for 50–90 % load conditions. Under normal conditions these control technologies would be mounted directly after the exhaust manifold to retain the heat of the exhaust. As these gensets were rented, some modifications to the installation were made due to the temporary nature of the installation. Metal ductwork (16 in. diameter, ~10 ft length) was used to route the exhaust downstream of the engine muffler to the different control technologies. The duct was insulated and the duct length was minimized to reduce heat and particle losses to the walls.

The A-DPF consists of four cylindrical sections (cans) containing a light-weight filter (proprietary material) followed by a DOC. For the largest genset tested (XQ600), it was necessary to install an exhaust splitter such that a portion of the exhaust could go to the A-DPF unit and a portion could vent to an in-house air handling system. This was necessary to avoid overloading the A-DPF (i.e., providing too high a face velocity) that was not sized large enough for the exhaust volume from the XQ600. Active regeneration is carried out by direct heating of the filter material to burn off the deposited PM. Regeneration is done with one can at a time and during this testing was set to occur periodically regardless of the engine backpressure. Unlike a typical installation where the genset would power the A-DPF regeneration, this was supplied from the laboratory in order to maintain constant load for steady-state testing conditions.

The P-DPF consists of as many as five cans containing a DOC followed by a ceramic filter substrate (proprietary material). The number of cans was varied depending upon the size of the genset, three for the XQ230, four for the XQ400, and five for the XQ600. Regeneration is achieved by operating the engine at high load, increasing the exhaust temperature to burn off deposited PM in the filter. Backpressure was monitored during testing to determine if a regeneration was necessary (i.e., switching to a higher load). However, the manufacturer's backpressure limit was never reached during testing and no regeneration cycles were needed.

The DOC used here was constructed of cordierite and a catalyst contained in a can. As with the P-DPF, as many as five DOC cans were used depending on the size of the genset.

Gas and particle phase measurements

Table 2 describes the instruments and measurement methods used. Undiluted gas-phase measurements of CO_2, CO, O_2, and NO_x were made following the EPA methods. Particulate phase measurements were made from a dilution manifold (described below) along with a second CO_2 analyzer used to calculate the dilution ratio.

PM mass was measured on Teflon filters (Pall, 47 mm Teflo) and EC was measured on quartz-fiber filters (Pall, 47-mm Tissuquartz). Although thermal–optical methods were used to determine EC emissions, organic carbon (OC) emissions are not reported as high OC concentrations were observed in the background air samples. Attempts to quantify this OC contamination in the sample lines and manifold resulted in varying OC artefact that could not be used for correcting samples in a manner representative of all conditions tested. X-Ray Fluorescence (XRF) was used to quantify the non-carbon compounds in several of the particulate filters collected. BC mass concentration was measured with an Aethalometer (AE-633). The light absorption coefficient and scattering coefficient were measured with a photoacoustic soot spectrometer (PASS-3). The particle size distribution was measured with a Scanning Mobility Particle Sizer (SMPS) operated with a sample and sheath flow of 0.3 and 3 lpm, respectively, resulting in a size range of 14.6–615.3 nm. Distributions were bimodal with a minimum at approximately 20 nm, which was used to define the two modes: nuclei mode

Table 2 Description of instrumentation and methods for measurement and calculations

	Instrument description	Instrument manufacturer	Sampling interval	References for instrumentation and methodology
BC	7-wavelength aethalometer	Teledyne API model AE-633	1 min	Hansen et al. (1984), Park et al. (2010), Virkkula et al. (2007) and Arnott et al. (2005)
Absorption	3-wavelength photoacoustic soot spectrometer	Droplet MEASUREMENT Technology model PASS3	2 s	Flowers et al. (2010)
EC	thermal–optical carbon analyzer	Sunset Laboratory	20–90 min	EPA Method 5 (modified), NIOSH Method 5040; Khan et al. (2012) and Chow et al. (2009)
PM mass	Teflon filter	Sartorius SE2 Ultra Micro Balance	20–90 min	EPA Method 5 (modified)
Particle concentration	particle counter	TSI, Inc. model SMPS	~2 min scan	Wang and Flagan (1990)
CO_2	Gas analyzer	California Analytical Inc. model 600	1 s	EPA Method 3A
CO_2, dilute	Gas analyzer	Li-COR model LI840	1 s	
CO	Gas analyzer	California Analytical Inc. model ZRH1	1 s	EPA Method 10
O_2	Gas analyzer	California Analytical Inc. model 600	1 s	EPA Method 3A
NO_x	Gas analyzer	Advanced Pollution Instrumentation model 200AH	1 s	EPA Method 7E

($<$20 nm) and accumulation mode ($>$20 nm). A portion of the nuclei mode was not measured since it was below the size range of the SMPS causing a low bias of the nuclei concentration. The implications of this bias on the nuclei concentration will be discussed in the results section.

A Welch's t test (two-tail, 90 % confidence level) was performed to compare emissions between the controlled and uncontrolled cases. This analysis determined whether or not the PM, BC, and EC reduction provided by a given control device was statistically significant.

Sampling design

The gensets and the load bank were operated outdoors under varying ambient conditions. No testing was done during precipitation events due to the potential damage to the load bank. Each genset was tested with the three aftermarket controls in random order. When resources permitted, an initial and final uncontrolled test were done before and after testing the aftermarket controls. Exhaust from the genset was routed to each control and then to the exhaust duct where a sampling probe was placed in the center to avoid wall effects while sampling occurred. A schematic of the exhaust sampling arrangement is shown in Fig. 1.

An undiluted and filtered sample was taken for gas-phase measurements. A diluted sample for PM measurements was obtained with an eductor supplied with filtered dry dilution air scrubbed of CO_2. Varying dilution ratios were obtained by changing the orifice (diameter ranging from 0.01 to 0.04 inches) in the eductor. Dilution ratios were optimized for each condition to obtain PM concentrations within the instrument measurement ranges.

The diluted sample was routed through 3/8″ anti-static silicone tubing (approximately 25 ft) to a stainless steel manifold and to each instrument through 1/4″ anti-static silicone tubing (less than 10 ft). Residence time to most instruments was generally less than two seconds. The longest residence time was to the SMPS at approximately 12 s. Particle losses in the sampling line are expected to be dominated by diffusional losses due to the small particle size and amounted to less than 0.5 % to most instruments and filters. The largest losses were calculated for the SMPS at less than 6 %.

Results and discussion

Three diesel gensets were used to test the removal efficiency of three different aftermarket control technologies and compared to uncontrolled emissions from the same gensets. The emissions averages for each condition and load are shown in Tables 3 and 4 and discussed in further detail below.

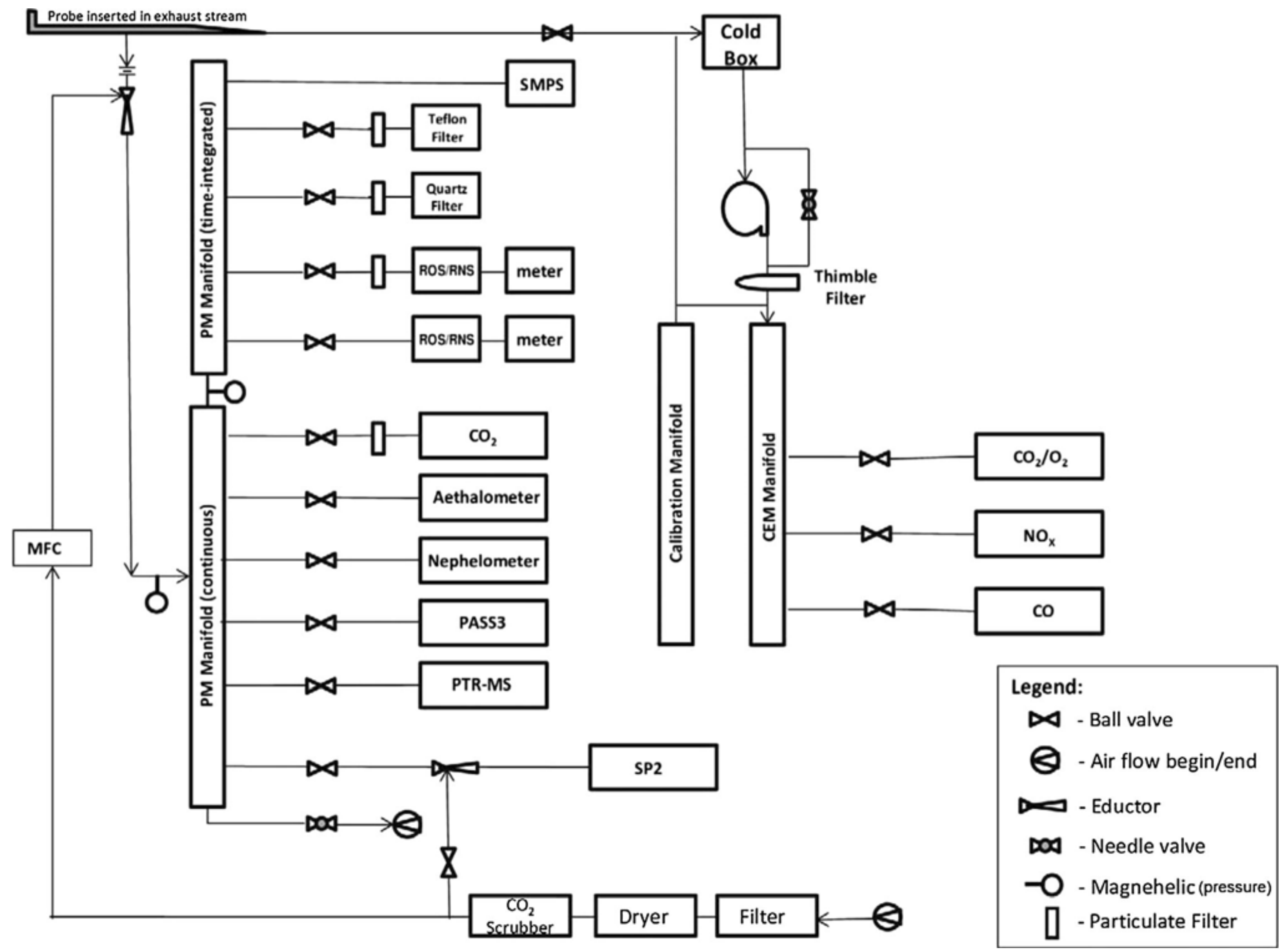

Fig. 1 Sampling schematic (measurements from several instruments shown in the schematic are not discussed or presented here, but are anticipated to be the subject for another expected article)

Gaseous emissions

Increases in load from 50 to 90 % on the uncontrolled gensets caused increases in CO_2 and NO_x emissions, and decreases in CO emissions. This is in agreement with reported data from a similar uncontrolled diesel genset (Caterpillar 500 kW) tested at 50 and 75 % load by Wien et al. (2004). Also, as expected, CO_2 and O_2 were inversely correlated across all cases tested (both uncontrolled and controlled). Further, CO_2 in many cases (with the exception of the XQ230) increased when either the P-DPF or A-DPF were used, which is likely attributable to increased fuel consumption while controls were in use and/or partially attributable to oxidation of hydrocarbons and PM conversion to CO_2.

For the tests conducted with uncontrolled gensets, the NO_x emissions overall were higher at 90 % rather than 50 % load. Several instances of higher NO_x average emissions were measured (particularly the XQ230) with an aftermarket control in use as compared to uncontrolled. The largest average NO_x emission measured was from the XQ600 with the DOC at 90 % load, 1.26 lb/MMBtu (1.95 g/kW h). This "worst-case scenario" measured through the investigation on the XQ600 still maintains compliance with EPA's RICE rule (40 CFR part 63) for stationary engines for Tier 2. Further, for its size with the DOC in place, it achieves the emissions limits required for 2014 and newer engines under Tier 4. The same is true for the largest average CO emission measured during the study of 0.831 lb/MMBtu (1.29 g/kW h), from the XQ400 uncontrolled at 50 % load.

Particulate emissions

While the gaseous emission trends (higher CO_2, CO, and NO_x emissions at higher load) from the current study agree well with those of Wien et al. (2004), the PM emissions (shown in Table 4) do not share the similar trend as the

Table 3 Gaseous emissions from XQ230, XQ400, XQ600 both uncontrolled and controlled

Units			Samples		Gaseous emissions			
			No. Collected	$Time_{AVG}$ Minutes	CO_2 %	O_2 %	NO_x Ib/MMBtu	CO Ib/MMBtu
XQ230	50 % Load	Uncontr'd	3	40	5.63 ± 0.06	13.3 ± 0.06	3.43E−01	1.47E−01
		P-DPF	3	60	5.00 ± 0.02	14.3 ± 0.04	4.76E−01	1.43E−03
		A-DPF	3	60	4.90 ± 0.07	14.3 ± 0.11	5.07E−01	4.52E−02
		DOC	3	40	4.88 ± 0.02	14.4 ± 0.03	3.71E−01	LOD
	90 % Load	Uncontr'd	3	45	6.42 ± 0.01	12.2 ± 0.04	4.41E−01	1.02E−01
		P-DPF	3	60	5.24 ± 0.01	13.4 ± 0.02	4.94E−01	3.02E−03
		A-DPF	3	55	5.43 ± 0.04	13.6 ± 0.06	6.44E−01	3.94E−02
		DOC	3	43	5.53 ± 0.05	13.5 ± 0.05	4.54E−01	LOD
XQ400	50 % Load	Uncontr'd	6	30	6.54 ± 0.25	12.2 ± 0.37	4.29E−01	8.31E−01
		P-DPF	3	40	6.89 ± 0.03	11.8 ± 0.04	3.66E−01	2.51E−02
		A-DPF	3	30	6.78 ± 0.01	12.0 ± 0.02	4.68E−01	9.63E−02
		DOC	4	26	6.57 ± 0.03	12.2 ± 0.03	2.88E−01	2.55E−02
	90 % Load	Uncontr'd	6	29	8.22 ± 0.22	10.1 ± 0.37	1.07E?00	2.64E−01
		P-DPF	3	40	8.48 ± 0.01	9.7 ± 0.00	8.85E−01	1.74E−02
		A-DPF	4	31	8.52 ± 0.05	9.65 ± 0.05	8.56E−01	5.93E−02
		DOC	3	20	8.02 ± 0.02	10.3 ± 0.03	6.81E−01	7.58E−03
XQ230	50 % Load	Uncontr'd	6	20	7.17 ± 0.02	11.3 ± 0.03	8.39E−01	5.94E−02
		P-DPF	2	95	7.37 ± 0.03	11.1 ± 0.04	6.23E−01	2.60E−03
		A-DPF	3	47	7.60 ± 0.02	10.9 ± 0.04	6.79E−01	6.92E−03
		DOC	3	30	7.18 ± 0.03	11.5 ± 0.04	6.69E−01	LOD
	90 % Load	Uncontr'd	7	25	9.49 ± 0.39	8.29 ± 0.29	1.12E?00	2.39E−01
		P-DPF	3	90	9.67 ± 0.06	8.33 ± 0.06	1.10E?00	7.24E−03
		A-DPF	3	30	9.96 ± 0.02	7.81 ± 0.03	1.10E?00	7.43E−02
		DOC	3	30	9.36 ± 0.04	8.69 ± 0.03	1.26E?00	5.09E−03

LOD represents instances measurements taken that were below the limit of detection

500 kW genset they tested, which had higher PM at lower load.

For the current study, the XQ230 average PM mass decreased from 1.70e-2 to 6.05e-3 lb/MMBtu, when changing from 50 to 90 % load for the uncontrolled condition. However, the opposite is seen from the uncontrolled XQ400 and XQ600, where the average PM mass increased with increased load. With the exception of the XQ230 at 50 % load with the DOC, the uncontrolled gensets had higher PM emissions than any controlled cases, which is in agreement with Wien et al. (2004). However, Wien et al. (2004) also found for the DPF-controlled cases that there were higher PM emissions at 50 % as opposed to 90 % load, which agreed with the PM emissions from the XQ230 and XQ400, but not the XQ600. Interestingly, the largest PM emission of 1.99e-2 lb/MMBtu (0.03 g/kW h) was measured during testing of the XQ230 at 50 % load with the DOC. Rather than the DOC providing a co-benefit of PM removal, in this instance the average PM emissions were greater (although not statistically significant) than that of the uncontrolled XQ230 genset at 50 % load. It should be noted, however, that even this highest level of PM emissions measured (XQ230 with DOC) would not only meet and exceed requirements for the Tier 3 rating required for the manufacturing year of this genset under EPA's Control of Emissions from New and In-Use Nonroad Compression Ignition Engines Rule (40 CFR part 89 and 1039), but would nearly meet the Tier 4 PM emissions requirements of a similar but newer genset (0.02 g/kW•h).

As part of the PM emissions characterization, EC and BC were measured for all conditions from filter samples and continuous instrumentation, respectively. To better understand potential changes in particle composition, the ratios of EC/PM were considered (shown in Table 4 and Figure S1), and ranged from 0 to 0.79. Typically uncontrolled diesel engines would produce predominately carbon emissions with contributions from metals and inorganics such as sulfur (Subramanian et al. 2009; Kittelson 1998). All uncontrolled cases measured in the current study show similar composition, with EC/PM ratio being greater than

Table 4 Particulate emissions and optical properties from XQ230, XQ400, XQ600 both uncontrolled and controlled (number of samples collected in Table 3)

Units	Particulate emissions				Particle number count			Optical characteristics		
	PM mass Ib/MMBtu	EC Ib/MMBtu	BC Ib/MMBtu	Absorption 1/Mm	Nuclei no/MMBtu	Accum. no/MMBtu	Total no/MMBtu	EC/PM	SSA	a
XQ230										
50 % Load										
Uncontr'd	1.70E−02	1.02E−02	2.25E−02	5.29E?04	2.64E?15	1.95E?16	2.21E?16	0.60	0.275	1.078
P-DPF	1.40E−04	0.00E?00	1.50E−06	8.07E?00	5.53E?10	7.52E?11	8.07E?11	0.00		
A-DPF	1.41E−03	9.91E−04	1.55E−03	3.91E?03	3.29E?14	1.83E?15	2.16E?15	0.71	0.245*	1.087*
DOC	1.99E−02*	1.23E−02	2.05E−02*	5.74E?04	2.50E?15	1.87E?16	2.12E?16	0.62	0.266*	1.058*
90 % Load										
Uncontr'd	6.05E−03	3.27E−03	7.24E−03	1.80E?04	1.71E?15	7.43E?15	9.14E?15	0.54	0.297	1.057
P-DPF	5.68E−04	0.00E?00	1.21E−06	4.74E?01	6.41E?10	6.55E?11	7.19E?11	0.00		
A-DPF	1.09E−03	6.39E−04	1.58E−03	3.14E?03	2.12E?14	1.04E?15	1.26E?15	0.58	0.262*	1.060*
DOC	6.54E−03*	3.20E−03*	8.05E−03*	1.75E?04*	1.89E?15*	7.31E?15	9.20E?15*	0.49	0.275	1.074*
XQ400										
50 % Load										
Uncontr'd	1.45E−02	9.68E−03	1.94E−02	6.64E?04	7.37E?14	1.48E?16	1.55E?16	0.67	0.235	1.117
P-DPF	5.41E−04	2.93E−04	6.41E−04	2.04E?03	9.80E?12	3.15E?14	3.24E?14	0.54		
A-DPF	2.24E−03	1.07E−03	2.37E−03 |	9.54E?03	7.62E?13	2.03E?15	2.11E?15	0.48	0.202*	1.162*
DOC	1.14E−02*	8.25E−03		5.16E ? 04*	3.77E ? 14*	1.04E ? 16	1.08E ? 16	0.73	0.249*	1.112*
90 % Load										
Uncontr'd	1.54E−02	1.18E−02	1.83E−02	6.41E ? 04	3.94E?14	7.63E?15	8.02E?15	0.77	0.313	0.974
P-DPF	4.51E−04	2.85E−04		1.72E?03**	9.18E?12	1.90E?14	1.99E?14	0.63		
A-DPF	7.08E−04	4.46E−04	1.48E−03	1.99E?03	1.44E?13	3.60E?14	3.74E?14	0.63	0.286*	1.014*
DOC	1.36E−02I*	8.86E−03		4.59E?04 *	2.51E?14|	5.21E?15	5.46E?15|	0.65	0.321*	1.010*
XQ600										
50 % Load										
Uncontr'd	6.59E−03	4.29E−03	8.92E−03	2.73E?04	1.55E?15	9.31E?15	1.09E?16	0.65	0.231	1.128
P-DPF	7.62E−05	2.40E−05	5.38E−05	1.88E?02	1.49E?12	2.09E?13	2.24E?13	0.32		
A-DPF	2.34E−03	7.48E−04	2.27E−03	8.15E?03	1.38E?13	1.15E?15	1.16E?15	0.32	0.204*	1.255*
DOC	6.30E−03*	4.17E−03*	8.01E−03*	2.74E?04*	7.43E?14	7.01E?15	7.75E?15	0.66	0.223	1.179*
90 % Load										
Uncontr'd	1.08E−02	6.77E−03	1.41E−02	4.30E?04	8.94E?14	6.65E?15	7.55E?15	0.63	0.264	0.993
P-DPF	1.40E−04	8.98E−05	2.32E−04	9.34E?02	1.98E?12	5.72E?13*	5.92E?13	0.64		
A-DPF	4.02E−03*	1.38E−03*	4.20E−03*	1.72E?04	1.11E?13	1.22E?15*	1.23E?15*	0.34	0.228*	1.093*
DOC	5.67E−03*	4.47E−03*	9.52E−03*	4.06E?04*	4.55E?14	4.51E?15*	4.97E?15*	0.79	0.255*	1.096*

* Represents instances where removal, as compared to uncontrolled, was statistically insignificant

** Represents instances where only one data point was available, thus statistical significance could not be determined

0.5. However, several instances of EC/PM ratio below 0.5 were measured with DPFs in use. EC/PM ratios for all conditions tested suggest a substantial portion of the PM measured consists of compounds other than EC, which could be attributed to OC and sulfur (Fujita et al. 2007). For all tests in the current study, non-highway ULSD was used, restricting the sulfur content to less than 15 ppm, and as such, sulfur produced solely from the fuel in the PM emissions was expected to be low. Although using a different control device design, Khalek et al. (2011) found sulfur content to comprise roughly 50 % of the PM when using DPFs for onroad diesel engines with ULSD. Therefore, XRF was performed on nine of the current PM filter samples spanning the entire test matrix and no quantifiable levels of any metals were detected, and only trace levels of sulfur were detected in two samples when a DOC was utilized. Previous research by Shah et al. (2004) with backup generators showed EC dominating the particulate emissions for two different 4-stroke gensets tested from 10 to 100 % load, which is not seen in the particulate emissions measured from the uncontrolled gensets in the current study. As with PM, there was no consistent trend with load for EC or BC emission factors. However, a very consistent trend in the ratios EC/PM and EC/BC was seen, with EC measuring 33 % less than PM and BC emissions measuring nearly twice that of EC emissions for every genset, load, and control tested (shown Figure S1).

Removal efficiency

The main objective of the current study was to investigate the removal efficiency of PM using several aftermarket control devices. An important note for the discussion of PM removal efficiency is that sample duration varied by test day. This sampling duration was determined to ensure sufficient mass was collected on the filter samples and thus depended on the PM concentration. As mentioned previously, sampling did not stop or delay when the A-DPF went into a regeneration cycle, which means variability exists across this measurement. Furthermore, no regeneration cycles were carried out for the P-DPF during sampling. Therefore, the removal efficiency for either DPF under typical operation could be different than reported here. These reported removal efficiencies represent the average removal while sampling with the genset at steady state. Had the test duration been lengthened to 100 or 1,000 h, then multiple regeneration cycles could have occurred while sampling, potentially reducing the standard deviation across the average. However, lengthening the test duration by that many hours was not possible for the current study. Future research should focus on longer test cycles at steady-state genset conditions in order to ensure the samples taken incorporated at least one full regeneration of the DPFs.

Table 5 shows the average percent removal and standard deviation for PM, BC, and EC across all gensets for each control device. A table with the average removal for PM broken down by genset is available in Table S2 in the supplemental material. For all gensets and loads, the P-DPF resulted in statistically significant reductions of PM, BC, and EC. Likewise, the A-DPF resulted in statistically significant reductions in all cases, with the exception of XQ600 at 90 % load. Conversely, with the exception of the XQ230 at 50 % load (which provided a statistically significant increase in EC), none of the tests performed with the DOC provided statistically significant PM, BC, or EC emission reductions. The statistical insignificance of the minimal PM removal (8–25 %) demonstrates that the DOC is not effective at reducing the PM, BC, and/or EC in these gensets with ULSD fuel. However, the DOC was effective at removing CO, with greater than 97 % removal. Therefore, it is clear that the DOC is functioning, and is sized, properly for the gensets tested.

Particle size distribution from SMPS

All distributions are essentially bimodal and in agreement with measurements from on-road diesels and small-scale gensets (Kittelson 1998; Lee et al. 2006). Figures S2 and S3 in the supplemental materials show particle size distributions for all three gensets, with each control configuration, at 50 and 90 % load, as well as uncontrolled cases compared at 50 and 90 % load. All particle size distributions represent averages over several tests for each condition and were corrected for dilution. Approximately 86–95 % of the particles exist in the accumulation mode ($>$20 nm), whereas the nuclei mode ($<$20 nm) accounts for roughly 5–14 % of total particle number. The nuclei fraction is biased low since particles smaller than 14.6 nm were not measured by the SMPS, but can still be used to identify trends in the particle size distribution with control technology.

All three gensets have very similar particle number size distributions and total number of particles emitted at the same load condition. In agreement with the PM emission factors, number concentrations (shown in Table 4) were significantly higher at 50 % load compared to 90 % load (nearly 1.9 times higher for the XQ400 genset). The peak diameters of the accumulation mode varied from approximately 40 nm (XQ230 genset at 90 % load) to approximately 70 nm (XQ600 genset at 90 % load), in agreement with the geometric mean number diameter of the accumulation mode for on-road diesel engines reported previously to be 50–80 nm diameter (Khalek et al. 1998; Kittelson et al. 2004).

Figures 2a–c show the influence of the aftermarket controls on the particle number (PN) size distributions at

Table 5 Control device average PM, BC, and EC removal

	Average PM % removal	Average EC % removal	Average BC % removal	Average PN % removal
50 % Load				
P-DPF	98 ± 1.6	99 ± 1.6	99 ± 1.8	99 ± 1.2
A-DPF	80 ± 14	87 ± 4.1	85 ± 10	89 ± 2.0
DOC	3.0 ± 19*	−1.0 ± 18*	9.7 ± 0.6*	21 ± 15
90 % Load				
P-DPF	96 ± 4.3	99 ± 1.2	99 ± 1.2	99 ± 1.3
A-DPF	80 ± 16	85 ± 9.3	80 ± 11	89 ± 6.1
DOC	17 ± 28*	20 ± 17*	11 ± 31*	22 ± 20*

* Represents instances where removal, as compared to uncontrolled, was statistically insignificant

50 % load for all three gensets. The highest average particle removal efficiency (≥97 % for all three gensets) was measured with the P-DPF control device, with a total particle removal efficiency of more than 99 % measured for the XQ230 genset. Particle removal efficiency for the A-DPF was greater than 83 % for all three gensets, with the highest measured removal efficiency occurring on the XQ400 genset at 90 % load (≥95 %).

While PN reduction with the DOC was significantly lower, a co-benefit of particle removal was observed with total PN removal between roughly 4 and 34 %. The only exception to this trend in PN removal was the XQ230 genset at 90 % load which had a (statistically insignificant) negative removal. The PN increase for this particular condition is in agreement with increases in PM mass and BC (also not statistically significant) for the same condition indicating increased particle formation with a DOC. A slight drop in EC/PM ratio coupled with an increase of PN in the nuclei mode could suggest the presence of semi-volatile compounds, and trace amount of sulfur measured by the XRF indicate formation of sulfate nanoparticles. A similar trend was seen by Shah et al. (2007) when testing with a 350 kW diesel genset at 100 % load with a DOC (exhaust temperature ~550 °C), and was attributed to the formation of sulfate nanoparticles, as the testing was conducted with 500 ppm sulfur diesel. However, these changes in EC/PM ratio and PN nuclei formation likely resulted in minimal change to the overall PM composition. For XQ400 and XQ600 gensets with each of the three controls, particles in the nuclei mode were removed more efficiently than those in the accumulation mode. The trend of decreasing particle removal efficiency with increasing particle size indicates that smaller particles may consist of more volatile OC compared to EC and thus more likely to be oxidized.

Optical properties

The average aerosol absorption at 781 nm, SSA at 532 nm, and a from 405 nm to 781 nm for each condition is shown in Table 4. The aerosol absorption had a similar trend to that observed for the PM, BC, and EC, i.e., large reductions in absorption with the A-DPF and P-DPF and minimal if any reduction with the DOC. Low particle concentrations during the P-DPF cases necessitated low dilution ratios to meet the detection limits of most of the instruments. Therefore, the diluted sample NO_2 absorption was larger than the particle absorption. Although the PASS-3 accounts for gas-phase light absorption with periodic baseline adjustment with a filtered sample, fluctuations of the NO_2 concentration in between adjustments caused larger light absorption than the particles at the 532 nm and 405 nm wavelengths for these P-DPF cases. The A-DPF case also had lower dilution ratios, but in general had lower NO_2 concentrations and higher particle concentrations and was thus less affected by NO_2 fluctuations in the diluted exhaust sample.

The SSA averaged over all conditions tested, with the exception of the P-DPF cases (likely impacted by NO_2 absorption), for these gensets was 0.26 ± 0.03, which was slightly larger than similar measurements (at mid-visible wavelengths) from tunnel studies of on-road diesels at 0.2 (Strawa et al. 2010) and 0.14 (Dallman et al. 2012) and from a chamber experiment with a light-duty diesel engine at 0.2 (Schnaiter et al. 2003). The SSA exhibited statistically significant increases with engine load, except for the XQ400 genset, where the increase was not statistically significant. Generally, the SSA was decreased when the DOC or A-DPF was used, but the decrease was small (~20 %) and not statistically significant in most cases.

The average a for all cases (except when the P-DPF was used) of 1.09 ± 0.07 was almost the same as the 1.1 measured by Schnaiter et al. (2003) on emissions from a light-duty diesel engine. Except for the XQ230 genset, a showed a slight decrease with increasing load that was not statistically significant. For the most part, a increased with the use of the A-DPF or DOC, but even the largest increase was less than 12 % and was not statistically significant.

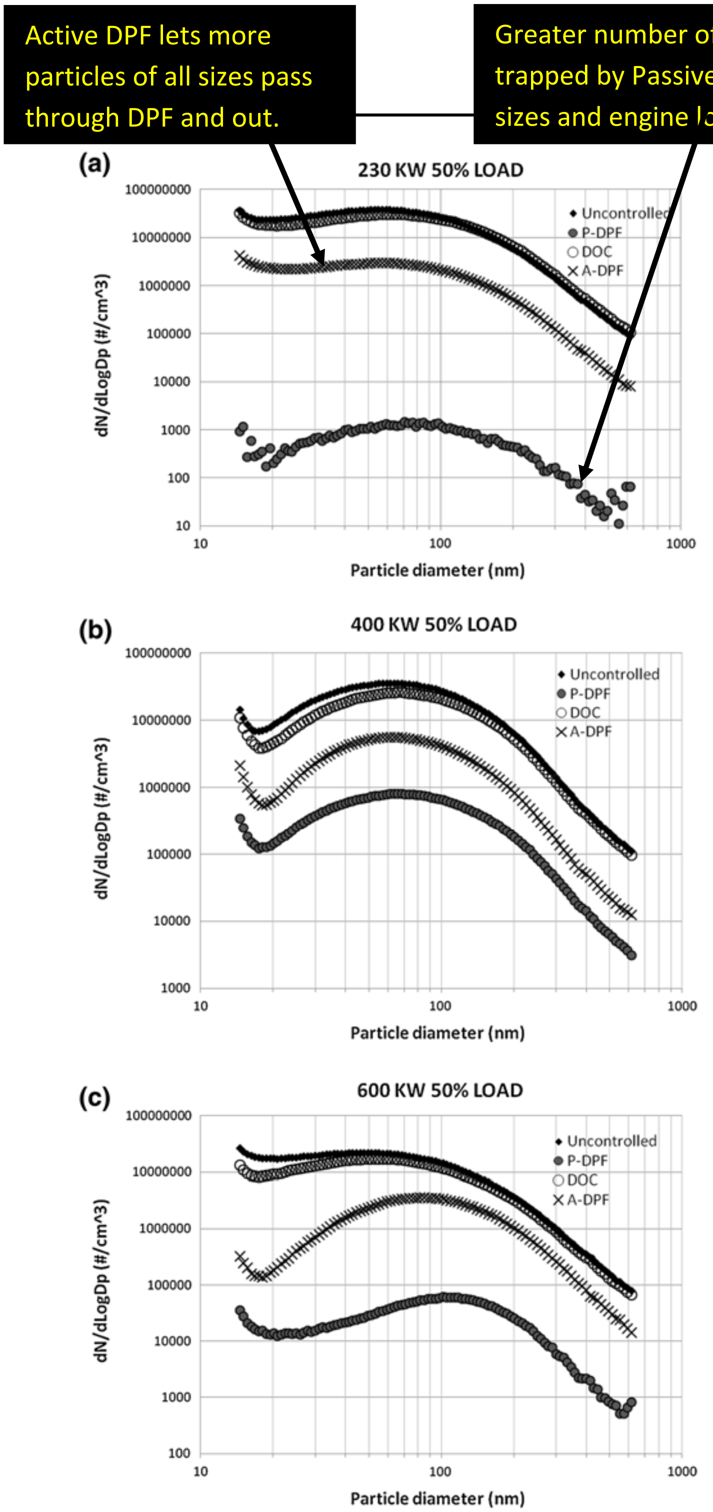

Fig. 2 Particle size distribution of 50 % load for each genset a XQ230, b XQ400, and c XQ600 with and without aftermarket controls in log–log space

Summary

The results presented here describe the gaseous and particulate emissions of three stationary diesel gensets ranging from 230 to 600 kW configured with and without A-DPF, P-DPF, and DOC aftermarket control technologies. The DPFs tested, both active and passive, were found to be viable means for mitigating PM emissions from large-scale diesel gensets with 4-cycle engines, across the entire submicron particle size range. However, no statistically significant PM removal was measured from any of the gensets while using the DOC. PM, EC, and BC emissions were reduced from those of the uncontrolled gensets in most conditions tested with either DPF. Low EC/PM values seen at some conditions suggest potential for compositional changes, and in all cases tested the BC measured was roughly twice that of EC. Increasing the load caused a small but statistically significant increase of the SSA. The addition of aftermarket controls caused a slight decrease in SSA and slight increase in a that was not entirely consistent over all conditions and was not statistically significant. Findings from this study would suggest that further investigation into changes in carbon emissions composition with the use of aftermarket PM control devices is needed.

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Julia Luongo

From: Sri Sridharan <ssridharan@vantagedatacenters.com>
Sent: Friday, January 26, 2018 1:17 PM
To: Bo Chen
Cc: Israel Segura
Subject: FW: McLaren data request - air quality
Attachments: Yelverton et al, 2015 (diesel EF)-highlighted.pdf

Please see attached.

VANTAGE DATA CENTERS
Srivastav Sridharan, Project Engineer
2820 Northwestern Parkway
Santa Clara, CA 95051
(571) 528-3491 Cell
ssridharan@vantagedatacenters.com

From: Brett M Greene [mailto:BMGreene@petersonpower.com]
Sent: Friday, January 26, 2018 1:11 PM
To: Sri Sridharan
Cc: Israel Segura
Subject: RE: McLaren data request - air quality

Sri,

Here's the feedback on the topic from Johnson Matthey.

Our DPF(s) have absolute filters inside, so load doesn't affect the amount of PM reduction. At any engine load the filters act in the same manner of removing PM, just like a piece of filter paper will filter out what it can, as long as it doesn't break apart. Same with our ceramic filters, they will filter PM material out at any engine load as long as they don't physically break. Thus, across all loads the product will deliver 85%+ total PM reduction.
One technical paper that might be of some help is one I've attached. It was performed and reported by EPA, and compared the Johnson Matthey DPF to the Rypos DPF. In the attached paper the Johnson Matthey DPF (referred to as the P-DPF) is just like the ones we sell to Peterson Power. The Rypos DPF is referred to as the A-DPF in the paper.
I hope this helps. If not, please let me know.

(See attached file: Yelverton et al, 2015 (diesel EF)-highlighted.pdf)

Thank You,

Brett Greene
Sales Representative
Peterson Power Systems - Caterpillar
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Customer First | Integrity | Excellence | Teamwork | Fun

Julia Luongo

From: Sri Sridharan <ssridharan@vantagedatacenters.com>
Sent: Monday, January 29, 2018 3:43 PM
To: Julia Luongo
Cc: michael@lakestreetventures.com; Shari Beth Libicki; Bo Chen
Subject: RE: McLaren data request - air quality

Hi Julia,

On parsing through the submittal information that we have for the Gens that we used on Phase 1, I was able to get the following information:

13.A.IV	C	Diesel Particulate Filter (DPF) a. DPF shall be passive emission control system. b. DPF shall meet the performance…to comply with Tier 2 Standards.	Engine Emissions with the DPF exceeds Tier 2 standards. Please note the passive DPF is sized to handle 24 cold starts with 30 minutes of operation at 0% load or 12 hours of continuous operation at 0% load, before regeneration.

Please let me know if this sufficiently answers your query or needs further clarification from Johnson Mathey.

Thanks,
Sri

VANTAGE DATA CENTERS
Srivastav Sridharan, Project Engineer
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ssridharan@vantagedatacenters.com

From: Julia Luongo [mailto:jluongo@ramboll.com]
Sent: Monday, January 29, 2018 3:30 PM
To: Bo Chen
Cc: michael@lakestreetventures.com; Shari Beth Libicki; Sri Sridharan
Subject: RE: McLaren data request - air quality

Hey Bo,

We have one follow up question for Johnson Matthey, can you please ask for the capacity for regeneration of the DPF? In other words, what are the total number of hours or total PM emissions that it can take until it requires regeneration to continue having the 85%+ reduction in PM?

Thanks,
Julia

Yours sincerely
Julia Luongo, PhD

Senior Consultant | Air Quality

Julia Luongo

From:	Sri Sridharan <ssridharan@vantagedatacenters.com>
Sent:	Wednesday, January 31, 2018 1:10 PM
To:	Julia Luongo
Cc:	michael@lakestreetventures.com; Shari Beth Libicki; Bo Chen
Subject:	RE: McLaren data request - air quality

Julia,

Additional note from the vendor:

"Sri,
In your annual test scenario of 50, 75, and 100%, the DPF will regenerate at all of these load points. We can safely say 20% load will get regeneration on our 3000kW engine for V5 and our proposed 2750kW engine for McLaren."

I think we can assume that the DPF gets regenerated every time the load is increased during the Annual Load test 50%>75%>100%. Please let me know if this information is helpful or if more clarity is required from the vendor.

Thanks,
Sri

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ssridharan@vantagedatacenters.com

From: Sri Sridharan
Sent: Wednesday, January 31, 2018 9:15 AM
To: 'Julia Luongo'
Cc: 'michael@lakestreetventures.com'; 'Shari Beth Libicki'; Bo Chen
Subject: RE: McLaren data request - air quality

Hi Julia,

The vendor responded that the DPF is continuously regenerating during a loaded condition to capture 85% of the PM. Vendor quote – *"The DPF has 85% reduction in PM at all times as it is trapping the particulate and gradually clogging."*

The previous response that I had provided with a snapshot from the submittal was the DPF regeneration that takes place during an unloaded condition (0% load). When the gens are being run at an unloaded condition (0% load) for a continuous period of time without satisfying the requirements for regeneration, they can run for (Snapshot below)

13.A.IV	C	Diesel Particulate Filter (DPF) a. DPF shall be passive emission control system. b. DPF shall meet the performance…to comply with Tier 2 Standards.	Engine Emissions with the DPF exceeds Tier 2 standards. Please note the passive DPF is sized to handle 24 cold starts with 30 minutes of operation at 0% load or 12 hours of continuous operation at 0% load, before regeneration.

(Vantage runs the gens at 0% load only for 5 minutes) *attached a Caterpillar letter with more detail on the subject. For any permitting with BAAQMD we are usually submitting the D2 Cycle data in the attachment with Peterson Logo titled "Manufacturer's Emissions Data", see attached. This is essentially the same "nominal" data consolidated into a single value using the D2 cycle method*." Email from Caterpillar (Email DR5-01) and Caterpillar emissions data guideline (Attachment DR5 - CAT Factory Emission Data Guideline DM1176) are attached.

BACKGROUND: CRITERIA POLLUTANTS MODELING IMPACTS ASSESSMENT

Staff noticed there were no quantitative emissions estimates or impacts analysis for all criteria pollutants except NOx. Staff will need a modeling assessment for impacts of all other criteria pollutants, including Reactive Organic Gases (ROGs), Particulate Matter (PM10 and PM2.5), Carbon Monoxide (CO) and Sulfur Oxides (SOx). During a phone conversation with the applicant's air quality consultant Ramboll Environ on January 10, 2018, Energy Commission staff was advised that air quality impact modeling was not required and not performed because the project was below "CEQA threshold guidelines of the BAAQMD" for all criteria pollutants except NOx. However, the BAAQMD CEQA Air Quality Guidelines from May 2017 (http://www.baaqmd.gov/~/media/files/planning-and-research/ceqa/ceqa_guidelines_may2017-pdf.pdf?la=en) state in Section 3. Screening Criteria page 3-1: *"If a project includes emissions from stationary source engines (e.g., back-up generators) and industrial sources subject to Air District Rules and Regulations, the screening criteria should not be used. The project's stationary source emissions should be analyzed separately from the land use-related indirect mobile- and area-source emissions."*

Staff will need a modeling assessment for impacts for all other criteria pollutants for Reactive Organic Gases (ROGs), Particulate Matter (PM10 and PM2.5), Carbon Monoxide (CO) and Sulfur Oxides (SOx). Staff will need this information in order to complete their assessment.

DATA REQUEST

6. Please provide a modeling impacts analysis for the remaining criteria pollutants specified above.

RESPONSE TO DATA REQUEST 7

After further discussion with BAAQMD, Staff has notified Vantage that modelling of criteria pollutants other than NOx is no longer being requested.

DR5 - CAT Factory Emission Data Guideline DM1176
Email DR5-01

PERFORMANCE PARAMETERS [DM1176] **JANUARY 25, 2018**

For Help Desk Phone Numbers Click here

Performance Number: DM1176 **Change Level:** 07

TMI EMISSION DATA USERS

Guideline for the use of factory emissions data for use in local air permit applications.

For sample emission letter see DM9549.

Emission Data Level:

Emission data is expressed as two values. The "Nominal" value presents data measured from an engine operated at ISO 8178 conditions. The Nominal value does not include a "Tolerance Factor" to allow for engine to engine, ambient, or measurement variation. Because the Nominal value represents the average expected emissions from this particular engine model and rating, the Nominal value can be used to develop a reasonable estimate of expected emissions from the entire population of this engine model and rating located in the airshed (if the total population and average operating hours are known). The Nominal value **does not** represent the highest emissions level expected during on-site measurement. Likewise, on site measured emissions should not be used to determine permit limits as they represent only one sample of the entire engine population.

The other value provided is called "Potential Site Variation", which replaces "Not To Exceed" values that Caterpillar provided in the past. These Potential Site Variation emissions values include potential site variation due to engine-to-engine variability,ambient conditions, and emissions measurement methods. Consequently, these values are always higher than the Nominal values. These numbers are based on Caterpillar experience and expected variation in emissions during on site tests.

The Potential Site Variation values are provided by engine load. Points in between published load points can be derived by linear interpolation. Care should be taken to permit only to one unit of measure. For example, Caterpillar strongly recommends mass/hour for the regulated pollutant. Power specific values(e.g. g/hp-hr or g/kW-hr) introduce more measurement error in the field. The simplest means of checking emissions performance on site is verifying that the concentration of regulated pollutants in the exhaust is at or below Potential Site Variation values (in ppm or mg/nm3)at a specified steady-state load.

Note: Crankcase Emissions
For engines with open crankcase ventilation (OCV) systems, the crankcase emissions are not included in the Nominal or Potential Site Variation data. For engines with closed crankcase ventilation (CCV) systems, the crankcase emissions are included in the Nominal and Potential Site variation data.

Note: NOx (NO2)
NOx Emissions are presented as NO_2. It is assumed that all NO emissions are converted to NO_2 when exposed to the atmosphere.

Unit of Measure:

The units provided are (g/bhp-hr), (g/hr), (mg/normal cubic meter at 5 % O2), (ppm at 5% O2), or (lb/hr). If opacity data is required, contact Caterpillar (Application Support Center).

Note:
g/bhp-hr emission unit is calculated using observed power during factory testing. The column heading is shown as corrected power, Reference DM9600, to match the general performance data section in TMI. Observed power was used to represent site conditions.

Measurement Procedure:

The measurement procedures used to obtain the emission data provided to the EPA are consistent with those described in 40 CFR Parts 89, 94, 1033, 1039, 1042 and 1065 and ISO 8178 for measuring HC, CO, CO2, NOx and particulate matter.

TMI emission data are determined with measurement methods similar to 40 CFR Parts 89, 94, 1033, 1039, 1042, 1065 and ISO 8178 for measuring HC, CO, CO2, NOx, and particulate matter, with minor modifications from those procedures. For example, test fuel, back pressure, or load points may be different for TMI data publication purposes but the data collection process is representative of these methods.

Data presented in TMI is for an engine that has had some reasonable break-in period. This can range from 40 to 80 hours. A proper break-in period for the engine being tested on site will generally improve agreement between TMI data and on-site test data.

Humidity correction to the NOx concentration is found in 40 CFR section 1065.670. Humidity correction should be applied first to the concentration and then corrected to the appropriate oxygen level.

Concentration data, ppm and mg/normal meter cubed, are corrected to standard oxygen levels to accurately compare concentration levels from different sources.

Concentration Corrected @ %O2Ref = (Concentration Measured)x(20.9 - %O2Ref)/(20.9 - %StackO2)

Concentration Corrected = Exhaust Concentration corrected to reference O2 concentration.

%O2Ref = Typically 5% for Metric units and 15% for English units. See local requirements for guidance.

%StackO2 = The measured exhaust oxygen content in %.

Particulate Matter:

The laboratory PM measurement method is not the same as "on-site" or field EPA methods. EPA specifies several methods for measuring particulate matter in the field. The most common is Method 5. Method 5 has larger measurement error than laboratory methods.

Caterpillar measures particulate matter for stationary and off-highway certification with a micro-dilution tunnel system. The system follows ISO 8178 procedures and is used to certify engines for non-road applications for both CARB and EPA.

Method 5 can be used to measure particulate matter in two ways.

The first requires a hot filter sample and accompanying front half wash. This means that the sampling system from the stack to the filters must be flushed with solvent and the extract weighed. When this procedure is used, the results of Method 5 can be slightly less than results obtained with the ISO procedure. This is because the filter temperature used in Method 5 is higher than the filter temperature used in the ISO procedure. The lower filter temperature of the micro-dilution system condenses more soluble organic matter and thus gives a higher particulate matter weight than Method 5.

The second way to use Method 5 requires a front and back half wash. If this procedure is used, additional organic fractions are condensed after the filter by passing the sample through a condenser with outlet gas temperature of 20 Deg C (68 Deg F). Generally, an impinger in an ice bath is used thereby increasing condensation of volatile organics. With this procedure, many of the hydrocarbons in the exhaust will be measured as particulate matter. For air permitting purposes, if a back half wash is to be used in a stack test, the hydrocarbons produced by the engine should be added to the particulate matter data in TMI.

Tests that require back half wash with Method 5 will also be influenced by the fuel sulfur level. If any form of Method 5 is to be used in the field test, contact Caterpillar (Application Support Center).

Sulfur Oxides:

All sulfur present in the fuel is assumed to be converted to SO2 during combustion and in the atmosphere.

SO2 (g/kw-hr)=0.01998x(fuel rate g/bkw-hr)x(% fuel Sulfur by weight)

Where the factor 0.01998 is:
0.01998 = (molecular weight of SO2)/(molecular weight of S)
0.01998 = (molecular weight of S+O+O)/(molecular weight of S x 100%)
0.01998 = (32.06 + 15.9994 + 15.9994)/(32.06 x 100)

Molecular weight of Sulfur, S = 32.06
Molecular weight of Oxygen, O = 15.9994

For SO2 in terms of lb/bhp-hr, use a fuel rate measured in lb/bhp-hr
For SO2 in terms of lb/hr, use a fuel rate measured in lb/hr
For SO2 in terms of g/hr, use a fuel rate measured in g/hr
For SO2 in terms of g/bkw-hr, use a fuel rate measured in g/bkw-hr

Example Calculation:
If fuel has 0.2% Sulfur content
If fuel Rate = 200 g/bkw-hr

SO2 = 0.01998 x (200 g/bkw-hr) x (0.2 % sulfur)
SO2 = 0.799 g/bkw-hr

If SOx is provided in the emission data, the following sentence should be included with the data:

The SOx value is based on fuel sulfur content of 0.2% by weight.

Date Released : 06/27/12

Julia Luongo

From: Israel Segura <isegura@vantagedatacenters.com>
Sent: Thursday, January 25, 2018 4:27 PM
To: Sri Sridharan; Bo Chen
Subject: FW: McLaren data request - air quality
Attachments: CAT Factory Emission Data Guideline DM1176.pdf; Cat C175-16 3MW Emissions Data 2017.pdf

FYI –

From: Brett M Greene [mailto:BMGreene@petersonpower.com]
Sent: Thursday, January 25, 2018 3:54 PM
To: Sri Sridharan <ssridharan@vantagedatacenters.com>
Cc: Israel Segura <isegura@vantagedatacenters.com>
Subject: RE: McLaren data request - air quality

Sri,

Still waiting for some feedback from Johnson Matthey.....

The Caterpillar emissions data to use is the "nominal" data. (short answer)

The nominal data follows ISO8178 conditions for testing where as the "potential site variation" data is not to be used for permitting and is very much representative of "worst case scenario" type data. I've attached a Caterpillar letter with more detail on the subject. (long answer)
(See attached file: CAT Factory Emission Data Guideline DM1176.pdf)

For any permitting with BAAQMD we are usually submitting the D2 Cycle data in the attachment with Peterson Logo titled "Manufacturer's Emissions Data", see attached. This is essentially the same "nominal" data consolidated into a single value using the D2 cycle method.
(See attached file: Cat C175-16 3MW Emissions Data 2017.pdf)

Thanks,
Brett Greene
Sales Representative
Peterson Power Systems - Caterpillar
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925.457.5135 cell
bmgreene@petersonpower.com
http://www.linkedin.com/in/brettmgreene
Customer First | Integrity | Excellence | Teamwork | Fun

Sri Sridharan ---01/25/2018 09:50:42 AM---Adding attachments Regards,

From: Sri Sridharan <ssridharan@vantagedatacenters.com>
To: Brett Greene <BMGreene@petersonpower.com>
Cc: Israel Segura <isegura@vantagedatacenters.com>

BACKGROUND: CUMULATIVE IMPACTS ANALYSIS

The application produced a cumulative summary as part of the health risk assessment (HRA), which identified 13 projects and a residential street within 1,000 feet of the project site on which McLaren may have cumulative impacts. Staff needs a cumulative modeling analysis, or additional justification why an air quality cumulative modeling analysis is not needed for this project, to complete the staff analysis for cumulative air quality impacts.

DATA REQUESTS

7. Please provide a list from the Bay Area Air Quality Management District (BAAQMD) of large stationary source projects with permitted emissions for projects with greater than 5 tons per year of permitted emissions of any single criteria pollutant, located within six miles of the project site, including projects that have been recently permitted, or are in the process of being permitted and are reasonably foreseeable.

8. Please provide a cumulative impacts modeling analysis in consultation with Energy Commission staff, if necessary, based on the project list provided by BAAQMD.

RESPONSES TO DATA REQUESTS 7 and 8

After discussion with Commission Staff, Ramboll has submitted a public records request with the BAAQMD for a list of new (2014 or later) permitted sources with emissions greater than 5 tons per year of any single criteria pollutant within 6 miles from the MBGF. When the results are provided, they will be provided to the Commission Staff. After the list of potential cumulative projects is provided, Ramboll and Commission Staff will confer to discuss the scope of Data Request 9.

BACKGROUND: SCREENING ANALYSIS

Page 5 of the document titled MCLAREN DATA CENTER: AIR DISPERSION MODELING REPORT FOR ONE-HOUR NO2 CAAQS AND NAAQS dated November 2017 in Appendix E (TN# 222041-11) shows that each generator would be tested for 4 hours annually and for 5 minutes monthly:

> *During this 4-hour test, the generator is ramped up in load. The first hour of testing is at 50% load, the second hour is at 75% load, and the last two hours are at 100% load. Generators are also testing (sic) monthly for 5 minutes at 0% load, but this scenario was not modeled since the annual 4-hour test is the more conservative scenario. For comparison with the NAAQS and CAAQS, the most conservative hourly emission rate was used in both models, assuming one hour of testing at 100% load.*

Applicants normally do a screening analysis to determine which operating scenario results in worst-case impacts. Even though Table B-3 shows that the 100 percent load testing would have the worst-case emission rates, full load does not always result in worst-case project impacts. During lower load testing, differences in emission rates, exhaust temperatures, and exhaust velocities could lead to lower plume rise and less dispersion, which could result in higher ground-level impacts. Therefore, a screening analysis is needed to determine which operating scenario results in worst-case impacts.

DATA REQUESTS

9. Please provide the exhaust temperature, exhaust velocity, and emission rates for the 5 minute testing at 0 percent load.

RESPONSE TO DATA REQUEST 9

The Peterson/CAT factory does not record emission characteristics at 0% load and as a result they do not have this information available. They recommend using the 10% load data, so Ramboll has proceeded with the screening analysis requested in Data Request 10 using 10% load data to represent operation at 0% load.

10. Please provide a screening analysis to show which of the above operating scenarios (100 percent load, 75 percent load, 50 percent load, and 0 percent load) results in worst-case impacts (short-term and long-term) for NO_2, PM, SOx, and CO.

RESPONSE TO DATA REQUEST 10

Ramboll performed a screening analysis using SCREEN3 to determine the worst-case operating scenario for each pollutant (Table DR10, provided to the Commission via upload). 100% load conditions were found to be the worst case for short and long term effects of NO2, SO2, and ROG. Low load conditions (10% load in this analysis, which is the closest data we have to 0% load) were found to be worst case for 1-hour of emissions, but were no longer worst case when the duration of the low load test, 5-minutes, was accounted for. Taking that into account, 75% load was worst case for CO and 50% load was worst case for PM for both short and long term effects. 50% load PM concentration at the maximum impact was 38% greater than the concentration at 100% load. Even if long-term health risks were doubled, they would still result in levels below BAAQMD CEQA thresholds. However, Ramboll justifies not requiring a refined analysis at the 50% load condition because generators will spend a larger portion (at least double) of the year's testing hours at 100% load versus 50% load, so assuming all testing hours at the worst case load of 50% would not be representative of operations. The same argument can be made for CO. Even if currently modelled concentrations were doubled, CO concentrations would be well below BAAQMD CEQA Thresholds, and in practice the generators will spend more than double of the year's testing hours at 100% load versus 75% load, so the modelled impacts are representative of the operating scenario and the worst-case impacts based on those operating scenarios.

BACKGROUND: HOUR-BY-HOUR NO_2 BACKGROUND

Page 2 of the document titled MCLAREN DATA CENTER: AIR DISPERSION MODELING REPORT FOR ONE-HOUR NO2 CAAQS AND NAAQS dated November 2017 in Appendix E (TN# 222041-11) shows that an hour-by-hour representative background NO_2 concentration was added to the modeled concentrations on an hour-by-hour basis for comparison against the applicable NAAQS and CAAQS.

However, the U.S. EPA does not recommend pairing modeled and monitored NO_2 on an hour-by-hour basis using hourly concurrent monitored background data. According to the U.S. EPA March 2011 guidance document *Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO2 National Ambient Air Quality Standard*:

> *"However, the implicit assumption underlying this approach is that the background monitored levels for each hour are spatially uniform and that the monitored values are fully representative of background levels at each receptor for each hour. Such an assumption clearly ignores the many factors that contribute to the temporal and spatial variability of ambient concentrations across a typical modeling domain on an hourly basis. Therefore we do not recommend such an approach except in rare cases of relatively isolated sources where the available monitor can be shown to be representative of the ambient concentration levels in the areas of maximum impact from the proposed new source. Another situation where such an approach may be justified is where the modeled emission inventory clearly represents the majority of emissions that could potentially contribute to the cumulative impact assessment and where inclusion of the monitored background concentration is intended to conservatively represent the potential contribution from minor sources and natural or regional background levels not reflected in the modeled inventory. In this case, the key aspect which may justify the hour-by-hour pairing of modeled and monitored values is a demonstration of the overall conservatism of the cumulative assessment based on the combination of modeled and monitored impacts. Except in rare cases of relatively isolated sources, a single ambient monitor, or even a few monitors, will not be adequately representative of hourly concentrations across the modeled domain to preclude the need to include emissions from nearby background sources in the modeled inventory."*

DATA REQUESTS

11. Please provide justification for the use of the hour-by-hour pairing of modeled and monitored NO_2 concentrations according to the above U.S. EPA Appendix W guidance.

RESPONSE TO DATA REQUEST 11

Ramboll believes that the hour-by-hour pairing of modeled and monitored NO2 concentrations is a conservative approach to estimating 1-hour NO2 impacts. If the above referenced U.S. EPA Appendix W guidance were followed for modelling NO_2 impacts for intermittent sources, such as the emergency generators specifically referred to in the guidance, the model would result in lower concentrations than the approach presented to the Commission.

Ramboll performed an analysis following U.S. EPA Appendix W guidance (file named mclaren.no2.20180131.zip – modeling file provided to Commission Staff via upload). We note that this guidance first recommends excluding intermittent sources, such as emergency generators whose operation does not occur frequently enough to contribute significantly to the annual distribution of daily maximum 1-hour concentrations, from modelling altogether. If such sources are to be modelled, the guidance recommends treating intermittent sources such as emergency generators on the basis of an average hourly rate based on the annual permit limit of number of hours of testing. Ramboll's analysis running the model consistent with the Appendix W guidance used the Caterpillar emission rates for each of the 48 generators (a conservative rate for the one life safety generator) and conservatively did not use the ADJ_U* met data. This run excluded hour-by-hour background in favor of more conservatively adding the 98th percentile NO_2 background concentration to the modelled result, and also conservatively assumed a fixed 98th percentile from the most recent 36 months of available hourly ozone concentration data at all hours. The resulting 5-year average 1st highest high of modelled concentrations was 7.87 $\mu g/m^3$ without background. Regardless of the approach used for adding the background NO2 concentration, this modeled result clearly demonstrates that the hour-by-hour pairing approach is more protective than the federal guidance. For this reason, the approach is justified and results in a more conservative estimate of concentration than the U.S. EPA Appendix W guidance.

12. If justification for the use of the hour-by-hour pairing could not be provided, please use the U.S. EPA recommended seasonal hour-of-day or monthly hour-of-day NO_2 background data.

RESPONSE TO DATA REQUEST 12

Please see Response to Data Request 11.

BACKGROUND: GAP FILLING FOR NO_2 BACKGROUND FILES

Page 3 of the document titled MCLAREN DATA CENTER: AIR DISPERSION MODELING REPORT FOR ONE-HOUR NO2 CAAQS AND NAAQS dated November 2017 in Appendix E (TN# 222041-11) shows how the applicant filled missing values in background NO_2 data. For one or two consecutive missing hours, the applicant filled in the larger value of the preceding or following hour; for 3 or more consecutive missing hours, the applicant used 40.6 ppb to replace the missing values. The applicant stated that the 40.6 ppb value is the 98^{th} percentile value for the 5-year period.

However, staff checked the NO_2 data at San Jose Jackson Street station on the ARB website: http://www.arb.ca.gov/adam/topfour/topfour1.php. Staff found that the 5-year average of the 98^{th} percentile NO_2 concentrations for the modeling years (2009-2013) was 50.8 ppb, which is higher than the 40.6 ppb value the applicant used. Staff also found the design value (3-year average) of the most recent three years (2014-2016) to be 47 ppb, also higher than the 40.6 ppb value the applicant used.

Staff needs to understand how the applicant obtained the 40.6 ppb value as the 98^{th} percentile value for the 5 year period. A lower background NO_2 value could possibly lead to lower total impacts of the project.

DATA REQUESTS

13. Please provide references/calculations to show how the 40.6 ppb value was derived.

RESPONSE TO DATA REQUEST 13

Justification for the conservative nature of this approach is provided in Response to Data Request 11. Please see the spreadsheet (Table DR13-01, which has been provided to Commission Staff via upload) for a demonstration of the substitution and 98^{th} percentile calculation. Comments in the column headers describe the calculations.

14. Please update the missing NO_2 data filling procedure to replace the missing values for 3 or more consecutive missing hours with data that agree with the ARB website.

RESPONSE TO DATA REQUEST 14

Please see Response to Data Request 13. Justification for data filling procedure has been provided and a reference demonstrating the calculation procedure has also been provided.

15. Please update the modeling with the updated NO_2 data from the above step, including updated ozone values, if needed after considering the ozone value data requests below.

RESPONSE TO DATA REQUEST 15

Please see Responses to Data Requests 11, 13, 14 and 16.

BACKGROUND: GAP FILLING FOR OZONE BACKGROUND FILES

Page 3 of the document titled MCLAREN DATA CENTER: AIR DISPERSION MODELING REPORT FOR ONE-HOUR NO2 CAAQS AND NAAQS dated November 2017 in Appendix E (TN# 222041-11) shows that the applicant substituted missing ozone data with a 98^{th} percentile value of 50 ppb.

Staff has not seen any NO_2 impact analysis using the 98^{th} percentile value to substitute for missing ozone data. Staff believes that using this approach might underestimate NO_2 impacts, especially for the 1-hour NO_2 CAAQS compliance demonstration.

Staff checked the ozone data files that the applicant provided. Staff sorted the ozone data in the files and calculated the 5-year average 98^{th} percentile value (8^{th} highest daily maximum 1-hour concentration) to be 72.8 ppb, which is higher than the 50 ppb value that the applicant said they used. Staff needs to understand how the applicant obtained the 50 ppb value as the 98^{th} percentile for the ozone data.

DATA REQUESTS

16. Please justify the approach of using the 98^{th} percentile value to substitute for the missing ozone data.

RESPONSE TO DATA REQUEST 16

Justification for the conservative nature of this approach is provided in Response to Data Request 11.

17. Please provide references/calculations to show how the 50 ppb value as the 98th percentile ozone value was derived.

RESPONSE TO DATA REQUEST 17

Please see the spreadsheet (Table DR17-01, which has been provided to CEC Staff via upload) for a demonstration of the 98th percentile calculation.

18. Please update the missing ozone data filling procedure with more reasonable or more conservative data, as appropriate.

RESPONSE TO DATA REQUEST 18

Justification for the conservative nature of this approach is provided in Response to Data Request 11.

19. Please update the modeling with the updated ozone data from the above step, as appropriate, also including updated NO_2 data as appropriate.

RESPONSE TO DATA REQUEST 19

For the reasons described in Responses to Data Requests 11 through 18, we believe the modeling already performed is conservative for CEQA purposes and additional modeling should not be required.

BACKGROUND: EXHAUST PARAMETERS OF THE LIFE SAFETY GENERATOR

Table 6 in Appendix E-1 (TN# 222104) shows the exhaust parameters used in the modeling. The exhaust parameters of the life safety generator were also provided in the manufacturer's "spec" sheet in Attachment C of Appendix E (TN# 222041-11). Staff noticed the following inconsistencies between the parameters shown in Table 6, those actually used in the NO_2 modeling files, and those from the manufacturer's "spec" sheet. Staff needs to understand why the modeled parameters are different from those provided in the manufacturer's "spec" sheet.

	Table 6 (TN# 222104)	Modeling files	Manufacturer's spec sheet (TN# 222041-11)
Exhaust temperature (K)	823.15	809.81	823.15 (1022 °F)
Exhaust diameter (m)	0.2	0.2	0.127
Exhaust velocity (m/s)	49.34	49.34	126.3 [a]

Note: [a] Staff calculated the exhaust velocity based on the exhaust flow rate (96 m^3/min) and exhaust diameter (0.127 m) shown in the manufacturer's spec sheet.

DATA REQUESTS

20. Please explain why the modeled parameters are different from those provided in the manufacturer's spec sheet.

21. Please explain why the exhaust temperature used in the modeling files is lower than those shown in Table 6 and the manufacturer's spec sheet.

22. Please update the AQ and HRA modeling if needed.

RESPONSES TO DATA REQUESTS 20, 21 and 22

The discrepancy in temperature of the life safety generator exhaust is due to a change in the generator cut sheet when a new generator model was selected and the temperature was not corrected to match the new spec sheet. Since the modeled temperature is lower than that listed on the spec sheet, and therefore more conservative than the actual temperature stated in the spec sheet, there is no need to update the model as it covers a more conservative scenario. The exhaust diameter used for this generator was selected by Ramboll in order to avoid error messages from the AERMOD software. AERMOD throws errors when the exit velocity of a stack exceeds 50 m/s (Staff pointed out that the spec sheet lists a velocity of 126.3 m/s). If the spec sheet parameters would have been used, the resulting dispersion would be much greater, and much less conservative, than the values used in the model. For this reason, Ramboll does not believe the model needs updating. This change in the exhaust diameter was done purely for modelling sake. We believe no changes in the model are needed due to the conservative nature of the assumptions used in the model.

BACKGROUND: RECEPTORS

Staff has reviewed the document titled “Air Quality Technical Report Replacement for MBGF Application for SPPE - Appendix E-1”. The applicant reported the health risk impacts of the maximally exposed individual sensitive receptor (MEISR) in Table ES-2 and Table 13. However, MEISR is equivalent to the receptor of the maximally exposed individual (MEI) at a residence, or a MEIR. Staff would like to get information of health risk impacts of other receptors, including the hypothetical point of maximum impact (PMI) and the maximally exposed individual worker (or MEIW), off-site.

DATA REQUEST

23. Please provide the health risk impacts (including cancer risk, chronic non-cancer health index, acute non-cancer hazard index, and UTM coordinates) of both construction and operation for the following receptors:
    a. Point of maximum impact (PMI);
    b. Maximally exposed individual worker (MEIW), off-site; and,
    c. The soccer facility south of the project site.

RESPONE TO DATA REQUEST 23

Ramboll is currently working on revision to the HRA consistent with the guidance from Staff. The results will be submitted under separate cover and modelling files uploaded to the Commission on February 6, 2018.

BIOLOGICAL RESOURCES

BACKGROUND: NITROGEN DEPOSITION AND IMPACTS TO SPECIAL PLANT COMMUNITIES

The MBGF would be located approximately 1 mile west-southwest of the Guadalupe River corridor, a dedicated open space area containing wetlands, riparian woodlands, and aquatic habitats. The MBGF would also be located approximately 4 miles southeast of Baylands Park, which contains a preserve of 105 acres of seasonal wetlands. Operation of the proposed emergency diesel backup generators would result in emissions of oxides of nitrogen (NOx) which could, depending on the height and velocity of the emission plume from the generators, negatively impact the special-status plant and wetland communities in the Guadalupe River corridor and Baylands Park. Such communities are often rare and support many of California's rare and endangered plant and animal species. Nitrogen deposition has several detrimental effects on these plant communities, including decreased plant function due to leached nutrients (e.g., calcium) from the soil; loss of fine root biomass; decreases in symbiotic mycorrhizal fungi; promotion of exotic invasive species; and leaching into surface waters and ground waters, which increases acidification. Because of the negative effects of soil nitrification it is desirable to estimate the changes in nitrogen deposition that could occur as a result of the new diesel backup generators.

DATA REQUESTS

24. Please quantify the existing baseline total nitrogen deposition rate, in the vicinity of the proposed MBGF, in kilograms per hectare per year (kg/ha/yr). The geographical extent of the nitrogen deposition mapping should be directed by the results, i.e. extend geographically to where the deposition is considered below any stated threshold of significance for vegetation communities. Thresholds for nitrogen deposition by vegetation type are available within the March 2007 California Energy Commission report, titled "Assessment of Nitrogen Deposition: Modeling and Habitat Assessment," available at: http://www.energy.ca.gov/2006publications/CEC-500-2006-032/CEC-500-2006-032.PDF, and the May 2006 California Energy Commission PIER report, titled "Impacts of Nitrogen Deposition on California Ecosystems and Biodiversity," available at: http://www.energy.ca.gov/2005publications/CEC-500-2005-165/CEC-500-2005-165.PDF. Please include references and guidelines used in your baseline analyses.

25. Please use AERMOD or an equivalent model to provide an analysis of impacts due to total nitrogen deposition from operation of the MBGF. The analysis should specify the amount of total nitrogen deposition in kg/ha/yr at the Guadalupe River corridor and Baylands Park and any other sensitive vegetation communities or habitats that occur within 6 miles of the project area for wet and dry deposition. Please provide complete citation for references used in determining this number.

26. Please provide an isopleths graphic over the most recent aerial photographs (or equally detailed maps) of the direct nitrogen deposition rates caused by the MBGF. This will be a graphical depiction of the project's nitrogen deposition.

27. Please provide a comprehensive cumulative impact analysis for the nitrogen deposition in kg/ha/yr caused by MBGF in combination with other reasonably foreseeable projects and provide an isopleths graphic over the most recent aerial photographs of the nitrogen deposition values.

RESPONSE TO DATA REQUESTS 24 through 27

DayZen and Ramboll discussed nitrogen deposition with Commission Staff and are awaiting further guidance. Responses to these data requests will be submitted shortly after CEC Staff guidance is received.

CULTURAL RESOURCES

BACKGROUND

Staff identified information needed to complete a comprehensive cultural resources analysis of the proposed MDC and MBGF that was not included with the previously submitted IS/MND and SPPE application. Providing this information would ensure staff's ability to assess the analysis contained in the SPPE application and conduct its own independent analysis.

Staff requests the following information to complete their analysis.

28. Please provide the results of a literature search from the California Historical Resources Information System (CHRIS) Northwest Information Center (NIC) at Sonoma State University conducted within the last year. The record search should include an area not less than a 1-mile radius around the project site, including the proposed substation. The results should identify any cultural resources listed pursuant to ordinance by a city or county, or recognized by any local historical or archaeological society or museum. The literature search should be completed by, or under the direction of, individuals who meet the Secretary of the Interior's Professional Standards for the technical areas addressed.

RESPONSE TO DATA REQUEST 28

Notwithstanding the objection to this data request, Vantage has coordinated with the consultant (ICF) that prepared the MDC IS/MND for the City and will be preparing the Addendum to the IS/MND to document the minor revisions to the MDC. ICF has agreed to perform the CHRIS literature search. Vantage is concerned that the results will not be available to support the schedule but has requested the search be expedited. Vantage reiterates that this information is not needed for the Commission Staff to fully evaluate the potential effects of the MBGF.

29. Please provide copies of California Department of Parks and Recreation (DPR) 523 forms (Cal. Code Regs., tit. 14, § 4853) for all cultural resources (ethnographic, architectural, historical, and archaeological) identified in the literature search as being 45 years or older or of exceptional importance as defined in the National Register Bulleting Guidelines, (36 C.F.R., § 60.4(g)).

    Please provide a copy of the USGS 7.5' quadrangle map of the literature search area delineating the areas of all past surveys. CHRIS identifying numbers shall be provided. Copies also shall be provided of all technical reports whose survey coverage is wholly or partly within 0.25 miles of the area surveyed for the project, or which provide information on any archaeological excavations or architectural surveys within the literature search area.

30. Please provide the results of new surveys or surveys less than 5 years old if survey records of the area potentially affected by the project are more than five (5) years old. Surveys to identify new cultural resources must be completed by (or under the direction of) individuals who meet the Secretary of the Interior's Professional Standards for the technical area addressed.

    Pedestrian archaeological surveys shall be conducted inclusive of the project site, extending to no less than 200 feet around the project site, substations, and staging areas. If the applicant believes that a pedestrian archaeological survey is not necessary for a cultural resources analysis of this project, please justify that reasoning based on the results of a literature search and the current on-the-ground conditions of the proposed project site.

    Historic architecture field surveys in urban and suburban areas shall be conducted to include properties no less than one parcel's distance from all proposed project site boundaries. The survey shall include the Southern Pacific Railroad tracks to the east, the parcels to the south across Mathew Street, the parcels to the west, and the parcels north of the railroad easement on the northern property boundary. If the applicant believes that a historic architecture field survey is not necessary for a cultural resources analysis of this project, please justify that reasoning based on the results of a literature search and the current on-the-ground conditions of the proposed project site.

31. Please provide a technical report of the results of the new surveys, conforming to the Archaeological Resource Management Report format (OHP 1990), submitted under confidential cover if archaeological site locations are included. The report should also include:

    - a summary of the literature search and all correspondence with the NIC,
    - the survey procedures and methodology used to identify cultural resources and a discussion of the cultural resources identified by the surveys,
    - copies of all new and updated DPR 523(A) forms, and appropriate DPR 523 detail forms,
    - a map at scale of 1:24,000 U.S. Geological Survey quadrangle depicting the locations of all previously known and newly identified cultural resources,

- the names and qualifications of the cultural resources specialists who contributed to and were responsible for literature searches, surveys, and preparation of the technical report, and
- a discussion of proposed mitigation measures to mitigate any impacts to known, previously unknown, and any unanticipated cultural resources.

RESPONSES TO DATA REQUESTS 29 through 32

Vantage objects to these data requests as described in the general objection. Specific to potential cultural resources impacts, Vantage believes the Commission Staff should consider that the MBGF will not require demolition or site grading as those components will be completed as part of the MDC prior to any construction activities associated with the MBGF. The site grading activities and construction of the buildings for the MDC will be completed pursuant to the mitigation measures already adopted by the City for cultural resources. The only potential for uncovering potentially significant cultural resources would be from the minimal trenching to bury electrical connections from the generator yards to the MDC buildings.

The IS/MND concluded that, although there are no known prehistoric or historic archaeological deposits on or directly adjacent to the MDC site, future development under the project could result in the exposure or destruction of as yet undiscovered subsurface prehistoric archaeological resources. If the exposure or destruction of subsurface prehistoric resources were to occur, it would be considered a significant impact. To mitigate this impact to less than significant the IS/MND adopted the following mitigation measures.

> **MM CR-1.1:** A qualified archaeologist shall be on site to monitor grading of native soil once all pavement is removed from the project site. The project applicant shall submit the name and qualifications of the selected archeologist to the Director of Community Development prior to the issuance of a grading permit. After monitoring the grading phase, the archaeologist shall make recommendations for further monitoring if it is determined that the site has cultural resources. Recommendations for further monitoring shall be implemented during any remaining ground-disturbing activities. If the archaeologist determines that no resources are likely to be found on site, no additional monitoring shall be required. A letter report summarizing the results of the initial monitoring during site grading and any recommendations for further monitoring shall be provided to the Director of Community Development prior to onset of building construction.

MM CR-1.2: In the event that prehistoric or historic resources are encountered during on-site construction activities, all activity within a 50-foot radius of the find shall be stopped, the Director of Community Development shall be notified, and a qualified archaeologist or paleontologist shall examine the find and make appropriate recommendations. Recommendations could include collection, recordation, and analysis of any significant cultural materials. A report of findings documenting any data recovery during monitoring shall then be submitted to the Director of Community Development.

The IS/MND identified that the City is rich with archaeological and paleontological resources, including the Santa Clara Mission, Native American burial grounds, the Berryessa Adobe, and many others listed in the Santa Clara General Plan. The Santa Clara General Plan ensures that archaeological and cultural resources are protected, now and into the future, and that appropriate mitigation measures for unforeseen impacts are enforced in the event unknown resources are encountered. General Plan Policy 5.6.3-P5 requires that, in the event that archaeological/paleontological resources are discovered, work be suspended until the significance of the find and recommended actions are determined by a qualified archaeologist/paleontologist. General Plan Policy 5.6.3-P6 indicates that, in the event human remains are discovered, work with the appropriate Native American representative is to be conducted following the procedures set forth in State law. To ensure appropriate treatment would be provided in the unlikely event that human remains were discovered during grading and excavation activities performed for the MDC, the IS/MND adopted the following mitigation measure.

MM CR-1.3: In the event that human remains are discovered during on-site construction activities, all activity within a 50-foot radius of the find shall be stopped. The Santa Clara County Coroner shall be notified and shall make a determination as to whether the remains are of Native American origin or whether an investigation into the cause of death is required. If the remains are determined to be Native American, the Coroner shall notify the Native American Heritage Commission (NAHC) immediately. Once NAHC identifies the most likely descendants, the descendants shall make recommendations regarding proper burial, which shall be implemented in accordance with Section 15064.5(e) of the CEQA Guidelines.

Although the MDC site will be graded prior to construction of any of the MBGF facilities, trenching to install the underground cabling for the electrical interconnection between each generator yard and the MDC building it serves could uncover cultural resources that were not discovered during grading and construction activities performed for the

MDC site and buildings. However, with the implementation of the above mitigation measures any potential impacts from the trenching activities for the MBGF would be reduced to less than significant levels.

Staff should rely on the implementation of these Mitigation Measures as the environmental baseline conditions and then evaluate whether after their implementation is there a potential for impacts when the MBGF facilities are installed. We believe it is clear that the mitigation measures will mitigate any potential impacts from the MBGF and additional literature searches or surveys will simply not change that conclusion and therefore are not required for the Commission to fully evaluate the potential environmental impacts of the MBGF.

GREENHOUSE GAS EMISSIONS

BACKGROUND: UPDATED GREENHOUSE GAS GLOBAL WARMING POTENTIALS (GWPs)

The GWPs for CH_4 and N_2O were updated in the US EPA's Federal Register (FR) final rule published on November 29, 2013 [78 FR 71904] and effective on January 1, 2014.

DATA REQUEST

33. Please update the GWPs and re-compute emissions from the Air Quality and Greenhouse Gas Technical Report of Appendix E, Table 1A titled, Emergency Generator Emission Factors, and Table 1B titled, Life Safety Generator Emission Factors.

RESPONSE TO DATA REQUEST 33

Ramboll has updated the GWPs based on the US EPA's Federal Register (FR) final rule published on November 29, 2013 [78 FR 71904] and effective on January 1, 2014. GWP values used are 1 for CO2, 25 for CH4, and 298 for N2O. Updated Air Quality and Greenhouse Gas Technical Report (Appendix E) Tables 1a, 1b, and 5 are provided (Attachment Tables DR33-01, DR33-02, and DR33-03). CO2e emission factor went up from 523.37 g/hp-hr to 523.41 g/hp-hr, so changes in GHG emissions are minimal and unnoticed due to the number of significant digits presented in the table.

DR-33 – Tables DR33-01, DR33-02 and DR33-03

Table 1a
Emergency Generator Emission Factors
McLaren Project
Santa Clara, California

Generator Information

Make	Caterpillar
Model	C175-16
USEPA Tier	2
USEPA Engine Family	HCPXL106.NZS
Generator Output at 100% Load (kilowatt)	3,000
Engine Output at 100% Load (horsepower)	4,423

Control Efficiency (DPF) Information

Make	Johnson Matthey
Model	CRT® Particulate Filter System

Pollutant	Uncontrolled Emission Factors[1] (g/hp-hr)	Control Efficiency at 100% Load	Controlled Emission Factors[2] (g/hp-hr)
NOx	4.2	0%	4.2
ROG	0.18	70%	0.05
CO	1.3	80%	0.25
PM	0.067	85%	0.010
$PM_{2.5}$	0.067	85%	0.010
CO_2[3]	522	0%	522
CH_4[4]	0.021	0%	0.021
N_2O[4]	0.0042	0%	0.0042
CO_2e[5]	523	0%	523

Notes:

1. Uncontrolled Emission Factors are from USEPA Engine Family Certification.
2. Controlled Emission Factors are the USEPA Engine Family Certification emission factors with reductions assuming a Johnson Matthey CRT® Particulate Filter System on each engine.
3. Emissions factor from AP-42, Vol. I, Section 3.3, Table 3.3-1 for Uncontrolled Gasoline and Diesel Industrial Engines.
4. Emissions factors from 40 CFR 98, Subpart C, Table C-2. Petroleum emissions listed as 3 g CH_4/mmBtu and 0.6 g N_2O/mmBtu. Assumed conversion factor of 7000 Btu/hp-hr per AP-42 Vol I, Table 3.3-1.
5. Global warming potential values of 1 for CO_2, 25 for CH_4, and 298 for N_2O from US EPA's Federal Register (FR) final rule published on November 29, 2013 [78 FR 71904] and effective on January 1, 2014, were used to convert emissions to metric tones of carbon dioxide equivalents.

Table 1a
Emergency Generator Emission Factors
McLaren Project
Santa Clara, California

Abbreviations:

CH_4 - methane
CO - carbon monoside
CO_2 - carbon dioxide
CO_2e - carbon dioxide equivalents
g - gram
hp - horsepower
hr - hour
N_2O - nitrous oxide
NMHC - Non-methane hydrocarbon
NOx - oxides of nitrogen
PM - Particulate Matter
USEPA - United States Environmental Protection Agency

References:

Peterson Power Systems. 2015. Manufacturer's Performance Data for Model C175-16.
Johnson Matthey Proposal No. GR-394 to Peterson
USEPA. 2015. Large Engine Certification Data for Model Year 2015. Available at: https://www3.epa.gov/otaq/documents/eng-cert/nrci-cert-ghg-2015.xls.

Table 1b
Life Safety Generator Emission Factors
McLaren Project
Santa Clara, California

Generator Information

Make	Perkins
Model	SD/MD500
USEPA Tier	2
USEPA Engine Family	HCPXL15.2NZS
Generator Output at 100% Load (kilowatt)	500
Engine Output at 100% Load (horsepower)	762

Control Efficiency (DPF) Information

Make	Johnson Matthey
Model	CRT® Particulate Filter System

Pollutant	Uncontrolled Emission Factors[1] (g/hp-hr)	Control Efficiency at 100% Load	Controlled Emission Factors[2] (g/hp-hr)
NOx	4.0	0%	4.0
ROG	0.072	70%	0.022
CO	1.2	80%	0.24
PM	0.067	85%	0.010
$PM_{2.5}$	0.067	85%	0.010
CO_2[3]	522	0%	522
CH_4[4]	0.021	0%	0.021
N_2O[4]	0.0042	0%	0.0042
CO_2e[5]	523	0%	523

Notes:

1. Uncontrolled Emission Factors are from USEPA Engine Family Certification.
2. Controlled Emission Factors are the USEPA Engine Family Certification emission factors with reductions assuming a Johnson Matthey CRT® Particulate Filter System on each engine.
3. Emissions factor from AP-42, Vol. I, Section 3.3, Table 3.3-1 for Uncontrolled Gasoline and Diesel Industrial Engines.
4. Emissions factors from 40 CFR 98, Subpart C, Table C-2. Petroleum emissions listed as 3 g CH_4/mmBtu and 0.6 g N_2O/mmBtu. Assumed conversion factor of 7000 Btu/hp-hr per AP-42 Vol I, Table 3.3-1.
5. Global warming potential values of 1 for CO_2, 25 for CH_4, and 298 for N_2O from US EPA's Federal Register (FR) final rule published on November 29, 2013 [78 FR 71904] and effective on January 1, 2014, were used to convert emissions to metric tones of carbon dioxide equivalents.

Table 1b
Life Safety Generator Emission Factors
McLaren Project
Santa Clara, California

Abbreviations:

CH_4 - methane
CO - carbon monoside
CO_2 - carbon dioxide
CO_2e - carbon dioxide equivalents
g - gram
hp - horsepower
hr - hour
N_2O - nitrous oxide
NMHC - Non-methane hydrocarbon
NOx - oxides of nitrogen
PM - Particulate Matter
USEPA - United States Environmental Protection Agency

References:

Peterson Power Systems. 2015. Manufacturer's Performance Data for Model C175-16.

Johnson Matthey Proposal No. GR-394 to Peterson

USEPA. 2015. Large Engine Certification Data for Model Year 2015. Available at: https://www3.epa.gov/otaq/documents/eng-cert/nrci-cert-ghg-2015.xls.

Table 5
Operational Mass Emissions of Greenhouse Gases
McLaren Project
Santa Clara, California

Emissions Source	GHG Emissions[1]	Units
Emergency Generators	5,460	MT CO_2e/yr
BAAQMD Stationary Source Threshold	**10,000**	

Abbreviations:

BAAQMD - Bay Area Air Quality Management District
CO_2e - carbon dioxide equivalents
GHG - greenhouse gas
MT - metric ton
SP - service population
yr - year

RAMBOLL ENVIRON

LAND USE/PLANNING

BACKGROUND

The SPPE application includes Figure 2-1, "General Arrangement and Site Layout," which conceptually shows areas for the data centers and diesel generators. No areas are shown for other project features (e.g., the electrical substation, parking areas, and mechanical equipment yards). Staff anticipates including a description of areas and locations for the main project features in the Land Use and Planning section of the analysis.

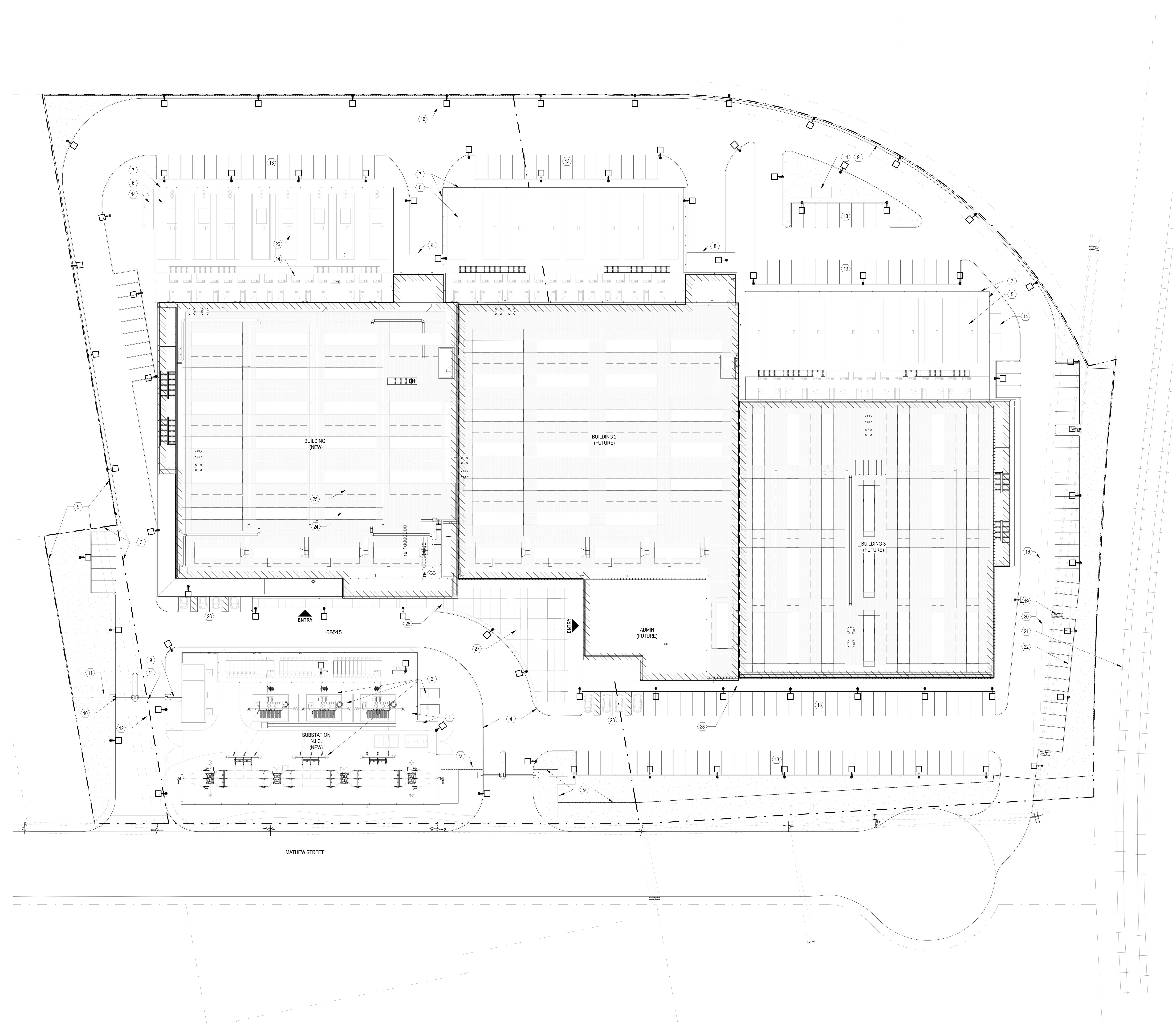
DATA REQUEST

34. Please provide an updated figure(s) showing the general arrangement and site layout that includes the main project features, similar to the site plans shown in the city's February 2017 IS/MND. Please label the project features shown on the figure(s).

RESPONSE TO DATA REQUEST 34

Notwithstanding the general objection to this data request, please see Attachment DR-34, Figure AS100.02.

DR-34 – Campus Site Plan



1 ARCHITECTURAL SITE PLAN - CAMPUS
1" = 30'-0"

GENERAL NOTES

PARKING

THE CITY OF SANTA CLARA'S ZONING ORDINANCE DOES NOT PROVIDE A MINIMUM NUMBER OF PARKING SPACES FOR A DATA CENTER. HOWEVER, THE PROPOSED PROJECT IS ESTIMATED TO PROVIDE ENOUGH PARKING FOR ITS EMPLOYEES AND VISITORS.
APPROXIMATELY 207 PARKING SPOTS WOULD BE PROVIDED WITHIN THE PROJECT SITE. IT IS NOT ANTICIPATED THAT THE 207 PARKING SPACES WOULD BE NECESSARY FOR EMPLOYEES AND VISITORS TO THE SITE ON A CONSISTENT BASIS. THEREFORE, THE PROPOSED PARKING SUPPLY WOULD BE ADEQUATE TO SATISFY THE CITY'S PARKING REQUIREMENTS.

SHEET NOTES

NOTE: NOT ALL SHEET NOTES BELOW MAY BE USED ON THIS SHEET

1	SUBSTATION SCREEN WALL
2	SUBSTATION EQUIPMENT N.I.C.
3	PROPERTY LINE
4	ROADWAY
5	FUTURE GENERATOR YARD
6	GENERATOR YARD
7	8' TALL CHAIN LINK FENCE AROUND GENERATOR YARD
8	LOADING DOCK
9	8' TALL PERIMETER FENCE
10	ENTRY GATE
11	ENTRY GATE OPERATOR
12	ENTRY GATE CARD READER
13	PARKING
14	ELECTRICAL GEAR
16	EXISTING PRIVATE RAIL EASEMENT TO REMAIN
17	EXISTING PUBLIC UTILITY EASEMENT TO REMAIN
18	EXISTING SANITARY SEWER EASEMENT TO REMIAN
19	EXISTING OVERHEAD TRANSMISSION LINES AND POLES
20	EXISTING PUBLIC UTILITY EASEMENT
21	EXISTING RAILROAD TRACKS
22	EXISTING TELECOM EASEMENT
23	ADA PARKING
24	MECHANICAL EQUIPMENT
25	ROOFTOP MECHANICAL DUNNAGE PLATFORM
26	GENERATOR
27	PLAZA
28	SEWER LIFT STATION. SEE CIVIL DWGS
29	EXISTING FENCE TO REMAIN
30	EXISTING PAVEMENT TO REMAIN
31	EXISTING BUILDING TO REMAIN
32	TRAFFIC LINES TO BE PAINTED OVER EXISTING PAVEMENT
33	FIRE LANE. 26'-0" MIN CLEAR

LEGEND

Parking count
177

OWNER

VANTAGE DATA CENTERS

ARCHITECT

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NO.	DESCRIPTION	DATE
B	GATE ONE REVISION	11-16-2017
A	GATE ONE	10-02-2017

DRAWING ISSUES

PROJECT:

VANTAGE - MCLAREN

Project Status

725 MATHEW STREET
SANTA CLARA, CA

DWG. TITLE

ARCHITECTURAL
CAMPUS SITE PLAN

PROJECT NO: Project Number
DATE: Issue Date
SCALE:
AS NOTED

DWG. NO:
AS100.02