November 26, 2019

Washington State Department of Ecology
Eastern Regional Office
4601 North Monroe Street
Spokane, WA 99205

Attn: Karin Baldwin

Transmitted via email to: *kbal461@ecy.wa.gov*

Re: Approval Order Amendment Request
Microsoft MWH Data Center
Quincy, Washington
LAI Project No. 1822001.010

Dear Ms. Baldwin:

Microsoft Corporation (Microsoft) operates a data center campus at 1515 NW Port Industrial Parkway in Quincy, Washington under an Approval Order from the Washington State Department of Ecology (Ecology). This letter and its attachments comprise an Approval Order amendment request prepared by Landau Associates, Inc. (LAI) on behalf of Microsoft.

In September 2019, Ecology issued a revised Approval Order (No. 19AQ-E031) that permits construction and operation of a data center campus hosting the following generators:

MWH-01 and -02 installed equipment:

- Forty (40) Caterpillar Model 3 516C-HD-T A diesel-powered electrical emergency generators with a power rating of 2.5 megawatts electrical (MWe) per generator
- Four (4) Caterpillar Model 3 516C-T A diesel-powered electrical emergency generators with a power rating of 2.0 MWe per generator
- One (1) Caterpillar Model C27 AT AAC diesel-powered electrical emergency generator with a power rating of 0.75 MWe
- Thirty-two (32) cooling towers.

MWH-03/04/05/06 permitted but not yet installed:

- Four (4) 1.0-MWe or 1.5-MWe Cummins Model 1500DQGAF or Caterpillar (CAT) Model C32 or 3512C generators with a combined capacity of up to 6.0 MWe
- Sixty-eight (68) 3.0-MWe Cummins Model C3000 D6e or CAT Model C175 generators
- One hundred thirty-six (136) Baltimore Aircoil Company (BAC) Model HXV-I012C-24T-L-2 evaporative fluid coolers or equivalent.

To accommodate modifications to site development plans, Microsoft proposes a modification to the site layout, reducing the total number of generators installed in MWH-03/04/05/06. Additionally, Microsoft requests an operating limit modification to reflect changes to its operations and maintenance (O&M) needs for MWH-03/04/05/06.

The table below summarizes the proposed change in number of generators, generator capacity, and number of fluid coolers.

Permitted MWH-03/04/05/06	Total Permitted	Proposed MWH-03/04/05	Proposed MWH-06	Total Proposed	Change
4 x 1.0 or 1.5 MWe	6.0 MWe	1 x 1.0 MWe 2 x 1.5 MWe	1 x 0.5 MWe	4.5 MWe	-1.5 MWe
68 x 3.0 MWe	204 MWe	40 x 3.0 MWe	16 x 3.0 MWe	168 MWe	-36 MWe
72 generators		60 generators			-12 generators
136 fluid coolers		68 fluid coolers	32 fluid coolers	100 fluid coolers	-36 coolers

Microsoft also requests a change to Operating Limitation 3.b.viii in the Approval Order to accommodate necessary O&M activities, specifically, increasing the limit on the number of calendar days per year this activity can be carried out from 24 to 33 calendar days in any 3 calendar-year period.

The proposed changes represent a decrease in the number of installed generators, and a decrease in permitted emissions (compared with the generator configuration permitted in Approval Order No. 19AQ-E031). No changes are proposed to the existing permitted and installed MWH-01/02 engines or cooling towers. Because the project will result in a decrease in emissions of all regulated criteria pollutants and toxic air pollutants, the project does not trigger New Source Review (NSR) under Washington Administrative Code (WAC) 173-400-110 and 173-460.

Because the project does not trigger NSR, there is no regulatory requirement to complete air dispersion modeling for this project. To support a holistic review of the proposed modifications, Microsoft has voluntarily conducted air dispersion modeling to evaluate the impacts associated with those modifications; the results of that modeling are presented herein for Ecology's review. Modeled concentration changes associated with the project are generally small (i.e., there are small increases in some areas and decreases in other areas).

In consideration of the reduced potential-to-emit associated with the decrease in number of generators and evaporative fluid coolers, and because there are only minor changes to the modeled ambient air quality impacts (all maintaining compliance with ambient air quality standards), Microsoft requests that Ecology issue an administrative modification to the Approval Order allowing for the proposed changes.

Proposed Changes

The Approval Order allows for the installation of up to 72 additional 3.0-MWe Cummins or CAT emergency generators in MWH-03/04/05/06. In their place, Microsoft proposes to install the following emission units in MWH-03/04/05:

- One 1.0-MWe CAT Model C32
  - Stacks will be 72 feet above grade with a diameter of up to 20 inches
- Two 1.5-MWe CAT Model 3512C
  - Stacks will be 72 feet above grade with a diameter of up to 20 inches
- Forty 3.0-MWe CAT Model C175-16 generators
  - Stacks will be 72 feet above grade with a diameter of up to 24 inches
- Sixty-eight Baltimore Aircoil Company (BAC) Model HXV-I012C-24T-L-2 evaporative fluid coolers or equivalent.

Microsoft also proposes to install the following emission units in MWH-06:

- One 0.5-MWe CAT Model C18
  - Stacks will be 30 feet above grade with a diameter of up to 8 inches
- Sixteen 3.0-MWe CAT Model C175-16
  - Stacks will be 72 feet above grade with a diameter of up to 24 inches
- Twenty-six BAC Model HXV-I012C-24T-L-2 evaporative fluid coolers or equivalent.

The one 0.5-MWe generator and 16 3.0-MWe generators (see Attachment 1 for specification sheets and emissions data) would be installed adjacent to a proposed building in the western portion of the MWH property. A site plan is provided as Figure 1, which shows the new configuration of MWH-03/04/05/06. Microsoft is currently constructing MWH-03/04/05 and plans to install the MWH-06 emission units in the second half of 2019.

As noted above, Microsoft also requests a change to Operating Limitation 3.b.viii in the Approval Order. In order to accommodate necessary O&M activities, Microsoft requests that the limit on the number of calendar days per year this activity can be carried out be increased from 24 to 33 calendar days in any 3 calendar-year period. This change will not increase the quantity of emissions, but will provide the operational flexibility that is needed to properly maintain all the equipment on site. This change has been incorporated in the ambient air quality compliance evaluation described below.

Emission Estimates

Air pollutant emission rates were calculated for the generators per the requirements of WAC 173-400-103 and WAC 173-460-050 (see Attachments 2 and 3).

Derivation of Generator Emission Factors

The proposed emergency generators will US Environmental Protection Agency (EPA) Tier 2-certified and will be equipped with a catalyzed diesel particulate filter and urea-based selective catalytic reduction to meet EPA Tier 4 emission standards. CAT's reported not-to-exceed generator emission factors for carbon monoxide (CO), nitrogen oxides (NO_x), and particulate matter (PM) were used to estimate emission rates. Emissions of diesel engine exhaust particulate matter (DEEP) are conservatively assumed to be equal to the manufacturers' not-to-exceed emissions value for total PM emission rates. The emission rates for PM with aerodynamic diameters of less than or equal to 10 microns (PM_{10}) and less than or equal to 2.5 microns ($PM_{2.5}$) include an estimate for "front-half" (filterable PM) and "back-half" (condensable PM) emissions. The filterable PM estimate is equal to the manufacturer's not-to-exceed emission factor for PM.

An estimate of condensable PM was developed based on a previous source test report for a similar size engine in which filterable PM was measured using EPA Method 5 and condensable PM was measured using EPA Method 202 (AMTEST 2012). The worst-case ratio of total PM to filterable PM (i.e., Total PM:Filterable PM) is multiplied by the manufacturers' not-to-exceed emissions value for PM emissions for this project to "scale up" the filterable PM estimate to an estimate of total PM. Additionally, the manufacturer-provided hydrocarbon emission rate was assumed to represent the emission rate for total volatile organic compounds (VOCs). Emission estimates based on vendor-provided data are provided in Attachment 2.

All remaining pollutant emission rates, except for sulfur dioxide (SO_2), were calculated using emission factors from the EPA's AP-42, Volume I, Chapter 3.4, which provides emission factors for hazardous air pollutants from large internal combustion diesel engines (EPA 1995) based on maximum potential fuel consumption. The emission rate for SO_2 was calculated using a mass-balance approach based on the maximum sulfur content in the fuel (i.e., 15 parts per million) and the maximum potential fuel consumption. The change in maximum potential fuel consumption for the 60 proposed generators would be 241,858 fewer gallons of diesel fuel per year than the 72 currently permitted generators. Fuel-based emission estimates are provided in Attachment 2.

In order to account for slightly higher emissions during the first minute of each engine cold startup, the estimated emission rates of pollutants associated with cold-startup (PM, CO, total VOCs, and volatile toxic air pollutants) were scaled up using a "cold-start spike" emission factor. These "cold-start spike" factors are based on short-term concentration trends for VOC and CO emissions observed immediately after the cold-start of a large diesel backup generator. These observations were documented by the California Energy Commission's report, Air Quality Implications of Backup Generators in California (Miller and Lents 2005). LAI's method for deriving cold-start emission factors is summarized in Attachment 2.

Evaporative Fluid Cooler Emissions

The evaporative fluid coolers will be operated using drift eliminators certified to reduce the drift droplet rate to at most 0.0005 percent of the recirculation water flow rate. It will be assumed that the non-volatile chemical concentrations in the drift droplets will be identical to the non-volatile aqueous concentrations in the recirculation water, and the drift droplets will quickly evaporate to form solid drift particles containing those non-volatile compounds.

The size distribution of the liquid droplets for mechanical draft evaporative fluid coolers with a drift performance of 0.0005 percent will be based on data from SPX/Marley, a major manufacturer of evaporative fluid coolers. The size distribution of the evaporated solid particles will be calculated based on the liquid droplet size distribution and the assumption that the total dissolved solids (TDS) concentration inside the liquid droplets will be the same as the TDS concentration within the cooler recirculation water.

It is assumed that the water supply will be a combination of industrial reuse water from the City of Quincy's industrial wastewater treatment plant and potable water from the City of Quincy's municipal water supply treated with reverse osmosis. Because the specific mixture of industrial reuse water and potable water may vary depending on water availability, the worst-case concentration of chemicals from either water source will be used to evaluate the worst-case emissions from the evaporative fluid coolers. Cooler emission rates are provided in Attachment 2. The resultant evaporative fluid cooler and project-specific potentials-to-emit are provided in Attachment 3. The reduction in facility-wide emissions based on the reduced number of evaporative fluid cooler units is provided in Attachment 3.

Facility-Wide Emission Rates

Emission rates were calculated for criteria pollutants and toxic air pollutants based on peak hourly (worst-case maximum) and long-term (annual maximum) operating scenarios. Microsoft's permit allows the flexibility to operate the emergency generators at any load, which will be set based on electrical demand. Considering that not all pollutant emission rates are maximum under the same operating load, the pollutant-specific maximum emission rate, under any load up to 100 percent, was assumed for calculating the worst-case emission rates. Facility-wide emission rates were calculated based on maximum permitted fuel consumption and operating hours.

Attachment 3 includes tables that summarize the new proposed facility-wide potential-to-emit and the project-related change in facility-wide potential-to-emit. The resultant potential-to-emit for the proposed generators is provided in Attachment 3-1. The difference in potential-to-emit between the proposed generators and the currently permitted but not installed generators is provided in Attachment 3-2. The proposed design changes will collectively reduce the potential-to-emit for all pollutants. There are no facility-wide emission rate increases associated with the proposed modification.

Regulatory Review

The subsections below present the results of a regulatory review for the proposed project.

New Source Review

NSR is required in the case of a modification to an existing stationary source [WAC 173-400-110(1)(A)], where a "modification" is defined in WAC 173-400-030(51) as "any physical change in, or change in the method of operation of, a stationary source that *increases the amount of any air contaminant emitted by such source* or that results in the emissions of any air contaminant not previously emitted." Additionally, "new source review of a modification is limited to the emission unit or units proposed to be modified and the air contaminants whose emissions would increase as a result of the modification" [WAC 173-400-110(1) (d)]. As shown in Attachment 3-2, the proposed changes would result in a decrease of all air contaminants emitted; therefore, they would not trigger NSR. However, in accordance with Condition 10.e of the Approval Order, LAI is notifying Ecology of Microsoft's proposed changes.

Best Available Control Technology Analysis

LAI's understanding is that EPA Tier 2 certification requirements currently represent the best available control technology (BACT) for emergency generators. All of the proposed generators to be installed at the facility will be EPA Tier 2-certified, with a capacity of 0.5 MWe, 1.0 MWe, 1.5 MWe, or 3.0 MWe (i.e., equal to or smaller than the previously-permitted generators), and the proposed changes would result in an emission reduction (see Attachment 3). On that basis, Microsoft requests that the project be approved with BACT limitations as currently permitted. However, please note that while the recommendation for the BACT and tBACT[1] emission limitations is consistent with the EPA's Tier 2 emission standards, Microsoft will voluntarily equip the generators with selective catalytic reduction and catalyzed diesel particulate filter controls to meet EPA Tier 4 emission standards.

Ambient Air Quality Analysis

While an ambient air quality analysis is not automatically required under this amendment request process because NSR requirements were not triggered, Microsoft recognizes that ambient DEEP and nitrogen dioxide (NO_2) concentrations are a consideration during regulatory review.

As presented in the Notice of Construction (NOC) Application Supporting Information Report(LAI 2018a), a requirement for a Second-Tier Health Impact Analysis (HIA) was triggered due to modeled ambient concentrations of DEEP and NO_2 exceeding the Acceptable Source Impact Level (ASIL). As presented in the Second-Tier HIA Report (LAI 2018b) submitted to Ecology in 2018, the calculated increased cancer risk resulting from exposure to potential project-related DEEP emissions was 2.7 per

[1] Best available control technology for toxic air pollutants.

million at the maximally impacted residential receptor. The 2018 evaluation demonstrated that DEEP impacts were not a constraining factor on facility design or operation.

Project-related NO_2 concentrations were evaluated in the 2018 NOC Application and HIA reports (LAI 2018a, b). Those evaluations demonstrated that NO_2 impacts were not a constraining factor on facility design or operation. For example, the modeled cumulative NO_2 concentration was less than 60 percent of the 1-hour average National Ambient Air Quality Standard (NAAQS). Additionally, in its revised HIA review document dated July 2018, Ecology noted that due to the estimated recurrence interval of NO_2 concentrations exceeding the ASIL, "*…outage emissions coming from MWH-03/04/05/06 alone are not likely to cause impacts of concern.*" Ecology also noted that while power outages involving multiple data centers have a potential to result in NO_2 levels of concern, existing power reliability information suggests that recurring simultaneous power outage emission scenarios are uncommon and the health risk is acceptable (Ecology 2018).

Additional air modeling has been completed to ensure that the MWH Data Center Campus complies with NAAQS standards, and that changes in modeled DEEP, NO_2, SO_2, CO, PM_{10}, and $PM_{2.5}$ concentrations from the project are not a concern after the proposed new configuration is fully built. Methods and results are presented below.

Air Dispersion Model Setup and Assumptions

The following models were run:

- Annual average DEEP (70-year lifetime scenario)
- 1-hour average NO_2 (power outage scenario), annual average NO_2 (theoretical maximum year with commissioning)
- 3-hour and 1-hour average SO_2 (power outage scenario)
- 8-hour and 1-hour average CO (power outage scenario)
- 24-hour average PM_{10} (power outage scenario)
- Annual average $PM_{2.5}$ (theoretical maximum year with commissioning) and 24-hour average $PM_{2.5}$ (non-emergency monthly operations).

The standard Ecology-required protocols were used, as described below.

- The AERMOD[2] v19191 modeling system used in accordance with the EPA's Guideline on Air Quality Models (EPA 2017) to estimate ambient pollutant concentrations.
- The AERMOD View™ version 9.8 interface provided by Lakes Environmental will be used for all air dispersion modeling (Lakes Environmental 1995-2019).

[2] AERMOD = American Meteorological Society (AMS)/US Environmental Protection Agency (EPA) regulatory model.

- A receptor grid consisting of Cartesian flagpole receptor grids placed at a height of 1.5 meters (m) above ground to approximate the human breathing zone. The grid spacing varied with distance from the facility, as listed below:
  - 12.5-m spacing from the property boundary to 150 m from the nearest emission source
  - 25-m spacing from 150 m to 400 m
  - 50-m spacing from 400 m to 900 m
  - 100-m spacing from 900 m to 2,000 m
  - 300-m spacing between 2,000 m and 4,500 m
  - 600-m spacing beyond 4,500 m (to 6,000 m maximum extent).
- Additional modeling setup details for evaluating all NO_2 emission impacts include:
  - The ambient NO_2 concentrations will be modeled using the plume volume molar ratio method option. This AERMOD option calculates ambient NO_2 concentrations surrounding the site by applying a default NO_2/NO_x equilibrium ratio of 0.90 and an NO_2/NO_x in-stack ratio of 0.1.
  - The estimated ambient ozone concentration of 51.8 micrograms per cubic meter ($\mu g/m^3$) was the AERMOD input level for all corresponding NO_2 modeling setups. This value was taken from the Idaho Department of Environmental Quality 2014-2017 design value of criteria pollutants website, for the Quincy, Washington area (IDEQ; accessed July 2, 2019).
- The AERMET[3] version 19191 meteorological pre-processor used to process meteorological data for the 5 years from January 1, 2012 through December 31, 2016:
  - National Weather Service (NWS) hourly surface observations from Grant County International Airport in Moses Lake, Washington, located approximately 24 miles from the Microsoft site. Five years (January 1, 2012 through December 31, 2016) of hourly surface data were processed in AERMET.
    - AERMINUTE was run to reduce the instance of “calms.” A potential concern related to the use of meteorological data for dispersion modeling is the high incidence of “calms,” or periods of time with low wind speeds. NWS and Federal Aviation Administration data coding defines a wind speed of less than 3 knots as “calm” and assigns a value of 0 knots. This results in an overestimation of the amount of calm conditions. Similarly, if wind speed is up to 6 knots, but wind direction varies more than 60 degrees during a 2-minute averaging period, wind direction is reported as “missing.” AERMINUTE reprocesses ASOS[4] 1-minute wind data at a lower threshold and calculates hourly average wind speed and directions to supplement the standard hourly data processed in AERMET.

[3] AERMET = AMS/EPA regulatory meteorological model.

[4] ASOS = Automated Surface Observation System.

    - To further enhance AERMOD's treatment of calms, the ADJ_U* processing method in Stage 3 of AERMET was used.
  - NWS twice-daily upper air soundings from Spokane, Washington. Five years (January 1, 2012 through December 31, 2016) of upper air data were processed in AERMET.
  - AERSURFACE was used to determine the Albedo, Bowen ratio, and surface roughness within 12 equal sectors of a circle centered on the surface station tower. The default study radius of 1 kilometer (km) for surface roughness and 10 km for Bowen ratio and albedo was used. Land cover data from the US Geological Survey (USGS) National Land Cover Data 1992 archives were used as an input to AERSURFACE (USGS 1992). Default seasonal categories are used in AERSURFACE to represent the four seasonal categories as follows: 1) midsummer with lush vegetation; 2) autumn with unharvested cropland; 3) winter with continuous snow; and 4) transitional spring with partial green coverage or short annuals. The AERSURFACE designation for an airport location (with the assumed surface roughness calculated based on 95 percent transportation and 5 percent commercial and industrial) is appropriate for this site. Annual precipitation for Moses Lake for each modeled year was obtained from the Western Regional Climate Center database. The annual precipitation was within the top 30th percentile of the past 30 years of annual precipitation totals for 2012, 2015, and 2016. Therefore, in accordance with EPA guidance, surface moisture conditions were considered wet when compared to historical norms and Bowen ratio values for wet surface moisture were used for those 3 years. The annual precipitation was between the top and bottom 30th percentile of the past 30 years of annual precipitation totals for 2013 and 2014 so Bowen ratio values for average surface moisture were used for those 2 years.

- Building downwash occurs when the aerodynamic turbulence induced by nearby buildings causes a pollutant emitted from an elevated source to mix rapidly toward the ground (downwash), resulting in higher ground-level pollutant concentrations. The software program Building Profile Input Program-PRIME will be used to determine if exhaust from emission units would be affected by nearby building structures. In general, these determinations are made if a stack's height is less than the height defined by the EPA's Good Engineering Practice stack height.
- To model complex terrain, AERMOD requires information about the surrounding terrain. This information includes a height scale and a base elevation for each receptor location. The AMS/EPA regulatory model terrain pre-processor (AERMAP) was used to obtain a height scale and the base elevation for a receptor location, and to develop receptor grids with terrain effects. Digital topographical data for the analysis region were obtained from the Web GIS website (www.webgis.com) and processed for use in AERMOD. The Shuttle Radar Topography Mission data used for this project have a resolution of approximately 30 m (1 arc-second).
- For modeling compliance with the probabilistic 24-hour average $PM_{2.5}$ and 1-hour average NO_2 NAAQS, ranked generator runtime scenarios are defined in Attachment 4-1. Pollutant emission inputs and stack parameters are summarized in Attachment 4-2. Backup documentation to support the NO_2 1-hour average NAAQS Monte Carlo evaluation is provided in Attachment 5.

In order to estimate the difference in NO_2 and DEEP concentrations that would result between the old permitted configuration scenario and the new proposed configuration scenario, both model scenarios were run and the difference in concentration was calculated at each location within the receptor grid. Model plot files showing the difference in concentration were then converted into graphical isopleths and overlaid onto aerial photographs using ArcGIS (see Figures 2 and 3).

In order to demonstrate compliance with standards based on an annual, 1-hour, 3-hour, 8-hour, or 24-hour averaging periods, the modeling methods used were the same as those presented in the 2018 NOC Application Supporting Information Report (LAI 2018a).

Air Dispersion Model Results and Conclusions

The results of air dispersion modeling for criteria pollutants CO, SO_2, PM_{10}, $PM_{2.5}$, and NO_x are presented in Attachment 4-3. As shown, the modeled project plus local background concentrations are below NAAQS for all criteria pollutants.

Figure 2 presents the results of air dispersion modeling for DEEP (annual average concentrations). As shown, the changes would result in decreases in modeled DEEP concentrations to areas to the north, east, and south of the site. The changes would result in minor increases in modeled DEEP concentrations to areas adjacent to the west of the site. The DEEP increases to the west of the site are below the ASIL.

Figure 3 presents the results of air dispersion modeling for NO_2 (maximum 1-hour average concentration during a power outage). As shown, the project will result in NO_2 concentration decreases in some areas and minor NO_2 increases in other areas. NO_2 increases are below the ASIL and the highest increase is located in undeveloped land far to the north of the site.

As shown in Table 1 and Figures 2 and 3, because many of the generator locations have shifted to the west of the site, away from the more densely developed areas of Quincy, the modeled change in DEEP and NO_2 concentrations are generally reduced in areas occupied by people. Areas where modeling shows the potential for small increases in DEEP and NO_2 concentrations are limited to locations near the site or in primarily unoccupied areas.

Conclusions and Recommendations

In summary, LAI requests that Microsoft be permitted to install one 1.0-MWe generator, two 1.5-MWE generators, and 40 3.0-MWe generators at MWH-03/04/05, plus one 0.5-MWe generator and 16 3.0-MWe generators at MWH-06 instead of the 72 generators currently permitted. The conditions established in the Approval Order provide mechanisms for Ecology to consider whether NSR should be required for a proposed modification. Based on the definition of NSR applicability for modifications [WAC 173-400-110(1) (d)], it is LAI's understanding that the proposed design modifications do not trigger a regulatory requirement for NSR. Furthermore, the elective, focused ambient air quality analysis presented herein reinforces the conclusion that the proposed design changes present a net environmental benefit by generally reducing impacts in locations that are likely to be occupied by people. The proposed changes result in reduced emissions facility-wide for all pollutants and also reduce the potential for DEEP and NO_2-related human health impacts. LAI believes that the regulations, the permit conditions, and the impact analyses presented herein support the recommendation that Ecology approve the proposed design modifications with an administrative modification of the Approval Order.

* * * * *

Please contact me if you have any comments or questions about this request. Thank you for your time and consideration of this request.

Respectfully submitted,

LANDAU ASSOCIATES, INC.

Mark Brunner
Senior Associate

AEM/MWB/ccy
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LAI. 2018b. Second-Tier Health Impact Assessment for Diesel Engine Exhaust Particulate Matter and Nitrogen Dioxide, MWH-03/04/05/06 Data Center, Quincy, Washingotn. Landau Associates, Inc. June 6.

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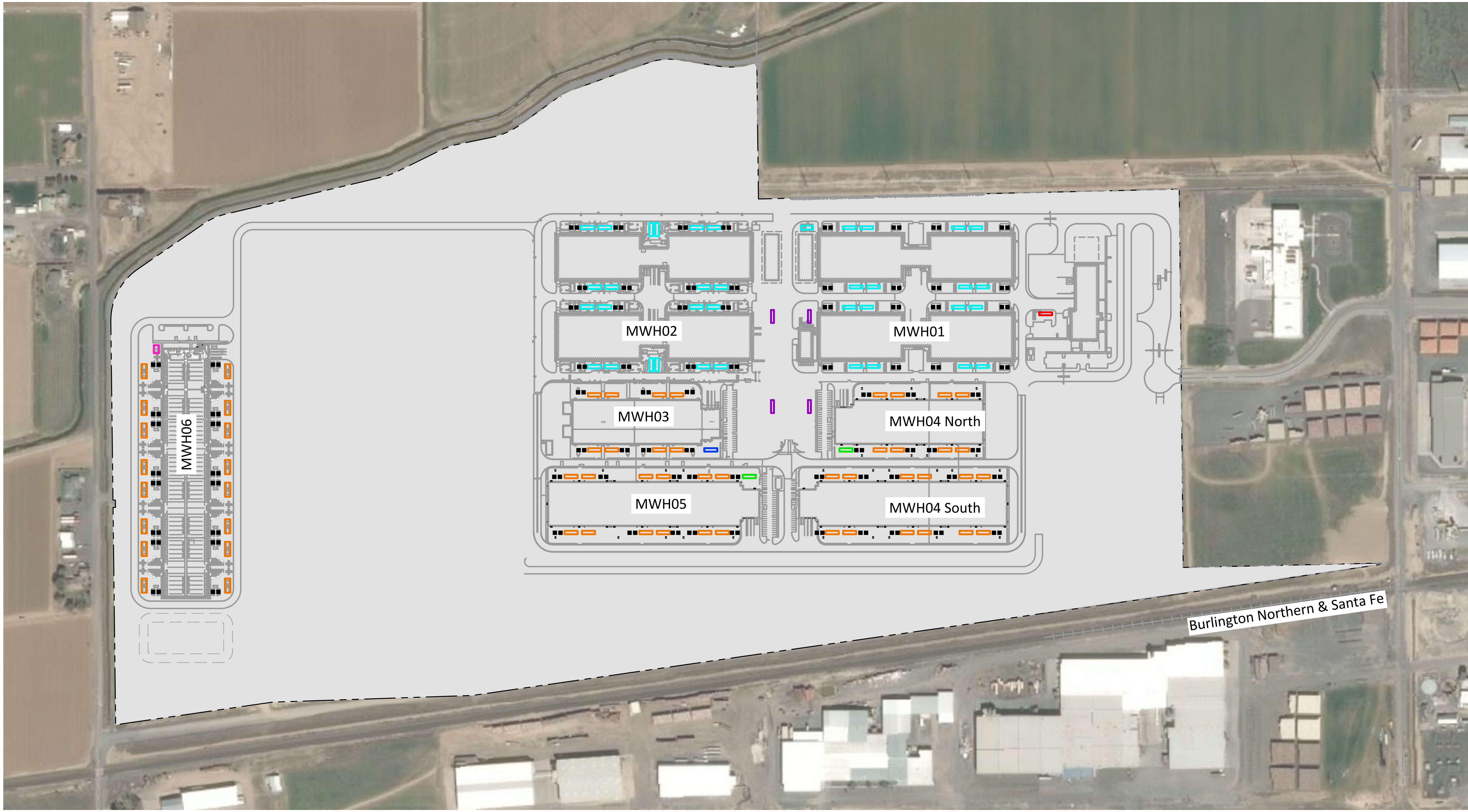
Attachments

Figure 1: Revised Site Plan
Figure 2: DEEP Project Impacts
Figure 3: NO_2 Project Impacts
Table 1: Change in DEEP Concentrations
Table 2: Change in NO_2 Concentrations
Attachment 1: Emergency Generator Specifications
Attachment 2: Emission Estimates
- 2-1: Vendor-Reported Air Pollutant Emission Rates
- 2-2: Fuel-Based Emissions Summary
- 2-3: Startup Emissions Summary
- 2-4: Fluid Cooler Emissions Summary
- 2-5: Diesel Generator Cold-Start Spike Adjustment Factors
- 2-6: Cold Start Emission Trends

Attachment 3: Facility Potential-to-Emit
- 3-1: Project Potential-to-Emit Emissions Summary
- 3-2: Facility Potential-to-Emit Emissions Summary

Attachment 4: Ambient Air Quality Standard Compliance
- 4-1: Summary of Ranked Generator Runtime Scenarios
- 4-2: Modeling Stack Parameters and Emission Rates
- 4-3: Estimated Impacts Compared to National Ambient Air Quality Standards

Attachment 5: NO_2 1-hour Average NAAQS Monte Carlo Backup Documentation
- 5-1: NO_2 Monte Carlo Analysis Modeling Inputs
- 5-2: Summary of NO_2 Monte Carlo Analysis and Results



Legend

- 3,000-kW Generator
- 2,500-kW Generator
- 2,000-kW Generator
- 1,500-kW Generator
- 1,000-kW Generator
- 750-kW Generator
- 500-kW Generator
- Cooling Towers
- Subject Property

0 400 800
Scale in Feet

Note

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Aerial background: Bing aerial imagery, 2019. Basemap Source: Navix, 2019

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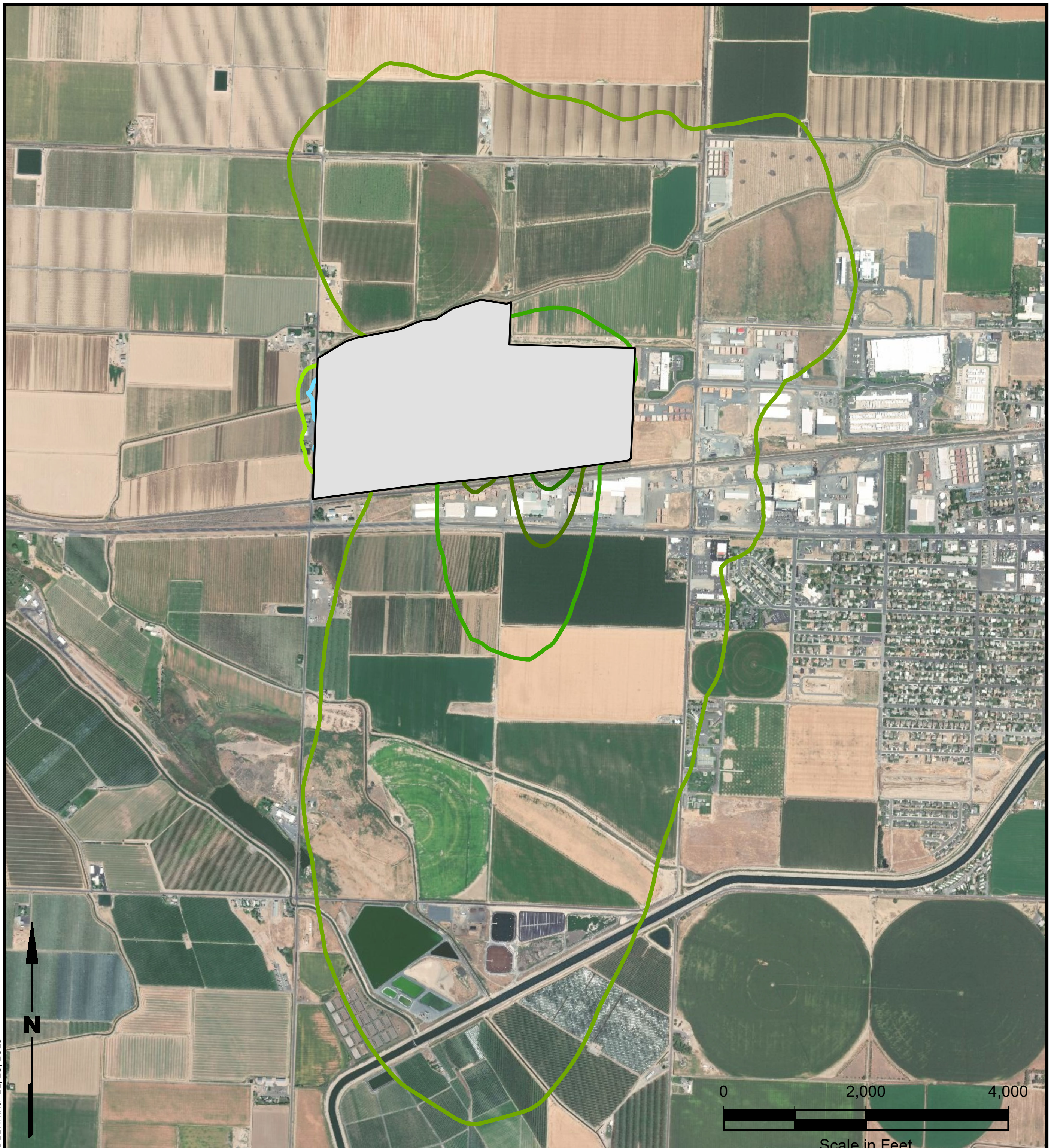
Microsoft MWH Data Center
Quincy, Washington

Revised Site Plan

Figure 1



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Modeled Concentration Difference

- -0.040 µg/m³
- -0.027 µg/m³
- -0.015 µg/m³
- -0.0033 µg/m³
- 0 µg/m³
- 0.0015 µg/m³

Note

1. DEEP = diesel engine exhaust particulates
2. Differences are based on modeled concentrations associated with the proposed project.
3. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Data Source: Esri World Imagery, AERMOD files NAAQS/caDPM and NAAQS/NO2_1HR

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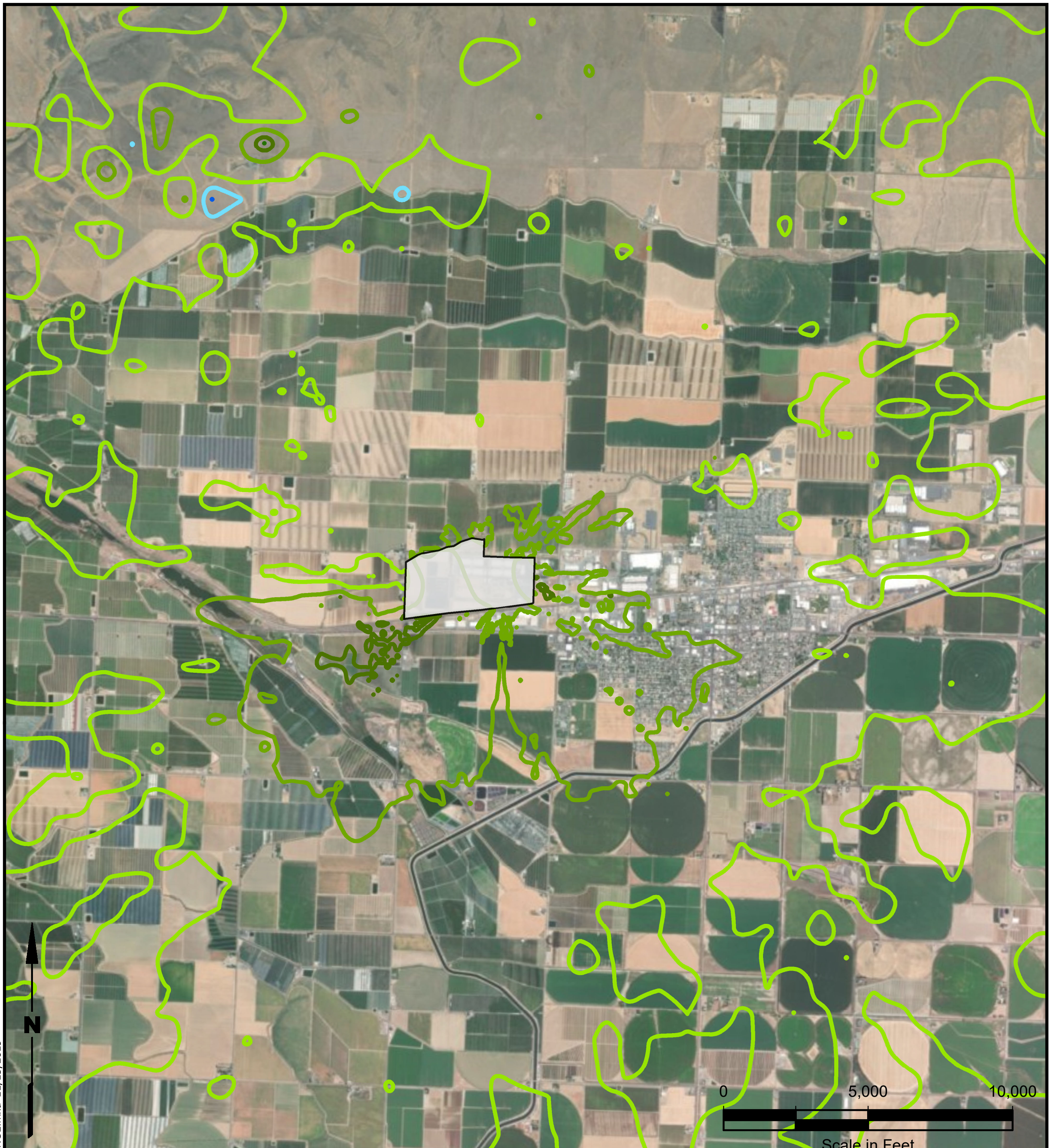
Microsoft MWH Data Center Notice of Construction Application Quincy, Washington	**DEEP Project Impacts**	Figure 2



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Legend

Modeled Concentration Difference

- -545 µg/m³
- -380 µg/m³
- -190 µg/m³
- 0 µg/m³
- 190 µg/m³
- 380 µg/m³

Note

1. Differences are based on model concentrations associated with the proposed project.
2. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Data Source: Esri World Imagery, AERMOD files NAAQS/ncDPM_ANN and NAAQS/NO2_1HR

Landau Associates

Microsoft MWH Data Center Notice of Construction Application Quincy, Washington	**NO_2 Project Impacts**	Figure 3

Table 1
Change in DEEP Concentrations
MWH-03/04/05/06 Data Center
Quincy, Washington

Risk Receptors	UTM Coordinates		Project-Only Annual Average DEEP Concentration				DEEP Risk per Million		
	E (m)	N (m)	2018 HIA ($\mu g/m^3$)	2019 Amendment ($\mu g/m^3$)	Concentration Change	% Change	URF	2018 HIA	2019 Amendment
2018 MIIR	282,441.75	5,234,275.00	0.0038	0.00059	-0.0032	-84%	4.3	0.016	0.0025
2018 MIRR	282,360.00	5,236,225.00	0.0090	0.0021	-0.0070	-77%	300	2.7	0.62
2018 MIBR/MICR	281,796.74	5,235,338.05	0.055	0.0065	-0.049	-88%	7.3	0.40	0.047
Quincy Valley Medical Center	282,835.00	5,234,925.00	0.0032	0.00061	-0.0026	-81%	4.9	0.016	0.0030
New 2019 MIRR	280,735.00	5,235,675.00	0.0030	0.0045	0.0015	50%	300	0.91	1.4

Abbreviations and Acronyms:

$\mu g/m^3$ = micrograms per cubic meter
DEEP = diesel engine exhaust particulate matter
E = easting
HIA = Second-Tier Health Impact Analysis
m = meters
MIBR = maximally impacted boundary receptor
MICR = maximally impacted commercial receptor
MIIR = maximally impacted institutional receptor
MIRR = maximally impacted residential receptor
N = northing
URF = unit risk factor
UTM = universal transverse mercator

Table 2
Change in NO_2 Concentrations
MWH-03/04/05/06 Data Center
Quincy, Washington

Risk Receptors	UTM Coordinates		Project-Only 1-hour Average NO_2 Concentration		
	E (m)	N (m)	2018 HIA ($\mu g/m^3$)	2019 Amendment ($\mu g/m^3$)	Concentration Change ($\mu g/m^3$)
2018 MICR	282,310.00	5,235,475.00	798	221	-577
2018 MIIR	282,441.75	5,234,275.00	454	175	-279
2018 MIRR	280085.00	5234671.00	535	180	-355
2018 MIBR	279,285.00	5,240,247.00	877	323	-554
Quincy Valley Medical Center	282,885.00	5,234,775.00	477	188	-289
New 2019 MIRR*	280,737.00	5,235,461.70	444	420	-24
New 2019 MIBR	278,729.44	5,239,655.00	363	754	391

Abbreviations and Acronyms:

$\mu g/m^3$ = micrograms per cubic meter
E = easting
HIA = Second-Tier Health Impact Analysis
m = meters
MIBR = maximally impacted boundary receptor
MICR = maximally impacted commercial receptor
MIIR = maximally impacted institutional receptor
MIRR = maximally impacted residential receptor
N = northing
NO_2 = nitrogen dioxide
UTM = universal transverse mercator

ATTACHMENT 1

Emergency Generator Specifications

PERFORMANCE DATA [175DR86]

JUNE 18, 2019

For Help Desk Phone Numbers Click here

Perf No: DM8455 **Change Level:** 08

General Heat Rejection Sound Emissions Regulatory Altitude Derate Cross Reference Perf Param Ref

View PDF

SALES MODEL:	C175-16	**COMBUSTION:**	DIRECT INJECTION
BRAND:	CAT	**ENGINE SPEED (RPM):**	1,800
ENGINE POWER (BHP):	4,376	**HERTZ:**	60
GEN POWER W/O FAN (EKW):	3,100.0	**ASPIRATION:**	TA
COMPRESSION RATIO:	15.3	**AFTERCOOLER TYPE:**	SCAC
RATING LEVEL:	STANDBY	**AFTERCOOLER CIRCUIT TYPE:**	JW+OC+1AC, 2AC
PUMP QUANTITY:	2	**AFTERCOOLER TEMP (F):**	115
FUEL TYPE:	DIESEL	**JACKET WATER TEMP (F):**	210.2
MANIFOLD TYPE:	DRY	**TURBO CONFIGURATION:**	PARALLEL
GOVERNOR TYPE:	ADEM4	**TURBO QUANTITY:**	4
ELECTRONICS TYPE:	ADEM4	**TURBOCHARGER MODEL:**	GTB6251BN-48T-1.38
CAMSHAFT TYPE:	STANDARD	**CERTIFICATION YEAR:**	2008
IGNITION TYPE:	CI	**CRANKCASE BLOWBY RATE (FT3/HR):**	2,436.4
INJECTOR TYPE:	CR	**FUEL RATE (RATED RPM) NO LOAD (GAL/HR):**	25.1
FUEL INJECTOR:	4439455	**PISTON SPD @ RATED ENG SPD (FT/MIN):**	2,598.4
REF EXH STACK DIAMETER (IN):	14		

INDUSTRY	SUB INDUSTRY	APPLICATION
ELECTRIC POWER	STANDARD	GENERATOR SET

General Performance Data Top

GENSET POWER WITHOUT FAN	PERCENT LOAD	ENGINE POWER	BRAKE MEAN EFF PRES (BMEP)	BRAKE SPEC FUEL CONSUMPTN (BSFC)	VOL FUEL CONSUMPTN (VFC)	INLET MFLD PRES	INLET MFLD TEMP	EXH MFLD TEMP	EXH MFLD PRES	ENGINE OUTLET TEMP
EKW	%	BHP	PSI	LB/BHP-HR	GAL/HR	IN-HG	DEG F	DEG F	IN-HG	DEG F
3,100.0	100	4,376	373	0.337	210.7	90.7	121.5	1,204.7	62.1	892.7
2,790.0	90	3,938	335	0.334	188.1	80.7	121.3	1,155.4	53.8	873.9
2,480.0	80	3,501	298	0.337	168.4	72.6	121.1	1,116.8	47.3	859.2
2,325.0	75	3,282	279	0.341	159.8	69.4	121.1	1,102.6	44.8	853.8
2,170.0	70	3,063	261	0.349	152.7	67.4	121.2	1,093.5	43.3	850.2
1,860.0	60	2,626	224	0.371	139.3	63.4	121.4	1,079.0	40.8	844.7
1,550.0	50	2,188	186	0.400	125.1	57.9	121.5	1,063.1	37.5	839.3
1,240.0	40	1,750	149	0.427	106.9	46.6	121.1	1,034.3	30.4	830.3
930.0	30	1,313	112	0.460	86.2	34.5	120.7	998.5	23.2	819.5
775.0	25	1,094	93	0.480	75.0	28.2	120.7	974.1	19.6	810.6
620.0	20	875	75	0.504	63.1	21.9	120.8	902.3	15.9	766.3
310.0	10	438	37	0.599	37.4	8.9	121.4	706.0	8.7	640.0

GENSET POWER WITHOUT FAN	PERCENT LOAD	ENGINE POWER	COMPRESSOR OUTLET PRES	COMPRESSOR OUTLET TEMP	WET INLET AIR VOL FLOW RATE	ENGINE OUTLET WET EXH GAS VOL FLOW RATE	WET INLET AIR MASS FLOW RATE	WET EXH GAS MASS FLOW RATE	WET EXH VOL FLOW RATE (32 DEG F AND 29.98 IN HG)	DRY EXH VOL FLOW RATE (32 DEG F AND 29.98 IN HG)

GENSET POWER WITHOUT FAN	PERCENT LOAD	ENGINE POWER	COMPRESSOR OUTLET PRES	COMPRESSOR OUTLET TEMP	WET INLET AIR VOL FLOW RATE	ENGINE OUTLET WET EXH GAS VOL FLOW RATE	WET INLET AIR MASS FLOW RATE	WET EXH GAS MASS FLOW RATE	WET EXH VOL FLOW RATE (32 DEG F AND 29.98 IN HG)	DRY EXH VOL FLOW RATE (32 DEG F AND 29.98 IN HG)
EKW	%	BHP	IN-HG	DEG F	CFM	CFM	LB/HR	LB/HR	FT3/MIN	FT3/MIN
3,100.0	100	4,376	90	445.6	9,273.3	24,296.2	40,791.3	42,266.1	8,833.4	8,053.0
2,790.0	90	3,938	80	408.8	8,581.1	22,048.1	37,500.0	38,818.1	8,129.1	7,426.2
2,480.0	80	3,501	72	379.4	8,017.1	20,236.9	34,828.9	36,008.9	7,544.3	6,908.9
2,325.0	75	3,282	69	368.5	7,806.4	19,559.6	33,830.6	34,950.7	7,322.0	6,714.9
2,170.0	70	3,063	67	362.0	7,678.5	19,133.1	33,216.8	34,286.4	7,182.0	6,597.4
1,860.0	60	2,626	63	350.0	7,429.0	18,357.1	32,048.0	33,022.1	6,919.7	6,378.1
1,550.0	50	2,188	58	332.5	7,035.8	17,288.9	30,262.9	31,137.8	6,543.9	6,049.9
1,240.0	40	1,750	47	296.6	6,180.3	15,170.1	26,388.4	27,142.7	5,782.1	5,350.6
930.0	30	1,313	35	251.1	5,230.5	12,595.9	22,202.2	22,809.7	4,841.3	4,490.0
775.0	25	1,094	28	224.9	4,722.5	11,143.7	20,000.1	20,524.8	4,313.3	4,008.9
620.0	20	875	22	197.1	4,216.9	9,643.8	17,813.6	18,255.1	3,867.8	3,607.2
310.0	10	438	9	135.1	3,161.9	6,371.4	13,304.1	13,565.9	2,848.7	2,681.3

Heat Rejection Data Top

Note(s)

PUMP POWER IS INCLUDED IN HEAT REJECTION BALANCE, BUT IS NOT SHOWN.

GENSET POWER WITHOUT FAN	PERCENT LOAD	ENGINE POWER	REJECTION TO JACKET WATER	REJECTION TO ATMOSPHERE	REJECTION TO EXH	EXHUAST RECOVERY TO 350F	FROM OIL COOLER	FROM 2ND STAGE AFTERCOOLER	WORK ENERGY	LOW HEAT VALUE ENERGY	HIGH HEAT VALUE ENERGY
EKW	%	BHP	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN
3,100.0	100	4,376	77,079	10,265	175,510	97,180	24,081	27,356	185,573	452,113	481,614
2,790.0	90	3,938	68,674	9,652	155,505	85,959	21,506	22,077	167,015	403,771	430,117
2,480.0	80	3,501	61,729	9,188	139,739	77,324	19,247	18,045	148,458	361,362	384,941
2,325.0	75	3,282	58,955	9,026	133,914	74,165	18,272	16,609	139,179	343,060	365,445
2,170.0	70	3,063	56,876	8,928	130,176	72,152	17,456	15,731	129,901	327,733	349,118
1,860.0	60	2,626	53,227	8,797	124,059	68,578	15,919	14,476	111,343	298,886	318,389
1,550.0	50	2,188	49,411	8,680	117,110	63,840	14,300	13,183	92,786	268,478	285,997
1,240.0	40	1,750	44,005	8,463	104,802	54,521	12,215	10,300	74,229	229,338	244,303
930.0	30	1,313	37,225	8,151	88,182	44,714	9,854	7,429	55,672	184,999	197,070
775.0	25	1,094	33,267	7,945	78,149	39,422	8,568	6,178	46,393	160,871	171,368
620.0	20	875	28,325	7,533	65,780	31,522	7,209	5,244	37,114	135,351	144,182
310.0	10	438	16,748	6,451	36,503	16,106	4,278	3,828	18,557	80,318	85,559

Sound Data Top

Note(s)

SOUND DATA REPRESENTATIVE OF NOISE PRODUCED BY THE "ENGINE ONLY"

EXHAUST: Sound Power (1/3 Octave Frequencies)

GENSET POWER WITHOUT FAN	PERCENT LOAD	ENGINE POWER	OVERALL SOUND	100 HZ	125 HZ	160 HZ	200 HZ	250 HZ	315 HZ	400 HZ	500 HZ	630 HZ	800 HZ
EKW	%	BHP	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
3,100.0	100	4,376	134.4	109.7	115.8	113.6	115.4	115.8	118.8	119.7	121.4	120.2	121.0
2,790.0	90	3,938	133.1	110.4	116.2	112.4	114.1	114.3	117.1	118.2	119.8	118.1	119.2
2,480.0	80	3,501	131.8	111.9	116.7	110.7	112.5	112.8	115.3	116.7	118.2	116.2	117.4
2,325.0	75	3,282	131.1	112.7	116.9	109.8	111.6	112.0	114.5	115.9	117.3	115.3	116.4
2,170.0	70	3,063	130.5	113.5	117.2	108.9	110.7	111.3	113.6	115.2	116.4	114.4	115.5
1,860.0	60	2,626	129.2	115.1	117.7	107.1	109.0	109.8	111.9	113.7	114.7	112.6	113.6
1,550.0	50	2,188	127.9	116.8	118.2	105.3	107.3	108.4	110.2	112.3	113.0	110.7	111.7

GENSET POWER WITHOUT FAN	PERCENT LOAD	ENGINE POWER	OVERALL SOUND	100 HZ	125 HZ	160 HZ	200 HZ	250 HZ	315 HZ	400 HZ	500 HZ	630 HZ	800 HZ
1,240.0	40	1,750	126.6	118.4	118.7	103.5	105.6	106.9	108.4	110.8	111.3	108.9	109.8
930.0	30	1,313	125.3	120.0	119.2	101.7	103.9	105.4	106.7	109.3	109.5	107.1	107.9
775.0	25	1,094	124.6	120.8	119.5	100.8	103.0	104.7	105.8	108.6	108.7	106.2	106.9
620.0	20	875	124.0	121.6	119.7	99.9	102.1	103.9	105.0	107.8	107.8	105.3	106.0
310.0	10	438	122.7	123.2	120.3	98.1	100.4	102.5	103.2	106.4	106.1	103.4	104.1

EXHAUST: Sound Power (1/3 Octave Frequencies)

GENSET POWER WITHOUT FAN	PERCENT LOAD	ENGINE POWER	1000 HZ	1250 HZ	1600 HZ	2000 HZ	2500 HZ	3150 HZ	4000 HZ	5000 HZ	6300 HZ	8000 HZ	10000 HZ
EKW	%	BHP	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
3,100.0	100	4,376	122.0	122.4	123.4	124.7	124.5	122.9	122.2	121.4	119.9	118.8	123.5
2,790.0	90	3,938	120.5	120.8	122.0	123.4	123.0	121.3	120.6	119.8	118.6	117.7	123.8
2,480.0	80	3,501	119.2	119.5	120.6	122.3	121.7	120.2	119.7	118.9	117.5	117.0	123.5
2,325.0	75	3,282	118.5	118.9	119.8	121.8	121.0	119.7	119.2	118.4	117.0	116.7	123.2
2,170.0	70	3,063	117.9	118.3	119.1	121.2	120.4	119.1	118.8	118.0	116.4	116.4	123.0
1,860.0	60	2,626	116.5	117.1	117.6	120.2	119.0	118.1	117.9	117.1	115.4	115.8	122.5
1,550.0	50	2,188	115.2	115.8	116.2	119.1	117.7	117.0	117.0	116.2	114.3	115.1	122.0
1,240.0	40	1,750	113.9	114.6	114.7	118.1	116.4	116.0	116.1	115.3	113.3	114.5	121.5
930.0	30	1,313	112.6	113.4	113.2	117.0	115.1	114.9	115.2	114.4	112.2	113.9	121.0
775.0	25	1,094	112.0	112.8	112.5	116.5	114.5	114.4	114.8	114.0	111.7	113.6	120.7
620.0	20	875	111.3	112.2	111.8	116.0	113.8	113.9	114.4	113.6	111.2	113.3	120.5
310.0	10	438	110.0	110.9	110.3	115.0	112.5	112.8	113.5	112.7	110.2	112.6	120.0

MECHANICAL: Sound Power (1/3 Octave Frequencies)

GENSET POWER WITHOUT FAN	PERCENT LOAD	ENGINE POWER	OVERALL SOUND	100 HZ	125 HZ	160 HZ	200 HZ	250 HZ	315 HZ	400 HZ	500 HZ	630 HZ	800 HZ
EKW	%	BHP	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
3,100.0	100	4,376	125.9	89.8	105.6	98.3	100.7	104.3	108.4	111.5	113.2	112.5	114.1
2,790.0	90	3,938	125.8	89.3	105.5	97.9	100.9	103.2	108.7	111.1	112.6	112.2	113.7
2,480.0	80	3,501	126.0	88.9	104.9	97.8	99.6	102.3	107.8	111.0	111.6	111.8	112.9
2,325.0	75	3,282	126.1	88.7	104.5	97.8	98.8	101.9	107.3	111.0	111.1	111.7	112.5
2,170.0	70	3,063	126.3	88.5	104.2	97.8	98.0	101.5	106.8	111.0	110.6	111.5	112.0
1,860.0	60	2,626	126.5	88.0	103.5	97.8	96.5	100.7	105.8	111.0	109.5	111.1	111.2
1,550.0	50	2,188	126.8	87.6	102.8	97.8	95.0	99.9	104.8	111.0	108.5	110.8	110.3
1,240.0	40	1,750	127.0	87.2	102.2	97.7	93.5	99.2	103.8	110.9	107.5	110.5	109.5
930.0	30	1,313	127.3	86.7	101.5	97.7	92.0	98.4	102.8	110.9	106.5	110.1	108.6
775.0	25	1,094	127.4	86.5	101.1	97.7	91.2	98.0	102.3	110.9	105.9	109.9	108.2
620.0	20	875	127.5	86.3	100.8	97.7	90.5	97.6	101.8	110.9	105.4	109.8	107.8
310.0	10	438	127.8	85.9	100.1	97.7	89.0	96.8	100.8	110.9	104.4	109.4	106.9

MECHANICAL: Sound Power (1/3 Octave Frequencies)

GENSET POWER WITHOUT FAN	PERCENT LOAD	ENGINE POWER	1000 HZ	1250 HZ	1600 HZ	2000 HZ	2500 HZ	3150 HZ	4000 HZ	5000 HZ	6300 HZ	8000 HZ	10000 HZ
EKW	%	BHP	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
3,100.0	100	4,376	112.7	113.9	114.6	115.3	114.9	112.7	110.8	111.8	114.2	113.3	117.9
2,790.0	90	3,938	112.5	113.7	114.4	114.9	114.4	112.2	110.3	111.0	113.6	112.8	119.5
2,480.0	80	3,501	112.1	113.1	113.7	114.3	114.2	111.8	109.9	110.6	113.1	112.6	121.8
2,325.0	75	3,282	111.9	112.8	113.3	113.9	114.1	111.6	109.8	110.4	112.9	112.5	123.1
2,170.0	70	3,063	111.7	112.5	112.8	113.6	114.0	111.4	109.6	110.3	112.6	112.4	124.3
1,860.0	60	2,626	111.2	111.9	112.0	112.9	113.8	110.9	109.2	109.9	112.2	112.2	126.8
1,550.0	50	2,188	110.8	111.3	111.1	112.2	113.7	110.5	108.9	109.6	111.8	112.1	129.3
1,240.0	40	1,750	110.4	110.7	110.3	111.5	113.5	110.1	108.5	109.2	111.3	111.9	131.8
930.0	30	1,313	110.0	110.1	109.4	110.8	113.3	109.6	108.2	108.8	110.9	111.7	134.2
775.0	25	1,094	109.7	109.8	109.0	110.5	113.2	109.4	108.0	108.7	110.7	111.6	135.5
620.0	20	875	109.5	109.5	108.6	110.2	113.1	109.2	107.8	108.5	110.5	111.5	136.7
310.0	10	438	109.1	108.9	107.8	109.5	112.9	108.8	107.5	108.1	110.0	111.3	139.2

Emissions Data Top

Units Filter: All Units

RATED SPEED POTENTIAL SITE VARIATION: 1800 RPM

GENSET POWER WITHOUT FAN		EKW	3,100.0	2,325.0	1,550.0	775.0	310.0
ENGINE POWER		BHP	4,376	3,282	2,188	1,094	438
PERCENT LOAD		%	100	75	50	25	10
TOTAL NOX (AS NO2)		G/HR	31,683	20,556	8,412	3,523	3,586
TOTAL CO		G/HR	2,743	3,359	1,704	1,822	1,827
TOTAL HC		G/HR	238	195	372	378	330
PART MATTER		G/HR	162.5	167.1	120.5	135.6	125.3
TOTAL NOX (AS NO2)	(CORR 5% O2)	MG/NM3	3,729.4	3,245.7	1,732.0	1,314.5	2,738.0
TOTAL CO	(CORR 5% O2)	MG/NM3	284.3	453.8	295.6	579.5	1,199.1
TOTAL HC	(CORR 5% O2)	MG/NM3	20.3	23.4	57.6	103.9	188.1
PART MATTER	(CORR 5% O2)	MG/NM3	14.4	19.7	18.8	38.6	76.0
TOTAL NOX (AS NO2)	(CORR 5% O2)	PPM	1,817	1,581	844	640	1,334
TOTAL CO	(CORR 5% O2)	PPM	227	363	236	464	959
TOTAL HC	(CORR 5% O2)	PPM	38	44	108	194	351
TOTAL NOX (AS NO2)		G/HP-HR	7.26	6.28	3.85	3.22	8.18
TOTAL CO		G/HP-HR	0.63	1.03	0.78	1.66	4.17
TOTAL HC		G/HP-HR	0.05	0.06	0.17	0.35	0.75
PART MATTER		G/HP-HR	0.04	0.05	0.06	0.12	0.29
TOTAL NOX (AS NO2)		LB/HR	69.85	45.32	18.54	7.77	7.91
TOTAL CO		LB/HR	6.05	7.41	3.76	4.02	4.03
TOTAL HC		LB/HR	0.52	0.43	0.82	0.83	0.73
PART MATTER		LB/HR	0.36	0.37	0.27	0.30	0.28

RATED SPEED NOMINAL DATA: 1800 RPM

GENSET POWER WITHOUT FAN		EKW	3,100.0	2,325.0	1,550.0	775.0	310.0
ENGINE POWER		BHP	4,376	3,282	2,188	1,094	438
PERCENT LOAD		%	100	75	50	25	10
TOTAL NOX (AS NO2)		G/HR	26,403	17,130	7,010	2,936	2,988
TOTAL CO		G/HR	1,524	1,866	947	1,012	1,015
TOTAL HC		G/HR	179	147	279	284	248
TOTAL CO2		KG/HR	2,206	1,619	1,240	696	327
PART MATTER		G/HR	116.1	119.3	86.1	96.8	89.5
TOTAL NOX (AS NO2)	(CORR 5% O2)	MG/NM3	3,107.8	2,704.7	1,443.3	1,095.5	2,281.7
TOTAL CO	(CORR 5% O2)	MG/NM3	157.9	252.1	164.2	321.9	666.1
TOTAL HC	(CORR 5% O2)	MG/NM3	15.2	17.6	43.3	78.1	141.4
PART MATTER	(CORR 5% O2)	MG/NM3	10.3	14.0	13.4	27.5	54.3
TOTAL NOX (AS NO2)	(CORR 5% O2)	PPM	1,514	1,317	703	534	1,111
TOTAL CO	(CORR 5% O2)	PPM	126	202	131	258	533
TOTAL HC	(CORR 5% O2)	PPM	28	33	81	146	264
TOTAL NOX (AS NO2)		G/HP-HR	6.05	5.23	3.21	2.68	6.82
TOTAL CO		G/HP-HR	0.35	0.57	0.43	0.92	2.32
TOTAL HC		G/HP-HR	0.04	0.04	0.13	0.26	0.57
PART MATTER		G/HP-HR	0.03	0.04	0.04	0.09	0.20
TOTAL NOX (AS NO2)		LB/HR	58.21	37.76	15.45	6.47	6.59
TOTAL CO		LB/HR	3.36	4.11	2.09	2.23	2.24
TOTAL HC		LB/HR	0.39	0.32	0.62	0.63	0.55
TOTAL CO2		LB/HR	4,863	3,570	2,735	1,535	720
PART MATTER		LB/HR	0.26	0.26	0.19	0.21	0.20
OXYGEN IN EXH		%	9.6	10.3	11.7	12.9	15.2
DRY SMOKE OPACITY		%	0.7	0.9	0.3	0.9	2.3
BOSCH SMOKE NUMBER			0.26	0.34	0.12	0.35	0.74

Regulatory Information Top

EPA TIER 2 **2006 - 2010**

GASEOUS EMISSIONS DATA MEASUREMENTS PROVIDED TO THE EPA ARE CONSISTENT WITH THOSE DESCRIBED IN EPA 40 CFR PART 89 SUBPART D AND ISO 8178 FOR MEASURING HC, CO, PM, AND NOX. THE "MAX LIMITS" SHOWN BELOW ARE WEIGHTED CYCLE AVERAGES AND ARE IN COMPLIANCE WITH THE NON-ROAD REGULATIONS.

Locality	Agency	Regulation	Tier/Stage	Max Limits - G/BKW - HR
U.S. (INCL CALIF)	EPA	NON-ROAD	TIER 2	CO: 3.5 NOx + HC: 6.4 PM: 0.20

EPA EMERGENCY STATIONARY **2011 - ----**

GASEOUS EMISSIONS DATA MEASUREMENTS PROVIDED TO THE EPA ARE CONSISTENT WITH THOSE DESCRIBED IN EPA 40 CFR PART 60 SUBPART IIII AND ISO 8178 FOR MEASURING HC, CO, PM, AND NOX. THE "MAX LIMITS" SHOWN BELOW ARE WEIGHTED CYCLE AVERAGES AND ARE IN COMPLIANCE WITH THE EMERGENCY STATIONARY REGULATIONS.

Locality	Agency	Regulation	Tier/Stage	Max Limits - G/BKW - HR

EPA EMERGENCY STATIONARY		2011 - ----		
U.S. (INCL CALIF)	EPA	STATIONARY	EMERGENCY STATIONARY	CO: 3.5 NOx + HC: 6.4 PM: 0.20

Altitude Derate Data Top

Note(s)

ALTITUDE DERATE DATA IS BASED ON THE ASSUMPTION OF A 20 DEGREES CELSIUS(36 DEGREES FAHRENHEIT) DIFFERENCE BETWEEN AMBIENT OPERATING TEMPERATURE AND ENGINE INLET MANIFOLD TEMPERATURE (IMAT). AMBIENT OPERATING TEMPERATURE IS DEFINED AS THE AIR TEMPERATURE MEASURED AT THE TURBOCHARGER COMPRESSOR INLET.

ALTITUDE CORRECTED POWER CAPABILITY (BHP)

AMBIENT OPERATING TEMP (F)	30	40	50	60	70	80	90	100	110	120	130	140	NORMAL
ALTITUDE (FT)													
0	4,376	4,376	4,376	4,376	4,376	4,376	4,376	4,376	4,376	4,376	4,376	4,376	4,376
1,000	4,376	4,376	4,376	4,376	4,376	4,376	4,376	4,376	4,376	4,376	4,376	4,376	4,376
2,000	4,376	4,376	4,376	4,376	4,376	4,376	4,376	4,376	4,376	4,376	4,376	4,355	4,376
3,000	4,376	4,376	4,376	4,376	4,376	4,376	4,376	4,376	4,376	4,376	4,309	4,216	4,376
4,000	4,345	4,345	4,345	4,345	4,345	4,345	4,344	4,344	4,343	4,280	4,190	4,100	4,345
5,000	4,174	4,174	4,174	4,174	4,174	4,174	4,173	4,172	4,170	4,130	4,073	4,017	4,174
6,000	4,015	4,015	4,015	4,015	4,015	4,015	4,013	4,011	4,008	3,988	3,960	3,933	4,015
7,000	3,868	3,868	3,868	3,868	3,868	3,868	3,866	3,863	3,859	3,853	3,847	3,840	3,868
8,000	3,751	3,751	3,751	3,751	3,751	3,751	3,749	3,745	3,742	3,736	3,729	3,723	3,751
9,000	3,634	3,634	3,634	3,634	3,634	3,634	3,633	3,628	3,624	3,618	3,612	3,606	3,634
10,000	3,523	3,523	3,523	3,523	3,523	3,523	3,521	3,517	3,512	3,506	3,500	3,495	3,523
11,000	3,417	3,417	3,417	3,417	3,417	3,417	3,415	3,411	3,406	3,400	3,394	3,388	3,417
12,000	3,312	3,312	3,312	3,312	3,312	3,312	3,310	3,304	3,299	3,294	3,288	3,282	3,312
13,000	3,206	3,206	3,206	3,206	3,206	3,206	3,204	3,198	3,193	3,188	3,182	3,176	3,206
14,000	3,100	3,100	3,100	3,100	3,100	3,100	3,098	3,093	3,088	3,083	3,079	3,074	3,100
15,000	2,993	2,993	2,993	2,993	2,993	2,993	2,991	2,988	2,984	2,981	2,977	2,974	2,993

Cross Reference Top

Test Spec	Setting	Engine Arrangement	Engineering Model	Engineering Model Version	Start Effective Serial Number	End Effective Serial Number
0K9167	LL6027	3079788	GS265	-	WYB00620	

Performance Parameter Reference Top

Parameters Reference: DM9600 - 11

PERFORMANCE DEFINITIONS

PERFORMANCE DEFINITIONS DM9600

APPLICATION: Engine performance tolerance values below are representative of a typical production engine tested in a calibrated dynamometer test cell at SAE J1995 standard reference conditions. Caterpillar maintains ISO9001:2000 certified quality management systems for engine test Facilities to assure accurate calibration of test equipment. Engine test data is corrected in accordance with SAE J1995. Additional reference material SAE J1228, J1349, ISO 8665, 3046-1:2002E, 3046-3:1989, 1585, 2534, 2288, and 9249 may apply in part or are similar to SAE J1995. Special engine rating request (SERR) test data shall be noted.

PERFORMANCE PARAMETER TOLERANCE FACTORS: Power +/- 3% Torque +/- 3% Exhaust stack temperature +/- 8% Inlet airflow +/- 5% Intake manifold pressure-gage +/- 10% Exhaust flow +/- 6% Specific fuel consumption +/- 3% Fuel rate +/- 5% Specific DEF consumption +/- 3% DEF rate +/- 5% Heat rejection +/- 5% Heat rejection exhaust only +/- 10% Heat rejection CEM only +/- 10%
Heat Rejection values based on using treated water.
Torque is included for truck and industrial applications, do not use for Gen Set or steady state applications.
On C7 - C18 engines, at speeds of 1100 RPM and under these values are provided for reference only, and may not meet the tolerance listed.
These values do not apply to C280/3600. For these models, see the tolerances listed below.

C280/3600 HEAT REJECTION TOLERANCE FACTORS: Heat rejection +/- 10% Heat rejection to Atmosphere +/- 50% Heat rejection to Lube Oil +/- 20% Heat rejection to Aftercooler +/- 5%

TEST CELL TRANSDUCER TOLERANCE FACTORS: Torque +/- 0.5% Speed +/- 0.2% Fuel flow +/- 1.0% Temperature +/- 2.0 C degrees Intake manifold pressure +/- 0.1 kPa
OBSERVED ENGINE PERFORMANCE IS CORRECTED TO SAE J1995 REFERENCE AIR AND FUEL CONDITIONS.

REFERENCE ATMOSPHERIC INLET AIR FOR 3500 ENGINES AND SMALLER SAE J1228 AUG2002 for marine engines, and J1995 JAN2014 for other engines, reference atmospheric pressure is 100 KPA (29.61 in hg), and standard temperature is 25deg C (77 deg F) at 30% relative humidity at the stated aftercooler water temp, or inlet manifold temp.
FOR 3600 ENGINES Engine rating obtained and presented in accordance with ISO 3046/1 and SAE J1995 JANJAN2014 reference atmospheric pressure is 100 KPA (29.61 in hg), and standard temperature is 25deg C (77 deg F) at 30% relative humidity and 150M altitude at the stated aftercooler water temperature.

MEASUREMENT LOCATION FOR INLET AIR TEMPERATURE Location for air temperature measurement air cleaner inlet at stabilized operating conditions.

REFERENCE EXHAUST STACK DIAMETER The Reference Exhaust Stack Diameter published with this dataset is only used for the calculation of Smoke Opacity values displayed in this dataset. This value does not necessarily represent the actual stack diameter of the engine due to the variety of exhaust stack adapter options available. Consult the price list, engine order or general dimension drawings for the actual stack diameter size ordered or options available.

REFERENCE FUEL DIESEL Reference fuel is #2 distillate diesel with a 35API gravity; A lower heating value is 42,780 KJ/KG (18,390 BTU/LB) when used at 29 deg C (84.2 deg F), where the density is 838.9 G/Liter (7.001 Lbs/Gal).
GAS Reference natural gas fuel has a lower heating value of 33.74 KJ/L (905 BTU/CU Ft). Low BTU ratings are based on 18.64 KJ/L (500 BTU/CU FT) lower heating value gas. Propane ratings are based on 87.56 KJ/L (2350 BTU/CU Ft) lower heating value gas.

ENGINE POWER (NET) IS THE CORRECTED FLYWHEEL POWER (GROSS) LESS EXTERNAL AUXILIARY LOAD
Engine corrected gross output includes the power required to drive standard equipment; lube oil, scavenge lube oil, fuel transfer, common rail fuel, separate circuit aftercooler and jacket water pumps. Engine net power available for the external (flywheel) load is calculated by subtracting the sum of auxiliary load from the corrected gross flywheel out put power. Typical auxiliary loads are radiator cooling fans, hydraulic pumps, air compressors and battery charging alternators. For Tier 4 ratings additional Parasitic losses would also include Intake, and Exhaust Restrictions.

ALTITUDE CAPABILITY Altitude capability is the maximum altitude above sea level at standard temperature and standard pressure at which the engine could develop full rated output power on the current performance data set. Standard temperature values versus altitude could be seen on TM2001.
When viewing the altitude capability chart the ambient temperature is the inlet air temp at the compressor inlet.
Engines with ADEM MEUI and HEUI fuel systems operating at conditions above the defined altitude capability derate for atmospheric pressure and temperature conditions outside the values defined, see TM2001.
Mechanical governor controlled unit injector engines require a setting change for operation at conditions above the altitude defined on the engine performance sheet. See your Caterpillar technical representative for non standard ratings.

REGULATIONS AND PRODUCT COMPLIANCE TMI Emissions information is presented at 'nominal' and 'Potential Site Variation' values for standard ratings. No tolerances are applied to the emissions data. These values are subject to change at any time. The controlling federal and local emission requirements need to be verified by your Caterpillar technical representative.
Customer's may have special emission site requirements that need to be verified by the Caterpillar Product Group engineer.

EMISSIONS DEFINITIONS: Emissions : DM1176

EMISSION CYCLE DEFINITIONS
1. For constant-speed marine engines for ship main propulsion, including,diesel-electric drive, test cycle E2 shall be applied, for controllable-pitch propeller sets test cycle E2 shall be applied.
2. For propeller-law-operated main and propeller-law-operated auxiliary engines the test cycle E3 shall be applied.
3. For constant-speed auxiliary engines test cycle D2 shall be applied.
4. For variable-speed, variable-load auxiliary engines, not included above, test cycle C1 shall be applied.

HEAT REJECTION DEFINITIONS: Diesel Circuit Type and HHV Balance : DM9500

HIGH DISPLACEMENT (HD) DEFINITIONS: 3500: EM1500

RATING DEFINITIONS: Agriculture : TM6008
Fire Pump : TM6009
Generator Set : TM6035
Generator (Gas) : TM6041
Industrial Diesel : TM6010
Industrial (Gas) : TM6040
Irrigation : TM5749
Locomotive : TM6037
Marine Auxiliary : TM6036
Marine Prop (Except 3600) : TM5747
Marine Prop (3600 only) : TM5748
MSHA : TM6042
Oil Field (Petroleum) : TM6011
Off-Highway Truck : TM6039
On-Highway Truck : TM6038

SOUND DEFINITIONS: Sound Power : DM8702
Sound Pressure : TM7080

Date Released : 11/29/18

PERFORMANCE DATA [C18DE9D]

JUNE 18, 2019

For Help Desk Phone Numbers Click here

Perf No: EM1017 **Change Level:** 03

General | Heat Rejection | Emissions | Regulatory | Altitude Derate | Cross Reference | Perf Param Ref

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SALES MODEL:	C18	**COMBUSTION:**	DIRECT INJECTION
BRAND:	CAT	**ENGINE SPEED (RPM):**	1,800
ENGINE POWER (BHP):	779	**HERTZ:**	60
GEN POWER WITH FAN (EKW):	500.0	**FAN POWER (HP):**	32.2
COMPRESSION RATIO:	16.1	**ADDITIONAL PARASITICS (HP):**	2.7
RATING LEVEL:	STANDBY	**ASPIRATION:**	TA
PUMP QUANTITY:	1	**AFTERCOOLER TYPE:**	ATAAC
FUEL TYPE:	DIESEL	**AFTERCOOLER CIRCUIT TYPE:**	JW+OC, ATAAC
MANIFOLD TYPE:	DRY	**INLET MANIFOLD AIR TEMP (F):**	127
GOVERNOR TYPE:	ELEC	**JACKET WATER TEMP (F):**	192.2
ELECTRONICS TYPE:	ADEM4	**TURBO CONFIGURATION:**	SINGLE
CAMSHAFT TYPE:	STANDARD	**TURBO QUANTITY:**	1
IGNITION TYPE:	CI	**TURBOCHARGER MODEL:**	S430S 0.88 A/R VOF
INJECTOR TYPE:	EUI	**CERTIFICATION YEAR:**	2015
REF EXH STACK DIAMETER (IN):	6	**PISTON SPD @ RATED ENG SPD (FT/MIN):**	2,161.4
MAX OPERATING ALTITUDE (FT):	3,002		

INDUSTRY	SUB INDUSTRY	APPLICATION
ELECTRIC POWER	STANDARD	PACKAGED GENSET

General Performance Data Top

Note(s)
INLET MANIFOLD AIR TEMPERATURE ("INLET MFLD TEMP") FOR THIS CONFIGURATION IS MEASURED AT THE OUTLET OF THE AFTERCOOLER.

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	BRAKE MEAN EFF PRES (BMEP)	BRAKE SPEC FUEL CONSUMPTN (BSFC)	VOL FUEL CONSUMPTN (VFC)	INLET MFLD PRES	INLET MFLD TEMP	EXH MFLD TEMP	EXH MFLD PRES	ENGINE OUTLET TEMP
EKW	%	BHP	PSI	LB/BHP-HR	GAL/HR	IN-HG	DEG F	DEG F	IN-HG	DEG F
500.0	100	744	296	0.348	37.0	69.3	122.2	1,261.4	86.5	836.8
450.0	90	673	267	0.349	33.5	63.8	122.1	1,208.5	79.6	799.7
400.0	80	601	239	0.348	29.9	57.8	122.1	1,152.4	72.0	761.9
375.0	75	566	225	0.349	28.2	54.7	122.1	1,125.7	68.2	744.2
350.0	70	530	211	0.350	26.5	51.5	122.1	1,100.2	64.4	727.6
300.0	60	460	183	0.354	23.2	45.2	122.0	1,048.6	56.7	694.6
250.0	50	390	155	0.360	20.1	38.6	122.0	993.0	49.1	659.8
200.0	40	321	128	0.370	17.0	31.6	121.7	930.1	41.7	620.8
150.0	30	252	100	0.386	13.9	24.9	121.2	856.8	34.2	576.1
125.0	25	218	87	0.400	12.4	21.8	120.9	815.8	30.5	551.4
100.0	20	182	73	0.419	10.9	18.9	120.0	769.5	27.2	523.9
50.0	10	110	44	0.506	7.9	14.1	114.9	654.1	23.6	456.8

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	COMPRESSOR OUTLET PRES	COMPRESSOR OUTLET TEMP	WET INLET AIR VOL FLOW RATE	ENGINE OUTLET WET EXH GAS VOL FLOW RATE	WET INLET AIR MASS FLOW RATE	WET EXH GAS MASS FLOW RATE	WET EXH VOL FLOW RATE (32 DEG F AND 29.98 IN HG)	DRY EXH VOL FLOW RATE (32 DEG F AND 29.98 IN HG)
EKW	%	BHP	IN-HG	DEG F	CFM	CFM	LB/HR	LB/HR	FT3/MIN	FT3/MIN
500.0	100	744	76	401.6	1,340.0	2,465.3	5,817.5	6,076.5	934.9	843.1
450.0	90	673	70	382.0	1,282.0	2,350.9	5,554.9	5,788.7	917.8	831.6
400.0	80	601	64	360.3	1,211.3	2,221.8	5,237.0	5,446.2	894.3	813.8
375.0	75	566	60	349.3	1,173.9	2,156.0	5,069.8	5,267.1	880.5	802.8
350.0	70	530	57	338.1	1,135.6	2,089.2	4,899.2	5,084.7	865.2	790.2
300.0	60	460	50	315.1	1,056.3	1,949.9	4,547.3	4,709.8	830.6	761.4
250.0	50	390	43	290.8	972.6	1,801.9	4,177.8	4,318.1	791.4	728.3
200.0	40	321	36	261.7	871.7	1,621.2	3,735.6	3,854.2	737.7	682.0
150.0	30	252	29	232.7	780.5	1,440.5	3,336.9	3,434.4	683.8	635.7
125.0	25	218	25	218.8	742.6	1,354.0	3,171.5	3,258.4	658.4	614.1
100.0	20	182	22	205.9	714.2	1,274.2	3,047.2	3,123.6	637.0	596.4
50.0	10	110	18	183.4	688.2	1,136.5	2,933.1	2,988.7	609.7	577.6

Heat Rejection Data Top

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	REJECTION TO JACKET WATER	REJECTION TO ATMOSPHERE	REJECTION TO EXH	EXHUAST RECOVERY TO 350F	FROM OIL COOLER	FROM AFTERCOOLER	WORK ENERGY	LOW HEAT VALUE ENERGY	HIGH HEAT VALUE ENERGY
EKW	%	BHP	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN
500.0	100	744	16,038	5,739	24,758	12,589	4,231	6,509	31,568	79,429	84,612
450.0	90	673	14,560	5,356	22,331	11,023	3,827	5,781	28,519	71,857	76,546
400.0	80	601	13,203	4,843	19,835	9,453	3,419	4,995	25,499	64,187	68,376
375.0	75	566	12,567	4,609	18,654	8,732	3,222	4,613	23,998	60,493	64,440
350.0	70	530	11,954	4,397	17,522	8,056	3,030	4,239	22,495	56,894	60,607
300.0	60	460	10,771	3,992	15,335	6,779	2,656	3,515	19,509	49,869	53,123
250.0	50	390	9,626	3,651	13,207	5,563	2,292	2,825	16,539	43,040	45,848
200.0	40	321	8,495	3,583	10,986	4,318	1,939	2,095	13,629	36,413	38,788
150.0	30	252	7,376	3,338	8,946	3,194	1,593	1,490	10,707	29,906	31,858
125.0	25	218	6,818	3,097	8,025	2,691	1,421	1,243	9,230	26,674	28,414
100.0	20	182	6,239	2,779	7,179	2,218	1,249	1,048	7,733	23,449	24,979
50.0	10	110	4,839	2,191	5,647	1,288	907	804	4,660	17,030	18,141

Emissions Data Top

Units Filter All Units

RATED SPEED POTENTIAL SITE VARIATION: 1800 RPM

GENSET POWER WITH FAN		EKW	500.0	375.0	250.0	125.0	50.0
ENGINE POWER		BHP	744	566	390	218	110
PERCENT LOAD		%	100	75	50	25	10
TOTAL NOX (AS NO2)		G/HR	232	225	70	22	53
TOTAL CO		G/HR	0	0	0	0	0
TOTAL HC		G/HR	20	8	0	0	0
PART MATTER		G/HR	16.6	7.8	5.0	3.2	2.1
TOTAL NOX (AS NO2)	(CORR 5% O2)	MG/NM3	144.8	183.4	80.3	45.3	188.2
TOTAL CO	(CORR 5% O2)	MG/NM3	0.0	0.0	0.0	0.0	0.1
TOTAL HC	(CORR 5% O2)	MG/NM3	10.5	5.4	0.0	0.0	0.0
PART MATTER	(CORR 5% O2)	MG/NM3	8.3	5.3	4.9	5.3	5.8
TOTAL NOX (AS NO2)	(CORR 5% O2)	PPM	71	89	39	22	92
TOTAL CO	(CORR 5% O2)	PPM	0	0	0	0	0
TOTAL HC	(CORR 5% O2)	PPM	20	10	0	0	0
TOTAL NOX (AS NO2)		G/HP-HR	0.31	0.40	0.18	0.10	0.49
TOTAL CO		G/HP-HR	0.00	0.00	0.00	0.00	0.00
TOTAL HC		G/HP-HR	0.03	0.01	0.00	0.00	0.00
PART MATTER		G/HP-HR	0.02	0.01	0.01	0.01	0.02
TOTAL NOX (AS NO2)		LB/HR	0.51	0.50	0.15	0.05	0.12
TOTAL CO		LB/HR	0.00	0.00	0.00	0.00	0.00
TOTAL HC		LB/HR	0.04	0.02	0.00	0.00	0.00

GENSET POWER WITH FAN ENGINE POWER		EKW BHP	500.0 744	375.0 566	250.0 390	125.0 218	50.0 110
PERCENT LOAD		**%**	**100**	**75**	**50**	**25**	**10**
PART MATTER		LB/HR	0.04	0.02	0.01	0.01	0.00

RATED SPEED NOMINAL DATA: 1800 RPM

GENSET POWER WITH FAN ENGINE POWER		EKW BHP	500.0 744	375.0 566	250.0 390	125.0 218	50.0 110
PERCENT LOAD		**%**	**100**	**75**	**50**	**25**	**10**
TOTAL NOX (AS NO2)		G/HR	161	156	48	15	37
TOTAL CO		G/HR	0	0	0	0	0
TOTAL HC		G/HR	9	4	0	0	0
TOTAL CO2		KG/HR	375	285	203	125	80
PART MATTER		G/HR	4.3	2.0	1.3	0.8	0.6
TOTAL NOX (AS NO2)	(CORR 5% O2)	MG/NM3	100.5	127.4	55.8	31.4	130.7
TOTAL CO	(CORR 5% O2)	MG/NM3	0.0	0.0	0.0	0.0	0.0
TOTAL HC	(CORR 5% O2)	MG/NM3	4.9	2.5	0.0	0.0	0.0
PART MATTER	(CORR 5% O2)	MG/NM3	2.2	1.4	1.3	1.4	1.5
TOTAL NOX (AS NO2)	(CORR 5% O2)	PPM	49	62	27	15	64
TOTAL CO	(CORR 5% O2)	PPM	0	0	0	0	0
TOTAL HC	(CORR 5% O2)	PPM	9	5	0	0	0
FORMALDEHYDE	(CORR 15% O2)	PPM	0.00	0.00	0.00	0.03	0.01
ACROLEIN	(CORR 15% O2)	PPM	0.10	0.15	0.57	0.35	0.62
ACETALDEHYDE	(CORR 15% O2)	PPM	0.16	0.32	0.42	0.10	0.71
METHANOL	(CORR 15% O2)	PPM	0.00	0.07	0.03	0.00	0.00
NON-METHANE HC	(CORR 15% O2)	PPM	2.42	1.28	0.00	0.00	0.00
NON-ETHANE HC	(CORR 15% O2)	PPM	2.42	1.28	0.00	0.00	0.00
TOTAL NOX (AS NO2)		G/HP-HR	0.22	0.28	0.13	0.07	0.34
TOTAL CO		G/HP-HR	0.00	0.00	0.00	0.00	0.00
TOTAL HC		G/HP-HR	0.01	0.01	0.00	0.00	0.00
PART MATTER		G/HP-HR	0.01	0.00	0.00	0.00	0.01
TOTAL NOX (AS NO2)		LB/HR	0.36	0.34	0.11	0.03	0.08
TOTAL CO		LB/HR	0.00	0.00	0.00	0.00	0.00
TOTAL HC		LB/HR	0.02	0.01	0.00	0.00	0.00
TOTAL CO2		LB/HR	826	628	447	275	176
PART MATTER		LB/HR	0.01	0.00	0.00	0.00	0.00
OXYGEN IN EXH		%	7.6	9.5	11.1	13.2	15.7

Regulatory Information Top

EPA TIER 4 FINAL **2015 - ----**

GASEOUS EMISSIONS DATA MEASUREMENTS PROVIDED TO THE EPA ARE CONSISTENT WITH THOSE DESCRIBED IN EPA 40 CFR PART 1039 SUBPART F AND ISO 8178 FOR MEASURING HC, CO, PM, AND NOX. THE "MAX LIMITS" SHOWN BELOW ARE WEIGHTED CYCLE AVERAGES AND ARE IN COMPLIANCE WITH THE NON-ROAD REGULATIONS.

Locality	Agency	Regulation	Tier/Stage	Max Limits - G/BKW - HR
U.S. (INCL CALIF)	EPA	NON-ROAD GENSET	TIER 4 FINAL	CO: 3.5 NOx: 0.67 HC: 0.19 PM: 0.03

Altitude Derate Data Top

ALTITUDE CORRECTED POWER CAPABILITY (BHP)

AMBIENT OPERATING TEMP (F)	50	60	70	80	90	100	110	120	130	140	NORMAL
ALTITUDE (FT)											
0	779	779	779	779	777	774	771	768	576	516	779
1,000	779	779	779	777	774	771	768	699	557	511	778
2,000	779	778	776	774	771	751	719	593	529	501	776
3,000	777	775	773	770	751	651	571	543	516	489	773
4,000	773	771	769	754	674	582	552	526	501	476	770
5,000	769	761	736	669	602	557	533	509	485	462	765
6,000	725	679	653	604	560	536	514	492	470	449	704
7,000	648	592	577	560	537	515	495	474	454	435	648
8,000	585	567	553	538	516	495	475	456	437	418	595
9,000	557	544	531	516	496	476	456	436	418	400	573
10,000	533	522	508	494	474	454	431	404	380	362	555
11,000	514	503	495	487	462	431	398	373	358	357	534

AMBIENT OPERATING TEMP (F)	50	60	70	80	90	100	110	120	130	140	NORMAL
12,000	495	485	483	471	445	417	384	372	371	369	514
13,000	473	463	461	444	412	381	379	378	376	374	495
14,000	449	434	420	392	381	379	378	376	374	372	470
15,000	397	379	367	381	379	377	376	374	372	370	442

Cross Reference Top

Test Spec	Setting	Engine Arrangement	Engineering Model	Engineering Model Version	Start Effective Serial Number	End Effective Serial Number
4150867	PP7129	4190902	PS072	LS	CM800001	
4150867	PP7129	4190904	GS759	LS	CM800001	
4150867	PP7129	5194410	PS072	LS	CM800001	
5526359	PP7990	5424853	EE545	-	TC400001	

Performance Parameter Reference Top

Parameters Reference: DM9600 - 11

PERFORMANCE DEFINITIONS

PERFORMANCE DEFINITIONS DM9600

APPLICATION: Engine performance tolerance values below are representative of a typical production engine tested in a calibrated dynamometer test cell at SAE J1995 standard reference conditions. Caterpillar maintains ISO9001:2000 certified quality management systems for engine test Facilities to assure accurate calibration of test equipment. Engine test data is corrected in accordance with SAE J1995. Additional reference material SAE J1228, J1349, ISO 8665, 3046-1:2002E, 3046-3:1989, 1585, 2534, 2288, and 9249 may apply in part or are similar to SAE J1995. Special engine rating request (SERR) test data shall be noted.

PERFORMANCE PARAMETER TOLERANCE FACTORS: Power +/- 3% Torque +/- 3% Exhaust stack temperature +/- 8% Inlet airflow +/- 5% Intake manifold pressure-gage +/- 10% Exhaust flow +/- 6% Specific fuel consumption +/- 3% Fuel rate +/- 5% Specific DEF consumption +/- 3% DEF rate +/- 5% Heat rejection +/- 5% Heat rejection exhaust only +/- 10% Heat rejection CEM only +/- 10%
Heat Rejection values based on using treated water.
Torque is included for truck and industrial applications, do not use for Gen Set or steady state applications.
On C7 - C18 engines, at speeds of 1100 RPM and under these values are provided for reference only, and may not meet the tolerance listed.
These values do not apply to C280/3600. For these models, see the tolerances listed below.

C280/3600 HEAT REJECTION TOLERANCE FACTORS: Heat rejection +/- 10% Heat rejection to Atmosphere +/- 50% Heat rejection to Lube Oil +/- 20% Heat rejection to Aftercooler +/- 5%

TEST CELL TRANSDUCER TOLERANCE FACTORS: Torque +/- 0.5% Speed +/- 0.2% Fuel flow +/- 1.0% Temperature +/- 2.0 C degrees Intake manifold pressure +/- 0.1 kPa
OBSERVED ENGINE PERFORMANCE IS CORRECTED TO SAE J1995 REFERENCE AIR AND FUEL CONDITIONS.

REFERENCE ATMOSPHERIC INLET AIR FOR 3500 ENGINES AND SMALLER SAE J1228 AUG2002 for marine engines, and J1995 JAN2014 for other engines, reference atmospheric pressure is 100 KPA (29.61 in hg), and standard temperature is 25deg C (77 deg F) at 30% relative humidity at the stated aftercooler water temp, or inlet manifold temp.
FOR 3600 ENGINES Engine rating obtained and presented in accordance with ISO 3046/1 and SAE J1995 JANJAN2014 reference atmospheric pressure is 100 KPA (29.61 in hg), and standard temperature is 25deg C (77 deg F) at 30% relative humidity and 150M altitude at the stated aftercooler water temperature.

MEASUREMENT LOCATION FOR INLET AIR TEMPERATURE Location for air temperature measurement air cleaner inlet at stabilized operating conditions.

REFERENCE EXHAUST STACK DIAMETER The Reference Exhaust Stack Diameter published with this dataset is only used for the calculation of Smoke Opacity values displayed in this dataset. This value does not necessarily represent the actual stack diameter of the engine due to the variety of exhaust stack adapter options available. Consult the price list, engine order or general dimension drawings for the actual stack diameter size ordered or options available.

REFERENCE FUEL DIESEL Reference fuel is #2 distillate diesel with a 35API gravity; A lower heating value is 42,780 KJ/KG (18,390 BTU/LB) when used at 29 deg C (84.2 deg F), where the density is 838.9 G/Liter (7.001 Lbs/Gal).
GAS Reference natural gas fuel has a lower heating value of 33.74 KJ/L (905 BTU/CU Ft). Low BTU ratings are based on 18.64 KJ/L (500 BTU/CU FT) lower heating value gas. Propane ratings are based on 87.56 KJ/L (2350 BTU/CU Ft) lower heating value gas.

ENGINE POWER (NET) IS THE CORRECTED FLYWHEEL POWER (GROSS) LESS EXTERNAL AUXILIARY LOAD Engine corrected gross output includes the power required to drive standard equipment; lube oil, scavenge lube oil, fuel transfer, common rail fuel, separate circuit aftercooler and jacket water pumps. Engine net power available for the external (flywheel) load is calculated by subtracting the sum of auxiliary load from the corrected gross flywheel out put power. Typical auxiliary loads are radiator cooling fans, hydraulic pumps, air compressors and battery charging alternators. For Tier 4 ratings additional Parasitic losses would also include Intake, and Exhaust Restrictions.

ALTITUDE CAPABILITY Altitude capability is the maximum altitude above sea level at standard temperature and standard pressure at which the engine could develop full rated output power on the current performance data set. Standard temperature values versus altitude could be seen on TM2001.
When viewing the altitude capability chart the ambient temperature is the inlet air temp at the compressor inlet.
Engines with ADEM MEUI and HEUI fuel systems operating at conditions above the defined altitude capability derate for atmospheric pressure and temperature conditions outside the values defined, see TM2001.
Mechanical governor controlled unit injector engines require a setting change for operation at conditions above the altitude defined on the engine performance sheet. See your Caterpillar technical representative for non standard ratings.

REGULATIONS AND PRODUCT COMPLIANCE TMI Emissions information is presented at 'nominal' and 'Potential Site Variation' values for standard ratings. No tolerances are applied to the emissions data. These values are subject to change at any time. The controlling federal and local emission requirements need to be verified by your Caterpillar technical representative.
Customer's may have special emission site requirements that need to be verified by the Caterpillar Product Group engineer.

EMISSIONS DEFINITIONS: Emissions : DM1176

EMISSION CYCLE DEFINITIONS
1. For constant-speed marine engines for ship main propulsion, including,diesel-electric drive, test cycle E2 shall be applied, for controllable-pitch propeller sets test cycle E2 shall be applied.
2. For propeller-law-operated main and propeller-law-operated auxiliary engines the test cycle E3 shall be applied.
3. For constant-speed auxiliary engines test cycle D2 shall be applied.
4. For variable-speed, variable-load auxiliary engines, not included above, test cycle C1 shall be applied.

HEAT REJECTION DEFINITIONS: Diesel Circuit Type and HHV Balance : DM9500

HIGH DISPLACEMENT (HD) DEFINITIONS: 3500: EM1500

RATING DEFINITIONS: Agriculture : TM6008
Fire Pump : TM6009
Generator Set : TM6035
Generator (Gas) : TM6041
Industrial Diesel : TM6010
Industrial (Gas) : TM6040
Irrigation : TM5749
Locomotive : TM6037
Marine Auxiliary : TM6036
Marine Prop (Except 3600) : TM5747
Marine Prop (3600 only) : TM5748
MSHA : TM6042
Oil Field (Petroleum) : TM6011
Off-Highway Truck : TM6039
On-Highway Truck : TM6038

SOUND DEFINITIONS: Sound Power : DM8702
Sound Pressure : TM7080

Date Released : 11/29/18

C175-16 (DM8455, Rev 08)
Rated speed PSV: 1800 rpm

Genset Power (w/o fan)	ekW	3100	2325	1550	775	310
Engine Power	bhp	4376	3282	2188	1094	438
% Load	%	100	75	50	25	10
Exhaust Temperature	deg C	478	457	449	433	338
Total NOx (as NO2)	lb/hr	69.85	45.32	18.54	7.77	7.91
% Reduction	%	90	90	90	90	90
Post Catalyst NOx (as NO2)	lb/hr	6.99	4.53	1.85	0.78	0.79
Total CO	lb/hr	6.05	7.41	3.76	4.02	4.03
% Reduction	%	80	80	80	80	80
Post Catalyst CO	lb/hr	1.21	1.48	0.75	0.80	0.81
Total HC	lb/hr	0.52	0.43	0.82	0.83	0.73
% Reduction	%	80	80	80	80	80
Post Catalyst HC	lb/hr	0.10	0.09	0.16	0.17	0.15
Total PM	lb/hr	0.36	0.37	0.27	0.3	0.28
% Reduction	%	85	85	85	85	85
Post Catalyst PM	lb/hr	0.05	0.06	0.04	0.05	0.04

ATTACHMENT 2

Emission Estimates

Attachment 2-1
Vendor-Reported Air Pollutant Emission Rates
MWH-03/04/05/06 Data Center
Quincy, Washington

Pollutant	CAT 500 kW Full-variable (≤ 100%) Load Emission Parameters[a]			CAT 1,000 kW Full-variable (≤ 100%) Load Emission Parameters[a]		
	Worst-case Emissions (lb/hr)	Load-specific Exhaust Temp. (°F)	Load-specific Exhaust Flow (cfm)	Worst-case Emissions (lb/hr)	Load-specific Exhaust Temp. (°F)	Load-specific Exhaust Flow (cfm)
NO_X	0.51	780	2,465	2.93	318	1,982
CO	0.00	286	1,137	0.56	318	1,982
HC	0.04	780	2,465	0.070	318	1,982
DEEP[b]	0.04	780	2,465	0.030	318	1,982
PM (FH+BH)[c]	0.22	780	2,465	0.17	318	1,982
Ammonia	0.09	780	2,465	0.31	832	8,065
Min Flow/Temp	--	286	1,137	--	318	1,982
Max Flow/Temp	--	780	2,465	--	832	8,065
Fuel usage per genset (gph)		37			72	

Pollutant	CAT 1,500 kW Full-variable (≤ 100%) Load Emission Parameters[a]			CAT 3,000 kW Full-variable (≤ 100%) Load Emission Parameters[a]		
	Worst-case Emissions (lb/hr)	Load-specific Exhaust Temp. (°F)	Load-specific Exhaust Flow (cfm)	Worst-case Emissions (lb/hr)	Load-specific Exhaust Temp. (°F)	Load-specific Exhaust Flow (cfm)
NO_X	6.24	369	3,339	7.91	469	6,371
CO	0.87	503	4,777	1.48	722	19,560
HC	0.17	574	9,869	0.17	649	11,144
DEEP[b]	0.06	503	4,777	0.06	722	19,560
PM (FH+BH)[c]	0.33	503	4,777	0.33	722	19,560
Ammonia	0.50	699	11,734	0.94	836	24,296
Min Flow/Temp	--	369	3,339	--	469	6,371
Max Flow/Temp	--	699	11,734	--	836	24,296
Fuel usage per genset (gph)		105			211	

Notes:

[a] "Full-variable load" is the pollutant-specific worst-case emission rate at any load ≤100 percent load.

[b] DEEP (diesel engine exhaust particulate matter) is assumed equal to front-half NTE particulate emissions, as reported by the vendors.

[c] FH+BH (Front-half and back-half emissions) was calculated using a FH+BH scaling-factor based on acutal worst-case stack test results.

FH to PM Scaling Factor = 5.5

Attachment 2-2
Fuel-Based Emissions Summary
MWH-03/04/05/06 Data Center
Quincy, Washington

Fuel-Based Emissions Summary

Parameter	Value				Units
Generator Size	500	1,000	1,500	3,000	kW
No. of Generators	1	1	2	56	--
Fuel Usage (per genset)	37	72	105	211	gph
Hourly Heat Input	5.07	9.85	14.33	28.87	MMBtu /hr
Fuel Type	Ultra-low Sulfur Diesel				--
Fuel Sulfur Content	15				ppm weight
Fuel Density	7.1				lbs /gallon
Fuel Heat Content	137,000				Btu /gallon

Annual Hours of Operation	
Average	86
Max with Commissioning	136

Duration	Units	Peak Hourly	Peak Daily	Annual Average	Max Year (With Commissioning)
Fuel Usage (per period)	Gallons	12,117	290,815	1,042,088	1,647,953
Heat Input (per period)	MMBtu	1,660	39,842	142,766	225,770

Pollutant	CAS Number	Emission factor	Peak Emission Rate[a] 0.50 MW (lb/hr per genset)	1.0 MW (lb/hr per genset)	1.5 MW Hourly (lb/hr per genset)	3.0 MW Hourly (lb/hr per genset)	Project Hourly (lb/hr)	Project Daily (lb/dy)	Annual Emission Rate (TPY) Average	Max Year (With Commissioning)
SO_2	7446-09-5	0.0015% Sulfur (wt) [b]	0.0079	0.015	0.0222	0.045	2.6	62	-	-
Ammonia	7664-41-7	40 ppm [c]	0.0895	0.31	0.50	0.94	54	1294	-	-
Benzene	71-43-2	7.8E-04 lb/MMBtu [d]	4.1E-03	0.0081	0.0117	0.024	1.4	31	0.056	0.089
Toluene	108-88-3	2.8E-04 lb/MMBtu [d]	1.5E-03	0.0029	0.0042	0.0086	0.49	11	0.020	0.032
Xylenes	95-47-6	1.9E-04 lb/MMBtu [d]	1.0E-03	0.0020	0.0029	0.0059	0.34	7.7	0.014	0.022
1,3-Butadiene	106-99-0	3.9E-05 lb/MMBtu [d]	2.1E-04	4.1E-04	5.9E-04	1.2E-03	0.068	1.6	0.0028	0.0045
Formaldehyde	50-00-0	7.9E-05 lb/MMBtu [d]	4.2E-04	8.2E-04	0.0012	0.0024	0.14	3.2	0.0057	0.0090
Acetaldehyde	75-07-0	2.5E-05 lb/MMBtu [d]	1.3E-04	2.6E-04	3.8E-04	7.7E-04	0.044	1.0	0.0018	0.0029
Acrolein	107-02-8	7.9E-06 lb/MMBtu [d]	4.2E-05	8.2E-05	1.2E-04	2.4E-04	0.014	0.31	5.69E-04	9.00E-04
Benzo(a)pyrene	50-32-8	2.6E-07 lb/MMBtu [d]	1.4E-06	2.7E-06	3.9E-06	7.8E-06	4.5E-04	0.010	1.86E-05	2.94E-05
Benzo(a)anthracene	56-55-3	6.2E-07 lb/MMBtu [d]	3.3E-06	6.5E-06	9.4E-06	1.9E-05	0.0011	0.025	4.49E-05	7.11E-05
Chrysene	218-01-9	1.5E-06 lb/MMBtu [d]	8.2E-06	1.6E-05	2.3E-05	4.7E-05	0.0027	0.061	1.11E-04	1.75E-04
Benzo(b)fluoranthene	205-99-2	1.1E-06 lb/MMBtu [d]	5.9E-06	1.2E-05	1.7E-05	3.4E-05	0.0019	0.044	8.02E-05	1.27E-04
Benzo(k)fluoranthene	207-08-9	2.2E-07 lb/MMBtu [d]	1.2E-06	2.3E-06	3.3E-06	6.6E-06	3.8E-04	0.0087	1.57E-05	2.49E-05
Dibenz(a,h)anthracene	53-70-3	3.5E-07 lb/MMBtu [d]	1.8E-06	3.6E-06	5.2E-06	1.1E-05	6.1E-04	0.014	2.50E-05	3.95E-05
Indeno(1,2,3-cd)pyrene	193-39-5	4.1E-07 lb/MMBtu [d]	2.2E-06	4.3E-06	6.3E-06	1.3E-05	7.2E-04	0.017	2.99E-05	4.73E-05
Naphthalene	91-20-3	1.3E-04 lb/MMBtu [d]	6.9E-04	0.0014	0.0020	0.0040	0.23	5.2	9.39E-03	0.015
Propylene	115-07-1	2.8E-03 lb/MMBtu [d]	0.015	0.029	0.042	0.085	4.9	111	0.20	0.319

Notes:

[a] Emission rate accounts for one startup event.

[b] SO_2 emissions are based on a mass balance of the use of ultra-low sulfur diesel fuel, assuming fuel sulfur content of 15 ppm.

[c] Based on a vendor-reported NTE ammonia slip concentration at 100% load

[d] Source: AP-42 Sec 23.4 (EPA 1995).

Attachment 2-3
Startup Emissions Summary
MWH-03/04/05/06 Data Center
Quincy, Washington

"Black-Puff" Emissions Test Data (see Appendix B)

Pollutant	Spike Duration (seconds)	Measured Concentration (ppm) Cold-Start Emission Spike	Measured Concentration (ppm) Steady-State (Warm) Emissions	Cold-Start Emission Factor
PM+HC	14	900	30	4.3
NO_X	8.0	40	38	0.94
CO	20	750	30	9.0

Pollutant	Worst-case Emission Rate (lbs/hr) CAT 500 kW		CAT 1,000 kW		CAT 1,500 kW		CAT 3,000 kW	
	Cold-start[a]	Warm	Cold-start[a]	Warm	Cold-start[a]	Warm	Cold-start[a]	Warm
HC	0.17	0.040	0.30	0.070	0.73	0.17	0.73	0.17
NO_X[b]	0.5	0.5	2.9	2.9	6.2	6.2	7.9	7.9
CO	0.044	0.0049	5.0	0.56	7.8	0.87	13	1.5
DEEP[c]	0.17	0.040	0.13	0.030	0.26	0.060	0.26	0.060
PM (FH+BH)	0.94	0.22	0.70	0.17	1.4	0.33	1.4	0.33

Startup emission rate applied to one hour (full-variable Load (≤100% Load) emissions)

Pollutant	CAT 500 kW - Single Hour Emissions (lb/hr)			CAT 1,000 kW - Single Hour Emissions (lb/hr)			CAT 1,500 kW - Single Hour Emissions (lb/hr)			CAT 3,000 kW - Single Hour Emissions (lb/hr)		
	Startup (1 min)	Warm (59 min)	Total (1 hr)	Startup (1 min)	Warm (59 min)	Total (1 hr)	Startup (1 min)	Warm (59 min)	Total (1 hr)	Startup (1 min)	Warm (59 min)	Total (1 hr)
HC	0.003	0.04	0.04	0.005	0.069	0.074	0.012	0.17	0.18	0.012	0.17	0.18
NO_X	0.01	0.5	0.5	0.049	2.9	2.9	0.10	6.1	6.2	0.13	7.8	7.9
CO	0.00	0.00	0.01	0.084	0.55	0.63	0.13	0.86	0.99	0.22	1.5	1.7
DEEP[c]	0.0028	0.039	0.042	0.0021	0.030	0.032	0.0043	0.059	0.063	0.0043	0.059	0.063
PM (FH+BH)	0.016	0.22	0.23	0.0117	0.16	0.17	0.023	0.32	0.35	0.023	0.32	0.35

Notes:

[a] Startup emission factor applies to the first 60 seconds of emissions after engine startup.

[b] Although the startup emission factor derived for NO_x is less than 1 (i.e., decreased emissions), this evaluation will conservatively assume a factor of 1.0.

[c] DEEP (diesel engine exhaust particulate matter) is assumed equal to front-half NTE particulate emissions, as reported by the vendors.

Attachment 2-4
Fluid Cooler Emissions Summary
MWH-03/04/05/06 Data Center
Quincy, Washington

Parameter	Value
Number of Cooling Towers	100
Hours of Operation	8,760 hr/yr
Recirculation Water TDS	1,850 mg/L
Feedwater TDS	1,338 mg/L
Cycles of Concentration	5 cycles
Recirculation Rate	1,300 gpm
Drift Rate	0.0005 % of recirc flow
Liquid Drift Droplet Emissions	325 lb/hr

Pollutant	Emission Factor	Emission Rate				
		Hourly per Cooling Tower (lbs/hr)	Total Hourly (lbs/hr)	Total Daily (lbs/day)	Total Annual (lb/yr)	Total Annual (TPY)
Criteria Pollutants						
PM[b]	100% of TDS [a]	*0.0218*	*2.18*	*52.2*	19,057	9.53
PM_{10}[b]	100% of TDS [a]	*0.0218*	*2.18*	*52.2*	19,057	9.53
$PM_{2.5}$[b]	56% of TDS [a]	*0.0121*	*1.21*	*29.0*	10,596	5.30
Toxic Air Pollutants						
Arsenic	*0.002 mg/L* [b]	*3.25E-08*	*3.25E-06*	*7.81E-05*	*0.0285*	*1.42E-05*
Beryllium	*0.002 mg/L* [b]	*3.25E-08*	*3.25E-06*	*7.81E-05*	*0.0285*	*1.42E-05*
Cadmium	*0.001 mg/L* [b]	*1.63E-08*	*1.63E-06*	*3.90E-05*	*0.0142*	*7.12E-06*
Chromium	*0.002 mg/L* [b]	*3.25E-08*	*3.25E-06*	*7.81E-05*	*0.0285*	*1.42E-05*
Copper	*0.25 mg/L* [b]	*4.07E-06*	*4.07E-04*	*9.76E-03*	*3.56*	*1.78E-03*
Lead	*0.002 mg/L* [b]	*3.25E-08*	*3.25E-06*	*7.81E-05*	*0.0285*	*1.42E-05*
Manganese	**0.03 mg/L** [b]	4.88E-07	4.88E-05	1.17E-03	0.427	2.14E-04
Mercury	*0.2 mg/L* [b]	*3.25E-06*	*3.25E-04*	*7.81E-03*	*2.85*	*1.42E-03*
Selenium	*0.002 mg/L* [b]	*3.25E-08*	*3.25E-06*	*7.81E-05*	*0.0285*	*1.42E-05*
Vanadium	**0.034 mg/L** [b]	5.53E-07	5.53E-05	1.33E-03	0.484	2.42E-04
Total Cyanide	*0.01 mg/L* [b]	*1.63E-07*	*1.63E-05*	*3.90E-04*	*0.142*	*7.12E-05*
Ammonia	*0.122 mg/L* [b]	*1.98E-06*	*1.98E-04*	*4.74E-03*	*1.73*	*8.66E-04*
Total Phosphorus	**3.53 mg/L** [b]	5.74E-05	5.74E-03	0.138	50.3	0.0251

Notes:

[a] Italic text indicates reporting limits were used because the analyte was not detected. Bold text indicates the analyte was detected and the maximum value is used. Maximum of Potable Water (Brown and Caldwell, 2015) and Softened Reuse Water (WCTI. 2014. and Brown and Caldwell. 2014c).

[b] Methodology for calculating the evaporated solid particle size distribution based on the droplet size distribution is taken from "Calculating Realistic PM_{10} Emissions from Cooling Towers," Reisman and Frisbie, Environmental Progress, July 2002.

ATTACHMENT 2-5

Diesel Generator "Cold-Start Spike" Adjustment Factors

Short-term concentration trends for emissions of volatile organic compounds (VOCs), carbon monoxide (CO), and oxides of nitrogen (NO_x) immediately following a cold startup of a large diesel backup generator were measured by the California Energy Commission (CEC) in its document entitled Air Quality Implications of Backup Generators in California (Lents et al. 2005)[1]. CEC used continuous monitors to measure the trends shown in the attached figure (Attachment 2-6), which are discussed below.

As shown on Attachment 2-6, during the first 14 seconds after a cold start, the VOC concentration spiked to a maximum value of 900 parts per million (ppm) before dropping back to the steady-state exhaust concentration of 30 ppm. The measured (triangular) area under the 14-second concentration-vs-time curve represents emissions during a "VOC spike," which is 6,300 ppm-seconds.

Unlike VOC emissions, the NO_x exhaust concentration did not "spike" during cold-start. It took 8 seconds for the exhaust concentration of NO_x to rise from the initial value of zero to its steady-state concentration of 38 ppm. The measured area under the concentration-vs-time curve represents the "NO_x deficit" emissions of 160 ppm-seconds.

The CEC was unable to measure the time trend of diesel engine exhaust particulate matter (DEEP) concentrations during the first several seconds after a cold start. Therefore, for the purpose of estimating the DEEP trend, it was assumed that DEEP would exhibit the same concentration-vs-time trend as VOC emissions.

The numerical value of the Cold-Start Spike Adjustment Factor was derived by dividing the area under the "cold-start spike" by the area under the steady-state concentration profile for the 1-minute averaging period.

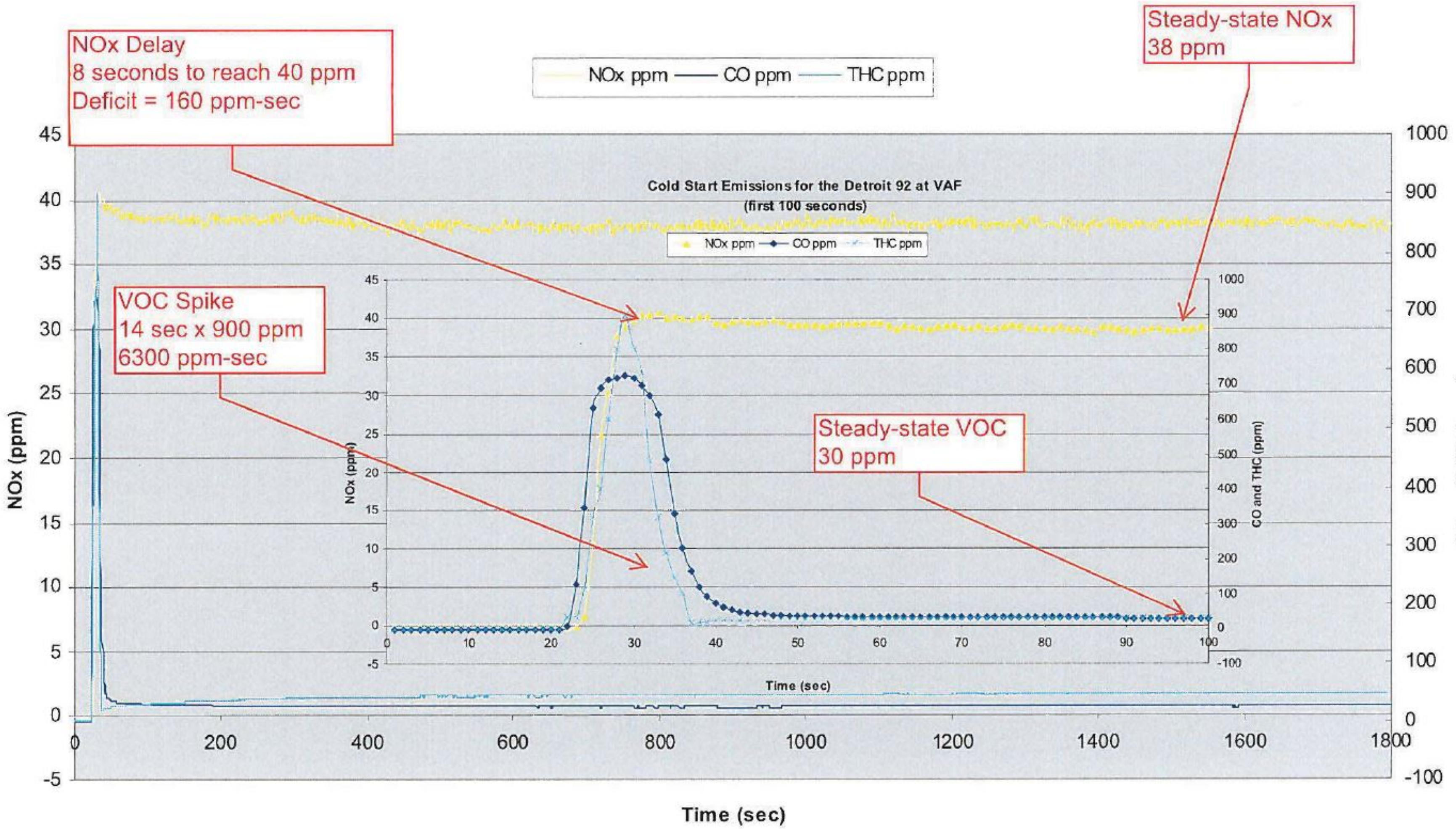
Example: Cold-Start Spike Factor for VOCs, first 1-minute after cold-start at low load.

The "VOC spike" was observed 14 seconds after cold-start and reached a concentration of 6,300 ppm-seconds. The **<u>triangular</u>** area under the curve is $\frac{14\,\text{seconds} \times 900\,ppm}{2} = 6{,}300\ \textit{ppm-seconds}$.

The steady-state VOC concentration is 30 *ppm*. For the 1-minute (60-seconds) steady-state period the area under the curve is $(60\ seconds - 14\ seconds) \times 30\ ppm\ = 1{,}380$ *ppm-seconds.*

Therefore, the cold-start emission factor (to be applied to the warm-emission rate estimate for the first 1-minute after cold-start) was estimated by $\frac{6{,}300\ ppm{-}seconds + 1{,}380\ ppm{-}seconds}{30\ ppm \times 60\ seconds}$.

[1] Lents, J.M., L. Arth, M. Boretz, M. Chitjian, K. Cocker, N. Davis, K Johnson, Y Long, J.W. Miller, U. Mondragon, R.M. Nikkila, M. Omary, D. Pacocha, Y. Quin, S. Shah, and G. Tonnesen. 2005. Air Quality Implications of Backup Generators in California - Volume One: Generation Scenarios, Emissions and Atmospheric Modeling, and Health Risk Analysis. Publication No. CEC-500-2005-048. California Energy Commission, PIER Energy-Related Environmental Research. March.



Source: Lents et al. 2005.

Microsoft MWH Data Center Quincy, Washington	**Cold-Start Emission Trends**	Attachment 2-6

Landau Associates

ATTACHMENT 3

Facility Potential-to-Emit

Attachment 3-1
Project Potential-to-Emit Emissions Summary
MWH-03/04/05/06 Data Center
Quincy, Washington

Parameter	Units	Value
Annual Hours of Operation (per unit)	Hours	86
Number of Cold Startup Events	Events	19
Duration Each Cold Startup Event	Hours	0.017
Total Duration Cold Conditions	Hours	0.32

	PTE Project-Only Rates[a]		
Pollutant	Hourly (lbs/hr)	Annual (TPY)	Max Year (with Commissioning) (TPY)
Criteria Pollutants			
NO_X	459	20	31
CO	97	3.8	6.1
SO_2	2.6	0.11	0.18
PM_{10} (all sources)	23	10	11
$PM_{10}/PM_{2.5}$ (gensets only)	21	0.8	1.4
$PM_{2.5}$ (all sources)	22	6.1	6.7
VOCs	11	0.43	0.7
Toxic Air Pollutants			
Primary NO_2[b]	46	2.0	3.1
DEEP	3.7	0.15	0.25
CO	97	3.8	6.1
SO_2	2.6	0.11	0.18
Ammonia (Gens Only)	54	2.3	3.7
Ammonia (with Cooling Towers)	54	2.3	3.7
Carbon-based TAPs			
Acrolein	0.014	5.7E-04	9.0E-04
Benzene	1.4	0.056	0.089
Propylene	4.9	0.20	0.32
Toluene	0.49	0.020	0.032
Xylenes	0.34	0.014	0.022
Formaldehyde	1.4E-01	0.0057	0.0090
Acetaldehyde	0.044	0.0018	0.0029
1,3-Butadiene	0.068	0.0028	0.0045
Polycyclic Aromatic Hydrocarbons			
Naphthalene	0.23	0.0094	0.015
Benz(a)anthracene	0.0011	4.5E-05	7.1E-05
Chrysene	0.0027	1.1E-04	1.7E-04
Benzo(b)fluoranthene	0.0019	8.0E-05	1.3E-04
Benzo(k)fluoranthene	3.8E-04	1.6E-05	2.5E-05
Benzo(a)pyrene	4.5E-04	1.9E-05	2.9E-05
Indeno(1,2,3-cd)pyrene	7.2E-04	3.0E-05	4.7E-05
Dibenz(a,h)anthracene	6.1E-04	2.5E-05	4.0E-05

Attachment 3-1
Project Potential-to-Emit Emissions Summary
MWH-03/04/05/06 Data Center
Quincy, Washington

Pollutant	PTE Project-Only Rates[a]		
	Hourly (lbs/hr)	Annual (TPY)	Max Year (with Commissioning) (TPY)
Cooling Tower TAPs			
Arsenic	3.3E-06	1.4E-05	1.4E-05
Beryllium	3.3E-06	1.4E-05	1.4E-05
Cadmium	1.6E-06	7.1E-06	7.1E-06
Chromium	3.3E-06	1.4E-05	1.4E-05
Copper	4.1E-04	0.0018	0.0018
Lead	3.3E-06	1.4E-05	1.4E-05
Manganese	4.9E-05	2.1E-04	2.1E-04
Mercury	3.3E-04	0.0014	0.0014
Selenium	3.3E-06	1.4E-05	1.4E-05
Vanadium	5.5E-05	2.4E-04	2.4E-04
Total Cyanide	1.6E-05	7.1E-05	7.1E-05
Total Phosphorus	0.0057	0.025	0.025

Notes:

[a] Startup emissions are accounted for in the project emissions.

[b] NO_2 is assumed to be 10% of the NO_X.

Attachment 3-2
Facility Potential-to-Emit Emissions Summary
MWH-03/04/05/06 Data Center
Quincy, Washington

Pollutant	Proposed PTE Facility-Wide Rates[a] Annual (TPY)	Proposed PTE Facility-Wide Rates[a] Max Year (with Commissioning) (TPY)	Currently Permitted PTE Facility-Wide Rates Annual (TPY)	Currently Permitted PTE Facility-Wide Rates Max Year (with Commissioning) (TPY)	Net Emissions Change Annual (TPY)	Net Emissions Change Max Year (with Commissioning) (TPY)
Criteria Pollutants						
NO_X	53	64	58	73	-5.7	-9.1
CO	11	13	13	16	-1.6	-2.6
SO_2	0.18	0.24	0.21	0.28	-0.026	-0.041
PM_{10} (all sources)	24	25	43	44	-19	-20
$PM_{10}/PM_{2.5}$ (gensets only)	1.7	2.2	3.4	4.9	-1.7	-2.7
$PM_{2.5}$ (all sources)	10.0	10.5	17	19	-7.4	-8.5
VOCs	1.5	1.7	5.7	8.4	-4.2	-6.7
Toxic Air Pollutants						
Primary NO_2[b]	5.3	6.4	5.8	7.3	-0.57	-0.91
DEEP	0.97	1.1	1.3	1.6	-0.31	-0.50
CO	11	13	13	16	-1.6	-2.6
SO_2	0.18	0.24	0.21	0.28	-0.026	-0.041
Ammonia (Gens Only)	3.5	4.8	4.0	5.7	-0.54	-0.85
Ammonia (with Cooling Towers)	3.5	4.8	4.0	5.7	-0.54	-0.85
Carbon-based TAPs						
Acrolein	6.0E-04	9.4E-04	7.4E-04	1.1E-03	-1.3E-04	-2.1E-04
Benzene	6.0E-02	9.2E-02	7.3E-02	1.1E-01	-1.3E-02	-2.1E-02
Propylene	2.1E-01	3.3E-01	2.6E-01	4.1E-01	-4.7E-02	-7.4E-02
Toluene	2.2E-02	3.3E-02	2.6E-02	4.1E-02	-4.7E-03	-7.5E-03
Xylenes	1.5E-02	2.3E-02	1.8E-02	2.8E-02	-3.2E-03	-5.1E-03
Formaldehyde	6.0E-03	9.4E-03	7.4E-03	1.1E-02	-1.3E-03	-2.1E-03
Acetaldehyde	1.9E-03	3.0E-03	2.4E-03	3.7E-03	-4.2E-04	-6.7E-04
1,3-Butadiene	3.0E-03	4.6E-03	3.7E-03	5.7E-03	-6.6E-04	-1.0E-03
Polycyclic Aromatic Hydrocarbons						
Naphthalene	1.0E-02	1.5E-02	1.2E-02	1.9E-02	-2.2E-03	-3.4E-03
Benz(a)anthracene	4.8E-05	7.4E-05	5.8E-05	9.0E-05	-1.0E-05	-1.6E-05
Chrysene	1.2E-04	1.8E-04	1.4E-04	2.2E-04	-2.6E-05	-4.1E-05
Benzo(b)fluoranthene	8.5E-05	1.3E-04	1.0E-04	1.6E-04	-1.9E-05	-2.9E-05
Benzo(k)fluoranthene	1.7E-05	2.6E-05	2.0E-05	3.2E-05	-3.7E-06	-5.8E-06
Benzo(a)pyrene	2.0E-05	3.1E-05	2.4E-05	3.7E-05	-4.3E-06	-6.8E-06
Indeno(1,2,3-cd)pyrene	3.2E-05	4.9E-05	3.9E-05	6.0E-05	-6.9E-06	-1.1E-05
Dibenz(a,h)anthracene	2.7E-05	4.1E-05	3.2E-05	5.0E-05	-5.8E-06	-9.2E-06

Attachment 3-2
Facility Potential-to-Emit Emissions Summary
MWH-03/04/05/06 Data Center
Quincy, Washington

Pollutant	Proposed PTE Facility-Wide Rates[a]		Currently Permitted PTE Facility-Wide Rates		Net Emissions Change	
	Annual (TPY)	Max Year (with Commissioning) (TPY)	Annual (TPY)	Max Year (with Commissioning) (TPY)	Annual (TPY)	Max Year (with Commissioning) (TPY)
Cooling Tower TAPs						
Arsenic	1.4E-05	1.4E-05	1.9E-05	1.9E-05	-5.1E-06	-5.1E-06
Beryllium	1.4E-05	1.4E-05	1.9E-05	1.9E-05	-5.1E-06	-5.1E-06
Cadmium	7.1E-06	7.1E-06	9.7E-06	9.7E-06	-2.6E-06	-2.6E-06
Chromium	1.4E-05	1.4E-05	1.9E-05	1.9E-05	-5.1E-06	-5.1E-06
Copper	1.9E-03	1.9E-03	2.6E-03	2.6E-03	-6.4E-04	-6.4E-04
Lead	1.4E-05	1.4E-05	1.9E-05	1.9E-05	-5.1E-06	-5.1E-06
Manganese	6.7E-04	6.7E-04	7.5E-04	7.5E-04	-7.7E-05	-7.7E-05
Mercury	1.4E-03	1.4E-03	1.9E-03	1.9E-03	-5.1E-04	-5.1E-04
Selenium	1.4E-05	1.4E-05	1.9E-05	1.9E-05	-5.1E-06	-5.1E-06
Vanadium	2.4E-04	2.4E-04	3.3E-04	3.3E-04	-8.7E-05	-8.7E-05
Total Cyanide	7.1E-05	7.1E-05	9.7E-05	9.7E-05	-2.6E-05	-2.6E-05
Total Phosphorus	2.5E-02	2.5E-02	3.4E-02	3.4E-02	-9.1E-03	-9.1E-03
Chloroform (MWH01/02 only)	2.6E-04	2.6E-04	2.6E-04	2.6E-04	n/a	N/A
Bromodichloromethane (MWH01/02 only)	2.6E-04	2.6E-04	2.6E-04	2.6E-04	n/a	N/A
Bromoform (MWH01/02 only)	6.9E-03	6.9E-03	6.9E-03	6.9E-03	n/a	N/A
Fluoride (MWH01/02 only)	4.8E-03	4.8E-03	4.8E-03	4.8E-03	n/a	N/A

Notes:

[a] Startup emissions are accounted for in the project emissions.

[b] NO_2 is assumed to be 10% of the NO_x.

N/A = not applicable

ATTACHMENT 4

Ambient Air Quality Standard Compliance

Attachment 4-1
Summary of Ranked Generator Runtime Scenarios
MWH-03/04/05/06 Data Center
Quincy, Washington

Ranked Generator Runtime Scenarios - $PM_{2.5}$

Ranked Day	Activity	Activity Duration (hours/generator)	Max. No. Generators to Operate Concurrently	Max. Daily Operating Hours	Max. Annual Operating Days	Max. Daily Project-$PM_{2.5}$ Emissions (lbs/day)
1-6	Emergency operations	24	60	24	6	499
7-31	Non-emergency monthly operations	0.34	2	12	24	38
31-54	Non-emergency semiannual operations	3	2	12	24	37
55-65	Non-emergency triennial operations	2	5	12	11	36
66+	Additional non-emergency monthly or semiannual operations	1	1	12	1+	5

Ranked Generator Runtime Scenarios - NO_x

Ranked Day	Activity	Max. No. Generators to Operate Concurrently	Max. Annual Operating Days	Max. Hourly Project-NO_x Emissions (lbs/hour)
1-6	Emergency operations	60	6	459
7-17	Non-emergency triennial operations	5	11	38
18-41	Non-emergency monthly operations	2	24	16
41-65	Non-emergency semiannual operations	2	24	16
66+	Additional non-emergency monthly or semiannual operations	1	1+	7.9

Attachment 4-2
Modeling Stack Parameters and Emission Rates
MWH-03/04/05/06 Data Center
Quincy, Washington

AERMOD Input - Stack Dimensions

Parameter	0.5-MWe Genset	1.0-MWe Genset	1.5-MWe Genset	3.0-MWe Genset	Cooling Tower Cell[c]
MWH 03/04/05 Stack height (ft)	--	72	72	72	17.5
MWH 06 Stack height (ft)	30.0	--	--	72	17.5
Stack diameter (in)	8	20	20	24	95.04

AERMOD Input - Theoretical Maximum Year with Commissioning

Parameter	0.5-MWe Genset	1.0-MWe Genset	1.5-MWe Genset	3.0-MWe Genset	Cooling Tower Cell[c]
AERMOD Input Emissions per Point Source (lb/hr)[a,b]					
NO_x (annual NAAQS)	0.0079	0.0455	0.0969	0.1228	NA
$PM_{2.5}$ (annual NAAQS)	0.0035	0.0026	0.0052	0.0052	0.0121
AERMOD Input Exhaust Parameters					
Worst-case Exhaust Temp. (°F)	286	318	369	469	80
Worst-case Exhaust Flow (cfm)	1,137	1,982	3,339	6,371	127,690

AERMOD Input Power Outage Scenario (Worst-case 1-hour)

Operating Condition	Assumptions for Cold-start Emissions Calculations							
	0.5-MWe Genset		1.0-MWe Genset		1.5-MWe Genset		3.0-MWe Genset	
	Startup	Warm	Startup	Warm	Startup	Warm	Startup	Warm
Number of events	1	1	1	1	1	1	1	1
Duration of each event (hours)	0.017	0.983	0.017	0.983	0.017	0.983	0.017	0.983
Hours at each runtime mode	0.017	0.983	0.017	0.983	0.017	0.983	0.017	0.983
Maximum Generators Concurrently Operating	1		1		2		56	

Parameter	0.5-MWe Genset	1.0-MWe Genset	1.5-MWe Genset	3.0-MWe Genset	Cooling Tower Cell[c]
CO (1 & 8-hour NAAQS)					
Emissions per Point Source (lb/hr)[a]	0.00555	0.635	0.986	1.68	N/A
Load-Specific Exhaust Temp. (°F)	286	318	503	722	N/A
Load-Specific Exhaust Flow (cfm)	1,137	1,982	4,777	19,560	N/A
SO_2 (1 & 3-hour NAAQS)					
Emissions per Point Source (lb/hr)[a]	0.0079	0.015	0.022	0.045	N/A
Load-Specific Exhaust Temp. (°F)	780	832	699	836	N/A
Load-Specific Exhaust Flow (cfm)	2,465	8,065	11,734	24,296	N/A

Attachment 4-2
Modeling Stack Parameters and Emission Rates
MWH-03/04/05/06 Data Center
Quincy, Washington

AERMOD Setup: Emergency operations (power outage)

Operating Condition	Assumptions for Cold-start Emissions Calculations								
	0.5-MWe Genset		1.0-MWe Genset		1.5-MWe Genset		3.0-MWe Genset		
	Startup	Warm	Startup	Warm	Startup	Warm	Startup	Warm	
Number of events per day	1	1	1	1	1	1	1	1	
Duration of each event (hours)	0.017	23.983	0.017	23.983	0.017	23.983	0.017	23.983	
Hours at each runtime mode	0.017	23.983	0.017	23.983	0.017	23.983	0.017	23.983	
Maximum Generators Concurrently Operating	1		1		2		56		

Parameter	0.5-MWe Genset	1.0-MWe Genset	1.5-MWe Genset	3.0-MWe Genset	Cooling Tower Cell[c]
PM_{10} (24-hour NAAQS)[a]	**24 hours of operation per day**				
Emissions per Point Source (lb/hr)	0.2205	0.1654	0.3307	0.3307	0.0218
Load-Specific Exhaust Temp. (°F)	780	318	503	722	80
Load-Specific Exhaust Flow (cfm)	2,465	1,982	4,777	19,560	127,690

AERMOD Setup: Non-emergency routine monthly operations (worst-case)[d]

Operating Condition	Assumptions for Startup Emissions Calculations								
	0.5-MWe Genset		1.0-MWe Genset		1.5-MWe Genset		3.0-MWe Genset		
	Startup	Warm	Startup	Warm	Startup	Warm	Startup	Warm	
Hours of operation per day	12		12		12		12		
Number of events per day	36	36	36	36	36	36	36	36	
Duration of each event (hours)	0.017	0.317	0.017	0.317	0.017	0.317	0.017	0.317	
Hours at each runtime mode (per day)	0.60	11.4	0.60	11.4	0.60	11.4	0.60	11.4	
Maximum gensets to concurrently operate	0 [e]		0 [e]		0 [e]		2 [e]		

Parameter	0.5-MWe Genset	1.0-MWe Genset	1.5-MWe Genset	3.0-MWe Genset	Cooling Tower Cell[c]
$PM_{2.5}$ (24-hour NAAQS)[e]					
Emissions per Point Source (lb/hr)	0.2559	0.1920	0.3839	0.3839	0.01210
Load-Specific Exhaust Temp. (°F)	780	318	503	722	80
Load-Specific Exhaust Flow (cfm)	2,465	1,982	4,777	19,560	127,690

Notes:

[a] All generators were modeled under full-variable load conditions (≤100% Load). Startup emissions were included for all applicable pollutants.

[b] For modeling local background impacts, neighboring data centers were assumed to emit at the permitted potential-to-emit rates. Cooling towers and the Lamb Weston facility were assumed to operate continuously and emit at permited rates.

[c] Two cooling tower cells per cooling unit. All cooling units were assumed to operate continuously, all year.

[d] Modeled operating scenario for 8th-highest ranked PM emitting day for a 24-hr power outage scenario. The evaluated results correspond to the 1st-highest impact.

[e] Monthly maintencance operations are expected to occur on two engines at a time 20 minutes per engine per month. In the event that complications arise during testing, this duration may be greater. Likewise, multiple sequential tests may occur within the same day for up to 12 hr/dy. Two randomly chosen neighboring 3.0-MWe gensets were run in this model.

Attachment 4-3
Estimated Impacts Compared to National Ambient Air Quality Standards
MWH-03/04/05/06 Data Center
Quincy, Washington

Criteria Pollutant	National and Washington Ambient Standards (µg/m³)	Significant Impact Level (µg/m³)	Modeled Operating Scenario	AERMOD Filename	Modeled Project[a]	Modeled Project + Local Background	Regional Background[b]	Estimated Cumulative Concentration[c]
					(µg/m³)			
Carbon Monoxide (CO)								
8-hour average	10,000	500	Unplanned power outage	CO_ST.ADI	77 [d]	--	--	--
1-hour average	40,000	2,000	Unplanned power outage		269 [d]	--	--	--
Sulfur Dioxide (SO_2)								
3-hour average	1,310	25	Unplanned power outage	SO2.ST.ADI	14 [d]	--	--	--
1-hour average	200	7.8	Unplanned power outage		24 [d]	--	7.6	32
Particulate Matter (PM_{10})								
24-hour average	150	5	Unplanned power outage	PM10_24hr_PO24.ADI	13 [d, e]	54	78	132
Particulate Matter ($PM_{2.5}$)								
Annual average	12	0.2	Theoretical Max. Year	PM25_Ann.ADI	0.71 [e]	1.9	1.8	3.7
24-hour average	35	1.2	Non-emergency monthly operations (Ranked Day 7)	PM25_24hr_MT.ADI	3.0 [f]	3.1	19	22
Nitrogen Oxides (NO_x)								
Annual average	100	1	Theoretical Max. Year	NO2_Ann.ADI	1.3 [e]	10	6.6	17
1-hour average	188	7.5	Concurrent generator operation	Refer to Monte Carlo Evaluation (Attachment 5)	--	133 [g]	37	170

Notes:

[a] Maximum design value concentration of proposed new sources alone.

[b] Regional background level obtained from Idaho Department of Environmental Quality for model and monitoring data from July 2014 through June 2017 (IDEQ; accessed August 16, 2019).

[c] Cumulative concentrations are calculated for pollutant's where project related contributions are above the Significant Impact Level.

[d] Reported values represent the 1st-highest modeled impacts.

[e] It was assumed that local data centers were concurrently operating in facility-wide power outage mode. The Lamb Weston facility was modeled as continuously operating at PTE rates. All cooling towers were modeled as continuously operating at PTE rates.

[f] Monthly maintenance operations are expected to occur on each engine for 20 minutes per engine per month. In the event that complications arise during testing, this duration may be greater. Multiple sequential tests may occur within the same day for up to 12 hours per day. This model conservatively assumes that two engines may be running at a time and that operations may occur any time during daytime hours (7 a.m. to 7 p.m.). Local background modeling for this scenario assumed nearby data centers were operating generators in a maintenance run scenario.

[g] Reported value is based on the Monte Carlo assessment for NO_2. See the Monte Carlo Analysis (Attachment 5) for further details.

ATTACHMENT 5

NO_2 1-Hour Average NAAQS Monte Carlo Backup Documentation

Attachment 5-1
NO2 Monte Carlo Analysis Modeling Inputs
MWH-03/04/05/06 Data Center
Quincy, Washington

1-hr NO_2 NAAQS Monte Carlo Analysis

Parameter	0.5-MWe Genset	1.0-MWe Genset	1.5-MWe Genset	3.0-MWe Genset
Emissions per Point Source (lb/hr)[a]	0.510	2.93	6.24	7.91
Load-specific exhaust temp. (°F)	780	318	369	469
Load-specific exhaust flow (cfm)	2,465	1,982	3,339	6,371
	Maximum Generators Concurrently Operating			
Runtime Activity	**0.5-MWe Genset**	**1.0-MWe Genset**	**1.5-MWe Genset**	**3.0-MWe Genset**
Emergency operation (24-hr power outage)[b, c]	1	1	2	56
Non-emergency triennial operation 5 unit colo[d, e]	Emissions from maintenance operations on the 0.5-MWe and 1.0 MWe gensets are less than maintenance operations on the 1.5-MWe gensets.		1	4
Non-emergency triennial operation 4 unit colo[d, e]	The admin generators are not expected to run during this runtime activity.			4
Non-emergency routine monthly operations [e, f]	Emissions from maintenance operations on the house gensets are less than maintenance operations on the 3.0-Mwe gensets.			2
Non-emergency routine semiannual operations[e, g]	Emissions from maintenance operations on the house gensets are less than maintenance operations on the 3.0-Mwe gensets.			2
Non-emergency single generator operations [e]	Emissions from maintenance operations on the house gensets are less than maintenance operations on the 3.0-Mwe gensets.			1

Notes:

[a] All generators were modeled under full-variable load conditions (≤100% Load).

[b] This application assumes 6 days of power outage operations. In order to account for the permit limitation set on the MWH-01 through MWH-02 generators, which allows up to 4 days of power outage operation, one model was set up to estimate impacts from those 4 days of facility-wide power outage. A second model was set up to simulate the additional 2 days of power outage operations when only the MWH-03/04/05/06 generators will be allowed to operate in that scenario.

[c] This scenario assumed that local data centers were concurrently operating in facility-wide power outage mode. The Con-Agra facility was modeled as continuously operating at PTE rates.

[d] Electrical bypass operations are expected to occur for 2 hours and involve four or five concurrently operating generators, within the same colo. Additional single engine operations may continue within the same day for up to 12 hours/day (total operation). These operations are expected to occur triennially for each generator and at any location within the project for up to a total of 11 days per year.

[e] This scenario conservatively assumed that local data centers were concurrently operating in maintenance mode. The Con-Agra facility was modeled as continuously operating at PTE rates.

[f] Monthly maintenance operations are expected to occur on a single engine for 20 minutes per engine per month. In rare cases, this duration may be greater. Multiple sequential tests may occur within the same day for up to 12 hours/day. This model conservatively assumes that two engines may concurrently operate between daylight hours (assumed 7 a.m. to 7 p.m.).

[g] Semiannual operations are expected to occur on each generator for 3 hours every 6 months. Multiple sequential tests may occur within the same day for up to 12 hours/day. This model conservatively assumes that two generators may concurrently operate any time during daylight hours (assumed 7 a.m. to 7 p.m.).

Attachment 5-2
Summary of NO2 Monte Carlo Analysis and Results
MWH-03/04/05/06 Data Center
Quincy, Washington

	UTM Zone 11, NAD 83	
	Easting (m)	Northing (m)
Monte Carlo Predicted NO_2 98th Percentile Project + Local Background	280,762.5	5,235,450.0
	NO_2 Concentration ($\mu g/m^3$)	
Monte Carlo Predicted NO_2 98th Percentile Project + Local Background	133	
Regional Background	37	
Estimated Cumulative	170	
National Ambient Air Quality Standard	188	

	Generator Runtime Activity (a)	Source Group Monte Carlo Input Filename AERMOD Filename	Simulation Days of Operation
Facility Wide	Facility-wide emergency operation (24-hr power outage)[b, c]	PO MAXDAILY.POALL.NO2.DAT NO2_POall_5yrs.ADI	4
Project Operations	Project emergency operation (24-hr power outage)[b, c]	PO MAXDAILY.POPRJ.NO2.DAT NO2_POprj_5yrs.ADI	6
	Non-emergency triennial operation 5 unit colo[d, e]	EB0301 MAXDAILY.EB0301.NO2.DAT NO2_EB0301_5yrs.ADI	1
	Non-emergency triennial operation 4 unit colo[d, e]	EB0302 MAXDAILY.EB0302.NO2.DAT NO2_EB0302_5yrs.ADI	1
	Non-emergency triennial operation 5 unit colo[d, e]	EB0401 MAXDAILY.EB0401.NO2.DAT NO2_EB0401_5yrs.ADI	1
	Non-emergency triennial operation 4 unit colo[d, e]	EB0402 MAXDAILY.EB0402.NO2.DAT NO2_EB0402_5yrs.ADI	1
	Non-emergency triennial operation 4 unit colo[d, e]	EB0403 MAXDAILY.EB0403.NO2.DAT NO2_EB0403_5yrs.ADI	1
	Non-emergency triennial operation 5 unit colo[d, e]	EB0501 MAXDAILY.EB0501.NO2.DAT NO2_EB0501_5yrs.ADI	1
	Non-emergency triennial operation 4 unit colo[d, e]	EB0502 MAXDAILY.EB0502.NO2.DAT NO2_EB0502_5yrs.ADI	1
	Non-emergency triennial operation 4 unit colo[d, e]	EB0503 MAXDAILY.EB0503.NO2.DAT NO2_EB0503_5yrs.ADI	1
	Non-emergency triennial operation 5 unit colo[d, e]	EB0601 MAXDAILY.EB0601.NO2.DAT NO2_EB0601_5yrs.ADI	1
	Non-emergency triennial operation 4 unit colo[d, e]	EB0602 MAXDAILY.EB0602.NO2.DAT NO2_EB0602_5yrs.ADI	1
	Non-emergency triennial operation 4 unit colo[d, e]	EB0603 MAXDAILY.EB0603.NO2.DAT NO2_EB0603_5yrs.ADI	1

Attachment 5-2
Summary of NO2 Monte Carlo Analysis and Results
MWH-03/04/05/06 Data Center
Quincy, Washington

	Generator Runtime Activity (a)	Source Group Monte Carlo Input Filename AERMOD Filename	Simulation Days of Operation
Project Operations	Non-emergency routine monthly operations [e, f]	MONTH MAXDAILY.MONTH.NO2.DAT NO2_MT_5yrs.ADI	24
	Non-emergency routine semiannual operations[e, g]	SEMI MAXDAILY.SEMI.NO2.DAT NO2_MT_5yrs.ADI	24
	Non-emergency single generator operations [e]	ONE MAXDAILY.ONE.NO2.DAT NO2_ONE_5yrs.ADI	50
Existing Operations	Bypass Scenario 1, represents two AZ buildings at NE quadrant	EB0101 MAXDAILY.EB0101.NO2.DAT NO2_EB0101_5yrs.ADI	4
	Bypass Scenario 2, represents two AZ buildings at NW quadrant	EB0105 MAXDAILY.EB0105.NO2.DAT NO2_EB0105_5yrs.ADI	4
	Bypass Scenario 3, represents two AZ buildings at SW quadrant	EB0202 MAXDAILY.EB0202.NO2.DAT NO2_EB0202_5yrs.ADI	4
	Bypass Scenario 4, represents two AZ buildings at SE quadrant	EB0203 MAXDAILY.EB0203.NO2.DAT NO2_EB0203_5yrs.ADI	4

Notes:

[a] All generators were modeled under full-variable load conditions (≤100% Load).

[b] This application assumes 6 days of power outage operations. In order to account for the permit limitation set on the MWH-01 through MWH-02 generators, which allows up to 4 days of power outage operation, one model was set up to estimate impacts from those 4 days of facility-wide power outage. A second model was set up to simulate the additional 2 days of power outage operations when only the MWH-03/04/05/06 generators will be allowed to operate in that scenario.

[c] This scenario assumed that local data centers were concurrently operating in facility-wide power outage mode. The Con-Agra facility was modeled as continuously operating at PTE rates.

[d] Electrical bypass operations are expected to occur for 2 hours and involve four or five concurrently operating generators, within the same colo. Additional single engine operations may continue within the same day for up to 12 hours/day (total operation). These operations are expected to occur triennially for each generator and at any location within the project for up to a total of 11 days per year.

[e] This scenario conservatively assumed that local data centers were concurrently operating in maintenance mode. The Con-Agra facility was modeled as continuously operating at PTE rates.

[f] Monthly maintenance operations are expected to occur on a single engine for 20 minutes per engine per month. In rare cases, this duration may be greater. Multiple sequential tests may occur within the same day for up to 12 hours/day. This model conservatively assumes that two engines may concurrently operate between daylight hours (assumed 7 a.m. to 7 p.m.).

[g] Semiannual operations are expected to occur on each generator for 3 hours every 6 months. Multiple sequential tests may occur within the same day for up to 12 hours/day. This model conservatively assumes that two generators may concurrently operate any time during daylight hours (assumed 7 a.m. to 7 p.m.).