Revised Notice of Construction Application Supporting Information Report WA-13 Data Center Expansion Vantage Data Centers Facility Quincy, Washington

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Prepared for

Vantage Data Centers
2101 M Street NE
Quincy, Washington

LANDAU ASSOCIATES

155 NE 100th St, Ste 302
Seattle, WA 98125
206.631.8680

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Supporting Information Report
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Vantage Data Centers Facility
Quincy, Washington

This document was prepared by, or under the direct supervision of, the technical professionals noted below.

Document prepared by: ____________________ Chloe A. Gore
Primary Author

Document reviewed by: ____________________ Mark W. Brunner
Quality Reviewer

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Project Coordinator: Christopher C. Young

Landau Associates

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LIST OF ABBREVIATIONS AND ACRONYMS

μg/m^3	microgram per cubic meter
AERMAP	AMS/EPA regulatory model terrain pre-processor
AERMET	AERMOD meteorological pre-processor
AERMOD	AMS/EPA regulatory model
AMS	American Meteorological Society
ASIL	acceptable source impact level
BACT	best available control technology
CAT	Caterpillar
cDPF	catalyzed diesel particulate filter
CFR	Code of Federal Regulations
CO	carbon monoxide
DEEP	diesel engine exhaust particulate matter
DOC	diesel oxidation catalyst
DPF	diesel particulate filter
Ecology	Washington State Department of Ecology
EPA	US Environmental Protection Agency
g/kWm-hr	grams per mechanical kilowatt-hour
GEP	good engineering practice
HAP	hazardous air pollutant
HC	hydrocarbon
IDEQ	Idaho Department of Environmental Quality
km	kilometer
kWe	kilowatt electrical
LAI	Landau Associates, Inc.
m	meter
MTU	MTU Onsite Energy
MWe	megawatts electrical
NAAQS	National Ambient Air Quality Standards
NESHAP	National Emission Standards for Hazardous Air Pollutants
NO_2	nitrogen dioxide
NOC	Notice of Construction
NO_X	nitrogen oxides
NSPS	New Source Performance Standard
NWS	National Weather Service
PM	particulate matter
$PM_{2.5}$	PM with an aerodynamic diameter less than or equal to 2.5 microns
PM_{10}	PM with an aerodynamic diameter less than or equal to 10 microns
ppm	parts per million

LIST OF ABBREVIATIONS AND ACRONYMS (CONTINUED)

PVMRM .... Plume Volume Molar Reaction Model
RCW .... Revised Code of Washington
RICE .... reciprocating internal combustion engine
SCR .... selective catalytic reduction
SIL.. significant impact level
SO_2 .... sulfur dioxide
SQER.. small-quantity emission rate
TAP .... toxic air pollutant
tBACT .... BACT for toxic air pollutants
VDC .... Vantage Data Centers
VOC .... volatile organic compound
WAAQS...Washington Ambient Air Quality Standards
WAC .... Washington Administrative Code

1.0 EXECUTIVE SUMMARY

Vantage Data Centers (VDC) is proposing to expand its existing data center campus in Quincy, Washington (Figure 1). This document has been prepared to support the submittal of a Notice of Construction (NOC) application for additional emergency generators, under air quality regulations promulgated by the Washington State Department of Ecology (Ecology). The facility is located at 2101 M Street NE in Quincy, Washington.

VDC currently has two existing buildings (WA-11 and WA-12) at its Quincy data center campus. VDC operates five MTU Onsite Energy (MTU) 3.0-megawatt electrical (MWe) diesel-fired emergency generator sets at WA-11. Additionally, VDC operates 10 Caterpillar (CAT) 2.75-MWe diesel-fired emergency generators and two CAT 500-kilowatt electrical (kWe) diesel-fired life safety emergency generators at WA-12. These were previously permitted by Ecology under Approval Order No. 19AQ-E026.

VDC is proposing no changes to the operational limits and emission levels for the five existing MTU generators at WA-11. No changes are requested for the WA-11 generators and air pollutant contributions from these generators are accounted for in background concentrations provided by Ecology.

VDC is evaluating higher emission levels for some pollutants from the WA-12 generators to account for the results of source testing completed in August 2020 (i.e., source testing results showed that emissions were higher than limits for some pollutants). VDC is also requesting additional operating flexibility for the WA-12 generators. For the purpose of the air quality permitting evaluation, the WA-12 generators will be included in this NOC application as new sources; however, no new generators are proposed at WA-12.

VDC also proposes to install an additional 44 CAT 2.75-MWe generators equipped with passive catalyzed diesel particulate filters (cDPFs) and selective catalytic reduction (SCR). After full buildout of WA-13, the Quincy campus will have a combined 61 generators (inclusive of WA-11 and WA-12 generators). The additional 44 generators will provide emergency backup power to additional server equipment to be located in a new building (WA-13) at the Quincy campus. A site map for the proposed development is provided on Figure 2.

Consistent with the recent approach to permitting data centers in Washington—in which the worst-case emissions are evaluated to allow permitting on a cumulative hours basis rather than on a scenario- and load-specific basis—VDC is requesting the following Approval Order conditions for the facility emergency generators:

1. Non-emergency annual runtime must not exceed 84 hours per year, per generator for WA-12 and WA-13.

2. Maximum fuel usage must not exceed 2,999 gallons per year per generator for the WA-12 500-kWe generators, 16,952 gallons per year per generator for the WA-12 2.75-MWe generators, and 21,594 gallons per year per generator for the WA-13 generators.
3. This application proposes a one-time allowance of 23 hours for commissioning each WA-13 generator. After use, these 23 hours will expire, and the remainder of hours needed for commissioning (up to 27 more hours) will be used from the annual runtime limit allowance.

Annual operations listed above are summarized in Table 1. Air pollutant emission rate estimates were calculated based on vendor-provided "potential site variation" emission estimates for nitrogen oxides (NO_X), carbon monoxide (CO), hydrocarbons (HC), and filterable particulate matter (PM); sulfur mass-balance for sulfur dioxide (SO_2) assuming 100 percent conversion of sulfur in the fuel to SO_2; and emission factors from the US Environmental Protection Agency's (EPA's) AP-42 Volume I, Chapter 3.4 (EPA 1995) for toxic air pollutants (TAPs). To account for slightly higher emissions during the first minute of each engine startup, the estimated emission rates of pollutants associated with startup were scaled up using a "black-puff" scaling factor.

Based on the results of the evaluations supporting this NOC application, the recommended best available control technology (BACT) for criteria pollutants and toxic air pollutants (tBACT) is emission limitations consistent with the EPA's Tier 2 emission standards, which are achieved with combustion controls and the use of ultra-low sulfur diesel fuel. The basis for this recommendation is that the cost of EPA Tier 4-compliant emission controls is disproportionate to the benefit (i.e., emission reduction) achieved. Subject to Ecology's review and approval, the evaluations presented in this NOC application support the following emission limitations as BACT and tBACT for the emergency generators to be installed at the proposed facility:

Best Available Control Technology Proposal

Pollutant(s)	BACT and tBACT Proposal
Particulate matter (PM), carbon monoxide (CO), volatile organic compounds (VOCs), and nitrogen oxides (NO_X)	Use of EPA Tier 2-certified engines when installed and operated as emergency engines, as defined by 40 Code of Federal Regulations (CFR) 60.4219. Compliance with the operation and maintenance restrictions of 40 CFR Part 60, Subpart IIII.
Sulfur dioxide (SO_2)	Use of ultra-low sulfur diesel fuel containing no more than 15 parts per million (ppm) by weight of sulfur.
Toxic air pollutants, including primary nitrogen dioxide (NO_2), diesel engine exhaust particulate matter (DEEP), CO, SO_2, ammonia, 1,3-butadiene, acetaldehyde, acrolein, benzene, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, formaldehyde, indeno(1,2,3-cd)pyrene, naphthalene, propylene, xylenes	Compliance with the proposed BACT requirements for PM, CO, VOCs, NO_X, and SO_2.

VDC is proposing to voluntarily install cDPFs and SCRs on the generators at WA-13. No add-on emission controls are proposed for WA-12 generators.

Air dispersion modeling was conducted for criteria air pollutants and TAPs. The results of modeling demonstrate that ambient criteria pollutant concentrations that result from operations at the facility, and other local and regional background sources, are below the National Ambient Air Quality Standards (NAAQS). Additionally, the results of modeling demonstrate that ambient TAP concentrations that result from operations at the facility are below Washington acceptable source impact levels (ASILs), with the exception of NO_2 and DEEP. Because modeled NO_2 and DEEP concentrations exceed ASILs, a second-tier health impact assessment has been prepared and is being submitted to Ecology under separate cover.

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2.0 INTRODUCTION

Landau Associates, Inc. (LAI) prepared this document on behalf of VDC to support the submittal of an NOC application for installation and operation of new emergency generators and emission limit modifications to existing generators, under air quality regulations promulgated by Ecology. The VDC facility is located at 2101 M Street NE in Quincy, Washington, on Grant County Parcel Nos. 040411115, 040411116, and 040411111. The legal description of the property is as follows: Parcel B Vantage Data Centers BSP, Parcel A-2 Vantage Data Centers Amended BSP, and Parcel A-1 Vantage Data Centers Amended BSP.

VDC operates five MTU emergency generators as part of its WA-11 building. VDC is proposing no changes to the operational limits and emission levels for the five existing MTU generators at WA-11. No changes are requested for the WA-11 generators and air pollutant contributions from these generators are accounted for in background concentrations provided by Ecology.

Twelve existing emergency generators (10 2.75-MWe and two 500-kWe) at WA-12 will be re-evaluated through this NOC permit application to provide additional operating flexibility and higher emission limits. This NOC permit application also proposes installation of an additional 44 2.75-MWe generators at WA-13 to be equipped with cDPFs and SCRs.

On December 21, 2020, VDC received Notice of Correction No. 19528. LAI, on behalf of VDC, responded to the Notice of Correction with a proposal to submit an NOC permit application to request an increase to some of the emission limits in Approval Order Condition 5.4 and to request an increase to the opacity limit to account for the diameter of the generator stacks and the EPA Method 9 accuracy. The air quality evaluation contained in this application supports VDC's request to increase some of the emission limits in Condition 5.4 for the WA-12 generators and the opacity limit for all permitted generators.

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3.0 PROJECT DESCRIPTION

(Section III of NOC application form)

3.1 Facility Description

VDC's existing facility includes two data center buildings. The data center campus is located north of M Street NE, as shown on Figure 1. The site is accessible from M Street NE. A site map for the proposed project is provided as Figure 2.

3.1.1 Diesel-Powered Emergency Generators

This section describes the emission units evaluated in this NOC application. Each emergency generator includes a diesel-powered engine that drives an alternator section to produce electricity. The alternator section does not emit any air pollutants, so the overall emissions from a diesel generator are produced only from the diesel engine. State and federal air quality regulations apply only to the emissions from the diesel engines. The terms "generator" and "engine" are used interchangeably in this report.

Each generator will be operated only as an emergency generator, with generator usage and runtime hours limited to those for "emergency generators" by the federal New Source Performance Standard (NSPS) Subpart IIII, which requires that emergency engines satisfy EPA Tier 2 emission standards as defined by the federal regulations (40 CFR Part 89). VDC operates 12 existing Tier 2-certified generators at WA-12 and proposes to install and operate 44 generators at WA-13 that are equipped with a cDPF and SCR. Also, all VDC emergency generators will use ultra-low sulfur diesel fuel (15 ppm sulfur content).

Each of the emergency generators will be housed within an enclosure at the locations shown on Figure 2. Specifications and manufacturer-provided emissions data for the proposed diesel generators are provided in Appendix A. The generators have the following specifications:

- 10 CAT Model 3516E 2.75-MWe diesel-fired emergency generators. The 10 generators will be EPA Tier 2-certified and have a combined capacity of 27.5 MWe.
- Two CAT Model C15 500-kWe diesel-fired life safety emergency generators. The 500-kWe generators will be EPA Tier 2-certified and have a combined capacity of 1.0 MWe.
- 44 CAT Model 3516E 2.75-MWe diesel-fired emergency generators. The 44 generators will be EPA Tier 2-certified and be equipped with cDPFs and SCRs. These generators will have a combined capacity of 121 MWe.

VDC will not install any other diesel engines for use as fire pumps or for building safety generators.

3.2 Generator Runtime Scenarios

The emission estimates presented in this NOC application are based on emissions at "full-variable load," which corresponds to the characteristic worst-case emission load of each pollutant. Emission estimates are discussed in more detail in Section 4.0.

Generator operating scenarios for the facility are as follows:

- **Non-emergency monthly operation**: Routine operation and maintenance on the emergency generators will be conducted on a monthly basis. This runtime activity will be conducted on one emergency generator at a time for up to 0.5 hours per generator per month without load.
- **Repair Testing**: Repair testing will be conducted on one emergency generator at a time for up to 2 hours per test. One test will be conducted per day for WA-12 engines and at most two tests per day for WA-13 engines.
- **Annual Load Testing**: Annual load testing will be conducted on one emergency generator at a time for up to 4 hours per test at greater than or equal to 75 percent load. At most, two tests will be performed per day.
- **Pull the Plug Test**: Pull the plug testing will occur for one day per year per building. All generators in a building will operate concurrently for up to 4 hours. Pull the plug testing will occur on different days for each building.
- **Transformer Maintenance**: Transformer maintenance will occur on five emergency generators at a time for up to 6 hours per day. At WA-12, transformer maintenance will occur for 2 days every 5 years. At WA-13, transformer maintenance will occur for up to 2 days per year. Transformer maintenance will not be conducted on both buildings concurrently.
- **MX Board Maintenance**: MX board maintenance will occur on five emergency generators at WA-13 and six emergency generators at WA-12 for up to 6 hours per day and up to 2 days per year. MX board maintenance will not be conducted on both buildings concurrently.
- **Unplanned power outage**: During a power outage at the site, all installed generators will activate in order to provide power to the data center. All 56 generators may operate concurrently under full-variable load.
- **Generator startup and commissioning**: After a new generator is installed, that generator will require commissioning. During commissioning, one generator will operate at a time for up to 40 hours per commissioned generator, followed by a site integration test in which up to 11 generators will operate concurrently for up to 10 hours in 1 day, for a total of 50 commissioning hours per generator. Commissioning is required only for new engines, so it will occur only at WA-13.
- **Stack testing**: It is anticipated that Ecology will require exhaust stack emission testing of a single generator of each make/model and size once every 5 years in order to demonstrate continued compliance with air quality standards. It is assumed that each stack test will take 7 hours.

The evaluation documented in this NOC application demonstrates that the above-described operating scenarios will result in facility operations and air pollutant impacts that are in compliance with all federal and state laws and regulations. In summary, VDC requests the following Approval Order conditions to allow for VDC's operational needs:

1. Non-emergency annual runtime must not exceed 84 hours per year, per generator for WA-12 and WA-13.
2. Maximum fuel usage must not exceed 2,999 gallons per year per generator for the WA-12 500-kWe generators, 16,952 gallons per year per generator for the WA-12 2.75-MWe generators, and 21,594 gallons per year per generator for the WA-13 generators.
3. This application proposes a one-time allowance of 23 hours for commissioning each WA-13 generator. After use, these 23 hours will expire, and the remainder of hours needed for commissioning (up to 27 more hours) will be used from the annual runtime limit allowance.

On an annual basis, VDC requests that per-generator runtime limits be aggregated among all generators of the same design and size.

3.3 Compliance with State and Federal Regulations

The facility will comply with the following applicable air regulations, in accordance with the federal and state Clean Air Acts. These requirements are specified in:

- Chapter 70.94 Revised Code of Washington (RCW) (Washington Clean Air Act)
- Chapter 173-400 Washington Administrative Code (WAC) (General Regulations for Air Pollution Sources)
- Chapter 173-460 WAC (Controls for New Sources of Toxic Air Pollutants; updated November 22, 2019)
- 40 Code of Federal Regulations (CFR) Part 60 Subpart A (General Provisions)
- 40 CFR Part 60 Subpart IIII (Stationary Compression Ignition Internal Combustion Engines)
- 40 CFR Part 63 Subpart ZZZZ (National Emission Standards for Hazardous Air Pollutants [NESHAP] for Reciprocating Internal Combustion Engines [RICEs]).

Specifically, the project includes sources of air contaminants and will follow applicable air contaminant regulations as listed in:

- RCW 70.94.152
- WAC 173-400-113
- WAC 173-460-040.

The project is located in an attainment area for all Clean Air Act criteria pollutants. Facilities that produce more than 100 tons per year of any criteria pollutant, 10 tons per year of individual hazardous air pollutant (HAP), or 25 tons per year of combined HAPs are considered major sources under the federal regulation 40 CFR Part 70 and the state regulation WAC 173-410 et seq. Potential-to-emit estimates provided in Section 4.0 demonstrate that the facility will emit:

- Less than 100 tons per year of any criteria pollutant (PM, CO, NO_2, SO_2, and VOCs)
- Less than 10 tons per year of any individual HAP
- Less than 25 tons per year of combined HAPs.

As a result, a Title V operating permit is not required. Likewise, a Prevention of Significant Deterioration New Source Review pre-construction permit is not required because all emissions are below the major source threshold of 250 tons per year.

All of the generators will be operated in a manner that satisfies the definition of “emergency engines” according to the federal regulations NSPS Subpart IIII and NESHAP Subpart ZZZZ. Therefore, NSPS Subpart IIII requires that each generator be manufactured and certified to meet EPA Tier 2 emission limits. The applicable sections of NESHAP Subpart ZZZZ indicate that compliance with the NESHAP for emergency engines requires each generator to meet the EPA Tier 2 emission standards, and each generator must be operated and maintained in accordance with the requirements of NSPS Subpart IIII.

4.0 AIR POLLUTANT EMISSION ESTIMATES

(Section VIII of NOC application form)

Air pollutant emission rates were calculated for the generators per the requirements of WAC 173-400-103 and WAC 173-460-050. Emission rates were calculated for criteria pollutants and TAPs based on peak hourly (worst-case maximum) and long-term (annual maximum) operating scenarios.

The emergency generator manufacturer will be CAT. Manufacturer-reported not-to-exceed generator emission factors for CO, NO_X, and PM were used to estimate emission rates. Additionally, the manufacturer-provided HC emission rate was assumed to represent the emission rate for total VOC emissions.

4.1 Generator Emission Calculation Method

During all operations, the generators will activate at less than or equal to 100 percent load (full-variable load). Operating scenarios used to calculate emission estimates are provided in Table 1. Considering that not all pollutant emission rates are maximum under the same operating load, the pollutant-specific maximum emission rate under any load less than or equal to 100 percent was assumed for calculating the worst-case potential emission rates. These vendor-reported worst-case emission rates are provided in Table 2.

Emissions of DEEP are conservatively assumed to be equal to the manufacturers' not-to-exceed emissions value for 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 ($PM_{2.5}$) are conservatively estimated to be the sum of "front-half" (filterable PM) and "back-half" (condensable PM) emissions. The filterable PM estimate is equal to the manufacturers' not-to-exceed emission factor for PM. An estimate of condensable PM is the manufacturers' not-to-exceed emission factor for HC.

All remaining pollutant emission rates, except for SO_2, were calculated using emission factors from the EPA's AP-42, Volume I, Chapter 3.4, which provides emission factors for HAPs from large internal combustion diesel engines (EPA 1995). These factors are based on maximum fuel consumption. As listed in the generator specification sheets (provided in Appendix A), fuel consumption is highest at 100 percent load. Therefore, the maximum fuel consumption for full-variable load operations of all 56 generators would be 992,317 gallons of diesel fuel per year. Table 3 summarizes the maximum fuel-based project-only emission estimates and fuel consumption rates.

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 ppm) and the maximum expected fuel usage.

4.1.1 Startup Emissions

In order to account for slightly higher emissions during the first minute of each engine startup, the estimated emission rates of pollutants associated with startup (PM, CO, total VOCs, and volatile TAPs) were scaled up using a "black-puff" emission factor. These "black-puff" factors are based on short-term concentration trends for VOC and CO emissions observed immediately after startup 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" (Lents et al. 2005). LAI's derivation of startup emission factors is provided in Table 4. Additional details are provided in Appendix B.

Because an SCR must reach activation temperature before effectively controlling NO_X, emission calculations assume no NO_X emission reduction for the first 15 minutes of an hour after a cold start when operating at 25 percent load and above. No control efficiency for NO_X was applied to the 10 percent load case.

The resultant project-only and facility-wide potentials-to-emit are provided in Table 5. Table 6 shows the estimated project generator emission rates for each TAP, and compares those emission rates to the corresponding small-quantity emission rate (SQER; discussed further in Section 7.1.7).

4.1.2 Opacity Limit

During the source test of the 2.75-MWe generator, the observed opacity at 100 percent operating load was recorded as 10 percent, which represents the percent of light obstructed between the transmitter and the observer. As described in the EPA Method 9 field guide, an increase of observed path length causes an increase in percent observed opacity (EPA 1993). CAT opacity measurements during factory testing were 2.4, 4.3, 2.0, 1.7, and 2.5 at 10, 25, 50, 75, and 100 percent operating load, respectively. Factory testing was conducted with a 12-inch stack versus the 20-inch stack that has been constructed on site to accommodate back pressure with the taller stacks. An increase in path length by 1.67D (i.e., 20/12) will increase observed opacity by 9.5 percent for a baseline reference value of 20 percent observed opacity or a roughly 50 percent increase in the observed opacity over reference opacity. Considering what is roughly a 50 percent increase in observed opacity due to a larger field stack size compounded with a 7.5 percent Method 9 accuracy, the measured opacity is within the measurement error range of the value measured during the CAT factory test. Applying this method to the opacity measurements taken in the CAT factory results in a potential opacity level ranging from 10 to 14 percent, depending on the operating load. VDC requests an increase to the opacity limit to 10 percent for all onsite and proposed generators to account for the increased stack diameter and method accuracy.

VDC has not received information from CAT or MTU about opacity levels at the factory for the CAT 500-kWe and MTU 3.0-MWe generators; however, in consideration of the information presented above, VDC would like to request an increase to at least 10 percent for those units as well.

5.0 EMISSION STANDARD COMPLIANCE

(Section VII of NOC application form)

The emergency diesel generators are subject to the emission control requirements under NSPS Subpart IIII, "Standards of Performance for Stationary Compression Ignition Internal Combustion Engines." The runtime limits requested for the generators satisfy the definition of "emergency generator" as specified by NSPS Subpart IIII. Based on that definition of "emergency generators," NSPS Subpart IIII indicates that the new generators are subject to EPA Tier 2 emission limits for emergency engines as specified by 40 CFR Part 89.

VDC will conduct all notifications, generator maintenance, recordkeeping, and reporting as required by NSPS Subpart IIII.

The generators will also be subject to the NESHAP requirements under Subpart ZZZZ, "National Emission Standards for Hazardous Air Pollutants for Reciprocating Internal Combustion Engines (RICEs)." NESHAP Section 63.6590(c)(1) specifies requirements for emergency RICEs that are also subject to NSPS Subpart IIII. The VDC facility will be an "area source" of federal HAPs; accordingly, NESHAP Section 63.6590(c)(1) indicates that the emergency generators will not be required to comply with any portions of Subpart ZZZZ as long as the generators comply with EPA Tier 2 emission standards and VDC operates the generators in compliance with NSPS Subpart IIII.

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6.0 BEST AVAILABLE CONTROL TECHNOLOGY ANALYSIS

(Section VIII of NOC application form)

This section describes the process of evaluating BACT for emergency generators.

6.1 General Approach for Best Available Control Technology Assessment

BACT is an emission limitation based on the maximum degree of reduction that can be feasibly achieved for each air pollutant emitted from any new or modified stationary source. Ecology determines BACT using a “top-down” approach as described in the EPA’s draft New Source Review Workshop Manual: Prevention of Significant Deterioration and Non-Attainment Area Permitting (EPA 1990). The following five steps are involved in the top-down process:

1. The first step in the top-down analysis is to identify all available control technologies that can be practicably applied for each emission unit.
2. The second step is to determine the technical feasibility of potential control options and to eliminate options that are demonstrated to be technically infeasible.
3. The third step is to rank all remaining options based on control effectiveness, with the most effective control alternative at the top.
4. The fourth step is to evaluate the remaining control alternatives. If the top-ranked control alternative is considered unacceptable based on disproportionate economic, environmental, and/or energy impacts, it is discarded. Justifications for discarding top-ranked control options must be approved by Ecology.
5. The fifth and final step is to choose the top-ranked alternative from the list of control options remaining after applying Steps 1 through 4. BACT is the emission rate that results from the control.

Control options for potential reductions in criteria pollutant and, as practical, TAP emissions were identified for each source. In Washington State, the term BACT refers to the control technology applied to achieve reductions in criteria pollutant emission rates. The term “tBACT” refers to BACT applied to achieve reductions in TAP emission rates. Technologies were identified by considering Ecology’s previous environmental permit determinations for diesel generators in Washington State. Available controls that are judged to be technically feasible are further evaluated taking into account energy, environmental, and economic impacts and other costs.

The following sections summarize the findings and recommended BACT determination. Detailed cost estimates and assumptions that support this BACT assessment are provided in Appendix C.

6.2 Steps 1, 2, and 3: Identify Feasible Control Technologies for Diesel Generators

Based on Ecology's prior determinations in permitting diesel generators at computer data centers, the following technologies were considered to be commercially available and technically feasible for use at the facility:

- **Tier 4 integrated control package**. This control option consists of an integrated diesel particulate filter (DPF), diesel oxidation catalyst (DOC), and urea-based selective catalytic reduction (SCR). This system is highly efficient for control of NO_X (90 percent), PM_{10}/$PM_{2.5}$/DEEP (85 percent of "front-half"), CO (80 percent), VOCs and gaseous TAPs (70 percent), and meets Tier 4 emission standards as defined by the federal regulations (40 CFR Part 89). Note, when engine or emission control system manufacturers are producing Tier 4-compliant engines, they will typically weld the DOC to the DPF and call it a "catalyzed DPF." While the Tier 4 integrated control package is technically feasible, it does have some operational constraints for emergency generators. For example, SCRs typically do not provide NO_X removal when the engine exhaust temperature is below the target temperature of 575°F, which may occur at low loads.
- **Urea-based SCR**. This control option is highly efficient for control of NO_X (90 percent) and NO_2. While the SCR is technically feasible, it does have some operational constraints for emergency generators as described above.
- **Catalyzed DPF (passive)**. This control option is highly efficient for control of PM_{10}/$PM_{2.5}$/DEEP (85 percent of "front-half"), CO (80 percent), and VOCs and gaseous TAPs (70 percent). The amount of condensable ("back-half") particulates removed by cDPFs (if any) is not well understood.
- **Diesel oxidation catalyst**. This control option is highly efficient for removal of CO (80 percent), and VOCs and gaseous TAPs (70 percent). It is marginally effective for removal of PM_{10}/$PM_{2.5}$/DEEP (15 to 25 percent depending on the load). This analysis conservatively assumed 25 percent removal of PM_{10}/$PM_{2.5}$/DEEP ("front-half") for the DOC system.
- **Tier 2-certified**. Tier 2-certified engines rely on combustion controls and the use of ultra-low sulfur diesel fuel (15 ppm sulfur content) to comply with EPA Tier 2 emission standards.

6.3 Step 4: Evaluate Technically Feasible Technologies for Diesel Generators

All of the technologies listed above are assumed to be commercially available, reasonably reliable, and safe for use on backup diesel generators.

6.3.1 Methodology for Cost-Effectiveness Analyses for Diesel Generators

Detailed calculation spreadsheets for the BACT cost-effectiveness analyses are provided in Appendix C. For the individual pollutants, cost effectiveness was calculated by dividing the total life-cycle annual cost (dollars per year) by the tons of pollutant removed by the control device. The derived cost effectiveness was then compared to the following cost-effectiveness criteria values, which were developed based on Ecology's methodology for previous BACT evaluations for diesel generators or were calculated by LAI using the Hanford[1] methodology as recommended by Ecology:

- Criteria air pollutants: Range between $5,000 and $12,000 per ton of removed pollutants (Ecology 2016; Appendix C)
- Toxic air pollutants: Range between $730 and $79,000 per ton of TAP removed based on the Hanford methodology (Haass et al. 2010; Appendix E).

The cost-effectiveness analyses for this NOC application were conducted using generally accepted assumptions that provide a reasonable but conservatively low estimate of the capital and operating costs, and a reasonable but conservatively high estimate of the pollutant removal efficiencies.

The capital cost, operating cost, life-cycle annualized cost, and cost effectiveness (dollars per ton of destroyed pollutant) were calculated using the methodology specified in the EPA Air Pollution Control Cost Manual (EPA 2019).

Cost estimates and pollutant destruction and removal efficiencies were obtained from CAT for each evaluated emission control option. Indirect cost factors to derive a conservatively low total installation cost were obtained from the EPA Air Pollution Control Cost Manual (EPA 2019). The annual capital recovery costs were calculated assuming a 30-year system lifetime and a 5.5 percent annual discount rate. Conservatively low estimates of annual operation and maintenance costs for each control option were derived by assuming that there would be no operating cost for electricity or equipment maintenance. To provide a conservatively low estimate of the annual operating cost, the operational unit costs for each emission control option were set to zero.

6.4 Best Available Control Technology Cost Effectiveness

This section describes the evaluation conducted to determine the cost effectiveness of controlling criteria pollutant emissions using the technologies identified in Section 6.2. As discussed below, the costs of controlling criteria pollutant emissions using the Tier 4 integrated control package, cDPF (passive), SCR, and DOC are disproportionate to the benefit received.

6.4.1 Cost Effectiveness Analysis for Tier 4 Integrated Control Package

The cost effectiveness (as dollars per ton of pollutant removed) of installing the Tier 4 integrated control package for control of NO_X, $PM_{10}/PM_{2.5}$, CO, VOCs, and combined criteria air pollutants is provided in Table 8 As shown in Table 7, the forecast cost effectiveness for control of individual and combined pollutants exceeds Ecology's thresholds for cost effectiveness; therefore, subject to

[1] The Hanford method for evaluating the cost effectiveness of control technologies is documented in a report titled, Evaluation of Best Available Control Technology for Toxics (tBACT), Double Shell Tank Farms Primary Ventilation Systems Supporting Waste Transfer Operations (Haass et al. 2010; on DVD in Appendix E).

Ecology's review and concurrence, the Tier 4 integrated control package is cost-prohibitive for the purpose of reducing criteria air pollutant emissions.

6.4.2 Cost Effectiveness Analysis for SCR

As shown in Table 8, the forecast cost effectiveness for control of NO_X exceeds Ecology's cost-effectiveness threshold of $12,000 per ton of NO_X; therefore, subject to Ecology's review and concurrence, an SCR is cost-prohibitive for the purpose of controlling NO_X emissions.

6.4.3 Cost Effectiveness Analysis for Catalyzed DPF (Passive)

The cost effectiveness of installing a passive cDPF for control of $PM_{10}/PM_{2.5}$, CO, VOCs, and combined pollutants is provided in Table 8. As shown in Table 8, the forecast cost effectiveness for control of individual and combined pollutants exceeds Ecology's thresholds for cost effectiveness; therefore, subject to Ecology's review and concurrence, the passive cDPF is cost-prohibitive for the purpose of controlling criteria air pollutant emissions.

6.4.4 Cost Effectiveness Analysis for DOC

The cost effectiveness of installing a DOC for control of $PM_{10}/PM_{2.5}$, CO, VOCs, and combined pollutants is provided in Table 8. As shown in Table 8, the forecast cost effectiveness for control of individual and combined pollutants exceeds Ecology's thresholds for cost effectiveness. Therefore, subject to Ecology's review and concurrence, the DOC is cost-prohibitive for the purpose of reducing individual criteria air pollutant emissions.

6.5 Toxics Best Available Control Technology Cost Effectiveness

This section describes the evaluation conducted to determine the cost effectiveness of controlling TAP emissions using the technologies identified in Section 6.2. As discussed below, the costs of controlling TAP emissions using the Tier 4 integrated control package, catalyzed DPF, SCR, and DOC are disproportionate to the benefit received. Subject to Ecology's review and concurrence, the analysis presented below supports the conclusion that Tier 4 integrated controls are cost-prohibitive for designation as tBACT on the basis of control efficiencies for TAPs.

TAPs emitted by Tier 2 emergency generators at rates exceeding the *de minimis* thresholds consist of: NO_2, DEEP, CO, SO_2, ammonia, 1,3-butadiene, acetaldehyde, acrolein, benz(a)anthracene, benzene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, formaldehyde, indeno(1,2,3-cd)pyrene, naphthalene, propylene, and xylenes.

The air pollutant emission control options described in Section 6.2 would be effective at various ranges of efficiencies for control of TAPs. A cost-effectiveness summary for each TAP control option is provided in Appendix C. Table 9 summarizes the calculated TAP cost effectiveness for each control option in comparison to the presumed acceptable thresholds derived using the Hanford methodology.

Emission control technologies and the cost-effectiveness evaluation for control of PM_{10}/$PM_{2.5}$ is the same for control of DEEP, because cDPFs remove only filterable ("front-half") particulates. The derived cost threshold (i.e., the Hanford "ceiling cost"—or the cost threshold above which controls are considered cost-prohibitive) for removal of DEEP, based on the Hanford method, is $72,544 per ton. As shown in Table 9, the forecast cost effectiveness to control DEEP using a Tier 4 integrated control package, passive cDPF, active cDPF, or DOC exceeds Ecology's thresholds for cost effectiveness. Therefore, subject to Ecology's review and concurrence, the control options identified are cost-prohibitive for the purpose of controlling DEEP emissions.

A cost-effectiveness evaluation was completed for CO as a criteria pollutant (see Section 6.4 and Table 8). CO is also evaluated as a TAP in this section. The derived cost threshold for removal of CO, based on the Hanford method, is $731 per ton. As shown in Table 8, the forecast cost effectiveness to control CO using a Tier 4 integrated control package, passive cDPF, active cDPF, and DOC exceeds Ecology's thresholds for cost effectiveness. Therefore, subject to Ecology's review and concurrence, the control options identified are cost-prohibitive for the purpose of controlling CO emissions.

NO_2 is a minor component of NO_X at the point of release; the in-stack ratio of NO_2 to NO_X is assumed to be 10 percent. Therefore, control technologies evaluated for NO_X (Section 6.4) are applicable to NO_2 and costs are proportionately applicable. The derived cost threshold for removal of NO_2, based on the Hanford method, is $18,472 per ton. As shown in Table 8, the forecast cost effectiveness to control NO_2 using a Tier 4 integrated control package and SCR exceeds Ecology's thresholds for cost effectiveness. Therefore, subject to Ecology's review and concurrence, the control options identified are cost-prohibitive for the purpose of controlling NO_2 emissions.

Emissions of ammonia, 1,3-butadiene, acetaldehyde, acrolein, benz(a)anthracene, benzene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, formaldehyde, indeno(1,2,3-cd)pyrene, naphthalene, propylene, and xylenes are treatable using the same control options applicable to control VOCs. The derived cost thresholds for removal of these TAPs, based on the Hanford method, are:

- $18,190 per ton of removed ammonia
- $62,085 per ton of removed 1,3-butadiene
- $51,063 per ton of removed acetaldehyde
- $51,317 per ton of removed acrolein
- $70,256 per ton of removed benz(a)anthracene
- $55,833 per ton of removed benzene
- $78,029 per ton of removed benzo(a)pyrene
- $70,256 per ton of removed benzo(b)fluoranthene
- $81,190 per ton of removed dibenz(a,h)anthracene

- $54,610 per ton of removed formaldehyde
- $70,256 per ton of removed indeno(1,2,3-cd)pyrene
- $62,674 per ton of removed naphthalene
- $10,020 per ton of removed propylene
- $21,934 per ton of removed xylenes.

As shown in Table 9, the forecast costs to control these individual TAPs each exceed Ecology's thresholds for cost effectiveness for all applicable control options; therefore, subject to Ecology's review and concurrence, the control options identified are cost-prohibitive for the purpose of controlling individual TAP emissions.

Table 9 also provides the combined cost effectiveness for controlling all TAPs for each emission control option. As shown in Table 9, the combined cost effectiveness for TAPs exceeds Ecology's threshold for cost effectiveness for each control option.

6.6 Step 5: Recommended Best Available Control Technology for Diesel Generators

Although all of the add-on control technology options associated with Tier 4 diesel engine controls (Tier 4 integrated control package, SCR, active or passive cDPF, or DOC) are technically feasible, each of them failed the BACT and tBACT cost-effectiveness evaluations. Therefore, none of the add-on controls are recommended as BACT or tBACT because the costs of emissions control are disproportionate to the benefit received. Instead, emission limitations consistent with the EPA's Tier 2 emission standards—achieved with combustion controls and the use of ultra-low sulfur diesel fuel—are the recommended BACT and tBACT determination. The BACT recommendation is based on compliance with the EPA's Tier 2 emission standards for a non-road diesel engine: 0.20 grams per mechanical kilowatt-hour (g/kWm-hr) for PM, 3.5 g/kWm-hr for CO, and 6.4 g/kWm-hr for combined NO_X plus VOCs.

Use of ultra-low sulfur diesel fuel containing no more than 15 ppm by weight of sulfur is proposed as tBACT for SO_2.

VDC is proposing to voluntarily install catalyzed DPFs and SCRs on the generators at WA-13. No add-on emission controls are proposed for WA-12 generators.

7.0 AMBIENT AIR QUALITY IMPACT ANALYSIS

(Section IX of NOC application form)

This section discusses the air dispersion modeling results and provides a comparison of the results to the NAAQS and Washington Ambient Air Quality Standards (WAAQS) for criteria pollutants and the Washington State small-quantity emission rates (SQERs) and ASILs for TAPs. Air dispersion modeling input values and selected isopleths are provided in Appendix D. Copies of the electronic modeling files and inputs are provided in Appendix E.

As discussed in the following sections, the modeled ambient impacts expected from project emissions are either less than the significant impact levels (SILs) or less than the NAAQS and WAAQS, even after summing with background concentrations. With the exception of two TAPs (DEEP and NO_2), all predicted ambient TAP impacts are less than the ASILs. Therefore, a second-tier health impact assessment will be conducted only for DEEP and NO_2.

7.1 Model Methodology and Assumptions

Air dispersion modeling was conducted using the AERMOD[2] modeling system in general accordance with the EPA's 40 CFR 51 Appendix W; Final Rule (EPA 2017).

Ambient air impacts were modeled for all criteria pollutants and TAPs for which compliance is not demonstrated via emissions threshold screening. The Industrial Source Complex-AERMOD View Version 10.0 interface provided by Lakes Environmental was used for AERMOD modeling. This version of the Lakes Environmental software incorporated the most recent version of AERMOD (Version v21112) at the time the modeling was completed. AERMOD requires input from several pre-processors, described below, for meteorological parameters, downwash parameters, and terrain heights. AERMOD incorporates the data from the pre-processors with emission estimates and physical exhaust release point characteristics to predict ambient concentrations as a result of the proposed project. The model calculates concentrations based on various averaging times (e.g., 1 hour, 24 hours, annual, etc.) for a network of receptors and results are compared to air quality standards.

The AERMOD model was used to estimate the short-term impacts (i.e., 24-hour average or less) of PM_{10}, $PM_{2.5}$, CO, NO_2, SO_2, ammonia, and acrolein emissions and long-term impacts (i.e., annual average) of DEEP, PM_{10}, $PM_{2.5}$, NO_2, benzene,1,3-butadiene, and naphthalene emissions.

7.1.1 Stack Parameters

VDC uses rain caps on generator exhaust stacks to prevent precipitation from entering the generator stacks. At or below 10 percent load, the exhaust velocity is not great enough to entirely open the rain caps. This obstructs the flow of the exhaust, reducing the vertical velocity and increasing the plume

[2] American Meteorological Society (AMS)/US Environmental Protection Agency (EPA) Regulatory Model.

width. According to a review conducted by Ecology, the exhaust exit velocity is reduced by 30 percent for a vertical stack with a rain cap that has an angle of 45 degrees (multiply the actual exhaust velocity by an adjustment factor of 0.7). A conservatively low exhaust exit velocity adjustment factor of 0.42 was used to calculate the adjusted velocity at 10 percent generator operating load. The stack diameter was also adjusted to simulate the widening of the plume and to maintain the actual flow rate of the release. The effective stack diameter was calculated by dividing the actual flow by the adjusted exhaust velocity.

The actual stack dimensions are 60 feet in height above grade and a 20-inch inside diameter for the proposed CAT 2.75-MWe engines, 43 feet in height above grade and a 20-inch inside diameter for the existing CAT 2.75-MWe engines, and 15 feet in height above grade and a 7.6-inch inside diameter for the existing 500-kWe life safety generators. The adjusted stack velocities and diameters were modeled as follows:

- Proposed CAT 2.75-MWe at 10 percent load: Effective diameter = 30.8 inches; adjusted velocity = 725 feet per minute
- Existing CAT 2.75-MWe at 10 percent load: Effective diameter = 30.8 inches; adjusted velocity = 725 feet per minute
- Existing 500-kWe at 10 percent load: Effective diameter = 11.7 inches; adjusted velocity = 1,005 feet per minute.

Because stack exhaust temperature and velocity impact dispersion of pollutants, a screening model was run to determine the operating load that results in the worst-case concentration for each pollutant and averaging period modeled. In the screening model, the exhaust temperature and exit velocity for each load case is modeled using a 1 pound per hour emission rate to generate a dispersion factor for each load and averaging period. The results of the screening analysis are presented in Table 9. The modeled emission rates and stack parameter for each pollutant and modeled scenario is provided in Table D-1 in Appendix D.

An additional safety factor was applied reducing the modeled exhaust flow by 20 percent to account for variations in onsite environmental conditions. This safety factor also accounts for the temperature drop associated with the use of DPFs, which averages approximately 17 percent.

7.1.2 Building Downwash

Building downwash occurs when the aerodynamic turbulence induced by nearby buildings causes a pollutant emitted from an elevated source to be mixed rapidly toward the ground (downwash), resulting in higher ground-level pollutant concentrations. The software program Building Profile Input Program-Plume Rise Model Enhancements was 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 (GEP) stack height.

GEP stack height is defined as the height of the nearby structure(s) measured from the ground-level elevation at the base of the stack plus 1.5 times the lesser dimension, height, or projected width of the nearby structure(s). The WA-12 data center building height is 27.5 feet and the WA-13 data center building height is 46 feet. The generator stacks will be located along each side of the WA-13 building and along the north side of the WA-12 building.

7.1.3 Receptor Grid

To model complex terrain, AERMOD requires information about the surrounding terrain. The AMS/EPA Regulatory Model Terrain Pre-processor (AERMAP, version 18081) was used to obtain the hill height scale and the base elevation for each receptor location.

A receptor flagpole height of 1.5 meters (m) above ground was defined to approximate the human breathing zone. The receptor grid spacing increases with distance from the facility, as listed below:

- 12.5-m spacing from the property boundary to 150 m
- 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 from 2,000 m to 4,500 m
- 600-m spacing from 4,500 m to 10,000 m.

Fourteen receptors were placed inside the plant boundary to represent exposure to workers not employed by VDC that are on site.

AERMAP requires the use of topographic data to estimate surface elevations above mean sea level. Digital topographic data (in the form of National Elevation Data files) for the analysis region were obtained from the Lakes Web GIS website (http://www.webgis.com) and processed for use in AERMOD. The National Elevation Data used for this project have a resolution of approximately 10 m (⅓ arc-second).

AERMAP produces a Receptor Output File (*.rou) containing the calculated terrain elevations and hill height scale for each receptor. The *.rou file was used as an input runstream file (AERMOD Include File). AERMAP also produces a Source Output File (*.sou). This file contains the calculated base elevations for all sources.

7.1.4 Meteorology

The AERMOD Meteorological Pre-Processor (AERMET; Version 21112) is the meteorological pre-processor model that estimates boundary-layer parameters for use in AERMOD. AERMET processes formatted meteorological data from observation stations and generates two input files for the AERMOD model: the Surface File with hourly boundary-layer parameter estimates; and the Profile

File with multi-level observations of wind speed, wind direction, temperature, and standard deviations of fluctuating wind components. Three years (January 1, 2018 through December 31, 2020) of meteorological observation data were processed by AERMET for this project as described below.

- Onsite wind speed, wind direction, and temperature data from Quincy, Washington were provided by Ecology.
- National Weather Service (NWS) hourly surface observations from Grant County International Airport in Moses Lake, Washington were used to substitute for missing hours and parameters not measured by the onsite data. The airport is located approximately 24 miles from the facility. 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 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.
- NWS twice-daily upper air soundings were obtained from Spokane, Washington.
- Surface characteristics of albedo, Bowen ratio, and surface roughness are used by AERMET in stage 3 of the processing. Albedo is a measure of the solar radiation reflected back from earth into space. The Bowen ratio is an evaporation-related measurement and is defined as the ratio of sensible heat to latent heat. The surface roughness length is the theoretical height above ground where the wind speed becomes zero.

  AERSURFACE version 20060 was used to determine the albedo, Bowen ratio, and surface roughness based on data on the use of land surrounding the surface observation site from the 2016 National Land Cover Database (USGS 1992). AERSURFACE calculates the percentage of land-use type within each of 12 equal sectors of a circle centered on the surface station tower. The default study radii of 1 kilometer (km) for surface roughness and 10 km for the Bowen ratio and albedo were used. Default months were assigned in AERSURFACE to represent the four seasonal categories as follows: 1) mid-summer 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 for all sectors.

  Annual precipitation for Quincy for each modeled year was obtained from the Western Regional Climate Center database. The annual precipitation was between the top and bottom 30th percentile of the past 30 years of annual precipitation totals for 2018 and 2020, so the Bowen ratio values for average surface moisture were used for those 2 years. The annual precipitation was within the bottom 30th percentile of the past 30 years of annual precipitation totals for 2019 so the Bowen ratio values for dry surface moisture were used for that year.

7.1.5 NO_X to NO_2 Conversion

The ambient NO_2 concentrations were calculated using the Plume Volume Molar Ratio Method (PVMRM) option within AERMOD. This AERMOD option calculates the amount of NO_X that is converted to NO_2 in the ambient air using a user-specified NO_2/NO_X equilibrium ratio, NO_2/NO_X in-stack ratio, and ambient ozone concentration. The PVMRM parameters were set as follows:

- Default NO_2/NO_X equilibrium ratio of 0.90
- NO_2/NO_X in-stack ratio of 0.1
- Ambient ozone concentration of 51.8 micrograms per cubic meter (µg/m^3) from the Idaho Department of Environmental Quality (IDEQ) 2014-2017 design value of criteria pollutants website, for the project area (IDEQ; accessed April 23, 2021).

7.1.6 Background Concentration

This evaluation includes background concentrations contributed by existing regional and local nearby sources. Regional background concentrations were obtained from the IDEQ website (IDEQ; accessed April 23, 2021). Ecology provided local background concentrations based on the "StoryMap" data for use in the second-tier review of TAPs and NO_2 1-hour NAAQS. Regional and local background concentrations were added to the modeled predicted project concentrations to estimate the projected cumulative concentrations for those pollutants and averaging periods with results above the SIL.

7.1.7 First-Tier Screening of Toxic Air Pollutant Impacts

A first-tier TAP assessment compares the forecast emission rates to the SQERs and compares the maximum ambient concentrations to ASILs. Table 6 shows the estimated project emission rates for each TAP emitted, and compares those emission rates to the corresponding SQER. Each SQER is an emission rate threshold, below which Ecology does not require an air quality impact assessment for the corresponding TAP. As shown in Table 6, estimated project-only emissions of NO_2, DEEP, CO, SO_2, ammonia, 1-3-butadiene, acrolein, benzene, and naphthalene are greater than their respective SQERs, so an ambient impact analysis was completed for those TAPs.

Ecology requires facilities to conduct a first-tier screening analysis for each TAP whose emissions exceed its SQER by modeling the 1st-highest 1-hour, 1st-highest 24-hour, and annual ambient impacts (depending on the TAP of interest), then comparing the modeled values to the ASILs (WAC 173-460-080).

7.1.8 Monte Carlo Statistical Analysis

Project generator operations will be intermittent and, on any given day, the operating scenarios and arrangement of activated engines will vary, as will the meteorological conditions that affect the pollutant dispersion. Due to the random unpredictability of weather patterns and variable timing of operations for intermittent emission sources, a statistical approach has been developed by Ecology using a stochastic Monte Carlo analysis to demonstrate compliance with air quality standards that are based on a percentile of the daily maximum ambient impacts, such as the $PM_{2.5}$ 24-hour average, NO_2 1-hour average, and SO_2 1-hour SO_2 NAAQS.

Ecology has generated a Monte Carlo script, for the statistical freeware "R," that was designed specifically to evaluate compliance of intermittent emissions, such as from emergency generators at data centers, and it has been previously used to demonstrate compliance with the NO_2 1-hour and $PM_{2.5}$ 24-hour average NAAQS for emergency generators at other data centers located in Washington State. This script processes output files from several AERMOD runs that are representative of each engine operating scenario. The script iteratively tests 1,000 combinations of results from all the generator runtime scenarios and hourly results to estimate, at any given receptor location, if the NAAQS standard will be violated. The script estimates the 98^{th}-percentile (i.e., 8^{th} highest) concentration at each individual receptor location within the modeling domain.

7.2 Modeled Emission Rates

7.2.1 Annual Averaging Period

Annual potential-to-emit rates were established based on the annual runtime limit of 84 hours of operation per generator. For WA-13 generators, annual potential-to-emit rates were established by also adding a one-time runtime allotment to be used for commissioning purposes of 23 hours. To demonstrate compliance for the "maximum year" during which VDC would perform commissioning of new WA-13 generators, emission rates for modeling were calculated based on a runtime of 84 hours for the WA-12 generators and 107 hours for the WA-13 generators. The total maximum year emission rate was divided by the number of hours in a year (8,760 hours) to establish the pounds per hour emission rate input into AERMOD. These emission assumptions are used for the following:

- $PM_{2.5}$ annual average
- NO_2 annual average
- TAPs annual average (naphthalene, benzene, and DEEP).

7.2.2 Short-Term Averaging Period

To determine the worst-case ambient impacts for short-term averages (i.e., 1-hour, 3-hour, and 8-hour), the modeling setup assumed all 56 generators would be concurrently operating for 24 hours per day, 365 days per year. These assumptions are to address the conservative consideration that a power outage could occur at any time of day or night on any day of the year. These emission assumptions were used for the following:

- CO, 1-hour and 8-hour average
- SO_2, 1-hour and 3-hour average
- Any applicable TAP with short-term averaging period (CO, SO_2, and NO_2).

7.2.3 24-Hour Averaging Period

The $PM_{2.5}$ 24-hour average NAAQS is also a probabilistic standard based on the 98th percentile of the 24-hour average concentration (8th-highest 24-hour concentration) averaged over 3 years. LAI proposes compliance to be demonstrated with this standard by modeling the 22nd-highest daily emissions of 3 years. Table D-2 shows the ranking of the daily emissions for each generator runtime scenario based on the number of days per year and days per 5 years required for each scenario. As shown in Table D-2, the 18th through 22nd-highest emitting day occurs during single generator operations when one engine operates at a time for up to 8 hours per day. Since this scenario would occur five times in a 3-year period before reaching the 22nd-high, the reported model result is based on the 5th-highest predicted impact of the 3-year modeling period.

The PM_{10} 24-hour average NAAQS is not to be exceeded more than once per year on average over 3 years. Compliance with this standard is determined using the 6th-highest concentration averaged over 3 years. This modeling scenario assumed all 56 generators would be concurrently operating due to a 4-hour power outage.

For TAPs with 24-hour averaging periods (acrolein and ammonia), the modeling setup assumed that all 56 generators would be concurrently operating for 4 hours per day due to a power outage.

7.3 Predicted Criteria Pollutant Ambient Concentrations

The results of the criteria pollutant modeling are provided in Table 10. Emission rate estimates and stack parameters for these scenarios are provided in Table D-1.

The model-predicted ambient impacts for the 3-hour average for SO_2 would be less than the SIL. The model-predicted ambient impacts plus background for all other pollutants and averaging periods would be less than the NAAQS.

7.3.1.1 NO_2 1-Hour Average Modeling and Statistical Analysis

For demonstration of project compliance with the NO_2 1-hour average NAAQS, each engine runtime scenario has been characterized using project emissions and stack parameters shown in Table D-1. The operating days considered in the statistical analysis are presented in Table D-3 and are as follows:

- All 56 generators activate concurrently at full-variable load during an unplanned outage for up to 2 days per year.
- All 12 WA-12 generators will operate concurrently at full-variable load during a pull-the-plug test for up to 1 day per year.
- All 44 WA-13 generators will operate concurrently at full-variable load during a pull-the-plug test for up to 1 day per year.
- Six WA-12 generators will operate concurrently at full-variable load during MX Board maintenance for up to 2 days per year.

- Five WA-13 generators will operate concurrently at full-variable load during MX Board maintenance for up to 2 days per year.
- Eleven WA-13 generators will operate concurrently at full-variable load during site integration test commissioning for up to 2 days per year.
- Five WA-13 generators will operate concurrently at full-variable load during transformer maintenance for up to 2 days per year.
- One WA-12 generator will operate at full-variable load during repair testing and annual load testing for up to 9 days per year.
- One WA-13 generator will operate at full-variable load during repair testing, stack testing, and commissioning burn-in and testing for up to 26 days per year.
- One WA-12 generator will operate at 10 percent load during monthly maintenance testing for up to 11 days per year.
- One WA-12 generator will operate at full-variable load during stack testing for up to 6 days in 5 years.
- Five WA-12 generators will operate concurrently at full-variable load during transformer maintenance for up to 2 days in 5 years.

If the highest first high concentration plus background is less than the NAAQS for a given operating scenario, demonstration of compliance with the NAAQS is complete. As such, these scenarios are not included in the Monte Carlo analysis because even continuous operation under that scenario would not cause or contribute to a violation of the NAAQS. Modeled NO_2 concentrations associated with annual load testing and monthly maintenance at WA-13 are below the NAAQS and are therefore not included in the Monte Carlo simulation.

Each of the above-noted engine runtime scenarios was modeled using the PVMRM option. The resultant daily maximum 1-hour average concentration of each of the above-listed AERMOD runs was post-processed using Ecology's Monte Carlo script in "R." Electronic copies of the AERMOD and Monte Carlo simulation output files are provided in Appendix E. This script was used to predict the median of the 98th-percentile impact value at every receptor location within the modeling domain.

Based on the assumptions outlined above for the stochastic Monte Carlo analysis, the 98th-percentile of the project's maximum daily 1-hour average concentration of NO_2 is predicted to be 154 μg/m^3 and to occur on site on the southwest side of the WA-12 building (as shown on Figure 3). As shown in Table 10, the estimated cumulative concentration at this maximum project impact location is 184 μg/m^3, which is less than the NO_2 1-hour average NAAQS of 188 μg/m^3.

7.4 Predicted Toxic Air Pollutant Ambient Concentrations

The first-tier ambient concentration screening analysis is summarized in Table 11. This screening analysis was conducted on all TAPs with expected emission rates that exceed the SQER (as presented in Table 6). As shown in Table 11, the maximum modeled ambient concentrations for ammonia, 1,3-butadiene, acrolein, benzene, and naphthalene are less than their respective ASILs.

7.4.1 Annual Average DEEP Impacts

The DEEP modeling analysis was conducted by assuming that all generators at the facility would operate for the maximum annual runtime hours. Further details on the modeling input parameters are provided in Table D-1 in Appendix D. The maximum modeled annual average ambient DEEP concentration was 0.25 $\mu g/m^3$ (Table 11), which exceeds the ASIL of 0.0033 $\mu g/m^3$. The location of the modeled maximum ambient impact is shown on Figure 3.

Since the maximum modeled ambient DEEP concentration (attributable to project-related sources) was modeled to be greater than the ASIL, a second-tier health impact assessment will be conducted for DEEP (to be provided to Ecology under separate cover).

7.4.2 1-Hour NO_2 Impacts During Facility-Wide Concurrent Generator Operation

The AERMOD model for this scenario was set up to assume that VDC would operate 56 generators for 24 hours per day, 365 days per year. The maximum modeled 1st-highest 1-hour average ambient NO_2 concentration was 1,249 $\mu g/m^3$ (Table 11), which exceeds the ASIL of 470 $\mu g/m^3$. The location of the modeled maximum ambient impact is shown on Figure 3.

Since the maximum modeled ambient NO_2 concentration (attributable to project-related sources) was modeled to be greater than the ASIL, a second-tier health impact assessment will be conducted for NO_2 (to be provided to Ecology under separate cover).

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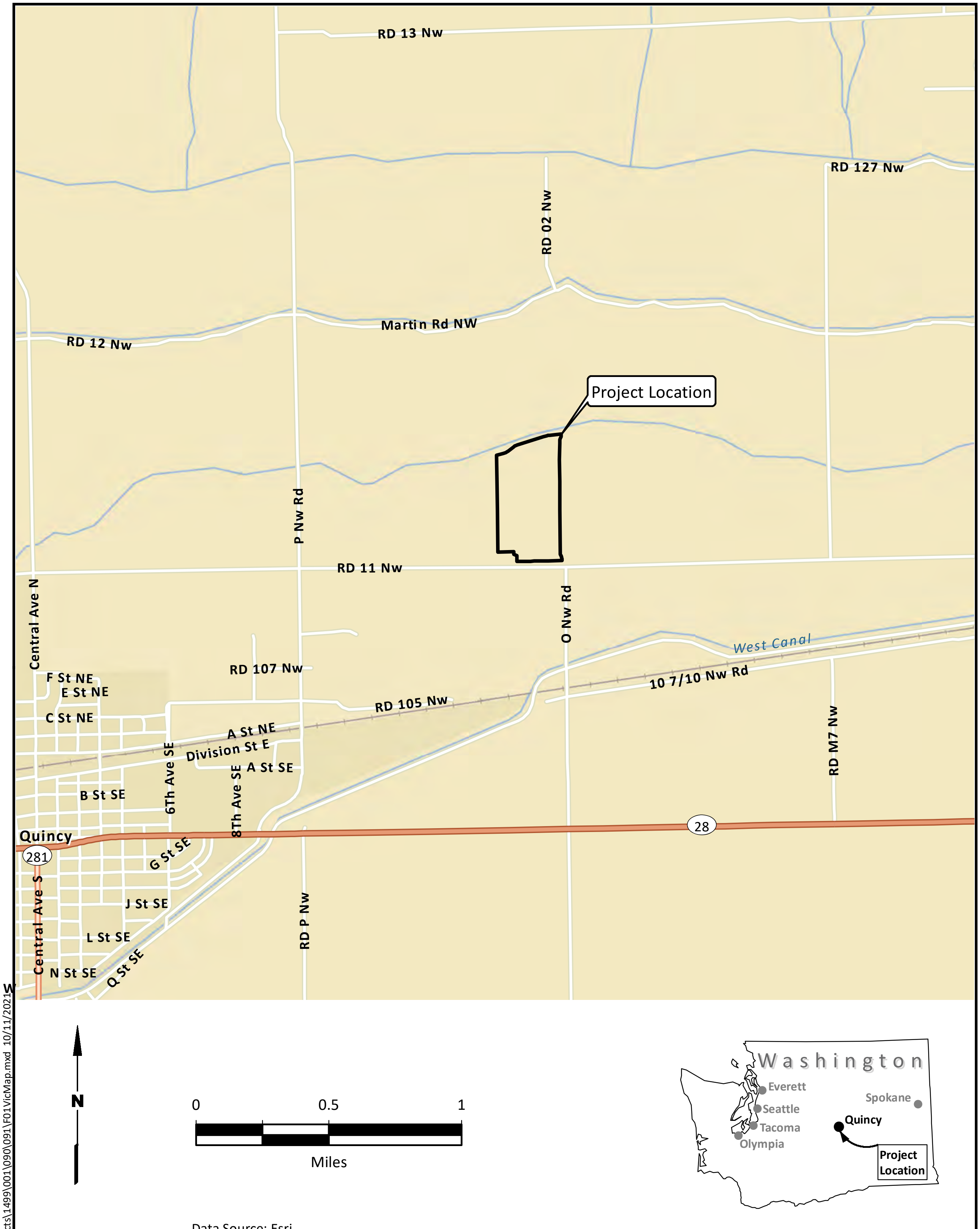

Data Source: Esri.

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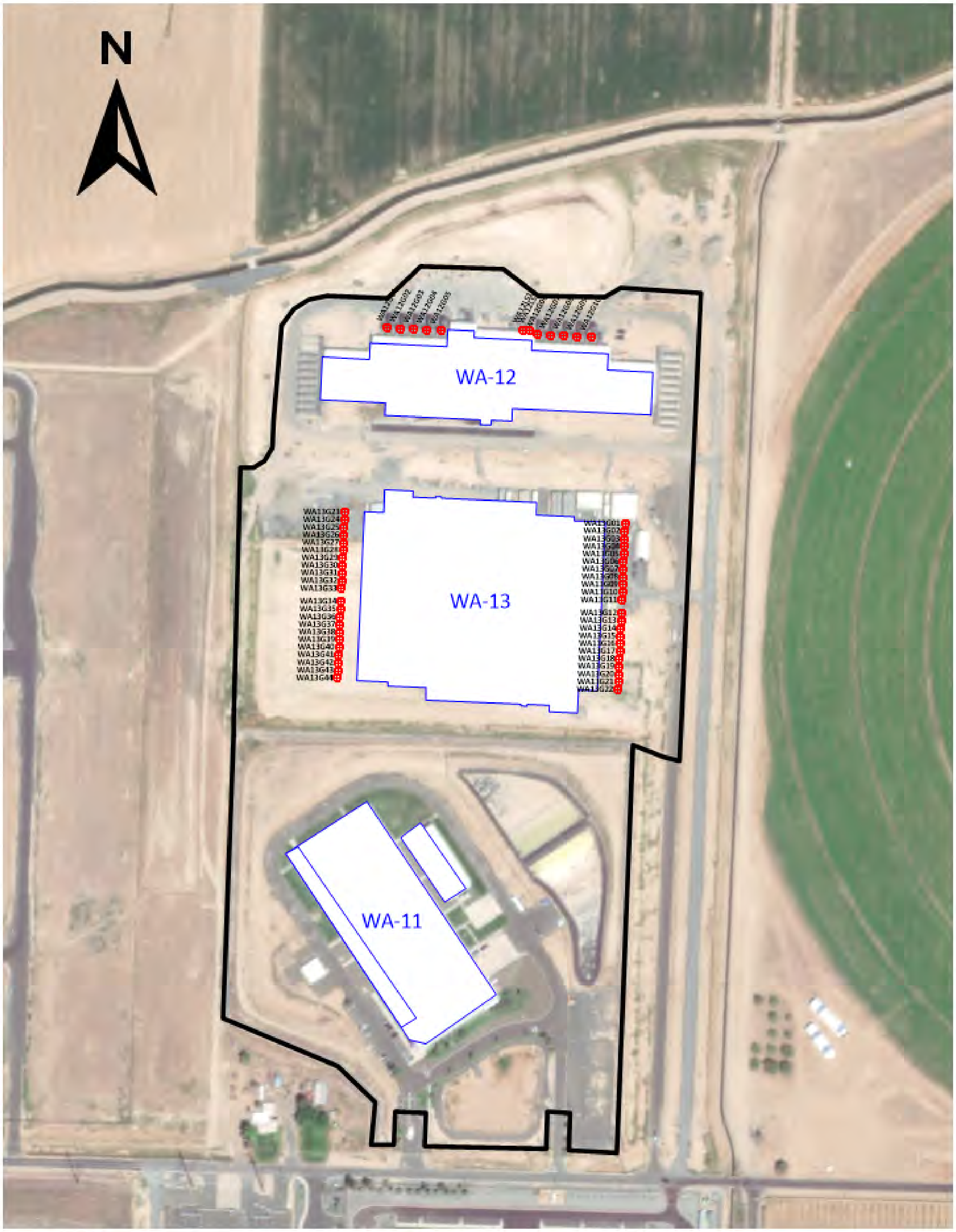
Vantage Data Centers Quincy, Washington	**Vicinity Map**	Figure 1



Legend

⊕ Generator Stack Location

☐ Fence Line

Note

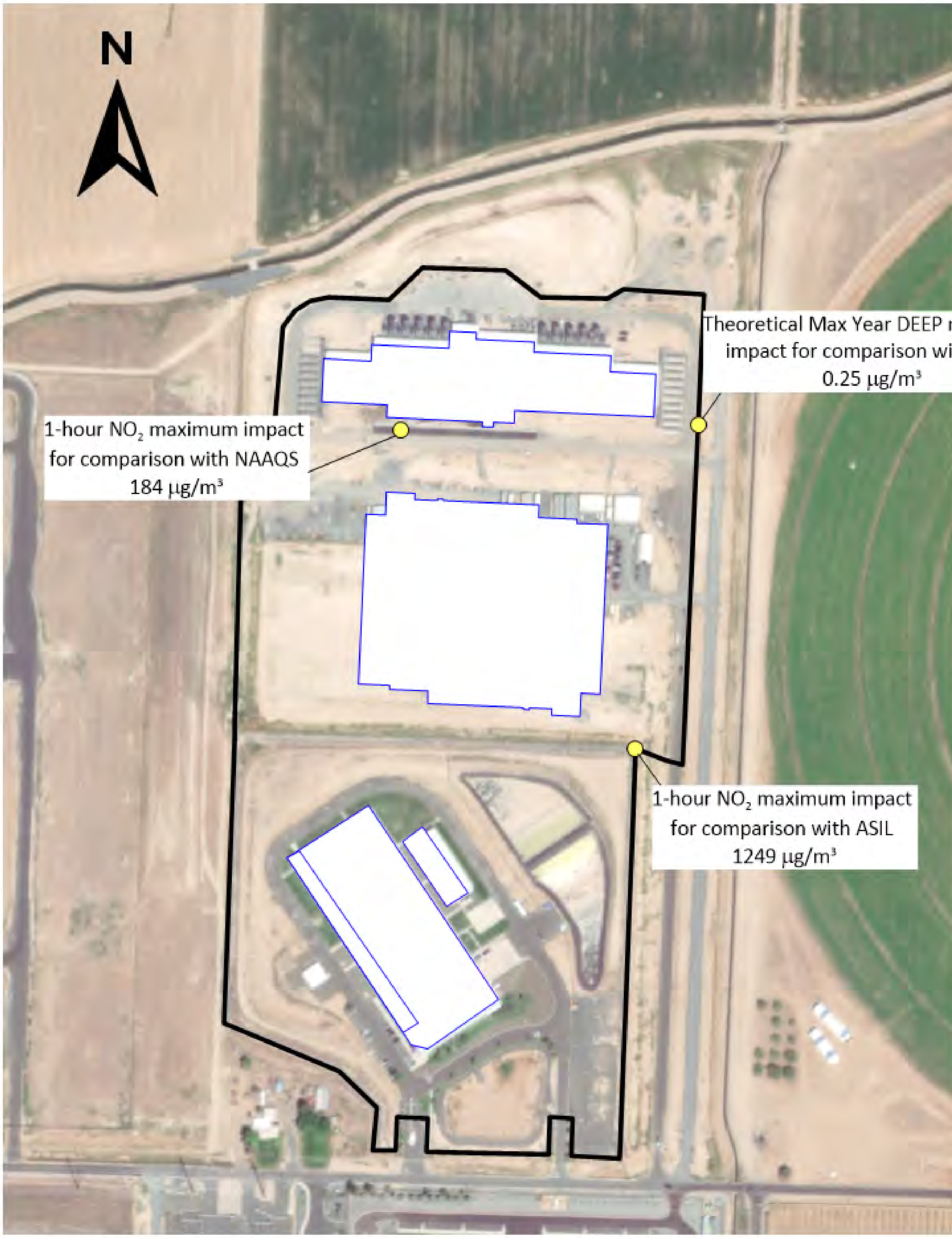
1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Scale:

0m 50m 100m 150m

Data Source: Esri World Imagery.

Landau Associates	Vantage Data Centers Quincy, Washington	Site Map	Figure 2



Legend

Fence Line

Note

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

Scale:

0m 50m 100m 150m

Data Source: Esri World Imagery.

LANDAU ASSOCIATES

Vantage Data Centers Quincy, Washington	Project Impacts	Figure 3

Abbreviations and Acronyms
Vantage Data Center
Quincy, Washington

Abbreviations and Acronyms:

$\mu g/m^3$	micrograms per cubic meter
ASIL	acceptable source impact level
avg	averaging
BH	"back-half" condensable emissions
Btu	British thermal unit
CAS	Chemical Abstracts Service
cfm	cubic feet per minute
CO	carbon monoxide
DEEP	diesel engine exhaust particulate matter
E	Easting
FH	"front-half" filterable emissions
ft	feet
gph	gallons per hour
gpm	gallons per minute
HC	hydrocarbons
HQ	hazard quotient
hr	hour
in	inches
kW	kilowatts
L	liter
lbs	pounds
lbs/hr	pounds per hour
m	meters
mg	milligrams
MMBtu	million British thermal units
MW	megawatts
MWe	megawatts electrical
N	Northing
NA	not applicable
NAAQS	National Ambient Air Quality Standards
No.	number
NO_2	nitrogen dioxide
NO_X	nitrogen oxides
NTE	not to exceed
PM	particulate matter
PM_{10}	particulate matter with aerodynamic diameter less than or equal to 10 microns
$PM_{2.5}$	particulate matter with aerodynamic diameter less than or equal to 2.5 microns
ppm	parts per million
PTE	potential-to-emit
Sec	section
SO_2	sulfur dioxide
SQER	small-quantity emission rate
TAPs	toxic air pollutants
tpy	tons per year
ULSD	ultra-low sulfur diesel
UTM	universal transverse mercator coordinate system zone
VOCs	volatile organic compounds

Table 1
Equipment Summary and Operating Rates
Vantage Data Centers
Quincy, Washington

Engine Parameter	WA-13 2.75-MWe Genset	WA-12 2.75-MWe Genset	WA-12 0.5-MWe Genset
Generator output (kW)	2,750	2,750	500
Number of generators	44	10	2
Fuel type	ULSD	ULSD	ULSD
Fuel usage per genset (gph)[a]	202	202	36
One-time operating hours for new engines[b] (hr/yr)	23	--	--
Annual operating hours (hr/yr)	84	84	84
Maximum year annual operating hours (hr/yr)[c]	107	84	84

Notes:

[a] Maximum of proposed Caterpillar generator at any load (≤100 percent load).

[b] VDC requests a one-time allotment of 23 hours for each new WA-13 generator to be used for generator commissioning purposes. It is understood that this 23-hour allotment will only be used once in each generator's lifetime and any additional hours needed for commissioning would be deducted from the regular annual operating hours of 84 hours per year. At most 11 generators would be commissioned in one year.

[c] Maximum year operating hours includes commissioning for proposed new generators in WA-13.

Table 2
Vendor-Reported Air Pollutant Emission Rates
Vantage Data Centers
Quincy, Washington

Pollutant	Worst-Case Emissions[a] (lb/hr)		
	WA-13 2.75-MWe Genset	WA-12 2.75-MWe Genset	WA-12 0.5-MWe Genset
NO_X	18	55	9.2
CO	3.1	16	2.2
HC	0.25	0.84	0.10
DEEP[b]	0.15	1.0	0.17
PM (FH+BH)[c]	0.39	1.8	0.24

Notes:

[a] Pollutant-specific worst-case emission rate at any load (≤100 percent load).

[b] DEEP is assumed equal to front-half NTE particulate emissions, as vendor-reported

[c] FH+BH (Front-half and back-half emissions) were calculated by summing vendor-reported PM and HC emission rates.

Table 3
Fuel-Based Emissions Summary
Vantage Data Centers
Quincy, Washington

Engine Parameters	WA-13 2.75-MWe Genset	WA-12 2.75-MWe Genset	WA-12 0.5-MWe Genset
Generator Output (kW)	2,750	2,750	500
No. of Generators	44	10	2
Maximum Hourly Fuel Usage Per Genset (gph)	202	202	36
Maximum Annual Fuel Usage Per Genset[a] (gal/yr/genset)	21,594	16,952	2,999
Maximum Hourly Heat Input Per Genset (MMBtu/hr)	27.65	27.65	4.89

Fuel Parameters	Value
Fuel Type	ULSD
Fuel Sulfur Content (ppmw)	15
Fuel Density (lb/gal)	7.1
Fuel Heat Content (Btu/gal)	137,000

Combined Fuel Usage	Hourly	Daily	Annual[a]
Fuel Usage (gal/period)	10,969	263,260	972,467
Heat Input (MMBtu/period)	1,503	36,067	133,228

Pollutant	CAS No.	Emission Factor		Peak Emission Rate[b] WA-13 2.75-MWe Hourly (lb/hr)	WA-12 2.75-MWe Hourly (lb/hr)	WA-12 0.5-MWe Hourly (lb/hr)	Combined Hourly (lb/hr)	Combined Daily (lb/dy)	Combined Annual Emission Rate[a] (tpy)
SO_2	7446-09-5	0.0015% Sulfur (wt)		4.3E-02	4.3E-02	7.6E-03	2.3E+00	9.3E+00	1.0E-01
Ammonia	7664-41-7	25 ppm	c	5.6E-01	--	--	2.5E+01	9.9E+01	1.1E+00
1,3-Butadiene	106-99-0	3.91E-05 lb/MMBtu	c	1.1E-03	1.1E-03	2.0E-04	6.2E-02	2.4E-01	2.7E-03
Acetaldehyde	75-07-0	2.52E-05 lb/MMBtu	c	7.3E-04	7.3E-04	1.3E-04	4.0E-02	1.5E-01	1.7E-03
Acrolein	107-02-8	7.88E-06 lb/MMBtu	c	2.3E-04	2.3E-04	4.1E-05	1.2E-02	4.8E-02	5.5E-04
Benzene	71-43-2	7.76E-04 lb/MMBtu	c	2.3E-02	2.3E-02	4.0E-03	1.2E+00	4.7E+00	5.4E-02
Benz(a)anthracene	56-55-3	6.22E-07 lb/MMBtu	c	1.8E-05	1.8E-05	3.2E-06	9.9E-04	3.8E-03	4.3E-05
Benzo(a)pyrene	50-32-8	2.57E-07 lb/MMBtu	c	7.5E-06	7.5E-06	1.3E-06	4.1E-04	1.6E-03	1.8E-05
Benzo(b)fluoranthene	205-99-2	1.11E-06 lb/MMBtu	c	3.2E-05	3.2E-05	5.7E-06	1.8E-03	6.8E-03	7.7E-05
Benzo(k)fluoranthene	207-08-9	2.18E-07 lb/MMBtu	c	6.4E-06	6.4E-06	1.1E-06	3.5E-04	1.3E-03	1.5E-05
Chrysene	218-01-9	1.53E-06 lb/MMBtu	c	4.5E-05	4.5E-05	7.9E-06	2.4E-03	9.3E-03	1.1E-04
Dibenz(a,h)anthracene	53-70-3	3.46E-07 lb/MMBtu	c	1.0E-05	1.0E-05	1.8E-06	5.5E-04	2.1E-03	2.4E-05
Formaldehyde	50-00-0	7.89E-05 lb/MMBtu	c	2.3E-03	2.3E-03	4.1E-04	1.3E-01	4.8E-01	5.5E-03

Table 3
Fuel-Based Emissions Summary
Vantage Data Centers
Quincy, Washington

				Peak Emission Rate[b]				Combined Annual Emission Rate[a]
				WA-13 2.75-MWe Hourly	WA-12 2.75-MWe Hourly	WA-12 0.5-MWe Hourly	Combined Hourly	Combined Daily	
Indeno(1,2,3-cd)pyrene	193-39-5	4.14E-07 lb/MMBtu	c	1.2E-05	1.2E-05	2.1E-06	6.6E-04	2.5E-03	2.9E-05
Naphthalene	91-20-3	1.30E-04 lb/MMBtu	c	3.8E-03	3.8E-03	6.7E-04	2.1E-01	7.9E-01	9.0E-03
Propylene	115-07-1	2.79E-03 lb/MMBtu	c	8.1E-02	8.1E-02	1.4E-02	4.4E+00	1.7E+01	1.9E-01
Toluene	108-88-3	2.81E-04 lb/MMBtu	c	8.2E-03	8.2E-03	1.4E-03	4.5E-01	1.7E+00	1.9E-02
Xylenes	95-47-6	1.93E-04 lb/MMBtu	c	5.6E-03	5.6E-03	1.0E-03	3.1E-01	1.2E+00	1.3E-02

Notes:

[a] Includes one-time allotment of 23 hours and 17 startup events for up to 11 new WA-13 generators in a single year to be used for generator commissioning purposes.

[b] Hourly emission rate accounts for one startup event per hour. Daily emission rate accounts for one startup event per day. Combined emissions include emissions from concurrent operation of all proposed generators.

[c] Source: AP-42 Sec 3.3 and 3.4 (EPA 1995). To be conservative no reduction from the Tier 4 control is applied to the WA13 emissions for TAPs.

Table 4
Vendor-Reported Emissions with Startup
Vantage Data Center
Quincy, Washington

Startup Emissions Summary

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

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

Emissions per Cold-Start Event[a]

Hourly Emissions per Genset

Pollutant	WA-13 2.75-MWe Genset		
	Startup - 1 min (lb/event)	Warm - 59 min (lb/event)	Total Hour (lbs/hr)
NO_X[b]	0.30	18	18
CO	0.47	3.1	3.5
HC	0.018	0.25	0.27
DEEP	0.011	0.15	0.16
PM (FH+BH)	0.028	0.39	0.42

Pollutant	WA-12 2.75-MWe Genset		
	Startup - 1 min (lb/event)	Warm - 59 min (lb/event)	Total Hour (lbs/hr)
NO_X[b]	0.91	54	55
CO	2.3	15	18
HC	0.060	0.82	0.88
DEEP	0.072	0.99	1.1
PM (FH+BH)	0.13	1.8	1.9

Pollutant	WA-12 0.5-MWe Genset		
	Startup - 1 min (lb/event)	Warm - 59 min (lb/event)	Total Hour (lbs/hr)
NO_X[b]	0.15	9.0	9.2
CO	0.33	2.1	2.5
HC	0.0071	0.10	0.11
DEEP	0.012	0.17	0.18
PM (FH+BH)	0.017	0.24	0.25

Annual Emissions with Cold-Start

Pollutant	Annual Emissions per Genset[c] (lbs/yr)		
	WA-13 2.75-MWe Genset	WA-12 2.75-MWe Genset	WA-12 0.5-MWe Genset
NO_X[b]	1,598	4,601	769
CO	308	1,442	201
HC	23	73	8.7
DEEP	14	88	15
PM (FH+BH)	37	159	21

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] Includes one-time allotment of 23 hours and 17 startup events for up to 11 new WA-13 generators in a single year to be used for generator commissioning purposes.

Table 5
Potential-to-Emit Emissions Summary
Vantage Data Centers
Quincy, Washington

Pollutant	PTE Project Sources (WA-12 and WA-13)[a] Hourly (lbs/hr)	PTE Project Sources (WA-12 and WA-13)[a] Annual[c] (tpy)	PTE Existing Sources (WA-11)[a,b] Annual (tpy)	PTE Facility-Wide Total[a] Annual[c] (tpy)
Criteria Pollutants				
NO_X	1,349	59	21	80
CO	339	14	3.9	18
VOCs	21	0.89	0.015	0.91
SO_2	2.3	0.10	0.94	1.0
$PM_{10}/PM_{2.5}$	38	1.6	0.66	2.3
Toxic Air Pollutants				
Primary NO_2[d]	135	5.9	2.1	8.0
DEEP	18	0.77	0.27	1.0
CO	339	14	3.9	18
SO_2	2.3	0.10	0.015	0.12
Ammonia	2.5E+01	1.1E+00	--	1.1E+00
1,3-Butadiene	6.2E-02	2.7E-03	3.8E-04	3.1E-03
Acetaldehyde	4.0E-02	1.7E-03	2.5E-04	2.0E-03
Acrolein	1.2E-02	5.5E-04	7.7E-05	6.2E-04
Benzene	1.2E+00	5.4E-02	7.6E-03	6.1E-02
Benz(a)anthracene	9.9E-04	4.3E-05	6.1E-06	4.9E-05
Benzo(a)pyrene	4.1E-04	1.8E-05	2.5E-06	2.0E-05
Benzo(b)fluoranthene	1.8E-03	7.7E-05	1.1E-05	8.8E-05
Benzo(k)fluoranthene	3.5E-04	1.5E-05	2.1E-06	1.7E-05
Chrysene	2.4E-03	1.1E-04	1.5E-05	1.2E-04
Dibenz(a,h)anthracene	5.5E-04	2.4E-05	3.4E-06	2.7E-05
Formaldehyde	1.3E-01	5.5E-03	7.8E-04	6.2E-03
Indeno(1,2,3-cd)pyrene	6.6E-04	2.9E-05	4.1E-06	3.3E-05
Naphthalene	2.1E-01	9.0E-03	1.3E-03	1.0E-02
Propylene	4.4E+00	1.9E-01	2.7E-02	2.2E-01
Toluene	4.5E-01	1.9E-02	2.8E-03	2.2E-02
Xylenes	3.1E-01	1.3E-02	1.9E-03	1.5E-02

Notes:

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

[b] PTE for existing sources is based on currently permitted emission rates (19AQ-E026).

[c] Includes one-time allotment of 23 hours and 17 startup events for up to 11 new WA-13 generators in a single year to be used for generator commissioning purposes.

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

Table 6
Project Emissions Compared to *De Minimis* and Small-Quantity Emission Rates
Vantage Data Centers
Quincy, Washington

Pollutant	CAS No.	Averaging Period	Project Emissions	*De Minimis*	SQER	Required Action
			(lbs/averaging period)			
Primary NO_2	10102-44-0	1-hr	135	0.46	0.87	Model
DEEP	DPM	year	1,535	0.027	0.54	Model
CO	630-08-0	1-hr	339	1.1	43	Model
SO_2	7446-09-5	1-hr	2.3	0.46	1.2	Model
Ammonia	7664-41-7	24-hr	99	1.9	37	Model
1,3-Butadiene	106-99-0	year	5.4	0.27	5.4	Model
Acetaldehyde	75-07-0	year	3.5	3.0	60	Report
Acrolein	107-02-8	24-hr	0.048	0.0013	0.026	Model
Benzene	71-43-2	year	107	1.0	21	Model
Benz(a)anthracene	56-55-3	year	0.086	0.045	0.89	Report
Benzo(a)pyrene	50-32-8	year	0.036	0.0082	0.16	Report
Benzo(b)fluoranthene	205-99-2	year	0.15	0.045	0.89	Report
Benzo(k)fluoranthene	207-08-9	year	0.030	0.045	0.89	
Chrysene	218-01-9	year	0.21	0.45	8.9	
Dibenz(a,h)anthracene	53-70-3	year	0.048	0.0041	0.082	Report
Formaldehyde	50-00-0	year	11	1.4	27	Report
Indeno(1,2,3-cd)pyrene	193-39-5	year	0.057	0.045	0.89	Report
Naphthalene	91-20-3	year	18	0.24	4.8	Model
Propylene	115-07-1	24-hr	17	11	220	Report
Toluene	108-88-3	24-hr	1.7	19	370	
Xylenes	1330-20-7	24-hr	1.2	0.82	16	Report

Notes:

Highlighted cells indicate pollutants that require ambient air dispersion model analysis

Table 7
Summary of Cost Effectiveness for Removal of Criteria Pollutants
Vantage Data Centers
Quincy, Washington

	$PM_{10}/PM_{2.5}$	CO	Total VOCs	NO_x	Actual Cost for Combined Criteria Pollutants
Acceptable Unit Cost (dollars per ton)	$12,000	$5,000	$12,000	$12,000	
Control Option	**Actual Cost to Control (dollars per ton)**				
Tier 4 Integrated Control Package[a]	$2,915,000	$190,000	$4,278,000	$56,000	$42,000
SCR[b]	--	--	--	$50,000	$50,000
Catalyzed Passive DPF[c]	$554,000	$36,000	$813,000	--	$33,000
DOC[d]	$2,129,000	$41,000	$919,000	--	$38,000
	not acceptable	not acceptable	not acceptable	not acceptable	

Notes:

[a] The expected control efficiency for a Tier 4 integrated control package to reduce emission is 90% for NO_x, 85% for PM (front half), 80% for CO, and 70% for VOCs.

[b] The expected control efficiency for an SCR is 90% for NO_x.

[c] The expected control efficiency for a catalyzed DPF is 85% for PM (front half), 80% for CO, and 70% for VOCs.

[d] The expected control efficiency for a DOC is 80% for CO, 70% for VOCs, and 25% for filterable $PM_{10}/PM_{2.5}$.

Abbreviations and Acronyms:

-- = Ineffective control technology
CO = Carbon monoxide
DEEP = Diesel engine exhaust particulate matter is assumed equal to front-half NTE particulate emissions, as reported by the vendor.
DOC = Diesel oxidation catalyst
DPF = Diesel particulate filter
NO_x = Nitrogen oxides
$PM_{2.5}/PM_{10}$ = Particulate matter attributable to front-half and back-half emissions is assumed equal to the sum of vendor NTE values for PM and hydrocarbons.
SCR = Selective catalytic reduction
VOC = Volatile organic compound

Table 8
Summary of Cost Effectiveness for Removal of Toxic Air Pollutants
Vantage Data Centers
Quincy, Washington

Toxic Air Pollutant	ASIL (µg/m^3)	Hanford Method Cost Factor	Hanford Method Ceiling Cost (dollar per ton)	Emission Control Option - Actual Cost to Control (dollars per ton)			
				Tier 4 Integrated Control Package[a]	SCR[b]	Catalyzed Passive DPF[c]	DOC[d]
DEEP	0.0033	6.9	$72,585	$2,915,000	--	$554,000	$2,129,000
CO	23,000	0.070	$731	$190,000	--	$36,000	$41,000
NO_2 (10% of NO_x)	470	1.8	$18,472	$528,000	$466,000	--	--
SO_2	660	1.6	$16,924	$82,180,000	--	$15,626,000	$17,649,000
1,3-Butadiene	3.30E-02	5.9	$62,085	$3,136,730,000	--	$596,437,000	$673,638,000
Acetaldehyde	3.7E-01	4.9	$51,063	$4,866,910,000	--	$925,425,000	$1,045,208,000
Acrolein	3.5E-01	4.9	$51,317	$15,564,231,000	--	$2,959,480,000	$3,342,543,000
Benz(a)anthracene	5.5E-03	6.7	$70,256	$197,180,293,000	--	$37,493,088,000	$42,346,044,000
Benzene	1.3E-01	5.3	$55,833	$158,049,000	--	$30,052,000	$33,942,000
Benzo(a)pyrene	1.0E-03	7.4	$78,029	$477,222,343,000	--	$90,742,027,000	$102,487,314,000
Benzo(b)fluoranthene	5.5E-03	6.7	$70,256	$110,492,020,000	--	$21,009,641,000	$23,729,045,000
Dibenz(a,h)anthracene	5.0E-04	7.7	$81,190	$354,468,619,000	--	$67,400,870,000	$76,124,970,000
Formaldehyde	1.7E-01	5.2	$54,610	$1,554,450,000	--	$295,573,000	$333,831,000
Indeno(1,2,3-cd)pyrene	5.5E-03	6.7	$70,256	$296,246,720,000	--	$56,330,196,000	$63,621,352,000
Naphthalene	2.9E-02	6.0	$62,674	$943,432,000	--	$179,390,000	$202,610,000
Propylene	3000	1.0	$10,020	$43,959,000	--	$8,359,000	$9,441,000
Xylenes	220	2.1	$21,934	$635,472,000	--	$120,833,000	$136,473,000
Carcinogenic VOCs	NA	NA	NA	$116,396,000	--	$22,132,000	$24,997,000
Non-Carcinogenic VOCs	NA	NA	NA	$37,485,000	--	$7,128,000	$8,050,000
Combined TAPs Cost-effectiveness				$132,000	$466,000	$34,000	$40,000
Presumed Acceptable Annual Cost for Combined TAP Control (based on the Hanford Method)				$8,567	$18,472	$5,253	$2,241

Notes:

[a] The expected control efficiency of a Tier 4 integrated control package to reduce emission of VOCs and gaseous TAPs is 70%.

[b] There is no expected control of VOCs and gaseous TAPs using SCR.

[c] The expected control efficiency to reduce emission of VOCs and gaseous TAPs using the catalyzed passive DPF is 70%.

[d] The expected control efficiency to reduce emission of VOCs and gaseous TAPs using the DOC is 70%.

Abbreviations and Acronyms:

-- = Ineffective control technology
µg/m^3 = Micrograms per cubic meter
ASIL = Acceptable source impact level
CO = Carbon monoxide
DOC = Diesel oxidation catalyst
DPF = Diesel particulate filter
NA = Not applicable
NO_2 = Nitrogen dioxide
SCR = Selective catalytic reduction
SO_2 = Sulfur dioxide
TAP = Toxic air pollutant
VOC = Volatile organic compound
DEEP = Diesel engine exhaust particulate matter is assumed equal to front-half "not-to-exceed" vendor particulate emissions

Table 9
Worst-Case Load Screening Analysis Results
Vantage Data Centers
Quincy, Washington

Load	Dispersion Factor 1-hour	Dispersion Factor 24-hour	Dispersion Factor Annual	Model Results[a] NO_X 1-hour	CO 1-hour	SO_2 and TAPs 1-hour	$PM_{10}/PM_{2.5}$ 24-hour	$PM_{2.5}$ Annual	NO_X Annual	DEEP Annual
	(µg/m³ per lb/hr)			(µg/m³)						
WA-13 2.75-MWe Genset										
10%	29	8.1	1.4	393.89	24.38	0.19	1.96	0.33	18.39	0.06
25%	23	6.6	0.9	56.12	20.20	0.28	2.03	0.27	2.20	0.08
50%	18	5.4	0.7	90.28	9.48	0.42	1.58	0.19	3.20	0.04
75%	16	4.9	0.6	166.48	12.57	0.52	1.54	0.18	5.76	0.03
100%	14	4.3	0.47	249.11	43.81	0.60	1.71	0.19	8.37	0.07
WA-12 2.75-MWe Genset										
10%	59	30	5.8	793.79	245.64	0.37	20.30	4.00	78.08	1.67
25%	41	24	4.1	338.02	184.05	0.52	31.91	5.52	33.62	2.59
50%	31	20	2.7	507.07	80.51	0.71	23.06	3.18	44.40	1.06
75%	27	18	2.1	922.16	105.31	0.87	22.53	2.65	72.51	0.86
100%	24	16	1.6	1,312.30	375.05	1.03	29.95	2.94	88.63	1.64
WA-12 0.5-MWe Genset										
10%	235	72	12	465.30	195.05	0.33	11.57	1.88	23.22	0.82
25%	185	60	10	625.83	129.61	0.43	10.81	1.88	35.26	1.15
50%	141	50	9	675.63	173.86	0.56	11.98	2.16	43.01	1.53
75%	113	42	8	469.93	246.26	0.69	9.56	1.73	31.37	0.98
100%	106	39	7	967.64	204.10	0.80	5.89	1.06	64.92	0.57

Note:

[a] Highlighted cells indicate which operating load correlates to the highest modeled impact for each pollutant and averaging period.

Table 10
Estimated Concentrations Compared to National Ambient Air Quality Standards
Vantage Data Center
Quincy, Washington

Pollutant	Averaging Period	National and Washington AAQS (µg/m^3)	Significant Impact Level (µg/m^3)	Modeled Operating Scenario	AERMOD Filename	Modeled Project Concentration (µg/m^3)	Background Concentration[a] (µg/m^3)	Projected Cumulative Concentration[b] (µg/m^3)	Location of Design Value Concentration: UTM Easting (meters)	Location of Design Value Concentration: UTM Northing (meters)
CO	8-hour	10,000	500	Unplanned power outage	CO.ADI	1,878 [c]	928	2,806	287,042.80	5,237,188.00
	1-hour	40,000	2,000	Unplanned power outage	CO.ADI	2,574 [c]	1,317	3,891	286,951.00	5,237,217.67
SO_2	3-hour	1,310	25	Unplanned power outage	SO2.ADI	12 [c]	14.3	--	287,217.52	5,236,937.76
	1-hour	200	7.8	Unplanned power outage	SO2.ADI	14 [c]	7.6	22	287,217.52	5,236,937.76
PM_{10}	24-hour	150	5	Unplanned power outage	PM10_24hr_PO.ADI	25 [f]	78	103	287,042.80	5,237,188.00
$PM_{2.5}$	Annual	12	0.2	Maximum annual	PM25_ANN.ADI	0.54	5.8	6.3	287,264.59	5,237,192.17
	24-hour	35	1.2	Non-emergency single engine operations for 8 hours (Ranked Day 22)[d]	PM25_24hr_ONE8.ADI	14 [g]	18.9	33	287,042.80	5,237,188.00
NO_2	Annual	100	1	Maximum annual	NO2_ANN.ADI	13	6.6	20	287,218.00	5,236,950.00
	1-hour	188	7.5	Monte Carlo	See Table D-3	154 [e]	29.5	184	287,042.80	5,237,188.00

Notes:

[a] Regional background level obtained from Idaho Department of Environmental Quality for model and monitoring data from July 2014 through June 2017 (IDEQ; accessed April 23, 2021). Background concentrations for NO_2 were determined using Ecology's Quincy Storymap of NO_2.

[b] Cumulative concentrations are calculated for pollutant's where project-related contributions are above the significant impact level.

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

[d] Non-emergency operations are expected to occur on a single engine at ≤100% load. Multiple sequential tests may occur within the same day for up to 8 hours per day.

[e] Reported value is based on the Monte Carlo assessment for NO_2. See the Monte Carlo Analysis (Table D-3) for further details.

[f] Reported value represents the 6th-highest modeled impacts.

[g] Reported value represents the 5th-highest modeled impacts.

Table 11
Estimated Project Concentrations Compared to Acceptable Source Impact Levels
Vantage Data Center
Quincy, Washington

Pollutant	CAS No.	Averaging Period	Facility-wide Emission Rate (lbs/avg. period)	Project Concentration ($\mu g/m^3$)	ASIL ($\mu g/m^3$)
Primary NO_2	10102-44-0	1-hr	135	1,249	470
DEEP	DPM	year	1,535	0.25	0.0033
CO	630-08-0	1-hr	339	2,574	23000
SO_2	7446-09-5	1-hr	2.3	14	660
Ammonia	7664-41-7	24-hr	99	10 [a]	500
1,3-Butadiene	106-99-0	year	2.3	0.00038	0.033
Acrolein	107-02-8	24-hr	0.048	0.0050	0.35
Benzene	71-43-2	year	0.086	0.000014 [b]	0.13
Naphthalene	91-20-3	year	18.0	0.0030 [b]	0.029

Notes:

[a] Predicted concentrations are calculated using a dispersion factor derived from the Acrolein model.

[b] Predicted concentrations are calculated using a dispersion factor derived from the DEEP model.

APPENDIX A

Vendor Specification Sheets

Perf No: DM8155 **Change Level:** 05

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

View PDF

SALES MODEL:	C15	**COMBUSTION:**	DIRECT INJECTION
BRAND:	CAT	**ENGINE SPEED (RPM):**	1,800
ENGINE POWER (BHP):	762	**HERTZ:**	60
GEN POWER WITH FAN (EKW):	500.0	**FAN POWER (HP):**	19.4
COMPRESSION RATIO:	16.1	**ADDITIONAL PARASITICS (HP):**	14.2
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):**	120
GOVERNOR TYPE:	ELEC	**JACKET WATER TEMP (F):**	192.2
CAMSHAFT TYPE:	STANDARD	**TURBO CONFIGURATION:**	SINGLE
IGNITION TYPE:	CI	**TURBO QUANTITY:**	1
INJECTOR TYPE:	EUI	**TURBOCHARGER MODEL:**	GTA5518BS-56T-1.58
REF EXH STACK DIAMETER (IN):	6	**CERTIFICATION YEAR:**	2006
MAX OPERATING ALTITUDE (FT):	3,281	**PISTON SPD @ RATED ENG SPD (FT/MIN):**	2,025.0

INDUSTRY	SUB INDUSTRY	APPLICATION
ELECTRIC POWER	STANDARD	PACKAGED GENSET
OIL AND GAS	LAND PRODUCTION	PACKAGED GENSET

General Performance Data Top

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	762	361	0.333	35.7	68.2	120.4	1,296.3	46.8	988.0
450.0	90	683	324	0.348	33.5	67.0	119.4	1,280.7	45.9	973.8
400.0	80	607	288	0.358	30.6	61.6	115.2	1,250.1	42.3	956.6
375.0	75	570	271	0.358	28.8	56.4	111.0	1,229.5	38.8	947.8
350.0	70	534	253	0.356	26.8	50.1	106.0	1,205.6	34.6	938.3
300.0	60	462	219	0.347	22.6	36.6	95.5	1,148.6	25.6	915.7
250.0	50	392	186	0.336	18.6	24.0	86.2	1,080.0	17.4	887.9
200.0	40	323	153	0.339	15.4	16.9	83.6	1,003.8	13.3	838.1
150.0	30	253	120	0.347	12.4	11.3	81.0	910.6	10.2	768.4
125.0	25	218	103	0.355	10.9	9.1	79.8	857.1	9.0	725.6
100.0	20	182	86	0.368	9.4	7.0	78.6	795.3	8.0	674.7
50.0	10	109	52	0.420	6.5	3.3	76.2	639.0	6.1	542.9

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	762	73	405.8	1,347.7	3,605.5	6,001.8	6,255.3	1,224.6	1,109.4
450.0	90	683	72	402.2	1,345.2	3,558.0	5,981.4	6,219.2	1,220.4	1,110.6
400.0	80	607	66	381.3	1,283.7	3,364.8	5,686.7	5,904.2	1,168.1	1,066.0
375.0	75	570	61	361.0	1,219.4	3,187.1	5,381.2	5,585.8	1,113.3	1,016.3

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)
350.0	70	534	54	336.1	1,139.2	2,970.6	5,001.5	5,191.7	1,044.7	953.4
300.0	60	462	40	282.1	965.5	2,500.8	4,183.5	4,344.1	894.0	815.5
250.0	50	392	27	229.6	799.0	2,040.7	3,407.8	3,539.6	744.6	679.6
200.0	40	323	19	195.0	697.8	1,729.1	2,959.9	3,069.2	655.1	600.0
150.0	30	253	13	165.5	615.8	1,447.5	2,601.3	2,689.1	579.6	534.1
125.0	25	218	11	152.7	581.8	1,317.2	2,454.7	2,532.1	546.4	505.6
100.0	20	182	9	140.6	551.1	1,190.0	2,322.2	2,389.2	515.8	479.7
50.0	10	109	5	118.5	497.4	940.2	2,088.6	2,134.4	461.1	434.6

Heat Rejection Data Top

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	REJECTION TO JACKET WATER	REJECTION TO ATMOSPHERE	REJECTION TO EXH	EXHAUST 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	762	10,375	5,182	28,039	17,119	4,138	6,860	32,301	77,688	82,757
450.0	90	683	9,686	4,904	27,298	16,583	3,881	6,775	28,958	72,867	77,622
400.0	80	607	8,796	4,826	25,540	15,270	3,549	6,061	25,750	66,626	70,974
375.0	75	570	8,322	4,716	24,127	14,230	3,337	5,388	24,187	62,652	66,740
350.0	70	534	7,911	4,524	22,387	13,011	3,104	4,610	22,642	58,272	62,074
300.0	60	462	7,240	4,038	18,412	10,458	2,621	3,127	19,611	49,217	52,428
250.0	50	392	6,630	3,455	14,380	8,084	2,153	1,957	16,633	40,417	43,054
200.0	40	323	5,924	2,968	11,812	6,328	1,786	1,321	13,687	33,524	35,712
150.0	30	253	5,187	2,459	9,434	4,713	1,435	880	10,732	26,935	28,692
125.0	25	218	4,807	2,196	8,319	3,963	1,264	716	9,239	23,729	25,277
100.0	20	182	4,414	1,924	7,227	3,212	1,093	577	7,727	20,530	21,869
50.0	10	109	3,615	1,370	5,008	1,677	749	353	4,629	14,057	14,974

DM8155 rev5

Emissions Data Top

Units Filter All Units

RATED SPEED POTENTIAL SITE VARIATION: 1800 RPM

GENSET POWER WITH FAN ENGINE POWER PERCENT LOAD		EKW BHP %	500.0 762 100	375.0 570 75	250.0 392 50	125.0 218 25	50.0 109 10
TOTAL NOX (AS NO2)		G/HR	4,153	1,885	2,170	1,532	899
TOTAL CO		G/HR	877	987	558	317	377
TOTAL HC		G/HR	30	45	33	31	39
PART MATTER		G/HR	38.1	59.8	79.3	48.8	31.4
TOTAL NOX (AS NO2)	(CORR 5% O2)	MG/NM3	2,576.3	1,521.8	2,654.4	3,107.2	2,976.4
TOTAL CO	(CORR 5% O2)	MG/NM3	563.8	767.7	677.2	661.9	1,406.0
TOTAL HC	(CORR 5% O2)	MG/NM3	16.6	30.0	34.1	56.2	121.3
PART MATTER	(CORR 5% O2)	MG/NM3	18.5	41.0	80.1	84.7	94.9
TOTAL NOX (AS NO2)	(CORR 5% O2)	PPM	1,255	741	1,293	1,513	1,450
TOTAL CO	(CORR 5% O2)	PPM	451	614	542	530	1,125
TOTAL HC	(CORR 5% O2)	PPM	31	56	64	105	226
TOTAL NOX (AS NO2)		G/HP-HR	5.54	3.33	5.56	7.05	8.25
TOTAL CO		G/HP-HR	1.17	1.75	1.43	1.46	3.46
TOTAL HC		G/HP-HR	0.04	0.08	0.08	0.14	0.35
PART MATTER		G/HP-HR	0.05	0.11	0.20	0.22	0.29
TOTAL NOX (AS NO2)		LB/HR	9.15	4.16	4.78	3.38	1.98
TOTAL CO		LB/HR	1.93	2.18	1.23	0.70	0.83
TOTAL HC		LB/HR	0.07	0.10	0.07	0.07	0.09
PART MATTER		LB/HR	0.08	0.13	0.17	0.11	0.07

RATED SPEED NOMINAL DATA: 1800 RPM

GENSET POWER WITH FAN ENGINE POWER PERCENT LOAD		EKW BHP %	500.0 762 100	375.0 570 75	250.0 392 50	125.0 218 25	50.0 109 10
TOTAL NOX (AS NO2)		G/HR	3,432	1,558	1,793	1,266	743

GENSET POWER WITH FAN ENGINE POWER PERCENT LOAD		EKW BHP %	500.0 762 100	375.0 570 75	250.0 392 50	125.0 218 25	50.0 109 10
TOTAL CO		G/HR	469	528	298	170	202
TOTAL HC		G/HR	16	24	17	17	20
TOTAL CO2		KG/HR	357	287	186	110	65
PART MATTER		G/HR	19.6	30.6	40.7	25.0	16.1
TOTAL NOX (AS NO2)	(CORR 5% O2)	MG/NM3	2,129.1	1,257.7	2,193.7	2,567.9	2,459.9
TOTAL CO	(CORR 5% O2)	MG/NM3	301.5	410.5	362.1	354.0	751.9
TOTAL HC	(CORR 5% O2)	MG/NM3	8.8	15.9	18.0	29.7	64.2
PART MATTER	(CORR 5% O2)	MG/NM3	9.5	21.1	41.1	43.4	48.7
TOTAL NOX (AS NO2)	(CORR 5% O2)	PPM	1,037	613	1,068	1,251	1,198
TOTAL CO	(CORR 5% O2)	PPM	241	328	290	283	602
TOTAL HC	(CORR 5% O2)	PPM	16	30	34	55	120
TOTAL NOX (AS NO2)		G/HP-HR	4.58	2.76	4.60	5.83	6.82
TOTAL CO		G/HP-HR	0.63	0.93	0.76	0.78	1.85
TOTAL HC		G/HP-HR	0.02	0.04	0.04	0.08	0.19
PART MATTER		G/HP-HR	0.03	0.05	0.10	0.12	0.15
TOTAL NOX (AS NO2)		LB/HR	7.57	3.43	3.95	2.79	1.64
TOTAL CO		LB/HR	1.03	1.16	0.66	0.37	0.44
TOTAL HC		LB/HR	0.04	0.05	0.04	0.04	0.05
TOTAL CO2		LB/HR	786	633	410	243	144
PART MATTER		LB/HR	0.04	0.07	0.09	0.06	0.04
OXYGEN IN EXH		%	8.3	9.6	9.4	11.4	14.3

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

Altitude Derate Data Top

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	762	762	762	762	762	762	762	762	762	762	762	762	762
1,000	762	762	762	762	762	762	762	762	762	762	757	744	762
2,000	762	762	762	762	762	762	762	762	754	741	728	716	762
3,000	762	762	762	762	762	762	752	739	726	713	701	689	762
4,000	762	762	762	762	751	737	724	711	698	686	674	663	759
5,000	762	762	750	736	722	709	696	683	671	660	649	638	735
6,000	751	736	722	708	694	681	669	657	646	634	624	613	712
7,000	722	707	694	680	667	655	643	632	620	610	599	589	689
8,000	693	680	666	653	641	629	618	607	596	586	576	566	666
9,000	666	653	640	628	616	604	593	583	572	563	553	544	644
10,000	639	626	614	602	591	580	570	559	550	540	531	522	623
11,000	614	601	589	578	567	557	546	537	527	518	510	501	602
12,000	588	577	565	554	544	534	524	515	506	497	489	480	582
13,000	564	553	542	532	522	512	503	494	485	477	469	461	562
14,000	541	530	520	510	500	491	482	473	465	457	449	442	542
15,000	518	508	498	488	479	470	462	453	445	438	430	423	523

Cross Reference Top

Test Spec	Setting	Engine Arrangement	Engineering Model	Engineering Model Version	Start Effective Serial Number	End Effective Serial Number
0K6281	PP5612	2864923	GS282	-	FTE02794	
0K6281	PP5612	2864924	GS282	-	FTE02794	

Performance Parameter Reference Top

Parameters Reference: DM9600 - 12

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 15 deg C (59 deg F), where the density is 850 G/Liter (7.0936 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.

EMISSION CYCLE LIMITS: Cycle emissions Max Limits apply to cycle-weighted averages only. Emissions at individual load points may exceed the cycle-weighted limit.

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 : 07/10/19

Amy Maule

Sent:
To:
Subject:

From: Jacob Rozenblit <jacob.rozenblit@safetypower.ca>
Sent: Thursday, June 10, 2021 3:39 PM
To: Mark Brunner <mbrunner@landauinc.com>; Brian Layton <Layton_Brian_E@cat.com>; Rick Walkup <Walkup_Frederick_L@cat.com>
Cc: Brett Greene <bmgreene@petersonpower.com>; David Stelzer <david.stelzer@safetypower.ca>; John Grousopoulos <john.grousop@safetypower.ca>; John Shen <john.shen@safetypower.ca>; T.J. Tarabulski <Tarabulski_TJ@cat.com>; Neil Tarrant <ntarrant@petersonpower.com>; Alden Cramer <AbCramer@petersonpower.com>
Subject: RE: Vantage WA12 // Emissions Data Request Meeting Follow Up //

Hi Mark,

Please see table below now with updated engine test power. Let us know if you need anything else.

CAT 3516E 2750eKW					
Engine Load (%)	10	25	50	75	100
Engine Power (bkW), observed	310	775	1550	2325	3100
Exhaust Gas Mass Flow (kg/hr)	4907	6863	11152	14499	17456
Exhaust Gas Temperature (°C)	301.9	421.5	452.4	453.7	496.7
Raw NOx Emissions – Potential Site Variation (g/hr)	6062.3	3702.5	7346.4	15347.3	24847.3
Post-ecoCUBE NOx Emissions Potential Site Variation (g/hr)		259.2	514.2	1074.3	2484.7
Raw CO Emissions Potential Site Variation (g/hr)	1876.0	2016.0	1166.4	1752.7	7101.3
Post- ecoCUBE CO Emissions Potential Site Variation (g/hr)	375.2	403.2	233.3	350.5	1420.3
Raw THC Emissions Potential Site Variation (g/hr)	180.2	323.1	351.1	380.3	366.1
Post- ecoCUBE THC Emissions Potential Site Variation (g/hr)	90.1	96.9	105.3	114.1	109.8
Raw PM Emissions Potential Site Variation (g/hr)	130.00	284.90	175.40	181.20	458.70
Post- ecoCUBE PM Emissions Potential Site Variation (g/hr). ***PM MUST** be measured using ISO method 8178 as this is the method which was used during the EPA engine testing. Safety Power cannot guarantee the PM g/hr if other methods are utilized as there is no corresponding measurements for the engine raw PM emissions.	19.5	42.7	26.3	27.2	68.8
NH_3 Slip	Well below than carb requirement of 25ppm				

Best Regards,
Jacob Rozenblit, P.Eng, M.Eng
Senior Applications Engineer
Safety Power Inc.
5155 Spectrum Way, Unit 26
Mississauga, Ontario
L4W5A1
Office: (416) 477-2709 ext.32
Mobile (514) 927-2898
jacob.rozenblit@safetypower.ca
www.safetypower.ca

2750 ekW Emissons for Source Test

		10% Load	25% Load	50% Load	75% Load	100% Load
Engine Power, Observed	bkW	310	775	1550	2325	3100
Fuel Rate	g/min	1602.1	3166.4	5759.6	8068.6	10897.8
Exh Mass Flow	kg/hr	4907	6863	11152	14499	17456
Exh Stack Temp	deg C	301.9	421.5	452.4	453.7	496.7
Measured Stack Pressure	kPa	0.05	0.44	1.53	2.67	4.10
Exh Volumetric flow	m^3/min	136.8	230.3	386.6	497.8	625.9
NOx Corr to 75 grains	g/hr	5051.9	3164.5	6279.0	12789.4	20706.1
Nox PSV	g/hr	6062.3	3702.5	7346.4	15347.3	24847.3
THC	g/hr	135.5	242.9	264.0	286.0	275.3
THC PSV	g/hr	180.2	323.1	351.1	380.3	366.1
CO	g/hr	928.7	1207.2	698.4	1049.5	4252.3
CO PSV	g/hr	1876.0	2016.0	1166.4	1752.7	7101.3
PM	g/hr	61.76	117.81	111.51	115.40	297.47
PM PSV	g/hr	130.00	284.90	175.40	181.20	458.70

Cycle Weighted Averages

		From PSV	EPA Limits
Nox	g/kW-hr	6.14	
HC	g/kW-hr	0.23	
Nox + HC	g/kW-hr	6.37	6.4
CO	g/kW-hr	1.32	3.5
PM	g/kW-hr	0.15	0.2

APPENDIX B

Startup Emissions Estimation Method

APPENDIX B

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 (Figure B-1), which are discussed below.

As shown on Figure B-1, 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.

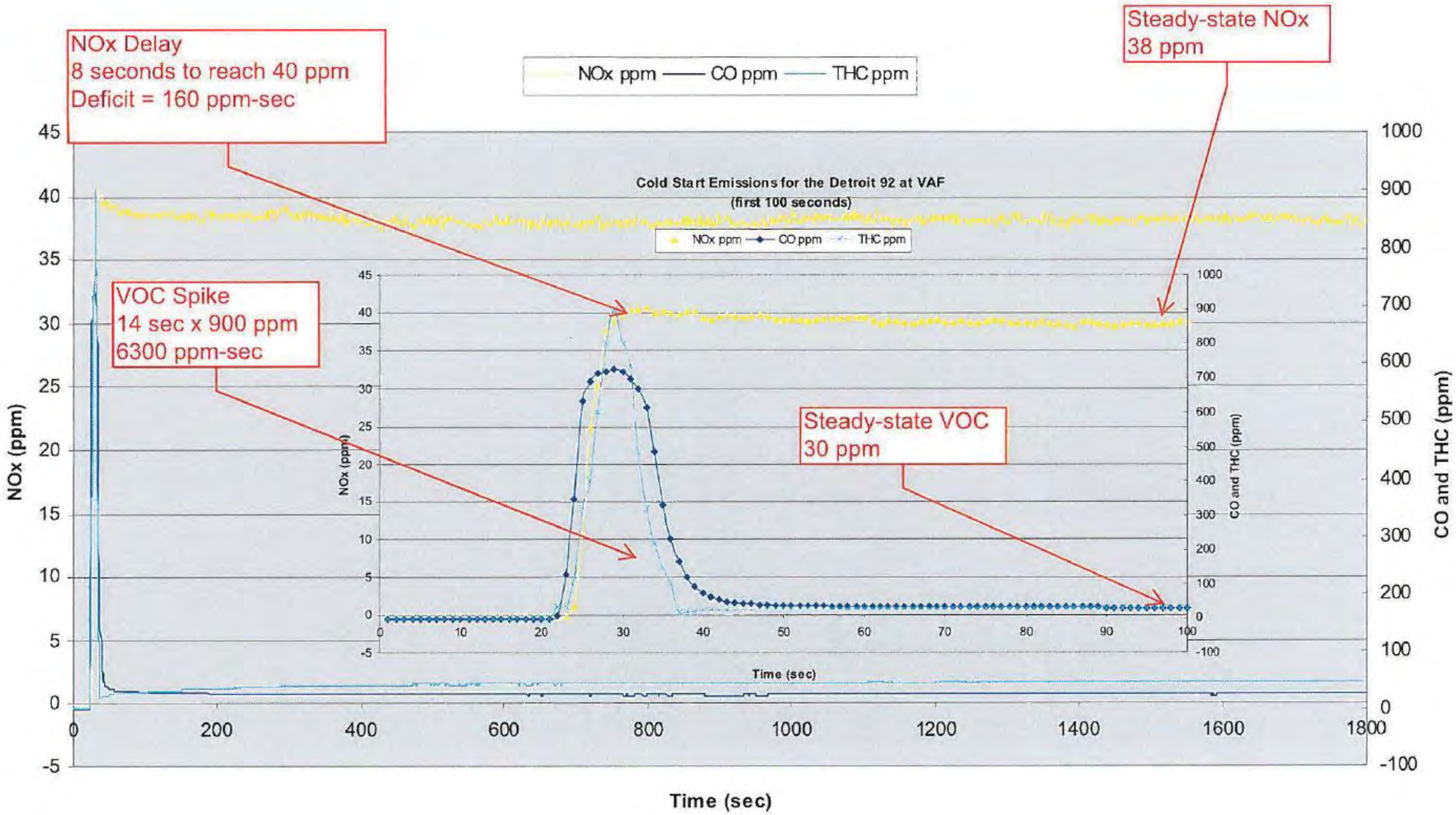
Example: Cold-Start Spike Factor for VOCs, first 1-minute after cold-start at low load.

The "VOC spike" was observed 14 seconds after cold-start and reached a concentration of 6,300 ppm-seconds. The **triangular** 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 $(60\ seconds - 14\ seconds) \times 30\ ppm\ = 1{,}380\ \textit{ppm-seconds}$.

Therefore, the startup emission factor (to be applied to the warm-emission rate estimate for the first 1-minute after startup) 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.

LANDAU ASSOCIATES

Vantage Data Centers Quincy, Washington	**Cold-Start Emission Trends**	Figure B-1

APPENDIX C

Best Available Control Technology Cost Summary Tables

Table C-1
Tier 4 Integrated Control Package Capital Cost
Vantage Data Centers
Quincy, Washington

Cost Category	Cost Factor	Source of Cost Factor	Quant.	Unit Cost	Subtotal Cost
Direct Costs					
Purchased Equipment Costs					
2,750-KWe CAT emission control package	Cost estimate by NC Power (CAT)		54	$229,266	$12,380,364
2,750-KWe CAT miscellaneous parts	Assumed no cost			$0	$0
500-KWe CAT emission control package	Cost estimate by Johnson Matthey		2	$133,500	$267,000
500-KWe CAT miscellaneous parts	Assumed no cost			$0	$0
Combined systems cost					$12,647,364
Instrumentation	Assumed no cost		0	$0	$0
Sales Tax	WA state tax	WA state tax	6.5%	--	$822,079
Shipping (2,750-KWe CAT)		NC Power (CAT)	54	$ 13,000	$702,000
Shipping (500-KWe CAT)		NC Power (CAT)	2	$ 1,000	$2,000
Subtotal Purchased Equipment Cost (PEC)					$14,173,443
Direct Installation Costs					
Enclosure structural supports (2,750-KWe CAT)	Cost estimate by Johnson Matthey		54	$3,500	$189,000
Onsite Installation (2,750-KWe CAT)	Cost estimate by NC Power (CAT)		54	$68,153	$3,680,262
Enclosure structural supports (500-KWe CAT)	Cost estimate by Johnson Matthey		2	$3,500	$7,000
Onsite Installation (500-KWe CAT)	Cost estimate by NC Power (CAT)		2	$4,588	$9,176
Electrical	Included above		0	$0	$0.00
Piping	Included above		0	$0	$0.00
Insulation	Assumed no cost		0	$0	$0.00
Painting	Assumed no cost		0	$0	$0.00
Subtotal Direct Installation Costs (DIC)					$3,885,438
Site Preparation and Buildings (SP)	Assumed no cost		0	$0	$0.00
Total Direct Costs, (DC = PEC + DIC + SP)					$18,058,881
Indirect Costs (Installation)					
Engineering		Johnson Matthey	56	$5,000	$280,000
Construction and field expenses		Johnson Matthey	56	$3,000	$168,000
Contractor Fees	From DIS data center		6.8%	--	$959,542
Startup		Johnson Matthey	56	$3,000	$168,000
Performance Test (Tech support)	0.01*PEC	EPA Cost Manual	1.0%	--	$141,734
Contingencies	0.10*PEC	EPA Cost Manual	10.0%	--	$1,417,344
Subtotal Indirect Costs (IC)					$3,134,621
Total Capital Investment (TCI = DC+IC)					**$21,193,501**

Table C-2
Tier 4 Integrated Control Package Cost Effectiveness
Vantage Data Centers
Quincy, Washington

Item	Quantity	Units	Unit Cost	Units	Subtotal
Annualized Capital Recovery					
Total Capital Investment (TCI)					$21,193,501
Capital Recovery Factor:	30	years	5.5%	discount	0.069
Subtotal Annualized 30-year Capital Recovery Cost					$1,458,227
Direct Annual Cost					
Increased Fuel Consumption	Insignificant				$0
Reagent Consumption (estimated by Pacific Power Group)	909,830	gallons/year	$4.00	per gallon	$3,639,320
Catalyst Replacement (EPA Manual)	Insignificant				$0
Annual operation/labor/maintenance costs: Upper-bound estimate would assume CARB's value of $1.50/hp/year and would result in $464,664/year for the 2,750 kW-hr generators and $84,484/year for the 500 kW-hr generators. Lower-bound estimate would assume zero annual O&M. Mid-range value would account for fuel for pressure drop, increased inspections, periodic OEM visits, and the costs for Ecology's increased emission testing requirements. <u>For this screening-level analysis, we assumed the lower-bound annual O&M cost of zero.</u>					$0
Subtotal Direct Annual Cost					$3,639,320
Indirect Annual Costs					
Annual Admin charges (EPA Manual)	2.0%	of Total Capital Investment			$423,870
Annual Property tax (EPA Manual)	1.0%	of Total Capital Investment			$211,935
Annual Insurance (EPA Manual)	1.0%	of Total Capital Investment			$211,935
Subtotal Indirect Annual Costs					$847,740
Total Annual Cost (Capital Recovery + Direct Annual Costs + Indirect Annual Costs)					**$5,945,287**
Uncontrolled Emissions (Combined Pollutants)					169
Annual Tons Removed (Combined Pollutants)					141
Cost Effectiveness ($ per tons combined pollutant destroyed)					**$42,315**

Annual O&M Cost Based on CARB Factors (lowermost CARB estimate)	**Annual O&M Cost Based on CARB Factors (lowermost CARB estimate)**
$464,664 per year per generator	$84,484 per year per generator
2,750 KW-hr	500 KW-hr
4536 annual generator hours	168 annual generator hours
$1.50 per HP_M per year	$1.50 per HP_M per year

MULTI-CRITERIA POLLUTANT COST EFFECTIVENESS (Reasonable vs. Actual Cost to Control)[a]

Pollutant	Ecology Acceptable Unit Cost ($/ton)	Forecast Removal (TPY)[a]	Subtotal Reasonable Annual Cost ($/year)
NO_x	$12,000	106	$1,269,073 per year
CO	$5,000	31	$156,584 per year
VOCs	$12,000	1.4	$16,678 per year
PM	$12,000	2.0	$24,470 per year
Total Reasonable Annual Control Cost for Combined Pollutants			$1,466,805 per year
Actual Annual Control Cost			$5,945,287 per year
	Is the Control Device Reasonable?		**NO (Actual >> Acceptable)**

CRITERIA POLLUTANT CONTROL EFFICIENCIES[a]

Pollutant	PM (FH)	CO	VOCs	NO_x
Tier 2 Uncontrolled Emissions (TPY)	2.4	39	2.0	125
Controlled Emissions (TPY)	0.36	7.8	0.60	19
TPY Removed	2.0	31	1.4	106
Combined Uncontrolled Emissions (TPY)	169			
Combined TPY Removed	141			
Expected Removal Efficiency	85%	80%	70%	90%
Annualized Cost ($/year)	$5,945,287			
Individual Pollutant $/Ton Removed	$2,915,495	$189,844	$4,277,765	$56,217

Table C-2
Tier 4 Integrated Control Package Cost Effectiveness
Vantage Data Centers
Quincy, Washington

MULTI-TOXIC AIR POLLUTANT COST EFFECTIVENESS (Reasonable vs. Actual Cost to Control)[a]

Pollutant	ASIL (μg/m³)	"Hanford Method" Cost Factor	Ecology Guidance "Ceiling Cost" ($/ton)	Forecast Removal (TPY)[a]	Subtotal Reasonable Annual Cost ($/year)
DEEP	0.0033	6.9	$72,585	2.0	$148,015 per year
CO	23,000	0.070	$731	31	$22,898 per year
NO_2 (10% of NO_x)	470	1.8	$18,472	1.1E+01	$207,825 per year
SO_2	660	1.6	$16,924	7.2E-02	$1,224 per year
1,3-Butadiene	3.30E-02	5.9	$62,085	1.9E-03	$118 per year
Acetaldehyde	3.7E-01	4.9	$51,063	1.2E-03	$62 per year
Acrolein	3.5E-01	4.9	$51,317	3.8E-04	$20 per year
Benz(a)anthracene	5.5E-03	6.7	$70,256	3.0E-05	$2 per year
Benzene	1.3E-01	5.3	$55,833	3.8E-02	$2,100 per year
Benzo(a)pyrene	1.0E-03	7.4	$78,029	1.2E-05	$1 per year
Benzo(b)fluoranthene	5.5E-03	6.7	$70,256	5.4E-05	$4 per year
Dibenz(a,h)anthracene	5.0E-04	7.7	$81,190	1.7E-05	$1 per year
Formaldehyde	1.7E-01	5.2	$54,610	3.8E-03	$209 per year
Indeno(1,2,3-cd)pyrene	5.5E-03	6.7	$70,256	2.0E-05	$1 per year
Naphthalene	2.9E-02	6.0	$62,674	6.3E-03	$395 per year
Propylene	3000	1.0	$10,020	1.4E-01	$1,355 per year
Xylenes	220	2.1	$21,934	9.4E-03	$205 per year
Carcinogenic VOCs	n.a.	n.a.	$9,999	5.1E-02	$511 per year
Non-Carcinogenic VOCs	n.a.	n.a.	$5,000	1.6E-01	$793 per year
Total Reasonable Annual Control Cost for Combined Pollutants					$384,437 per year
Actual Annual Control Cost					$5,945,287 per year
				Is the Control Device Reasonable?	**NO (Actual >> Acceptable)**

TOXIC AIR POLLUTANT CONTROL EFFICIENCIES[a]

TAP	Tier 2 Uncontrolled Emissions	Controlled Emissions (TPY)	TPY Removed	Expected Removal Efficiency	Individual Pollutant $/Ton Removed
DEEP	2.4	0.36	2.0	85%	$2,915,495
CO	39	7.8	31	80%	$189,844
NO_2 (10% of NOx)	13	1.3	11	90%	$528,440
SO_2	1.0E-01	3.1E-02	7.2E-02	70%	$82,179,699
1,3-Butadiene	2.7E-03	8.1E-04	1.9E-03	70%	$3,136,729,981
Acetaldehyde	1.7E-03	5.2E-04	1.2E-03	70%	$4,866,910,407
Acrolein	5.5E-04	1.6E-04	3.8E-04	70%	$15,564,231,252
Benz(a)anthracene	4.3E-05	1.3E-05	3.0E-05	70%	$197,180,293,035
Benzene	5.4E-02	1.6E-02	3.8E-02	70%	$158,049,152
Benzo(a)pyrene	1.8E-05	5.3E-06	1.2E-05	70%	$477,222,343,455
Benzo(b)fluoranthene	7.7E-05	2.3E-05	5.4E-05	70%	$110,492,020,061
Dibenz(a,h)anthracene	2.4E-05	7.2E-06	1.7E-05	70%	$354,468,619,271
Formaldehyde	5.5E-03	1.6E-03	3.8E-03	70%	$1,554,450,472
Indeno(1,2,3-cd)pyrene	2.9E-05	8.6E-06	2.0E-05	70%	$296,246,720,454
Naphthalene	9.0E-03	2.7E-03	6.3E-03	70%	$943,431,864
Propylene	1.9E-01	5.8E-02	1.4E-01	70%	$43,959,191
Xylenes	1.3E-02	4.0E-03	9.4E-03	70%	$635,472,240
Carcinogenic VOCs	7.3E-02	2.2E-02	5.1E-02	70%	$116,396,025
Non-Carcinogenic VOCs	2.3E-01	6.8E-02	1.6E-01	70%	$37,484,915
Annualized Cost ($/yr)					$5,945,287
Combined Uncontrolled Emissions (TPY)					54.4
Combined TPY Removed					44.9
Combined TAPs $/Ton Removed					$132,486

[a] The expected Tier 4 control efficiency to reduce emission is 90% for NO_x, 85% for PM (front half), 80% for CO, and 70% for VOCs.

Notes:

FH ("front-half" filterable emissions)
BH ("back-half" condensable emissions)
PM (particulate matter) attributable to front-half and back-half emissions is assumed equal to the sum of vendor NTE values for PM and hydrocarbons.
DEEP (diesel engine exhaust particulate matter) is assumed equal to front-half NTE particulate emissions, as reported by the vendors.

Table C-3
Selective Catalytic Reduction Capital Cost
Vantage Data Centers
Quincy, Washington

Cost Category	Cost Factor	Source of Cost Factor	Quant.	Unit Cost	Subtotal Cost
Direct Costs					
Purchased Equipment Costs					
2,750-KWe CAT emission control package	Cost estimate by NC Power (CAT)		54	$186,612	$10,077,048
2,750-KWe CAT miscellaneous parts	Assumed no cost			$0	$0
500-KWe CAT emission control package	Cost estimate by Johnson Matthey		2	$100,000	$200,000
500-KWe CAT miscellaneous parts	Assumed no cost			$0	$0
Combined systems cost					$10,277,048
Instrumentation	Assumed no cost		0	$0	$0
Sales Tax	WA state tax	WA state tax	6.5%	--	$668,008
Shipping (2,750-KWe CAT)		NC Power (CAT)	54	$12,000	$648,000
Shipping (500-KWe CAT)		Johnson Matthey	2	$2,200	$4,400
Subtotal Purchased Equipment Cost (PEC)					$11,597,456
Direct Installation Costs					
Enclosure structural supports (2,750-KWe CAT)	Cost estimate by Johnson Matthey		54	$3,500	$189,000
Onsite Installation (2,750-KWe CAT)	Cost estimate by NC Power (CAT)		54	$68,153	$3,680,262
Enclosure structural supports (500-KWe CAT)	Cost estimate by Johnson Matthey		2	$2,200	$4,400
Onsite Installation (500-KWe CAT)	Cost estimate by Johnson Matthey		2	$10,000	$20,000
Electrical	Included above		0	$0	$0
Piping	Included above		0	$0	$0
Insulation	Assumed no cost		0	$0	$0
Painting	Assumed no cost		0	$0	$0
Subtotal Direct Installation Costs (DIC)					$3,893,662
Site Preparation and Buildings (SP)	Assumed no cost		0	$0	$0
Total Direct Costs, (DC = PEC + DIC + SP)					$15,491,118
Indirect Costs (Installation)					
Engineering		Johnson Matthey	56	$3,000	$168,000
Construction and field expenses		Johnson Matthey	56	$3,000	$168,000
Contractor Fees	From DIS data center		6.8%	--	$785,148
Startup		Johnson Matthey	56	$3,000	$168,000
Performance Test (Tech support)	0.01*PEC	EPA Cost Manual	1.0%	--	$115,975
Contingencies	0.10*PEC	EPA Cost Manual	10.0%	--	$1,159,746
Subtotal Indirect Costs (IC)					$2,564,868
Total Capital Investment (TCI = DC+IC)					**$18,055,986**

Table C-4
Selective Catalytic Reduction Cost Effectiveness
Vantage Data Centers
Quincy, Washington

Item	Quantity	Units	Unit Cost	Units	Subtotal
Annualized Capital Recovery					
Total Capital Investment (TCI)					$18,055,986
Capital Recovery Factor:	30	years	5.5%	discount	0.069
Subtotal Annualized 30-year Capital Recovery Cost					$1,242,349
Direct Annual Cost					
Increased Fuel Consumption	Insignificant				$0
Reagent Consumption (estimated by Pacific Power Group)	909,830	gallons/year	$4.00	per gallon	$3,639,320
Catalyst Replacement (EPA Manual)	Insignificant				$0
Annual operation/labor/maintenance costs: Upper-bound estimate would assume CARB's value of $1.50/hp/year and would result in $464,664/year for the 2,750 kW-hr generators and $84,484/year for the 500 kW-hr generators. Lower-bound estimate would assume zero annual O&M. Mid-range value would account for fuel for pressure drop, increased inspections, periodic OEM visits, and the costs for Ecology's increased emission testing requirements. For this screening-level analysis, we assumed the lower-bound annual O&M cost of zero.					$0
Subtotal Direct Annual Cost					$3,639,320
Indirect Annual Costs					
Annual Admin charges (EPA Manual)	2.0%	of Total Capital Investment			$361,120
Annual Property tax (EPA Manual)	0.0%	of Total Capital Investment			$0
Annual Insurance (EPA Manual)	0.0%	of Total Capital Investment			$0
Subtotal Indirect Annual Costs					$361,120
Total Annual Cost (Capital Recovery + Direct Annual Costs + Indirect Annual Costs)					**$5,242,788**
Uncontrolled Emissions (Combined Pollutants)					169
Annual Tons Removed (Combined Pollutants)					106
Cost Effectiveness ($ per tons combined pollutant destroyed)					**$49,574**

Annual O&M Cost Based on CARB Factors (lowermost CARB estimate)		Annual O&M Cost Based on CARB Factors (lowermost CARB estimate)	
$464,664	per year per generator	$84,484	per year per generator
2,750	KW-hr	500	KW-hr
4536	annual generator hours	168	annual generator hours
$1.50	per HP_M per year	$1.50	per HP_M per year

MULTI-CRITERIA POLLUTANT COST EFFECTIVENESS (Reasonable vs. Actual Cost to Control)[a]

Pollutant	Ecology Acceptable Unit Cost ($/ton)	Forecast Removal (TPY)[a]	Subtotal Reasonable Annual Cost ($/year)
NO_x	$12,000	106	$1,269,073 per year
CO	$5,000	0	$0 per year
VOCs	$12,000	0	$0 per year
PM	$12,000	0	$0 per year
Total Reasonable Annual Control Cost for Combined Pollutants			$1,269,073 per year
Actual Annual Control Cost			$5,242,788 per year
		Is the Control Device Reasonable?	**NO (Actual >> Acceptable)**

CRITERIA POLLUTANT CONTROL EFFICIENCIES[a]

Pollutant	PM (FH)	CO	VOCs	NO_x
Tier 2 Uncontrolled Emissions (TPY)	2.4	39	2.0	125
Controlled Emissions (TPY)	2.4	39	2.0	19
TPY Removed	0	0	0	106
Combined Uncontrolled Emissions (TPY)	169			
Combined TPY Removed	106			
Expected Removal Efficiency	0%	0%	0%	90%
Annualized Cost ($/year)	$5,242,788			
Individual Pollutant $/Ton Removed	--	--	--	$49,574

Table C-4
Selective Catalytic Reduction Cost Effectiveness
Vantage Data Centers
Quincy, Washington

MULTI-TOXIC AIR POLLUTANT COST-EFFECTIVENESS (Reasonable vs. Actual Cost to Control)[a]

Pollutant	ASIL (μg/m³)	"Hanford Method" Cost Factor	Ecology Guidance "Ceiling Cost" ($/ton)	Forecast Removal (TPY)[a]	Subtotal Reasonable Annual Cost ($/year)
DEEP	0.0033	6.9	$72,585	0.0	$0 per year
CO	23,000	0.070	$731	0.0	$0 per year
NO_2 (10% of NO_x)	470	1.8	$18,472	11	$207,825 per year
SO_2	660	1.6	$16,924	0.0	$0 per year
1,3-Butadiene	3.30E-02	5.9	$62,085	0.0	$0 per year
Acetaldehyde	3.7E-01	4.9	$51,063	0.0	$0 per year
Acrolein	3.5E-01	4.9	$51,317	0.0	$0 per year
Benz(a)anthracene	5.5E-03	6.7	$70,256	0.0	$0 per year
Benzene	1.3E-01	5.3	$55,833	0.0	$0 per year
Benzo(a)pyrene	1.0E-03	7.4	$78,029	0.0	$0 per year
Benzo(b)fluoranthene	5.5E-03	6.7	$70,256	0.0	$0 per year
Dibenz(a,h)anthracene	5.0E-04	7.7	$81,190	0.0	$0 per year
Formaldehyde	1.7E-01	5.2	$54,610	0.0	$0 per year
Indeno(1,2,3-cd)pyrene	5.5E-03	6.7	$70,256	0.0	$0 per year
Naphthalene	2.9E-02	6.0	$62,674	0.0	$0 per year
Propylene	3000	1.0	$10,020	0.0	$0 per year
Xylenes	220	2.1	$21,934	0.0	$0 per year
Carcinogenic VOCs	n.a.	n.a.	$9,999	0.0	$0 per year
Non-Carcinogenic VOCs	n.a.	n.a.	$5,000	0.0	$0 per year
Total Reasonable Annual Control Cost for Combined Pollutants					$207,825 per year
Actual Annual Control Cost					$5,242,788 per year
				Is the Control Device Reasonable?	**NO (Actual >> Acceptable)**

TOXIC AIR POLLUTANT CONTROL EFFICIENCIES[a]

TAP	Tier 2 Uncontrolled Emissions (TPY)	Controlled Emissions (TPY)	TPY Removed	Expected Removal Efficiency	Individual Pollutant $/Ton Removed
DEEP	2.4	2.4	0.0	0%	--
CO	39	39	0.0	0%	--
NO_2 (10% of NO_x)	13	1.3	11	90%	$465,999
SO_2	1.0E-01	1.0E-01	0.0	0%	--
1,3-Butadiene	2.7E-03	2.7E-03	0.0	0%	--
Acetaldehyde	1.7E-03	1.7E-03	0.0	0%	--
Acrolein	5.5E-04	5.5E-04	0.0	0%	--
Benz(a)anthracene	4.3E-05	4.3E-05	0.0	0%	--
Benzene	5.4E-02	5.4E-02	0.0	0%	--
Benzo(a)pyrene	1.8E-05	1.8E-05	0.0	0%	--
Benzo(b)fluoranthene	7.7E-05	7.7E-05	0.0	0%	--
Dibenz(a,h)anthracene	2.4E-05	2.4E-05	0.0	0%	--
Formaldehyde	5.5E-03	5.5E-03	0.0	0%	--
Indeno(1,2,3-cd)pyrene	2.9E-05	2.9E-05	0.0	0%	--
Naphthalene	9.0E-03	9.0E-03	0.0	0%	--
Propylene	1.9E-01	1.9E-01	0.0	0%	--
Xylenes	1.3E-02	1.3E-02	0.0	0%	--
Carcinogenic VOCs	7.3E-02	0.073	0.0	0%	--
Non-Carcinogenic VOCs	2.3E-01	0.227	0.0	0%	--
Annualized Cost ($/yr)					$5,242,788
Combined Uncontrolled Emissions (TPY)					54
Combined TPY Removed					11.3
Combined TAPs $/Ton Removed					$465,999

Notes:

FH ("front-half" filterable emissions)

BH ("back-half" condensable emissions)

PM (particulate matter) attributable to front-half and back-half emissions is assumed equal to the sum of vendor NTE values for PM and hydrocarbons.

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

[a] The expected control efficiency using the SCR control option is 90% for NO_x, only.

Table C-5
Catalyzed Diesel Particulate Filter Capital Cost
Vantage Data Centers
Quincy, Washington

Cost Category	Cost Factor	Source of Cost Factor	Quant.	Unit Cost	Subtotal Cost
Direct Costs					
Purchased Equipment Costs					
2,750-KWe CAT emission control package	Cost estimate by NC Power (CAT)		54	$132,742	$7,168,068
2,750-KWe CAT miscellaneous parts	Assumed no cost			$0	$0
500-KWe CAT emission control package	Cost estimate by NC Power (CAT)		2	$32,375	$64,750
500-KWe CAT miscellaneous parts	Assumed no cost			$0	$0
Combined systems cost					$7,232,818
Instrumentation	Assumed no cost		0	$0	$0
Sales Tax	WA state tax	WA state tax	6.5%	--	$470,133
Shipping (2,750-KWe CAT)		NC Power (CAT)	54	$10,000	$540,000
Shipping (500-KWe CAT)		NC Power (CAT)	2	$3,000	$6,000
Subtotal Purchased Equipment Cost (PEC)					$8,248,951
Direct Installation Costs					
Enclosure structural supports (2,750-KWe CAT)	Cost estimate by Johnson Matthey		54	$1,000	$54,000
Onsite Installation (2,750-KWe CAT)	Cost estimate by NC Power (CAT)		54	$7,593	$410,022
Enclosure structural supports (500-KWe CAT)	Cost estimate by Johnson Matthey		2	$1,000	$2,000
Onsite Installation (500-KWe CAT)	Cost estimate by NC Power (CAT)		2	$6,529	$13,058
Electrical	Included above		0	$0	$0
Piping	Included above		0	$0	$0
Insulation	Assumed no cost		0	$0	$0
Painting	Assumed no cost		0	$0	$0
Subtotal Direct Installation Costs (DIC)					$479,080
Site Preparation and Buildings (SP)	Assumed no cost		0	$0	$0
Total Direct Costs, (DC = PEC + DIC + SP)					$8,728,031
Indirect Costs (Installation)					
Engineering		Johnson Matthey	56	$2,000	$112,000
Construction and field expenses		Johnson Matthey	56	$0	$0
Contractor Fees	From DIS data center		6.8%	--	$558,454
Startup		Johnson Matthey	56	$1,500	$84,000
Performance Test (Tech support)	0.01*PEC	EPA Cost Manual	1.0%	--	$82,490
Contingencies	0.10*PEC	EPA Cost Manual	10.0%	--	$824,895
Subtotal Indirect Costs (IC)					$1,661,839
Total Capital Investment (TCI = DC+IC)					**$10,389,870**

Table C-6
Catalyzed Diesel Particulate Filter Cost Effectiveness
Vantage Data Centers
Quincy, Washington

Item	Quantity	Units	Unit Cost	Subtotal
Annualized Capital Recovery				
Total Capital Investment (TCI)				**$10,389,870**
Capital Recovery Factor: lifetime =	30 years	interest rate = 5.5%		0.069
Subtotal Annualized 30-year Capital Recovery Cost				$714,879
Direct Annual Costs				
Annual Admin charges	2% of TCI (EPA Manual)		0.02	$207,797
Annual Property tax	1% of TCI (EPA Manual)		0.01	$103,899
Annual Insurance	1% of TCI (EPA Manual)		0.01	$103,899
Annual operation/labor/maintenance costs: Upper-bound estimate would assume CARB's value of $1.00/hp/year and would result in $309,776/year for the 2,750 kW-hr generators and $56,323/year for the 500 kW-hr generators. Lower-bound estimate would assume zero annual O&M. Mid-range value would account for fuel for pressure drop, increased inspections, periodic OEM visits, and the costs for Ecology's increased emission testing requirements. For this screening-level analysis we assumed the lower-bound annual O&M cost of zero.				$0
Subtotal Direct Annual Costs				$415,595
Total Annual Cost (Capital Recovery + Direct Annual Costs)				**$1,130,474**
Uncontrolled Emissions (Combined Pollutants)				169
Annual Tons Removed (Combined Pollutants)				35
Cost Effectiveness ($ per tons combined pollutant destroyed)				**$32,536**

Annual O&M Cost Based on CARB Factors (lowermost CARB estimate)	Annual O&M Cost Based on CARB Factors (lowermost CARB estimate)
$309,776 per year per generator	$56,323 per year per generator
2,750 KW-hr	500 KW-hr
4536 annual generator hours	168 annual generator hours
$1.00 per HP_M per year	$1.00 per HP_M per year

MULTI-CRITERIA POLLUTANT COST EFFECTIVENESS (Reasonable vs. Actual Cost to Control)[a]

Pollutant	Ecology Acceptable Unit Cost ($/ton)	Forecast Removal (TPY)[a]	Subtotal Reasonable Annual Cost ($/year)
NO_x	$12,000	0	$0 per year
CO	$5,000	31	$156,584 per year
VOCs	$12,000	1.4	$16,678 per year
PM	$12,000	2.0	$24,470 per year
Total Reasonable Annual Control Cost for Combined Pollutants			$197,732 per year
Actual Annual Control Cost			$1,130,474 per year
		Is the Control Device Reasonable?	**NO (Actual >> Acceptable)**

CRITERIA POLLUTANT CONTROL EFFICIENCIES[a]

Pollutant	PM (FH)	CO	VOCs	NO_x
Tier 2 Uncontrolled Emissions (TPY)	2.4	39	2.0	125
Controlled Emissions (TPY)	0.36	7.8	0.60	125
TPY Removed	2.0	31	1.4	0
Combined Uncontrolled Emissions (TPY)	169			
Combined TPY Removed	35			
Expected Removal Efficiency	85%	80%	70%	0%
Annualized Cost ($/year)	$1,130,474			
Individual Pollutant $/Ton Removed	$554,370	$36,098	$813,401	--

Table C-6
Catalyzed Diesel Particulate Filter Cost Effectiveness
Vantage Data Centers
Quincy, Washington

MULTI-TOXIC AIR POLLUTANT COST-EFFECTIVENESS (Reasonable vs. Actual Cost to Control)[a]

Pollutant	ASIL (μg/m³)	"Hanford Method" Cost Factor	Ecology Guidance "Ceiling Cost" ($/ton)	Forecast Removal (TPY)[a]	Subtotal Reasonable Annual Cost ($/year)
DEEP	0.0033	6.9	$72,585	2.0	$148,015 per year
CO	23,000	0.070	$731	31	$22,898 per year
NO_2 (10% of NO_x)	470	1.8	$18,472	0	$0.0 per year
SO_2	660	1.6	$16,924	7.2E-02	$1,224 per year
1,3-Butadiene	3.30E-02	5.9	$62,085	1.9E-03	$118 per year
Acetaldehyde	3.7E-01	4.9	$51,063	1.2E-03	$62 per year
Acrolein	3.5E-01	4.9	$51,317	3.8E-04	$20 per year
Benz(a)anthracene	5.5E-03	6.7	$70,256	3.0E-05	$2 per year
Benzene	1.3E-01	5.3	$55,833	3.8E-02	$2,100 per year
Benzo(a)pyrene	1.0E-03	7.4	$78,029	1.2E-05	$1 per year
Benzo(b)fluoranthene	5.5E-03	6.7	$70,256	5.4E-05	$4 per year
Dibenz(a,h)anthracene	5.0E-04	7.7	$81,190	1.7E-05	$1 per year
Formaldehyde	1.7E-01	5.2	$54,610	3.8E-03	$209 per year
Indeno(1,2,3-cd)pyrene	5.5E-03	6.7	$70,256	2.0E-05	$1 per year
Naphthalene	2.9E-02	6.0	$62,674	6.3E-03	$395 per year
Propylene	3000	1.0	$10,020	1.4E-01	$1,355 per year
Xylenes	220	2.1	$21,934	9.4E-03	$205 per year
Carcinogenic VOCs	n.a.	n.a.	$9,999	5.1E-02	$511 per year
Non-Carcinogenic VOCs	n.a.	n.a.	$5,000	1.6E-01	$793 per year
Total Reasonable Annual Control Cost for Combined Pollutants					$176,612 per year
Actual Annual Control Cost					$1,130,474 per year
				Is the Control Device Reasonable?	**NO (Actual >> Acceptable)**

TOXIC AIR POLLUTANT CONTROL EFFICIENCIES[a]

TAP	Tier 2 Uncontrolled Emissions (TPY)	Controlled Emissions (TPY)	TPY Removed	Expected Removal Efficiency	Individual Pollutant $/Ton Removed
DEEP	2.4	0.36	2.0	85%	$554,370
CO	39	7.8	31	80%	$36,098
NO_2 (10% of NO_x)	13	13	0	0%	--
SO_2	1.0E-01	3.1E-02	7.2E-02	70%	$15,626,159
1,3-Butadiene	2.7E-03	8.1E-04	1.9E-03	70%	$596,437,365
Acetaldehyde	1.7E-03	5.2E-04	1.2E-03	70%	$925,424,642
Acrolein	5.5E-04	1.6E-04	3.8E-04	70%	$2,959,479,818
Benz(a)anthracene	4.3E-05	1.3E-05	3.0E-05	70%	$37,493,088,372
Benzene	5.4E-02	1.6E-02	3.8E-02	70%	$30,052,450
Benzo(a)pyrene	1.8E-05	5.3E-06	1.2E-05	70%	$90,742,027,111
Benzo(b)fluoranthene	7.7E-05	2.3E-05	5.4E-05	70%	$21,009,640,511
Dibenz(a,h)anthracene	2.4E-05	7.2E-06	1.7E-05	70%	$67,400,869,849
Formaldehyde	5.5E-03	1.6E-03	3.8E-03	70%	$295,572,889
Indeno(1,2,3-cd)pyrene	2.9E-05	8.6E-06	2.0E-05	70%	$56,330,195,574
Naphthalene	9.0E-03	2.7E-03	6.3E-03	70%	$179,390,007
Propylene	1.9E-01	5.8E-02	1.4E-01	70%	$8,358,674
Xylenes	1.3E-02	4.0E-03	9.4E-03	70%	$120,832,648
Carcinogenic VOCs	7.3E-02	2.2E-02	5.1E-02	70%	$22,132,265
Non-Carcinogenic VOCs	2.3E-01	6.8E-02	1.6E-01	70%	$7,127,615
Annualized Cost ($/yr)					$1,130,474
Combined Uncontrolled Emissions (TPY)					54.4
Combined TPY Removed					33.6
Combined TAPs $/Ton Removed					$33,621

Notes:
FH ("front-half" filterable emissions)
BH ("back-half" condensable emissions)
PM (particulate matter) attributable to front-half and back-half emissions is assumed equal to the sum of vendor NTE values for PM and hydrocarbons.
DEEP (diesel engine exhaust particulate matter) is assumed equal to front-half NTE particulate emissions, as reported by the vendors.

[a] The expected control efficiency using the catalyzed DPF is 85% for PM (front half), 80% for CO, and 70% for VOCs. There is no expected control of NO_x emissions using the catalyzed DPF option.

Table C-7
Diesel Oxidation Catalyst Capital Cost
Vantage Data Centers
Quincy, Washington

Cost Category	Cost Factor	Source of Cost Factor	Quant.	Unit Cost	Subtotal Cost
Direct Costs					
Purchased Equipment Costs					
2,750-KWe CAT emission control package		NC Power (CAT)	54	$153,032	$8,263,728
2,750-KWe CAT miscellaneous parts	Assumed no cost			$0	$0
500-KWe CAT emission control package		NC Power (CAT)	2	$5,891	$11,782
500-KWe CAT miscellaneous parts	Assumed no cost			$0	$0
Combined systems cost					$8,275,510
Instrumentation	Assumed no cost		0	$0	$0
Sales Tax		WA state tax	6.5%	--	$537,908
Shipping (2,750-KWe CAT)		NC Power (CAT)	54	$11,000	$594,000
Shipping (500-KWe CAT)		NC Power (CAT)	2	$2,000	$4,000
Subtotal Purchased Equipment Cost (PEC)					$9,411,418
Direct Installation Costs					
Enclosure structural supports (2,750-KWe CAT)		Johnson Matthey	54	$0	$0
Onsite Installation (2,750-KWe CAT)		NC Power (CAT)	54	$9,006	$486,324
Enclosure structural supports (500-KWe CAT)		Johnson Matthey	2	$0	$0
Onsite Installation (500-KWe CAT)		NC Power (CAT)	2	$6,671	$13,342
Electrical	Included above		0	$0	$0
Piping	Included above		0	$0	$0
Insulation	Assumed no cost		0	$0	$0
Painting	Assumed no cost		0	$0	$0
Subtotal Direct Installation Costs (DIC)					$499,666
Site Preparation and Buildings (SP)	Assumed no cost		0	$0	$0
Total Direct Costs, (DC = PEC + DIC + SP)					**$9,911,084**
Indirect Costs					
Engineering		Johnson Matthey	56	$1,200	$67,200
Construction and field expenses		Johnson Matthey	56	$0	$0
Contractor Fees	6.8%*PEC	From DIS data center	6.8%	--	$637,153
Startup		Johnson Matthey	56	$1,500	$84,000
Performance Test (Tech support)	0.01*PEC	EPA Cost Manual	1.0%	--	$94,114
Contingencies	0.10*PEC	EPA Cost Manual	10.0%	--	$941,142
Total Indirect Costs (IC)					**$1,823,609**
Total Capital Investment (TCI = DC+IC)					**$11,734,693**

Table C-8
Diesel Oxidation Catalyst Cost Effectiveness
Vantage Data Centers
Quincy, Washington

Item	Variables	Subtotal
Annualized Capital Recovery		
Total Capital Investment (TCI)		$11,734,693
Capital Recovery Factor: lifetime =	30 years interest rate = 5.5%	0.069
Subtotal Annualized 30-year Capital Recovery Cost		**$807,410**
Direct Annual Costs		
Annual Admin charges	2.0% of TCI (EPA Manual)	$234,694
Annual Property tax	1.0% of TCI (EPA Manual)	$117,347
Annual Insurance	1.0% of TCI (EPA Manual)	$117,347
Catalyst Replacement	Assume cost of zero.	$0
Annual Operation/Labor/Maintenance cost	Upper-bound estimate would assume CARB's value of $0.20/hp/year and would result in $61,955/year for the 2,750 kW-hr generators and $11,265/year for the 500 kW-hr generators. Lower-bound estimate would assume zero annual O&M. Mid-range value would account for fuel for pressure drop, increased inspections, periodic OEM visits, and the costs for Ecology's increased emission testing requirements. For this screening-level analysis we assumed the lower-bound annual O&M cost of zero.	$0
Subtotal Direct Annual Costs		**$469,388**
Total Annual Cost (Capital Recovery + Direct Annual Costs)		**$1,276,798**
Cost Effectiveness		
Uncontrolled Emissions (Combined Pollutants)		169
Annual Tons Removed (Combined Pollutants)		33
Cost Effectiveness ($ per tons combined pollutant destroyed)		**$38,335**

Annual O&M Cost Based on CARB Factors (lowermost CARB estimate)	**Annual O&M Cost Based on CARB Factors (lowermost CARB estimate)**
$61,955 per year per generator	$11,265 per year per generator
2,750 KW-hr	500 KW-hr
4536 annual generator hours	168 annual generator hours
$0.20 per HP_M per year	$0.20 per HP_M per year

MULTI-CRITERIA POLLUTANT COST EFFECTIVENESS (Reasonable vs. Actual Cost to Control)[a]

Pollutant	Ecology Acceptable Unit Cost ($/ton)	Forecast Removal (TPY)[a]	Subtotal Reasonable Annual Cost ($/year)
NO_X	$12,000	0	$0 per year
CO	$5,000	31	$156,584 per year
VOCs	$12,000	1.4	$16,678 per year
PM	$12,000	0.60	$7,197 per year
Total Reasonable Annual Control Cost for Combined Pollutants			$180,459 per year
Annual Control Cost			$1,276,798 per year
		Is the Control Device Cost Effective?	**No**

CRITERIA POLLUTANT CONTROL EFFICIENCIES[a]

Pollutant	PM (FH)	CO	VOCs	NO_x
Tier 2 Uncontrolled Emissions (TPY)	2.4	39	2.0	125
Controlled Emissions (TPY)	1.8	7.8	0.60	125
TPY Removed	0.60	31	1.39	0
Combined Uncontrolled Emissions (TPY)	169			
Combined TPY Removed	33			
Expected Removal Efficiency	25%	80%	70%	0%
Annualized Cost ($/year)	$1,276,798			
Individual Pollutant $/Ton Removed	$2,128,828	$40,770	$918,684	--

Table C-8
Diesel Oxidation Catalyst Cost Effectiveness
Vantage Data Centers
Quincy, Washington

MULTI-TOXIC AIR POLLUTANT COST EFFECTIVENESS (Reasonable vs. Actual Cost to Control)[a]

Pollutant	ASIL (μg/m³)	"Hanford Method" Cost Factor	Ecology Guidance "Ceiling Cost" ($/ton)	Forecast Removal (TPY)[a]	Subtotal Reasonable Annual Cost ($/year)
DEEP	0.0033	6.9	$72,585	0.60	$43,534 per year
CO	23,000	0.070	$731	31	$22,898 per year
NO_2 (10% of NO_x)	470	1.8	$18,472	--	-- per year
SO_2	660	1.6	$16,924	7.2E-02	$1,224 per year
1,3-Butadiene	3.30E-02	5.9	$62,085	1.9E-03	$118 per year
Acetaldehyde	3.7E-01	4.9	$51,063	1.2E-03	$62 per year
Acrolein	3.5E-01	4.9	$51,317	3.8E-04	$20 per year
Benz(a)anthracene	5.5E-03	6.7	$70,256	3.0E-05	$2 per year
Benzene	1.3E-01	5.3	$55,833	3.8E-02	$2,100 per year
Benzo(a)pyrene	1.0E-03	7.4	$78,029	1.2E-05	$1 per year
Benzo(b)fluoranthene	5.5E-03	6.7	$70,256	5.4E-05	$4 per year
Dibenz(a,h)anthracene	5.0E-04	7.7	$81,190	1.7E-05	$1 per year
Formaldehyde	1.7E-01	5.2	$54,610	3.8E-03	$209 per year
Indeno(1,2,3-cd)pyrene	5.5E-03	6.7	$70,256	2.0E-05	$1.4 per year
Naphthalene	2.9E-02	6.0	$62,674	6.3E-03	$395 per year
Propylene	3000	1.0	$10,020	1.4E-01	$1,355 per year
Xylenes	220	2.1	$21,934	9.4E-03	$205.21 per year
Carcinogenic VOCs	n.a.	n.a.	$9,999	0.0511	$511 per year
Non-Carcinogenic VOCs	n.a.	n.a.	$5,000	1.6E-01	$793.02 per year
Total Reasonable Annual Control Cost for Combined Pollutants					$72,130 per year
Annual Control Cost					$1,276,798 per year
				Is the Control Device Cost Effective?	No

TOXIC AIR POLLUTANT CONTROL EFFICIENCIES[a]

TAP	Tier 2 Uncontrolled Emissions (TPY)	Controlled Emissions (TPY)	TPY Removed	Expected Removal Efficiency	Individual Pollutant $/Ton Removed
DEEP	2.4	1.80	0.60	25%	$2,128,828
CO	39	7.8	31.3	80%	$40,770
NO_2 (10% of NO_x)	13	1.3E+01	0.0E+00	0%	--
SO_2	1.0E-01	3.1E-02	7.2E-02	70%	$17,648,747
1,3-Butadiene	2.7E-03	8.1E-04	1.9E-03	70%	$673,637,842
Acetaldehyde	1.7E-03	5.2E-04	1.2E-03	70%	$1,045,207,921
Acrolein	5.5E-04	1.6E-04	3.8E-04	70%	$3,342,543,098
Benz(a)anthracene	4.3E-05	1.3E-05	3.0E-05	70%	$42,346,044,394
Benzene	5.4E-02	1.6E-02	3.8E-02	70%	$33,942,319
Benzo(a)pyrene	1.8E-05	5.3E-06	1.2E-05	70%	$102,487,313,668
Benzo(b)fluoranthene	7.7E-05	2.3E-05	5.4E-05	70%	$23,729,044,696
Dibenz(a,h)anthracene	2.4E-05	7.2E-06	1.7E-05	70%	$76,124,969,979
Formaldehyde	5.5E-03	1.6E-03	3.8E-03	70%	$333,830,667
Indeno(1,2,3-cd)pyrene	2.9E-05	8.6E-06	2.0E-05	70%	$63,621,351,722
Naphthalene	9.0E-03	2.7E-03	0.0063	70%	$202,609,535
Propylene	1.9E-01	5.8E-02	1.4E-01	70%	$9,440,588
Xylenes	1.3E-02	4.0E-03	9.4E-03	70%	$136,472,744
Carcinogenic VOCs	7.3E-02	2.2E-02	5.1E-02	70%	$24,996,977
Non-Carcinogenic VOCs	2.3E-01	6.8E-02	1.6E-01	70%	$8,050,185
Annualized Cost ($/yr)					$1,276,798
Combined Uncontrolled Emissions (TPY)					54.4
Combined TPY Removed					32.2
Combined TAPs $/Ton Removed					$39,671

Notes:
FH ("front-half" filterable emissions)
BH ("back-half" condensable emissions)
PM (particulate matter) attributable to front-half and back-half emissions is assumed equal to the sum of vendor NTE values for PM and hydrocarbons.
DEEP (diesel engine exhaust particulate matter) is assumed equal to front-half NTE particulate emissions, as reported by the vendors.

[a] The expected control efficiency using the DOC is 80% for CO, and 70% for VOCs. DOCs are marginally effective for removal of PM (15% - 25% depending on the load). There is no expected control of NOx emissions using the DOC control option.

APPENDIX D

Summary of AERMOD Inputs and Selected Isopleths

Table D-1
Modeled Stack Parameters and Emission Rates
Vantage Data Centers
Quincy, Washington

Stack Dimensions

Engine	Minimum Stack Height (ft)	Actual Stack Diameter (in)
WA-13 2.75-MWe Genset	60	20
WA-12 2.75-MWe Genset	43	20
WA-12 0.5-MWe Genset	15	7.6

Exhaust Parameters and Modeled Emission Rates

Pollutant	Averaging Period	Emissions Scenario	Modeled Load (%)	Operating Hours: Total hours of operation	Operating Hours: Cold-Start Minutes	Operating Hours: Warm Minutes	Exhaust Parameters[a]: Exhaust Temperature (°F)	Exhaust Parameters[a]: Exhaust Flow (cfm)	Exhaust Parameters[a]: Adjusted Velocity[a] (ft/min)	Exhaust Parameters[a]: Effective Stack Diameter[a] (in)	Emissions per Point Source[b] (lb/hr)
WA-13 2.75-MWe Genset											
Criteria Air Pollutants											
CO	1-hour and 8-hour	Power outage	100	1	1	59	741	17,877	--	--	3.55E+00
SO_2	1-hour and 3-hour	Power outage	100	1	1	59	741	17,877	--	--	4.29E-02
PM_{10}	24-hour	Power outage	25	4	1	239	633	6,342	--	--	5.20E-02
$PM_{2.5}$	Annual	Maximum annual[c]	10	89.75	65.25	5,320	460	3,754	725	31	2.57E-03
	24-hour	Single Gen Variable Load	WA12 2.75-MWe generator is worst-case for $PM_{2.5}$ 24-hour modeling.								
NO_X	Annual	Maximum annual[c]	10	89.75	65.25	5,320	460	3,754	725	31	1.37E-01
	1-hour	Variable Load	10	1	1	59	460	3,754	725	31	1.34E+01
		Monthly Maintenance[d]	10	1	1	59	460	3,754	725	31	1.34E+01
		Yearly Load Test[e]	100	1	1	59	741	17,877	--	--	1.78E+01

Table D-1
Modeled Stack Parameters and Emission Rates
Vantage Data Centers
Quincy, Washington

Pollutant	Averaging Period	Emissions Scenario	Modeled Load (%)	Operating Hours: Total hours of operation	Operating Hours: Cold-Start Minutes	Operating Hours: Warm Minutes	Exhaust Parameters[a]: Exhaust Temperature (°F)	Exhaust Parameters[a]: Exhaust Flow (cfm)	Exhaust Parameters[a]: Adjusted Velocity[a] (ft/min)	Exhaust Parameters[a]: Effective Stack Diameter[a] (in)	Emissions per Point Source[b] (lb/hr)
Toxic Air Pollutants											
Primary NO_2	1-hour	Power outage	10	1	1	59	460	3,754	725	31	1.34E+01
DEEP	Annual	Maximum annual[c]	25	89.75	65.25	5,320	633	6,342	--	--	1.00E-03
Acrolein	24-hour	Power outage	100	4	1	239	741	17,877	--	--	3.68E-05
Naphthalene	Annual	Maximum annual[c]	100	89.75	65.25	5,320	741	17,877	--	--	3.83E-05
Benzene	Annual	Maximum annual[c]	100	89.75	65.25	5,320	741	17,877	--	--	2.29E-04
WA-12 2.75-MWe Genset											
Criteria Air Pollutants											
CO	1-hour and 8-hour	Power outage	100	1	1	59	741	17,877	--	--	1.77E+01
SO_2	1-hour and 3-hour	Power outage	100	1	1	59	741	17,877	--	--	4.29E-02
PM_{10}	24-hour	Power outage	25	4	1	239	633	6,342	--	--	2.26E-01
$PM_{2.5}$	Annual	Maximum annual	25	84	61	4,979	633	6,342	--	--	1.34E-02
	24-hour	Single Gen Variable Load	25	8	8	472	633	6,342	--	--	9.42E-01
NO_X	Annual	Maximum annual	100	84	61	4,979	741	17,877	--	--	5.25E-01
	1-hour	Variable Load	100	1	1	59	741	17,877	--	--	5.48E+01
		Monthly Maintenance[d]	10	1	1	59	460	3,754	725	31	1.34E+01
		Yearly Load Test[e]	100	1	1	59	741	17,877	--	--	5.48E+01

Table D-1
Modeled Stack Parameters and Emission Rates
Vantage Data Centers
Quincy, Washington

Pollutant	Averaging Period	Emissions Scenario	Modeled Load (%)	Operating Hours: Total hours of operation	Operating Hours: Cold-Start Minutes	Operating Hours: Warm Minutes	Exhaust Parameters[a]: Exhaust Temperature (°F)	Exhaust Parameters[a]: Exhaust Flow (cfm)	Exhaust Parameters[a]: Adjusted Velocity[a] (ft/min)	Exhaust Parameters[a]: Effective Stack Diameter[a] (in)	Emissions per Point Source[b] (lb/hr)
Toxic Air Pollutants											
Primary NO_2	1-hour	Power outage	100	1	1	59	741	17,877	--	--	5.48E+01
DEEP	Annual	Maximum annual	25	84	61	4,979	633	6,342	--	--	6.26E-03
Acrolein	24-hour	Power outage	100	4	1	239	741	17,877	--	--	3.68E-05
Naphthalene	Annual	Maximum annual	100	84	61	4,979	741	17,877	--	--	3.58E-05
Benzene	Annual	Maximum annual	100	84	61	4,979	741	17,877	--	--	2.14E-04
WA-12 0.5-MWe Genset											
Criteria Air Pollutants											
CO	1-hour and 8-hour	Power outage	75	1	1	59	758	2,550	--	--	2.47E+00
SO_2	1-hour and 3-hour	Power outage	100	1	1	59	790	2,884	--	--	7.60E-03
PM_{10}	24-hour	Power outage	50	4	1	239	710	1,633	--	--	4.05E-02
$PM_{2.5}$	Annual	Maximum annual	50	84	61	4979	710	1,633	--	--	2.39E-03
	24-hour	Single Gen Variable Load	WA12 2.75-MWe generator is worst-case for $PM_{2.5}$ 24-hour modeling.								
NO_X	Annual	Maximum annual	100	84	61	4,979	790	2,884	--	--	8.77E-02
	1-hour	Variable Load	100	1	1	59	790	2,884	--	--	9.15E+00
		Monthly Maintenance[d]	10	1	1	59	434	752	1,005	12	1.98E+00
		Yearly Load Test[e]	100	1	1	59	790	2,884	--	--	9.15E+00

Table D-1
Modeled Stack Parameters and Emission Rates
Vantage Data Centers
Quincy, Washington

Pollutant	Averaging Period	Emissions Scenario	Modeled Load (%)	Operating Hours			Exhaust Parameters[a]				Emissions per Point Source[b] (lb/hr)
				Total hours of operation	Cold-Start Minutes	Warm Minutes	Exhaust Temperature (°F)	Exhaust Flow (cfm)	Adjusted Velocity[a] (ft/min)	Effective Stack Diameter[a] (in)	
Toxic Air Pollutants											
Primary NO_2	1-hour	Power outage	100	1	1	59	790	2,884	--	--	9.15E+00
DEEP	Annual	Maximum annual	50	84	61	4979	710	1,633	--	--	1.69E-03
Acrolein	24-hour	Power outage	100	4	1	239	790	2,884	--	--	6.51E-06
Naphthalene	Annual	Maximum annual	100	84	61	4,979	790	2,884	--	--	6.34E-06
Benzene	Annual	Maximum annual	100	84	61	4,979	790	2,884	--	--	3.78E-05

Notes:

[a] Velocity for operations at 10 percent load were adjusted using a scaling factor to represent a vertical stack with a rain cap open to a 30 degree angle. The effective stack diameter was calculated by dividing the actual flow by the adjusted velocity.

[b] Startup emissions were included for applicable pollutants. A screening analysis was run to determine the worst-case load for each pollutant and averaging period. SO_2 was used as a surrogate for all fuel-based pollutants.

[c] Includes one-time allotment of 23 hours and 17 startup events for up to 11 new WA-13 generators in a single year to be used for generator commissioning purposes. Hours are averaged across the total number of stacks modeled.

[d] Monthly maintenance operates at 10% load. A 1-hour emission rate was modeled to represent 2 generators running sequentially each hour for 0.5-hour each.

[e] WA-13 gensets are reistricted to ≥75% Load for the Yearly load test operates. The worst-case load identified in the screening analysis is assumed for WA-12 generators.

Table D-2
Ranked Generator Runtime Scenarios - $PM_{2.5}$
Vantage Data Centers
Quincy, Washington

Ranked Day	Activity[a]	Activity Duration (hrs/genset)	Number of Generators Operating Concurrently	Max. Daily Operating Hours (hrs/day)	Cold Startups (events/day)	Load Required (%)	Max. Daily $PM_{2.5}$/PM_{10} Emissions[b] (lbs/day)
1	Emergency Power Outage	4	56	4	1	≤100%	111
2	Emergency Power Outage	4	56	4	1	≤100%	111
3	Emergency Power Outage	4	56	4	1	≤100%	111
4	Emergency Power Outage	4	56	4	1	≤100%	111
5	Emergency Power Outage	4	56	4	1	≤100%	111
6	Emergency Power Outage	4	56	4	1	≤100%	111
7	WA12 PTP Test	4	44	4	1	≤100%	56
8	WA12 PTP Test	4	44	4	1	≤100%	56
9	WA12 PTP Test	4	44	4	1	≤100%	56
10	WA12 MX Board Maintenance	6	6	6	2	≤100%	49
11	WA12 MX Board Maintenance	6	6	6	2	≤100%	49
12	WA12 MX Board Maintenance	6	6	6	2	≤100%	49
13	WA12 MX Board Maintenance	6	6	6	2	≤100%	49
14	WA12 MX Board Maintenance	6	6	6	2	≤100%	49
15	WA12 MX Board Maintenance	6	6	6	2	≤100%	49
16	WA12 Transformer Maintenance Every 5 Years	6	5	6	2	≤100%	41
17	WA12 Transformer Maintenance Every 5 Years	6	5	6	2	≤100%	41
18	WA12 Single Gen Variable Load[c]	1	1	8	8	≤100%	11
19	WA12 Single Gen Variable Load[c]	1	1	8	8	≤100%	11
20	WA12 Single Gen Variable Load[c]	1	1	8	8	≤100%	11
21	WA12 Single Gen Variable Load[c]	1	1	8	8	≤100%	11
22	WA12 Single Gen Variable Load[c]	1	1	8	8	≤100%	11

Notes:

[a] Modeling of the WA13 non-emergency scenarios result in concentrations below the NAAQS so it is not necessary to include in those scenarios in the ranking table.

[b] Startup emissions are included.

[c] Single Gen Variable Load operations include monthly maintenance, repair test, yearly load test, and stack testing. The highest 5th high concentration across all modeled years is reported for comparison to the NAAQS.

Table D-3
Generator Runtime Scenarios for Monte Carlo - NO_X
Vantage Data Centers
Quincy, Washington

Activity	Number of Generators Operating Concurrently	Load Required (%)	Total Hourly NO_X Emissions (lbs/hour)	Source Group Monte Carlo Input Filename AERMOD Filename	Number of Operating Days
Annual Operations					
Emergency Power Outage	56	≤100%	1,154	PO MAXDAILY_NO2_PO.DAT NO2_1HR_PO.ADI	2
WA13 PTP Test	44	≤100%	588	PTPWA13 MAXDAILY_NO2_PTPWA13.DAT NO2_1HR_PTPWA13.ADI	1
WA12 PTP Test	12	≤100%	566	PTPWA12 MAXDAILY_NO2_PTPWA12.DAT NO2_1HR_PTPWA12.ADI	1
WA12 MX Board Maintenance	6	≤100%	329	MXBWA12 MAXDAILY_NO2_MXBWA12.DAT NO2_1HR_MXBWA12.ADI	2
WA13 Commissioning SIT	11	≤100%	147	CMSSIT MAXDAILY_NO2_CMSSIT.DAT NO2_1HR_CMSSIT.ADI	2
WA13 MX Board Maintenance and Transformer Maintenance	5	≤100%	67	MXBWA13 MAXDAILY_NO2_MXBWA13.DAT NO2_1HR_MXBWA13.ADI	4
WA12 Repair Test and Yearly Load Test	1	≤100%	55	ONE12 MAXDAILY_NO2_ONE12.DAT NO2_1HR_ONE12.ADI	9
WA13 Repair Test, Stack Testing[a], Commissioning Burn-In and Testing	1	≤100%	13	ONE13 MAXDAILY_NO2_ONE13.DAT NO2_1HR_ONE13.ADI	26
WA12 Monthly Maintenance	1	10%	13	MTWA12 MAXDAILY_NO2_MT12HR.DAT NO2_1HR_MT12HR.ADI	11
WA13 Monthly Maintenance	1	10%	13	N/A - See NO2_1hr_MT13.ADO	Unlimited[b]
WA13 Yearly Load Test	1	≥75%	17.8	N/A - See NO2_1hr_YTWA13.ADO	Unlimited[b]

Table D-3
Generator Runtime Scenarios for Monte Carlo - NO_X
Vantage Data Centers
Quincy, Washington

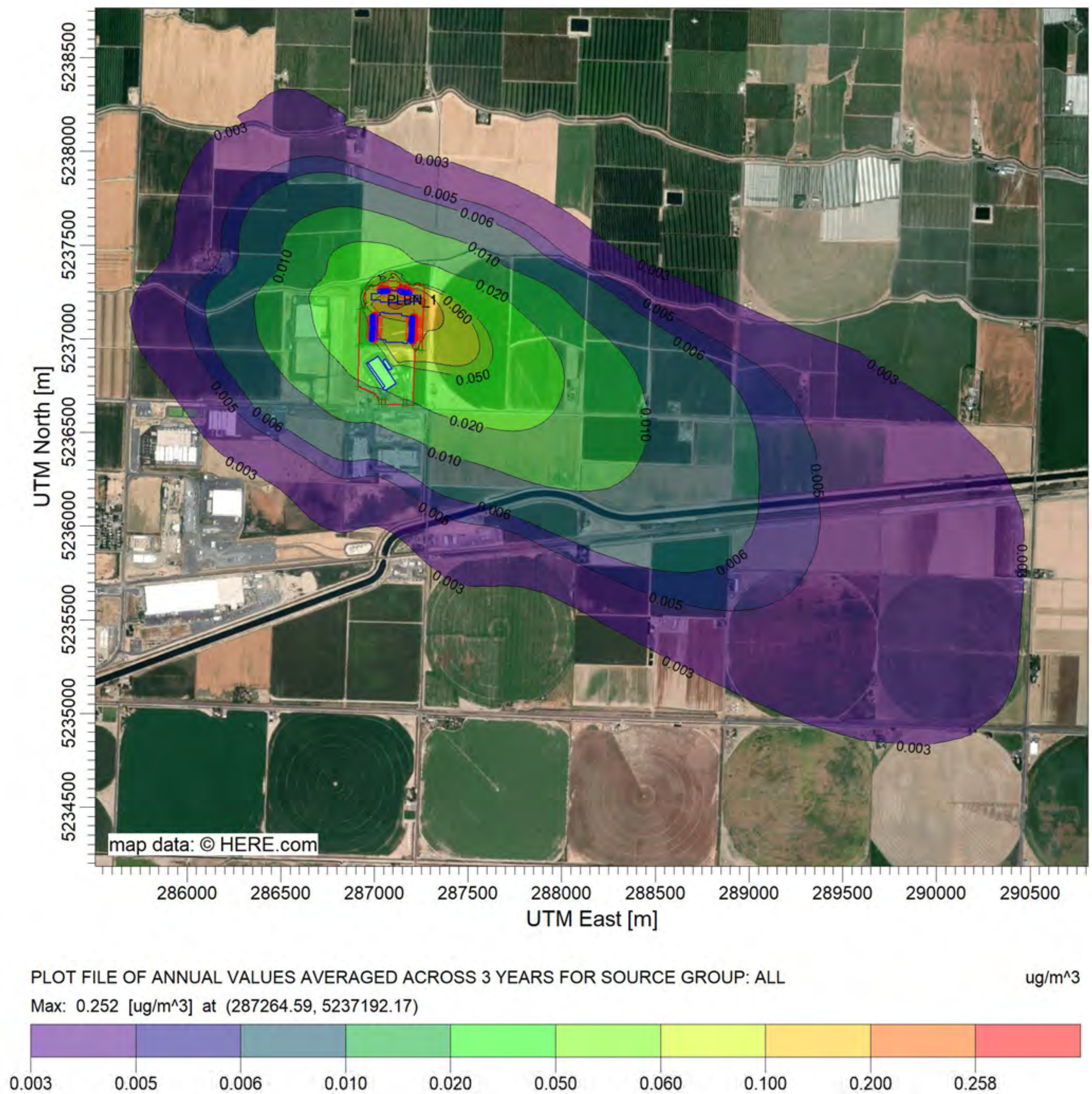
Activity	Number of Generators Operating Concurrently	Load Required (%)	Total Hourly NO_X Emissions (lbs/hour)	Source Group Monte Carlo Input Filename AERMOD Filename	Number of Operating Days
Every 5 Years Operations					
WA12 Stack Testing[c]	1	≤100%	55	5YRWA12 MAXDAILY_NO2_STWA12.DAT NO2_1HR_STWA12.ADI	6
WA12 Tranformer Maintenance	5	≤100%	274	5YRWA12 MAXDAILY_NO2_TMWA12.DAT NO2_1HR_TMWA12.ADI	2

Notes:

[a] WA13 stack testing will be the first year after installation and once every five years after that.

[b] The modeled highest 1st high concentration plus background is less than the NAAQS for all receptors even if operating all hours of the year.

[c] WA12 stack testing will be conducted once every 5 years.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5237500
5237000
5236500
5236000
5235500
5235000
5234500
286000
286500
287000
287500
288000
288500
289000
289500
290000
290500
map data: © HERE.com
PLBN_1
0.003
0.005
0.006
0.010
0.020
0.050
0.060
PLOT FILE OF ANNUAL VALUES AVERAGED ACROSS 3 YEARS FOR SOURCE GROUP: ALL
ug/m^3
Max: 0.252 [ug/m^3] at (287264.59, 5237192.17)
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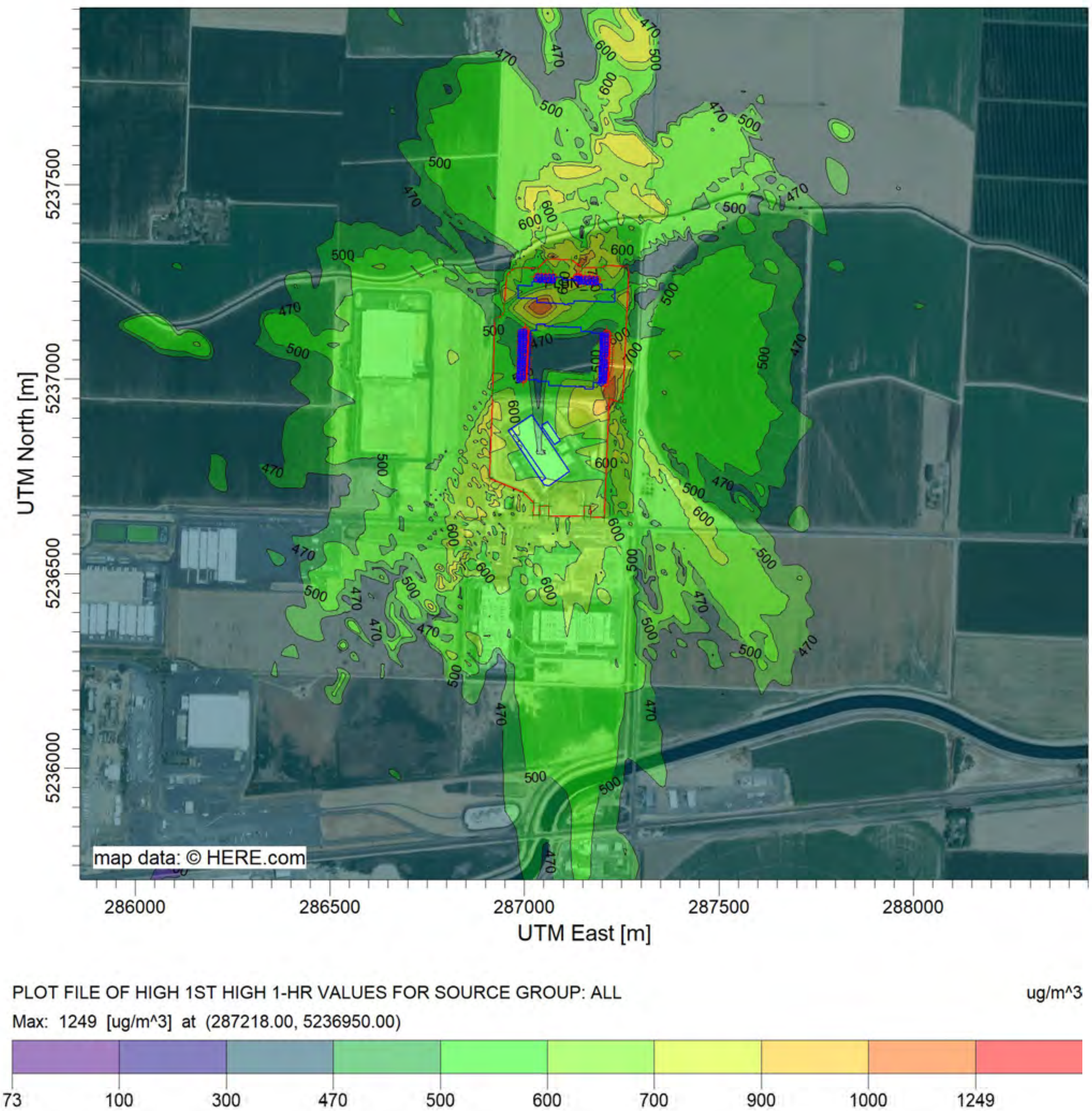
0.005
0.006
0.010
0.020
0.050
0.060
0.100
0.200
0.258


map data: © HERE.com
UTM North [m]
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5237000
5236500
5236000
286000
286500
287000
287500
288000
UTM East [m]
PLOT FILE OF HIGH 1ST HIGH 1-HR VALUES FOR SOURCE GROUP: ALL
ug/m^3
Max: 1249 [ug/m^3] at (287218.00, 5236950.00)
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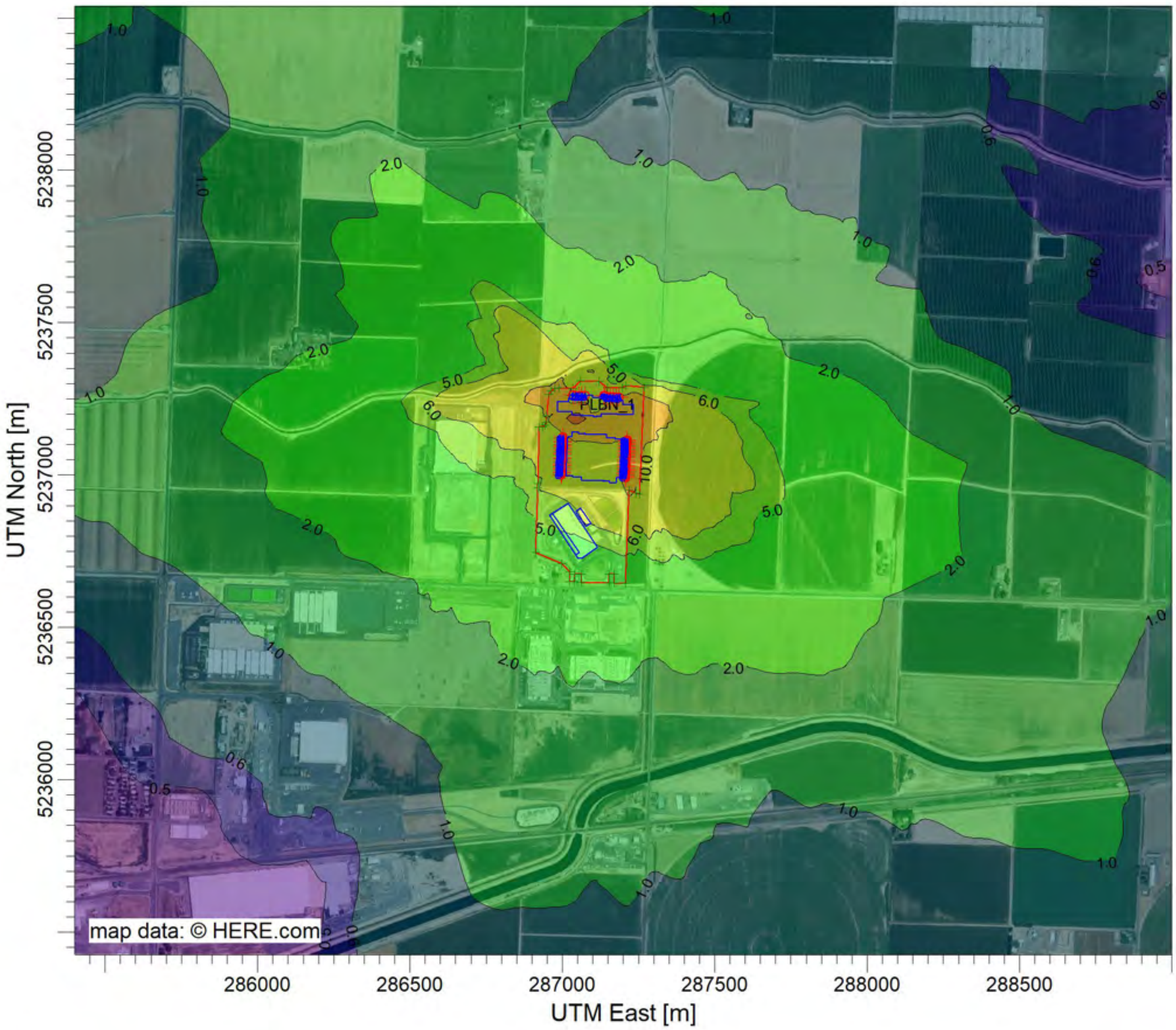
100
300
470
500
600
700
900
1000
1249



PLOT FILE OF HIGH 6TH HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

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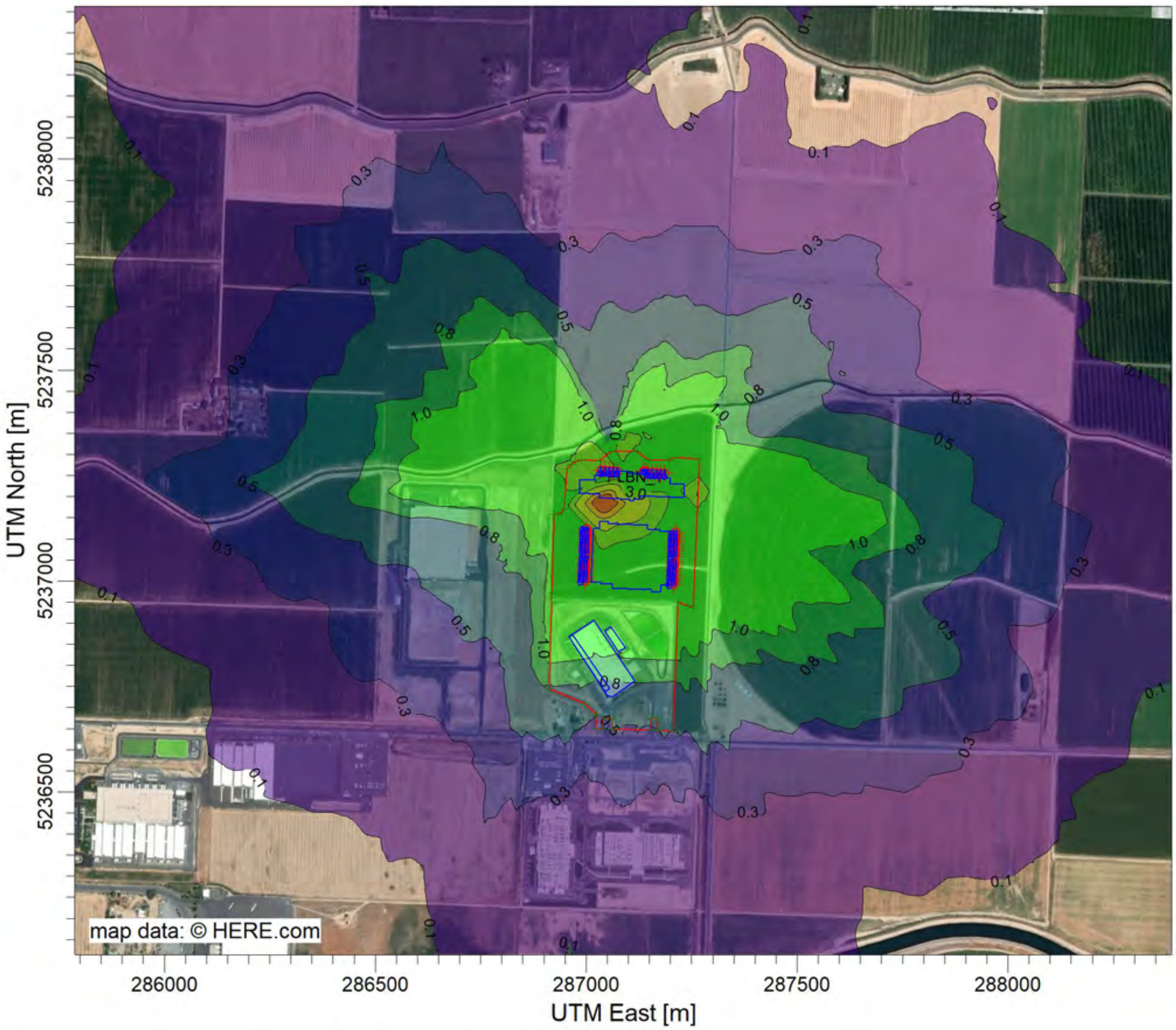

PLOT FILE OF HIGH 5TH HIGH 24-HR VALUES FOR SOURCE GROUP: WA12G04

ug/m^3

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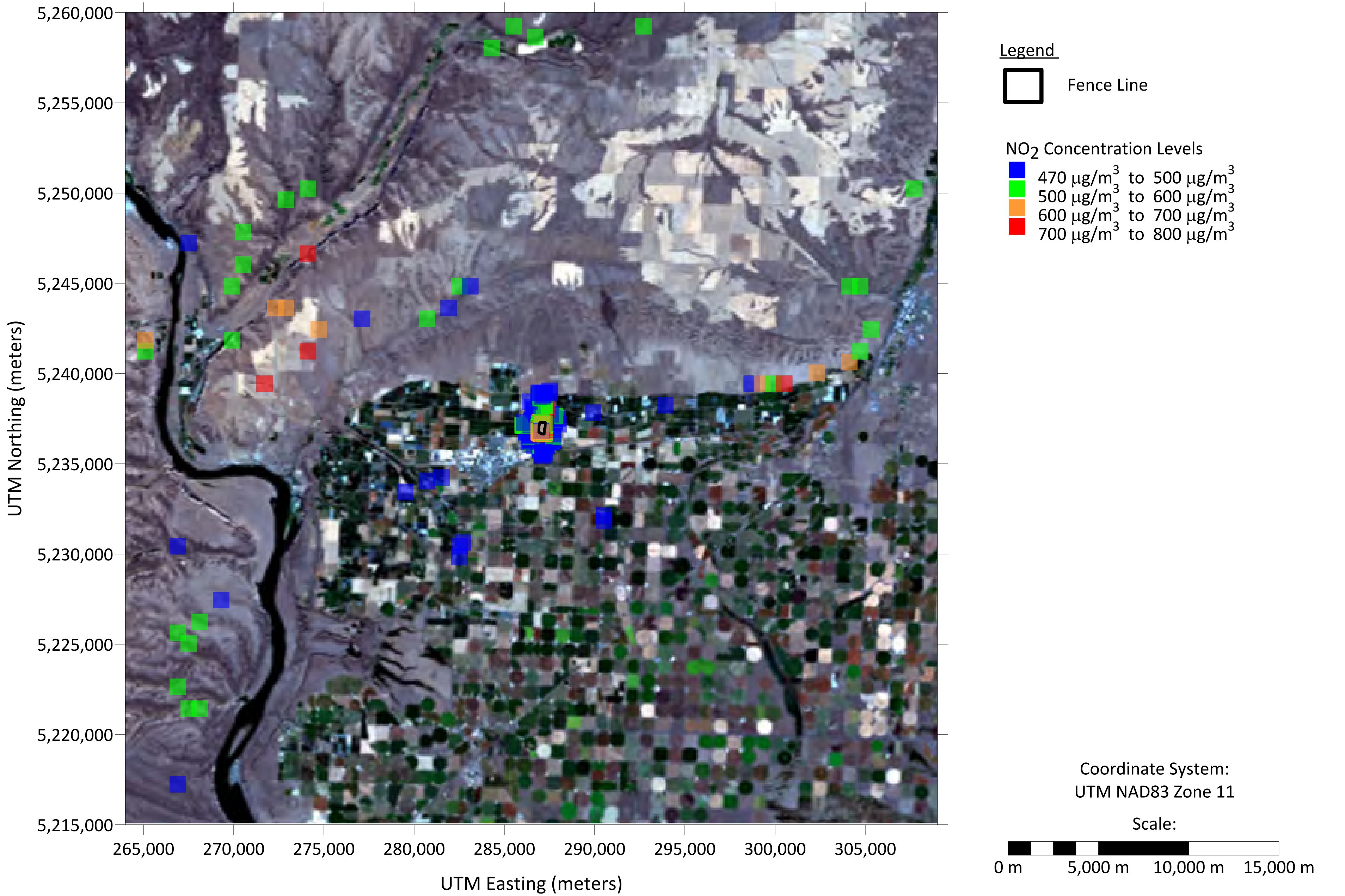

Data Sources: Esri World Imagery; AERMOD model NO2_1hr_ASIL

Landau Associates

Vantage Data Centers
Quincy, Washington

Project-Only NO_2 Impacts

Figure
D-5

APPENDIX E

Electronic Files Archive

(on DVD)