TECHNICAL SUPPORT DOCUMENT
NOTICE OF CONSTRUCTION APPROVAL ORDER NO. 11AQ-E4XX
SABEY INTERGATE QUINCY, LLC
INTERGATE-QUINCY DATA CENTER
JUNE 24, 2011

1. BACKGROUND

Starting in 2006, internet technology companies became interested in the City of Quincy in Grant County as a good place to build data centers. Data centers house the servers that provide e-mail, manage instant messages, and run applications for our computers. Grant County has a low-cost, dependable power supply and an area wide fiber optic system. During 2007 and 2008, the Ecology Air Quality Program (AQP) issued approval orders to Microsoft Corporation, Sabey Intergate Inc., and Intuit Inc. that allowed them to construct and operate data centers.

In 2010, the Washington State Legislature approved a temporary sales tax exemption for data centers building in Grant County and other rural areas. To qualify for the tax exemption, the data center must have at least 20,000 square feet dedicated to servers and start construction before July 1, 2011. The AQP has received permit applications from Microsoft Corporation and Sabey Intergate Inc. for expansion of their existing data centers in Quincy. Dell Marketing, LP and Sabey Intergate Quincy, LLC have also submitted applications for new data ceneters in Quincy.

To build or expand, a data center company must first apply to the Washington Department of Ecology (Ecology) for a permit called a "notice of construction approval order" (NOC). Its purpose is to protect air quality. The NOC is needed because data centers use large, diesel-powered backup generators to supply electricity to the servers during power failures. Diesel engine exhaust contains both criteria and toxic air pollutants. As part of the permit review process, Ecology carefully evaluates whether the diesel exhaust from a data center's backup generators cause health problems.

2. EXECUTIVE SUMMARY

Sabey Intergate Quincy, LLC submitted a Notice of Construction (NOC) application on January 4, 2011, for the installation of the Intergate-Quincy Data Center at the junction of Road 11 NW and Road C NW, Quincy, in Grant County. The Intergate-Quincy Data Center will be leased to up to eight (8) independent tenants. The primary air contaminant sources at the facility consist of forty-four (44) electric generators powered by diesel engines. The generators have a power capacity of up to 88 MWe, and will provide emergency backup power to the facility during infrequent disruption of Grant County PUD electrical power service. The project will be phased in over several years depending on customer demand.

Review of the January 4, 2011 NOC application began on January 5, 2011, and a completeness determination was issued on January 24, 2011 by the permit team (Flibbert, Ogulei) under the supervision of the Science and Engineering Section Manager (Johnston) and the Eastern Regional Office Section Manager (Wood). A revised NOC application was submitted by Sabey Intergate on February 23 and March 29, 2011. The NOC application was considered complete as of May 4, 2011. The final draft Preliminary Determination (i.e., Proposed Decision) was submitted to HQ on May 5, 2011, for review and to facilitate completion of the second tier review. The Preliminary Determination was issued on June 24, 2011, and public review began on approximately June 28, 2011.

3. PROJECT DESCRIPTION

The Ecology Air Quality Program (AQP) received a Notice of Construction (NOC) application for the Intergate-Quincy Data Center on January 4, 2011. The Intergate-Quincy Data Center, hereafter referred to as Intergate-Quincy, consists of phased construction of 3 buildings, i.e., Phase 1, Phase 2, and Phase 3. Phase 1 construction of 135,257 square feet Building C will commence during 2011, and includes twelve 2.0 Megawatts (MWe) electric generators powered by 2937 brake horse power Caterpillar 3516 engines. Phase 2 and 3 construction will be Buildings A and B with 186,660 ft^2 of space each, and each includes sixteen (16) 2.0 Megawatts (MWe) electric generators powered by 2937 brake horse power Caterpillar 3516 engines. The Intergate-Quincy generators will have a total capacity of approximately 88 MWe upon final build out of the three Phases. The Intergate-Quincy Data Center will be leased for occupancy by up to eight independent tenant companies that require fully supported data storage and processing space.

Sabey Intergate Quincy, LLC, hereafter referred to as Sabey Intergate or Sabey, has requested operational limitations on the Intergate-Quincy facility to reduce emissions below major source thresholds and to minimize air contaminant impacts to the community. Sabey Intergate has asked to restrict diesel fuel usage at Intergate-Quincy to 263,725 gallons of road specification diesel fuel. Engines operating restrictions to 57.5 hours per year that are commensurate with the diesel fuel limit have also been requested.

Air contaminant emissions from the Intergate-Quincy Data Center project have been calculated based entirely on operation of the emergency generators. Table 1a contains criteria pollutant potential to emit for the Intergate-Quincy Data Center expansion project. Table 1b contains toxic air pollutant potential to emit for the Intergate-Quincy Data Center expansion project.

Table 1a: Criteria Pollutant Potential to Emit for Intergate-Quincy Data Center

Pollutant	Emission Factor (EF) Reference	Emission Factors	Facility Emissions
Criteria Pollutant		g/kWm-hr	tons/yr
2.1.1 NOx Total			29.49
2.1.1a NOx <75% load	EPA Tier 2	6.12	na
2.1.1b NOx 75% load	Caterpillar	6.20	na
2.1.1c NOx 100% load	Caterpillar	8.68	na
2.1.2 CO	EPA Tier 2	3.50	14.15
2.1.3 SO_2	Mass Balance	na	0.028
2.1.4 $PM_{2.5}$/DEEP	EPA Tier 2	0.20	0.809
2.1.5 VOC	EPA Tier 2	0.282	1.14

Table 1b: Toxic Air Pollutant Potential to Emit for Intergate-Quincy Data Center

Pollutant	AP-42 Section 3.4 EF	Facility Emissions
Organic Toxic Air Pollutants	Lbs/MMbtu	tons/yr

2.1.6 Propylene	2.79E-03	4.2E-02
2.1.7 Acrolein	7.88E-06	1.42E-04
2.1.8 Benzene	7.76E-04	1.40E-02
2.1.9 Toluene	2.81E-04	5.08E-03
2.1.10 Xylenes	1.93E-04	3.49E-03
2.1.11 Napthalene	1.30E-04	1.96E-03
2.1.11 1,3 Butadiene	1.96E-05	3.53E-04
2.1.12 Formaldehyde	7.89E-05	1.43E-03
2.1.13 Acetaldehyde	2.52E-05	4.55E-04
Poly Aromatic Hydrocarbons (PAH)		
2.1.14 Benzo(a)Pyrene	1.29E-07	2.32E-06
2.1.15 Benzo(a)anthracene	6.22E-07	1.12E-05
2.1.16 Chrysene	1.53E-06	2.76E-05
2.1.17 Benzo(b)fluoranthene	1.11E-06	2.01E-05
2.1.18 Benzo(k)fluoranthene	1.09E-07	1.97E-06
2.1.19 Dibenz(a,h)anthracene	1.73E-07	3.13E-06
2.1.20 Ideno(1,2,3-cd)pyrene	2.07E-07	3.74E-06
2.1.21 PAH (no TEF)	3.88E-06	7.01E-05
2.1.22 PAH (apply TEF)	4.98E-07	9.00E-06
State Criteria Pollutant Air Toxics		
2.1.23 DEEP/$PM_{2.5}$	EPA Tier 2	0.809
2.1.24 Carbon monoxide	EPA Tier 2	14.15
2.1.25 Sulfur dioxide	EPA Tier 2	0.028
2.1.26 Primary NO_2*	10% total NOx	2.95

*Assumed to be equal to 10% of the total NOx emitted.

The Intergate-Quincy Data Center relies on cooling systems to dissipate heat from electronic equipment at the facility. Cooling system particulate matter emissions were calculated based on design and operating parameters for 176 Munters Model PV-W35-PVT. The emission rate contained in Tabel 2.0 has been overestimated by a factor of three times based on actual water usage calculations by the manufacturer.

Table 2.0: Cooling System Emission Estimates			
Pollutant	**Water supply conc. Mg/l**	**Maximum Recirc. water conc. Mg/l**	**Emission rate Lbs/year**
TDS as $PM_{2.5}$	Na	7500	4,635.5

4. APPLICABLE REQUIREMENTS

The proposed by Intergate-Quincy Data Center 2010 Expansion project qualifies as a new source of air contaminants as defined in Washington Administrative Code (WAC) 173-400-110 and WAC 173-460-040, and requires Ecology approval. The installation and operation of the Intergate-Quincy Data Center is regulated by the requirements specified in:

4.1 Chapter 70.94 Revised Code of Washington (RCW), Washington Clean Air Act,
4.2 Chapter 173-400 Washington Administrative Code (WAC), General Regulations for Air Pollution Sources,
4.3 Chapter 173-460 WAC, Controls for New Sources of Toxic Air Pollutants, and
4.4 Title 40 CFR Part 60 Subpart IIII

All state and federal laws, statutes, and regulations cited in this approval shall be the versions that are current on the date the final approval order is signed and issued.

5. BEST AVAILABLE CONTROL TECHNOLOGY

Best Available Control Technology (BACT) is defined[1] as "*an emission limitation based on the maximum degree of reduction for each air pollutant subject to regulation under chapter 70.94 RCW emitted from or which results from any new or modified stationary source, which the permitting authority, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for such source or modification through application of production processes and available methods, systems, and techniques, including fuel cleaning, clean fuels, or treatment or innovative fuel combustion techniques for control of each such pollutant. In no event shall application of the "best available control technology" result in emissions of any pollutants which will exceed the emissions allowed by any applicable standard under 40 CFR Part 60 and Part 61….*"

For this project, Ecology is implementing the "top-down" approach for determining BACT for the proposed diesel engines. The first step in this approach is to determine, for each proposed emission unit, the most stringent control available for a similar or identical emission unit. If that review can show that this level of control is not technically or economically feasible for the proposed source, then the next most stringent level of control is determined and similarly evaluated. This process continues until the BACT level under consideration cannot be eliminated by any substantial or unique technical, environmental, or economic objections.[2] The "top-down" approach shifts the burden of proof to the applicant to justify why the proposed source is unable to apply the best technology available. The BACT analysis must be conducted for each pollutant that is subject to new source review.

The proposed diesel engines will emit the following regulated pollutants which are subject to BACT review: nitrogen oxides (NOx), carbon monoxide (CO), volatile organic compounds (VOCs), particulate matter (PM, PM_{10} and $PM_{2.5}$) and sulfur dioxide.

5.1 BACT ANALYSIS FOR NOx

Sabey Intergate reviewed EPA's RACT/BACT/LAER Clearinghouse (RBLC) database to look for NOx add-on controls recently installed on internal combustion engines. The RBLC provides a listing of BACT determinations that have been proposed or issued for large facilities within the United States, Canada and Mexico. Sabey Intergate's review of the RBLC found that urea -based selective catalytic reduction (SCR) was the most stringent add-on control option demonstrated on diesel engines. The

[1] RCW 70.94.030(7) and WAC 173-400-030(12)
[2] J. Craig Potter, EPA Assistant Administrator for Air and Radiation memorandum to EPA Regional Administrators, "Improving New Source Review (NSR) Implementation", December 1, 1987.

application of the SCR technology for NOx control was therefore considered the top-case control technology and evaluated for technical feasibility and cost-effectiveness.

The most common BACT determination identified in the RBLC for NOx control was compliance with EPA Tier 2 standards using engine design, including exhaust gas recirculation (EGR) or fuel injection timing retard with turbochargers. Other NOx control options identified through a literature review include water injection and NOx adsorbers.

5.1.1 ***Selective Catalytic Reduction.*** The SCR system functions by injecting a liquid reducing agent, such as urea, through a catalyst into the exhaust stream of the diesel engine. The urea reacts with the exhaust stream converting nitrogen oxides into nitrogen and water. The use of a lean ultralow sulfur fuel is required to achieve good NOx destruction efficiencies. SCR can reduce NOx emissions by up to 90-95 percent while simultaneously reducing hydrocarbon (HC), CO and PM emissions.

For SCR systems to function effectively, exhaust temperatures must be high enough (about 200 to 500^{o}C) to enable catalyst activation. For this reason, SCR control efficiencies are expected to be relatively low during the first 20 to 30 minutes after engine start up, especially during maintenance, and testing loads. There are also complications of managing and controlling the excess ammonia (ammonia slip) from SCR use. Because backup engines typically experience long idle periods between operations, urea crystallization inside reagent distribution lines could cause damage to the SCR system and to the engine.

Sabey Intergate has evaluated the cost effectiveness of installing and operating SCR systems on each of the proposed diesel engines. The analysis indicates that the use of SCR systems would cost approximately $37,804 per ton of NOx removed from the exhaust stream based on worst-case power outage of eight (8) hours per year. A previous survey by Ecology found that the permitting agencies surveyed have required installation of NOx controls as BACT with expected operational costs ranging from $143 to $9,473 per ton of NOx removed. Ecology concludes that while SCR is a demonstrated emission control technology for prime diesel engines, it is not economically feasible for this project. Therefore, Ecology rejects this NOx control option as BACT.

5.1.2 ***NOx adsorbers.*** The use of NOx adsorbers (sometimes called lean NOx traps) is a catalytic method being developed and tested by diesel engine manufacturers to reduce NOx emissions, primarily from mobile sources. The NOx adsorber contains a catalyst (e.g., zeolite or platinum) that is used to “trap” NOx (NO and NO_2) molecules found in the exhaust. NOx adsorbers can achieve NOx reductions greater than 90% at typical steady-state exhaust gas temperatures.

However, as of this writing, NOx adsorbers are experimental technology and are, therefore, very expensive. Additionally, a literature search did not reveal any indication that this technology is commercially available for stationary backup generators. Thus, Ecology rejects NOx adsorbers as BACT for the proposed diesel engines.

5.1.3 ***Combustion Controls and Tier 2 compliance.*** Diesel engine manufacturers typically use proprietary combustion control methods to achieve the emission reductions needed to meet applicable EPA tier standards. Common controls include fuel injection timing retard and exhaust gas recirculation. Injection timing retard reduces the peak flame temperature and NOx emissions, but may lead to higher fuel consumption. Sabey Intergate will install 2937 hp Caterpillar Model 3516 engines that will use a combination of combustion control methods, including fuel injection timing retard, to comply with EPA Tier-2 emission limits.

5.1.4 *Two-Stage Oxidation Catalysts for NOx Reduction*

Ecology has learned that 2-stage oxidation catalysts ("3-way" catalysts) can be designed to reduce NOx emissions from emergency generators. Such a system has been proposed by R S Titan Lotus, LLC for the Titan Data Center expansion in Moses Lake, Washington. The system proposed by R S Titan Lotus, LLC and proposed for approval by Ecology is specially designed to remove 35% or more of NOx emissions, as well as considerable quantities of diesel particulate, CO and VOC emissions. The system reviewed by Ecology is a single-pass system that can be installed without retrofitting closed-loop systems such as Exhaust Gas Recirculation. Each catalyst system uses a stainless steel honeycomb mesh catalyst element coated with three catalysts: cerium washcoat; platinum (Pt) and rhodium (Rh) catalyst coatings.

The 2-stage oxidation catalysts first oxidize CO and VOC while removing oxygen from the gas stream, then the remaining rich-burn environment reacts with the Rh catalyst to chemically convert the NO and NO_2 in the exhaust stream to nitrogen. The system achieves the required low-oxygen environment by using a specialized catalyst coating and cell structure to remove oxygen molecules from the diesel exhaust stream. Exhaust temperature must be at least 250^{o}C and not exceed 750^{o}C for the system to be effective.

Although 2-stage oxidation catalyst systems appear to have been commercially deployed for standby diesel engine applications in Europe, Australia and Canada, Ecology is unaware of specific applications within the United Sates. The Titan Data Center (Moses Lake, Washington) has proposed to use two 35" diameter x 3.5" thick 3-way catalysts within one stainless steel housing for their planned expansion. The manufacturer of that catalyst system (Clean Emissions Products, Inc.) will guarantee a NOx reduction of not less than 35% although their website and a company salesman both claim that their 2-stage catalysts are capable of reducing up to 99% of CO, 70% of NOx and 90% of diesel particulate.[3] The catalysts proposed by the Titan Data Center are also expected to reduce at least 90% of VOC. Actual test data have reported about 43% NOx reduction and about 88% diesel particulate reduction.

Ecology evaluated the cost effectiveness of installing and operating specially-designed 2-stage oxidation catalyst systems (3-way catalysts) for NOx reduction from Sabey's proposed engines. Based on information supplied by one manufacturer, Ecology estimates that the use of these catalysts would cost Sabey more than $12,400 for each ton of NOx removed from the exhaust stream, based on a worst-case power outage scenario of eight (8) hours per year.

As stated above, a previous survey by Ecology found that the surveyed permitting agencies had required installation of NOx controls as BACT with expected operational costs ranging from $143 to $9,473 per ton of NOx removed. In general, Ecology considers operating costs for NOx control equipment that exceed $10,000 per ton of NOx removed to be cost-prohibitive under BACT. This presumption can be defeated if the applicant proposes to install a specific emissions control technology regardless of the associated costs. Ecology concludes that while

[3] http://www.cleanemissions.com/pdf/TwoStageCatalyst.pdf

specially designed 2-stage oxidation catalysts are promising and potentially effective for NOx control, they are not cost effective under general BACT guidelines. Since Sabey does not propose the use of 2-stage (3-way) catalysts to control NOx emissions, Ecology cannot force Sabey to install 2-stage catalysts as BACT.

5.1.5 ***Other control options***. Other NOx control options, such as water injection, were rejected because there was no indication that they are commercially available and/or effective in new large diesel engines.

5.1.6 **BACT determination for NOx**
Ecology determines that BACT for NOx is:

a. Use of good combustion practices;
b. Use of an engine design that incorporates fuel injection timing retard, turbocharger and a low-temperature aftercooler;
c. Use of EPA Tier 2 certified engines if the engines are installed and operated as emergency engines, as defined at 40 CFR§60.4219; or applicable emission standards found in 40 CFR Part 89.112 Table 1 and 40 CFR Part 1039.102 Tables 6 and 7 if Model Year 2011 or later engines are installed and operated as non-emergency engines; and
d. Compliance with the operation and maintenance restrictions of 40 CFR Part 60, Subpart IIII.

5.2 BACT ANALYSIS FOR PARTICULATE MATTER, CARBON MONOXIDE AND VOLATILE ORGANIC COMPOUNDS

Sabey Intergate reviewed the available published literature and the RBLC and identified the following demonstrated technologies for the control of diesel engine exhaust particulate, carbon monoxide and volatile organic compounds from the proposed diesel engines:

5.2.1 ***Diesel particulate filters (DPFs)***. These add-on devices include passive and active DPFs, depending on the method used to clean the filters (i.e., regeneration). Passive filters rely on a catalyst while active filters typically use continuous heating with a fuel burner to clean the filters. The use of DPFs to control diesel engine exhaust particulate emissions has been demonstrated in multiple engine installations worldwide. Particulate matter reductions of up to 85% or more have been reported. Therefore, this technology was identified as the top case control option for diesel engine exhaust particulate emissions from the proposed engines.

Sabey Intergate has evaluated the cost effectiveness of installing and operating DPFs on each of the proposed diesel engines. The analysis indicates that the use of DPFs would cost approximately $1,214,805 per ton of engine exhaust particulate removed from the exhaust stream, assuming eight (8) hours of power outage per year. A previous survey by Ecology found that none of the permitting agencies surveyed had required installation of a particulate matter control device (as BACT) that was expected to cost more than $23,200 per ton of particulate removed.

Since the estimated DPF cost effectiveness value for the proposed Sabey Intergate project far exceeds the $23,200 per ton upper limit, Ecology concludes that the use of DPFs is not economically feasible for this project. Therefore, Ecology rejects this control option as BACT for particulate matter.

5.2.2 ***Diesel oxidation catalysts***. This method utilizes metal catalysts to oxidize carbon monoxide, particulate matter, and hydrocarbons in the diesel exhaust. Diesel oxidation catalysts (DOCs) are commercially available and reliable for controlling particulate matter, carbon monoxide and hydrocarbon emissions from diesel engines. While the primary pollutant controlled by DOCs is carbon monoxide (approximately 90% reduction), DOCs have also been demonstrated to reduce up to 30% of diesel engine exhaust particulate emissions, and more than 50% of hydrocarbon emissions.

Sabey Intergate has evaluated the cost effectiveness of installing and operating DOCs on each of the proposed diesel engines. The cost effectiveness of DOC use has not been evaluated using the total amount of particulate matter reduced since control efficiency is only 5% to 10%. The DOC cost effectiveness value for carbon monoxide and volatile organic compounds destruction is approximately $9,736 per ton and $133,078 per ton, respectively.

Diesel Oxidation Catalyst technology is commercially available. A previous survey by Ecology found that the permitting agencies surveyed have required installation of carbon monoxide controls as BACT on other types of emission units, with expected operational costs ranging from $300 to $9,795 per ton of carbon monoxide removed. The upper level of that range is suspect and it is possible that that number actually reflects California BACT which is typically equivalent to a Lowest Achievable Emissions Rate (LAER) limit. In Washington, costs for controlling CO from combined cycle natural gas electric generating facilities are usually in the $3,500 to $5,000 range. The cost effectiveness estimates calculated for the Sabey Intergate project are outside this range when all pollutants to be controlled are considered, or if only carbon monoxide is considered.

5.2.3 ***Two-Stage Oxidation Catalysts***

The theory and design of 2-stage diesel oxidation catalysts (i.e., diesel oxidation catalysts operating in a 3-way catalyst mode) was described in Section 5.1.4. As stated above, one manufacturer of one such commercially-available system claims their systems are capable of reducing up to 99% of CO, 70% of NOx, 90% of VOC, and 90% of diesel particulate.

Ecology has evaluated the cost effectiveness of installing and operating specially-designed 2-stage oxidation catalyst systems (3-way catalysts) for NOx reduction from Sabey's proposed engines. Based on information supplied by one manufacturer, and assuming a worst-case power outage scenario of eight (8) hours per year, Ecology estimates that the use of these catalysts would cost Sabey **more than**:

- $351,500 for each ton of PM removed from the exhaust stream;
- $18,269 for each ton of CO removed from the exhaust stream; and
- $249,440 for each ton of VOC removed from the exhaust stream.

Ecology considers the above annual control cost estimates to be prohibitive under BACT guidelines. Ecology concludes that while specially designed 2-stage oxidation catalysts are promising and potentially effective for CO, PM and VOC control, they are not cost effective under general BACT guidelines. Since Sabey does not propose the use of 2-stage (3-way) catalysts to control CO, PM or VOC emissions, Ecology cannot force Sabey to install 2-stage catalysts as BACT.

5.2.4 **BACT Determination for Particulate Matter, Carbon Monoxide and Volatile Organic Compounds**
Ecology determines BACT for particulate matter, carbon monoxide and volatile organic compounds is:

a. Use of good combustion practices;
b. Use of EPA Tier 2 certified engines if the engines are installed and operated as emergency engines, as defined at 40 CFR§60.4219; or applicable emission standards found in 40 CFR Part 89.112 Table 1 and 40 CFR Part 1039.102 Tables 6 and 7 if Model Year 2011 or later engines are installed and operated as non-emergency engines; and
c. Compliance with the operation and maintenance restrictions of 40 CFR Part 60, Subpart IIII.

5.3 BACT ANALYSIS FOR SULFUR DIOXIDE

5.3.1 Ecology and Sabey Intergate did not find any add-on control options commercially available and feasible for controlling sulfur dioxide emissions from diesel engines. Sabey Intergate's proposed BACT for sulfur dioxide is the use of ultra-low sulfur diesel fuel (15 ppm by weight of sulfur). Using this control measure, sulfur dioxide emissions would be limited to 0.028 tons per year.

5.3.2 **BACT Determination for Sulfur Dioxide**
Ecology determines that BACT for sulfur dioxide is the use of ultra-low sulfur diesel fuel containing no more than 15 parts per million by weight of sulfur.

5.4 BEST AVAILABLE CONTROL TECHNOLOGY FOR TOXICS

Best Available Control Technology for Toxics (tBACT) means BACT, as applied to toxic air pollutants.[4] The procedure for determining tBACT follows the same procedure used above for determining BACT. Under state rules, tBACT is required for all toxic air pollutants for which the increase in emissions will exceed de minimis emission values as found in WAC 173-460-150.

For the proposed project, tBACT must be determined for each of the toxic air pollutants listed in Table 1 below. As illustrated by Table 2, Ecology has determined that compliance with BACT, as determined above, satisfies the tBACT requirement.

Table 2. tBACT Determination

Toxic Air Pollutant	tBACT
Acetaldehyde	Compliance with the VOC BACT requirement
Acrolein	Compliance with the VOC BACT requirement
Benzene	Compliance with the VOC BACT requirement

[4] WAC 173-460-020

Benzo(a)pyrene	Compliance with the VOC BACT requirement
1,3-Butadiene	Compliance with the VOC BACT requirement
Carbon monoxide	Compliance with the CO BACT requirement
Diesel engine exhaust particulate	Compliance with the PM BACT requirement
Formaldehyde	Compliance with the VOC BACT requirement
Nitrogen dioxide	Compliance with the NOx BACT requirement
Sulfur dioxide	Compliance with the SO_2 BACT requirement
Toluene	Compliance with the VOC BACT requirement
Total PAHs	Compliance with the VOC BACT requirement
Xylenes	Compliance with the VOC BACT requirement

6. AMBIENT IMPACTS ANALYSIS

ICF conducted air dispersion modeling for Sabey Data Center's generators to demonstrate compliance with ambient air quality standards and acceptable source impact levels. The generators were modeled as multiple discharge points. ICF used AERMOD (Version 09292), with EPA's PRIME algorithm for building downwash, to determine worst-case ambient air quality impacts caused by emissions from the proposed generators at the property line and beyond, and at the rooftop of the commonly occupied data center building. The ambient impacts analysis indicates that no ambient air quality standard is expected to be exceeded.

6.1 Ambient Air Quality Compliance Boundary

Multiple information technology tenants will lease space in the Sabey Data Center, and each tenant will use one or more of the backup generators that are the subject of this permit application. Intake air for the entire building is taken from the air handling units on the building rooftop.

Ecology directed ICF to assume that for purposes of AERMOD modeling, the air quality compliance boundary consists of:

- All locations beyond the facility boundary, regardless of whether they are occupied.
- The rooftops of the onsite data center buildings, which are occupied by multiple tenants. All ventilation air fed to the data center buildings is taken from the air handling systems at the rooftop. Therefore, the rooftop represents the source of public air that is used by all tenants inside each building. An AERMOD receptor was placed on each rooftop. Sabey placed 8 receptors on the restricted-access rooftops of the buildings within the facility boundary, with one receptor placed on the rooftop at the center of each tenant's space where pollutants could be drawn into the indoor work spaces by rooftop ventilation systems.

Ecology did not require a demonstration of compliance with ambient air quality standards at outdoor common areas located within the facility boundary because:

- The parking areas and other outdoor areas inside the property boundary will not be exclusively leased to any individual tenant. The entire outdoor common areas will be shared by all tenants.
- Tenants will be free to use any outdoor parking space within the property. There will not be posted signs or other barriers that restrict tenant parking to specific areas or that forbid specific

tenants from certain outdoor areas within the property. Therefore, each tenant will jointly utilize the common areas.

- Sabey will maintain a physical fence around the entire property. The fence will restrict general public access to the outdoor areas.
- Each of the tenants will undertake their own separate actions in collaboration with Sabey to ensure that public access is restricted in the outdoor areas. These individual actions may be in the form of specific provisions in the lease agreement that preclude general public access and require a physical barrier to be maintained around the Sabey property.

6.2 AERMOD Dispersion Modeling Methodology

The AERMOD model employed the following data and assumptions[5]:

a) Five years of sequential hourly meteorological data (2004-2008) from Moses Lake were used.

b) Twice-daily upper air data from Spokane were used to define mixing heights.

c) Digital topographical data (in the form of Digital Elevation Model files) for the vicinity were obtained from the Micropath Corporation. 2001 National Land Cover (NLCD2001) land use data.

d) The data center building was included to account for building downwash.

e) The Cartesian receptor grid spacing used for the AERMOD modeling was as follows:

- 12.5-meter spacing out to 150 meters beyond the property line
- 25-meter spacing out to 500 meters
- 50-meter spacing out to 900 meters
- 100-meter spacing out to beyond the Celite facility.

In addition, 8 discrete receptors were placed inside the Sabey fenceline. These discrete onsite receptors were placed on the center of each tenant's rooftop at the air intake systems for each tenant's ventilation systems.

f) One-hour NO_2 concentrations were modeled using the Plume Volume Molar Ratio Method (PVMRM) module, with default ozone concentrations of 40 parts per billion (ppb), and an equilibrium NO_2/NO_X ambient ratio of 90 percent. For purposes of modeling NO_2 impacts, the primary NO_X emissions were assumed to be 10% NO_2 and 90% nitric oxide (NO) by mass.

g) Compliance with the 1-hour NO_2 and 24-hour $PM_{2.5}$ NAAQS was demonstrated as shown in the following sections. For purposes of demonstrating compliance with the 24 hour NAAQS and the 24 hour ASILs, Sabey assumed the forecast 8 hours/year of power outages would occur on a single day. To estimate annual average concentrations (for DEEP and

[5] See NOC application and second tier petition support documents.

other pollutants with annual averages), AERMOD/PVMRM was run using 44 different generator stacks each with its assigned engine size, engine load, stack diameter, stack height, stack temperature, stack velocity, and maximum annualized emission rates. The generators were assumed to operate continuously at their assigned load for 24 hours, 7 days per week, 365 days per year for each of the five years. AERMOD then specified the 1st-highest annual impact location and magnitude. The maximum impact per year and the number of hours for which the ASIL was exceeded during the five-year simulation period were recorded.

h) The 1st-highest 1-hour NO_2 concentrations during a full power outage were modeled to assess compliance with the ASIL. Because a power outage could occur at any time on any day, all 44 new generators were modeled at their assigned loads continuously, for 24 hours per day and 365 days per year for the five years of meteorology used in the analysis. The AERMOD/PVMRM was set to indicate the 1st-highest 1-hour value for each separate modeling year.

i) Scheduled testing was assumed to take place between 7:00 a.m. to 7:00 p.m. Sabey assumed unplanned outages could occur anytime during the day or night.

6.3 Compliance With the 1-Hour NO_2 National Ambient Air Quality Standard (NAAQS)

In 2010, EPA established a new 1-hour NAAQS for NO_2, set at 100 parts per billion (ppb) or approximately 188 $\mu g/m^3$. The new 1-hour standard is intended to protect against short-term exposure to high NO_2 concentrations, particularly near major roadways. The new NO_2 standard establishes a new 1-hour averaging period for the NO_2 NAAQS. To comply with the 1-hour NO_2 NAAQS, the three-year average of the 98th percentile of the annual distribution of daily maximum 1-hour average concentrations at the ambient air receptor must be less than 100 ppb. The 1-hour NAAQS is designed to protect against health effects associated with short-term exposures to NO_2, which are generally highest on and near major roads.

Sabey assumed the facility would experience 8 hours per year of unplanned power outages, and for estimating worst-case annual emissions, Sabey assumed each tenant would conduct their occasional electrical bypass maintenance in the same worst-case year. For purposes of demonstrating compliance with the 24 hour NAAQS and the 24 hour ASILs, Sabey further assumed the forecast 8 hours/year of power outages would occur on a single day. However, for purposes of the statistical “Monte Carlo” analysis used to demonstrate compliance with the 1-hour NO_2 NAAQS it was assumed there would be power outages lasting at least one hour on 4 days per year.

The NAAQS limits for 24-hour $PM_{2.5}$ and 1-hour NO_2 are both based on the 3-year average of the 98th percentile highest daily impact. This is equivalent to the eighth-highest operating day during each year. It is unlikely that the Moses Lake area would experience 8 major power failures in any given year. Therefore, for purposes of evaluating 24-hour average $PM_{2.5}$ impacts it was assumed the seventh (and eighth)-highest operating days in any year would consist of the routine monthly engine testing, which consists of each generator running one at a time on the same day for short duration at low load (1.5 hours at 50% load).

To demonstrate compliance with the 1-hour NO_2 NAAQs, a"Monte Carlo" statistical analysis was used to estimate the likelihood of an exceedance of the ambient 1-hour NO_2 NAAQS.

6.3.1. Emissions and Operating Scenarios

Table 3 lists the diesel generator runtimes for each operating mode within each building. Table 4 lists the forecast facility-wide emission rates for the criteria pollutants. As a worst case assumption, Sabey modeled emissions from the fully developed facility, and the initial startup emissions from one of the largest tenant spaces (Tenant B-1, which will use 8 generators) were added to the routine operational emissions and were modeled for all 5 years of meteorological data. Table 5 summarizes the generator operations associated with the typical startup and commissioning testing for one generator. Table 6 shows the hierarchy of maximum 1-hour NOx emissions for each category of generator runtime at each tenant for the fully develop data center. The orange-highlighted rows of Table 6 indicate the one-time only emissions from initial startup testing of one tenant (Tenant B-1).

The load-specific NOx emission factors used to determine NOx emission rates for each of the 15 AERMOD runs were set for each load to either the vendor-guaranteed rates provided by Caterpillar or to the EPA Tier-2 standard, whichever is higher. Thus, the NOx emission rates used for this analysis are conservatively high.

6.3.2. Off-Site Background Industrial Sources

The following local background sources were modeled. Emissions data for each facility are described in the bottom rows of Table 5.

- Yahoo! Data Center. The facility was assumed to experience four days of power outage each year, lasting at least one hour each. It was assumed 19 of the facility's 23 generators would run during an outage. The facility conducts annual testing on 15 days per year, when 1 generator at a time is run at 100% load. The facility also conducts monthly testing when one generator at a time is run at idle load, but the inconsequential emissions from monthly testing were not modeled.

- Intuit Data Center. Sabey assumed Intuit operates the same as Yahoo!. The facility was assumed to experience four days of power outage each year, lasting at least one hour each. It was assumed the facility conducts annual testing for an assumed 15 days per year, when 1 generator at a time is run at 100% load. It was assumed the facility also conducts monthly testing when one generator at a time is run at idle load, but the inconsequential emissions from monthly testing were not modeled.

- Celite. The continuous NOx emissions from this facility were set at Celite's annual permit limit (38 tons/year).

In addition, the regional background value of 29 $\mu g/m^3$, which was generated by Ecology, was added to estimate the total cumulative NO_2 concentration.

Table 3. Summary of Diesel Generator Operating Modes

Generator		Generator Size	Power Outages (Still 8 hrs)		Monthly Tests (Previously 1 hr/test)			Annual Load Bank Tests (Previously 6 hrs per test)		Corrective Tests (Previously 10 hrs)		Main Switchgear & Transformer Tests (Previously 14 hrs)		Engine Runtime Hrs per Year Per Gen (Previously 47 hrs)
Gen #	Gen Area	kWe	% load	hrs/yr	% load	hrs/test	tests/yr	% load	hrs/yr	% load	hrs/yr	% load	hrs/yr	
A01	Bldg A	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
A02	Bldg A	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
A03	Bldg A	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
A04	Bldg A	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
A05	Bldg A	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
A06	Bldg A	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
A07	Bldg A	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
A08	Bldg A	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
A09	Bldg A	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
A10	Bldg A	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
A11	Bldg A	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
A12	Bldg A	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
A13	Bldg A	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
A14	Bldg A	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
A15	Bldg A	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
A16	Bldg A	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
B01	Bldg B	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
B02	Bldg B	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
B03	Bldg B	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
B04	Bldg B	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
B05	Bldg B	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
B06	Bldg B	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
B07	Bldg B	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
B08	Bldg B	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
B09	Bldg B	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
B10	Bldg B	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
B11	Bldg B	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
B12	Bldg B	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
B13	Bldg B	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
B14	Bldg B	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
B15	Bldg B	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
B16	Bldg B	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
C01	Bldg C	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
C02	Bldg C	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
C03	Bldg C	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
C04	Bldg C	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
C05	Bldg C	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
C06	Bldg C	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
C07	Bldg C	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
C08	Bldg C	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
C09	Bldg C	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
C10	Bldg C	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
C11	Bldg C	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5
C12	Bldg C	2000	75%	8	50%	1.5	11	100%	6	50%	12	75%	15	57.5

Table 4. Summary of Facility-Wide Emission Rates for Full Buildout Scenario

Pollutant	Monthly Testing (ton/yr)	Load Bank Testing (ton/yr)	Unplanned Outage (8 hrs/yr) (ton/yr)	Main Switch and Transformer Testing (ton/yr)	Corrective Testing (ton/yr)	Total Emissions (ton/yr)
NOX	5.6	5.5	4.0	10.4	4.04	29.5
PM2.5 (Worst single year)	0.18	0.13	0.13	0.24	0.13	0.809
CO	3.2	2.2	2.2	4.2	2.31	14.2
VOC	0.3	0.2	0.2	0.3	0.19	1.1
SO2	0.0	0.0	0.0	0.0	0.00	0.0
Primary Nitrogen Dioxide (NO2)	0.6	0.6	0.4	1.0	0.40	2.9

Table 5. Runtime Scenario for Initial Startup and Commissioning Tests

Day of Test	Test Description	No. of Typical Hours	Average Load
Manufacturer Tests			
Day 1	4 hours at full load, 1 generator any given day	4	100%
Day 2	6 hours at idle, 1 generator any given day	6	Idle
Functional Performance Tests			
Day 3	8 hours, step through multiple loads (10% through 100%), 1 generator any given day	8	50%
Integrated Systems Tests			
Day 4	8 hours, step through multiple loads (10% through 100%), 1 generator any given day	8	50%
Day 5	All generators at the same time, 75% load, 4 hours	4	75%
Summary of Per-Engine Startup Quantities			
Calendar Days of Testing (Each Generator)			5
Runtime Hours Each Generator			30
kWm-hrs During Testing (Each Generator)			35,354
Fuel Usage During Testing (Each Generator)			2,309
NOx Emissions Each Generator			477 lbs
DPM Emissions During Testing (Each Generator)			15.6 lbs

Table 6. Hierarchy of Generator Runtime Modes

					Max 1-Hour NOx Emissions		
Tenant	No. of Gens	Runtime Regime	Combined Days/yr	% Load	No. Gens	E.F.	Nox lbs/hour
All	44	Full Power Outage, 75% Load	8	75%	44	6.2	991
Bldg A	16	Bldg A Main Switchgear	1	75%	16	6.2	361
Bldg B	16	Bldg B Main Switchgear	1	75%	16	6.2	361
Bldg C	12	Bldg C Main Switchgear	1	75%	12	6.2	270
B-1	8	Startup: Int. Sys Test Day 2	1	75%	8	6.2	180
B-2	4	Startup: Int. Sys Test Day 2	1	75%	4	6.2	90.1
B-3	4	Startup: Int. Sys Test Day 2	1	75%	4	6.2	90.1
C-1	3	Transf. Maint., 75%	1	75%	2	6.2	45.1
C-2	3	Transf. Maint., 75%	1	75%	2	6.2	45.1
C-3	6	Transf. Maint., 75%	2	75%	2	6.2	45.1
A-1	8	Transf. Maint., 75%	2	75%	2	6.2	45.1
A-2	8	Transf. Maint., 75%	2	75%	2	6.2	45.1
B-1	8	Transf. Maint., 75%	2	75%	2	6.2	45.1
B-2	4	Transf. Maint., 75%	1	75%	2	6.2	45.1
B-3	4	Transf. Maint., 75%	1	75%	2	6.2	45.1
C-1	3	Annual Test, 100% load	3	100%	1	8.68	41.9
C-2	3	Annual Test, 100% load	3	100%	1	8.68	41.9
C-3	6	Annual Test, 100% load	6	100%	1	8.68	41.9
A-1	8	Annual Test, 100% load	8	100%	1	8.68	41.9
A-2	8	Annual Test, 100% load	8	100%	1	8.68	41.9
B-1	8	Annual Test, 100% load	8	100%	1	8.68	41.9
B-2	4	Annual Test, 100% load	4	100%	1	8.68	41.9
B-3	4	Annual Test, 100% load	4	100%	1	8.68	41.9
B-1	8	Startup: Mfr Testing Day 1	8	100%	1	8.68	41.9
B-1	8	Startup: Funct. Perf Test	8	100%	1	8.68	41.9
B-2	4	Startup: Mfr Testing Day 1	4	100%	1	8.68	41.9
B-2	4	Startup: Funct. Perf Test	4	100%	1	8.68	41.9
B-3	4	Startup: Mfr Testing Day 1	4	100%	1	8.68	41.9
B-3	4	Startup: Funct. Perf Test	4	100%	1	8.68	41.9
C-1	3	Montly Test, 50% Load	11	50%	1	6.12	15.3
C-1	3	Corrective Testing, 50% load	3	50%	1	6.12	15.3
C-2	3	Montly Test, 50% Load	11	50%	1	6.12	15.3
C-2	3	Corrective Testing, 50% load	3	50%	1	6.12	15.3
C-3	6	Montly Test, 50% Load	11	50%	1	6.12	15.3
C-3	6	Corrective Testing, 50% load	6	50%	1	6.12	15.3
A-1	8	Montly Test, 50% Load	11	50%	1	6.12	15.3
A-1	8	Corrective Testing, 50% load	8	50%	1	6.12	15.3
A-2	8	Montly Test, 50% Load	11	50%	1	6.12	15.3
A-2	8	Corrective Testing, 50% load	8	50%	1	6.12	15.3
B-1	8	Montly Test, 50% Load	11	50%	1	6.12	15.3
B-1	8	Corrective Testing, 50% load	8	50%	1	6.12	15.3
B-2	4	Montly Test, 50% Load	11	50%	1	6.12	15.3
B-2	4	Corrective Testing, 50% load	4	50%	1	6.12	15.3
B-3	4	Montly Test, 50% Load	11	50%	1	6.12	15.3
B-3	4	Corrective Testing, 50% load	4	50%	1	6.12	15.3
B-1	8	Startup: Int. Sys Test Day 1	8	50%	1	6.12	15.3
B-2	4	Startup: Int. Sys Test Day 1	4	50%	1	6.12	15.3
B-3	4	Startup: Int. Sys Test Day 1	4	50%	1	6.12	15.3
B-1	8	Startup: Mfr Testing Day 2	8	10%	1	6.49	4.36
B-2	4	Startup: Mfr Testing Day 2	4	10%	1	6.49	4.36
B-3	4	Startup: Mfr Testing Day 2	4	10%	1	6.49	4.36

6.3.3. "Monte Carlo" Statistical Analysis For Demonstrating Compliance with the 1-Hour NO_2 NAAQS

The 1-hour NO_2 NAAQS is based on the 3-year rolling average of the 98th percentile of the daily maximum 1-hour NO_2 impacts. Data centers operate their generators on an intermittent basis under a wide range of engine loads, under a wide range of meteorological conditions. As such it is difficult to determine whether high-emitting generator runtime regimes coincide with meteorological conditions giving rise to poor dispersion, and trigger an exceedance of the 1-hour NO_2 NAAQS at any given location beyond the facility boundary. This issue was recently recognized by EPA when they stated that "[m]odeling of intermittent emission units, such as emergency generators, and/or intermittent emission scenarios, such as startup/shutdown operations, has proven to be one of the main challenges for permit applicants undertaking a demonstration of compliance with the 1-hour NO_2 NAAQS".[6]

To address this problem, Ecology developed a statistical re-sampling technique, that we loosely call the "Monte Carlo analysis". This technique performs a statistical analysis of the AERMOD-derived ambient NO_2 impacts caused by individual generator operating regimes, each of which exhibits its own NOx emission rates at various locations throughout the facility. The randomizing function of the Monte Carlo analysis allows inspection of how the combination of sporadic generator operations, sporadic generator emissions at various locations, and variable meteorology affect the modeled 98th-percentile concentrations at modeling receptors placed within the facility and outside the facility boundary.

The first step in the Monte Carlo NO_2 analysis was to use the AERMOD/PVMRM model for each representative generator runtime regime by each tenant at the Sabey facility. To do so, 14 different generator operating regimes proposed by Sabey were each modeled separately with AERMOD, using 5 years of meteorology (2004- 2008). For each of the 14 AERMOD runs, the number of calendar days per year of operation for that generator operating regime was established. To test the effect of initial startup and commissioning testing on ambient air quality, the NOx-emitting scenarios corresponding to the initial startup testing were included in the 2004 meteorological set. For all 5 years of modeling, it was assumed that all of the tenants conducted their scheduled maintenance each year. For each of the 5 modeling years, the existing emissions contributed by the existing Ask.com facility were included in the analysis. For each of the 5 modeling years, it was assumed there would be 4 random days on which power outages lasted at least 1 hour.

The Monte Carlo method then randomly selects the days on which the generators operated in each regime, combines the modeled concentrations on those days across all operating regimes and iterates the process 1000 times, so as to obtain a distribution of the possible concentrations at each receptor.

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[6] http://www.epa.gov/ttn/scram/Additional_Clarifications_AppendixW_Hourly-NO2-NAAQS_FINAL_03-01-2011.pdf

6.3.4. AERMOD Modeling of Individual Runtime Scenarios

In order to conduct the Monte Carlo analysis, the hierarchy of individual generator runtime events listed in Table 4 was clustered into 15 separate AERMOD runs, which are described in Table 7. The NOx emissions from the offsite background sources are also listed in Table 7. For each of the 15 independent AERMOD scenarios, the number of calendar days of generator runtime was established. The two yellow-highlighted rows on the right side of Table 7 show the number of calendar days per year of generator runtime for each AERMOD scenario.

6.3.5. NO_2 Compliance Results

The results of the Monte Carlo analysis are listed in Table 8. For each modeling year, the Monte Carlo analysis lists the 98^{th}-percentile daily 1-hour NO_2 concentration at the maximally impacted receptor. Compliance is demonstrated by the median value of the five modeling years. As listed in Table 8 the maximum impact at or beyond the Sabey property line (or on the tenant building rooftops) is only 111 $\mu g/m^3$. Figure 5 shows the location of that maximally impacted receptor, which is on the east property line in unpopulated industrially-zoned land roughly midway between the northeast and southeast property corners. As listed below, the impact at that maximum receptor is below the allowable NAAQS:

Impact from Sabey and Offsite-Sources:	111 $\mu g/m^3$
Regional Background:	29 $\mu g/m^3$
Total NO_2 Concentration	140 $\mu g/m^3$
Allowable NAAQS:	188 $\mu g/m^3$

Based on this analysis, it is concluded the intermittent NOx emissions from the Intergate-Quincy Data Center, combined with the emissions from other local sources and regional background, would not cause ambient impacts exceeding the allowable NAAQS limit at any point at or beyond the fenced facility boundary or on the tenant building rooftops within the facility.

Table 7. AERMOD Runs Used for Monte Carlo Analysis

Tenant	No. of Installed Gens	Runtime Regime	Monte Carlo Days/yr	Day of Regime	% Load	kWm	No. Running Gens	Hrs/Day	kWmhrs/ day	E.F.	Nox lbs/hour	Monte Carlo AERMOD Run	Monte Carlo Days/yr
All	44	Full Power Outage, 75% Load	4	1	75%	1650	44	1	72600	6.2	991	1	4
Bldg B	16	Bldg B Main Switchgear	1		75%	1650	16	1	26400	6.2	361	2	1
B-1	8	Startup: Int. Sys Test Day 2	1		75%	1650	8	1	13200	6.2	180	3	1
C-3	6	Transf. Maint., 75%	2	1	75%	1650	2	1	3300	6.2	45.1	4	2
A-1	8	Transf. Maint., 75%	2	1	75%	1650	2	1	3300	6.2	45.1	5	2
A-2	8	Transf. Maint., 75%	2	1	75%	1650	2	1	3300	6.2	45.1	6	2
B-2	4	Transf. Maint., 75%	2	1	75%	1650	2	1	3300	6.2	45.1	7	2
C-1	3	Annual Test, 100% load		1	100%	2191		1	2191	8.68			
C-2	3	Annual Test, 100% load		1	100%	2191		1	0	8.68			
C-3	6	Annual Test, 100% load	12	1	100%	2191	1	1	0	8.68	41.9	8	12
A-1	8	Annual Test, 100% load		1	100%	2191		1	2191	8.68			
A-2	8	Annual Test, 100% load	16	1	100%	2191	1	1	0	8.68	41.9	9	16
B-1	8	Annual Test, 100% load		1	100%	2191		1	2191	8.68			
B-2	4	Annual Test, 100% load		1	100%	2191		1	0	8.68			
B-3	4	Annual Test, 100% load		1	100%	2191		1	0	8.68			
B-1	4	Startup: Mfr Testing Day 1			100%	2191		1	0	8.68			
B-1	4	Startup: Funct. Perf Test	24		100%	1135	1	1	0	8.68	41.9	10	24
C-1	3	Montly Test, 50% Load		1	50%	1135		1	1135	6.12			
C-1	3	Corrective Testing, 50% load		1	50%	1135		1	0	6.12			
C-2	3	Montly Test, 50% Load		1	50%	1135		1	0	6.12			
C-2	3	Corrective Testing, 50% load		1	50%	1135		1	0	6.12			
C-3	6	Montly Test, 50% Load		1	50%	1135		1	0	6.12			
C-3	6	Corrective Testing, 50% load	45	1	50%	1135	1	1	0	6.12	15.3	11	45
A-1	8	Montly Test, 50% Load		1	50%	1135		1	1135	6.12			
A-1	8	Corrective Testing, 50% load		1	50%	1135		1	0	6.12			
A-2	8	Montly Test, 50% Load		1	50%	1135		1	0	6.12			
A-2	8	Corrective Testing, 50% load	38	1	50%	1135	1	1	0	6.12	15.3	12	38
B-1	8	Montly Test, 50% Load		1	50%	1135		1	1135	6.12			
B-1	8	Corrective Testing, 50% load		1	50%	1135		1	0	6.12			
B-2	4	Montly Test, 50% Load		1	50%	1135		1	0	6.12			
B-2	4	Corrective Testing, 50% load		1	50%	1135		1	0	6.12			
B-3	4	Montly Test, 50% Load		1	50%	1135		1	0	6.12			
B-3	4	Corrective Testing, 50% load		1	50%	1135		1	0	6.12			
B-1	4	Startup: Int. Sys Test Day 1	53		50%	1135	1	1	0	6.12	15.3	13	53
CELITE	1	Continuous Operation	365		--		--				8.6	14	365
Intuit	9	Outage			90%		7				200		
Yahoo	23	Outage	8		90%		19				544	1	4
Intuit	9	Annual tests			100%		1				32.0		
Yahoo	23	Annual tests	15		100%		1				32.0	15	15

Table 8. Monte Carlo NO_2 Results (Full Buildout Plus 1 Tenant Startup/Commissioning Each Year)

Receptor Location	**98th-Percentile Daily 1-Hour NO_2, ug/m3**					
	2004	**2005**	**2006**	**2007**	**2008**	**Median (2004-2008)**
Property Line and Beyond (Eastern property line)	114	111	108	108	111	111
Within Sabey Property (rooftop of Tenant A-2)	63	63	63	62	59	63

Note: Listed values do not include 29 μg/m^3 regional background. Target value (without background) for NAAQS compliance = 188 μg/m^3 – 29 μg/m^3 = 159 μg/m^3.

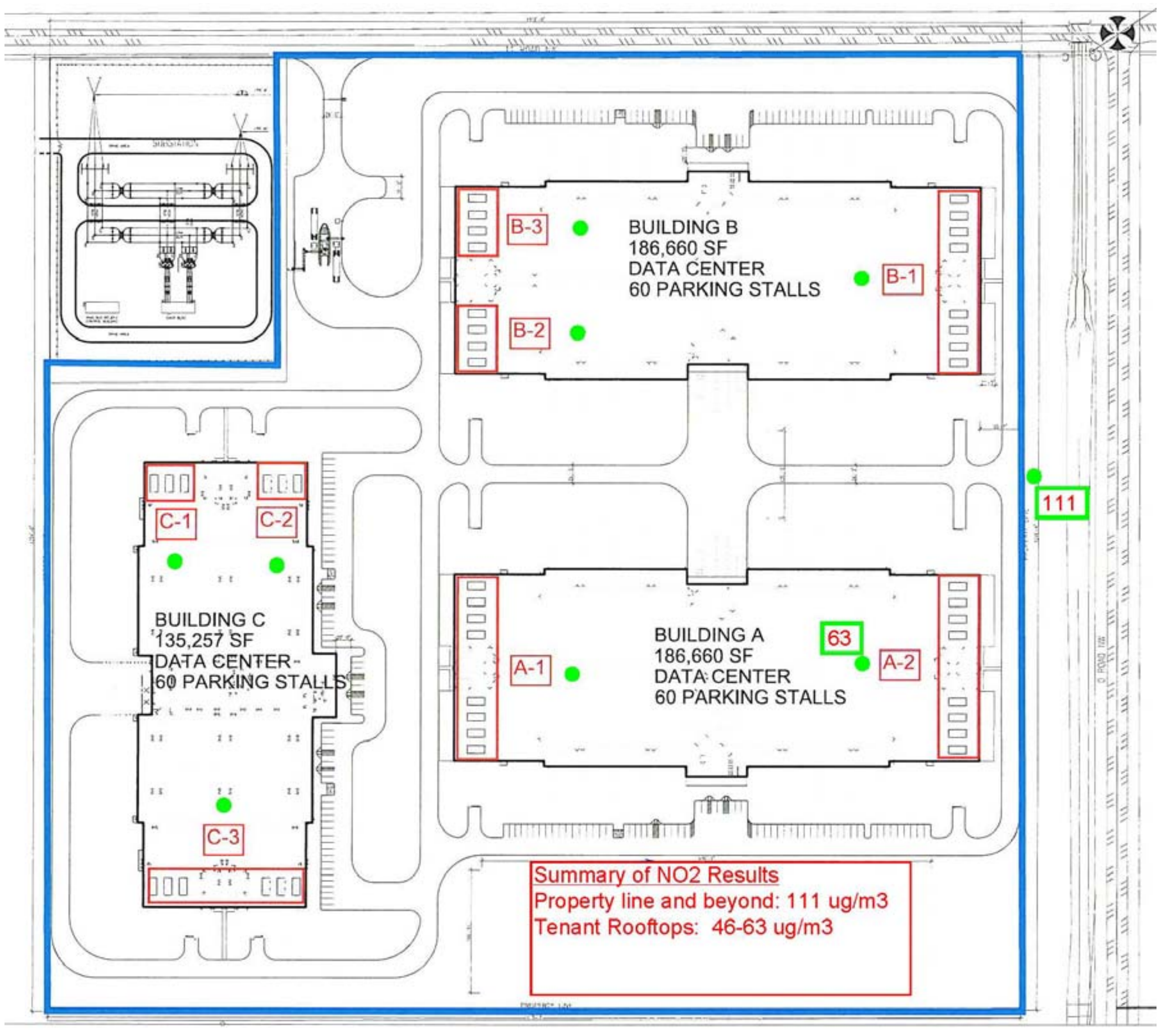

Figure 1. Locations of Maximum Modeled 98th-Percentile 1-Hour NO_2 Impacts.

6.4 Compliance With the 24-Hour $PM_{2.5}$ NAAQS

6.4.1. Nature of the 24-hour $PM_{2.5}$ NAAQS

The 24-hour $PM_{2.5}$ NAAQS is based on the 3-year average of the 98th percentile 24-hour concentrations in each year. To attain the 24-hour PM2.5 standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 µg/m3. EPA has interpreted that the "98th percentile" concentration in any year is equivalent to the 8th highest concentration for that year. Thus in new source review, an applicant must demonstrate through dispersion modeling that:

- the 3-year average of the 8th highest 24-hour average concentrations at each modeled receptor will not exceed 35 µg/m^3 after adding local background.

6.4.2. Hierarchy of Daily PM2.5 Emissions For Various Generator Operating Scenarios

Upon full buildout the Intergate-Quincy data center would be occupied by up to eight independent tenants, which are show on Figure 1. Ecology will require each tenant to coordinate their routine testing so that no two tenants do that testing at the same time. Figure 1 shows the various tenants are spatially distributed and each tenant likely has its own "maximum impact point". For example, the maximum impact for Tenant C-3 is probably at the southwest property line, while the maximum impact for Tenant B-1 is probably at the northeast corner. Those two tenants probably contribute relatively little to the other's maximum fenceline impacts.

Table 9 shows the daily $PM_{2.5}$ emission rates generated by each operating mode for each tenant. For this analysis it was assumed the facility would experience a conservatively high 8 power outages per year, with each outage lasting one hour. This analysis considers two worst-case operating scenarios:

- The full buildout condition when all tenants have developed their spaces, and all generators are used according to their permit limits.

- The year before the full buildout condition, when the last large tenant (Tenant B-1) conducts their commissioning testing, and after which all tenants operate their generators as under the full buildout scenario. The yellow-highlighted rows of Table 9 show the commissioning testing events for Tenant B-1.

Table 10 shows the hierarchy of the daily $PM_{2.5}$ emissions for each generator operating scenario, ranked by the 24-hour average $PM_{2.5}$ emission rate. The highest eight days of emission rate would consist of the eight hypothetical power outages. The following representative runtime events for scheduled generator testing and maintenance activities were evaluated:

- Scenario 1, Building A Triennial Switchgear Maintenance. This is done at each building once every three years. Every generator inside that building would operate for 13 hours at design electrical load. The 24-hour $PM_{2.5}$ emission rate is 23.3 lbs/day. This work would be limited to daytime hours.
- Scenario 2, One-time commissioning testing for Tenant B-1, which is one of the tenants with the largest number of generators. During the maximum day of commission testing, all eight generators used by Tenant B-1 would operate at 75% load for 4 hours in one calendar day. The 24-hour $PM_{2.5}$ emission rate is 23.3 lbs/day. This work would be limited to daytime hours.
- Scenario 3, Corrective testing for tenant C-1. This represents the maximum emissions that would occur at each tenant every year. On that typical day, one generator would be operated for 12 hours at an average load of 50%. The 24-hour $PM_{2.5}$ emission rate is 6 lbs/day. This work would be limited to daytime hours.

Table 9. Data Center Activity (Each Tenant and Each Runtime Scenario)

					24-Hour PM2.5 Emissions		
Tenant	No. of Gens	Runtime Regime	Combined Days Per Year	% Load	No. Gens Any Time	Hrs/Day	PM2.5 lbs/day
C-1	3	Montly Test, 50% Load	11	50%	1	4.5	2.25
C-1	3	Annual Test, 100% load	3	100%	1	6	5.79
C-1	3	Corrective Testing, 50% load	3	50%	1	12	6.00
C-1	3	Transf. Maint., 75%	1	75%	2	13	18.90
C-2	3	Montly Test, 50% Load	11	50%	1	4.5	2.25
C-2	3	Annual Test, 100% load	3	100%	1	6	5.79
C-2	3	Corrective Testing, 50% load	3	50%	1	12	6.00
C-2	3	Transf. Maint., 75%	1	75%	2	13	18.90
C-3	6	Montly Test, 50% Load	11	50%	1	9	4.5
C-3	6	Annual Test, 100% load	6	100%	1	6	5.79
C-3	6	Corrective Testing, 50% load	6	50%	1	12	6.00
C-3	6	Transf. Maint., 75%	2	75%	2	13	18.90
Bldg C	12	Bldg C Main Switchgear	1	75%	12	2	17.44
A-1	8	Montly Test, 50% Load	11	50%	1	12	6
A-1	8	Annual Test, 100% load	8	100%	1	6	5.79
A-1	8	Corrective Testing, 50% load	8	50%	1	12	6.00
A-1	8	Transf. Maint., 75%	2	75%	2	13	18.90
A-2	8	Montly Test, 50% Load	11	50%	1	12	6.0
A-2	8	Annual Test, 100% load	8	100%	1	6	5.79
A-2	8	Corrective Testing, 50% load	8	50%	1	12	6.00
A-2	8	Transf. Maint., 75%	2	75%	2	13	18.90
Bldg A	16	Bldg A Main Switchgear	1	75%	16	2	23.26
B-1	8	Montly Test, 50% Load	11	50%	1	12	6
B-1	8	Annual Test, 100% load	8	100%	1	6	5.79
B-1	8	Corrective Testing, 50% load	8	50%	1	12	6.00
B-1	8	Transf. Maint., 75%	2	75%	2	13	18.90
B-1	8	Startup: Mfr Testing Day 1	8	100%	1	4	3.86
B-1	8	Startup: Mfr Testing Day 2	8	10%	1	6	2.70
B-1	8	Startup: Funct. Perf Test	8	50%	1	8	4.00
B-1	8	Startup: Int. Sys Test Day 1	8	50%	1	8	4.00
B-1	8	Startup: Int. Sys Test Day 2	1	75%	8	4	23.26
B-2	4	Montly Test, 50% Load	11	50%	1	6	3
B-2	4	Annual Test, 100% load	4	100%	1	6	5.79
B-2	4	Corrective Testing, 50% load	4	50%	1	12	6.00
B-2	4	Transf. Maint., 75%	1	75%	2	13	18.90
B-3	4	Montly Test, 50% Load	11	50%	1	6	3
B-3	4	Annual Test, 100% load	4	100%	1	6	5.79
B-3	4	Corrective Testing, 50% load	4	50%	1	12	6.00
B-3	4	Transf. Maint., 75%	1	75%	2	13	18.90
Bldg B	16	Bldg B Main Switchgear	1	75%	16	2	23.26
All	44	Full Power Outage, 75% Load	8	75%	44	1	31.98

Table 10. Hierarchy of Daily PM2.5 Emissions (Sorted by Daily PM2.5 Emission Rate)

					24-Hour PM2.5 Emissions		
Tenant	No. of Gens	Runtime Regime	Combined Days/yr	% Load	No. Gens Any Time	Hrs/Day	PM2.5 lbs/day
All	44	Full Power Outage, 75% Load	8	75%	44	1	32.0
Bldg A	16	Bldg A Triannial Main Switchgear	1	75%	16	2	23.3
B-1	8	Startup: Int. Sys Test Day 2	1	75%	8	4	23.3
C-1	3	Triannial Transf. Maint., 75%	1	75%	2	13	18.9
A-1	8	Triannial Transf. Maint., 75%	2	75%	2	13	18.9
B-2	4	Triannial Transf. Maint., 75%	1	75%	2	13	18.9
C-1	3	Corrective Testing, 50% load	3	50%	1	12	6.00
C-2	3	Corrective Testing, 50% load	3	50%	1	12	6.00
C-3	6	Corrective Testing, 50% load	6	50%	1	12	6.00
A-1	8	Montly Test, 50% Load	11	50%	1	12	6
A-1	8	Corrective Testing, 50% load	8	50%	1	12	6.00
A-2	8	Montly Test, 50% Load	11	50%	1	12	6.0
A-2	8	Corrective Testing, 50% load	8	50%	1	12	6.00
B-1	8	Montly Test, 50% Load	11	50%	1	12	6
B-1	8	Corrective Testing, 50% load	8	50%	1	12	6.00
B-2	4	Corrective Testing, 50% load	4	50%	1	12	6.00
B-3	4	Corrective Testing, 50% load	4	50%	1	12	6.00
C-1	3	Annual Test, 100% load	3	100%	1	6	5.79
C-3	6	Annual Test, 100% load	6	100%	1	6	5.79
A-1	8	Annual Test, 100% load	8	100%	1	6	5.79
A-2	8	Annual Test, 100% load	8	100%	1	6	5.79
B-1	8	Annual Test, 100% load	8	100%	1	6	5.79
B-2	4	Annual Test, 100% load	4	100%	1	6	5.79
B-3	4	Annual Test, 100% load	4	100%	1	6	5.79
C-3	6	Montly Test, 50% Load	11	50%	1	9	4.5
B-1	8	Startup: Funct. Perf Test	8	50%	1	8	4.00
B-1	8	Startup: Int. Sys Test Day 1	8	50%	1	8	4.00
B-1	8	Startup: Mfr Testing Day 1	8	100%	1	4	3.86
B-2	4	Montly Test, 50% Load	11	50%	1	6	3
B-3	4	Montly Test, 50% Load	11	50%	1	6	3
B-1	8	Startup: Mfr Testing Day 2	8	10%	1	6	2.70
C-1	3	Montly Test, 50% Load	11	50%	1	4.5	2.25
C-2	3	Montly Test, 50% Load	11	50%	1	4.5	2.25

6.4.3. AERMOD Modeling of Highest-Ranked Generator Operating Scenarios

The AERMOD model was used to model the 1st through 10th highest ambient $PM_{2.5}$ concentrations at or beyond the property line for the each of the three highest-emitting generator operating scenarios described above. As a worst-case screening assumption, AERMOD was set so each source runs continuously, all day and every day for 5 years, except the emissions would occur only between 7 am to 7 pm each day. The 1st through 10th highest $PM_{2.5}$ impacts, based on 5 years of modeling, are listed in Table 11.

1st-hightest through 10th-highest 24-hour average AERMOD dispersion factors were modeled for the originally-proposed 38-foot. Based on subsequent AERMOD modeling for the 48-foot stack configuration, the original 38-foot dispersion factors were manually adjusted by a scale factor of 0.85. As a conservative step, the 1st-highest 24-hr $PM_{2.5}$ impact was used to demonstrate compliance for each scenario.

6.4.4. Local Background $PM_{2.5}$ Sources

The following local background sources were modeled. The highest $PM_{2.5}$ impacts caused solely by Sabey's emissions were modeled to occur along the southern boundary. To estimate local background, the individual 24-hour $PM_{2.5}$ value from each of the local sources was modeled at the location of Sabey's maximum impact. The total background was calculated by summing the 8th-highest 24-hour impacts from each of the individual background sources, which gives a conservatively high estimate of the combined local background . In reality, it is unlikely that the winds would simultaneously blow from each of those local sources directly toward the Sabey facility on any given day.

- Yahoo Data Center. The 24-hour emissions were set by assuming the facility would test up to 8 generators for one hour each in one calendar day, using a load bank at 50% load.

- Intuit Data Center. The 24-hour emissions were set by assuming the facility would test up to 8 generators for one hour each in one calendar day, using a load bank at 50% load.

- Celite. The 24-hour emissions were set equal to the facility's permitted emission rates.

In addition, the regional background value of 29 $\mu g/m^3$,which was provided by Clint Bowman of Ecology, was added to each calculation to estimate the total cumulative $PM_{2.5}$ concentration.

Table 11. Screening-Level $PM_{2.5}$ NAAQS Compliance Demonstration (May-2011 Results)

Generator Operation	Bldg A Main Switchgear Triennial Maintenance	Tenant C-1 Corrective Testing	Tenant B-1 Startup Commission Testing
AERMOD Rank	**24-hr PM2.5 (ug/m3)**	**24-hr PM2.5 (ug/m3)**	**24-hr PM2.5 (ug/m3)**
1st	4.19	3.36	3.05
2nd	3.46	2.56	2.33
3rd	3.35	2.54	2.31
4th	3.28	2.32	2.10
5th	2.98	2.11	1.92
6th	2.83	2.08	1.89
7th	2.75	2.02	1.83
8th	2.66	1.96	1.78
9th	2.61	1.90	1.73
10th	2.57	1.88	1.71
Compliance Demonstration			
Source	**24-hr PM2.5 Impact (ug/m3)**	**24-hr PM2.5 Impact (ug/m3)**	**24-hr PM2.5 Impact (ug/m3)**
Intergate Data Center	4.19	3.36	3.05
Intuit	0.12	0.12	0.12
Celite	0.8	0.8	0.8
Yahoo	0.12	0.12	0.12
Regional Background	21	21	21
Total Sources	**26.2**	**25.4**	**25.1**
NAAQS Limit	35	35	35

6.4.5. Compliance Demonstration for $PM_{2.5}$ NAAQS (Based on 1st-Highest AERMOD Results)

As listed in Table 11, the 1st-highest 24-hour $PM_{2.5}$ impacts associated with each of the three representative runtime scenarios are lower than the NAAQS, after adding regional background and local background. Even assuming the facility runs 365 days per year for 12 hours per day, the modeled 1st-highest Sabey-only impacts range from only 3.05 to 4.19 $\mu g/m^3$. After adding local background plus regional background, the cumulative PM2.5 concentrations range from only 25 to 26 $\mu g/m^3$, compared to the NAAQS of 35 $\mu g/m^3$. Therefore, this screening-level analysis confirms the Intergate-Quincy data center would comply with the $PM_{2.5}$ NAAQS.

6.4.6 Addition of $PM_{2.5}$ emissions from cooling systems

Cooling system particulate matter emissions were considered to be $PM_{2.5}$, and were evaluated using SCREEN 3. Based on operating and design parameters for 176 Munters Model PV-W35-PVT, $PM_{2.5}$ impacts from the cooling system added less than 1 ug/m^3 to the 24 hour $PM_{2.5}$ concentration range listed in Section 6.4.5. Total 24 hour $PM_{2.5}$ concentrations remained below the $PM_{2.5}$ NAAQS threshold of 35 ug/m^3.

7. SECOND TIER REVIEW FOR DIESEL ENGINE EXHAUST PARTICULATE AND NITROGEN DIOXIDE EMISSIONS

As discussed above, proposed emissions of diesel engine exhaust particulate (DEEP) and nitrogen dioxide (NO_2) from the forty-four (44) additional engines exceed the regulatory trigger level for toxic air pollutants (also called an Acceptable Source Impact Level, (ASIL). A second tier review is required for DEEP and NO_2 in accordance with WAC 173-460-090.

Sabey Intergate's computer data center is in addition to the three data centers operating in the rural town of Quincy, WA. The three data centers utilize dozens of large (>2 MW) diesel engines to supply backup power in support of data center operations. Additionally, due to the April, 2010 enactment of the *Computer Data Centers – Sales and Tax Exemption* law in Washington State, several companies have expressed interest in expanding existing or developing new data centers in Quincy. Thus, more large diesel-powered generators will be needed to supply backup power for the additional data centers.

Large diesel-powered backup engines emit DEEP, which is a high priority toxic air pollutant in the state of Washington. In light of the potential rapid development of other data centers in the Quincy area, and recognizing the potency of DEEP emissions, Ecology decided to evaluate Sabey Intergate's proposal on a community-wide basis. The community-wide evaluation approach considers the cumulative impacts of DEEP emissions resulting from Sabey Intergate's project, and includes consideration of prevailing background emissions from existing permitted data centers and other DEEP sources in Quincy. This evaluation was conducted under the second tier review requirements of WAC 173-460-090.

The results of Ecology's evaluation of cumulative risks associated with Sabey Intergate's project are included in a separate technical support document. Please refer to that technical support document for a discussion and evaluation of the risks associated with DEPP and NO_2 emitted by Sabey Intergate.

8. CONCLUSION

Based on the above analysis, Ecology concludes that operation of the forty-four (44) generators will not have an adverse impact on air quality. Ecology finds that Sabey Intergate has satisfied all requirements for NOC approval.

******END OF SABEY INTERGATE TSD** ****