LANDAU ASSOCIATES

March 4, 2015

Washington State Department of Ecology
4601 North Monroe Street
Spokane, Washington 99205

Attn: Mr. Greg Flibbert

**RE: REVISED REQUEST FOR APPROVAL ORDER REVISIONS (NOC ORDER NO. 11AQ-E424)
SABEY INTERGATE-QUINCY DATA CENTER
QUINCY, WASHINGTON**

Dear Greg:

On behalf of Sabey Quincy LLC (Sabey), we are submitting this revised request for revisions to Notice of Construction (NOC) Order No. 11AQ-E424, for the Sabey Intergate-Quincy Data Center in Quincy, Washington. This revised request responds to the Washington State Department of Ecology (Ecology) Incompleteness Letter dated December 5, 2014 and Ecology's emailed supplemental data request (Ecology 2014; Huitsing 2015).

A Notice of Construction (NOC) Application Form, signed by Sabey's Responsible Official, is provided as Appendix A. An additional check for $625 has been sent to Ecology's Cashiering Unit for this application to supplement Sabey's original payment of $875 and to bring Sabey's total fee payment to $1,500. A track-changes version of our requested changes to the text and tables of the NOC Order is provided in Appendix B. A complete package of manufacturers' generator specifications is provided in Appendix C. An updated Best Available Control Technology assessment is provided in Appendix D. A summary of the revised emission calculations and an ambient impact assessment are provided in Appendix E. A revised Second-Tier Health Impact Assessment (Landau Associates 2015) has been submitted under separate cover.

The following table summarizes the requested key changes to the 2011 Approval Order and revisions to the emission calculations for the ambient impact assessment.

Item	Current Approval Order and 2011 Permit Application	This 2015 Permit Revision Request
Allowable construction period	Each generator must be installed within 18 months	Sabey requests a phased project extension of at least 36 months as a "phased project."
Generator manufacturer	Caterpillar	Any manufacturer would be allowed, in all cases subject to the currently permitted load-specific emission limits in Conditions 5.2-5.4.

Item	Current Approval Order and 2011 Permit Application	This 2015 Permit Revision Request
Activity-specific allowable runtime	Condition 3.2 sets runtime limits for each individual activity, totaling 57.5 hours per year per generator.	Consolidate the runtime limits for three categories (unplanned outages, scheduled electrical bypass, and corrective testing) into a combined category with a runtime limit of 35 hours/year (the sum of the previous individual runtime limits). The currently-permitted runtimes for monthly testing (16.5 hours/year) and annual load bank testing (6 hours/year) should be retained.
Activity-specific allowable generator load	Condition 3.2 sets load limits for each individual activity.	For the combined category "unplanned outages, electrical bypass, and corrective testing," allow any random load from zero to 100% to provide operational flexibility to respond to variable server electrical demand.
Activity-specific and load-specific emission limits	Conditions 5.2-5.5 set allowable lbs/hour limits based on allowable load for each activity.	The current limits should be retained. Note that for this resubmittal the revised emissions for each pollutant are calculated by assuming every generator always runs at the worst-case load for each pollutant: 25% load for PM; 100% load for NO_x, CO and VOCs; 100% load for fuel and AP-42 (EPA 1995) toxic air pollutants.
Annual emissions from initial generator commissioning and periodic stack testing.	Not accounted for in annual emission calculations.	Accounted for in the 70-year average annual emission calculations.
"Black puff" cold-start adjustments	Not accounted for.	Accounted for in the annual-average and short-term emission rates and AERMOD modeling.
Maximum theoretical annual emission rates	70-year average emission rates	Maximum theoretical annual emission rates for consideration of compliance with NAAQS, ASIL, and assessment of chronic non-cancer risk were based on assumptions that the total emissions for a 3-year rolling period might occur in one single year.
70-year DEEP emissions for cancer risk modeling	0.31 tons/year	0.467 tons/year
Sabey-Only DEEP cancer risk at maximum house	7 per million	9 per million
Facility-wide NO_x limit during power outage for ASIL	NO_x limited to 991 lbs/hour, 1st-highest 1-hour limit.	The current limits should be retained. Therefore, a revised Second-Tier Risk Report for NO_2 is not necessary.

Item	Current Approval Order and 2011 Permit Application	This 2015 Permit Revision Request
Recordkeeping for actual NO_x emissions during power outages and electrical bypass	No recordkeeping required.	Sabey proposes to add a new condition, requiring recordkeeping for the actual 1st-highest annual 1-hour NO_x emissions during outages and electrical bypass that activate more than 16 generators simultaneously, to compare to the allowable limit of 990 lbs/hour.
Limits on load, runtime, and simultaneous generators for **monthly testing and annual load bank testing only**	Table 3.2 of the Approval Order sets operational limits, which reflected Sabey's 2011 Monte Carlo modeling for the 98th-percentile 1-hr NO_2 NAAQS.	The current limits should be retained. These limits will continue to ensure compliance with the 1-hour NO_2 NAAQS.

BACKGROUND INFORMATION

Sabey operates the Intergate-Quincy Data Center in Quincy, Washington. Permitted air pollutant emission sources at the data center include emergency diesel generators, and particulate drift from rooftop cooling units. Sabey applied for the NOC air quality permit in February 2011 by providing a series of formal application reports and several addenda to revise the generator runtime estimates and generator emission estimates. The data center was proposed to be constructed in phases. Phase 1 consists of tenants and equipment in Building C, and future Phases 2 and 3 will consist of tenants and equipment in Buildings A and B. The key assumptions stated in the original permit application were as follows:

- The actual construction schedules for all phases of the data center were tentative and would be market-driven.
- All generators would be used solely as emergency generators. Therefore, the required emission controls were specified as installation of emergency generators equipped with Tier 2-certified engines.
- All generators would have an electrical capacity of 2,000 kilowatts of electrical output (kWe), with diesel engines rated at 2,937 brake horsepower (BHP).
- The application presented alternative emission estimates based on smaller generators (1,500 kWe), and demonstrated that the emission rates for the smaller generators would be less than the emissions from the permitted 2,000-kWe generators. Therefore, Sabey is allowed to install either 1,500-kWe or 2,000-kWe generators.
- Emission estimates for the permit application were based on the assumption that all generators would be provided by Caterpillar Corporation (Caterpillar).
- The permit application package demonstrated that the emissions for all pollutants from the full-buildout equipment at the data center would comply with the National Ambient Air Quality Standards (NAAQS) and the Ecology toxic air pollutant regulations.

On August 5, 2011, Ecology issued NOC Order No. 11AQ-E424. This permit included the following key provisions:

- All generators were specified as Caterpillar Model 3516C units with 2,000 kWe of capacity.
- The construction approval would be rescinded for any generators whose construction did not begin within 18 months after issuance of the permit.
- Annual runtime limits (specified as 3-year rolling totals) were set for each individual generator and for each mode of operation, as indicated in Table 3.2, Engine Operating Restrictions, of the permit.
- In Permit Condition 5, the hourly emission limits were set for each pollutant for the key electrical loads that were described in the original application.

Construction of the data center proceeded smoothly but more slowly than Sabey anticipated. Sabey has now constructed most of the generators and cooling units planned for Phase 1 (Building C) with minor changes from buildout conditions. These details, related to actual construction and facility operation, which differ from the assumptions established in the permit application, are:

- The market-driven duration of three construction phases was longer than the 18-month construction timeframe specified by the permit. Only Phase 1 construction goals have been met (Sabey has not yet begun construction of Buildings A and B) and the 18-month deadline has now lapsed.
- Most of the installed generators in Building C are 1,500 kWe capacity rather than the permitted 2,000-kWe units assumed in the application to forecast emission rates.
- Sabey would like to retain an open market in evaluating suppliers for future generators during construction of Buildings A and B (rather than be limited to a single supplier's bid) provided that the alternative generator suppliers would guarantee that the load-specific hourly emission rates for their generators will be within the emission limits established in Permit Condition 5.

CHANGE IN MODE OF OPERATION FOR GENERATOR USAGE DURING ELECTRICAL BYPASS DURING TRANSFORMER AND SWITCHGEAR MAINTENANCE

Sabey proposes to change the way of conducting electrical bypass operations during transformer and switchgear maintenance. As demonstrated below, this would not change the annual generator emissions, but it could theoretically increase the maximum daily emissions solely during electrical bypass operations.

The 2011 permit application indicated switchgear maintenance and transformer maintenance would be conducted at each building and other independent buildings (or tenants). This routine maintenance would be conducted on a 3-year recurring cycle. On one day during that year, all of the generators in a single building (no more than 16 generators at a time) would be activated simultaneously for 2 hours of switchgear maintenance. The original application also indicated that triennial transformer maintenance in that same building would be conducted over a multi-day period, no more than two generators at a time activated for 13 straight hours. Therefore (for electrical bypass), any generator in that building would run for up to 15 hours per year, in that triennial period.

Under Sabey's revised maintenance procedure, any given generator would still be operated for 15 hours during the triennial period. However, Sabey requests that the transformer maintenance and switchgear maintenance procedures be consolidated into a single maintenance session lasting up to 15 hours in a single day. This revised maintenance procedure requires that up to 22 generators (all the generators in one building, plus some of the generators in the neighboring building) be operated simultaneously for 15 hours during the combined bypass event.

The resulting change in the daily emission rates, and confirmation that this change will not adversely affect the 24-hour ambient air quality impacts, are described in the section of this letter entitled "Emission and Ambient Air Quality Implications."

Request for Increased Flexibility: Consolidation of Allowable Runtimes, and Expanded Range of Allowable Generator Loads

In the original Request for Approval Order Revisions (October 2014), Sabey requested that Table 3.2 of the original Approval Order be revised to consolidate the annual runtime limit for "Electrical Bypass" (15 hours/year) and "Power Outage" (8 hours/year) to allow flexibility in the generator activities. In Ecology's Incompleteness Letter, the agency requested that Table 3.2 be revised further, to address public concern and provide a range of operating loads and maximum emission rates that could actually be expected during this consolidated runtime.

The current Table 3.2 allows the generators to operate only at 75 percent load during outages or electrical bypass. However, Sabey's electrical contractor (Keith Lane of Lane, Coburn & Associates) has indicated that actual generator loads are based on a range that depends partly on server electrical demand, and partly on the number of generators available to serve each tenant (Lane, K., 2014, personal communication). These generators are sized to run at upper bound loads from 56 percent to 75 percent, provided that all of the tenants' generators successfully activate during a power outage. In the event that a redundant generator malfunctions, then the remaining generators will compensate load and may operate at loads as high as 85 percent. However, under this scenario not as many emergency generators would be running because not all generators activated. Therefore, under this upper-bound worst-case operating condition, a few generators would run at 85 percent load, fewer generators would be operating than permitted, and most of the generators would operate between 56 percent and 75 percent load (as expected). Mr. Lane also indicated that the likelihood for any generators to ever run at loads exceeding 85 percent is small and that it is inconceivable for all generators to ever activate at 100 percent load.

The lower bound of the generator load during an outage is uncertain, and would depend entirely on the electrical demand required by the servers at that particular time. Under normal conditions, the generators are expected to run at loads of 56 percent to 75 percent. However, it is conceivable that under unusual circumstances some of the generators in some lightly-used quadrants might activate at less than 50 percent load. It is inconceivable that most of the 44 full-buildout generators would ever activate simultaneously at less than 25 percent load.

Therefore, Sabey agrees to modify Table 3.2 of the Approval Order to reflect the uncertain range of generator loads during unplanned outages, scheduled electrical bypass, and corrective generator testing. The requested track-changes revisions to Table 3.2 are shown below (the complete set of track-changes proposed edits to the entire Approval Order is provided in Appendix B).

Table 3.2: Engine Operating Restrictions (Revisions March-2015)

Operating Activity	Average hours/year per engine, 3-year monthly rolling totals	Average Operating Electrical Loads (%)	Facility-Wide Diesel fuel gallons/year, 3-year monthly rolling totals	# Operating Concurrently
Monthly Testing	16.5	~~Idle~~ Zero electrical load to50%		4
Annual Load Bank Testing	6	100%		4
Combined Electrical Bypass and Power Outage	~~15~~35	Any random load from zero to 100% ~~75%~~		22 during electrical bypass; 44 during power outage; 1 during corrective testing
~~Corrective Tests~~	~~12~~	~~50%~~		~~1~~
~~Power Outage~~	~~8~~	~~75%~~		~~44~~
Total	57.5		263,725	

EMISSION AND AMBIENT AIR QUALITY IMPLICATIONS

Sabey has requested changes that would not increase the allowable runtime of the generators, but could theoretically allow the generators to run at loads under which the instantaneous emissions rates would change. The requested load range (instead of a steady load of 75 percent that was forecast in the original 2011 application) better reflects actual operating conditions and variability, inherent to project-specific considerations like variable server demand during power outages. It also addresses public concern (based on public comment from the Microsoft Project Oxford Data Center permit, where citizens expressed concern that the Quincy data centers might not be operating their generators in the same manner as were evaluated in ambient impact modeling) that the permit emission rates reflect actual operation.

The more practical load range, requested for operating generators during emergency bypass, etc., would increase instantaneous emission rates depending on the actual load. For example, during a high operating load range (between 80 percent and 100 percent) the instantaneous nitrogen oxides (NO_x) emission rate would increase. Similarly, during a low operating load range (between only 25 percent and 50 percent) the instantaneous diesel engine exhaust particulate matter (DEEP) emission rate would increase.

After evaluating these considerations, it was determined that Sabey's requested revisions would increase the theoretical maximum annual-average DEEP emission rate, the theoretical maximum 24-hour PM_{10} and $PM_{2.5}$[1] emission rates during power outages, and the theoretical maximum facility-wide 1-hour NO_x emission rate during power outage. This section demonstrates that although the emission rates might theoretically increase, the maximum ambient impacts will continue to comply with the NAAQS and the Acceptable Source Impact Levels (ASILs). Detailed emission calculations and AERMOD[2] ambient impact modeling are presented in Appendix E. Copies of the revised emission calculation spreadsheets and revised AERMOD dispersion modeling files have been provided to Ecology under separate cover.

Revised Emission Assumptions

The revised emission assumptions are as follows:

- The short-term and annual-average particulate matter emission rates were revised to assume that the generators always run at 25 percent load, which is the load at which the instantaneous lbs/hour emission rate for particulate matter would be highest.
- The short-term and annual-average emission rates for carbon monoxide (CO), NO_x, and volatile organic compounds were revised to assume that the generators always run at 100 percent load, which is the load at which the instantaneous lbs/hour emission rate for those pollutants would be highest.
- "Black puff" cold-start adjustment factors were added to increase the forecast short-term and annual-average emission rates for particulate matter, CO, and volatile organic hydrocarbons.
- The 70-year annual-average DEEP emission rate used to evaluate DEEP cancer risks was scaled upward to account for initial generator commissioning and periodic stack emission testing.
- All annual-average emission rates used to evaluate compliance with the annual NAAQS, annual ASILs, and to evaluate chronic (non-cancer) health risk were tripled, which accounts for the possibility that all of the allowable emissions within the 3-year rolling permit limit could occur in a single year. However, the forecast 70-year average DEEP emission rate used to evaluate cancer risks was not tripled, because it is most appropriate to evaluate cancer risks based on a lifetime (average 70-year lifetime) exposure to emissions instead a single theoretical maximum year.

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[1] PM_{10} = Particulate matter with an aerodynamic diameter less than or equal to 10 microns.
$PM_{2.5}$ = Particulate matter with an aerodynamic diameter less than or equal to 2.5 microns.

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

Revised AERMOD Dispersion Modeling Assumptions

The revised AERMOD modeling assumptions are as follows:

- Short-term ambient impacts for particulate matter, CO, and gaseous toxic air pollutants were modeled with stack temperature and flow rate based on a 25 percent generator load. The 1^{st}-highest 24-hour value was used to evaluate the 98^{th}-percentile 24-hour $PM_{2.5}$ NAAQS.
- Annual-average ambient impacts for all pollutants were modeled with stack temperature and flow rate based on the arithmetic average of generator loads of 10 percent, 25 percent, 50 percent, 75 percent, and 100 percent.

DEEP Emissions and DEEP Cancer Risk

The conclusions of the revised DEEP impact assessment are summarized below:

- The theoretical 70-year average annual DEEP emission rate increases to 0.467 tons/year, compared to the previous value of 0.31 tons/year that was evaluated in Ecology's 2011 DEEP Second Tier risk report (Ecology 2011).
- The DEEP cancer risk at the maximally-impacted dwelling caused solely by Sabey's emissions increases to 9-per-million, compared to the previous value of 7-per-million that was evaluated in the Ecology's 2011 DEEP Second Tier risk report (Ecology 2011).
- The cumulative DEEP cancer risk at the maximally-impacted dwelling caused by all City-wide emission sources increases to 47-per-million, compared to the previous value of 39-per-million that was evaluated in the Ecology's 2011 DEEP Second Tier risk report (Ecology 2011). Most of the increase since 2011 is caused by emissions from the recently permitted Vantage Data Center (permitted in 2012).

24-Hour PM_{10} and 24-Hour $PM_{2.5}$ Compliance

The modeled concentrations of 24-hour average PM_{10} and $PM_{2.5}$ increase, but the cumulative concentrations (including local and regional background) are comfortably below the NAAQS. The 98^{th}-percentile $PM_{2.5}$ demonstration used the 1^{st}-highest AERMOD value.

Ambient NO_2 Impacts Will Not Change

The 1-hour nitrogen dioxide (NO_2) impacts were not re-modeled for this application for the reasons described below.

- The 1-hour NO_2 impacts during a power outage (for comparison to the ASIL) were not re-modeled, and Sabey will continue to comply with the current 1-hour NO_2 limit of 990 lbs/hour, which was developed by assuming that there would be 44 generators, each 2,000 kWe, operating at 75 percent load. We believe there is a negligible potential for the actual emission rate to approach that limit. Sabey has already installed six generators in Building C that are smaller and lower-emitting (1,500 kWe) than the permitted 2,000-kWe generators. Furthermore, Sabey's electrical systems are designed so most of the generators will operate at loads less than 75 percent during an outage. And to add to the margin of safety, Sabey's stack emission testing to date has shown the actual NO_x emission rates at high load have been much lower than the allowable limit of 41.9 lbs/hour. Therefore, after full build-out of the data center the actual NO_x emissions will certainly be lower than the currently-permitted 990 lbs/hour. For these reasons, Sabey is comfortable with retaining the current facility-wide NO_x emission limit of 990 lbs/hour. Sabey proposes to revise the Approval Order to require keeping records of the calculated actual NO_x emission rate during each unplanned outage or scheduled electrical bypass event, to demonstrate compliance with the 990 lbs/hour limit.

- The 98^{th}-percentile 1-hour NO_2 impacts (for comparison to the NAAQS) were not re-modeled, and Sabey will continue to comply with the runtime limits and load limits currently specified for monthly testing and annual load bank testing. Sabey's 2011 Monte Carlo modeling demonstrated compliance with the 98^{th}-percentile NO_2 NAAQS with an adequate safety margin, and retaining the current operational limits (runtime and load limits) for the most frequent scheduled routine activities (monthly testing and annual load bank testing) that comprise the typical 8^{th}-highest daily NO_x emission events each year will ensure continued compliance.

DETAILED ITEMIZATION OF REQUESTED REVISIONS TO NOC ORDER

Appendix B provides a track-changes version of the 2011 Approval Order, indicating Sabey's requested changes to certain conditions. Discussions of each requested revision are provided in the following sections.

Page 1: Equipment

We suggest editorial changes to the summary paragraph in this section to reflect the activities that Sabey conducted at the data center between 2011 and the present.

Table 1.1 should be revised to indicate the generator sizes, manufacturer, and serial numbers for the generators that have been installed to date.

Sabey should be allowed to install generators smaller than 2,000 kWe, and to install generators provided by any manufacturer, as long as the load-specific emissions are no more than the allowable limits set by the permit tables in Condition 5.

Page 3: Project Summary

The text should clarify that the emission rates listed in the tables apply only to the diesel generators, not to the drift emissions from rooftop cooling equipment.

Tables 2a and 2b should be revised to show the correct annual emission rates that were submitted to Ecology as part of addenda to the original February 2011 permit application.

Page 5, Table 3: Best Available Control Technology

Sabey requests no changes to Tables 3 or 4 related to Best Available Control Technology (BACT). In response to Ecology's Incompleteness Letter, an updated BACT assessment is provided in Appendix D. Based on this updated analysis, we recommend that BACT for the new engines remain unchanged, consisting of installation of Tier 2-certified equipment.

Page 8, Condition 2: Equipment Restrictions

The deadline to commence construction of the remaining generators and cooling units should be extended by at least an additional 36 months to reflect the market-driven, phased nature of construction at this facility.

The engine BHP values provided by the three prospective bidders exhibit a narrow range, from 2,191 to 3,056 BHP. Therefore, the upper limit for the generator BHP should be set at 3,056, contingent on the hourly emission limits set by the tables in Condition 5. As requested by Ecology in its Incompleteness Letter, we have provided manufacturer specifications in Appendix C.

Page 9, Condition 3: Operating Restrictions

In Table 3.2, Engine Operating Restrictions, the annual runtime limits for “Electrical Bypass” (15 hours/year), Corrective Testing (12 hours/year), and “Power Outages” (8 hours/year) should be consolidated to a single aggregate line item “Combined Electrical Bypass, Corrective Testing, and Power Outages” (35 hours/year). The generator loads for that new line item should be changed to “Any random variable load from zero to 100%.”

In Table 3.2, we request that new row titled “Combined Electrical Bypass and Power Outage” be added, and the allowable number of generators operating simultaneously should be changed to “22 during electrical bypass; 44 during power outage; 1 during correct testing.” This change reflects Sabey’s revised maintenance procedures to combine switchgear and transformer maintenance in one session.

In Table 3.2, Engine Operating Restrictions, the runtime limits are currently specified for each individual engine, and each individual operating mode. We request that the runtime limits be made more flexible by specifying that they apply as “averaged across all generators in service at the Intergate-Quincy Data Center during that year.” This is the same type of flexibility that Ecology recently granted to the Microsoft Project Oxford Data Center, and for portions of the Vantage Data Center. This revision will provide additional flexibility to Sabey without affecting the emission rates or ambient air quality compliance. The most critical ambient air quality impact at the Intergate-Quincy Data Center is the cancer risk caused by DEEP [from 70-year (lifetime) average facility-wide DEEP exposure from the 44 permitted generators]. These emissions and the modeled 70-year average ambient DEEP impacts would not be affected by applying the runtime limits on a facility-wide average rather than single-engine values. Furthermore, the AERMOD ambient modeling, to evaluate compliance with the short-term NAAQS for $PM_{2.5}$ and NO_2, would not be affected by this revision because the number of generators (that the original air permit assumed would operate concurrently during electrical bypass maintenance) is restricted by the allowable number of operating generators listed in the right-hand column of Table 3.2.

Table 3.2 should, also, be revised to clearly indicate that the loads are generator electrical loads, rather than engine horsepower loads.

Page 11, Condition 4

Section 4.3.2 should be revised to eliminate stack testing at any load less than 50 percent. John Poffenroth of Ecology and Ryan Beebout of Sabey discussed this issue. They agreed that Sabey never intends to run at 10 percent or zero load for any extended period of time, and the only times Sabey ever intend to do so would be during very brief cool-down periods, or rapidly transient periods as the generator cycles up to the routine higher loads.

Sections 4.3.3 and 4.3.7 appear to be redundant and conflict with each other, in regard to how many engines must be tested for any given manufacturer and engine size. Ecology should review and delete one of those two paragraphs, as appropriate.

Pages 12-13, Condition 5: Emission Limit Tables

In all the emission limit tables, the column header should indicate that the operating load is the electrical load, not the engine mechanical load.

In all emission limit tables, the term “10%” should be replaced with “Zero load,” to reflect John Poffenroth’s direction that emission rates for idling generators should be measured during conditions of zero electrical output.

The engine load and emission limits for the line item “Electrical Bypass” should be set to 75 percent load to be consistent with the assumptions made in the 2011 air quality permit.

In Table 5.4, Carbon Monoxide, the emission limit at Zero Load should be corrected to 4.05 lbs/hour, which is the correct emission rate that corresponds to the Tier 2 emission factor of 3.5 grams per kilowatt-hour.

Page 14, Conditions 5.6 and 5.7: Facility-Wide Emission Limits

The values should be revised to reflect the revised emission limits described in Appendix E.

Page 14, Condition 6: Operation and Maintenance Manuals

Sabey agrees to include the manufacturers’ recommendations for low-load operation. Any high-load runtime required to burn accumulated oil from the engine after extended low-load operation will be included in the runtime limits listed in Table 3.2.

Page 14, Condition 5.10: Opacity Limits

Sabey's emission testing for new generators shows the plume opacity at 10 percent electrical load can be higher than 5 percent (for example, Generator QC3-C exhibited 6 percent opacity while operating at 10 percent electrical load). This did not indicate that the generator was malfunctioning at that load; it simply reflects the way the new generators are designed to operate. Fortunately, Sabey's emission testing to date has demonstrated that the generators exhibit much lower plume opacity at zero electrical load and loads above 50 percent. Therefore, this condition should be revised to allow more flexibility. For example, it should allow 10 percent plume opacity while operating at generator loads of 5 to 20 percent.

Page 15, Condition 8: Recordkeeping

Sabey agrees to add new recordkeeping requirements. Sabey will retain records of the algebraic equations used to calculate load-specific NO_x emissions. For comparison to the current limit of 990 lbs/hour, Sabey will maintain records of the actual maximum 1-hour NO_x emissions during each unplanned outage or scheduled electrical bypass event that causes more than 16 generators to operate simultaneously.

Page 16, Condition 10.1

The deadline to commence construction of the remaining buildings, generators, and cooling units should be extended by at least an additional 18 months, and longer if Ecology has the authority to do so, to reflect the market-driven, phased nature of construction at this facility.

REFERENCES

Ecology. 2014. Letter: *Incompleteness Letter for Sabey Intergate-Quincy Data Center Permit Modification NOC Application Received October 9, 2014*. From Gary Huitsing, P.E., Washington State Department of Ecology, to Cris Engel, Sabey Quincy LLC. December 5.

Ecology. 2011. *Technical Support Document for Second Tier Review, Sabey Data Center, Quincy, Washington*. Washington State Department of Ecology. June 22.

EPA. 1995. *Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources*. Fifth Edition. AP-42. Office of Air Quality Planning and Standards, Office of Air and Radiation, U.S. Environmental Protection Agency. January.

Huitsing, G.J. 2015. Email message from Gary Huitsing, Washington State Department of Ecology, to Cris Engel, Sabey-Quincy LLC. Re: *Sabey Air Permit: Additional Items Requested*. January 7.

Lane, K.. 2014. Personal communication (telephone conversation with Jim Wilder, Senior Associate, Landau Associates). Keith Lane, President/Chief Executive Officer, Lane Coburn & Associates, LLC. Re: *Upper-Bound and Lower-Bound Generator Loads*. December 22.

Landau Associates. 2015. Report: *Second-Tier Risk Analysis for Diesel Engine Exhaust Particulate Matter, Sabey Intergate-Quincy Data Center, Quincy, Washington*. Prepared for Intergate Quincy LLC. March 3.

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We thank you for your prompt attention to these requested permit revisions. Please call me if you have any additional questions about this matter.

Sincerely,

LANDAU ASSOCIATES, INC.

James Wilder

Jim Wilder, P.E.
Senior Associate Engineer

JMW/ccy

APPENDICES:

Appendix A: Notice of Construction Application Form
Appendix B: Proposed Revisions to Approval Order No. 11AQ-E424
Appendix C: Manufacturer Specifications for Alternative Generators
Appendix D: Updated Best Available Control Technology Assessment
Appendix E: Revised Emission Calculations and Ambient Impact Assessment

APPENDIX A

Notice of Construction Application Form

February 2015 Notice of Construction Application

This application applies statewide for facilities under the Department of Ecology's jurisdiction. Submit this form for review of your project to construct a new or modified source of air emissions. Please refer to Ecology Forms ECY 070-410a-g, "Instructions for NOC Application," for general information about completing the application.

Ecology offers up to two hours of free pre-application assistance. We encourage you to schedule a pre-application meeting with the contact person specified for the location of your proposal, below. If you use up your two hours of free pre-application assistance, we will continue to assist you after you submit Part 1 of the application and the application fee. You may schedule a meeting with us at any point in the process.

Upon completion of the application, please enclose a check for the initial fee and mail to:

Department of Ecology
Cashiering Unit
P.O. Box 47611
Olympia, WA 98504-7611

For Fiscal Office Use Only:
001-NSR-216-0299-000404

Check the box for the location of your proposal. For assistance, call the contact listed below:		
	Ecology Permitting Office	**Contact**
☐ **CRO**	**Chelan, Douglas, Kittitas, Klickitat, or Okanogan County** Ecology Central Regional Office – Air Quality Program	Lynnette Haller (509) 457-7126 lynnette.haller@ecy.wa.gov
☒ **ERO**	**Adams, Asotin, Columbia, Ferry, Franklin, Garfield, Grant, Lincoln, Pend Oreille, Stevens, Walla Walla or Whitman County** Ecology Eastern Regional Office – Air Quality Program	Greg Flibbert (509) 329-3452 gregory.flibbert@ecy.wa.gov
☐ **NWRO**	**San Juan County** Ecology Northwest Regional Office – Air Quality Program	David Adler (425) 649-7082 david.adler@ecy.wa.gov
☐ **IND**	**For actions taken at** **Kraft and Sulfite Paper Mills and Aluminum Smelters** Ecology Industrial Section – Waste 2 Resources Program Permit manager: ______________________	Garin Schrieve (360) 407-6916 garin.schrieve@ecy.wa.gov
☐ **NWP**	**For actions taken on the** **US Department of Energy Hanford Reservation** Ecology Nuclear Waste Program	Philip Gent (509) 372-7983 philip.gent@ecy.wa.gov

If you need this document in a format for the visually impaired, call the Air Quality Program at 360-407-6800. Persons with hearing loss can call 711 for Washington Relay Service. Persons with a speech disability can call 877-833-6341.

February 2015 Notice of Construction Application

Check the box below for the fee that applies to your application.

New project or equipment:

☒	**$1,500: Basic project** initial fee covers up to 16 hours of review. $875 was paid in October, 2014. An additional check for $625 is enclosed to bring the total to $1,500.
☐	**$10,000: Complex project** initial fee covers up to 106 hours of review.

Change to an existing permit or equipment:

☐	**$200: Administrative or simple change** initial fee covers up to 3 hours of review Ecology may determine your change is complex during completeness review of your application. If your project is complex, you must pay the additional $675 before we will continue working on your application.
☐	**$875: Complex change** initial fee covers up to 10 hours of review
☐	**$350** flat fee: **Replace or alter control technology equipment under WAC 173-400-114** Ecology will contact you if we determine your change belongs in another fee category. You must pay the fee associated with that category before we will continue working on your application.

Read each statement, then check the box next to it to acknowledge that you agree.	
☒	The initial fee you submitted may not cover the cost of processing your application. Ecology will track the number of hours spent on your project. If the number of hours Ecology spends exceeds the hours included in your initial fee, Ecology will bill you $95 per hour for the extra time.
☒	You must include all information requested by this application. Ecology may not process your application if it does not include all the information requested.
☒	Submittal of this application allows Ecology staff to visit and inspect your facility.

DEPARTMENT OF ECOLOGY
State of Washington

February 2015 Notice of Construction Application

Part 1: General Information

I. Project, Facility, and Company Information

1. Project Name Permit Modification for Intergate-Quincy Data Center
2. Facility Name Intergate-Quincy Data Center
3. Facility Street Address 2200 M Street NE, Quincy, WA 98848
4. Facility Legal Description Not applicable
5. Company Legal Name (if different from Facility Name) Intergate Quincy LLC
6. Company Mailing Address (street, city, state, zip) 12201 Tukwila International Blvd., Fourth Floor, Seattle, WA 98168

II. Contact Information and Certification

1. Facility Contact Name (who will be onsite) Cris Engel	
2. Facility Contact Mailing Address (if different than Company Mailing Address) 2200 M Street NE, Quincy, WA 98848	
3. Facility Contact Phone Number 509-449-1368	4. Facility Contact E-mail criseng@sabey.com
5. Billing Contact Name (who should receive billing information) Lisa Carr	
6. Billing Contact Mailing Address (if different than Company Mailing Address) 12201 Tukwila International Blvd., Fourth Floor, Seattle, WA 98168	
7. Billing Contact Phone Number 206-281-8700	8. Billing Contact E-mail
9. Consultant Name (optional – if 3rd party hired to complete application elements) James Wilder	
10. Consultant Organization/Company Landau Associates	
11. Consultant Mailing Address (street, city, state, zip) 130 2nd Avenue Edmonds, WA 98020	
12. Consultant Phone Number 425-329-0320	13.Consultant E-mail jwilder@landauinc.com
14. Responsible Official Name and Title (who is responsible for project policy or decision-making) John Sabey	
16. Responsible Official Phone 206-281-8700	17. Responsible Official E-mail johns@sabey.com
18. Responsible Official Certification and Signature I certify, based on information and belief formed after reasonable inquiry, the statements and information in this application are true, accurate and complete. Signature________________ Date 2/27/15	

If you need this document in a format for the visually impaired, call the Air Quality Program at 360-407-6800. Persons with hearing loss can call 711 for Washington Relay Service. Persons with a speech disability can call 877-833-6341.

February 2015 Notice of Construction Application

Part 2: Technical Information

The Technical Information may be sent with this application form to the Cashiering Unit, or may be sent directly to the Ecology regional office with jurisdiction along with a copy of this application form.

For all sections, check the box next to each item as you complete it.

III. Project Description

Please attach the following to your application. **Note to Ecology: See attached letter and track-changes text for changes to permit language.**

- ☒ Written narrative describing your proposed project.
- ☐ Projected construction start and completion dates.
- ☐ Operating schedule and production rates.
- ☒ List of all major process equipment with manufacturer and maximum rated capacity.
- ☐ Process flow diagram with all emission points identified.
- ☐ Plan view site map.

- ☐ Manufacturer specification sheets for major process equipment components.
- ☐ Manufacturer specification sheets for pollution control equipment.
- ☐ Fuel specifications, including type, consumption (per hour & per year) and percent sulfur.

Note to Ecology: See attached letter and track-changes text for changes to permit language.

IV. State Environmental Policy Act (SEPA) Compliance

Check the appropriate box below.

☒ SEPA review is complete:
Include a copy of the final SEPA checklist and SEPA determination (e.g., DNS, MDNS, EIS) with your application. **Note to Ecology: We presume that this administrative change does not trigger SEPA.**

☐ SEPA review has not been conducted:

☐ If review will be conducted by another agency, list the agency. You must provide a copy of the final SEPA checklist and SEPA determination before Ecology will issue your permit.
Agency Reviewing SEPA:

DEPARTMENT OF ECOLOGY State of Washington

February 2015 Notice of Construction Application

☐ If the review will be conducted by Ecology, fill out a SEPA checklist and submit it with your application. You can find a SEPA checklist online at www.ecy.wa.gov/programs/sea/sepa/docs/echecklist.doc

V. Emissions Estimations of Criteria Pollutants See attached letter. We have updated the permitted emission rates to account for increased flexibility on the allowable generator loads.

Does your project generate criteria air pollutant emissions? ☐ Yes ☐ No

If yes, please provide the following information regarding your criteria emissions in your application.

☐ The names of the criteria air pollutants emitted (i.e., NO_x, SO_2, CO, $PM_{2.5}$, PM_{10}, TSP, VOC, and Pb)

☐ Potential emissions of criteria air pollutants in tons per hour, tons per day, and tons per year (include calculations)

☐ If there will be any fugitive criteria pollutant emissions, clearly identify the pollutant and quantity

VI. Emissions Estimations of Toxic Air Pollutants. See attached letter. We have updated the permitted emission rates to account for increased flexibility on the allowable generator loads.

Does your project generate toxic air pollutant emissions? ☐ Yes ☐ No

If yes, please provide the following information regarding your toxic air pollutant emissions in your application.

☐ The names of the toxic air pollutants emitted (specified in WAC 173-460-150[1])

☐ Potential emissions of toxic air pollutants in pounds per hour, pounds per day, and pounds per year (include calculations)

☐ If there will be any fugitive toxic air pollutant emissions, clearly identify the pollutant and quantity.

VII. Emission Standard Compliance. See attached letter. We have updated the permitted emission rates to account for increased flexibility on the allowable generator loads.

☐ Provide a list of all applicable new source performance standards, national emission standards for hazardous air pollutants, national emission standards for hazardous air pollutants for source categories, and emission standards adopted under Chapter 70.94 RCW.

Does your project comply with all applicable standards identified? ☒ Yes ☐ No

VIII. Best Available Control Technology

☒ Provide a complete evaluation of Best Available Control Technology (BACT) for your proposal. **See attached letter. We conclude that BACT and tBACT have not changed since the original permit was issued.**

[1] http://apps.leg.wa.gov/WAC/default.aspx?cite=173-460-150

February 2015 Notice of Construction Application

IX. Ambient Air Impacts Analyses **See attached letter. We have updated the permitted emission rates to account for increased flexibility on the allowable generator loads, and we have updated the ambient air assessment.**

Please provide the following:

☐ Ambient air impacts analyses for Criteria Air Pollutants (including fugitive emissions)

☐ Ambient air impacts analyses for Toxic Air Pollutants (including fugitive emissions)

Does your project cause or contribute to a violation of any ambient air quality standard or acceptable source impact level? ☒ Yes ☐ No. **See attached letter. We have updated the permitted emission rates to account for increased flexibility on the allowable generator loads. The currently-permitted DEEP emissions exceed the ASIL, and the proposed DEEP emissions will continue to exceed the ASIL. Our updated ambient impact assessment and our updated DEEP Second Tier Risk Assessment show we will continue to satisfy Ecology's ambient limits.**

APPENDIX B

Proposed Revisions to Approval Order No. 11AQ-E424

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY (Landau Associates 2-18-2015)

IN THE MATTER OF APPROVING A NEW)
AIR CONTAMINANT SOURCE FOR) ORDER No. 11AQ-E424
SABEY INTERGATE QUINCY, LLC)
INTERGATE-QUINCY DATA CENTER)

TO: John Ford, Vice President
Sabey Intergate Quincy, LLC
12201 Tukwila International Blvd
Seattle, WA 98168-5121

EQUIPMENT

The list of equipment that was evaluated for this order of approval, as described in the original 2011 air quality permit application package, consisted~~s~~ of 44 Caterpillar Model 3516 diesel engines used to power emergency electrical generators. The forty-four 2.0 megawatt (MWe) generators presented in the permit application indicated ~~will have~~ a combined capacity of 88 MWe. Provisions for the use of smaller ~~Caterpillar~~ engines and engines supplied by other manufacturers are contained in this Approval Order. Other generator manufacturers and smaller generator sizes are allowed, as long as the hourly emission rates for all pollutants from each installed engine are no more than the mass emission limits listed in Condition 5. Annual operations and emissions will be restricted by 263,725 gallons per year of fuel consumption and an average of 57.5 hours per year of engine operation. Each engine will operate for an average of approximately 1.5 hour per month for required monthly maintenance testing, at an average electrical load of either 50% of the standby electrical rating using a load bank, or alternatively at zero electrical load. The generators will be installed in three construction phases. ~~Phase 1 will consist of~~Most of the twelve ~~2.0 MWe~~ approved generators (each up to 2.0 MWe) ~~that will be installed upon approval~~for Phase 1 were installed between 2012 and 2014 in compliance with the original 2011 Approval Order, and the remainder of the Phase 1 engines will be installed upon approval. Phase 2 and 3 will consist of sixteen ~~2.0 MWe~~ generators (each Phase, up to 2.0 MWe), and will be installed at the facility as independent tenant companies contract for space at the Intergate-Quincy Data Center.

Table 1.1: ~~2.0 MWe~~ Emergency Engine & Generator Serial Numbers

Phase	Unit ID	Allowed Capacity MWe	Mfr. And Model No.	Installed Capacity MWe	Engine SN	Generator SN	Build date
Phase 3	A01	2.0		~~2.0~~	~~EBG00972~~	~~SBG0124~~	~~07/22/2011~~
"	A02	2.0		~~2.0~~	~~EBG00973~~	~~SBG1025~~	~~07/22/2011~~
"	A03	2.0		~~2.0~~	~~EBG00975~~	~~SBG1026~~	~~07/22/2011~~
"	A04	2.0		~~2.0~~			
"	A05	2.0		~~2.0~~			
"	A06	2.0		~~2.0~~			
"	A07	2.0		~~2.0~~			

“	A08	2.0		~~2.0~~			
“	A09	2.0		~~2.0~~			
“	A10	2.0		~~2.0~~			
“	A11	2.0		~~2.0~~			
“	A12	2.0		~~2.0~~			
“	A13	2.0		~~2.0~~			
“	A14	2.0		~~2.0~~			
“	A15	2.0		~~2.0~~			
“	A16	2.0		~~2.0~~			
Phase 2	B01	2.0		~~2.0~~			
“	B02	2.0		~~2.0~~			
“	B03	2.0		~~2.0~~			
“	B04	2.0		~~2.0~~			
“	B05	2.0		~~2.0~~			
“	B06	2.0		~~2.0~~			
“	B07	2.0		~~2.0~~			
“	B08	2.0		~~2.0~~			
“	B09	2.0		~~2.0~~			
“	B10	2.0		~~2.0~~			
“	B11	2.0		~~2.0~~			
“	B12	2.0		~~2.0~~			
“	B13	2.0		~~2.0~~			
“	B14	2.0		~~2.0~~			
“	B15	2.0		~~2.0~~			
“	B16	2.0		~~2.0~~			
Phase 1	QC3-A ~~C01~~	2.0	Caterpillar 3512C	1.5~~2.0~~	EBG00972	G5Y00653	07/22/2011
“	QC3-B ~~C02~~	2.0	“	1.5~~2.0~~	EBG00975	G5Y00652	07/22/2011
“	QC3-C ~~C03~~	2.0	“	1.5~~2.0~~	EBG00973	G5Y00654	07/22/2011
“	QC1-A ~~C04~~	2.0	Caterpillar 3516C	2.0~~2.0~~	DD600363	G7F00178	11/24/2013
“	QC1-B ~~C05~~	2.0	“	2.0~~2.0~~	DD600364	G7F00177	11/22/2013
“	QC4-A ~~C06~~	2.0	Caterpillar 3512C	1.5~~2.0~~	CT200132	G2N00529	3/5/2014
“	QC4-B ~~C07~~	2.0	“	1.5~~2.0~~	CT200134	G2N00532	3/7/2014
“	QC4-C ~~C08~~	2.0	“	1.5~~2.0~~	CT200133	G2N00531	3/5/2014
“	QC2-A~~C09~~	2.0	Caterpillar 3516C	2.0~~2.0~~	DD600488	G7F00188	7/9/2014
“	QC2-B~~C10~~	2.0	“	2.0~~2.0~~	DD600490	G7F00187	7/9/2014
“	C11	2.0		~~2.0~~			
“	C12	2.0		~~2.0~~			
total	44	88.0		~~88.0~~			

The Intergate-Quincy Data Center- will utilize -Munters Model PV-W35-PVT cooling units or equivalents to dissipate heat from electronic equipment at the facility.

Table 1.2: Munters Model PV-W35-PVT Cooling Units			
	# Fans per	# Cooling Units	Total # Cooling

	Cooling Unit	per engine	Units
Total	3	4	176

PROJECT SUMMARY

The Intergate-Quincy Data Center Phase 1 construction will consist of Building C with 135,257 ft^2 of floor space. Phase 2 and 3 construction will consist of Buildings A and B, respectively, with 186,660 ft^2 of floor space each. The data center will be leased for occupancy by companies that require a fully supported data storage and processing facility. Air contaminant emissions from the Intergate-Quincy Data Center project have been based primarily on operation of the 44 emergency generator engines. Table 2a contains criteria pollutant potential- to- emit for the diesel engines at the Intergate-Quincy Data Center project. Table 2b contains toxic air pollutant potential- to- emit for diesel engines at the the Intergate-Quincy Data Center project. Table 2c contains emissions from the cooling systems.

Table 2a: Criteria Pollutant Potential to Emit for Diesel Engines at 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~~23.9
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 Total	EPA Tier 2	3.50	11.9 ~~14.15~~
2.1.2a CO 10% load	EPA Tier 2	3.50	na
2.1.2b CO 50% load	EPA Tier 2	3.50	na
2.1.2c CO 75% load	EPA Tier 2	3.50	na
2.1.2d CO 100% load	EPA Tier 2	3.50	na
2.1.3 SO_2	Mass Balance	na	0.028
2.1.4 $PM_{2.5}$/DEEP Total	EPA Tier 2	0.20	~~0.809~~ 0.467
2.1.4a DEEP 10% load	Caterpillar	0.67	na
2.1.4b DEEP 50% load	Caterpillar	0.108	na
2.1.4c DEEP 75% load	Caterpillar	0.0605	na
2.1.4d DEEP 100% load	Caterpillar	0.0477	na
2.1.5 VOC	EPA Tier 2	0.282	1.43 ~~1.14~~

Comment [jw1]: Ecology's Second Tier report used the correct value of 0.31 tpy. We now request to increase to 0.467.

Table 2b: Toxic Air Pollutant Potential to Emit for Diesel Engines at 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	1.9 ~~1.42~~E-04
2.1.8 Benzene	7.76E-04	1.9 ~~1.4~~0E-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	3.1 ~~1.96~~E-03
2.1.11 1,3 Butadiene	1.96E-05	4.7 E-04 ~~3.53E-04~~
2.1.12 Formaldehyde	7.89E-05	1.43E-03
2.1.13 Acetaldehyde	2.52E-05	4.55E-04
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~~ 0.467
2.1.24 Carbon monoxide	EPA Tier 2	11.9 ~~14.15~~
2.1.25 Sulfur dioxide	EPA Tier 2	0.028
2.1.26 Primary NO_2*	10% total NOx	~~2.95~~ 2.39

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

Comment [jw2]: Ecology's Second Tier report used the correct value of 0.31 tpy. We now want to increase to 0.467.

The Intergate-Quincy Data Center will utilize cooling systems to dissipate heat from electronic equipment at the facility. The tenants at the Intergate-Quincy Data Center may use a variety of 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 cooling units or equivalents at full buildout. The emission rate contained in Tabel 2.c has been estimated based on total water consumption (water evaporation plus sump bleed-down) and a maximum drift rate of 0.001% of water consumption. Actual water consumption from evaporation will be approximately 66% of total water consumption.

Table 2.c: 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

*"TDS" stands for Total Dissolved Solids.

DETERMINATIONS

In relation to this project, the State of Washington Department of Ecology (Ecology), pursuant to Revised Code of Washington (RCW) 70.94.152, Washington Administrative Code (WAC) 173-460-040, and WAC 173-400-110, makes the following determinations:

1. The project, if constructed and operated as herein required, will be in accordance with applicable rules and regulations, as set forth in Chapter 173-400 WAC, and Chapter 173-460 WAC, and the operation thereof, at the location proposed, will not emit pollutants in concentrations that will endanger public health.

2. The proposed project, if constructed and operated as herein required, will utilize best available control technology (BACT) as defined below:

Table 3: Best Available Control Technology Requirements	
Pollutant(s)	**BACT Determination**
Particulate matter (PM), carbon monoxide and volatile organic compounds (VOC)	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; c. Compliance with the operation and maintenance restrictions of 40 CFR Part 60, Subpart IIII; and d. Maintaining the water droplet drift rate from cooling systems and drift eliminators to a maximum drift rate of 0.001% of the circulating water flow rate.
Nitrogen oxides (NOx)	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.
Sulfur dioxide	Use of ultra-low sulfur diesel fuel containing no more than 15 parts per million by weight of sulfur.

3. The proposed project, if constructed and operated as herein required, will utilize best available control technology for toxic air pollutants (tBACT) as defined below:

Table 4: Best Available Control Technology for Toxics Requirements	
Toxic Air Pollutant(s)	**tBACT Determination**
Acetaldehyde, carbon monoxide, acrolein, benzene, benzo(a)pyrene, 1,3-butadiene, diesel engine exhaust particulate, formaldehyde, propylene, toluene, total PAHs, xylenes	Compliance with the VOC BACT requirement.
Nitrogen dioxide	Compliance with the NOx BACT requirement.
Sulfur dioxide	Compliance with the SO_2 BACT requirement.

4. The modeled ambient concentrations of two toxic air pollutants – diesel engine exhaust particulate matter and nitrogen dioxide – exceed the Acceptable Source Impact Levels (ASILs) for those pollutants, as defined in Chapter 173-460 WAC. Ecology has evaluated the health risks associated with diesel engine exhaust particulate and nitrogen dioxide emissions from the proposed project, in accordance with WAC 173-460-090. Ecology has concluded that the health risks from the project are acceptable as defined in WAC 173-460-090(7). The technical analysis supporting this determination is hereby incorporated into this Notice of Construction Approval Order.

THEREFORE, IT IS ORDERED that the project as described in the Notice of Construction application and more specifically detailed in plans, specifications, and other information submitted to Ecology is approved for construction and operation, provided the following are met:

APPROVAL CONDITIONS

1. **ADMINISTRATIVE CONDITION**

1.1 Sabey Intergate shall schedule a meeting with Quincy School District officials by no later than July 19, 2011. The purpose of the meeting will be to both communicate, and better understand, any potential concerns or complaints that the Quincy School District may have regarding emergency generator maintenance testing and operation. In addition, Sabey Intergate will provide school administrators with the telephone number for the Intergate-Quincy Data Center and a 24-hour contact number for a Sabey Intergate manager. The school administrators shall also be provided a maintenance testing schedule as developed by Sabey Intergate. The Intergate-Quincy Data Center will notify the school whenever (Ecology) approved changes occur in the maintenance testing schedule. As decided by the school administrators and the Intergate-Quincy Data Center, an ongoing relationship shall be established to facilitate future communications.

1.2 Sabey-Intergate submitted a NOC application for the Intergate-Quincy Data Center to determine compliance with all applicable state and federal air quality regulations. At full build out of all three phases, the Intergate-Quincy Data Center is anticipated to be occupied by up to eight independent tenants. Each independent tenant will be issued an approval order based on the parameters established in this approval order. A NOC application (form only) and engine manufacturer's specification sheets will be required from each independent tenant prior to occupancy, subject to Approval Conditions 2.4 and 2.7. Ecology will review the NOC application form to determine whether the proposed project conforms to the parameters contained in this approval order. If the proposed project conforms to the approval order, Ecology will issue an administrative approval order to the applicant without further review. If the proposed project does not conform to this approval order, Ecology will require new source review under Chapters 173-400 WAC and 173-460 WAC. The purpose of the administrative approval orders for each independent tenant is to establish responsibility for their individual operations, and to ensure conformity to this approval Order.

1.3 The administrative approval orders issued to each independent tenant will contain conditions that will require coordination of operations with other tenants to provide for compliance with this approval order with the intent to minimize community impacts.

1.4 Sabey shall make available information on diesel engine exhaust health risks and emergency generator operations to existing residents and commercial and industrial facilities within 0.25 miles of the Intergate-Quincy Data Center property boundaries. Information on diesel exhaust health risks and emergency generator operations shall be provided to the City of Quincy Building and Planning Department for distribution to new homeowners and businesses that locate on undeveloped parcels within 0.25 miles of the Intergate-Quincy Data Center property boundary. The health risk information may be, or should be similar to, Ecology Focus on Diesel Exhaust Health Risks dated February 2011, Publication Number 11-02-005. A copy of the materials to be used to comply with this condition shall be provided to Ecology for review, and distributed prior to starting Phase 1 operations.

2. **EQUIPMENT RESTRICTIONS**

2.1. Any engine used to power the electrical generators shall be certified by the manufacturer to meet 40 CFR 89 Tier II emission levels or other specifications as required by the EPA at the time the engines are installed. Each engine to be installed must be permanently labeled by the manufacturer as an emergency engine in accordance with 40 CFR § 60.4210(f). Each engine approved in this Order must operate as an emergency engine as defined at WAC 173-400-930(3).

2.2. The only engines and electrical generating units approved for operation at the Intergate-Quincy Data Center are those listed by serial number in Table 1 above.

2.3. Replacement of failed engines with identical engines (same manufacturer and model) requires notification prior to installation but will not require new source review unless there is an increase in emission rates or community impacts.

2.4. The installation of any new engines after XXXX [INSERT NEW DATE, 36 MONTHS OR LONGER AFTER THE APPROVAL DATE]~~July 1, 2014~~ will require notification to Ecology that includes engine manufacturer's specification sheets. Ecology will decide whether new source review is required based on various factors including whether the new engines will have either an increased emission rate or result in an emission concentration that may increase community impacts over those evaluated for this approval Order, or if an update to the current BACT analysis is necessary.

2.5. The forty-four (44) ~~Caterpillar Model 3516~~ engine~~s~~ exhaust stack heights shall be greater than or equal to 48 feet above ground level and will be no more than 16 inches in diameter. All engines that may be used for this project shall be required to verify that exhaust stack parameters such as diameter, height, and exhaust rate and velocity do not result in community emissions impacts greater than what was evaluated for this project.

2.6. The manufacture and installation of the forty-four (44) engine/generator sets proposed for Building A, Building B and Building C of the project shall occur by XXXXXX [INSERT DATE XXX MONTHS AFTER THE APPROVAL DATE OF THIS REVISED PERMIT] ~~January 1, 2014~~. If the manufacture and installation of the engines has not been completed within the above schedule, new source review may be required prior to installation, and community impacts will be re-evaluated if new source review is required. Sabey Intergate may request an extension of this time schedule, and Ecology may approve of an extension without revision to this Order.

2.7. This Order only applies to the forty-four (44) ~~Caterpillar Model 3516~~ engines, each with a rated full standby capacity ~~of~~ up to 3,056~~2937~~ hp, which are consistent with the

Comment [jw3]: Since this is a phased project with the schedule driven by market demand, can we extend the commence construction deadline longer than 36 months?

Can we declare this to be a "phased project", and extend the period even longer? Presumably still subject to extended BACT review.

Comment [jw4]: Since this is a phased project with the schedule driven by market demand, can we extend the commence construction deadline longer than 36 months?

Comment [jw5]: Given this flexible condition, is there a benefit to specify a commence construction deadline that is more than 36 months?

engines that were evaluated in the Notice of Construction application and second tier review. New source review will not be required for engines from other manufacturers or smaller engines with a rated full standby capacity of less than ~~2937~~ 3,056 hp that comply with the engine certification requirements contained in Approval Condition 2.1 and the per-engine and facility-wide emission limits in Condition 5 unless there is an increase in community emission impacts. On a case-by-case basis, Ecology may require additional ambient impacts analyses prior to installation of smaller engines.

Comment [jw6]: The bhp for the three manufacturers ranges from 2191 (Cummins) up to 3,056 (MTU), but any selected manufacturer must guarantee the load-specific lbs/hr emission limits listed in Condition 5.

3. OPERATING LIMITATIONS

3.1. The fuel consumption at the Intergate-Quincy Data Center facility shall be limited to a total of 263,725 gallons per year of diesel fuel equivalent to on-road specification No. 2 distillate fuel oil (less than 0.00150 weight percent sulfur). Total annual fuel consumption by the facility may be averaged over a three (3) year period using monthly rolling totals.

3.2 Except as provided in Approval Condition 3.5, the forty-four (44) Intergate-Quincy Data Center engines are limited to the following average hours of operation, averaging periods, total fuel limit, and number of engines operating concurrently. The allowable annual runtime may be averaged across all generators in service at the Intergate-Quincy Data Center during the year, and they may be averaged over a three (3) year period using monthly rolling totals.~~:~~

Table 3.2: Engine Operating Restrictions (Revisions Feb-2015)

Operating Activity	Average hours/year per engine, 3-year monthly rolling totals	Average Operating Electrical Loads (%)	Facility-Wide Diesel fuel gallons/year, 3-year monthly rolling totals	# Operating Concurrently
Monthly Testing	16.5	~~Idle~~ Zero electrical load to 50%		4
Annual Load Bank Testing	6	100%		4
Combined Electrical Bypass and Power Outage	35 ~~15~~	Any random load from zero to 100% ~~75%~~		22 during electrical bypass; 44 during power outage; 1 during corrective testing
~~Corrective Tests~~	~~12~~	~~50%~~		~~1~~
~~Power Outage~~	~~8~~	~~75%~~		~~44~~
Total	57.5		263,725	

Comment [jw7]: Sabey requests to run more than one building at a time for the triennial electrical bypass.

3.3. A load bank will be used for electrical energy dissipation whenever prescheduled monthly maintenance testing, corrective testing or annual load bank testing occurs above zero electrical load ~~idle~~.

3.4. The forty-four (44) ~~Caterpillar Model 3516~~ engines at the Intergate-Quincy Data Center require periodic scheduled operation. To mitigate engine emission impacts, Intergate-Quincy Data Center will perform all scheduled engine maintenance testing, bypass operations, and load testing during daylight hours. The Intergate-Quincy Data Center shall develop an operating schedule for tenants of the facility, and that schedule shall be available for review by Ecology upon request. Changes to the operating schedule will not trigger revision or amendment of this Order as long as the number of engines operating concurrently do not exceed Table 3.2 in this Order.

3.5. Initial start-up (commissioning) testing for the forty-four (44) ~~Caterpillar Model 3516~~ engines at the Intergate-Quincy Data Center is restricted to an average of 30 hours per generator and 2309 gallons of fuel per generator, averaged over all generators installed during any consecutive 3 year period.

3.5.1 Except during site integration testing as specified below, only one engine shall be operated at any one time during start-up testing.

3.5.2 During a site integration test, no more than sixteen (16) generator engines may operate concurrently for up to four continuous hours.

3.5.3 All startup and commissioning testing shall be conducted during daylight hours.

3.5.4 Fuel use limits contained in Approval Conditions 3.1 and emission limits contained in Approval Conditions 5, remain in effect during initial start-up testing.

3.6. The Intergate-Quincy Data Center will utilize up to 176 Munters PV-W35-PVT or equivalent cooling units. Each individual unit shall maintain a maximum drift rate to no more than 0.001 percent of the circulating water rate.

4. GENERAL TESTING AND MAINTENANCE REQUIREMENTS

4.1. The Intergate-Quincy Data Center will follow engine-manufacturer's recommended diagnostic testing and maintenance procedures to ensure that each engine will conform to 40 CFR 89 emission specifications throughout the life of each engine.

4.2 Within 12 months of installation of any new proposed engine approved in this Order, the Intergate-Quincy Data Center shall measure concentrations of nitric oxide (NO), nitrogen dioxide (NO_2), carbon monoxide (CO), and oxygen (O_2) leaving that engine's exhaust stack in accordance with Approval Condition 4.3. This testing will serve to demonstrate compliance with the emission limits contained in Section 5, and as an indicator of proper operation of the engines. Periodic testing shall be conducted at the conclusion, or upon termination, of the manufacturer's warranty term for each engine, on a frequency of every 60 months from warranty expiration date, or 3,000 hours of operation, whichever occurs first.

4.3 The following procedure shall be used for each test for the engines as required by Approval Condition 4.2 unless an alternate method is proposed by the Intergate-Quincy Data Center and approved in writing by Ecology prior to the test.

4.3.1 Initial emissions testing should be combined with start-up and commissioning testing. Subsequent periodic emissions testing should be combined with pre-scheduled maintenance testing and annual load bank engine testing. Additional operation of the engines for the purpose of emissions testing beyond the operating hours allowed in this Order may be allowed by Ecology upon request.

4.3.2 NO, NO_2, and CO emissions measurement shall be conducted for each engine at each of the proposed average ~~engine~~ generator electrical loads of ~~10% (idle)~~, 50%, 75%, and 100% that correspond to scheduled engine testing scenarios in Approval Conditions 3.2.

Comment [jw8]: John Poffenroth and Ryan Beebout of Sabey agreed to eliminate the stack testing at 10% or zero load, because Sabey actually runs at those loads for only very infrequent and transient events such as cooldown.

4.3.3 EPA Reference Methods from 40 CFR 60 and/or 40 CFR 89 as appropriate for each pollutant shall be used for no less than two engines from each manufacturer and each size engine from each manufacturer. A test plan will be submitted for Ecology approval at least 30 days before any testing is conducted.

Comment [jw9]: Conditions 4.3.3 and 4.3.7 seem to conflict. 2 engines tested? 4 engines tested?

4.3.4 The Intergate-Quincy Data Center may propose using a portable emissions instrument analyzer after compliance is verified under Approval Condition 4.3.3. The analyzer model must be approved in writing by Ecology prior to testing. The analyzer shall be calibrated using EPA Protocol 1 gases according to the procedures for drift and bias limits outlined in EPA Methods 7E and Method 10. Alternate calibration procedures may be approved in advance by Ecology.

4.3.5 Three test runs shall be conducted for each engine when using a portable emissions instrument analyzer. Each run must last at least 15 minutes. Analyzer data shall be recorded at least once every minute during the test. Engine run time and fuel usage shall be recorded during each test run for each load and shall be included in the test report.

4.3.6 The F-factor method, as described in EPA Method 19, may be used to calculate exhaust flow rate through the exhaust stack. The fuel meter data, as measured according to Approval Condition 4.6, shall be included in the test report, along with the emissions calculations.

4.3.7 If the measured NO, NO_2 and CO emission rates from the first 4 engines of each make, size, and model number are found to be consistent and less than the emission limits contained in this order, the Intergate-Quincy Data Center may request approval from Ecology to discontinue initial compliance emission testing on the remainder of the engines of that make and model number.

Comment [jw10]: Conditions 4.3.3 and 4.3.7 seem to conflict. 2 engines tested? 4 engines tested?

4.4 Each engine shall be equipped with a properly installed and maintained non-resettable meter that records total operating hours.

4.5 Each engine shall be connected to a properly installed and maintained fuel flow monitoring system that records the amount of fuel consumed by that engine during operation.

4.6 Ecology may relax the frequency of periodic testing under Approval Condition 4.2 if the manufacturer's warranty term for each engine is extended. Periodic testing will be required upon conclusion or termination of the manufacturer's warranty.

5 EMISSION LIMITS

The forty-four (44) engines shall meet the emission rate limitations contained in this section. The listed emission limits apply for any engine manufacturer and any engine size with a rated capacity up to 3,056 bhp. Unless otherwise approved by Ecology in writing, compliance with emission limits for those pollutants that are required to be tested under Approval Conditions 4.2 and 4.3 shall be based on emissions test data as determined according to those approval conditions.

Comment [jw11]: The rated bhp from the 3 manufacturers ranges from 2919 (Cummins) to 3,056 (MTU), but they will all guarantee the same lbs/hr emission rates.

5.1 If required to demonstrate compliance with the g/kW-hr EPA Tier 2 average emission limits through stack testing, the Intergate-Quincy Data Center shall conduct exhaust stack testing and average emission rates for 5 individual operating loads (10%, 25%, 50%, 75% and 100%) according to 40 CFR §89.410, Table 2 of Appendix B, 40 CFR Part 89, Subpart E, and/or 40 CFR Part 60, Subpart IIII, or any other applicable EPA requirement in effect at the time the engines are installed.

5.2 Nitrogen oxide (NOx) emissions from each of the forty-four (44) ~~Caterpillar Model 3516~~ engines ~~rated at 2937 brake horse power~~ shall not exceed the following emission rates at the stated loads, based on emission factors provided by the engine manufacturer:

Table 5.2: Nitrogen oxide (NOx) emission rate limits

	Operating Scenario	Operating Electrical Load		Emissions Limit per engine in lb/hr[1]
5.2.1	Annual Load Testing	100%		41.9
5.2.2	Electrical Bypass	~~100~~75%		~~41.9~~22.5
5.2.3	Monthly Maintenance	50% ~~10%~~ Zero load		15.3 6.49
5.2.4	Corrective Testing	50%		15.3
5.2.5	Power Outages	75%		22.5

[1] Caterpillar "Not To Exceed" or EPA Tier-2 (6.12 g/kw-hr) whichever is higher

5.3 Nitrogen dioxide (NO_2) emissions from each of the forty-four (44) ~~Caterpillar Model 3516~~ engines ~~rated at 2937 brake horse power~~ shall not exceed the following emission rates at the stated loads, based on emission factors provided by the engine manufacturer:

Table 5.3: Nitrogen dioxide (NO_2) emission rate limits				
	Operating Scenario	Operating Electrical Load		Emissions Limit per engine in lb/hr[1]
5.3.1	Annual Load Testing	100%		4.19
5.3.2	Electrical Bypass	~~100~~75%		~~4.19~~2.25
5.3.3	Monthly Maintenance	50% ~~10%~~ Zero load		1.53 0.65
5.3.4	Corrective Testing	50%		1.53
5.3.5	Power Outages	75%		2.25

[1] 10% of total NOx emission limits

5.4 Carbon monoxide emissions from each of the forty-four (44) ~~Caterpillar Model 3516~~ engines ~~rated at 2937 brake horse power~~ shall not exceed the following emission rates at the stated loads, based on emission factors provided by the engine manufacturer:

Table 5.4: Carbon monoxide (CO) emission rate limits				
	Operating Scenario	Operating Electrical Load		Emissions Limit per engine in lb/hr[1]
5.4.1	Annual Load Testing	100%		16.9
5.4.2	Electrical Bypass	~~100~~75%		~~16.9~~12.7
5.4.3	Monthly Maintenance	50% ~~10%~~Zero load		8.75 ~~2.35~~ 4.05
5.4.4	Corrective Testing	50%		8.75
5.4.5	Power Outages	75%		12.7

[1] Caterpillar Not To Exceed ” or EPA Tier-2 (3.5 g/kw-hr) whichever is higher

Comment [jw12]: Ecology erred in calculating the allowable CO at 10% load. It should be 4.05 lbs/hr, which is the NTE value, which is higher than the Tier-2 value from 3.5 g/kW-hr.

5.5 Diesel Engine Exhaust Particulate (DEEP) emissions from each of the forty-four (44) ~~Caterpillar Model 3516~~ engines ~~rated at 2937 brake horse power~~ shall not exceed the following emission rates at the stated loads, based on emission factors provided by the engine manufacturer:

Table 5.5: Diesel Engine Exhaust Particulate (DEEP) emission rate limits				
	Operating Scenario	Operating Electrical Load		Emissions Limit per engine in lb/hr[1]
5.5.1	Annual Load Testing	100%		0.23
5.5.2	Electrical Bypass	~~100~~75%		~~0.23~~0.22
5.5.3	Monthly Maintenance	50% ~~10%~~ Zero load		0.27 0.45
5.5.4	Corrective Testing	50%		0.27
5.5.5	Power Outages	75%		0.22

[1] Caterpillar “Not-to-Exceed” data

5.6 Particulate matter emissions from all 44 engines combined shall not exceed ~~0.809~~ 0.467 tons/yr (~~1618~~ 934 lbs/yr). All PM emissions shall be considered diesel engine exhaust particulate (DEEP) and $PM_{2.5}$ emissions.

Comment [jw13]: Ecology's Second Tier HIA used the correct value of 0.31 tpy.

5.7 Nitrogen dioxide (NO_2) emissions from all 44 engines combined shall not exceed 99 lbs/hr and ~~2.95~~2.39 tons/yr.

5.8 Volatile organic compound (VOC) emissions from all 44 engines combined shall not exceed 1.43 ~~1.14~~ tons/yr (2860 ~~2280~~ lbs/yr).

5.9 Sulfur dioxide emissions from all 44 engines combined shall not exceed 0.028 tons/yr (56 lbs/yr).

5.10 Visual emissions from each diesel electric generator exhaust stack while operating at an electrical load greater than 20 percent or less than 5 percent shall be no more than 5 percent opacity, and visible emissions during operating loads between 5 to 20 percent shall be no more than 10 percent opacity, with the exception of a two (2) minute period after unit start-up. Visual emissions shall be measured by using the procedures contained in 40 CFR 60, Appendix A, Method 9.

Comment [jw14]: The 1500 kW gens exhibited 6% opacity when operating at 10 percent load, but they we well below 5% opacity when operating at zero load, 50%, 75% and 100%.

6 OPERATION AND MAINTENANCE MANUALS

A site-specific O&M manual for the Intergate-Quincy Data Center facility equipment shall be developed and followed. Manufacturers' operating instructions and design specifications for the engines, generators, and associated equipment shall be included in the manual. The manual shall include the manufacturers' recommended protocols for extended low-load operation. The O&M manual shall be updated to reflect any modifications of the equipment or its operating procedures. Emissions that result from failure to follow the operating procedures contained in the O&M manual or manufacturer's operating instructions may be considered proof that the equipment was not properly installed, operated, and/or maintained. The O&M manual for the diesel engines and associated equipment shall at a minimum include:

Comment [jw15]: Include the manufacturer low-load sheets provided by Ecology.

6.1 Manufacturer's testing and maintenance procedures that will ensure that each individual engine will conform to the EPA Tier Emission Standards appropriate for that engine throughout the life of the engine.
6.2 Normal operating parameters and design specifications.
6.3 Operating maintenance schedule.

7 SUBMITTALS

All notifications, reports, and other submittals shall be sent to:

Washington State Department of Ecology
Air Quality Program
4601 N. Monroe Street
Spokane, WA 99205-1295

8 RECORDKEEPING

All records, Operations and Maintenance Manual, and procedures developed under this Order shall be organized in a readily accessible manner and cover a minimum of the most recent 60-month period. Any records required to be kept under the provisions of this Order shall be provided within 30 days to Ecology upon request. The following records are required to be collected and maintained.

8.1 Fuel receipts with amount of diesel and sulfur content for each delivery to the facility.

8.2 Monthly and annual hours of operation for each diesel engine.

8.3 Purpose, electrical load and duration of runtime for each diesel engine period of operation.

8.4 Records of algebraic equations used to calculate load-specific NOx emissions.

~~8.3~~8.5 Facility-wide actual 1-hour average NOx emission rates during each unplanned power outage and scheduled electrical bypass event that activates more than 16 generators simultaneously. Compare the actual NOx emission rate to the allowable limit of 990 lbs/hour.

~~8.4~~8.6 Annual gross power generated by each independent building quadrant ~~tenant~~ at the facility and total annual gross power for the facility.

~~8.5~~8.7 Upset condition log for each engine and generator that includes date, time, duration of upset, cause, and corrective action.

~~8.6~~8.8 Any recordkeeping required by 40 CFR Part 60 Subpart IIII.

8.9 Air quality complaints received from the public or other entity, and the affected emissions units.

Comment [jw16]: We need these, if Ecology wants us to do a quantitative demonstration that the actual facility-wide NOx emissions are less than 990 lbs/hr during each power outage or electrical bypass.

Comment [jw17]: The tenants within each building quadrant wish to remain confidential, so we request that the reporting should require Sabey only to identify the "building quadrant".

9 REPORTING

9.1 Within 10 business days after entering into a binding agreement with an independent tenant, Sabey-Intergate shall provide Ecology with the company and the name and contact information of the company representative. Information on the Phase 2 and 3 engine/generator sets for Equipment Table 1.1 above will be the responsibility of the independent tenants of the Intergate-Quincy Data Center. The serial number, manufacturer make and model, standby capacity, and date of manufacture will be submitted prior to installation for each Phase 1, 2, and 3 engine and generator.

9.2 The following information will be submitted to the AQP at the address in Condition 7 above by January 31 of each calendar year. This information may be submitted with annual emissions information requested by the AQP.

9.2.1 Monthly rolling annual total summary of air contaminant emissions,
9.2.2 Monthly rolling hours of operation with annual total,
9.2.3 Monthly rolling gross power generation with annual total as specified in Approval Condition 8.4,
9.2.4 A listing of each start-up of each diesel engine that shows the purpose, fuel usage, and duration of each period of operation.

9.3 Any air quality complaints resulting from operation of the emissions units or activities shall be promptly assessed and addressed. A record shall be maintained by each tenant of the action taken to investigate the validity of the complaint and what, if any, corrective action was taken in response to the complaint. Ecology shall be notified within three (3) days of receipt of any such complaint.

9.4 Each tenant shall notify Ecology by e-mail or in writing within 24 hours of any engine operation of greater than 60 minutes if such engine operation occurs as the result of a power outage or other unscheduled operation. This notification does not alleviate the tenant from annual reporting of operations contained in any section of Approval Condition 9.

10 GENERAL CONDITIONS

10.1 **Commencing/Discontinuing Construction and/or Operations:** This approval shall become void if construction of the facility is not begun within XX~~18~~ months of permit issuance or if facility operation is discontinued for a period of XX~~eighteen (18)~~ months or more. In accordance with WAC 173-400-111(7)(c), each phase must commence construction within XX~~18~~ months of the projected and approved construction dates in this Order.

Comment [jw18]: Since this is phased project with the construction schedule driven by market demand, can we request a "commence construction" deadline longer than 36 months?

10.2 **Compliance Assurance Access:** Access to the source by representatives of Ecology or the EPA shall be permitted upon request. Failure to allow such access is grounds for enforcement action under the federal Clean Air Act or the Washington State Clean Air Act, and may result in revocation of this Approval Order.

10.3 **Availability of Order and O&M Manual:** Legible copies of this Order and the O&M manual shall be available to employees in direct operation of the diesel electric generation station, and be available for review upon request by Ecology.

10.4 **Equipment Operation:** Operation of the 44 Caterpillar Model 3516 diesel engines used to power emergency electrical generators and related equipment shall be conducted in compliance with all data and specifications submitted as part of the NOC application and in accordance with the O&M manual, unless otherwise approved in writing by Ecology.

10.5 **Modifications:** Any modification to the generators or engines and their related equipment's operating or maintenance procedures, contrary to information in the NOC application, shall be reported to Ecology at least 60 days before such modification. Such modification may require a new or amended NOC Approval Order.

10.6 **Activities Inconsistent with the NOC Application and this Approval Order:** Any activity undertaken by the permittee or others, in a manner that is inconsistent with the NOC application and this determination, shall be subject to Ecology enforcement under applicable regulations.

10.7 **Obligations under Other Laws or Regulations:** Nothing in this Approval Order shall be construed to relieve the permittee of its obligations under any local, state or federal laws or regulations.

All plans, specifications, and other information submitted to the Department of Ecology relative to this project and further documents and any authorizations or approvals or denials in relation thereto shall be kept at the Eastern Regional Office of the Department of Ecology in the "Air

Quality Controlled Sources" files, and by such action shall be incorporated herein and made a part thereof.

Nothing in this approval shall be construed as obviating compliance with any requirement of law other than those imposed pursuant to the Washington Clean Air Act and rules and regulations thereunder.

Authorization may be modified, suspended or revoked in whole or part for cause including, but not limited to the following:

a. Violation of any terms or conditions of this authorization;

b. Obtaining this authorization by misrepresentation or failure to disclose fully all relevant fact.

The provisions of this authorization are severable and, if any provision of this authorization, or application of any provision to any circumstance is held invalid, the application of such provision to other circumstances, and the remainder of this authorization, shall not be affected thereby.

YOUR RIGHT TO APPEAL

You have a right to appeal this Approval Order to the Pollution Control Hearing Board (PCHB) within 30 days of the date of receipt of this Approval Order. The appeal process is governed by Chapter 43.21B RCW and Chapter 371-08 WAC. "Date of receipt" is defined in RCW 43.21B.001(2).

To appeal you must do the following within 30 days of the date of receipt of this Approval Order:

- File your appeal and a copy of this Approval Order with the PCHB (see addresses below). Filing means actual receipt by the PCHB during regular business hours.
- Serve a copy of your appeal and this Approval Order on Ecology in paper form - by mail or in person. (See addresses below.) E-mail is not accepted.

You must also comply with other applicable requirements in Chapter 43.21B RCW and Chapter 371-08 WAC.

ADDRESS AND LOCATION INFORMATION

Street Addresses	Mailing Addresses
Department of Ecology Attn: Appeals Processing Desk 300 Desmond Drive SE Lacey, WA 98503	**Department of Ecology** Attn: Appeals Processing Desk PO Box 47608 Olympia, WA 98504-7608
Pollution Control Hearings Board 1111 Israel RD SW	**Pollution Control Hearings Board** PO Box 40903

STE 301 Tumwater, WA 98501	Olympia, WA 98504-0903

For additional information visit the Environmental Hearings Office Website: *http://www.eho.wa.gov*

To find laws and agency rules visit the Washington State Legislature Website: *http://www1.leg.wa.gov/CodeReviser*

DATED this 26th day of August, 2011, at Spokane, Washington.

Reviewed By:

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David Ogulei, P.E.
Science & Engineering Section
Department of Ecology
State of Washington

Approved By:

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Karen K. Wood, Section Supervisor
Eastern Regional Office
Department of Ecology
State of Washington

Prepared By:

____

Gregory S. Flibbert, Unit Manager
Eastern Regional Office
Department of Ecology
State of Washington

APPENDIX C

Manufacturer Specifications for Alternative Generators

APPENDIX C

GENERATOR SPECIFICATIONS FOR ANY POTENTIAL SUPPLIER (CATERPILLAR, CUMMINS, MTU)

Table 1. Allowable Load-Specific Emission Limits Regardless of Generator Supplier

Electrical Load	**NOx (lbs/hr) (NOC Table 5.2)**	**CO (lbs/hr) (NOC Table 5.4)**	**PM (lbs/hr) (NOC Table 5.5)**
100%	41.9	16.9	0.23
75%	22.5	12.7	0.22
50%	15.3	8.75	0.27
Zero load	6.49	4.05	0.45

Table 2. Comparison of Engine Parameters for 2000 kWe Generators

Manufacturer and Model No.	**Engine Brake Horsepower at 100% Load**	**Fuel Consumption at 100% Load**
Caterpillar 3516DTA	2,937 bhp	139 gal/hr
Cummins DQKAF	3,280 bhp	158 gal/hr
MTU	3,056 bhp	Unspecified

CATERPILLAR

GENERATOR SPECIFICATIONS

Sabey's tenants will use a combination of 2000 kWe, 1750 kWe, and 1500 kWe Caterpillar generators. This package shows emission data for the largest generator (Caterpillar 3516C, 2000 kWe)

GEN SET PACKAGE PERFORMANCE DATA [LA4571]

MARCH 07, 2008

For Help Desk Phone Numbers Click here

Performance Number: DM8263

2,000 kWe Caterpillar

Change Level: 01

Sales Model: 3516CDITA
Combustion: DI
Aspr: TA
Engine Power: 2000 W/F EKW 2080 W/O F EKW 2,937 HP
Speed: 1,800 RPM
After Cooler: ATAAC
Manifold Type: DRY
Governor Type: ADEM3
After Cooler Temp(F): 122
Turbo Quantity: 4
Engine App: GP
Turbo Arrangement: Parallel
Hertz: 60
Engine Rating: PGS
Strategy:
Rating Type: STANDBY
Certification: EPA TIER-2 2006 -

General Performance Data 1

GEN W/F EKW	PERCENT LOAD	ENGINE POWER BHP	ENGINE BMEP PSI	FUEL RATE LB/BHP-HR	FUEL RATE GPH	INTAKE MFLD TEMP DEG F	INTAKE MFLD P IN-HG	INTAKE AIR FLOW CFM	EXH MFLD TEMP DEG F	EXH STACK TEMP DEG F	EXH GAS FLOW CFM
2,000.0	100	2937	307	0.331	138.9	121.5	78.7	6,367.2	1,123.2	761.7	15,135.9
1,800.0	90	2641	276	0.333	125.5	119.7	73.4	6,130.6	1,070.1	722.5	14,097.6
1,600.0	80	2353	246	0.338	113.5	118.2	68.3	5,897.6	1,028.7	696.0	13,197.1
1,500.0	75	2212	231	0.341	107.8	117.5	65.5	5,763.4	1,009.6	685.8	12,766.3
1,400.0	70	2071	216	0.345	102.1	117.0	62.5	5,615.0	990.7	676.6	12,339.0
1,200.0	60	1795	188	0.353	90.4	115.3	55.7	5,247.8	953.2	660.4	11,357.2
1,000.0	50	1521	159	0.358	77.7	113.7	46.6	4,718.0	914.4	649.2	10,096.5
800.0	40	1253	131	0.358	64.1	111.9	35.1	4,001.2	865.2	644.2	8,521.4
600.0	30	979	102	0.365	51.0	110.7	24.3	3,330.2	804.7	635.9	7,045.3
500.0	25	839	88	0.375	44.9	110.1	19.8	3,044.1	767.5	626.7	6,384.9
400.0	20	698	73	0.389	38.7	109.8	15.7	2,782.8	724.6	614.1	5,749.2
200.0	10	409	43	0.451	26.4	109.0	8.9	2,348.4	596.1	540.5	4,516.8

GEN W/F EKW	PE[illegible]	[illegible]GY [illegible]IN
2,000.0	[illegible]	[illegible]5.0
1,800.0	[illegible]	[illegible]9.0
1,600.0	[illegible]	[illegible]1.0
1,500.0	[illegible]	[illegible]1.0
1,400.0	[illegible]	[illegible]8.0
1,200.0	[illegible]	[illegible]5.0
1,000.0	[illegible]	[illegible]8.0
800.0	[illegible]	[illegible]4.0
600.0	[illegible]	[illegible]7.0
500.0	[illegible]	[illegible]3.0
400.0	[illegible]	[illegible]6.0
200.0	[illegible]	[illegible]2.0

EMISSIONS DATA

EPA TIER-2 2006 - ** B5

Gaseous emissions data measurements are consistent with those described in EPA 40 CFR PART 89 SUBPART D and ISO 8178 for measuring HC, CO, PM, and NOx

Gaseous emissions values are WEIGHTED CYCLE AVERAGES and are in compliance with the following non-road regulations:

LOCALITY	AGENCY/LEVEL	MAX LIMITS - g/kW-hr		
U.S. (incl Calif)	EPA/TIER-2	CO:3.5	NOx + HC:6.4	PM:0.2

EXHAUST STACK DIAMETER	8 IN
WET EXHAUST MASS	29,056.9 LB/HR
WET EXHAUST FLOW (761.00 F STACK TEMP)	15,146.47 CFM
WET EXHAUST FLOW RATE (32 DEG F AND 29.98 IN HG)	6,071.00 STD CFM
DRY EXHAUST FLOW RATE (32 DEG F AND 29.98 IN HG)	5,562.07 STD CFM
FUEL FLOW RATE	138 GAL/HR

RATED SPEED "Not to exceed data"

GEN PWR EKW	PERCENT LOAD	ENGINE POWER BHP	TOTAL NOX (AS NO2) LB/HR	TOTAL CO LB/HR	TOTAL HC LB/HR	PART MATTER LB/HR	OXYGEN IN EXHAUST PERCENT	DRY SMOKE OPACITY PERCENT	BOSCH SMOKE NUMBER
2,000.0	100	2937	41.8700	3.4300	.9100	.2300	10.8000	.8000	1.2800
1,500.0	75	2212	22.5400	1.8700	1.1100	.2200	12.3000	.9000	1.2800
1,000.0	50	1521	12.8500	2.0000	1.1300	.2700	13.4000	1.3000	1.2800
500.0	25	839	9.4300	3.9200	.9500	.5700	14.2000	3.1000	1.3100
200.0	10	409	6.4900	4.0500	1.0000	.4500	15.9000	2.8000	1.3100

RATED SPEED "Nominal Data"

GEN PWR EKW	PERCENT LOAD	ENGINE POWER BHP	TOTAL NOX (AS NO2) LB/HR	TOTAL CO LB/HR	TOTAL HC LB/HR	TOTAL CO2 LB/HR	PART MATTER LB/HR	OXYGEN IN EXHAUST PERCENT	DRY SMOKE OPACITY PERCENT	BOSCH SMOKE NUMBER
2,000.0	100	2937	34.8900	1.9100	.6900	3,021.7	.1700	10.8000	.8000	1.2800
1,500.0	75	2212	18.7800	1.0400	.8400	2,348.7	.1600	12.3000	.9000	1.2800
1,000.0	50	1521	10.7100	1.1100	.8500	1,692.1	.2000	13.4000	1.3000	1.2800
500.0	25	839	7.8600	2.1800	.7100	974.4	.4000	14.2000	3.1000	1.3100
200.0	10	409	5.4100	2.2500	.7500	565.0	.3200	15.9000	2.8000	1.3100

These are Caterpillar's vendor guarantees for emission rates on any given engine

	HP	Kwm	NOx lbs/hr	NOx g/kw hr	PM #/hr	PM g/kw hr
75%	2212	1650	22.54	6.20	0.22	0.0605
64%				5.82		
57%				5.52		
50%	1521	1135	17.85	5.14	0.27	0.108
47%				5.01		
100%	2937	2191	41.87	8.68	0.23	0.0477
10%	409	305	6.49	9.66		
10% DPM	407	305	0.45	0.670		

Altitude Capability Data(Corrected Power Altitude Capability)

Ambient Operating Temp. / Altitude	50 F	68 F	86 F	104 F	122 F	NORMAL
0 F	2,937 hp	2,937 hp	2,937 hp	2,937 hp	2,937 hp	2,937 hp
984 F	2,937 hp	2,937 hp	2,937 hp	2,937 hp	2,922 hp	2,937 hp
1,640 F	2,937 hp	2,937 hp	2,937 hp	2,937 hp	2,854 hp	2,937 hp
3,281 F	2,937 hp	2,937 hp	2,863 hp	2,772 hp	2,686 hp	2,922 hp
4,921 F	2,885 hp	2,785 hp	2,694 hp	2,608 hp	2,526 hp	2,780 hp
6,562 F	2,712 hp	2,619 hp	2,533 hp	2,451 hp	2,376 hp	2,643 hp
8,202 F	2,548 hp	2,461 hp	2,379 hp	2,304 hp	2,233 hp	2,510 hp
9,843 F	2,392 hp	2,311 hp	2,234 hp	2,163 hp	2,096 hp	2,384 hp
10,499 F	2,332 hp	2,253 hp	2,178 hp	2,108 hp	2,044 hp	2,335 hp

The powers listed above and all the Powers displayed are Corrected Powers

Identification Reference and Notes

Engine Arrangement:	2666137	**Lube Oil Press @ Rated Spd(PSI):**	--
Effective Serial No:	SBJ00150	**Piston Speed @ Rated Eng SPD (FT/Min):**	2,173.2
Primary Engine Test Spec:	0K6996	**Max Operating Altitude(FT):**	3,116.8
Performance Parm Ref:	TM5739	**PEEC Elect Control Module Ref**	
Performance Data Ref:	DM8263	**PEEC Personality Cont Mod Ref**	
Aux Coolant Pump Perf Ref:			
Cooling System Perf Ref:	DM1298	**Turbocharger Model**	GTA5518 56T-1.12
Certification Ref:	EPA TIER 2	**Fuel Injector**	2664387
Certification Year:	2006	**Timing-Static (DEG):**	--
Compression Ratio:	14.7	**Timing-Static Advance (DEG):**	--
Combustion System:	DI	**Timing-Static (MM):**	--
Aftercooler Temperature (F):	122	**Unit Injector Timing (MM):**	64.3
Crankcase Blowby Rate(CFH):	2,938.2	**Torque Rise (percent)**	--
Fuel Rate (Rated RPM) No Load (Gal/HR):	13.7	**Peak Torque Speed RPM**	--
Lube Oil Press @ Low Idle Spd(PSI):	--	**Peak Torque (LB/FT):**	--

Reference Number: DM8263 EPA TIER-2 2006 B5

Parameters Reference: TM5739

GEN SET - PACKAGED - DIESEL
TOLERANCES:
AMBIENT AIR CONDITIONS AND FUEL USED WILL AFFECT THESE VALUES. EACH OF THE VALUES MAY VARY IN ACCORDANCE WITH THE FOLLOWING TOLERANCES.

ENGINE POWER	+/-	3%
EXHAUST STACK TEMPERATURE	+/-	8%
GENERATOR POWER	+/-	5%
INLET AIR FLOW	+/-	5%
INTAKE MANIFOLD PRESSURE - GAGE	+/-	10%
EXHAUST FLOW	+/-	6%
SPECIFIC FUEL CONSUMPTION	+/-	3%
FUEL RATE	+/-	5%
HEAT REJECTION	+/-	5%
HEAT REJECTION EXHAUST ONLY	+/-	10%

CONDITIONS:
ENGINE PERFORMANCE IS CORRECTED TO INLET AIR STANDARD CONDITIONS OF 99 KPA (29.31 IN HG) AND 25 DEG C (77 DEG F).

THESE VALUES CORRESPOND TO THE STANDARD ATMOSPHERIC PRESSURE AND TEMPERATURE IN ACCORDANCE WITH SAE J1995. ALSO INCLUDED IS A CORRECTION TO STANDARD FUEL GRAVITY OF 35 DEGREES API HAVING A LOWER HEATING VALUE OF 42,780 KJ/KG (18,390 BTU/LB) WHEN USED AT 29 DEG C (84.2 DEG F) WHERE THE DENSITY IS 838.9 G/L (7.002 LB/GAL).

THE CORRECTED PERFORMANCE VALUES SHOWN FOR CATERPILLAR ENGINES WILL APPROXIMATE THE VALUES OBTAINED WHEN THE OBSERVED PERFORMANCE DATA IS CORRECTED TO SAE J1995, ISO 3046-2 & 8665 & 2288 & 9249 & 1585, EEC 80/1269 AND DIN70020 STANDARD REFERENCE CONDITIONS.

ENGINES ARE EQUIPPED WITH STANDARD ACCESSORIES; LUBE OIL, FUEL PUMP AND JACKET WATER PUMP. THE POWER REQUIRED TO DRIVE AUXILIARIES MUST BE DEDUCTED FROM THE GROSS OUTPUT TO ARRIVE AT THE NET POWER AVAILABLE FOR THE EXTERNAL (FLYWHEEL) LOAD. TYPICAL AUXILIARIES INCLUDE COOLING FANS, AIR COMPRESSORS, AND CHARGING ALTERNATORS.

RATINGS MUST BE REDUCED TO COMPENSATE FOR ALTITUDE AND/OR AMBIENT TEMPERATURE CONDITIONS ACCORDING TO THE APPLICABLE DATA SHOWN ON THE PERFORMANCE DATA SET.

GEN SET - PACKAGED - DIESEL
ALTITUDE:
ALTITUDE CAPABILITY - THE RECOMMENDED REDUCED POWER VALUES FOR SUSTAINED ENGINE OPERATION AT SPECIFIC ALTITUDE LEVELS AND AMBIENT TEMPERATURES.

COLUMN "N" DATA - THE FLYWHEEL POWER OUTPUT AT NORMAL AMBIENT TEMPERATURE.

AMBIENT TEMPERATURE - TO BE MEASURED AT THE AIR CLEANER AIR INLET DURING NORMAL ENGINE OPERATION.
NORMAL TEMPERATURE - THE NORMAL TEMPERATURE AT VARIOUS SPECIFIC ALTITUDE LEVELS IS FOUND ON TM2001.

THE GENERATOR POWER CURVE TABULAR DATA REPRESENTS THE NET ELECTRICAL POWER OUTPUT OF THE GENERATOR.

GENERATOR SET RATINGS
EMERGENCY STANDBY POWER (ESP)

OUTPUT AVAILABLE WITH VARYING LOAD FOR THE DURATION OF AN EMERGENCY OUTAGE. AVERAGE POWER OUTPUT IS 70% OF THE ESP RATING. TYPICAL OPERATION IS 50 HOURS PER YEAR, WITH MAXIMUM EXPECTED USAGE OF 200 HOURS PER YEAR.

STANDBY POWER RATING

OUTPUT AVAILABLE WITH VARYING LOAD FOR THE DURATION OF AN EMERGENCY OUTAGE. AVERAGE POWER OUTPUT IS 70% OF THE STANDBY POWER RATING. TYPICAL OPERATION IS 200 HOURS PER YEAR, WITH MAXIMUM EXPECTED USAGE OF 500 HOURS PER YEAR.

PRIME POWER RATING

OUTPUT AVAILABLE WITH VARYING LOAD FOR AN UNLIMITED TIME. AVERAGE POWER OUTPUT IS 70% OF THE PRIME POWER RATING. TYPICAL PEAK DEMAND IS 100% OF PRIME RATED EKW WITH 10% OVERLOAD CAPABILITY FOR EMERGENCY USE FOR A MAXIMUM OF 1 HOUR IN 12. OVERLOAD OPERATION CANNOT EXCEED 25 HOURS PER YEAR.

CONTINUOUS POWER RATING

OUTPUT AVAILABLE WITH NON-VARYING LOAD FOR AN UNLIMITED TIME. AVERAGE POWER OUTPUT IS 70-100% OF THE CONTINUOUS POWER RATING. TYPICAL PEAK DEMAND IS 100% OF CONTINUOUS RATED EKW FOR 100% OF OPERATING HOURS.

1,500 kWe Caterpillar

PERFORMANCE DATA[DM8260]

February 11, 2011

Performance Number: DM8260

Change Level: 02

SALES MODEL:	3512C	COMBUSTION:	DI
ENGINE POWER (BHP):	2,206	ENGINE SPEED (RPM):	1,800
GEN POWER WITH FAN (EKW):	1,500.0	HERTZ:	60
COMPRESSION RATIO:	14.7	FAN POWER (HP):	88.5
APPLICATION:	PACKAGED GENSET	ASPIRATION:	TA
RATING LEVEL:	STANDBY	AFTERCOOLER TYPE:	ATAAC
PUMP QUANTITY:	2	AFTERCOOLER CIRCUIT TYPE:	JW+OC, ATAAC
FUEL TYPE:	DIESEL	INLET MANIFOLD AIR TEMP (F):	122
MANIFOLD TYPE:	DRY	JACKET WATER TEMP (F):	210.2
GOVERNOR TYPE:	ADEM3	TURBO CONFIGURATION:	PARALLEL
ELECTRONICS TYPE:	ADEM3	TURBO QUANTITY:	4
CAMSHAFT TYPE:	STANDARD	TURBOCHARGER MODEL:	GTB4708BN-52T-0.96
IGNITION TYPE:	CI	CERTIFICATION YEAR:	2006
INJECTOR TYPE:	EUI	CRANKCASE BLOWBY RATE (FT3/HR):	2,203.4
FUEL INJECTOR:	2664387	FUEL RATE (RATED RPM) NO LOAD (GAL/HR):	9.9
REF EXH STACK DIAMETER (IN):	10	PISTON SPD @ RATED ENG SPD (FT/MIN):	2,244.1
MAX OPERATING ALTITUDE (FT):	3,937		

General Performance Data

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
1,500.0	100	2,206	307	0.332	104.6	77.5	120.9	1,145.6	74.6	759.0
1,350.0	90	1,983	276	0.336	95.2	72.2	116.1	1,102.7	68.8	726.8
1,200.0	80	1,768	246	0.343	86.6	66.9	113.2	1,069.1	63.1	708.7
1,125.0	75	1,662	232	0.346	82.0	63.4	111.5	1,052.3	59.5	700.6
1,050.0	70	1,556	217	0.348	77.4	59.7	109.8	1,035.3	55.8	693.6
900.0	60	1,349	188	0.352	67.9	51.1	107.1	1,000.5	47.6	682.5
750.0	50	1,144	159	0.355	58.1	40.6	107.5	963.7	38.4	686.4
600.0	40	940	131	0.359	48.2	30.0	108.4	921.9	29.4	686.0
450.0	30	736	103	0.368	38.6	20.9	107.1	856.1	21.9	667.6
375.0	25	632	88	0.376	33.9	16.9	106.2	809.6	18.8	648.1
300.0	20	527	73	0.388	29.2	13.3	105.2	754.6	16.0	621.1
150.0	10	312	43	0.443	19.7	7.3	103.2	609.7	11.4	526.2

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
1,500.0	100	2,206	82	449.8	4,570.7	10,909.2	20,179.4	20,912.0	4,401.2	3,984.7
1,350.0	90	1,983	77	428.8	4,387.3	10,167.0	19,354.1	20,020.6	4,213.1	3,825.4
1,200.0	80	1,768	71	409.0	4,190.2	9,533.7	18,456.0	19,062.3	4,012.0	3,655.5
1,125.0	75	1,662	68	396.6	4,062.8	9,156.1	17,861.1	18,435.5	3,879.9	3,539.6
1,050.0	70	1,556	64	382.7	3,917.6	8,750.8	17,185.6	17,727.5	3,730.8	3,407.5
900.0	60	1,349	55	350.3	3,576.3	7,863.4	15,607.1	16,082.3	3,384.9	3,097.2
750.0	50	1,144	44	309.9	3,132.5	6,856.9	13,608.7	14,015.1	2,941.7	2,693.8
600.0	40	940	33	266.6	2,669.6	5,821.5	11,547.1	11,884.6	2,498.4	2,290.8
450.0	30	736	23	224.6	2,255.4	4,830.1	9,719.1	9,989.4	2,106.6	1,937.5
375.0	25	632	19	204.3	2,072.0	4,354.9	8,915.9	9,153.2	1,932.9	1,782.3
300.0	20	527	15	184.3	1,901.9	3,888.6	8,175.8	8,380.0	1,769.0	1,636.5
150.0	10	312	9	148.8	1,629.0	3,012.8	6,991.2	7,129.2	1,502.5	1,404.3

1500 KWe

Heat Rejection Data

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	REJECTION TO JACKET WATER	REJECTION TO ATMOSPHERE	REJECTION TO EXH	EXHUAST RECOVERY TO 350F	FROM OIL COOLER	FROM AFTERCOOLER	WORK ENERGY	LOW HEAT VALUE ENERGY	HIGH HEAT VALUE ENERGY
EKW	%	BHP	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN
1,500.0	100	2,206	35,045	7,072	75,190	35,916	11,958	27,337	93,547	224,502	239,151
1,350.0	90	1,983	32,811	6,707	68,272	31,548	10,884	24,908	84,110	204,338	217,671
1,200.0	80	1,768	30,708	6,394	62,804	28,510	9,899	22,371	74,958	185,849	197,976
1,125.0	75	1,662	29,571	6,250	59,771	26,919	9,378	20,805	70,466	176,063	187,551
1,050.0	70	1,556	28,384	6,110	56,659	25,337	8,847	19,142	66,004	166,092	176,930
900.0	60	1,349	25,881	5,841	50,233	22,204	7,761	15,544	57,205	145,705	155,213
750.0	50	1,144	23,184	5,565	43,580	19,571	6,637	11,412	48,509	124,605	132,736
600.0	40	940	20,363	5,287	36,864	16,564	5,513	7,503	39,882	103,503	110,257
450.0	30	736	17,435	4,840	29,997	13,124	4,417	4,600	31,201	82,927	88,339
375.0	25	632	15,907	4,570	26,510	11,255	3,877	3,492	26,809	72,781	77,530
300.0	20	527	14,318	4,299	22,979	9,339	3,336	2,570	22,353	62,636	66,723
150.0	10	312	10,869	3,818	15,812	5,101	2,253	1,253	13,214	42,305	45,066

1500 KWe

PERFORMANCE DATA[DM8260]

February 11, 2011

Emissions Data

RATED SPEED NOT TO EXCEED DATA: 1800 RPM

GENSET POWER WITH FAN		**EKW**	**1,500.0**	**1,125.0**	**750.0**	**375.0**	**150.0**
ENGINE POWER		**BHP**	**2,206**	**1,662**	**1,144**	**632**	**312**
PERCENT LOAD		**%**	**100**	**75**	**50**	**25**	**10**
TOTAL NOX (AS NO2)		G/HR	13,311	6,733	4,486	3,351	2,583
TOTAL CO		G/HR	1,745	1,092	1,544	1,806	1,733
TOTAL HC		G/HR	326	354	333	263	302
PART MATTER		G/HR	90.5	92.4	140.5	169.6	102.7
TOTAL NOX (AS NO2)	(CORR 5% O2)	MG/NM3	2,631.0	1,672.1	1,552.2	2,038.1	2,711.4
TOTAL CO	(CORR 5% O2)	MG/NM3	394.6	312.6	662.4	1,129.4	2,176.8
TOTAL HC	(CORR 5% O2)	MG/NM3	63.8	89.0	114.9	162.2	330.4
PART MATTER	(CORR 5% O2)	MG/NM3	16.8	22.3	50.7	100.7	105.3
TOTAL NOX (AS NO2)	(CORR 5% O2)	PPM	1,282	814	756	993	1,321
TOTAL CO	(CORR 5% O2)	PPM	316	250	530	903	1,741
TOTAL HC	(CORR 5% O2)	PPM	119	166	215	303	617
TOTAL NOX (AS NO2)		G/HP-HR	6.09	4.09	3.95	5.33	8.34
TOTAL CO		G/HP-HR	0.80	0.66	1.36	2.88	5.59
TOTAL HC		G/HP-HR	0.15	0.22	0.29	0.42	0.97
PART MATTER		G/HP-HR	0.04	0.06	0.12	0.27	0.33
TOTAL NOX (AS NO2)		LB/HR	29.35	14.84	9.89	7.39	5.70
TOTAL CO		LB/HR	3.85	2.41	3.40	3.98	3.82
TOTAL HC		LB/HR	0.72	0.78	0.73	0.58	0.66
PART MATTER		LB/HR	0.20	0.20	0.31	0.37	0.23

RATED SPEED NOMINAL DATA: 1800 RPM

GENSET POWER WITH FAN		**EKW**	**1,500.0**	**1,125.0**	**750.0**	**375.0**	**150.0**
ENGINE POWER		**BHP**	**2,206**	**1,662**	**1,144**	**632**	**312**
PERCENT LOAD		**%**	**100**	**75**	**50**	**25**	**10**
TOTAL NOX (AS NO2)		G/HR	11,092	5,610	3,738	2,793	2,153
TOTAL CO		G/HR	969	607	858	1,003	963
TOTAL HC		G/HR	245	267	251	197	227
TOTAL CO2		KG/HR	1,012	791	557	324	186
PART MATTER		G/HR	64.7	66.0	100.4	121.1	73.3
TOTAL NOX (AS NO2)	(CORR 5% O2)	MG/NM3	2,192.5	1,393.4	1,293.5	1,698.4	2,259.5
TOTAL CO	(CORR 5% O2)	MG/NM3	219.2	173.7	368.0	627.4	1,209.3
TOTAL HC	(CORR 5% O2)	MG/NM3	48.0	66.9	86.4	121.9	248.4
PART MATTER	(CORR 5% O2)	MG/NM3	12.0	15.9	36.2	72.0	75.2
TOTAL NOX (AS NO2)	(CORR 5% O2)	PPM	1,068	679	630	827	1,101
TOTAL CO	(CORR 5% O2)	PPM	175	139	294	502	967
TOTAL HC	(CORR 5% O2)	PPM	90	125	161	228	464
TOTAL NOX (AS NO2)		G/HP-HR	5.08	3.41	3.29	4.45	6.95
TOTAL CO		G/HP-HR	0.44	0.37	0.76	1.60	3.11
TOTAL HC		G/HP-HR	0.11	0.16	0.22	0.31	0.73
PART MATTER		G/HP-HR	0.03	0.04	0.09	0.19	0.24
TOTAL NOX (AS NO2)		LB/HR	24.45	12.37	8.24	6.16	4.75
TOTAL CO		LB/HR	2.14	1.34	1.89	2.21	2.12
TOTAL HC		LB/HR	0.54	0.59	0.55	0.44	0.50
TOTAL CO2		LB/HR	2,230	1,743	1,228	714	409
PART MATTER		LB/HR	0.14	0.15	0.22	0.27	0.16
OXYGEN IN EXH		%	10.4	11.6	12.3	13.3	15.3
DRY SMOKE OPACITY		%	1.0	1.3	2.9	5.0	3.0
BOSCH SMOKE NUMBER			0.37	0.45	1.06	1.60	1.11

1500 KWe

Regulatory Information

EPA TIER 2		2006 - 2010		
GASEOUS EMISSIONS DATA MEASUREMENTS ARE CONSISTENT WITH THOSE DESCRIBED IN EPA 40 CFR PART 89 SUBPART D AND ISO 8178 FOR MEASURING HC, CO, PM, AND NOX. GASEOUS EMISSIONS VALUES 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 ARE CONSISTENT WITH THOSE DESCRIBED IN EPA 40 CFR PART 60 SUBPART IIII AND ISO 8178 FOR MEASURING HC, CO, PM, AND NOX. GASEOUS EMISSIONS VALUES 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	STATIONARY	EMERGENCY STATIONARY	CO: 3.5 NOx + HC: 6.4 PM: 0.20

1500 KWe

Altitude Derate Data

ALTITUDE CORRECTED POWER CAPABILITY (BHP)

AMBIENT OPERATING TEMP (F)	50	60	70	80	90	100	110	120	130	NORMAL
ALTITUDE (FT)										
0	2,206	2,206	2,206	2,206	2,206	2,206	2,206	2,206	2,206	2,206
1,000	2,206	2,206	2,206	2,206	2,206	2,206	2,206	2,206	2,206	2,206
2,000	2,206	2,206	2,206	2,206	2,206	2,206	2,206	2,200	2,163	2,206
3,000	2,206	2,206	2,206	2,206	2,206	2,193	2,155	2,118	2,082	2,206
4,000	2,206	2,206	2,206	2,188	2,149	2,110	2,073	2,037	2,003	2,206
5,000	2,206	2,186	2,144	2,105	2,066	2,029	1,994	1,959	1,926	2,183
6,000	2,143	2,101	2,062	2,023	1,987	1,951	1,917	1,884	1,852	2,113
7,000	2,059	2,020	1,981	1,945	1,909	1,875	1,842	1,811	1,780	2,045
8,000	1,978	1,940	1,904	1,868	1,834	1,802	1,770	1,739	1,710	1,978
9,000	1,900	1,863	1,828	1,794	1,762	1,730	1,700	1,670	1,642	1,913
10,000	1,824	1,789	1,755	1,723	1,691	1,661	1,632	1,604	1,576	1,850
11,000	1,750	1,717	1,684	1,653	1,623	1,594	1,566	1,539	1,513	1,788
12,000	1,679	1,647	1,616	1,586	1,557	1,529	1,502	1,476	1,451	1,727
13,000	1,610	1,579	1,549	1,520	1,493	1,466	1,440	1,415	1,391	1,668
14,000	1,543	1,513	1,485	1,457	1,431	1,405	1,380	1,357	1,334	1,610
15,000	1,478	1,450	1,422	1,396	1,371	1,346	1,322	1,300	1,278	1,554

1500 KWe

Cross Reference

Engine Arrangement			
Arrangement Number	Effective Serial Number	Engineering Model	Engineering Model Version
2673949	EBG00001	GS335	-

Test Specification Data						
Test Spec	Setting	Effective Serial Number	Engine Arrangement	Governor Type	Default Low Idle Speed	Default High Idle Speed
0K7015	GG0288	EBG00001	2673949	ADEM3		

General Notes

General Notes DM8260 - 02
SOUND PRESSURE DATA FOR THIS RATING CAN BE FOUND IN PERFORMANCE NUMBER - DM8779

Performance Parameter Reference

Parameters Reference:DM9600-02
PERFORMANCE DEFINITIONS

<h2><u>PERFORMANCE DEFINITIONS DM9600</u></h2>

<B>APPLICATION:</B>
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%
Heat rejection +/- 5%
Heat rejection exhaust only +/- 10%

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%

*Torque is included for truck and industrial applications, do not use for Gen Set or steady state applications.

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

<i>FOR 3500 ENGINES AND SMALLER</i>
SAE J1228 reference atmospheric pressure is 100 KPA (29.61 in hg) and standard temperature is 25°C (77°F) at 60% relative humidity.

<i>FOR 3600 ENGINES</i>
Engine rating obtained and presented in accordance with ISO 3046/1 and SAE J1995 JAN90 standard reference conditions of 25°C, 100 KPA 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.

1500 kWe

PERFORMANCE DATA[DM8260]

REFERENCE FUEL

<i>DIESEL</i>
Reference fuel is #2 distillate diesel with a 35° API gravity; A lower heating value is 42,780 KJ/KG (18,390 BTU/LB) when used at 29°C (84.2°F), where the density is 838.9 G/Liter (7.001 Lbs/Gal).

<i>GAS</i>
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.

ALTITUDE CAPABILITY
Altitude capability is the maximum altitude above sea level at standar d 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.

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 'not to exceed' 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. Log on to the Technology and Solutions Divisions (T&SD) web page (http://tsd.cat.com/etsd/index.cfm?tech_id=2635ICAL) for information including federal regulation applicability and time lines for implementation. Information for labeling and tagging requirements is also provided.

<i> NOTES:</i>
Regulation watch covers regulations in effect and future regulation ch anges for world, federal, state and loca. This page includes items on the watch list where a regulation change or product change might be pending and may need attention of the engine product group. For additional emissions information log on to the TMI web page.

Additional product information for specific market application is available.
Customer's may have special emission site requirements that need to be verified by the Caterpillar Product Group engineer.

<h5><u>HEAT REJECTION DEFINITIONS:</u></h4>
Diesel Circuit Type and HHV Balance : DM9500

<h5><u>SOUND DEFINITIONS:</u></h4>
Sound Power : DM8702

Sound Pressure : TM7080

PERFORMANCE DATA[DM8260]

<h5><u>RATING DEFINITIONS:</u></h5>
Agriculture <a href="http://tmiweb.cat.com/tmi/servlet/TMIDirector?Act
ion=buildtab&tab=DDDefinitionsDisplay&log=genData&jsp=PerfDetail&perfN
o=TM6008">TM6008

Fire Pump <a href="http://tmiweb.cat.com/tmi/servlet/TMIDirector?Actio
n=buildtab&tab=DDDefinitionsDisplay&log=genData&jsp=PerfDetail&perfNo=
TM6009">TM6009

Generator Set <a href="http://tmiweb.cat.com/tmi/servlet/TMIDirector?A
ction=buildtab&tab=DDDefinitionsDisplay&log=genData&jsp=PerfDetail&per
fNo=TM6035">TM6035

Generator (Gas) <a href="http://tmiweb.cat.com/tmi/servlet/TMIDirector
?Action=buildtab&tab=DDDefinitionsDisplay&log=genData&jsp=PerfDetail&p
erfNo=TM6041">TM6041

Industrial Diesel <a href="http://tmiweb.cat.com/tmi/servlet/TMIDirect
or?Action=buildtab&tab=DDDefinitionsDisplay&log=genData&jsp=PerfDetail
&perfNo=TM6010">TM6010

Industrial (Gas) <a href="http://tmiweb.cat.com/tmi/servlet/TMIDirecto
r?Action=buildtab&tab=DDDefinitionsDisplay&log=genData&jsp=PerfDetail&
perfNo=TM6040">TM6040

Irrigation <a href="http://tmiweb.cat.com/tmi/servlet/TMIDirector?Acti
on=buildtab&tab=DDDefinitionsDisplay&log=genData&jsp=PerfDetail&perfNo
=TM5749">TM5749

Locomotive <a href="http://tmiweb.cat.com/tmi/servlet/TMIDirector?Acti
on=buildtab&tab=DDDefinitionsDisplay&log=genData&jsp=PerfDetail&perfNo
=TM6037">TM6037

Marine Auxiliary <a href="http://tmiweb.cat.com/tmi/servlet/TMIDirecto
r?Action=buildtab&tab=DDDefinitionsDisplay&log=genData&jsp=PerfDetail&
perfNo=TM6036">TM6036

Marine Prop (Except 3600) <a href="http://tmiweb.cat.com/tmi/servlet/T
MIDirector?Action=buildtab&tab=DDDefinitionsDisplay&log=genData&jsp=Pe
rfDetail&perfNo=TM5747">TM5747

Marine Prop (3600 only) <a href="http://tmiweb.cat.com/tmi/servlet/TMI
Director?Action=buildtab&tab=DDDefinitionsDisplay&log=genData&jsp=Perf
Detail&perfNo=TM5748">TM5748

MSHA <a href="http://tmiweb.cat.com/tmi/servlet/TMIDirector?Action=bui
ldtab&tab=DDDefinitionsDisplay&log=genData&jsp=PerfDetail&perfNo=TM604
2">TM6042

Oil Field (Petroleum) <a href="http://tmiweb.cat.com/tmi/servlet/TMID
irector?Action=buildtab&tab=DDDefinitionsDisplay&log=genData&jsp=PerfD
etail&perfNo=TM6011">TM6011

Off-Highway Truck <a href="http://tmiweb.cat.com/tmi/servlet/TMIDirect
or?Action=buildtab&tab=DDDefinitionsDisplay&log=genData&jsp=PerfDetail
&perfNo=TM6039">TM6039

On-Highway Truck <a href="http://tmiweb.cat.com/tmi/servlet/TMIDirecto
r?Action=buildtab&tab=DDDefinitionsDisplay&log=genData&jsp=PerfDetail&
perfNo=TM6038">TM6038

<h6 align="right">Date Released : 12/06/10</h6>

CUMMINS

GENERATOR SPECIFICATIONS

CUMMINS 2,000 KWE

Power Generation

Exhaust Emission Data Sheet DQKAF

60 Hz Diesel Generator Set EPA NSPS Stationary Emergency

Engine Information:

Model:	Cummins Inc QSK60-G14 NR2	Bore:	6.25 in. (159 mm)
Type:	4 Cycle, 60°V, 16 Cylinder Diesel	Stroke:	7.48 in. (189 mm)
Aspiration:	Turbocharged and Low Temperature Aftercooled (2 Pump/2 Loop)	Displacement:	3673 cu. In. (60.1 liters)
Compression Ratio:	14.5:1		
Emission Control Device:	Turbocharged with Low Temperature Aftercooler		

PERFORMANCE DATA	1/4 Standby	1/2 Standby	3/4 Standby	Full Standby	Full Prime
BHP @ 1800 RPM (60 Hz)	820	1640	2460	3280	2655
Fuel Consumption (gal/Hr)	49.2	92.6	120.4	157.9	128.1
Exhaust Gas Flow (CFM)	6705	11800	13635	16700	14205
Exhaust Gas Temperature (°F)	785	835	850	885	855
EXHAUST EMISSION DATA					
HC (Total Unburned Hydrocarbons)	0.14	0.09	0.06	0.08	0.07
NOx (Oxides of Nitrogen as NO2)	3.40	3.20	5.30	6.20	5.80
CO (carbon Monoxide)	0.64	0.53	0.21	0.40	0.22
PM (Particular Matter)	0.22	0.18	0.03	0.08	0.02
SO2 (Sulfur Dioxide)	0.14	0.13	0.11	0.11	0.11
Smoke (Bosch)	0.80	0.70	0.20	0.50	0.10

All values are Grams per HP-Hour

TEST CONDITIONS

Data is representative of steady-state engine speed (± 25 RPM) at designated genset loads. Pressures, temperatures, and emission rates were stabilized.

Fuel Specification:	ASTM D975 No. 2-D diesel fuel with 0.03-0.05% sulfur content (by weight), and 40-48 cetane number.
Fuel Temperature:	99 ± 9 °F (at fuel pump inlet)
Intake Air Temperature:	77 ± 9 °F
Barometric Pressure:	29.6 ± 1 in. Hg
Humidity:	NOx measurement corrected to 75 grains H2O/lb dry air
Reference Standard:	ISO 8178

The NOx, HC, CO and PM emission data tabulated here are representative of test data taken from a single engine under the test conditions shown above. Data for the other components are estimated. These data are subjected to instrumentation and engine-to-engine variability. Field emission test data are not guaranteed to these levels. Actual field test results may vary due to test site conditions, installation, fuel specification, test procedures and instrumentation. Engine operation with excessive air intake or exhaust restriction beyond published maximum limits, or with improper maintenance, may results in elevated emission levels.

CUMMINS 1,500 KWE

Power Generation

Exhaust Emission Data Sheet DQGAF

60 Hz Diesel Generator Set

Engine Information:

Model:	Cummins Inc QSK50-G5 NR2	Bore:	6.25 in. (159 mm)
Type:	4 Cycle, 60°V, 16 Cylinder Diesel	Stroke:	6.25 in. (159 mm)
Aspiration:	Turbocharged and Low Temperature Aftercooled (2 Pump/2 Loop)	Displacement:	3067 cu. In. (50.2 liters)
Compression Ratio:	15.0:1		
Emission Control Device:	Turbocharged with Low Temperature Aftercooler		

PERFORMANCE DATA	1/4 Standby	1/2 Standby	3/4 Standby	Full Standby	Full Prime
BHP @ 1800 RPM (60 Hz)	555	1110	1665	2220	1971
Fuel Consumption (gal/Hr)	34.1	61.9	84.1	109.9	98.0
Exhaust Gas Flow (CFM)	5345	8675	10365	12105	11230
Exhaust Gas Temperature (°F)	755	815	860	965	905
EXHAUST EMISSION DATA					
HC (Total Unburned Hydrocarbons)	0.45	0.27	0.15	0.13	0.14
NOx (Oxides of Nitrogen as NO2)	3.10	3.30	4.70	5.70	5.30
CO (carbon Monoxide)	1.46	0.78	0.62	0.83	0.68
PM (Particular Matter)	0.11	0.06	0.05	0.04	0.04
SO2 (Sulfur Dioxide)	0.14	0.13	0.12	0.11	0.11
Smoke (Bosch)	0.40	0.30	0.30	0.30	0.20
All values are Grams per HP-Hour					

TEST CONDITIONS

Data is representative of steady-state engine speed (± 25 RPM) at designated genset loads. Pressures, temperatures, and emission rates were stabilized.

Fuel Specification:	ASTM D975 No. 2-D diesel fuel with 0.03-0.05% sulfur content (by weight), and 40-48 cetane number.
Fuel Temperature:	99 ± 9 °F (at fuel pump inlet)
Intake Air Temperature:	77 ± 9 °F
Barometric Pressure:	29.6 ± 1 in. Hg
Humidity:	NOx measurement corrected to 75 grains H2O/lb dry air
Reference Standard:	ISO 8178

The NOx, HC, CO and PM emission data tabulated here are representative of test data taken from a single engine under the test conditions shown above. Data for the other components are estimated. These data are subjected to instrumentation and engine-to-engine variability. Field emission test data are not guaranteed to these levels. Actual field test results may vary due to test site conditions, installation, fuel specification, test procedures and instrumentation. Engine operation with excessive air intake or exhaust restriction beyond published maximum limits, or with improper maintenance, may results in elevated emission levels.

MTU

GENERATOR SPECIFICATIONS

Inhaltsverzeichnis
Contents

	Genset	Marine	O & G	Rail	C & I
Application	x				
Engine model	16V4000G43				
Emission Stage	EPA2 (EPA2 parameter-setting/D2-Cycle)				
Optimisation					
Application group	3D				

				MTU Friedrichshafen GmbH			Benennung/Title **Emissionsdatenblatt** **Emission Data Sheet**
					Datum/Date	Name/Name	Zeichnungs-Nr./Drawing No.
a	Hinzufügen „Not to exceed Werte“	21.01.14	Lenhof	Bearbeiter/Drawn by	11.01.2012	Lenhof	**EDS 4000 0406**
-	Freigabe	08.02.12	Link	Geprüft/Checked	08.02.2012	Rehm	
Buchstabe/ Revision	Änderung Modifikation	Datum Date	Name Name	Org.-Einheit/Dept.	TKF	Veser	

Vers.2.0

Revision *Change index*					

Emissions Daten Blatt (EDS)

emission Data Sheet (EDS)

	Genset	Marine	O & G	Rail	C & I
Application	x				
Engine model	16V4000G43				
Emission Stage	EPA2 (EPA2 parameter-setting/D2-Cycle)				
Optimisation					
Application group	3D				
Date	11.01.2012				
fuel sulphur content [ppm]	5				
mg/mN³ values base on residual oxygen value of [%]	measured				

Engine raw emissions*

Cycle point	[-]	n1	n2	n3	n4	n5	n6	n7	n8
Power (P/PN)	[-]	1	0,75	0,50	0,25	0,10			
Power	[kW]	2280	1710	1140	570	228			
Speed (n/nN)	[-]	1	1	1	1	1			
Speed	[rpm]	1800	1800	1800	1800	1800			
Exhaust temperature after turbine	[°C]	443	386	352	310	277			
Exhaust massflow	[kg/h]	16298	12846	10492	7544	6056			
Exhaust back pressure	[mbar]	-	-	-	-	-			
NOx	[g/kWh]	7,1	5,6	4,5	4,6	6,8			
	[mg/mN³]	1540	1145	755	531	382			
CO	[g/kWh]	0,6	0,6	0,9	2,0	4,5			
	[mg/mN³]	106	105	134	202	225			
HC	[g/kWh]	0,11	0,15	0,23	0,47	0,55			
	[mg/mN³]	22	28	34	48	28			
O2	[%]	12,0	12,1	13,4	14,8	16,2			
Particulate measured	[g/kWh]	0,06	0,10	0,18	0,34	0,68			
	[mg/mN³]	10,54	18,09	26,06	35,24	34,36			
Particulate calculated	[g/kWh]	-	-	-	-	-			
	[mg/mN³]	-	-	-	-	-			
Dust (only TA-Luft)	[mg/mN³]	-	-	-	-	-			
FSN	[-]	0,5	0,6	1,0	1,1	1,4			
NO/NO2**	[-]	-	-	-	-	-			
CO2	[g/kWh]	648,2	663,6	699,8	822,0	1267,5			
	[mg/mN³]	125002	121600	103865	84099	64006			
SO2	[g/kWh]	0,002	0,002	0,002	0,003	0,004			
	[mg/mN³]	0,4	0,4	0,3	0,3	0,2			

* Emission data measurement procedures are consistent with the respective emission evaluation process. Noncertified engines are measured to sales data (TVU/TEN) standard conditions.
These boundary conditions might not be representative for detailed dimensioning of exhaust gas aftertreatment, in this case it is recommended to contact the responsible department for more information.
Measurements are subject to variation. The nominal emission data shown is subject to instrumentation, measurement, facility, and engine-to-engine variations.
All data applies to an engine in new condition. Over extended operating time deterioration may occur which might have an impact on emission.
Exhaust temperature depends on engine ambient conditions.

** No standard test. To be measured on demand.

							Benennung/Title: **Emissionsdatenblatt Emission Data Sheet**
				MTU Friedrichshafen GmbH			
					Datum/Date	Name/Name	Zeichnungs-Nr./Drawing No.
a	Hinzufügen „Not to exceed Werte“	21.01.14	Lenhof	Bearbeiter/Drawn by	11.01.2012	Lenhof	
-	Freigabe	08.02.12	Link	Geprüft/Checked	08.02.2012	Rehm	**EDS 4000 0406**
Buchstabe/ Revision	Änderung Modifikation	Datum Date	Name Name	Org.-Einheit/Dept.	TKF	Veser	

Vers.2.0

Revision *Change index*	a				

Not to exceed Werte
not to exceed values

	Genset	Marine	O & G	Rail	C & I
Application	x				
Engine model	16V4000G43				
Emission Stage	EPA2 (EPA2 parameter-setting/D2-Cycle)				
Optimisation					
Application group	3D				
Date	21.01.2014				
fuel sulphur content [ppm]	5				
mg/mN³ values base on residual oxygen value of [%]	measured				

Engine raw emissions - Not to exceed

Cycle point	[-]	n1	n2	n3	n4	n5	n6	n7	n8
Power (P/PN)	[-]	1	0,75	0,50	0,25	0,10			
Power	[kW]	2280	1710	1140	570	228			
Speed (n/nN)	[-]	1	1	1	1	1			
Speed	[rpm]	1800	1800	1800	1800	1800			
NOx	[g/kWh]	8,5	6,7	5,5	5,6	8,1			
	[mg/mN³]	1848	1374	907	638	459			
NO2**	[g/kWh]	1,0	0,8	0,6	0,7	0,9			
	[mg/mN³]	216	160	106	74	54			
CO	[g/kWh]	1,0	1,0	1,6	3,6	8,0			
	[mg/mN³]	191	189	242	364	405			
HC	[g/kWh]	0,17	0,23	0,34	0,71	0,83			
	[mg/mN³]	33	42	51	73	42			
O2	[%]	12,0	12,1	13,4	14,8	16,2			
Particulate measured	[g/kWh]	0,08	0,14	0,25	0,48	0,95			
	[mg/mN³]	15	25	36	49	48			

GASEOUS EMISSIONS DATA MEASUREMENTS ARE CONSISTENT WITH THOSE DESCRIBED IN EPA 40 CFR PART 60 SUBPART IIII AND ISO 8178 FOR MEASURING HC, CO, PM, AND NOX.

Locality	Agency	Regulation	Tier/Stage	Max Limits - G/(KW – HR)
U.S. (INCL CALIF)	EPA	STATIONARY	EMERGENCY STATIONARY	NOx + HC: 6.4 CO: 3.5 PM: 0.20

** No standard test. To be measured on demand.

				MTU Friedrichshafen GmbH		Benennung/Title: **Emissionsdatenblatt Emission Data Sheet**
					Datum/Date	Name/Name
a	Hinzufügen „Not to exceed Werte“	21.01.14	Lenhof	Bearbeiter/Drawn by	11.01.2012	Lenhof
-	Freigabe	08.02.12	Link	Geprüft/Checked	08.02.2012	Rehm
Buchstabe/ Revision	Änderung Modifikation	Datum Date	Name Name	Org.-Einheit/Dept.	TKF	Veser

Zeichnungs-Nr./Drawing No.

EDS 4000 0406

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	Genset	Marine	O & G	Rail	C & I
Application	x				
Engine model	12V4000G43				
Emission Stage	EPA2 (EPA2 parameter-setting/D2-Cycle)				
Optimisation					
Application group	3D				

				mtu MTU Friedrichshafen GmbH		Benennung/Title **Emissionsdatenblatt** **Emission Data Sheet**
					Datum/Date	Name/Name	Zeichnungs-Nr./Drawing No.
a	Hinzufügen „Not to exceed“ Werte	21.01.14	Lenhof	Bearbeiter/Drawn by	10.01.2012	Lenhof	
-	Freigabe	01.02.12	Link	Geprüft/Checked	01.02.2012	Rehm	**EDS 4000 0191**
Buchstabe/ Revision	Änderung Modifikation	Datum Date	Name Name	Org.-Einheit/Dept.	TKF	Veser	

Vers.2.0

Revision *Change index*					

Emissions Daten Blatt (EDS)
emission Data Sheet (EDS)

	Genset	Marine	O & G	Rail	C & I
Application	x				
Engine model	12V4000G43				
Emission Stage	EPA2 (EPA2 parameter-setting/D2-Cycle)				
Optimisation					
Application group	3D				
Date	10.01.2012				
fuel sulphur content [ppm]	5				
mg/mN³ values base on residual oxygen value of [%]	measured				

Engine raw emissions*

Cycle point	[-]	n1	n2	n3	n4	n5	n6	n7	n8
Power (P/PN)	[-]	1	0,75	0,50	0,25	0,10			
Power	[kW]	1736	1302	868	438	179			
Speed (n/nN)	[-]	1	1	1	1	1			
Speed	[rpm]	1800	1800	1800	1800	1800			
Exhaust temperature after turbine	[°C]	431	371	342	292	216			
Exhaust massflow	[kg/h]	10220	9295	7422	5195	4000			
Exhaust back pressure	[mbar]	-	-	-	-	-			
NOx	[g/kWh]	6,9	5,6	5,0	4,8	7,7			
	[mg/mN³]	1875	1219	916	622	531			
CO	[g/kWh]	0,6	0,5	0,7	1,5	3,3			
	[mg/mN³]	153	98	110	176	195			
HC	[g/kWh]	0,15	0,19	0,29	0,60	1,79			
	[mg/mN³]	36	36	46	68	107			
O2	[%]	10,0	11,8	12,9	14,3	16,2			
Particulate measured	[g/kWh]	-	-	-	-	-			
	[mg/mN³]	-	-	-	-	-			
Particulate calculated	[g/kWh]	0,11	0,14	0,20	0,34	0,39			
	[mg/mN³]	26	27	33	39	23			
Dust (only TA-Luft)	[mg/mN³]	-	-	-	-	-			
FSN	[-]	0,5	0,6	0,9	1,2	0,4			
NO/NO2**	[-]	-	-	-	-	-			
CO2	[g/kWh]	651,2	663,9	700,3	795,9	1059,2			
	[mg/mN³]	153813	128014	111839	90825	63403			
SO2	[g/kWh]	0,002	0,002	0,002	0,003	0,003			
	[mg/mN³]	0,5	0,4	0,4	0,3	0,2			

* Emission data measurement procedures are consistent with the respective emission evaluation process. Noncertified engines are measured to sales data (TVU/TEN) standard conditions.
These boundary conditions might not be representative for detailed dimensioning of exhaust gas aftertreatment, in this case it is recommended to contact the responsible department for more information.
Measurements are subject to variation. The nominal emission data shown is subject to instrumentation, measurement, facility, and engine-to-engine variations.
All data applies to an engine in new condition. Over extended operating time deterioration may occur which might have an impact on emission.
Exhaust temperature depends on engine ambient conditions.

** No standard test. To be measured on demand.

							Benennung/Title: Emissionsdatenblatt Emission Data Sheet
				MTU Friedrichshafen GmbH			
					Datum/Date	Name/Name	Zeichnungs-Nr./Drawing No.
a	Hinzufügen „Not to exceed“ Werte	21.01.14	Lenhof	Bearbeiter/Drawn by	10.01.2012	Lenhof	
-	Freigabe	01.02.12	Link	Geprüft/Checked	01.02.2012	Rehm	**EDS 4000 0191**
Buchstabe/ Revision	Änderung Modifikation	Datum Date	Name Name	Org.-Einheit/Dept.	TKF	Veser	

Vers.2.0

Revision *Change index*	a				

Not to exceed Werte
not to exceed values

	Genset	Marine	O & G	Rail	C & I
Application	x				
Engine model	12V4000G43				
Emission Stage	EPA2 (EPA2 parameter-setting/D2-Cycle)				
Optimisation					
Application group	3D				
Date	21.01.2014				
fuel sulphur content [ppm]	5				
mg/mN³ values base on residual oxygen value of [%]	measured				

Engine raw emissions - Not to exceed

Cycle point	[-]	n1	n2	n3	n4	n5	n6	n7	n8
Power (P/PN)	[-]	1	0,75	0,50	0,25	0,10			
Power	[kW]	1736	1302	868	438	179			
Speed (n/nN)	[-]	1	1	1	1	1			
Speed	[rpm]	1800	1800	1800	1800	1800			
NOx	[g/kWh]	8,3	6,7	6,0	5,7	9,3			
	[mg/mN³]	2250	1462	1099	747	637			
NO2**	[g/kWh]	1,0	0,8	0,7	0,7	1,1			
	[mg/mN³]	262	171	128	87	74			
CO	[g/kWh]	1,2	0,9	1,2	2,8	5,9			
	[mg/mN³]	276	176	198	317	352			
HC	[g/kWh]	0,23	0,28	0,43	0,89	2,69			
	[mg/mN³]	53	54	68	102	161			
O2	[%]	10,0	11,8	12,9	14,3	16,2			
Particulate measured	[g/kWh]	-	-	-	-	-			
	[mg/mN³]	-	-	-	-	-			

GASEOUS EMISSIONS DATA MEASUREMENTS ARE CONSISTENT WITH THOSE DESCRIBED IN EPA 40 CFR PART 60 SUBPART IIII AND ISO 8178 FOR MEASURING HC, CO, PM, AND NOX.

Locality	Agency	Regulation	Tier/Stage	Max Limits - G/(KW – HR)
U.S. (INCL CALIF)	EPA	STATIONARY	EMERGENCY STATIONARY	NOx + HC: 6.4 CO: 3.5 PM: 0.20

** No standard test. To be measured on demand.

				MTU Friedrichshafen GmbH		Benennung/Title **Emissionsdatenblatt Emission Data Sheet**
					Datum/Date	Name/Name	Zeichnungs-Nr./Drawing No.
a	Hinzufügen „Not to exceed“ Werte	21.01.14	Lenhof	Bearbeiter/Drawn by	10.01.2012	Lenhof
-	Freigabe	01.02.12	Link	Geprüft/Checked	01.02.2012	Rehm
Buchstabe/ Revision	Änderung Modifikation	Datum Date	Name Name	Org.-Einheit/Dept.	TKF	Veser

EDS 4000 0191

Vers.2.0

APPENDIX D

Updated Best Available Control Technology Assessment

LANDAU ASSOCIATES
ENVIRONMENTAL | GEOTECHNICAL | NATURAL RESOURCES

TECHNICAL MEMORANDUM

TO: Dale Spencer, Sabey-Intergate Quincy, LLC

FROM: Christel Olsen and Jim Wilder, P.E.

DATE: March 4, 2015

RE: **UPDATED BEST AVAILABLE CONTROL TECHNOLOGY ASSESSMENT SABEY-INTERGATE DATA CENTER QUINCY, WASHINGTON**

INTRODUCTION

This technical memorandum presents an updated Best Available Control Technology (BACT) assessment for the remaining 32 emergency diesel generators at Sabey-Intergate Quincy, LLC's Sabey Data Center (Sabey) in Quincy, Washington. The annual-average emission rates used for this analysis reflect the increased emission rates requested in the letter to the Washington State Department of Ecology (Ecology): Revised Request for Approval Order Revisions (NOC Order No. 11AQ-E424) (Landau Associates 2015).

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. Most Ecology permit writers determine BACT using a "top-down" approach as described in the U.S. Environmental Protection Agency (EPA) 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. Identify all available control technologies that can be practicably applied for each emission unit.
2. Determine the technical feasibility of potential control options and eliminate options that are demonstrated to be technically infeasible.
3. Rank all remaining options based on control effectiveness, with the most effective control alternative at the top.
4. 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. Choose the top-ranked alternative from the list of control options remaining after applying Steps 1 through 4. This option becomes the BACT, including the resulting emission rate.

Control options for potential reductions in criteria pollutant and, as practical, toxic air pollutant (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. Candidate control technologies were identified by considering Ecology's previous environmental permitting experience for diesel generators in Washington State. Available controls that are judged to be technically feasible are further evaluated based on an analysis of economic, environmental, and energy impacts.

STEPS 1, 2, AND 3: IDENTIFY AND RANK TECHNICALLY FEASIBLE CONTROL TECHNOLOGIES FOR DIESEL GENERATORS

Based on Landau Associates' experience with permitting diesel generators at computer data centers, the following candidate control technologies were considered to be commercially available and technically feasible for use on the 32 remaining diesel generators at Sabey:

- Emission controls inherent to **EPA Tier 2-certified engines**.
- **Three-way catalysts** had previously been considered a technologically feasible control for use on diesel generators. However, recent compliance stack tests required at the Titan Data Center in Moses Lake, Washington showed three-way catalysts ineffective for removal of nitrogen oxides (NO_x). The three-way catalysts at the Titan Data Center actually increased the emission rate for nitrogen dioxide (NO_2). Based on this finding, the three-way catalyst was dropped from the list of candidate technologies considered in this BACT assessment.
- **Urea-based Selective Catalytic Reduction (SCR)** system is designed for control of NO_x and NO_2.
- **Diesel Oxidation Catalyst (DOC)** is designed for removal of carbon monoxide (CO), volatile organic compounds (VOCs), and gaseous TAPs. It is marginally effective for removal of particulate matter (PM).
- **Catalyzed-diesel particulate filter (DPF)** includes a DOC integrated with the filter package. This system is designed for control of PM, CO, VOCs, and particulate and gaseous TAPs.
- **Integrated Control Package** consisting of a combined SCR and catalyzed-DPF (DPF plus DOC). This system is designed for controlling NO_x, PM, CO, VOCs, and particulate or gaseous TAPs.

Table 1 shows the reported emission control efficiency for each control device. Manufacturer data for each device are provided in Attachment D-1. The estimated removal efficiencies provided by each reviewed technology listed in Table 1 are conservatively high. The expected percent removal efficiencies were provided by one generator manufacturer (Caterpillar Corporation), and apply only to the warmed-up, steady-state operating condition at 100 percent load. As shown in Table 1, the top-ranked control technology—based on control effectiveness—is the Integrated Control Package, which removes greater than 70 percent of PM, CO, VOCs, and NO_x. Caterpillar indicates that the listed efficiencies apply at 100 percent load. For this analysis, it was assumed that those same efficiencies will apply at all loads.

STEP 4: TOP-DOWN EVALUATION OF EACH CANDIDATE CONTROL TECHNOLOGY

All of the above-listed candidate control technologies are known to be commercially available, reasonably reliable, and safe for use on backup diesel generators, with the exception of the three-way catalyst. Based on the findings at the Titan Data Center, the three-way catalyst was considered infeasible, as described previously, and dropped from consideration for this assessment. None of remaining candidate control technologies present unreasonable liabilities related to system reliability or energy consumption. The use of DOCs may have a tendency to increase the emission rate for NO_2, but because of the high removal efficiencies of CO and VOCs, the use of DOCs (by themselves) has not been eliminated from consideration based solely on that tendency.

METHODOLOGY FOR COST-EFFECTIVENESS ANALYSES FOR DIESEL GENERATORS

Detailed calculation spreadsheets for the BACT cost-effectiveness analyses are provided in Attachment D-1. For the individual pollutants, cost-effectiveness was estimated by dividing the total life-cycle annual cost ($/year) by the tons of facility-wide pollutant removed by the control device. The calculated cost-effectiveness was compared to the following cost-effectiveness criteria values, which were developed based on Landau Associates' understanding of Ecology's most recent BACT evaluation for diesel generators in eastern Washington:

- PM and DEEP: $23,200 per ton removed
- NO_x: $10,000 per ton removed
- VOCs: $10,000 per ton removed
- CO: $5,000 per ton removed
- Other TAPs: $20,000 per ton removed.

The cost-effectiveness analysis for this BACT assessment was conducted using 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. These assumptions include:

- Purchase price bids from Caterpillar (shown in Attachment D-1).
- The capital cost, operating cost, life-cycle annualized cost, and cost-effectiveness (dollars per ton of destroyed pollutant) were calculated according to methodology specified in the *EPA Air Pollution Control Cost Manual* (EPA 2002).
- Indirect cost factors to derive the total installation cost were also obtained from the *EPA Air Pollution Control Cost Manual* (EPA 2002).
- The annual capital recovery costs were calculated assuming a 25-year system lifetime and a 4 percent annual discount rate.
- Annual operation and maintenance costs for each control option were derived from estimates published by the California Air Resources Board (CARB 2010).

- Considering that the operating load is variable and random, the related uncontrolled emission rate (used for estimating tons of pollutant removed) was set conservatively high by evaluating the maximum emission rate for each individual pollutant with several operating loads.

Table 2 summarizes the cost-effectiveness (expressed as life-cycle annual cost per ton of removed pollutant) to remove criteria air pollutants by each candidate control technology. Table 2 compares the cost-effectiveness to the eastern Washington criteria values discussed previously. As described in the following sections, all of the add-on control technologies are considered to be economically prohibitive based on their unacceptable cost-effectiveness values. Therefore, this assessment concludes that the BACT for Sabey should be defined as EPA Tier 2-certified emergency generators.

COST-EFFECTIVENESS ANALYSIS FOR INTEGRATED CONTROL PACKAGE (SELECTIVE CATALYTIC REDUCTION PLUS CATALYZED-DIESEL PARTICULATE FILTER)

The Integrated Control Package is the most effective control technology to reduce emissions of PM, CO, VOCs, and NO_x (see Table 1). However, as shown in Table 2 (which compares cost-effectiveness to acceptable cost criteria values), this control technology is cost-prohibitive. For example, the estimated cost-effectiveness for NO_x is $42,800 per ton removed, which is almost five times greater than the criteria value of $10,000 per ton. Likewise, the cost-effectiveness for all other criteria pollutants (that this control technology is effective at removing) is unreasonably high and prohibitive. Detailed calculations for this cost-effectiveness evaluation are provided in Attachment D-1. This evaluation demonstrates that to use the Integrated Control Package would exceed the acceptable cost for air pollution control and is, therefore, eliminated from BACT candidacy for Sabey's 32 remaining emergency generators.

COST-EFFECTIVENESS ANALYSIS FOR CATALYZED-DIESEL PARTICULATE FILTER (DIESEL PARTICULATE FILTER PLUS DIESEL OXIDATION CATALYST) ALONE

The catalyzed-DPF candidate technology (by itself) would provide significant removal efficiencies for PM, CO and VOCs (see Table 1). This control technology is ineffective at removing NO_x. As shown in Table 2, the estimated cost-effectiveness values for each of these pollutants exceed their acceptable thresholds, as shown by the comparison of individual-pollutant cost-effectiveness to the corresponding cost criteria. The system failed in all cost-effectiveness evaluations as the $/ton of each pollutant removed far outweighs the acceptable cost criteria values. Detailed cost spreadsheets to support the BACT assessment are provided in Attachment D-1. This evaluation demonstrates that to use the catalyzed-DPF would exceed the acceptable cost for air pollution control and is, therefore, eliminated from BACT candidacy for Sabey's 32 remaining emergency generators.

COST-EFFECTIVENESS ANALYSIS FOR DIESEL OXIDATION CATALYST ALONE

The DOC candidate technology (by itself) would provide substantial removal efficiencies for CO and VOCs, but only moderate reduction of PM emissions, and is ineffective in removing NO_x from the exhaust stream (see Table 1). As shown in Table 2, the estimated cost-effectiveness values for each of these pollutants exceed their acceptable thresholds, as shown by the comparison of individual-pollutant cost-effectiveness to the corresponding cost criteria. The system failed in all cost-effectiveness evaluations as the $/ton of each pollutant removed far outweighs the acceptable cost criteria values. Detailed cost spreadsheets to support the BACT assessment are provided in Attachment D-1. This evaluation demonstrates that to use the DOC would exceed the acceptable cost for air pollution control and is, therefore, eliminated from BACT candidacy for Sabey's 32 remaining emergency generators.

COST-EFFECTIVENESS ANALYSIS FOR SELECTIVE CATALYTIC REDUCTION ALONE

The SCR candidate control technology is effective and highly efficient in reducing emissions of only NO_x (see Table 1). However, this technology is cost-prohibitive. As shown in Table 2, the estimated cost-effectiveness value ($50,000 per ton NO_x) outweighs the acceptable cost of $10,000 per ton. Detailed cost spreadsheets to support the BACT assessment are provided in Attachment D-1.

Among the technically feasible candidate control technologies evaluated in this BACT assessment for Sabey's 32 remaining emergency diesel engines, each of the add-on control devices (SCR, DOC, catalyzed-DPF, and the Integrated Control Package) was eliminated as cost-prohibitive control technologies. It is therefore concluded that the BACT for Sabey should be defined as EPA Tier 2-certified emergency generators.

BEST AVAILABLE CONTROL TECHNOLOGY FOR TOXIC AIR POLLUTANTS (tBACT)

The TAPs expected to be emitted at a rate that exceeds their Small-Quantity Emission Rate (SQER) threshold include DEEP [as particulate matter with an aerodynamic diameter less than or equal to 2.5 microns ($PM_{2.5}$/DEEP)], CO, benzene, and NO_2. The criteria air pollutant emission control options described previously would be effective at various ranges of efficiencies for the control of TAP emissions (Table 3). The cost-effectiveness calculations are shown in Attachment D-1 for each candidate control technology. Table 4 summarizes each estimated TAP cost-effectiveness', and compares that to the presumed threshold of $20,000 per ton of TAP removed.

Diesel Engine Exhaust Particulate Matter

For this analysis, all $PM_{2.5}$ emitted from diesel engines [including both the filterable "front-half" (FH) and the condensable "back-half" (BH) fractions] was considered DEEP. Table 4, which compares the cost-effectiveness of TAP removal to the cost criteria values, shows that each of the candidate control options exhibits prohibitively high cost to reduce DEEP emissions. Details on the cost analysis are provided in Attachment D-1. The candidate control technology with the lowest cost-effectiveness ($/ton DEEP removed) is the Catalyzed-DPF system, which is estimated at $1.7 million per ton removed and is excessively high compared to the criteria value of $23,200 per ton of DEEP. Therefore, all of the add-on control technologies are cost-prohibitive with respect to controlling DEEP emissions.

Carbon Monoxide

BACT was evaluated for CO as a criteria pollutant in the previous section. As shown in Table 4, each of the control options exhibits prohibitively high cost-effectiveness for CO. The candidate control technology with the lowest $/ton of CO removed is the DOC system ($20,000 per ton), which is four times higher than the acceptable $5,000 per ton. Therefore, all of the add-on control technologies are cost-prohibitive with respect to controlling CO emissions.

Benzene

Benzene emissions could be treated using the same control options applicable for VOCs. As shown in Table 4, each of the candidate control technologies evaluated in this BACT assessment exhibits prohibitively high cost-effectiveness for reduction of benzene emissions. The candidate control technology with the lowest $/ton of benzene removed is the DOC system. At $16 million per ton to control benzene, the DOC system is excessive compared to the acceptable $20,000 per ton TAP removal threshold. Therefore, all of the add-on control technologies are cost-prohibitive with respect to controlling benzene emissions.

Nitrogen Dioxide

NO_2 is a minor component of NO_x; therefore, control technologies evaluated for NO_x are applicable to NO_2 and costs are proportionately applicable (the in-stack ratio of NO_2 to NO_x is assumed to be 10 percent). As shown in Table 4, each of the candidate control technologies exhibits prohibitively high cost-effectiveness for NO_x and NO_2. The candidate control technology with the lowest cost $/ton of NO_2 removed is SCR, with a cost-effectiveness value of $363,000 per ton, which is excessive compared to the $20,000 per ton TAP removal threshold. Therefore, all of the add-on control technologies are cost-prohibitive with respect to controlling emissions of NO_2.

Considering that all of the add-on control technologies are cost-prohibitive with respect to every evaluated TAP (DEEP, CO, benzene, and NO_2), it is concluded that the tBACT for Sabey Data Center should be defined as EPA Tier 2-certified emergency generators.

STEP 5: RECOMMENDED BEST AVAILABLE CONTROL TECHNOLOGY FOR DIESEL EMERGENCY GENERATORS

Although all of the add-on control technology options (SCR, DOC, catalyzed-DPF, and the Integrated Control Package) are technically feasible, each of them failed the BACT and tBACT cost-effectiveness evaluations. Therefore, none of the add-on controls should be considered the BACT. Instead, the emission controls inherent to EPA Tier 2-certified generators should be required as the BACT.

CO/JMW/ccy

REFERENCES

CARB. 2010. *Public Workshop to Consider Amendments to the Requirements for New Emergency Standby Engines in the Airborne Toxic Control Measure for Stationary Compression Ignition Engines*. California Air Resources Board, California Environmental Protection Agency. March 1. Available at http://www.arb.ca.gov/diesel/presentations/030110/workshop030110.pdf. Accessed January 16, 2015.

EPA. 2002. *EPA Air Pollution Control Cost Manual*. Sixth Edition. EPA/452/B-02-001. January. Available at www.epa.gov/ttncatc1/dir1/c_allchs.pdf. U.S. Environmental Protection Agency. Accessed January 15, 2014.

EPA. 1990. Draft: *New Source Review Workshop Manual, Prevention of Significant Deterioration and Non-Attainment Area Permitting*. October. Available at http://www.epa.gov/region07/air/nsr/nsrmemos/1990wman.pdf. U.S. Environmental Protection Agency. Accessed January 15, 2014.

Landau Associates. 2015. Letter: *Revised Request for Approval Order Revisions (NOC Order No. 11AQ-E424), Sabey Intergate-Quincy Data Center, Quincy, Washington*. From Jim Wilder, P.E., to Greg Flibbert, Washington State Department of Ecology. February 27.

ATTACHMENTS

Table D-1: Criteria Pollutant Control Efficiencies
Table D-2: Summary of Cost-Effectiveness to Remove Criteria Pollutants
Table D-3: Toxic Air Pollutant Control Efficiencies
Table D-4: Summary of Cost-Effectiveness to Remove Toxic Air Pollutants

Attachment D-1: Caterpillar Cost Sheets and Cost-Effectiveness Calculations

TABLE D-1
CRITERIA POLLUTANT CONTROL EFFICIENCIES
SABEY DATA CENTER
QUINCY, WASHINGTON

Technology	Percent Removal Efficiency for each Pollutant			
	PM/DEEP	CO	VOCs	NO_x
Integrated Control Package	85%	80%	70%	92%
Catalyzed-DPF	85%	80%	70%	Ineffective
DOC	20%	80%	70%	Ineffective
SCR	Ineffective	Ineffective	Ineffective	92%

TABLE D-2
SUMMARY OF COST-EFFECTIVENESS TO REMOVE CRITERIA POLLUTANTS
SABEY DATA CENTER
QUINCY, WASHINGTON

Technology	Cost-Effectiveness ($/ton)				Combined Pollutants
	PM	CO	VOCs	NO_x	
Integrated Control Package	$2,514,990	$99,496	$945,906	$42,865	$28,700
Catalyzed-DPF	$1,713,409	$67,784	$644,424	Ineffective	$59,000
DOC	$2,126,875	$19,798	$188,219	Ineffective	$17,800
SCR	Ineffective	Ineffective	Ineffective	$36,300	$36,300
Criteria Values	**$23,200**	**$5,000**	**$10,000**	**$10,000**	**N/A**

TABLE D-3
TOXIC AIR POLLUTANT CONTROL EFFICIENCIES
SABEY DATA CENTER
QUINCY, WASHINGTON

Technology	Percent Removal Efficiency for each Pollutant			
	DEEP (FH+BH)	CO	Benzene	NO_2
Integrated Control Package	85%	Ineffective	70%	92%
Catalyzed-DPF	85%	80%	70%	Ineffective
DOC	20%	80%	70%	Ineffective
SCR	Ineffective	Ineffective	Ineffective	92%

TABLE D-4
SUMMARY OF COST-EFFECTIVENESS TO REMOVE TOXIC AIR POLLUTANTS
SABEY DATA CENTER
QUINCY, WASHINGTON

Technology	Cost-Effectiveness ($/ton)				Combined Pollutants
	DEEP (FH+BH)	CO	Benzene	NO_2	
Integrated Control Package	$2,514,990	Ineffective	$80,432,730	$428,649	$78,000
Catalyzed-DPF	$1,713,409	$67,784	$54,797,099	Ineffective	$65,000
DOC	$2,126,875	$19,798	$16,004,776	Ineffective	$19,600
SCR	Ineffective	Ineffective	Ineffective	$363,000	$363,000
Criteria Values	**$23,200**	**$5,000**	**$20,000**	**$20,000**	**N/A**

DEEP = Diesel engine exhaust particulate matter
FH = Front-half
BH = Back-half
CO = Carbon monoxide
NO_2 = Nitrogen dioxide
DPF = Diesel particulate filter
DOC = Diesel oxidation catalyst
SCR = Selective catalytic reduction

ATTACHMENT D-1

Caterpillar Cost Sheets and Cost-Effectiveness Calculations

CATERPILLAR®

CAT® SCR PROPOSAL

Tuesday, January 06, 2015 Quotation Number: **15010203RW-E** Revision: **1**

SCR units in a 409L Stainless Steel Double Wall Critical Grade Silencer Housing

Project Description: **SABEY Data Center, Quincy, WA - 3516C 2000 ekW**

Prepared for:

NC Power Systems
Don Lee King
Power Generation Sales
17900 W. Valley Highway
Tukwila, WA 98188

Email: dlking@ncpowersystems.com
Telephone: **(425) 656-4586**
Mobile:

Application Specifications:

Site Location (Address):	**Quincy, WA**		
Environment (Alt,Temp,RH):			
Mounting Location:			
Regulation Requirement:	**Local Permit and EPA Title V**		
Average Running Load (%):		Runtime (hr/yr):	
Minimal Operating Load (%):	**30%**	Minimal Exhaust Temp:	**350 deg C**

Engine Specifications: *Quantity 6 CAT, reference # DM8263*

Engine Model Number:	**3516C , Tier 2**			Engine S/N:	**516DE5B**
Generator Power Rating (ekW):	**2,000**	**Standby**		EPA Family #:	
Engine Displacement (liters):	**69**			Model Name:	**Generator**
Max Fuel Sulfur Content (ppm):	**< 50**				
Engine Power Output (bhp):	**2,937**	or	***2191***	***bkW @ 1800 RPM***	
Exhaust Flow Rate (ACFM):	**15,293**	or	***433.0***	***m^3/min***	
Exhaust Stack Temp (deg F):	**752**	or	***400.0***	***deg C***	
Max Exhaust Pressure(" H_2O):	**27**	or	***6.7***	***kPa***	

Estimated Engine Emissions Data:

Requirement **Emissions Source:** ***100% Load, PSV***

Permit		***Pre Catalyst***	***Post Catalyst Estimates****
g/bhp-hr		**g/bhp-hr**	**g/bhp-hr**
0.50	**NOx***	**6.54**	**0.50**

**NOx Reductions will be validated by a calibrated gas analyzer during Dealer Site Commissioning of the CAT SCR System at defined load points and steady-state conditions.*

***Post Catalyst Emissions Reduction based on 100% Load & Engine Rating obtained and presented in accordance with ISO 3046/1 & SAE J1995 JAN90 Standard Reference Conditions*

CATERPILLAR

SCR Specifications:

Material:	**Extruded Vanadia Substrates**		# T6 Modules:	
Total Amount of Catalyst (cubic ft):	**32 (9.1 cubic meters)**		# T2 Modules:	
Number of Catalyst Layers:	**3 layers @ 48 blocks/layer**	***8 wide by 6 high***	# T4 Modules:	**36**
Injection Lance:	**36 inches (914 mm)**			
Approximate DEF Consumption:	**8.4 gal/hr or 31.8 liters/hr of 32.5% Technical Grade Urea**			
Recommended Reductant:	***32.5% DEF (Diesel Exhaust Fluid), Please reference Cat document PELJ1160***			
Maximum Ammonia Slip:	***Not Specified***			

Dosing Control Cabinet: ***Nema 12 Enclosure (36" high x 32" wide x 12" deep)***

*Touch Screen Display & Dual NOx Sensors for a True Closed-Loop System
*Controller, Pressure Sensor, Temperature Sensor, Dosing Pump, Pressure Regulator, Secondary Urea Filter
*Nox Sensor, Back Pressure, and Boost Harnesses Standard Length 50 feet, 75 feet Length available for additional charge
*Power requirement: 240/120 volts AC, 10/20 amps, 50 or 60 Hertz
*Records NOx levels pre and post, Temperature and Pressure, Time and Date
*ModBus Communications Enabled
*Auto Start, Stop and Purge Cycle

Tube Bundle: ***Dosing Control Cabinet to Injection Lance -*** *Standard length 25 feet, 50 feet available for additional charge*

*1/4" Heat Traced Stainless Steel tubing for DEF Flow
*1/2" Stainless Steel or Poly tubing for Compressed Air

Injection and Mixing Section: ***Integrated within the E-POD housing***

*Air & Urea Injection with Static Mixers internal to the SCR Silencer Housing
*Compressed Air requirement to be Oil Free, 10 SCFM @ 100 PSIG with a refrigerated dryer

Silencer Housing Specifications: ***457-8417 / SCR0009***

Material:	**409L Stainless Steel, Double Wall, Welded Surface Finish**				
Approximate Dimensions L x W x H (inches):	**153**	**x**	**90**	**x**	**54**
Approximate Dimensions L x W x H (mm):	**3,886**	**x**	**2,286**	**x**	**1,372**
Estimated Weight (pounds / kilograms):	**7,500**	**/ 3410**			
Silencer Sound Reduction (dBa):	**27-35**	**Critical Grade Silencing**			
Est. Pressure Drop Silencer as configured ("H_2O):	**12.7**	*as configured at rated load or (kPa):*			***3.2***
Inlet Size inches (mm):	**16 (406)**		**Flange**	# of Inlets:	**2**
Outlet Size inches (mm):	**20 (508)**		**Flange**		

This System Includes:

SILENCER - Stainless Steel:	**Yes**	INTERNAL Mixing and DEF Injection:	**Yes**
SCR Catalyst:	**Yes**	Dosing Control Cabinet:	**Yes**
DOC Units:	**No**	Operation & Maintenance Manual:	**Yes**
		Start-up Commissioning:	**No**

This System Excludes:

Delivery/Freight Expenses, Consumables and Utilities
Installation and supply of interconnecting power, control cables, conduit, reductant tanks, plumbing, supply pumps, etc.
Installation, Commissioning of the Proposed System and any required permitting
Exhaust piping insulation *(Recommend insulating the exhaust from the engine to the inlet of the emissions control system)*

CATERPILLAR®

Notes:

Terms & Conditions: ***Incoterms:*** **FCA** **Santa Fe**

Estimated Ship Date:	**Consult Factory**
Terms:	**Net 30 Days**
Proposal Valid :	**30 days from proposal date**
Warranty:	**24 months or 8,000 hours of operation, whichever comes first, from date of commissioning**

Pricing:

	Cat #/ Feature Code	***Closed-Loop System*** **Description**	**Quantity**	**Unit Price**	**Dealer Net Total (USD)**
1	**457-8417 / SCR0009**	Cat®SCR in a 409L Stainless Steel Double Wall Critical Grade Silencer (Insulation Blanket Included)	**6**	**$ 135,803**	**$ 814,820.00**
				Estimated Freight:	
				Total:	**$ 814,820.00**

#DIV/0!

Cat® Diesel Particulate Filter (DPF) PROPOSAL

Tuesday, January 06, 2015 Quotation Number: **15010204RW-F** Revision:

Cat® DPF System in a 304L Stainless Steel Double Wall Critical Grade Silencer

Project Description:	**SABEY Data Center, Quincy, WA - 3516C 2000 ekW**

Prepared for:

NC Power Systems
Don Lee King
Power Generation Sales
17900 W. Valley Highway
Tukwila, WA 98188

Email: dlking@ncpowersystems.com
Telephone: **(425) 656-4586**
Mobile:

Application Specifications:

Site Location (Address):	**Quincy, WA**		
Environment (Alt,Temp,RH):			
Mounting Location:			
Regulation Requirement:	**Local Permit and EPA Title V**		
Average Running Load (%):		Runtime (hr/yr):	
Minimal Operating Load (%):	**30%**	Minimal Exhaust Temp:	**350 deg C**

Engine Specifications: Quantity 6 *CAT, reference # DM8263*

Engine Model Number:	**3516C , Tier 2**			Engine S/N:	**516DE5B**
Generator Power Rating (ekW):	**2,000**	**Standby**		EPA Family #:	
Engine Displacement (liters):	**69**			Model Name:	**Generator**
Max Fuel Sulfur Content (ppm):	**<50**	**ppm of Sulfur**			
Engine Power Output (bhp):	**2,937**	or	***2191***	**bkW @ 1800 RPM**	
Exhaust Flow Rate (ACFM):	**15,293**	or	***433.0***	***m^3/min***	
Exhaust Stack Temp (deg F):	**752**	or	***400.0***	***deg C***	
Max Exhaust Pressure(" H_2O):	**27**	or	***6.7***	***kPa***	

Estimated Engine Emissions Data:

Requirement **Emissions Source:** ***100% Load, PSV***

Permit		*Pre Catalyst*	*Post Catalyst Estimates*	
		g/bhp-hr	% Reduction	g/bhp-hr
	CO	0.54	80%	0.11
	HC	0.15	70%	0.05
	PM	0.04	85%	0.01

***Post Catalyst Emissions Reduction based on 100% Load & Engine Rating obtained and presented in accordance with ISO 3046/1 & SAE J1995 JAN90 Standard Reference Conditions*

DPF Specifications:

Material:	**Platinum Group Catalyzed Cordierite Ceramic wall-flow filter substrates**
Number of Filters:	**9 FDA221**
Typical Regeneration using ULSD:	Above 350 deg C (662 deg F) for 30% of engine operating time & greater than 40% engine load
Max Number of Cold Starts:	**12 consecutive 10 minute idle sessions followed by 2 hrs regeneration**

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Critical Grade Silencer Housing Specifications: *Option 1 428-8566 / DFP0003*

Material:	**304L Stainless Steel, Double Wall, Welded Surface Finish**				
Approximate Dimensions L x W x H (inches):	**96**	**x**	**90**	**x**	**52**
Approximate Dimensions L x W x H (mm):	**2,438**	**x**	**2,286**	**x**	**1,321**
Estimated Weight (pounds / kilograms):	**3,750**	**/ 1700**			
Silencer Sound Reduction (dBa):	**27-35**	**Critical Grade Silencing**			
Est. Pressure Drop Silencer+DPF ("H_2O):	**14.0**	*as configured at rated load or (kPa):*			***3.5***
Inlet Size inches (mm):	**22 (559)**	**Flange**	# of Inlets:	**1**	
Outlet Size inches (mm):	**22 (559)**	**Flange**			

Cat® DLAS300 Data Logger & Alarm System:

Data Logger:	Monitors and Records the Exhaust Temperature, Pressure, Date, and Time every 15 sec. for 26,000 readings
Alarm System:	Red warning light for maximum pressure exceeded, Yellow warning light for pending high pressure levels
Self Diagnostics:	Flashing lights indicate if the pressure or temperature not recording
Rugged Construction:	Cast Aluminum weathertight housing
Cable/Hose Length:	Standard 20 feet lengths with 50 feet as an option with additional cost.
Easy data downloads:	With software the logged data can be downloaded to an excel spreadsheet for analysis

This System Includes:

DPF Unit:	**Yes**	Operation & Maintenance Manual:	**Yes**
Silencer - Stainless Steel	**Option 1**	Cat® DLAS300 Data Logger & Alarm System:	**Yes**

This System Excludes:

Delivery/Freight Expenses, Consumables and Utilities (electricity, etc.)

Installation and supply of interconnecting power, control cables, conduit, etc.

Installation of the DPF System and any required permitting

Exhaust piping insulation *(Recommend insulating the exhaust from the engine to the inlet of the emissions control system)*

Notes:

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Terms & Conditions:	*Incoterms:*	FCA	Santa Fe
Estimated Ship Date:	**6**	**weeks from date of purchase order and approved design**	
Terms:	**Net 30 Days**		
Proposal Valid :	**30 days from proposal date**		
Warranty:	**1 year from date of shipment**		

Pricing:

	Option 1	*Combination DPF & Critical Grade Silencer*			Dealer Net
	Cat #/ Feature Code	Description	Quantity	Unit Price	Total (USD)
1	**428-8566 / DFP0003**	**Cat® DPF in a 304L Stainless Steel Double Wall Critical Grade Silencer**	**6**	**$ 102,476**	**$ 614,854.00**
2	**382-4593**	**Cat® DLAS300 Data Logger & Alarm System**	**6**	**$ 2,156**	**$ 12,936.00**
3					**$ -**
				Estimated Freight:	
				Total:	**$ 6,627,790.00**

	Recommended Equipment:				Dealer Net
	Cat #/ Feature Code	Description	Quantity	Unit Price	Total (USD)
1	**470-5748**	**Option 1 Custom Insulating Blanket**	**6**	**$ 10,435**	**$ 62,607.00**

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Cancellations: Standard Parts – A flat 20% fee will be charged on canceled orders for standard parts.

Custom Parts – All expenses will be charged on order cancellation including; materials, engineering & labor plus 20%.

Cat® Diesel Oxidation Catalyst (DOC) PROPOSAL

CATERPILLAR®

Tuesday, January 06, 2015 Quotation Number: **15010205RW-D** Revision:

Cat® DOC System in a 304L Stainless Steel Double Wall Critical Grade Silencer

Project Description: **SABEY Data Center, Quincy, WA - 3516C 2000 ekW**

Prepared for:

NC Power Systems
Don Lee King
Power Generation Sales
17900 W. Valley Highway
Tukwila, WA 98188

Email: dlking@ncpowersystems.com
Telephone: **(425) 656-4586**
Mobile:

Application Specifications:

Site Location (Address):	**Quincy, WA**		
Environment (Alt,Temp,RH):			
Mounting Location:			
Regulation Requirement:	**Local Permit and EPA Title V**		
Average Running Load (%):		Runtime (hr/yr):	
Minimal Operating Load (%):	**30%**	Minimal Exhaust Temp:	**350 deg C**

Engine Specifications: Quantity 6 *CAT, reference # DM8263*

Engine Model Number:	**3516C , Tier 2**				Engine S/N:	**516DE5B**
Generator Power Rating (ekW):	**2,000**	**Standby**			EPA Family #:	
Engine Displacement (liters):	**69**				Model Name:	**Generator**
Max Fuel Sulfur Content (ppm):	**<50**	**ppm of Sulfur**				
Engine Power Output (bhp):	**2,937**	or	***2191***	**bkW @ 1800 RPM**		
Exhaust Flow Rate (ACFM):	**15,293**	or	***433.0***	***m^3/min***		
Exhaust Stack Temp (deg F):	**752**	or	***400.0***	***deg C***		
Max Exhaust Pressure(" H_2O):	**27**	or	***6.7***	***kPa***		

Estimated Engine Emissions Data:

Requirement **Emissions Source:** ***100% Load, PSV***

Permit		*Pre Catalyst*	*Post Catalyst Estimates*	
		g/bhp-hr	% Reduction	g/bhp-hr
	CO	0.54	80%	0.11
	HC	0.15	70%	0.05
	PM	0.04	20%	0.03

***Post Catalyst Emissions Reduction based on 100% Load & Engine Rating obtained and presented in accordance with ISO 3046/1 & SAE J1995 JAN90 Standard Reference Conditions*

Combination DOC & Critical Grade Silencer: *Option 1 378-0908 / DGOC019*

Material: Platinum Group Catalyzed Cordierite Ceramic substrates in Stainless Steel Housing, Welded Surface Finish

Amount of Catalyst (cubic ft):	**3.8**	**9**	DOC units #	**CJH1250B, 300 cpi**	
Approximate Dimensions L x W x H (inches):	**96**	**x**	**64**	**x**	**44**
Approximate Dimensions L x W x H (mm):	**2,438**	**x**	**1,626**	**x**	**1,118**
Estimated Weight (pounds / kilograms):	**2,650**	**/ 1200**			
Silencer Sound Reduction (dBa):	**27-35**	**Critical Grade Silencing**			
Est. Pressure Drop Silencer+DOC ("H_2O):	**8.5**	*as configured at rated load or (kPa):*			***2.1***
Inlet Size inches (mm):	**16 (406)**	**Flange**	# of Inlets:	**1**	
Outlet Size inches (mm):	**16 (406)**	**Flange**			

Standard DOC Unit: *Option 2 378-0917 / DGOC010*

Material: Platinum Group Catalyzed Cordierite Ceramic substrates in Stainless Steel Housing, Welded Surface Finish

Amount of Catalyst (cubic ft):	**4.4**	**36**	DOC units #	**CJI0036B, 230 cpi**	
Approximate Dimensions (inches):	**44**	**x**	**40**	**x**	**40**
Approximate Dimensions L x W x H (mm):	**1,118**	**x**	**1,016**	**x**	**1,016**
Estimated Weight (pounds / kilograms):	**550**	**/ 250**			
Est. Pressure Drop DOC ("H_2O):	**6.3**	*as configured at rated load or (kPa):*			***1.6***
Inlet Size inches (mm):	**20 (508)**	**Flange**			
Outlet Size inches (mm):	**20 (508)**	**Flange**			

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Cat® DLAS300 Data Logger & Alarm System:

Data Logger:	Monitors and Records the Exhaust Temperature, Pressure, Date, and Time
Alarm System:	Red warning light for maximum pressure exceeded, Yellow warning light for pending high pressure levels
Rugged Construction:	Weathertight housing
Cable/Hose Length:	Standard 20 feet lengths with 50 feet as an option with additional cost.
Easy data downloads:	Logged data can be downloaded via Ethernet or USB port

This System Includes:

DOC Unit:	**Yes**	Operation & Maintenance Manual:	**Yes**
Silencer - Stainless Steel:	**Option 1**		
Standard DOC Housing:	**Option 2**		

This System Excludes:

Delivery/Freight Expenses, Consumables and Utilities (electricity, etc.)
Installation and supply of interconnecting power, control cables, conduit, etc.
Installation of the DOC System and any required permitting
Exhaust piping insulation *(Recommend insulating the exhaust from the engine to the inlet of the emissions control system)*

Notes:

Terms & Conditions: *Incoterms:* FCA Santa Fe

Estimated Ship Date:	**6 weeks from date of purchase order and approved design**
Terms:	**Net 30 Days**
Proposal Valid :	**30 days from proposal date**
Warranty:	**1 year from date of shipment**

Pricing:

Option 1 — Combination DOC & Critical Grade Silencer

	Cat #/ Feature Code	Description	Quantity	Unit Price	Dealer Net Total (USD)
1	**378-0908 / DGOC019**	**Cat® DOC in a 304L Stainless Steel Double Wall Critical Grade Silencer**	**6**	**$ 23,314**	**$ 139,880.00**
			Estimated Freight:		
				Total:	**$ 139,880.00**

Option 2 — Standard DOC Unit:

	Cat #/ Feature Code	Description	Quantity	Unit Price	Dealer Net Total (USD)
1	**378-0917 / DGOC010**	**Cat® DOC in a 304L Stainless Steel Housing**	**6**	**$ 17,295**	**$ 103,767.00**
			Estimated Freight:		
				Total:	**$ 103,767.00**

Recommended Equipment:

	Cat #/ Feature Code	Description	Quantity	Unit Price	Dealer Net Total (USD)
1	**470-5745**	**Option 1 Custom Insulating Blanket**	**6**	**$ 7,514**	**$ 45,080.00**
2	**470-5735**	**Option 2 Custom Insulating Blanket**	**6**	**$ 3,161**	**$ 18,960.00**

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Cancellations: Standard Parts – A flat 20% fee will be charged on canceled orders for standard parts.
Custom Parts – All expenses will be charged on order cancellation including; materials, engineering & labor plus 20%.

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CAT® SCR+DPF "Integrated Package" PROPOSAL

Tuesday, January 06, 2015 Quotation Number: **15010202RW-E** Revision: **1**

SCR & DPF units in a 409L Stainless Steel Double Wall Critical Grade Silencer Housing

Project Description:	**SABEY Data Center, Quincy, WA - 3516C 2000 ekW**

Prepared for:

NC Power Systems
Don Lee King
Power Generation Sales
17900 W. Valley Highway
Tukwila, WA 98188

Email: dlking@ncpowersystems.com
Telephone: **(425) 656-4586**
Mobile:

Application Specifications:

Site Location (Address):	**Quincy, WA**		
Environment (Alt,Temp,RH):			
Mounting Location:			
Regulation Requirement:	**Local Permit and EPA Title V**		
Average Running Load (%):		Runtime (hr/yr):	
Minimal Operating Load (%):	**30%**	Minimal Exhaust Temp:	**350 deg C**

Engine Specifications: *Quantity 6 CAT, reference # DM8263*

Engine Model Number:	**3516C , Tier 2**			Engine S/N:	**516DE5B**
Generator Power Rating (ekW):	**2,000**	**Standby**		EPA Family #:	
Engine Displacement (liters):	**69**			Model Name:	**Generator**
Max Fuel Sulfur Content (ppm):	**< 50**				
Engine Power Output (bhp):	**2,937**	or	***2191***	***bkW @ 1800 RPM***	
Exhaust Flow Rate (ACFM):	**15,293**	or	***433.0***	***m^3/min***	
Exhaust Stack Temp (deg F):	**752**	or	***400.0***	***deg C***	
Max Exhaust Pressure(" H_2O):	**27**	or	***6.7***	***kPa***	

Estimated Engine Emissions Data:

Requirement **Emissions Source:** ***100% Load, PSV***

Permti		***Pre Catalyst***	***Post Catalyst Estimates****	
g/bhp-hr		**g/bhp-hr**	% Reduction	**g/bhp-hr**
0.50	**NOx***	**6.54**	92%	**6.04**
2.60	**CO**	**0.54**	80%	**0.43**
0.14	**HC**	**0.15**	70%	**0.11**
0.02	**PM**	**0.04**	85%	**0.03**

**NOx Reductions will be validated by a calibrated gas analyzer during Dealer Site Commissioning of the CAT SCR System at defined load points and steady-state conditions.*

***Post Catalyst Emissions Reduction based on 100% Load & Engine Rating obtained and presented in accordance with ISO 3046/1 & SAE J1995 JAN90 Standard Reference Conditions*

DPF Specifications:

Material:	**Platinum Group Catalyzed Cordierite Ceramic wall-flow filter substrates**		
Number of Filters:	**10**	**FDA221**	***AC DPF, 200 cpsi***
Typical Regeneration using ULSD:	Above 350 deg C (662 deg F) for 30% of engine operating time & greater than 40% engine load		
Max Number of Cold Starts:	**12 consecutive 10 minute idle sessions followed by 2 hrs regeneration**		

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SCR Specifications:

Material:	**Extruded Vanadia Substrates**		# T6 Modules:	
Total Amount of Catalyst (cubic ft):	**32 (9.1 cubic meters)**		# T2 Modules:	
Number of Catalyst Layers:	**3 layers @ 48 blocks/layer**	***8 wide by 6 high***	# T4 Modules:	**36**
Injection Lance:	**36 inches (914 mm)**			
Approximate DEF Consumption:	**8.4 gal/hr or 31.8 liters/hr of 32.5% Technical Grade Urea**			
Recommended Reductant:	***32.5% DEF (Diesel Exhaust Fluid), Please reference Cat document PELJ1160***			
Maximum Ammonia Slip:	***Not Specified***			

Dosing Control Cabinet: ***Nema 12 Enclosure (36" high x 32" wide x 12" deep)***

*Touch Screen Display & Dual NOx Sensors for a True Closed-Loop System
*Controller, Pressure Sensor, Temperature Sensor, Dosing Pump, Pressure Regulator, Secondary Urea Filter
*Nox Sensor, Back Pressure, and Boost Harnesses Standard Length 50 feet, 75 feet Length available for additional charge
*Power requirement: 240/120 volts AC, 10/20 amps, 50 or 60 Hertz
*Records NOx levels pre and post, Temperature and Pressure, Time and Date
*ModBus Communications Enabled
*Auto Start, Stop and Purge Cycle

Tube Bundle: ***Dosing Control Cabinet to Injection Lance -*** *Standard length 25 feet, 50 feet available for additional charge*

*1/4" Heat Traced Stainless Steel tubing for DEF Flow
*1/2" Stainless Steel or Poly tubing for Compressed Air

Injection and Mixing Section: ***Integrated within the E-POD housing***

*Air & Urea Injection with Static Mixers internal to the SCR Silencer Housing
*Compressed Air requirement to be Oil Free, 10 SCFM @ 100 PSIG with a refrigerated dryer

Silencer Housing Specifications:

Material:	**409L Stainless Steel, Double Wall, Welded Surface Finish**				
Approximate Dimensions L x W x H (inches):	**153**	**x**	**90**	**x**	**54**
Approximate Dimensions L x W x H (mm):	**3,886**	**x**	**2,286**	**x**	**1,372**
Estimated Weight (pounds / kilograms):	**7,500**	**/ 3410**			
Silencer Sound Reduction (dBa):	**27-35**	**Critical Grade Silencing**			
Est. Pressure Drop Silencer+SCR+DPF ("H_2O):	**22.6**	*as configured at rated load or (kPa):*			***5.6***
Inlet Size inches (mm):	**16 (406)**		**Flange**	# of Inlets:	**2**
Outlet Size inches (mm):	**20 (508)**		**Flange**		

This System Includes:

SILENCER - Stainless Steel:	**Yes**	INTERNAL Mixing and DEF Injection:	**Yes**
SCR Catalyst:	**Yes**	Dosing Control Cabinet:	**Yes**
DPF Units:	**Yes**	Operation & Maintenance Manual:	**Yes**
		Start-up Commissioning:	**No**

This System Excludes:

Delivery/Freight Expenses, Consumables and Utilities
Installation and supply of interconnecting power, control cables, conduit, reductant tanks, plumbing, supply pumps, etc.
Installation, Commissioning of the Proposed System and any required permitting
Exhaust piping insulation *(Recommend insulating the exhaust from the engine to the inlet of the emissions control system)*

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Notes:

Includes AC 200 cpsi CDPF substrates which are catalyzed and reduce CO, HC, and PM

Terms & Conditions:	***Incoterms:*** **FCA** **Santa Fe**
Estimated Ship Date:	**Consult Factory**
Terms:	**Net 30 Days.**
Proposal Valid :	**30 days from proposal date**
Warranty:	**24 months or 8,000 hours of operation, whichever comes first, from date of commissioning**

Pricing:

	Cat #/ Feature Code	***Closed-Loop System*** **Description**	**Quantity**	**Unit Price**	**Dealer Net Total (USD)**
1	**457-8417 / SCR0017**	Cat® SCR w/ DPF in a 409L Stainless Steel Double Wall Critical Grade Silencer (Insulation Blanket Included)	**6**	**$ 168,178**	**$ 1,009,066.00**
				Estimated Freight:	
				Total:	**$ 1,009,066.00**

Capital Cost for Integrated Control Package (SCR, DPF and DOC)

Cost Category		Cost Factor	Source of Cost Factor	Quant.	Unit Cost	Subtotal Cost
Direct Costs						
Purchased Equipment Costs						
	2000 kWe emission control package	ROM cost estimate by Caterpillar		32	$168,178	$5,381,696
	Combined systems FOB cost					$5,381,696
	Instrumentation	Assume no cost	Assume no cost	0	0	0
	Sales Tax	WA state tax	WA state tax	6.5%	--	$349,810
	Shipping	0.05A	EPA Cost Manual	5.0%	--	$269,085
Subtotal Purchased Equipment Cost, PEC						$6,000,591
Direct Installation Costs						
	Enclosure structural supports	Assume no cost	Assume no cost	0	$0	$0
	Installation	1/2 of EPA Cost Manual	1/2 of EPA Cost Manual	2.5%	--	$150,015
	Electrical	Assume no cost	Assume no cost	0	0	0
	Piping	Assume no cost	Assume no cost	0	0	0
	Insulation	Assume no cost	Assume no cost	0	0	0
	Painting	Assume no cost	Assume no cost	0	0	0
Subtotal Direct Installation Costs						$150,015
Site Preparation and Buildings (SP)		Assume no cost	Assume no cost	0	0	0
Total Direct Costs, DC (PEC + Direct Installation + Site Prep)						$6,150,606
Indirect Costs (Installation)						
	Engineering	0.025*PEC	1/4 of EPA Cost Manual	2.5%	--	$150,015
	Construction and field expenses	0.025*PEC	1/2 of EPA Cost Manual	2.5%	--	$150,015
	Contractor Fees	From DIS data center	From DIS data center	6.8%	--	$425,584
	Startup	0.02*PEC	EPA Cost Manual	2.0%	--	$120,012
	Performance Test (Tech support)	0.01*PEC	EPA Cost Manual	1.0%	--	$60,006
	Contingencies	0.03*PEC	EPA Cost Manual	3.0%	--	$180,018
Subtotal Indirect Costs, IC						$1,085,649
Total Capital Investment (TCI = DC+IC)						$7,236,255
						TCI per gen $226,133

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Cost-Effectiveness for Integrated Control Package (SCR, DPF and DOC)

Item	Quantity	Units	Unit cost	Subtotal
Annualized Capital Recovery				
Total Capital Cost				$7,236,255
Capital Recovery Factor, 25 yrs, 4% discount rate				0.06401
Subtotal Annualized 25-year Capital Recovery Cost				$463,193
Direct Annual Costs				
Annual Admin charges	2% of TCI (EPA Manual)		0.02	$144,725
Annual Property tax	1% of TCI (EPA Manual)		0.01	$72,363
Annual Insurance	1% of TCI (EPA Manual)		0.01	$72,363
Annual operation and maintenance costs: Mid-range CARB value would account for urea, fuel for pressure drop, increased inspections, periodic OEM visits	129,228	Installed hp	$1.50	$193,842
Subtotal Direct Annual Costs				$483,292
Total Annual Cost (Capital Recovery + Direct Annual Costs)				**$946,485**
Uncontrolled emissions (Combined Pollutants)				37.7
Annual Tons Removed (Combined Pollutants)				32.97
Cost Effectiveness ($ per tons combined pollutant destroyed)				**$28,707**

Installed HP:	No. Gens	Each BHP	Total BHP
	44	2937	129228

Annual O&M Cost Based on CARB Factors

Annual operation + maintenance (lowermost CARB estimate)	131,552	Installed hp	$1.50	$197,328

Criteria Pollutants Multi-Pollutant Cost-Effectiveness (Reasonable vs. Actual Control Cost)

Pollutant	Ecology Acceptable Unit Cost ($/ton)	Forecast Removal (tons/yr)	Subtotal Reasonable Annual Cost ($/year)	
NOX	$10,000	22.08	$220,806	per year
CO	$5,000	9.51	$47,564	per year
VOC	$10,000	1.00	$10,006	per year
PM (FH+BH)	$23,200	0.376	$8,731	per year
Other				
Total Reasonable Annual Control Cost for Combined Pollutants			**$287,108**	**per year**
Actual Annual Control Cost			**$946,485**	**per year**
Is The Control Device Reasonable?			**NO (Actual >> Acceptable)**	

Criteria Pollutants Removal Tonnages (Nominal-Controlled) **57.5 <--hrs per year**

Pollutant	PM (FH+BH)	CO	VOC	NOX	Other
Tier-2 Uncontrolled TPY	**0.443**	**11.891**	**1.429**	**23.9**	
Controlled TPY	**0.066**	**2.378**	**0.429**	**1.828**	
Tons Removed/Year	**0.376**	**9.513**	**1.001**	**22.081**	
Combined Uncontrolled Tons/yr	37.67				
Combined tons/yr Removed	32.97				
100%-load Removal Effcy	85%	80%	70%	92%	
Annualized Cost ($/yr)	$946,485	$946,485	$946,485	$946,485	$946,485
Indiv Poll $/Ton Removed	$2,514,990	$99,496	$945,903	$42,865	

TAPs Multi-Pollutant Cost-Effectiveness (Reasonable vs. Actual Control Cost)

Pollutant	Ecology Acceptable Unit Cost ($/ton)	Forecast Removal (tons/yr)	Subtotal Reasonable Annual Cost ($/year)	
NO2	$20,000	2.21	$44,161	per year
CO	$5,000	9.51	$47,564	per year
Benzene	$20,000	0.0131	$262	per year
DEEP (FH+BH)	$23,200	0.376	$8,731	per year
Total Reasonable Annual Control Cost for Combined Pollutants			**$100,718**	**per year**
Actual Annual Control Cost			**$946,485**	**per year**
Is The Control Device Reasonable?			**NO (Actual >> Acceptable)**	

TAPs Removal Tonnages (Nominal-Controlled)

Pollutant	DEEP (FH+BH)	CO	Benzene	NO2
Tier-2 Uncontrolled TPY	**0.44**	**11.89**	**0.0187**	**2.39**
Controlled TPY	**0.066**	**2.378**	**0.006**	**0.183**
Tons Removed/Year	**0.376**	**9.513**	**0.013**	**2.208**
Combined Uncontrolled Tons/yr	14.74			
Combined tons/yr Removed	12.11			
100%-load Removal Effcy	85%	80%	70%	92%
Annualized Cost ($/yr)	$946,485	$946,485	$946,485	$946,485
Indiv Poll $/Ton Removed	$2,514,990	$99,496	$72,331,591	$428,649
Combined TAPs $/Ton Removed	$78,155			

Capital Cost for Catalyzed-DPF

Cost Category		Cost Factor	Source of Cost Factor	Quant.	Unit Cost	Subtotal Cost
Direct Costs						
Purchased Equipment Costs						
	2000 kWe emission control package	ROM cost estimate by Caterpillar		32	$115,067	$3,682,144
	Combined systems FOB cost					$3,682,144
	Instrumentation	Assume no cost	Assume no cost	0	0	0
	Sales Tax	WA state tax	WA state tax	6.5%	--	$239,339
	Shipping	0.05A	EPA Cost Manual	5.0%	--	$184,107
Subtotal Purchased Equipment Cost, PEC						$4,105,591
Direct Installation Costs						
	Enclosure structural supports	Assume no cost	Assume no cost	0	$0	$0
	Installation	1/2 of EPA Cost Manual	1/2 of EPA Cost Manual	2.5%	--	$102,640
	Electrical	Assume no cost	Assume no cost	0	0	0
	Piping	Assume no cost	Assume no cost	0	0	0
	Insulation	Assume no cost	Assume no cost	0	0	0
	Painting	Assume no cost	Assume no cost	0	0	0
Subtotal Direct Installation Costs						$102,640
Site Preparation and Buildings (SP)		Assume no cost	Assume no cost	0	0	0
Total Direct Costs, DC (PEC + Direct Installation + Site Prep)						$4,208,230
Indirect Costs (Installation)						
	Engineering	0.025*PEC	1/4 of EPA Cost Manual	2.5%	--	$102,640
	Construction and field expenses	0.025*PEC	1/2 of EPA Cost Manual	2.5%	--	$102,640
	Contractor Fees	From DIS data center	From DIS data center	6.8%	--	$297,292
	Startup	0.02*PEC	EPA Cost Manual	2.0%	--	$82,112
	Performance Test (Tech support)	0.01*PEC	EPA Cost Manual	1.0%	--	$41,056
	Contingencies	0.03*PEC	EPA Cost Manual	3.0%	--	$123,168
Subtotal Indirect Costs, IC						$748,907
Total Capital Investment (TCI = DC+IC)						$4,957,138
						TCI per gen $154,911

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Cost-Effectiveness for Catalyzed-DPF

Item	Quantity	Units	Unit cost	Subtotal
Annualized Capital Recovery				
Total Capital Cost				$4,957,138
Capital Recovery Factor, 25 yrs, 4% discount rate				0.06401
Subtotal Annualized 25-year Capital Recovery Cost				$317,306
Direct Annual Costs				
Annual Admin charges	2% of TCI (EPA Manual)		0.02	$99,143
Annual Property tax	1% of TCI (EPA Manual)		0.01	$49,571
Annual Insurance	1% of TCI (EPA Manual)		0.01	$49,571
Annual operation + maintenance (lowermost CARB estimate)	129,228	Installed hp	$1.00	$129,228
Subtotal Direct Annual Costs				$327,514
Total Annual Cost (Capital Recovery + Direct Annual Costs)				**$644,820**
Uncontrolled emissions (Combined Pollutants)				37.7
Annual Tons Removed (Combined Pollutants)				10.89
Cost Effectiveness ($ per tons combined pollutant destroyed)				**$59,213**

Installed HP:	No. Gens	Each BHP	Total BHP
	44	2937	129228

Annual O&M Cost Based on CARB Factors

Annual operation + maintenance (lowermost CARB estimate)	129,228	Installed hp	$1.00	$129,228

Criteria Pollutants Multi-Pollutant Cost-Effectiveness (Reasonable vs. Actual Control Cost)

Pollutant	Ecology Acceptable Unit Cost ($/ton)	Forecast Removal (tons/yr)	Subtotal Reasonable Annual Cost ($/year)	
NOX	$10,000	0.00	$0	per year
CO	$5,000	9.51	$47,564	per year
VOC	$10,000	1.00	$10,006	per year
PM (FH+BH)	$23,200	0.38	$8,731	per year
Other				
Total Reasonable Annual Control Cost for Combined Pollutants			**$66,301**	**per year**
Actual Annual Control Cost			**$644,820**	**per year**
Is The Control Device Reasonable?			**NO (Actual >> Acceptable)**	

Criteria Pollutants Removal Tonnages (Nominal-Controlled)

Pollutant	PM (FH+BH)	CO	VOC	NOX	Other
Tier-2 Uncontrolled TPY	**0.443**	**11.891**	**1.429**	**23.909**	
Controlled TPY	**0.066**	**2.378**	**0.429**	**23.909**	
Tons Removed/Year	**0.376**	**9.513**	**1.001**	**0.000**	
Combined Uncontrolled Tons/yr	37.7				
Combined tons/yr Removed	10.89				
Quoted Removal Effcy	85%	80%	70%	0%	
Annualized Cost ($/yr)	$644,820	$644,820	$644,820	$644,820	$644,820
Indiv Poll $/Ton Removed	$1,713,409	$67,784	$644,424	#DIV/0!	

TAPs Multi-Pollutant Cost-Effectiveness (Reasonable vs. Actual Control Cost)

Pollutant	Ecology Acceptable Unit Cost ($/ton)	Forecast Removal (tons/yr)	Subtotal Reasonable Annual Cost ($/year)	
NO2	$20,000	0.00	$0	per year
CO	$5,000	9.51	$47,564	per year
Benzene	$20,000	0.0131	$262	per year
DEEP (FH+BH)	$23,200	0.376	$8,731	per year
Total Reasonable Annual Control Cost for Combined Pollutants			**$56,557**	**per year**
Actual Annual Control Cost			**$644,820**	**per year**
Is The Control Device Reasonable?			**NO (Actual >> Acceptable)**	

TAPs Removal Tonnages (Nominal-Controlled)

Pollutant	DEEP (FH+BH)	CO	Benzene	NO2
Tier-2 Uncontrolled TPY	**0.44**	**11.89**	**0.0187**	**2.39**
Controlled TPY	**0.066**	**2.378**	**0.006**	**2.391**
Tons Removed/Year	**0.376**	**9.513**	**0.013**	**0.000**
Combined Uncontrolled Tons/yr	14.74			
Combined tons/yr Removed	9.90			
Overall Cold-Start Removal Effcy	85%	80%	70%	0%
Annualized Cost ($/yr)	$644,820	$644,820	$644,820	$644,820
Indiv Poll $/Ton Removed	$1,713,409	$67,784	$49,277,966	#DIV/0!
Combined TAPs $/Ton Removed	$65,119			

Capital Cost for DOC (alone)

Cost Category		Cost Factor	Source of Cost Factor	Quant.	Unit Cost	Subtotal Cost
Direct Costs						
Purchased Equipment Costs						
	2000 kWe emission control package	ROM cost estimate by Caterpillar		32	$30,828	$986,496
	Combined systems FOB cost					$986,496
	Instrumentation	Assume no cost	Assume no cost	0	0	0
	Sales Tax	WA state tax	WA state tax	6.5%	--	$64,122
	Shipping	0.05A	EPA Cost Manual	5.0%	--	$49,325
Subtotal Purchased Equipment Cost, PEC						$1,099,943
Direct Installation Costs						
	Structural supports	Additional cost, based on Caterpillar cost estimate for Microsoft Columbia Data Center		44	$5,000	$220,000
	Installation	1/2 of EPA Cost Manual	1/2 of EPA Cost Manual	2.5%	--	$27,499
	Electrical	Assume no cost	Assume no cost	0	0	0
	Piping	Assume no cost	Assume no cost	0	0	0
	Insulation	Assume no cost	Assume no cost	0	0	0
	Painting	Assume no cost	Assume no cost	0	0	0
Subtotal Direct Installation Costs						$247,499
Site Preparation and Buildings (SP)		Assume no cost	Assume no cost	0	0	0
Total Direct Costs, DC (PEC + Direct Installation + Site Prep)						$1,347,442
Indirect Costs (Installation)						
	Engineering	0.025*PEC	1/4 of EPA Cost Manual	2.5%	--	$27,499
	Construction and field expenses	0.025*PEC	1/2 of EPA Cost Manual	2.5%	--	$27,499
	Contractor Fees	From DIS data center	From DIS data center	6.8%	--	$93,810
	Startup	0.02*PEC	EPA Cost Manual	2.0%	--	$21,999
	Performance Test (Tech support)	0.01*PEC	EPA Cost Manual	1.0%	--	$10,999
	Contingencies	0.03*PEC	EPA Cost Manual	3.0%	--	$32,998
Subtotal Indirect Costs, IC						$214,804
Total Capital Investment (TCI = DC+IC)						$1,562,245
						TCI per gen $48,820

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Cost-Effectiveness for DOC (alone)

Item	Quantity	Units	Unit cost	Subtotal
Annualized Capital Recovery				
Total Capital Cost				$1,562,245
Capital Recovery Factor, 25 yrs, 4% discount rate				0.06401
Subtotal Annualized 25-year Capital Recovery Cost				$99,999
Direct Annual Costs				
Annual Admin charges	2% of TCI (EPA Manual)		0.02	$31,245
Annual Property tax	1% of TCI (EPA Manual)		0.01	$15,622
Annual Insurance	1% of TCI (EPA Manual)		0.01	$15,622
Annual operation + maintenance (lowermost CARB estimate)	129,228	Installed hp	$0.20	$25,846
Subtotal Direct Annual Costs				$88,335
Total Annual Cost (Capital Recovery + Direct Annual Costs)				**$188,335**
Uncontrolled emissions (Combined Pollutants)				37.7
Annual Tons Removed (Combined Pollutants)				10.60
Cost Effectiveness ($ per tons combined pollutant destroyed)				**$17,764**

Installed HP:	No. Gens	Each BHP	Total BHP
	44	2937	129228

Annual O&M Cost Based on CARB Factors

Annual operation + maintenance (lowermost CARB estimate)	131,552	Installed hp	$0.20	$26,310

Criteria Pollutants Multi-Pollutant Cost-Effectiveness (Reasonable vs. Actual Control Cost)

Pollutant	Ecology Acceptable Unit Cost ($/ton)	Forecast Removal (tons/yr)	Subtotal Reasonable Annual Cost ($/year)	
NOX	$10,000	0.00	$0	per year
CO	$5,000	9.51	$47,564	per year
VOC	$10,000	1.00	$10,006	per year
PM (FH+BH)	$23,200	0.09	$2,054	per year
Other				
Total Reasonable Annual Control Cost for Combined Pollutants			**$59,625**	**per year**
Actual Annual Control Cost			**$188,335**	**per year**
Is The Control Device Reasonable?			**NO (Actual >> Acceptable)**	

Criteria Pollutants Removal Tonnages (Nominal-Controlled)

Pollutant	PM (FH+BH)	CO	VOC	NOX	Other
Tier-2 Uncontrolled TPY	**0.443**	**11.891**	**1.429**	**23.909**	
Controlled TPY	**0.354**	**2.378**	**0.429**	**23.909**	
Tons Removed/Year	**0.089**	**9.513**	**1.001**	**0.000**	
Combined Uncontrolled Tons/yr	37.7				
Combined tons/yr Removed	10.60				
Quoted Removal Effcy	20%	80%	70%	0%	
Annualized Cost ($/yr)	$188,335	$188,335	$188,335	$188,335	$188,335
Indiv Poll $/Ton Removed	$2,126,875	$19,798	$188,219	#DIV/0!	

TAPs Multi-Pollutant Cost-Effectiveness (Reasonable vs. Actual Control Cost)

Pollutant	Ecology Acceptable Unit Cost ($/ton)	Forecast Removal (tons/yr)	Subtotal Reasonable Annual Cost ($/year)	
NO2	$20,000	0.00	$0	per year
CO	$5,000	9.51	$47,564	per year
Benzene	$20,000	0.0131	$262	per year
DEEP (FH+BH)	$23,200	0.089	$2,054	per year
Total Reasonable Annual Control Cost for Combined Pollutants			**$49,880**	**per year**
Actual Annual Control Cost			**$188,335**	**per year**
Is The Control Device Reasonable?			**NO (Actual >> Acceptable)**	

TAPs Removal Tonnages (Nominal-Controlled)

Pollutant	DEEP (FH+BH)	CO	Benzene	NO2
Tier-2 Uncontrolled TPY	**0.44**	**11.89**	**0.0187**	**2.39**
Controlled TPY	**0.354**	**2.378**	**0.006**	**2.391**
Tons Removed/Year	**0.089**	**9.513**	**0.013**	**0.000**
Combined Uncontrolled Tons/yr	14.74			
Combined tons/yr Removed	9.61			
Overall Cold-Start Removal Effcy	20%	80%	70%	0%
Annualized Cost ($/yr)	$188,335	$188,335	$188,335	$188,335
Indiv Poll $/Ton Removed	$2,126,875	$19,798	$14,392,784	#DIV/0!
Combined TAPs $/Ton Removed	$19,589			

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Capital Cost for SCR (alone)

Cost Category		Cost Factor	Source of Cost Factor	Quant.	Unit Cost	Subtotal Cost
Direct Costs						
Purchased Equipment Costs						
	2000 kWe emission control package	ROM cost estimate by Caterpillar		32	$135,803	$4,345,696
	Combined systems FOB cost					$4,345,696
	Instrumentation	Assume no cost	Assume no cost	0	0	0
	Sales Tax	WA state tax	WA state tax	6.5%	--	$282,470
	Shipping	0.05A	EPA Cost Manual	5.0%	--	$217,285
Subtotal Purchased Equipment Cost, PEC						$4,845,451
Direct Installation Costs						
	Enclosure structural supports	Assume no cost	Assume no cost	0	$0	$0
	Installation	1/2 of EPA Cost Manual	1/2 of EPA Cost Manual	2.5%	--	$121,136
	Electrical	Assume no cost	Assume no cost	0	0	0
	Piping	Assume no cost	Assume no cost	0	0	0
	Insulation	Assume no cost	Assume no cost	0	0	0
	Painting	Assume no cost	Assume no cost	0	0	0
Subtotal Direct Installation Costs						$121,136
Site Preparation and Buildings (SP)		Assume no cost	Assume no cost	0	0	0
Total Direct Costs, DC (PEC + Direct Installation + Site Prep)						$4,966,587
Indirect Costs (Installation)						
	Engineering	0.025*PEC	1/4 of EPA Cost Manual	2.5%	--	$121,136
	Construction and field expenses	0.025*PEC	1/2 of EPA Cost Manual	2.5%	--	$121,136
	Contractor Fees	From DIS data center	From DIS data center	6.8%	--	$347,381
	Startup	0.02*PEC	EPA Cost Manual	2.0%	--	$96,909
	Performance Test (Tech support)	0.01*PEC	EPA Cost Manual	1.0%	--	$48,455
	Contingencies	0.03*PEC	EPA Cost Manual	3.0%	--	$145,364
Subtotal Indirect Costs, IC						$880,381
Total Capital Investment (TCI = DC+IC)						$5,846,968
						TCI per gen $182,718

Cost-Effectiveness for SCR (alone)

Item	Quantity	Units	Unit cost	Subtotal
Annualized Capital Recovery				
Total Capital Cost				$5,846,968
Capital Recovery Factor, 25 yrs, 4% discount rate				0.06401
Subtotal Annualized 25-year Capital Recovery Cost				$374,264
Direct Annual Costs				
Annual Admin charges	2% of TCI (EPA Manual)		0.02	$116,939
Annual Property tax	1% of TCI (EPA Manual)		0.01	$58,470
Annual Insurance	1% of TCI (EPA Manual)		0.01	$58,470
Annual operation + maintenance (CARB estimate). Mid-range CARB value would account for urea, fuel for pressure drop, increased inspections, periodic OEM visits	129,228	Installed hp	$1.50	$193,842
Subtotal Direct Annual Costs				$427,721
Total Annual Cost (Capital Recovery + Direct Annual Costs)				**$801,985**
Uncontrolled emissions (Combined Pollutants)				37.7
Annual Tons Removed (Combined Pollutants)				22.08
Cost Effectiveness ($ per tons combined pollutant destroyed)				**$36,321**

Installed HP:	No. Gens	Each BHP	Total BHP
	44	2937	129228

Annual O&M Cost Based on CARB Factors

Annual operation + maintenance (lowermost CARB estimate)	131,552	Installed hp	$1.50	$197,328

Criteria Pollutants Multi-Pollutant Cost-Effectiveness (Reasonable vs. Actual Control Cost)

Pollutant	Ecology Acceptable Unit Cost ($/ton)	Forecast Removal (tons/yr)	Subtotal Reasonable Annual Cost ($/year)	
NOX	$10,000	22.08	$220,806	per year
CO	$5,000	0.00	$0	per year
VOC	$10,000	0.00	$0	per year
PM (FH+BH)	$23,200	0.00	$0	per year
Other				
Total Reasonable Annual Control Cost for Combined Pollutants			**$220,806**	**per year**
Actual Annual Control Cost			**$801,985**	**per year**
Is The Control Device Reasonable?			**NO (Actual >> Acceptable)**	

Criteria Pollutants Removal Tonnages (Nominal-Controlled)

Pollutant	PM (FH+BH)	CO	VOC	NOX	Other
Tier-2 Uncontrolled TPY	**0.443**	**11.891**	**1.429**	**23.909**	
Controlled TPY	**0.443**	**11.891**	**1.429**	**1.828**	
Tons Removed/Year	**0.000**	**0.000**	**0.000**	**22.081**	
Combined Uncontrolled Tons/yr	37.7				
Combined tons/yr Removed	22.08				
Quoted Removal Effcy	0%	0%	0%	92%	
Annualized Cost ($/yr)	$801,985	$801,985	$801,985	$801,985	$801,985
Indiv Poll $/Ton Removed	#DIV/0!	#DIV/0!	#DIV/0!	$36,321	

TAPs Multi-Pollutant Cost-Effectiveness (Reasonable vs. Actual Control Cost)

Pollutant	Ecology Acceptable Unit Cost ($/ton)	Forecast Removal (tons/yr)	Subtotal Reasonable Annual Cost ($/year)	
NO2	$20,000	2.21	$44,161	per year
CO	$5,000	0.00	$0	per year
Benzene	$20,000	0.0000	$0	per year
DEEP (FH+BH)	$23,200	0.000	$0	per year
Total Reasonable Annual Control Cost for Combined Pollutants			**$44,161**	**per year**
Actual Annual Control Cost			**$801,985**	**per year**
Is The Control Device Reasonable?			**NO (Actual >> Acceptable)**	

TAPs Removal Tonnages (Nominal-Controlled)

Pollutant	DEEP (FH+BH)	CO	Benzene	NO2
Tier-2 Uncontrolled TPY	**0.44**	**11.89**	**0.0187**	**2.39**
Controlled TPY	**0.443**	**11.891**	**0.019**	**0.183**
Tons Removed/Year	**0.000**	**0.000**	**0.000**	**2.208**
Combined Uncontrolled Tons/yr	14.74			
Combined tons/yr Removed	2.21			
Overall Cold-Start Removal Effcy	0%	0%	0%	92%
Annualized Cost ($/yr)	$801,985	$801,985	$801,985	$801,985
Indiv Poll $/Ton Removed	#DIV/0!	#DIV/0!	#DIV/0!	$363,207
Combined TAPs $/Ton Removed	$363,207			

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APPENDIX E

Revised Emission Calculations and Ambient Impact Assessment

APPENDIX E (March 2015)
REVISED EMISSION CALCULATIONS & AMBIENT IMPACT ASSESSMENT
AIR QUALITY APPROVAL ORDER REVISION APPLICATION
SABEY INTERGATE-QUINCY DATA CENTER
QUINCY, WASHINGTON

This appendix presents the revised generator runtime scenarios, revised emission calculations, and revised AERMOD[1] ambient air quality dispersion modeling to support the 2015 revised air quality permit revision application for the Sabey Intergate-Quincy Data Center (Sabey) in Quincy, Washington.

SUMMARY OF REVISED ASSUMPTIONS

This revised set of emission calculations and AERMOD dispersion modeling incorporates the following changes to the emission calculations that were originally provided to the Washington State Department of Ecology (Ecology) in June 2011 to support Sabey's original permit application:

- Short-term emission rate estimates for particulate matter (PM) and diesel engine exhaust particulate matter (DEEP) are now based on maximum emission rates (from the worst-case condition for DEEP emission under 25 percent load). This is the load at which Caterpillar's data indicate mass emission rates for PM are highest.
- Short-term emission rate estimates for nitrogen oxides (NO_x), carbon monoxide (CO), volatile organic compounds (VOCs), and AP-42 (EPA 1995) gaseous toxic air pollutants (TAPs) are now based on the assumption that the generators always run at the operating load that would emit the maximum amount for these pollutants, which is 100 percent load according to emission rates reported by Caterpillar.
- The annual-average emission rate estimates for PM, DEEP, NO_x, CO, VOCs, and TAPs are based on 57.5 operating hours per year with an emission rate derived by averaging those rates reported by Caterpillar for 10 percent, 25 percent, 50 percent, 75 percent, and 100 percent loads.
- The short-term and annual emission rates have been updated to account for the "black puff factors" applied to the first 15 minutes during each cold start. Those "black puff factors" were derived from the recent air quality permit application for the Microsoft Project Oxford Data Center (Landau Associates 2014) and correspond to 1.26 for PM and VOC emissions and 1.56 for CO emissions.
- All permitted emissions, allowed during a 3-year rolling average period, to occur in a single 12-month period (as a "maximum theoretical annual emission" rate) was used to evaluate compliance with all annual National Ambient Air Quality Standards (NAAQS) and the annual Acceptable Source Impact Levels (ASILs).
- The 70-year average emission rate for DEEP, which is used to evaluate the 70-year DEEP cancer risk, was revised upward to include the initial emissions from generator commissioning and the emissions from periodic stack emission testing.

[1] AERMOD = American Meteorological Society (AMS)/U.S. Environmental Protection Agency (EPA) regulatory model.

REVISED ACTIVITY-SPECIFIC ALLOWABLE RUNTIMES AND LOAD LIMITS

Sabey requests that the allowable activity-specific runtime limits and load limits (specified by Table 3.2 of the current Approval Order) be revised for two reasons: 1) to provide more flexibility for the allowable runtime limits for combined power outages and scheduled electrical bypass transformer maintenance; and 2) to allow a full range of allowable loads for combined power outages, scheduled electrical bypass transformer maintenance, and corrective testing, when the generators might have to activate at random, variable loads between 10 and 100 percent. Sabey's requested revisions to Table 3.2 of the Approval Order are shown below.

Table 3.2: Engine Operating Restrictions (Revisions March-2015)

Operating Activity	Average hours/year per engine, 3-year monthly rolling totals	Average Operating Electrical Loads (%)	Facility-Wide Diesel fuel gallons/year, 3-year monthly rolling totals	# Operating Concurrently
Monthly Testing	16.5	~~Idle~~ Zero electrical load to50%		4
Annual Load Bank Testing	6	100%		4
Combined Electrical Bypass and Power Outage	~~15~~35	Any random load from zero to 100% ~~75%~~		22 during electrical bypass; 44 during power outage; 1 during corrective testing
~~Corrective Tests~~	~~12~~	~~50%~~		~~1~~
~~Power Outage~~	~~8~~	~~75%~~		~~44~~
Total	57.5		263,725	

Based on Sabey's requested revisions, the new worst-case runtime scenarios for the ambient impact analysis for annual DEEP, 24-hour PM_{10}, and 98th-percentile 24-hour $PM_{2.5}$[2] are as follows:

- For annual DEEP—acknowledging the possibility for a "maximum theoretical annual emission" under random variable loads between 10 and 100 percent—the worst-case runtime scenario would be to operate under a steady 25 percent operating load for 57.5 hours within a single year.
- For 2nd-highest 24-hour PM_{10}, it would be theoretically possible to have two power outages per year, each lasting 17.5 hours per outage (35 hours / 2 outages = 15.5 hours/outage).
- For 98th-percentile 24-hour $PM_{2.5}$, it would be theoretically possible to have eight outages per year, each lasting 4.4 hours (35 hours / 8 outages = 4.4 hours/outage).

[2] PM_{10} = Particulate matter with an aerodynamic diameter less than or equal to 10 microns.
$PM_{2.5}$ = Particulate matter with an aerodynamic diameter less than or equal to 2.5 microns.

REVISED WORST-CASE LOAD-SPECIFIC EMISSION ESTIMATES FROM CATERPILLAR

The emission calculations for Sabey's original June 2011 application assumed that emissions would vary based on the engine load characteristics of each individual activity. However, for this application for revisions, Sabey requests that the load limits for each individual activity be replaced with a more flexible, facility-wide runtime limit. This is so that Sabey could theoretically operate any generator at any load, for any reason. To account for this consideration:

- The short-term (1-hour and 24-hour) emission rates were adjusted upward under the worst-case assumptions that the generators always operate at the load for which the currently-permitted emission for each pollutant is highest (as listed in Tables 5.2 through 5.5 of the current Approval Order).
- The annual-average emission rates were derived by averaging the currently-permitted emission limits at 10 percent, 25 percent, 50 percent, 75 percent, and 100 percent loads, with the assumption that over the course of a full year (and especially over a 70-year period) the generator load could vary randomly across all loads because the server demand randomly varies.
- For the purpose of calculating the emission rates for the gaseous TAPs described by AP-42 (EPA 1995), which have emission factor units of pounds per million British thermal units of fuel input (lbs/MMBTU), we assumed that the fuel consumption during every hour of generator usage would be equal to the fuel rate at 100 percent generator load.

Based on these worst-case assumptions, the assumed emission rate for each pollutant is listed in Table E-1. The yellow-highlighted cells in the table indicate the worst-case load that was assumed to occur at all times.

70-YEAR AVERAGE RUNTIMES FOR INITIAL GENERATOR COMMISSIONING AND PERIODIC STACK EMISSION TESTING

Sabey's 2011 Second-Tier Risk Report for DEEP did not consider the 70-year average DEEP contributions by either initial generator commissioning or periodic stack testing. However, emissions from those activities are now incorporated into this revised analysis. Sabey's current Approval Order allows for up to 30 hours of runtime per generator for initial commissioning, so it was assumed that each of the 44 generators would be commissioned once, with a runtime of 30 hours at an average generator load of 50 percent, with the hourly emission corresponding to the "Average of All Loads" value listed in Table E-1. To estimate the contribution from periodic stack emission testing, it was assumed that Sabey will eventually be required to conduct emission testing on up to 16 generators. It was assumed that each stack test will require 30 hours of generator runtime, at an average load of 50 percent, with the hourly emission corresponding to the "Average of All Loads" value listed in Table E-1. The 30 hours per year of runtime for emission testing is in addition to the allowable 57.5 hours per year for Sabey's routine annual activity. The 70-year average contribution by these activities was calculated by distributing these emissions from initial commissioning and periodic stack testing evenly over 70 years.

COLD START "BLACK PUFF" CONDITIONS

Sabey's original 2011 application did not consider the emissions caused by the "black puff" lasting for about 30 seconds after each cold start. However, those "black puff" emissions were incorporated in these revised calculations. Black puff factors were derived from the recent air quality permit application for the Microsoft Project Oxford Data Center (Landau Associates 2014). The black puff factor for PM and VOCs was 1.26 and for CO the black puff factor was 1.56. These were applied to the short-term and annual emission rates for emergency diesel generators at Sabey in order to correct for the first 15 minutes of each generator cold start.

A detailed evaluation for the number of cold starts that Sabey might conduct each year was not attempted for these revised calculations. Instead, the same cold-start assumptions that were included in the emission calculations for the Microsoft Project Oxford Data Center were applied to Sabey diesel generators. Microsoft estimated that the combined 15-minute cold-start periods would comprise 17 percent of its generators' total annual runtime (15 hours per year of aggregated cold-start runtime, out of 86 hours per year of total generator runtime). Therefore, "black puff factors" were applied to 17 percent of Sabey's requested 57.5 hours per year under the following runtime scenarios: annual routine runtime, commissioning runtime, and stack emission testing runtime. The black puff factors were also applied to the first 15 minutes of each short-term runtime scenario.

THEORETICAL MAXIMUM ANNUAL RUNTIME AND EMISSIONS

Sabey's current Approval Order specifies the runtime limits as 3-year rolling averages, so in theory Sabey could emit the total allowable emissions within any 3-year rolling period in one single year. This "maximum theoretical annual" condition was used when evaluating compliance with the single-year annual ambient standards (the NAAQS and the ASILs) and for calculation of the chronic (annual-average) TAP non-cancer hazard quotients. However, we did not apply the "maximum theoretical annual" approach to our calculation of the 70-year average DEEP cancer risks because it is appropriate to evaluate long-term cancer risks based on the average lifetime exposure concentrations rather than the maximum single-year concentration.

REVISED FACILITY-WIDE EMISSION RATES

The facility-wide emission rates were re-calculated using the revised assumptions described in the preceding sections. Screenshots of the revised emission calculation spreadsheets are provided in Attachment E-1. The revised facility-wide emission rates are listed in the Table E-2.

As shown in Table E-2, the facility-wide DEEP rate listed in Condition 5 of the current Approval Order (0.809 tons/year) is higher than the value presented in Sabey's June 2011 permit application addendum and Ecology's June 2011 DEEP Second-Tier Risk Analysis (which was 0.31 tons/year). The revised facility-wide PM emission rate for routine activities (which is 0.463 tons/year, not including initial commissioning or periodic stack testing) is higher than the value proposed in Sabey's June 2011 application.

REVISED FIRST-TIER TOXIC AIR POLLUTANT ASSESSMENT (COMPARED TO SMALL-QUANTITY EMISSION RATES)

The emission rate for each TAP was recalculated using the revised assumptions described above. Table E-3 shows a comparison of these revised TAP emission rates to Ecology's Small-Quantity Emission Rate (SQER) thresholds.

The annual-average emission rates listed in Table E-3 are based on the "maximum theoretical annual emission" values that assume all of the allowable emissions within a 3-year rolling period occur in a 12-month period. As listed in Table E-3, the following TAPs exhibit worst-case emission rates exceeding their respective SQERs: DEEP, CO, primary nitrogen dioxide (NO_2), benzene, 1,3-butadiene, and naphthalene. Compliance with the ASILs is described in a later section.

UPDATED AERMOD MODELING RUNS (USED TO DEVELOP DISPERSION FACTORS)

The June 2011 AERMOD modeling runs were updated for this March 2015 revision request. A DVD of the revised AERMOD files has been provided to Ecology under separate cover. Two new AERMOD runs were used to develop "dispersion factors" for the maximum short-term impacts and the annual-average impacts:

- The short-term dispersion factors (for averaging periods of 24 hours, 8 hours, or 1 hour) are for a runtime condition consisting of a 24-hour power outage, with all generators operating at only 25 percent load (the load at which the PM emission rate is highest). A screenshot of the AERMOD stack parameters is provided in Attachment E-1, Table E1-6. The input stack temperature was based on the value measured during the most recent stack emission test. The derivation of these dispersion factors are shown in Attachment E-1, Table E1-8.
- AERMOD modeling for the 24-hour PM_{10} NAAQS is based on the 2^{nd}-highest 24-hour value. The modeling for the 98^{th}-percentile 24-hour $PM_{2.5}$ NAAQS was based on the 1^{st}-highest value in order to provide a conservatively high assessment.

- The annual-average dispersion factor is for the runtime scenario of all generators operating under random, variable load (between 10 and 100 percent), over the course of the entire year. The input stack exhaust temperatures were the average of temperatures under 10 percent, 25 percent, 50 percent, 75 percent, and 100 percent loads. These five iterative loads are taken from the most recent stack test results and supplemented by data from Caterpillar. A screenshot of the AERMOD stack parameters is provided in Attachment E-1 (Table E1-6).

COMPLIANCE WITH AMBIENT AIR QUALITY LIMITS

The worst-case emission rates and calculations, for each generator runtime scenario used in comparison to the NAAQS and ASIL, are shown in the spreadsheet screenshots provided in Attachment E-1 (Table E1-7). The forecast ambient concentrations were then calculated by applying the previously discussed dispersion factors. The total cumulative ambient impacts were calculated by applying regional background concentrations (provided by Ecology) and "local background" impacts derived from AERMOD modeling of other local data centers and industrial facilities. Detailed calculations are provided in Attachment E-1 (Table E1-8). Table E-4 summarizes the modeling results for each TAP whose emission rate exceeds the SQER and for each criteria air pollutant. The key runtime assumptions used to model compliance are described below.

Sabey requests that Table 3.2 of the Approval Order be revised to consolidate the allowable runtimes for outages, electrical bypass, and corrective testing into a single flexible category with a combined runtime limit of 35 hours per year. Theoretically, for the purpose of calculating the 2nd-highest daily PM_{10} emissions, Sabey could use that entire 35 hours for unplanned power outages, and theoretically those outages could be distributed over 2 or more days. Therefore, the emissions calculations and AERMOD modeling for 24-hour PM_{10} assume two consecutive outages of 17.5 hours (35 hours / 2 outages = 17.5 hours/outage) occurring at the worst-case condition (under a steady 25 percent operating load). The 2nd-highest daily PM_{10} emission rate (including the "black puff factor" correction) is 440 lbs/day.

Sabey requests that Table 3.2 of the Approval Order be revised to consolidate the allowable runtimes for outages, electrical bypass, and corrective testing into a single flexible category with a combined runtime limit of 35 hours per year. Theoretically, for the purpose of calculating the 8th-highest daily $PM_{2.5}$ emissions, Sabey could use that entire 35 hours for power outages, and theoretically those outages could be distributed over 8 or more days per year. Therefore, the emissions calculations and AERMOD modeling for the 98th-percentile 24-hour $PM_{2.5}$ assume eight consecutive outages of 4.4 hours (35 hours / 8 outages = 4.4 hours/outage) occurring under worst-case conditions (25 percent load). The 8th-highest daily $PM_{2.5}$ emission rate (including the "black puff factor" correction) is 112 lbs/day.

REQUIRED DEEP SECOND-TIER RISK ASSESSMENT

To accommodate the requested flexibility in the allowable range of engine operating loads, Sabey requests that the allowable DEEP emission rate be increased. Based on such an increase, the modeled worst-case DEEP concentration exceeds the ASIL [0.00333 micrograms per cubic meter (ug/m^3)]. Therefore, as requested by Ecology, a complete DEEP Second-Tier Risk Analysis (Landau Associates 2015) has been submitted under separate cover. That risk assessment demonstrates the following:

- The revised DEEP risk assessment assumes a Sabey baseline of zero emissions. Therefore, we have evaluated the total emissions from the Intergate-Quincy Data Center, not just the incrementally increased emissions caused by this requested permit revision.
- From the 70-year average DEEP emission rate of 0.467 tons per year (which includes emissions from stack testing, initial engine commissioning, and the black-puff factor correction for cold-start operation), the maximum DEEP cancer risk at any receptor, caused solely by Sabey emissions, is only 9-per-million (compared to the previous 2011 value of 6-per-million), which is less than Ecology's second-tier approval threshold of 10-per-million.
- The maximum cumulative DEEP cancer risk caused by Sabey and other DEEP emission sources within the modeling range (including roads, railroads, and other data centers) is only 47 per-million (compared to the previous 2011 value of 39-per-million), which is less than the specific community-wide threshold of 100-per-million that Ecology has established for the city of Quincy. This cumulative increase accounts not only for the project-related increase but the updated addition of the Vantage Data Center (permitted in 2012) that has added a local DEEP source since the original 2011 evaluation. In fact, most of the increase in DEEP impact since 2011 is from this new Vantage Data Center.

AMBIENT NO_2 IMPACTS EXCEEDING THE ASIL

Sabey requests that the allowable limit for the 1st-highest NO_x emission rate be retained at the current limit of 990 lbs/hour (as set by Condition 5.7 of the current Approval Order). That is the same facility-wide NO_x emission rate that was evaluated in Ecology's 2011 Technical Support Document for Second Tier Review (Ecology2011). In that evaluation, Ecology demonstrated that the occurrences of Sabey's emissions causing exceedances of the NO_2 ASIL would be very infrequent, so Ecology determined that Sabey's NO_x emissions will not cause an unacceptable risk to the public.

POLLUTANTS REQUIRING SPECIAL PERMIT CONDITIONS BASED ON MODELED AMBIENT IMPACTS EXCEEDING LIMITS

Sabey proposes the following emission limits and operational limits to ensure its facility-wide emissions do not exceed values that would cause the ambient concentrations to exceed either the NAAQS or the ASILs.

- Sabey requests that the current operational limits (allowable load, allowable runtime, and number of generators operating simultaneously) for monthly testing and annual load bank testing (currently set by Table 3.2 of the Approval Order) be retained without change. The current limits were set based on Sabey's previous 2011 Monte Carlo modeling for the 98th-percentile 1-hour NO_2 NAAQS. Monthly and annual generator testing are the only activities that can realistically be anticipated to occur for more than 8 days per year (electrical bypass maintenance will be done only on a triennial basis, and it is inconceivable that more than 2 or 3 days of power outages could realistically occur on a regular basis). Therefore, maintaining the current operational limits for monthly testing and annual load bank testing is the best strategy for ensuring compliance with the 1-hour NO_2 NAAQS.

- The actual 1^{st}-highest 1-hour NO_x emission rate should continue to be limited to 990 lbs/hour during a power outage to ensure that the ambient NO_x impact is no more than documented in Ecology's 2011 NO_2 second-tier risk analysis. That is the limit set by the current Approval Order. Based on the low emission rates that have been demonstrated to date by Sabey's stack emission testing, Sabey is confident that the actual NO_x emissions during a 44-generator, facility-wide power outage would be well below that limit, even if some of the generators activate at loads as high as 100 percent. Sabey additionally proposes that a new Approval Order Condition 6.4 require Sabey to retain records of the actual NO_x emissions during each unplanned outage or scheduled electrical bypass event.

REFERENCES

Ecology. 2011. *Technical Support Document for Second Tier Review, Sabey Data Center, Quincy, Washington*. Washington State Department of Ecology. June 22.

EPA. 1995. *Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources*. Fifth Edition. AP-42. Office of Air Quality Planning and Standards, Office of Air and Radiation, U.S. Environmental Protection Agency. January.

Landau Associates. 2015. Report: *Second-Tier Risk Analysis for Diesel Engine Exhaust Particulate Matter, Sabey Intergate-Quincy Data Center, Quincy, Washington*. Prepared for Intergate Quincy LLC. March 2.

Landau Associates. 2014. *Final Notice of Construction Supporting Information Report, Microsoft Project Oxford Data Center, Quincy, Washington*. Prepared for The Microsoft Corporation. June 11.

ATTACHMENTS

Table E-1: Revised Caterpillar Load-Specific Emission Factors for Diesel Generators
Table E-2: Revised Facility-Wide Emission Rates
Table E-3: Revised Toxic Air Pollutant Emission Rates Compared to SQERs
Table E-4: Revised Cumulative Ambient Impacts Caused by Requested Permit Revisions

Attachment E-1: Screenshots of January 2015 Revised Emission Calculation Spreadsheets

TABLE E-1
REVISED CATERPILLAR LOAD-SPECIFIC EMISSION FACTORS FOR DIESEL GENERATORS
SABEY INTERGATE-QUINCY DATA CENTER
QUINCY, WASHINGTON

Generator Electrical Load	Currently-Permitted Emission Rate at Each Load (lbs/hour)			
	PM/DEEP	NO_x	CO	VOCs
100%	0.23	41.9	16.9	0.91
75%	0.22	22.5	12.7	1.11
50%	0.27	15.3	8.75	1.13
25%	0.57	9.4	3.9	0.95
10%	0.45	6.49	4.05	1.0
Average of All Loads (Used for Annual Average)	0.35	18.9	9.4	1.0

Yellow-highlighted values indicate worst-case values used for revised emission calculations.

TABLE E-2
REVISED FACILITY-WIDE EMISSION RATES
SABEY INTERGATE-QUINCY DATA CENTER
QUINCY, WASHINGTON

Pollutant	Original June 2011 Application (tons/year)	Permit Limit in Current Approval Order (tons/year)	Revised January 2015 Emission Calculation for Routine Activity (tons/year)	January 2015 Theoretical Maximum Year (Single Year of 3-Year Rolling Period) (tons/year)
PM	0.31	0.809	0.463	1.39
70-year Average DEEP	0.31	0.809	0.467 (includes commissioning and periodic stack testing)	N/A
NO_x	26.5	29.5	23.9	71.7
CO	14.15	14.15	11.89	35.7
VOCs	1.14	1.14	1.43	4.3

TABLE E-3
REVISED TOXIC AIR POLLUTANT EMISSIONS COMPARED TO SQERS
INTERGATE-QUINCY DATA CENTER
QUINCY, WASHINGTON

Pollutant	SQER	Units	Sabey Emission	SQER Ratio
DEEP	0.639	lbs/yr, max year of 3-year period	2,778	4,347
CO	50.2	lbs/1-hour	848	16.9
SO_2	1.45	lbs/1-hour	1.16	0.80
Primary NO_2	1.03	lbs/1-hour	991	962
Benzene	6.62	lbs/yr, max year of 3-year period	112.2	17
Toluene	657	lbs/24-hr day	5.60	0.009
Xylenes	58	lbs/24-hr day	3.88	0.07
1,3-Butadiene	1.13	lbs/yr, max year of 3-year period	2.8	2.50
Formaldehyde	32	lbs/yr, max year of 3-year period	10.3	0.32
Acetaldehyde	71	lbs/yr, max year of 3-year period	3.3	0.05
Acrolein	0.00789	lbs/24-hr day	0.1580	20.0
Benzo(a)pyrene	0.174	lbs/yr, max year of 3-year period	0.0167	0.10
Benzo(a)anthracene	1.74	lbs/yr, max year of 3-year period	0.081	0.05
Chrysene	17.4	lbs/yr, max year of 3-year period	0.199	0.011
Benzo(b)fluoranthene	1.74	lbs/yr, max year of 3-year period	0.144	0.08
Benzo(k)fluoranthene	1.74	lbs/yr, max year of 3-year period	0.014	0.01
Dibenz(a,h)anthracene	0.16	lbs/yr, max year of 3-year period	0.022	0.14
Ideno(1,2,3-cd)pyrene	1.74	lbs/yr, max year of 3-year period	0.027	0.015
Propylene	394	lbs/24-hr day	56.1	0.14
Naphthalene	5.64	lbs/yr, max year of 3-year period	18.8	3.33

Note: Shaded cells indicate exceedance of SQER.

TABLE E-4
REVISED CUMULATIVE AMBIENT IMPACTS CAUSED BY REQUESTED PERMIT REVISIONS
INTERGATE-QUINCY DATA CENTER
QUINCY, WASHINGTON

Pollutant and Averaging Time		Emission Rates for January 2015 Resubmittal		Ambient Impacts (µg/m^3)			
		Emission Rate Including "Black Puff" Factor	Emission Rate Units	Sabey Increment (includes 3x factor for annual average values)	Regional and Local Background	Total Ambient Impact	NAAQS or ASIL
PM_{10}							
2nd-high 24-hr during 2nd consecutive 17-hour facility-wide outage	lbs/day facility-wide	440	lbs/day during 2nd consecutive 17-hour outage	45	85	130	150
$PM_{2.5}$							
1st-high 24-hr during 8th consecutive 4.4-hour power outage	lbs/day facility-wide	112	lbs/day during 8th consecutive 4.4 hour outage	12	22	34	35
Annual (ultra-worst-case max year of 3-year rolling)	facility-wide annual	0.463	tons/yr	0.307 (3x the annual average)	6.5	6.8	12
Carbon Monoxide							
2nd-high 1-hr during facility-wide outage	lbs/hr facility-wide	848	lbs/hr	6,223	842	7,065	40,000
2nd-high 8-hr during facility-wide outage	lbs/hr facility-wide	848	lbs/hr	3,014	482	3,496	10,000
Nitrogen Dioxide							
1-hr NAAQS, 1st-highest during electrical bypass	lbs/hr NO_x, facility-wide	1st-highest facility-wide 1-hour NO_x emissions limited to 990 lbs/hour, the same value that was evaluated in the 2011 NO_2 Second-Tier Risk Assessment. See the worksheet "2015 NAAQS-ASIL Scenarios" for a range of example operating scenarios that can satisfy that emission limit with worst-case NO_x emission factors.					
NO_2 ASIL, 1st-highest 1-hr during facility-wide outage	lbs/hr NO_x, facility-wide	The current load limits and runtime limits for monthly testing, annual load bank testing, and corrective testing listed in Table 3.2 of the current Approval Order should be retained to ensure the 8th-highest daily 1-hr NO_x emission rates are consistent with the values that Sabey used for the NO_2 Monte Carlo modeling in 2011.					
Annual (ultra-worst-case max year of 3-year rolling)	facility-wide annual	23.9	tons/yr	15.8 (3x the annual average)	2.8	18.6	100
Toxic Air Pollutants							
Annual DEEP at onsite tenant (ultra-worst case, 3x annual average)	facility-wide annual	0.463	tons/yr	0.307 (3x the annual average)	Annual DEEP ASIL = 0.0033		
1,3-butadiene annual at onsite tenant (ultra-worst case, 3x annual average)	tons/yr facility-wide	4.71E-04	tons/yr	0.00031 (3x the annual average)	1,3-butadiene annual ASIL = 0.00588		

TABLE E-4
REVISED CUMULATIVE AMBIENT IMPACTS CAUSED BY REQUESTED PERMIT REVISIONS
INTERGATE-QUINCY DATA CENTER
QUINCY, WASHINGTON

Naphthalene annual at onsite tenant (ultra-worst case, 3x annual average)	tons/yr facility-wide	3.13E-03	tons/yr	0.0021 (3x the annual average)	Naphthalene annual ASIL = 0.0294
1st-high acrolein 24-hr at onsite tenant (ultra-worst case)	lbs/day facility-wide	0.158	lbs/day	0.0170	Acrolein 24-hr ASIL = 0.06
Benzene annual at onsite tenant (ultra-worst case, 3x annual average)	facility-wide annual	1.87E-02	tons/yr	0.012 (3x the annual average)	Benzene annual ASIL = 0.0345

Note: Theoretical maximum annual impact assumes the allowable emissions in a 3-year rolling period occur in one single year.

ATTACHMENT E-1

Screenshots of February 2015 Revised Emission Calculations Spreadsheets

Table E1-1. Ultra-Worst-Case_Intergate-Quincy Data Center Engine Runtime Forecast (Dec-2014)

Fuel Consumption and TAPs Based on Outages and Electrical Bypass Occurring Always at 100% Load

No. of Generators	44

Generator			Zero Power Outages (84% Load)				Zero Monthly Tests					Zero Annual Load Bank Tests				Combined Worst-Case Scheduled Tests(100% Load, 34.5 hrs/yr)				Combined Worst-Case Outages Plus Main Switchgear & Transformer Tests (100% Load, 23 hrs/yr)				Testing + Unplanned Outages	Total Engine Runtime
		Generator Size																							
Gen #	Gen Area	kWe	% load	kWm	hrs/yr	kWm-hr/yr	% load	kWm	hrs/test	tests/yr	kWm-hr/yr	% load	kWm	hrs/yr	kWm-hrs/yr	% load	kWm	hrs/yr	kWm-Hrs/yr	% load	kWm	hrs/yr	kWm-Hrs/yr	kWm-hrs/yr	hrs per year per engine
A01	Bldg A	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
A02	Bldg A	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
A03	Bldg A	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
A04	Bldg A	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
A05	Bldg A	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
A06	Bldg A	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
A07	Bldg A	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
A08	Bldg A	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
A09	Bldg A	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
A10	Bldg A	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
A11	Bldg A	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
A12	Bldg A	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
A13	Bldg A	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
A14	Bldg A	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
A15	Bldg A	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
A16	Bldg A	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
B01	Bldg B	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
B02	Bldg B	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
B03	Bldg B	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
B04	Bldg B	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
B05	Bldg B	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
B06	Bldg B	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
B07	Bldg B	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
B08	Bldg B	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
B09	Bldg B	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
B10	Bldg B	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
B11	Bldg B	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
B12	Bldg B	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
B13	Bldg B	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
B14	Bldg B	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
B15	Bldg B	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
B16	Bldg B	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
C01	Bldg C	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
C02	Bldg C	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
C03	Bldg C	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
C04	Bldg C	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
C05	Bldg C	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
C06	Bldg C	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
C07	Bldg C	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
C08	Bldg C	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
C09	Bldg C	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
C10	Bldg C	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
C11	Bldg C	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
C12	Bldg C	2000	84%	2490	0	0	84%	2490	0	0	0	84%	2490	0	0	100%	2191	34.5	75590	100%	2191	23	50393	125,983	57.5
Total kWm-hrs/year						0					0				0				3,325,938				2,217,292	5,543,230	2,530

Table E1-2 Emission Summary

Averages 10%-100% 1-21-2015

Fully-Flexible Average Loads 10%-100%

All generator Runtime Activates at average of 10%-100% for each pollutant

Annual Emissions Adjusted for 17% Cold-Start Runtime					
PM ("Black puff factor" = 1.26)					
Warmed Up (83% of year)	0.83	0.443	1	0.368	
Cold start (17% of year)	0.17	0.443	1.26	0.095	
Annual Average				0.463	tons/yr incl. cc
VOC ("Black puff factor" = 1.26)					
Warmed Up (83% of year)	0.83	1.43	1	1.19	
Cold start (17% of year)	0.17	1.43	1.26	0.31	
Annual Average				1.49	tons/yr incl. cc
CO ("Black puff factor" = 1.56)					
Warmed Up (83% of year)	0.83	11.89	1	9.87	
Cold start (17% of year)	0.17	11.89	1.56	3.15	
Annual Average				13.02	tons/yr incl. cc

Backup Engine Fuel Usage

Maximum Daily Generation For Outage (kwm-hrs/day)	0
Annual generation during monthly tests (kwm-hr/yr)	0
Annual generation during load bank tests (kwm-hr/yr)	0
Annual generation during corrective tests tests (kwm-hr/yr)	3,325,938
Annual Main Switchgear and Transformer Testing (kwm-hr/yr)	2,217,292
Annual Generation for unplanned outage (kwm-hr/yr)	0
DPM 70-Year risk assumption unplanned outage (kwm-hr/yr)	0
Low-load fuel factor for monthly testing (gal/kwm-hr)	0.0312
High-load fuel factor for load bank testing (gal/kwm-hr)	0.0558
Mid-load fuel factor for corrective testing (gal/kwm-hr)	0.0634
Fuel factor for Main Switch and Transformer Testing (gal/kwm-hr)	0.0634
High-Load fuel factor for outage (gal/kwm-hr)	0.0502
Annual Engine Usage, kwm-hrs/year	5,543,230
Fuel Usage for Monthly Tests (gal/year)	0
Fuel Usage for Load Bank Tests (gal/year)	0
Fuel Usage for Corrective Tests (gal/year)	211,002
Fuel Usage for Main Switch and Transformer Testing (gal/year)	140,668
Fuel Usage for Outages (gal/year)	0
Allowable Annual fuel Usage (gallons/year)	351,670

70-Year Average DEEP for Cancer Risk Modeling (Includes Commissioning + Stack Testing)		
Average-Year Incl. Cold Starts	0.463	tons/yr
70-Year Avg. Commiss + Stacktest	0.0045	
Total 70-year Average for Cancer Risk	0.467	tpy

70-yr avg. = 0.467 tpy

Emission Rates

Pollutant	Zero Monthly Testing (lbs/hr)	Zero Monthly Testing (lbs/day)	Zero Monthly Testing (ton/yr)	Combined Power Outages Plus Main Switch and Transformer Testing (23 hrs/yr) (lbs/day)	Combined Power Outages Plus Main Switch and Transformer Testing (23 hrs/yr) (ton/yr)	Combined Monthly, Annual and Corrective Testing (34.5 hrs/yr) (lbs/day)	Combined Monthly, Annual and Corrective Testing (34.5 hrs/yr) (ton/yr)	Maximum/Total Emissions (lbs/hr)	Maximum/Total Emissions (lbs/day)	Maximum/Total Emissions Rolling 3-yr Annual (ton/yr)
NOX	0.0	0	0.00	19126.8	9.56	28690.2	14.35	831.6	28690.2	23.9
Fully-Flex Worst Year DEEP	0.00	0.00	0.000	354.20	0.1771	531.30	0.2657	15.40	531.30	0.443
CO	0.0	0.0	0.00	9512.8	4.76	14269.2	7.13	413.6	14269.2	11.89
VOC	0.00	0.00	0.00	1143.6	0.57	1715.3	0.86	49.72	1715.3	1.43
SO2	0.000	0.000	0.00E+00	29.540	1.48E-02	44.310	2.22E-02	1.28	44.310	0.0369
Primary Nitrogen Dioxide (NO2)	0.612	0.0	0.00	1912.7	0.96	2869.0	1.43	83.16	2869.0	2.39
Benzene	0.000	0.000	0.0E+00	14.955	7.48E-03	15.605	1.12E-02	0.650	15.605	1.87E-02
Toluene	0.000	0.000	0.00E+00	5.4153	2.71E-03	5.6507	4.06E-03	0.235	5.6507	6.77E-03
Xylenes	0.00E+00	0.00E+00	0.00E+00	3.7194	1.86E-03	3.8811	2.79E-03	0.162	3.8811	4.65E-03
1,3-Butadiene	0.00E+00	0.00E+00	0.00E+00	3.77E-01	1.88E-04	3.93E-01	2.83E-04	0.016	3.93E-01	4.71E-04
Formaldehyde	0.00E+00	0.00E+00	0.00E+00	1.52E+00	7.60E-04	1.59E+00	1.14E-03	0.066	1.59E+00	1.90E-03
Acetaldehyde	0.00E+00	0.00E+00	0.00E+00	4.86E-01	2.43E-04	5.07E-01	3.64E-04	0.021	5.07E-01	6.07E-04
Acrolein	0.00E+00	0.00E+00	0.00E+00	1.52E-01	7.59E-05	1.58E-01	1.14E-04	0.0066	1.58E-01	1.90E-04
Benzo(a)Pyrene	0.00E+00	0.00E+00	0.00E+00	2.48E-03	1.24E-06	2.58E-03	1.86E-06	0.00011	2.58E-03	3.10E-06
Benzo(a)anthracene	--	0.00E+00	0.00E+00	1.20E-02	5.99E-06	1.25E-02	8.99E-06	--	1.25E-02	1.50E-05
Chrysene	--	0.00E+00	0.00E+00	2.95E-02	1.47E-05	3.08E-02	2.21E-05	--	3.08E-02	3.69E-05
Benzo(b)fluoranthene	--	0.00E+00	0.00E+00	2.14E-02	1.07E-05	2.23E-02	1.60E-05	--	2.23E-02	2.67E-05
Benzo(k)fluoranthene	--	0.00E+00	0.00E+00	2.10E-03	1.05E-06	2.19E-03	1.58E-06	--	2.19E-03	2.63E-06
Dibenz(a,h)anthracene	--	0.00E+00	0.00E+00	3.33E-03	1.67E-06	3.48E-03	2.50E-06	--	3.48E-03	4.17E-06
Ideno(1,2,3-cd)pyrene	--	0.00E+00	0.00E+00	3.99E-03	1.99E-06	4.16E-03	2.99E-06	--	4.16E-03	4.99E-06
Total PAHs (simple sum, no TEFs)	0.00E+00	0.00E+00	0.00E+00	7.48E-02	3.74E-05	7.80E-02	5.61E-05	0.0033	7.80E-02	9.35E-05
Total PAHs (Applying TEFs)	0.00E+00	0.00E+00	0.00E+00	9.60E-03	4.80E-06	1.00E-02	7.20E-06	0.00042	1.00E-02	1.20E-05
Propylene				53.8	2.69E-02	56.1	4.03E-02		56.1	6.72E-02
Napthalene				2.5	1.25E-03	2.6	1.88E-03		2.6	3.13E-03

P:\1362\004\T\[Fully-Flex Average PM-NOx-CO 2-6-2015.xls]T8 2015 Disp Factor NAAQS ASIL

Table E1-3. Outages Plus Electrical Bypass Emissions

Full-Flex Average 10%-100%

Outages and Electrical Bypass Occur at Averages of 10%-100%

Engine Parameters

Parameter	Value	Units
Generator Output (at operating % load)	2,191	kWm
Engine Horsepower (at operating % load)	2,937	bhp
Fuel Consumption (at operating % load)	139	gallons/hr each engine
No. of Engines	44	Generators
Engines Any given Hour	44	Outage
Engines Any given Day	44	
Max diagnostic Engine Load	100%	
Maximum Daily Usage	23	hours/day
Fuel Type	EPA Diesel	
Fuel Density	7	lbs/gallon
Fuel Heat Content	137,000	BTU/gallon
Engine Heat Rate (at operating % load)	0.00869	MMBTU/kWm-hr
Fuel Sulfur Content	15	ppm weight
Max Hourly Generation	96,404	kWm-hrs/hr
Max Daily Generation	2,217,292	KWm-hrs/day
Annual Generation	2,217,292	KWm-hrs/year
Max Daily Heat Input	19,272	mmBTU/day
Annual Heat Input	19,272	mmBTU/year

Emission Rates (Electrical Bypass)

	Emission Factor			Emission Rates	
Pollutant	Factor	Units	Source	(lbs/day)	(tons/year)
NOX	18.90		Average 10-100% load	19,127	9.56
PM2.5	0.350		Average 10-100% load	354.2	0.1771
Annual PM2.5/DPM	0.350	0	Average 10-100% load	354	0.1771
CO	9.4		Average 10-100% load	9,513	4.76
VOC	1.130		Max lbs/hr/gen at 50% load	1,143.6	0.572
SO2	Fuel sulfur mass balance			29.540	1.48E-02
Primary Nitrogen Dioxide (NO2)			10% of NOx	1,912.68	0.96
Benzene	7.76E-04	lbs/MMBTU	AP-42 Sec 3.4	14.955	7.48E-03
Toluene	2.81E-04	lbs/MMBTU	AP-42 Sec 3.4	5.4153	2.71E-03
Xylenes	1.93E-04	lbs/MMBTU	AP-42 Sec 3.4	3.7194	1.86E-03
1,3-Butadiene	1.96E-05	lbs/MMBTU	AP-42 Sec 3.3	3.77E-01	1.88E-04
Formaldehyde	7.89E-05	lbs/MMBTU	AP-42 Sec 3.4	1.5205	7.60E-04
Acetaldehyde	2.52E-05	lbs/MMBTU	AP-42 Sec 3.4	4.86E-01	2.43E-04
Acrolein	7.88E-06	lbs/MMBTU	AP-42 Sec 3.4	1.52E-01	7.59E-05
Benzo(a)Pyrene	1.29E-07	lbs/MMBTU	AP-42 Sec 3.4	2.48E-03	1.24E-06
Benzo(a)anthracene	6.22E-07	lbs/MMBTU	AP-42 Sec 3.4	1.20E-02	5.99E-06
Chrysene	1.53E-06	lbs/MMBTU	AP-42 Sec 3.4	2.95E-02	1.47E-05
Benzo(b)fluoranthene	1.11E-06	lbs/MMBTU	AP-42 Sec 3.4	2.14E-02	1.07E-05
Benzo(k)fluoranthene	1.09E-07	lbs/MMBTU	AP-42 Sec 3.4	2.10E-03	1.05E-06
Dibenz(a,h)anthracene	1.73E-07	lbs/MMBTU	AP-42 Sec 3.4	3.33E-03	1.67E-06
Ideno(1,2,3-cd)pyrene	2.07E-07	lbs/MMBTU	AP-42 Sec 3.4	3.99E-03	1.99E-06
Total PAHs (simple sum, no TEFs)	3.88E-06	lbs/MMBTU	AP-42 Sec 3.4	7.48E-02	3.74E-05
Total PAHs (Applying TEFs)	4.98E-07	lbs/MMBTU	AP-42 Sec 3.4	9.60E-03	4.80E-06
Propylene	2.79E-03	lbs/MMBTU	AP-42 Sec 3.4	5.38E+01	2.69E-02
Napthalene	1.30E-04	lbs/MMBTU	AP-42 Sec 3.4	2.51E+00	1.25E-03

P:\1362\004\T\[Fully-Flex Average PM-NOx-CO 2-6-2015.xls]T8 2015 Disp Factor NAAQS ASIL

Table E1-4. Commissioning + Stack Testing

Average 10%-100%

Commissioning + Stack testing activates at average load 10%-100% for each pollutant

Commissioning: 44 gens in 70 years; 30 hrs/gen runtime, Average load = 50%; Fuel per commissioning = 2309 gallons

Stack Testing: 16 gens in 70 years; 30 hrs/gen runtime, Average load = 50%; Fuel per Stack Test = 2309 gallons

Engine Parameters

Parameter	Value	Units
Generator Output (at diagnostic % load)	1,135	kWm
Engine Horsepower (at diagnostic % load)	1,521	bhp
Fuel Consumption (at diagnostic % load)	77.70	gallons/hr each engine
70-yr average No. of Engines/year	0.86	Generators per year, 70-year average
Total engines commissioned in 70 yrs	44	
Total engines stack tested in 70 years	16	
Average Engine Load	50%	Average load during stacktesting or commission
Average Runtime	30.0	Runtime each stacktest or commissioning test
Fuel Type	EPA Diesel	
Fuel Density	7	lbs/gallon
Fuel Heat Content	137,000	BTU/gallon
Diesel fuel S content, ppmw	15	ppmw
Annual fuel usage	1,998	gal/year 70-year average
Annual Heat Input	274	mmBTU/year

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Emission Rates (Scheduled Monthly Diagnostic Tests)

	Emission Factor			Emission Rates		SCREEN3 Emission (g/sec)
Pollutant	**Factor**	**Units**	**Source**	**(lbs/day)**	**(tons/year)**	**Annual**
NOX	18.90		Average 10-100% load		0.24	0.0070
PM2.5	0.350		Average 10-100% load		0.0045	1.30E-04
Annual PM2.5/DPM	0.350	0	Average 10-100% load		0.0045	1.30E-04
CO	9.4		Average 10-100% load		0.12	3.48E-03
VOC	1.130		Max lbs/hr/gen at 50% load		0.015	N/A
SO2	Fuel sulfur mass balance				2.10E-04	6.04E-06
Primary Nitrogen Dioxide (NO2)			10% of NOx		0.024	7.00E-04
Benzene	7.76E-04	lbs/MMBTU	AP-42 Sec 3.4		1.06E-04	3.06E-06
Toluene	2.81E-04	lbs/MMBTU	AP-42 Sec 3.4		3.85E-05	1.11E-06
Xylenes	1.93E-04	lbs/MMBTU	AP-42 Sec 3.4		2.64E-05	7.61E-07
1,3-Butadiene	1.96E-05	lbs/MMBTU	AP-42 Sec 3.3		2.68E-06	7.70E-08
Formaldehyde	7.89E-05	lbs/MMBTU	AP-42 Sec 3.4		1.08E-05	3.11E-07
Acetaldehyde	2.52E-05	lbs/MMBTU	AP-42 Sec 3.4		3.45E-06	9.93E-08
Acrolein	7.88E-06	lbs/MMBTU	AP-42 Sec 3.4		1.08E-06	3.11E-08
Benzo(a)Pyrene	1.29E-07	lbs/MMBTU	AP-42 Sec 3.4		1.76E-08	5.06E-10
Benzo(a)anthracene	6.22E-07	lbs/MMBTU	AP-42 Sec 3.4		8.51E-08	2.45E-09
Chrysene	1.53E-06	lbs/MMBTU	AP-42 Sec 3.4		2.09E-07	6.03E-09
Benzo(b)fluoranthene	1.11E-06	lbs/MMBTU	AP-42 Sec 3.4		1.52E-07	4.37E-09
Benzo(k)fluoranthene	1.09E-07	lbs/MMBTU	AP-42 Sec 3.4		1.49E-08	4.30E-10
Dibenz(a,h)anthracene	1.73E-07	lbs/MMBTU	AP-42 Sec 3.4		2.37E-08	6.82E-10
Ideno(1,2,3-cd)pyrene	2.07E-07	lbs/MMBTU	AP-42 Sec 3.4		2.83E-08	8.16E-10
Propylene	2.79E-03	lbs/MMBTU	AP-42 Sec 3.4		3.82E-04	1.10E-05
Napthalene	1.30E-04	lbs/MMBTU	AP-42 Sec 3.4		1.78E-05	5.12E-07

Table E1-5. Combined Testing Emissions

Average 10%-100%

All testing (Monthly, annual, corrective) activates at average load 10%-100% for each pollutant

Engine Parameters

Parameter	Value	Units
Generator Output (at diagnostic % load)	2,191	kWm
Engine Horsepower (at diagnostic % load)	2,937	bhp
Fuel Consumption (at diagnostic % load)	139.00	gallons/hr each engine
No. of Engines	44	Generators
Engines Any given Hour	44	
Engines Any given Day	44	
Max diagnostic Engine Load	100%	
Maximum Daily Usage	34.5	hours/day and hours/year each engine
Fuel Type	EPA Diesel	
Fuel Density	7	lbs/gallon
Fuel Heat Content	137,000	BTU/gallon
Engine Heat Rate (at diagnostic % load)	0.00869	MMBTU/kWm-hr
Fuel Sulfur Content	15	ppm weight
Max Hourly Generation	96,404	kWm-hrs/hr
Max Daily Generation	2,313,696	KWm-hrs/day
Annual Generation	3,325,938	KWm-hrs/year
Max Daily Heat Input	20,109	mmBTU/day
Annual Heat Input	28,907	mmBTU/year

Combined testing 24

Emission Rates (Scheduled Monthly Diagnostic Tests)

	Emission Factor			Emission Rates		SCREEN3 Emission (g/sec)
Pollutant	**Factor**	**Units**	**Source**	**(lbs/day)**	**(tons/year)**	**Annual**
NOX	18.90		Average 10-100% load	28,690	14.35	0.4130
PM2.5	0.350		Average 10-100% load	531.3	0.2657	7.65E-03
Annual PM2.5/DPM	0.350	0	Average 10-100% load	531.3	0.2657	7.65E-03
CO	9.4		Average 10-100% load	14,269	7.13	2.05E-01
VOC	1.130		Max lbs/hr/gen at 50% load	1,715.3	0.858	N/A
SO2	Fuel sulfur mass balance			44.310	2.22E-02	6.38E-04
Primary Nitrogen Dioxide (NO2)			10% of NOx	2,869.0	1.43	4.13E-02
Benzene	7.76E-04	lbs/MMBTU	AP-42 Sec 3.4	15.6049	1.12E-02	3.23E-04
Toluene	2.81E-04	lbs/MMBTU	AP-42 Sec 3.4	5.6507	4.06E-03	1.17E-04
Xylenes	1.93E-04	lbs/MMBTU	AP-42 Sec 3.4	3.8811	2.79E-03	8.03E-05
1,3-Butadiene	1.96E-05	lbs/MMBTU	AP-42 Sec 3.3	3.93E-01	2.83E-04	8.14E-06
Formaldehyde	7.89E-05	lbs/MMBTU	AP-42 Sec 3.4	1.59E+00	1.14E-03	3.28E-05
Acetaldehyde	2.52E-05	lbs/MMBTU	AP-42 Sec 3.4	5.07E-01	3.64E-04	1.05E-05
Acrolein	7.88E-06	lbs/MMBTU	AP-42 Sec 3.4	1.58E-01	1.14E-04	3.28E-06
Benzo(a)Pyrene	1.29E-07	lbs/MMBTU	AP-42 Sec 3.4	2.58E-03	1.86E-06	5.35E-08
Benzo(a)anthracene	6.22E-07	lbs/MMBTU	AP-42 Sec 3.4	1.25E-02	8.99E-06	2.59E-07
Chrysene	1.53E-06	lbs/MMBTU	AP-42 Sec 3.4	3.08E-02	2.21E-05	6.37E-07
Benzo(b)fluoranthene	1.11E-06	lbs/MMBTU	AP-42 Sec 3.4	2.23E-02	1.60E-05	4.62E-07
Benzo(k)fluoranthene	1.09E-07	lbs/MMBTU	AP-42 Sec 3.4	2.19E-03	1.58E-06	4.54E-08
Dibenz(a,h)anthracene	1.73E-07	lbs/MMBTU	AP-42 Sec 3.4	3.48E-03	2.50E-06	7.20E-08
Ideno(1,2,3-cd)pyrene	2.07E-07	lbs/MMBTU	AP-42 Sec 3.4	4.16E-03	2.99E-06	8.61E-08
Propylene	2.79E-03	lbs/MMBTU	AP-42 Sec 3.4	5.61E+01	4.03E-02	1.16E-03
Napthalene	1.30E-04	lbs/MMBTU	AP-42 Sec 3.4	2.61E+00	1.88E-03	5.41E-05

Table E1-6. Sabey-Quincy 2015 Re-Submittal AERMOD Parameters

Worst-Case 24-hour Power Outage at 25% Load

Gen #	Gen Area	Engine Load	Exit Temp (K)	Exit Velocity (m/sec)	Stack Dia (m)	DPM Rate per Engine (lbs/hr)	Load	Engine Size (kWm)	Temp F (T-Mobile Data)	ACFM	Dia Inches	Area ft2	Velocity fps	Facility Wide lbs/day	No. of Gens
24-hour power outage															
All 44 Gens	All 44 Gens	25%	576	23.2	0.407	0.417	25%	1650	578	6385	16	1.40	76.25	**441**	44

Averaging periods for each modeling year:
Annual
1st 24-hr ASIL
2nd 24-hr NAAQS
4th 24-hr NAAQS
8th 24-hr NAAQS
2nd 8-hr CO NAAQS
1st 1-hr ASIL
2nd 1-hr CO NAAQS

Annual-Average DEEP, Random Average Loads 10%-100%

Gen #	Gen Area	Engine Load	Exit Temp (K)	Exit Velocity (m/sec)	Stack Dia (m)	DPM Rate per Engine (lbs/hr)	Load	Engine Size (kWm)	Temp F (T-Mobile Data)	ACFM	Dia Inches	Area ft2	Velocity fps	Facility Wie tons/yr	No. of Gens
Annual-Average at Random Loads 0-100%															
All 44 Gens	All 44 Gens	Average 0-100	609	35.6	0.407	0.00240	Average 0-100	1650	636	9780.2	16	1.40	116.80	**0.463**	44

Averaging periods each modeling year:
Annual

10	466	4517
25	578	6385
50	638	10097
75	728	12766
100	772	15136
Average	**636.4**	**9780.2**

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Table E1-7
ASIL AND NAAQS IMPLICATIONS OF PROVIDING FLEXIBILITY AT "10-100%" LOAD; ULTRA-WORST CASE
Sabey Intergate-Quincy Data Center
Quincy, Washington

B. 1-HOUR NO2-ASIL DURING POWER OUTAGE (Ultra-Worst Max 100%)

Original June-2011 Application NOx-NO2 ASIL During Facility-Wide Power Outage at 75% Load

Gen Size	Engine Temp	No. of Gens	Lbs/hour	Duration, hours	Subtotal Emissions	Emission Units	
2.0 Mwe @ 75%	All at 75%	44	22.5	1	990.0	lbs/hr	66.0 Mwe facility-wide generation @75%
Facility-Wide Emissions					990.0	lbs/hr	

Worst-Case High-Load Generators (85% Load Because Some Generators Failed)

Gen Size	Engine Temp	No. of Gens	Lbs/hour	Duration, hours	Subtotal Emissions	Emission Units	
Bldg A	Active @ 85%	12	27.5	1	330.0	lbs/hr	20.4 Mwe facility-wide generation
	Failed (Idling)	4	6.49	1	26.0	lbs/hr	
Bldg B	Active @ 85%	12	27.5	1	330.0	lbs/hr	20.4 Mwe facility-wide generation
	Failed (Idling)	4	6.49	1	26.0	lbs/hr	
Bldg C	Active @ 85%	8	27.5	1	220.0	lbs/hr	13.6 Mwe facility-wide generation
	Failed (Idling)	4	6.49	1	26.0	lbs/hr	
Facility-Wide Emissions					957.9	lbs/hr	54.4 Mwe facility-wide generation

C. 1-HOUR NO2-NAAQS | **Allowable Limit = 65 lbs/hr NOx, scaled from 2011 Monte Carlo modeling**

Derivation of 65 lbs/hr 8th-highest NOx limit

Allowable NO2 Increment

NAAQS	188	ug/m3
Regional background (from 2014 MSFT Oxford application)	-15.6	
Assumed Vantage contribution (10% of combined 111 ug/m3 source increment from Sabey's 2011 Monte Carlo modeling)	-11	
Net Allowable NO2 Increment	161.4	ug/m3

2011 Monte Carlo mdeling indicated the 98th percentile NO2 increment was 111 ug/m3, and the 8th-highest NO2 emission rate was 45.1 lbs/hr. Scale to determine the allowable lbs/hr emission rate to satisfy the allowable NO2 increment of 161.4 ug/m3

$$\frac{45.1 \text{ lbs/hr}}{111 \text{ ug/m3}} = \frac{X \text{ lbs/hr}}{161.4 \text{ ug/m3}}$$

Solve for X: X = 65 lbs/hr NOx, 8th-highest 1-hr

Max Gen at 100% Load

Gen Size	Load	No. of Gens	Lbs/hour	Duration, hours	Subtotal Emissions	Emission Units		
2.0 Mwe	100%	1	41.9	1	41.9	lbs/hr	2000	
2.0 Mwe	75%	1	22.5	1	22.5	lbs/hr	1500	
Facility-Wide Emissions					64.4	lbs/hr		3500 Facility-wide kWe

Max Gen at 85% Load

Gen Size	Load	No. of Gens	Lbs/hour	Duration, hours	Subtotal Emissions	Emission Units		
2.0 Mwe	85%	1	27.5	1	27.5	lbs/hr	1700	
2.0 Mwe	56%	2	16.9	1	33.8	lbs/hr	2240	
Facility-Wide Emissions					61.3	lbs/hr		3940 Facility-wide kWe

Max Gen at 75% Load

Gen Size	Load	No. of Gens	Lbs/hour	Duration, hours	Subtotal Emissions	Emission Units	
2.0 Mwe	75%	3	22.5	1	67.5	lbs/hr	4500
Facility-Wide Emissions					67.5	lbs/hr	

Max Gen at 50% Load

Gen Size	Load	No. of Gens	Lbs/hour	Duration, hours	Subtotal Emissions	Emission Units	
2.0 Mwe	50%	4	15	1	60.0	lbs/hr	4000
Facility-Wide Emissions					60.0	lbs/hr	

C.2 8th-Highest Day Generator Operating Scenarios to Meet 65 lbs/hour NOx Limit (8th-highest day)

Max Gen at 100% Load

Gen Size	Load	No. of Gens	Lbs/hour	Duration, hours	Subtotal Emissions	Emission Units		
2.0 Mwe	100%	1	41.9	1	41.9	lbs/hr	2000	
2.0 Mwe	75%	1	22.5	1	22.5	lbs/hr	1500	
Facility-Wide Emissions					64.4	lbs/hr		3500 Facility-wide kWe

Max Gen at 90% Load

Gen Size	Load	No. of Gens	Lbs/hour	Duration, hours	Subtotal Emissions	Emission Units		
2.0 Mwe	90%	1	31.1	1	31.1	lbs/hr	1800	
2.0 Mwe	56%	2	16.9	1	33.8	lbs/hr	2240	
Facility-Wide Emissions					64.9	lbs/hr		4040 Facility-wide kWe

Max Gen at 85% Load

Gen Size	Load	No. of Gens	Lbs/hour	Duration, hours	Subtotal Emissions	Emission Units		
2.0 Mwe	85%	1	27.5	1	27.5	lbs/hr	1700	
2.0 Mwe	56%	2.2	16.9	1	37.2	lbs/hr	2464	
Facility-Wide Emissions					64.7	lbs/hr		4164 Facility-wide kWe

Max Gen at 80% Load

Gen Size	Load	No. of Gens	Lbs/hour	Duration, hours	Subtotal Emissions	Emission Units		
2.0 Mwe	80%	1	24.7	1	24.7	lbs/hr	1600	
2.0 Mwe	56%	2.3	16.9	1	38.9	lbs/hr	2576	
Facility-Wide Emissions					63.6	lbs/hr		4176 Facility-wide kWe

Max Gen at 75% Load

Gen Size	Load	No. of Gens	Lbs/hour	Duration, hours	Subtotal Emissions	Emission Units		
2.0 Mwe	75%	1	22.5	1	22.5	lbs/hr	1500	
2.0 Mwe	56%	2.5	16.9	1	42.3	lbs/hr	2800	
Facility-Wide Emissions					64.8	lbs/hr		4300 Facility-wide kWe

Max Gen at 70% Load

Gen Size	Load	No. of Gens	Lbs/hour	Duration, hours	Subtotal Emissions	Emission Units		
2.0 Mwe	70%	1	20.7	1	20.7	lbs/hr	1400	
2.0 Mwe	56%	2.6	16.9	1	43.9	lbs/hr	2912	
Facility-Wide Emissions					64.6	lbs/hr		4312 Facility-wide kWe

Max Gen at 56% Load

Gen Size	Load	No. of Gens	Lbs/hour	Duration, hours	Subtotal Emissions	Emission Units	
2.0 Mwe	56%	3.8	16.9	1	64.2	lbs/hr	4256
2.0 Mwe	56%	0	16.9	1	0.0	lbs/hr	0

Facility-Wide Emissions	64.2	lbs/hr

4256 Facility-wide kWe

D. 24-HOUR PM2.5 NAAQS (8th consecutive 2.9-hr power outage at 25% load)

Allowable 8th-Highest PM2.5 Increment		
24-hr NAAQS	35	ug/m3
Minus regional background	-21	
Minus Inuit testing 8 generators	-0.12	
Minus Yahoo testing 8 generators	-0.12	
Minus Celite at permitted limit	-0.8	
Minus Vantage (assumed same as Intuit)	-0.12	
Allowable 8th-Highest PM2.5 Increment	12.8	ug/m3

8th consecutive 4.4-hr hour power outage with all 44 generators

Gen Size	Engine Temp	No. of Gens	Lbs/hour	Duration, hours	Subtotal Emissions	Emission Units
2.0 Mwe	Cold Start with 1.26 black puff factor	44	0.718	0.25	7.9	
	Warmed Up	44	0.57	4.15	104.1	
Facility-Wide Emissions					112.0	lbs/day

E. 1-HOUR CO-NAAQS DURING POWER OUTAGE (Ultra-Worst Case 100%)

Original 2011 Application CO-NAAQS During Facility-Wide Power Outage at 75% Load

Gen Size	Engine Temp	No. of Gens	Lbs/hour	Duration, hours	Subtotal Emissions	Emission Units
2.0 Mwe	Cold Start	44	0	0	0.0	lbs/hr
	Warmed Up	44	12.7	1	558.8	lbs/hr
Facility-Wide Emissions					558.8	lbs/hr

Tier-2 = 3.5 g/kWm-hr
75% load = 2212 bhp = 1650 kWm
12.7 lbs/hr

Cherry-Picked CO-NAAQS During Facility-Wide Power Outage; Ultra-Worst Case at 100% Load

Gen Size	Engine Temp	No. of Gens	Lbs/hour	Duration, hours	Subtotal Emissions	Emission Units
2.0 Mwe	Cold Start with 1.56 black puff factor	44	26.4	0.25	290.0	lbs/hr
	Warmed Up	44	16.9	0.75	557.7	lbs/hr
Facility-Wide Emissions					847.7	lbs/hr

Actual NTE = 3.43 lbs/hr at 100% load

Net Increase in Facility-Wide Emissions During Outage	152%	Increase in max CO emissions
Original CO-NAAQS Result, ug/m3	873	
Revised "Cherry Picked" Result, ug/m3	1324	This new result is below the NAAQS
Available CO Increment Subtracting Background, ug/m3	9518	

F. 24-hr PM10-NAAQS DURING 24-HOUR POWER OUTAGE (Ultra-Worst Case 25% Load)

Original 2011 Application PM10-NAAQS During 8-hr Facility-Wide Power Outage at 75% Load

Gen Size	Engine Temp	No. of Gens	Lbs/hour	Duration, hours	Subtotal Emissions	Emission Units
	Cold Start	44	0	0	0.0	lbs/day
2.0 Mwe	Warmed Up	44	0.726	8	255.6	lbs/day
Facility-Wide Emissions					255.6	lbs/day

Tier-2 = 0.2 g/kw-hr

75% load = 2212 bhp = 1650 kWm
0.726 lbs/hr

Ultra-Worst Case PM10-NAAQS During Facility-Wide Power Outage (2nd 17.5-hour day at 25% load)

Gen Size	Engine Temp	No. of Gens	Lbs/hour	Duration, hours	Subtotal Emissions	Emission Units
	Cold Start with 1.26 black puff factor	44	0.718	0.25	7.9	lbs/day
2.0 Mwe	Warmed Up	44	0.57	17.25	432.6	lbs/day
Facility-Wide Emissions					440.5	lbs/day

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Table E1-8
AERMOD Disersion Factors and Ambient Impact Assessment for Sabey Intergate-Quincy Data Center Permit Revision Application
Quincy, Washington

		AERMOD Dispersion Factor							Emission Rates for Jan-2015 Re-Submittal		Ambient Impacts, ug/m3			
Pollutant and Averaging Time	Emission Rate Units	AERMOD File	AERMOD ug/m3	Max. Impact Location	Emission Rate	Disp. Factor	Units	Modeled Stack Conditions	Emission Rate Incl. "Black Puff" Factor	Emission Rate Units	Sabey Increment (Includes 3x factor for annual average values)	Regional and Local Background	Total Ambient Impact	NAAQS or ASIL
PM10														
2nd-High 24-hr during 2nd consecutive 17-hour facility-wide outage	lbs/day facility-wide	DEEP_011915	60.89	South property boundary	595	0.1023	2nd-high 24-hr '(ug/m3)/(lbs/day)	25% load temp. and flow, facility-wide power outage	440.5	lbs/day during 2nd consecutive 17- hour outage	45	85	130	150
PM2.5														
1st-high 24-hr during 8th cosecutive 4.4-hour power outage power outage	lbs/day facility-wide	DEEP_011915	63.87	SW parking lot Bldg B	595.0	0.107	1st-high 24-hr '(ug/m3)/(lbs/day)	25% load temp. and flow; facility wide power outage	112.0	lbs/day during 8th consecutive 4.4 hour outage	12	22	34	35
Annual (Ultra-worst-case max year of 3-year rolling)	**facility-wide annual, 3x the annual average to account for 3-year rolling**	DEEP_011515	0.102	NW parking lot Bldg A	0.463	0.221	(ug/m3)/(tpy)	annual average (10% - 100%) load temp. and flow	0.463	tons/yr	0.307	6.5	6.8	**12**
Carbon Monoxide														
2nd-high 1-hr during facility-wide outage	lbs/hr facility-wide	DEEP_011915	184.3	North property boundary	25.1	7.34	(ug/m3)/(lbs/hr)	25% load temp. and flow, facility-wide power outage	848	lbs/hr	6223	842	7,065	40,000
2nd-high 8-hr during facility-wide outage	lbs/hr facility-wide	DEEP_011915	89.23	North property boundary	25.1	3.56	(ug/m3)/(lbs/hr)	25% load temp. and flow, facility-wide power outage	848	lbs/hr	3014	482	3,496	10,000
Nitrogen Dioxide														
1-hr NAAQS, 1st-highest during electrical bypass	lbs/hr NOx, facility-wide	1st-highest faciilty-wide 1-hour NOx emissions limited to 990 lbs/hour, the same value that was evaluated in the 2011 NO2 Second-Tier Risk Assessment. See the worksheet "2015 NAAQS-ASIL Scenarios" for a range of example operating scenarios that can satisfy that emission limit with worst-case NOx emission factors.												
NO2 ASIL, 1st-highest 1-hr during facility-wide outage	lbs/hr NOx, facility-wide	The current load limits and runtime limits for monttly testing, annual load bank testing, and corrective testing listed in Table 3.2 of the current Approval Order should be retained, to ensure the 8th-highest daily 1-hr NOx emission rates are consistent with the values that Sabey used for the NO2 Monte Carlo modeling in 2011.												
Toxic Air Pollutants Compared to ASILs														
Annual (Ultra-worst-case max year of 3-year rolling)	**facility-wide annual, 3x the annual average to account for 3-year rolling**	DEEP_011515	0.102	NW parking lot Bldg A	0.463	0.221	(ug/m3)/(tpy)	annual average (10% - 100%) load temp. and flow	23.9	tons/yr	15.8	2.8	18.6	100
Annual DEEP at on-site tenant (ultra-worst case, 3x annual average)	**facility-wide annual, 3x the annual average to account for 3-year rolling**	DEEP_011515	0.102	NW parking lot Bldg A	0.463	0.221	(ug/m3)/(tpy)	annual average (10% - 100%) load temp. and flow	0.463	tons/yr	0.307	Annual DEEP ASIL = 0.0033		
1,3-butadiene annual at on-site tenant (ultra-worst case, 3x annual average)	tons/yr facility-wide	DEEP_011515	0.102	NW parking lot Bldg A	0.463	0.2209	(ug/m3)/(tons/yr)	annual average (10% - 100%) load temp. and flow	4.71E-04	tons/yr	0.00031	1,3-butadiene annual ASIL = 0.00588		
Naphthalene annual at on-site tenant (ultra-worst case, 3x annual average)	tons/yr facility-wide	DEEP_011515	0.102	NW parking lot Bldg A	0.463	0.2209	(ug/m3)/(tons/yr)	annual average (10% - 100%) load temp. and flow	3.13E-03	tons/yr	0.0021	naphthalene annual ASIL = 0.0294		
1st-high Acrolein 24-hr at on-site tenant (ultra-worst case)	lbs/day facility-wide	DEEP_011915	63.87	SW parking lot Bldg B	595.0	0.1073	1st-high 24-hr '(ug/m3)/(lbs/day)	25% load temp. and flow; facility wide power outage	0.158	lbs/day	0.0170	Acrolein 24-hr ASIL = 0.06		
Benzene annual at on-site tenant (ultra-worst case, 3x annual average)	**facility-wide annual, 3x the annual average to account for 3-year rolling**	DEEP_011515	0.102	NW parking lot Bldg A	0.463	0.221	(ug/m3)/(tpy)	annual average (10% - 100%) load temp. and flow	1.87E-02	tons/yr	0.012	benzene annual ASIL = 0.0345		

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Table E1-9 Ultra-Worst SQERs

	24-hr lbs/day	3-yr Rolling tpy	Max 1-hr lbs/hr
DEEP		0.463	
CO			848
SO2			1.160
Primary (NO2)			991
Benzene		0.019	
Toluene	5.60		
Xylenes	3.88		
1,3-Butadiene		4.71E-04	
Formaldehyde		1.71E-03	
Acetaldehyde		5.46E-04	
Acrolein	0.158		
Benzo(a)Pyrene		2.78E-06	
Benzo(a)anthracene		1.35E-05	
Chrysene		3.31E-05	
Benzo(b)fluoranthene		2.40E-05	
Benzo(k)fluoranthene		2.36E-06	
Dibenz(a,h)anthracene		3.75E-06	
Ideno(1,2,3-cd)pyrene		4.48E-06	
Propylene	56.1		
Naphthalene		3.13E-03	

Table __ Comparison of Toxic Air Pollutant Emission Rates vs. SQERs

Pollutant	CAS Number	SQER	Units	Emission	SQER Ratio
Diesel Exhaust Particulate	None	0.639	lbs/yr, max yr of 3-yr period	2778	4347
CO	630-08-0	50.2	lbs/1-hour	848	16.9
SO_2		1.45	lbs/1-hour	1.16	0.80
Primary NO_2	10102-44-0	1.03	lbs/1-hour	991	962
Benzene	71-43-2	6.62	lbs/yr, max yr of 3-yr period	112.2	17
Toluene	108-88-3	657	lbs/24-hr day	5.60	0.009
Xylenes	95-47-6	58	lbs/24-hr day	3.88	0.07
1,3-Butadiene	106-99-0	1.13	lbs/yr, max yr of 3-yr period	2.8	2.50
Formaldehyde	50-00-0	32	lbs/yr, max yr of 3-yr period	10.3	0.32
Acetaldehyde	75-07-0	71	lbs/yr, max yr of 3-yr period	3.3	0.05
Acrolein	107-02-8	0.00789	lbs/24-hr day	0.1580	20.0
Benzo(a)Pyrene	50-32-8	0.174	lbs/yr, max yr of 3-yr period	0.0167	0.10
Benzo(a)anthracene	56-55-3	1.74	lbs/yr, max yr of 3-yr period	0.081	0.05
Chrysene	218-01-9	17.4	lbs/yr, max yr of 3-yr period	0.199	0.011
Benzo(b)fluoranthene	205-99-2	1.74	lbs/yr, max yr of 3-yr period	0.144	0.08
Benzo(k)fluoranthene	207-08-9	1.74	lbs/yr, max yr of 3-yr period	0.014	0.01
Dibenz(a,h)anthracene	53-70-3	0.16	lbs/yr, max yr of 3-yr period	0.022	0.14
Ideno(1,2,3-cd)pyrene	193-39-5	1.74	lbs/yr, max yr of 3-yr period	0.027	0.015
Propylene	115-07-1	394	lbs/24-hr day	56.1	0.14
Napthalene	91-20-3	5.64	lbs/yr, max yr of 3-yr period	18.8	3.33

Note: Shaded cells indicate exceedance of SQER.

Table 6-6. ASIL Compliance at Facility Boundary Based on Full-Flexibility Ultra-Worst Case Emission Rates

Toxic Air Pollutant	Mode of Operation	Modeled Ambient Conc. (ug/m^3)			ASIL (ug/m^3)			Fraction of ASIL	
		1-Hr	24-Hr	Annual	1-Hr	24-Hr	Annual		
Total NO_2	Max hour power outage	960	--	--	470	--	--	204%	1-hr
DEEP at tenant building	Worst 1-yr of 3-yr rolling period	--	--	0.307	--	--	3.33E-03	9214%	Annual
CO (1-hr)	Max hour power outage	6223			23000			27%	1-hr
Benzene	Worst 1-yr of 3-yr rolling period	--	--	1.24E-02	--	--	3.45E-02	36%	Annual
1,3-Butadiene	Worst 1-yr of 3-yr rolling period	--	--	3.12E-04	--	--	5.88E-03	5%	Annual
Acrolein	Max day, 23-hr outage	--	0.0170	--	--	0.06	--	28%	24-hr
Naphthalene	Worst 1-yr of 3-yr rolling period	--	--	2.08E-03	--	--	9.09E-03	23%	Annual

Note: Shaded cells indicate exceedance of ASIL.