APPENDIX A

Background PSD Applicability Analysis for the 777X and Production Rate Increase[1]

The 777 airplane model has been manufactured at the Boeing Everett plant since the 777 program first began in the mid-1990s. In the past 10 years, the 777 production rate has varied between approximately 3 airplanes a month and 8.3 airplanes a month in response to market demand and delivery schedules. Boeing was able to reach the 8.3 airplanes per month rate in part because in August 2011, the Washington Department of Ecology issued PSD-11-01 to allow Boeing Everett to increase the 777 production capacity and production rate from approximately 7 airplanes per month to approximately 8.3 airplanes per month. For this project Boeing proposes to produce new models of the Boeing 777, hereafter referred to as the 777X models. Production of the 777X models will require several new emission units, mostly to produce a new larger wing that will be primarily made of composite material. Boeing may also further increase the production rate of the 777 to approximately 10.4 planes per month, or 125 planes per year, depending on future Boeing management directives.

The changes being made to produce the 777X and to possibly increase the production rate (hereafter referred to as the "Project") will require a Prevention of Significant Deterioration (PSD) permit if both the emission increase and the net emissions increase of volatile organic compounds (VOCs) caused by the Project exceed the PSD significance level of 40 tons per year for VOCs. This PSD applicability analysis examines only the emissions increase caused by the Project and not the net emissions increase. If the emissions increase of VOCs is less than 40 tons per year, then the Project is not subject to PSD for VOCs. If the emissions increase of VOCs is greater than 40 tons per year, Boeing may elect to seek a PSD permit for this Project without performing a net emission increase analysis.

The main 777-related production operations at Boeing Everett can be categorized as follows:

- 777 assembly operations, which include:
  - Wing component fabrication
  - Wing assembly
  - Body section assembly
  - Wing and body structures seal/paint and vertical fin paint
  - Airplane assembly
- Interiors Responsibility Center (IRC) operations
- Everett Delivery Center (EDC) operations
- Propulsion systems operations
- Emergent operations
- Electrical Systems Responsibility Center (ESRC) operations

[1] This analysis only evaluates VOC emissions. For an analysis of all other New Source Review regulated pollutants, see the document "Estimate of Non-Significant PSD Pollutant Emissions Increases from the 777X Project" in Appendix B.

For the significant emissions increase analysis, the proposed project will involve both constructing new emissions units and modifying existing units. Other units or activities will not be new or modified, but will be debottlenecked as a result of this project. The PSD regulations require use of the hybrid test for projects that involve both the addition of new emission units and the modification of existing emission units (40 Code of Federal Regulations [CFR] 52.21(a)(2)(iv)(f)). Under the hybrid test, a significant emissions increase of a regulated NSR pollutant is projected to occur if the sum of the emissions increases for each emissions unit, using the actual-to-projected-actual applicability test (40 CFR 52.21(a)(2)(iv)(c)) for modified and debottlenecked units and the actual-to-potential applicability test (40 CFR 52.21(a)(2)(iv)(d)) for new units, equals or exceeds the significant amount for that pollutant (as defined in 40 CFR 52.21 (b)(23)).

The actual-to-projected-actual applicability test involves adding the projected (future) actual emissions from existing emission units that are modified as part of the project or that are expected to experience an emission increase as a result of the project, and then subtracting the past actual emissions (referred to as "baseline actual emissions") from those units. In lieu of projecting future actual emissions for a particular existing emission unit, an applicant can choose instead to use the unit's potential to emit as the unit's post-project emissions (40 CFR 52.21(b)(41)(ii)(d)). The actual-to-potential test, which is required for all new units being constructed as part of the project, involves totaling the potential emissions of the proposed new emission units, then subtracting past actual emissions of those units. A new unit that is being constructed as part of the project has a baseline of zero (40 CFR 52.21(b)(48)(iii)).

777 Assembly Emissions Increase from Existing Emission Units

Using material transaction data from Boeing's Haztrax database and VOC content estimates provided by Sunhealth and material safety data sheets (MSDSs), estimated actual VOC emissions from 777 assembly operations for the last 9 years are provided in Table A-1.

Baseline actual emissions, using 2012 and 2013 as the baseline years, is calculated below.

Baseline actual emissions:

= (156.5 + 164.0) / 2 = 160.3 tons/yr

In this analysis, projected actual emissions are based on a maximum anticipated production rate of 125 777s per year. The emission factor used to calculate projected actual emissions is based on the emission factor from the second highest recent annual VOC emissions per plane (2008) as shown in Table A-1.

Projected actual emissions are:

= (125 planes/yr x 2.125 tons/plane)
= 265.6 tons/yr

Projected actual emission – baseline actual emissions

= 265.6 – 160.3 = 105.3 tons/yr

TABLE A-1. ESTIMATED VOC EMISSIONS FROM 777 ASSEMBLY OPERATIONS FOR 2005 THROUGH 2013

Year	# of 777s Produced	Estimated VOC Emissions Before Subtracting Waste (tons)	Estimated VOCs in Waste (tons)	Estimated VOC Emissions After Subtracting Waste (tons)	Estimated VOC Emissions per Airplane (tons)
2005	44	107.8	4.2	103.6	2.35
2006	62	117.9	5.9	112.0	1.82
2007	83	179.3	8.7	170.6	2.06
2008[a]	68	152.7	8.2	144.5	2.12
2009	83	164.5	10.1	154.4	1.86
2010	71	133.3	8.0	125.3	1.77
2011	75	146.8	8.6	138.2	1.84
2012	83	167.7	11.2	156.5	1.89
2013	99	181.1	17.1	164.0	1.66

[a] A 2-month work stoppage occurred in 2008.

Wing Component Fabrication Emissions Increase from New Emission Units

Wing component fabrication will involve about 25 new emissions units, and as discussed above, all new units being constructed as part of the Project are required to undergo the actual-to-potential test. A new unit that is being constructed as part of the Project has a baseline of zero (40 CFR 52.21(b)(48)(iii)). Potential emissions for the wing component fabrication include open floor and point sources. Some of the emissions units also have associated combustion emissions from process heating; however, these emissions are accounted for in the combustion section of this appendix. The potential emissions for wing component fabrication are based on the projected maximum production rate of 125 airplanes per year and a combined emission rate for all the new wing component fabrication emissions units. The individual emission rates for each new wing component fabrication emission units and their combined emission rate are shown in Table A-2.

Potential emissions are:

= (3,763 lb VOC/airplane x 125 airplanes/yr) / 2,000 lb/ton
= 235 tons VOC/yr

Wing Assembly Emissions Increase from New Emission Units

No new VOC emission units will be installed for wing assembly operations as part of the 777X Project. (The emissions increase from the existing wing assembly operation has been accounted for in the 105.3 tpy emissions increase calculated above for the existing 777 assembly operation.)

TABLE A-2. WING COMPONENT FABRICATION: NEW SOURCES

Emission Unit or Activity Identifier	Emission Unit or Activity Description	Exhaust CFM	Non-Combustion Related VOC Emission Estimate Per Shipset	Estimate of Quantity of Each Coating, Solvent, Sealant and Other Products Used Per Shipset and Boeing MSDS #s[a]
WCF-1	Prep of layup mandrels (cleaning and application of mold release, tackifier (if req'd), and tooling filler (if req'd)) Wing panel buildup (shop floor emissions from hand-wipe cleaning, sealing, touchup coating, and other miscellaneous activities) Wing spar buildup (shop floor emissions from hand-wipe cleaning, sealing, touchup coating, and other miscellaneous activities)	NA	Total: 1,895~~2,047~~ lb/shipset (subtotals listed below) Prep: 1,552 lb per shipset Wing panel buildup: 190 lb/shipset Wing spar buildup: 15~~3~~2~~305~~ lb/shipset	Prep estimate: 97 gal per shipset of IPA to clean mandrels, caul plates, and other tooling (MSDS #s 64334 or 133755) 86 gal per shipset of mold release compound (Frekote 710 NC, MSDS #59753) 43 gal per shipset tackifier solution (Toray E-09 tackifier / MEK thinner, assume 1:3 mix ratio, MSDS #s 38669 and 64337 or 133755, respectively) 12 gal per shipset mandrel repair coating (Chemlease MPP 117, MSDS #115060) 14 gal per shipset mandrel repair coating (Zyvax Sealer GP, MSDS #69607) Wing panel buildup: Wing panel assembly, wing panel buildup, and wing assembly for the aluminum 777 wing currently occur within Building 40-34. Based on Haztrax data for 12/1/2012 to 11/30/2013, VOC emissions from Building 40-34 were 759 lb/shipset. The wing panel buildup is assumed to account for approximately 20% of the VOC emissions that occur in Building 40-34. Therefore, the 777X wing panel buildup emissions are estimated at 0.2 x 759 lb/shipset x 1.25 = 190 lb/shipset (using a 1.25 safety factor). Wing spar buildup: Wing spar assembly and wing spar buildup for the aluminum 777 wing currently occur within Building 40-04. VOC emissions from wing spar buildup in Bldg. 40-04 occur from both shop floor activities and from four existing wing spar seal booths. Based on Haztrax data for 12/1/2012 to 11/30/2013, VOC emissions from Building 40-04 were 244 lb/shipset. The wing spar buildup is assumed to account for all the VOC emissions that occur in Building 40-04 (conservative estimate since some of the emissions are attributable to the wing spar assembly operations), so for the 777X wing spar buildup, emissions are estimated at 244 lb/shipset x 1.25 = 305 lb/shipset (using a 1.25 safety factor). Of this 305 lbs VOC/shipset, approximately 152 lbs/shipset is estimated to be emitted from the wing spar seal booth(s) (see entry for the WCF-14 at the bottom of this table). Therefore, shop

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TABLE A-2. WING COMPONENT FABRICATION: NEW SOURCES

Emission Unit or Activity Identifier	Emission Unit or Activity Description	Exhaust CFM	Non-Combustion Related VOC Emission Estimate Per Shipset	Estimate of Quantity of Each Coating, Solvent, Sealant and Other Products Used Per Shipset and Boeing MSDS #s[a]
				floor VOC emissions from 777X wing spar buildup are estimated at 305 lb/shipset – 152 lbs/shipset = 153 lbs/shipset.
WCF-4	Vacuum pump(s) servicing autoclaves (2 per autoclave, or 6 vacuum pumps total)	65	Total of 114 lb VOC emitted from all vacuum pumps combined per shipset.	38,152 lb of BMS 8-276 prepreg per shipset. Boeing MSDS #s of products qualified under BMS 8-276 are 123335, 133438, and 131737. BMS allows for a maximum of 1.5% by wt volatiles in prepreg, but test results from prepreg vendor (Toray) indicate average volatile content is less than 0.3% by weight.
WCF-5	Dust collector used to collect particulates from trimming, drilling, and other machining operations on cured components	5,000	0	NA
WCF-6a	Wing panel wash stall #1	16,250	0 lb	Ardrox JC-5 aqueous cleaner used to wash parts. Boeing MSDS #18100. MSDS states that the VOC content is zero. Quantity used per shipset not estimated since VOC content is zero.
WCF-6b	Wing panel wash stall #2	16,250	0 lb	Ardrox JC-5 aqueous cleaner used to wash parts. Boeing MSDS #18100. MSDS states that the VOC content is zero. Quantity used per shipset not estimated since VOC content is zero.
WCF-6c	Wing spar and stringer wash stall #1	3,900	0 lb	Ardrox JC-5 aqueous cleaner used to wash parts. Boeing MSDS #18100. MSDS states that the VOC content is zero. Quantity used per shipset not estimated since VOC content is zero.
WCF-6d	Wing spar and stringer wash stall #2	3,900	0 lb	Ardrox JC-5 aqueous cleaner used to wash parts. Boeing MSDS #18100. MSDS states that the VOC content is zero. Quantity used per shipset not estimated since VOC content is zero.

TABLE A-2. WING COMPONENT FABRICATION: NEW SOURCES

Emission Unit or Activity Identifier	Emission Unit or Activity Description	Exhaust CFM	Non-Combustion Related VOC Emission Estimate Per Shipset	Estimate of Quantity of Each Coating, Solvent, Sealant and Other Products Used Per Shipset and Boeing MSDS #s[a]
WCF-7	Gas-fired plasma unit for treatment of wing panel stringer	23,400	NA	NA
WCF-8a	Wing panel prep booth(s) (abrasive blast/sanding, solvent handwipe, edge seal)	32,500	504 lb per shipset. Currently Boeing is considering building one or two wing panel prep booths.~~; however, for the purposes of this application only one booth will be considered.~~ If Boeing decides to build two wing panel prep booths, the 504 pounds of VOC emission will be divided between the two booths.	Various hand-wipe cleaning solvents might be used, including MPK, MEK, 70/30 blend of MPK and MEK, IPA, Turco 4460-BK (MSDS #s 88325, 64337, 140751, 64334, and 85374, respectively.) Assume 18 gal of solvent per wing panel (i.e., 36 gal per wing, 72 gal per shipset). Edge seal: Two-part adhesive. Will use either 3M EC2216 or Henkel Hysol EA9330. For EC2216, mix ratio is 3 parts accelerator (part A) / 2 parts base (part B). Per 3M's online MSDS dated 8/5/2008, VOC content of mixed EC2216 is 12 g/liter. For EA9330, mix ratio is 100 parts by wt Part A (MSDS 32991) / 33 parts by wt Part B (MSDS 32992). Per MSDSs, VOC content of both parts is less than 10 g/liter. Total usage of edge seal per shipset is anticipated to be just a few gallons at the most, so VOC emissions are negligible.
WCF-8b	Wing spar prep booth (abrasive blast/sanding, solvent handwipe, edge seal)	7,800	70 lb per shipset.	Various hand-wipe cleaning solvents might be used, including MPK, MEK, 70/30 blend of MPK and MEK, IPA, Turco 4460-BK (MSDS #s 88325, 64337, 140751, 64334, 85374, respectively.) Assume 2.5 gal of solvent per wing spar (i.e., 5 gal per wing, 10 gal per shipset). Edge seal: Two-part adhesive. Will use either 3M EC2216 or Henkel Hysol EA9330. For EC2216, mix ratio is 3 parts accelerator (part A) / 2 parts base (part B). Per 3M's online MSDS dated 8/5/2008, VOC content of mixed EC2216 is 12 g/liter. For EA9330, mix ratio is 100 parts by wt Part A (MSDS 32991) / 33 parts by wt Part B (MSDS 32992). Per MSDSs, VOC content of both parts is less than 10 g/liter. Total usage of edge seal per shipset is anticipated to be just a few gallons at the most, so VOC emissions are negligible.

TABLE A-2. WING COMPONENT FABRICATION: NEW SOURCES

Emission Unit or Activity Identifier	Emission Unit or Activity Description	Exhaust CFM	Non-Combustion Related VOC Emission Estimate Per Shipset	Estimate of Quantity of Each Coating, Solvent, Sealant and Other Products Used Per Shipset and Boeing MSDS #s[a]
WCF-9a	Wing panel spray booth #1	195,000	818 lb per shipset, but note there are threetwo wing panel booths, so assuming each booth is used for one third of all wing panelsonly half the panels of a shipset, each booth would actually only emit 273409 lb per shipset on average.	36.5 gal of BMS 10-103 Grade A primer per shipset (512X310 base / 910X533 catalyst, 1/1 mix ratio, MSDS #s 82874 and 81600, respectively). 108 gal of BMS 10-20 per shipset (454-4-1 base / CA-109 cat / TL-52 (optional), assume 3/1/0.5 mix ratio, MSDS #s 85408, 85406, and 84472, respectively). 12 gal 70/30 MPK/MEK blend for spray equipment cleaning per shipset. Assume 20% of this amount is emitted to the air during the cleaning process, the rest is collected for disposal. MSDS #140751.
WCF-9b	Wing panel spray booth #2	195,000	818 lb per shipset, but note there are threetwo wing panel booths, so assuming each booth is used for one third of all wing panelsonly half the panels of a shipset, each booth would actually only emit 273409 lb per shipset on average.	36.5 gal of BMS 10-103 Grade A primer per shipset (512X310 base / 910X533 catalyst, 1/1 mix ratio, MSDS #s 82874 and 81600, respectively). 108 gal of BMS 10-20 per shipset (454-4-1 base / CA-109 cat / TL-52 (optional), assume 3/1/0.5 mix ratio, MSDS #s 85408, 85406, and 84472, respectively). 12 gal 70/30 MPK/MEK blend for spray equipment cleaning per shipset. Assume 20% of this amount is emitted to the air during the cleaning process, the rest is collected for disposal. MSDS #140751.
WCF-9d	Wing panel spray booth #3	195,000	818 lb per shipset, but note there are three wing panel booths, so assuming each booth is used for one third of all wing panels, each booth would actually only emit 273 lb per shipset on average.	36.5 gal of BMS 10-103 Grade A primer per shipset (512X310 base / 910X533 catalyst, 1/1 mix ratio, MSDS #s 82874 and 81600, respectively). 108 gal of BMS 10-20 per shipset (454-4-1 base / CA-109 cat / TL-52 (optional), assume 3/1/0.5 mix ratio, MSDS #s 85408, 85406, and 84472, respectively). 12 gal 70/30 MPK/MEK blend for spray equipment cleaning per shipset. Assume 20% of this amount is emitted to the air during the cleaning process, the rest is collected for disposal. MSDS #140751.

TABLE A-2. WING COMPONENT FABRICATION: NEW SOURCES

Emission Unit or Activity Identifier	Emission Unit or Activity Description	Exhaust CFM	Non-Combustion Related VOC Emission Estimate Per Shipset	Estimate of Quantity of Each Coating, Solvent, Sealant and Other Products Used Per Shipset and Boeing MSDS #s[a]
WCF-9c	Wing spar spray booth	46,800	118 lb per shipset	5.4 gal of BMS 10-103 Grade A primer per wing spar shipset (512X310 base / 910X533 catalyst, 1/1 mix ratio, MSDS #s 82874 and 81600, respectively). 12.9 gal of BMS 10-20 per wing spar shipset (454-4-1 base / CA-109 cat / TL-52 (optional), assume 3/1/0.5 mix ratio, MSDS #s 85408, 85406, and 84472, respectively). 12 gal 70/30 MPK/MEK blend for spray equipment cleaning per shipset. Assume 20% of this amount is emitted to the air during the cleaning process, the rest is collected for disposal. MSDS #140751.
WCF-10a	Wing panel primer curing booth #1	97,500	53 lb per shipset, but note there are two wing panel booths, so assuming each booth is used for only half the panels of a shipset, each booth would actually only emit 26.6 lb per shipset on average.	NA
WCF-10b	Wing panel primer curing booth #2	97,500	53 lb per shipset, but note there are two wing panel booths, so assuming each booth is used for only half the panels of a shipset, each booth would actually only emit 26.6 lb per shipset on average.	NA
WCF-10c	Wing spar primer curing booth	23,400	7.7 lb per shipset.	NA
WCF-11	Small quantity paint mix booth	3,635	On the order of 1 lb or less.	NA
WCF-12a	Coating equipment cleaning booth #1	3,635	32 lb per shipset, but note there are two cleaning booths for the wing component spray booths, so assuming each booth is used for only one-half of the cleaning, each booth would actually only emit 16 lb per shipset on average.	24 gal 70/30 MPK/MEK blend for spray equipment cleaning per shipset. Assume 20% of this amount is emitted to the air during the cleaning process, the rest is collected for disposal. MSDS #140751.

TABLE A-2. WING COMPONENT FABRICATION: NEW SOURCES

Emission Unit or Activity Identifier	Emission Unit or Activity Description	Exhaust CFM	Non-Combustion Related VOC Emission Estimate Per Shipset	Estimate of Quantity of Each Coating, Solvent, Sealant and Other Products Used Per Shipset and Boeing MSDS #s[a]
WCF-12b	Coating equipment cleaning booth #2	3,635	32 lb per shipset, but note there are two cleaning booths for the wing component spray booths, so assuming each booth is used for only one-half of the cleaning, each booth would actually only emit 16 lb per shipset on average.	24 gal 70/30 MPK/MEK blend for spray equipment cleaning per shipset. Assume 20% of this amount is emitted to the air during the cleaning process, the rest is collected for disposal. MSDS #140751.
WCF-14 ~~a - d~~	Wing spar seal booth(s) ~~#1 - #4~~	Variable: 10,000 CFM for sealing; 25,000 CFM for solvent wipe cleaning; 53,000 CFM for spray coating[b]	152 lbs per shipset (the majority of these emissions come from hand-wipe cleaning). Currently Boeing is considering building up to four wing spar seal booths. If Boeing decides to build multiple booths, the 152 pounds of VOC emission will be divided between the multiple booths.	Various hand-wipe cleaning solvents might be used, including MPK, MEK, or IPA (MSDS #s 88325, 64337, 64334, respectively.) Assume 3.75 gal of solvent per wing spar or 15 gal per shipset. 135 lbs BMS 5-45 Class B sealant per spar, or 540 lbs per shipset. Assume sealant is PR-1776M B-2 (MSD#121363). 15 lbs BMS 5-45 Class A sealant per spar, or 60 lbs per shipset. Assume sealant is Pro Seal 890M A-2 (MSDS# 126361). 0.2 gallons of BMS 10-20 per spar, or 0.8 gallons per shipset (454-4-1 base / CA-109 cat / TL-52 (optional), assume 3/1/0.5 mix ratio, MSDS # 85408, 85406, and 84472, respectively). FRONT SPAR ONLY: 0.1 gallons of BMS 10-103 Grade A primer per spar, or 0.2 gallons per shipset (512X310 base / 910X533 catalyst, 1/1 mix ratio, MSDS # 82874 and 81600, respectively) FRONT SPAR ONLY: 0.05 gallons of BMS 10-60 topcoat per spar, or 0.1 gallons per shipset (ECL-G-101 / PC-233 / TR-112, 2/1/1 mix ratio, MSDS # 97699, 92002, & 95733, respectively).
TOTAL	--	--	**3,763 lb per shipset.**	--

[a] Mix ratios are by volume unless otherwise specified.

[b] Because the majority of emissions from the seal booths will occur during the solvent cleaning step, BACT costs are based on an exhaust flow rate of 25,000 CFM.

TABLE A-2. WING COMPONENT FABRICATION: NEW SOURCES

Emission Unit or Activity Identifier	Emission Unit or Activity Description	Exhaust CFM	Non-Combustion Related VOC Emission Estimate Per Shipset	Estimate of Quantity of Each Coating, Solvent, Sealant and Other Products Used Per Shipset and Boeing MSDS #s[a]

IPA = Isopropyl Alcohol
MEK = methyl ethyl ketone
MPK = methyl propyl ketone

Body Section Assembly Emissions Increase from New Emission Units

No new VOC emission units will be installed for body section assembly operations as part of the Project. (The emissions increase from the existing body section assembly operation has been accounted for in the 105.3 tpy emissions increase calculated above for the existing 777 assembly operation.)

Wing and Body Structures Seal/Paint Building Emissions Increase from New Emission Units

Wing and body structures seal/paint operations will involve four new emissions units, which are subject to the actual-to-potential test. Potential emissions for these new units are based on the projected maximum production rate of 125 airplanes per year and a combined emission rate for all four new emissions units in this category. The individual emission rates for each new emission unit and their combined emission rate are shown in Table A-3. (The emissions increase from the existing seal/paint building operation has been accounted for in the 105.3 tpy emissions increase calculated above for the existing 777 assembly operation.)

Potential emissions:

= (230 lb VOC/airplane x 125 airplanes/yr) / 2,000 lb/ton
= 14.4 tons VOC/yr

Airplane Assembly Emissions Increase from New Emission Units

Airplane assembly operations will involve two new emission units and are subject to the actual-to-potential test. Potential emissions for airplane assembly from these new emission units are based on the projected maximum production rate of 125 airplanes per year and a combined emission rate for the two new emissions units in this category. The individual emission rates for each new emission unit and their combined emission rate are shown in Table A-4. (The emissions increase from the airplane assembly operation has been accounted for in the 105.3 tpy emissions increase calculated above for the existing 777 assembly operation.)

Potential emissions are:

= (22 lb VOC/airplane x 125 airplanes/yr) / 2,000 lb/ton
= 1.38 tons VOC/yr

TABLE A-3. WING AND BODY STRUCTURES SEAL/PAINT BUILDING: NEW SOURCES

Emission Unit or Activity Identifier	Emission Unit or Activity Description	Exhaust (cfm)	Non-Combustion Related VOC Emission Estimate Per Shipset	Estimate of Quantity of Each Coating, Solvent, Sealant and Other Products Used Per Shipset and Boeing MSDS #s[a]
WBSP-10	Vertical fin HLFC prep booth	50,000	20 lb per shipset.	3 gal MPK (MSDS #88325) or CDG-110 (MSDS #86849). 4.5 gal Pace B-82 cleaner (MSDS #6172).
WBSP-11a	Vertical fin HLFC spray booth #1b	3 stacks @ 50,000 each	209 lb per shipset, but note there are three vertical fin booths, so assuming each booth is used for only one-third the fins, each booth would actually only emit 70 lb per shipset on average.	9 gal of BMS 10-103 Grade A primer per shipset (512X310 base / 910X533 catalyst, 1/1 mix ratio, MSDS #s 82874 and 81600, respectively). 15 gal BMS 10-125 topcoat per shipset (3001GXXXXX base / CS6000 curing solution / A9004 activator, 6/1/0.5 mix ratio; MSDS #s 143664, 139555, and 146375, respectively). Note that MSDS for base component will vary depending on color. A white base is most common. MSDS #143664 is for one of the most common white bases used. 6 gal Sur-Prep AP-1 Adhesion Promoter per shipset (Part A / Part B, 1 / 8.33 mix ratio, MSDS #s 140722 and 140723, respectively.) 15 gal BMS 10-125 clearcoat per shipset (3001G00002 base / CS6003 curing solution / A9052 activator, 2/2/1 mix ratio; MSDS #s 144406, 141227, and 145945, respectively). 9 gal MPK (MSDS #88325) for spray equipment cleaning. Assume 20% of this amount is emitted to the air during the cleaning process, the rest is collected for disposal.
WBSP-11b	Vertical fin HLFC spray booth #2b	3 stacks @ 50,000 each	209 lb per shipset, but note there are three vertical fin booths, so assuming each booth is used for only one-third the fins, each booth would actually only emit 70 lb per shipset on average.	9 gal of BMS 10-103 Grade A primer per shipset (512X310 base / 910X533 catalyst, 1/1 mix ratio, MSDS #s 82874 and 81600, respectively). 15 gal BMS 10-125 topcoat per shipset (3001GXXXXX base / CS6000 curing solution / A9004 activator, 6/1/0.5 mix ratio; MSDS #s 143664, 139555, and 146375, respectively). Note that MSDS for base component will vary depending on color. A white base is most common. MSDS #143664 is for one of the most common white bases used. 6 gal Sur-Prep AP-1 Adhesion Promoter per shipset (Part A / Part B, 1 / 8.33 mix ratio, MSDS #s 140722 and 140723, respectively.)

TABLE A-3. WING AND BODY STRUCTURES SEAL/PAINT BUILDING: NEW SOURCES

Emission Unit or Activity Identifier	Emission Unit or Activity Description	Exhaust (cfm)	Non-Combustion Related VOC Emission Estimate Per Shipset	Estimate of Quantity of Each Coating, Solvent, Sealant and Other Products Used Per Shipset and Boeing MSDS #s[a]
				15 gal BMS 10-125 clearcoat per shipset (3001G00002 base / CS6003 curing solution / A9052 activator, 2/2/1 mix ratio; MSDS #s 144406, 141227, and 145945, respectively). 9 gal MPK (MSDS #88325) for spray equipment cleaning. Assume 20% of this amount is emitted to the air during the cleaning process, the rest is collected for disposal.
WBSP-11c	Vertical fin HLFC spray booth #3b	3 stacks @ 50,000 each	209 lb per shipset, but note there are three vertical fin booths, so assuming each booth is used for only one-third of the fins, each booth would actually only emit 70 lb per shipset on average.	9 gal of BMS 10-103 Grade A primer per shipset (512X310 base / 910X533 catalyst, 1/1 mix ratio, MSDS #s 82874 and 81600, respectively). 15 gal BMS 10-125 topcoat per shipset (3001GXXXXX base / CS6000 curing solution / A9004 activator, 6/1/0.5 mix ratio; MSDS #s 143664, 139555, and 146375, respectively). Note that MSDS for base component will vary depending on color. A white base is most common. MSDS #143664 is for one of the most common white bases used. 6 gal Sur-Prep AP-1 Adhesion Promoter per shipset (Part A / Part B, 1 / 8.33 mix ratio, MSDS#s 140722 and 140723, respectively.) 15 gal BMS 10-125 clearcoat per shipset (3001G00002 base / CS6003 curing solution / A9052 activator, 2/2/1 mix ratio; MSDS #s 144406, 141227, and 145945, respectively). 9 gal MPK (MSDS #88325) for spray equipment cleaning. Assume 20% of this amount is emitted to the air during the cleaning process, the rest is collected for disposal.
Total			**230 lb per shipset**	

[a] Mix ratios are by volume unless otherwise specified.

TABLE A-4. AIRPLANE ASSEMBLY: NEW SOURCES

Emission Unit or Activity Identifier	Emission Unit or Activity Description	Exhaust CFM	Non-Combustion VOC Related Emission Estimate Per Shipset	Estimate of Quantity of Each Coating, Solvent, Sealant and Other Products Used Per Shipset and Boeing MSDS #s[a]
AA-2a	Wing stub spray-coating ventilation system	4,000	22 lb per shipset. Note that although there are two wing stub spray coating ventilations systems, one of them will be associated with the "low rate initial production" airplane assembly line, which may be deactivated after a period of time. Therefore, for the BACT analysis, assume all 22 lb of VOC emissions from each airplane produced will be emitted from just one wing stub spray coating ventilation system (i.e., assume annual emissions from one wing stub spray coating ventilation system is 22 lb x 125 airplanes per year = 2,750 lb per year).	1.875 gal of BMS 10-11 Type I primer per shipset (44-Y-022 base / 44-Y-022 cat / water, assume 2/1/4.5 mix ratio, MSDS #s 81045 and 81046, respectively). 0.15 gal of BMS 10-20 per wing primer shipset (454-4-1 base / CA-109 cat / TL-52 (optional), assume 3/1/0.5 mix ratio, MSDS #s 85408, 85406, and 84472, respectively). 0.3 gal of BMS 10-11 Type II topcoat per shipset (446-22-2000 base / X-530 catalyst, assume 3/1 mix ratio, MSDS #s 90168 and 82649, respectively). 1.25 gal of BMS 5-81 Type II fuel barrier coating per shipset (PR-1197 Part A / PR-1197 Part B / MEK thinner, mix ratio is 90 parts by weight Part A, 100 parts by weight Part B, then thin with MEK at a ratio of 10 parts by weight mixed coating to 4 parts by weight MEK, MSDS #s 84584, 84585, and 64337, respectively). 0.375 gal Cor-Ban 35 aerosol per shipset (MSDS #106501). 0.25 gal AV-8 aerosol per shipset (MSDS#78343).

TABLE A-4. AIRPLANE ASSEMBLY: NEW SOURCES

Emission Unit or Activity Identifier	Emission Unit or Activity Description	Exhaust CFM	Non-Combustion VOC Related Emission Estimate Per Shipset	Estimate of Quantity of Each Coating, Solvent, Sealant and Other Products Used Per Shipset and Boeing MSDS #s[a]
AA-2b	Wing stub spray coating ventilation system	4,000	22 lb per shipset. Note that although there are two wing stub spray coating ventilations systems, one of them will be associated with the "low rate initial production" airplane assembly line, which may be deactivated after a period of time. Therefore, for the BACT analysis, assume all 22 lb of VOC emissions from each airplane produced will be emitted from just one wing stub spray coating ventilation system (i.e., assume annual emissions from one wing stub spray coating ventilation system is 22 lb x 125 airplanes per year = 2,750 lb per year).	1.875 gal of BMS 10-11 Type I primer per shipset (44-Y-022 base / 44-Y-022 cat / water, assume 2/1/4.5 mix ratio, MSDS #s 81045 and 81046, respectively). 0.15 gal of BMS 10-20 per wing primer shipset (454-4-1 base / CA-109 cat / TL-52 [optional], assume 3/1/0.5 mix ratio, MSDS #s 85408, 85406, and 84472, respectively). 0.3 gal of BMS 10-11 Type II topcoat per shipset (446-22-2000 base / X-530 catalyst, assume 3/1 mix ratio, MSDS #s 90168 and 82649, respectively). 1.25 gal of BMS 5-81 Type II fuel barrier coating per shipset (PR-1197 Part A / PR-1197 Part B / MEK thinner, mix ratio is 90 parts by weight Part A, 100 parts by weight Part B, then thin with MEK at a ratio of 10 parts by weight mixed coating to 4 parts by weight MEK, MSDS #s 84584, 84585, and 64337, respectively). 0.375 gal Cor-Ban 35 aerosol per shipset (MSDS #106501). 0.25 gal AV-8 aerosol per shipset (MSDS#78343).
Total			**22 lb per shipset**	

[a] Mix ratios are by volume unless otherwise specified.

Interiors Emissions Increase

No changes to the IRC emission units are anticipated for Phase 1 of the Project. However, for Phase 2, five new IRC VOC sources are proposed as part of this Project. These include three adhesive spray booths, a paint spray booth, and a crushed core press. The actual-to-potential test, which is required for all new units being constructed or installed as part of the Project, involves totaling the potential emissions of the proposed new emissions units, then subtracting past actual emissions of those units. Unlike other new emissions units in this Project, the new IRC emissions units' potential emissions are not calculated on a shipset basis. The potential emissions for the new units are based on the maximum VOC emissions per year from each unit. The new IRC units are shown in Table A-5.

Existing cleaning, coating, and other activities (including open floor activities and activities conducted at existing spray booths, presses, etc.) that generate emissions during the production of 777 interiors will be debottlenecked by the Project since once the Project is complete, more 777 interior shipsets are expected to be produced to support the higher 777X production rate. Because the same equipment is also used to produce interiors for other airplane models, for the purposes of this estimate, the existing emission units being debottlenecked are taken to be the cleaning, coating, and other activities associated with the production of 777 interiors only. The emission increase from these existing emission units is estimated here by determining the difference between projected actual emissions and baseline actual emissions.

Although overall VOC emissions from IRC operations are tracked to demonstrate compliance with the PSD-05-02 annual VOC emission cap, VOC emissions from 777 interiors production are not tracked separately from VOC emissions from interiors production for other airplane programs. However, it is estimated that approximately 0.53 ton of VOCs are generated per 777 interiors shipset produced.[2]

Using this emission factor and an average annual 777 interiors shipset production during the 2012/2013 baseline years of (99 + 83)/2 = 91, baseline actual emissions for IRC are:

= (91 shipsets/yr) x (0.53 ton VOC/shipset)
= 48.2 tons VOC/yr

Projected actual emissions based on 125 shipsets per year for IRC are:

= (125 shipsets/yr) x (0.53 ton VOC/shipset)
= 66.3 tons VOC/yr

Potential new emissions are:

= [IRC-1a, -1b, and -1c adhesive spray booths (17,700 lb VOC /booth x 3 booths) + IRC-2 paint spray booth (10,000 lb VOC) + IRC-3 crushed core press (4,500 lb VOC)] /year / 2,000 lb/ton
= 33.8 tons VOC/yr

[2] See Appendix B of the Prevention of Significant Deterioration Application for the 787 Project, March 2005.

TABLE A-5. IRC NEW EMISSIONS UNITS

Emission Unit or Activity Identifier	Emission Unit or Activity Description	Exhaust CFM	Non-Combustion-Related VOC Emission Estimate Per Shipset	Estimate of Quantity of Each Coating, Solvent, Sealant and Other Products Used Per Shipset and Boeing MSDS #'s[a]
IRC-1a	Adhesive spray booth #1	20,000	17,700 lb/year **Note**: This is not a per shipset estimate. It is an annual estimate based on a production rate of 125 airplanes per year.	2,860 gal per year of BMS 5-127 adhesive (Bostik 7132 base / Boscodur 24T activator / MEK thinner, assume 16/1/17 mix ratio, MSDS #'s 45308, 31392, and 80402, respectively).
IRC-1b	Adhesive spray booth #2	20,000	17,700 lb/year **Note**: This is not a per shipset estimate. It is an annual estimate based on a production rate of 125 airplanes per year.	2,860 gal per year of BMS 5-127 adhesive (Bostik 7132 base / Boscodur 24T activator / MEK thinner, assume 16/1/17 mix ratio, MSDS #'s 45308, 31392, and 80402, respectively).
IRC-1c	Adhesive spray booth #3	20,000	17,700 lb/year **Note**: This is not a per shipset estimate. It is an annual estimate based on a production rate of 125 airplanes per year.	2,860 gal per year of BMS 5-127 adhesive (Bostik 7132 base / Boscodur 24T activator / MEK thinner, assume 16/1/17 mix ratio, MSDS #'s 45308, 31392, and 80402, respectively).
IRC-2	Paint spray booth	20,000	10,000 lb/year **Note**: This is not a per shipset estimate. It is an annual estimate based on a production rate of 125 airplanes per year.	690 gal per year BMS 10-83 Type 4 primer (Polane primer E61WC40 base / V66VC227 catalyst / R99KY29 thinner, assume 7/1/8 mix ratio, MSDS #'s 39195, 105392, and 80657, respectively). 1030 gal per year BMS 10-83 Type 2, 3, or 5 topcoat (Polane F63WY30 base / V66VC229 catalyst / R99KY29 thinner, assume 7/1/8 mix ratio, MSDS #'s 20442, 105387, and 80657, respectively). Note that the MSDS for base component will vary depending on color. A white base is most common. MSDS #20442 is for one of the most common white bases used.
IRC-3	Crushed core press	7,500	4,500 lb/yr **Note**: This is not a per shipset estimate. It is an annual estimate based on a production rate of 125 airplanes per year.	75 gal per year mold release agent (1894-EX-S, MSDS #15462). 585 gal per year mold release agent thinner (Shellsol OMS, MSDS #123245). 162,000 lb pre-impregnated material (prepreg) (BMS 8-222, Cytec MXB 6070, MSDS #31457) MXB 6070 is the most common type of prepreg used in the crushed core presses. Per lab tests, the VOC content of MXB is estimated at 0.17% by weight. Other types of prepreg used in the crushed core presses have not be tested but are believed to have a similar VOC content.

[a] Mix ratios are by volume unless otherwise specified.

The Project's hybrid emission increase from IRC operations is:

= (Projected actual emissions – baseline actual emissions) + potential new emissions

= (66.3 tons VOC/yr – 48.2 tons VOC/yr) + 33.8 tons VOC/yr
= 51.9 tons VOC/yr

This is a very conservative approach because the project actual emissions is based on 125 airplanes per year and includes some of the 33.8 tons per year (tpy) VOC emissions from the new emission units. Hence, some of the 33.8 tpy is double counted.

Everett Delivery Center Emissions Increase

The EDC does not anticipate any new or modified emission units in support of the Project. EDC work can be divided into paint hangar work and everything else. The EDC paint hangars are by far the largest source of emissions at the EDC, and they are already operated at their capacity. Because there are currently no plans to increase paint hangar capacity to support this Project, the Project will not result in increased emissions at Everett from paint hangars.

Work performed by the EDC that arguably will be debottlenecked and thereby experience an emission increase as a result of the Project is the coating and cleaning of 777 rudders and elevators (the moving surfaces on the vertical fin and horizontal stabilizer, respectively) performed in one of three existing EDC rudder and elevator spray booths, and the preflight/delivery work that occurs in Building 45-02 and on the flightline. Because work in support of other airplane models is also performed in these same spray booths, Building 45-02, and on the flightline, for the purposes of this estimate, the emission units being debottlenecked are taken to be the cleaning and coating of 777 rudders and elevators, and the preflight/delivery work performed on 777 airplanes. The emission increases from these emission units are estimated here by determining the difference between projected actual emissions and baseline actual emissions.

Although overall VOC emissions from EDC operations are tracked to demonstrate compliance with the PSD-05-02 annual VOC emission cap, VOC emissions from EDC work related to 777 production are not tracked separately from VOC emissions related to other airplane programs. However, based on estimates of the quantity of materials used to clean and coat 777 rudders and elevators, it is estimated that VOC emissions per rudder/elevator shipset are approximately 0.1 ton. Similarly, based on material transaction data for the flightline, it is estimated that the preflight/delivery VOC emissions per 777 are approximately 0.05 ton. For EDC then, total VOC emissions per 777 from these presumed debottlenecked emissions units are estimated at approximately 0.15 ton.

Using this emission factor and an average annual 777 production rate during the 2012/2013 baseline period of 91 [(83 + 99) /2], baseline actual emissions are:

= (91 airplanes/yr) x (0.15 ton VOC/airplane)
= 13.7 tons VOC/yr

Projected actual emissions based on 125 shipsets per year are:

= (125 airplanes/yr) x (0.15 ton VOC/airplane)
= 18.8 tons VOC/yr

Projected actual emission – baseline actual emissions

= 18.8 tons VOC/yr – 13.7 tons VOC/yr
= 5.1 tons VOC/yr

Propulsion Systems Emissions Increase

Propulsion Systems does not anticipate any new or modified emission units in support of the Project. However, the cleaning, coating, and other activities that generate emissions during the work performed on 777 engines and engine struts are arguably debottlenecked by the Project, since once the Project is complete, more 777 engines and engine struts are expected to be processed to support the higher production rate. Because the Propulsion Systems also supports other airplane models, for the purposes of this estimate, the emission units being debottlenecked are taken to be the cleaning, coating, and other activities associated with preparing 777 engines and engine struts. The emissions increases from these emission units are estimated here by determining the difference between projected actual emissions and baseline actual emissions.

Based on material transaction data from the Haztrax database and VOC content estimates provided by Sunhealth and MSDSs, Propulsion Systems' 2009 emissions are estimated at 0.276 ton. In 2009, 83 777s, 13 767s, and 10 747s were produced at Boeing Everett, meaning a total of [(83 + 13) x 2] + (10 x 4) = 232 engines were processed by Propulsion Systems. Propulsion Systems' VOC emissions per engine are then:

= 0.276 ton/232 engines = 0.00119 ton/engine or 2.38 lb/engine

Prior to Propulsion Systems moving to the Boeing Everett site in 2008, VOC emissions per engine were estimated at up to 0.003 ton/engine. Therefore, for purposes of this exercise, a conservative estimate of 0.005 ton/engine will be used.

Using this emission factor and an average annual 777 production rate during the 2012/2013 baseline period of 91 [(83 + 99) /2], baseline actual emissions are:

= (91 airplanes/yr) x (0.005 ton VOC/engine) x (2 engines/airplane)
= 0.91 ton VOC/yr

Projected actual emissions based on 125 shipsets per year are:

= (125 airplanes/yr) x (0.005 ton VOC/engine) x (2 engines/airplane)
= 1.25 tons VOC/yr

Projected actual emissions – baseline actual emissions

= 1.25 tons VOC/yr – 0.91 ton VOC/yr
= 0.34 ton VOC/yr

Emergent Operations Emissions Increase

No new or modified emission units are anticipated for Emergent Operations. However, the cleaning, coating, and other activities that generate emissions during emergent operations related to 777 production are presumed to be debottlenecked by the Project since once the Project is complete, more emergent operations related to 777 production are expected to occur to support the higher 777 production rate. Because Emergent Operations also supports other airplane models as well as the 777, for the purposes of this estimate, the emission units being debottlenecked are assumed to be the cleaning, coating, and other activities associated with emergent operations related to 777 production. The emissions increase from these emission units is estimated here by determining the difference between projected actual emissions and baseline actual emissions.

VOC emissions from emergent operations are not tracked separately for each airplane program. However, based on material transaction data from the Haztrax database from 2007 through 2010 and VOC content estimates provided by Sunhealth and MSDSs, it is estimated that VOC emissions from emergent operations related to 777 production is approximately 0.06 ton/airplane.

Using this emission factor and an average annual 777 production during the 2012/2013 baseline years of (83 + 99)/2 = 91, baseline actual emissions are:

= (91 777s/yr) x (0.06 ton VOC/777)
= 5.46 tons VOC/yr

Projected actual emissions based on 125 shipsets per year are:

= (125 airplanes/yr) x (0.06 ton VOC/airplane)
= 7.5 tons VOC/yr

Projected actual emission – baseline actual emissions

= 7.5 tons VOC/yr – 5.46 tons VOC/yr
= 2.04 tons VOC/yr

Electrical Systems Emissions Increase

The ESRC does not anticipate any new or modified emission units in support of the Project. However, the cleaning, coating, and other activities that generate emissions during the production of electrical systems for the 777 are likely to be debottlenecked by the Project since once the Project is complete, more 777 electrical system components are expected to be produced to support the higher 777 production rate. Because the ESRC also supports other airplane models, for the purposes of this estimate, the emission units being debottlenecked are taken to be the cleaning, coating, and other activities associated with 777 electrical systems production. The emissions increase from these emission units is estimated here by determining the difference between projected actual emissions and baseline actual emissions.

VOC emissions from electrical systems production are not tracked separately for each airplane program. However, based on material transaction data from the Haztrax database from 2005 through 2010 and VOC content estimates provided by Sunhealth and MSDSs, it is estimated that VOC emissions from 777 electrical systems production are approximately 25 lb/airplane or 0.0125 ton/airplane.

Using this emission factor, and an average annual 777 production during the 2012/2013 baseline years of (83 + 99)/2 = 91, baseline actual emissions are:

= (91 shipsets/yr) x (0.0125 ton VOC/shipset)

= 1.14 tons VOC/yr

Projected actual emissions based on 125 shipsets per year are:

= (125 airplanes/yr) x (0.0125 ton VOC/airplane)
= 1.56 tons VOC/yr

Net increase = Projected actual emission – baseline actual emissions

= 1.56 tons VOC/yr – 1.14 tons VOC/yr
= 0.42 ton VOC/yr

Boilers and Other Combustion Equipment Emissions Increase from Existing Emission Units

Six existing 150-million-British-thermal-units-per-hour (MMBtu/hr) natural-gas-fired industrial steam boilers provide steam for process and space heating in support of all twin-aisle airplane programs (i.e., 747, 767, 777, and 787 models) and IRC manufacturing operations (including twin-aisle airplanes and 737 interiors manufacturing) at Boeing Everett. Boilers #1 through #4 are located in the Building 40-12 boiler plant on the north side of the Everett site, and Boilers #5 and #6 are located in the Building 45-07 boiler plant on the south side of the Everett site. The six boilers consume approximately 90 percent of the total amount of natural gas delivered to Boeing Everett. The remainder of the natural gas delivered to Boeing Everett is consumed in small (less than 10-MMBtu/yr) boilers, furnaces, process equipment, HVAC equipment, and hot water heaters. To simplify the emissions estimates from the boilers and other stationary fuel-burning equipment, it is assumed that all the natural gas burned onsite is burned only in the 150-MMBtu/hr boilers. All six boilers burn distillate #2 fuel oil when the natural gas provider curtails delivery due to regionally high demand for natural gas during winter cold spells. In addition, the boilers burn distillate oil for test purposes. Other than the six boilers, the only other existing stationary equipment onsite that burns distillate oil is the emergency generators and fire pump engines, which are not included in this emission estimate since the 777X Project is not expected to result in an increase in emissions from those units.

The emission increase that will occur as a result of the Project from the existing boilers and other stationary fuel-burning equipment is the difference between projected actual emissions and baseline actual emissions. For purposes of this emission estimate, the 24-month period is taken to be 2012 and 2013. Baseline actual emissions, using 2012 and 2013 as the baseline years as shown in Table A-6, are calculated below.

Baseline actual emissions are:

= (3.26 + 3.32) / 2 = 3.29 tons/yr

In this analysis, projected actual emissions are based on a maximum anticipated production rate of 125 777X's per year and the 2012/2013 average production rate, (83 + 99)/2 = 91, for a projected increase of 34 airplanes a year over the baseline (125 – 91 = 34). A natural gas usage factor of 3,206 MMBtu/airplane is used to estimate projected actual emissions resulting from the increased production rate. A detailed analysis of this natural gas usage factor is found in Appendix B, Estimate of Non-Significant PSD Pollutant Emissions Increases from the 777X Project, and its associated Attachment A.

TABLE A-6. ESTIMATED VOC EMISSIONS BOILERS #1-6 FOR 2005 THROUGH 2012

Year	# of 777s Produced	Boilers #1-6 VOC Emissions (tons)
2005	44	2.59
2006	62	2.68
2007	83	2.92
2008[a]	68	3.00
2009	83	3.07
2010	71	2.94
2011	75	3.24
2012	83	3.26
2013	99	3.32

[a] A 2-month work stoppage occurred in 2008.

Distillate oil #2 is only burned in the boilers when the natural gas supply is curtailed or for test purposes. Therefore, the amount of fuel oil burned in the boilers annually is primarily dependent on the length of the curtailment (if any), not on the airplane production rate. In the baseline years of 2012 and 2013, natural gas was never curtailed, so very little fuel oil was burned in the boilers. In order to provide a conservative estimate of the projected actual VOC emissions increase from the boilers and other stationary fuel-burning equipment as a result of the Project, it is assumed that a curtailment period lasting nine manufacturing days (the highest number of days that natural gas was curtailed to the Everett site in any of the past 15 years) will occur. The same consumption factor derived for natural gas (3,206 MMBtu/airplane) is used for fuel oil. The estimate assumes distillate #2 fuel oil contains 140 MMBtu/1,000 gal (Figure 27.3 on page 27-10 of *Perry's Chemical Engineers' Handbook*[3]). The airplane manufacturing rate was derived from 125 airplanes produced in 250 work days per year for a daily rate of 0.5 airplane produced per day.

Projected natural gas emissions increase from Boilers #1-6 are:

= (34 planes/yr x 3,206 MMBtu/airplane x 5.4E-3 lb VOC/MMBtu) / 2,000 lb/ton
= 0.294 ton/yr

Projected fuel oil emissions increase from Boilers #1-6 are:

= (9 days/yr x 0.5 plane/day x 3,206 MMBtu/airplane x 0.200 lb VOC/1,000 gal) / (140 MMBtu/1,000 gal) / 2,000 lb/ton
= 0.010 ton/yr

Projected total emissions increase from Boilers #1-6 are:

= 0.294 ton VOC/yr + 0.010 ton VOC/yr
= 0.304 ton VOC/yr

[3] 8th Edition, October 2007.

Combustion Equipment Emissions Increases from New Emission Units

In addition to the increased emissions from the existing boilers and other existing natural gas combustion units, this Project is also proposing to add new combustion equipment for additional process heating. The actual-to-potential test, which is required for all new units being constructed as part of the Project, involves totaling the potential emissions of the proposed new emissions units, then subtracting past actual emissions of those units. A new unit that is being constructed as part of the Project has a baseline of zero (40 CFR 52.21(b)(48)(iii)). The estimated heat input for all new combustion emissions units for the Project are shown in Table A-7.

The potential total heat input per airplane for all process heaters is approximately ~~715~~~~720~~750,000 MMBtu per 12-month rolling total. Adding a safety factor of 1.33~~1.4~~ to the potential total heat input yields a 12-month rolling total of approximately 1,000,000 MMBtu. Using this conservative total heat input and using standard US EPA AP-42 emission factors, the potential emissions from new process heaters are:

= ~~715~~~~720~~750,000 MMBtu/year x 1.33~~1.4~~ safety factor ≈ 1,000,000 MMBtu/year
= (1,000,000 MMBtu/year x 5.4E-3 lb VOC/MMBtu) / 2,000 lb/ton
= 2.7 tons VOC/year

Standby diesel generators are also proposed new emissions units as a part of this Project. Nine 2,750-kW generators and one 750-kW rated generator are proposed to provide standby power for the wing component fabrication process. The engines necessary to power the generators have a net power rating of 2,957 kW and 816 kW. As stated previously, the actual-to-potential test is required for these new emissions units. Estimated VOC emissions are based on Tier 2 EPA non-road engine emissions standards, the engine rating, and the maximum annual operating schedule of 100 hours per year as these engines qualify as emergency engines. They are:

= [(2,957 kW/engine x 9 engines) + (816 kW/engine x 1 engine)] x 100 hours/yr x 0.32 gram (g) VOC/kW-hr* / 1,000 g/kg / (1,000 kg/metric ton x 1.1 US tons/metric ton)
= 0.965 ton VOC/year

*Note: The EPA's Tier 2 NOx + non-methane hydrocarbons (NMHC) emission factor was apportioned to NOx and VOC by a ratio of 0.95 and 0.05, respectively, according to "The Carl Moyer Program Guidelines - Approved Revisions 2011", released March 27, 2013, California Environmental Protection Agency - Air Resources Board, Table D-25: Pollutant Fractions NOx + NMHC Standards.

Adding the total projected actual emissions increase from existing boilers to the potential emissions from the new process heaters and diesel generators yields the total VOC emissions increase from the Project from the existing and new combustion sources.

Total Project emissions increase from combustion sources is:

= 0.304 ton VOC/yr + 2.7 tons VOC/year + 0.965 ton VOC/year
= 3.97 tons VOC/year

TABLE A-7. COMBUSTION: NEW SOURCES		
Emission Unit or Activity Identifier	**Emission Unit or Activity Description**	**Estimated MMBtu of Fuel Consumed at 125 Planes per Year**
WCF-2	Gas-fired heater for liquid nitrogen vaporization unit (if this option is chosen to supply autoclaves with nitrogen)	7,500
WCF-3a	Gas-fired process heater for autoclave #1	33,333
WCF-3b	Gas-fired process heater for autoclave #2	33,333
WCF-3c	Gas-fired process heater for autoclave #3	33,333
WCF-6a	Wing panel wash stall #1	2,668
WCF-6b	Wing panel wash stall #2	2,668
WCF-6c	Wing spar and stringer wash stall #1	640
WCF-6d	Wing spar and stringer wash stall #2	640
WCF-7	Gas-fired plasma unit for treatment of wing panel stringer	3,841
WCF-8a	Wing panel abrasive blast/sanding booth(s) ~~#1~~	10,670
WCF-8b	Wing spar abrasive blast/sanding booth	1,280
WCF-9a	Wing panel spray booth #1	32,011
WCF-9b	Wing panel spray booth #2	32,011
WCF-9d	Wing panel spray booth #3	32,011
WCF-9c	Wing spar spray booth	7,683
WCF-10a	Wing panel primer curing booth #1	16,006
WCF-10b	Wing panel primer curing booth #2	16,006
WCF-10c	Wing spar primer curing booth	3,841
WCF-14 ~~a-d~~	Wing spar seal booth(s)	4,104
WBSP-10	Vertical fin HLFC prep booth	8,865
WBSP-11a	Vertical fin HLFC spray booth #1b	26,266
WBSP-11b	Vertical fin HLFC spray booth #2b	26,266
WBSP-11c	Vertical fin HLFC spray booth #3b	26,266
F-1	Combustion equipment for comfort or process heating not already identified above. This combustion equipment consists of multiple small units located throughout the wing component fabrication building.	388,271
Total	**All new process heaters**	**749513~~713717,398~~ 502 (~~~715~~ ~~720~~750,000)**

HLFC = hybrid laminar flow control

Total Emissions Increase for the Project

Based on the above analysis, the total emissions increase for existing emissions units is estimated to be approximately 132 tons per year:

= 777 Assembly (105 tons/yr) + Interiors (18.0 tons/yr) + EDC (5.1 tons/yr) + Propulsion (0.34 ton/yr) + Emergent Operations (2.04 tons/yr) + ESRC (0.43 ton/yr) + Boilers (0.30 ton per year)
= 132 tons/yr

Based on the above analysis, the potential emissions increase for new units is estimated to be approximately 288 tons per year:

= Wing Component Fabrication (235 tons/yr) + Interiors (33.8 tons/yr) + Wing Assembly (0.0 tons/yr) + Wing and Body Structures Seal/Paint (14.4 tons/yr) + Airplane Assembly (1.38 tons/ yr) + Process Heaters (2.72 tons/yr) + Generators (0.97 ton per year)
= 288 tons/yr

APPENDIX B

Estimate of Non-Significant PSD Pollutant Emissions Increases from the 777X Project

The purpose of this appendix is to demonstrate that, other than for volatile organic compounds (VOCs), the 777X Project will not result in a significant emission increase of any pollutant regulated by the Prevention of Significant Deterioration (PSD) program.

Table B-1 below lists the non-VOC PSD pollutants and identifies the operations, if any, at Boeing Everett that are expected to have emissions of those pollutants related to 777 production.

TABLE B-1. POLLUTANTS REGULATED BY PSD (OTHER THAN VOCS) AND THE OPERATIONS WITH EMISSIONS OF THOSE POLLUTANTS RELATED TO 777 PRODUCTION

Pollutants Regulated by PSD (Significant Emission Rate)	Operations Whose Emissions Might Increase as a Result of the 777 Project
Nitrogen Oxides (NOx) (40 tpy) Carbon Monoxide (CO) (100 tpy) Sulfur Oxides (SOx) (40 tpy) Particulate Matter (PM) (25 tpy) Particulate Matter Less Than 10 microns in Diameter (PM10) (15 tpy) Lead (0.6 tpy)	Boilers and other stationary fuel-burning equipment.
Ozone Depleting Substances (100 tpy)	Cleaning operations and other miscellaneous uses of ozone depleting substances
Fluorides (3 tpy) Sulfuric Acid Mist (7 tpy) Hydrogen Sulfide (H_2S) (10 tpy) Total Reduced Sulfur (including H_2S) (10 tpy) Reduced Sulfur Compounds (including H_2S) (10 tpy) Municipal Waste Combustor Organics (3.5×10^{-6} tpy) Municipal Waste Combustor Metals (15 tpy) Municipal Waste Combustor Acid Gases (40 tpy) Municipal Solid Waste Landfills Emissions (50 tpy)	There are no operations at Boeing Everett whose emissions of the listed pollutants might increase as a result of the 777 project.
Greenhouse Gases (75,000 tpy)	Boilers and other stationary fuel-burning equipment.

tpy = tons per year

Boilers and Other Fuel Burning Equipment

As discussed in Appendix A, the six natural-gas-fired industrial steam boilers provide steam for process and space heating in support of all twin-aisle airplane programs and interiors manufacturing operations at Boeing Everett. See Appendix A for a more detailed discussion on the boilers' operation and the assumptions used in the PSD determination calculations.

Table B-2 and Table B-3 show the applicable boiler emission factors on natural gas and distillate oil, respectively, taken from Section 1.3 and 1.4 in EPA's *AP-42: Compilation of Air Pollutant Emission Factors* (Fifth Edition) for each PSD pollutant, with the exception of the NOx emission factors shown for Boilers #4, 5, and 6 and the SO_2 emission factor for natural gas. Boilers #4, 5, and 6 were installed in the 1990s, are subject to 40 Code of Federal Regulations (CFR) Part 60 Subpart Db, and are equipped with low-NOx burners and flue gas recirculation. In addition, Boilers #4, 5, and 6 are subject to a PSD permit condition that limits the NOx emission rate to 0.05 lb/million British thermal units (MMBtu) on gas and 0.10 lb/MMBtu on distillate oil. Therefore, the NOx emission factors for Boilers #4, 5, and 6 are estimated at 0.05 lb/MMBtu on gas and 0.10 lb/MMBtu (or 14 lb/1,000 gal) on oil. Actual NOx emissions from Boilers #4, 5, and 6 as measured by their continuous emission monitor systems are consistently well below these limits. The SO_2 emission factor is based on 100 percent conversion of fuel sulfur to SO_2 and derived by multiplying the AP-42 SO_2 emission factor of 0.60 lb/million standard cubic feet (MMscf) by the ratio of site-specific sulfur content to sulfur content of 2,000 grains (gr)/MMscf assumed in AP-42. The site-specific sulfur content is based on the 2012 annual average sulfur content in natural gas of 0.61 gr per 100 scf as reported at the Williams Northwest Pipeline Sumas Compressor Station.

TABLE B-2. BOILER EMISSION FACTORS FOR NATURAL GAS

NOx (lb/MMBtu)	CO (lb/MMBtu)	PM, Total (lb/MMBtu)	SO_2 (lb/MMBtu)	Lead (lb/MMBtu)
0.137 (Boilers #1, 2, and 3) 0.05 (Boilers #4, 5, and 6)	0.08	0.0075	0.00654	4.9×10^{-7}

Note: With the exception of the NOx emission factor for Boilers #4, 5, and 6 and the SO_2 emission factor, all emission factors are taken from Table 1.4-1 and 1.4-2 of AP-42 and converted to units of lb/MMBtu.
SO_2 = sulfur dioxide

TABLE B-3. BOILER EMISSION FACTORS FOR DISTILLATE #2 FUEL OIL

NOx (lb/1,000 gal)	CO (lb/1,000 gal)	PM, Total (lb/1,000 gal)	$SO_2 + SO_3$ (lb/1,000 gal)	Lead (lb/1,000 gal)
19 (Boilers #1, 2, and 3) 14 (Boilers #4, 5, and 6)	5	3.3	147.7S, where S is wt. % sulfur in oil [a]	0.00126

Note: With the exception of the NOx emission factor for Boilers #4, 5, and 6, all emission factors are taken from Table 1.3-1, 1.3-2, and 1.3-10 of AP-42. The emission factor for lead in Table 1.3-10 has been converted to units of lb/1,000 gal.
[a] A PSD permit condition limits the sulfur content of the distillate oil burned in Boilers #4, 5, and 6 to 0.05% by weight. Since Boilers #1, 2, and 3 draw their oil from the same tank used by Boiler #4, they too burn oil with a sulfur content of 0.05% by weight or less. At 0.05% by weight sulfur, the SOx emission factor from fuel oil combustion is 147.7 x 0.05 = 7.39 lb/1,000 gal.
SO_3 = sulfur trioxide

Boilers #1, 2, and 3 are equipped with low-NOx burners. Therefore, the NOx emission factor of 140 lb/10^6 standard cubic feet (0.137 lb/MMBtu) is the applicable emission factor from Table 1.4-1 in AP-42 when these boilers are combusting gas. Consistent with Table 1.3-14 of

AP-42, the NOx emission factor of 24 lb/1,000 gal shown in Table 1.3-1 of AP-42 for No. 2 oil-fired boilers greater than 100 MMBtu/hr is reduced by 20 percent to account for the fact that Boilers #1, 2, and 3 are equipped with low-NOx burners.

The emission increase that will occur as a result of the 777X Project from the existing boilers and other stationary fuel-burning equipment is the difference between projected actual emissions and baseline actual emissions. For all new combustion emissions units, the emission increase will be estimated by calculating their potential emissions, with a baseline of zero.

As defined in 40 CFR 52.21(b)(48), baseline actual emission is the rate of emission in tons per year at which an emission unit actually emitted the pollutant during any consecutive 24-month period within the 10-year period immediately preceding actual construction of the project. Table B-4 shows the past 10 years of actual emissions from Boilers #1-6. For purposes of this emission estimate, the 24-month period is taken to be 2012 and 2013.

TABLE B-4. ACTUAL EMISSIONS BOILERS #1-6 FOR 2004 THROUGH 2012 (tons)

Year	CO	NOx	PM	SOx	Lead	CO_2e
2004	41.3	50.8	4.01	1.58	3.7E-04	60,556
2005	39.7	59.3	3.66	1.04	2.7E-04	57,163
2006	41.1	52.9	3.83	1.15	2.9E-04	59,442
2007	44.7	53.8	4.04	0.98	2.7E-04	63,950
2008	45.8	54.0	4.14	1.00	2.7E-04	65,543
2009	46.9	59.1	4.25	1.03	2.8E-04	67,176
2010	44.9	58.3	4.06	0.98	2.7E-04	64,241
2011	49.4	61.8	4.47	1.08	2.9E-04	70,784
2012	49.9	57.4	4.51	1.09	3.0E-04	71,367
2013	50.7	61.9	4.59	1.10	3.0E-04	72,553

CO_2e = carbon dioxide equivalent

Baseline emissions were highest in 2012/2013 for CO, PM, and CO_2e; however, SO_2, lead, and NOx had higher baseline emissions in years other than 2012/2013. For this analysis 2012/2013 was chosen as the baseline years for all pollutants. The 2012/2013 actual emissions from Boilers #1-6 were averaged to calculate the baseline actual emissions, as shown in Table B-5.

TABLE B-5. BASELINE ACTUAL EMISSIONS FROM BOILERS AND OTHER STATIONARY FUEL BURNING EQUIPMENT (tpy)

Year	CO	NOx	PM	SOx	Lead	CO_2e
2012/2013	50.3	59.6	4.55	1.10	3.0E-04	71,960

As defined in 40 CFR 52.21(b)(41), projected actual emissions means the maximum annual rate, in tons per year, at which the emission unit is projected to emit in any one of the 5 years following the date the emission unit resumes regular operations after the project (10 years if the project involves increasing the emission unit's design capacity or potential to emit and full utilization of the unit would result in a significant emission increase). Projected actual emissions exclude that portion of the emission unit's emissions following the project that the existing unit could have accommodated during the consecutive 24-month period used to establish the baseline actual emissions and that are unrelated to the project.

For the 777X Project, projected actual emissions from the boilers and other stationary fuel-burning equipment are taken to be the baseline actual emissions plus the emissions increase that results from producing additional 777s above the number produced in the baseline years of 2012 and 2013, once the Project is complete. Excluded from projected actual emissions from the boilers and other stationary fuel-burning equipment are emission increases that may result from any increased production (relative to the baseline years) associated with the other airplane models at Boeing Everett since those emissions are unrelated to the Project, and the boilers and other stationary fuel-burning equipment could have accommodated those emissions during the baseline years.

Attachment A contains a chart showing Boeing Everett's natural gas consumption, measured in MMBtu, and the number of airplane deliveries for the years 1998 through 2004. The chart displays two sets of data points with a "best fit" line drawn through each set. The upper set of data points is the natural gas consumption versus airplanes delivered when both the Building 40-12 (i.e., Boilers #1-4) and Building 45-07 (i.e., Boilers #5 and 6) boiler plants were operating. The lower set of data points is natural gas consumption versus airplanes delivered when only the Building 40-12 boiler plant was operating. (The data were split into two sets since, as the chart shows, the baseline natural gas consumption for the site [i.e., the natural gas consumption for the site regardless of the number of airplanes delivered] is lower when only the Building 40-12 boiler plant is operating.) The "best fit" line through each set of data points was determined using linear regression. The slopes of these lines (3,206 MMBtu/airplane for the upper line, 3,101 MMBtu/airplane for the lower curve) provide an estimate of the natural gas consumed per additional airplane delivered.

During the baseline years of 2012 and 2013, 182 777s were produced at Boeing Everett, or an average of 91 per year. A total of 125 777s per year is projected to be produced once the 777X Project is complete. Using the highest natural gas usage factor (3,206 MMBtu/airplane) shown in the chart in order to maintain conservatism, the additional natural gas that is estimated to be consumed annually at Boeing Everett as a result of the 777 Project is:

= (125 – 91) x 3,206 MMBtu/airplane
= 109,004 MMBtu/yr

Assuming this natural gas is distributed between Boilers #1-3 and Boilers #4-6 in the same approximate percentages as occurred in years past (i.e., 70 percent to Boilers #1-3 and 30 percent to Boilers #4-6), then the projected actual NOx emissions from natural gas combustion in the boilers and other stationary fuel-burning equipment as a result of the 777X Project are:

= (109,004 MMBtu/yr) x [(0.7) x (0.137 lb NOx/MMBtu) + (0.3) x (0.05 lb NOx/MMBtu)]/2,000 lb/ton
= 6.04 tons NOx/yr

As mentioned above, distillate oil #2 is only burned in the boilers when natural gas is curtailed or for test purposes. Therefore, the amount of fuel oil burned in the boilers annually is primarily dependent on the length of the curtailment (if any), not on airplane production rate.

In order to provide a conservative estimate of the projected actual NOx emissions increase from the boilers and other stationary fuel-burning equipment as a result of the 777X Project, it is assumed that a curtailment period lasting 9 manufacturing days (the highest number of days that natural gas was curtailed to the Everett site in any of the past 15 years) will occur. The same consumption factor derived for natural gas (3,206 MMBtu/airplane) is used for fuel oil. The estimate assumes distillate #2 fuel oil contains 140 MMBtu/1,000 gal (Figure 27.3 on page 27-10 of *Perry's Chemical Engineers' Handbook*[4]).

Distillate fuel used during curtailment period is:

= (9 days curtail) x (0.5 777s /day) x (3,206 MMBtu/airplane) / (140 MMBtu/1,000 gal)
= 103,000 gal/yr

Again assuming this distillate fuel is distributed between Boilers #1, 2, and 3 and Boilers #4 and 6 in the same approximate percentages as occurred in past years for natural gas, then the projected actual NOx emissions from distillate fuel combustion in the boilers as a result of the 777X Project are:

= (103,000 gal/yr) x [(0.7) x (19 lb NOx/1,000 gal) + (0.3) x (14 lb NOx/1,000 gal)] / 2,000 lb/ton
= 0.902 ton NOx/yr

Total projected actual NOx emissions from the boilers and other stationary fuel-burning equipment related to the 777X Project is therefore 59.6 + (6.04 + 0.902) = 66.5 tpy. Projected actual emission estimates for the other pollutants identified in Tables B-4 and B-5 from the boilers and other stationary fuel-burning equipment were calculated in a similar manner and are shown in Table B-6. Table B-7 shows the emissions increase of each pollutant (i.e., the difference between projected actual emissions in Table B-6 and baseline actual emissions in Table B-5). The emission increases for all the pollutants are below their respective PSD significance rates.

TABLE B-6. PROJECTED ACTUAL EMISSIONS FROM BOILERS AND OTHER STATIONARY FUEL-BURNING EQUIPMENT RELATED TO THE 777X PROJECT (tpy)

CO	NOx	PM	SOx	Lead	CO_2e
54.9	66.6	5.1	1.8	0.0004	79,500

TABLE B-7. EMISSION INCREASES FROM BOILERS AND OTHER STATIONARY FUEL-BURNING EQUIPMENT AS A RESULT OF THE 777X PROJECT (tpy)

CO	NOx	PM	SOx	Lead	CO_2e
4.62	6.95	0.58	0.70	0.00009	7,500

Details of these calculations are shown in Table B-8. The emissions from the new natural gas fired combustion units were based on the emission factors in Table B-9 and a proposed limit of 1,000,000 MMBtu/yr. Detailed calculations of the emissions from the proposed emergency generators are shown in Table B-10.

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Ozone Depleting Substances (ODS)

ODS are found in a handful of chemical products onsite, but by far the greatest use of ODS is 1,1,2-trichloro-1,2,2-trifluoroethane as a cleaning solvent. Based on 2004 hazardous materials use records, 0.09 ton of ODS per airplane was used. It is assumed that all the ODS used are emitted to the atmosphere.

The emission increase that will occur as a result of the 777X Project is the difference between projected actual emissions and baseline actual emissions. During the baseline years of 2012 and 2013, a total of 182 777s were produced at Boeing Everett, or an average of 91 per year. The estimated emission increase of ODS that will occur as a result of the 777X Project is:

= (125 – 91) x 0.09 ton ODS/airplane
= 3.06 tons ODS/yr

This is less than the 100 tons/yr significant emission rate for ODS.

Table B-8

Combustion Emission Calculations for VOC PSD Determination

	Factors											
Total Gas Used in Baseline Period:			2.44E+06	MMBtu/ 2-yr		1.22E+06	MMBtu/yr					
Gas Used in Boilers 1-3 in Baseline Period:			1.70E+06	MMBtu/ 2-yr		8.50E+05	MMBtu/yr					
Gas Used in Boilers 4-6 in Baseline Period:			7.40E+05	MMBtu/ 2-yr		3.70E+05	MMBtu/yr					
Total Oil Used in Baseline Period:			1544	Gal/2-yr		0.772	1000 Gal/y	140	MMBtu/1000 gal		108.08	MMBtu/yr
	Baseline Years:	2012 - 2013	ıonth Avg Production:		91	airplanes/yr						
	Pollutant of Concern:	VOC										
Baseline												
			CO	NOx 1-3	NOx 4-6	NOx Total	PM	SO2	Lead	VOC	CO2e	
Gas	Emission Factor	lb/MMBtu	0.08	0.137	0.05		0.0075	0.00059	4.90E-07	0.00539	117.004	
	Emissions	Ton/yr	48.80	58.23	3.80	62.03	4.58	0.36	0.0003	3.29	71,372	
Oil	Emission Factor	lb/1000 gal (lb/MMBtu of GHG)	5	19	14		3.3	7.385	0.00126	0.2	163.5916	
	Emissions	Ton/yr	0.00	0.01	0.01	0.01	0.00	0.00	0.0000	0.00	8.84	
	Total Baseline	Tons/yr	50.27			59.64	4.55	1.10	0.0003	3.29	71,960	
			Gas increase:			Oil increase:				Fraction of fuel burned in Boilers 1-3:	Fraction of fuel burned in Boilers 4-6:	
			3,206	MMBtu/plane		9	day/yr on oil			0.7	0.3	
			34	plane/yr		0.5	plane/day					
			109,004	MMBtu/yr		14,427	MMBtu/yr		Gas:	76,302.80	32,701	
						103.05	1000 gal/yr		Oil:	72.14	30.92	
			CO	NOx 1-3	NOx 4-6	NOx Total	PM	SO2	Lead	VOC	CO2e	
Gas	Emission Factor	lb/MMBtu	0.08	0.137	0.05		0.0075	0.00059	4.90E-07	0.00539	117.004	
	Emissions	Ton/yr	4.36	5.23	0.82	6.04	0.41	0.03	0.00003	0.294	6,377	
Oil	Emission Factor	lb/1000 gal (lb/MMBtu of GHG)	5	19	14		3.3	7.385	0.00126	0.2	163.5916	
	Emissions	Ton/yr	0.26	0.69	0.22	0.902	0.17	0.38	0.00006	0.010	1,180.07	
	Total Increase	Tons/yr	4.62	5.91	1.03	6.95	0.58	0.41	0.00009	0.304	7,557	

Table B-9. NSR Pollutants and Combustion Emissions from Natural Gas Combustion

Pollutant	Emission Factor (lb/MMBtu)	Annual Emissions-1,000,000 MMBtu/yr (tpy)
CO @ 50 ppm	0.04	20
NO_x (low NOx)	0.012	6
SO_2	0.001	0.5
PM	0.008	4
PM_{10}	0.008	4
$PM_{2.5}$	0.008	4
VOC	0.0054	2.7
Ozone	NA	-
Lead	NA	-
Fluorides	NA	-
Sulfuric Acid Mist	NA	-
H_2S	NA	-
Total Reduced Sulfur	NA	-
Reduced Sulfur Compounds	NA	-
Ozone-Depleting Substances	NA	-
Greenhouse Gases	118.8	59,411

Table B-10. Diesel Engine Emissions

					CO	NOx[a]	VOC[a]	PM	SO2[b, c]	CO2e[b]
EPA Tier 2 Standards				g/kW-hr	3.5	6.08	0.32	0.2		
				lb/hp-hr					0.0004045	1.16
kW	BHP	Eng. kW	No. Eng.	Hr/eng.	Annual Emissions (tpy)					
2,750	3,965	2,957	9	100	10.24	17.80	0.94	0.59	0.54	1,543
750	1,094	816	1	100	0.31	0.55	0.03	0.02	0.02	0.10
				Total	**10.56**	**18.34**	**0.97**	**0.60**	**0.55**	**1,544**

[a] The EPA's Tier 2 NOx + NMHC emission factor was apportioned to NOx and VOC by a ratio of 0.95 and 0.05, respectively, according to "The Carl Moyer Program Guidelines - Approved Revisions 2011", released March 27, 2013, California Environmental Protection Agency - Air Resources Board, Table D-25: Pollutant Fractions NOx+NMHC Standards.
[b] AP-42 Table 3-4.1.
[c] Assume 500 ppm sulfur.

ATTACHMENT A