

**Technical Supplement Document**  
**for**  
**PSD 91-6 AMENDMENT 2**  
**BOEING COMMERCIAL AIRPLANE GROUP**  
**EVERETT DIVISION PLANT**  
*Date*

## **1. Introduction**

### ***1.1 The PSD Process***

The Prevention of Significant Deterioration (PSD) procedure is established in Title 40, Code of the Federal Regulations, Part 52.21. Ecology implements those rules under WAC 173-400-711. The rules require PSD review of all new or modified air pollution sources that meet certain criteria. The objective of the PSD program is to "prevent significant deterioration" due to emissions of PSD-regulated air pollutants by a new or modified source. The program limits deterioration of air quality to a specified increment of the National Ambient Air Quality Standard for some pollutants. It also sets up a mechanism for evaluating the effect that the proposed emissions might have on visibility, soils, and vegetation in protected Areas.

### ***1.2 The Boeing, Everett 777 Facility***

Boeing Commercial Airplane Group (Boeing) manufactures Model 747, 767, and 777 aircraft at the Everett Division Plant. The Model 777 production operations (not including paint hanger and interior operations) are currently subject to volatile organic compound (VOC) emission limits in three separate PSD permits that total 238.8 tons per year.

### ***1.3 Everett 777 PSD History***

In 1991, Boeing proposed to modify this plant by expanding to build Model 777 aircraft. Ecology issued several PSD permits to cover this expansion:

**PSD 91-01** was issued in May 1991 for the construction of Building 45-04. This building is the 777 paint hangar. Two amendments to this permit have been issued. The first amendment allowed expansion of painting operations. The second amendment allowed use of Aerospace NESHAP painting techniques described in the National Emissions Standards for Hazardous Air Pollutants (NESHAPs) for Aerospace Manufacturing and Rework Facilities (40 CFR 63 Subpart GG).

**PSD 91-03** was issued for construction of Building 40-37. The primary purpose for this building is the cleaning, sealing, testing, and painting 777 wings and body sections. There have been no amendments to this permit.

**PSD 91-05** was issued for the construction of Buildings 40-25 and 40-26. These buildings accommodate the Corrosion Inhibitor Compound Emissions Exhaust Systems for Model 777 Aircraft. Two amendments to this permit have been issued. The first amendment allowed use of air-assisted spray guns as well as the airless type specified in the original PSD Approval. The second amendment incorporated more flexible limitations on coverage, film thickness, and VOC content, and allowed VOC emission factor calculation using coating density, theoretical coverage, and volatile content. No increase in allowable VOC emissions was requested by Boeing or allowed by Ecology in the amendment.

**PSD 91-06** was issued for 777 cleaning, sealing, and spray coating facilities in Buildings 40-04, 40-25, 40-26, and 40-34. The original permit was amended to allow a more flexible range of solvent cleaners and application technique, but with greater restriction on the solvents' volatility.

**PSD 92-05** was issued for the installation of three 150-MM Btu/hr steam boilers. This approval was amended to ease restrictions on use of backup oil fuel and to extend the averaging times of some of the NO<sub>x</sub> limits.

## 2. This Amendment

In order to reduce costs of Model 777 production at the Everett facility, Boeing plans to reorganize the production process in a manner consistent with "Lean Manufacturing."<sup>1</sup> This reorganization will involve consolidation of activities permitted separately under PSD 91-03, PSD 91-05, and PSD 91-06. In addition to amending approval conditions directly related to the "Lean Manufacturing" transition, Boeing requested deletion of approval conditions that are no longer relevant or are duplicative. Finally, Boeing requested corrections to past potential oversights the approval conditions in PSD 91-03, PSD 91-05, and PSD 91-06 and incorporation of exemptions allowed under 40 CFR 63 Part GG. These changes will be implemented via this proposed second amendment to PSD 91-06. PSDs 91-03 and 91-05 will be rescinded when this proposed amendment is finalized. Details of the requested changes are shown in the table, below:

<b>Changes incorporated in this amendment</b>	
<b>Boeing's intended action or requested change in the permit</b>	<b>Explanation</b>
Consolidation of these permits will allow Boeing to reorganize subject activities in the assembly operation of the Model 777.	<p>The separately designated work areas in Buildings 40-04, 40-25, 40-26, 40-34, and 40-37, are actually work stations housed in a single structure at Boeing-Everett.</p> <p>Reorganization of the assembly line to accommodate modernized production techniques ("Lean Manufacturing") for Model 777 assembly requires relocating, reorganizing, and consolidating these work stations within the Everett facility.</p> <p>This permit allows the relocation and</p>

<sup>1</sup> The Production System Design Laboratory (PSD), Massachusetts Institute of Technology (MIT) <http://lean2.mit.edu/> states that "Lean production is aimed at the elimination of waste in every area of production including customer relations, product design, supplier networks and factory management. Its goal is to incorporate less human effort, less inventory, less time to develop products, and less space to become highly responsive to customer demand while producing top quality products in the most efficient and economical manner possible."

Principles of Lean Enterprise:

- Zero waiting time
- Zero Inventory
- Scheduling -- internal customer pull instead of push system
- Batch to Flow -- cut batch sizes
- Line Balancing
- Cut actual process times.

<b>Changes incorporated in this amendment</b>	
<b>Boeing's intended action or requested change in the permit</b>	<b>Explanation</b>
	consolidation of the 777 work stations anywhere within the Boeing-Everett facility as long as emissions from spray coating at the Wing Spar, Wing Panel, and Wing Body Join tool positions continue to be vented through dedicated exhaust systems.
Boeing will replace limited existing equipment and will modify limited existing processes and equipment.	Boeing demonstrated that these changes do not trigger PSD review as a major modification because the combined potential VOC emissions increase is less than the significance threshold of 40 tpy.
Boeing requested that certain assembly processes with minor emissions that were not included in any of the three PSD permits be included in the single, consolidated PSD permit.	These processes include solvent wipe cleaning, sealing, and touchup coating for the empennage and body section assembly. Emissions from these processes are estimated cumulatively to be less than 5 tpy of VOC and do not cause the facility to exceed the VOC emissions allowed in the original permits
Boeing requested deletion of defunct/satisfied approval conditions or approval conditions that duplicate existing, federally enforceable Puget Sound Clean Air Agency regulations.	1. PSD 91-03, Approval Condition 7 limited Boeing to pressure testing no more than two wings in any continuous 24-hour period. Since Boeing will use only non-pollutant gas (air, nitrogen, inert gas, or carbon dioxide) for 777 models in the future, this restriction is no longer necessary.  Approval Condition 2 in this amendment limits Boeing to using only non-pollutant gasses in wing pressure testing, but does not limit the number of Model 777 wing pressure tests that may be performed in any time period.
	2. PSD 91-03, Approval Condition 8, PSD 91-05 Amendment 2, Approval Condition 5, and PSD 91-06 Amendment 1, Approval Condition 8 required Boeing to obtain and maintain VOC offset reductions totaling 263 tons per year (TPY).  In the December 4, 1992 Ecology letter from Joseph R. Williams (Ecology Air Quality Program Manager) to Kirk J. Thomson (Boeing Director of

**Changes incorporated in this amendment**

<b>Boeing's intended action or requested change in the permit</b>	<b>Explanation</b>
	<p>Environmental Affairs), Ecology agreed that 140 TPY of the VOC offset requirement had been permanently satisfied. In the February 6, 1995 letter from David Kircher (Puget Sound Clean Air Agency Engineering Manager) to Kirk J. Thomson, Puget Sound Clean Air Agency acknowledged Boeing's satisfaction of the remaining VOC offset requirement in the form of emission reduction credits. Consequently, the relevant approval conditions have been permanently satisfied, and are deleted from this amendment.</p> <p>3. PSD 91-03, Approval Condition 9 and PSD 91-05 Amendment 2, Approval Condition 7 require that the operations relevant to those permits comply with Regulation II of the Puget Sound Clean Air Agency.</p> <p>Regulation II prescribes the maximum VOC content allowed in coatings used in any aerospace equipment manufacturing in Puget Sound Clean Air Agency's jurisdiction. The regulation is fully federally enforceable. Its inclusion as an approval condition in a PSD permit is redundant, and adds nothing to the stringency or enforceability of the requirement. It is deleted in this amendment.</p> <p>4. PSD 91-03, Approval Condition 10, PSD 91-05 Amendment 2, Approval Condition 8, and PSD 91-06 Amendment 1, Approval Condition 11 required that construction of the respective operations be commenced within eighteen (18) months of issuance of the permit.</p> <p>The facilities are already constructed. This amendment consolidates the existing permits. Consequently, those approval conditions are satisfied, and are deleted from this amendment.</p>
Boeing requested that approval conditions	The "most stringent" spray gun cleaning

<b>Changes incorporated in this amendment</b>	
<b>Boeing's intended action or requested change in the permit</b>	<b>Explanation</b>
related to spray gun cleaning be corrected.	<p>approval condition from the three original permits is technically infeasible. Namely, it required "prevent(ion) of all emissions of VOC" (PSD 91-06, Amendment 1, Approval Condition 7).</p> <p>Feasible spray gun cleaning methods that EPA deemed to be "maximum achievable control techniques" have been extracted from 40 CFR 63 Part GG and substituted for the original, technically infeasible approval condition.</p>
Boeing requested that certain minor and/or occasional surface cleaning and touch-up operations be exempted from operational limits on general surface cleaning and coating.	<p>The following activities have de minimis VOC emissions due to the extent or infrequency of their occurrence (estimated to be less than one gallon of solvent loss per year):</p> <ul style="list-style-type: none"> <li>• Cleaning and surface activation by hand wiping prior to adhesive bonding.</li> <li>• Cleaning solvent usage associated with research and development, quality control, and laboratory testing.</li> </ul>

## **Best Available Control Technology**

### ***2.1 Definition***

Best available control technology (BACT) is defined as an emission limitation based on the most stringent level of emission control available or applied at an identical or similar source. Boeing must achieve this level of control or prove it is technically or economically infeasible before a less stringent level of control is allowed.

### ***2.2 BACT for VOC Emissions from Cleaning and Painting Operations***

PSD 91-03: Ecology determined best available control technology (BACT) for cleaning, sealing, testing, and painting 777 wings and body sections and pressure testing fuel cells to be

- Surface coating efficiency of 60 percent or greater except for application of corrosion inhibiting compound (CIC) in the lower lobe of the aircraft body sections.
- Capture and recovery of paint gun cleaning solvents by methods approved by the Puget Sound Air Pollution Control Agency (now Puget Sound Clean Air Agency).
- Depositing spent, solvent-filled cleaning rags in containers that contain and capture VOCs and are approved by the Puget Sound Air Pollution Control Agency.
- Bulk application of solvent by low pressure hose for cleaning intricate surfaces or where access is limited..

PSD 91-05: Ecology determined BACT for applying CICs at the Final Body Join<sup>2</sup> and Final Assembly<sup>3</sup> tool positions to be

- Application of CICs using air-assisted and airless spray guns and near-surface technique.
- Capture and recovery of CIC spray paint gun, wand, and hose cleaning solvents by methods approved by the Puget Sound Air Pollution Control Agency
- VOC content of the CICs no greater than and coverage no less than Dinitol AV 8 and Dinitrol AV 30<sup>4</sup>. This was modified in the second amendment to PSD 91-05 to be
  - CIC coatings must be qualified under Boeing Material Specifications (BMS)
    - BMS 3-23: A maximum calculated VOC emission factor of 0.012 kilogram per square meter (kg/m<sup>2</sup>) of surface area covered,
    - BMS 3-29: A maximum calculated VOC emission factor of 0.023 kg/m<sup>2</sup> of surface area covered, or
    - BMS 3-35: A maximum calculated VOC emission factor of 0.016 kg/m<sup>2</sup> of surface area covered.
- The VOC emissions factor is calculated from the coatings density, theoretical coverage, and VOC content.

PSD 91-06: Ecology determined BACT for cleaning and applying coatings to the interior and exterior surfaces and structural components of the wings and sealing fuel cells at the Wing Spar, Wing Panel, Wing Major, and Wing Body Join tool positions to be

- High volume low pressure (HVLP) surface coating;
- Cleaning operations at the Wing Panel and the Wing Spar tool positions conducted by either
  - Flush cleaning using a semi-aqueous solution containing a minimum of 60 percent by weight water and having a VOC composite vapor pressure no greater than 5 millimeters of mercury (mm Hg) at 20 degrees Celsius (°C), or
  - Hand wiping using a solvent with a VOC composite vapor pressure no greater than 45 mm Hg at 20 °C.
- For surface cleaning by hand wiping at the Wing Majors and Wing Body Join tool positions:
  - Solvents having no greater VOC composite vapor pressure than 45 mm Hg at 20 °C except for solvent used for hand wiping inside fuel tanks and fuel cells.
  - Solvents having no greater VOC composite vapor pressure than 72 mm Hg at 20 °C for hand wiping inside fuel tanks and fuel cells.
- Recovery of spray paint gun, wand, and hose cleaning solvents at stations that "prevent all emissions of VOC," and are approved by the Puget Sound Air Pollution Control Agency.
- Depositing spent, solvent-filled cleaning rags in containers that control VOCs and are approved by the Puget Sound Air Pollution Control Agency.
- Chromium VI<sup>5</sup> removal effectiveness of 98.9 or greater percent via a filtering system for the emission exhaust from the clean, seal and paint processes at the Wing Panel, Wing Spar, Wing Body Join, and mid-section seal and paint tool positions.

### **3. PSD 91-06 Amendment 2**

---

<sup>2</sup> CICs applied above and below the passenger deck.

<sup>3</sup> CICs applied to the aft pressure bulkhead, cargo bays, and wheel well pockets.

<sup>4</sup> Generically specified in the permit as CICs qualified under Boeing Material Specification 3-23, -29, or -35.

<sup>5</sup> Cr VI is a component of the primers used in Boeing's aircraft coatings required to inhibit corrosion.

With the exception of substitution of specific approved spray gun cleaning methods for an infeasible requirement in PSD 91-06 and introduction of exemptions from permit approval conditions for minor surface cleaning operations, nothing in this proposed amendment triggers BACT analysis.

BACT cost effectiveness estimates performed in development of PSDs 91-03, 91-05, and 91-06 indicated that application of control equipment<sup>6</sup> to control VOCs from the related processes would cost between \$17,000 and \$120,000 per ton of VOC reduction. These analyses were made assuming 95% VOC reduction from the 238 tons per year potential-to-emit from the Model 777 coating operation. The addition of the maximum of five tons per year of VOCs by inclusion of the minor processes<sup>7</sup> that were overlooked in the original permitting action would not appreciably change these BACT cost effectiveness analyses. Ecology concluded these to be excessively high costs for a BACT determination, and Ecology retains that conclusion. Consequently, Ecology concludes that the **BACT determinations from the original permitting actions, summarized in §2.2, above, remain valid** with the following exceptions and additions.

**Touch-up and repair coating** is defined in 40 CFR 63 Subpart GG as that portion of the coating operation that is the incidental application of coating used to cover minor imperfections in the coating finish or to achieve complete coverage, and includes out-of-sequence or out-of-cycle coating. Due to its intermittent character, infrequency, and the unpredictability of what may need touch-up and repair, it is infeasible to attempt to impose or predict any particular transfer efficiency. The same is true of other **minor operations such as stenciling, lettering, and applying other identification marking**, and in **coating surfaces that are peculiarly difficult to access**. On occasion, the only practical method for applying coating material is by a hand-held aerosol can. Transfer efficiency of aerosol can applied coatings is unpredictable. Ecology concludes that **BACT for these operations is good operating practice performed by properly trained personnel**, and exempts them from operational limits placed on general surface cleaning and coating.

Ecology believes that recovery of spray-paint gun cleaning solvents at stations that " prevent all emissions of VOC " is scientifically infeasible if interpreted literally. Ecology is correcting this BACT determination in this amendment. Ecology reviewed the EPA's RACT, BACT, LAER Clearinghouse or in the EPA's analysis leading to the Aerospace NESHAP in search of feasible controls for controlling VOC emissions from spray-paint gun cleaning. Ecology found nothing indicating that surface coating operations similar to that taking place at Boeing-Everett have been required to use more rigorous VOC emissions control for spray-paint gun cleaning than the options listed in the Aerospace NESHAP. Ecology estimates that Boeing-Everett's potential-to-emit VOCs from spray gun cleaning following the techniques listed as BACT, below, is less than 300 pounds per year. Ecology believes that it is intuitively obvious that any physical or mechanical control technology<sup>8</sup>, although technically feasible, would be economically unjustifiable due to the small amount of VOC reduction that could be achieved. EPA guidance<sup>9</sup>

---

<sup>6</sup> Such as direct collection of the air in the vicinity of the coating operation, concentration over activated carbon beds, and thermal destruction.

<sup>7</sup> Solvent wipe cleaning, sealing, and touchup coating for the empennage and body section assembly.

<sup>8</sup> Such as direct collection of the air in the vicinity of the touch-up or spray gun cleaning operation, concentration over activated carbon beds, and thermal destruction.

<sup>9</sup> EPA Environmental Appeals Board Order Granting Review in Part and Denying Review in Part" for PSD appeal Nos. 99-4 and 99-5

allows Ecology to forego a BACT cost effectiveness in eliminating control technologies from consideration where "the cost of employing a particular technology [is] obviously excessive in relation to the removal efficiency of the technology." Consequently, Ecology concludes that the following spray paint gun cleaning methods listed in the Aerospace NESHAP are equivalent alternatives as **BACT for spray paint gun cleaning in aircraft surface coating**:

- Enclosed system: Clean the spray gun in an enclosed system that is closed at all times except when inserting or removing the spray gun. Cleaning shall consist of forcing solvent through the gun.
- Nonatomized cleaning: Clean the spray gun by placing cleaning solvent in the pressure pot and forcing it through the gun with the atomizing cap in place. No atomizing air is to be used. Direct the cleaning solvent from the spray gun into a vat, drum, or other waste container that is closed when not in use.
- Disassembled spray gun cleaning: Disassemble the spray gun and clean the components by hand in a vat, which shall remain closed at all times except when in use. Alternatively, soak the components in a vat, which shall remain closed during the soaking period and when not inserting or removing components.
- Atomized cleaning: Clean the spray gun by forcing the cleaning solvent through the gun and direct the resulting atomized spray into a waste container that is fitted with a device designed to capture the atomized cleaning solvent emissions.
- Nozzle tips on automated and robotic systems shall be programmed to spray into a closed, container where that is an element of their designed capability.
- Cleaning of the nozzle tips of automated spray equipment systems that are not designed to spray into a closed container: Good operating practice performed by properly trained personnel.
- Use of cleaning solvents containing VOC at concentrations less than 1.0 percent by weight and hazardous air pollutants<sup>10</sup> (HAPs) at concentrations less than .1 percent by weight for carcinogens or 1.0 percent by weight for noncarcinogens: Good operating practice performed by properly trained personnel.

Surfaces being activated prior to application of adhesive bonding must be completely clean of solvent residue. The primary solvent used for this purpose is methyl ethyl ketone (which has a vapor pressure less than 72 mm Hg). However, for some aircraft surfaces, a more volatile solvent (i.e., one having a vapor pressure greater than 72 mm Hg) may be needed to obtain an adequate level of dryness prior to application of the bonding material. Cleaning solvent usage associated with research, development, quality control, and laboratory testing is incidental activity requiring flexibility in solvent types. In developing the Aerospace NESHAP requirements, the USEPA exempted cleaning and surface activation prior to adhesive bonding and cleaning solvent usage associated with research, development, quality control, and laboratory testing from solvent volatility limits in 40 CFR 63 Subpart GG.

These surface cleaning processes proposed as exemptions from operational limits on general surface cleaning and coating are expected to emit less than a gallon per year of VOCs. For these

---

<sup>10</sup> Hazardous air pollutants are those chemicals listed in 42 USC 7412(b)(1) and incorporating subsequent revisions made in accordance with 42 USC 7412(b)(2).

reasons, Ecology concludes that

- BACT for cleaning and surface activation prior to adhesive bonding and cleaning solvent usage associated with research, development, quality control, and laboratory testing is good operating practice performed by properly trained personnel.

#### **4. Change in Actual Emissions**

Boeing estimates there will be no increase in actual emissions per airplane as a result of this permit action. Boeing believes the improvements resulting from implementation of the Lean Manufacturing concepts will decrease labor input per plane, rework, and work-in-process inventory. However, throughput capacity for the Model 777 will not be increased.

#### **5. Change in Potential-to-Emit or Allowable Emissions**

Allowable emissions consolidated from PSD 91-03, 91-05, and 91-06 are unchanged in total by this permit amendment action.

#### **6. Ambient Air Quality Analysis and Impacts on Air Quality Related Values**

VOC emissions participate in ozone (smog) formation and can impact visibility in Class I areas. However, the proposed amendment does not involve any increase in allowable VOC emissions. Consequently, there is no impact on ambient air quality or air quality related values resulting from this permit action. On April 8, 2005, the USEPA, Region X, informed Ecology that PSD 91-06 Amendment 2 authorizing the rearrangement of partitions and coating stations at Boeing-Everett will not require Endangered Species Act review<sup>11</sup>.

#### **7. Conclusion**

The project will use BACT for all pollutant-emitting processes and have no significant adverse impact on air quality or air quality related values. The Washington State Department of Ecology finds that the applicant, Boeing-Everett, has satisfied all requirements for approval of the PSD permit amendment.

---

<sup>11</sup> Electronic mail from Dan Meyer, EPA Region X, to Bernard Brady, Ecology (April 8, 2005)