EPA United States Environmental Protection Agency New England

One Congress Street, Suite 1100
Boston, MA 02203

STATEMENT OF BASIS

General Electric Aviation
1000 Western Avenue
Lynn, MA 01910

Test Cells 2 and 5 Modification

EPA Draft Permit Number
048-119-MA09

Acronyms and Abbreviations

BACT	Best Available Control Technology
BTU	British thermal unit
CAA	Clean Air Act
CEM	Continuous Emission Monitor
CFR	Code of Federal Regulations
CPA	Comprehensive Plan Approval
DEP	Massachusetts Department of Environmental Protection
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FWS	US Fish and Wildlife Service
MM	million
NAAQS	National Ambient Air Quality Standards
NSR	New Source Review
ppm	parts per million
PSD	Prevention of Significant Deterioration
SCR	Selective Catalytic Reduction
tpy	tons per year

I GENERAL INFORMATION

Name of Source:	General Electric Aviation
Location:	GE Aviation Facility, Lynn, Massachusetts
Applicant's Name and Address:	GE Aviation 1000 Western Avenue Lynn, MA 01910
Application Prepared By:	CH2M HILL, Inc. 25 New Chardon Street, Suite 300 Boston, MA 02114
Draft PSD Permit Number:	048-119-MA09
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On September 7, 2007, General Electric Aviation (GE) filed a Prevention of Significant Deterioration (PSD) permit application with the Environmental Protection Agency (EPA) New England. A copy of the application is attached. GE proposes to modify two engine test cells located at GE's facility in Lynn, Massachusetts. The proposed changes are intended to accommodate the performance testing requirements of an engine development project at the GE's Lynn facility.

EPA proposes to approve GE's application and to issue a PSD permit for the proposed changes to the engine test cells. This document serves as the statement of basis (SOB) as required by 40 CFR part 124-Procedures for Decisionmaking and explains the legal and factual basis for EPA's approval.

Please note that this project is also subject to the Massachusetts Department of Environmental Protection's (DEP) Comprehensive Plan Approval (CPA) requirements under the state regulations at 310 Code of Massachusetts Regulations (CMR) 7.02. The DEP intends to issue a CPA that regulates all pollutants affected by the proposed project including the pollutants regulated under the PSD permit. In addition, the project subject to the DEP's nonattainment New Source Review (NSR) program regulations at 310 CMR 7.00: Appendix A. GE must comply with both the federal PSD permit and the DEP's CPA and NSR permits. However, EPA has worked closely with the DEP to ensure this

PSD permit does not conflict with the DEP's CPA or NSR permit requirements.

II. Project Location

The GE facility is located in Lynn, MA. EPA has designated the eastern portion of Massachusetts including Lynn, MA as attainment/unclassified for the following national ambient air quality standards (NAAQS): nitrogen oxide (NO_2), sulfur dioxide (SO_2), carbon monoxide (CO), particulate matter – 2.5 microns ($PM_{2.5}$) and lead. EPA has also designated eastern Massachusetts as a moderate non-attainment area under the 8-hour ground level ozone NAAQS.

III. Facility Description

The GE Aviation Facility occupies 3.4 million square feet of buildings on 221 acres in Lynn, MA. In addition to the various engine manufacturing and testing operations, the site includes a 56.8 MW power plant employing four boilers and one combustion turbine that generates electricity and steam for onsite uses and a variety of other small heaters and emergency/stand-by generators that provide heat or back-up power.

GE has manufactured and tested engines at the Lynn facility since the 1940s. The facility currently manufactures, assembles, tests, and ships aircraft engines and engine parts offsite to customers. GE also conducts engine testing for research and development (R&D). In addition, Navy gears are manufactured and tested onsite. The Lynn facility is an existing major stationary source for NO_2, SO_2, volatile organic compounds (VOCs), CO, and $PM_{2.5}$. Section 2 of the application provides a detailed description of GE's Lynn facility.

IV. Proposed Project

The facility currently has a total of 17 permitted test cells (including Test Cells 2 and 5) available for various modes of operation for engine and engine component development, as well as for production testing. An engine test cell is a structural enclosure that includes an engine mounting frame that is connected to various engine testing and operating systems. The test cell allows engineers to remotely operate and test an engine's performance under a range of operational flight condition from a nearby control room.

GE's application noted that it was recently awarded a major, multi-year contract by Sikorsky Inc. to provide engines for the new CH53K, the U.S. Marine Corps Heavy Lift Replacement Helicopter. The GE38-1B engine, a 8000 shaft horsepower ("shp") turbo-shaft/turboprop (TS/TP) engine, is slated to power the CH53K. To accommodate the testing requirements for this contract, GE is proposing to enlarge and/or upgrade numerous components of Test Cells 2 and 5. The two test cells were originally constructed in the mid 1950s and have seen minimal use in the last 10 years. GE's

proposed test cell modification project is principally intended to support the GE38–1B development and testing program. Section 2 of GE's application contains a detailed description of the proposed test cell project.

V. Current Permits

To reflect the numerous changes that have occurred at the test cells over the life of the facility, on June 24, 1998, the DEP issued a 310 CMR 7.02 Major Comprehensive Plan Approval (CPA), (approval number MBR-93-COM-021) that applies to seventeen operational test cells at the facility. Among other requirements, the CPA caps the combined NO_x emissions from all seventeen (17) test cells at 637 tons per 365-day rolling calendar period. Test cell numbers 2 and 5 are included in this cap.

In addition, on May 26, 1998 (revised October 31, 2002), the DEP issued a separate combined CPA/PSD permit (approval number MBR-98-COM-017/MBR-92-COM-019) that applies to Test Cells 114 and 115. This permit caps NO_x and VOC emissions from Test Cells 114 and 115 at 532 tons and 43 tons, respectively, on a 365-day rolling calendar period.

On August 30, 2007, the DEP issued the Final Title V Operating Permit (Permit no. MBR-95-OPP-083. The Title V permit incorporates the requirements of the previous CPA/PSD permit requirements under a single permit. GE notes that the previous CPA/PSD permits and the operating permit do not restrict the types of engines that may be tested in any of the existing test cell permits.

Both the CPA and PSD permits use parametric monitoring techniques to calculate the air emissions from each test cell. In brief, GE monitors the fuel used by each test cell during an engine test cycle. GE also calculates the emission factors in pounds per thousand gallons of fuel for each pollutant emitted from the engine undergoing testing. Standard aerospace sampling procedures are used to determine the engine emission factors. Finally, an automated system multiplies the fuel usage by the appropriate emission factor to provide the total emissions either as an instantaneous, monthly or yearly emission rate.

In addition, EPA notes that the proposed PSD permit only applies to test cells 2 and 5. The existing PSD and CPA permits and associated test cell emission caps will continue to remain in effect.

VI. PSD Review

Before March 2003, under a delegation agreement with the EPA, Massachusetts administered the federal PSD program at 40 CFR 52.21 and issued PSD permits to sources in Massachusetts. However, on March, 2003, Massachusetts returned the PSD program to EPA. Since this time, EPA issues PSD permits in Massachusetts. The DEP

continues to administer its state permitting regulations and to issue CPAs to sources in Massachusetts. Typically, sources that are subject to the federal PSD program are also subject to the state permitting program.

The PSD regulations require major new stationary sources or major modifications to an existing major stationary source to undergo a PSD review and to receive a PSD permit before commencement of construction.

40 CFR 52.21 (b) (1) of the federal PSD regulations defines a major stationary source as any 28 designated stationary source categories with potential emissions of 100 tons per year or more of any criteria pollutant, or any other stationary source with potential emissions of 250 tons per year or more of any criteria pollutant.

40 CFR 52.21 (b)(2) defines a major modification as "any physical change in or change in method of operation of a major stationary source that would result in: a significant emissions increase of a regulated NSR pollutant; and a significant net emissions increase of that pollutant from the major stationary source."

40 CFR 52.21(b)(23) defines the "significant" emission rate for the each regulated NSR pollutant.

If the permitting authority determines that a new stationary source or new modification is subject to the PSD program, the source must apply for and obtain a PSD permit that meets regulatory requirements including:

- Best Available Control Technology (BACT) that requires sources to minimize emissions to the greatest extent possible;
- An ambient air quality analysis to ensure that all the emission increases do not cause or contribute to a violation of any applicable PSD increments or NAAQS;
- An additional impact analysis to determine the direct and indirect effects of the proposed source on industrial growth in the area, soil, vegetation and visibility; and
- Public comment including an opportunity for a public hearing.

VII. PSD Applicability

To determine if the proposed project is subject to PSD review, EPA first determined if the existing GE facility is a major stationary source. GE's application noted that, while the facility is not one of the 28 source categories identified in the federal PSD regulations, it does have potential emissions in excess of 250 tons annually of NO_x, SO_2, VOC, PM, and CO. Therefore, the existing facility is a major stationary source.

Next, EPA determined if the project is a major modification at a major stationary source. EPA relied on GE's application that provided emissions estimates to determine whether the test cell project resulted in a significant emissions increase. If the project results in a

significant emission increase, it is a major modification subject to PSD review. 40 CFR 52.21(b)(2)(i), (b)(40), (b)(23).

In accordance with EPA's PSD regulations, the emissions increase from a physical or operational change are determining by calculating the difference between the "baseline actual emissions" and "projected actual emissions." 40 CFR 52.21(b)(41), (48). "Baseline actual emissions" is the actual emissions from an emission unit before a physical or operational change and means "the average rate, in tons per year, at which the unit actually emitted the pollutant during any consecutive 24-month period selected by the owner or operator within the 10-year period immediately preceding" the operational change. 40 CFR 52.21(b)(48)(ii). "Projected actual emissions" is the emissions rate from an emission unit just after the physical or operational change and means "the maximum annual rate, in tons per year, at which an existing emissions unit is projected to emit a regulated NSR pollutant in any one of the 5 years (12-month period) following the date the unit resumes regular operation after the [operational change]…." 40 CFR 52.21(b)(41). In determining the projected actual emissions, the owner or operator of the source must consider all relevant information, including but not limited to historical operational data, the company's expected business activity, and the company's highest projections of business activity. 40 CFR 52.21(b)(41)(ii)(a).

Following EPA's PSD applicability regulations, GE calculated "baseline actual emissions" for test cells 2 and 5 at less than 1 tpy. GE noted that the tests cells were rarely used during the last ten years.

GE's "projected actual emissions" calculation involves several steps. First, using standard aerospace emission measurement procedures, GE measured the emission rates (in pounds (lbs.) per fuel usage) at various engine power levels for each pollutant for a typical engine. GE then determined the amount of time the engine operates at each power level during a typical engine test cycle. From this information, GE calculated the time weighted average emission rate in lbs per fuel usage for each pollutant for a typical engine test cycle. Using operational information from previous research and development testing projects, GE projected the hours of operation and fuel usage requirements for the proposed engine development project at test cells 2 and 5. In this case, GE conservatively estimated that the proposed project would require each test cell to operate 3000 hours in any twelve month period. GE has demonstrated that the process of testing engines in the test cells involves a substantial amount of time devoted to non-emitting activity, such as swapping engines in and out of the cells. Therefore, the operation of the cells is inherently limited to less than the hypothetical maximum emissions based on 8760 hours per year. Finally, GE calculated the project's annual emission rate for each pollutant by multiplying the fuel usage that would occur in a 3,000 hour period times the time-weighted average emission rate.

Considering that the "baseline actual emissions" was essentially zero for all pollutants, the project's emission increase is the "projected actual emissions." Table 1 summarizes

GE's projected actual emission calculations. The table also provides the PSD significance threshold levels for each pollutant. As shown, the proposed project resulted in a 157 tpy increase for NOx, well above the PSD significance threshold level of 40 tpy. Therefore, the project is a major modification subject to PSD review for NOx. All other emission increases from the project are below the PSD significance levels.

TABLE 1: TEST CELLS 2 AND 5
PSD Significance Threshold levels and projected actual emission increase

Pollutant	Significance Threshold levels	Projected actual emission increase (tpy)
NO_x	40	157
CO	100	16
SO_2	40	35
PM_{10}	15	4
VOC	40	2
	-	

Section 3 of the application provides the complete emissions information used in the applicability calculations. EPA has reviewed GE's emissions information and concurs with GE's findings.

IX. BACT

As required by the federal PSD program at 40 CFR 52.21(j)(2) and (3), GE is required to apply BACT to the NOx emission increase from test cells 2 and 5. BACT is defined as, *an emissions limitation... based on the maximum degree of reduction for each pollutant subject to regulation under [the Clean Air] Act which would be emitted from any proposed major stationary source or major modification which the Administrator, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for such source or modification through application of production processes or available methods, systems and techniques... for control of such pollutant.* 40 CFR 52.21(b)(12); Clean Air Act (CAA) 169(3).

In making its BACT determination, EPA follows the October 1990 draft New Source Review Workshop Manual. The manual outlines the following five step "top-down" methodology for determining BACT:

1. **Identify all control technologies.** Identify all possible control options, including inherently lower emitting processes and practices, add-on control equipment, or combination of inherently lower emitting processes and practices and add-on control equipment.
2. **Eliminate technically infeasible options**. Eliminate technically infeasible options based on physical, chemical, and engineering principles.
3. **Rank remaining control technologies by control effectiveness**. Rank the remaining control options by control effectiveness, expected emission reduction, energy impacts, environmental impacts, and economic impacts.
4. **Evaluate most effective controls and document results**. Determine the economic, energy, and environmental impacts of the control technology on a case-by-case basis.
5. **Select the BACT**. Select the most effective option not rejected as the BACT.

Section 5 of the September 7, 2007 application provides GE's complete BACT analysis. The BACT analysis concluded that BACT for the test cell project is no controls. The following summarizes GE's BACT analysis and findings.

GE identified all possible NOx controls that could apply to engines. These controls can be divided into two broad categories, combustion control methods that reduce NOx emissions during the combustion process and post combustion control technologies that reduce NOx emissions from the post-combustion flue gas (i.e., end-of-pipe controls).

GE then considered the technical feasibility of the various control options. GE noted that combustion control techniques require adjustments to an engine's combustion operations to reduce combustion temperature and ultimately NOx formation.[1] However, because engine testing programs are intended to evaluate engine performance under all operation scenarios, combustion controls would interfere with the ability of the testing program to evaluate the safety and performance of the engine. Therefore, GE considered these controls technically infeasible and eliminated them from further review.

GE then evaluated the technical feasibility of post-combustion controls. EPA notes that the various post combustion controls such as selective catalytic reduction have been used successfully in numerous applications. However, these technologies require relatively stable flue gas characteristics (i.e., velocity, temperature, oxygen and NOx concentrations, etc.,) to operate successfully. As noted, engine performance testing requires engines to operate under large load fluctuations in extreme conditions. As a result, flue gas characteristics vary widely making it impractical to successfully operate post combustion controls. Therefore, GE also found these controls to be technically infeasible.

[1] NOx formation is primarily a function of combustion temperature.

With both combustion and post-combustion controls technically infeasible, GE's analysis concluded that BACT for the test cells was no controls. EPA has reviewed GE's BACT analysis and concurs with the results.

Regarding the BACT emission rate, GE did not propose a short term emission rate for the test cells other than a monthly limit of 67.2 tons and an annual limit of 157 tons every 12-month rolling period. In several conversations with EPA, GE identified several reasons for not including shorter term emissions limits. GE noted that it could develop short term emission estimates for any given engine. However, engine development projects require GE to test and evaluate numerous engine varieties, each with its own emissions profile. In addition, since these engines are undergoing development, accurate short term emission information for each engine variety is simply not available.

GE also noted that simply selecting the highest estimated emission rate based on maximum engine output for BACT would not accurately reflect how GE intends to operate the test cells. Unlike most other industrial operations, engine development projects intentionally operate engines through the full power range within a relatively short period of time. As such, engines typically do not operate at maximum load for any extended time period.

Considering the unique operation requirements of engine testing project, EPA agrees that shorter term emission rates are not required. Therefore, EPA finds that the BACT emission rate for the test cell project is the monthly limit of 67.2 tons and an annual limit of 157 tons every 12-month rolling period.

IX. Monitoring

As noted previously, the existing CPA and PSD permits use parametric monitoring techniques to show compliance with the annual emission caps. These techniques relied on aerospace recommended practice rather than the EPA-approved stack testing methods to measure emission rates. In a letter dated December 18, 2007, GE stated that EPA-approved conventional stack testing is not feasible for engine test cells. The letter noted that test cell design and operation does not provide a stable laminar exhaust flow that meets the sampling requirements for the various EPA-approved stack test methods. Therefore, EPA will continue using the current parametric monitoring techniques that use the emission factors measured by the aerospace recommended procedures and fuel usage measured by fuel monitors to estimate total emissions from the two test cells.

X. Source Impact Analysis

The PSD regulations require an ambient air quality impact analysis to determine the impacts of a proposed permit action on ambient air quality. For all regulated pollutants emitted in significant amounts, the analysis must consider whether the proposed project will cause or contribute to a violation of (1) the NAAQS and (2) the applicable PSD increments. 40 CFR 52.21(k), (m). In addition, the applicant must demonstrate that the project's emissions will not adversely affect air quality related values in any Class I area (national parks and wilderness areas). 40 CFR 52.21(p).

Section 6 of GE's application provides the initial air quality analysis and findings. On January 24, GE Aviation's consultant, CH2M Hill, submitted a revised air impact analysis to the DEP and EPA-New England providing further information and updated modeling runs in response to remarks and questions from the DEP regarding the initial analysis.

After reviewing the revised impact analysis, EPA finds that the proposed NOx emission increase will not cause or contribute to a violation of the NO_2 NAAQS or PSD increment. In addition, EPA finds that CH2M Hill correctly followed EPA's guideline AERMOD model to determine NO_2 NAAQS and increment consumption.

The NAAQS analysis estimated a maximum total NO_2 impact of 40.6 $\mu g/m^3$, well below the NO_2 NAAQS of 100 $\mu g/m^3$. The estimated NO_2 impact included the maximum modeled NO_2 and the maximum monitored NO_2 measured at the Lynn facility. For the NAAQS analysis, CH2M Hill modeled the 4 power boilers and the turbine located at the GE facility, test cells 114 and 115, and the modified test cells 2 and 5. CH2M Hill also modeled the following non-GE sources; Medical Area Total Energy Plant, Wheelabrator-Saugus, Salem Harbor, Mystic Station, and Eastman-Gelatin. EPA notes that several of the non-GE source are near the GE Lynn operations. Therefore, impacts from these sources may have been included in the air quality data measured at the Lynn facility and 'double-counting' in the NAAQS analysis.

The increment analysis estimated a maximum cumulative NO_2 increment consumption of 20 $\mu g/m^3$ which is below the annual Class 2 limit of 25 $\mu g/m^3$. EPA notes that CH2M Hill only included increment-consuming sources, including the GE test cells 2 and 5 and 114 and 115, and not the local monitored data in the increment analysis. EPA does not use monitoring data to assess increment consumption because such measurements can not distinguish between increment-consuming and total NO_2 concentrations.

The following table provides the NO_2 increment consumption and NAAQS results for the project.

NO_2 NAAQS and increment consumption results

Maximum modeled cumulative NO_2 increment consumption	**20 µg/m^3**	Class 2 Increment	**25 µg/m^3**
Maximum modeled total NO_2 plus maximum measured NO_2	**40.6 µg/m^3**	NAAQS	**100 µg/m^3**

EPA notes that this review was for the purposes of determining whether the modification would contribute to a violation of the NAAQS for pollutants that are being attained in the area of the GE facility, in this case NOx. This PSD permit is not addressing the emissions of pollutants to the extent they contribute to existing nonattainment, such as NOx emissions with respect to the ground-level ozone NAAQS. The DEP is issuing a nonattainment NSR permit addressing the requirements for NOx as a nonattainment pollutant.

In addition, EPA notes that the SOB only evaluates the impacts from pollutants that had significant net emission increases, in this case NOx. For all other pollutants with allowable emission increases, EPA is relying on the DEP's air permitting regulations to ensure that those emissions do not result in a violation of a NAAQS. EPA notes that the DEP's air permitting regulations require all sources or modifications that result in allowable emission increases above 1 tpy to obtain an comprehensive plan approval and to demonstrate that the increase does not cause a violate NAAQS or other applicable air regulation. EPA believes that the combination of the analysis supporting this PSD permit and the state air regulations ensure that GE 's emission increases do not result in a NAAQS or increment violation.

XI. Additional Impact Analysis

The PSD regulations at 40 CFR 52.21(o) require an additional impact analyses to assess the direct and indirect effects of GE's proposed project on commercial and residential growth, visibility, and soils and vegetation. Section 7 of the application provides GE's complete additional impact analysis and conclusions. In summary, the analysis concluded that the project would have no significant impacts to growth, visibility or soils and vegetation. EPA has reviewed the analysis and concurs with the findings.

XII. Endangered Species Act (ESA)

Section 7 of the ESA requires that certain federal actions such as federal PSD permits address the protection of endangered species in accordance with the ESA. To comply

with the ESA, Region 1 consulted with the United States Fish and Wildlife Department (FWS)-New England Field Office. Our initial discussions with FWS indicates that a formal consultation regarding endangered species is very unlikely. The GE facility has been in this location for many years and the proposed project is not increasing the size of the facility. We are currently working with FWS to complete our ESA consultation and do not anticipate any issues.

XIII. Records

The following documents are part of the record for this permit:

GE Aviation, PSD Permit Application, Test Cell 2 and 5 Modification, September 7, 2007

Letter from Amy Wong, GE Aviation, dated January 8, 2008

Letter from Amy Wong, GE Aviation, dated December 18, 2007

Letter from Raymond Porter, CH2M Hill, January 24, 2008