Federal Aviation Administration

Memorandum

FAA Order 1050.1E, Change 1, Guidance Memo #4[1]

Date:	March 21, 2012
To:	FAA Lines of Business and Managers with NEPA Responsibilities
From:	Julie Marks, Manager, Environmental Policy and Operations, AEE-400
Prepared by:	Rebecca Cointin and Steve Urlass
Subject:	Guidance on Using AEDT 2a to Conduct Environmental Modeling for FAA Air Traffic Airspace and Procedure Actions

PURPOSE

This memorandum and associated technical appendix provide guidance on the use of the Aviation Environmental Design Tool (AEDT) 2a to conduct aircraft noise, fuel burn, and emissions modeling for FAA *air traffic airspace and procedure actions* under the National Environmental Policy Act of 1969 (NEPA), as amended, 42 United States Code (U.S.C.) §§4321 et seq.

APPLICABILITY

FAA Order 1050.1E, Appendix A, Section 14.5e, states that "[f]or air traffic airspace actions where the study area is larger than the immediate vicinity of an airport, incorporates more than one airport, or includes actions above 3,000 feet AGL, noise modeling will be conducted using [the Noise Integrated Routing System (NIRS)]." AEDT 2a replaces NIRS, and is now the required FAA NEPA compliance tool for modeling aircraft noise, as well as fuel burn and emissions, for air traffic airspace and procedure actions that meet one or more of the above-quoted criteria.[2]

Except where advance written approval has been granted to use an equivalent methodology and computer model by the FAA Office of Environment and Energy, all aircraft noise, fuel burn, and emissions modeling for the FAA air traffic airspace and procedure actions described above must be performed using the most current version of AEDT 2a available at the start of the analysis process for an action. Consistent with current FAA policy and practice, the use of AEDT 2a is not required for projects whose environmental analysis began before March 1, 2012. In such

[1] This document is interim guidance memo #4 for FAA Order 1050.1E (Change 1). It is the fourth in a series of memos to provide additional guidance on FAA's NEPA requirements, procedures, and practices.

[2] The FAA Office of Environment and Energy has approved AEDT 2a as a methodology equivalent to NIRS for analyzing aircraft level noise and fuel burn, and equivalent to the Emissions and Dispersion Modeling System (EDMS) for developing aircraft-only emissions inventories.

circumstances, however, the responsible FAA official, in coordination with the appropriate FAA service center or headquarters contacts, should carefully consider using AEDT 2a when there is a major revision or addition to the analysis or project (e.g., if baseline and/or forecast years are updated, thereby creating the potential for different impacts).

Those who prepare NEPA documentation must provide one copy of the AEDT 2a Administrative File used in the environmental modeling to the FAA official on electronic media specified by that official.

BACKGROUND

FAA Order 1050.1E describes the FAA's agency-wide policies and procedures for compliance with NEPA. Appendix A of that order describes how to analyze 19 environmental impact categories. The modeling of potential impacts in accordance with FAA Order 1050.1E may include aircraft noise, fuel burn, and/or emissions. Appendix A, Section 14, states noise analysis requirements, including required metrics, models, and significant impact thresholds. Appendix A, Section 13, describes the FAA policy to conserve resources such as energy, and the requirement "to identify any proposed major changes in stationary facilities or the movement of aircraft and ground vehicles that would have a measurable effect on local supplies of energy or natural resources." Appendix A, Section 2, states air quality analysis requirements, including that "the [Emission and Dispersion Modeling System (EDMS)] is FAA's required methodology for performing air quality analysis modeling for aviation sources."

Aircraft noise, fuel burn, and emissions are interdependent and occur simultaneously throughout all phases of flight. AEDT is a comprehensive software tool that provides information to FAA stakeholders on each of these specific environmental impacts. By consolidating the modeling of these environmental impacts in a single tool, AEDT facilitates environmental review activities required under NEPA.

AEDT 2a is the first of two phases of AEDT release. AEDT 2a replaces and enhances the functionality of NIRS. It provides the capability to assess aircraft noise, fuel burn, and emissions for the air traffic airspace and procedure actions described above. In the future, AEDT 2b will enhance the capabilities of AEDT 2a. AEDT 2b will replace AEDT 2a, the Integrated Noise Model (INM), and EDMS for all FAA actions. AEDT 2b will be released with associated guidance.

For further information, contact:

Your Federal Aviation Administration Headquarters Program Office

Or

Rebecca Cointin or Steve Urlass, Office of Environment and Energy, 800 Independence Avenue, SW, Washington, DC 20591

Guidance on Using AEDT 2a to Conduct Environmental Modeling for FAA Air Traffic Airspace and Procedure Actions

TECHNICAL APPENDIX

This Technical Appendix to the Federal Aviation Administration (FAA) Order 1050.1E, Change 1, Guidance Memo #4[1] "Guidance on Using [the Aviation Environmental Design Tool (AEDT)] 2a to Conduct Environmental Modeling for FAA Air Traffic Airspace and Procedure Actions" provides information on the use of AEDT 2a to conduct environmental modeling of aircraft noise, fuel burn and emissions for FAA air traffic airspace and procedure actions. As used in this document, "air traffic airspace and procedure actions" means such actions for which the study area is larger than the immediate vicinity of an airport, incorporates more than one airport, and/or includes actions above 3,000 feet above ground level (AGL).[2]

While the AEDT 2a User Guide provides information on default data and how to use AEDT 2a, this document provides information on how to use the tool to satisfy the requirements of the National Environmental Policy Act (NEPA) in accordance with FAA Order 1050.1E (Change 1), Environmental Impacts: Policies and Procedures (March 20, 2006).

AEDT 2a has the capability to model aircraft performance based on fleet mix, airport configuration, and operations schedule, and use these data as input to compute aircraft noise, fuel burn and emissions. Since aircraft position computations in AEDT 2a are based on the same data, performance is only run once, and environmental consequences are provided simultaneously. By standardizing these data, AEDT 2a will help FAA stakeholders make more informed decisions on specific environmental impacts of aviation.

1. Representative Schedules in AEDT 2a

The following information must be input to a study to conduct an air traffic airspace or procedure analysis for noise: average annual day, evening (for the Community Noise Equivalent Level (CNEL) metric only), and night operations on each track for each profile by aircraft type (airframe, engine, and engine modification).

In analysis studies of air traffic airspace and procedure actions where an aircraft emissions inventory is needed[3], the analyst must enter a design day ratio in the AEDT Standard Input File (ASIF) for the study in order to compute an aircraft emissions inventory appropriately.

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[1] This memo is the fourth in a series of memos to provide additional guidance on FAA's NEPA requirements, procedures, and practices.

[2] See FAA Order 1050.1E, Appendix A, paragraph 14.5e.

[3] An aircraft emissions inventory is needed for studies where there are changes below the altitude of the airport's mixing height (or 3,000 feet above field elevation (AFE) where the mixing height is not identified). Any changes above the mixing height (or 3,000 feet AFE) are exempt from study as they have been determined to be de minimis. Environmental Protection Agency (EPA) 40 CFR parts 51 and 93, Revisions to the General Conformity Regulations, Federal Register Vol. 75, pages 17257–17258.

To create the design day ratio:

1. Determine the month with the most operations for the baseline year, i.e. the peak month.
2. Compute the average daily operations for that month (known as peak month average day (PMAD) operations). [PMAD = Peak Month/ # Days in that Month]
3. Compute the average annual day (AAD) operations for the year. [AAD = Total # Operations in the Year / # Days in that Year]
4. Compute the design day ratio. [Design Day Ratio = PMAD / AAD]

2. Representation of Results in AEDT 2a

Noise

Results of noise analysis for air traffic airspace and procedure actions must be represented at population points throughout the study area[4] based on an AAD fleet mix, airport configuration, and operations schedule from the ground to 10,000 ft. AGL.[5] AEDT 2a allows an altitude cutoff for noise based on mean sea level (MSL). Some analysts should consider using an altitude cutoff of 18,000 ft. MSL to ensure that noise will be computed to at least 10,000 ft. AGL regardless of terrain[6].

AEDT 2a replaces the Noise Integrated Routing System (NIRS) as the FAA-required NEPA compliance tool for environmental modeling of air traffic airspace and procedure actions. Consistent with FAA Order 1050.1E, Appendix A, Section 14.3 to 14.5e, the noise analysis will focus on change-of-exposure tables and maps at population internal points[7] and noise sensitive areas (e.g., schools, churches, hospitals, residences, parks and recreation areas) throughout the study area using the following:

Day-Night Average Sound Level (DNL) $\geq$ 65 dB $\pm$ 1.5 dB
DNL $\geq$ 60 to <65 dB $\pm$ 3 dB
DNL $\geq$ 45 to <60 dB $\pm$ 5 dB

As stated in the FAA Order 1050.1E Appendix A paragraph 14.3, a significant noise impact would occur if analysis shows that the action will cause noise sensitive areas to experience an increase in noise of DNL 1.5 dB or more at or above DNL 65 dB noise exposure when compared to the no action alternative for the same timeframe. For example, an increase from 63.5 dB to 65 dB is considered a significant impact.

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[4] See FAA Order 1050.1E, Appendix A, Section 14.5e.

[5] Any decision to analyze aircraft noise above 10,000 ft. AGL is an exception and should be coordinated with the ATO Airspace Management Group at FAA headquarters at the earliest possible time. See Memorandum, Altitude Cut-Off for National Airspace Redesign (NAR) Environmental Analyses, dated September 15, 2003.

[6] In certain areas of Alaska, an altitude cutoff above 18,000 ft. MSL may be more appropriate.

[7] "The Census Bureau calculates an internal point (latitude and longitude coordinates) for each geographic entity. For many geographic entities, the internal point is at or near the geographic center of the entity. For some irregularly shaped entities (such as those shaped like a crescent), the calculated geographic center may be located outside the boundaries of the entity. In such instances, the internal point is identified as a point inside the entity boundaries nearest to the calculated geographic center and, if possible, within a land polygon." Source: U.S. Census Bureau.

AEDT 2a can produce noise contours. Noise contours may be created at the FAA's discretion, however, noise contours are not required and are not normally used for analysis of air traffic airspace and procedure actions. If the study encompasses a large geographical area, it is not recommended that contours be created for the representation of results below 55 dB DNL due to fidelity of receptor sets needed to create an accurate representation of the contour.

Criteria Pollutant Emissions

AEDT 2a reports aircraft emissions results below various altitudes above field elevation (AFE). When required[8], an aircraft emissions inventory for air traffic airspace and procedure actions must be represented based on a peak month average day operations schedule (select "PMAD" in the AEDT 2a Emissions Report). Results must be submitted for emissions below the altitude of the airport's mixing height (or 3,000 ft. AFE if the airport's mixing height is not available) and must include all regulated criteria pollutants.[9]

Fuel Burn and CO_2 Emissions

There is a direct relationship between fuel burn and CO_2 emissions. Results of fuel burn and CO_2 emissions analysis of air traffic airspace and procedure actions must be represented as annual total fuel burn and CO_2 emissions for the entire study area, with no altitude restriction. Fuel burn and CO_2 emissions are computed based on the operations input into the study. The analyst should run the AEDT 2a Emissions Report with "Annual" selected and choose the fuel burn and CO_2 emissions results based on the "Full Flight" mode. Totals and the incremental change (i.e. delta) between the no-action and action alternatives must be provided in the NEPA document (provide fuel burn results in the Energy section and CO_2 results in the Climate section).[10]

3. Non-Default Methods and Data

All aircraft noise, fuel burn, and emissions modeling of FAA air traffic airspace and procedure actions must be performed using AEDT 2a default methods and data (including aircraft, aircraft mappings, flight profiles/procedures, and stage lengths), unless otherwise approved by the FAA's Office of Environment and Energy (AEE). Use of non-default methods or data[11] for environmental analysis of air traffic airspace and procedure actions requires written approval from AEE. A written request must be first submitted to the appropriate FAA regional or service center office, and it must include supporting data and analysis, in order to facilitate the AEE review. The regional or service center contact will then forward the request to the appropriate

[8] An aircraft emissions inventory is needed for studies where there are changes below the altitude of the airport's mixing height (or 3,000 ft. AFE where the mixing height is not identified). Any changes above the mixing height (or 3,000 ft. AFE) are exempt from study as they have been determined to be de minimis. EPA 40 CFR parts 51 and 93, Revisions to the General Conformity Regulations, Federal Register Vol. 75, pages 17257–17258.

[9] See FAA Order 1050.1E Appendix A Section 2 and the FAA Air Quality Procedures for Civilian Airports & Air Force Bases, Sections 2 and 3.2.1, FAA-AEE-97-03, AL/EQ-TR-1996-0017.

[10] See FAA Order 1050.1E, Change 1, Guidance Memo #3, Considering Greenhouse Gases and Climate Under the National Environmental Policy Act (NEPA): Interim Guidance, dated January 12, 2012.

[11] Non-default methods or data are methods or data that are not inherent within the tool, such as user-defined aircraft or user-defined profiles.

headquarters contact, who in turn will forward the request to AEE. AEE may work directly with the regional or service center contact, the headquarters contact and/or the requestor on any technical issues and will provide a timely written decision.

If AEE approves use of non-default methods or data, the following must be provided as part of the project's environmental documentation: (1) a copy of AEE's approval letter; and (2) a description of the approved non-default method(s) and/or data.

The approval for use of non-default methods or data is limited to the particular study under consideration. The approval of particular non-default methods or data in past studies does not guarantee approval in a future study. Each modeling situation is unique and must be evaluated on a case-by-case basis.

The following information is always required for any request to use non-default methods or data:

1. *Background*. Briefly describe the project, including location, for which non-default methods or data are needed. State if the environmental review is an Environmental Assessment (EA), an Environmental Impact Statement (EIS), or other type of analysis. Include any additional relevant information.
2. *Statement of Benefit*. Briefly describe why the non-default methods or data are needed for this project, how the non-default methods or data are more appropriate, and why the default method or data are not sufficient.

The sections below discuss the *additional* specific information required to be submitted for each type of non-default method or data.

User-Defined Aircraft and Aircraft Mappings

The default aircraft mappings in the AEDT 2a Fleet database are required by the FAA for use in environmental studies of air traffic airspace and procedures actions. However, AEDT 2a allows analysts to create user-defined aircraft and to specify aircraft mappings that differ from default data provided in the AEDT 2a Fleet database. If the analyst use aircraft or aircraft mappings that are not part of AEDT 2a for air traffic airspace and procedure environmental analyses, AEE approval is required.

The following additional information must be included in a submittal package requesting AEE approval for use of user-defined aircraft or aircraft mappings:

1. *Aircraft Information*. Provide the following information in table form for the new aircraft or, if requesting an aircraft mapping, both the original aircraft and the mapping aircraft.
    - Manufacturer Type
    - Type Designation
    - Maximum Take-off Weight (MTOW) (lb)
    - Maximum Landing Weight (MLW) (lb)
    - Engine static thrust

- Engine Manufacturer /Type Designation
- Certification Noise: Fly Over, Lateral, and Approach
- (Optional) percentage of operation

An example table is provided for your reference:

User-Defined Aircraft	"Mapped" Aircraft in AEDT	Manufacturer	Type Designation	MTOW (lb)	MLW (lb)	Engine Static Thrust	Engine Manufacturer / Type Designator	Noise Level (EPN dB)		
								Fly Over	Lateral	Approach

User-Defined Profiles

AEDT 2a provides standard profiles that are appropriate for most studies of air traffic airspace and procedure actions. In certain situations, where a more detailed profile is needed, the AEDT 2a flight path performance module (FPPM) can be used. The AEDT/FPPM uses performance characteristics to create user-defined profiles based on altitude controls set by the analyst. If the analyst uses AEDT/FPPM to develop profiles, then AEE approval is not required. If standard profiles and AEDT/FPPM cannot provide the profiles needed for the study, then the analyst must request approval from AEE to develop user-defined profiles based on a different method.

Additional information to include in submittal package for user-defined profiles (non-FPPM method):

1. *Analysis Demonstrating Benefit*. For departure tracks, provide Sound Exposure Level (SEL) values for a receptor network spaced 0.5 nautical miles apart underneath the flight track, beginning at the start of takeoff roll and ending at the end of the profile, or at 10 nautical miles from the start of takeoff roll (whichever is shorter). For arrival tracks, place the receptors 0.5 nautical miles apart underneath the flight track, beginning at the start of the profile, or at 10 nautical miles away from the runway threshold (whichever is shorter), and ending at the last point of the landing roll-out on the runway. Also include receptors for any noise sensitive areas. Interpret the results of the analysis and explain how the results correlate with the "Statement of Benefit". For each profile, provide a table with the following information. Submit with the AEDT Administrative File, which includes study information used to perform the above analysis.

AEDT Aircraft Model _____ Profile Weight _____

Receptors (nmi) 0.5 1.0 1.5 2.0 … 10.0	AEDT Default Profile (SEL dB)	User-Defined Profile (SEL dB)	Difference (dB)
Noise Sensitive Areas (nmi) x_1, y_1 x_2, y_2 … x_n, y_n			

2. *Concurrence on Aircraft Performance*. In this section, obtain verification from an airline operator or aircraft manufacturer familiar with the performance characteristics of the aircraft. This verification could be either:
    a. A description of the performance characteristics of the aircraft, such as a profile description copied from a flight manual. Define all abbreviations and terms used on the copied material. Or,
    b. A statement by the operator or manufacturer certifying that the proposed profile falls within reasonable bounds of the aircraft's performance for the modeled airport location.
3. *Performance Characteristics*. State that the aircraft performance characteristics submitted by the operator or manufacturer have been correctly translated into the AEDT formatted profile or procedure. Specifically, certify that:

    If the new profiles are defined in terms of profile points:
    a. Altitude is AFE in feet.
    b. Speed is true airspeed in knots.
    c. State the units of thrust-setting (for example, pounds). State that the units match the units of the thrust-setting parameter used in the aircraft's associated noise-power-distance curves.

    If the new profiles are defined in terms of procedure steps:
    a. If new aircraft performance coefficient data were developed, separate AEE review is required. In addition, direct manufacturer support or flight test information is required to facilitate that review.

b. The procedure step data conform to the Profile Rules given in the AEDT 2a User Guide.
c. If percent units are used for thrust-setting, give the value of the aircraft's static thrust parameter used in the denominator when calculating percents. State that this value is in units of pounds.
d. If the profile thrust setting is in terms of RPM, EPR, N1 or other parameters, show the method for converting thrust to pounds.

4. *Graphical and Tabular Comparison.* Provide three graphics for each proposed change in profile in each seat class:
   a. Altitude vs. Distance
   b. Speed vs. Distance
   c. Thrust vs. Distance

   Plot the default profiles and the proposed user-defined profiles on the same graph. Also, submit tables of information used to plot the graphs.

User-Defined Stage Lengths

Stage lengths for departure tracks can be user-defined in AEDT 2a. Stage lengths for arrival tracks cannot be user-defined in AEDT 2a, because there is only a stage length of "one" for arrivals.

Additional information to include in submittal package for user-defined stage lengths:

1. *Analysis Demonstrating Benefit.* For departure tracks, provide SEL values for a receptor network spaced 0.5 nautical miles apart underneath the flight track, beginning at the start of takeoff roll and ending at the end of the profile, or at 10 nautical miles from the start of takeoff roll (whichever is shorter). Also include receptors for any noise sensitive areas. Interpret the results of the analysis and explain how the results correlate with the "Statement of Benefit". For each profile, provide a table with the following information. Submit with the AEDT Administrative File, which includes study information used to perform the above analysis.

AEDT Aircraft Model _____ Profile Weight _____

Receptors (nmi)	AEDT Default Stage Length (SEL dB)	User-Defined Stage Length (SEL dB)	Difference (dB)
0.5 1.0 1.5 2.0 … 10.0			
Noise Sensitive Areas (nmi)			

x_1, y_1 x_2, y_2 ... x_n, y_n			

2. *Graphical and Tabular Comparison.* Profiles from using different stage lengths must be plotted against aircraft trajectory data for visual comparison. Furthermore, quantitative comparison, such as an estimate of the least mean square of differences, should be provided and explained.

4. Use of weather information for analyses

Airport average weather conditions must be used to compute aircraft performance, emissions, fuel burn and noise for environmental analyses of air traffic airspace and procedure actions. The use of airport average weather better represents the long-term effects that are to be captured for NEPA reviews. Airport average weather information is provided in AEDT 2a in the Airport database.

The analyst must identify which airport in the study will provide the airport average weather data for the entire study area. In consultation with the appropriate FAA contact, the analyst should select the primary airport in the study (in terms of number of operations). In AEDT 2a Run Options, select the box "Use Single Airport Weather" and then select the appropriate study airport in the dropdown menu to apply that airport's average annual weather data to the entire study area.

5. Atmospheric Absorption

Atmospheric absorption is the calculation of the absorption of sound by the atmosphere due to weather conditions (temperature, relative humidity, atmospheric pressure, etc.).

When using Apply Atmospheric Absorption in AEDT 2a, the airport average weather conditions in the study are used to calculate atmospheric absorption adjustments to standard Noise-Power-Distance (NPD) curves. This function uses the method described in Society of Automotive Engineers' (SAE) Aerospace Recommended Practice (ARP) 866A, taking into account changes in atmospheric absorption due to airport specific temperature and relative humidity.

For environmental analyses of air traffic airspace and procedure actions, the "Apply Atmospheric Absorption" box in AEDT 2a Run Options must be checked to account for study-specific weather information.

6. Use of terrain for analyses

AEDT 2a allows users to import terrain files and use terrain data in noise computations to account for elevation as well as line-of-sight blockage. When terrain is not applied in AEDT 2a (the "Use Terrain" box in AEDT 2a Run Options is unchecked), the model computes receptor-to-source distances in the noise calculations based on flat ground.

Much like the use of weather information at multiple airports, the analyst must identify which airport in the multi-airport study will provide the study reference elevation. When "Use Terrain" is not invoked in AEDT 2a and the receptor elevation is defined (based on MSL for the reference airport), the elevation from this reference airport will override the elevation information at the other airports in the study. This reference airport must be the same airport that was selected to "Use Single Airport Weather," and chosen based on consultation with the appropriate FAA contact. The Receptors section of the AEDT 2a User Guide describes how to set the receptor elevation based on the elevation of a reference airport.

In regions where topography is relatively flat, use of terrain is not required for environmental studies. If there is uncertainty in the use of terrain and its potential influence on noise exposure in a specific study, for example, where there is substantial variation (hundreds of feet) in natural terrain in the study area, the analyst should coordinate with the appropriate FAA regional or service center office. After this coordination, the use of terrain should be considered where it would have a substantial influence on noise exposure.

Terrain in AEDT 2a may be applied either with or without line-of-sight blockage. Although line-of-sight blockage is not required for environmental studies, it should be considered for analyses that have substantial terrain features located between the aircraft noise sources and the noise receptors. The analyst should coordinate with the appropriate FAA regional or service center office if there is uncertainty regarding the use of line-of-sight blockage and its potential influence on noise exposure in a specific study.

7. Use of lateral attenuation for propeller aircraft and helicopters

Lateral attenuation describes the difference in sound level between the sound directly under an aircraft's flight path and at a location to the side of the aircraft. In AEDT 2a, the lateral attenuation adjustment is based on the methods described in the SAE Aerospace Information Report (AIR) 5662 "Method for Predicting Lateral Attenuation of Airplane Noise". It takes into account the following effects on aircraft sound due to over-ground propagation: (1) ground reflection effects; (2) atmospheric refraction effects; and (3) airplane shielding effects, as well as other ground and engine/aircraft installation effects. AEDT 2a assumes that sound propagation occurs over acoustically soft ground, which is appropriate for the majority of analyses.

For environmental analyses of air traffic airspace and procedure actions, regardless of the aircraft types, lateral attenuation must be modeled (select All Soft Ground for Lateral Attenuation in AEDT 2a Run Options). This is due to the fact that air traffic airspace and procedure studies tend

to cover a large study area of predominantly soft ground, and results are less sensitive to ground surface type due to the high elevation angle.

8. Impact Evaluation

After a Change Analysis is performed, AEDT 2a has a function that allows the analyst to perform "what if" scenarios within the tool. This functionality is called Impact Evaluation. Impact Evaluation can be used to identify alternatives to reduce the noise impacts on areas heavily affected by noise. The analyst can move operations to different tracks in a new scenario and analyze changes in noise levels. In making changes to track assignments, the analyst can also identify changes to fuel burn and emissions through the Emissions Report. Alternatives selection and changes to alternatives must be coordinated with appropriate FAA personnel. Coordination will ensure that the alternatives are reasonable and implementable. The Impact Evaluation modeling capability is optional for environmental modeling of FAA air traffic airspace and procedure actions.