



Emissions and Dispersion Modeling System

5-Year Research and Development Plan

Version FY01.1

October 2000



Federal Aviation Administration
Office of Environment and Energy
Washington, DC

Emissions and Dispersion Modeling System 5-Year Research and Development Plan

1.0 Introduction

The Federal Aviation Administration's (FAA) Office of Environment and Energy has engaged in a 5-Year Research and Development Plan for the Emissions and Dispersion Modeling System (EDMS) in order to continue improvement of FAA analytic and planning tools and provide a better understanding of aviation's impact on local air quality. EDMS is the FAA's required model for assessing the local air quality impacts of aviation sources from proposed FAA airport actions. EDMS is used to inventory emissions and model air dispersion at an airport based upon the emissions of aircraft, auxiliary power units, ground support equipment, and other sources operating on the airport surface or in nearby vicinity. EDMS incorporates EPA-approved emission factors and calculation methodologies (e.g., dispersion algorithms).

EDMS was developed jointly by the FAA's Office of Environment and Energy and the US Air Force. Since its original release, EDMS has undergone continuous enhancement to respond to the needs of the user community and to incorporate advances made in the field of local air quality analysis. In 1997 the FAA's Office of Environment and Energy released a significantly re-engineered model, EDMS Version 3.0. Subsequent to this, incremental enhancements to the model have been released approximately once per year with the latest, Version 3.21, released in September of 2000.

The purpose of this document is to outline the model development and local air quality research activities planned over the next 5 years. These planned activities are loosely categorized into two functional areas:¹

- Model Development: Model development refers to physical and functional enhancements planned for incorporation into EDMS. This plan addresses major model enhancements and releases (e.g., the plan does not identify interim model releases such as simple database updates).
- Research and Analysis: Research and analysis activities are planned for topics in which increased understanding is needed. As these research and analysis activities are carried out and yield increased insights, they will become candidates for EDMS enhancements.

The remainder of this document presents the activities to be performed in each of these functional areas over the next 5 years, as well as major milestones. Activities are grouped into the following fiscal year time periods: 2001, 2002-2003, and 2004-2005. Activities

¹ In addition to Model Development and Research and Analysis, activities also are planned for Model Maintenance. Model maintenance activities largely involve enhancements to the model design documentation to facilitate further development of the EDMS system in subsequent years. For the purposes of this document, discussion will focus on model development and research and analysis activities.

range from more simplistic one-year efforts to more complex multi-year efforts. Activities were evaluated for inclusion and implementation year based on several factors including priority, availability of information, and extent of effort. The order in which they are presented in no way reflects their perceived importance. The last section of this document provides a summary of the major activities and milestones. It is important to note that planned activities are based on “requested” funding levels. Actual research and model development activities will be determined based on annual appropriations of funds.

2.0 Fiscal Year 2001 Activities

Activities planned for FY2001 include the following:

2.1 Model Development

- Database Updates: The accuracy of EDMS depends on not only the algorithms it uses, but also the data that feeds those algorithms. During FY2001 the aircraft and APU databases will be updated with the currently available information including aircraft-engine combinations, engine emission factors, and aircraft-APU combinations. Keeping the EDMS databases current is a continuous process that does not necessarily need to coincide with a new release of the model.
- GSE Data & Methodology: The EPA is continuing development of their “non-road” model in response to increase regulation during the 1990s of construction, logging, and other off-road equipment. This model calculates emissions for a variety of scales from the national level down to a specific non-attainment area. In many ways, airport GSE also fall into the same category as other non-road sources calculated by EPA’s NONROAD model. While EDMS currently associates GSE with individual aircraft, and then calculates the emissions in relation to the number of aircraft operations, NONROAD takes a population-based approach, with the ability to assign operating times to individual pieces of equipment. In FY2001, the EDMS GSE data inputs and calculation methodology will be enhanced to be more consistent with the development of EPA’s NONROAD model.
- Stationary Sources: Although it is not reasonable to attempt to include every potential source of airport emissions into EDMS, it is important that the sources that EDMS models provide benefit to the user. Currently, EDMS treats stationary sources in a relatively simple manner that often requires the advanced user to seek other models to complete their analysis. In order to better accommodate the EDMS user-base, in FY2001 an improved means of assessing emissions from stationary sources within EDMS will be developed
- Data Import: Many of the more advanced EDMS users find that the EDMS graphical user interface (GUI) is useful for entering a small number of sources, but can become cumbersome for entering large amounts of data. As with many other models from both EPA and the FAA, in FY2001 EDMS will be enhanced to include more options for importing data from files as opposed to requiring the user to manually input the information.
- User Interface: The current EDMS airport view provides a crude representation of the sources included in the study. This view will be enhanced in FY2001 to include labeling of sources and receptors.
- Model Documentation: Obviously, the changes made to EDMS during FY2001 will need to be thoroughly documented to fully benefit the users. The online help will also be updated to reflect the changes made to the model.

2.2 Research and Analysis

- Evaluation of Dispersion Algorithms: During FY2001, rigorous testing of the algorithmic performance of new EPA dispersion algorithms (i.e., AERMOD) recently incorporated into EDMS will be completed. This testing is necessary to quantify the impact of these new algorithms on EDMS results. After testing and evaluating the new dispersion algorithms incorporated into EDMS, the findings of the effort will be documented. The assessment of new modeling concepts as a possible long-term enhancement to EDMS also will continue.
- Multi-Year Validation Effort: Initial implementation of a multi-year plan for validation of EDMS dispersion algorithms and associated databases will begin in FY2001. The validation plan includes identification and collection of previously-collected field measurement data, rigorous exercising of EDMS for comparison with collected data, comparison of EDMS performance with that of other similar models in Europe, and design and implementation of a field measurement plan.
- Assessment of Aircraft Performance Methodologies: As a follow-up to the inclusion of aircraft performance data and static aircraft flight profiles in EDMS 4.0, EDMS developers will keep apprized of related research being performed for aircraft noise modeling and analysis purposes, and consider refinements to the static flight profile approach. The ultimate, long-term goal will be to include a dynamic aircraft profile generator in EDMS capable of taking into account user-supplied airport conditions and specific flight procedures.
- Air Quality Screening Tool: As part of a multi-year effort to develop an air quality screening tool to facilitate quick and easy assessments of apparently minor changes in aircraft-related activity, a prototype of the tool will be completed by the end of FY2001.
- Aircraft PM: As part of a longer-term research effort to evaluate methods for computing aircraft particulate matter (PM) emissions, FAA will collaborate with EPA, European counterparts, and others to research appropriate methodologies for estimating particulate emissions given available data. By the end of FY2001, FAA plans to develop a short-term recommendation for estimating aircraft PM emissions using available data. FAA also will continue with activities and coordination aimed at filling the aircraft PM emission factor data gap.
- Aircraft Plume Rise & Initial Release Characterization: During FY2001, FAA will formally begin researching aircraft plume rise and potential modeling approaches. An initial progress report on the aircraft plume rise research will be published in the third quarter of FY2001. FAA also will continue research on the initial aircraft plume spread (i.e., initial sigma values) for use in dispersion modeling.
- GSE Data: During FY2001, the current EDMS GSE databases will be evaluated for appropriateness and completeness given a review of existing EDMS data and

newly available data. GSE databases will be updated and supplemented as necessary to reflect analysis results.

- Construction Emissions: FAA will begin researching a preliminary method and/or guidance for handling airport construction emissions.

2.3 Major Milestones

- EDMS Release: FAA anticipates release of version 4.0 of EDMS in the second quarter of FY2001. Based on model development activities in FY2000, Version 4.0 will include several significant improvements to the modeling system including new EPA dispersion algorithms and aircraft performance data. The new dispersion algorithms are taken from EPA's AERMOD. Aircraft performance data included in Version 4.0 will be used to calculate aircraft-specific takeoff, climbout, and approach times as well as dispersion from in-flight emissions of aircraft during takeoff, climbout, and approach.
- Evaluation of Dispersion Algorithms: After testing and evaluating the new dispersion algorithms incorporated into EDMS, the findings of the effort will be documented.
- Air Quality Screening Tool: A prototype of the air quality screening tool will be completed by the end of FY2001.
- Aircraft PM: By the end of FY2001, FAA plans to develop a short-term recommendation for estimating aircraft PM emissions using available data.
- Aircraft Plume Rise & Initial Release Characterization: An initial progress report on aircraft plume rise research will be published in the third quarter of FY2001.

3.0 Fiscal Years 2002-2003 Activities

The following activities are planned for FY2002-2003:

3.1 Model Development

- Database Update and Enhancement: Aircraft and APU databases will be updated with newly available information including aircraft-engine combinations and engine emission factors. GSE databases will be updated and supplemented to reflect FY2001 analysis results of existing and newly available data. EDMS system databases will be enhanced through such activities as including annual average taxi time data for available airports from FAA's Consolidated Operations and Delay Analysis System (CODAS).
- Stationary Sources: With the research on improving stationary source modeling within EDMS complete in FY2001, these improved methodologies will be incorporated during FY2002-2003.
- Dispersion Algorithms: Update EDMS to remain compatible with EPA's most-recent release of AERMOD, and incorporate results of FAA's algorithmic performance evaluation and ongoing model validation effort.
- Aircraft PM: Based on FY2000 and FY2001 research and coordination on aircraft PM, an aircraft PM emissions estimation methodology will be incorporated in EDMS.
- Enhanced User Flexibility: Many users are finding that it would be useful to overlay EDMS source and receptor information on an actual layout of the airport. As the FAA continues to provide more such diagrams in electronic format, a new version of EDMS will allow some airport layout diagrams to be imported directly into the study. Users are also requesting enhancements to the user-created aircraft screen to offer more flexibility with importing the emission factors for their new aircraft. User flexibility will be enhanced in FY2002-FY2003 and future years through several activities including the capability to import airport map files, expanded airport viewing capability, and an improved user-created aircraft screen.
- Model Documentation: Again, the EDMS User Manual and Online-Help will be updated to be consistent with FY2002 and FY2003 model enhancements.

3.2 Research & Analysis

- Evaluation of Dispersion Algorithms: Advanced evaluation of EDMS dispersion algorithms and other modeling concepts will be conducted to improve the operation and accuracy of EDMS. The evaluation will include comparing various approaches, implementing promising approaches into a research model, testing for continuity, performing sensitivity studies, and coordinating with EPA and other US and European researchers.
- Multi-Year Validation Effort: Continue implementation of multi-year validation plan for EDMS including implementation of the field measurement plan and analysis of results.
- Assessment of Aircraft Performance Methodologies: EDMS developers will keep apprized of related research being performed for aircraft noise modeling and analysis purposes with the ultimate goal of including a dynamic aircraft profile generator in EDMS. In addition to considering refinements to the static flight profile approach, initial development of a dynamic aircraft profile generator for incorporation into EDMS will begin. The dynamic profile generator would be capable of taking into account user-supplied airport conditions and specific flight procedures.
- Air Quality Screening Tool: Review of the air quality screening tool prototype released in FY2001, and continued research and development.
- Aircraft PM: Continued support of the FAA long-term research effort to evaluate methods for computing aircraft PM emissions, as well as filling the aircraft PM emission factor data gap.
- Aircraft Plume Rise & Initial Release Characterization: Continue research into aircraft plume rise and initial plume spread. Based on initial research, begin development of an approach for modeling aircraft plume rise within EDMS, as well as a refined approach for characterizing the initial aircraft plume spread.
- Construction Emissions: Continue research on a preliminary method and/or guidance for handling airport construction emissions.

3.3 Major Milestones

- EDMS Release: FAA anticipates release of a new version of EDMS in the last quarter of FY2002. Based on model development activities in FY2001 and FY2002, the new EDMS release will include improved flight profile capability, dispersion algorithm improvements as a result of the ongoing validation effort, incorporation of a “short-term” approach for computing aircraft particulate matter (PM) emissions, improved and updated databases, and improved methodologies for assessing stationary source and GSE emissions.

4.0 Fiscal Years 2004-2005 Activities

Activities planned for FY2004-2005 include the following:

4.1 Model Development

- Database Update and Enhancement: It is very likely that by FY2004-2005 new data will be available on aircraft, APU, and GSE emission factors. As previously mentioned, it is a key element of EDMS to have up-to-date data for its calculations. FAA will continue to update and enhance EDMS system databases with newly available information on aircraft, APUs, and GSE during FY2004-2005
- Dispersion Algorithms: Update EDMS, if necessary, to remain compatible with the most-recent release of EPA's AERMOD, and incorporate results of FAA's advanced evaluation of algorithmic performance and ongoing model validation effort.
- Aircraft PM: Based on research and coordination on aircraft PM, incorporate into EDMS any new data or developments in estimating aircraft PM emissions. This will be a significant enhancement to the model, since EDMS is currently unable to estimate aircraft PM emissions due to the lack of data.
- Enhanced User Flexibility: EDMS user flexibility will continue to be enhanced in FY2004-FY2005 through several activities including additional importing capabilities, expanded viewing capabilities, and improved input screens.
- Assessment of Aircraft Performance Methodologies: Based on industry agreement of advances in research being performed for aircraft noise modeling and analysis purposes, incorporate a dynamic aircraft profile generator within EDMS. During FY2001, a static lookup-table of aircraft profiles for a fixed set of aircraft weights will be provided in EDMS. While this is a significant improvement to the model, in order to offer the user complete flexibility for modeling specific aircraft operations, the profile generator will be included.
- Operational Modeling: By enabling EDMS to interface with AERMOD for dispersion calculations, it became possible to model significantly more complex studies. AERMOD allows the user to model terrain and topography impacts, which increases the accuracy. Advanced users will be able to take full advantage of these features with the FY2004-2005 release of EDMS, while users not requiring this level of fidelity will be able to continue using EDMS without terrain and topography data.
- Aircraft Plume Rise & Initial Release Characterization: Currently, it is not possible to model plume rise from jet engine exhaust in EDMS. However, many users believe that being able to model this would dramatically improve the accuracy of the model. Based on FAA research, it is anticipated that it will be possible to model aircraft plume rise in a FY2004-2005 release of EDMS. Although EDMS currently allows the user to characterize the initial release of the aircraft plume

(i.e., the initial sigma values), FAA also anticipates that research will lead to a more refined characterization in a FY2004-2005 release of EDMS.

- Model Documentation: Update and enhance the EDMS User Manual and Online-Help to be consistent with FY2004 and FY2005 model enhancements.

4.2 Research & Analysis

- Evaluation of Dispersion Algorithms: If significant changes to the dispersion algorithms within AERMOD are implemented, then an evaluation of their continued applicability to the unique sources within EDMS will be required. In addition, if new dispersion models suitable for use in EDMS are introduced and approved by EPA, then they will need to be considered as well.
- Multi-Year Validation Effort: Continued implementation of multi-year validation plan for EDMS including implementation of the field measurement plan and analysis of results.
- Assessment of Aircraft Performance Methodologies: Based on industry agreement of related research being performed for aircraft noise modeling and analysis purposes, complete development of an initial dynamic aircraft profile generator for inclusion in EDMS. Continue advanced analysis and development of the dynamic aircraft profile generation methodology for refinement of the EDMS capability.
- Air Quality Screening Tool: Continued research and development of a refined air-quality screening tool for assessment of apparently minor changes in aircraft-related activity.
- Aircraft PM: Continued support of FAA's long-term research effort to evaluate methods for computing aircraft PM emissions and fill aircraft PM data gaps.
- Construction Emissions: Develop a method and guidance for handling airport construction emissions.

4.3 Major Milestones

- EDMS Release: FAA anticipates release of a new version of EDMS in FY2005. The improved version of EDMS will include dynamic flight profile generation, enhanced dispersion algorithm improvements as a result of the ongoing validation effort, enhanced operational modeling, aircraft plume rise impacts, a refined characterization of the initial aircraft plume spread, and any new data or developments in estimating aircraft PM emissions.

5.0 Summary of Activities and Milestones

The final section of this document provides a summary of major activities and milestones.

Activities	Program Schedule				
	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005
Model Development					
Release of EDMS version 4.0	◇				
Release of FY2002 version of EDMS		◇			
Release of FY2005 version of EDMS					◇
Research & Analysis					
Development and implementation of a multi-year plan for validation of EDMS; continued activities related to development and validation of EDMS and associated databases	◇	—	—	—	—
Evaluate and Upgrade GSE databases	—	◇			
Aircraft plume rise research and annual progress reports	◇	◇	◇	◇	
Documentation of findings from the testing and evaluation of new EDMS dispersion algorithms and continued development	◇	—	—	—	—
Analysis of potential refinements to the static aircraft flight profile approach incorporated in FY01	—	—	—	—	
Analysis and development of a dynamic aircraft flight profile generator for incorporation into EDMS	—	—	—	—	
Release and evaluation of a prototype air quality screening tool	◇	—	—	—	
Development of a short-term recommendation for estimating aircraft PM emissions using available data	◇				