An Integrated Environmental Information System (EIS) 
Implemented with Base SAS*, SAS/FSP*, SAS/AF*, and SAS/OR*

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The Connecticut Department of Environmental Protection (DEP), Air Compliance Unit (ACU), is currently designing and implementing an integrated Environmental Information System (EIS). The EIS is comprised of three major components: Technical component, Administrative component, and Air Quality component (see Figure 1). The Technical component is comprised of eight subsystems which are used for managing the technical aspects associated with the regulatory role of the ACU. The Administrative component is comprised of two major subsystems which are used for tracking all major tasks and monetary resources associated with the Air Program. The Air Quality component is comprised of two subsystems. One subsystem is used for the collection, storage, and retrieval of real-time meteorological and air quality data. The other subsystem is used for the storage and retrieval of processed data which has been refined and edited. The subsystem is also used for the storage of non-continuous data which is collected manually.

The EIS resides on the ACU’s Data General (DG) MV/10000 and MV/15000* mini-computer systems linked together using Xyloc and running DG’s Advanced Operating System with Virtual Storage (ACOS/VS) (see Figure 2). The EIS was written using Base SAS, SAS/GRAPH, SAS/FSP, SAS/AF, and SAS/OR.

This paper will briefly describe the Administrative and Air Quality components and will focus in detail on the Technical component of the subject EIS.

Administrative Component

The Administrative component (see Figure 3) is comprised of the Task Tracking and PR/Budget subsystems. The Task Tracking subsystem is used by the Director of the Air Compliance Unit to track all major tasks associated with the management and direction of the ACU. Tasks associated with the following disciplines are tracked: air dispersion modeling, permit review, source inspections, stack tests, administrative enforcement, and other general tasks. Task items tracked include the following data issued: due date; staff person issued task; status of task; status update; task number; task priority; estimated man-hours; actual man-hours; task description; task comments; and a flag to indicate whether the task is associated with a Federal budgetary grant requirement.

The PR/BUDGET subsystem is used by the Administrative Management Section of the ACU for tracking various elements associated with the general administration of the Air Program and by the Director to prepare ACU budgets. Included are budget management, purchase request tracking, warranty maintenance information, magazine subscription information, and a computerized library module.

Air Quality Component

The Air Quality component (see Figure 4) is comprised of two subsystems: the Data Acquisition subsystem and Air Quality Data Handling subsystem. These two subsystems are used by the ACU’s Air Monitoring Section for the collection, storage, and analysis of air quality and meteorological data. Real-time data is collected several times a day from approximately twenty-five (25) remote monitoring sites throughout the State of Connecticut. This data is reduced and stored in the current file for subsequent analysis and display. After a one-year period the current file is moved to the archive file. The Air Quality Data Handling subsystem is used for data storage and the production of reports needed to meet Federal data reporting criteria.

Technical Component

The Technical Component (see Figure 5) is currently comprised of eight (8) operational subsystems. Five (5) additional subsystems are in various stages of development. The aforementioned subsystems are used by three (3) of the four (4) major sections which comprise the ACU: The Technical Services Section, the Enforcement Section, and the New Source Review/Administrative Enforcement Section.

The thirteen (13) subsystems within this component were all developed with the Data General (DG) version of SAS. SAS/Base was initially used to build the SAS datasets. The SAS datasets comprising these subsystems were then read with SAS/FSP so that customized screens could be developed for editing and browsing SAS/FSP-FL/LETTER was extensively used in order to generate the large amount of form letters associated with a regulatory program. Once the screens were modified to user satisfaction, SAS/AF was used to build the user friendly menu's needed for access to the subsystems.

In order to facilitate the integration of information within the various subsystems which comprise the EIS, the ACU requires that all subsystems developed by ACU engineers contain unique identifiers. The unique identifiers used by the ACU are known as the Client, Sequence, Town, and Premise numbers. Since all ACU subsystems contain this unique identifier, ACU engineers can create any number of data files containing specifically requested information from any combination of subsystems. The Technical Services Section has been delegated the task of assigning keys, for use in all files, to ensure a unique identifier.

Information systems developed by other line units within the Environmental Quality (EQ) Division of DEP (e.g., Water Compliance) are required to contain the aforementioned identifiers. Consequently, MS systems developed by various line units in the EQ Division can be merged into a common EQ/M S for whatever purpose desired (e.g., when deciding whether to grant a particular company an air pollution construction permit, the Commissioner may want to see whether the DEP has any outstanding enforcement actions against this company for violations of other environmental statutes or regulations; this can be accomplished by merging the enforcement compliance history files of the appropriate line units).

Another unique feature of the EIS focuses on the means by which transaction records are integrated into the various subsystems. Since data in most subsystems are related to one another, transaction records are created during off-peak hours. These transaction records are then reviewed by the engineers who are responsible for the various subsystems to ensure that the quality of the data meets their individual requirements. Once the data has been reviewed, it is then processed and added to the various subsystems. This technique ensures that only the engineer who is responsible for the subsystem is able to change that data. An example of this technique is presented later in this paper.

The following is a brief description of the aforementioned subsystems:

Source Emissions Inventory

The Source Emissions Inventory Subsystem contains detailed information on the air pollutant stack emissions generated by manufac-
turing processes and fuel burning equipment throughout the State. Three files are used to store the information. The Parent file contains 5,294 observations identifying corporations with companies operating in the State. The Premise file contains 7,321 observations identifying the companies in the State. The Detail file contains 13,585 observations of detailed information on each point source of air pollution in the State. The three files contain a common key so that merging can occur. This database is also updated on an annual basis through mailings and by information collected in other subsystems. A SAS/AF menu application with SAS/FSP using 5 customized input screens is used to maintain these files (See Figures 6-10). This subsystem also maintains an inventory of sources categorized as area sources. This database contains emissions generated by motor vehicles and point sources too small to track on a point by point basis (e.g., emissions from residential and small business boilers, etc.). This subsystem and its interaction with the other subsystems described herein will be discussed in more detail below.

Permit Subsystem

The Permit Subsystem is used by ACU Permit Review Engineers to track their reviews of permit applications. Applications are submitted by Connecticut business and industry who are required to obtain permits to construct and operate "sources" under the Air Regulations. Each application is logged in and assigned to an engineer. Each engineer is responsible for processing 15 to 35 applications at any one time. Each review can involve up to 12 steps including air pollutant and toxic emissions calculations, an ambient impact modeling analysis, meeting public comment requirements, on-site inspections and acceptance of any operating restrictions. PROC FSEEDIT is used to database approximately 600 variables for each permit, maintain a correspondence log, and determine allowable toxic emissions.

Source Compliance Subsystem

The Source Compliance Subsystem is a detailed inventory of the raw materials used in all major manufacturing processes and fuel burning sources in the State. Detailed information on each facility's location, other sites operated by the company, the average weekly usage of raw materials, annual fuel usage, and information regarding suppliers of chemical materials is contained within this subsystem. PROC FSEEDIT is used to update this database using information obtained from a questionnaire the ACU mails out to each company on an annual basis.

Inspection Laptop Subsystem

The Inspection Laptop Subsystem is designed to give the field inspectors better access to ACU information while conducting an on-site investigation. This will involve the transfer of data needed by the field inspectors to portable laptop computers they would carry into the field. Therefore, if any questions arise concerning ACU database files or if more correct data can be supplied by the company, the inspectors will have the capability of updating the information while in the field. This subsystem will also allow the inspector to prepare his/her inspection report.

Enforcement Control Subsystem

The Enforcement Control Subsystem tracks all of the enforcement activities initiated by the ACU. Each Notice of Violation issued is logged into this database using PROC FSEEDIT and is tracked until the violating source comes back into compliance. In cases where a serious problem must be handled by issuing a State Order and/or Civil Penalty, this database will enable the staff to record each action taken, request reports on the status of the actions needed to be taken, and eventually, prepare form letters to sources delinquent in responding to prescribed actions.

Compliance Data Subsystem

The Compliance Data Subsystem is a database maintained to meet Federal reporting requirements primarily on State level enforcement activities. Each quarter, data collected during that quarter is culled out of the database and put on magnetic tape and sent to the National Computer Center for inclusion in a Federal national database which tracks Federal and State enforcement activities.

SARA Right-to-Know Subsystem

The SARA Right-To-Know Subsystem is used to record information regarding toxic and hazardous material storage and use by companies in the State. This database of information then becomes available to Local Emergency Planning Commissions to assist them with the development of emergency action plans. In addition, Freedom of Information requests can be fulfilled using this database of information.

Inspection Tracking Subsystem

The Inspection Tracking Subsystem was designed to track requests for on-site inspections to be conducted by ACU field inspectors. This subsystem consists of two modules in order to serve a dual purpose. As each request is logged in, one purpose is to track all activity leading to a final outcome for each request. Since a significant activity in responding to a complaint or inspection request is the actual scheduling of an inspector to visit the site in question, the second module is a resource management tool which is used by a dispatcher to prepare daily inspection schedules for each field inspector.

Asbestos Subsystem

The Asbestos Subsystem will track the activity of contractors involved in asbestos demolition/renovation projects throughout the State and provide information regarding inspections made by ACU inspectors to determine compliance with applicable regulations. This subsystem will eventually feed data into the Inspection subsystem. Both the Department of Health Services and the DEP will be involved in maintaining this subsystem.

Complaint Tracking Subsystem

The Complaint Tracking Subsystem will be used to record information supplied by people filing telephone complaints with the ACU. This subsystem will eventually feed data into the Inspection Tracking Subsystem in an effort by the ACU to become more responsive to citizens' complaints regarding air pollution.

Toxic Air Pollutant Retrieval Subsystem

The Toxic Air Pollution Retrieval Subsystem is designed to catalog information regarding the chemical properties of toxic and hazardous chemical compounds regulated by the State. It contains parameters such as CAS number, OSHA and NIOSH limits, 30-minute and 8-hour threshold exposure limits (based on toxicity). In addition, many of the common names used by industry and the public to describe these chemicals are cataloged so that the file may be searched using one or more of the commonly known names.

Stack Test Subsystem

The Stack Test Subsystem will contain data involving stack tests required by the Air Regulations. According to the Air Regulations, all major sources are required to be stack tested on a regular basis to verify compliance with the regulatory emission limits. In addition, new large sources may be required to submit stack test results in order to obtain a Permit to Operate. The Information compiled here will also be used to update the emission inventories.
Continuous Emissions Monitoring Subsystem

The Continuous Emissions Monitoring Subsystem will enable the ACU to collect information on a near real time basis of stack emissions. Several major newly permitted sources will be required to send stack test data to the ACU through a computer link on an ongoing basis. This Subsystem will be designed to collect and summarize this data in an effort to better track compliance with regulatory limitations.

Example of Subsystem Relationships

The Source Emissions Inventory (SEIS) contains data collected through a wide variety of sources (see Figure 11). In addition, the SEIS is interrelated with the other twelve (12) subsystems which comprise the Technical Component of the EIS (see Figure B). When an update is made directly to the SEIS, a transaction file for the Source Compliance Subsystem (SCS) is automatically generated and sent to the engineer responsible for the SCS. The transaction file is in the form of a SAS dataset and can then be read into a SAS/FSP menu for review. If the SCS engineer is satisfied with the information in the transaction dataset, he/she can initiate a menu-driven task to update the SCS subsystem. If there is a problem with the transaction dataset, the engineer can return it to the originator. Conversely, six (6) subsystems can also generate transaction records for the SEIS. The engineer responsible for the EIS has several menu-driven (SAS/AF) options to choose from when he/she receives these various transaction datasets. He/she may choose to accept and add them to his/her subsystem, he/she may return them to the originator, or he/she may choose to edit them directly and then add them to the subsystem. The central idea is that the engineers in charge of their individual subsystems have virtual control as to how they want to implement changes and additions.

The ACU has deliberately chosen to design all of these Subsystems in SAS to take advantage of the many ways in which data maintained by different ACU Groups can be easily integrated, manipulated and summarized. Each Group responsible for using and maintaining the existing Subsystems have formed User Groups which meet once each month. These meetings are typically a forum where problems are discussed and resolved and enhancements can be explored. In addition, the ACU has encouraged the staff's use of SAS by sponsoring a number of in-house training courses. Three 3-day sessions were held in 1987 and six 2- to 3-day sessions are planned to be held in 1989.

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FIGURE 2
ACU DATA PROCESSING SECTION - COMPUTER SYSTEM CONFIGURATION

DATA GENERAL MV10000
24 MEGABYTES RAM
AOS/VS OPERATING SYSTEM
4.5 GIGABYTES ON-LINE DISK

XODIAC LINK

DATA GENERAL MV15000
4 MEGABYTES RAM
2.25 GIGABYTES ON-LINE DISK

[Diagram of computer system configuration showing various components, drives, and connections]