Virginia's Point Source Inventory System Experience - Transition from AFS to CEDS

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ABSTRACT

During most of the 1990's, Virginia has used the AIRS Facility Subsystem (AFS) to maintain air emissions inventory data for stationary point sources. However, beginning in 1997, the Virginia Department of Environmental Quality (VDEQ) began the development of a comprehensive multi-media facility data system to meet the Department's current and future environmental data needs. The Comprehensive Environmental Data System (CEDS) has been the result of this effort, and represents a new chapter in the Department's data management program.

The basic structure of the CEDS system is as follows. The system centers on a core business area of common "facility" level data. Major media-specific data modules (air, water, and waste) are linked to the core level through a common facility identifier. This paper will include a general discussion of the structure and main features of the overall system. The air program portion of the system is partitioned into facility, permits, compliance and enforcement, and emissions modules. This paper will touch on all these modules, but will focus of the air emissions inventory module that maintains the traditional point source emissions and related data. In developing the emissions inventory module, the basic data model and structure of the AIRS Facility Subsystem was used as a starting point. From there, a consolidation of screens and data items was performed to improve the flow of data entry and viewing. The inventory has many features such as computer calculation of data and online reports. Separate sub-modules for allowable limits and SIP emissions data have also been developed.

Finally, this paper will discuss the general experience of the transition from AFS to CEDS for point source inventory purposes, including the issues and problems encountered, as well as the lessons learned during the process.

INTRODUCTION

In 1991, the Department of Air Pollution Control (DAPC) made the decision to use the Aerometric Information Retrieval System's (AIRS) Facility Subsystem as the Department's data system for stationary point source air pollutant emissions information. Prior to this, the Department had used a state operated Emissions Inventory System (EIS) program provided by EPA.   However, this program and the supporting hardware had become obsolete. The decision to use AFS was made due to the fact that it was fully developed and operational, and was available to Department via a direct communication line to the National Computer Center. In addition, there was a substantial cost saving in using AFS, as opposed to developing a new or updated state emissions inventory system.

To utilize AFS for emissions inventory purposes, several years of emissions inventory data were loaded into AFS, beginning with 1990. Once this was completed, access was provided to the Department's regional office staff and the first annual inventory was compiled online for calendar year 1993. This process was then repeated for the inventory years from 1994 to 1998. While this arrangement lasted, AFS provided the Department with a workable and reliable emissions inventory system.

However, in 1997 the Department began an agency wide evaluation of its environmental databases and systems. The end result of this evaluation was a decision to develop an in-house comprehensive multi-media data system to maintain all its major environmental data needs. The idea of CEDS was created at this time. The development of this system was driven by the issues and motives described below:

- Consolidation of numerous separate environmental data bases into one single data system, using a common system platform and data architecture.

- Reduction of database maintenance/support costs, and data loss risks associated with many separate systems.

- Resolution of potential year 2000 problems of the existing systems.

- Replacement of obsolete systems, or systems scheduled to be discontinued.

TRANSITION FROM AFS TO CEDS

The development of CEDS and the transition from AFS to this new system for emissions inventory purposes will be described in this section. This will include a description of the CEDS development process and timeline, the overall system architecture and structure, and the specific structure and features of the air emissions inventory module.

CEDS Development Process

Once the decision was made to develop in-house, all-inclusive environmental data system, VDEQ established an initial development group that was to work with a system development consultant. The purpose of this group was to:

- Define the existing Department systems for potential inclusion in CEDS,

- identify additional CEDS system needs and requirements, and

- develop a system analysis and design document to serve as the system development guide.

Since an existing system identification and evaluation project identified that over 100 separate environmental data systems existed within the Department at the time, this initial group was very large and had to be divided into several subgroups (along major media lines). In hindsight, this was too large a group and too many systems to deal with effectively which hindered the focus and progress of the group. The resulting products of this initial system design effort also suffered from a lack of focus and continuity. This initial effort began in 1997 and was completed in early 1998.

After the delivery of the initial group's final document, it was determined that additional work was required to define or redefine the CEDS conceptual system design. To accomplish this, smaller media specific design groups were established to work directly with the system design engineers and programmers to move the overall project forward.   These workgroups began in 1998 and continued though much of 1999. During 1998, the initial system design and data structure was developed, along with screen layouts and other basic system features. This was followed by actual system development and test deployment in 1999.

During this two-year period, the air emissions inventory module took shape along with the other air program modules. During this time, preparations for downloading historical emissions data from AFS were begun. The inclusion of the emissions inventory module in the initial release of CEDS became much more urgent during this time due to EPA's announcement that the emissions inventory module of AFS would be discontinued by August of 2000.
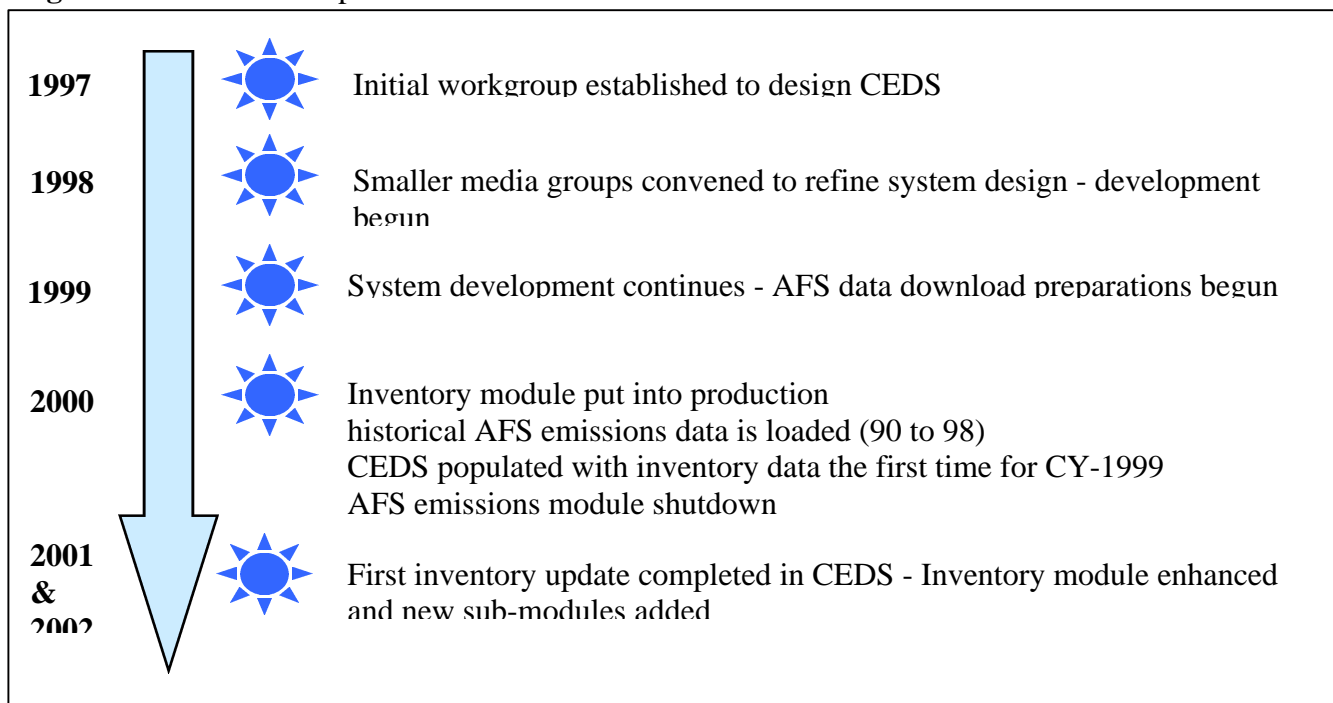
Calendar year 2000 became a critical year in the development of CEDS, and the transition from AFS to CEDS for emissions purposes. During this year, the initial operating version of CEDS was implemented. For the emissions inventory module, the following specific milestones were reached:

- The inventory module was put into production.

- Historical facility and emissions data for 1990 to 1998 was loaded in CEDS.

- In-house training on the use of the emission inventory module was provided.

- Emissions data was entered online in the system for calendar year 1999.

This was by far the most resource intensive year of effort involved in the entire system transition project, and took an extraordinary effort on the part of all involved. If circumstances had been different, the ability to spread all these tasks out over a longer period of time would have made this process less difficult and stressful.

During 2001, most of the work on the inventory module of CEDS was focussed on correcting bugs in the program, adding additional features and reports to the module, and adding a sub-module to maintain allowable limits associated with facilities at various levels (plant, stack, point, and segment). Thus far in 2002, the current work effort involves the development of a Title V fee assessment and adjustment screen to track and amend annual emissions fees. The CEDS development timeline discussed here is summarized in Figure 1.

**Figure 1.** CEDS Development Timeline

1997	Initial workgroup established to design CEDS
1998	Smaller media groups convened to refine system design - development begun
1999	System development continues - AFS data download preparations begun
2000	Inventory module put into production historical AFS emissions data is loaded (90 to 98) CEDS populated with inventory data the first time for CY-1999 AFS emissions module shutdown
2001 & 2002	First inventory update completed in CEDS - Inventory module enhanced and new sub-modules added

CEDS Design and Overall Data Structure

CEDS is an Oracle-based database and system. The main database of the system resides in the VDEQ central office, and actually consists of a number of redundant databases that are used for separate purposes such as production, reporting, and testing. The regional offices access these centralized databases through telecommunications links.

The data structure of CEDS, as mentioned earlier, consists of a core level of "facility" data which stores name and location information on all facilities tracked by one or more of the Department's programs. At this level, the system automatically assigns a core facility identifier that links all subordinate levels of data to the core record. Major media-specific data modules (air, water, waste, and others) are in turn linked to the core level using this core facility identifier. Other data stored at the core level includes geographic location coordinates, previous names, contacts, and other general facility data. Over 53,000 facilities are currently stored and tracked in CEDS.

The overall data structure of CEDS is presented in Figure 2.

Figure 2. CEDS Overall Database Structure
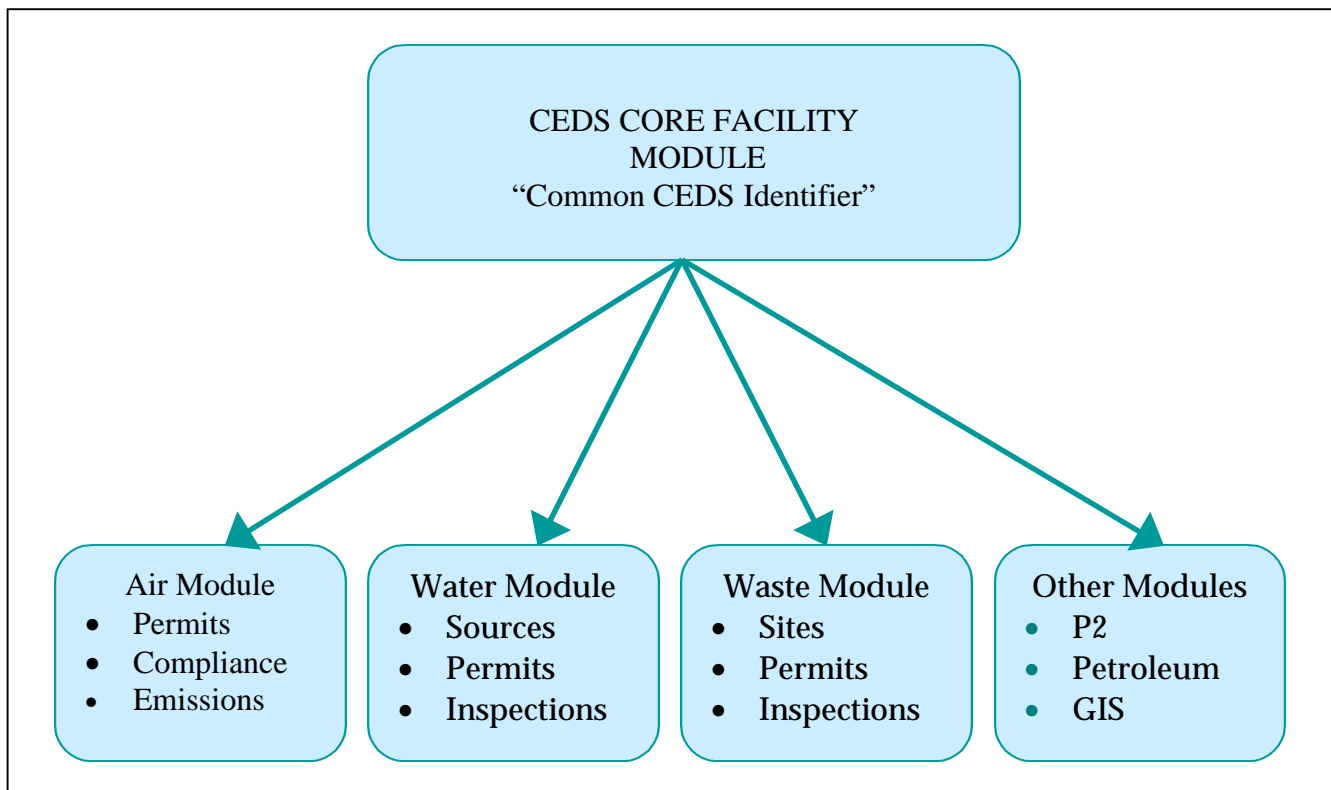
CEDS Air Module Structure

The air module of CEDS is structured in a similar manner to the core database structure. A main air facility data level exists which stores general facility data of interest and use to the air program. This air facility level can be accessed and viewed from the core CEDS facility level. An example of the combination core and air facility level screen in present in Appendix A of this paper.

From the air facility data screen, links are provided to key air program business areas that contain data specific to these functions. These areas are described below:

- General – Contains data on specific air emissions units such as equipment names, descriptions and capacities. Information on the major federal and state air programs that apply to a particular facility (PSD, NSR, NSPS, Title V, etc.) is also maintained here.

- Permit – Contains data on permits issued to a particular facility, events involved in the permitting process, specific permit requirements and conditions, and permit allowable emissions and operating limits.

- Compliance & Enforcement – Contains data on requirements relating to source compliance, source inspections, other compliance events, inspection targeting, and enforcement activities.

- Stage Two – Contains data on gasoline service stations relating to the installation, testing and inspection of Stage II vapor recovery equipment.

- Emissions – Contains data on air pollutant emissions. This module will be described in detail in the next section.

CEDS Air Emissions Inventory Module

The air emissions inventory module of CEDS was designed using the basic data module of the AFS emissions module. This was done for several reasons including those described below:

- Since VDEQ had used AFS prior to CEDS for inventory purposes, there was a substantial institutional knowledge base of this data structure.

- As stated earlier, the Department experience with AFS was generally favorable, although not without problems and areas needing improvement.

- Using the basic AFS structure ensured consistency with established emissions data collection procedures. It was also thought that this would support the continued submission of this data to EPA.

Provided below is a description of the levels and screens of the emissions inventory module. Examples of these screens are also presented in Appendix A of this paper.

Emissions Inventory Module – Main Data Form and Screens

This screen is structured in the traditional AFS emissions inventory data hierarchy with stack related data at the top and point, segment, and emissions data at the lower levels. One of the main drawbacks of AFS with regard to inventory data was the number of screens involved in entering and viewing this data. With that in mind, the main CEDS inventory module was designed as one large form with all the data levels available on one scrollable screen. The first part of this comprehensive form displays the stack and point level data.

The top of this screen provides general data on the facility and unit identification numbers being viewed, and the year of inventory. There are also a series of buttons that perform the following functions:

- Road Map – Produces an onscreen and printable report of the emissions unit structure of the facility including ID #s and unit descriptions.

- Pollutant Emissions Report – Produces a summary emissions report for the facility and at selected sub-facility levels.

- Consolidated Report – Produces a detailed report of all emissions inventory data for the facility.

- Increment Year – Increments the year of inventory to the next year for update purposes.

- Remove Year – Removes specific inventory years.

- Update Express – Accesses an abbreviated inventory form that facilitates quick data entry and update of emissions data.

Below these buttons on the screen is the actual stack and point levels of facility data. As was the case in AFS, these data levels cover the traditional types of data such as stack parameters, and emissions unit operating and size characteristics.

As one scrolls down the rest of the inventory form displays the segment and emissions data that is the foundation of the CEDS inventory module. The segment part of the form contains unit description, SCC, fuel, and throughput data that closely follows the AFS model. The emissions part of the form is the only place in the system where actual annual emissions data is stored. Emissions data for all higher levels is derived from this level. Emissions are presented by pollutant and data on control equipment is also stored here. This level is tied to a FIRE-derived emission factor file so that emissions can be automatically calculated if one chooses to use federal factors. Emissions can also be directly entered into the form if the estimates are based on some other estimation method such as CEM or stack test data.

Emissions Inventory Module – SIP Emissions Inventory Screen

Another problem experienced with AFS was the way in which different emissions types were displayed on the same screen. This was particularly problematic with ozone SIP related emission types such as ozone season daily and rule effectiveness estimates. Having these various emissions types on the same screen often caused great confusion to system users and the public. To resolve this problem the SIP inventory related emissions data in CEDS is calculated and stored in a separate screen. In this way the various annual and SIP related emissions estimates are kept separate to reduce the confusion involved.

The other main feature of this screen is that the ozone SIP emissions estimates are automatically calculated using a link to the main emissions form. These calculations are performed using standard formulas to convert annual emissions into the SIP related estimates. These calculated estimates can then be manually changed if more accurate data is available. This automatic calculation function of CEDS has substantially reduced the time and effort involved in developing ozone SIP inventories.

Emissions Inventory Module – Allowable Emission Limitation Screen

The other screen associated with both the emissions and permit modules of CEDS that deserves mention is the air allowable limits and emissions screen. This screen stores information on emission limits established by the Department at a facility and/or sub-facility level. This screen allows for the direct entry of allowable limit data, and is also linked to the main permit screen where limits can also be entered. This screen is also linked to the inventory module so that actual emissions data is displayed for quality assurance, audit, and compliance purposes.

The general structure of the air emissions inventory module of CEDS and the major links to other parts of the system are presented in Figure 3.

Figure 3. CEDS Air Emission Module Structure
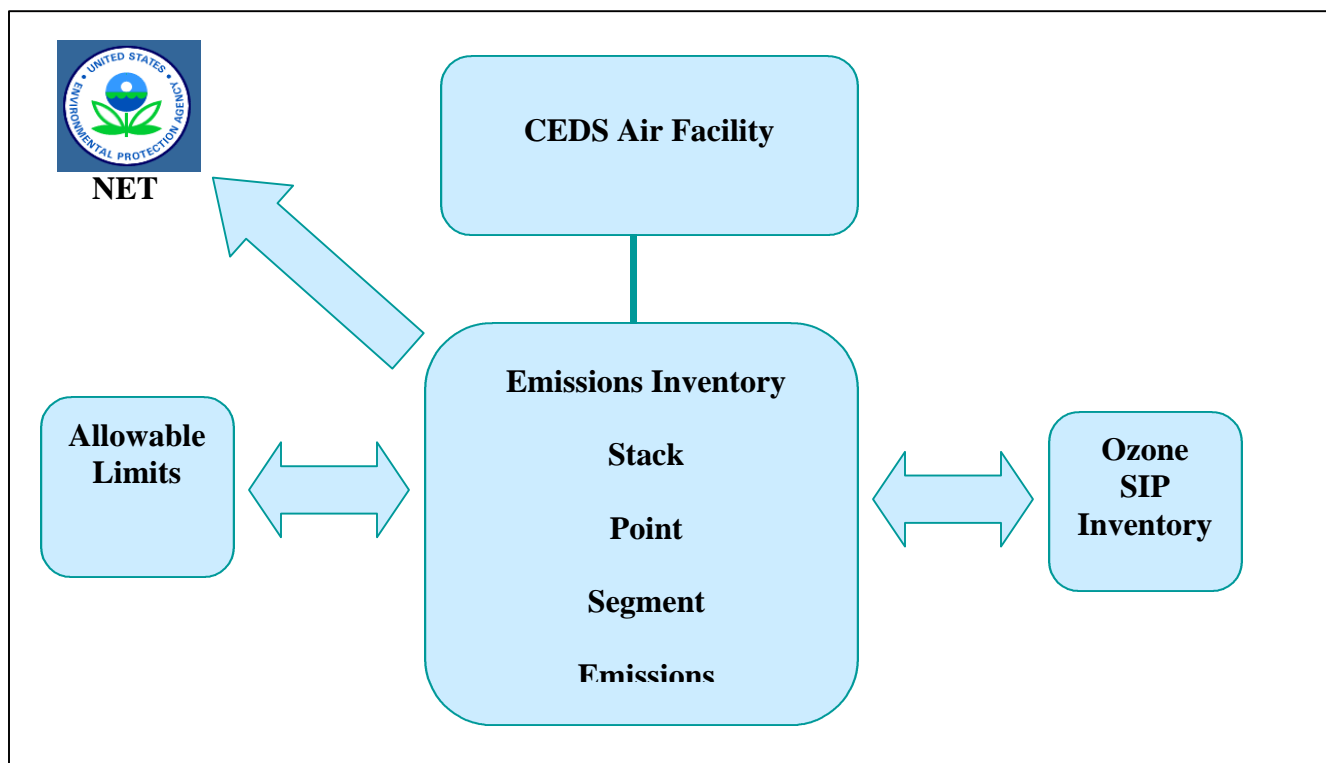
CONCLUSIONS

The conclusions of this paper come in the form of the lessons learned during the development of CEDS and the transition to this system from AFS. None of these conclusions are particularly profound or outside of the realm of common sense. However, they may be of interest to anyone about to embark on a similar adventure.

In general, the process of developing and implementing a new environmental data system is a long, arduous, and time-consuming process. It can especially be difficult for those responsible for air emissions inventories because although we like to think that the world revolves around our data and systems, it can be a relatively obscure, misunderstood, and sometimes overlooked function in terms of an agency-wide system development project. The one key that can be pointed to as the reason for our success in developing a well regarded inventory module, is the knowledge, experience, and hard work of the VDEQ emissions inventory staff that have seen this process through to a successful conclusion (thus far). This has been accomplished through their constant attention, persistence, and insistence that things be done the right way. It was also invaluable that a daily working relationship was established between the inventory staff and the consultant programmers involved in developing the module. One other key that has enabled us to make the transition from AFS to CEDS and continue the transfer of inventory data to and from EPA, was to always think of data transfer considerations when designing or modifying the new system.

Other specific observations and lessons learned are:

- Be prepared for failures and setbacks. Both will be encountered during a major system development project.
- Resist the temptation of trying to get the system to do too much, or creating a system that changes the way in which a basic business function is performed.

- If possible, involve outside resources (consultants) that are familiar with environmental programs and data systems.

- Keep workgroups involved in system development down to a reasonable working size, and make sure the right people are involved.

- Keep informed of the external data systems you deal with, and any changes in these systems so they can be accounted for this in the system being developed.

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KEY WORDS

AIRS Facility Subsystem (AFS)
Comprehensive Environmental Data System (CEDS)
Data Management
Emissions Inventory Systems

APPENDIX A
CEDS EMISSIONS INVENTORY EXAMPLE SCREENS

Figure 1. Core Facility and Air Facility Screen

Figure 2. Stack and Point Screen

Figure 3. Segment and Emissions Screen

Figure 4. Ozone SIP Inventory Screen

Figure 5. Allowable Limits Screen