An Integrated Approach to Meeting a State's Air Quality Data Needs, Encompassing Emission Inventory, Fees and Billing, Permits Development and Issuance, Compliance Monitoring and Enforcement, Source Testing, Ambient Monitoring, Stack Monitoring, SIP Strategy Development and Other Relational Aspects, Including Reporting to EPA

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Abstract

North Carolina has developed multiple integrated modules of a database that currently facilitates most functions of the Division and is expected to eventually encompass remaining elements of the states air quality management program. Even though development continues, the current capabilities provide valuable and unique support for the Division of Air Quality. These several modules share data elements that have universal field descriptions and field lengths (with exceptions where unique and justifiable differences must be maintained) through all modules, often those of the NIF where they overlap. The data model tables resulting are huge and complex. However, the data entries stored in these tables are accessible to any module in the system, as needed. This system is not yet fully complete, nor will it ever likely be, as it continues to be enhanced and to grow as the needs of the program evolve and grow (or subside), and as resources allow the application of more and more time saving and sensible inter-relationships. Some discussions of the costs of engineering and IT resources for the inventory components are provided, in limited detail, and contrasted with costs of using paper inventory forms, redundant or overlapping (not interrelated) systems and other data entry and quality assurance aspects.

This paper is intended to convey the concepts utilized in building this system to date, give some pointers to others on the hazards and benefits of such inter-organizational coordination, sharing of data, data entry efficiencies and discuss lessons learned. The discussions will not provide a template for the use of other agencies to build a duplicate system, but point out how such a system could be best conceived to meet the needs of the specific agency within a reasonable cost allowance, and result in an even better system than North Carolina DAQ now enjoys. Some enlightenment of how these data interface with multimedia data from other "sister" agencies in North Carolina up through EPA's master data system will be attempted.

Introduction

The primary author is only "passably computer literate." Thus, the three years spent organizing and leading a group of North Carolina Division of Air Quality (DAQ) staff and support contractors in efforts to develop an emission inventory system to interface with other existing computer programs, files and systems was a chore that involved many inputs and much cooperative support and team work. The widely skilled team of the Division's regional emission inventory practitioners and an able and unflinching IT staff, all functioning with a true team spirit, has resulted in a system for emission inventories that is web-addressable (in a reasonably user-friendly basis) by some 3,100 external facility "reporters," and often their consultants. This was no small undertaking, but well worth the effort.

Circumstances required that the resulting system to be as simple as possible, make both good common and good engineering sense, and be usable by a technical and a generally computer-familiar, but not necessarily emission-inventory-skilled staff at the agency and facility levels. Several modules of the overall system already existed or were under design, when the emission inventory system development was undertaken. The Division had previously used proprietary software for several years for the inventory functions and was familiar with the needs, terminology and general flow of information required. Thus, the team did not have to start from a blank page, but instead inherited some constraints, general rules and "hoops" to use as design criteria. These constraints helped to meld the system into an overall product that fits multiple needs throughout the Division. The discussions below is intended to lead the reader through some of the important thoughts, considerations, steps and constraints that North Carolina DAQ faced to arrive at a multiple user and multiple use system.

Overview of NC's Air Data Systems and Interfaces

The North Carolina DAQ is in the Department of Environment and Natural Resources (DENR - which also houses several other divisions that address water quality, pollution prevention, solid waste, forestry, and other diverse aspects of planning and regulation of the environment and natural resources within the state. DENR has also been working intensely with EPA 's Headquarter IT functional organizations and their staff to also integrate the state's data reporting functions into the national multi-media efforts. Substantial progress in these regards has been realized. The DAQ's air systems have become an integral part, even a template or pattern, for the other DENR divisions and the DENR overall departmental system and its structure. Data for facilities that have media-crossing regulations or requirements will eventually be accessible through one system, with layers of GIS-enriched data being accessible and capable of being displayed in multiple formats. The air data systems thus must meet a wide variety of requirements as outlined in the crude schematic in Figure 1. Further background and discussion of the individual modules follows.

The various divisions of labor are handled through the Planning, Technical Services, Permits and Ambient Monitoring Sections, and through the Division's seven

Regional field offices. These Sections are each under a chief that reports to the Division Director and his Deputy. The Regions similarly report to the Director and Deputy, with various aspects of that Division be handled more by one than the other, depending upon the function. In addition, the Director's office also oversees an administrative staff which includes the administration of the IT staff and functions. However, the IT staff are also connected to Departmental and higher IT staff through the various methods common in the IT arena (planning tools, approval mechanisms and procedures, etc.). The point being attempted here is that there are a lot of functions being carried out by diverse groups and that the data system and its modules serve as a major assist and focus for many of the interactions and knowledge transfers among those individuals and groups. Thus, it is critical that everyone use the same information to the extent feasible and that the data only be entered one time into the data system.

In addition, overseeing or guiding the IT functions, and their integration with the mission of the Division, is the IT Steering Committee. It is its role to provide an overview function, analyzing the needs of the Division and guiding how the IT services and systems might help those missions to be accomplished more efficiently, more timely, and with less expense, so as to meet schedules and requirements etc. It serves as a review and priority-setting group viewing the Division and its functions both horizontally and vertically to make sure that needs are met to the best degree possible. All this requires common information and efficiency.

Each module, in turn, is associated with a specific list of identified individuals who are the user group for assuring that the proper information is collected, processed properly, and generally they write the business rules (BR's) in great detail for making the desired function happen. The user group then works with the assigned IT individual or individuals to interact in making the code simulate the real world situation and functions desired. The group then tests the developed code and authorizes the "process" for activation into the "live" system. The group also continues to monitor day-to-day operations of the module and identifies enhancements and further business rules as they are needed. The tie to the IT staff at this point is critical and a good working relationship and interaction is needed, often on a quick response basis.

Permit-Based Focus

North Carolina DAQ, as many other states, relies heavily on a permit-orientation to carry out its charter, functions and goals. Though DAQ has planning functions, rule development functions, enforcement/compliance functions, ambient monitoring roles, etc., but a major load of the day-to-day implementation responsibility lies in the permit development and application process. A major external relationship "node" of a regulated facility is thus through that permit process and that particular facility's permit. The facility owner/staff tend to view the Division as that authority that grants them the ability to operate and prescribes what conditions apply to the facility. Thus, a major burden lies with the data, information to make sure that the permit reflects the appropriate rules and restrictions/conditions and that the State Implementation Plan (SIP) is appropriately inclusive and consistent with that interface.

Title V facilities are required to report their annual actual emissions each year. This accounting must address actual emissions from the permitted and other emission sources within the facility and includes criteria pollutants, but also all federal Hazardous Air Pollutants (HAPs), and all North Carolina Toxic Air Pollutants (TAPs). These actual emissions are used to assess the annual fees based on the previous year's inventory. The permitted sources must be (and are) kept consistent (exact) with the source descriptions and other information in the permit. Permit fees are assessed on the reported and confirmed emissions. A module also handles fee calculation and invoicing, in the same system, using the results of the inventory.

Facilities holding permits classified as Synthetic Minors and Small are required to inventory their emissions only once each 5 years, at the time of their permit renewal application. Though there are likely important excursion years (events), this schedule allows compliance with the CERR regulations from EPA. It also allows DAQ to maintain a low-impact inventory for these smaller facilities, which when coupled with a moderately rigorous inspection function, allows one to monitor the stability of emissions from these smaller facilities.

Facilities Module

North Carolina has approximately 3,100 facilities that qualify for point source status. Approximately 400 of these (down from about 600 in the last half dozen years while the first round of final Title V's were being issued) are Title V facilities, which potentially surpass the 100 ton/year classification limits for the criteria pollutants and the 10/25 ton/year limits for Hazardous Air Pollutants (HAPs) and a supplemental list of Toxic Air Pollutants.(TAPs) under the North Carolina Air Toxics Program. The Synthetic Minor category of facilities "could have been" Title V if they had not chosen to take state and federally enforceable limits to reduce their potential. The remaining point source facilities fall into the permit category classified as Small. The number of Synthetic Minor and Small facilities totals to about 2700.

The Facilities Module could probably be characterized as the "backbone" of the system. This module stores all the names, identification numbers, geographic information (including longitude/latitude, addresses, etc), the contact information, etc. This module contains, or functions as, the address book and meta data for the entire facility. Details such as equipment permitted and other information in the facility are not necessarily stored in this module and its tables, but the information is linked with other tables and modules by means of common identifiers. Note that this does not necessarily mean that the same information may not exist in more than one table, but the linking and system rules require the actual storage to be done once so that a change in one location means that the "same" information changes in other locations.

Any calculations, etc. that may be required are handled within the appropriate modules. For example, North Carolina uses the longitude and latitude as the geo-locator. The system transforms those coordinates to United Transverse Mercator (UTM) or whatever alternate form is needed by the user, through pre-defined relationships.

Emission Source Module

This module is a holding area for emission source (equipment and control device or system) information. The identification of the equipment, using the nomenclature of the applicant and/or a former permit are included here with such information as design rate, rated capacity, etc. Since permit requirements include control device information, each control device must be listed here along with the descriptors as to type, control efficiency, etc. (Using NIF terminologies as possible) that are used in the inventory and permits modules for emission estimation. A key function of this module is that it serves as the place to add or review this kind of information so that it is available and always consistent whether a permit, an inventory, enforcement action, fee invoice, etc. is being process. This reduces or eliminates the confusion and time required for multiple entries that may vary so that the users are not fully certain as to whether the same piece of equipment is involved.

Keeping the data in this module up to date and correct is primarily the function of the permit staff as they are the first usually to get a permit modification or application, which may trigger an update of the data in the module. One exception is that there is a "U" prefix allowed in the emission inventory module to provide a way to enter emission sources that are not on the permit (sometimes meaning there is a related permit violation). Since one of the purposes of the permitting process is to assure that all emission sources are addressed, this will likely also have opportunity to cause an interface with the compliance module when the "U source" is a legitimate emission source that should have been on the permit. Again, another advantage of interlinking functions through different modules in the same overall system.

Permits Module

The permit module capabilities are generally divided by classification of permit. For non-Title V, the system is set up to write (actually provide assistance and consistency to the permit writer) the permit directly with appropriate language being available for the specific equipment list used. Future modules and applications are planned that will allow the facility staff to access the current information on the web and update it in an application renewal or new application process. The permit module also utilizes information in the Fees module, the Emission Source module and provides output to the Fees module. This information in turn feeds the emission inventory module.

Emission Inventory Module

The North Carolina Division of Air Quality has a continuing emission inventory effort for all criteria and federal hazardous air pollutants (HAPs) as well as for over 100 additional pollutants on the state's own toxic air pollutant list. There have been several changes in the procedures and frequency for collecting these data over the past few years. The summary below is general and covers the main points.

- Facilities holding a Title V permit are inventoried each year for all criteria pollutants and HAPs (Generally, the CERR-reporting-required facilities, about 400 in number).

    - These data are either submitted through the state's on line system (AERO) by the facility or by means of pre-filled paper forms which the facility uses to update and enter current data. (Approximately >75% of facilities now enter their data on-line).
    - Title V's generally account for a very large percentage of any one pollutant of interest, but there are a few exceptions.
    - DAQ regional office (field) staff review the inventories entered and approve them or go back to the facility and dispute or clarify information submitted until criteria for approval are satisfied. In most cases, the reviewer is also the inspector who has been at the facility within the past few months and familiar with it.
    - If inventories are not submitted, the facility is likely issued aNotice of Violation of permit requirements and subject to punitive actions (fines, suspension of permit, etc.)
- Facilities that have a Small or Synthetic Minor permit classification (Generally, below CERR reporting requirement cut-off; approximately 2,700 facilities)
    - Were last inventoried as a whole group for CY 1999
    - Are now inventoried on a revolving 5-year cycle,
        - with updated inventory required for most recent calendar year
        - upon application for permit renewal
        - emissions in interim periods assumed same as last reported year, unless inspectors determine reason to doubt and require added inventory from facility.
    - Use web-based internet system (but with lower percentage participation)
    - Otherwise, are reviewed and approved under the same process and procedures as the TV facilities.

The emission inventory module (or Emission Data – "ED" module) provides a key link in the collection, review and use of the data system overall. The facility user may access the Air Emissions Reporting On-line (AERO) system via the internet and gain access using a PIN and ID # provided in a letter that was generated by ED (and mailed for tracking and compliance purposes), where their previous year's data from ED (for Title V facilities) are used in many cases as defaults, etc. The changes that may have taken place in their permit since the last submittal will show up here with appropriate information required to update the emissions information as required in the NIF. About 50% for the smaller non-Title V facilities which only have to submit an inventory each fifth year upon permit renewal, or more often if circumstances warrant.

Facility users also have the option to select a form option within the web system. This selection will generate the forms with available and appropriate information being pre-filled from other modules and the ED data for the previous year shown for comparison. The users of this option thus far are more likely to be the smaller facilities that only do their inventory once each fifth year on a rolling basis. These facilities are also identified by the system as to when their renewal and inventory are due and the certified letter to them is generated automatically (or semi-automatically). Instructions for use of the forms reside on the DAQ web pages along with printable lists of the

pollutants required (criteria, CAA HAPs, NC TAPs, and now another list for TBAC and perhaps, Greenhouse gases in the future).

When the data are submitted, regional office inspectors and other inventory staff review them. The system accepts an approve command and they are then "officially" in ED. From here, the data may be accessed by a number of reports, either publicly on the DAQ web pages or internally on the LAN. The internal "canned" reports allow for both data analysis and for management (who has/has not submitted, who is assigned reviewer, when were the data received, what were the facilities comments, etc.). The system will also generate custom data tables that may accessed by those who wish to make queries and generate custom reports. These reports are done from a frequently updated data table to allow the preservation of security measures.

Fees Module

After the inventory data are entered into the system, and approved by the regional office staff (often the inspector who has actually been on site and familiar with the facility), the data flow to the Fees module where the emissions information is used to generate a fee determination and an invoice to be sent to the proper contact (from Facilities Module) in the proper office (from Facilities Module) of the proper facility by the proper time. Invoice due dates are also keyed to the permit renewal date so that they all are not due to be sent at the same time. Depending upon whether the facility is permitted as a Title V or non-Title V, the permit fee is calculated based on emissions or on a flat fee basis, respectively. The system handles tracking of the flow of information and also the receipt or non-receipt and penalty steps of the money trail.

Compliance and Enforcement (Module nearing final development)

When data are solicited and the inventories are received, the dates are automatically or semi-automatically entered into the system. For inventories submitted through AERO, the entry of the receipt dates is automatic. If beyond the due date, the system will identify that a Notice of Violation (NOV) should be sent and various tools provided to assist in generating such a notice. Subsequently, official documents regarding any facility are stored in the **Documents Module**. Similarly, inspection information, rule violation information, tracking of other required reports and several similar functions are consolidated in this module, which eventually also feeds the penalty issuance process. Again, all the data fields are interlaced such that base information is pulled from tables in other modules and recorded where appropriate. Many actions require penalties to be assessed and then invoiced. This function will be carried out by this module when completed and operational.

Stack Test Data Module (Under advanced development)

The Division requires stack testing (monitoring) on various occasions. These operations may relate to issuance of the permit or to compliance and other related operations such as generating a custom emission factor for the emission estimates. These functions result in data regarding scheduling, levels of pollutants measured (some generated on site and some generated at a laboratory off site), conditions and

circumstances of the tests, chain of evidence information, etc. for multiple pollutants. Again, all these data are required to be in the system and have a commonality with other modules in terms and in functions.

Recent proposals at EPA have suggested a new role with states in getting their data for use in development of enhanced emission factors with enhanced uncertainty qualifiers. Such an interaction is likely feasible with this module, but not without significant enhancements and redesign of some portions. North Carolina has been identified as a possible participant in developing further such interconnections and systems with the renewed emission factor proposals from EPA. These proposals put more focus on state data and how those data may be able to feed an automated or semi-automated emission factor generation function at EPA.

Ambient Monitoring Module

The ambient monitoring data are similar in ways related to connections and availability, but quite dissimilar in several other functions. The information in this module is not linked to emission sources, except by geo-location information, and is of a more unique nature in the system design aspects. It is not covered further here since the audience is primarily "emission oriented," but the reader is just advised that it exists and serves several valuable functions regarding the collection of ambient data, analysis and statistics on these data, projections and predictions regarding "ozone action" days and the like, and other similar roles.

Reports

No system is useful unless it can provide useful data in return for all the data entry and data collection efforts. Each module generates information that is useful for reports within it and other queries may go across the database and pull out information from several modules in order to generate the desired report. As alluded to above, there are several "canned" reports available on-line publicly, as well as some that must be accessed by special routines to meet custom requests. Other provide the data in static tables or other formats for generation of custom reports by the users themselves. Public reports are on the Division's web pages to answer many of the most expected requests. In these cases, the users can design and implement their own requests within a general set of limitations.

NIF Output to EPA

EPA, of course, through the CERR and other requirements or requests and needs various emission data, among other things, for the development of trends data, modeling, special reports and general oversight. To facilitate compatibility, consistency, and the very ability to generate a database, the EPA has developed the National Emission Trends Information Format (NIF). Thus, one of the things the system must do is export these data in the proper format and meeting submittal criteria, annually to EPA through a defined data portal. This report constitutes one of the major reports the system must generate. Though somewhat standardized, the report is actually more of a custom report than a fully standard report as it keeps changing from year to year. Currently, it requires direct IT intervention to make sure that the data process are those that are required and

that they meet the formatting requirements. The lack of a many to many relationship for allowing multiple processes (operating scenarios in ED terminology) to vent to multiple stacks or emission release points remains one of the major problems and shortfalls of this export process. We continue to hope that suggestions for revisions of the NIF in this area take place. Also, NC has recently developed a CDX node capability for its point source information and will be likely pursuing these advantages and interconnections in the future. No related work has yet been done on the area source interfaces.

SIP Modeling Interfaces

Internally, the Division uses the data for input to modeling exercises as portions of the state are in non-attainment for ozone and for PM2.5. The Division uses a software package named SMOKE to access and manipulate the point source data and interface with the regional modeling efforts. The state is involved in several state and regional modeling efforts and surrounded by states in similar situations, and this interface will likely continue to change frequently.

Other Outputs

The DAQ receives frequent requests for data on facilities. These data, though mostly available on line, are provided for a cost-reimbursable fee. Thus the public and other interests are served by having these data available.

Conclusions

The national system (NIF) is not yet perfected, but serves a valuable function related to a centralized and consistent inventory database for the states. NC's system of modules has proven to be a productive approach to entry, storage and update of the appropriate data so that multiple user needs are satisfied. The underlying context require some attention to continually evolving but related aspects that have been addressed to some degree in the past by other treatises[1] [2] [3]on topics of air quality management that are closely intertwined with the emission inventory. These will continue to evolve as the science and art advance.

The concept of using the same identifiers and descriptive data in permits and inventories has led to crossing the bridge from permits to inventories and back, and allows the facility a new sense of dealing with one agency and one database. Ability to access the same data online whether for inventory or for permits gives these facilities the comfort that they are dealing with one competent organization and that the left hand is dealing with the right. It also alerts them that their data are indeed being accessed, scrutinized and utilized so that the quality assurance aspects become more important.

References

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