

MoEIS
Missouri's Implementation of the
Emission Inventory Improvement Program's (EIIP) Phase I Data Model
for Collecting Annual Emission Inventories

Randall E. Raymond
Missouri Air Pollution Control Program, P.O. Box 176, Jefferson City, MO 65102
nrraymr@mail.dnr.state.mo.us

Alicia J. Weaver
Tier Technologies, 1002 Diamond Ridge, Suite 1200, Jefferson City, MO 65109
aweaver@tier.com

ABSTRACT

This paper examines the development process of Missouri Air Pollution Control Program's annual emission inventory data system using the Emission Inventory Improvement Program's Phase I Data Model as the basis. We will explore the things that went well, and not so well, in the 3-year journey from the desktop system to a networked, client/server, department-wide product. This paper also describes the specifics of Missouri's system, such as integration of the emission fees subsystem; Internet application data collection; training CD-ROM development; and human resource factors.

INTRODUCTION

Together, the Missouri Department of Natural Resources (MoDNR) and Tier Technologies, Inc. (Tier), are ensuring the State efficiently and accurately collects air pollution emissions inventory data and fees by phasing in a system that takes full advantage of both large area network (LAN) and Internet technologies.

The Missouri Emissions Inventory System (MoEIS) combines four legacy systems, which were disjointed, poorly documented, difficult to maintain, and not Y2K compliant, into one client/server application. The MoEIS data structure combines the data from over 7,000 legacy Paradox tables and Access databases into one common DB2 database. The MoEIS technical architecture set the new standard for automation projects within the MoDNR.

The MoDNR's cost-conscious, phased approach to the project has resulted in a system that allows both the regulated community and regulators use the MoEIS to report and track air pollution emissions and fees. Table 1 shows the combined costs of the MoEIS Phases 1 to 3.

Table 1. MoEIS Combined Phases Estimated and Total Costs.

Start Date:	January 4, 1999	End Date:	Ongoing
Total Est. Cost:	\$2,500,000	Total Actual Cost:	\$2,415,069.14
Total Est. Hours:	22,200	Total Actual Hr.:	21,200

The MoEIS was originally intended as the foundation for future application development in the Air Pollution Control Program (APCP). Due to the success of the project, MoEIS became the foundation for future application development for the entire department.

BODY

The MoEIS has gone through three development phases. The first version of MoEIS was developed during 1999, when the department addressed Y2K compliance issues by combining four existing systems, consisting of over 7,000 individual databases, into one Y2K-compliant relational database management system. The second phase of the project included the evaluation of software tools for creating the online version of MoEIS. The third and current phase of the project will allow the regulated community to submit their emission inventory questionnaires (EIQ) via the Internet. Finally, the MoEIS is designed to accommodate future functions, and the APCP hopes to satisfy requests from the regulated community by continuing the development of the system to allow online permit applications and fee payments.

During each project phase, the human factors side was important. The project staff's ability to identify user needs and reach compromises was essential when working up specifications. The project team's input on the specifications and prototype was also important in producing the final products. With so many odds stacked against it, many people believed the project would fail. Instead, we regularly achieved major milestones on time and on budget as the project team led the department into new technologies. Leading the department into the new technologies was difficult, as the infrastructures for developing and delivering the client/server and web systems were not yet in place. During the life cycle of the project, some items had to be scoped out of one phase and incorporated into another. Although this phased approach helped to ensure success, in hindsight, we needed to meet with the industry more regularly as a team, and we needed more human resources on the project than were available at the time.

Phase 1: Progress from Desktop to Network Client/Server

In 1995, staff at the Missouri Air Pollution Control Program began to realize that the desktop database programs would eventually have to be replaced. The relational desktop systems were quite powerful for small applications, and they were also easy to use. At times, however, the ease of use actually outstripped the staff's ability to manage the information. The result was a proliferation of duplicate tables that made reporting a challenge.

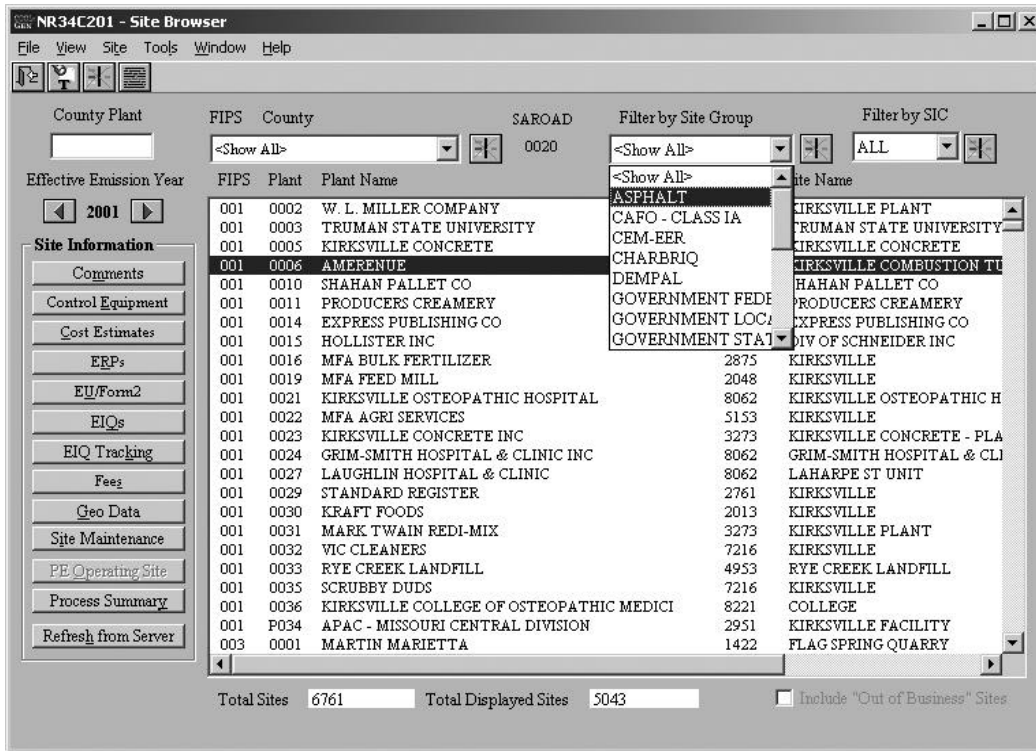
During MoEIS Phase I, the MoEIS team used a Rapid Application Prototyping (RAP) approach to analyze, design, develop, and implement the MoEIS as an integrated emissions inventory program. This first phase of the system provided the basic functions that were available on our personal computer, desktop system. However, there were additional things that we wanted from our MoEIS that the desktop system did not provide. These were "enhancements" over the desktop system that we were certain would come as a result of model improvement and system software:

- Fix the Year 2000 problem (with the systems being converted: PCEIS, EIQTRACK, CASH)
- Set-up the data model for point source type emissions, around which all subsequent APCP data can be integrated
- Convert our existing facility list to the new system
- Provide for the distribution, receipt, and capture of the emissions inventory information (to the extent that this was being done with the old system)
- Verify emission inventory data and allow for the tracking of staff assignments
- Provide for the tracking of fees received that are associated with the facilities
- Conversion of the 1996 emission inventory data, EIQ tracking information, and associated fees to the new system
- Provide all APCP staff with access to the emission inventory data through report writer and data extraction software.

- Some of the elements above still have manual effort associated with them, but the new system is able to track the efforts as well or better than the old system.

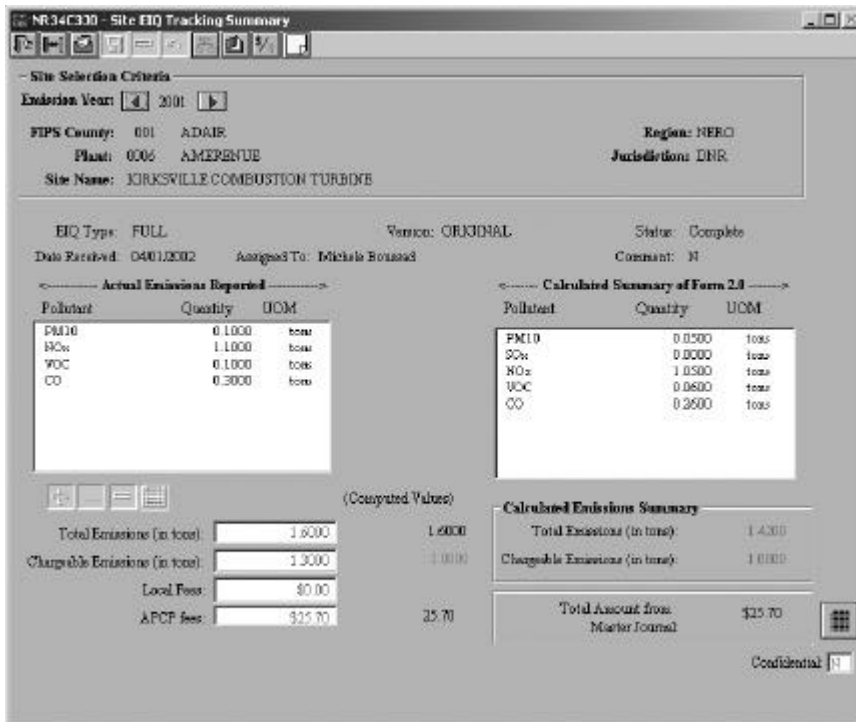
Below are some window captures from the client/server application. The Site Browser shown in Figure 1 allows the user to easily identify and locate site-specific information. The sites listed in the table can be sorted by various criteria, such as Site Group, or located with a text search capability.

Figure 1. Site Browser.



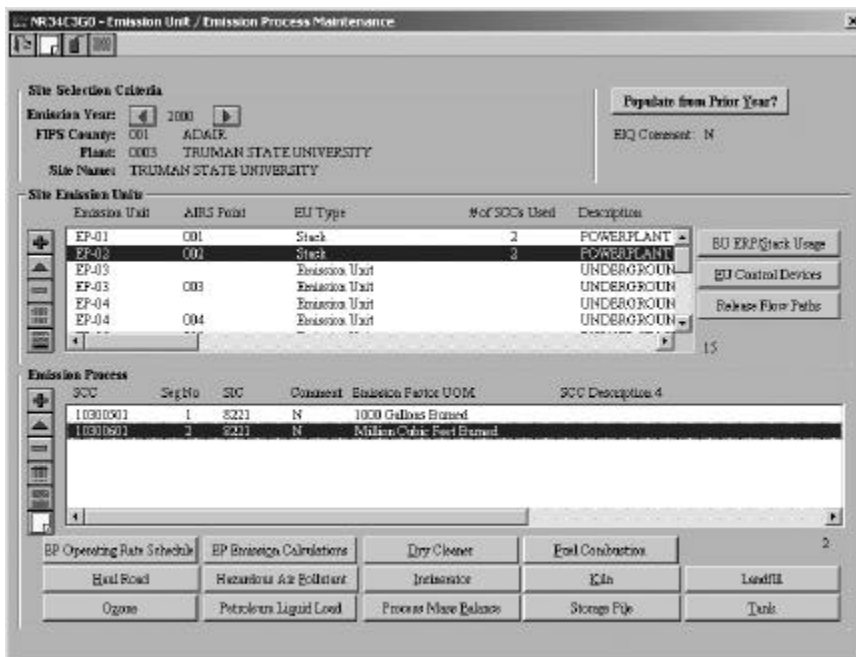
The Site EIQ Tracking Summary depicted in Figure 2 enables the users to view the EIQ data as it progresses from receipt to final data entry. The preliminary EIQ summary data entered when the EIQ is first received is shown in the center left of the window. The data entered by State staff, temporary staff, or Sites via the web application are shown in the center right of the window. Data is totaled and discrepancies between the data highlighted for review.

Figure 2. Site EIQ Tracking Summary.



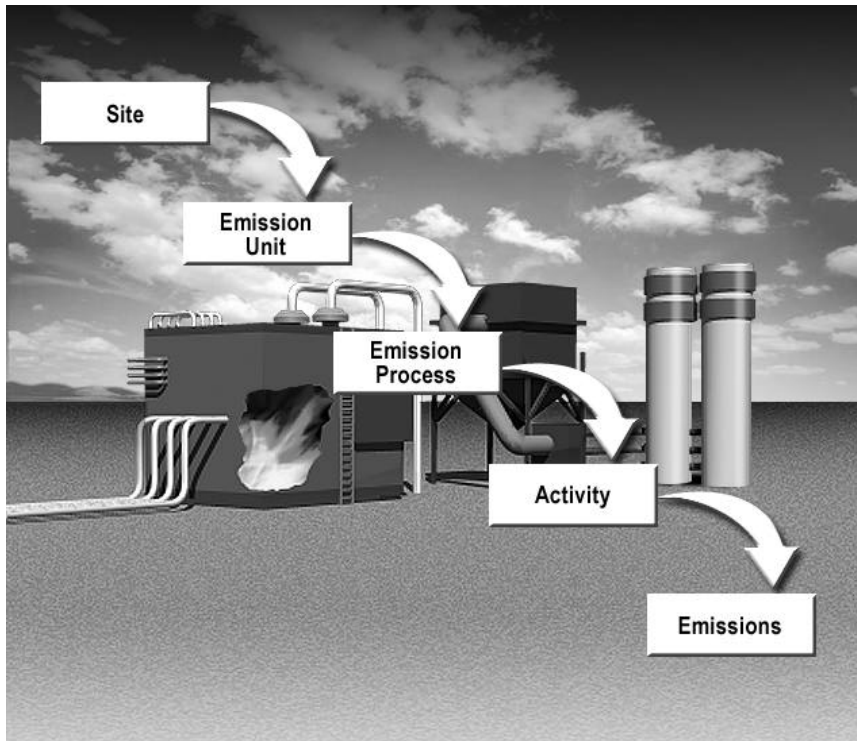
Throughout the system, the users can enter and track emission unit information at a summary level or at a detailed level. To navigate from the summary to the detail, the user simply highlights the information for which more detail is desired and the selects the desired topic. The emission unit/emission process (EU/EP) screen in Figure 3 shows where the user has selected an emission unit, and then the emissions processes for that unit were displayed. An emission process was selected, and now the user can view the various worksheets and detailed information specific to that EU/EP combination.

Figure 3. Emission Unit/Emission Process Maintenance.



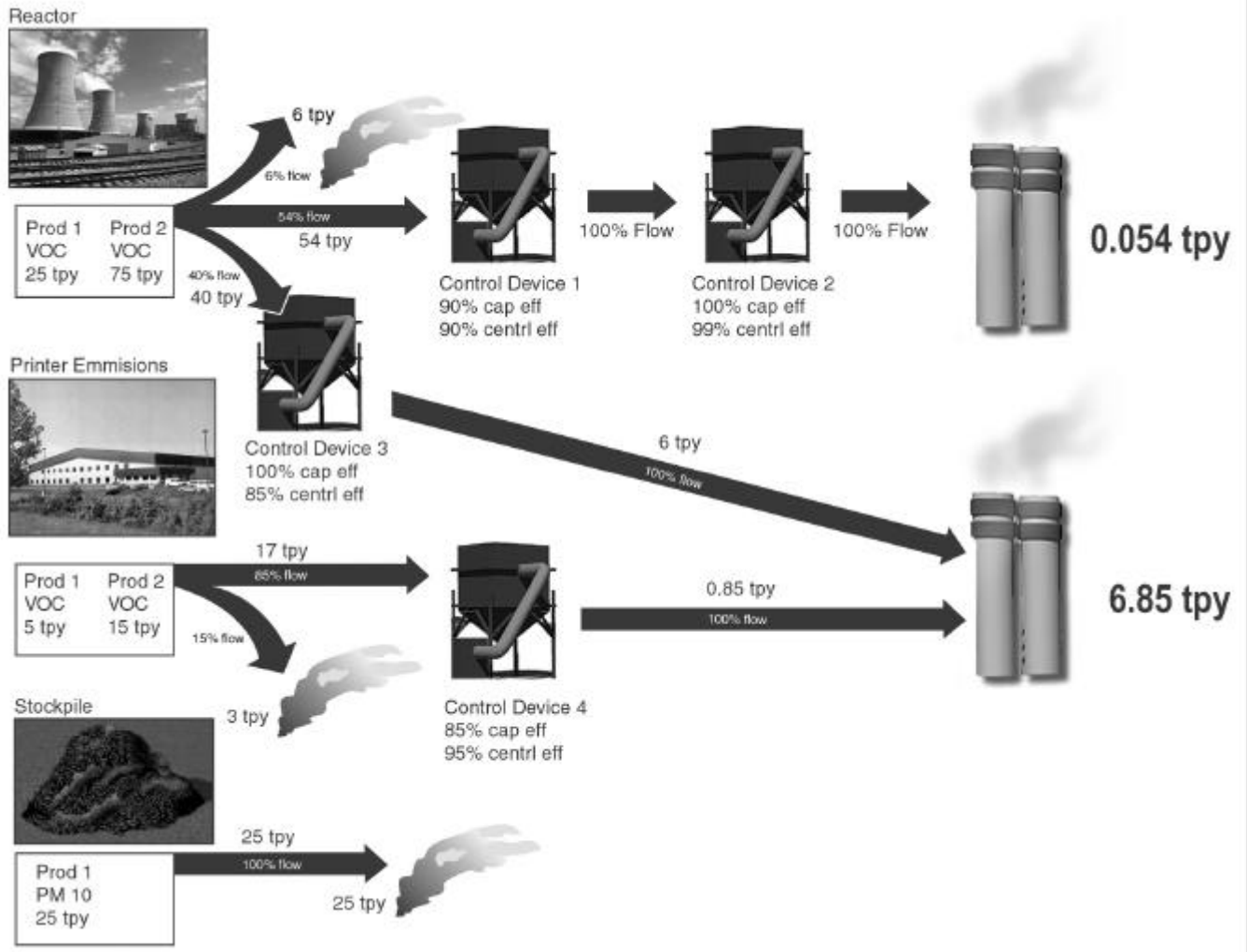
The new MoEIS data model, based on the EIIP Phase I data model, allows the industry to represent their business data without the duplication required by our old system. The new system allows information to be captured once and then displayed throughout the system. This is possible because of the MoEIS backbone shown in Figure 4.

Figure 4. MoEIS Backbone.



In the old system, information had to be duplicated at many levels in order to reflect a complex pollutant stream; for example, how the pollutant goes from being generated to the atmospheric release. Figure 5 depicts the input of material, the generation of the pollutant, and the release of the pollutant into the ambient air. The new system allows us to capture this information in a coherent manner.

Figure 5. MoEIS Path Graphic.



Integration of the Emissions Fees Sub-system

Integration of the emissions fees sub-system is an often overlooked, but an important aspect, and for most states is associated with the Title V operations permits. MoDNR decoupled the EIQ fee from the Title V permit to allow it to be tied in to the EIQ

At the beginning of Phase 1, we laid out our design goals and we moved to a new data model. This was significant, as the EIIP data model that was our basis is accepted nationally, and it supports our regulatory framework. Concentrating on EU and EP and changing the national model to accommodate the inventory proved very important for the rest of the program.

The MoEIS Phase I system was better designed and was as functional as—in some regards, more functional than—our legacy system, and it was year 2000 compliant. The costs for this phase are shown in the table below. The costs in Table 2 reflect monies spent on consultants.

Table 2. MoEIS Phase I Costs.

Start Date	January 4, 1999	End Date	July 31, 1999	Cost	\$353,738.80
------------	-----------------	----------	---------------	------	--------------

Phase II: Department-Wide (MoEIS 2000)

During MoEIS 2000, we continued to expand on the client/server functionality established during Phase I. MoEIS 2000 covered most of the remaining functionality that we desired for a complete emission inventory system. These items included the following:

- Provide for the conversion of all electronically available historical EIQs
- Expand the quality assurance, quality control functions performed by MoEIS, in order to improve the data quality and insure consistency
- Conduct an extensive evaluation of three web development tools. The evaluation was conducted to select a web development tool capable of supporting the MoDNR's web application needs—both static and transactional. Tier provided technical expertise to lead the evaluation process and help the MoDNR adopt a strategic Web architecture.
- Develop an industry survey as a pilot project to thoroughly test the new technical architecture
- Provide support for the preprinting of EIQ forms, and the creation and distribution of specific letter types to facilities (mail merge function).

The costs in Table 3 reflect monies spent on consultants.

Table 3. MoEIS Phase II Costs.

Start Date	July 1, 1999	End Date	June, 2000	Cost	\$431,787.77
Start Date	July 1, 2000	End Date	June, 2001	Cost	\$583,956.86
Start Date	July 1, 2001	End Date	December 31, 2001	Cost	\$204,785.00

Phase III: Web System (MoEIS 2001)

During MoEIS 2001, we worked with the MoDNR staff to develop a web portal for the regulated community to electronically submit Emissions Inventory Questionnaires (EIQ). This phase represented a big step for the MoDNR, and it was the department's first effort in the area of electronic Government-to-Business (G2B) transactions. The new web-based integrated emissions inventory system has proven to be more accurate and efficient than our legacy systems.

The MoEIS web application is designed for ease of use. This is especially important since EIQs are complicated documents, and the users may be new to completing them. Help pages on each screen provide instructions for the users; a toll-free number provides access to the manned MoEIS help desk, who are ready to assist users with their questions; and a "Contact Us" option allows users to provide and obtain feedback via e-mail.

Many of the web pages in the MoEIS contain a combination of read-only and data entry fields. Figure 6 is a screen capture of the page that enables users to entered detailed information regarding their Hazardous Air Pollutant emissions.

Figure 6 – MoEIS Web Application, Hazardous Air Pollutant Detail Web Page



Ease of navigation to information in the web application is important, as a Site may need to complete many worksheets. The Hazardous Air Pollutant worksheet depicted in Figure 6 is just one type of worksheet that may need to be completed by the Site. Figure 7 shows how a Site can easily navigate to their worksheet information in only a few mouse clicks.

Figure 7 – MoEIS Web Application, Worksheet Navigation Page



A new feature for the EIQ was the ability to easily link up various objects using a Release Flow Path depicted in Figure 8. The Release Flow Path describes the route the emission takes from the emission unit to the emission release point. This path would include any control equipment that reduces the emission levels along the way. In MoEIS, release flow path is the mechanism used to document how emission units (such as a boiler), control equipment (such as a baghouse), and emission release points (such as a stack) are connected.

Figure 8 – MoEIS Web Application, Release Flow Path Graphic



Technical Architecture

The MoDNR has both LAN and WAN networking. It is an Ethernet-based routed network. The WAN consists of T1 or faster connections and some dialups. The Ethernet ports are switched. There is a 1 Gigabit backbone and fast Ethernet to the desktops. Twenty-one remote locations are serviced.

Several types of software were used to create the MoEIS. The Graphical User Interface (GUI) client/server application was written using COOL:Gen version 5.1 and runs on an NT 4.0 platform with IBM’s Universal Database 2 v7. The transaction-based Web application is being developed with IBM’s WebSphere Studio version 3.5, WebSphere Application Server version 3.5, Visual Age Java version 3.5, UDB2, MacroMedia’s Dreamweaver UltraDev version 4, Rational Rose J, Merant’s PVCS Professional, XML, XSL, JSP, HTML, EJB, Jakarta Struts, and stored procedures.

The user base is geographically dispersed. Users are in various locations, including 6 regional offices, 8 county offices, 1 main office, 4 local agencies, and 3,000-6,000 private industry locations. The MoEIS has approximately 200 state government users and the estimated 3,000-6,000 private industry users who can submit EIQs.

The MoEIS web application consists of 110 web pages, each with associated help pages. The MoEIS client/server application consists of 300 windows. The 1.5 Gigabyte database contains approximately 2,500,00 records for the 3 emission years currently in the system. Future effort includes data conversion for historic EIQ information. The data is stored in 108 tables, including a generic code table structure that contains 110 virtual code tables.

The costs in Table 4 reflect monies spent on consultants.

Table 4 – MoEIS Phase III Costs

Phase III Start Date	August 1, 2001	End Date	January 2002	Cost	\$480,282.00
Phase III Start Date	February 1, 2002	End Date	June 30, 2002	Cost	\$268,998.71
CBT Training Start Date	May 15, 2002	End Date	August 31, 2002	Cost	\$91,520.00

CONCLUSIONS

The MoEIS projects have been very successful from several perspectives. First, they have been completed on time and within budget, and each project’s deliverables satisfied all original functional requirements. Second, they have prepared the department for future e-government initiatives by evaluating Web tools and the department’s technical abilities to support such initiatives. Third, they will provide the department with the ability to reduce the reporting burden of our regulated community, reduce data entry, and improve data integrity. Finally, the MoEIS has been used as a tool to mentor and train government staff so that they will be able to maintain and enhance the resultant MoEIS, as well as

other departmental systems developed and maintained using the same standardized tools and methodologies.

Real Savings, Real Fast

The MoEIS helped the Air Pollution Control Program (APCP) realize significant savings due to reduced data entry efforts for the 2000 Emission Inventory Year. Following previous years' practices, the APCP budgeted 3,600 overtime hours to complete their annual EIQ data entry task. However, due to the new MoEIS, they required only 625 overtime hours—an 83 percent reduction of overtime hours needed to complete the data entry task. Additional examples of quality or productivity enhancement include the following:

- The old system would only allow one person to enter checks at a time. The new MoEIS allows an unlimited number of simultaneous check entries.
- Using the old system, if the APCP received a check dedicated to 72 EIQs, the check information would have to be entered 72 times. Using MoEIS, the check associated with the 72 EIQs only needs to be entered once.
- Previous year efforts to prepare databases to receive the new year emissions data took countless hours. On January 3, 2002, the required annual MoEIS update was completed flawlessly in 10 minutes.
- Prior to MoEIS, approximately 250 EIQ annual questionnaire packages were returned because of bad addresses (an 11 percent return rate). Due to the improved data integrity provided by MoEIS, this number decreased to approximately 60 (a return rate of less than 3 percent).
- The new system allows companies to enter and view their information over the Internet, easing State and Regulated community reporting burdens. Companies are now able to look at the real data that is reported to others—EPA, other states, and public citizens. Previously they did not have access to this information from our system.

The e-government and G2B transactions make the emissions inventory process more efficient and reduce the reporting burden on the regulated community. This can mean significant time savings for large companies. Electronic submittal also reduces entry errors and improves data integrity. The APCP, local agencies, regional offices, and the regulated community will all benefit from the web portal, while the MoDNR benefits from its preparation for future e-government expansion.

Lessons Learned

Things that *seem* simple are sometimes not so simple:

- From time to time, development efforts are burdened with such issues as legacy data integrity or funding constraints.
- Integrating relatively simple items such as electronic images requires certain specifics to be taken into consideration, such as looking across the business to see what is currently being done with this data and what needs to be done with it.
- When proposing something simple in the context of a department that wants to accomplish many different things, a simple application can become very complex.

MoEIS Future Projects

All of the following projects would involve on-line, direct (using the Internet) submittal of:

1) Emission Inventory Information

This would allow industry to update their emissions data on-line throughout most of the year. Sources will notify MoDNR when the information is ready for submittal. Quality control elements will be built into the on-line data updating process.

2) Compliance Monitoring Reports

Part 70 installations must submit their monitoring data reports every 6 months. One of the data reports will coincide with the Annual Compliance Certification (and the deadline for the emissions data). Allowing on-line submittal will give industry the maximum amount of time to review and quality assure the information before it is sent.

3) Annual Compliance Certification

This is the same as item (2) above, with the addition that the installations must certify whether compliance throughout the year was continuous or intermittent for each operating permit condition.

4) Construction Permit Application (major, minor, de minimis, temporary, portable, and an exemption analysis)

Electronic submittal and processing of construction permit application could possibly cut weeks out of the approval process by avoiding (or greatly reducing) the wait on the post office for delivery or receipt of printed material (and the associated request for such material).

5) Operating Permit Applications (initial, renewal and all types of modifications)

Integration of emissions data, construction, and operating permit application information would streamline the processing of such information in addition to reducing the duplication of the data. Duplication of data often results in inconsistencies between the various processing groups.

6) Sales Tax Exemptions

This would simply reduce the paperwork burden associated with sales tax exemption processing.

7) DNR Permit Action Tracking

This project should be integrated into the previous item (4), but could be done separately.

Considerations for performing separately would be all the various permitting functions that are performed throughout the department. This project is less about Internet applications than it is about integration of the functions in the MoEIS data model.

8) DNR Enforcement Action Tracking

This project would actually be the integration of the enforcement tracking system (similar to the proposal for item (7)) into the MoEIS data model. This would allow greater consistency across the department and greater involvement and interaction of the regional inspection staff.

9) Geographic Information System (GIS) Integration

The department has been trying to develop the GIS capability for quite some time. Integration of GIS functionality into the MoEIS data model would allow the dream to be realized.

10) Asbestos Registrations and Certifications

Although the asbestos program may require that significant changes be made to the MoEIS data model, the client/server architecture, Internet/Web environment could be leveraged to allow most the processing of this paperwork to be done electronically. This would certainly result in paperwork reduction, and most likely a number of staff efficiencies realized. The industry should also see reduced time needed for processing. We could also integrate department Regional Office and Missouri local agency asbestos efforts at the same time.

REFERENCES

BIBLIOGRAPHY

KEY WORDS

Emission Inventory Improvement Program's (EIIP) Phase I Data Model

The Missouri Emissions Inventory System (MoEIS)

Missouri Air Pollution Control Program (APCP)

Missouri Department of Natural Resources (MoDNR)

Tier Technologies, Inc (Tier)

ACKNOWLEDGMENTS (OPTIONAL)

DISCLAIMER (OPTIONAL)

TABLES (OPTIONAL)

FIGURES (OPTIONAL)