# System Enhancement of Point Source Inventories

Yun-Fat Lam, Wayne T. Davis, Terry L. Miller and Joshua S. Fu
The University of Tennessee, Department of Civil and Environmental Engineering, 223 Perkins Hall,
Knoxville, TN 37996-2010
ylam@utk.edu
wtdavis@utk.edu
tmiller3@utk.edu
jsfu@utk.edu

## ABSTRACT

Emission inventories are a critical component for air quality management.  An accurate and up-to-date inventory data is an essential element of air quality modeling that is crucial in determining compliance with ambient standards and in making policy decisions.  To insure that accurate inventory data are obtained in a State or local agency, a combined Title V permitting process and point source inventory reporting infrastructure are being implemented using Microsoft's Access database program.  This application is to develop the consolidated system for the State of Tennessee point source inventory, the Consolidated Emission Reporting Rule (CERR) request information system and Tennessee Title V permitting system together and manages permitting records and reporting inventory.  The Access interface provides a method for major source companies to complete their Title V permit applications electronically and, at the same time, generate their point source inventory required by CERR.  For validation purposes, the inventory data obtained from the electronic Title V permit application via the Access interface are checked against the Nation Emission Inventory Input Format (NIF 3.0) quality assurance algorithm.  With this method of collecting and verifying data, regulatory agencies can update emission inventories with valid data to meet the requirements of the Consolidated Emissions Reporting Rule with minimal effort and the needs for air quality modeling.

## INTRODUCTION

Emission inventories are a critical component for air quality management.  An accurate and up-to-date inventory data is an essential element of air dispersion modeling that provides future emissions projection. The correctness of the modeling results is based upon reliability and accurateness of the inventory data.  It is an indispensable part of air quality management.  The Federal, State, and local agencies utilize the modeling results as a basis for their policy decisions, as part of their efforts to attain and maintain National Ambient Air Quality Standards (NAAQS) [1].

In August 2002, the U.S. Environmental Protection Agency (EPA) promulgated the Final Consolidated Emissions Reporting Rule (CERR) to simplify and streamline existing emission reporting requirements.  CERR provides flexibility for data collection and exchange, and merges various reporting dates for various categories of criteria pollutant emission inventories[2].  Before the final CERR was fully implemented, the Tennessee Department of Environment and Conservation's Division of Air Pollution Control (TDEC DAPC) requested assistance from the University of Tennessee's Department of Civil and Environmental Engineering (Dr. Wayne T. Davis and Dr. Terry L. Miller, Dr. Joshua S. Fu and graduate students) to develop the emission inventories and database management associated with the requirements of the CERR.  This project was broken into two phases.  Phase I involved evaluating the current emission inventory program, identifying critical paths required to maintain all the inventories that satisfying the requirements for CERR, identifying sources of information for the Tennessee point source inventory, and developing a preliminary system for modifying and maintaining the inventory.  Phase II involved evaluating any problems or weaknesses associated with the existing emission inventory management and reporting infrastructure, and recommendations or solutions to the problems/weaknesses.

## Phase I  (June 2000 to June 2002)

In the initial stage, a preliminary database consisted of 456 companies was created by combining the information from the existing Tennessee point source emission database (TPSED), EPA's National Emission Trends 1996 (NET96) database, and EPA's AIRS-AFS (Air Facility Subsystem) 1989-1996 emission database.  The preliminary database was managed and maintained in a NIF-based validation/QA database management program (TEDMS) developed by Dr. Joshua Fu[3].  This program was built using the Microsoft Access ® and had the capabilities of generating visual representations of database, such as forms and reports for request information purpose.  In addition, this program adopted the database structure of the National Emission Inventory Input Format (NIF) version 2.0 for compatibility reason[4].  For detailed information of the program, see reference number 3.

Each company in the preliminary database was extracted and compared with the information listed in the Title V permit application for validation purpose.  Any missing information in the database was filled out according to the Title V application, and any inconsistency existed between the database data and the Title V information, the Title V information was used.  After this process, a request information package from TEDMS was generated and sent to the company.  Any responses received from the company were input back to the TEDMS.  Prior to the CERR submittal, all the company data in the TEDMS were checked against the EPA's QA/QC program to ensure the data quality.  Figure 1 shows a flow diagram for the Phase I of the project.

**Figure 1.** Flow Diagram for the Phase I of the project
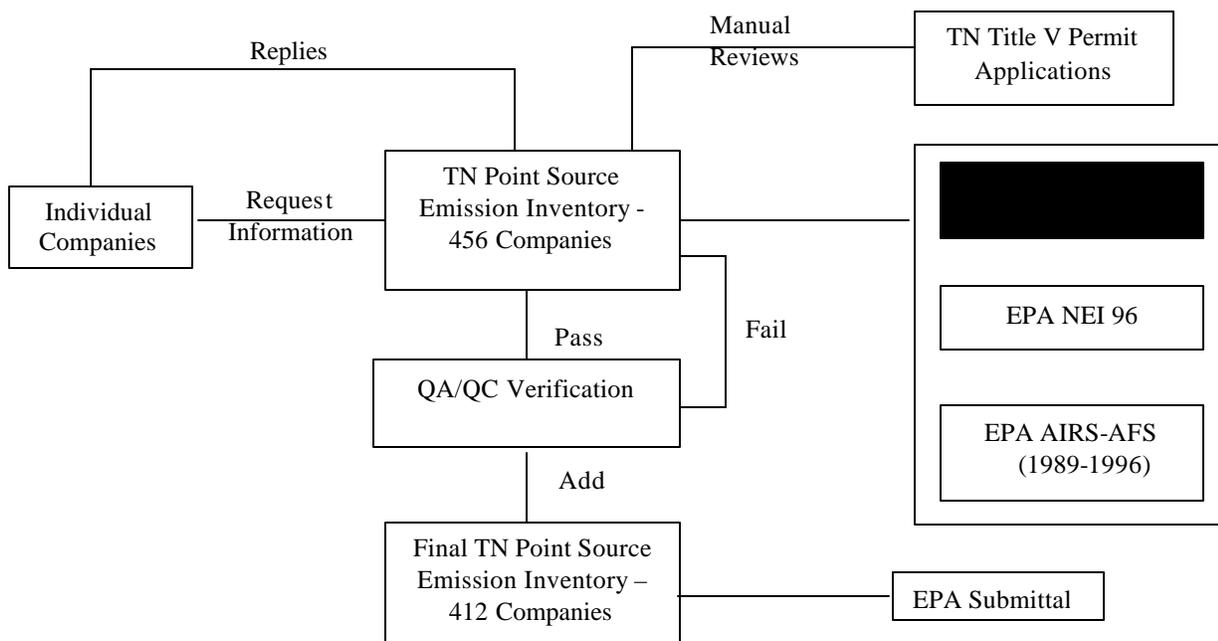


## Phase II (June 2002 to June 2004)

Over 400 major air pollution sources (Title V source) were regulated under the Tennessee Department of Environment and Conservation, Division of Air Pollution Control in 2002.  Figure 2 shows the existing Tennessee permitting and inventory infrastructure.

**Figure 2.** Existing Permitting and Inventory Infrastructure
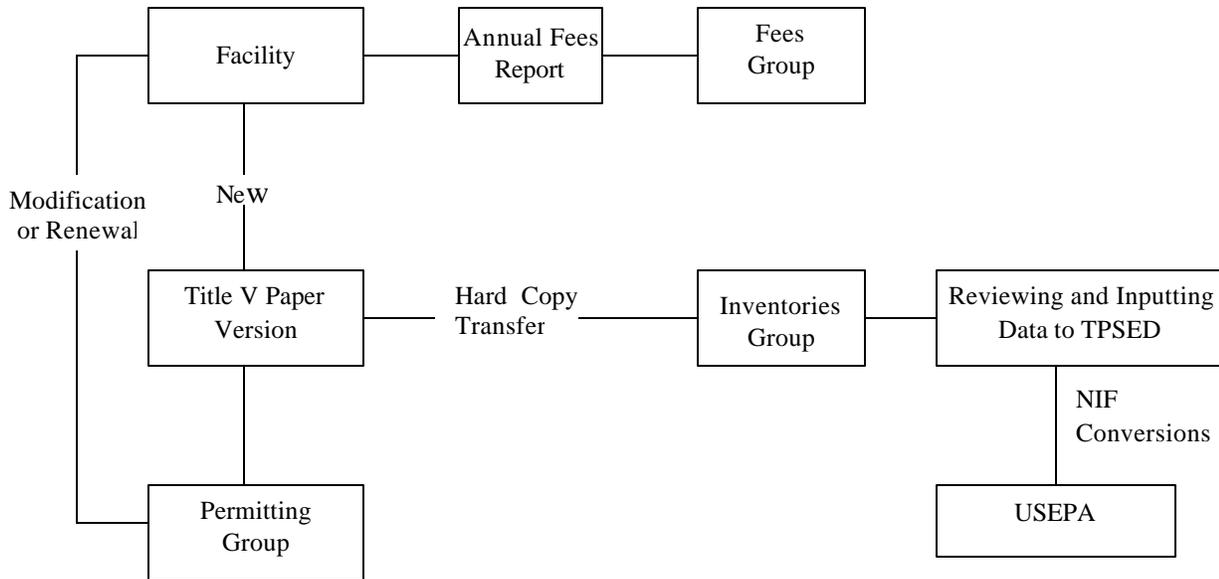


For new permits, major source companies have to submit multiple copies of the Title V permit applications to the TDEC DAPC permitting group for review, after which the TDEC permitting group determines permit restrictions and operating requirements for the companies and issues operation permits. The submittal is by paper copy. A paper copy of the final permit is then provided to the TDEC DAPC inventory group. The inventory group reviews, organizes information and inputs necessary information into Tennessee Point Source Emissions Database. This process is a time-consuming task that takes an average of 15 to 20 hours to complete. Often times, mandatory inventory information is not reported in the application because it is not required in the application. Therefore, the inventories group has to send out separate request questionnaires to the companies to obtain additional information. When permit modifications are made or annual fees reports are submitted, the changes that were made by the companies in the modifications or renewal processes may not be provided on a timely basis to inform the inventory group of changes that need to be made in the inventory database. Also, up-to-date emissions information provided by annual fee reports is not necessarily being utilized as a source of data that can be used for updating the existing emissions database.

An evaluation investigation was performed in the current existing emission inventory management and reporting infrastructure. Several weaknesses of using Title V permit applications as a source of information were identified.

1) Incompatibility Issue: the major source of information for the point source emission inventory was from the Title V permit applications. Unfortunately, the point source emission inventory and the Title V permit applications have somewhat different requirements and emission thresholds. The first is based upon actual emissions and the second is based upon actual or potential emissions, depending on how companies choose to pay their Title Permit fees. Therefore, companies fall into CERR requirements which may not necessary fall into Title V requirements.
2) Incomplete Information Issue: emission information from the Title V permit application is not sufficient to satisfy the CERR requirements.
3) Modification Restriction Issue: modifying the Title V permit organization requires an approval from the State of Tennessee Air Pollution Board, and it is a lengthy process and may require a long time to be approved. However, CERR requirements update year by year.

4) Efficiency Issue: the existing point source emission inventory system is not efficient in handling existing companies since it requires intensive labors to enter all the information from the Title V permit applications into the point source inventory.
5) Submittal Media Issue: Title V information is handled and submitted in paper form, not electronically.

Many suggestions have been proposed to TDEC to help solve the existing problems. TDEC has chosen one of the recommendations to help eliminate some of the existing problems. The suggestion is to develop an electronic Title V application form process that is also linked to the emission inventory process to provide a more efficient means of tying the two as yet independent systems together. The expectation of the program is to link CERR reporting infrastructure and Title V permit reporting infrastructure together, and make the program electronically available for use by the agency and by companies that are required to submit Title V permit applications. Figure 3 shows the proposed changes of permitting and inventory infrastructure.

**Figure 3.** Proposed Permitting and Inventory Infrastructure
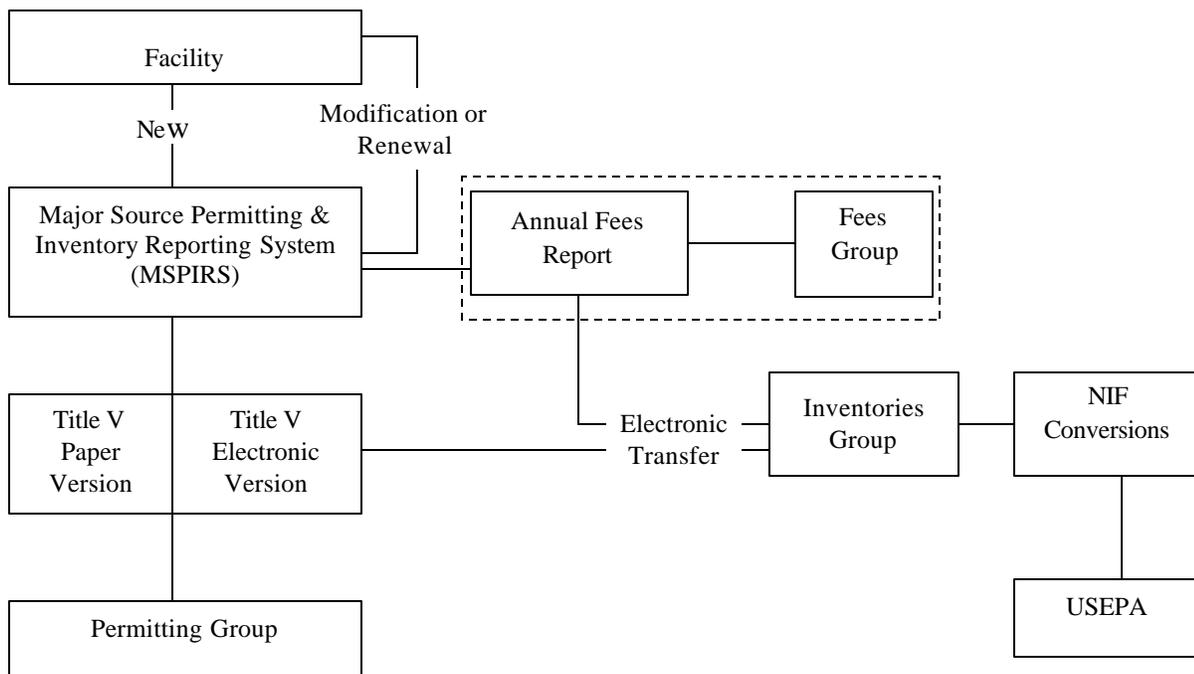


The main idea behind the changes is to create an electronic linkage between the permitting group, inventories group and the fees group. The linkage serves as a central information unit for all three groups and allows different groups within the department to share information electronically. The central information unit is referred to as the Major Source Permitting & Inventory Reporting System (MSPIRS). MSPIRS organizes the existing Title V permit application into a well-defined hierarchy. Therefore, it can be maintained and managed in a relational database. It is a Microsoft Access database program that provides a common electronic platform for data exchange among the groups and also to the companies. For validation purposes, MSPIRS incorporates Title V requirement checking recommended by TDEC and the National Emission Inventory Input Format (NIF 3.0) quality assurances (currently available version) provided by the U.S. EPA to facilitate rapid error screening.

Under the new infrastructure, major source companies would be required to complete their permit applications through MSPIRS. MSPIRS generates a hardcopy version and two electronic versions, which are Title V version and inventory version. In general, the Title V version contains full

details of plant information and the inventory version is just a subset of it because most of the detailed information in the Title V version is not needed for inventory purposes. Once the hardcopy version and both of the electronic versions are generated by the person preparing the forms, the hard copy version and the Title V electronic version would be submitted to the permitting and inventory groups for review.

The new infrastructure, if adopted, would allow the inventory group to capture all possible changes that were associated with modifications and renewals through MSPIRS, since the companies would only be allowed to make their modifications through MSPIRS. This ensures that the inventory will be updated whenever the changes occur. Moreover, the duration of operating permits is set between 3 to 5 years in Tennessee and therefore, company information will be updated at least once every five years. The new infrastructure also covers the submittal of annual fees reports. The company fee reports could be submitted through the new system. MSPIRS not only can generate the emission fees report, but also provides a comprehensive report that contains enough information for updating the emission inventory (these two features currently are not implemented into MSPIRS).

**Current Status of Electronic Title V System Development Across the United States**

According to an Internet search conducted in 2002, only a few states have implemented electronic Title V permit application submission processes. Table 1 shows the current status of electronic Title V system development across the United States and Table 2 shows a list of states that have implemented an electronic Title V database management system. Software formats used for the electronic submittal are Visual Basic ®, Adobe PDF ®, Word® and Word Perfect ®.

**Table 1.** Summary of Current Electronic Title V System Status

| Number of State/Local Air Pollution Control in the Survey | Permit Application Available to Download Online | Available in Word Processor Format | Available in Database Related Format |
|---|---|---|---|
| 114 | 68 | 65 | 5 |

**Table 2.** A list of states that has implemented an electronic Title V system

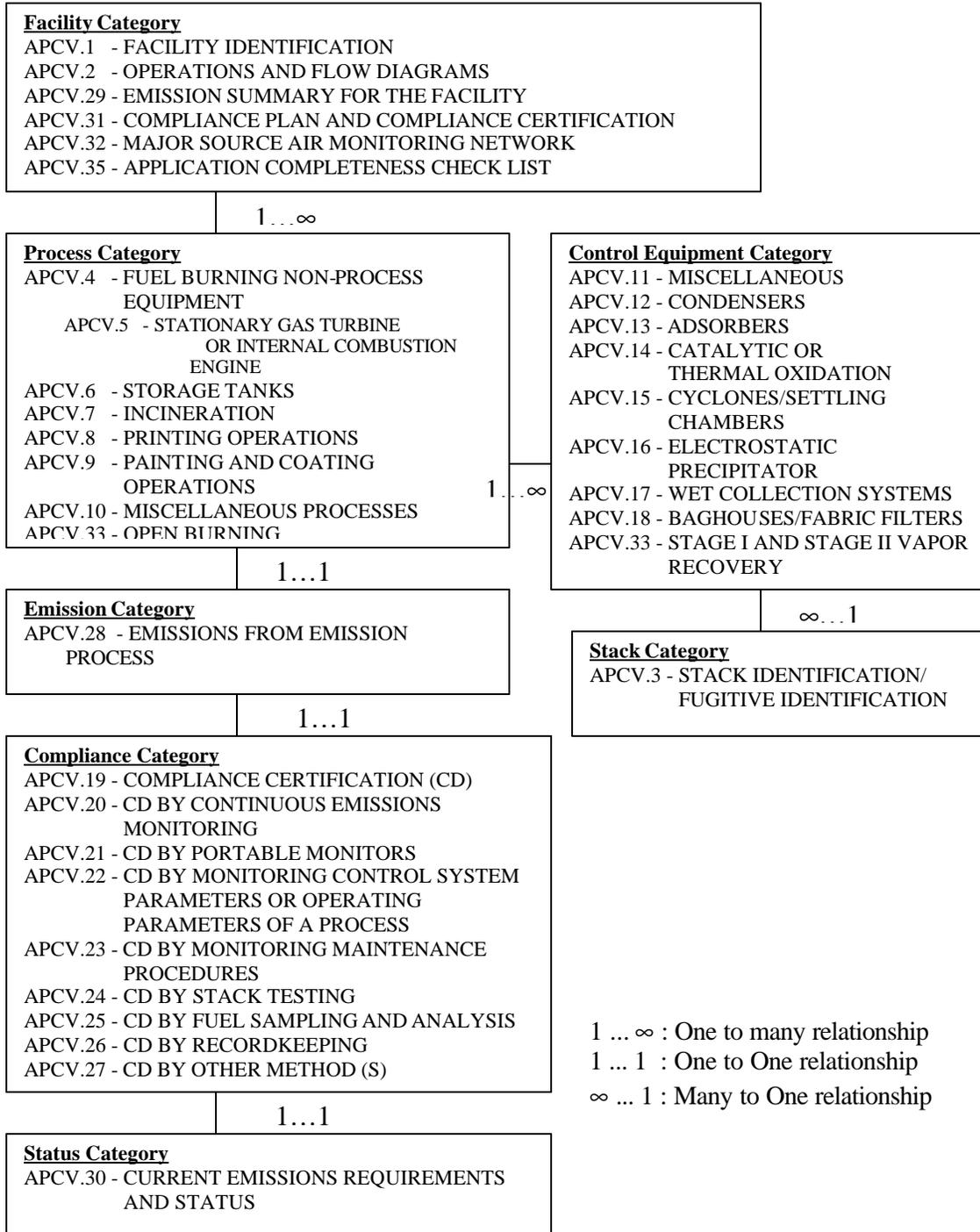| EPA Region | State/Local Air Pollution Control | Web Address | Software/ Software Format | Submit through Internet? |
|---|---|---|---|---|
| 2 | New Jersey | http://www.state.nj.us/dep/aqpp/radius.html[5] | RADIUS –Visual Basic | No |
| 4 | Florida | http://www.dep.state.fl.us/air/forms/transfer.htm#transferair[6] | - | Yes |
| 5 | Ohio | http://www.epa.state.oh.us/dapc/fops/pmu.html[7] | STARShip –Visual Basic | Yes |
| 6 | Texas | http://www.tnrcc.state.tx.us/permitting/airperm/index.html#oppermits[8] | Adobe PDF or WordPerfect | Yes |
| 7 | Iowa | http://www.state.ia.us/epd/air/prof/oper/opapp.htm[9] | SPARS – Visual Basic, Adobe PDF or Word | Yes |

**OVERVIEW OF THE MAJOR SOURCE PERMITTING & INVENTORY REPORTING SYSTEM (MSPIRS)**

MSPIRS consists of thirty-six forms and four mains forms. The thirty-six forms essentially mimic the current Title V forms, with the slight modifications to include the additional inventory information needed by the emissions inventory group. The intent here of maintaining the integrity of the original Title V forms in MSPIRS is to provide a familiar system for those who already have experience with the Tennessee Title V permit application process in the past. It does not require additional training and maintains a user-friendly approach.

## MSPIRS Organization

Each form in the Title V permit application contains certain characteristics.  Forms that contain similar characteristics are grouped into the same category.   Seven categories are identified.  MSPIRS uses these categories to define its relational database structure.   Figure 4 shows how different forms are categorized and the relationship among the categories.

**Figure 4.** Relational Flow Chart Of MSPIRS

**Facility Category**
APCV.1  - FACILITY IDENTIFICATION
APCV.2  - OPERATIONS AND FLOW DIAGRAMS
APCV.29 - EMISSION SUMMARY FOR THE FACILITY
APCV.31 - COMPLIANCE PLAN AND COMPLIANCE CERTIFICATION
APCV.32 - MAJOR SOURCE AIR MONITORING NETWORK
APCV.35 - APPLICATION COMPLETENESS CHECK LIST

1 … ∞

**Process Category**
APCV.4  - FUEL BURNING NON-PROCESS
                 EQUIPMENT
      APCV.5  - STATIONARY GAS TURBINE
                     OR INTERNAL COMBUSTION
                     ENGINE
APCV.6  - STORAGE TANKS
APCV.7  - INCINERATION
APCV.8  - PRINTING OPERATIONS
APCV.9  - PAINTING AND COATING
                 OPERATIONS
APCV.10 - MISCELLANEOUS PROCESSES
APCV.33 - OPEN BURNING

**Control Equipment Category**
APCV.11 - MISCELLANEOUS
APCV.12 - CONDENSERS
APCV.13 - ADSORBERS
APCV.14 - CATALYTIC OR
                 THERMAL OXIDATION
APCV.15 - CYCLONES/SETTLING
                 CHAMBERS
APCV.16 - ELECTROSTATIC
                 PRECIPITATOR
APCV.17 - WET COLLECTION SYSTEMS
APCV.18 - BAGHOUSES/FABRIC FILTERS
APCV.33 - STAGE I AND STAGE II VAPOR
                 RECOVERY

1 … ∞

1 … 1

**Emission Category**
APCV.28  - EMISSIONS FROM EMISSION
        PROCESS

∞ … 1

**Stack Category**
APCV.3 - STACK IDENTIFICATION/
                 FUGITIVE IDENTIFICATION

1 … 1

**Compliance Category**
APCV.19 - COMPLIANCE CERTIFICATION (CD)
APCV.20 - CD BY CONTINUOUS EMISSIONS
                 MONITORING
APCV.21 - CD BY PORTABLE MONITORS
APCV.22 - CD BY MONITORING CONTROL SYSTEM
                 PARAMETERS OR OPERATING
                 PARAMETERS OF A PROCESS
APCV.23 - CD BY MONITORING MAINTENANCE
                 PROCEDURES
APCV.24 - CD BY STACK TESTING
APCV.25 - CD BY FUEL SAMPLING AND ANALYSIS
APCV.26 - CD BY RECORDKEEPING
APCV.27 - CD BY OTHER METHOD (S)

1 ... ∞ : One to many relationship
1 ... 1 : One to One relationship
∞ ... 1 : Many to One relationship

1 … 1

**Status Category**
APCV.30 - CURRENT EMISSIONS REQUIREMENTS
                 AND STATUS

**Cover Form Window**

The first data form of the MSPIRS is the cover form. This form allows user to enter facility name, federal state and county ID (selected by county), and local facility ID. When the federal state and county ID is entered, the local county ID will be automatically created. To ensure the consistency of the facility name throughout the program, MSPIRS automatically generates the facility name whenever a form is created. Notice that fields with light blue color represent editable fields and fields with white color are non-editable. A button on the right with a picture of a door with an arrow mark allows one to quit or exit the program (For simplicity, this button will be called the "CLOSE" button). These two conventions are used throughout the MSPIRS. Figure 5 shows an example of the cover form window.

**Figure 5.** An example of Cover Form Window in MSPIRS



**Title V Permit Application Form window**

After clicking the "GO NEXT" button in the cover form, the APCV.1 form window will pop up. This form, as shown in Figure 6, is an example of how a Tennessee (TN) Title V permit application form window looks that has many built-in list boxes for quick lookup and has a "GO NEXT", "GO BACK" and "CLOSE" button in the right hand corner. The "GO BACK" button allows user to go back to a previous page at any time for modification, where as the "GO NEXT" button allows user to go to a next form.

**Figure 6.** An example of Title V permit application form window



## Site Information Form Window

After clicking on "GO NEXT" in the APCV.1 form, it brings to the APCV.2 form. Clicking on "GO NEXT" twice will call forth the "Summary of the site information" form. Figure 7 shows an example of the site information form window.

**Figure 7.** An example of the site information form window

This summary form shows the information that one has entered in the previous Title V permit application forms. At the bottom left hand side, there is a "QA/QC CHECK" box. The function of this box is to show the results of a sequence of quality checks performed in the previous Title V permit application forms by a QA/QC program. The letterbox TV represents the quality check required by the Title V permit group and INV represents the quality check required by the emission inventory. WRM represents the quality check for any warning status. At the top of the form, there is a button called "QA/QC Summary". Click on the button, and the QA/QC summary table pops up. Figure 8 shows an example of the QA/QA summary table. This summary table provides detailed information on the QA/QC results. Only the fields that failed the QA/QC test will be listed on the table. The main function of the summary table is to show where the errors are. Errors are categorized into two types, *Mandatory* and *Warning*. Any errors designated with *mandatory* are required to be fixed to pass the QA/QC. On the other hand, the warning error indicates it is a potential error. However, if one believes the information one has entered in the forms are correct, warning errors can be ignored.

**Figure 8.** An example of the QA/QC summary table
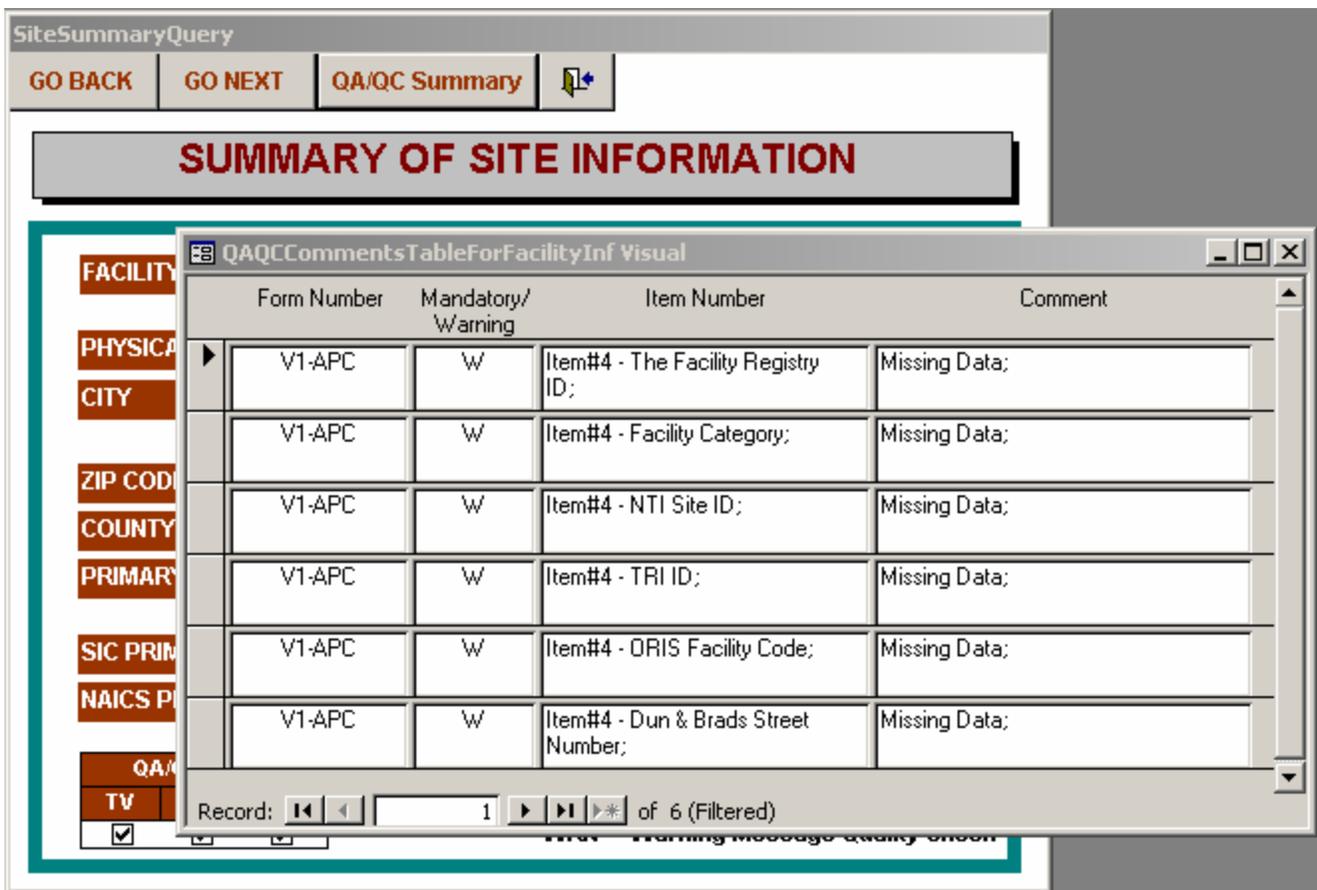


**Main Form Window**

Click on the "GO NEXT" button in the summary of site information window and a form called "main form" will pop up. Figure 9 shows an example of the main form window.

**Figure 9.** An example of the main form window



## Touch Screen/Switchboard Style Main Form

MSPIRS adopts the idea of "touch screen or switchboard concept" unlike the conventional program that requires a step-by-step process. The advantage of using the switchboard over the conventional step-by-step program is in the flexibility that it provides. The switchboard does not restrict the user to filling out the forms in a step-by-step way. The companies are allowed to fill out any form in any order in the switchboard. The switchboard is like a television remote control. One can press on the control to switch to any channel one wants to watch. In this analogy, the control will be the switchboard and the channel will be the form one wants to fill out. For instance, if the user wants to fill out the emission process information for process ID "EF-4" prior to filling out the emission unit information, then the user can simply click the "Go" (third row and second column) in the emission process. A process selection form will pop up if the form number box is blank, as shown in Figure 10. The function of this box is to show user which Title V permit application form have been created/selected. Once a process form is selected, the program automatically generates a new process form (Title V permit application form) and records the form number into the empty form number box.

**Figure 10.** An example of the process selection form



Figure 10. An example of the process selection form

| FORM NUMBER | QA/QC CHECK TV | INV | WRN | Stack ID / Fugitive ID | FORM | HAVE FORM | QA/QC CHECK TV | INV | WRN |
|---|---|---|---|---|---|---|---|---|---|
| APCV5 | ☑ | ☐ | ☐ | 301a | GO | ⊙ | ☐ | ☐ | ☐ |
| APCV6 | ☑ | ☑ | ☑ | 401a | GO | ⊙ | ☑ | ☑ | ☑ |
|  | ☐ | ☐ | ☐ | 501 | GO | ○ | ☐ | ☐ | ☐ |
| APCV8 | ☑ | ☐ | ☐ | 101 | GO | ○ | ☐ | ☐ | ☐ |
| APCV9 | ☐ | ☑ | ☐ | 102a | GO | ⊙ | ☐ | ☐ | ☐ |
| APCV34 | ☐ | ☑ | ☐ | 301a | GO | ⊙ | ☑ | ☑ | ☑ |
| APCV4 | ☑ | ☑ | ☑ | 101a | GO | ⊙ | ☑ | ☑ | ☑ |
| APCV10 | ☐ | ☑ | ☐ | 103a | GO | ⊙ | ☐ | ☐ | ☐ |

## QA/QC Checks in the Main Form

Once the information is completed in the process form (the selected Title V permit application form), then one can close the process form by clicking the close button and returning to the switchboard. The close button automatically activates the internal QA/QC program and the results of QA/QC program will show in the square box next to the process form number. When the QA/QC passes, a check will appear in the square box indicating that the process form has passed the QA/QC requirement. Notice that three sets of QA/QC boxes are shown in the program. They represent the different QA/QC programs that are required by different groups for different purposes. Once all the information has been included in the switchboard, the user can visually see where the QA/QC test failed. Failure to pass the QA/QC programs is unacceptable and indicates that the application does not meet the requirements. This procedure insures that the inventory data and Title V data received from the company meets the requirements of all groups.

**Facility Summary Form Window**

The Facility Summary Form is a dual-purpose form that serves as a summary table and a printing switchboard. For the purpose of the summary table, the form provides summarized information about the permit application. Information such as form number, number of forms, and QA/QC results are listed on this form. For the purpose of the printing switchboard, the form utilizes the summarized information with additional "GO" buttons to provide one the ability to retrieve any form for printing purposes. There are two types of page number options available in the program. One can choose either custom page number or default page number. The custom page number follows the page number scheme that one has entered when filling out the forms, whereas the default page number is based on a pre-programmed sequence according to the Figure 4. Figure 11 shows an example of the facility summary form window.

**Figure 11.**  An example of the facility summary form window
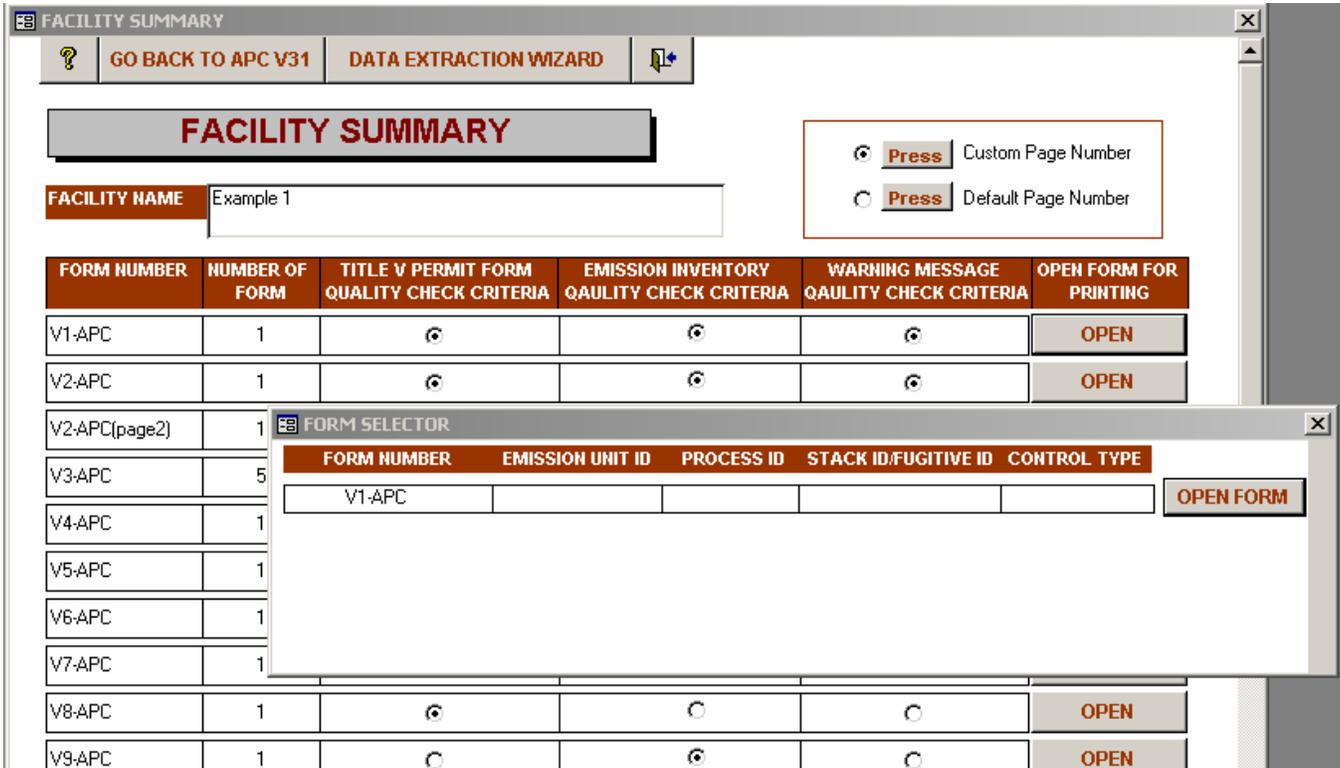


**Data Extraction Wizard Window**

A data extraction wizard is also included in the MSPIRS, which allows user to extract emission information for submittal.  Two types of extractions are available in the data extraction wizard: query for emission inventory submittal and query for Title V electronic submittal.   The query for emission inventory submittal is used to generate the EPA's NIF format data, where as the query for Title V electronic submittal is used to generate the Title V format data.  Figure 12 shows an example of the data extraction wizard windows.

**Figure 12.**  An example of the data extraction wizard window
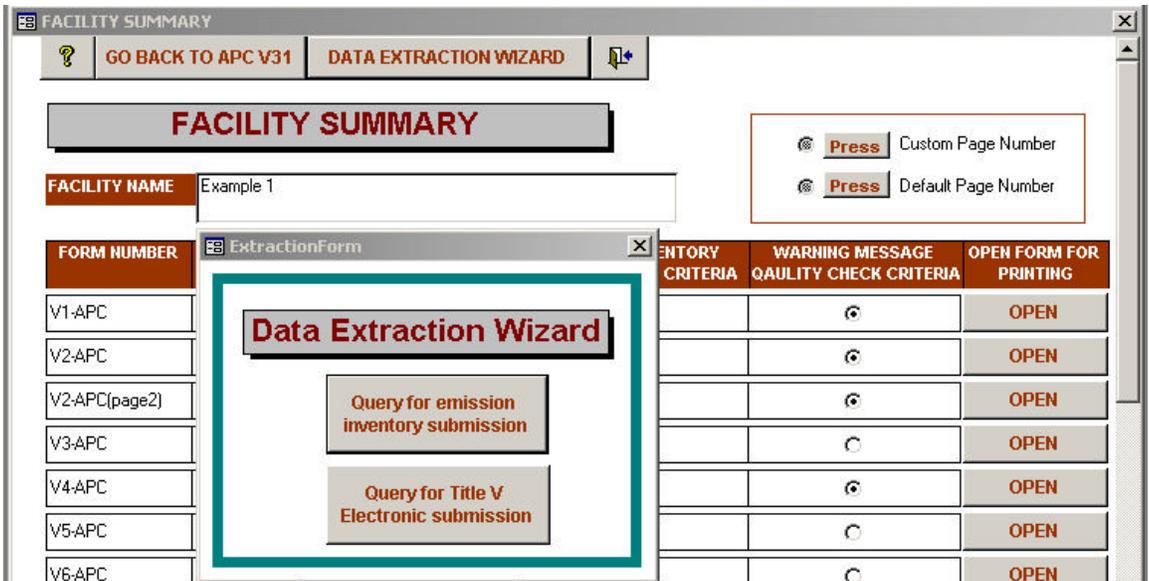
# CONCLUSIONS

MSPIRS is a program that can also serve as a central information unit. On the management side, MSPIRS solves the communication problems that exist among the various groups (the permitting group, the inventory group and the fees group). It provides an electronic copy of Title V permit application for the permitting group, while at the same time, eliminating unnecessary manual and often tedious reviewing of the Title V permit by the inventory group. It greatly improves the efficiency of the review process. The quality of the data is assured and is always up-to-date. On the company (or user) side, MSPIRS serves as a tool for completing the initial and subsequent modifications of the Title V permit application. The companies are able to maintain an electronic copy for future modification. The user-friendly design smoothes out the transition obstacles. The "switchboard design" provides flexibility for inputting data. The QA/QC design reduces the chances of the submittal being returned because of the lack of information or errors. MSPIRS satisfies the basic requirements of both the Title V rule and consolidation of emission reporting rule. Additional feature, such as providing a program to assist in the calculation of annual fees and the generation of an emission summary report, can be added to the MSPIRS in the future.

# ACKNOWLEGEMENT

# REFERENCES

1. Wark, K.; Warner, C.F.; Davis, W.T. *Air Pollution Its Origin and Control*, 3rd Edition; Addison Wesley Publishers, 1998, 61-75.

2. Consolidation and Emission Reporting Rule. Federal Register Vol 67, No 111/ Monday, June 10, 2002 Rules and Regulations Page 39603-39611

3. Fu, J.S. "A NIF-based Validation/QA Database Management System for the Tennessee Emission Inventory", Presented at the 11th International Emission Inventory Conference of the U.S. Environmental Protection Agency, Atlanta, GA, June 2002; p 1.

4. NEI Input Format (NIF) Version 3.0 User's Guide Instructions and Conventions of Use, U.S. EPA, Washington, D.C., April, 2003.

5. New Jersey Title V Permit Application Website, May 2003, http://www.state.nj.us/dep/aqpp/radius.html

6. Florida Title V Permit Application Website, August 2003, http://www.dep.state.fl.us/air/forms/transfer.htm#transferair

7. Ohio Title V Permit Application Website, August 2003, http://www.epa.state.oh.us/dapc/fops/pmu.html

8. Texas Title V Permit Application Website, August 2003, http://www.tnrcc.state.tx.us/permitting/airperm/index.html#oppermits

9. Iowa Title V Permit Application Website, August 2003, http://www.state.ia.us/epd/air/prof/oper/opapp.htm

**KEYWORDS**

Consolidated Emission Reporting Rule (CERR)
Criteria Pollutants
Database Management
Data Integrity
Inventory Validation
NEI
NIF
Point Source Emission Inventory
QA/QC
Title V Permit Application