A NIF-based Validation/QA Database Management System for the Tennessee Emission Inventory

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ABSTRACT

A system for managing an emission inventory database was developed based on the National Emissions Inventory (NEI) and the NEI Input Format (NIF) for the State of Tennessee. This system is designed to easily update and maintain the emission inventory in a Microsoft Access format. Inventory data were obtained from the State's air quality permitting processes, EPA's National Emission Trends 1996 (NET96) database and EPA's AIRS-AFS (Air Facility Subsystem) 1989-1996 emission databases. From these data, emissions of criteria and hazardous air pollutants were reviewed and updated as necessary for compiling the 1999 NEI.

This emission inventory database management system is based on Microsoft Access capability and includes tables, forms, queries, reports and macros. The tables (i.e., Site, Emission Unit, Emission, etc.) have identical formatting to that of NIF. The features in the forms replicate the fields listed in the NIF tables and include drop-down lists of NEI-specific codes such as pollutant codes and control device codes. Links to the forms provide a listing of Source Classification Code (SCC) values and guidance to the reviewer via a Road Map that specifies locations of requisite information. A report, representing a type of flowchart, can be generated and used to validate inventory data and insure data integrity for each company.

The system is not only a useful validation and QA/QC tool, but serves as a database management system. As such, it has the potential to be integrated with a permit management system, and it can be expanded to satisfy future emission inventory and permit fee collection requirements.

INTRODUCTION

Emission inventories are used for a wide variety of purposes, but are most often developed in response to regulation. Emission inventory data are used to evaluate the status of existing air quality as related to air quality standards, trends, and problems, to assess the effectiveness of air pollution policy, and to initiate changes as needed. Individual states may have their own specific inventory requirements, while at the federal level, requirements for emission estimates stem mainly from the Clean Air Act (CAA). In May 2000, the U.S. EPA initiated a ruling referred to as the Consolidated Emissions Reporting Rule (CERR) which requires that each state develop and maintain more comprehensive air emission inventories for

all of the sources within the state, including point, area and mobile sources[1]. EPA's Emission Factor and Inventory Group (EFIG) is currently preparing the 1999 National Emission Inventory for criteria and hazardous air pollutants (HAPs)[2]. States and local agencies are to submit state and local emission inventories for inclusion in the 1999 National Emission Inventory (NEI).

Currently, the State of Tennessee is working on validation of the state's 1999 emission inventory under the CERR requirements and EFIG's guidance for data submittal. A system for managing an emission inventory database was developed based on the NEI and the NEI Input Format (NIF) version 2.0[3] for the State of Tennessee. This system is designed to easily update and maintain the emission inventory in a Microsoft Access® format. Inventory data were obtained from the State's air quality permitting processes, EPA's National Emission Trends 1996 (NET96) database and EPA's AIRS-AFS (Air Facility Subsystem) 1989-1996 emission databases. From these data, emissions of criteria and hazardous air pollutants are reviewed and updated as necessary for compiling the 1999 NEI.

OVERVIEW OF A NIF-BASED VALIDATION/QA DATABASE MANAGEMENT SYSTEM (TEDMS)

The TEDMS is based on Microsoft Access® capability and includes tables, forms, queries, reports and macros. The tables (i.e., Site, Emission Unit, Emission, etc.) have identical formatting to that of NIF. The features in the forms replicate the fields listed in the NIF tables and include drop-down lists of NEI-specific codes such as pollutant codes and control device codes. Links to the forms provide a listing of Source Classification Code (SCC) values and guidance to the reviewer via a Road Map that specifies locations of requisite information. A report, representing a type of flowchart, can be generated and used to validate inventory data and insure data integrity for each company. The followings sections describe the features of the TEDMS.

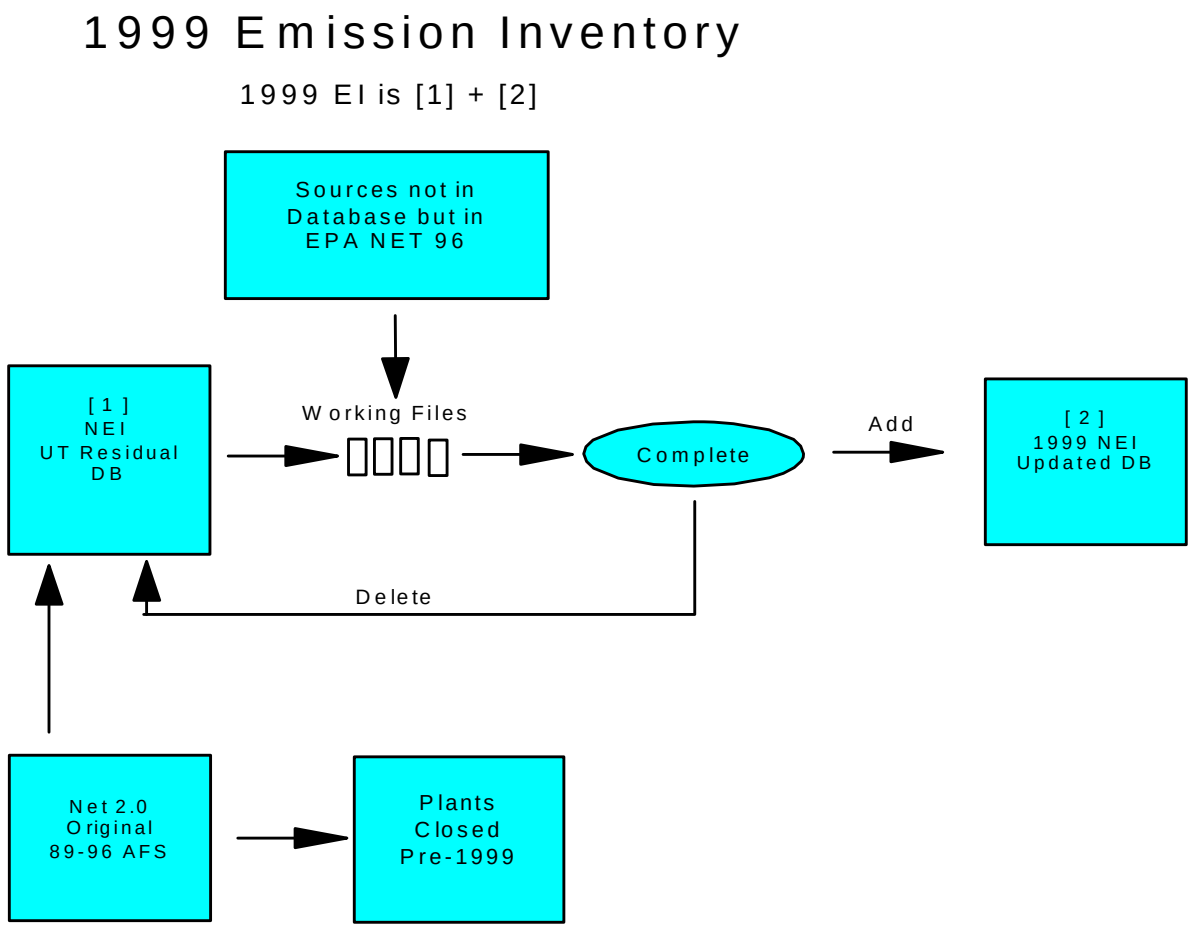
Creation of 1999 Emission Inventory Database

To monitor and record changes in the total number of sources as well as changes in operation of existing sources, the emission data as mentioned above are based on several different resources. During any given year, changes can occur that might impact the emissions inventory. For example: existing facilities could deactivate process equipment or close completely; new facilities and/or processes could come on-line; existing facilities could increase or decrease production schedules; existing facilities could modify their product lines; updates in emission factors or other emission estimation tools could require recalculation of certain emission estimates. It is necessary to collect new data and information to calculate emissions to represent current conditions. Existing inventories should serve as a starting point because they contain extensive data and support information files. For effective use of resources, we should build upon and improve the quality of existing data to fulfill inventory requirements, document these changes as we become aware of them, and update the emission estimates accordingly.

The process of revising the emission inventory database in Tennessee began with the AIRS-AFS 1989-1996 emission databases, added those sources not in the AIRS-AFS databases but in EPA NET96 and those sources permitted after 1996. The next step was to remove all companies closed before 1999. The remaining database was called the 1996 NEI Residual

Database. The data of an individual company were copied from the 1996 NEI Residual Database to a separate file and revised using Title V permit applications or other more current data to reflect 1999 operations. The revised data were printed and sent to the company for review. Upon return of the printed document, corrections were made, and the file was appended to the new 1999 NEI Updated Database. The company's individual file was processed though EPA's QA/QC program before being printed and, again, before it was appended to the 1999 NEI Updated Database. The systematic process to create the 1999 emission inventory database is shown in Figure 1.

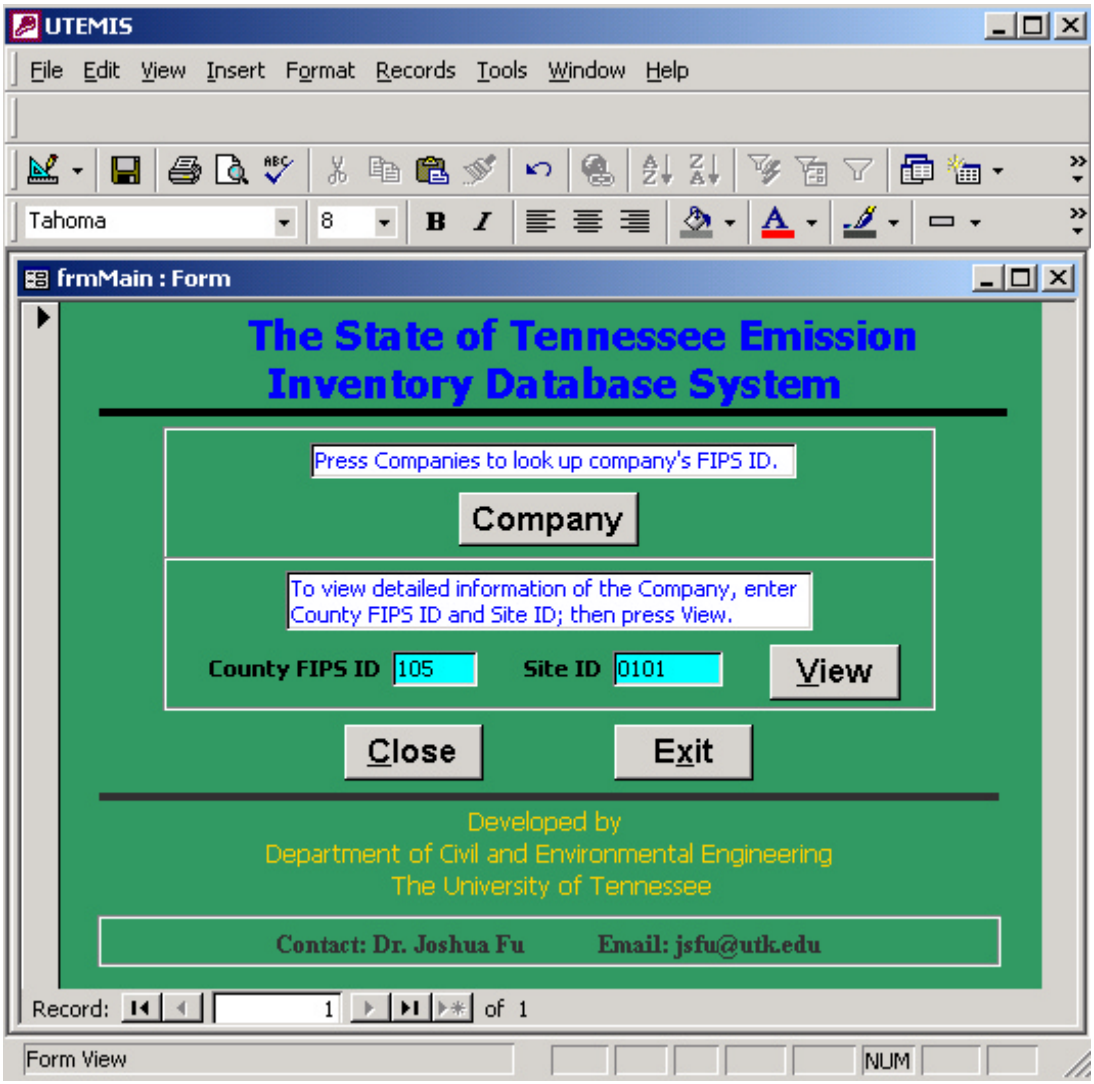
Figure 1. Flowchart of 1999 Tennessee Emission Inventory Data Validation



Features of the NIF-based Validation/QA Database Management System

This emission inventory database management system is based on Microsoft Access® capability. Some features of the TEDMS are shown in Figure 2. The TEDMS includes the 1996 NEI Residual Database. The TEDMS allows easy retrieval of an individual company's information including all tables (EU, ER, EP, PE, EM, CE, AI), forms, queries, reports and macros that can then be copied to a separate file. The description of the TEDMS follows.

Figure 2. The NIF-based Inventory Validation/QA Database Management System



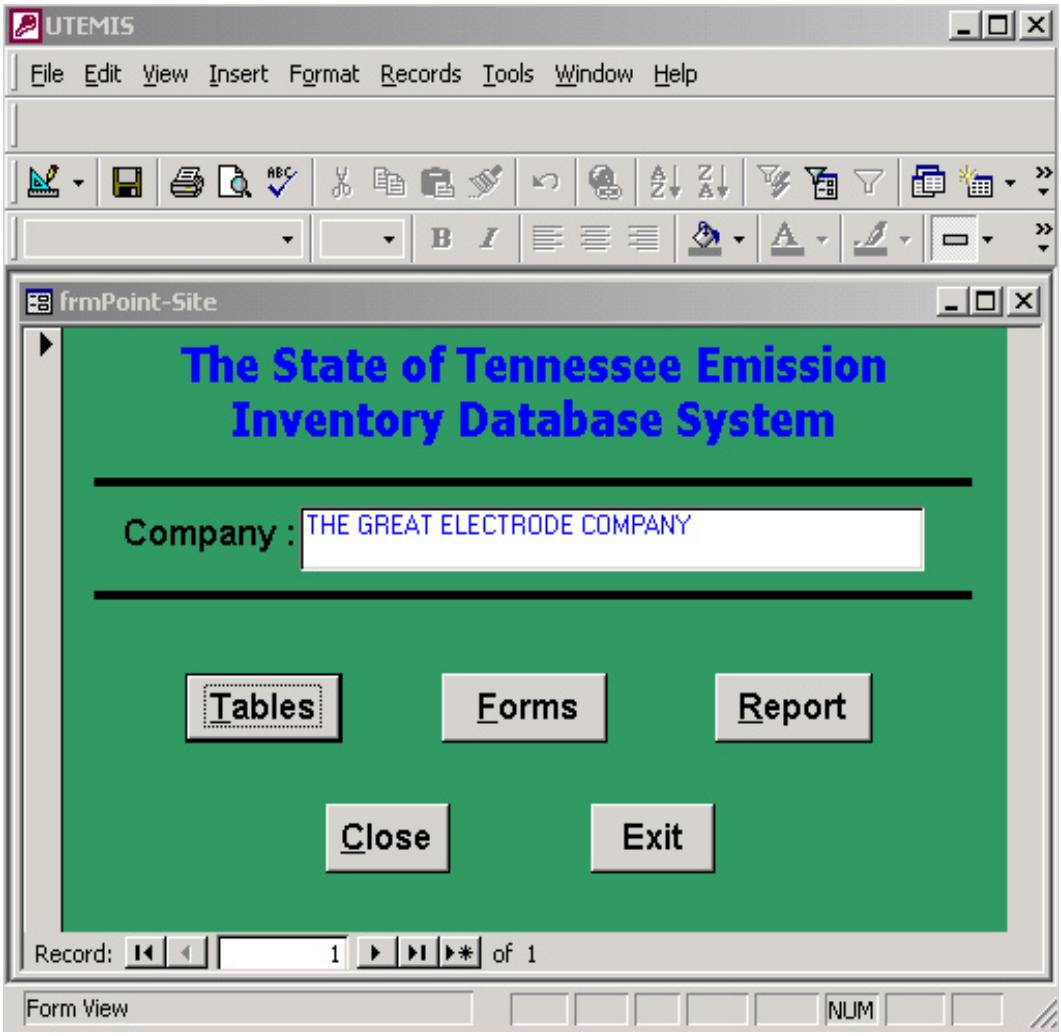
Main Window

The Main Window, shown in Figure 2, provides a Company button to look up the company's county FIPS ID and site ID. Once the user enters the FIPS and site ID's, and clicks the View button, all information of an individual company will be retrieved from tables of the 1996 NEI Residual Database into new tables.

Company Window

After clicking the View button, the Company Window will come up on the screen. The name of the company the user wants to look at will be shown in the window as well as buttons for Tables, Forms, and the Report as shown in Figure 3.

Figure 3. The Company Window of the TEDMS



Tables Window

After clicking the Tables button on the Company Window, the Tables Window will pop up on the screen. Eight table buttons appear, as Table 4 shows, including:

Site Information (SI)
Emission Unit (EU)
Emission Release Point (ER)
Emission Process (EP)
Emission Period (PE)
Emission (EM)
Control Equipment (CE)
Additional Information (AI)

Users can click each button to look at the specific source information. The tables (i.e., Site, Emission Unit, Emission, etc.) have identical formatting to that of NIF version 2.0 for all records. For example, the Emission table is shown in Figure 5.

The Additional Information table is not included in NIF version 2.0. It contains additional internal information needed by the State of Tennessee such as name of contact person, telephone and fax numbers, and mailing address, but will not be submitted to EPA during data uploads.

Figure 4. The Tables Window of the TEDMS

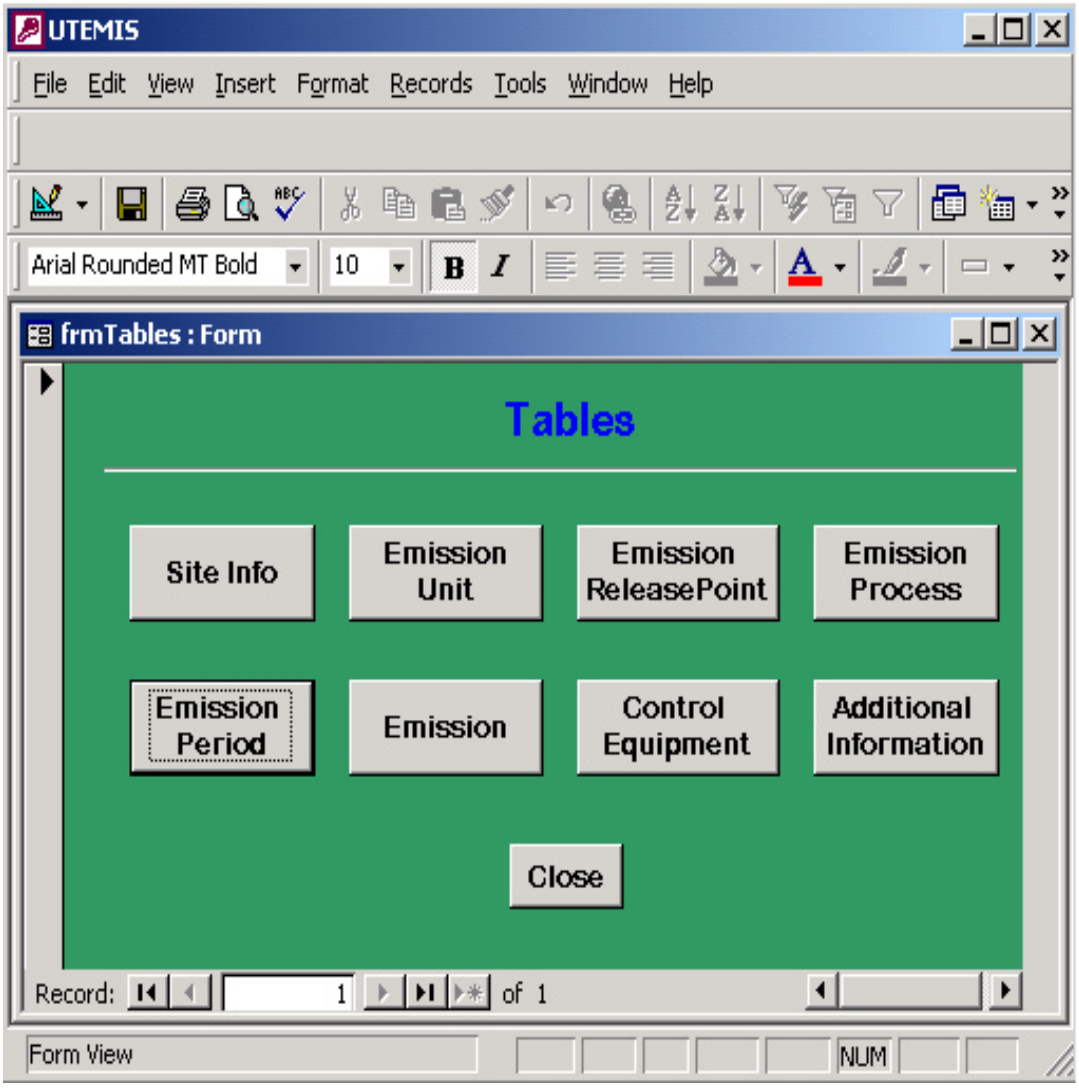
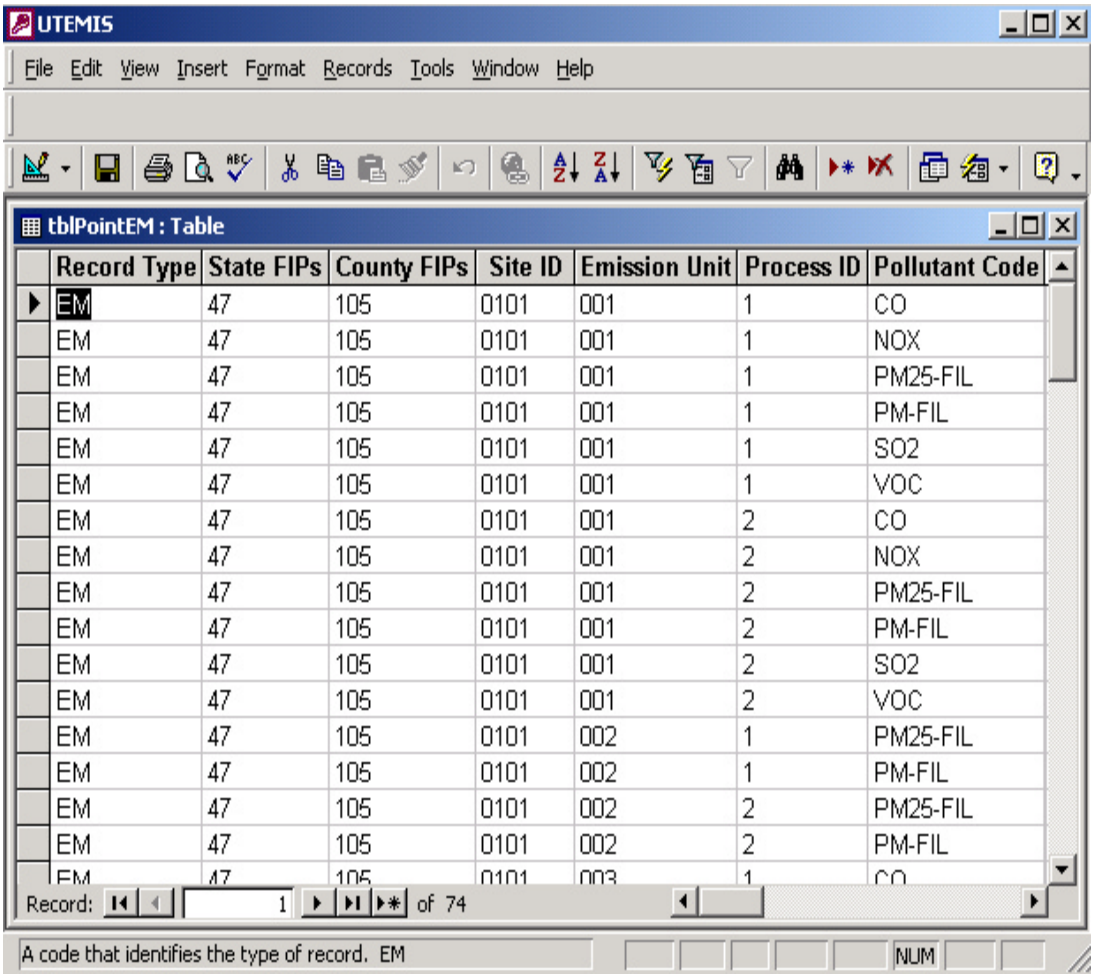


Figure 5. Example of the Emission Table in the TEDMS



Record Type	State FIPs	County FIPs	Site ID	Emission Unit	Process ID	Pollutant Code
EM	47	105	0101	001	1	CO
EM	47	105	0101	001	1	NOX
EM	47	105	0101	001	1	PM25-FIL
EM	47	105	0101	001	1	PM-FIL
EM	47	105	0101	001	1	SO2
EM	47	105	0101	001	1	VOC
EM	47	105	0101	001	2	CO
EM	47	105	0101	001	2	NOX
EM	47	105	0101	001	2	PM25-FIL
EM	47	105	0101	001	2	PM-FIL
EM	47	105	0101	001	2	SO2
EM	47	105	0101	001	2	VOC
EM	47	105	0101	002	1	PM25-FIL
EM	47	105	0101	002	1	PM-FIL
EM	47	105	0101	002	2	PM25-FIL
EM	47	105	0101	002	2	PM-FIL
EM	47	105	0101	003	1	CO

Forms Window

After clicking the Forms button on the Company Window, the Forms Window will pop up on the screen. Again, eight buttons appear:

Site Information (SI)
Emission Unit (EU)
Emission Release Point (ER)
Emission Process (EP)
Emission Period (PE)
Emission (EM)
Control Equipment (CE)
Additional Information (AI)

Users can click any one of the buttons to look at the specific source information as shown in Figure 6. The features in the forms (i.e., Site, Emission Unit, Emission, etc.) replicate the fields listed in the NIF tables and include drop-down lists of NEI-specific codes such as pollutant

codes and control device codes. For example, the Emission form with drop-down lists of pollutant codes – carbon monoxide is highlighted – is shown in Figure 7.

Links to the forms provide a listing of Source Classification Code (SCC) values (see Figure 8) and guidance to the reviewer via a Road Map (see Figure 9) that specifies locations of requisite information. In the Emission form, the user can open a Control Equipment form to edit the control information for a particular pollutant such as the primary control efficiency, primary control device code, etc. as shown in Figure 10. The forms also provide a button to bring up their tables and a button to close the forms. Every form has a Report button to generate a printable report that can be sent out with a company's package of inventory information for verification (see Figure 11).

Figure 7. Example of the Emission Form with the Drop-Down Lists of Pollutant CO

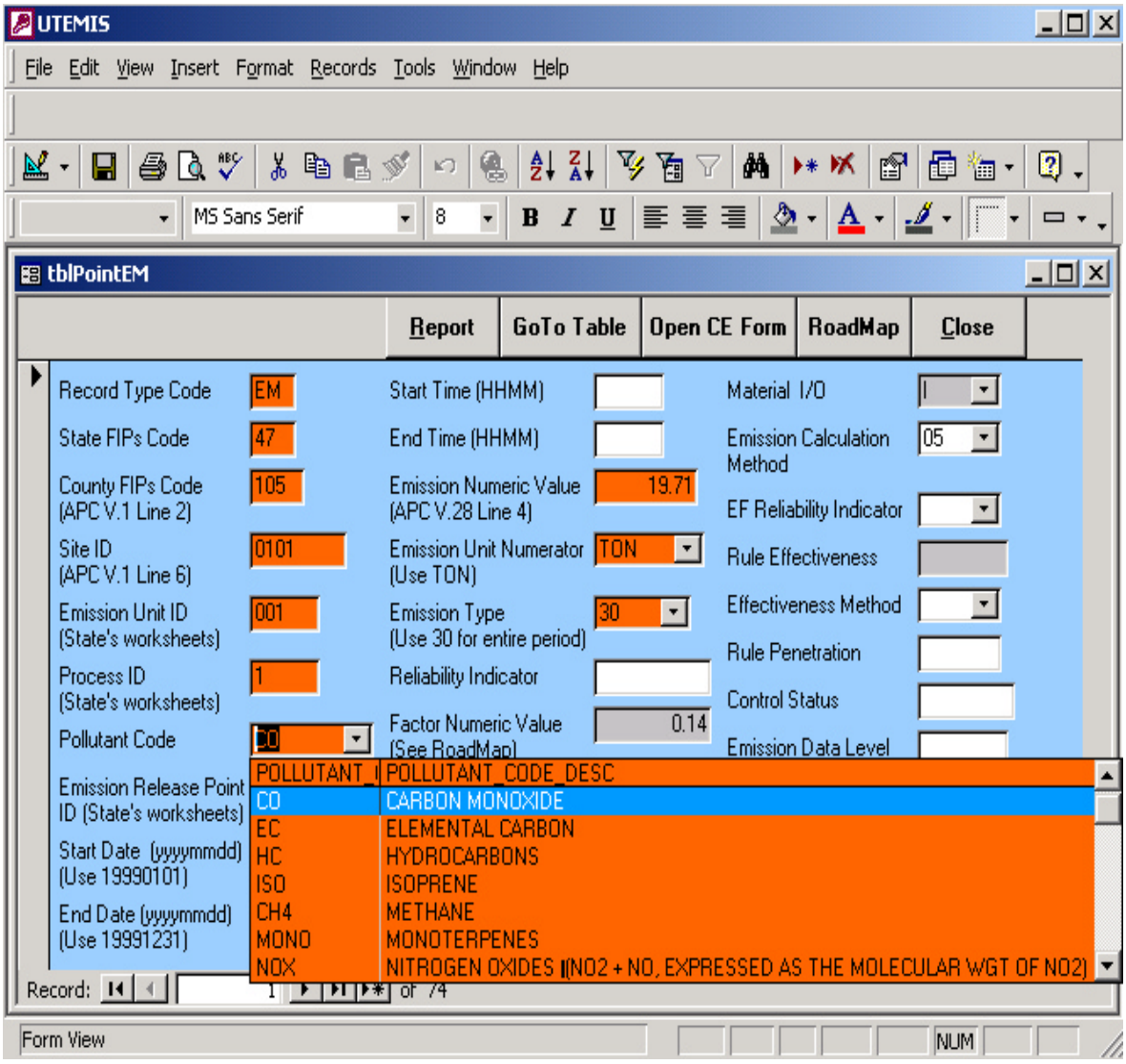


Figure 8. Illustration of the Linked SCC Table on the Emission Process Form

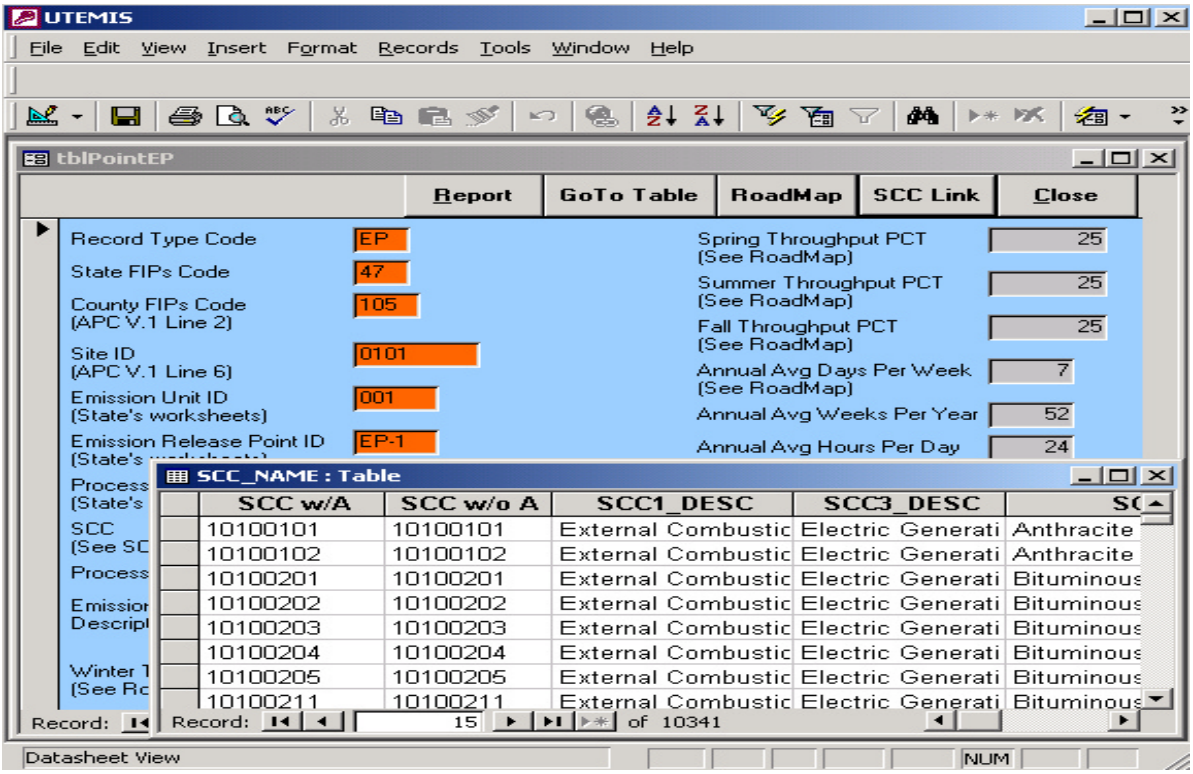


Figure 9. Example of the Roadmap Table for the Emission Form

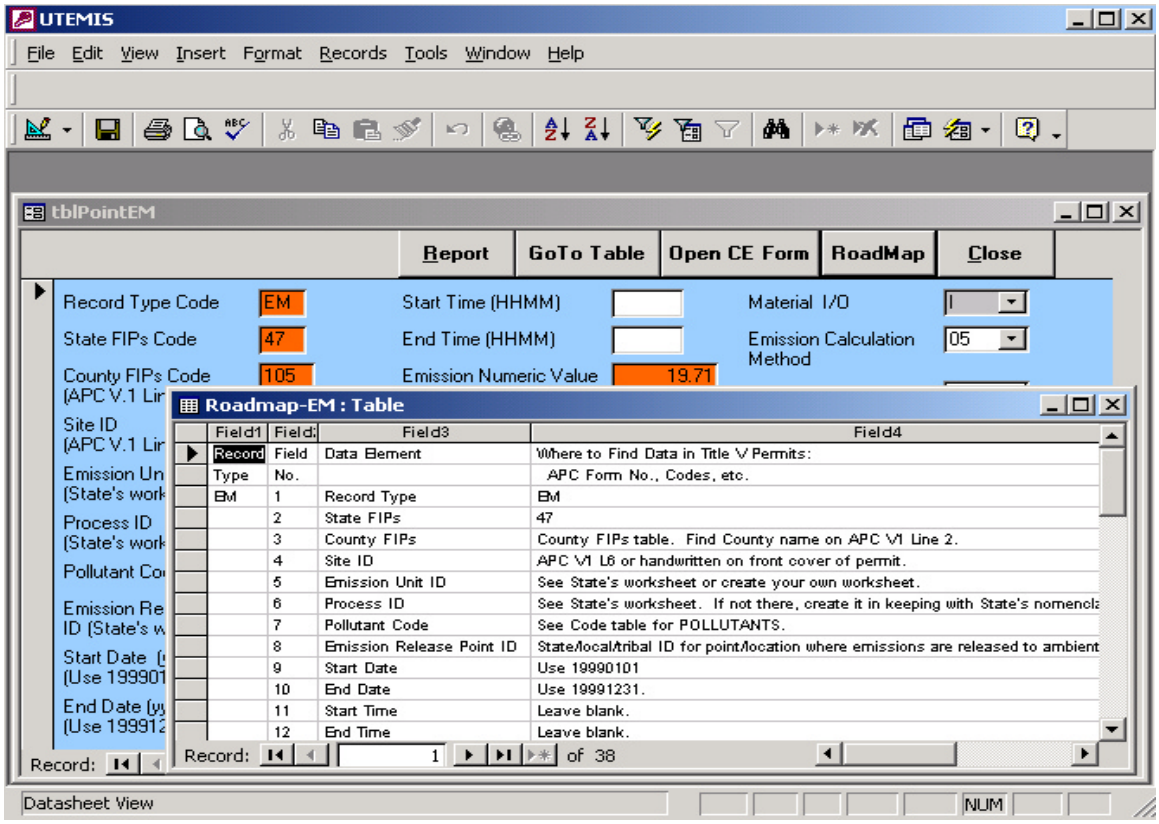


Figure 10. Example of the Control Equipment Form Opened from the Emission Form

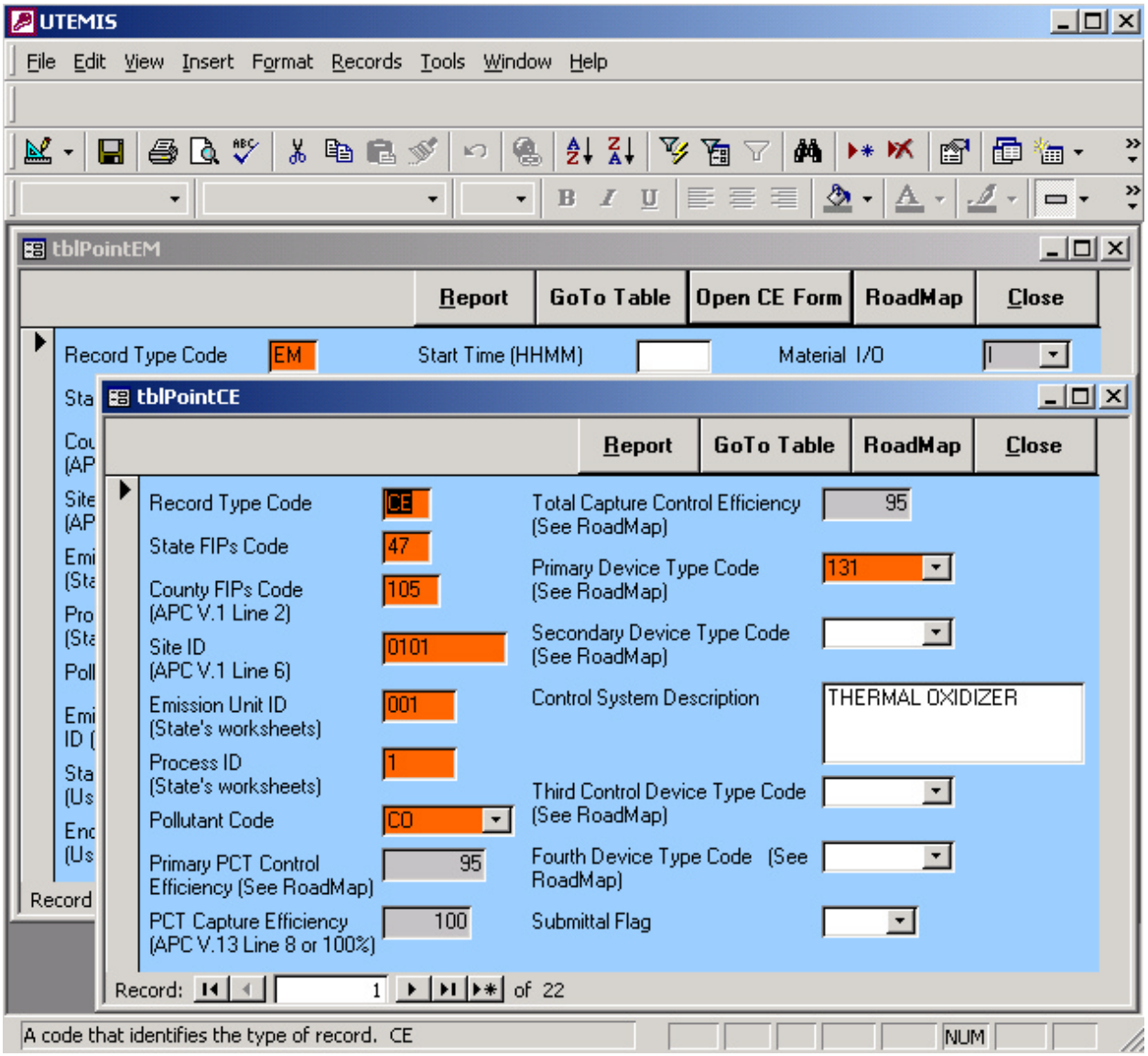


Figure 11. Example of the Printable Sheets of the Emission Records

Emission Records

Record Type Code	EM	**Start Time (HHMM)**		**Emission Calculation Method**	05
State FIPs Code	47	**End Time (HHMM)**		**EF Reliability Indicator**	
County FIPs Code (APC V.1 Line 2)	105	**Emission Numeric Value (APC V.28 Line 4)**	19.71	**Rule Effectiveness**	
Site ID (APC V.1 Line 6)	0101	**Emission Unit Numerator (Use TON)**	TON	**Effectiveness Method**	
Emission Unit ID	001	**Emission Type (Use 30 for entire period)**	30	**Rule Penetration**	
Process ID	1	**Reliability Indicator**		**Control Status**	
Pollutant Code	CO	**Factor Numeric Value**	0.14	**Emission Data Level**	
Emission Release Point ID	EP-1	**Factor Unit Numerator**	LB	**Submittal Flag**	
Start Date (YYYYMMDD) (Use 19990101)	19990101	**Factor Unit Denominator**	TON		
End Date (YYYYMMDD) (Use 19991231)	19991231	**Material**	189		
		Material I/O	I		

Record Type Code	EM	**Start Time (HHMM)**		**Emission Calculation Method**	05
State FIPs Code	47	**End Time (HHMM)**		**EF Reliability Indicator**	
County FIPs Code (APC V.1 Line 2)	105	**Emission Numeric Value (APC V.28 Line 4)**	35.04	**Rule Effectiveness**	
Site ID (APC V.1 Line 6)	0101	**Emission Unit Numerator (Use TON)**	TON	**Effectiveness Method**	
Emission Unit ID	001	**Emission Type (Use 30 for entire period)**	30	**Rule Penetration**	
Process ID	1	**Reliability Indicator**		**Control Status**	
Pollutant Code	NOX	**Factor Numeric Value**	0.631	**Emission Data Level**	
Emission Release Point ID	EP-1	**Factor Unit Numerator**	LB	**Submittal Flag**	
Start Date (YYYYMMDD) (Use 19990101)	19990101	**Factor Unit Denominator**	TON		
End Date (YYYYMMDD) (Use 19991231)	19991231	**Material**	189		
		Material I/O	I		

Record Type Code	EM	**Start Time (HHMM)**		**Emission Calculation Method**	
State FIPs Code	47	**End Time (HHMM)**		**EF Reliability Indicator**	
County FIPs Code (APC V.1 Line 2)	105	**Emission Numeric Value (APC V.28 Line 4)**	14.48	**Rule Effectiveness**	
Site ID (APC V.1 Line 6)	0101	**Emission Unit Numerator (Use TON)**	TON	**Effectiveness Method**	
Emission Unit ID	001	**Emission Type (Use 30 for entire period)**	30	**Rule Penetration**	
Process ID	1	**Reliability Indicator**		**Control Status**	
Pollutant Code	PM25-FIL	**Factor Numeric Value**	0.162	**Emission Data Level**	
Emission Release Point ID	EP-1	**Factor Unit Numerator**	LB	**Submittal Flag**	
Start Date (YYYYMMDD) (Use 19990101)	19990101	**Factor Unit Denominator**	TON		
End Date (YYYYMMDD) (Use 19991231)	19991231	**Material**	189		
		Material I/O	I		

Report Window

A Company Process/Emission Report, representing a flowchart of the company's processes, can be generated and used to validate inventory data and insure data integrity for each company as shown in Figure 12. The Report is a printable feature that lists key information about the company and is created for each table (i.e., SI, EU, ER, EM, EP, PE, CE and AI tables). The last column in the Report indicates whether a CE form is present. The Report allows the user to quickly determine if key information is missing such as an EU description, Emission Release Point ID, Process ID, PE record, Emission value or CE record. A missing value in the Report under the CE Record means that the CE record has not been developed or that there is no control device for that particular pollutant.

The company's individual file is processed through EPA's QA/QC program after it has been revised. Revised data that have passed EPA's QA/QC program are printed and sent to the company for review. Upon return of the printed document, corrections are made, and the file is processed through EPA's QA/QC program again, before it is appended to the 1999 NEI Updated Database. A similar process will then be repeated once work is initiated on the 2002 inventory preparation.

CONCLUSIONS

Managing a state's emissions database is a large effort due to the size and complexity of the actual companies as well as the different sources from which data are obtained. The TEDMS discussed here is one part of a major effort to improve the ability to easily update and maintain the state's emission inventories and to maintain the ability to provide efficient reporting under the CERR requirements. In addition to the efforts that were undertaken to create the base 1999 emission inventory, it is also necessary to incorporate procedures to ensure that the inventory is tracked in a manner that enables it to be easily updated for the next three-year cycle (2002). Figure 13 illustrates a simple flowchart indicating specific activities that must be incorporated into the emission inventory process, such as sources that are modified during the three-year period, closed during the three-year period, and sources that are permitted but not operating. Work is in progress to incorporate all these activities into the inventory process. This will require a close operational relationship between those individuals who work in permitting areas and those who are responsible for inventory maintenance.

ACKNOWLEDGEMENT

This work was sponsored by the Tennessee Department of Environment and Conservation Division of Air Pollution Control.

REFERENCES

1. Consolidated Emissions Reporting Rule (CERR), Federal Register, Tuesday May 23, 2000, Vol.5, No. 100, pp.33268-80, http://www.epa.gov/ttn/chief/cerr/CERR_FR.pdf.

2. 1999 National Emission Inventory Preparation Plan-Revised, February 2001, http://www.epa.gov/ttn/chief/net/nei_plan_feb2001.pdf.

Figure 12. Example of the Inventory Validation in the Report

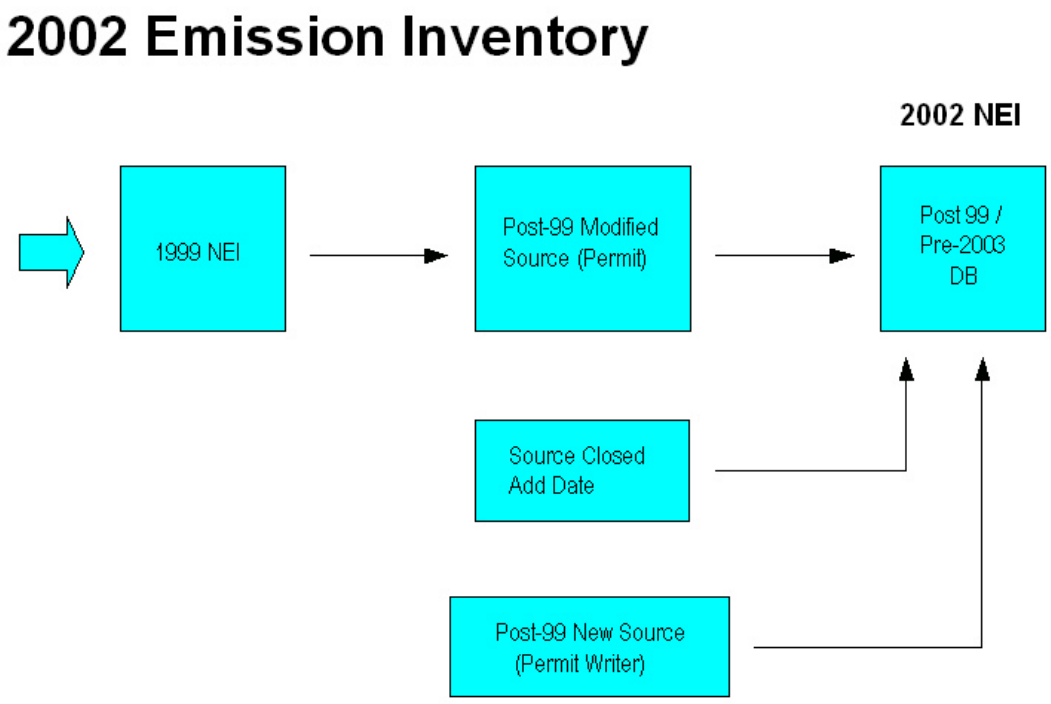
Company Process/Emission Report

THE GREAT ELECTRODE COMPANY
US HWY 41, PATTON ROAD
SMITHTOWN TN 371230903

Site ID	*Emis Unit ID (AIRS Point ID)*	*EU Description*	*ERP ID (AIRS STK ID)*	*Process ID (Segment ID)*	*EP Description*	*PE Record (AC Record)*	*Pollutant Code*	*Emission (ton/yr)*	*CE Record*
0101	001	N-1N-2 CARBON BAKE FURNA	EP-1	1	N-1 CARBON BAKE FURN	PE	CO	19.71	CE
				1	N-1 CARBON BAKE FURN	PE	NOX	35.04	
				1	N-1 CARBON BAKE FURN	PE	PM25-FIL	14.48	
				1	N-1 CARBON BAKE FURN	PE	PM-FIL	16.25	CE
				1	N-1 CARBON BAKE FURN	PE	SO2	419.78	
				1	N-1 CARBON BAKE FURN	PE	VOC	20.59	CE
			EP-12	2	N-2 CARBON BAKE FURN	PE	CO	19.71	CE
				2	N-2 CARBON BAKE FURN	PE	NOX	35.04	
				2	N-2 CARBON BAKE FURN	PE	PM25-FIL	14.48	
				2	N-2 CARBON BAKE FURN	PE	PM-FIL	16.25	CE
				2	N-2 CARBON BAKE FURN	PE	SO2	419.78	
				2	N-2 CARBON BAKE FURN	PE	VOC	20.59	CE
	002	BAKE PACK HANDLING	EP-16	1	BAKE PACK HNDL EP-16	PE	PM25-FIL	14.45	
				1	BAKE PACK HNDL EP-16	PE	PM-FIL	15.33	CE
			EP-17	2	BAKE PACK HNDL EP-17	PE	PM25-FIL	12.38	
				2	BAKE PACK HNDL EP-17	PE	PM-FIL	13.14	CE
	003	PITCH IMPREGNATION AUTO	EP-13	3	PITCH IMP EP-13	PE	CO	0.7	
				3	PITCH IMP EP-13	PE	NOX	4.284	
				3	PITCH IMP EP-13	PE	PM25-FIL	1.716	
				3	PITCH IMP EP-13	PE	PM-FIL	1.752	
				3	PITCH IMP EP-13	PE	SO2	3.416	
				3	PITCH IMP EP-13	PE	VOC	0.056	
			EP-14	4	PITCH IMP EP-14	PE	CO	0.7	
				4	PITCH IMP EP-14	PE	NOX	4.284	

3. National Emissions Inventory Input Format (NIF), Version 2.0, April 2001, http://www.epa.gov/ttn/chief/nif/index.html.

Figure 13. Illustration of A Flowchart for Updating the Year 2002 Emission Inventory



KEYWORDS

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