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Environmental Policy and Technology Project

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TECHNICAL REPORT

Development and Implementation of an Emissions Inventory System for Industrial Sources

by John Castleberry - June 1997
Delivery Order 10, Task 4

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Environmental Policy and Technology Project
A USAID Project Consortium Led by CH2M HILL

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This report has been reviewed for content and approved for distribution.

EPT Regional Director

1 July 1997
Date

Executive Summary

Under the Air Pollution Task of the EPT Novokuznetsk project, an emission inventory system for industrial sources was developed. The inventory was designed to be compatible with the American air dispersion model, ISCST3.

The Novokuznetsk Nature Protection Committee has completed all of the necessary data collection and emission calculations for the inventory. Data for approximately 3,000 emission sources have been compiled.

The only remaining step to completing the inventory system is for the City to transfer the data into a master spreadsheet prepared by EPT staff. EPT staff has provided the City with a computer program and training to complete this step. Once the inventory system is finished, City staff will be able to enter new data, modify existing data, sort data, and export selected data to ISCST3 for modeling.

About the Author

John Castleberry is an air quality specialist for CH2M HILL, Inc., Sacramento, California. He has 9 years professional experience. He specializes in dispersion modeling, emission inventories, meteorological monitoring, health risk assessment, and environmental assessment.

Abbreviations/Acronyms

EPT	Environmental Policy and Technology
ISCST3	Industrial Source Complex - Short Term, Version 3

Section 1
Introduction

This report summarizes the efforts and results of the development of an emission inventory system for the EPT Novokuznetsk project. This activity was accomplished under the Air Pollution Task, Delivery Order 10, Task 04.

A comprehensive inventory of air pollution emission sources in Novokuznetsk is fundamental to air pollution reduction efforts. The primary purpose of the emission inventory system developed for this project is to supply the data necessary for use in the American air dispersion model, ISCST3. Additionally, the emission inventory can be, and is, used for a number of other purposes, including, but not limited to:

- modeling with the Russian air dispersion model
- assessing emission fees
- health risk assessment
- prioritizing emission reduction efforts
- air pollution forecasting

Section 2
Findings

2.1 Development of the Emission Inventory System

The emission inventory system was developed jointly with staff from SibGiproMez and the Novokuznetsk Environment and Nature Protection Committee. SibGiproMez and the City identified the sources, collected the various source parameters, and performed the emission calculations. The data were compiled into an existing database contained within the Russian air dispersion model. We understand that this database is complete. According to SibGiproMez, data for approximately 3,000 emission sources are stored in the Russian database. Emissions were calculated for the following pollutants:

- Nitrogen oxides
- Particulate matter
- Sulfur dioxide
- Carbon monoxide
- Hydrogen fluoride
- Benzo(a)pyrene

Initially, the plan for using the emission inventory data in the American dispersion model, ISCST3, was to store the data in the Quest emission inventory program (see Figure 1). From Quest, data theoretically can be transported into the ISCST3 model with just a few keystrokes. To streamline the task of converting data from the Russian model into the Quest program, EPT staff provided the City with an Excel spreadsheet template. The City used the template to create numerous spreadsheets, one for each emission source. Each spreadsheet contains the source parameters and emissions rates required by ISCST3. The step of creating these Quest spreadsheets (labeled "1a" in Figure 1) was done manually by the City.

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Figure 1. Initial Plan for Using the Emission Inventory in ISCST3

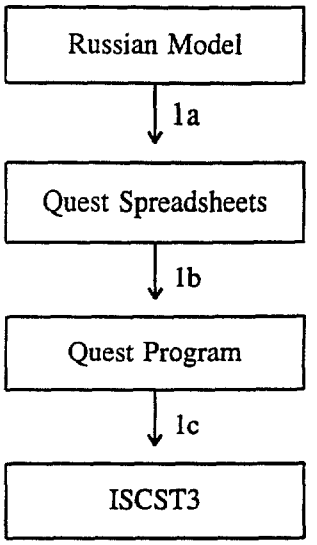
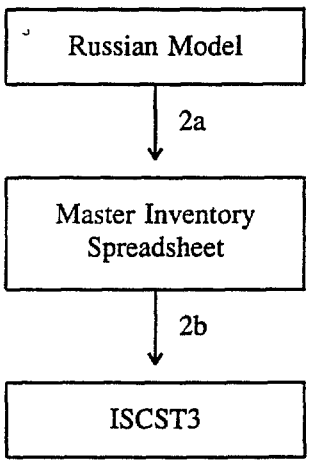


Figure 2. Revised Plan for Using the Emission Inventory in ISCST3



In May 1997, EPT staff revisited the process of importing the emission inventory data into ISCST3. Because of limitations of the Quest software, EPT staff determined that the most efficient method for handling the emission inventory data is to eliminate the use of the Quest spreadsheets and the Quest program altogether. The revised emission inventory system approach is depicted in Figure 2. In place of the Quest spreadsheets and the Quest program, EPT staff developed a single Excel "master" spreadsheet containing all inventory data for all sources. To switch to this new approach, EPT staff created a Visual Basic program that transfers data from the Quest spreadsheets (in Figure 1) into the Master Inventory Spreadsheet (in Figure 2).

2.2 Description of the Emission Inventory System

The Master Inventory Spreadsheet is designed to be complete in itself; that is, it contains all of the necessary source and emissions data, for all sources, required by ISCST3. It is essentially a duplicate of the Russian database, but in a form that can be readily used by ISCST3. It also contains additional data fields that are not in the Russian database, including:

- Source elevation (above sea level)
- Source type (point, area, volume, or open pit)
- Area source parameters
- Volume source parameters
- Open pit source parameters

The Master Inventory Spreadsheet comes equipped with a macro that automates the transfer of data to the ISCST3 model (step 2b in Figure 2). From within the Master Inventory Spreadsheet, City staff can enter new source and emissions data, modify existing data, sort data, and export selected data to ISCST3. Appendix A contains a sample printout of the Master Inventory Spreadsheet. All of the data fields are listed.

2.3 Summary of Training

City staff have been trained on the following activities regarding the emission inventory:

- How to transfer inventory data from the Quest spreadsheets to the Master Inventory Spreadsheet (a one-time process)
- How to use the Master Inventory Spreadsheet
- How to transfer data from the Master Inventory Spreadsheet to the ISCST3 model

Appendix B contains a list of the persons who attended the training. A complete set of instructions, translated into Russian, was distributed to the training attendees. All software and electronic data developed by EPT staff and/or used in the training, including the Master Inventory Spreadsheet, were turned over to the City.

2.4 Suggested Tasks for City Staff to Continue Progress

As of June 5, 1997, City staff had been trained on how to finish developing the emission inventory system, but the process was not yet complete. To use ISCST3 with maximum flexibility, the City needs to finish creating the Master Inventory Spreadsheet using the steps covered in the training. Specifically, City staff needs to use the Visual Basic program created by EPT staff to transfer inventory data from all 3,000 sources from the Quest spreadsheets to the Master Inventory Spreadsheet. Once this activity is complete, the City will have the capability to export data for any pollutant and any combination of sources to ISCST3 for modeling.

With each consecutive year, as the emission inventory is updated in the Russian model, City Staff will have to update the Master Inventory Spreadsheet simultaneously. At present, this is a manual process. Presumably, however, the City could develop a computer program that automatically transfers data from the Russian model to the Master

Inventory Spreadsheet. Automating this process would save man-hours and reduce the possibility for errors being introduced to the inventory.

Section 3
Conclusions

The City now has the data, tools, instructions, and training necessary to create and maintain a comprehensive source and emissions inventory for use in the ISCST3 model. It is now up to the City to continue the effort of completing the inventory and using the ISCST3 model.

Section 4
Recommendations

- City Staff should finish transferring emission inventory data for all sources from the Quest spreadsheets to the Master Inventory Spreadsheet. EPT staff provided the City with a Visual Basic program for automating this activity.

- City Staff should consider developing a program that automatically takes inventory data from the Russian model and inserts it into the Master Inventory Spreadsheet. This step is labeled "2a" in Figure 2. This improvement would eliminate the burdensome task of entering data manually, as well as reduce the possibility of data errors.

- EPT should contact City staff in July or August 1997, to verify that things are progressing without any problems and to encourage the City to continue this important task.

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Appendix A

Sample Printout of the Master Inventory Spreadsheet

General Site Information	Site name	Grid North (km)	Grid East (km)	Address	Process	Work time (hour/year)	SIC Code	Select Source for PNT File	Source Number
ая информация об объекте	Наименование объекта	Координата по Y (км) - Север	Координата по X (км) - Восток	Адрес	Процесс	Время работы (ч/год)	Код SIC	Выбрать источник для файла PNT	Номер трубы
Кузнецкие Ферросплавы" Плавильный цех 2	печь 7, дозпитатели , летка	9.69	17.18	654077, Новокузнецк	Подача шихты в печь, выплав- ка ферросилиция, слив сплава	8317		x	4020020
"Кузнецкие Ферросплавы" Плавильный цех 1	печь 1, дозпитатели , летка	9.565	16.9	654077, Новокузнецк	Подача шихты в печь, выплав- ка ферросилиция, слив сплава	7955		x	4020001
"Кузнецкие Ферросплавы" Плавильный цех 1	открытые печи 2,3,4, дозпитатели	9.565	16.929	654077, Новокузнецк	Подача шихты в печь, выплав- ка ферросилиция, слив сплава	7984		x	4020002
"Кузнецкие Ферросплавы" Плавильный цех 1	Летка печи 2	9.59	16.88	654077, Новокузнецк	Слив сплава	1600		x	4020003
"Кузнецкие Ферросплавы" Плавильный цех 1	Летка печи 3	9.6	16.905	654077, Новокузнецк	Слив сплава	1600		x	4020004
"Кузнецкие Ферросплавы" Плавильный цех 1	Летка печи 4	9.61	16.925	654077, Новокузнецк	Слив сплава	1600		x	4020005
Кузнецкие Ферросплавы" Плавильный цех 1	аэрационные выбросы	9.605	16.85	654077, Новокузнецк	Выплавка ферросилиция	8760		x	4020008
Кузнецкие Ферросплавы" Плавильный цех 1	аэрационные выбросы	9.575	16.88	654077, Новокузнецк	Выплавка ферросилиция	8760		x	4020009
Кузнецкие Ферросплавы" стовый двор плав.цеха 1	4-х валковая коксовая дробилка	9.65	16.72	654077, Новокузнецк	Дробление кокса	1719		x	4020010
узнецкие Ферросплавы" стовый двор плав.цеха 1	Грохот 4-х валковый коксовый	9.635	16.72	654077, Новокузнецк	Дробление кокса	1719		x	4020011
Кузнецкие Ферросплавы" стовый двор плав.цеха 1	Питатели шихтового двора	9.64	16.73	654077, Новокузнецк	Подача шихты	5369		x	4020012
узнецкие Ферросплавы" овый двор плав.цеха 1	Мусорные бункера	9.55	16.73	654077, Новокузнецк		5501		x	4020016
Кузнецкие Ферросплавы" товый двор плав.цеха 1	Кварцевый грохот	9.565	16.765	654077, Новокузнецк	Грохочение	1168		x	4020014
узнецкие Ферросплавы" товый двор плав.цеха 1	Коксовый грохот	9.565	16.76	654077, Новокузнецк	Грохочение	2063		x	4020015
нецкие Ферросплавы" Склад товой продукции 1	Дробилка ферросилиция	9.475	16.665	654077, Новокузнецк	Дробление ферросилиция	2251		x	4020018
нецкие Ферросплавы" ктовый двор цеха 1	Шлаковая дробилка	9.605	16.66	654077, Новокузнецк	дробление шлака	2047		x	4020013
знецкие Ферросплавы" лавильный цех 2	печь 6, дозпитатели , летка	9.665	17.145	654077, Новокузнецк	Подача шихты в печь, выплав- ка ферросилиция, слив сплава	7247		x	4020019
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Source Type: 0=stack [s] 1=volume [v] 2=area [a] 3=open pit [p]	Stack Height [s]/ Effective Release Height [v,a,p] (meters)	Stack Diameter [s] (meters)	Exit Velocity [s] (meters/sec)/ Lateral Dimension [v] (meters)/ Length of X Side [a,p] (meters)	Exit Temperature [s] (degrees C)/ Vertical Dimension [v] (meters)/ Length of Y Side [a,p] (meters)	Base Elevation [s,v,a,p] (meters)	Rotation Angle [a] (degrees)/ Open Pit Volume [p] (cubic meters)	Initial Vertical Dimension [a] (m)/ Rotation Angle [p] (degrees)	Emission Rate, Particles (g/sec)	Control Technology, Particles	Tested Efficiency, Particles
Гип источника: 0=труба [т] 1=объем [о] 2=площадь[п] 3=разрез[р]	Высота трубы [т]/ моделируемая высота выбросов [о,п,р] (метры)	Диаметр трубы [т] (м)	Выходная скорость [т] (м/с)/ горизонтальный размер [о] (м)/ длина стороны X [п,р] (м)	Выходная температура [т](С) вертикальный размер [о](метры) / длина стороны Y[п,р] (метры)	Высота основания [т,о,п,р] (метры)	Угол вращения [п](градусы)/ объем разреза [р] (м3)	начальный вертикальный размер[п](м)/ угол вращения[р](градусы)	Уровень выбросов,пыль (г/с)	Технология очистки,пыль	Фактическая эффективность,%
0	34	2.9	8.3	50	205	0	0	2.59	рукавный фильтр	99.3
0	45	2.7	4.6	60	205	0	0	2.39	рукавный фильтр	99
0	45		0.8	50	205	0	0	8.13	рукавные фильтры	98.6
0	25	1.2	11.4	40	205	0	0	6.33	нет	
0	25	1.2	10.2	40	205	0	0	6.26	нет	
0	25	1.2	9.1	40	205	0	0	6.18	нет	
0	25		1.3	30	205	0	0	0.99		
0	15		1	30	205	0	0	0.99		
0	16	0.65	13.9	25	205	0	0	0.23	циклон	88.4
0	18	0.65	13.9	25	205	0	0	0.4	циклон	86.7
0	18	0.44	32	25	205	0	0	0.44	циклон	85
0	20	0.63	15.7	25	205	0	0	0.3	циклон	78.1
0	12	0.8	15.1	25	205	0	0	0.71	циклон	84.8
0	12	0.72	13.5	25	205	0	0	0.32	циклон	89
0	12	0.8	20.1	25	205	0	0	5.4	циклон	70
0	20	0.63	15.7	25	205	0	0	0.45	циклон	94
0	30		0.8	50	205	0	0	2.7	рукавный фильтр	99

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on Rate, Sulfur Dioxide (g/sec)	Control Technology, Sulfur Dioxide	Tested Efficiency, Sulfur Dioxide	Emission Rate, Oxides of Nitrogen (g/sec)	Control Technology, Oxides of Nitrogen	Tested Efficiency, Oxides of Nitrogen	Emission Rate, Carbon Monoxide (g/sec)	Control Technology, Carbon Monoxide	Tested Efficiency, Carbon Monoxide	Emission Rate, Hydrogen Fluorid (g/sec)
выбросов,Двуокись сер (г/с)	Технология очистки	Фактическая эффективность	Уровень выбросов,Оксиды азота (г/с)	Технология очистки	Фактическая эффективность	Уровень выбросов,Окись углерода (г/с)	Технология очистки	Фактическая эффективность	Уровень выбросов,Фтористый водород (г/с)
3			1.8			2.22			
1.26			1.22			1.51			
4.67			3.66			4			
нет			нет			нет			нет
нет			нет			нет			нет
нет			нет			нет			нет
0.04						0.1			
0.04						0.1			
2.07			1.48			1.53			

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echnology, Hydrogen Fluoride	Tested Efficiency, Hydrogen Fluoride	Emission Rate, Benzopyrene PAHs (g/sec)	Control Technology, Benzopyrene PAHs	Tested Efficiency, Benzopyrene PAHs	Comments
Технология очистки	Фактическая эффективность	Уровень выбросов,Бенз(а)пирен (г/с)	Технология очистки	Фактическая эффективность	Комментарии
		0.0000001	рукавный фильтр	45.54	
		0.000000065	рукавный фильтр	45.54	
		0.00000016	рукавный фильтр	45.54	Для линейного источника выброса : Координата по Y 2*(км) - Север 9.631 Координата по X2* (км) - Восток 16.929 Объем отходящих газов (м3/с) 359.6
		нет			
		нет			
		нет			
					Для линейного источника выброса : Координата по Y 2*(км) - Север 9.625 Координата по X2* (км) - Восток 16.901 Объем отходящих газов (м3/с) 397.8
					Для линейного источника выброса : Координата по Y 2*(км) - Север 9.6 Координата по X2* (км) - Восток 16.915 Объем отходящих газов (м3/с) 306
		0.0000001	рукавный фильтр	45.54	Для линейного источника выброса : Координата по Y 2*(км) - Север 9.707 Координата по X2* (км) - Восток 17.145 Объем отходящих газов (м3/с) 231.2

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Appendix B
List of Emission Inventory Trainees

List of Attendees:

Olga Salnikova	Chief Specialist of the Land Use Economy Department, Environment and Nature Protection Committee
Nina Ninyova	Head of the Nature Use Economy Department, Environment and Nature Protection Committee
Alexander Mirolyubov	Head of the Environment and Nature Protection Committee (SibGiproMez)
Ludmila Markina	Chief Specialist of the Environment and Nature Protection Committee
Anatoly Bikov	Chief Specialist, Scientific Production Company Logos
V. Sidenko	Chief Specialist of the Expertise Department, Kemerovo State Nature Protection Committee
I. Lyalkova	Chief Specialist of the Expertise Department, Kemerovo State Nature Protection Committee
M. Malkova	Chief Specialist of the Environment and Nature Protection Committee (SibGiproMez)
S. Ushakov	Chief Specialist of the Environment and Nature Protection Committee (SibGiproMez)