Using and Improving National Emissions Inventory Data for Residual Risk and Technology Review Projects

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ABSTRACT

Over the past 2 years, the U.S. Environmental Protection Agency (EPA) has been actively engaged in its Risk and Technology Review (RTR) Program, which is a combined effort to evaluate both risk and technology after the application of maximum achievable control technology (MACT) standards, as required by the 1990 Clean Air Act Amendments. The RTR Program evaluates the effectiveness of technology-based standards, using cancer and noncancer risks as metrics, and determines the need for implementing additional and/or more stringent control requirements on specific source categories to reduce cancer and noncancer risks.

Version 3 of the 2002 National Emissions Inventory (NEI) is the starting point for the RTR process that is used for conducting the 8-year residual risk analysis for the first 50 source categories in the National Emissions Standard for Hazardous Air Pollutants (NESHAP) Program. Key NEI data that impact the modeling results are the following: stack parameters, location coordinates, MACT code assignments, hazardous air pollutant (HAP) emissions, and the speciation of HAP. During the review phase for the 22 categories listed in the first Advanced Notice of Public Rulemaking (ANPRM), state and local agencies, industry, and EPA have extensively reviewed these key NEI data elements. Data were posted on a public RTR Web site as part of the ANPRM, asking for public review and comment on the emissions data. The new data provided by public commenters were reviewed and incorporated into the datasets and used as input files for modeling with the Human Exposure Model Version 3 (HEM3). Significant time and resources were expended by industry, state agencies, and EPA to improve the RTR

[*] RTI International is a trade name of Research Triangle Park.

NEI dataset. This review also provided important benefits in revising the 2002 NEI, as well as in preparing the 2005 NEI. The revised emissions estimates often reflected a more current base year, such as 2005, and the MACT code assignments, stack parameters, and location coordinates often replaced default values that were used in the 2002 NEI. This same process will be used for future RTR assessments.

The purposes of this paper are to highlight the important contributions of the RTR process to make improvements in the NEI and also to illustrate the impact that improving NEI data elements has on RTR modeling results. Many data issues and challenges have been addressed under this process, and a summarization of those issues and challenges and potential impacts on the resulting risk evaluations are given. Examples from specific source categories will be highlighted in this paper to illustrate the issues.

INTRODUCTION

The Risk and Technology Review (RTR) project is an effort to conduct residual risk assessment and technology review under Clean Air Act (CAA) Section 112(f) and 112(d)(6), respectively. Section 112(f)(2) requires the U.S. Environmental Protection Agency (EPA) to conduct risk assessments on the source categories subject to maximum achievable control technology (MACT) standards and to determine if additional standards are necessary to reduce the residual risk. Under Section 112(f)(2), EPA will consider the residual risk to be low if the following criteria are met: for lifetime cancer risk to the individual most exposed to be less than 1 in 1 million; for chronic noncancer risk to the individual most exposed to be less than a target-organ-specific hazard index of 1; for air concentrations estimated for acute exposure scenarios to be less than health-protective reference levels; and for no potential for significant and widespread environmental effects. Section 112(d)(6) requires EPA to review and revise MACT standards as necessary, taking into account developments in practices, processes, and control technologies. Where there are advances in controls, EPA will consider costs, potential emissions reductions, and health and environmental risks in determining what further controls are necessary.

The RTR Program is conducting analyses of multiple source categories and subcategories with MACT compliance dates of 2002 and earlier. The source categories have been grouped into phases, which are further divided into groups, and then the groups have been divided into subgroups. Table 1 lists the source categories included in Phase I and Phase II, and the Groups 1, 2, and 3 under Phase II. The RTR process, including proposal and promulgation, has been completed for Phase I source categories. For Phase II, the Group 1 source categories have been proposed (72 FR 70543; December 12, 2007), and the Advanced Notice of Public Rulemaking (ANPRM) has been released for the Group 2 source categories (72 FR 14734; March 29, 2007). Proposal of the Group 2 source categories is expected in 2008 and 2009, and the ANPRM for Group 3 source categories is expected in 2008.

Table 1. RTR phases and groups for source category review.

Source Category	
Phase I	
Coke Ovens	Gasoline Distribution
Dry Cleaning	Ethylene Oxide Sterilizers
Industrial Cooling Towers	Magnetic Tape

Source Category	
Hazardous Organic National Emissions Standard for Hazardous Air Pollutants	Halogenated Solvents
Phase II	
Group 1	
Polymers and Resins I (4 categories)	Generic Maximum Achievable Control Technology (GMACT)–Hydrogen Fluoride
Polymers and Resins II (2 categories)	GMACT–Acetal Resins
Group 2	
Petroleum Refineries	
Group 2A	
Marine Vessel Loading	Polymers and Resins I (5 categories)
Mineral Wool Production	Printing and Publishing
Pharmaceutical Manufacturing	
Group 2B	
Aerospace Manufacturing and Rework	Oil and Natural Gas Production
Natural Gas Transmission and Storage	
Group 2C	
Polymers and Resins IV (7 categories)	Shipbuilding and Ship Repair
Primary Aluminum Reduction	
Group 3	
Acrylic and Modacrylic Fibers	Primary Lead Smelting
Chrome Electroplating (3 subcategories)	Publicly Owned Treatment Works
Ferroalloys Production	Pulp and Paper Production
Flexible Polyurethane Foam	Secondary Aluminum Production
Off-site Waste and Recovery	Secondary Lead Smelting
Phosphoric Acid/Phosphoric Fertilizer Production	Steel Pickling—HCl Process
Polycarbonates Production	Wood Furniture
Polyether Polyols Production	Wool Fiberglass

BODY

Data Process for RTR

The risk assessment analysis requires that EPA determine the emissions levels from the source categories and identify the emissions-release characteristics (e.g., stack parameters). The RTR project approach for collecting the best available emissions data and information for the RTR review includes three phases. EPA (1) conducts an engineering review of the National Emissions Inventory (NEI) dataset (for the majority of the source categories) and a screening risk assessment using the NEI data and releases an ANPRM that requests public comment on the data; (2) incorporates public comments into the dataset, conducts a technology review and risk assessment, and proposes additional standards based on the results of the residual risk and technology review analysis; and (3) addresses public comments, conducts any re-analysis, and promulgates the additional standards. More details on the approach follow.

Engineering Review and Release of ANPRM

For the majority of the source categories, EPA began with the 2002 NEI database as the starting point for emissions and emissions-release characteristics for the source categories. The NEI database contains information about sources that emit criteria air pollutants and their precursors and hazardous air pollutants (HAP), and it contains annual air pollutant emissions estimates. EPA collects this information and releases an updated version of the NEI database every 3 years. The information included company name, plant name, facility codes, MACT codes, emissions data, stack height, stack diameter, exit stream temperature, exit stream velocity, and latitude and longitude coordinates. For a few of the source categories, EPA collected emissions data and other data from industry (e.g., for five of the Polymers and Resins I source categories in Group 2A).

EPA's industry experts, who have many years of experience with individual source categories and industries, who typically worked on the original MACT development and who have continued to track the source category since promulgation, reviewed the source category data for consistency and completeness. The engineering review conducted by EPA's experts included an evaluation of facilities contained in the source category, the emissions units expected to be included for the processes in the source category, and the HAP compounds and emissions levels typically seen. The EPA experts often had additional information on the source category, and where better data were available, this information was included in the dataset.

The improved datasets for the source categories are referred to as the ANPRM datasets. These ANPRM datasets for Groups 1 and 2 were posted on EPA's Air Toxics Web site (http://www.epa.gov/ttn/atw/rrisk/rtrpg.html), and an ANPRM was published in a *Federal Register* notice to announce the availability of the data for public comment. The notice and the Web site included instructions for commenting electronically on the ANPRM datasets. Any data issues or anomalies that could not be resolved during the engineering review conducted by the industry experts were identified in the ANPRM notice, along with a request for comment on those issues. Table 2 provides the list of data fields in the ANPRM that EPA requested comments on.

Table 2. Data requests for clarification and corrections during ANPRM source category review.

ANPRM Data Requests
Input on Source Category Representation
Names and addresses for facilities
• Which should be included but are not
• Which should not be included
• Identify area sources and provide documentation
Facility-Specific and Emissions-Point-Specific Data
Facility location and identification

ANPRM Data Requests
• Facility name
• Facility address
• Facility category code (major or area source)
Emissions point data
• SCC and MACT codes
• Emissions of each HAP, tons per year (tpy)
• Emissions-release point type (e.g., fugitive, vertical, horizontal, gooseneck, vertical with raincap, downward facing vent)
• Emissions-release characteristics (e.g., stack height, stack diameter, exist gas temperature, velocity, flow rate)
• Emissions point latitude and longitude coordinates
Data characteristics
• Acute emissions factors
• Speciation of metal HAP and polycyclic organic matter
• HAP emissions performance level (i.e., actual, allowable, maximum)

ANPRM Public Comments and Proposal of Standards

Industry and state and local agencies have provided comment on the emissions data and information in the ANPRM datasets. EPA has evaluated these comments and data corrections and has included them in the datasets as appropriate where EPA concluded that the comments supported adjustment. The public comments included revisions to the emissions (both additions and deletions), facility names, MACT codes, stack parameters, and coordinates. After incorporating changes to the datasets from the public data-review process, the final or revised datasets were created. These revised datasets are referred to as the Notice of Proposed Rulemaking (NPRM) datasets, which are used to conduct the residual risk analysis on which a regulation will be based, if necessary. These revised datasets for the source categories were incorporated into the 2002 NEI and were made available to the public.

Proposal Public Comments and Promulgation of Standards

Following the creation of the NPRM datasets and the residual risk analysis, the proposal *Federal Register* notice for each source category is published along with the proposed regulatory action. The NPRM datasets are available for public review in the rulemaking docket. Documentation of the NPRM datasets includes a description of the data changes for each source category since the ANPRM was published and describes the data changes requested in public comments. As is true for traditional rulemaking efforts, industry and state and local agencies provide comments on the proposal notice, and EPA summarizes and responds to comments before finalizing the action (i.e., prior to publication of the promulgation *Federal Register* notice) and incorporates public comments on the action as appropriate.

RTR Emissions Data Review Activities to Date and Issues Encountered

Many data issues and challenges have been addressed under the RTR process as EPA conducted the initial review of the NEI datasets, and then reviewed the public comments on the ANPRM datasets. Some of the issues and challenges include the following:

- Are facilities correctly included in a source category universe?
- Are emissions units correctly included in a source category?
- How are data being handled for those facilities subject to multiple MACT rules?
- Can industry identify their facilities in the dataset?
- Can industry identify emissions units within their facilities?
- Are the assumptions about HAP speciation correct?
- Do the emissions represent actuals or allowables?
- How will data be augmented when facilities are missing and when anticipated HAP are missing from units within a facility?
- How does the data affect the risk results and any potential subsequent regulations?

Are Facilities Correctly Included in a Source Category Universe and Can Industry Identify Their Facilities in the Dataset?

The NEI datasets for a source category often did not match the expected number of facilities thought to be in the source category. In some instances, the NEI showed a fewer number of facilities that were estimated to be in the source category and in some instances showed more facilities than expected. Facilities are commonly misidentified as being part of a source category or omitted from the source category. If a facility is known to be part of a particular source category, the correct source category MACT code was added to the appropriate facility emissions units (see discussion of emissions units below). A review of what facilities were included in source categories was part of the initial engineering review of the datasets that was conducted by industry experts. In addition, the public reviewed the facilities in each source category and provided comments on which facilities belonged in the source category.

Petroleum Refining Example. An engineering review was conducted on the facilities included in the Petroleum Refining source category in the ANPRM dataset. The NEI dataset included approximately 175 facilities, 124 of which were listed as major sources. This NEI data list of facilities was based on those facilities and processes that were marked in the NEI with SIC 2911 and MACT code 0503. Based on the initial review, as well as a comparison to the project database listings and to the Energy Information Administration list of petroleum refineries, EPA confirmed that 148 of the listed facilities were petroleum refineries and were major sources, some of the facilities were not petroleum refinery facilities, and some other facilities should have been included but were missing from the dataset. EPA confirmed a total of 153 facilities in the petroleum refineries dataset. Of the facilities that were removed from the source category list, some were confirmed as not being refineries or were confirmed to have closed, to be terminals or transfer operations, or to be chemical plants. As EPA's petroleum refinery industry experts have tracked changes in the industry over the years, EPA had up-to-date information on the current facility names and former owners or operators, which was used to help identify and match facilities.

Marine Vessel Loading (MVL) Example. Following the ANPRM release, some public commenters noted that it was difficult to identify their facility in the dataset. For the MVL source category, one company provided comments, and EPA noted during its review of the information provided to the public docket that it was difficult to determine which facility the comments were in reference to. The company requested that the facility with NEI number NEI3TX48039San (in Sweeny, TX, Brazoria County, with an address of CR 372 at San Bernard River) be renamed from the "San Bernard Terminal Dock No. 1" to the "ConocoPhillips San Bernard Terminal Dock No. 1." Unfortunately, the NEI number NEI3TX48039San was not included on the facility list in the ANPRM dataset, so it appeared to be a new facility. EPA identified all 57 of the facilities in the ANPRM that had the state and county code 48039 for Brazoria County in Texas, and there were 3 facilities that could potentially be matched to this facility:

- NEI6519—ConocoPhillips Sweeny; Old Ocean, TX; Hwy 35 and 524 at Old Ocean
- NEITXT$11613—ConocoPhillips San Bernard Terminal; Sweeny, TX; CR 372
- NEI2TX139—San Bernard Terminal; Sweeny, TX; end of CR 321, on Ave. A (CR 372) 2

EPA contacted the company for clarification on whether its facility could be matched to one of the three already in the dataset or if it was a new facility. The company confirmed that the facility with NEI number NEITXT$11613 (ConocoPhillips San Bernard Terminal), the facility with NEI number NEI2TX139 (San Bernard Terminal), and the facility with NEI number NEI3TX48039San are all the same facility. They should not have separate NEI numbers and should have the same facility name. The emissions data were combined under NEI2TX139 and the public comments on emissions levels were incorporated. (The company also confirmed that the facility with NEI number NEI6519, called ConocoPhillips Sweeny, is a refinery [its MACT code was already marked as 0503] and is not part of the MVL source category.)

Are Emissions Units correctly Included in a Source Category and Can Industry Identify Emissions Units Within Their Facilities?

Each source category includes various processes or emissions units that are considered part of the source category. These processes and emissions units are typically defined explicitly in the source category definition (e.g., process vents, storage tanks, wastewater, equipment leaks). Each emissions unit in NEI is assigned a Source Classification Code (SCC) that describes the emissions unit. The SCC for processes or emissions units may be misidentified in the NEI datasets, may not be identified at all, or may have a generic description that does not allow the unit to be positively identified as part of a source category. For example, at a facility in the Mineral Wool source category, it is anticipated that every facility would have a cupola emissions unit. If an anticipated emissions unit was not included at a particular facility, a review of the emissions units at the site was conducted to determine if it was either included in the dataset but was incorrectly identified by another SCC or if it was mistakenly included as an emissions point under another MACT code at the facility. Following the ANPRM review, some industries noted that they had trouble recognizing their emissions units and information in the datasets. In some cases, industry provided completely new datasets.

How Are Data Handled for Facilities Subject to Multiple MACT Rules?

Each emissions point that is part of a source category is assigned a MACT code specific to that source category. At large facilities, there may be multiple processes that are covered by multiple source categories and therefore multiple MACT codes. At facilities with multiple source categories, it is sometimes difficult to clearly determine the source category to which each emissions unit belongs. In the ANPRM datasets, EPA included data for the MACT-specific source category and data for the entire facility and asked public reviewers to provide information on assigning the MACT code correctly to emissions units.

Petroleum Refining Example. Petroleum refining facilities are subject to two separate MACT standards: MACT 1 covers thermal cracking, vacuum distillation, crude distillation, hydrotreating, hydrorefining, isomerization, polymerization, lube oil processing, and hydrogen production, and MACT 2 covers catalytic cracking units, catalytic reforming units, and sulfur plant units. The MACT code for Petroleum Refining MACT 1 is 0503, and the MACT code for Petroleum Refining MACT 2 is 0502. The MACT codes were inappropriately assigned to emissions units in some instances. Specifically, in the ANPRM data, some units emitting certain metal HAP were designated as MACT 1 sources, although those HAP were expected to only be associated with MACT 2 sources. The emissions units associated with MACT 1 processes include petroleum refining process units, storage vessels, transfer racks, wastewater streams, and equipment leaks. The industry experts conducted a thorough engineering review of the dataset to determine what emissions points were appropriately associated with the MACT 1 source category. This review process also included the use of the SCC information previously discussed that provided descriptions of the emissions units. The MACT codes were changed accordingly.

<u>Are the Assumptions About HAP Speciation Correct?</u>

For some source categories, the speciation of certain HAP can significantly impact the predicted risk estimates. For many HAP metals, the NEI dataset will include HAP names for a generic category of metal compounds (e.g., generic chromium [Cr] or Cr compounds) and will not provide the specific compounds emitted (i.e., the speciation). For example, the speciation of Cr compounds into the oxidation states of Cr III or Cr VI will significantly affect risk. EPA attempted to provide the speciation of metal compounds based on the best available information, which included accepted standards or ratios of speciated metals for an industry or source category, emissions test data that provided detail on the speciated compounds, and the use of defaulted profiles based on similar industries.

Wool Fiberglass Manufacturing Example. Sources in the Wool Fiberglass Manufacturing source category emit Cr compounds, and the Cr is emitted from the deterioration of chromium refractories. The default speciation profile that has been applied to emissions reported as "chromium" or "chromium compounds" for this source category is 100 percent Cr VI compounds, based on limited information and test data from a test report provided by a state agency. For this source category, EPA used a worse case assumption (i.e., 100 percent Cr VI).

Aerospace Manufacturing and Rework Facilities Example. For the Aerospace Manufacturing and Rework source category, of the 137 major facilities in the source category, approximately 61 facilities had emissions of Cr or Cr compounds. In the ANPRM, EPA assumed that 25 percent of the generically reported Cr and Cr compounds data were Cr VI and 75 percent were Cr III. This assumption was based on information provided by one facility. Public comments in response to the ANPRM data were received on the Cr speciation data assumptions. The public comments provided input on the Cr speciation, and in addition to review of the public input, an analysis of each of the Cr species in the available data were also conducted. The Cr speciation input and data showed a range of 0 percent Cr VI up to 100 percent Cr VI. Following the analysis, EPA confirmed that the assumption for 25 percent Cr VI and 75 percent Cr III was the best assumption. These assumptions were incorporated into the NPRM dataset for generically reported Cr and Cr compounds.[1]

Do the Emissions Represent Actuals or Allowables?

It is generally accepted that the NEI datasets are representative of actual emissions levels. We also wanted to evaluate allowable emissions levels. EPA defined the allowable emissions as the highest emissions levels that could be emitted while still complying with the national emissions standard for hazardous air pollutants (NESHAP) requirements (i.e., the maximum level sources could emit and still comply). Although EPA does not have detailed information on the allowable emissions levels, EPA did estimate the potential differences between allowable and actual emissions. EPA examined the NESHAP requirements to determine whether the emissions that a source was allowed to emit when complying with the NESHAP would vary from the actual emissions data EPA gathered. EPA found that the actual or allowable determination was related to the format of the NESHAP standard. In general, actual emissions and allowable emissions are expected to be the same for design, equipment, or work practice standards. When the NESHAP requirement is a concentration standard, the allowable emissions levels could be estimated if the actual flow rates are known. The NEI data may be representative of the allowable emissions levels if further state and local regulations are not in place (i.e., the NEI emissions are reflective of the control requirements of the MACT program). There are some industries and facilities that are also subject to state and local regulations that are more stringent than the federal MACT requirements. In this case, the NEI emissions would be less than the federal allowable level.

Mineral Wool Production Example. For the Mineral Wool Production source category, the emissions limits are based on production levels (e.g., mass of pollutant emitted per mass of material melted). Although production levels can increase at most of the operating facilities, there are equipment and process limitations on how melting furnaces (cupolas) are operated, which in turn limits the allowable emissions at a given facility. While cupolas are considered batch operations, they are run on a continuous or semi-continuous basis to save the time and energy required to heat up the furnace. The melting operations at these facilities are the production-limiting process. Allowable emissions under the MACT standard are 0.1 lb particulate matter (PM) per ton melt and 0.06 lb formaldehyde per ton melt. Test data from the industry trade group show that average PM emissions from all cupola data are 0.044 lb PM per ton melt and show that average formaldehyde emissions from all curing oven data are 0.038 lb formaldehyde per ton melt. Therefore, the allowable PM emissions rate is approximately 2.3 times higher than the average reported PM emissions rate (0.1/0.044 = 2.3). The allowable formaldehyde emissions rate is approximately 1.6 times the average reported formaldehyde emissions rate (0.06/0.038 = 1.6). Based on these data, EPA decided that allowable emissions are estimated to be approximately two times the actual emissions for each facility and that this gives a realistic value for allowable emissions.

Aerospace Manufacturing and Rework Facilities Example. In the Aerospace Manufacturing and Rework Facilities source category, a review of the emissions dataset identified one facility with a HAP emissions level that was markedly different from other facilities. One facility in the source category had emissions that were substantially higher than what was expected to be emitted from the facility and were substantially higher than any other facility in the source category (i.e., 40 times higher than the next highest facility). The facility's emissions were reviewed to confirm the magnitude of emissions, including a review of the facility's permit, a review of the Toxics Release Inventory (TRI) data, and contacts with the facility to discuss the emissions level. Through the discussions, EPA determined that the emissions levels were allowable levels and were estimated based on a fenceline ambient concentration limit; the facility had back-calculated the HAP emissions level and performed iterative modeling to determine the HAP emissions that would create the ambient fenceline concentration and included these maximum HAP emissions in its ANPRM data submittal. Although this was certainly a maximum emissions value, it could not be considered a realistic or even plausible allowable emissions level. It was also determined during discussions with the facility staff that the emissions data included sources from the entire facility rather than for only the Aerospace Manufacturing and Rework source category. In follow up, the facility provided a more realistic emissions inventory of actual emissions, and the new data included only aerospace sources. If the original public comment submission had been used and included in the NEI, the emissions levels would not have represented actual emissions or a realistic level of allowable emissions.

How Will Data Be Augmented When Facilities Are Missing Emissions Units and When Anticipated HAPs Are Missing from Units Within a Facility?

For some source categories, certain HAP are expected to be emitted from facilities. For example, facilities in the Pharmaceuticals Manufacturing source category are expected to emit methylene chloride, N,N-dimethylformamide, toluene, and hydrochloric acid. HAP emissions that are not expected to be emitted from the Pharmaceuticals Manufacturing source category include ethylene oxide, p-dioxane, naphthalene, ethylene dichloride, arsenic, hydrazine, and polycyclic organic matter (POM). When expected, HAP are only reported from a few or none of the facilities in the source category or in some instances are not reported from any of the facilities, EPA attempted to address the data omissions in the NEI by adding emissions data to the inventory. If an expected HAP was not shown for any facility in the source category, the emissions estimates were based: (1) on emissions factors, if available, and if some process activity factor was also available; (2) by developing and applying HAP speciation profiles to volatile organic compound (VOC) and primary $PM_{2.5}$ and primary PM_{10} estimates; or (3) by using TRI data and assigning to MACT units based on other NEI data. (Using TRI data adds to the uncertainty because this information is compiled at the facility level and not at the unit level.) When TRI data were used, EPA made assumptions about how to assign data to units based on the HAP. For some cases when emissions data were shown for "known to be emitted" HAP for at least some of the facilities in the source category but no emissions factors were available, the emissions estimates were based on an emissions data ratio of one pollutant to another pollutant (missing pollutant). Emissions data were added for several categories where a known pollutant should be emitted, and this convention of including default emissions profiles helped to avoid underestimating the risk.

Wool Fiberglass Example. In the Wool Fiberglass source category, certain HAP metals emissions (e.g., arsenic, Cr) that were expected to be seen from all facilities were only reported from less than half of the facilities in the ANPRM dataset. In addition, methanol (MeOH) was also expected to be emitted from the source category, but it was reported from less than half of the facilities. To address some of the uncertainties involving the emissions from the source category, default assumptions were used to form a more complete dataset. For those facilities not reporting Cr compound emissions, default emissions were developed based on a correlation of reported PM_{10} emissions and Cr emissions at those facilities that did report Cr emissions. There were 16 facilities that reported both PM_{10} and Cr emissions (3,434 tons of PM_{10} and 0.35 tons of Cr). The average default factor used to estimate the emissions was 0.0001019 ton Cr /ton PM_{10}. For MeOH, default MeOH emissions were calculated based on a ratio of formaldehyde emissions to MeOH emissions reported by facilities (1,132 tons of MeOH and 337 tons of formaldehyde). The average default factor used to estimate MeOH emissions was 3.36 ton MeOH/ton formaldehyde.

Pulp and Paper Example. Cadmium (Cd) and mercury (Hg) emissions are anticipated HAP from some emissions sources at MACT II pulp and paper mills, including power boilers and chemical recovery combustion sources, such as recovery furnaces, smelt dissolving tanks (SDTs), lime kilns, and other combustion units.[2] The EPA AP-42 emissions factors and National Council for Air and Stream Improvement emissions factors were used to estimate the emissions using an activity level (i.e., liquor solids firing rate, lime production rate, heat inputs), an annual operating estimate (365 day/year), and a capacity factor. The emissions data for SCCs for power boilers and chemical recovery combustion sources at MACT II facilities and for SCCs for power boilers at MACT I and III facilities were reviewed to identify those with missing Cd and Hg emissions. Where facilities have MACT II sources and identify the specific type of source by SCC, average Cd and Hg emissions factors for the specific type of combustion source was used (e.g., kraft recovery furnace, SDT, or lime kiln). The same approach was used for sulfite combustion units (i.e., sulfite recovery furnace or fluidized-bed reactor). For semi-chemical combustion units (e.g., semi-chemical recovery furnace, fluidized-bed reactor, smelter, or rotary liquor kiln), worse-case emissions factors for kraft recovery furnaces were used. For facilities that identified MACT II sources but the SCC data were not sufficient to identify the specific type of source, the worse-case emissions factors for Cd and Hg were used. For those facilities where the fuel mix for the power boilers is known, the average Cd and Hg emissions factors for the fuel mix were used. For facilities that have power boilers with no information on the fuel mix, a worst-case emissions factors (from uncontrolled coal-fired boilers) were used. If the size/heat input information was not known, a maximum average value of 600 MMBtu/hour was used to estimate annual emissions.

How Will EPA Address Incomplete Control Technique Information?

From the NEI datasets, complete information on the control techniques in place and the control levels achieved by the techniques was not always available. For many NEI data records, the air pollution control device fields are empty or “unknown,” and it is not clear whether the emissions data reflect a controlled or uncontrolled level. For some of the source categories where facilities in the ANPRM datasets matched the known facilities based on previous experience with the industry, these control technique data could be added to the dataset. As part of the Group 3 ANPRM and Group 2 NPRM, EPA is requesting information on types of control measures in place and control efficiencies. ANPRM data files will contain a drop-down menu with a list of control measures for reviewers to provide information about the control measure and their efficiencies. EPA is hoping that this will greatly improve control measure data currently in the NEI.

MVL Example. In the Marine Vessel Loading source category, there was a question about whether a particular facility was controlling the emissions from a MVL operation. The address in the NEI was not clear (i.e., it appeared as South Wood Avenue) for a terminal called St. Linden Terminal in Union County in Linden, NJ, with the NEI facility ID of NEINJ030093. EPA wanted to contact the facility to confirm the control status, but there was no contact information in the NEI fields. There was no listing for this facility because either the facility name had changed or the facility was purchased by another company. To locate the facility, EPA identified all of the facilities that were listed in Union County, NJ, and, while conducting a permit search for the facility, found that it could potentially be one of three facilities in Union County. Because the address was a partial match for one of the facilities, EPA contacted that facility to clearly identify it as the one of interest and to confirm what control technology, if any, was in place on the terminal. The facility confirmed that the emissions from the terminal are controlled.

Shipbuilding and Ship Repair Example. The Shipbuilding and Ship Repair source category involves surface coating of ships at major source shipyards. The NESHAP set volatile HAP limits for several coating categories and also covered cleaning operations and the use of thinning solvents. At the time this paper was written, there are unresolved questions and issues involving abrasive blasting and welding operations at shipyards and how those processes, control techniques, and associated emissions will be addressed for residual risk.

How Should Emissions Units Be Grouped to Evaluate Various Control Options?

To evaluate the emissions-reduction potential of control options beyond the MACT requirements currently in place, the current emissions levels that represent the MACT level of control must be determined, along with the emissions reductions achieved by the control options. Typically, a review of all of the SCCs that are part of the source category is conducted, and each SCC is assigned to one of the various regulated emissions points under the MACT (e.g., process vents, storage tanks, equipment leaks, wastewater). In most cases, multiple SCCs that are similar or related are grouped together, and the emissions reduction achieved by a control option (beyond the current MACT requirement) can be determined, along with the risk reduction.

Petroleum Refining Example. There were more than 700 SCCs confirmed to be in the Petroleum Refining source category. The source category for Petroleum Refining MACT 1 includes various process vents, storage vessels, wastewater streams, loading racks, marine tank vessel loading operations, and equipment leaks associated with refining facilities. Each of the SCCs was grouped into particular types of emissions sources that are regulated under the MACT rule. For example, approximately 68 SCCs were grouped together under fugitive process equipment leaks, 221 SCCs were grouped together under storage tanks, 26 SCCs were grouped together as wastewater treatment operations, and 21 SCCs were grouped together as MVL. The remaining 400 SCCs were similarly grouped together under the various emissions point types.

Summary of Data Updates EPA Received for Certain Data Fields and Effects on Risk

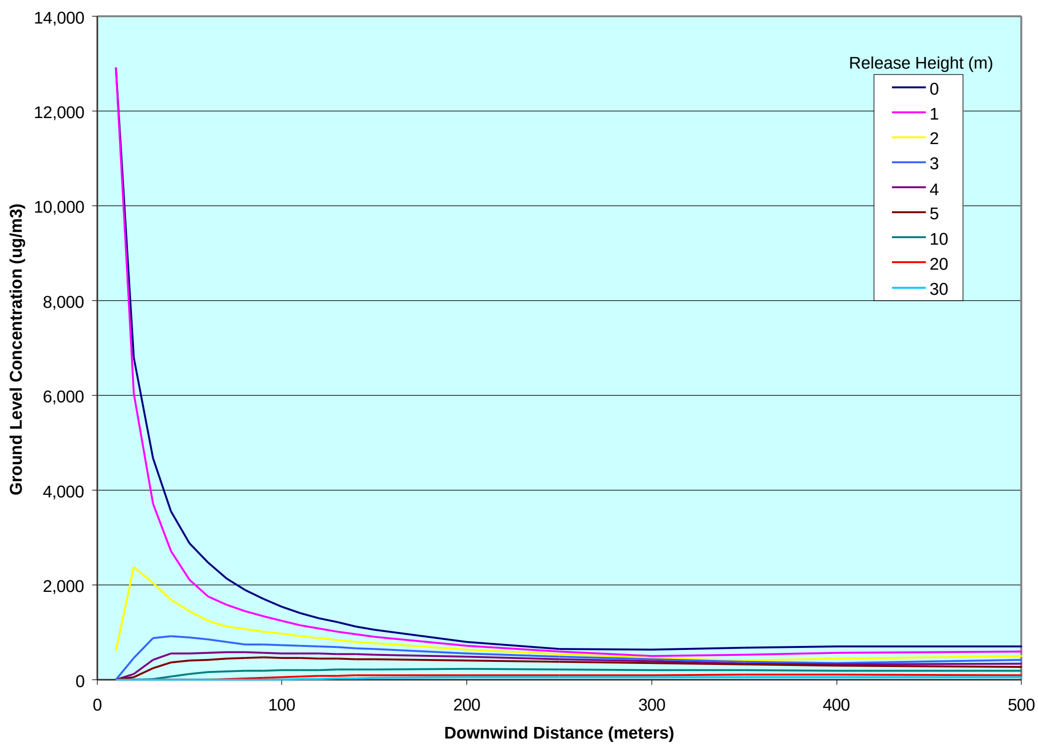
Ambient air quality models simulate the transport and dispersion of a pollutant from the emissions source to the exposure locations. In the case of the RTR Program, EPA predicted risks using the Human Exposure Model, Version 3 (HEM3), which incorporates a state-of-the-art air dispersion model (AERMOD) that was developed under the direction of the American Meteorological Society/Environmental Protection Agency Regulatory Model Improvement Committee (AERMIC).[3,4]

HEM3 performs three main operations: dispersion modeling, estimation of population exposure, and estimation of human health risks. For dispersion modeling, HEM3 uses the AERMOD. AERMOD simulates dispersion from a wide range of different source types which may be associated with an industrial source complex, including stack sources, area sources, and volume sources.

The basis for AERMOD is the Gaussian plume equation that simulates the growth and dispersion of a plume as a function of the source-release characteristics, meteorological conditions, terrain features, and receptor characteristics. According to these equations, the ambient concentration at ground level is inversely proportional to the distance from the source and the plume height (i.e., ground-level concentration decreases with increasing distance and with increasing plume height). The plume height is a function of the actual physical release height (e.g., stack height) and the plume's rise due to buoyancy and momentum. In turn, plume rise is a function of the plume's exit velocity, volumetric flow, and release temperature.

Figure 1 represents typical downwind ground-level concentrations for plumes released at different elevations. As shown in Figure 1, the greatest change in ambient concentrations occurs within the first few hundred meters downwind from the source. Furthermore, changes in plume height of just a few meters can result in significant changes in ambient concentrations.

Figure 1. Plume concentration as a function of release height and downwind distance.



For most risk characterizations, ambient and exposure concentrations are generally predicted at locations where people are believed to congregate for extended periods of time, such as in a home. For the RTR Program, in lieu of actual home locations, EPA selected the Census block centroids as being representative of where people are believed to be exposed. Thus, an incorrect stack origin can result in inaccurate distances between the source and the exposed population, resulting in inaccurate model predictions (i.e., inaccurate risk).

<u>Latitude and Longitude Changes</u>

The NEI includes specific emissions-release point (stack) locational coordinates, which were originally populated in the NEI with data provided by state, local, and Tribal agencies and EPA. For missing emissions-release point locational data, surrogate values were added by EPA as site averages, or worst-case county centroids. The source of the original coordinates can be identified in the locational default flag field. Through the ANPRM process, public reviewers could refine the locational coordinates, particularly the county centroids. In the future, public reviewers of the ANPRM and NPRM datasets will be asked to specify the North American Datum for the revised locational coordinates. In the NPRM, the corrected values will be reflected, and the locational default flag, which shows the source of the data, will be updated.

As previously mentioned, incorrect stack location coordinates can result in inaccurate risk predictions. In situations where the stack is too close to the receptor (Census block), the model will generally overpredict risks. If the stack is too far away from the receptor, risk results are generally underpredicted. These situations can be the result of (1) default coordinates in the NEI, (2) a mailing address provided in the NEI instead of physical address, or (3) all emissions points at the facility having the same coordinates (i.e., all emissions are modeled from the same location somewhere on the facility property). Careful review of location coordinates by state and local agencies and industry helps improve the data used to model these facilities and helps increase the accuracy of the modeled risk predictions.

For the RTR risk assessments, the coordinates in the NEI were generally used “as is” in the risk modeling. The quality assurance/quality control review and data augmentation process for coordinates to be included in the NEI is extensive and is described in *NEI Quality Assurance and Data Augmentation for Point Sources*.[5] However, there can still be errors in these coordinates that affect the risk estimates predicted by the model. For example, if an emissions point does not have coordinates when provided to the NEI, it is assigned a set of coordinates based on certain criteria. If there are no other emissions points in the NEI for that facility, the coordinates assigned could be those of the street address, the zip code center, or even the county center. These default coordinates could be far away from the actual physical location of the stack, and thus would not be of much use for risk modeling.

Publicly Owned Treatment Works Example. One example where the coordinates were defaulted in the NEI for a Publicly Owned Treatment Works (POTW) facility, the New York City Department of Environmental Protection Ward’s Island Water Pollution Control Plant (with NEI facility ID of NEI2NY300005). The NEI originally had coordinates defaulted to the center of the zip code (see A in Figure 2). These coordinates appear to be in a residential area, and the maximum individual lifetime cancer risk estimated at a populated Census block when using these coordinates was 100 in 1 million. However, using aerial photographs of the area, the actual facility location was identified to be several thousand meters to the southeast (see B in Figure 2). When the actual coordinates were used to model this facility, the estimated maximum predicted lifetime individual cancer risk fell to approximately 5 in 1 million.

Aerospace Manufacturing and Rework Example. When EPA first modeled the Northrop Grumman Pico Rivera aerospace facility (NEI facility ID of NEICA0371263), which has since closed, it had an estimated maximum individual lifetime cancer risk of 1,000 in 1 million. The coordinates in the NEI for this facility corresponded to what appears to be a school zip code (see A in Figure 3). However, based on an inspection of aerial photographs, the actual facility location was identified approximately 1 km to the west of the NEI location zip code (see B in Figure 3). When the facility was remodeled with the new coordinates, the estimated maximum individual lifetime cancer risk increased to 4,000 in 1 million. These two points and the aerial photograph are presented in Figure 3.

In other situations, the provided coordinates are rounded off to only a few decimal places. For example, a stack at a longitude of -97.02972 and a latitude 32.71556 rounded off to a longitude of -97.03 and latitude of 32.72 will be located nearly 500 m from its actual location.

Figure 2. Before and after emissions point locations for a publicly owned treatment works facility.

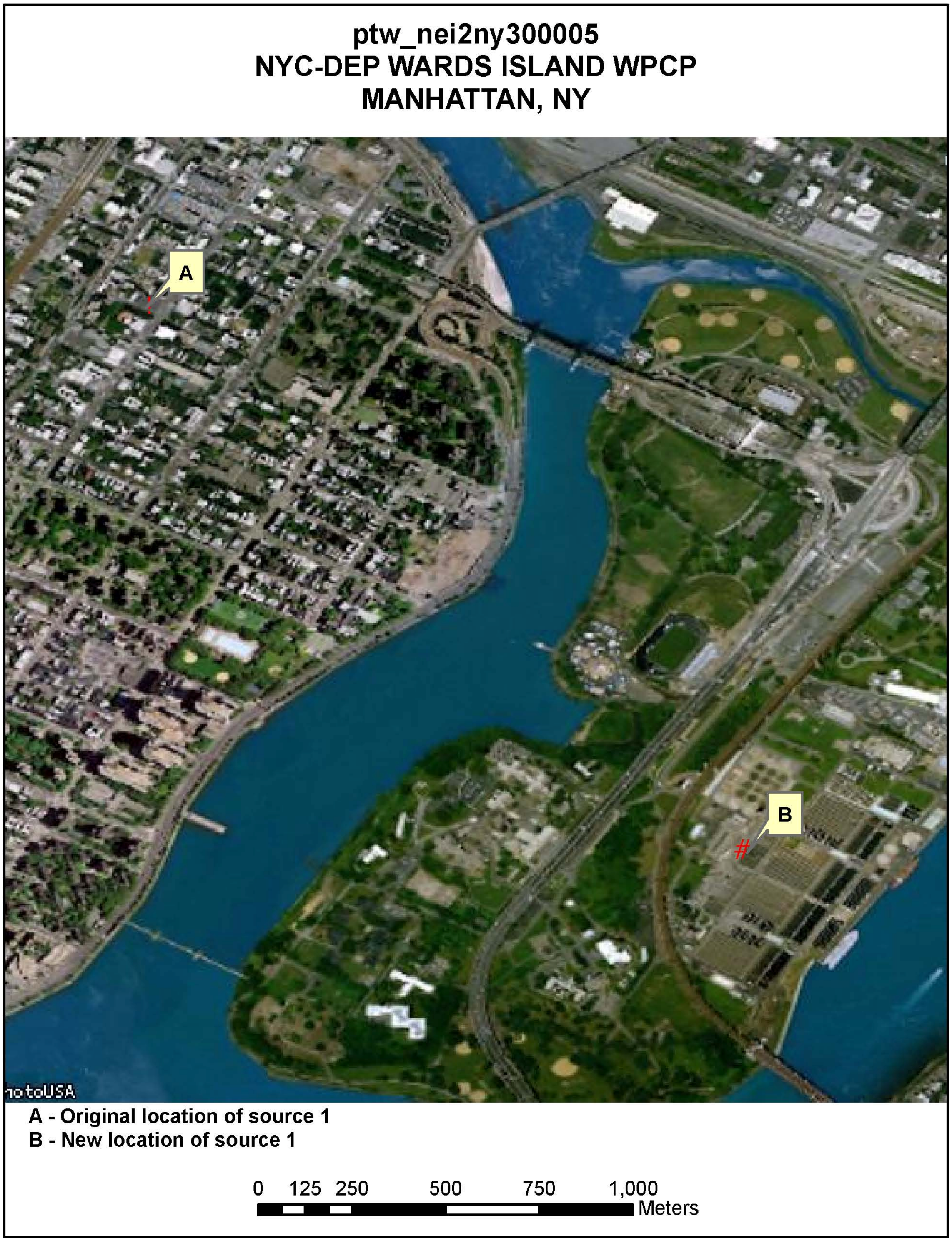
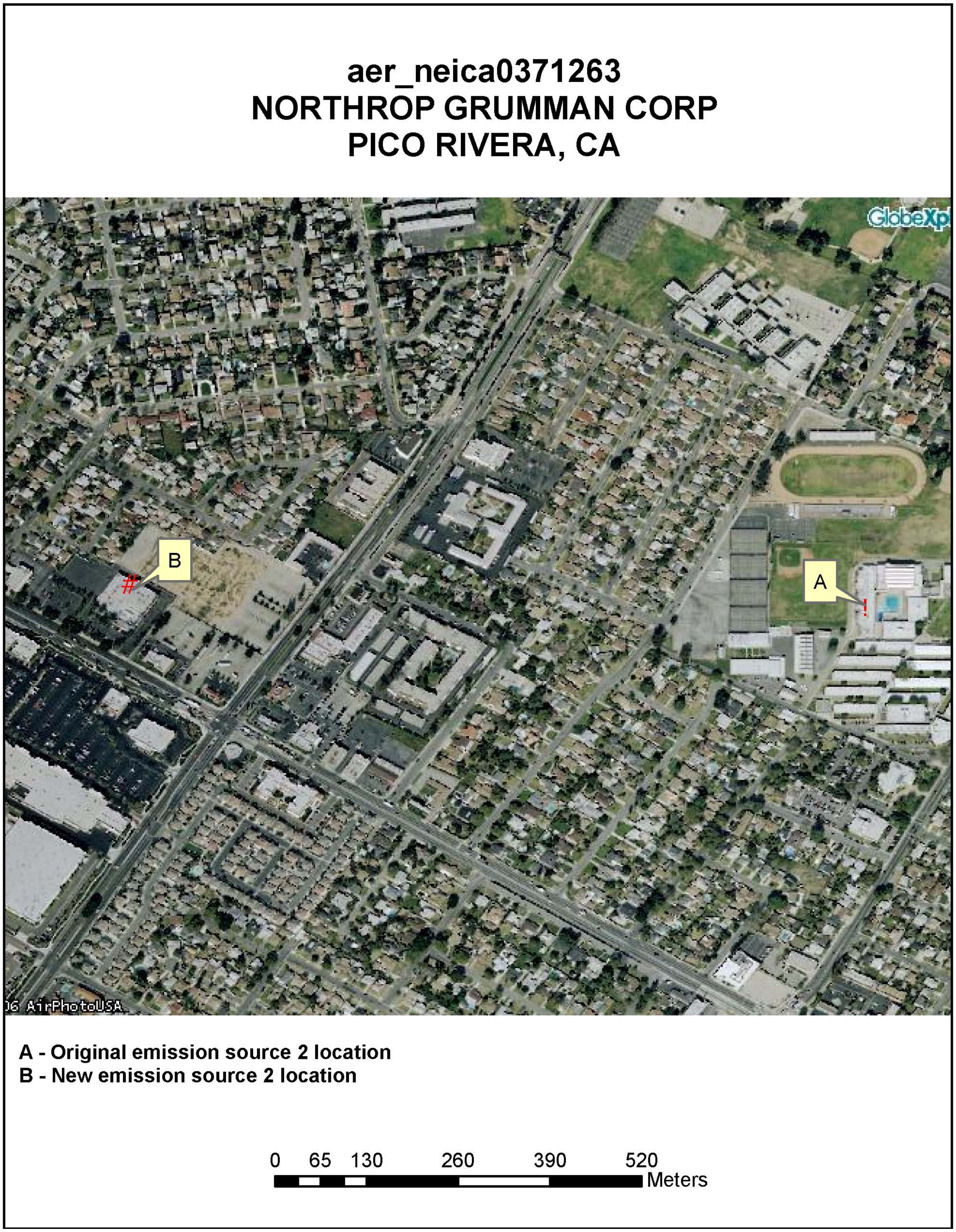


Figure 3. Before and after emissions point locations for an aerospace facility.



Stack Parameter Changes

The NEI identifies each emissions source by the emissions type (e.g., fugitive, vertical stack, horizontal stack); provides stack parameters for the height, diameter, exit gas temperature, exit gas velocity, and exit gas flow rate; and indicates the source of the stack information. The stack parameters were originally populated in the NEI with data provided by state, local, and Tribal agencies and EPA. For missing stack parameters, surrogate values were added by EPA based on the MACT source category, the SCC, the North American Industry Classification System (NAICS) code, or with a national average. Through the ANPRM process, public reviewers could correct and refine the stack parameters. The NPRM will reflect the corrected parameters, and the stack parameter default flag, which shows the source of the data, will be updated. In addition, the ANPRM files allowed EPA and reviewers to quantify information on the width, length, and angle of fugitive sources, such as tank farms. These data will be reflected in the 2005 NEI for the first time.

As shown in Figure 1, correct representation of the stack height, as well as plume height, is important in predicting downwind concentrations. In certain situations, a few meters difference in plume height can change the predicted ground-level concentrations by orders of magnitude. Similarly, proper source representation for an area source is important in estimating initial plume dispersion and resultant downwind ground-level concentrations.

Chromium Speciation

The speciation of Cr compounds into the most common oxidation states (Cr III and Cr VI) can have significant impacts on predicted risk estimates. In the absence of additional information or a category-specific speciation profile, a source category default speciation profile is applied to unspeciated Cr emissions (i.e., emissions reported as "chromium or "chromium compounds"). These default profiles are based on engineering judgment, stack testing, or other readily available information. Profiles for all categories can be found on the NEI Web page on EPA's Technology Transfer Network (TTN) Clearinghouse for Inventories & Emissions Factors (CHIEF) Web site for emissions inventories, which is available at http://www.epa.gov/ttn/chief/net/2002inventory.html. The current default profile with the highest percentage of Cr VI is 34 percent Cr VI and 66 percent Cr III. There are specific categories with higher percentages of Cr VI, such as Cr electroplating. One way to improve the information contained in the NEI and to rely less on the default speciation profiles is to enter the individual speciated Cr compound (e.g., strontium chromate, chromium trioxide) into the NEI.

Wood Furniture Manufacturing Example. As previously mentioned, the speciation profile applied to emissions reported as "chromium" or "chromium compounds" can have a significant impact on predicted risk estimates. For example, in an early screening assessment, the speciation profile applied to the Wood Furniture Manufacturing source category was 34 percent Cr VI and 66 percent Cr III. Using this default profile, the Clyde Pearson Company in High Point, NC (NEI45633) had an estimated maximum individual cancer risk of 400 in 1 million. After more investigation into the speciation profile that is appropriate for this category, it was determined that no Cr VI should be emitted from Wood Furniture Manufacturing facilities, so the profile was changed to 0 percent Cr VI and 100 percent Cr III. No other changes were made to the input data for this facility. When the facility was remodeled with the updated Cr speciation profile, the estimated maximum individual lifetime cancer risk was 0.

Secondary Aluminum Example. Revising the Cr speciation profile can also lead to an increase in the estimated maximum individual lifetime cancer risk for a facility. In an early screening assessment, a Secondary Aluminum facility, Nichols Aluminum Casting in Davenport, IA (NEI2IA01-089), had an estimated maximum individual lifetime cancer risk of 20 in 1 million. The Cr speciation profile used in the assessment was 3 percent Cr VI and 97 percent Cr III. With additional information, the Cr speciation profile was changed to 100 percent Cr VI and 0 percent Cr III. Using the new profile and keeping all other inputs the same, the estimated maximum individual lifetime cancer risk for this facility is 300 in 1 million.

Emissions Data

In the NEI, detailed information is provided for HAP emissions. In addition to the quantified emissions, information is provided on the type of emissions (e.g., actual, allowable), the emissions calculation method, and the controls in place. The emissions estimates were originally populated by state, local, and Tribal agencies and EPA. Through the ANPRM process, public reviewers could add, delete, and update emissions estimates for a given MACT process. Additionally, EPA industry experts evaluated the HAP emitted for the MACT process and developed surrogate emissions records for important HAP that were missing but were known to be emitted. The NPRM will reflect the emissions additions and revisions, and the data source code will be updated. In the future, public reviewers of the ANPRM and NPRM datasets will be asked to provide more details on the control equipment in place and to provide an emissions process description.

Mineral Wool Production Example. Missing or incomplete data were addressed for the metal HAP emissions from the Mineral Wool Production source category. There are 11 mineral wool production facilities in the 2002 NEI, and all of the facilities reported PM emissions but only two of the facilities reported metal emissions. Metal HAP emissions factors (in units of tons of each specific metal per tons PM_{10} and tons metal per tons $PM_{2.5}$) were calculated from metal emissions data from the two facilities with available metal, $PM_{10,}$ and $PM_{2.5}$ emissions data from the 2002 NEI. Calculated emissions factors for arsenic, beryllium, Cd, Cr, cobalt, lead, manganese, Hg, nickel, and selenium were developed and documented in project memoranda.

Metal HAP emissions were then calculated for the nine facilities that did not report actual metal emissions data (based on the reported PM_{10} and $PM_{2.5}$ emissions) by multiplying the PM_{10} or $PM_{2.5}$ value for that facility by the emissions factor for each metal. Chromium emissions were speciated as 34 percent Cr VI and 66 percent Cr III based on Cr speciation profiles on EPA’s TTN CHIEF Web site for emissions inventories (http://www.epa.gov/ttn/chief/net/2002inventory.html). Similarly, Hg emissions were speciated as 50 percent mercury (elemental) and 50 percent mercuric chloride based on Hg speciation profiles on EPA’s TTN CHIEF Web site. It was estimated that the maximum individual risk remaining from HAP (metal) emissions from the mineral wool source category is 30 in 1 million. Cancer incidence was estimated as 0.008 excess cancer cases per year (or eight cases every 1,000). No chronic noncancer inhalation human health thresholds were exceeded at off-site receptors, and the maximum target organ specific hazard index (TOSHI) was estimated to be 0.4.

Reviewing emissions data for HAP other than Cr can also lead to more accurate data in the NEI and better prediction of risk estimates. Obviously, large changes in the quantity of emissions can lead to large changes in risk for potent HAP. But small changes in the quantity of emissions, especially for potent HAP, can also have a noticeable effect on the risk results.

Petroleum Refining Example. In the ANPRM screening risk assessment, the petroleum refinery facility Flint Hills Resources in North Pole, AK (NEI18406) had approximately 15.14 tpy of emissions and an estimated maximum individual lifetime cancer risk of 100 in 1 million. The risk from this facility was largely driven by emissions of polycyclic organic matter (POM). Through the ANPRM process described previously, new emissions were provided for this facility. The total magnitude of new emissions used in the NPRM risk assessment was approximately 15.21 tpy, a slight increase from the ANPRM estimates. However, the estimated maximum individual lifetime cancer risk for this facility in the NPRM risk assessment decreased to 6 in 1 million, largely driven by benzene and naphthalene. Although the overall magnitude of emissions barely changed, emissions of several key HAP did change between the ANPRM and NPRM risk assessments. Emissions of POM, the key risk driver in the ANPRM risk assessment, went from 1.08 tpy to 0.003 tpy. Emissions of naphthalene, a risk driver in the NPRM risk assessment, went from 0 tpy in the ANPRM to 0.2 tpy in the NPRM risk assessment.

Flexible Polyurethane Foam Production Example. In addition to the magnitude of the actual HAP being emitted, it is important that the emissions estimates are updated when new information becomes available. For example, in early screening risk assessments for the Flexible Polyurethane Foam Production source category, the HAP methylene chloride was included because it was used in the process of foam production. However, because the MACT standard has been implemented and other rules, such as the recent Occupational Safety and Health Administration rule for methylene chloride, have come into effect, emissions of methylene chloride have been phased out in this industry. Recent communication with industry sources has confirmed that virtually no methylene chloride is used at this time in the production of flexible polyurethane foam. Despite this situation, the NEI still shows methylene chloride as being emitted from flexible polyurethane foam production facilities. In an early screening assessment, the Foamex facility in San Bernardino, CA (NEI22770) had an estimated maximum individual lifetime cancer risk of 50 in 1 million, mostly driven by methylene chloride. For the ANPRM risk assessment, methylene chloride emissions were not included in the dataset for modeling and the estimated maximum individual lifetime cancer risk decreased to 0.7 in 1 million.

MACT Codes and Identifying Emissions Units

The NEI includes process-specific MACT codes. For the most part, the MACT codes were populated by EPA, or based on the process-level SCC, or the facility NAICS. The MACT flag default field indicates the source of the MACT code assignment. Through the ANPRM process, public reviewers were able to flag processes and units to a different MACT category, or indicate that the process or unit was not subject to any MACT. EPA industry expert reviewers closely evaluated the MACT code revisions and often contacted the public reviewers for clarification. Public reviewers were also able to review and revise the “facility category,” which indicates if a facility is considered a major source or an area source. If a MACT standard only applies to major sources, this is an important facility-level distinction.

For most source categories included in the RTR risk assessments, the data are included based primarily on MACT code. For example, the initial dataset for the Flexible Polyurethane Foam Production source category was created by pulling all records in the NEI with a MACT code of 1314. Project engineers then reviewed the data to make sure the information was reasonable for that source category and during this process they could request, for example, that a specific SCC or HAP not be included in the dataset for that category. Using the Flexible Polyurethane Foam Production example, emissions of methylene chloride would then be removed from the dataset to be modeled.

Another example of identifying the correct emissions units comes from the Petroleum Refinery source category. In the ANPRM screening risk assessment, the Valero Refining–Norco facility in New Sarpy, LA, had a chronic noncancer TOSHI of 1 for the respiratory tract. Upon closer investigation, it was determined that chlorine emissions from cooling towers were included in the Petroleum Refinery source category dataset because the emissions units had the 0503 MACT code, even though they had SCC codes, which indicated cooling towers. The chlorine cooling tower emissions were removed from the entire dataset and the modeling was conducted again for those facilities affected. The chronic noncancer respiratory TOSHI for Valero Refining decreased to 0.03 when these chlorine emissions were removed and re-coded as cooling towers and rather than as refinery sources.

CONCLUSIONS

The RTR process has made contributions towards improving the accuracy of the NEI. Through public comment, source category-specific engineering reviews, and preliminary exposure modeling, improvements to NEI are being made. We have provided numerous specific examples of NEI data changes, why the changes were made, and how they led to more accurate modeled population risks. More accurate risk estimates lead to more reasoned and defensible rule proposals.

The changes in the number of facilities and the HAP emissions for each of the Group 1 and Group 2 source categories are summarized in Table 3. These data changes were reviewed and have for the large part been incorporated into the latest version of the NEI database.

Table 3. Summary of advanced notice of public rulemaking revisions.

MACT Code	MACT Source Category	Original Number of Facilities	Revised Number of Facilities	Original Emissions (total tons)	Revised Emissions (total tons)	Percentage of Change in Emissions
	Phase I, Group 1					
1301	GMACT—Acetal Resins Production	3	3	38.48	38.48	0.00%
1307	Polymers and Resins I—Butyl Rubber Production	2	2	502.0	502.0	0.00%
1312	Polymers and Resins II—Epoxy Resins Production	3	4	15.47	15.59	0.77%
1313	Polymers and Resins I—Ethylene–Propylene Rubber Production	5	5	1,067	1,062	-0.47%
1409	GMACT—Hydrogen Fluoride Production	2	2	5.48	5.48	0.00%
1320	Polymers and Resins I—Neoprene Production	1	1	289.1	138.9	-52%
1322	Polymers and Resins II—Non-Nylon Polyamides Production	4	4	6.37	6.37	0.00%
1332	Polymers and Resins I—Polysulfide Rubber	1	1	0.0045	0.0045	0.00%
	Phase II, Group 2					
0701	Aerospace Industries	301	267	2,337	1,509	-35%

MACT Code	MACT Source Category	Original Number of Facilities	Revised Number of Facilities	Original Emissions (total tons)	Revised Emissions (total tons)	Percentage of Change in Emissions
0603	Marine Vessel Loading	126	135	256.0	248.1	-3.1%
0409	Mineral Wool Production	12	8	509.1	430.8	-15%
0504	Natural Gas Transmission and Storage	123	123	273.2	330.5	21%
0501	Oil and Natural Gas Production	2,823	5,463	10,515	13,737	31%
0503	Petroleum Refineries	153	152	8,510	5,717	-33%
1201	Pharmaceutical Production	222	27	2,465	1,051	-57%
1311	Polymers and Resins I—Epichlorohydrin Elastomers Production	1	1	105.5	105.5	0.00%
1315	Polymers and Resins I—Hypalon Production	1	1	32.00	30.60	-4.4%
1321	Polymers and Resins I—Nitrile Butadiene Rubber Production	4	5	82.91	50.57	-39%
1325	Polymers and Resins I—Polybutadiene Rubber Production	5	4	2,311	1,992	-14%
1339	Polymers and Resins I—Styrene-Butadiene Rubber/Latex Production	15	14	351.8	306.9	-13%
0714	Printing/Publishing (Surface Coating)	473	416	11,090	8,493	-23%

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KEY WORDS
Residual risk

Technology review

Emissions inventory