

Task 2
Quality Assurance Plan (A1)
Control Analysis and Documentation for
Residential Wood Combustion in the MANE-VU Region

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1 Introduction

Task 2 of the contract for the *Control Analysis and Documentation for Residential Wood Combustion Emissions in the MANE-VU Region* is the preparation of a quality assurance plan. The quality assurance plan, provided here in the fulfillment of Task 2, follows the format specified in *Requirements for Quality Assurance Project Plans, EPA QA/R-5* (EPA/240/B-01/003) and the guidance in *Guidance for Quality Assurance Project Plans, EPA QA/G-5* (EPA/240/R-02/009). Many of the QA project plan elements are not applicable and are noted as such (N/A) in the table of contents. The lack of applicability of these QA project plan elements is due to the fact that the project will entail no direct environmental measurements, but rather, will obtain data from already published reports, technical literature, and compilations for use in subsequent calculations. Further, due to the small scale of the project – only four OMNI staff members will be involved, and OMNI and MARAMA will be the only two organizations directly participating in it, many of the quality assurance requirements that are designed for larger and organizationally more complex projects are superfluous to this project. However, for completeness each QA plan element specified in EPA/240/B-01/003 is listed in the table of contents, and as noted, with those that are not applicable being identified as such.

2 Group A Project Management

2.1 A3 Distribution List

The following is a list of individuals with their respective organizations that need copies of the approved QA project plan and any subsequent revisions.

Alice Lutrey, MARAMA
Susan Wierman, MARAMA
James E. Houck, OMNI
Brian N. Eagle, OMNI
Gary E. Nelke, OMNI

2.2 A4 Project/Task Organization

Susan S.G. Wierman is the Executive Director of MARMA and is the project manager for this project. Within OMNI, James E. Houck is the Principal Investigator, Paul Tiegs is a Senior Technical Consultant, Brian N. Eagle is the Quality Assurance Manager, and Gary E. Nelke is an Engineering Analyst. Mr. Nelke will be responsible for performing computations and data compilations. Mr. Tiegs will provide senior review and input on technical memorandum 3 (Task 5 – Reasonably Available Control Measure Analysis) and the final report. Dr. Houck will specify and direct the computations and data compilations and will be the primary author of the technical memoranda and final report.

2.3 A5 Problem Definition/Background

Residential Wood Combustion (RWC) is recognized as being a source of fine particles (PM_{2.5}). It has been difficult to estimate RWC activity due to the widespread and variable in-home use of wood for space heating. Similarly, it has been difficult to assign emission factors for air pollutants to RWC due to there being several major appliance types, hundreds of models, tens of different tree species used for fuel (as well as

manufactured fuels), highly variable usage patterns and installations among households, and various fuel properties such size and moisture content. Modern appliances used in lieu of older appliances, alternative fuels, regulatory restrictions, and voluntary programs can all be used to reduce emissions.

The outcome to be achieved with this project is to estimate RWC activity and develop a RWC emissions inventory for the 11 MANE-VU states and Washington D.C. and to conduct a reasonably available control measure (RACM) analysis for RWC PM_{2.5}.

2.4 A6 Project/Task Description

The project has three key technical tasks. These are: Task 3 – Develop Activity Data, Task 4 – Calculate Emissions Inventory from RWC Survey Data, and Task 5 – Reasonably Available Control Measure Analysis. (Task 1 is a Work Plan that has already been submitted and Task 2 is this QA plan). A final report will also be prepared as Task 6. Task 3 is scheduled for completion after MARAMA’s review on January 27, 2006, Task 4 on March 24, 2006 and Task 5 on May 12, 2006. The final report is scheduled for completion June 9, 2006, again after MARAMA’s review.

Task 3 will be accomplished by combining survey data collected by various organizations to estimate wood-burning appliance ownership by counties. These organizations include: MARAMA, U.S. Census Bureau, American Housing Survey, Energy Information Administration, Simmons Marketing Research, Hearth, Patio, and Barbecue Association (HPBA) and various state surveys. Once an estimate of the wood-burning appliance ownership by county is made by appliance category (The categories are: cordwood-heater, fireplace without insert, pellet heater and centralized wood heating systems.), the amount of wood burned in each appliance category will be estimated. This will be estimated by relating wood usage in cords (tons for pellets) to heating degree day (HDD) values by county. There have been over a hundred RWC surveys done in North America from which an estimate of cord usage in different heating degree day increments can be made. Cords will be converted to mass of wood on a dry basis from an estimate of the relative fraction of hardwood to softwood used as fuel. This fraction may vary with location within the MANE-VU region. Forestry literature will be used to estimate the relative fraction of hardwood as compared to softwood used as fuel by location.

Task 4 will be accomplished by compiling emission factors for each of the air pollutants by reviewing RWC reports and literature. Compilations for each of the appliance categories will be made from which mean, median and standard deviations will be calculated. The sources of the data will be referenced. A simple multiplication of the mean emission factor (g pollutant/kg wood) times the mass of wood (kg) used per county by appliance category will provide the emission inventory results.

Task 5 will be accomplished by reviewing published reports and literature on emission factors achieved with new technology appliances, ancillary hardware and fuels other than cordwood. Reductions in PM_{2.5} emissions by replacing old technology cordwood-burning appliances with new technology appliances and/or other fuels will be calculated. “Non-hardware” reductions achieved by regulatory and voluntary programs have been

documented in RACM strategies for PM₁₀ non-attainment areas over a decade ago and their PM_{2.5} efficacy will also be reviewed in this RACM analysis.

2.5 A7 Quality Objectives and Criteria

The performance of this project will be conducted entirely with existing data sources. Accordingly, as directed in EPA/240/R-02/009, the quality objectives and performance criteria are provided in section 3.8 “B9 Non-direct Measurements.” not in this Section 2.5 “A7 Quality Objectives and Criteria” as A7 applies only to measurements taken as part of the project.

2.7 A9 Documents and Records

The approved QA plan will be distributed to OMNI project staff electronically. All data compilations with applicable references will be included as appendices in the Technical memoranda and final report. Hard copies and electronic copies will be submitted to MARAMA and archived at OMNI’s Beaverton, Oregon facility for three years. The documents that will be produced are:

Technical Memorandum 1 – Residential Wood Combustion Activity in the MANE-VU Region (report for task 3)

Technical Memorandum 2 – Residential Wood Combustion Emission Inventory in the MANE-VU Region (report for task 4)

Technical Memorandum 3 – Reasonable Available Control Measure Analysis for Residential Wood Combustion (report for task 5)

Final Report – Control Analysis and Documentation for Residential Wood Combustion Emissions in the MANE-VU Region (task 6)

3 Group B Data Generation and Acquisition

3.9 B9 Non-direct Measurements

The project goals, objectives and resources have been defined by MARAMA’s Request for Proposals and, in response, the respective work approach proposed by OMNI. The available database is commensurate with these goals and objectives, albeit, as with all emission inventories, there are uncertainties that are difficult to quantify. All relevant data that are available either from public or private sector databases will be considered, as there is a paucity of relevant data for (1) the development of county-wide ownership of wood-burning appliances, (2) the amount of wood used per appliance category adjusted for heating demand, and (3) emission factors by appliance category. In contrast, OMNI has done considerable work in the area of emission factor reductions associated with the replacement of old technology cordwood-burning appliances with new technology appliances and/or alternative fuels for the EPA, HPBA and other public and private sector clients. These reports and publications will be used and referenced in the performance of Task 3 (RACM Analysis), along with new calculations with the new emission factors compiled in Task 2 based on a literature review. In terms of “non-hardware” reductions

in PM_{2.5} that can be realized by regulatory and voluntary programs, the protocols developed by EPA in coordination with state and local air quality regulatory agencies will be used and cited. (See, e.g., EPA-450/2-89-015 and EPA-452/R-93-016.)

In the cases where the same information is available from more than one source, all information will be reviewed and the best quality data as determined by the data quality indicators (DQI's) of representativeness, comparability and completeness will be selected or independent calculations using the different databases will be performed to allow for comparisons. In some cases, similar data from several sources may be combined or averaged. Best professional judgment will be used, in many cases, in the selection and acceptance of data. The quality of data that will be used for Task 3 is variable. As the data that will be used in Task 3 is principally from surveys, the number of samples as compared to the total population is a key indicator of data quality for properly designed surveys. The quality of data range from a high for primary fuel usage by fuel type by county from the U.S. Census Bureau's "long form," which was sent to one in every six households, to a low for centralized heating systems ownership. Centralized heating systems ownership will primarily be derived from the MARAMA survey of 1905 households, which owned in total 40 central heating systems in the MANE-VU states, combined with supporting information from various unrelated state surveys, federal Section 114 tabulations, and if obtainable, industry estimates. The American Housing Survey, the U.S. Census Bureau, and the Energy Information Administration reports, which will play prominently in the calculations of woodheater and fireplace numbers, have extensive documentation of data quality. These will be referenced in the technical memoranda and final report. Other sources of ownership data are primarily from surveys conducted by private sector surveying firms or state agencies and have, in general, some documentation of indicators of quality. These will be referenced. In most cases, the number of interviewees and the geographic area covered are at least provided and will be noted in the memoranda and final report.

There have been over a hundred RWC surveys conducted across North America and these will be used to the extent possible (not all surveys have usable data) to obtain the amount of wood burned annually in different appliance categories in different geographic regions. These surveys have been conducted by federal and state agencies and by the private sector. The data will allow for the calculation of amount of wood burned per appliance type for various heating degree day (HDD) increments by obtaining the 30-year average HDD values from the National Oceanic and Atmospheric Administration (NOAA) applicable to the region. (It should be noted that the normal year-to-year variation in HDD is small as compared to the differences in different geographic areas across the North America.) After the annual amount of wood burned by appliance type for various HDD is tabulated, these values will be matched with the 30-year average HDD for each county (also obtained from NOAA) and multiplied by the total number of appliances in each county to obtain the wood burning activity levels by county. NOAA has solid QA documentation.

The final emission inventory will be obtained by multiply the RWC activity for each appliance category for each county times the emission factor for each appliance category.

A mean emission factor with an associated standard deviation for each air pollutant for each appliance category will be obtained from a literature review. OMNI maintains a comprehensive library of reports and published literature on RWC emission factors as it has specialized in this field since its founding in 1979. The Project Manager will review each document to determine if the wood-burning appliance was tested during normal operation and for the quality of the testing procedure. As there is no standard, best professional judgment based on over 25 years experience in the field will be used to select test results to be used to develop the database. OMNI has already made some compilations for fireplace emission factors in a similar fashion, which will be used in this work. All sources of data will be referenced.

3.10 B10 Data Management

Microsoft Excel and Access software will be used for data transformations and reductions (mathematical operations). Data will be electronically stored and transferred among project personnel on OMNI's internal network. The data will be stored on OMNI's Dell PowerEdge 2500 server installed with a double-redundancy RAID-5 disk system. Back-up is conducted daily and a complete system backup is conducted weekly. The back-up magnetic tape is stored offsite.

As there are a variety of primary data sources, in some cases data will be hand entered into the Excel work sheets and Access databases, in other cases, such as with U.S. Census Bureau sources, data will be electronically transferred from web-site databases.

The data will be electronically stored on OMNI's system for the course of the project. Upon completion of the project, files will be burned onto CD's and stored with OMNI's archive files for a minimum of three years. Hard copies of key data tabulations will be prepared for use as appendices in the technical memorandums and the final report and will also be stored in OMNI's project files for a minimum of three years.

4 Group C Assessment and Oversight

4.1 C1 Assessments and Response Actions

Assessments will be conducted by the Quality Assurance Manager as described in sections 5.1 and 5.2 (D1 and D2) at the completion of the calculations prior to the preparation of each of the three technical memoranda submitted to MARAMA as specified in the RFP.

4.2 C2 Reports to Management

The Quality Assurance Manager will conduct the assessments noted in section 4.1 (C1) after the calculations are completed for each of the three key technical tasks in turn. He will notify the principal investigator electronically of his findings. The Project Manager will oversee the correction of any errors or deficiencies found. The corrections will be made prior to the preparation of the technical memoranda to MARAMA.

5 Group D Data Validation and Usability

5.1 D1 Data Review, Verification, and Validation

Each data set (input, intermediate, and final for use with technical memorandum preparation) will be checked for data entry, transcription, calculation, reduction and transformation errors. The completeness of the data sets will also be checked. Data will not be accepted and the technical memoranda will not be prepared until this step is completed and data are verified and validated.

5.2 D2 Verification and Validation Methods

The quality assurance manager will independently check the databases. Ten percent of the hand entered, as well as, electronically transferred data will be checked for correctness. For each calculation, data reduction and transformation step, an example calculation, data reduction or transformation will independently be performed to validate the step.

5.3 D3 Reconciliation with User Requirements

The reconciliation with user requirements will be an integral part of the technical memoranda and final report. As with the preparation of any emission inventory, a discussion of the assumptions that were necessary will be provided. In some cases, the same parameters will be calculated from independent sources. The agreement of these independently derived parameters will allow for an assessment of the overall quality and reasonableness of the parameters. Comparison of the results and intermediate data for the MANE-VU region with the results for other regions and previous studies will also allow the reasonableness of the results to be assessed. Throughout the three technical memoranda and the final report, all sources of data will be referenced to provide documentation of the level of quality inherent in the databases. All relevant, identifiable, and obtainable, sources of data will be used in the calculation of results.