QUALITY ASSURANCE PROJECT PLAN

FOR THE
SOUTHERN OXIDANT STUDY
ATLANTA SUPERSITE
FIELD EXPERIMENT
1999

Revision 1.1
November, 1999

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QUALITY ASSURANCE PROJECT PLAN
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1.0 PROJECT DESCRIPTION AND MANAGEMENT

1.1 Overview

The "SuperSite" program was first conceived as a set of special studies extending beyond national regulatory networks for particulate matter (PM) to elucidate source-receptor relationships and atmospheric processes in support of State Implementation Plans (SIPs)[1]. The program would be established in 4-7 airsheds representing a spectrum of PM problems across the country. In addition to supporting SIPs, the program would: accelerate the testing of advanced sampling methods to replace current technologies provide advanced measurements that simultaneously support PM and ozone SIPs foster collaborative partnerships across the research and regulatory monitoring communities provide additional information useful in upcoming health risk assessments of PM and it components. Spurred by the recommendations of the National Academy of Sciences (NAS) committee on PM research.

EPA staff further developed the mission of the SuperSite program to address priority health and exposure related research needs identified by the committee through a coordinated monitoring/ coordinated science planning effort. An important part of the effort has been instituting a dialogue among health and atmospheric science disciplines and research and regulatory groups, such as took place at the July, 1998 workshop on PM Measurements held in Chapel Hill, North Carolina[1].

The view of the SuperSites program that took shape at the July workshop is that of anintegrated measurement approach that combines a mix of intensive or advanced measurements at a central location combined with other monitoring sites. The SupeSite should not be looked on as a single site making research grade measurements.

Since its inception in June 1988, the Southern Oxidant Study (SOS) program has developed and evolved as a long-term, cooperative, regionally focused, science-driven, research and assessment program. SOS implemented activities through an alliance of universities, federal research and regulatory agencies, private sector research organizations, air-quality management organizations, and a few private-sectors contractors[2]. Traditionally SOS has focused on:

- The mechanisms responsible for the formation, accumulation, transport, fate, and effects of ozone (O_3), other photochemical oxidants, and related pollutants in the southeastern United States (i.e., the South); and

- The development of scientifically robust methods for evaluating the possible strategies for mitigation of the effects of photochemical oxidants and related pollutants in the South and in the nation.

In recognition of the growing concern over the deleterious health effects of atmospheric fine particulate matter and the commonalties and synergisms that exist between photochemical oxidants and Particulate Matter 2.5 micron ($PM_{2.5}$), SOS began making a transition in late 1997 from a research and assessment program concerned primarily with ozone and other oxidants in rural and urban areas of the South, to a research and assessment program concerned with O_3, other oxidants, and $PM_{2.5}$ in this same region. This transition was solidified in the spring of 1998 with EPA funding of SOS' Southern Center for the Integrated Study of Secondary Pollutants (SCISSAP); SCISSAP's initial 3-year focus is the integrated study of ground-level O_3 and $PM_{2.5}$ in the South. Shortly thereafter, SOS began planning for a major field experiment during the summer of 1999 to address key scientific issues related to the interactions and couplings between the formation of photochemical oxidants and $PM_{2.5.}$

EPA decided that Atlanta would be the center for one of two initial SuperSite Programs (the other one being located at Fresno-Bakersfield, California). In December 1998, the SOS Science Team was contacted by officials from the EPA and requested that it develop a plan for the Atlanta SuperSite that could be implemented during the Fiscal Year 99-00. In support of such an activity, EPA indicated an intention to increase total SOS funding in FY-99 from its base-funding amount of $800,000 to $1,800,000.

In August 1999 many emerging and/or state-of-the-science measurement methods for fine, airborne particles will be deployed at a site in Atlanta, Ga., 829 Jefferson Street, from the period of August 3, through 31, 1999. These measurements are being made as part of the first of the regional SuperSites being established. The Atlanta SuperSite is being coordinated by the Southern Oxidants Study in collaboration with the numerous universities and agencies that comprise SOS as well as a number of other programs and agencies including the Southeastern Aerosol Research Characterization / Aerosol Research Inhalation Epidemiology Study (SEARCH/ARIES) and SCISSAP. The purpose of this document is to provide the SuperSite investigators and management team with a working plan for the maintenance of quality assurance and quality control on the data collected during the SuperSite Experiment.

1.2 Objectives

Goals of the Atlanta SuperSite study are threefold: first, to provide a platform for testing and contrasting some of the newer particle measurement techniques, second, to provide data to advance our scientific understanding of atmospheric processes regarding atmospheric particles, and lastly to evaluate hypotheses concerning health and air pollution concentrations. Specific objectives are:

- to characterize the performance of emerging and/or state-of-the-science "PM Measurements."
- to obtain information that can be gained from the planned EPA "PM mass and chemical composition" networks;

- to evaluate the scientific information gained by combining various independent and complementary PM Measurements; and
- to address various scientific issues and their ozone-and PM-related policy implications with this data base.

1.3 Project Organization

Table 1.1 lists the individuals with responsibility for various aspects of the Atlanta SuperSite activities. The Atlanta SuperSite is operated by the Southern Oxidants Study under a Cooperative Agreement between the National Exposure Research Laboratory At Research Triangle Park (NERL-RTP) of the U.S. EPA and the Georgia Institute of Technology. W.L. Chameides is the SOS Atlanta SuperSite Project Director and, as such, chairs the Atlanta SuperSite Steering Committee which has responsibility for all decisions relating to the scientific goals of the SuperSite and the methods and approaches to be taken to reach these goals. Members of the Steering Committee include Project Directors/Liaison Officers representing all organizations and agencies supporting the SuperSite Experiment.

The implementation of the project will be coordinated by the SuperSite Coordination Committee Underpinning Success (ASCC-US). ASCC-US has responsibility for the logistics and day-to-day operation of the August Field Experiment, as well as the overall synthesis and analysis of the data. ASCC-US is chaired by John Jansen and includes Tina Bahadori, W.L. Chameides Ellis Cowling, Eric Edgerton, Fred Fehsenfeld, Susanne Hering, C.S. Kiang, Peter McMurry, Jim Meagher, Dennis Mikel, and Paul Solomon.

Administration of the project is directed by the SOS Atlanta SuperSite Project Director (Chameides), along with Project Officers in charge of the Jefferson Street Site (Eric Edgerton), the sampling protocol (Susanne Hering), quality assurance (Dennis Mikel), data management (Jim St. John), and off-site laboratory facilities (Karsten Baumann).

Table 1. Atlanta SuperSite Organization

A. Steering Committee

W.L. Chameides, Chair	SOS SuperSite Project Director
Tina Bahadori	SEARCH/ARIES Project Officer
Ellis Cowling	SOS Study Director
Fred Fehsenfeld	NOAA Liaison Officer
C.S. Kiang	GaTech Liaison Officer
John Jansen	Southern Company Liaison Officer
Jim Meagher	SOS 1999 Field Marshall
Paul Solomon	EPA Project Director/Liaison Officer

B. Coordination Committee (ASCC-US)

John Jansen, Chair, Tina Bahadori, Bill Chameides Ellis Cowling, Eric Edgerton, Fred Fehsenfeld, Susanne Hering, C.S. Kiang, Peter McMurry, Jim Meagher, Dennis Mikel, and Paul Solomon

C. Administration

W.L. Chameides	SuperSite Project Director
Karsten Baumann	Off-site Laboratory Facilities Officer
Eric Edgerton	Jefferson Street Site Director
Susanne Hering	Sampling Protocol Officer
Dennis Mikel	Quality Assurance Officer
Jim St. John	Data Manager

1.3.1 Quality Assurance Coordination

Dennis Mikel will coordinate Quality Assurance (QA). Mr. Mikel's responsibilities will be to:

- produce the Quality Assurance Project Plan (QAPP)
- coordinate the Technical Systems Audits (TSAs), performance audits and audit flow checks

- update the Science Team on any Quality Assurance issues
- produce the Quality Assurance Final Report (QAFR)

EPA Region 4 staff will perform most of the quality assurance functions. EPA staff from the Science and Ecosystems Support Division in Athens, Georgia will perform the performance audits and flow checks. This team will provide the manpower and independent equipment to perform the audits and flow checks. Staff from the Air, Pesticides and Toxics Management Division in Atlanta, Georgia will perform the TSAs.

1.4 Project Documentation Organization

This QAPP is one of several documents that will discuss and describe the Atlanta SuperSite Study. The following list of material will provide the needed documentation for this project.

- QAPP: The Quality Assurance Project Plan will document the quality assurance procedures, indicators and discuss overall uncertainty of the project. The Data Quality Objectives (DQO) process for the study will be explained in detail.
- Monitoring Protocol: This protocol document will provide the basic information on location, logistics and other pertinent information concerning the operation of the study.
- Standard Operating Procedures (SOPs): The SOPs are the descriptive documents written by the principle investigators. Each of these should describe the procedure on how to operate the instruments in the field. In some cases, as with new experimental designs, the procedures have not been formalized. In that case, written procedures will be submitted to the Quality Assurance Manager (QAM) for review.
- The Site/Method Description Report: This will be a report that will illustrate the monitoring location with a description of the local sources. In addition, a description of each of the instruments will be documented.
- Quality Assurance Final Report (QAFR): The QAFR will discuss the outcome of the quality assurance activities that were performed during the study. It will divulge whether the DQOs and Measurement Quality Objectives (MQOs) are reached. The results of the audits will be discussed in that document.
- Technical Papers and Peer Review: In the foreseeable future, technical papers will be written and peer reviewed. This will result in a compendium of important findings concerning this study.

2.0 DATA QUALITY OBJECTIVES/INDICATORS

It is the policy of the SuperSite participants that all ambient air quality monitoring and research measurement data generated for internal and external use shall meet specific qualitative requirements, referred to as Data Quality Objectives. The DQO process is required to be performed by any project that receives EPA/governmental funding as stated in "EPA Quality Manual for Environmental Programs."[3] The DQO process is detailed in US-EPA's "Guidance for the Data Quality Objectives Process, EPA QA/G-4[4]. Measurement Quality Objectives (MQOs) are the set of objectives for each individual instrument that is utilized during the study. These vary from instrument to instrument. For some instruments, i.e., the $PM_{2.5}$ Federal Reference Method samplers and most gaseous instruments, the MQOs are known due to the extensive testing that has been performed. However, there will be many instruments employed during the study where the MQOs will not be known. It will be part of the principle investigators and the Quality Assurance Managers responsibility to attempt to determine the individual MQOs.

2.1 Data Quality Objectives

Activities are necessary for effective environmental protection, it is the goal of EPA and the SOS to minimize expenditures related to data collection by eliminating unnecessary, duplicative, or overly precise data. At the same time, the data collected should have sufficient quality and quantity to support defensible decision-making. The most efficient way to accomplish both of these goals is to establish criteria for defensible decision making before the study begins, and then develop a data collection design based on these criteria. By using the DQO Process to plan environmental data collection efforts, EPA and SOS can improve the effectiveness, efficiency, and defensibility of decisions in a resource-effective manner.

DQOs are qualitative and quantitative statements derived from the outputs of the first six steps of the DQO Process that: clarify the study objective; define the most appropriate type of data to collect; determine the most appropriate conditions from which to collect the data specify tolerable limits on decision errors, which will be used as the basis for establishing the quantity and quality of data needed to support the decision.

The DQOs are then used to develop a scientific and resource-effective data collection design. It provides a systematic procedure for defining the criteria that a data collection design should satisfy, including when to collect samples, where to collect samples, the tolerable level of decision errors for the study, and how many samples to collect. By using the DQO Process, the EPA and SOS will assure that the type, quantity, and quality of environmental data used in decision making will be appropriate for the intended application. In addition, the Agency will

guard against committing resources to data collection efforts that do not support a defensible decision.

2.1.1 Optimize the Design for Obtaining Data

The DQO Process consists of seven steps. The output from each step influences the choices that will be made later in the Process. During the first six steps of the DQO Process, the planning team developed the decision performance criteria that were used to develop the data collection design. The final step of the Process involves developing the data collection design based on the DQOs. Every step should be completed before data collection begins.

The seven steps of the DQO process are:

1) State the Problem
2) Identify the Decision
3) Identify the Inputs to the Decision
4) Define the Study Boundaries
5) Develop a Decision Rule
6) Specify Tolerable Limits on Decision Errors
7) Optimize the Design

Each of these steps will be examined in the following section. Each of these steps has been performed to ensure a maximized project.

2.1.2 Iteration of the DQO Process

State the Problem: The inter-relationship between fine particle and ozone formation is not widely understood. It is possible there may be causal effects of fine particle on ozone formation and visa versa. Another problem that faced the scientific community was how could the state-of-the-science instruments be field tested in a reasonable amount of time and in different regions of the country.

Identify the Decision: The EPA and the scientific community began to realize that there was a data gap in the ozone/fine particle research. It was recommended by NAS that a series of studies be defined and implemented by the EPA[5] , thus the SuperSite program was intiated. In addition, another goal of the SuperSite program is to test state-of-the-science instruments and techniques. Two of the EPA divisions, Office of Air Quality Planning and Standards (OAQPS) and Office of Research and Development (ORD) formed the EPA SuperSites committee. This committee meets to discuss issues and dictates decisions that need to be made concerning this program. Regional EPA staff also participate in this

committee, as well as EPA's Las Vegas office. Since the SOS/SCISSAP effort for FY99 was underway, EPA solicited the SOS/SCISSAP group concerning a co-operative program; the Atlanta SuperSite project.

Identify the Input to the Decision: Several inputs can be identified as inputs to the decision. These are:

- The SOS and EPA's SuperSite program share many of the same goals.
- SOS/SCISSAP/ARIES project has been in operation for several years. SCISSAP/ARIES is currently operating an air monitoring stations at 829 Jefferson Street, Atlanta Georgia. The monitoring station is an established research air monitoring station. Many air pollution instruments are all ready in place. Therefore, the SuperSite funds can be used to supplement rather than implement an air quality study. This will realize a tremendous cost savings for the SuperSite program.
- The SOS project team is a highly qualified, technical and widely recognized team that can create and implement a large-scale air quality study.
- The SOS team has a number of universities that can be integrated into the program. Contacts have been established throughout the years that allow the SOS to assemble a technically competent team.
- EPA has funded SOS in the past. Therefore, an enduring relationship has been established between these two entities.
- Atlanta has in the past few years, exhibited a number of days that have been classified as "unhealthy" for ozone by EPA. Therefore, Atlanta is a prime city to implement an ozone/fine particle study.
- The metropolitan Atlanta area has been operating Photochemcial Air Monitoring Stations since 1995. Data collected at the SuperSite may have some correlation to the PAMS data set. If so, then the results may be applied to the entire metropolitan area.

Define the Study Boundaries: As stated in the introduction, there appears to be a synergistic/temporal relationship between ozone and fine particles. In order to investigate this relationship study boundaries must be defined. These are:

- Approximately 3 to 4 million residents live in the metropolitan Atlanta area. In order to tie the data into health effects, which is the goal of the ARIES project, the monitoring location should be in an urbanized area. Although the entire population will not be exposed to the representative atmosphere, the Jefferson Street Site is in an urbanized area that has neighborhood scale for fine particles and urban scale for ozone.
- Atlanta is in an area that has been characterized as "unhealthful."
- Atlanta has a summertime ozone problem. Since this project is a short-term study, the project will be performed between August 3rd and 31st, 1999.

- There must be instruments that measure ozone, ozone related percursors, fine particles, course particles and particle related precursors. The SCISSAP/ARIES project had some of these instruments currently operational. Please see Reference 5.
- Data collection is of prime importance. It was decided to use the NARSTO database for the long-term storage of the data. See Reference 6.
- All investigators must work on the same time schedule.

Develop a Decision Rule: The purpose of the Decision rule is to weigh the parameters of interest and specify the action level. Integration of previous DQO outputs are used here to describe the logical basis upon which the final decision is made.

The decision to invest into the Atlanta area was formulated on the following parameters:
The SOS/SCISSAP/ARIES health study of 1999 provided a unique opportunity for the EPA to supplement an existing project
The Atlanta SuperSite would be located in an urbanized area, have an existing location
The monitoring station had ozone and ozone related and fine particle instruments in place
Work with an established university based scientific research group

Specify Tolerable Limits on Decision Errors: The EPA and SuperSite investigators are interested in knowing the true nature of the urban atmosphere in the Atlanta area. Since data can only estimate, decisions that are based on measurement data could be in error (decision error). The goal of the investigators was to develop a data collection design that reduces the chance of making a decision error to a tolerable level. There are two reasons why the true value of the atmosphere is for the most part, poorly characterized:

- The atmosphere almost always varies over time and space. Limited sampling will miss some features of this natural variation because it is usually impossible or impractical to measure. Sampling design error occurs when the sampling design is unable to capture the complete extent of natural variability that exists in the true state of the environment.
- Analytical methods and instruments are never absolutely perfect, hence a measurement can only estimate the true value of an environmental sample. Measurement error refers to a combination of random and systematic errors that inevitably arise during the various steps of the measurement process (for example, sample collection, sample handling, sample preparation, sample analysis, data reduction, and data handling).

The combination of sampling design error and measurement error is called total study error, which may lead to a decision error. Since it is impossible to eliminate error in measurement data, basing decisions on measurement data will lead to the possibility of making a decision error. In this approach, the data are used to select between one condition of the environment (the *null hypothesis,* H_o) and an alternative conditions (the *alternative hypothesis,* H_a). The null

hypothesis is treated like a baseline condition that is presumed to be true in the absence of strong evidence to the contrary.

In terms of the Atlanta SuperSite study, the null hypothesis states that there is a high probability that there are deleterious health effects that correlate to the concentration and combination of ozone, fine particles and their precursors. The second part of the null hypothesis is that there is a synergistic effect of ozone percursors and fine particles toward the formation of ozone and fine particles. The null hypothesis concludes that a major study would shed light on these relationships. The alternate hypothesis states that there is no correlation between ozone and fine particle, therefore, the project should not go forward. At this time, there is strong scientific evidence which points to deleterious health effects that are caused by ozone and fine particles. The objectives of the Atlanta SuperSite study are to evaluate atmospheric measurement technology used to quantify the concentration and characteristics of ozone, fine particles, and their precursors so that theories may be postulated and tested concerning the relationship between these pollutants. Human health may be reliably tested at the Atlanta SuperSite as well as at other sites around the nation. This can be accomplished by enhancing the existing SCISSAP/AIRES instrumentation at the Jefferson Street site with both routine Federal Reference Method and state-of-the-science instruments funded by the EPA SuperSite program. We estimate that there is a 95% probability that proceeding with the Atlanta SuperSite study will produce data that will afford a detailed evaluation of fine particle instruments as well as produce data that will elucidate the relationship between fine particles and ozone. There is a much smaller probability that the data collected during the experiment will directly shed light on the health effects of ozone and its synergist effect on fine particles.

Optimize the Design: The purpose of optimizing the design is to identify the most resource-effective data collection regime. In order to facilitate this effort, modelers, air quality scientists and experts were brought together at a SOS-SCISSAP SuperSite Aerosol Measurement Workshop on February 8-10, 1999, held at Georgia Tech, Atlanta, Georgia. During the Workshop, the project was discussed and instruments and techniques were discussed in terms of maximizing the study. Since the SCISSAP/ARIES project was on going, the EPA SuperSite funds were directed to enhancing the project. In addition, the monitoring location on Jefferson Street was ideal for the study since it was an existing monitoring site. Power, security, access issues, which normally come into play when siting a station, were non-issues. The outcome of the conference was the Draft Protocol, which addressed the basic tenants of the SuperSite study and how it was maximized. In addition, the workshop allowed frank discussions on which instruments would be useful and effective at this particular project. If possible, the state-of-the-science instruments were operated along side analyzers that have characteristic that are well defined and predictable.

2.2 MQO Indicators

The MQO indicators for the Atlanta SuperSite Experiment will be determined in the usual way for a research project. The typical MQO indicators associated with data measurements are: Precision, Accuracy, Representativeness, Completeness, Estimation of Bias, Minimum Detection Limits (MDLs) and Comparability. These MQOs can be measured on most of the instrument and the project as a whole. The MQOs will be determined for each individual instrument/system. However, some of the experimental instruments perform analyses that are not easily reproducible or cannot be compared against conventional analyzers. Therefore, the SuperSite study provides an interesting scenario in terms expanding the relationship of quality assurance and data quality. It is also concievable that some MQOs will be developed during the course of the study. The typical MQOs can be used as indicators of error or bias in a data set, however, there are a number of additional indicators that can be documented and can assess the data qualitatively. These are: Inference of Analysis, Intercomparison and Trend Analysis. By using all indicators, the following statements can be made about the quality of the data set:

- Attempts will be made to quantify the error of the data generated. This shall be accomplished by performing performance audits against gas phase instruments, accuracy flow checks and Technical System Audits. The QA data collected will be used to document accuracy, precision and bias.
- Data generated shall be of sufficient quality to facilitate intercomparison with differing methodologies measuring the same parameters. The QAM and principle investigators will perform statistical evaluation of data. Intercomparisons should only be performed on Field Analyses data.
- All researchers shall strive to provide the maximum quantity of data possible for the duration study to allow for a robust intercomparison of data.
- Communication will be encouraged throughout the study. Sharing of Level 0[a] data is encouraged but not required. Level 0 intercomparisons may clue different investigators into whether their instruments are operating correctly.

Each of the MQOs are discussed in detail below.

2.2.1 Accuracy

The accuracy of the continuous gas monitors will be determined from performance audits of the individual gas phase instruments. The performance audit will challenge the instrument with

[a] Level 0, 1 and 2 are defined as follows: Level 0 data are designated as data sets downloaded from field instruments that have not been examined. These measurements are used to evaluate instrument performance. Level 1 data have been scrutinized by the principle investigators prior to submission to a database. Level 2 data has been subjected to intercomparison with other data sets and adjusted to calibration sources and various statistical tests.

standards, from an independent, NIST traceable source not used for calibration, encompassing the operational range of the instrument. A minimum of three data points, including zero will be used to conduct the performance audit. The following equation will be used to estimate the slope, intercept and correlation coefficient. The following equation is be employed:

$$y = mx + b \qquad \text{Equation 1}$$

where the audit standard concentration is the independent (x) variable, the instrument reading is the dependent (y) variable, m is the slope, and b is the y intercept, will be used to assess accuracy.

For gravemetric and speciated fine particle samplers, the accuracy will be defined as a accuracy flow check. The estimation of accuracy for this method is:

$$\%\text{Accuracy} = [\ (Q_a - Q_m)/Q_a] \times 100 \qquad \text{Equation 2}$$

where Q_a is the flow rate measured using a NIST traceable flow device, Q_m is the flow rate measured by investigator.

2.2.2 Bias

Due to the unique research nature of many of the measurements to be conducted by SuperSite, the situation may arise where primary standards are unavailable to determine bias. In addition, bias of the discrete methodologies can only be determined for the analytical instruments, and does include effects introduced by sample collection and transport. In these instances the determination of bias is the correct action. Bias will be calculated under three distinct situations:

- a primary standard does not exist to determine instrumental accuracy
- the comparison of two discrete methodologies using ambient data
- comparison two discrete methodologies using ambient data, one of which is a Federal reference method.

When a primary standard method is not available, bias will be calculated using the equation:

$$\text{Bias} = 1/n \sum_{i=1}^{n} [(S - X_i)/S] \cdot 100 \qquad \text{Equation 3}$$

where S is the standard value and X_i is the instrument results of the ith measurement of the standard.

For comparison of two methodologies, neither of which is considered a reference standard, bias will be calculated by the equation:

$$\text{Bias} = 1/n \sum_{i=1}^{n} \left[((M1_i - M2_i)/((M1_i + M2_i)/2))\right] \times 100 \qquad \text{Equation 4}$$

where $M1_i$ and $M2_i$ are the ith measurement of the two methodologies (M1 and M2) being subjected to comparison. The use of the average of the two methodologies in computing bias recognizes that a primary standard is not available.

If the results of a particular methodology are being compared to a primary standard then the following equation:

$$\text{Bias} = 1/n \sum_{i=1}^{n} \left[(M1_i - M2_i)/M1_i\right] \times 100 \qquad \text{Equation 5}$$

where the numerator has been replaced with the ith measurement of the primary standard will be used to determine bias.

2.2.3 Precision

Precision of the continuous gas monitors will be determined from replicate analyses of calibration standards, instrument span check standard and/or precision check standard records. Precision for the GC/FID and GC/MS system will be determined using multiple analyses of a 5 component mixture supplied by NCAR. A minimum of 5 data points should be used for the precision to be calculated. Precision should be determined for data time periods between calibrations or other major maintenance periods that may effect the operation performance of the instrument. Precision for filter based instruments will be performed by comparing the percent difference between similar methods. Precision will be determined from the standard deviation using the following equations.

$$\textit{Standard Deviation}(s) = \sqrt{\frac{\sum_{i=1}^{n} (x_i - \bar{x})^2}{n-1}} \qquad \text{Equation 6}$$

where x_i is the experimentally determined value for the i^{th} measurement, n is the number of measurements performed, and $\bar{x}$ is the mean of the experimentally determined values.

The precision will be determined as percentage of the average concentration of the span check standard or precision check standard using the following equation.

$$Precision = \{x\}_{avg} +/- 1.96*s \qquad \text{Equation 7}$$

where $\{x\}_{avg}$ is the average of the span or precision measurements, s is the standard deviation of the replicate span check standard or precision check standard data. The upper and lower 95% probability limits are set using this statistical test.

2.2.4 Minimum Detection Limits

The MDL is defined as a statistically determined value above which the reported concentration can be differentiated, at a specific probability, from a zero concentration. Analytical procedures and sampling equipment impose specific constraints on the determination of detection limits. For the gaseous parameters, MDLs are determined by challenging the instruments with purified zero air, however, for filter based instruments, the MDLs are determined by blanks. It is recommended that all filter-based instruments perform the following filter blank tests: field blanks and laboratory blanks. Field blanks are defined as a filter that travels with the filters that will be utilized in sample collection. The filter should be treated in the same manner as any other filter with the exception of begin loaded into the filter mechanism. It is a good field practice to take the field blank up to the sampler and leave it inside the instrument housing with the filter cover on. When the sample filters are removed after the sample run, the field blank is also removed and processed in the same manner as all filters. It should also travel in the same carry case as all filters. Storage and handling should be as identical to all processed filters. Laboratory (lab) blanks are filters that are pre-weighed and processed in the same manner as all filters. It is a good laboratory practice to randomly pick a filter and leave it in the weighing room. This filter is then post-weighed and handled in the same manner as all filters arriving from the field. It is recommended that 10% of all filters handled should be lab and field blanks. The following sections will illustrate how MDLs are quantified for filter and non-filter methods.

2.2.4.1 Continuous Measurements

The configuration of the continuous gas monitors (in particular the ability to introduce standards at the sample inlet) allows for the determination of the MDL for each continuous analyte. The MDL includes all sampling and analytical procedures and therefore represents a detection limit that can be applied to ambient concentrations. The MDL concentration is determined in zero air and therefore will not address matrix interferences.

The MDL for each continuous gas monitor will be determined through statistical evaluation of the zero check standard. The following equation;

$$MDL = t_{(n-1,1-a=0.99)} * s \qquad \text{Equation 8}$$

where s is the standard deviation of the replicate zero analyses, t is the students t value appropriate to a 99% confidence level and a standard deviation estimate with n-1 degrees of freedom, will be used to determine the method detection limit[7].

2.2.4.2 Discrete Measurements

The laboratory analytical protocol requires that samples be collected at a location away from analysis. Standards for the determination of detection limits for these laboratory instruments are prepared in the laboratory and therefore are not subjected to the same procedures and equipment as the ambient samples. This detection limit is referred to as the instrument detection limit (IDL). The IDL is indicative of the ability of the instrument to differentiate, at a specific probability, between zero and at a specific concentration. The IDL standard does not experience the same handling procedures; collection on filter medium and denuders for HPLC analysis or canister collection for GCMS analysis; and therefore does not provide information relating to the detection limit at ambient. The IDL for each HPLC and GCMS analyte will be determined through statistical evaluation as described in equation 8.

2.2.5 Completeness

Completeness will be determined from the data generated using the following equation:

$$\text{Completeness} = (D_x - D_c)/D_c \times 100 \qquad \text{Equation 9}$$

where D_x is the number of samples for which valid results are reported and D_c is the number of samples that are scheduled to be collected and analyzed during the year.

2.2.6 Representativeness

Generally, representativeness expresses how closely a sample reflects the characteristics of the surrounding environment. This is usually quantified in terms of monitoring scale. 40 CFR 58, Appendix D[8] discusses monitoring scale in great detail. It is not the scope of this manual to discuss monitoring scale in detail, however, monitoring scale must be understood for the project. The major components of the SuperSite are ozone, ozone precursors, fine and coarse particles. The 40 CFR 58 recommends that ozone monitoring represent urban or regional scale. For Atlanta, urban scale represents the overall citywide exposure with dimensions in the order of 4 to 50 kilometers. On the other hand, fine and coarse particle scale is recommend to be neighborhood scale, which is defined as representing an area in the order of 0.5 to 4.0 kilometers.

The SuperSite project will be conducted is at the Georgia Power Company facility located at 829 Jefferson Street NW, Atlanta. The site was previously established for the SEARCH and ARIES programs and the capabilities will be expanded to accommodate the 1999 Atlanta SuperSite Experiment. The location of the site is within the greater Atlanta area. The exposure of the surrounding environs do represent urban scale for ozone and it precursors and neighborhood scale for particle monitoring. For more details on the location and site layout, please refer to the Monitoring Protocol and the Site/Methods Report.

Figure 1. Map of Downtown Atlanta showing monitoring location

2.2.7 Comparability

Comparability refers to how confidently one data set can be compared with another. Ideally, two instruments that measure the same parameter would be statistically comparable. One of the objectives of the SuperSite is to test new state-of-the-science instruments to see if the values collected are comparable with instruments of well-known and documented accuracy and precision. For a research study that will be testing state-of-the-science instruments and methods, comparability becomes more difficult to estimate. The way to ascertain comparability can be estimated using the following MQOs.

2.2.7.1 Inference of Analysis

At times, when instruments are used in research projects, such as a SuperSite, there may one instrument that measures species that cannot be duplicated or compared against other methods. In this case, the only QA activity would be internal calibrations or maintenance checks. To enhance the QA for this instrument, it is recommended that an instrument of known quality be operated and inferences be made by the collection of the research instrument. As an example, if a new method for analyzing sulfates in vapor phase is developed, but there are no instruments to compare against, it would be recommended that data be used from a speciated particle sampler that captures sulfates. By using phase to particle models, the sulfate data can be compared against the sulfate vapor data and inferences about the quality of the sulfate data can be made. The QAM must be aware of these types of analyses and perform the final analysis in the QAFR.

2.2.7.2 Trend Analysis

A technique that has been used very successfully in the Photochemical Assessment Monitoring Stations analysis is trend analysis. The following types of trend analyses can be effective indicators for SuperSite project. Mean or median concentrations, highest daily maximum, percentile of daily maxima can be used effectively to test whether hourly data and integrated 24-hour data are following similar trends. The following rules will be applied when performing trend analysis:

- Apply statistics for detecting trends, such as linear regressions of species or tests of variance, such a the student's t-Test
- Weight factors that are based upon models
- Using known ratios of parameters in the atmosphere

The principle investigators in conjunction with the QAM should select the types of trend analyses used for the SuperSite project.

2.2.7.3 Intercomparisons

A major goal of the quality assurance related data analysis will be to assess equivalency of $PM_{2.5}$ measurements. Our major emphasis will be placed on technologies that quantify $PM_{2.5}$ mass and chemical composition using: (a) filter-based integrated sampling, and (b) semi-continuous monitoring. Qualitative assessments will also be carried out on the data gathered from the more experimental single particle mass spectrometers. For the assessment of integrated samplers and semi-continuous monitors, the primary data of interest are: mass, sulfate, nitrate, ammonium, elemental carbon, and organic carbon. Trace elements virtually never comprise a major fraction of $PM_{2.5}$ mass, but are extremely important for receptor modeling and will be quantified in the integrated measurements. For each of these data, a "standard" or control value and related uncertainty will be derived for the integrated samplers and (where appropriate) for the semi-continuous monitors from the mean and the standard deviation of the mean of all Level 2 quality assured measurements made during a given time interval by the integrated samplers and the semi-continuous monitors, respectively. Control values can be refined by eliminating outliers through standard statistical tests. Within each of the measurement categories, consistency between various instruments will be assessed by comparing individual data with the control values.

Additional quality assurance related data analysis will be made by assessing the ability of integrated samplers to account for $PM_{2.5}$ mass measured gravimetrically with that obtained by reconstructing the mass from chemical speciation. Since mass balance checks on data from individual samplers will be carried out by each of the principle investigators, the overall QA analysis will focus on the control values derived from the combined dataset. The chemical speciation of the combined data set will be deemed to be statistically consistent with the $PM_{2.5}$ gravimetric mass measurements if the two values agree to within +/- 30%. Control values for any time interval when the two mass-values differ by more than +/- 30% will be flagged in the final archive. In addition to gravimetric analysis, there is a natural grouping of instrument that will be collecting data at the Atlanta SuperSite. Please see Intercomparison Matrix in Table 2.1. It would be assumed that similar instruments would be statistically equivalent. Therefore, control values will be generated for each group of instrument and the data will be intercompared against the individual instruments of that particular group. For groups that do not have common parameters (i.e., Single Particle Mass Spectrometers and Semi-Continuous Speciation Samplers), this statistical analysis will not be applicable.

Below is a matrix of which instruments may be intercompared.

Table 2.1 Intercomparison Matrix

Parameter	Instrument	Investigator	Time Period*	Comments
Ozone	UV-photometer	Edgerton	H	
	UV-photometer	Baumann	H	
	Lidar	Hardesty	H	
NOy	Chemluminescence	Edgerton	H	
	Chemluminescence	Baumann	H	
CO	NDIR	Edgerton	H	
	NDIR	Baumann	H	
Meteorological Parameters	WS,WD,T, RH	Edgerton	H	
	WS,WD,T, RH	Baumann	H	
Integrated Fine Mass	FRM PM2.5	Solomon	I	Teflon Filter
	FRM PM2.5	Solomon	I	Quartz Filter
	FRM PM2.5	Edgerton	I	
	FRM PM10	Edgerton	I	
PM filter speciation	PCM	Edgerton	I	
	HEADS	Koutrakis	I	
	PCM	Baumann	I	
	IOGAPS	Gundel	I	
	PC-BOSS	Tanner	I	
	PC-BOSS	Eatough	I	
	MAAS	Solomon	I	
	SASS	Solomon	I	
	VAPS	Solomon	I	
	RAAS	Solomon	I	

Parameter	Instrument	Investigator	Time Period*	Comments
Continuous Speciation	ICVC	Hering	C	Nitrates, Sulfates, Total Carbon
	SJAC	Slanina	C	Nitrates, Sulfates, Ammonium ion
	In-situ Carbon	Turpin	C	OC/EC only
	CPCIC	Weber	C	Suspended ions
	R+P Carbon	Edgerton	C	Total Carbon
	GFAA	Ondov	C	Metals only
	Cont. IC	Dasgupta	C	
	Aldehydes	Dssgupta		Aldehydes and Peroxide
	Aethelometer	Koutrakis	C	Total Carbon only
	Cont. NO3	Koutrakis	C	Nitrates only
Continuous Mass	TEOM	Bergen	C	
	RAMS	Eatough	C	
	CAMMS	Koutrakis	C	
	TEOM	Russell	C	
	Met One	Merrifield	C	
Particle Mass/Density	DMPS	McMurray	C	
Single Particle	ATMOFS	Prather	C	Qualitative analysis only
	AMS	Warsnop	C	
	RSMS2	Wexler	C	
	PALMS	Middlebrook	C	
Semi-Cont. Speciation	MOUDI	Maring	SC	Metals only
	MOUDI	Maring	SC	Anions only
	MOUDI	Bayer	SC	EC only
	MOUDI	Bayer	SC	OC only
Metals	MegaVol	Ondov	I	
	Toxics	Koutrakis	I	
Solar Measurements	Aerosol Optical Depth	Bergin	H	
	Brewer Rad.	Bergin	H	
	Spectral Rad.	Bergin		
	Solar Radiation	Edgerton	H	

* H = Hourly, I = 24 hour integrated, C = Continous with various time periods, SC = Semi-Continous

3.0 DATA ACQUISITION AND MEASUREMENTS

3.1 Background

Table 3.1 below provides a schedule for the activities associated with the 1999 SuperSite Experiment. Many pre-study activities must be performed for a successful project will occur. Table 3.1 outlines the activities that will occur before the investigators actually arrive on site. The field measurement portion of the experiment will commence at 0700 hrs on August 3 and end at 0700 hrs on September 1, 1999. The measurements to be conducted at the Atlanta SuperSite include measurements managed through a variety of organizations. Some of these are funded by U.S. EPA through the SOS Cooperative Agreement others are funded through alternate avenues. Although all measurements may be referenced in this document, only those directly funded through the SOS Cooperative Agreement fall within the purview of this QAPP.

Table 3.1. SuperSite Schedule

Pre-study	
2/8-10/99	Planning Workshop, Atlanta Georgia
Feb-Mar 99	Logistics questionnaire circulated, site plan drafted
5/12	Draft protocol, site layout and occupancy agreement circulated.
5/17	Participants submit Standard Operating Procedures to Bill Chameides
5/30	Site layout finalized and circulated
6/15	Protocol completed and submitted
11/19/99	QAPP completed and submitted
During Experiment	
7/27-7/30	Check-in at Headquarters
8/1, 8 p.m.	Kick-off Science Team Meeting at Headquarters
7/28-30, 8/2, 8/3	On-site TSAs and performance audits begin
8/3, 0700 EDT	**Measurements begin**
8/6, 8/12, 8/18, 8/24, 8/30, 8 p.m.	Investigator meeting at Headquarters (unless otherwise designated)
9/1, 0700 EDT	**Measurements end**
9/7	Site demobilization complete
Post-Experiment	
01/01/00	Data submittal due date
3/1/00	Quality Assurance Final Report completed and submitted
3/7-91/00	SOS Data Analysis Workshop
6/1/00	Submission of Interim Report to U.S. EPA
6/1/00	Joint Health Effects/Atmospheric Sciences Workshop
7/1/00	Submission of Report on Recommended Future Studies To Further Investigate the Link Between PM and Human Health
12/20/00	Special SOS Session at Winter AGU Meeting
01/15/01	Submission of papers for peer-review and publication in as Special Issue in a technical journal

3.2 Description of Measurements

Table 3.2 lists the complement of measurements and instrumentation to be deployed at Jefferson Street during the 1999 Atlanta SuperSite Experiment. These include filter-based techniques for mass concentration and chemical characterization of fine particles, automated, semi-continuous methods for high-time resolution of fine particle chemistry, single particle composition mass spectrometers, and techniques for characterization of the physical properties of fine particles. Additional continuous gas and meteorological measurements will support these measurements fine particle measurements.

Table 3. 2. List of measurements

Sch[1]	Investigator	Organization		Instrument & Measured Parameters
Integrated Particle Samplers with alternate 24-hr and 12-hr Collection beginning @ 0700 EDT				
A	Baumann	GaTech	1	PC: Multichannel denuder filter pack system for PM2.5 mass, ions, trace elements, OC/EC, and gaseous ammonia, nitric acid and sulfur dioxide.
A	Gundel	LBL	2	IOGAPS: integrated gas and particle sampler for organic speciation
			1	Low vol IOGAPS: OC/EC, selected PAH analysis
			1	High flow filter-PUFF for organic speciation method development
A	Tanner	TVA		PC-BOSS sampler
A	Solomon-Eatough	EPA,BYU		PC-BOSS sampler
A	Solomon	EPA	5	5 types of Speciation Samplers: Andersen, Met One, URG, VAPS
			3	FRM PM2.5 samplers with Teflon filters
			1	FRM PM2.5 sampler with quartz filter
			1	Auto Dichotomous sampler with electron microscopy and XRF analysis of fine and coarse PM.
Integrated Particle Samplers with daily 12-hr Collection beginning @ 0700 EDT				
B	Maring	U Miami	1	MOUDI for ions (RH controlled)
B			1	MOUDI for OC,EC, mass (RH controlled)
B	Edgerton	ARA		PCM particle composition monitor for PM2.5 mass, trace elements, water-soluble metals, ions, OC/EC.
On-Line Particle Mass Spectrometry				
C	Middlebrook	NOAA		PALMS: particle mass spectrometer
C	Prather	UC Riverside		ATOFMS: aerosol time of flight mass spectrometer
C	Warsnop	Aerodyne		AMS: aerosol mass spectrometer
C	Wexler	U Delaware		RSMS2: second generation rapid single particle mass spectrometer
Continuous and Semi-Continuous Particle Chemistry				
C	Dasgupta	Texas Tech		Automated IC with water vapor condensation collection system for

Table 3. 2. List of measurements

Sch[1]	Investigator	Organization		Instrument & Measured Parameters
				sulfate and nitrate
C	Edgerton	ARA		Automated catalytic reduction system for ammonium, nitrate, and sulfate. Commercial (R&P) for OC/EC.
C	Hering	ADI		ICVC: Integrated collection and vaporization cell for automated nitrate, sulfate and particulate carbon
C	Slanina	ECN		SJAC: Steam jet aerosol collector for nitrate, sulfate and Ammonium ion
C	Ondov			GFAA for continuous metals
C	Turpin	Rutgers		In situ carbon analyzer for organic and elemental carbon
C	Weber/Lee	GaTech,BLN		CPCIC: CNC-based collection for aerosol ion chromatography
Continuous and Semi-Continuous Particle Mass				
C	Koutrakis	Harvard		CAMMS: pressure drop mass measurement
C	Russell	GaTech		TEOM [3]: tapered element oscillating microbalance for particle mass, with RH control.
C	Merrifield	Met One		GT-640 Continuous portable PM monitor
C	Solomon	EPA/BYU		RAMS for continuous particle mass
Continuous and Semi-Continuous Particle Physical Characterization				
C	McMurry	U Minn.		Double size spectrometry for particle density
C	"	"		DMPS [3]: Particle size distributions 3 nm-3 um
Continuous and Semi-Continuous Supporting Measurements				
C	Edgerton	ARA		Met [3]: meteorology station at 10 m for wind speed, wind direction, temperature, barometric pressure, solar radiation and relative humidity.
C	Edgerton	ARA		Criteria and reactive gases [3] (O3, NOx, NO, NO2, SO2, CO, NOy, HNO3, NH3)
C	Baumann	GaTech		Met and criteria gases (T, RH, WS/ WD, global radiation, UV radiation, NO, NOy, O3, CO, SO2.
C	Bergin	GaTech		Aerosol optical depth, spectral radiometer, sun photometers
C	Hardesty	NOAA		LIDAR: boundary layer O3 and aerosol backscatter
C	Dasgupta	Texas Tech		Semi-continuous HCHO and H2O2 (gas)
C	McNider	UAH		Wind profilers for winds aloft
C	Zika	U Miami		On-line GC for volatile organics and oxygenates
Multiday Sample Collectors				
M	Maring	U Miami	1	MOUDI for organic speciation
M	"	"	1	MOUDI for heavy molecular weight compounds
M	Ondov		1	Mega Vol for trace metals
M	Koutrakis	Harvard SPH	1	High volume sampler for sample archiving
Particle and Vapor Collection through SEARCH/ARIES (24-hr beginning at 0100 EDT) [2]				
S	Burge	Harvard		Burkard Sampler for Pollen and Molds [3]
S	Edgerton	ARA		PM2.5 FRM mass [3]
				PM10 FRM mass (dichot) [3]

Table 3. 2. List of measurements

Sch[1]	Investigator	Organization	Instrument & Measured Parameters
			PCM particle composition monitor for PM2.5 mass, trace elements, water soluble metals, ions and OC/EC [3]
S	Koutrakis	Harvard	HEADS for gaseous ammonia, particle acidity and sulfate [3]
Supporting Laboratory Analyses			
	Jahren	GaTech	Isotope analysis of PM2.5 (C13 and N15)
	Bayor	GaTech	Trace element and heavy organics analysis of MOUDI samples

1 Sch: Schedule code, as given below.
2 SEARCH/ARIES instrumentation operating under different protocol and Quality Assurance.

Measurements will be conducted following discrete sample schedules as detailed in the following paragraphs.
Schedule A, "Alternate Day Schedule" is for the EPA speciation samplers and certain other filter collectors. Samples will be collected for a full 24 hours starting at 0700 hrs EDT on alternate days, beginning with the first day of the study. This schedule will provide for a total of 15 sampling periods, and allows for a full 24 hours of sample collection with a single manual sampler. Starting on August 3rd the sampling dates will correspond to odd numbered days.

Schedule B, "Base Schedule" is a day/night schedule with two sampling periods, starting at 0700 and 1900 hrs, per day. This schedule will be used by the MOUDI impactors and for one of the ARIES/SEARCH particle composition samplers.

Schedule C, "Continuous Sampling" is for those samplers with high time resolution. Data will be supplied in a time format that allows for calculation of one-hour averages.

Schedule M, "Multiday Sampling" provides for collection of large samples as required for trace metals and organic speciation analysis. Sample duration will vary from measurement to measurement, with the duration dependant upon the method requirements.

3.3 Quality Control Protocols

A description of the quality control protocols for the relevant instrumentation is provided in the SOPs. It is assumed that each principle investigator will perform the needed quality control to keep their instruments within internal QC limits. It is assumed that all investigators will calibrate their instruments at the beginning, middle and end of the monitoring period. The QAM will review all QC activities. Calibration records and operational procedures will be review during the Technical Systems Audit.

3.4 Sample Custody

It is assumed that all investigators and their staff will perform satisfactory sample custody. The QAM will inspect all sample custody forms, logs and procedures during the TSA. All SOPs will have detailed text discussing the sample custody. Any deviations will be noted during the TSA.

3.5 Data Acquisition

The purpose of this section is to document the procedures to be used in the management and archiving of data gathered during the 1999 Atlanta SuperSite Experiment. It is assumed that data will be stored on electronic media for continuous and semi-continuous instruments. It is strongly recommended that the data be "backed-up" every day or sampling interval. It is also recommended that separate CD-ROM or diskettes be created for data storage.

The ACC-US has devised a data template (data.template.9.16.99.xls) that will be furnished to all principle investigators. It is important for all principle investigators and co-investigators to use this template. Please see the format in Appendix B.

3.5.1 Formatting of Data

All data will be reported to and ultimately archived by the SCISSAP Data Office with appropriate time-stamping to indicate the time increment of the data .A valid time-averaged data set must contain validated data points for at least 90% of the total possible data points over the time interval. Otherwise, the time-averaged value is flagged and reported using an appropriate validation code (See Appendix B).

3.5.2 Date and Time Formats

Data will be reported in Eastern Standard Time in a MM/DD/YYHHMM format (e.g. 08/01/1999 14:15) The daily time cycle runs from 0000 to 2359 (2400 is not a valid time). Please see Appendix B.

3.5.3 Reporting Missing Data

All data fields should have a value present, either the measured or adjusted data value or a missing value representation. **There should be no blank data fields.** Contributors should report data where possible and use flag codes (see Table 3.3). All missing values should be numerical values, not character or alphanumeric values, to aid quality-control efforts. Missing values for data parameters should be represented by a value of -9999. Data flag codes should differentiate between valid values, invalid values, estimated values, interpolated values, and MDLs.

3.5.4 Reporting Calibration Values and Uncertainty Estimates

The calibration values and estimates of precision and minimum detection limit for all measurements will be maintained by the research organizations and reported to the Data Office. Access to calibration values is crucial for many quality-assurance, analytical, and modeling exercises.

3.5.5 Initial Documentation of Data Quality

All data reporting forms will contain a column for flagging and indicating the validity and quality of the data. See Appendix B for details. All problematic and missing data points will be highlighted in the form through the insertion of an appropriate coded flag. Table 3.3 lists and defines these flags. Flags beginning with the letter "Q" indicate datum that is useable but problematic. "M" is used for missing data points and "H" for historical data unable to be assessed or validated. No invalid data will be placed in the Reporting Form to avoid their possible inadvertent use.

Table 3.3 Data Quality Flags

Code	Data Quality Flag definition
V	Useable point has been screened and is a valid Level 2 datum
Q1	Useable datum but comprised wholly or partially of MDL data
Q2	Useable estimated datum
Q3	Useable interpolated value
Q4	Useable datum despite failing some statistical outlier tests
Q5	Useable datum but qualified because of possible contamination (e.g., pollution source, laboratory contamination source)
Q6	Useable datum but qualified due to non-standard sampling conditions (e.g., instrument malfunction, power failures)
M	Missing value, no value available
mdl	Value reported is below the minimum detection limit of the analysis method
H1	Historical data that have not been assessed or validated

3.5.6 Data Archival

As indicated in Table 3.1, principle investigators will transmit all data to the SCISSAP Data Office at Georgia Tech on or before January 1, 2000. These data will be quality assured and be transmitted for final storage at the NARSTO Data Archive on or before January 1, 2001. It is expected that the individual principle investigators will store their data in electronic format for at least 5 years.

4.0 CORRECTIVE ACTION AND RECONCILIATION

There is a distinct possibility that some data generated for this project would be considered unacceptable according to the DQOs and MQOs that have been set forth in section 2. This section will outline how the process will evolve if data are considered questionable.

4.1 Corrective Action Process

Each of the investigators is responsible for quality control of the data set collected. It is assumed that each investigator and sub-ordinates are performing the needed quality control calibrations and adjustments needed. It is the responsibility of the QAM to review the MQOs of each data set. In addition, the QAM will review the following information:

- Calibration information
- Data handling information (i.e., chain of custody forms)
- Field and lab blank data
- Field notes
- Field data sheets
- If possible, the accuracy, bias, precision and MDLs will be calculated for the data set
- Statistical trend analyses such as student's T-tests will be performed where applicable
- Any other tests that the QAM deems useful

From this information, the QAM will be able to ascertain whether the operation of the instruments and systems were within the SOPs. If this review indicates a possible problem, the investigator will be contacted for further information. If the QAM is not satisfied with the results of the review, the QAM will contact the SOS SuperSite Project Director and explain the problems observed with the data set. The discussion of the Project Director and QAM will determine whether data collected for this project will remain in the NARSTO database. The principle investigator will be informed of any data removal or invalidations that occur in the NARSTO database.

5.0 REFERENCE

1. PM Measurement Workshop Report, "Atmospheric Observations: Helping Build the Scientific Basis for Decisions Related to Air Borne Particulate Matter" EPA/NARSTO, October 1998
2. Cooperative Agreement between the National Exposure Research Laboratory at Research Triangle Park of the U.S. Environmental Protection Agency and The Georgia Institute of Technology for The Southern Oxidant Study Phase II Program on Analysis and Assessment of Alternate Strategies, June 1, 1996
3. "EPA Quality Manual for Environmental Programs", EPA Order 5360.1 CHG1 July 1998
4. EPA QA/G-4, "Guidance for the Data Quality Objectives Process", EPA document EPA/600/R96/055, September 1994
5. SuperSites Conceptual Plan, Draft prepared by Office of Air Planning and Standard and Office of Research and Development, Research Triangle Park, NC, November 9, 1998
6. Atlanta SuperSite '99 Study, Draft Protocol June 1, 1999
7. Code of Federal Regulations, Title 40 Part 136, Appendix B
8. Code of Federal Regulations, Title 40 Part 58, Appendix D

Appendix A. Technical Systems Audit Form

Southern Oxidant Study - Atlanta Super Site

Part 1- Systems Audit Checklist for Quality System Documentation

Reporting Organization _____

Assessor Name and Affiliation _____

Observer(s) Name and Affiliation _____

_____

Assessment Date _____

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
1. Is there an approved quality assurance project plan (QAPP) for the overall program and has it been reviewed by all appropriate personnel?				
2. Is a copy of the approved QAPP available for review by field operators and laboratory analysts? If not, briefly describe how and where QA and quality control (QC) requirements and procedures are documented and are made available to them.				
3. Is the design and implementation of the program as is specified in the QAPP?				
4. Are there deviations from the QAPP?				
5. How are any deviations from the QAPP noted?				
6. What are the critical measurements in the program as defined in the QAPP?				
7. Does the QAPP list measurement quality objectives (MQOs) for each critical measurement clearly and explicitly?				
8. Do the above MQOs appear to be based either on documented performance criteria or on actual QC data compiled for the measured parameter?				
9. Are there established procedures for corrective or response actions when MQOs (e.g., out-of-control calibration data) are not met? If yes, briefly describe them.				
10. Are corrective action procedures consistent with the QAPP?				
11. Have any such corrective actions been taken during the program?				

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
12. Has the performance of each of the critical measurements been assessed and documented during the program?				
13. Are written and approved standard operating procedures (SOPs) used in the program? If so, list them on the attached sheet and note whether they are available for review by field operators and laboratory analysts. If not, briefly describe how and where the program's operating procedures are documented.				
14. Are the SOPs complete, up-to-date, and followed?				
15. For each critical measurement, does the QAPP specify the frequency of calibration, the acceptance criteria for the calibration, and the process for calibration data reduction and review?				
Additional Questions or Comments:				

QUALITY CONTROL ITEM	RESPONSE			SOP TITLE
	Y	N	NA	
1. Selection of methods and equipment				
2. Training				
3. Installation of equipment				
4. Selection and control of calibration standards				
5. Calibrations and their frequency				
6. Flow rate checks and adjustments				
7. Control limits for flow rate calibrations, and associated corrective actions when such limits are surpassed				
8. Preventive and remedial maintenance				
9. Recording and validating data				
10. Date quality assessment (precision and accuracy)				
11. Documentation of QC information				
Additional Questions or Comments:				

Part 2- Systems Audit Checklist for Management and Organization

Reporting Organization _____

Assessor Name and Affiliation _____

Observer(s) Name and Affiliation _____

_____

Assessment Date _____

AUDIT QUESTIONS	RESPONSE Y	N	NA	COMMENTS
A. ORGANIZATION AND RESPONSIBILITIES Identify the following personnel and determine whether they have the listed responsibilities:				
1. Principle Investigator: - Overall responsibility for program, - Overall responsibility for quality systems, - Communications with quality assurance, manager and technical managers,				
2. Field Operations Manager: - Development of monitoring network, - Coordinates field operations, - Logistical support of field operations, - Training monitoring site operators, and - Review of routine sampler data and quality control data.				
3. Monitoring Site Operator(s): - Operation of samplers, - Calibration of samplers, - Maintenance of samplers, - Maintenance of monitoring site, and				
4. Who is authorized to halt the program in the event of a health or safety hazard or inadequate quality?				
5. Does the program maintain written descriptions of the program organization and personnel responsibilities?				
Additional Questions or Comments:				

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
B. TRAINING AND SAFETY				
1. Do the monitoring site operators have training or experience for the operation of the sampler?				
2. Do the laboratory analysts have training or experience for weighing filters?				
3. Does the program maintain current summaries of the training and qualifications of program personnel?				
4. Is there special safety equipment required to ensure the health and safety of personnel?				
5. Are personnel outfitted with any required safety equipment?				
6. Are personnel adequately trained regarding appropriate safety procedures?				
Additional Questions or Comments:				

Part 3- Systems Audit Checklist for Monitoring Site

Monitoring Site Location _____

AIRS Site Designation _____

Reporting Organization _____

Assessor Name and Affiliation _____

Observer(s) Name and Affiliation _____

_____

Assessment Date _____

AUDIT QUESTIONS	RESPONSE Y	N	NA	COMMENT
A. Sampler Siting				
1. Do the locations for both primary samplers and collocated samplers conform to the siting requirements of 40CFR58, Appendices A and E?				
2. Are there any changes at the site that might compromise original siting criteria (e.g., fast-growing trees or shrubs, new construction)?				
Additional Questions or Comments:				
B. Monitoring Site				
1. Are logbooks and required data sheets filled in promptly, clearly, and completely?				
2. Does the operator keep the filter-handling area neat and clean?				
3. Is (are) a copy of the applicable QAPP(s) available to the site operator?				

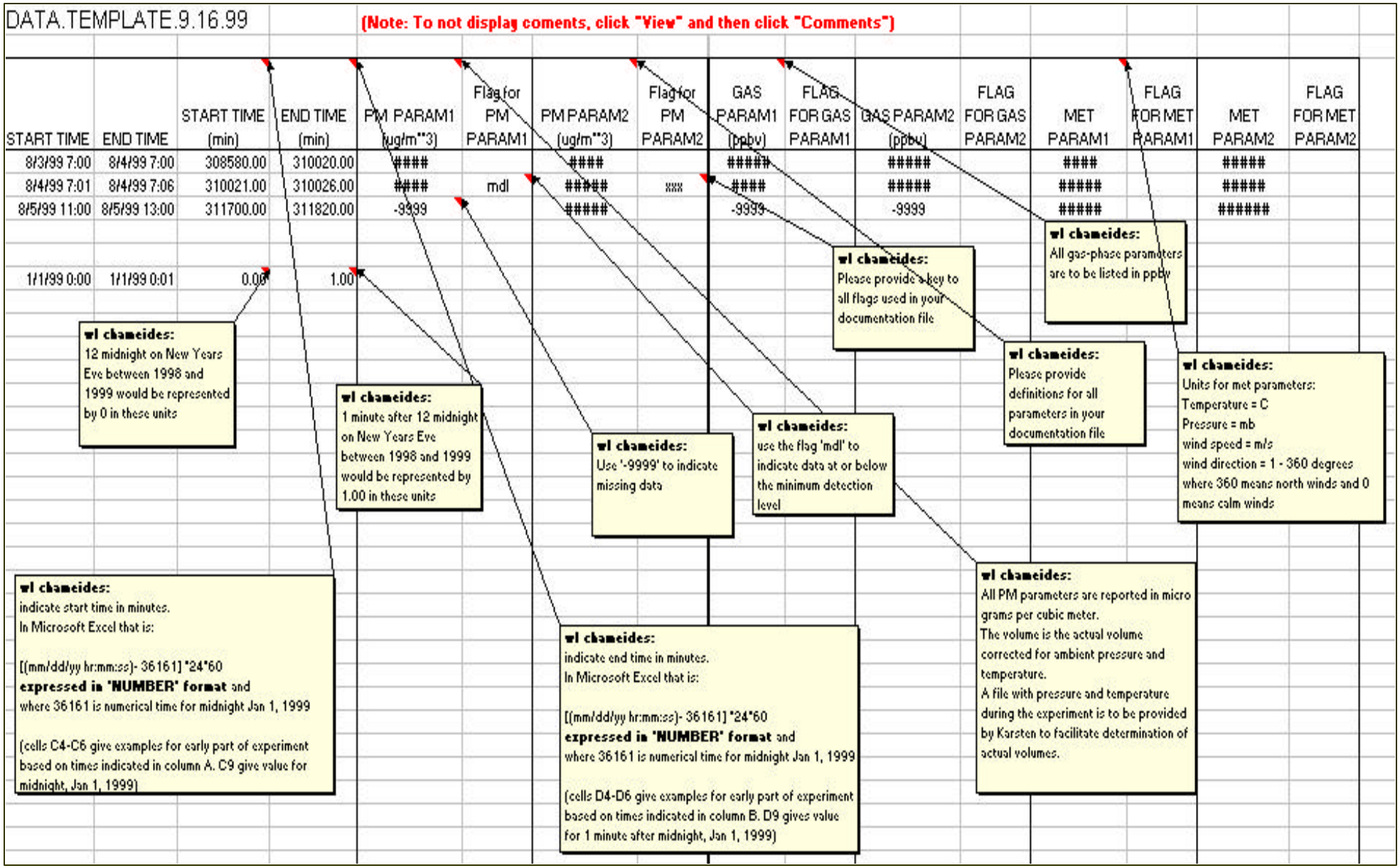
AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	NA	
site operator?				
4. Are copies of applicable SOPs available to the site operator?				
5. Do the sampler(s) appear to be well maintained and free of dirt and debris, bird/animal/insect nests, excessive rust and corrosion, etc.?				
6. Are the walkways to the station and equipment kept free of tall grass, weeds, and debris?				
7. Is the station shelter (if any) clean and in good repair?				
Additional Questions or Comments:				
C. Filter Handling				
1. Are all filters handled with the necessary care and finesse to avoid contamination and/or loss of material?				
2. Are field blanks routinely used by the monitoring organization? Check log books at the site to verify field blanks are run periodically, as specified by the weighing laboratory. *Approximately 10% of filter samples should be field blanks.*				
3. Observe the following handling steps for routine filters, verifying that the operator follows the filter handling SOPs correctly: - receipt of filters at the sampling site and unpacking				

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	NA	
- completion of filter logbook entries and other required documentation - inspection of the filter prior to sampling - installation of filter in the sampler - retrieval from the sampler after sampling - packing and sending to the laboratory - completion of chain of custody and field data forms supplied by the reporting organization				
4. Request the operator to perform the <u>field blank</u> filter-handling procedures (if not possible, go through the SOP step-by-step and verify that the operator knows the correct procedures.): - receipt of filters at the sampling site and unpacking - completion of filter logbook entries and other required documentation - inspection of the filter prior to sampling - installation of filter in the sampler - retrieval from the sampler (without sampling) - packing and sending to the laboratory - completion of chain of custody and field data forms supplied by the reporting organization				
Additional Questions or Comments:				
D. Calibration				
1. Is the flow rate standard used for routine sampler calibration/verification recalibrated or reverified against a NIST-traceable standard at least annually?				
2. Is the calibration relationship for the flow rate standard (e.g., an equation, curve, or family of curves relating actual flow rate [Q_a] to the flow rate indicator reading) accurate to within 2 percent over the expected range of ambient temperatures and pressures at which the flow rate standard may be used?				
3. Is the barometric pressure standard used for routine sampler calibration/verification recalibrated or re-verified against a NIST-traceable standard at least annually?				

AUDIT QUESTIONS	RESPONSE Y	N	NA	COMMENT
4. Is the temperature standard used for routine sampler calibration/verification recalibrated or re-verified against a NIST-traceable standard at least annually?				
5. Obtain the SOPs used for the following activities and observe the operator perform the periodic verifications: - leak check - temperature verification - barometric pressure verification - flow rate check				

E. Filter Handling				
1. Is the filter handling area clean?				
2. Is the filter handling area cleaned before each unloading session?				
3. Are the filters handled by their support rings using clean, smooth, non-serrated forceps?				
4. Are the filter-handling forceps different from the mass reference standards forceps?				
5. Describe the procedure that is followed to prepare unexposed filters for shipment into the field after their presampling weighing.				
6. Is the temperature of the exposed filters recorded upon their receipt from the field?				
7. Describe the procedure that is followed after an exposed filter is received from the field, including the filter storage temperature.				
Additional Questions or Comments:				

Appendix B. Data Processing Template



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