Draft Supersites Conceptual Plan

Prepared for the Technical Subcommittee on Fine Particle Monitoring of the Clean Air Scientific Advisory Committee

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by the

Office of Air Quality Planning and Standards
Office of Research and Development

of the

Environmental Protection Agency

1.0 Introduction

The "Supersite" program was first conceived as a set of special studies extending beyond the national regulatory networks for particulate matter (PM) to elucidate source-receptor relationships and atmospheric processes in support of State Implementation Plans (SIPs). 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 1) accelerate the testing of advanced sampling methods to replace current technologies, 2) provide advanced measurements[1] that simultaneously support $PM_{2.5}$ and ozone SIPs, 3) foster collaborative partnerships across the research and regulatory monitoring communities, and 4) provide additional information useful in upcoming health risk assessments of PM and it components. Spurred by the recommendations of the National Academy of Sciences 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 commitee 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.

This paper was prepared by staff from the Office of Air Quality Standards and the Office of Research and Development. It is intended to facilitate review of EPA staff's draft strategy for addressing overarching topics of program scheduling, project coordination, science integration, management structure, general objectives and guiding principles toward implementing a Supersites program. The fundamental principles for this program draw heavily on the insights provided in the PM Measurements Workshop Report, *Atmospheric Observations:Helping Build the Scientific Basis for Decisions Related to Airborne Particulate Matter* (EPA/NARSTO, October 1998), and this paper should be read in conjunction with that report.

1.2 What are "Supersites?"

The view of the "Supersites"program that took shape at the July workshop is that of an integrated measurement approach that combines a mix of intensive or advanced measurements at a central location combined with other monitoring sites. It should not be understood solely as a single site making research grade measurements. Figure 1, taken from the workshop report, illustrates this basic concept of a central platform complemented by a spatial ring of 5 or 6 chemical speciation sites operated[2] by State and local agencies. Note that this figure recognizes that any EPA program should factor in the existence of related ongoing and planned major field programs in Atlanta, Georgia, Central California, and Toronto, Canada. The regulatory monitoring program provides a wealth of continuous gaseous data for criteria pollutants (ozone,

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[1] Atmospheric species that are involved in the formation, maintenance and removal of both ozone and $PM_{2.5}$; examples include nitric acid, nitrogen dioxide, peroxides and peroxy radicals.

[2] Specific Supersites funding is provided by EPA Science and Technology funds; whereas the regulatory $PM_{2.5}$ monitoring network, including chemical speciation, is funded through EPA section 103 Grants to State and Local agencies.

nitrogen oxides, carbon monoxide, sulfur dioxide), ozone precursor data through the Photochemical Assessment Measurements Stations (PAMS), and forthcoming $PM_{2.5}$ mass and chemically resolved data valuable for SIP planning and science objectives. Supersites can provide enhanced chemical, temporal and size-resolved data not captured by a regulatory monitoring program where comparison with the NAAQS generally is the primary data objective. Thus, a particular central Supersite platform could include some combination of near continuous sampling and analysis of major aerosol components (e.g., carbon, sulfate and nitrate); detailed organic chemistry analysis beyond gross mass fractions; resolution of size from ultrafine to 10 microns; and measurement of important gaseous species such as ammonia, nitric acid, nitrogen dioxide and hydrogen peroxide that elucidate the often coupled formation and removal processes of particulate matter and ozone. Another Supersites approach could include very flexible mobilized sampling that moves across an airshed to provide more basic ambient air characterizations in diverse population groups. The program has moved away from incorporating a singular vision on the design of a "Supersite," and will base measurement design on needs posed by questions and hypotheses related to the coordinated research objectives for that location.

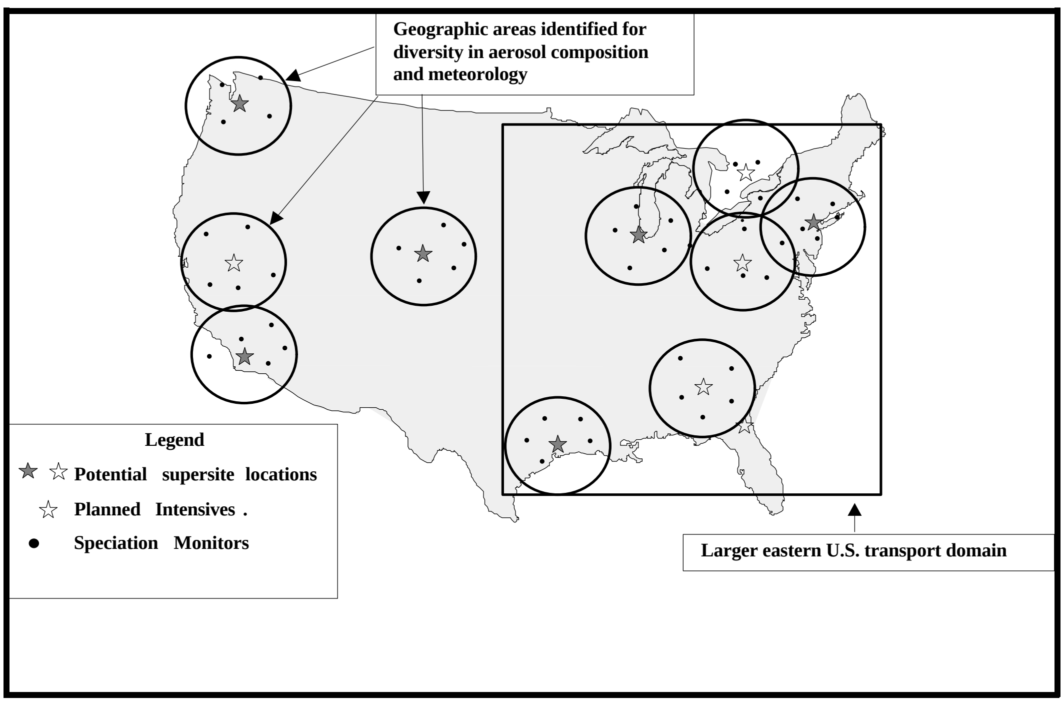

Figure 1 Example Supersite locations adapted from the PM Measurements Workshop Report (Table 7.2) indicating linkage with chemical speciation "Satellite" sites. Decisions on final locations and numbers of sites have not been made.

1.2 Program Objectives

The program will address objectives in three major areas :

1) SIPs....*support development of State Implementation Plans (SIP's) through improved understanding of source-receptor relationships leading to improved design, implementation, and tracking of control strategy effectiveness in the overall PM program;*

2) health effects and exposure.....*development of monitoring data and samples to support health and exposure studies to reduce uncertainty in National Ambient Air Quality Standards setting and to enable improved health risk assessments; and*

3)methods testing.... *comparison and evaluation of emerging sampling methods with routine techniques to enable a smooth transition to advanced methods*.

These objectives are broad in scope and present the challenge of developing specific data quality objectives within a National program responsive to many disciplines. Based on the original funding rationale, each of the Supersite study areas will provide some support for implementation questions. Some of the sites will add objectives related to research on health, exposure, and methods testing. Thus, while some aspects of the program will be common to all locations, others, including duration, measurement frequency, and indicators measured may vary with specific objectives at differing locations. The Measurements Workshop Report provides numerous examples of overlapping data needs across diverse science disciplines, that typically exhibit very limited interaction. A simple example includes the daily collection of chemically speciated data that assist both air quality model evaluations and exposure studies. Clearly, windows of opportunity exist for optimizing the use of environmental data to respond effectively to seemingly disparate objectives. An organized approach to building specific study objectives must be followed to ensure needs are met and resources optimized. Targeted program objectives will be developed by:

- ***starting*** from ***test hypotheses and questions*** that are generated by an integrated program planning team;

- utilizing ***site/time based objectives*** where certain locations and study periods are optimized for specific topic areas; e.g.:

  - specific airsheds optimized for source receptor and air quality model evaluation;

  - specific airsheds optimized to support epidemiological and exposure studies);

- emphasizing methods testing early, then transitioning to other objectives within a single airshed;

    - including discrete or intensive sampling periods optimized to address specific test hypothesis; and

- ***requiring*** all investigators to follow ***existing quality assurance protocols*** in the development of Quality Assurance Program Plans (QAPPs) which includes requirements for developing data quality objectives (DQOs).

Optimizing objectives by location or time does not preclude some level of support at all locations to SIPs, health effects and exposure studies and methods testing, given the multiple uses of similar data.

1.3 Program Principles

EPA staff will adhere to the following organizational and guiding principles derived from the PM Measurements Workshop Report in developing an overarching strategy for implementing the program:

- be ***comprehensive and integrated*** into the larger PM monitoring network;
- be designed as a ***"learning"*** rather than a "measurement" program;
- provide consistent and comparable, but not necessarily identical, measurements across the sites and the nation;
- be an investment that ***leverages*** the largest possible number of ***other governmental and private investments***;
- have ***analysis and evaluation built in from the start***; and
- organizing the ***measurements approach*** by ***asking; What*** are the major ***questions*** and ***hypotheses***; ***what*** should be ***measured; where*** and ***when*** should the measurements occur?

2.0 Overview of Program Schedule

The Supersite program must be flexible to adjust to and accommodate the unique needs of different research disciplines by planning across scientific disciplines (health effects, exposure and atmospheric science measurement needs) and regulatory agencies. Results must be developed in a timely manner to assist development of SIPs which are required as early as 2005, and review of the PM standard which is to be completed in 2002 and again in 2007. Therefore, program deployment will follow a dual track staging with an initial establishment of two sites in 1999 and a gradual full site deployment accomplished in 2002. The rationale for this dual track deployment is to test technical and organizational elements of the program early to aid the optimization of the full program, and allow adequate planning and design so that the full program can provide the most relevant support for a mix of regulatory and research based needs.

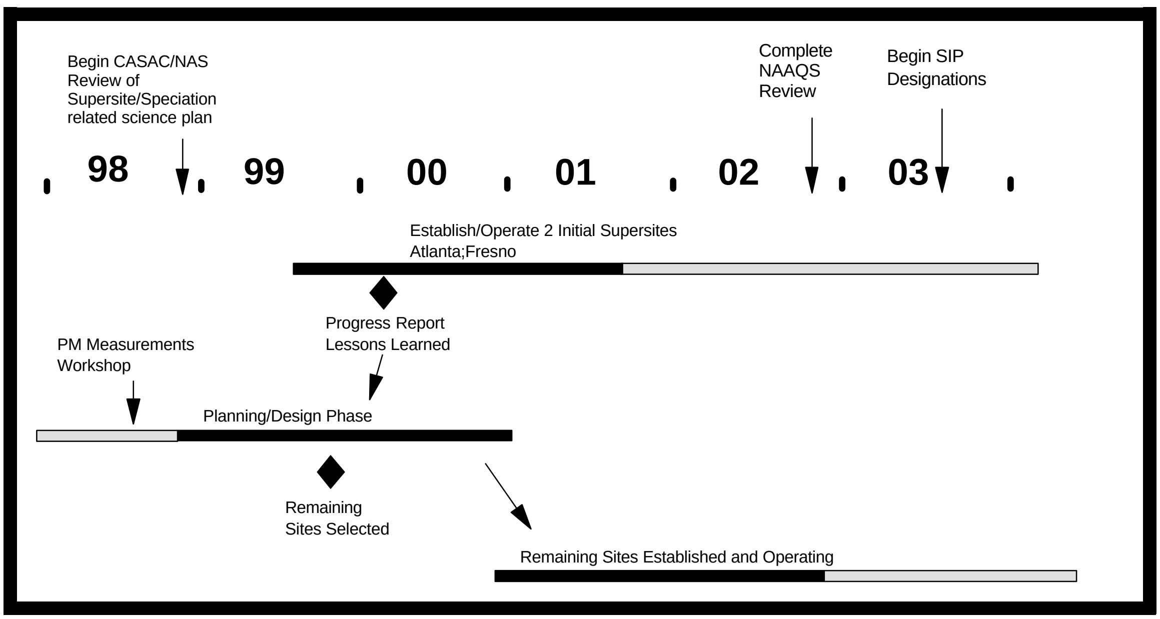

Figure 2. Overview of proposed program timeline showing staging of major elements.

Program planning and design to date has consisted of the planning meeting, and report writing by the steering committee and attendees related to the PM Measurements Workshop, along with internal EPA meetings involving regulatory, atmospheric sciences, health effects and exposure specialists. More formal planning and design with a coordination group (see Section 3) will start the beginning of 1999. EPA staff recommend the establishment of two initial sites (see Section 5) located in Atlanta, Georgia and Fresno/Bakersfield, California in mid-1999, which would operate from 2 to 5 years or longer. Initial objectives for these sites would be oriented toward source-receptor characterizations and testing non-routine monitoring methods and establishing logistical procedures, including assessment of resource needs, that will benefit subsequent deployment in other locations. They will also serve as primary ambient measurement support for short-duration panel studies of health effects and exposure being planned by ORD.

Preliminary feedback from the initial sites will be factored into subsequent design of the full program, which will benefit from more integrated planning among science disciplines and regulatory groups (see Section 7). Time series measurements of some PM components of interest should also be available for consideration in the EPA PM Staff Paper on the review of the standard. Selection of remaining site locations (2-6, dependent on resources) should be completed in the last calendar quarter, 1999 so that State and local agencies can take into account the availability of Supersites in deploying their chemical speciation network. EPA staff recommend the deployment of the remaining sites commencing in mid-2000, with operations expected for 2 to 5 years or longer, contingent on continued program assessment and resource availability.

3.0 Program Management, Organization and Review

Figure 3 provides an overview of program management organization that will establish the communications and accountability essential for program planning, coordination and implementation. OAQPS and ORD will share in the overall administration and management of the program. The Assistant Administrators of both Offices and their designates will be accountable for all program objectives, including the integration of science research sponsored and conducted by EPA with the Supersites measurements program. Internal EPA project management and technical coordinator teams that include regulatory, atmospheric sciences, health effects and exposure specialists will deal with resource management, communications, and technical issues on an as needed basis. The Coordination Committee will extend beyond EPA to sponsors of related programs in other Federal agencies, industry and State and local agencies. The role of this Committee is to provide a forum for coordination and leveraging of resources by establishing and maintaining a dialogue among the members collectively who share similar needs and interests. In addition, the Coordination Committee would provide a valuable resource in reviewing Supersites plans and assessing progress. The Supersites represent an important component to foster greater integration across several science research programs. The National Academy of Sciences subcommittee on particulate matter research clearly has expressed a desire to see comprehensive science planning. Accordingly, the Supersites program will be responsive to advice generated by other venues (represented as External Research Coordination in Figure 3) explicitly dealing with larger science integration issues.

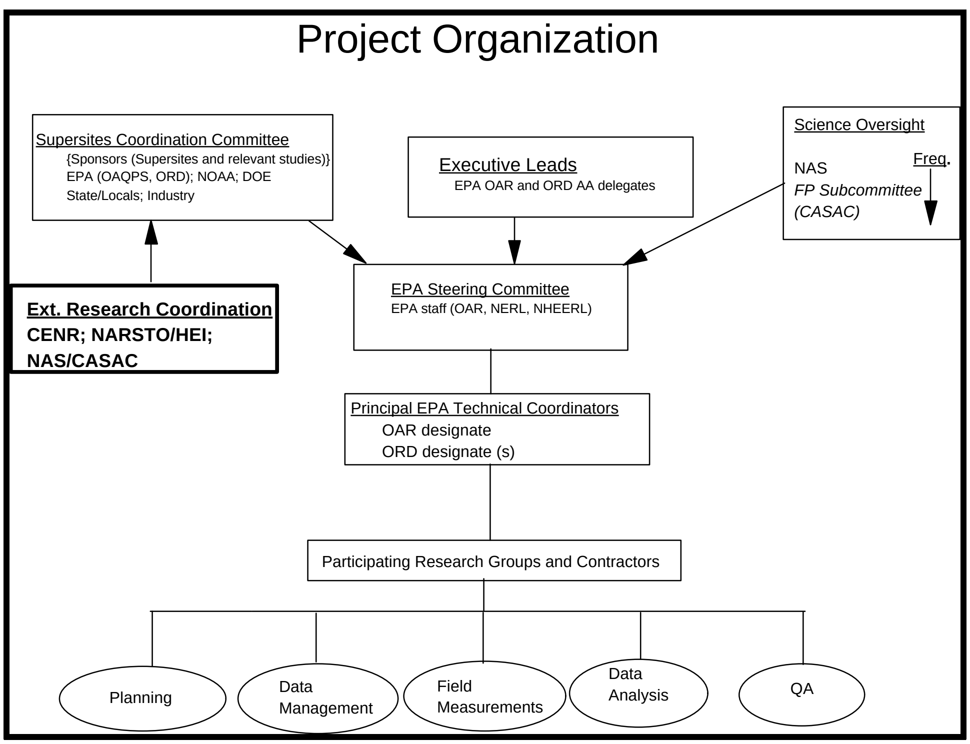

Figure 3. Project management overview.

The Technical Subcommittee on Fine Particle Monitoring of the Clean Air Scientific Advisory Committee (CASAC) *(hereafter referred to as the Subcommittee*) is reviewing this plan and will continue to provide advice and consultation on the program. Program execution involves a sequence of activities starting with conceptualization, design and planning, and measurement deployment, with necessary reviews and assessments that feed back into program design. The proposed role of the Subcommittee within this sequence of events is shown schematically in Figure 4. Each of the major stages is also outlined briefly below:

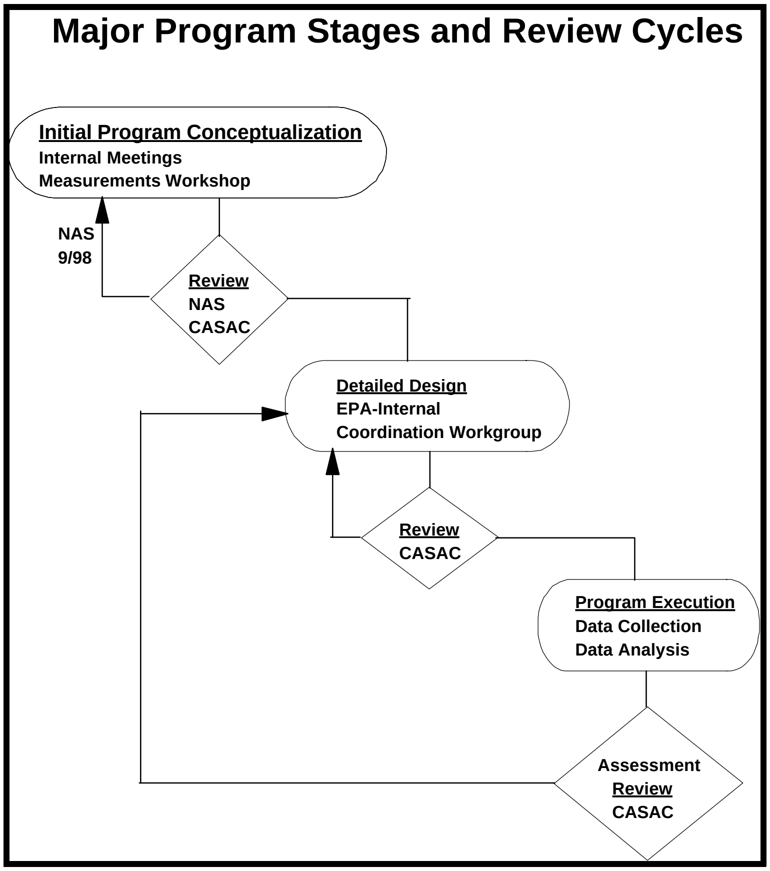

Figure 4. Flow diagram illustrating major program stages and review cycles.

Initial Planning and Conceptualization

The development of this plan was discussed in the introduction above.

Program Planning and Design

Following Subcommittee review scheduled for November 30, 1998, EPA will establish formal internal and external planning and design teams. Internally, EPA will establish a planning team composed of atmospheric science, regulatory and health effects and exposure specialists. In parallel, invitations will be mailed to other Federal and State/local agencies and private industries active in relevant research to participate in a broader External Coordination Workgroup. EPA staff will be responsible for developing more detailed program plans and working with the external committee at a partnership level by providing early drafts and conducting meetings on an as needed basis. The design approach will be based on developing a measurements strategy responsive to key questions (science and regulatory) and scientific hypotheses, taking advantage of the PM Measurements Workshop Report. EPA also will be responsible for establishing and managing all administrative tasks related to program funding. The active work with the External Coordination Committee is one of several steps (see Section 7) taken to optimize measurement resources across different organizations. The Subcommittee will be requested to review more detailed plans as part of the decision approval process.

Program Execution

EPA will manage program resources that result in funding vehicles to research groups and contractors that conduct much of the work. The actual work will be performed principally by university and other non-profit research groups with support as needed by contractor organizations. In addition, EPA scientists will conduct aspects of their research at Supersite locations. EPA will assign Technical Coordinators to the program to work closely with Project Principal Investigators.

4.0 Airshed Selection Criteria

The limited number of Supersite locations demands that a thoughtful and objective selection process be established. The initial assumptions underlying selections included the ability to capture unique airsheds in populated areas roughly defined through a combination of air chemistry, source distribution and geographical/meteorological characteristics. The following selection criteria, which again draw on the PM Workshop Report, will guide the selection of study areas (additional insight into location criteria are provided below in the measurements discussion in Section 6):

1. **High concentrations of $PM_{2.5}$ in unique and prototypical "airsheds".**..known or expected "high" concentration areas that *will approach* or exceed the PM NAAQS and affect substantial exposure to populations (serves SIPs and health effects and exposure). In the aggregate, these airsheds should reflect locations with varying meteorological, source composition and atmospheric properties, to allow for more comprehensive stressing of sampling methods, more sound statistical design for exposure/health research, and capture areas for varying dominance/mix of sources/atmospheric processes, including concentration regimes that approach the standard.

2. **Existence of ongoing/planned advanced monitoring** ....availability of existing advanced field studies with an established expert monitoring support infrastructure to increase the chance of success, and leverage environmental measurement resources (serves predominantly SIPs). However, "underserved" locations lacking a historically strong support infrastructure would benefit from advanced measurements, and test the ability to start up a sophisticated measurement program. When viewed in the aggregate as a group of airsheds, a desirable balance of well-served, complemented with historically "underserved" locations provide potential rewards toward expansion of widespread measurement capability.

3. **Ongoing and planned health effects and exposure research studies** that will benefit from Supersites measurements and foster greater coordination between measurements, atmospheric scientists and health and exposure science communities.

5.0 Initial Site selection and rationale

EPA staff recommend that we establish two sites in 1999 located in **Atlanta, GA and Fresno/Bakersfield, CA**. Both of these locations are likely to exhibit high $PM_{2.5}$ levels, are associated with planned or ongoing major field sampling programs with expert technical personnel, and represent diverse airsheds (e.g., east versus west; predominant high sulfate versus high nitrate; predominant summer versus winter episodes). Moreover, it is imperative that the initial sites offer a high success probability to increase the usefulness of data early in the program. These early needs include testing and intercomparisons of emerging sampling methods to expedite application to other areas, data to support EPA's review of the PM standard and to elucidate source-receptor relationships for SIPs. Atlanta and Fresno provide excellent opportunities for conducting health effects and exposure research studies in the near and long term. Furthermore, both locations serve as models for coordinating across university groups, industry and State/local agencies.

A series of health effects, exposure, and atmospheric science studies are planned for both locations (Attachment 1) that are sponsored by various entities. As noted above in Section 2, EPA researchers are developing health, emissions monitoring, and source-receptor projects in conjunction with both of these sites, including***:***

- Bulk mass collection to support toxicology studies focused on identifying hazardous components and toxicity mechanisms;

- Field measurements to characterize emissions sources in Atlanta;

- Health effects studies of epidemiology and exposure in Atlanta;

- Evaluating Models-3/CMAQ in the Atlanta/Nashville region, and against data gathered under the California Regional Particulate Air Quality Study in Central California;

- Field testing for newly developed instruments and methods is planned for both Atlanta and Fresno.

Expanding beyond EPA, several private and public sponsors of the California Regional Particulate Air Quality Study in Central California are planning a suite of exposure and source-receptor studies in Fresno/Bakersfield, and a similar consortium will conduct a wide range of exposure and atmospheric characterization studies in Atlanta. EPA staff will meet with Principal Investigators and sponsors associated with the programs in Central California and Atlanta and design a program that complements existing work and is consistent with directions provided in the Measurements Workshop Report. Initially, these sites will focus on testing some of the emerging sampling technologies to establish operational procedures that can be transferred to other locations. Progress from these sites will be monitored to develop accurate costing estimates for future locations, identify those aspects working well and those not as well, and generally provide a testing basis for smoother transitioning toward implementing the full program.

6.0 Recommended measurement strategies

Specific measurement programs will be developed as this program progresses through a planning process that links measurements with specific questions and hypotheses. The purpose of this paper is to provide more general guidelines that will be followed toward identifying measurements. To that end, the program will follow the principles provided by the PM Measurements Workshop Report (listed above in Section 1).

Measurements will be tailored to specific objectives that will vary from location and over time. For example, an airshed where exposure is the principal objective may choose to conduct daily/near continuous sampling of a moderate list of atmospheric species over a short duration (e.g., an enhanced chemical speciation site), and possibly at several locations (at different periods) through mobility (e.g., a tailored platform) to capture an array of exposed populations. At another airshed, a priority could be set for collecting a suite of intensive research grade measurements during episodic conditions to test process formulations within air quality simulation models. Another location could be prioritized to record a consistent suite of measurements (beyond those collected at regulatory sites) for extended health effects studies that extend operation for a decade or more. Furthermore, the priority of measurement objectives at a specific airshed could change over time, an example being the use of initial sites to focus on methods testing with a subsequent transition to other objectives.

The PM Measurements Report organizes the measurements approach by asking: What are the major questions and hypotheses; What should be measured; Where and When should the measurements occur? The Measurements Report provides an initial surveying of these basic what, when and where questions, sorted by discipline (health effects, exposure, source/receptor, accountability and measurement methods), and reproduced below in Tables 1-3. These tabulations provide the backbone of initial guidance for the program, and will affect the early sites in Georgia and California. In addition, EPA has tabulated (Attachment 1) a list of measurements and associated sampling frequency organized on a project basis to facilitate design of integrated measurements program.

Table 1. Summary of recommendations from the breakout sessions .What species/parameters need to be measured?
(after PM Measurements Workshop Report)

Health Effects	Exposure	Source/Receptor	Accountability	Measurement Methods
Should be driven by health hypotheses Size-fractionated mass $PM_{2.5}$, PM_{10} Particle number Elemental composition - including metals Criteria pollutants Meteorology	Should be driven by health hypotheses Total mass $PM_{2.5}$, PM_{10} Particle number Particle size distribution Aerosol acidity (H^+) Ions SO_4, NO_3, NH_4, Na, P Trace elements Biological aerosols Elemental carbon, Organic speciation Met parameters T, WS, WD, DP Vertical structure	Total mass $PM_{2.5}$, PM_{10} Gases CO, VOCs, O_3,SO_2 H_2O_2, NO,NO_2,NO_y PAN, HO, NO_3 Multi-phase components NH_3 & NH_4 HNO_3 & NO_3 Labile organics HCI & CI Particle water Fine particle components Total mass SO_4,H^+,OC,EC Trace elements Particle size distribution Light scattering Light absorption Meteorology Surface (T,WS,WD, DP) Aloft (T,WS,WD, DP) Mixing depth Clouds (Water, Ions)	Total mass $PM_{2.5}$ Speciation EC,OC,SO_4,NO_3, H^+,NH_4 Semi-volatile organics Trace elements Aerosol precursors (NO_y,VOCs,SO_2, NH_3)	Should be driven by health hypotheses $PM_{2.5}$ FRM Physical characteristics Particle number Particle size distribution Visibility Meteorological Parameters that influence collection efficiency (T,DP) Measurements should be made at the surface and aloft.

Table 2. Summary of recommendations from the breakout sessions.
<u>Where</u> should the measurements be made? (after PM Measurements Workshop Report)

Health Effects	Exposure	Source/Receptor	Accountability	Measurement Methods
Take advantage of regions with different air quality. Southern Cal.(NO_3) Northeast (SO_4) Utah Valley (low H^+ Measure biogenic PM. Moveable capability is desirable. Temporal variability is desirable. Coordinate with "national" studies.	Use mobile platforms to study a diverse group of cities. Selection criteria: Linkage with exposure studies Diverse conditions (sources, meteorology, primary/secondary) Geographic locations (climate, coastal, altitude) affect activity. Population considerations 1) density 2) high end exposure 3) represent a large segment of population Examples: New York, Boston Elizabeth, N.J. Atlanta, Houston Seattle, Los Angeles	Super sites in urban and satellite stations in rural locations. Regions with special air quality problems: Los Angeles Denver or Utah Valley Central California Urban Northwest Eastern urban areas with different sources & climatology: Metro NY/NJ The Ohio River Valley (e.g., Cincinnati) The Great Lakes (e.g., New Orleans, Houston) Transboundary (Canada, Mexico) Where possible utilize existing sites.	Areas representative of the larger U.S. population with health status monitoring. Need trends in rural areas.	Co-located with $PM_{2.5}$ FRMs. Co-located measurements using traditional and emerging methods. Upper air measurements. Co-located with health studies to maximize benefits.

Table 3. Summary of recommendations from the breakout sessions.
<u>When</u> (frequency/duration) should the measurements be made? (after PM Measurements Workshop Report)

Health Effects	Exposure	Source/Receptor	Accountability	Measurement Methods
The relevant time window depends on induction period and duration of the health outcome of interest. Mortality 24-48 hrs. Incident coronary events (Several hrs.) Panel studies 1-2 hr. Avgs. Weeks Time series studies Daily, 24-hr samples Years Chronic effects Every 3rd day Decades	Continuous to 24-hr. based on validated measurement methods. Studies 1-3 years in some locations, 1-month intensives in other locations.	Multi-year commitment (at least 3 yrs.) Year-long and intensive monitoring program. 10, 5-10 day intensives Overlapping 24-hr, 4-hr, and 1-hr measurements on particle dynamics. Fast time response aircraft measurements to look at covariation and process dynamics.	Long time series (decadal ?) to establish trends. Sufficient resolution to account for meteorological variability (synoptic to seasonal)	Health studies Everyday (2-6 hr) Source/receptor 10 min. - 12 hr. Transition from filter time scales (days to hours) to semi-continuous (hours to minutes) [both ambient and personal exposure]

Implementation Considerations.

A mix of sampling and analysis approaches are likely to be applied at the Supersites spanning routine through research grade measurements. To assist development of an implementation approach that considers available expertise and resources, it is useful to consider a three-tiered sampling approach roughly stratified by complexity:

Type 1 (Routine). Very routine measurements including most criteria pollutants, and basic PM mass and certain precursors with established techniques and largely available through regulatory networks (an area where integration with regulatory programs strongly benefits the Supersite program), or requiring commensurate level of expertise;

Type 2 (Advanced). A set of more advanced measurements utilizing commercial or widely used technologies that provide some combination of enhanced temporal, size distribution and chemical resolution. Examples include the deployment of MOUDI size selective impactors with chemistry, continuous nitric acid, ammonia, and other precursor gases, and continuous measurements of aerosol species, such as nitrate, sulfate, organic carbon, and elemental carbon;

Type 3. (Research). Specialized sampling and analysis that, for example, could include application of emerging technologies that capture near continuous size and chemical composition of aerosols, quantification of sampling artifacts associated with volatilization of labile species, or detailed organic chemistry profiling of aerosol samples.

Tables 4-6 provide ***examples*** of measurement parameters along this three-tiered approach. The expertise required becomes increasingly specialized as one proceeds from Type 1 through Type 3 measurements.

Table 4. Type 1 Measurements (Routine).

MEASUREMENT	TEMPORAL RESOLUTION	INSTRUMENT
PM10	24 hour	FRM sampler - single channel
$PM_{2.5}$	Continuous	Tapered Element Oscillating Microbalance or other continuous method for $PM_{2.5}$ mass
$PM_{2.5}$	24 hour	FRM sampler - sequential
$PM_{2.5}$	24 hour	Speciation sampler - 3 to 5 channel filter/denuder coupling as needed for semi-volatile species
Wind Speed / Direction, Vertical Wind Speed / Direction, Temperature, Pressure, Humidity, Precipitation, Solar Radiation	Continuous [Precip. 1 hour]	Automated Weather Observation System (bi-level wind and temperature measurements at 2 and 10 meters)
SO_2	Continuous	FRM
O_3	Continuous	FRM
CO	Continuous	FRM
NMHC	Continuous	GC-FID
NO/NOy or NO/NOx	Continuous	NO/NOx FRM NO/NOy by modified FRM
light scattering	Continuous	nephelometer
light absorption/aerosol elemental carbon	Continuous	aethelometer
HNO_3	24hr	filter/denuder difference
NH_3	24hr	filter/denuder difference

Table 5. Type 2 Measurements (Advanced).		
MEASUREMENT	**TEMPORAL RESOLUTION**	**INSTRUMENT**
PM size distribution	24/4	MOUDI Impactor
Particle numbers	Continuous	CNC, DMA
Ammonia	Continuous	Chemiluminescence with pre-converter
Aerosol nitrate	Continuous	Flash volatilization; chemiluminescence
Aerosol organic carbon/Total carbon	Continuous	thermal conversion at different temperatures
VOC (C2 - C10) species	2	Canisters/GC-MS
VOC (>C10) species	2	Cartridges/LC-MS
NO_3 radical, NO_2, HONO, HCHO, SO_2 (other VOC)	Continuous	DOAS
Speciated organic aerosols	24/4	filter/qtz....lab intensive
Wind Speed / Direction, Turbulence, Temperature (profiles through 10K ft AGL)	Continuous	Radar Profiler w/ Radio Acoustic Sounding System; Doppler acoustic sounder
Fog/cloud and fog/cloud chemistry and related species (e.g., H_2O_2)	Occurrence	Multistage fog collectors

Table 6. Type 3 Measurements (Research)		
MEASUREMENT	**TEMPORAL RESOLUTION**	**INSTRUMENT**
Nitric Acid	Continuous	Chemiluminescence/denuder or nylon filter
aerosol sulfate	Continuous	Flash volatilization
single particle chemistry	Continuous	Aerosol Time of Flight Mass Spectroscopy
semi-volatiles organic	24/2	filter/denuders
Vertical relative humidity	Continuous	Raman Lidar
Free radicals (OH; ROx; NO_3)	Continuous	LIF, radical amplifier, DOAS

7.0 Integration with other regulatory and science programs.

Ambient air monitoring is a resource intensive activity generally requiring high levels of expertise with limited availability. It is imperative that monitoring resources be optimized to raise the chance for success in meeting objectives across multiple programs and organizations. The Supersites program is attempting at a national level to bridge gaps that exist between regulatory and research communities, and at more refined levels, those gaps between health risk assessment and atmospheric characterization disciplines. The benefits to be derived from integrating data collection efforts include the obvious development of more powerful and interpretive information bases and, perhaps more importantly, an increased sharing of expertise and knowledge that should supersede the value of data alone. The Supersites will be coordinated with related efforts spanning the monitoring conducted by State and Local agencies, science research administered and conducted by EPA, and related field programs sponsored by various Federal agencies and private industries.

7.1 The National Monitoring Program Operated by State and Local Agencies

The Supersites and routine regulatory networks operated by State and local agencies are important complements to each respective program. Several activities require coordination across Supersites and the regulatory program:

> <u>Satellite chemical speciation sites.</u> The integration of the "routine" speciation network to serve as Satellite sites, which provide horizontal spatial complements to the Supersites, enhances both regulatory and research programs. EPA is requesting that State and local agencies incorporate Supersites in their design planning the entire speciation network. Associated with this request, EPA plans on specifying in forthcoming FY-2000 Grant guidance that Section 103 Grants to State and Local agencies be used to increase sampling frequency at expected Satellite sites to allow for enhancements that benefit the Supersites airsheds. For planning purposes, EPA is proposing that approximately 50 speciation "Satellite" sites operate on an every third day sampling schedule, roughly double the typical sampling frequency at most speciation sites. In order to support health and related studies and analyses, EPA is also planning to identify a subset of 10 of these sites for even more frequent sampling. In addition, EPA is encouraging the use of speciation resources to coordinate sampling and analysis during episodic periods with centrally located Supersite sampling, or enhance the Satellites in other ways, such as the collection of important precursors such as ammonia and nitric acid. The actual operation activities at Satellite sites will be determined through collaborative decisions made by participating Supersite investigators and the associated State/local and Regional EPA organizations. Note that this approach is entirely consistent with EPA's proposed chemical speciation program that is highly prescriptive for a limited number (~ 50) of National Trends sites, and far less prescriptive for the remaining speciation sites.

Routine Measurements collected at NAMS/SLAMS/PAMS. The Supersites should utilize the nearest SLAMS/NAMS site that measures a basic suite of criteria pollutants: $PM_{2.5}$, PM10, ozone, NO, SO2, and CO. These measurements simultaneously can serve duel objectives: NAAQS comparison from a NAMS/SLAMS perspective and contributions to a larger suite of measurements for atmospheric characterization at Supersites. Ideally, Supersites would be located at an existing NAMS/SLAMS/PAMS site, with appropriate modifications. Recognizing practical restrictions on enlarging existing platforms, every attempt should be made to locate Supersites in close proximity to NAMS/SLAMS/PAMS.

Coordination needs may arise for sampler and filter access. While criteria pollutant gaseous samplers run continuously, filter based particulate matter samplers often run at 1/3 or 1/6 day schedules. The Supersites will increase the sampling frequency, especially during episodic conditions, which requires appropriate partnering for sampler access. Alternatively, an additional filter based sampler can be deployed by the Supersite investigator, and it's operation scheduled to complement the State/Local agency sampler. Additional examples include the extended operation of ozone analyzers which often run only part of the year. The active collaboration with appropriate State and Local agencies should be a required element of the Supersites program.

Data Management, Access and Analysis. Supersites data eventually will be entered into AIRS which houses NAMS/SLAMS/PAMS data. More immediately, the data base management system developed for Supersites should incorporate or link closely with routine measurements produced by State and Local agencies as a component of Supersites.

7.1 Integration with EPA's Research program

During 1999 and 2000 and continuing on, EPA will be conducting and sponsoring a wide spectrum of research on particulate matter health, exposure and atmospheric sciences. This research will support both the implementation of the current NAAQS for PM by producing the source-to-receptor tools needed to plan and monitor attainment progress, and support upcoming reviews of the NAAQS by producing new insights on exposures, biological mechanisms, and dose/response associated with health effects. Most if not all EPA research will benefit directly from the data collected at Supersites and speciation sites. While there are many commonalities in the ambient air quality information needed to support these studies (PM Measurements Report), important differences remain. Differences span the range from exposure panel studies requiring ground level measurements taken for short intervals on local scales, to regional air quality model evaluations requiring three dimensional measurements over long periods on regional scales. Designing the PM Supersites and Speciation monitoring programs to meet their intended attainment and health related science purposes will take close coordination with ORD's research program. Similarly designing future research to take full advantage of the data from these monitoring programs, whether in-house or being solicited under new Requests For Applications by EPA's STAR grants program, will take close coordination with the OAR program. In addition, coordination must be arranged with others outside EPA, such as those conducting research under EPA's PM health and exposure centers, as they seek to take advantage of the wealth of information from these programs.

As previously discussed and restated here to emphasize program office commitment, OAR and ORD will ensure the highest level of coordination takes place, by instituting a management and organization structure that has several features. A Senior Executive from each of the two offices, OAR and ORD, will be designated as the joint lead for the Supersites and advanced speciation program. The Executive Leads will each appoint a Technical Program Manager to see to day-to-day coordination and operations. Both the Executive Leads and Technical Program Managers will be advised by a Steering Committee with appointed representatives from each appropriate research discipline and aspect of monitoring operations. In addition, special coordination teams will be constituted around research topics and geographic centers as needed to focus research planning, measurement, and data analysis. External scientific consultation and review will be provided be the Clean Air Science Advisory Committee.

The following are summary descriptions of EPA's internal and directly supported research that will be closely considered in the initial stages of coordination and design of the Supersites and advanced speciation program. Greater detail on these programs (and comparable programs being conducted by others outside EPA) are contained in the attached tables (See: Attachment 1 - PM Related Study Descriptions for Supersites Program Design and Planning; Attachment 2 - Regional Distributions of PM studies; and Attachment 3 - Time lines for PM related Studies). EPA intends to maintain these inventories of associated field studies and research as part of the Technical Manager duties above.

<u>Epidemiological and toxicological research:</u> EPA is both conducting its own in-house epidemiology and toxicological research, and sponsoring such research by others through its grants and centers programs. Its in-house epidemiology program will focus on Fresno/Bakersfield, CA and Atlanta, GA during 1999 and move to a Northeastern City (yet to be named) in 2000. In addition, EPA is sponsoring two epidemiology field studies (Boston, MA:1999-2002 and Seattle, WA:1996-2000) through its STAR grants program. EPA's in-house human and animal exposure study centers are located in the Chapel Hill and RTP, NC areas and can use concentrated particles collected at nearly any location nationwide given proper handling. Five PM health and exposure centers, which will include some combination of toxicological, epidemiological, and/or exposure research are expected to start up (locations yet to be named) in late 1999 and early 2000, based on STAR grant awards made in spring, 1999. It is expected that data will be available to these centers from Supersites and/or advanced speciation sites placed in each city where one of these studies is occurring.

<u>Exposure panels studies:</u> EPA is also conducting its own in-house exposure research program and sponsoring exposure panel studies through cooperative agreements with three universities. EPA's in house program is completing analysis of its Baltimore, MD

study done in the summer of 1998, and will next assist the EPA Fresno, CA epidemiology study in the Spring of 1999. Plans are being made for EPA's next panel study in the Research Triangle area of NC (Spring, 1999- Winter, 2001); followed by a subsequent study in the central US (St. Louis, Denver, or Salt Lake City: 2000-2001). Cooperative agreement based panel studies will take place in Atlanta, Los Angeles, Boston, Anaheim, New York City, and Seattle beginning spring, 1999 and continuing through the winter of 2001.

Source emissions: EPA's source emissions characterization program for mobile and biogenic sources of secondary PM precursors will continue in Atlanta, taking advantage of the Southeastern Aerosols Research and Characterization (SEARCH) study being jointly sponsored by EPRI, the Southern Company and SOS (June, 1998 - Aug. 2001). Along with directly supporting implementation planning, data produced here will be an integral part of the source apportionment and Models-3 work described immediately below.

Source apportionment: EPA's in-house source apportionment modeling program will take advantage of a field campaign planned by the Southern Oxidants Study (SOS cooperative agreement) in Nashville, TN - summer, 1999, and in Houston, TX - summer, 2000. The latest version of the Chemical Mass Balance model will be taken to these locations for testing. In addition, the in-house program will use data made available from the intensive studies of Atlanta, GA (the SEARCH and SCISSAP programs with supplemented speciation monitoring) and Fresno/Bakersfield, CA (the CRAQPS program with supplemented speciation monitoring) to further develop and test its receptor models.

Models-3/CMAQ; has been made publicly available (June, 1998), but remains basically unevaluated for fine particulate and regional haze. EPA is currently undergoing a program of extensive model evaluation with initial emphasis on oxidants. For PM, the CMAQ (Community Model for Air Quality) has incorporated science modules for mass, size distribution and composition of particulate matter. The data for both diagnostic and operation performance testing is very limited. Planning in underway to take advantage of a number of intensive air quality studies and measurement programs in the southeast (SOS-Nashville, Summer 1999; SEARCH, Atlanta, 1998-2001; enhanced IMPROVE monitoring beginning 1999; and the EPA STAR grants based atmospheric sciences center - SCISSAP, beginning 1999), adding additional measurements, data analysis and management, and assessment to produce the regional data sets needed for CMAQ evaluation.

Methods development and evaluation: research will continue on measurement methods for PM addressing current short comings in time resolution and data immediacy (automated methods) , organic aerosol sampling and characterization, size-resolved chemistry, and physical characteristics. Field testing of new instruments and methods needs to take place at multiple locations across the country, with Atlanta and Fresno/Bakersfield being ideal locations.

7.2 Cooperation with external health, exposure and atmospheric research

Federally sponsored PM research coordination: The Air Quality Subcommittee of the Committee on Environment and Natural Resources, which has historically coordinated all Federal atmospheric sciences research on air pollution, is proposing to expand its membership and responsibility to include PM health and exposure research. Using this approach, the complete Federal component of the national PM research program and priorities identified by the National Research Council would be coordinated for the first time. It is expected that the PM Supersites program and its coordination with research would be a separately identifiable part of this new responsibility. This matter will be taken before the full CENR at its next meeting.

Public/Private research coordination. In addition to the federal investment in PM research for which a coordination approach is being recommended (above), there is a sizable investment and interest in all parts of the PM research agenda by private industry, states, the academic community, and governments of bordering countries. To date, only the atmospheric sciences component of this research has been proposed for coordination. The NARSTO Executive Assembly (the public/private partnership for tropospheric ozone atmospheric sciences) has voted to amend its charter, and expand its membership and mission to include particulate matter, and to strengthen its liaison to the health and exposure research community. The NARSTO Observations Team, with its responsibility for measurements and observations, can be made responsible for overall coordination of the public and private participation in the Supersites program (including participation by exposure and health researchers); a role made easier by appointing a special subcommittee for this purpose. The health and exposure community may seek its own means of coordination and participation in the Supersites program. This effort may be complicated by the fact that at present the PM health and exposure research communities have no formal coordination organization. Coordination for these communities could be accomplished by an appointment and funding of a coordinating office. For example an institute might be funded jointly by industry and the Federal government, be directed to maintain an inventory of ongoing research, and charged with compiling a description of the combined public/private research PM program and its relation to the agenda laid out by the NRC. An additional role of this office would be to convene Supersites coordination group (or groups) to interact their NARSTO counterpart.

8.0 Quality Assurance Considerations

All projects supported by this program will be required to meet EPA's quality assurance requirements stated in Executive Order 5360.1 (April, 1984; updated in 1998). Projects will meet established guidelines developed by EPA's Quality Assurance Division (QAD) within the Office of Research and Development (ORD). Principal Investigators will be required to submit Quality Assurance Project Plans (QAPPs) describing project management, oversight, data validity and management, and data quality objectives (DQOs).

Consideration will be given to streamlining the Quality Assurance (QA) process by utilizing existing mechanisms for QA protocols and data management through NARSTO's Quality Systems Management Plan[3] (QSMP) that outlines a three-tiered QA approach for environmental data collection efforts:

1. *An overarching community level QSMP that establishes a framework and associated mechanisms.* The NARSTO QSMP is the framework for designing the Supersites QA program.

2. *A Program Quality Management Plan (PQMP) at the Supersites program level.* The PQMP articulates basic program planning; implementation and organizational approaches; broad objectives; and data acquisition, evaluation and management. This planning document constitutes part of the overall PQMP, which will be fully developed through consultation with project Principal Investigators (PIs) and the NARSTO/DOE Oak Ridge Quality Systems Science Center.

3. *Quality Integrated Work Plans (QIWP) at individual project levels*. Each PI will be responsible for developing a QIWP which minimally addresses Project Planning and Organization, Management Assessment, Implementation, Data Acquisition, Data Management, Routine Controls and Procedures, and Technical Assessment and Response. The NARSTO Quality Planning Handbook[4] provides templates for developing project specific QIWPs.

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[3] NARSTO Quality Systems Management Plan (ORNL/CDIAC-110), 1998, R.K. Patterson, L.A. Hook, M.D. Cheng, and T.A. Boden (preparation and electronic publishing by NARSTO Quality Systems Science Center)(http://cdiac.esd.ornl.gov/programs/NARSTO/narsto.html#qsmp)

[4] NARSTO Quality Planning Handbook (ORNL/CDIAC-111), 1998, L.A. Hook, M.D. Cheng, and T.A. Boden (preparation and electronic publishing by NARSTO Quality Systems Science Center)(http://cdiac.esd.ornl.gov/programs/NARSTO/narsto.html#qsmp)

Data Management

The NARSTO QSMP is a data management approach under consideration for Supersites data. The QSMP utilizes a 4 - tiered system with data validation levels 0 - 3 reflecting the degree of assessment and attendant confidence with a particular data set. Level 0 validation essentially is raw data that has undergone audits or assessments and generally is not available for public dissemination. Level 1 validation requires quality assurance procedures to be implemented and is the first level released to the public. Levels 2 and 3 reflect increased usage by a larger community, often through data interpretation activities that provide peripheral diagnostics and augment standard QA specific efforts. In concept, all investigators will be required to accelerate data assessment to achieve Level 1 data for broader dissemination.

Data Archiving and Dissemination

A priority will be placed on providing access to data as soon as possible to a wide community extending beyond the Principal Investigators and Program Sponsors. Supersites data will be entered into EPA's Aerometric Information Retrieval System (AIRS). An intermediate data base may need to be established through the NARSTO QSSC or some other means to ensure timely availability of all Supersites data, including those fields that may require special attention given the substantial temporal and chemical composition capability of emerging techniques. The data archiving will include all data generated by programs funded specifically through the Supersites, as well as those explicitly linked programs such as Satellite speciation sites and NAMS/SLAMS/PAMS data that constitute an integral part of a Supersites location. Centralized data archiving should facilitate subsequent data analysis and interpretation efforts.

9.0 Data Analysis and Interpretation

Sufficient resources will be provided for data analysis and interpretation activities beyond the requisite assessments for QA needs, acknowledging a historical tendency to compromise analysis in the midst of massive data generation efforts. Four tiers of data analysis will be supported through this program:

1. Instrument Level. Each investigator will be supported to perform the necessary QA assessments and additional interpretive analyses, as an explicit part of each Cooperative Agreement that is awarded for ambient sampling.

2. Site Level. Numerous relationships across multiple instruments (and atmospheric species) will be investigated for a range of source-receptor and health effects and exposure considerations.

3. Across Supersites. Intersite comparisons and relationships to elucidate differences across airsheds and assist evaluation of assessment tools of regional (and greater) scale.

4. Across related programs. Data analysis will be used to foster the needed integration of the subject Supersites with programs, discussed briefly in Section 5 (e.g., the chemical speciation program, other intensive field programs and health and exposure studies).

Attachmente 1. PM Related Study Descriptions for Supersites Programs Design and Planning

Study/PI[1]	What Kind[2]			When		Location/# Sites	Measurements[3]
	Extramural (E) or Intramural (I)	EPI, HE, TOX, EXP, S/R, EMIS, PROS	Annual (A)/ Intensives(I)/ Continuous(C)[4]/ Personal (P)/ Indoor-Outdoor (IO)/	Field Measurements	Data Analysis and Modeling		
Source/Receptor/Atmospheric Process Studies							
SEARCH Southeastern US[5] (SIP Development) / **Eric Edgerton**	E	S/R	1999 - daily; 2000 - 1/3 or 1/6 (C)	Phased in starting about June 1998 to Aug. 2001	On going and will continue after field program	4 urban and rural sites pairs in the southeastern US	O_3, PPG, APG, PMM, ACS1, ACS2, METS (See Note[6])
CRPAQS[7] Northern California (SIP Development) / **Karen Maglaino**	E	S/R	1/6 day sampling (A)	12/1/99 - 1/31/01	Mid-2001 2003	3 core (Fresno, Bakersfield, Angiola), 17 satellite sites, backbone network	O_3, PPG, APG, PMM, ACS1, VIS, METS, METU
CRPAQS	E	S/R	Fall – 30 episode days (I)	9/15/00 - 11/15/00.	Mid-2001 2003	Annual program plus 11 satellites within limited region around Corcoran,CA	O_3, PPG, APG, PMM, ACS1, VIS, METS, METU
CRPAQS	E	S/R	Winter – 20 episode days (I)	12/1/00 - 1/31/01	Mid-2001 2003	5 core (Fresno, Bakersfield, Angiola, 2 TBD in North Valley) plus over 150 existing, augmented existing, and new sites	O_3, OOX, PPG, APG, PMM, ACS1, ACS2, UAC, FOG, VIS, METS, METU
PROPHET[8] / **Mary Ann Carol**	E	PROS	FRM and gaseous species for ozone issue(C); Fall and summer (I)	Began summer 1997 (current emphasis ozone with limited aerosols, hoping to expand aerosols)	On going	1	O_3, OOX, PPG, PMM, ACS1*, METS

Attachmente 1. PM Related Study Descriptions for Supersites Programs Design and Planning

Study/PI[1]	What Kind[2]			When		Location/# Sites	Measurements[3]
Phoenix & Tucson / **Tom Moore**	E	S/R	1/6 & 1/6(A) Dec. Jan. 1996, 97-98 (I) FRM and gaseous species(C)	Various special studies and annual average monitoring since 1994. Future intensives hopeful	On going	Phoenix supersite plus 10 other sites with various level of effort	O_3, PPG, APG, PMM, ACS1, ACS2*, VIS, METS
Philadelphia / **Russell Philbrick**	E	S/R	Summer intensives main objective (I)	Summers 1999, 2000, Winter 1999	After intensives study duration from mid-1998-mid-2001	1 core site (NEC-OPS) plus two supporting sites	O_3, PPG, PPM, ACS1, ACS2*(OC spec.), VIS, METS
SOS-Nashville / **Ellis Cowling**	E	S/R	Summer (I)	Summer 1999, still in planning	Winter 1999 - winter 2000+ (?)	??? (1 or more core sites)	O_3, PPG, APG, PPM, ACS1, ACS2*, METS Others are likely
SOS-Houston / **Jim Price**		S/R	Summer (I)	Summer 2000	Winter 2000 - winter 2001+(?)	Deer Park plus 22-30 other with supporting data	O_3, PPG, APG(?), PPM, ACS1, ACS2*(?), UAC, VIS, METS, METU
Deterministic Modeling of PM Models-3/CMAQ and Neighborhood Scale Modeling / **Jason Ching**	I	S/R					

Attachmente 1. PM Related Study Descriptions for Supersites Programs Design and Planning

Study/PI[1]	What Kind[2]			When		Location/# Sites	Measurements[3]
Health Effects and Toxicology Studies							
Human Exposures to Concentrated Ambient Air $PM_{2.5}$ (Stationary Concentrator) / **Robert Devlin**	EPA/NHEERL/HSD	TOX		Feb 1999 - Feb 2000		Chapel Hill	O_3, OOX, PPG, APG,PPM, Hydrocarbons, Biogenics, Elemental Carbon, ACS2, METS
Human Exposures to Concentrated Ambient Air $PM_{2.5}$ (Mobile Concentrator) / **Henry Gong**	HEI	TOX				Southern California	
Human Exposures to Concentrated Ambient Air $PM_{2.5}$ / **Dane Wasterdahl**	E (CARB)	TOX					
Animal Exposures to Concentrated Ambient Air $PM_{2.5}$ (Stationary Concentrator) / **Daniel Costa**	EPA/NHEERL/ETD/PTB	TOX		Ongoing		Research Triangle Park	O_3, OOX, PPG, APG,PPM, Hydrocarbons, Biogenics, Elemental Carbon, ACS2, METS
Human Exposures to Concentrated Ambient Air $PM_{2.5}$ (Stationary Concentrator) / **Terry Gordon**, **Judy Zelikoff** **Christine Nadziejo**	HEI	TOX				Manhattan, New York City	O_3, OOX, PPG, APG,PPM, Hydrocarbons, Biogenics, Elemental Carbon, ACS2, METS

Attachmente 1. PM Related Study Descriptions for Supersites Programs Design and Planning

Study/PI[1]		What Kind[2]		When		Location/# Sites	Measurements[3]
Animal Exposures to Concentrated Ambient Air $PM_{2.5}$ (Stationary Concentrator) / **John Godleski Lester Kobzik**	HEI, NIH/NIEHS, EPA/NCERQA	TOX		1998 - 2001		Boston	O_3, OOX, PPG, APG,PPM, Hydrocarbons, Biogenics, Elemental Carbon, ACS2, METS
Animal Exposures to Concentrated Ambient Air $PM_{2.5}$ (Mobile Concentrator) / **Jack Harkema**	GM/HEI	TOX		1999 - 2002		Southwest Detroit	O_3, OOX, PPG, APG,PPM, Hydrocarbons, Biogenics, Elemental Carbon, ACS2, METS

Attachmente 1. PM Related Study Descriptions for Supersites Programs Design and Planning

Study/PI[1]	What Kind[2]			When		Location/# Sites	Measurements[3]
Exposure and Epidemiology Studies							
ARIES[9]/ **Eric Edgerton**	EPRI/ Southern, Co	EPI	C	1999 - daily Current through Jan. 2000	On going and after field program	Atlanta supported spatially by SEARCH	O_3, PPG, APG, PMM, ACS1, ACS2, METS
Coachella Valley/ **Bart Ostro**	EPA/NCERQA	EPI	IO	Pilot-Spring 1999 12 wk Apr-June 2000		Coachella Valley, CA	PMM, Ultrafine mass, CO, O_3, NO_2
Spokane Particulate Matter and Health Study/ **Jane Koenig**	EPA/WA DOE	S/R EPI	C	1994 - Ongoing (pending funding)	On going	Spokane, WA	$PM_{2.5}$, PM_{10}, CNC, CO, O_3, ACS1, ASCS, soluble metals, METS
Boston/ **Dianne Gold**	EPA/NCERQA			March 1999 - Feb 2002		Boston	$PM_{2.5}$, O_3, NO_2, SO_2, METS
Seattle/ **Suresh Moolgavkar**	EPA/NCERQA	EPI	C	1996-2000	1998-2001	Seattle	PMM, VIS(PM1.0), CO, Bio-aerosol (pollen)
Baltimore / **John Creason, Ron Williams**	EPA/NHEERL & NERL	EPI/EXP	P/IO	Summer 1998	9/98-4/99	Baltimore	$PM_{2.5}$, PM_{10}, CO, O_3, NO_2 , SO_2, CNC, $PM_{2.5}$ speciation
Boston / **Petros Koutrakis**	EPA/NERL	EXP	P/IO	1999-2001	2000-2002	Boston	$PM_{2.5}$, PM_{10},O_3, NO_2, CO, SO_2,
Boston/**ICAS**[10] **Boston Univ**	EPA/NIEHS	EPI/EXP	IO	1996-2001	2000-2002	Boston	$PM_{1.0}$(nephelometer), PMM ($PM_{2.5}$, PM_{10}) O_3, NO_2, nicotine, bio-aerosol (allergens)
New York/ **Morton Lippmann**	EPA/NER/HEI	EXP/EPI	P/IO IO	1999-2000 present-1999	2000-2002	New York Manhatton	$PM_{2.5}$, PM_{10}, $PM_{I>10}$, $PM_{<0.15\ (ultrafine)}$, O_3, NO_2,

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Study/PI[1]		What Kind[2]		When		Location/# Sites	Measurements[3]
NewYork/Bronx & Manhatton/ **ICAS Albert Einstein & Mt. Sinai**	EPA/NIEHS	EPI/EXP	IO	1996-2001	2000-2002	New York Bronx Manhatton	$PM_{1.0}$(nephelometer), PMM ($PM_{2.5}$, PM_{10}) O_3, NO_2, nicotine, bio-aerosol (allergens)
Atlanta / **Petros Koutrakis**	NERL	EXP	P/IO	1999-2000	2000-2001	Atlanta	$PM_{2.5}$, PM_{10},O_3, NO_2, CO, SO_2
Chicago/ **ICAS Children's Memorial Hosp.**	EPA/NIEHS	EPI/EXP	IO	1996-2001	2000-2002	Chicago	$PM_{1.0}$(nephelometer), PMM ($PM_{2.5}$, PM_{10}) O_3, NO_2, nicotine, bio-aerosol (allergens)
Dallas / **ICAS UT Southwestern**	EPA/NIEHS	EXP	IO	1996-2001	2000-2002	Dallas	$PM_{1.0}$(nephelometer), PMM ($PM_{2.5}$, PM_{10}) O_3, NO_2, nicotine, bio-aerosol (allergens)
Seattle /**Sally Liu**	EPA/NERL & NHEERL	EXP/EPI	P/IO	1999-2001	2000 - 2002	Seattle	$PM_{2.5}$, PM_{10}, NO_2, CO, $SO_{2,}$ PM elemental analysis
Seatlle /**ICAS Childhood Asthma Study Team**	EPA/NIEHS	EXP	IO	1996-2001	2000-2002	Seattle	$PM_{1.0}$(nephelometer), PMM ($PM_{2.5}$, PM_{10}) O_3, NO_2, nicotine, bio-aerosol (allergens)
Seattle / **Morton Lippmann**	EPA/NERL/HEI	EXP	P/IO	2000	2001-2002	Seattle	$PM_{2.5}$, PM_{10}, $PM_{I>10}$, $PM_{<0.15\ (ultrafine)}$, O_3, NO_2,
Seattle / **Harvey Checkoway**	HEI	EXP	Outdoor	1997-1999		Seattle	Nephelometry city-wide

Attachmente 1. PM Related Study Descriptions for Supersites Programs Design and Planning

Study/PI[1]		**What Kind**[2]		**When**		**Location/# Sites**	**Measurements**[3]
Los Angeles / **Petros Koutrakis**	EPA/NERL	EXP	P/IO	1999-2000	2000-2001	Los Angeles	$PM_{2.5}$, PM_{10},O_3, NO_2, CO, SO_2
Anchorage / **Mary Ellen Gordian**	NIEHS	EXP	Outdoor	1999-2002	2001-2003	Anchorage	$PM_{2.5}$, PM_{10}, CO
Anaheim / **Morton Lippman**	EPA/NERL	EXP	P/IO	2000-2001	2001-2002	Los Angeles/ Anaheim	$PM_{2.5}$, PM_{10}, $PM_{I>10}$, $PM_{<0.15\ (ultrafine)}$, O_3, NO_2,
Tuscon //**ICAS AZ Health Sciences Center**	EPA/NIEHS	EXP	IO	1996-2001	2000-2002	Tucson	$PM_{1.0}$(nephelometer), PMM ($PM_{2.5}$, PM_{10}) O_3, NO_2, nicotine, bio-aerosol (allergens)
Fresno /**Lucas Neas & John Creason**	EPA/NHEERL NERL	EPI/EXP	IO	1999 (Jan-Mar)	1999	Fresno	$PM_{2.5}$, PM_{10}, CO, O_3, NO_2
US Site/ not selected	EPA/NERL	EXP	IO	1999-2001	2000-2002	not selected	not selected
Air Science Centers							
Georgia Tech (March 1998-March 2001)	EPA			Continuous and with summer intensives 1999 (Nashville), 2000 (Houston)		3 sites (Atlanta, Nashville, Dixon) and coordinate with SOS Nashville and East Texas	Hypothesis driven, comprehensive measurements (study secondary air pollutants and their relationships. Collect data for regional model application
Caltech (March 1998-March 2001)	EPA					California and Northeast US	Modeling program using data already collected in the NE US and in Southern California.

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Study/PI[1]	What Kind[2]			When		Location/# Sites	Measurements[3]
Penn State Un. (March 1998-March 2001)	EPA		Intensive	Two summers – 6-8 week programs		Philadelphia	Remote sensing and in-situ, with supporting chemistry and meteorology. Study causes of high ozone and fine PM in Philadelphia.
Health and Exposure Science Centers – To Be Determined							

1. See Table 2 for contact information of PI.

2. What kind of study/major objectives, may have more than one: EPI - epidemiological; HE - health effects; TOX - Toxilogical; EXP - exposure; S/R - source/receptor & PROS; EMIS - emissions data, PROS - primarily atmospheric chemical process

3. O_3 Ozone
   OOX Other OXidizing species (e.g., radicals, H2O2)
   PPG Primary Precursor Gases – SO2, NOx/NOy, CO, VOC
   APG Aerosol Precursor Gases – HNO3, NH3
   PMM Particulate Matter Mass
   PM2.5 PMM <2.5μm
   PM10 PMM <10μm
   PM1.0 Nephelometry measurements PMM <2.5μm
   CNC Condensation nuclei counting
   ACS1 Aerosol Chemical Speciation – major chemical components only
   ACS2 Aerosol Chemical Speciation – ACS1 plus detailed chemical analysis (e.g., OC, chem. by size)
   Biogenics Hydrocarbons and other chemicals of biological origen (e.g., terpenes)
   Bioaerosol Biological matterial containing macromolecules (proteins, RNA, DNA) including measures of allergens (e.g., pollen, antigens, molds, etc.)

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UAC Upper air chemistry by aircraft
FOG Fog Measurements
VIS Visibility Related Measurements (scat., abs., chem. by size, size distributions,)
METS Surface meteorological data
METU Upper-air meteorological data

- ACS1 - Limited speciation, ACS2 - limited additional speciation.

4. Annual average - typically 1/6 day sampling; Intensive - limited duration study (months) with episodic type intensive monitoring; Continuous -comprehensive 1/3 or more frequent sampling over an extended period of time (one year or more)

5. **S**outh**e**astern **A**erosol **R**esearch and **Ch**aracterization.

6. PM chemical speciation uses filters and denuder with a move in the future to continuous species specific methods.

7. California Regional PM10/PM2.5 Air Quality Study

8. Program for Research for Oxidants: Photochemistry, Emissions, and Transport

9. ARIES – Aerosol Research Inhalation Epidemiology Study

10. **I**nner- **C**ity **A**sthma **S**tudy(**ICAS)** is a 7 city study of asthma funded by NIEHS with EPA funding for the indoor/outdoor (IO) exposure measurements. George O'Conner at Boston Univ. is the Study Coodinator and Herman Mitchell at Rho, Inc. is the Data Coordinating Center. The IO exposure measurement plan was developed for the study by two co-investigators at Seattle (Jane Koenig) and New York (Mort Lippman).

Attachment 2 - Regional Distribution of PM Studies

Region	City/State	Source/Receptor Studies	Exposure & Health (Epi & Tox)	TOTAL STUDIES
North East	Baltimore		1Epi/Exp	12
	Boston		1T, 2Epi, 2 Exp	
	New York		1H, 2 Epi, 2 Exp	
	Philadelphia	1		
South East	Atlanta		1Epi, 1 Exp	6
	SEARCH Sites(?)	1		
	Nashville	1		
	RTP/Chapel Hill		1T, 1H	
Mid West	Chicago		1 Epi-Exp	4
	Detroit		1T	
	Dallas		1Epi-Exp	
	Houston	1		
North West	Anchorage		1 Epi	9
	Seattle		2 Epi, 3 Epi-Exp	
	Spokane	1	1Epi	
South West	Bakersfield	1		9
	Coachella Vally ?		1Epi	
	Los Angeles Area	1	1H, 2 Exp	
	Fresno	1	1 Epi-Exp	
	Tucson/Phoenix		1 Epi-Exp	

Attachment 3. State/Private Studies for SIP Development and Chemical Process Understanding

Studies	Activity	1998	1999	2000	2001	2002	2003	2004	2005	Comments
SEARCH	Field Meas., daily									
	Field Meas., 1/3 days									Atlanta Supersite
	Data Analysis									
CRPAQS	Field Meas., 1/6 days									Fresno, Bakersfield, Angolia Supersites
	episode days, fall									
	epidsode days, winter									
	Data Analysis									
PROPHET	Field Meas., daily									Ongoing Study
	Data Analysis									
Phoenix/ Tucson	Field Meas., 1/6 days									Phoenix Supersite Ongoing study
	Data Analysis									
Philadelphia	Field Meas., Intensive									NEC-OPS Supersite
	Data Analysis									
SOS Nashville	Field Meas., Intensive									
	Data Analysis									
SOS Housten	Field Meas., Intensive									
	Data Analysis									
Spokane	Field Meas., daily									Data collection ending Dec 1998
	Data Analysis									

Health/EPI/TOX

Studies	Activity	1998	1999	2000	2001	2002	2003	2004	2005	Comments
Human Exposures to concentrated PM	Exposures Data Analysis									Robert Devlin
Human Exposures to concentrated PM	Exposures Data Analysis									Henry Gong
Human Exposures to concentrated PM	Exposures Data Analysis									Dane Wasterdahl
Animal Exposures to concentrated PM	Exposures Data Analysis									Terry Gorden
Animal Exposures to concentrated PM	Exposures Data Analysis									Daniel Costa Ongoing study
Animal Exposures to concentrated PM	Exposures Data Analysis									Judy Zelikoff
Animal Exposures to concentrated PM	Exposures Data Analysis									Christine Nadziejo
Animal Exposures to concentrated PM	Exposures Data Analysis									John Godleski
Animal Exposures to concentrated PM	Exposures Data Analysis									Lester Kobzik
Animal Exposures to concentrated PM	Exposures Data Analysis									Jack Harkema
Indoor/outdoor PM	Data collection Data Analysis									Bart Ostro, Pilot Study in Spring 1999
Boston, PM2.5, O3, NO2, SO2	Data collection Data Analysis									Dianne Gold
CAMP	Data collection Data analysis									Jane Koenig
Seattle	Data collection Data analysis									Suresh Moolgavkar
ARIES	Data collection Data analysis									Eric Edgerton

Exposure

Studies	Activity	1998	1999	2000	2001	2002	2003	2004	2005	Comments
Baltimore	Data collection Data analysis									Ron Williams
Boston	Data collection Data analysis									Petros Koutrakis
Boston	Data collection Data analysis									ICAS
New York	Data collection Data analysis									Mort Lippmann
Manhatton	Data collection Data analysis									Mort Lippmann
Atlanta	Data collection Data analysis									Petros Koutrakis
Chicago	Data collection Data analysis									EPA/NIEHS
Dallas	Data collection Data analysis									EPA/NIEHS
Seattle	Data collection Data analysis									Sally Liu
Seattle	Data collection Data analysis									ICAS
Seattle	Data collection Data analysis									Mort Lippmann
Seattle	Data collection Data analysis									Harvey Checkoway
Spokane	Data collection Data analysis									ORD/OPPE
Los Angeles	Data collection Data analysis									Petros Koutrakis
Anaheim	Data collection Data analysis									Mort Lippmann
Tuscon	Data collection Data analysis									ICAS
Fresno	Data collection Data analysis									Lucas Neas & John Creason
Anchorage	Data collection Data analysis									Mary Ellen Gordian

Air Science Centers

Studies	Activity	1998	1999	2000	2001	2002	2003	2004	2005	Comments
Georgia Tech	Data collection Nashville (Intensive) Housten (Intensive) Data analysis									William Chamcides PI
Caltech	Data collection Data analysis									Glenn R. Cass PI
Penn State	Data collection Data analysis									Russel Philbrick PI