

**US Environmental Protection Agency
Science Advisory Board
Clean Air Scientific Advisory Committee
Technical Subcommittee on Fine Particle Monitoring Meeting
April 18-19
Preliminary Agenda**

Tuesday, April 18

7:30	Introduction and Purpose	Phil Hopke
7:35	Review of 4-City Speciation sampler intercomparison	P. Solomon
8:00	Discussion	
8:30	Thermal Carbon Analysis...Overview of issues	J. Rice
8:40	EPA Research activities	Solomon/Lewis
9:00	Discussion	
9:45	Development of standards for aerosol components	R. Zweidinger
10:10	Break	
10:30	Implementation of Chemical Speciation Program	J. Homolya
11:00	Discussion	
11:30	Status on Supersites Program	Scheffe/Jones
	S Awards	
	S Initial Meetings and coordination efforts	
12:00	Lunch	
1:00	Status on deployment of FRM program	L. Byrd
1:15	EPA's data quality assessment approach	Papp/Eberly
1:40	Discussion	
2:00	Continuous mass monitoring	Hanley
2:30	Data Analysis Activities	TBD
3:00	Public Comment (if any)	TBA
3:30	Open Discussion	All
4:30	Adjourn day 1	

April 19

8:00	Coarse particle monitoring method	Wiener
8:10	Discussion	
9:00	Open Discussion	
9:30	Summary and Future Business	Phil Hopke
9:45	Adjourn	

Update
PM_{2.5} Monitoring Implementation
3/1/00

Table of Contents

Introduction	1
A. Network Conceptualization and Major Program Components	2
Network Elements & Changes to Network Since 1998	2
Compliance (Mass) Monitoring	2
Continuous Sampling	4
Chemical Speciation Sampling and Analysis	4
Supersites	6
IMPROVE Monitoring	8
Quality Assurance and Data Assessment	8
B. Implementing the Program: Milestones, Mechanisms, and Resources	10
Schedules and Milestones	10
Major National Procurements	12
Resources and Grant Allocations	13
Training	13
C. Options for a Revised Coarse Particle NAAQS	14
D. Communications	16
Common Acronyms	17
Table 1. PM _{2.5} Network Design Impacts from 1999 NAS Report and Current Operating Status	3
Table 2. PM _{2.5} Monitoring Implementation Schedule	10
Figure 1. Overview of Principal Communications Lines	16

Update - PM_{2.5} Monitoring Implementation

Introduction

The deployment of a new PM_{2.5} monitoring network is a critical component in the national implementation of the new PM_{2.5} National Ambient Air Quality Standard (NAAQS). To date, over \$128 million in federal funding has been provided to support a national monitoring network as described within President Clinton's Directive of July 16, 1997, in addition to those funds provided for particulate matter research. The PM_{2.5} network follows the regulations provided in Title 40 of the Code of Federal Regulations (40 CFR), Parts 50, 53, and 58, and published in the ***Federal Register*** on July 18, 1997. As described in the NAAQS packages, the ambient data from this network will drive an array of regulatory decisions, ranging from designating areas as attainment or nonattainment, to developing cost-effective control programs, and to track the progress of such programs.

This document provides a summary of progress to date, and an outline of the remaining actions that will be taken to complete the PM_{2.5} monitoring network. A copy of the original PM_{2.5} Monitoring Implementation Plan (3/98) is provided as an attachment for reference. The 1998 plan was used to describe the rationale underlying the network and its components; to establish and affirm major products (e.g., training programs, procurements) and timelines required to implement the network; to define roles and responsibilities of organizational groups and individuals; and to generate consensus among those responsible for network deployment and operation. Much work has gone into the program since 1998, and this summary attempts to describe how the program has evolved over that time period, and to highlight the major accomplishments.

A. Network Conceptualization and Major Program Components

Data from this program will be used for (1) PM_{2.5} NAAQS comparisons, (2) development and tracking of implementation plans, (3) assessments for regional haze, and (4) assistance for health studies and other ambient aerosol research activities. The PM_{2.5} network design addresses these four program objectives through a combination of siting and instrumentation strategies. The federal reference method (FRM) sampler design and network concepts like community-oriented monitoring (including “spatial averaging”) are predicated on the need to produce data commensurate with those health studies underlying the development of the PM_{2.5} NAAQS. The principal objective of the FRM sampler is to measure a particulate matter “indicator” which defines PM_{2.5} and which tracks back to those measurements used in the health studies supporting the PM_{2.5} NAAQS. The requirement that these instruments rely on specific design elements, rather than performance criteria alone, is structured to produce greater measurement precision and to avoid the data measurement uncertainties experienced in the PM₁₀ monitoring program. Because the FRM PM_{2.5} samplers do not provide temporally resolved data or full chemical characterization of ambient aerosols, other sampling instruments including continuous analyzers and speciation samplers constitute a major part of the PM_{2.5} network.

Network Elements & Changes to Network Design Since 1998.

Compliance (mass) monitoring. The network design focus for compliance of both the annual and 24-hour PM_{2.5} NAAQS strives to locate monitoring sites in populated areas, with a major emphasis on communities exposed to concentrations representing larger areas, or area-wide concentrations. This emphasis on area-wide concentrations again reflects the need to be consistent with studies underlying the PM_{2.5} NAAQS, analogous to the rationale for the FRM specifications.

The national PM_{2.5} network includes approximately 1,050 FRM sites, of which 850 sites are required as a minimum by the 40 CFR 58 regulation. (As of March 2000, 1,022 of these FRM sites are operating.) The sites that are not required to meet regulatory minimums (~200) are necessary in order to provide for adequate coverage of populated areas and for special purpose monitoring work. In 1997, the FRM network was designed to include nearly 1,400 sites. In March 1998, the National Academy of Science’s report Research Priorities for Airborne Particulate Matter: Immediate Priorities and a Long-Range Research Portfolio¹, made the recommendation that the mass portion of the network be reduced, and that the chemical speciation and continuous monitoring efforts be increased. EPA responded to this report, and the FRM network size was reduced by approximately 350 sites. This reduction allowed for a shifting of resources to continuous mass and chemical speciation measurements described below. Table 1 illustrates how the network design has been modified, and provides an indication of how many sites are operating at this time.

¹Published by the Committee on Research Priorities for Airborne Particulate Matter, National Research Council, National Academy of Sciences, March 1998.

Table 1. PM_{2.5} Network Design Impacts from 1999 NAS Report & Current Operating Status.

Network Element	Original # of Sites in 1997	Current # of Planned Sites	# of Sites Operating as of 3/1/00
Compliance (FRM) sites	1,392	1,050	1,022
Chemical Speciation	~300 sites sampling either 1in6 or 1in 12 days.	54 “trends” sites sampling 1in3; ~40 sites used to support Supersites, sampling 1in3 generally; ~10 sites sampling daily to support ongoing health studies; ~200 sites used to support SIP and other work, sampling 1in6.	13
IMPROVE network expansion	108	110	35
Continuous mass sites	100	~210	115
Supersites	4 to 9	8 (based upon award)	Atlanta site operated in 1999; remainder expected in 2000-01.

The description of the PM_{2.5} FRM is included in 40 CFR 50, Appendix L, published as a final rule in the Federal Register on July 18, 1997. Essentially, the PM_{2.5} FRM is a gravimetric method that acquires deposits over 24-hour periods on Teflon®-membrane filters from air drawn at a controlled flow rate through a tested PM_{2.5} inlet. The inlet and size separation components are specified by design as published in the Code of Federal Regulations. There are a number of designated federal reference method samplers at this time including:

C Single channel FRM samplers:

- C Andersen Model RAAS2.5-100 PM_{2.5} Ambient Air Sampler; designated 6/11/98.
- C BGI Inc. Model PQ200 Ambient Fine Particle Sampler; designated 4/16/98.
- C Rupprecht & Patashnick Partisol®-FRM Model 2000 Air Sampler; designated 4/16/98.
- C Thermo Environmental Instruments, Inc. Model 605 “CAPS” Sampler; designated 10/29/98.

C Sequential FRM samplers:

- C Andersen Model RAAS2.5-300 PM_{2.5} Sequential Ambient Air Sampler; designated 6/11/98.
- C Rupprecht & Patashnick Partisol®-Plus Model 2025 Sequential Air Sampler; designated 4/16/98.

- C Portable FRM audit samplers (used in the quality assurance program):
- C Andersen Model RAAS2.5-200 PM_{2.5} Ambient Audit Air Sampler; designated 3/11/99.
- BGI Inc. Model PQ200A Ambient Fine Particle Sampler; designated 4/16/98.
- C Rupprecht & Patashnick Partisol® Model 2000 Audit Sampler; designated 4/19/99.

The PM_{2.5} federal equivalent methods (FEM) vary from this basic FRM definition and are divided into three categories, Class I, II, and III. Definitions for each of these are provided in 40 CFR §53.1, published as a final rule in the Federal Register on July 18, 1997. The three classes of equivalent methods are used to describe the degree of variation between each equivalent PM_{2.5} method and the PM_{2.5} FRM design. There are no designated equivalent PM_{2.5} methods at this time, nor have any manufacturers formally pursued this type of designation.

It is important to emphasize that all PM_{2.5} sampling sites that provide data for comparison to either the 24-hour or the annual PM_{2.5} NAAQS for the purposes of addressing attainment and nonattainment decisions must employ designated FRM/FEM sampling techniques.

Continuous sampling. The 40 CFR 58, Appendix D, §2.8.2.3 regulation requires that a continuous sampler be placed in each of the nation's 52 largest metropolitan areas or cities. At present, State and local agencies are operating approximately 115 continuous monitoring sites, and this number is expected to increase to approximately 200 by the end of 2000. Continuous PM_{2.5} data will provide useful data for public reporting of short-term concentrations, for understanding diurnal and episodic behavior of fine particles, and for use by health scientists investigating exposure patterns.

State and local agencies have reported that they are using the TEOM method at a majority of these sites. Other methods to be used include beta gauge (BAM) monitors, nephelometers, and the CAMMS. EPA has established a continuous monitoring work group with the State and local agencies which has been a useful forum for discussing measurement approaches for continuous monitoring, quality assurance and control issues, and related topics.

Chemical speciation sampling and analysis. A large part of EPA's efforts to finish the PM_{2.5} network deployment is focused on the deployment of the chemical speciation sites. This program element has received and will continue to receive a great deal of attention. Beginning in early 1999, the General Accounting Office, under direction from the Congress, conducted an audit of EPA's actions to address the National Academy of Sciences' report mentioned previously. This audit was completed in August 1999, and the GAO's only recommendation read: "We recommend that the Administrator, Environmental Protection Agency, ensure that all remaining monitors planned for the PM_{2.5} network undergo and successfully pass full laboratory and full field testing and evaluation under actual operating conditions to ensure that the monitors meet data quality objectives before large-scale deployment of these monitors is authorized." The GAO report describes "full field testing" as "an evaluation of the monitor under actual field conditions where temperature, humidity, and other factors, such as season of

the year, are not simulated,” and the “remaining monitors” include the chemical speciation samplers. The EPA agreed that the remaining monitors planned for the PM_{2.5} network should undergo and successfully pass the full laboratory and full field testing evaluation, and we have taken steps to ensure that this work is completed.

The U.S.EPA recognizes that the PM_{2.5} network will be the major source of information for developing emission mitigation strategies and for tracking the success of implemented control programs. The basic objective of the chemical speciation analysis is to develop seasonal and annual chemical characterizations of ambient aerosols across the nation. These chemically resolved data will be used to perform source attribution analyses, evaluate emission inventories and air quality models, and support health related research studies and regional haze assessments. Note that comparisons of air quality model predictions and mass measurements alone provide unsatisfactory tests of model behavior and are complicated further by the inherent uncertainties in mass measurements due to sampling artifacts. Speciated data provide a wealth of information (as opposed to mass concentrations alone) that potentially can uncover model flaws and lead to greater confidence in model predictions. Development of this program element is being made in consultation with State and local agency representatives and the scientific/research community and in consideration for national scientific programs such as the Inner City Asthma Study and the Supersites programs.

The previously mentioned NAS report and all related recommendations from the speciation expert panel, and the GAO report have changed the implementation of the speciation program in the following ways:

- C The 54 trends sites will sample every third day. EPA, in conjunction with an external group of experts (expert panel), developed data quality objectives for the trends network which indicated a benefit in moving from an every sixth day schedule to an every third day schedule.
- C Ten of the 54 trends sites will be designated as “daily sampling” sites. The every third day sampling schedule at these sites will be complimented by a combination of additional integrated and/or semi-continuous sampling methods.
- C The full deployment of the speciation program will extend into the 4th quarter of 2001 in order to increase the field testing and assessment of emerging sampling techniques.

The current commercially available sampler designs for the chemical speciation network are largely filter-based methods which use a combination of Teflon®, nylon, and quartz filters to capture the various constituents of most interest including elements, elemental and organic carbon, and major ions including nitrate, sulfate, chloride, and ammonium. However, technology in this area is expected to change and continuous chemical speciation methods are expected to be available in the future. EPA expects that the Supersite program will provide a useful interface to transition new speciation sampling technologies into routine applications.

The EPA is developing laboratory standard operating procedures (SOPs) that will be consistent with techniques used by various agencies and research groups currently operating ambient air particulate matter speciation programs. Sampling for speciation purposes is a developing science, and as such, the U.S.EPA encourages creative approaches to speciation measurements. Retaining flexibility by not prescribing speciation sampling methods should be interpreted as a technology driver. Of course, the penalty for flexibility is some degree of data uncertainty stemming from different methods. The greatest uncertainty of the speciation sampling and analysis program exists in the laboratory protocols; therefore, the EPA is requiring greater standardization for the laboratory analysis component. The EPA has established a national laboratory analysis contract to support the chemical speciation program, and feedback from State and local monitoring agencies indicates that nearly all chemical speciation sampling programs will use this laboratory. All trends sites will use the national contract for filter analyses. The single exception to this is the Interagency Monitoring of Protected Visual Environments (IMPROVE) program, which has its own centralized laboratory.

The speciation program has been funded at a level to accommodate approximately 300 sites at the various sampling frequencies previously mentioned. This total of 300 sites reflects a planning estimate. Fifty-four speciation sites are required by 40 CFR 58, Appendix D, §2.8.1.5 regulation, and will serve as speciation trends sites. These 54 sites will be located in high population areas and in areas with emissions of interest such as the existing Photochemical Assessment Monitoring Stations (PAMS) #2 sites or at other sites with collocated FRM/FEM samplers. Additionally, approximately 40 sites will be used to coordinate the States' speciation programs with those of the Supersites. The balance between the 54 trends sites with the 40 Supersites support sites, and 300 planned sites reflects the need to tailor certain sites to area-specific needs. For example, some areas may choose to focus on episodes or specific seasons, such as winter time wood smoke. States will have some flexibility with these supplemental sites to design their speciation networks appropriately, for example, to operate fewer sites on more frequent schedules than an every sixth day schedule, or to adopt seasonal sampling regimes during periods of high particulate loadings. It is possible, and even likely, that some of these activities will be more resource intensive, particularly if additional types of analyses are needed or if advanced methods are used. These things will need to be taken into account in funding the program, and as necessary and technically warranted, they will impact the total number of supplemental (i.e., non-trends) speciation sites that will be installed. Alternative speciation approaches will be considered on a case-by-case basis through negotiation with appropriate EPA Regional Offices and the Office of Air Quality Planning and Standards (OAQPS).

Because data from the chemical speciation sites is of interest to the scientific community, the U.S.EPA encourages State and local agencies to develop their chemical speciation networks in consultation with local and national researchers who are conducting health effects studies. Funding to increase sampling frequencies at selected sites near Supersite study areas, and for a limited amount of daily speciation sampling is being provided through the State and local agency grant program.

Supersites (referred to as the “Special chemical speciation studies” in the March 1998

Implementation Plan). The primary objectives of the Supersites are to support SIP development activities, to provide information to support health effects studies and the reviews of the particulate matter NAAQS, and to assist in the testing of advanced sampling methods. The more "routine" chemical speciation program described above is a critical tool that will support both of these activities; however, they may need to be supplemented by more intensive data collection activities in order to better understand region-specific air pollution processes and to improve on the subsequent SIP development process. Assessments of technical tools such as source attribution techniques, emission inventories, or air quality models which predict over continuous time and space frames benefit from monitoring that has increased spatial, temporal, and chemical composition resolution. Historically, regulatory air programs have been criticized for not more fully utilizing special intensive studies to test the technical tools used for planning. To address these concerns, the U.S.EPA has established the Supersites which is dedicated to conducting specialized monitoring to address some of the rigorous demands involved in air quality assessments. The Supersite awards were announced in January 2000 and they include the following projects:

- C Atlanta. Advanced methods evaluation leveraged with multiple air quality and related studies. Monitoring was conducted during the Summer 1999.
- C Fresno. Methods evaluation with transition to routine networks leveraged with a major air quality study (CRPAQS) and several potential health related studies. Monitoring began in the Summer 1999 and will continue to Spring 2001 as the "CA Supersite Phase II". The Principal Investigator is John Watson, Desert Research Institute.
- C Houston. David Allen, University of Texas at Austin, "Gulf Coast Aerosol Research & Characterization Program."
- C St. Louis. Jay Turner, Washington University, "St. Louis - Midwest Supersite."
- C Los Angeles. John Froines, University of California Consortium, "Southern California Particulate Matter Supersite."
- C Baltimore. John Ondov, University of Maryland, "Baltimore Supersite: Highly Time & Size Resolved Concentrations of Urban PM_{2.5} & its Constituents for Resolution of Sources & Immune Responses."
- C Pittsburgh. Spyros Pandis, Carnegie Mellon University, "The Pittsburgh PM Supersite: A Multidisciplinary Consortium for Atmospheric Aerosols Research."
- C New York City. Ken Demerjian, ASRC, State University of New York "PM_{2.5} Technology Assessment & Characterization Study in New York."

The sampling and analysis may result in diurnal profiles of size-resolved and chemically speciated aerosols. In addition, secondary aerosol precursor and intermediate species such as nitric acid, ammonia, nitrogen dioxide and other NO_y constituents, peroxides and peroxy radicals could be measured to provide challenging tests of chemical mechanisms within air quality models. These measurements offer the peripheral advantage of supporting ozone and deposition assessments as well, since many of the physical and chemical processes operate across several pollutant categories. Additional Supersites activities include enhancing some of the existing field studies, supporting existing

programs, epidemiological and other health studies, and developing focused approaches on unique problem areas. The Supersites are being coordinated with ongoing national and regional activities in order to take full advantage of these efforts and available funding.

Funding for the Supersites is provided by EPA's Science and Technology (S&T) funds rather than §103 grant funds as for other program elements. The total funding package includes \$20 million provided through the OAQPS, and \$ million provided through the ORD.

IMPROVE Monitoring. There are a variety of strong technical connections between visibility and fine aerosols monitoring that support a comprehensive monitoring program that services both PM_{2.5} and visibility assessments. The new PM_{2.5} monitoring regulations encourage the placement of PM_{2.5} monitors outside of population centers to facilitate implementation of the PM_{2.5} NAAQS and to augment the existing visibility fine particle monitoring network. The coordination of these two monitoring objectives will facilitate implementation of a regional haze program and lead to an integrated monitoring program for fine particles. The 40 CFR 51 Regional Haze Regulation, published in the ***Federal Register*** on April 22, 1999, includes visibility monitoring requirements (www.epa.gov/oar/vis). This proposed haze regulation makes monitoring data representative of class I areas important to the State and local agencies since they are the basis for determining whether additional emission reductions would be needed to meet visibility targets.

The IMPROVE Network is operated by a Steering Committee that includes representatives of EPA, National Oceanic and Atmospheric Administration (NOAA), and the federal land managers (FLM) who are responsible for preserving and improving air quality over the lands in their charge (National Park Service, Forest Service, Fish and Wildlife Service and Bureau of Land Management). The IMPROVE Steering Committee also includes representatives from three state-based organizations (State and Territorial Air Pollution Program Administrators (STAPPA), Western States Air Resource Council (WESTAR), and Northeast States for Coordinated Air Use Management (NESCAUM)) in recognition of the States' interest in this program. Funding for basic IMPROVE network comes from the §105 funding, and resources to cover the IMPROVE expansion has been available through the §103 PM_{2.5} grant budget. The IMPROVE Steering Committee has worked closely with the States to design the expanded IMPROVE network of 110 sites. Additionally, there are several State and tribal air monitoring agencies that have decided to purchase, install, and operate 11 additional IMPROVE type sites as part of their chemical speciation network in rural areas. We expect that the IMPROVE network expansion will be completed in 2000.

Quality Assurance and Data Assessment. The quality assurance (QA) program strives to ensure that the network produces PM_{2.5} data of the quality necessary to support the objectives of the program. The quality assurance program covers many areas:

1. Establishment of data quality objectives that will ensure the usability and defensibility of the PM_{2.5} data in regulatory actions. At this time, EPA has started an evaluation of the

PM_{2.5} air quality data to determine if the monitoring system's performance meets these objectives. We intend to provide a report on the 1999 initial data in August/September 2000.

2. Development and implementation of a program for designating federal PM_{2.5} reference and equivalent methods, ensuring that each type of monitoring instrument will operate within similar bias and precision limits.
3. Development of standardized operating procedures for field, sample handling, and laboratory activities, to ensure data comparability. This effort has been completed.
4. Requirements for a broad range of standardized quality control activities to evaluate and control measurement uncertainties or errors, including a template for State and local agencies to use to validate PM_{2.5} data. This effort has also been completed.
- S** Collocation of samplers to quantify measurement precision. As noted earlier, EPA will include information on the monitoring network's precision in a report on the 1999 initial data in August/September 2000.
6. Performance of a federally implemented independent FRM performance evaluation program (PEP) to quantify system bias. EPA will include information on the monitoring network's bias and PEP results in a report on the 1999 initial data in August/September 2000.
7. Implementation of qualitative assessments at the local and Federal level to ensure the proper development and operation of the quality assurance program. This includes, for examples, technical systems audits and management system reviews.
8. Development and implementation of a data analysis plan for the currently operating 13 minitrends chemical speciation sampler intercomparison, and other speciation sampler intercomparisons as necessary (e.g., using advanced methods, comparisons between the IMPROVE and trends samplers.)
9. Work with the continuous monitoring work group to provide State and local agencies with approaches for correlating continuous measurements to FRM air quality data for use in Air Quality Index (AQI) reporting. AQI reporting is required for cities over 350,000 in population, as listed in 40 CFR 58, Appendix G.
10. Provide continuing technical support and evaluation including activities such as the OAQPS operated monitoring platform used to evaluate methods and measurement approaches.

B. Implementing the Program: Milestones, Mechanisms, Training, and Resources

Schedules and Milestones. Table 2 provides an update to the original listing of the major actions, training, and milestones for the implementation of the PM_{2.5} monitoring network. This list includes only the major milestones.

Table 2. PM_{2.5} Monitoring Implementation Schedule.

ACTION	MILESTONE
40 CFR 50, 53, and 58 PM _{2.5} regulation	July 18, 1997 Part 58 available on AMTIC* Parts 50 and 53 available on TTN Airlinks (http://www.epa.gov/ttn) Subsequent correction notice on 2/17/98;
States & Regions develop & approve network designs	September 1997 - June 30, 1998 Review & approval on July 1 of each year.
States establish 1,050 PM _{2.5} sites	September 1997 - December 31, 1999
"Guidance for Network Design & Optimum Site Exposure for PM"	December 15, 1997 - Available on AMTIC under Network Design*
Award for national procurement contract to buy 46.2mm Teflon® filters for use in FRMs.	January 31, 1998
"Summary of Guidance: Filter Conditioning & Weighing Facilities & Procedures for PM _{2.5} Reference and Class I Equivalent Methods"	February 27, 1998
"Particulate Matter (PM _{2.5}) Speciation Guidance (Draft to work group for review on February 25, 1998)	February 25, 1998 - 1 st draft July 1998 - Recommendations from Expert Panel October 7, 1999 - Final
Model QA Project Plan Guidance Document	March 6, 1998 (final draft) March 31, 1998 final version signed by each Region
U.S.EPA awards nat'l PM _{2.5} sampler proc. contract & makes first orders (info on # and type of samplers must be compiled by Regions and to OAQPS by March 2, 1998.)	March 25, 1998 contract award April 1998 first set of FRM orders June 1998 second set of FRM orders
FRM/FEM designations granted (Specific samplers and vendors listed here. This is a continuing process, however, and other samplers may go through with designation in the future.)	BGI single channel & portable 4/16/98 R&P single channel & sequentials 4/16/98 Andersen single channel & sequentials 6/11/98 Thermo Env. Instr. single channel 10/29/98 Andersen portable audit 3/11/99 R&P portable audit 4/19/99

QA Handbook (Red Book) with final Method 2.12 “Monitoring PM _{2.5} in Ambient Air Using Designated Reference or Class I Equivalent Methods.”	May 14, 1998 Final June 2000 - Next revision—to incorporate info learned from 1 st year.
U.S.EPA/NARSTO Workshop on the Supersites program design with scientific community.	May 19, 1998 Steering Committee mtg. June 11, 1998 Workshop
U.S.EPA/AWMA Training on PM _{2.5} Laboratory and Sampling Equipment	May 20-21, 1998 in RTP, NC
Vendors deliver first orders for FRM samplers to States	June 1, 1998 - November 3, 1998
“Guidance for Using Continuous Monitors in PM _{2.5} Monitoring Networks”	June 5, 1998
FRM Performance Evaluation Program QA Project Plan	June 1998
States submit final 1998 PM _{2.5} network descriptions to Regions	July 1, 1998
Regions approve final PM _{2.5} network descriptions	July 31, 1998
FRM Performance Evaluation Program Implementation Plan	August 28, 1998
FY99 §103 grant guidance to Regions from OAR (Draft in March)	October 23, 1998 (Final)
Portable QA FRM audit samplers delivered to PEP Auditors	October 30, 1998
FRM Performance Evaluation Program Standard Operating Procedures	November 2, 1998
“Field Program Plan for the PM _{2.5} Chemical Speciation Sampler Evaluation Study”	November 23, 1998
Speciation laboratory analysis contract award	December 1998
Development of the Data Quality Objectives (DQOs) for the 54 Trends Sites	December 16, 1998
Quality assurance project plans approved by Regions	December 31, 1998 - December 31, 1999
Supersites research public solicitation	March 9, 1999
PM _{2.5} Data Validation Template for use with mass data.	April 6, 1999
Strategic Plan for Development of the Particulate Matter (PM _{2.5}) Quality System for the Chemical Speciation Monitoring Trends Sites”	May 19, 1999
“Visibility Monitoring Guidance” EPA-454/R-99-003	June 1999
States submit final 1999 PM _{2.5} network descriptions to Regions	July 1, 1999
Atlanta Supersite data collection activities	Summer 1999
Fresno Supersite data collection activities, Phase 1 & 2	Summer 1999 to Spring 2001
“Quality Assurance Project Plan: PM _{2.5} Speciation Trends Network”	October 27, 1999 (3 rd Draft)

Deployment of initial chemical speciation sites (“mini-trends”)	November 1999 (Equipment delivery & training) February 2000 (1 st data collection) May 2000 (study completion)
1,050 PM _{2.5} FRM sites are established + all required continuous monitoring sites & States begin “routine” data collection.	December 31, 1999
Supersites award announcement at the PM2000 Conference in Charleston, SC	January 25, 2000 Sampling to begin in 2000-2001.
Chemical Speciation Program Satellite Broadcast	March 21, 2000
PM _{2.5} Monitoring, Quality Assurance & Data Analysis Workshop (targets State, local and tribal monitoring agencies)	May 22-25, 2000 in RTP
States submit 2000 PM _{2.5} network descriptions to Regions, which includes chemical speciation sites.	July 1, 2000
Deployment of all chemical speciation trends sites (54 total including 10 daily sites), and speciation sites used to support Supersites activities (~40).	December 31, 2000
Deployment of supplemental chemical speciation sites (~200).	October 2000 - October 2001

**For PM_{2.5} information on the Ambient Monitoring Technology Information Center (AMTIC), see <http://www.epa.gov/ttn/amtic/amticpm.html>*

Major National Procurements. The U.S.EPA developed national procurement contracts for elements of the program that benefit from centralized (or regional) coordination. The benefits from these including a net reduction in administrative burden, the advantage of economies of scale, consistency in services/products supplied, and the increased ability to account for expenditure of State Grant funds. National procurement vehicles include:

1. Multi-vendor, 5-year, National PM_{2.5} Sampler Procurement Contract for the purchase of samplers including FRM/FEM (both single channel and sequential varieties), speciation samplers, and portable FRM audit samplers, and associated accessories for each. The Request for Proposals was published on October 29, 1997, the vendor pre-proposal conference was held on November 6, 1997, and contract award was made on March 25, 1998.
2. National 5-year contract for purchasing the 46.2 mm Teflon® filters used for the PM_{2.5} FRM/FEM; and a national purchasing vehicle for the 37 mm Teflon® filters used for dichotomous samplers

3. Field and laboratory support for national FRM Performance Evaluation Program; awarded and operational by January 1, 1999.
4. Laboratory services for chemical speciation filter analyses, awarded to Research Triangle Institute.

These procurement efforts are a service provided by the U.S.EPA, and although State/local agency participation is not mandatory, we have experienced an extremely high level of participation in these efforts.

Resources and Grant Allocations. Funds to support the complete deployment and operation of the PM_{2.5} network were provided under authority of the Clean Air Act §103 in FY-98 (\$35.6 million), FY-99 (\$50.7 million), and FY-00 (\$42.5 million). Since several aspects of the monitoring program involve national procurement, substantial levels of Grant funds have been withheld to meet these expenditures (~20-25%). Categories subject to grant withholding include funding for samplers purchased from the National PM_{2.5} Sampler Procurement Contract (FRM/FEM, portable FRM audit samplers, and speciation samplers), filters, chemical speciation analyses, IMPROVE samplers, and national FRM performance evaluation program costs.

The FY-00 budget of \$42.5 million is the level of funding that will be needed to fund the State and local agency operated portions of the PM_{2.5} network as it is currently designed.

Training. The implementation of the PM_{2.5} ambient monitoring program has required a significant amount of training in a number of diverse subjects. This training has been arranged by EPA (as listed in the milestone table), by the equipment manufacturers, and by State and local air quality monitoring agencies. The U.S.EPA's training program focuses on four areas: PM_{2.5} network design, sampler operations, laboratory procedures, and quality assurance/quality control for field and laboratory activities. The U.S.EPA is using a number of mechanisms for both formal and informal training with stakeholders in the PM_{2.5} monitoring program. A listing of these mechanisms follows:

- ! **Workshops** - The Regional offices have hosted workshops for their States on several occasions, and the OAQPS has hosted one workshop for all States in May 1998. OAQPS will host another PM_{2.5} Monitoring, Quality Assurance, and Data Analysis Workshop on May 22-25, 2000 in Research Triangle Park, NC.
- ! **Satellite Training** - Satellite training workshops have been used to provide an initial overview for managers and a technical program for monitoring and laboratory technicians with an interactive component. These productions are available on video tape for later viewing.
- ! **Technical Assistance** - U.S.EPA is providing expert assistance from OAR, the Regional Offices and the Office of Research and Development (ORD) scientists and engineers in the design and implementation of specific PM_{2.5} monitoring networks.
- ! **Courses** - The U.S.EPA is revising its existing Air Pollution Training Institute (APTI)

courses to incorporate PM_{2.5} monitoring information. Courses will take the form of on-site training, satellite broadcasts, or self-instructional courses.

! Guidance Manuals

! Web Site - Technical information pertaining to PM_{2.5} monitoring is posted on the AMTIC, URL address <http://www.epa.gov/ttn/amtic/amticpm.html>. A public forum area is also available on this page which allows users to submit questions on the PM_{2.5} monitoring program directly to U.S.EPA contacts on these subjects.

K. Options for a Revised Coarse Particle NAAQS

On May 14, 1999, the U.S. Court of Appeals for the District of Columbia Circuit issued an opinion in response to challenges to the NAAQS filed by industry and others (*American Trucking Association v. U.S.EPA*) that vacated the revised coarse particle (PM_{10}) NAAQS. (The 1987 PM_{10} NAAQS is still in place.) While the Court did find “ample support” for EPA’s decision to regulate coarse particulate pollution, they did find that PM_{10} is “a poorly matched indicator for coarse particulate pollution” because PM_{10} contains fine particles.

EPA is now investigating the possibility of using a coarse particle indicator (PM_c) instead of the PM_{10} indicator in the currently applicable NAAQS. This coarse particle indicator would be defined as $PM_{10} - PM_{2.5}$. The measurement approach would be to determine PM_c through taking the difference between concurrent, collocated measurements of PM_{10} and $PM_{2.5}$ (24 hour integrated measurements).

Our current thinking suggests that the $PM_{2.5}$ measurement would be as currently specified in 40 CFR Parts 50, 53, and 58, with the possible exception that specified-color filters and/or filter cassettes may be required to clearly distinguish between the PM_{10} and $PM_{2.5}$ samples. The PM_{10} measurement would also be as currently specified for $PM_{2.5}$ measurements in 40 CFR Parts 50, 53, and 58, with the following exceptions:

- ! The WINS shall be replaced by a straight tube (explicitly specified by drawing) [or by a “ PM_{12} ” WINS or modified inlet impactor to be developed (and explicitly specified by design), pending the results of inlet bounce tests to begin shortly].
- ! Specified-color filters and/or filter cassettes may be required to clearly distinguish between PM_{10} and $PM_{2.5}$ samples.
- ! PM_{10} samplers used for PM_c measurements must be clearly differentiated from PM_{10} samplers currently designated as meeting the original Appendix J or M PM_{10} requirements. This could result in two “classes” of PM_{10} samplers.

For both the $PM_{2.5}$ and PM_{10} measurements, EPA would expect to specify parameters such as the proximity (minimum and maximum separation and differential inlet height) of $PM_{2.5}$ and associated PM_{10} samplers; possibly the sampler data output string so that uniformity among all samplers and compatibility with AIRS is achieved; and the filter weighing, operational protocol, and quality assurance procedures for both PM_{10} and $PM_{2.5}$ to be matched. EPA would need to consider whether new performance and test requirements for sequential samplers may be necessary as well. Current thinking regarding the federal equivalent methods (FEMs) for PM_c includes various classes of equivalent methods such as:

Class I - same definition as for Class I $PM_{2.5}$ FEMs (i.e. minor deviations from PM_c FRM

requirements).

Class II - similar definition as for Class II $PM_{2.5}$ FEMs (filter based, $PM_{10}/PM_{2.5}$ differential method having non-minor deviations from PM_c FRM requirements) with both PM_{10} and $PM_{2.5}$ measurement techniques to be closely matched as to design and operation.

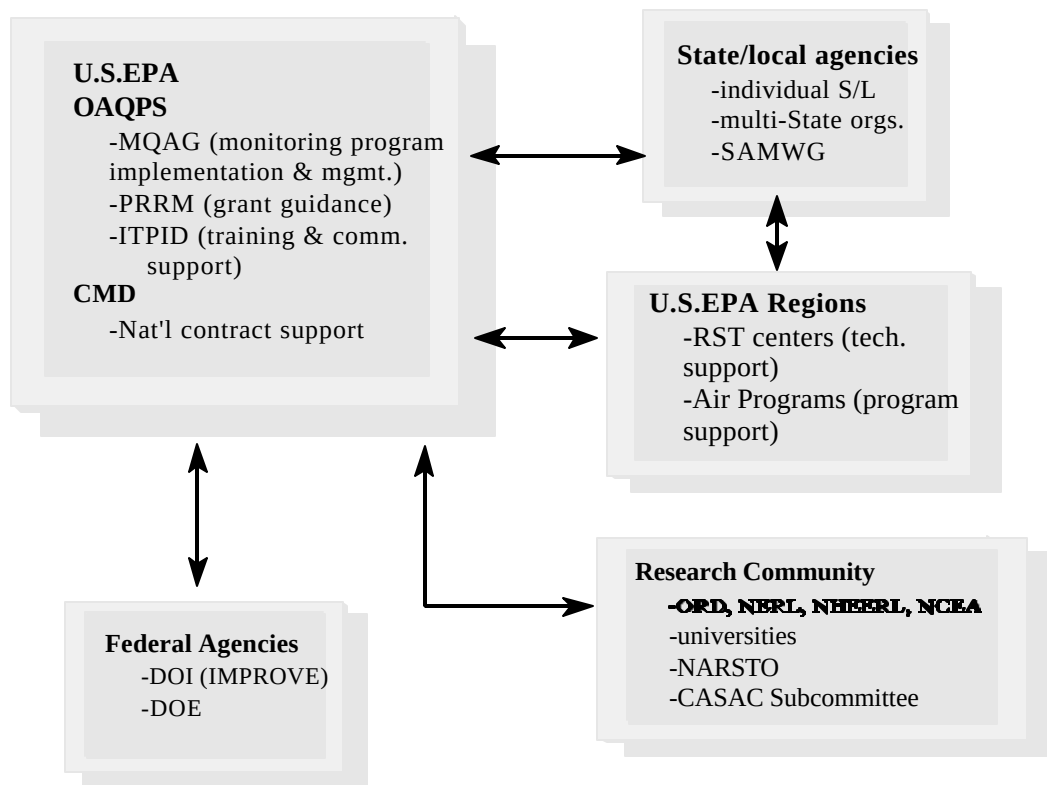
Class III - any candidate FEM not meeting Class I or Class II definition.

Obviously, significant effort will be necessary through the coming months in this area.

D. Communications

The roles and responsibilities described in the March 1998 Implementation Plan have not changed significantly over the course of the last 2 years, with the exception of how involved the scientific community has become. This is particularly true with regard to the chemical speciation program design and the Supersites program. The program has benefitted greatly from the expertise of external experts, and we intend to maintain this communication system. As presented in March 1998, Figure 1 provides an overview of the principal communications pathways.

Figure 1. Overview of Principal Communication Lines.



Common Acronyms

AIRS - Aerometric Information Retrieval System (maintained by the U.S.EPA)

ALAPCO - Association of Local Air Pollution Control Officials

AMTIC - Ambient Monitoring Technology Information Center, from U.S.EPA Internet site at <http://www.epa.gov/ttn/amtic>. Particulate matter information is available at <http://www.epa.gov/ttn/amtic/amticpm.html>.

APDLN - Air Pollution Distance Learning Network, U.S.EPA

APTI - Air Pollution Training Institute, U.S.EPA

AWMA - Air and Waste Management Association

CAA - Clean Air Act

CASAC - Clean Air Scientific Advisory Committee

CFR - Code of Federal Regulations

CMD - Contracts Management Division (within the Office of Acquisition Management, U.S.EPA)

CMZ - Community monitoring zone

CORE - Community-oriented monitoring

DOI - U.S. Department of Interior

DOPO - Delivery order project officer(s)

DQA - Data quality assessment

DQO - Data quality objectives

EORG - Education and Outreach Group, Information Transfer and Program Integration Division, Office of Air Quality Planning and Standards, U.S.EPA

FACA - Federal Advisory Committee Act

FLM - Federal land manager

FRM/FEM - Federal Reference Method/Federal Equivalent Method as approved by U.S.EPA

GPRA - Government Performance and Results Act

IMPROVE - Interagency Monitoring of Protected Visual Environments

ITPID - Information Transfer and Program Integration Division (within U.S.EPA OAQPS)

MARAMA - Mid-Atlantic Regional Air Managers Association

MQAG - Monitoring and Quality Assurance Group (within Emissions, Monitoring & Analysis Division of the Office of Air Quality Planning and Standards, U.S.EPA)

MSR - Management Systems Review

NAAQS - National Ambient Air Quality Standard

NARSTO - North American Research Strategy for Tropospheric Ozone

NAMS - National Air Monitoring Station(s)

NCEA - National Center for Environmental Assessment, U.S.EPA

NERL - National Exposure Research Laboratory (within the Office of Research and Development, U.S.EPA)

NESCAUM - Northeast States for Coordinated Air Use Management

NHEERL - National Health and Environmental Effects Laboratory, U.S.EPA

NOAA - National Oceanic and Atmospheric Administration

NPAP - National Performance Audit Program

NPS - National Park Service, U.S. Department of Interior

OAQPS - Office of Air Quality Planning and Standards, Office of Air and Radiation, U.S.EPA

OAR - Office of Air and Radiation

OPMO - Office of Program Management Operations, Office of Air and Radiation, U.S.EPA

ORD - Office of Research and Development, U.S.EPA

PAMS - Photochemical Assessment Monitoring Station

PM - Particulate matter, also further described for fine particles ($PM_{2.5}$), PM_{10} , and coarse particles (PM_c).

PRRMS - Planning, Resources, and Regional Management Staff (within U.S.EPA OAQPS)

PTFE - polytetrafluoroethylene

QA - Quality assurance

QAPP - Quality assurance project plan

RO - U.S.EPA Regional Office

RST - Regional Science and Technology laboratories/centers, U.S.EPA Regional Offices

RTP - Research Triangle Park, North Carolina

SAMWG - Standing Air Monitoring Work Group

SIP - State implementation plan

SLAMS - State or Local Air Monitoring Station(s)

SOP - Standard operating procedure

SPM - Special purpose monitor

STAPPA - State and Territorial Air Pollution Program Administrators

TSA - Technical systems audit

XRF - X-ray fluorescence

WESTAR - Western States Air Resources Council

PM_{2.5} Chemical Speciation Program Thermal Optical Analysis Issue Paper

Carbon represents a major constituent of fine PM_{2.5} mass in many parts of the country; therefore, mass balance and quality assurance require determination of PM_{2.5} particulate carbon. Differentiation of organic, elemental, and carbonate carbon, provides a useful characterization for source attribution and trends analysis. For the PM_{2.5} speciation trends program, total, organic, elemental, and carbonate carbon will be determined by thermal-optical transmittance (TOT) and the method specified in NIOSH 5040. The specific instrument chosen was based on commercial availability and the work done by Turpin, Cary and Huntzinger, 1990. Method selection was reviewed by the Chemical Speciation expert panel (Koutrakis, 1998) and based on data use objectives and the availability of standard operating procedures.

The differentiation of organic from elemental carbon, and elemental from carbonate carbon is dependent on the specific analytical technique and operational procedures used. There are currently no reference standards or a standardized method for distinguishing between organic and elemental carbon; therefore, differing results can be obtained for the same sample depending on the analytical method used. Because of these limitations, it is extremely important that a consistent analytical method be used for the speciation trends sites.

Two thermal-optical methods are currently in use for the analysis of carbonaceous aerosols, they are the NIOSH (TOT) and IMPROVE (TOR) methods. The NIOSH method has typically been used for analysis of diesel particulate. The IMPROVE method has historically been used for the EPA IMPROVE (Interagency Monitoring of Protected Visual Environments) program for mostly federal class I areas. The measurement principal is fundamentally the same; however, the methods differ with respect to analysis time, temperature profile (temperature vs. time), types of carbon speciated, and the pyrolysis correction technique (see below for more detailed discussion). The pyrolysis correction feature allows correction for the “char” that forms on the filter during analysis of some materials (e.g., cigarette and wood smoke). Correction for pyrolysis is made by continuously monitoring the filter transmittance or reflectance throughout the analysis.

Although it is understood that comparison between organic and elemental carbon is highly variable and not necessarily expected since these are operationally-defined, recent intercomparison analyses by Chow (PM2000) identify significant differences between the elemental carbon results provided by the NIOSH and IMPROVE methods. Given that the PM_{2.5} Speciation and IMPROVE programs characterize the aerosol in both urban and rural environments and provide data for use in the EPA PM_{2.5} program, there is a necessary linkage and need for comparability of data. Although many carbonaceous aerosol sampling issues remain, this paper focuses only on the analytical method and

outlines the operational differences, method issues and the beginnings of a short-term plan for resolving the analytical issues.

Thermal Optical Analysis Issues

Organic and elemental carbon by thermal optical analysis have meaning only in the operational sense. That is, the results reflect the method used and the appropriateness of a method depends on the data use objectives. Operational-based methods differ from those used for specific, identifiable analytes (e.g., sulfate or sulfur), where a well-defined entity is quantified and laboratory standards are available for its determination. Because organic and elemental carbon are defined operationally, the details of the method must be rigorously prescribed. A single organic and a single elemental carbon fraction are defined when using the operating parameters in NIOSH 5040. Total carbon is the sum of these two and the carbonate carbon (as simple carbonate, not a bicarbonate) can be estimated by integrating the carbonate peak. In contrast, four types of organic carbon and three types of elemental carbon are defined by the IMPROVE technique. Total carbon is the sum of all fractions and carbonate is typically determined by the acidification technique. In both cases, different classes of carbon are evolved from the sample during the analysis. The division into fractions reflects the data use and purpose of the method (i.e., occupational monitoring of diesel particulate for NIOSH and visibility monitoring for IMPROVE).

Results from intercomparison studies of DRI-TOR versus Sunset Labs TOT methods by Countess (1990), Birch (1998), Chow (PM2000), and Norris (in progress) are consistent. Results for total carbon are in fairly good agreement (generally < 10 %), while the agreement for organic and elemental carbon is highly variable. Agreement between organic and elemental carbon is generally not expected, since these components are operationally defined. The difference between organic carbon measurements has been shown to be as much as $17.5 \pm 15\%$ (Chow, PM 2000). Elemental carbon as determined by the IMPROVE EC method has been shown to be as much as a factor of 2 higher (Norris, 2000) when comparing to the NIOSH EC method. Data on specific comparisons of the carbonate carbon results were not available.

Generally, the analytical differences between the NIOSH and IMPROVE methods are as follows:

- **Temperature profile and subsequent total run time** - the total run time is approximately 12 minutes for the NIOSH method and 35 minutes for IMPROVE. Refer to the table below for a comparison of the temperature profiles.

NIOSH -OC	IMPROVE -OC	NIOSH - EC	IMPROVE - EC
Helium	Helium	2% O ₂ in He	2% O ₂ in He
250E C, 30 sec.	OC1: 120E C, 3-10 min.*	650E C, 1 min.	EC1: 550E C, 3-10 min.*
500E C, 30 sec.	OC2: 250E C, 3-10 min.*	750E C, 1 min.	EC2: 700E C, 3-10 min.*
650E C, 1 min.	OC3: 450E C, 3-10 min.*	850E C, 1 min.	EC3: 800E C, 3-10 min.*
850E C, 1.5 min.	OC4: 550E C, 3-10 min.*	940E C, 2 min.	--

* Based on time required for FID to return to baseline.

OC - organic carbon

EC - elemental carbon

- Procedure for quantifying organic carbon (OC) and elemental carbon (EC) peaks** - Two different procedures are used to quantify organic and elemental carbon. For NIOSH 5040, OC is the sum of carbon before the split between OC and EC, determined as the point where the transmittance reaches the initial value, and EC is the sum of the remainder. For IMPROVE, it is the sum of the organic and elemental carbon fractions; OC = OC1+OC2+OC3+OC4+Pyrolyzed carbon and EC = EC1+EC2+EC3+Pyrolyzed carbon as shown in the Table above.
- Optical measurement of pyrolysis correction** - This feature corrects for the pyrolysis-generated EC or “char” formed during the analysis of some materials. NIOSH uses transmittance and IMPROVE uses reflectance. The point at which the transmittance or reflectance reaches its initial value is where the OC/EC definition or split occurs. The carbon evolved prior to the split is considered OC (including carbonate) and the carbon volatilized after the split, and prior to the methane calibration peak, is considered EC. The method definition of the “split” has an impact on the amount of EC and OC determined.
- Procedure for determining carbonate carbon** - The IMPROVE procedure involves a more specific determination of carbonate carbon from a second filter punch that is acidified then analyzed. The NIOSH method can provide an estimation of the total carbonate-source carbon (i.e., potassium carbonate, sodium carbonate, magnesium carbonate, calcium carbonate) by integrating the last peak that occurs just before pyrolytic carbon. Verification of the carbonate carbon present in the sample can also be done by taking a second filter punch, acidifying and then analyzing.
- Higher sample loadings** - higher sample loading require special care during analysis and can affect the results from either thermal optical method.

- **Availability of NIST Calibration Materials**

Another important issue that remains unresolved is the availability of National Institute of Standards and Technology (NIST) or other calibration standards for OC, EC and carbonate carbon aerosols. Without these materials, there is no reliable way to determine method bias or true concentrations of the carbon fractions. Thermal-optical methods are currently calibrated using sucrose. Potassium acid phthalate (KHP) is sometimes used as an alternative to sucrose and the injection of a known volume of methane with every sample, is used as quality control check of the sucrose calibration.

Short-term Plan and Objectives

Given that the measurement of carbon is operationally-based and dependent on the specific analytical technique and operational procedures used, the ultimate goal is to determine and finalize the operational details of the method used for the PM_{2.5} Speciation program. It is important to generate data of acceptable quality and consistency in order to meet the primary data use objectives (trends, SIP development, source attribution, and linkage with IMPROVE). The following questions are raised:

- Does the NIOSH 5040 method generate measurements of TC, OC, EC and CC acceptable for the data uses of the Chemical Speciation program?
- If not, what operational or method changes are needed?

Collaboration between the OAQPS and ORD/NERL staff to identify and discuss the thermal-optical method issues and define a short-term plan of action is on-going. To start, we are gathering more information relative to the intercomparison of the two methods. This information will be used to provide feedback to the program manager, and policy and scientific decision makers regarding the specific method parameters needed for the PM_{2.5} Speciation program. This group will convene as information becomes available to discuss next steps and a further course of action.

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