AIR POLLUTION CONTROL TECHNOLOGY

PROGRAM STRATEGY

FY 1976

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I.

BACKGROUND

AGENCY MISSION

The overall mission of the Agency is to protect the public health and welfare from adverse effects of air pollution. This objective must be accomplished without creating a secondary problem such as water pollution, solid waste or major unacceptable impact on land use or esthetics. Also, this mission must be accomplished at a reasonable and acceptable cost and in such a way as to not seriously upset or endanger vital national functions such as defense, food and energy supplies, and individual liberties.

In his FY 1975 Air Program Policy Statement, the Administrator of the U.S. Environmental Protection Agency (EPA), Mr. Russell E. Train, stated the following: "The Clean Air Act (CAA), in order that air pollution be reduced and prevented, provides for the establishment of a set of environmentally important goals, sets forth the process by which the goals are to be attained, and expresses a philosophy with respect to both the goals and their method of attainment."

"The goals are quantified in the National Ambient Air Quality Standards, which set forth the allowable concentration in air of a set of air pollutants associated with diverse sources widely distributed throughout the Nation. A second set of standards impact directly on emitting sources through the establishment of Federal national emission limitations. These standards include National Emission Standards for Hazardous Air Pollutants, National New Source Performance Standards, and nationwide limitations on pollutant emissions from mobile sources."

"The philosophy of the Act gives first priority to the achievement of standards protective of health. Where protective of health, the Act established mandatory times for the attainment of the standard. Where protective of welfare, the Act provides for administrative discretion as to the time of attainment of standards."

"......The Act mandates the adoption of regulations setting forth legally enforceable emission reduction plans. It provides for the adoption of certain technologies in the private sector on a nationwide basis; for example, best adequately demonstrated technology in the case of new stationary air pollution sources and a mandated reduction from new light duty motor vehicles. The Act furthermore requires the use of certain controls not traditionally applied for air pollution control, such as the control of land use and transportation, when control technology seems inadequate to meet the environmental goals within the mandatory time schedules set forth in the Act."

"The highest priority for Federal and State action has generally been directed towards those Air Quality Control Regions where pollutant concentrations exceed national standards which are protective of health. After three years of experience with the Act, it has become clear that for some pollutants in some areas the standards protective of health cannot be attained in the mandatory time period with the available control technology..... In the case of pollutants emitted primarily by motor vehicles in some Air Quality Control Regions requiring transportation controls, the level of social and economic change which may be required to meet ambient standards may be unacceptable in terms of economic and social impact."

"For some Regions, control will not be feasible due to circumstances beyond control agencies' control (i.e., natural dust sources) or without unreasonable control measures."

Role of Research and Development

The principal tools of the Agency provided by the Clean Air Act are regulatory and enforcement. The function of the research and development activities are to provide the scientific and technical information and support required to carry out the regulatory and enforcement functions. The objective of the Air

Pollution Control Technology Program is to conduct research, development and demonstration to assure the availability of air pollution control processes, methods and devices to adequately control air pollution.

The Administrator noted that the CAA, "....expresses a philosophy with respect to both the goals and their method of attainment." Perhaps the single most important and responsible tool provided by the CAA to assure sound responsible and achievable regulation is the mandate, "The Administrator shall establish a national research and development program for the prevention and control of air pollution...."

The prescribed use of the research and development (R&D) tool is to assure an adequate technical basis for the establishment of sound responsible regulations that can be achieved at reasonable cost. It is further clear that all practical means are to be used to develop a sound technical data base for contracting and setting regulations; implying that the R&D tool is not to be the exclusive source of technical information and data. Coordination of programs to develop a technical base with other agencies, industry, foreign countries, universities, etc. is essential.

We have not always been successful in our efforts to develop defensible regulations. The Administrator's Air Program Policy Statement noted some of the existing and impending unsuccessful efforts. In several instances time and resources have mitigated against achieving the optimum product. In other cases the Agency's attempts to rely on the regulated industry or others for an adequate technical data base have been largely responsible for the subsequent difficulties encountered. This experience indicates the need for an Agency R&D program as a basis for their technical support.

Almost immediately upon its enactment, the 1970 Amendment of the Clean Air Act required setting regulations. Fortunately because of earlier R&D activity a data base was available for setting SO_2, particulate and NO_x standards. These standards were largely the direct products of the R&D programs; the technical standards for SO_2 and NO_x were actually prepared by ORD personnel. Much of the Agency's success in carrying out its air pollution regulatory and enforcement mission has been due to the existence and subsequent strengthening of this technical data base. Conversely, many of the problems facing the Agency are due largely to lack of control technology and related data. Because of the strong dependency of the regulatory mission on a sound technical data base the future success or difficulties of the Agency will undoubtedly continue to reflect our technical expertise.

The Agency's policy is now to emphasize implementing existing standards. This policy and the maturing activities of the Agency in implementing standards is resulting in the need for ORD to spend a larger effort in supporting the Agency's implementation and enforcement activities as opposed to sole support of new regulations. Experience gained by EPA regulatory and enforcement personnel over the past four years has provided a sound basis for defining and prioritizing technology requirements for carrying out their programs. Difficulties experienced by ORD in the past in identifying technology support needs have been largely overcome as clients gained firsthand experience in defending and enforcing existing standards. Technical assistance and data relating to technology application and verification are now in high demand.

Agency experience over the past four years has demonstrated the need to anticipate technology requirements and to initiate programs so that there is sufficient lead time to assure that the necessary data base is available when it is needed. Although there is bound to be some differences depending upon which pollutant is involved, on the average, it can be expected that about 10 years lead time is required to set a responsible, defensible standard assuming the Agency starts from a condition in which there is no existing repository of data. It should be noted that EPA and its predecessor organization, DHEW, have been working for at least 9 years on the development of criteria for sulfur oxide and, as of yet, we do not have adequate verified criteria. Research and development to provide the needed control technology requires from 4-10 years, depending upon the complexity of the technology and its level of maturity. Again, drawing from sulfur oxide experience, it has taken about 8 years to arrive at the present status of technology development. We are still a year away from having a fully demonstrated technology.

There exists ample information to establish that there are health and welfare affects from pollutants such as fine particulates, carcinogens, sulfur oxide, nitrogen oxide, nickel, lead, arsenic, cadmium, vanadium, copper and other trace materials. Most of this information is only qualitative and will require substantial portions of 10 years to quantitatively determine the health and welfare affects. Considerable information is available to help guide the decisions as to what pollutants might be selected for intensive, effects research control approach development and possible regulations. Such information includes identification of sources of pollutants, and correlations between gross health effects with the proximity of receptors to the sources.

Strategy Definition

In carrying out its primary environmental protection mission, EPA as well as the regulated sources of pollution are dependent on the availability of processes, equipment and methods for preventing or controlling sources of pollution. This document is a strategy for a research and development program to assure availability of the necessary air pollution control technology to support the Agency's overall mission.

This strategy has been based on the premise that a strategy is an overall plan to achieve a defined mission. As such, a strategy defines the problems to be solved and sets goals and objectives to be achieved. It is sufficiently comprehensive to permit sub-strategies and program plans to be developed and provides a basis for measuring the degree of their accomplishment. The major components of a strategy therefore include:

(1) A statement of organizational mission and goals.

(2) A statement of the major problems to be addressed.

(3) A summary of the status of the several technologies involved.

(4) Identification of the research needs that must be filled to achieve a solution.

(5) A list of priorities and time schedule for accomplishment of objectives goals and ORD missions.

It is assumed that a strategy differs from research plans in that research plans are the detailed road map for implementation of programs and projects to achieve the goals and objectives of the strategy.

Strategies are appropriate at various levels of detail. Clearly, there must be one overlying strategy that addresses itself to the Agency's and ORD's mission, goals, and objectives while subordinate strategies respectively address areas, sectors, problems, or even projects. This strategy focuses on that control technology needed to support the Agency's mission in the area of air pollution control.

A single but major exception to the above perspective was made; namely, pollution control related to energy production. Recent attention to this specific component of the air pollution control problem has resulted in the establishment of a separate program to address the problems associated with energy production. From almost any standpoint there are obvious overlaps of technology research undertaken under energy and non-energy related programs. For example, the effects, transport or control technologies in general are only indirectly sensitive to the specific source. Nevertheless, for purposes of this strategy, energy-specific air pollution control technology has not been included.

In the development of this air pollution control technology R&D strategy, an attempt has been made to consider and be responsive to all available inputs and factors that combine to influence the R&D function. These have included the congressional mandates, agency policies and guidelines, where they exist, data implied by budget levels, personnel distribution, stated and implied needs of the Regulatory and Enforcement Offices, and the stated needs of the Regions.

The primary clients, for purposes of this strategy include, (1) Office of the Administrator, (2) Office of Air Programs, (3) Office of Enforcement, and (4) the Regional Offices. Other key clients include State EPA offices, environmental organizations, other Federal agencies and Industry. The audience to which this strategy is addressed includes not only all clients listed above but also includes other EPA and ORD offices, Congress, certain Federal government offices such as OMB and CEQ, the general public and, of course, offices responsible for the implementation of the research objectives.

Organization of Strategy

This strategy first examines the missions, objectives and priorities of the Agency as found in the Clean Air Act and as provided by the Administrator. Since the primary missions of the Agency are regulatory and enforcement, the objectives and strategies of the regulatory and enforcement offices have been carefully reviewed for further guidance to the R&D program.

Considerable effort was made to identify and understand the views and technology requirements of the users of research and development (R&D) products.

The results of interviews with these users (clients) are presented in an appendix to the strategy document. This appendix attempts to state the clients' views and requirements as they were received without editing or analysis. It should be noted however that the clients' interests and technology requirements generally covered a broad range of R&D disciplines including health effects, monitoring regulations and enforcement. Since this strategy deals only with control technology R&D programs, only those clients' inputs that relate to control technology have been included here.

In Section II of the strategy, the clients' inputs have been collected and aggregated along lines of common problems and requirements. This was the first step in the development of a coherent, responsive R&D program.

The final section is a research and development program strategy to provide the Agency and clients with the air pollution control technologies possible within the constraints of available resources.

Because clients' backgrounds and interests differ widely and because control technology requirements are seldom stated by the clients in terms used by the researcher or research program, it has been necessary in some cases to restate the clients' technology needs and convert them to specific research programs. This was done in conjunction with the clients to assure that the meaning and intent of clients' needs were preserved.

The strategy is organized by program area and program element to correspond to the administrative (Federal Accounting System) categories under which the research is conducted. For convenience each major area or element is preceded by a brief background that summarizes relevant Agency and program history, Agency goals and clients' needs. A statement of the problem is included as a concise basis against which the program strategy and specific research objectives are stated.

Finally a tabular cross-walk between client's needs and strategy objectives is provided to assist the client in relating his problem to the R&D objectives and to assist those executing the program in identifying specific problems to be addressed by the objectives. A schedule of resources assigned to each major work area of the strategy is given in the attached tables.

II.

SUMMARY OF PROBLEMS

To be responsive to the Agency's mission and to provide support to the regulatory, enforcement and other offices of EPA, it is essential that ORD have a clear understanding of the clients' technology requirements. To assure that our understanding of the clients' technology needs is current and complete, each client was interviewed. Appendix A lists the needs identified by each client. These needs were then analyzed and aggregated to produce this section.

In addition to the specific and largely immediate needs identified in Appendix A, several clients expressed concern over the need for long-range technology programs to support the Agency's mission. Their concerns included both the requirement to further define or quantify problems such as sulfates, fine particulate or hazardous pollutants and larger range problems that relate to emerging industries and industrial expansion. These longer range needs were noted and have been summarized and included in this section.

In the following summary of R&D problems, common needs have been aggregated to improve readability and organization. An attempt has been made to preserve the statement of the problem from the client's viewpoint. Only those problems that relate to control technology requirements have been included. Therefore, the problems contained in this summary do not include all the problems/needs identified by the clients. Since each client (e.g., each region) has a somewhat different set of priorities it is not possible to assign overall priorities to each aggregation of clients' needs. However, an attempt has been made to reflect overall priority of aggregate by placing those of higher priority first in their order of appearance in this section.

ADMINISTRATIVE

Almost all of the clients expressed a need for improved coordination of R&D planning, communication of research finding and technical assistance. The following aggregates the needs in these areas.

Coordination of Research Planning

The research needs of EPA's operating groups should receive more consideration in programming, planning and execution than they have in the past. For example, many high priority regional problems may not be addressed if all priorities are derived from a generalized national viewpoint. Often the research needs of the operating groups within the Agency have special restraints and requirements on problem solutions, such as short time requirements, economic or special intermedia concerns. These requirements must be understood and accounted for in the planning and execution of work if the output is to be used to the maximum Agency benefit. Client offices need to make sure that their problems are well explained and to follow thru with changing requirements. A coordination mechanism is needed to allow OR&D to be more responsive to these time dependent and special needs. It is also recommended that ORD become better aligned with the operational activities to improve its overall responsiveness to the agency's total research requirements. Objectives and outputs of the R&D program should be more directed to developing technology thru the stage that it is capable of being applied to solve emission problems. Objectives should be directed at specific problems to a larger extent than in the past.

Communication

The client organization's work in solving air pollution problems requires the use and implementation of the scientific information and technology that has been developed by ORD. Many of the ORD research reports do not provide the information needed to translate research findings into problem solutions. It is important that control technology be developed to the point of learning to apply the technology and that research findings be reported with greater emphasis on implementation and solutions to specific problems. Additionally, state-of-the-art summaries, seminars and executive reports to provide and update technical information are needed. Design manuals, and technical transfer documents were mentioned as being particularly useful in this regard.

Technical Assistance

Periodically the clients require technical assistance from a variety of R&D programs. This assistance usually consists of technical consultation and/or assistance in prepration for hearings or court cases. Many problems requiring technical assistance are industry rather than scientific discipline related. As such designating focal points of expertise for specific industries within ORD would also be desirable.

URBAN BACKGROUND PARTICULATE

Particulate matter in urban areas caused by sources such as tire wear, brake lining, reentrained street dust, and open disposal sources cause National Air Quality Standards for particulates to be exceeded in many areas. Research is needed to better identify and quantify important sources of this background particulate. Appropriate technology is required to limit controllable sources. New reference methods for sampling particulates which differentiate among particle sizes will have to be developed.

Problem Characteristics

1. Identification, quantification and characterization of reentrained dust and dusts from open sources.

2. Development and demonstration methods for control of fugitive sources.

Referencing Groups

OAWM, Regions 2, 3 and 10

PARTICULATE SOURCE CONTROL

There is a pressing need for applicable technology to control all sources of particulates such as power plants, asphalt plants, chemical processes, iron & steel processes, wood burning fireplaces and sawmill operations. This need includes development of fabric filters which can function with high temperatures. Better modeling procedures are needed for control equipment design and specification. There is a need for further characterization of both open and contained particulate sources, especially with respect to particle size and associated health effects. This information will help determine if the standard should be changed to reflect particle size, and whether the existing or new standard can be met with available control methods. Note: ice fog is a unique form of this particulate problem.

Problem Characteristics

1. Industrial control problem includes a wide range of point and non-point sources.

2. Characterization requires size distribution and specie identification.

3. Several control methods to cope with full range of problems are needed to meet standards.

4. Lower cost control systems are needed.

Referencing Groups

OGE, Regions 5, 7, 9 and 10

(AISI) American Iron & Steel Institute

(APCA) Air Pollution Control Association

FUGITIVE DUSTS

Today no effective means exist to control fugitive dust emissions. Fugitive dusts from sources such as strip mines, iron & steel process disposal sites, tailings piles, unpaved roads, forest fires, agricultural operations, construction and recreational activities contribute to the background levels of dust. Some are thought to have associated health risk due to their heavy metal and silica content. A technical data base is needed which includes characterization, source evaluation, effects and possible control methods for this class of particulates.

Problem Characteristics

1. There is a need to quantitatively identify sources and assess importance of major sources of fugitive dusts.

2. Control techniques are needed for the more serious sources of fugitive dust.

3. Where control is impractical or unnecessary, methodology to compensate for fugitive dust source background measurements is needed.

Referencing Groups

OAWM, Office of Legislation

Regions 6, 8 and 9

AISI

FINE PARTICULATE CHARACTERIZATION AND CONTROL

Fine particulates are a health hazard because in contrast to coarse particles they can bypass the body's respiratory filters and penetrate deeply into the lungs. Fine particles released into the atmosphere remain airborne for extended periods of time, obstruct light and cause limited visibility typical of air pollution haze and smog. They have been identified as transport vehicles for gaseous pollutants. The health hazards of fine particulates are intensified by the tendency of metallic materials from high-temperature processes, such as pyrometallurgical and combustion processes, to condense as chemically and catalytically active fine particulates. Many toxic and potentially hazardous compounds are also emitted as fine particulate. Particulate matter formed in the atmosphere from the reaction and condensation of gasses is another major source of fine particulate pollution. These gas-phase reactions make it difficult to relate atmospheric particulate pollution levels to specific sources. This has hampered the development of effective control strategies and the establishment of meaningful emission standards. The control of these secondary forms of particulate must be through control of their precursors.

Many years will be required to develop a sound data base to quantify the health effects problem of fine particulates. Sufficient information does exist, however, to conclude that fine particulates must be controlled if public health is to be protected.

EPA has established a goal of setting fine particulate standards. To develop these standards, research and development is necessary to provide a minimum data base. This data base and the necessary technology does not now exist. Key among the R&D needs is a program to identify and characterize fine particulate sources. Work is needed in three areas: 1) identification and characterization of fine particulate point sources, 2) identification and characterization of gaseous precursors and the conditions under which gas-phase reactions form fine particulates, and 3) identification and characterization of open sources of particulates.

A second major need is in the area of control technology for fine particulates. This involves upgrading conventional particulate collection equipment to improve its efficiency to remove fine particulates. Also, development of new control methods is needed as part of the control technology program. Several new control mechanisms appear to have promise.

The performance of control equipment often decays with time, so that sources brought in compliance with new equipment may fail to meet emission standards after a period of time. A study characterizing the long-term performance of control equipment as needed to guide policy and enforcement decisions.

Problem Characteristics

1. Identify, characterize and quantify fine particulate sources.
2. Determine fine particulate control capabilities of conventional control equipment.
3. Develop and demonstrate fine particulate measuring equipment for sources and ambient concentrations.
4. Demonstrate control technology capabilities capable of controlling both large and small sources.
5. Develop effective collection devices with lower energy requirement and lower pressure drop.

Referencing Groups

OAWM, OGE, Region 6, AISI, Manufacturing Chemists Association (MCA), Industrial Gas Cleaning Institute (IGCI), Air Pollution Control Association (APCA).

SULFUR OXIDE

Past emphasis on control of utility emissions has resulted in demonstrated ability to control SO_2. The same degree of control does not yet exist for smaller sources including area sources, industrial processes and industrial combustion. This is due, in part, to the higher costs associated with adapting power plant control processes to control of these smaller sources. Yet it is important to control these smaller sources because it has been determined that these smaller sources contribute more than would be originally expected to the ambient levels of sulfur oxides. Although utilities contribute nearly 75% of the total inventory, they actually contribute only about 22% of the ambient concentrations. The remainder is contributed by these smaller sources of pollution. A viable, lower cost method of controlling these smaller sources is needed.

Control of SO_2 emissions from industrial processes such as coke ovens, secondary smelters (junk dealers), acid plants, pulp and paper, petroleum processing, gas sweetening and other industrial sources remain a significant problem. Development and demonstration of adequate technologies are needed for many of these sources. There is also a need for suitable control technology for small industrial boilers which will have to comply with state SO_2 regulations starting in 1975. As low sulfur fuels decrease in availability, higher sulfur oil and coal will have to be burned resulting in higher emissions of SO_2. Industrial groups pointed out that non-regenerative processes generate large quantities of waste which is expensive to haul away and difficult to dispose of for small SO_2 sources. There is also a need for improved efficiency of the SO_x scrubber and the demister used on larger SO_2 sources such as utilities and large industrial combustion processes.

EPRI indicated that specifically lime/limestone scrubbing needs to be evaluated and tested to provide engineering companies with data which will enable them to design and build large scale scrubbers to be used with high and medium sulfur coal.* Better understanding of the relationship between bench, pilot and large scale scrubbers has to be developed. Many industrial groups indicated further need to study SO_2 scrubber chemistry. Scaling and corrosion were mentioned by the industrial groups as persistent problems. They also pointed to a need to continue working on the dry-adsorbent systems for small boilers.

It was the opinion of IGCI that the government should increase its support of new processes to make their utilization practical for industrial boilers. Demonstrations for industrial boilers are needed for one more throw-away process and two or three recovery processes.

Problem Characteristics

1. There is a need for control technologies to economically and effectively handle the industrial process and small combustion sources of SO_2.

2. Many sources are low technology, low profit margin sources that require simple low-cost control solutions.

3. Achieving NAAQS in many areas will require control of small industrial processes and area sources.

4. Sludge fixation and disposal work is needed.

Referencing Groups

OGE, OPM, Regions 1, 4, 7, 8 and 9

Manufacturing Chemists Association, IGCI, Electric Power Research Inst. (EPRI), Air Pollution Control Association (APCA)

*Energy-related R&D is identified in the Energy Research Program

NITROGEN OXIDE*

Presently, control technology is not available to meet the NAAQS, (100 micrograms/meter^3), for NO_2. Two regions (ACQRs), Chicago and Los Angeles exceed the NAAQS while several others are marginal. Future growth of both industrial and transportation sources will ensure exceeding the NO_x NAAQS in several other areas.

The allowable emissions from light duty vehicles (automobiles and small trucks) as established by the 1970 Clean Air Act have been increased by the "Energy Supply and Environmental Coordination Act of 1974." The Agency has adopted a policy to emphasize the control of stationary sources and to deemphasize the stringent control of mobile sources. This strategy, known as the Maximum Stationary Source Strategy (MSST), will require application of control technology to a wide variety of stationary combustion sources.

Under the MSST strategy the stationary sources that require control include a wide range of large utility boilers, industrial combustion processes and small domestic heaters that use a full spectrum of fuel types; all of which respond differently to control techniques and all of which have special restraints and requirements on the application of controls.

While large utility sources account for most of the NO_x mass emissions, area sources, which include small domestic and commercial heaters and some small industrial boilers, are responsible for the largest impact on ambient air quality because of their locations and short stacks. Industrial boilers also have significant impact on air quality and will require control in some cities.

Nitrogen oxides react with hydrocarbons in the atmosphere to produce oxidants. This reaction is one important mechanism that causes oxidant standards

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*Also see Oxidant & Hydrocarbons

to be exceeded in many regions.

The major R&D needs include the further development of control techniques applicable to the smaller sources of NO_x and the development of methodology to apply this technology to the broad range of sources.

Field tests and demonstration programs to prove the applicability and effectiveness of these technologies are required.

Problem Characteristics

1. Agency policy is to emphasize control of NO_x from Stationary Sources.
2. Control technology for variety of sources needs to be demonstrated on major source categories.
3. Sources need to be better characterized for strategy planning.

Referencing Groups

OAWM, OPM, Region 9, AISI, Manufacturing Chemists Association.

HAZARDOUS

Trace metals and other potentially hazardous gaseous and particulate substances are emitted into the air from a large number of industrial sources in amounts that could threaten human health. The Agency's policy and attitude toward dealing with these kinds of pollutants is unclear largely due to the lack of data to define the problems, i.e. source characterization and health effects data. Difficulties that relate to the setting and enforcement of hazardous pollutant standards have to a large extent been responsible for Agency inactivity in this area. Nevertheless these pollutants represent a class of air pollution that cannot be long ignored. Episodes and localized problems of lead, hydrogen sulfide, freon, mercury, asbestos, etc. pollution force a reminder that the EPA charter is designed to include this type of problem. To date only three materials have been the subject of hazardous pollutant standards (mercury, asbestos and beryllium). Beyond these pollutants (and to a great extent for these pollutants) little is known.

There are other pollutants for which further control action will be required in the not too distant future. Some of the leading candidates would appear to be arsenic, lead, cadmium and antimony from copper and other non-ferrous primary and secondary smelters. Other pollutants of concern include chromium from primary manganese production; nickel from oil-fired power plants, ferroalloy operations and primary nickel production. Still others are barium, copper, fluorides, polynuclear organic material, selenium, boron, chlorine, zinc, vinyl chloride, tin, and vanadium.

Hydrocarbon emissions are also of great concern to the Agency. In addition to studies linking benzopyrenes with increasing incidents of lung cancer, many of the higher hydrocarbons undergo changes in the atmosphere that result in damage to vegetation, eye irritation and reduced visibility. A principal complication of this class of pollution is that the sources of hydrocarbons are quite numerous. Major sources of hydrocarbons include petroleum refineries, chemical manufacturing plants, coal coking operations, fuel burning (stationary and mobile sources) waste disposal; food processing and the manufacturing and end use of organic solvents.

Like most air emissions, hazardous air pollutants involve multimedia pollution. The origin and fate of hazardous materials involve not only air but land and water as well. For example, airborne asbestos from mining and milling operations, manufacturing of asbestos products, demolition of buildings with asbestos fire-proffing and insulation, ore dumps, tailing piles and land filled disposal areas contribute to asbestos particles found in street dust, rivers etc. The multimedia aspect relative to hazardous and potentially hazardous pollutions is not unique to asbestos but is also common to many trace materials (e.g., mercury, vanadium and cadmium).

The main problem facing the Agency in its attempt to establish standards and strategies for controlling potentially hazardous pollutants lies in the fact that the data base necessary to define and quantify the extent of the problem is essentially non-existent. The need exists for a program that will identify, quantify and characterize all potentially hazardous pollutants and the major sources. This information is required as the only logical starting point for selecting and prioritizing pollutants to initiate an effective health effects program.

As part of the hazardous and trace material identification, quantification and source characterization program, the availability and adequacy of control methods for these pollutants should be determined. Many of these pollutants are particulate and would be amenable to control by technologies devel ed for fine particulates. Thus this control technology development for this class of pollutants will require little work beyond that which is proper in other program areas. Rather adaption and demonstration of these methods on specific sources is required.

The OAWM expects that many toxic emissions will be controled as fine particulates. The Agency is now considering new regulations aimed at fine particulates. Data are needed to define the potentially toxic emissions that might be controled incidental to controlling fine particulates.

Problem Characteristics

1. Identify, quantify and characterize potentially hazardous pollution by major sources.

2. Determine availability and adequacy of control methods.

3. Develop and demonstrate control methods as needed.

Referencing Groups

OAWM, Office of Legislation, Regions 1, 2, 3, 4, 6, 7, 8, 9, 10

OXIDANTS

The relationships of ozone levels to hydrocarbon emissions and concentration of nitrogen oxides is not well understood. These relationships are further complicated by a lack of understanding of the transport, transformation and removal of oxidant and its precursor in urban areas and in rural locations. New control strategies are needed for photochemical oxidant and its precursors, hydrocarbons and NO_x, over many large areas of the country (especially the northeast) in order to meet the ambient air quality standards.

Problem Characteristics

1. Transport of oxidants is not understood.

2. Oxidant-HC-NO_x chemical interactions need to be established.

3. Source-receptor relationships are not understood.

4. Control of automotive and stationary HC & NO_x emissions.

Referecing Groups

OAWM, Regions 1, 2,3,4,5,6,7, and 9

HYDROCARBON CONTROL, STATIONARY SOURCE

Measures to control hydrocarbons (HC) from sources such as fuel evaporation, solvents, degreasing operation, food processing, paints, cooling, coking, chemical manufacturing, etc. are urgently needed. Many AQCRs will never meet oxidant standards even if mobile controls are implemented. Standards in other AQCRs will be exceeded shortly as growth in the automotive population increases emissions. Major action to control non-vehicular sources is essential. Specific programs to characterize the large number of potential sources, especially industrial and commercial processes are needed in order to determine the degree of control currently possible and to determine the control technology needs. Several control technologies now exist to deal with many of these control problems. They need adaption, modification and demonstration to support existing and developing control strategies.

Problem Characteristics

1. The large number of small HC sources need to be identified and characterized.

2. Control methods need to be identified, developed and demonstrated.

Referencing Groups

OAWM, Manufacturing Chemists Association

SMELTER CONTROL

The non-ferrous smelter industry, (mainly: lead, copper and zinc) constitutes a major air pollution control problem. The industry has successfully resisted regulations primarily because of arguments about the adequacy and economics of control technologies. In addition to being a major source of SO_2 these smelters are major sources of cadmium, lead, copper, arsenic, zinc and other toxic emissions. Although existing control technology for strong SO_2 streams may be applicable to these smelters, control methods for weak SO_2 streams and the heavy metals are needed. Also the degree of control possible by applying conventional technology is not well established. Technical assistance is required in establishing the degree of control for specific plants and to assist in the implementation of these plans.

Problem Characteristics

1. Complete characterization of smelter pollutants is needed.
2. State-of-the-art data on applicable control technology is required.
3. Technology to control fugitive smelter emissions is needed.
4. Control technology capable of adequately collecting weak-stream SO_2 and trace material requires demonstration.

Referencing Groups

OGE, Regions 6,7,8,9, and 10

SULFATES

Due to the potential impact of sulfates on the Agency control strategy currently used for SO_2, the priority for research in this area has greatly increased.

Efficient means to control sulfates is needed. Whether they originate mainly from stationary, mobile sources or are formed by reactions of SO_x in the atmosphere must be known. Measurement and control technology along with an understanding of the atmospheric chemistry is needed.

Problem Characteristics

1. As the principal precursor of sulfates, SO_2 emissions may have to be controlled to another order of magnitude.

2. Little is known about the origin and fate of sulfates. Atmospheric chemistry and transport information is insufficient.

3. Measurement methods are inadequate.

Referecing Groups

OAWM, Regions 1, 2, 7, 9 and 10

SOLID WASTE

Incineration of sewage sludge and raw chemical sludges are principal means of disposal. Incineration may, however, lead to significant emissions of such pollutants as mercury, cadmium, lead, copper, chromium, pesticides, pathogens and other toxic substances. Information regarding control technology applicable to incineration operations is needed. New control technology may be required. Bacteria and virus transport from sewage aeration is also a concern.

Problem Characteristics

1. Pollutants from sewage sludges and raw chemical sludges need to be more completely characterized.

2. Municipal and industrial incinerators control methods require demonstration.

3. Methods for trace pollutant control is needed.

Referencing Groups

Regions 1, 3, 5, 7, and 9

ODOR CONTROL

Characterization of the nature and magnitude of the odor control problems associated with processing agriculture and industry wastes is needed. Particularly, odors from feedlots, waste treatment composting piles and lagoons, raw chemical sludge composting piles, food, and animal feed processing need to be characterized and odor control techniques developed.

Problem Characteristics

1. Measurement technology is needed.

2. Control technology, applicable at a reasonable cost is needed.

3. Environmental impact including both health and welfare effects are needed.

Referencing Groups

Regions 3, 5, and 7; Manufacturing Chemists Association

FERTILIZER PROCESSES

There is a need for improved stack gas sampling of gas streams from fertilizer processes including prilling towers and nitric acid plants associated with the fertilizer industry. Pollutant characterization is needed and new control methods developed and demonstrated.

If the fertilizer industry expands to meet growing needs this class of source may have significant effects on ambient air quality.

Problem Characteristics

1. Stack sampling and monitoring methods are needed.

2. Pollutant characterization and new control methods are needed.

Referencing Groups

Regions 7 and 10

OPEN COMBUSTION SOURCES

Methods are needed to reduce the risk and to extinguish landfill fires that develop via spontaneous combustion. This is particularly a problem with landfills receiving construction debris and where old strip mines are used as landfill sites. Carbon monoxide resulting from such fires may be a severe problem.

Problem Characteristics

1. Technology is needed to reduce the risk of spontaneous combustion.
2. Develop fire control methods.

Referencing Group

Region 3, 10

CONTROL EQUIPMENT RELIABILITY

A limited amount of data indicates that control equipment, particularly electrostatic precipitators, deteriorate rapidly after an initial period of three to six months. It has been noted, for example, that even if steel mills were completely equipped with electrostatic precipitator scrubbers and baghouses, the standards still would not be met because of lack of proper maintenance and operation. An engineering study is needed to assess performance deterioration and to develop new design and maintenance features to reduce deterioration of control equipment and to provide guidelines to scheduling compliance checks.

Problem Characteristics

1. Methods and specifications relating to both the quality of construction and the degree and quality of maintenance of control equipment is needed.

2. Design maintenance and operating manuals that can be used by regulatory and enforcement personnel are needed.

3. Data defining performance deterioration is needed.

Referencing Groups

OAWM, OGE, Region 5

INDUSTRY CONTROL, SPECIFIC

Technology to control emissions from several specific industries that have unique characteristics and control problems is lacking. These include sources such as: sinter machines, electric furnaces, aluminum mills, pulp and paper charcoal kilns and freon sources. The source-specific problems range from inadequate coke oven door closures and collection sheds for control of unsophisticated charcoal kilns. In each case, pollutant characterization is needed along with definition of control technology that will provide acceptable multi-pollutant control of the industry. Methods of modelling are needed to show the best overall control strategy considering cost benefit analysis, cost effectiveness, energy, and total environmental impact.

Problem Characteristics

1. Control of industries with problems that do not respond to "Conventional" control technologies.

2. Industries because of lack of technology and resources, may be unable to economically solve their specific problems with existing control technology.

Referencing Groups

Regions 4,5,7,8, and 9; AISI; Manufacturing Chemists Association

IRON AND STEEL PROCESSES CONTROL

The iron and steel industry listed a number of needs that require that they be listed separately. These problems are industry specific and could not be fitted into other categories in this section.

Problem Characteristics

1. Development of methods for reuse, recycling, recovery or disposal of melt shop dust.

2. Development of processes for practical control of CO from sinter machines.

3. Development of processes for processes for practical control or removal of H_2S from coke over gas and disposal of H_2S.

4. Development of processes for practical control for collection or suppression of oil vapors form changing of oily scrap in electric furnaces and basic oxygen furnaces.

Referencing Groups

AISI

III

STRATEGY

Section I of this document described the relationship between the mission of the Agencyand the mission of the Office of Research and Development. The definition and function of air pollution control technology was discussed in relation to these missions. Section II addresses specifically the research and development needs as identified by ORD clients. Section III describes a research, development and demonstration strategy for air pollution control technology which is aimed at responding to clients' problems and, at the same time, responding to the longer range anticipated needs of the Agency.

The technology requirements of the Agency have been derived from specific problem statements and anticipated future needs of the Agency. Client organizations have also identified communications and administrative problems related to the ORD program. In this section, the R&D activities and objectives derived from these problems and required to support the Agency's mission are presented. Table I is provided as a convenient crosswalk between the clients' needs in Section II and the R&D objectives called for in the strategies. For the convenience of the reader, research and development program objectives in this section are identified in italics. Finally, resource summary Table 2 is provided to show the distribution of resources required to support the FY-76 program.

The strategies that follow are developed to the point of stating specific research objective statements. They stop short of defining specific research and development plans for their accomplishment. The objective statements address the question of what R&D is needed to be responsive to clients' needs and the Agency missions. It is anticipated that a detailed research program plan will be developed which will describe the R&D activities being done to support these objectives. Indeed, to the extent that this strategy correlates with the ongoing program, research objective statements can be related to current program EROS and ROAPS.

COMMUNICATION/ADMINISTRATIVE

Each client has identified and strongly emphasized the need to effectively deal with past communications and administrative problems outlined in Section II and in the appendix. These problems generally include the following:

- The need for better communications between all clients and ORD researchers in defining problems, in planning, and in executing to ORD program and in reporting results.

- The need for ORD to be responsive to specific client problems.

- The need for ORD's work to be carried to the point that application of problems are solved and the ORD output can (new technology and information) actually be applied to solve problems.

A principal objective of this strategy is to focus on the importance of this problem area to establish a high priority and to make available the resources required for their solution.

The solution of these problems depends mainly on the commitment of the research laboratories and the individual researchers to the concept that sharing in the responsibility for understanding and solving the specific client's problems is required to support the Agency's goals. The communication required to support this concept cannot be effectively handled through a third party but requires positive communication efforts between the ORD researchers and all of the client offices.

PARTICULATE

BACKGROUND

Particulate matter can be classified into coarse and fine. The principal problem lies in controlling the latter. The four principle control devices (electrostatic precipitators, fabric filters, scrubbers, and cyclones) are in general an efficient means of removal of coarse material. For particles less than 3 microns in diameter, major losses of collection efficiency occur.

With most heterogeneous sized dusts, the fine particulate frequently represents a minor fraction of total mass, (e.g. in average fly ash 3% or less of total mass). This fraction, however, remains airborne for extended periods of time and as a result accumulates in the atmosphere.

Particles of this size range tend to have maximum effect on light obstruction because their sizes frequently approach the wavelengths of light. Because they also tend to act more like molecules of gas than particles of dust, they are capable of being inhaled deeply into the lung passages. The high surface area per unit of mass tends to make fine particulates highly reactive both within the respiratory system and while suspended in air.

Fine particulates in ambient air can be classified by their origin as (1) primary when emitted as particulate from a source and (2) secondary, when formed in the atmosphere. Emitted fine particulates most frequently result from the condensation of gaseous emissions from processes such as combustion, metallurgical processes, pyrolysis, and processes involving organic and other materials that are gaseous at high temperature. Emitted fine particulates include all significant forms of metallic and metallic oxide fine particulates and most of the major carcinogenic hydrocarbons introduced into the atmosphere.

Emitted fine particulate, therefore, accounts for the major source of particulate hazardous or potentially hazardous air pollutants. Secondary fine particulates are formed by the reactions of gases, liquids, and solids in the atmosphere. Except as they may contain irritants or carcinogenic hydrocarbons, secondary particulates are generally less hazardous. It appears, however, that there is a strong interrelationship between the primary and secondary particulate. The primary emissions may supply the catalyst, the reaction surfaces and nuclei for the formation of secondary fine particulates.

The importance of fine particulate, both as an intrinsic pollutant and as a major form of hazardous and potentially hazardous pollutant, has been long recognized, however, no attention has been given to their control until about two years ago. Initially the Agency intended to set standards on those pollutants by 1974. The efforts have been unsuccessful principally because of the lack of technology and inadequate data base. It is the goal now to set standards within the next two years.

Statement of the Problem

In order to achieve the goal of setting standards for fine particulates as far as the control technology program scope is concerned, several problems will need to be addressed.

First of all, no reliable method for measurement of fine particulates in ambient air or in sources is yet available. Such methods are necessary for any useful research.

Because fine particles have a tendency to agglomerate easily it is difficult to measure the true effective size in the entrained or insitu condition. It is the entrained size distribution that affects the particulate collector efficiency, identifies real concentrations in the ambient air, and determines factors such as lung penetration and light scattering.

The most important parameter for fine particulate measurement is the surface area which is important in chemical kinetics and probably in health effects. Because particle count for a given size fraction is directly proportional to the surface area, particle count would appear to be a valid parameter for measurement of fine particulates. Several measurement techniques are available. Optical techniques can be used for particles down to about 0.5 microns. Below that, the particles approach the wavelengths of light so that measurement techniques which utilize light begin to fail. Other techniques, however, like those using electrostatic and diffusion characteristics are available. Attempts to cross-calibrate these several methods have met with limited success and there is no standardized method that presently exists.

The second problem area is the lack of quantitative knowledge of fine particulate sources, characterization of those sources and sources of precursors of fine particulates and the relationship between those sources and concentrations of fine particles in ambient air. That information is necessary for development of control technology and as a general data base for development of standards.

The third problem area, and the one for the solution of which the responsibility lies mainly in this program is the lack of technology to control fine particulate emissions. Three conventional control technologies, electrostatic precipitators, filters, and scrubbers, are capable of some level of fine particulate matter control but it is not known if these devices can be applied to the many sources that need to be controlled.

Filters appear to have the greatest promise of the three conventional devices. High collection efficiencies have been measured even for very fine particulates. Unfortunately, filters have limited application. They cannot be used at high temperatures or with corrosive gases. When the particulate being collected is wet or sticky, it will clog the filter until it can no longer be used.

Under ideal conditions, relatively high particulate control efficiencies are possible with the use of electrostatic precipitators. They have been used successfully with high power inputs and with long exposure paths. Improved electrostatic precipitator designs are needed to increase the efficiency, reduce the cost and increase applicability for fine particulate control.

The use of conventional scrubbers as collectors of fine particulates poses several problems. Very large energy inputs are required for fine particulate control. As particles decrease in size the efficiency of scrubbers drops quite rapidly. The use of scrubbers does not appear attractive unless devices which augment efficiency by increasing the size of the particles are developed. Some of the techniques to increase particle size appear to have promise but need more research and development. Possible techniques to increase agglomerate or increase particles are based on a variety of phenomena such as condensation, nucleation, electrostatic, sonic, and diffusion agglomeration.

Research Program

Two years ago the emphasis of the particulate control program was shifted to emphasize fine particulate control as opposed to the general upgrading of the collection equipment. Presently, in addition to the program considered by this strategy, fine particulate control technology program is also supported by the newly created Office of Energy Research within ORD which has the responsibility for pollution control from energy-related sources. The two programs will complement each other in development of technology and will provide input to the hazardous pollutant program.

The strategy calls for achievement of several objectives in this program area. The program consists of four major parts.

1. Identification and characterization of fine particulate sources and emissions (both mobile and stationary).

2. Assessment of capabilities and upgrading of conventional particulate control technology for collection of fine particulates.

3. Development of new technology for collection of fine particulates.

4. Development and or selection of standard methods and equipment for measurement of fine particulates.

Fine particulates originate from many sources (combustion, mechanical and chemical processes, fugitive dusts and open sources). The extent to which these sources contribute to ambient air pollution or type of particulate they emit is unknown. *The specific objectives are to identify the fine particulate sources, and characterize the chemical and physical properties of particles that are important to their collection.* Some fine particulates in ambient air result from atmospheric reactions. *Therefore, it will be necessary to identify and characterize population of sources of the precursors to secondary particulates.* An R&D program which might be needed to reduce these emissions most likely would be carried out under another more appropriate area.

The degree to which the conventional particulate collection equipment is capable of fine particulate collection is still unknown. *The objective of this strategy is to assess the capabilities of filters, electrostatic precipitators and scrubbers to collect fine particulates. This is to include an evaluation of* *the fractional efficiency of the most promising, best operating equipment and characterization and evaluation of the commercially available equipment.* Resulting from this program it can be foreseen that *upgrading of the design and operation parameters will be required to increase the efficiency of the conventional equipment to collect fine particulates.*

This part of the strategy addresses the identification and development of the new promising mechanisms which will increase efficiencies of fine particulate collection. *The objective here is to develop new control devices or mechanisms which can be used as augmentation of the control devices.* These most likely will be based on the special properties of fine particulates. The promising techniques include use of particulates as nuclei for condensation of liquids or solids, electrostatic agglomeration, sonic agglomeration, diffusion agglomeration, and electrostatic augmentation of scrubbers and filters.

At the present time there is no available standardized reliable equipment and method for measurement of fractional distribution of fine particulate sizes. The number of available methods decreases with the decrease in particle size. *It is an objective of this strategy to select from the available equipment or develop methods capable of efficient and reliable measurement of fine particulates in ambient air and in sources or to develop methods for this purpose.* The availability of such methods and equipment is an indispensible part of the control technology program.

The performance of particulate control devices may deteriorate with time. *The objective is to assess the long-term performance of control equipment and if needed determine the operating, maintenance and design features required to maintain performance.*

To provide the needed control technology for ice fog, control methods for major sources will be evaluated and developed.

SULFUR OXIDE

Background

The SO_x control program has historically been the largest signle EPA air pollution control research activity in terms of resources. As such, it has absorbed over 50% of the total air pollution control R&D budget through FY-74. Through FY-72, almost the entire effort was devoted to controlling utility power plant emissions, mainly through flue gas desulfurization processes (FGD) such as lime injection and scrubbing using lime/limestone, sodium, magnesia, or ammonia as the alkaline medium. Emphasis was placed on utility emissions recognizing that utilities are the single largest contributor by man to air pollution. Starting in 1968, additional emphasis was placed upon prevention of sulfur oxide emissions (as opposed to post-treatment) through the clean fuels program. This effort involved coal cleaning, coal/oil gasification and fluidized bed combustion. As a result of these previous activities, the state-of-the-art of flue gas desulfurization is far advanced. Large scale demonstration of scrubbing technology is nearing completion and many utilities are constructing, or planning construction of units based upon this past R&D.

Statement of the Problem

About 80% of all sulfur oxide emissions originate through the combustion of fossil fuels. The remainder comes from process industries such as smelters, refineries, pulp and paper mills and sulfuric acid plants. Nearly 50% of the emission inventory originates from utility power combustion of fossil fuels, coal and oil. Natural gas contributes very little to the inventory. However, the total emissions do not reflect the actual environmental impact. It has been determined that in the average industrial city while the utility emissions account for about 53% of the inventory, the actual distribution in the ambient air is around 22%. This is because power plants usually have tall stacks and are located in more rural areas remote, from the population centers. On the other hand the smaller, industrial and commercial sources and area sources account for about 46% of the emissions inventory but contribute 78% of the actual distribution in ambient air. This largely because these sources are lower, and closer to the affected population. This major environmental impact of non-utility sources is responsible for a major change in the emphasis in the SO_x control program.

SO_2 Research Program

Starting in 1973, the R&D emphasis was shifted from utility power plant emissions to industrial/commercial combustion sources and industrial process sources. While flue gas desulfurization is practical for large sources this same technology was economically impractical for smaller sources and marginally profitable industries. An assessment of technology applicability indicated that sources smaller than 10MWe (megawatt electrical equivalent) as a practical matter could use only clean fuels for SO_2 control. Only the larger sources should be considered for FGD. Intermediate size sources, comparable to 10-100MW can probably use FGD technology when it becomes available. Scale-down and demonstration on these smaller sizes is needed. Several clients (OGE, OPM, Regions) have focused on the need to develop applications data to support regulatory and enforcement functions. One of the specific objectives of this strategy is to *to develop and demonstrate effluent treatment technology for non-utility combustion sources capable of controlling SO_2 emissions from industrial boilers with regenerable or non-regenerable processes. This technology shall consider units* *with emissions equivalent to a range of 10MW to 100MW. The program shall include consideration of already proven processes useful on large utility boilers as well as additional processes which have not been developed as yet.*

Attention is called to the fact that in the present strategy, a major segment of the ORD program for the development and demonstration of SO_2 control is not included. As mentioned previously the Office of Energy Research has responsibility for pollution control of all utility and energy related emissions. This includes the FGD program and the clean fuels program. Therefore, the principal problem areas considered in this document are: (a) non-utility combustion sources, (b) industrial process sources, and (c) small industrial, commercial, institutional and residential sources (commonly called area sources).

Industrial sources such as coke ovens, pulp and paper mills, sulfuric acid plants, and refineries are significant SO_2 emitters. While technology exists for controling the more concentrated sulfur streams, control of significant SO_2 emissions from the numerous weak SO_2 streams has been largely ignored.

Primary smelters are one major industrial source which because of their size and importance are treated separately from other industrial sources. While only 15 copper smelters, 6 lead smelters and 8 zinc smelters exist in the U.S., these units contribute over 10% of the total SO_2 emissions. These primary smelters are concentrated in the Western portion of the U.S. and contribute significantly to the total ambient air pollution in those areas. Control of primary smelters was specifically identified by Regions 8, 9 and 10 as a significant problem area. Again, technology for the control of numerous streams with low SO_2 concentrations, is needed. These smelters require high priority attention from R&D.

The development and demonstration of SO_2 control technologies for control of Industrial Process Sources is one of the major goals of this program.

Specifically the objective is to develop and demonstrate emission treatment technology capable of controlling SO_2 sources. These technologies may include either or both regenerable or non-regenerable processes. Where technically and economically more desirable the technology should include process changes which have the effect of reducing the pollution potential of the subject industry. The primary industries to be considered include smelters, refineries, coke plants, pulp and paper mills and other industries which may be significant SO_2 emitters.

Area sources of SO_2 are characterized by their very large number and small size. They include very small industrial processes and large numbers of small, commercial, industrial and domestic combustion systems. Being generally in the few hundred to a few thousand cubic feet per minute size range and owned and operated by the general public there is practically no possibility for the use of even slightly complicated control systems. The only options for control are clean fuels (for the combustion sources) and simple control systems for the rest. The simple control technologies could approach the water softener or air filter technologies in that they could include control cartridges or systems that could be serviced by an agent or handled as a replacement filter or element. A key R&D objective of the SO_2 program therefore is to *develop and demonstrate area source control technologies capable of controlling SO_2 emissions from commercial, institutional and other area sources. Reevaluate the potential of systems and processes developed for larger scale sulfur oxide producing systems for economic and technical application in controlling smaller emissions as well. Also conduct R&D to evaluate, develop, and demonstrate new technologies for accomplishing this purpose. Consider add-on devices, process modification and alternate fuels as high priority candidates in this objective.*

The conversion of sulfur oxides to sulfuric acid mist and secondary particulate sulfate pollutants has recently received considerable attention as perhaps the most significant sulfur air pollutant. It is postulated (but not proven) that the major health and welfare effects noted in the past were actually due to sulfuric acid and secondary particulate rather than to SO_2. Since these sulfates are believed to form in the atmosphere from SO_2, their control will require a higher level of control of the SO_2 precursor. Therefore, if the suspected adverse health effects of sulfates are confirmed it may be necessary to push SO_2 control technology another order of magnitude from its present design capabilities. To assist the Agency in identifying and prioritizing its options with regard to the control of sulfates, a study is needed to assess the technical and economic feasibility of increasing the control capability of existing and developing technologies. An objective of this program will be to *assess options for a High Level SO_2 Control. Determine the technical and economic potential for achieving high level control of sulfur oxide emissions. Assess the practicality of achieving at least 99% control from some sources.*

Both the Office of Enforcement and several Regions have made the point that the control technology data base upon which standards are set almost without exception represents only one set of operating conditions (flow rate, temperature, production rate, pressure, etc.) for either or both the polluting process and control technology. In reality, however, both the polluting process and the control technologies operate over a wide range of conditions including start-ups, shutdowns and process upsets. A further complication is that polluting and pollution control processes change with age and use. In order to ensure that sustained compliance is possible or to develop a data base to establish the degree of control possible under various conditions of operation, it is necessary to perform long-term studies and determine the deterioration of such systems over a period of time. Emissions must be characterized as to their nature and extent for these various operating conditions in order for the enforcement arm of EPA to properly perform its regulatory functions. One of the important *objectives of this program is to provide the necessary data base to characterize emissions from various sources during plant start-up, shut-down and process upsets to determine the potential emissions during these transient events. Also, characterize the long-term performance of existing control systems to determine the deterioration with time.* The information should be in sufficient detail as to allow the Office of Enforcement to determine and implement appropriate regulatory options. The sources chosen for study should be among those with the highest priority as defined by the Office of Enforcement.

NITROGEN OXIDE

Background

The National Ambient Air Quality Standards for NO_x cannot be met in five regions, classed as Priority I, because adequate control technology is not available. Continued growth is expected to cause other ACQRs to exceed standards if controls are not applied.

About 98% of the ambient NO_2 comes from combustion sources. Nationally, about 60% is from stationary sources and 40% from mobile sources. This ratio, however, varies widely from city to city so that control of both stationary and mobile source, must be considered.

From the standpoint of ambient air quality impact, the control of automotive sources is the most important component of the nitrogen oxide control problem. Several years ago, however, EPA adopted the policy that control of automobile pollutants was the problem of the industry and that the necessary research and development should be undertaken by the industry. All significant EPA-sponsored research in this area was terminated. The advanced automotive power system program was continued as a forcing mechanism to assure the industry would be responsive. So far, the product of the industry's R&D effort has been little more than the fine tuning of the conventional internal combustion engine to minimize pollutants and the further development of the stratified combustion engine (which was done primarily under sponsorship by the Department of Defense). Except for the tired and controversial approach of using catalysts (an approach developed by EPA many years ago) the conclusions of the automobile industries appear to have been reached. The results are not satisfactory, particularly in view of the need to achieve better fuel economy. The AAPS program was transferred to ERDA in January 1975. As a result, there is essentially no driving force to prompt the industry to do any further research and development. Therefore, automotive source NO_x control technology will probably not make significant gains in the foreseeable future.

The Agency has adopted a policy, known as the Maximum Stationary Source Strategy (MSST), which will require control technology to be applied to a wide variety of stationary sources, and which deemphasizes the stringent control of mobile sources. This policy, based both on considerations of national costs and the relative availability of technology to control NO_x from these two sources would enable achievement of NAAQS in all areas except Los Angeles where stringent automobile emission controls will also be required.

Under the MSST strategy the stationary sources that require control include a wide range of large utility boilers, industrial combustion processes, small domestic heaters and stationary engines and turbines that use a full spectrum of fuel types; all of which respond differently to control techniques and all of which have special restraints and requirements on the application of controls.

Nitric acid plants which contribute heavily to local pollution is the principal industrial source of NO_2 that will require control.

The present program addresses all of these sources with primary emphasis on the development of technology to control NO_x from boilers and commercial and residential heaters. Industrial process furnaces are next in emphasis and stationary turbines/engines have recently received attention.

Three technical approaches have been pursued in the existing program, combustion modifications, flue gas treatment for combustion sources and molecurlar sieves for nitric acid plants. Molecular sieves will soon be adequately demonstrated. Owing to the difficulty of absorbing and dissolving nitrogen oxide, only one scrubber system for NO_x has been found worthy of continued development and is being piloted.

Combustion modifications which include low excess air, overfire air, staged combustion and flue gas recirculation can be accomplished by combustion process design and/or burner design for almost any size combustion unit and appear to be the lowest cost control method applicable to these sources. Initial field tests and pilot tests show that these methods can be expected to reduce uncontrolled NO_x emissions by more than 50%. Each class of combustion sources, however, varies in its response to combustion modifications depending on size, geometric design and fuel.

The current program has two major parts. Since NO_x control is a relatively new technology area, the chemistry and kinetics of NO_x formation and control is not well known. One part of the NO_x R&D program, therefore, focuses on developing fundamental information to support the RD&D of specific NO_x control technologies. The second part of the program is primarily empirical. It is built on earlier work that has indicated that changes in furnace and burner design parameters can reduce NO_x production. A major portion of this empirical program is being supported by the current energy program.

The Problem

Within each major class of stationary NO_x source (utilities, area sources, industrial boilers) a full spectrum of fuel is used and a variety of designs exist. Each combination of design and fuel responds differently to controls and each has special restraints and requirements on the application of control technology. Fundamental combustion control techniques have been developed to reduce NO_x emissions, the main problem now is to learn to apply this technology to the wide variety of sources that will require control.

The experience with SO_x from combustion sources suggests that the smaller area sources would contribute more to the ambient air degradation than to the total emissions inventory. Recent studies on NO_x have shown this to be true and of the five cities studied, the ambient concentration of NO_x resulting from area sources was greater than from any other class of source. There is a need for technologies to effectively control the smaller sources of NO_x emissions.

Research Program

One of the major thrusts of the NO_x control program is to pursue the emp.rical development and demonstration of modifications of combustion control technologies. This is aimed principally at control of large utility combustion sources. Since projects of this type have been transferred to the energy program for implementation, they are not included in detail in this strategy.

The primary thrust in this program continues to be the research and development of basic information on process chemistry and kinetics which will serve as a basis for control technology development and design. It also includes the bench pilot-scale and full-scale demonstration of approaches for the control of non-utility sources of NO_x. This includes both combustion chamber and burner design. New combustion concepts including catalytic combustion and surface combustion are investigated for their potential in dealing with the NO_x problem. The specific *objective for research in this area is to solicit, evaluate, develop and demonstrate commercial, industrial and area combustion control processes for the removal of nitrogen oxides.* A further *objective to provide a data base of emissions and control technology for which environmental impacts, control strategies, and RD&D strategies can be determined.* The technology developed is to be directed toward the broadest possible range of new, existing, and future emitters including both point and area sources.

While efforts to identify or develop processes for removing nitrogen oxide once formed from emission streams have been relatively unsuccessful, it is important that existing and future prospects for post-treatment be explored. One such approach includes the recently developed use of hydrogen (or other fuel) for selective reduction of nitrogen oxide. It is essential that ORD remain alert to and evaluate any promising processes that may arise. *An objective of the research and development program, therefore, will be to continue at a relatively low level the existing task of assessing the potential promising* NO_x, *control processes.* This objective will involve the establishment and systematic review of known and future technologies to seek out and develop new ideas for effluent treatment processes and evaluate these processes for their potential or as candidates for further development.

The molecular sieve has been shown to have considerable promise for the control of nitrogen oxides as well as other pollutants. They are particularly useful where high levels of control are required. At present, molecular sieve technology for the removal of nitrogen oxides has demonstrated the capability of control to levels lower than required by any standards that EPA currently has or is contemplating. Demonstration of this technology is in progress. It is the *objective of this program to demonstrate molecular sieve for nitrogen oxide control technology to permit confident assessment for the performance and economic factors associated with the commercial application of this process.* Every effort should be made to assure the supply of application and economic data to stimulate the broader application of this technology to suitable industrial processes.

HAZARDOUS AND OTHER POLLUTANTS

Background

Emission standards have been set for three hazardous pollutants; asbestos, beryllium and mercury. However, there are many trace materials and potentially hazardous emissions for which standards may be necessary, but the data are not available at this time for the Administrator to make the necessary determinations. For example, pollutants such as barium, copper, fluorides, polynuclear organic material, lead, zinc, hydrogensulfide, tin, cadmium, vanadium and vinyl chloride are among the substances considered to be potentially hazardous. Among the major sources of these emissions are the primary non-ferrous smelting industry (lead, zinc, copper, etc.), the iron and steel industry, utility and industrial boilers, incinerators, refineries, chemical plants and the ferroalloy industry. Many of these pollutants are emitted as fine particulate and fumes that will have to be controlled by devices which are being developed in the fine particulate R&D program.

Statement of the Problem

The most serious example of the Agency's inadequate technical background is found in the area of trace materials and hazardous or potentially hazardous materials. Several lists of known toxic materials have been assembled. Yet, little or nothing is known about their importance and the need for their control as air pollutants. It is not possible to launch the broad, expensive and time consuming (about 10 years) program to assess the health affects on even a small list of the leading hazardous pollutant candidates.

Difficulties in setting and administering hazardous standards in the past have caused the Agency to effectively withdraw from regulatory activity in this area; yet it is probably the most important area for air pollution concern for the Agency. One of the most pressing needs is for an overall identification of sources of hazardous and potentially hazardous materials. This inventory would provide a basis for the Agency to make a responsible decision concerning top priority hazardous pollutants that should be explored to determine their health effects.

The most pressing need relating to the control of hazardous and trace materials is to complete an overall emissions inventory and to develop a mass balance for hazardous and trace materials. This emissions inventory should start with the assessment of hazardous and potentially hazardous materials emitted from the spectrum of industries. This program now in progress should yield conclusions regarding the kinds and amounts of hazardous and trace materials being emitted into the air. This information should be made available as it is developed to all parts of the Office of Research and Development and the Agency to be used as a basis for establishing priorities for health effects R&D. The objective of this program, therefore, is to *identify, characterize, and quantify all significant hazardous, trace and potentially hazardous materials being emitted into the atmosphere. Identification and characterization of pollutants and sources should be in sufficient detail to assess the necessary degree of control and potential of control using conventional control technologies.*

The Agency has identified and has set standards for asbestos, mercury and beryllium. Because of difficulty with the analysis of asbestos and even greater difficulty with its control in the fine particulate form, and because of the large number and chemical species of emissions involving mercury, these two pollutants pose particularly difficult control problems. *To support its regulatory mission, additional information is needed concerning the sources* *and methods for control of these specific pollutants. To the extent that control technology is inadequate, new control technologies should be identified, developed and demonstrated.* To support the Agency's regulatory mission with respect to the three established hazardous pollutants as well as additional hazardous pollutants, an objective of the R&D program in hazardous pollutants is to *develop technology for control of major pollutant emissions from new and existing point and area sources whose principal emissions are one of the hazardous or potentially hazardous pollutants.*

Organic hydrocarbon emissions constitute a special class of problems requiring special attention. Hydrocarbons not only represent an important source of carcinogens but also represent a major component of the oxidant problem associated with photochemical smog. In addition, most odorous materials are organic or of organic, hydrocarbon origin. An attempt to deal with the hydrocarbon and oxidant problem by control of automotive sources has been only partially successful. Several air quality control regions will never meet standards while others will soon violate standards because of the increasing number of automobiles. A much greater emphasis is required on the control of stationary sources of hydrocarbons.

An array of technologies exist that might be applied for dealing with many of the large numbers of different kinds of hydrocarbon sources. Many of these processes must be better identified, developed, and demonstrated. To support the Agency's mission of regulating hydrocarbons from stationary sources, it is *the objective of this R&D program to develop technology for the control of emissions, particularly the most significant sources of reactive hydrocarbons in and near population centers. Develop technology and/or procedures for the control of odor compounds, emission from rendering plants, feedlots, chemical plants, service stations and solid waste disposal systems.*

A unique problem faced by the Agency and local regulatory groups is the control of open sources. Particulate, hazardous materials, hydrocarbons, nitrogen oxides, carbon monoxides, oxidants, and sulfur oxides are included in the pollutants emitted from various kinds of open sources. These include open dump sites, street dust, mining operations, agricultural burning, forest fires, agricultural activities, coal culm piles, etc. Some are controllable, others are not. These sources present a major problem in that they contribute to the background concentration of many of the above pollutants. In many cases such as culm piles and mining operations, they contribute to severe local pollution problems. An objective of the control technology research and development program in this area is to *develop the ability to control emissions generated from open sources including operation such as ore mining, milling, materials handling operations, etc. Major sources are to be identified and classified as to their controlability. Where control technology does not exist, it is to be developed and demonstrated.*

One of the unique problem areas involving primarily particulate control is that of controlling fugitive dusts from non-point, natural and manmade sources such as agriculture activities, road dust, forest fires, etc. Because of the non-point nature of these sources, conventional control equipment is not applicable. *It is the objective of the program to identify, characterize and to the extent possible quantify emissions from these sources. It is also the objective of the program to identify and assess control options and alternatives to control technology to deal with the problem.*

Several specific processes have been identified as representing known major sources of hazardous, trace or potentially hazardous materials. Programs have been initiated to proceed with developing controls for these offending sources rather than wait for the outcome of a general source survey. These include specific sources such as smelters, aluminum processes and iron and steel production. Specific objectives identified to initiate or continue research in these areas are listed in the following paragraphs:

Develop effective control technology for industrial operations with primary emphasis on non-ferrous smelters and halide emitting operations. Specific processes include roasting, retorting, sintering and other operations associated with non-ferrous industries. Halide emitting industries include fertilizer industry pulp and paper and bleaching operations.

Develop technology for control of hazardous pollutant emissions from fossil fuel fired heat and power generating systems. Special emphasis is to be placed on the control of trace materials emitted as fine particulate. Burning of residual oil is particularly important and should receive special attention.

Solicit and evaluate, develop and demonstrate control technology for the removal of hazardous and trace materials from the iron and steel industrial processes.

Demonstrate, at commercial scale, technology for the control of air pollution emissions from the secondary aluminum smelting industry. Primary attention should be given to the control of halide and other toxic and trace materials from this industry.

AUTOMOBILE POLLUTION

Background

The automobile is the single most important source of air pollution contributing major portions of carbon monoxide, nitrogen oxide, hydrocarbons, and particulate. Being relatively small in its individual contribution but very large in number and located near the groundlevel and among the population, it ranks as the major single contributor to ambient air pollution. More recently, the automobile has come into focus as potentially the major contributor of sulfates and other trace materials including phosphates and metallic ions from fuel additives.

When EPA came into existence (1971) the policy was adopted that control of automobile pollutants was an industry problem and that the necessary research and development to control the problem should be undertaken by the industry. At that time, all significant EPA-sponsored research and development in the area was terminated. In its place, the Advanced Automotive Power System Program was emphasized as a mechanism for forcing the industry to be responsive.

The industry responded by mounting a limited research and development program. Details of this program are not available to EPA. Products of the program have been minimal. The two most significant developments that relate to the control of pollution from the automobile were not a product of this industry R&D program. They were the stratified charge engine which was developed largely under a Department of Defense contract and the catalyst oxidation-reduction system which was developed years before and adopted to automotive use by a predecessor EPA organization.

Recently, the AAPS program was transferred to ERDA as part of the formation of that Agency. With it went the last vestage of an EPA R&D program in the automotive area. As a result, the EPA technology data base is essentially empty. The industry has exposed its air pollution control technology research and development results which are little more than fine tuning of the conventional internal combustion engine. (The Wankle engine does not represent a significant air pollution improvement over the internal combustion engine).

As a result, the Agency is in a difficult position with regard to carrying out its regulatory mission in the automotive area. Forced by the lack of viable developed technology, and under the pressure of the need to conserve energy, the Agency is faced with the almost certain need to request a change in the Clean Air Act to back off of existing standards.

Statement of the Problem

The Agency is in need of a technology base which could supply options to permit it to effectively deal with the regulatory mission relative to vehicular sources. A data base which will provide the Agency the technical qualification for dealing with the automotive industry is needed.

TABLE I (P.1 of 3)

CROSSWALK-CLIENT REQUIREMENTS TO OBJECTIVES

CLIENT'S REQUIREMENTS \ OBJECTIVES	PAGE	PARTICULATES: Identify Sources Characterize Emissions	Ident/Characterize FP Precursor Sources	Assess Control Tech. Capability for FP	Develop FP Control Technology	FP Measurement Techniques	Long Term Performance of Controls	HAZARDOUS & OTHER: Identify Sources/Characterize Emissions	Dev. CT for Point & Area Sources	Dev. CT for HC & Odors	CT for Fugitive & Non-Point Sources	Assess - CT Alternatives	Dev. CT for Specific Industries
	PAGE	42	42	42	43	43	43	56	57	57	58	58	59
Urban Particulate													
Open Burning	13	0						0			0	0	
Street Dusts	13	0						0			0	0	
Particulates													
Charac. of Sources	14	0											
Dev. & Assess CT	14			0									
Fugitive Dusts													
Source Id. & Charc.	15	0				0					0		0
Dev. CT	15										0		0
Eval. Alternatives to CT	15											0	
Fine Particulate													
Id. & Charac. Sources	16	0	0					0					
Assess Conventional CT Capabilities	17			0							0	0	
Demo. CT	17				0								
Dev. FP Measurement						0							
Precursor Charac.	17		0										
Long Term CT Equip. Performance	17						0						
Stationary HC													
Source Charac. & Id.	26							0					
Dev. CT	26									0		0	

TABLE I (P.2 of 3)

CROSSWALK-CLIENT REQUIREMENTS TO OBJECTIVES

CLIENT'S REQUIREMENTS \ OBJECTIVES	PARTICULATES	Identify Sources Characterize Emissions	Ident/Charac. FP Precursor Sources	Assess Control Tech. Capability for FP	Dev. FP Control Technology	FP Measurement Techniques	Long Term Performance of Controls	HAZARDOUS & OTHER: Identify Sources/Charac. Emissions	Dev. CT for Point & Area Sources	Dev. CT for HC & Odors	CT for Fugitive & Non-Point Sources	Assess - CT Alternatives	Dev. CT for Specific Industries
	PAGE	42	42	42	43	43	43	56	57	57	58	58	59
Smelters													
Emissions Charac.	27	0						0					
Dev. CT SO_2 **													
Dev. CT Other					0								0
Incineration of Wastes													
Charac. Emissions	29	0						0					
Dev. CT for Trace Emissions	29								0	0	0		
Odors-Ag. & Ind.	30									0			
Fertilizer Industry													
Charac. Emissions	31					0		0					0
Dev. CT	31												0
Uncontained Comb. Sources	32	0						0			0	0	
Hazardous Emissions	22							0	0	0	0	0	0
Specific Industry Problems	34							0					0
Oxidants*	25							0		0			
Iron & Steel	35							0			0		0

* Also see p.3 (Nitrogen Oxides)

** See P.3, Dev. Control of SO_x

TABLE I (P.3 Of 3)

CROSSWALK–CLIENT REQUIREMENTS TO OBJECTIVES

CLIENT'S REQUIREMENTS \ OBJECTIVES		SULFUR OXIDES					NITROGEN OXIDES			
		Dev. SO_2 Controls for Non-Utility Combustion	Assess & Dev. SO_2 Control for Industrial Processes	Assess & Dev. Controls for Area Sources	Hi Level SO_2 Control	Start-Up, Shut-Down, Long Term Performance of FGD	Dev./Demo Combustion Control for Area & Industrial Sources	Characterize Sources	Assess New Control Processes	Molecular Sieves
	PAGE	45	46	47	48	49	53	53	54	54
Dev. Control of SO_x										
Industrial Processes	18		0			0				
Adapt Utility CT for Non-Utility	18	0				0				
Dev. New CT for Ind. Boilers	18	0				0				
Area Sources for CT	18			0						
Sulfates Hi-Level Control	28				0					
Nitrogen Oxides CT										
CT for Area Sources	20						0		0	0
Source Characterization	21							0		
Oxidant Precursor Control	25						0	0	0	0

TABLE 2 (P.1 of 2)

FUNDING LEVELS

1976 RESOURCES FOR AIR CONTROL TECHNOLOGY R&D OBJECTIVES
(THOUSANDS OF $)

	1974	1975		1976	
SULFUR OXIDES	Base	Base	Energy	Base	Energy
Dev. SO_2 Controls for Non-Utility Combustion	968	200	5,260	275	1,850
Assess & Dev. SO_2 Control for Industrial Processes	449	283	00	275	--
Assess & Dev. Controls for Area Sources	100	867	00	275	--
Hi Level SO_2 Control	00	00	00	75	--
Start-Up, Shut-Down, Long Term Performance of FGD	220	399	00	60	--
SUB TOTAL	1,737	1,749	5,260	960	1,850
NITROGEN OXIDES					
Dev./Demo Combustion Control for Area & Industrial Sources	1,400	1,550	2,515	245	1,315
Characterize Sources	1,088	400	--	100	--
Assess New Control Processes	25	82	00	15	--
Molecular Sieves	102	00	00	10	--
SUB TOTAL	2,615	2,032	2,515	370	1,315
Technical Transfer and Assistance	85	128	--	365	--
Program Support	1,440	1,600	--	600	150
TOTAL	10,828	13,276	10,875	7,365	3,915

TABLE 2 (P.1 of 2)

FUNDING LEVELS

1976 RESOURCES FOR AIR CONTROL TECHNOLOGY R&D OBJECTIVES

(THOUSANDS OF $)

	1974	1975		1976	
PARTICULATES	Base	Base	Energy	Base	Energy
Identify Sources Charac. Emissions	100	250	00	130	0
Ident/Charac. FP Precursor Sources	300	100	00	50	--
Assess FP Control Tech. Capability	485	1,669	1,100	800	100
Develop FP Control Technology	1,245	2,089	2,000	1,450	500
FP Measurement Techniques	--	--	--	50	--
Long Term Performance of Controls	00	00	00	100	00
SUB TOTAL	2,130	4,108	3,100	2,580	600
HAZARDOUS & OTHER					
Sources/Charac. Emissions	520	1,256	00	350	00
Dev. CT for Point & Area Sources	1,100	300	00	800	00
Dev. CT for HC & Odors	130	1,359	00	300	00
CT for Fugitive & Open Sources	0	175	--	300	--
Assess CT Alternatives (Open Sources)	0	--	--	350	--
Dev. CT for Specific Industries	1,071	569	--	390	--
SUB TOTAL	2,821	3,659	00	2,490	00

APPENDIX

CATALOGUE OF CLIENT RESEARCH NEEDS

This appendix contains a listing of the air pollution control technology problems for each of several EPA offices, (client organizations). The lists were compiled principally from three sources:

- o reports, position papers and comments on previous ORD programs by the client groups;
- o interview reports based on the Air Strategy Task Force's needs, discussion with each of the various EPA organizations; interviews with several of the EPA regions conducted by the Air Pollution Control Division staff, and
- o responses to a memorandum dated November 22, 1974 from the Acting Assistant Administrator for Research and Development requesting EPA organizations to prepare lists of major areas requiring specific R&D outputs.

The problem areas have been screened to focus on air pollution control technology related topics. Thus, needs for health effects, monitoring and socio-economic studies are not included except where needed to provide perspective on some of the problems.

URBAN PARTICULATE BACKGROUND

A most pressing need is for information on fugitive and reentrained dust or what we might call the "urban particulate background." What are the sources, what is their magnitude, and how can they be controlled? At present, we have very little knowledge about the urban area sources of particulate matter, how they can be controlled, and their impact on air quality and our ability to meet the particulate standards. Information on the size distribution of particulate matter emitted from sources after good equipment has been installed is another need.

FUGITIVE DUSTS

As no effective means exists today to control fugitive dust emissions, it is not possible to approve or disapprove SIP regulations on TSP. It has been suggested that fugitive dusts from such sources as tailing piles, unpaved roads and construction activities may have an associated health risks due to their potential heavy metal content. Pesticides and fertilizers absorbed on fugitive dust aerosols may add to this risk. Silica, a major constituent of most fugitive dusts, may also have health effects not presently identified. A technical data base is needed which includes characterization, source evaluation, effects and possible control methods for this class of particulates.

FINE PARTICULATE CHARACTERIZATION AND CONTROL

An effective way to control fine particulate emissions is needed. By controlling fine particulates we will also control many of the trace metals and many potentially harmful compounds. While work is underway leading to a possible standard and control program on fine particulates, more work is needed on quantifying the additional pollutants that will be controlled by the application of specific control systems for fine particulates. Particulates present a difficult, long-term air pollution control problem and we need better control of particulate matter with emphasis on specific toxic pollutants and fine particulates.

In conjunction with this control technology research, more information is needed on the atmospheric formation mechanisms for fine particulates and on the relationship between emitted fine particulates and those found in the atmosphere.

NO_2 FROM STATIONARY SOURCES

The NO_2 standards for automobiles have been changed. To meet National Ambient Air Quality Standards (NAAQS) the Agency has adopted a strategy emphasizing control of stationary sources of NO_x. This strategy is expected to be less costly on a national basis than requiring the most stringent emission standards to mobile sources. Control of stationary sources is necessary to maintain ambient air quality levels of NO_x. To implement the national NO_x control stategy, OAQPS needs to know that R&D efforts for demonstrating NO_x control are being carried out. A few demonstrations of control technology on major NO_x sources are needed initially.

SULFATES

Due to the impact of the sulfate issue on the current control stategy for SO_2, the priority for research in this area is quite high. The health effects, measurement technology, understanding of atmospheric chemistry, knowledge of source to receptor relationships, and control methods are all needed.

OXIDANTS

The type and level of control needed to attain the air quality standards for oxidants is not established since the relationship between NO_x and HC emissions to oxidant concentrations is not well known. The potential health effects of oxidants are serious and they are one of the most pervasive pollutants. Transportation Control Plans would have great social impact and will not be adequate over the longer term. Increased population is expected to override their corrective trend within a very few years. Therefore, considerably expanded control of stationary sources are needed now.

STATIONARY SOURCE HYDROCARBON CONTROL

Measures to control HC evaporation and substitute other solvents where possible will probably need to be taken. New source performance standards (NSPS) will be used to control new sources, it is expected that NSPS for small HC sources will be set soon. Also changes in the Clean Air Act to allow equipment standards which will be applicable to the manufacturer are foreseen. A significant growth in HC emissions will require control of many sources of widely varying size. OAQPM may also need to control all sources of non-methane hydrocarbons, not just urban emissions.

Perhaps most important is the need for the capability to relate equipment specifications to control of emissions. Having this capability, the degree of control could be predicted and the approval or disapproval, of equipment specifications could be made before the manufacturer makes the investment in production.

LONG TERM PERFORMANCE OF CONTROL EQUIPMENT

Assessment of the long term performance of control technology should be considered in the control technology program since equipment performance may deteriorate with time. Knowledge of the long term performance will help to establish the need for monitoring.

COMMUNICATIONS/COORDINATION MEETINGS

Meetings of ORD managers with the Office of Air and Waste Management personnel to describe how their particular research project impacts on OAWM activities or proposed standards are needed. These meetings would be useful on a twice a year basis. Such meetings would be discussions of results of research and future plans of the project.

TECHNICAL ASSISTANCE.

ORD's direct support and technical assistance is most important to OAWM because it is essential to the day-to-day operation of the program.

Two major areas of direct support needed from ORD in the control technology are:

- o Consultation on Control Technology. This includes assistance in determining the availability, efficiency, and costs of control devices and from time to time participation in special committees such as a Control Techniques Advisory Panel.
- o Reviews. Requests of particular individuals to act as reviewers and consultants on technical papers which are to be used as backup to various ORD efforts.

AIR CONTROL TECHNOLOGY APPLICATIONS

OAQPS suggests that ORD should take steps to be sure that the results of control technology developments are widely disseminated and put into practice where reasonable. That is, there should probably be a formalized way to be sure that the technology is applied, and perhaps this might be the final task of a demonstration project. For example, coal cleaning may have great potential use in connection with the evolving supplementary control system guidance, but it has yet to be accepted or considered by utilities.

SCIENCE ADVISORY BOARD

COMMUNICATIONS

Response on technical/scientific matters should be rapid and direct from ORD to client organizations, but broader matters of resource levels and plan revisions should be routed through appropriate channels. R&D efforts should foster better communications between people working on the solutions to problems in all areas inside EPA, and with other agencies, industry, and local government.

OFFICE OF LEGISLATION

POLLUTANTS NOT COVERED BY STANDARDS

Many pollutants, for example a number of toxic substances emitted to the air, do not yet have standards established. Nevertheless, many of them can reasonably be expected to have standards established in the near future, so that research on means to control these pollutants should be underway.

Research and development needs to continue for means to control pollutants which are likely to have standards established eventually.

CONTINUAL ASSESSMENT OF CONTROL SYSTEMS

In order to provide accurate and timely information required for legislation and court action, continuing assessment of control processes, especially those in the early developmental states, is required.

COMMUNICATIONS

Both for longer term planning and for more rapid response to information requirements, ORD needs to be more responsive and maintain communication channels to clients.

FUGITIVE DUSTS

Little is now presently known concerning fugitive dust. The information required includes sources, particle sizes, health effects, transport, measurement, and control.

OFFICE OF EDUCATION AND MANPOWER TRAINING

AVAILABILITY OF TRAINED PERSONNEL

Controls for most stationary sources require highly trained personnel in research and development, design, construction and operation, as well as for testing, monitoring and enforcement.

ORD should be aware of the shortage of trained personnel for environmental protection, R&D planning and should consider ways to contribute to training where possible.

OFFICE OF ENFORCEMENT

EMPHASIS ON DETECTION AND CORRECTION

In the opinion of the Office of Enforcement (OE), it is unlikely that any of the basic standards will be subject to challenge with the possible exception of NO_2 standards subsequent to the development of an appropriate reference method. Rather, their concern is with the mechanics of detecting and correcting violations.

SOx SCRUBBER AND DEMISTER EFFICIENCY

The most important priority in control technology is the SOx scrubber.

Demisters are installed behind most wet scrubbers to remove entrained water droplets from the efficient gas stream. The effect of the scrubber is largely negated if the demister is inefficient.

Test methods for measuring carryover from the demister are needed to evaluate performance, and to improve demister design.

DEVELOPMENT OF PARTICULATE SAMPLING METHOD FOR CONDENSABLE PARTICULATES

The second most important priority in control technology is the control of total particulates. EPA has developed Method 5 for NSPS particulate measurements, but Method 5 is not always applicable. Special problems have been encountered with asphalt drum driers and saturators and with fiber glass furnaces and forming lines. These sources contain a high percentage of condensable particulates that gum up the sampling train.

A modified method is needed for such sources. There is also a need for test methods for other particulate sources.

SOx CONTROL FOR SMALL INDUSTRIAL BOILERS

By July, 1975, many small industrial boilers will need to comply with State SO_2 regulations. In order to meet these standards and adequately enforce the regulations, suitable control technology for small industrial boilers must be developed and demonstrated.

COKE OVENS

Emissions from coke ovens remain a significant problem. Sheds are now being used to control these emissions and more needs to be known about both detecting and controlling emissions from sheds.

SMELTERS

Smelter gas streams rich in SO_2 have adequately demonstrated controls. Weak SO_2 streams, however, are more difficult to treat. Demonstration of control techniques for the weak streams is needed.

INVESTIGATIONS OF FINE PARTICULATE CONTROL TECHNIQUES

Recent epidemiological surveys have suggested that fine sulfate particulates are causal factors in chronic bronchitis and other respiratory illnesses. Presently available control techniques are typically less efficient in the collection of submicron particulates.

There is a need to develop several fine particulate control techniques and demonstrate that these systems are both economical and efficient in the removal of submicron particulates. In order to maximize the applicability of these systems, power usage and space requirements should be minimized.

LONG-TERM CONTROL EQUIPMENT PERFORMANCE

A compliance test done within three to six months following startup of a new system is generally asserted as proof of compliance by control agencies. A limited amount of data indicates that control equipment, particularly electrostatis precipitators, deteriorate rapidly following this period even with proper maintenance. A detailed engineering study is needed to develop new design and maintenance features to reduce deterioration of control equipment and thereby maintain compliance with standards. The project should concentrate on the problem encountered in the power industry, where equipment deterioration also causes forced outages of power.

COMMUNICATIONS AND PROGRAM PLANNING

OR&D often is not responsive to the research requirements put forth in OEE NEEDS Statements. The impression given is that only the NEEDS that can be fitted into ongoing research programs are given consideration, rather than the research programs being derived from the NEEDS Statements.

Dialogue to communicate the importance of their problems is needed. For example, short-term response problems may be extremely important to enforcement objectives and therefore should not be dismissed simply because they are short-term.

TECHNICAL ASSISTANCE

Technical assistance is needed by OE in order to prepare testimony and to keep abreast of the latest available control technology. Expert testimony may also be required during hearing and court cases and should be made available upon request.

OFFICE OF PLANNING AND MANAGEMENT

MAJOR EMPHASIS - SOx AND NOx

Based on emphasis derived principally from the EPA Steering Committee, both SOx and NOx are important problems requiring work in health effects, atmospheric chemistry; control technology and monitoring.

SOx CONTROL FROM POWER PLANTS

Information is reqired on the actual status of SOx control technology for power plants. This item is relatively high on OPM's priority list.

SUPPORT OF AGENCY OPERATIONS

A balanced R&D program is needed which both supports the immediate research needs of the operating portions of EPA and is responsive to longer range research needs. In developing future research plans, ORD should become more fully aligned with the operational activities of the Agency. The latter is necessary if ORD activities are to gain greater acceptance from the rest of the Agency.

ENCOURAGE R&D BY INDUSTRY

ORD should identify ways to encourage control technology R&D by industry. Ways to spur such participation should be identified and put into practice.

EPA REGIONS

This part of the appendix catalogues the problems areas expressed by each of the ten EPA regions. Each of the regions expressed varying degrees of concern over the three administrative problems of coordination of research planning, communication of research findings and provision of technical assistance. As such, three problem areas are documented below and apply across all regions. Technical problems expressed by each region are reported separately following these administrative areas.

COORDINATION OF RESEARCH PLANNING

Each of the regions expressed the feeling that their research needs should receive greater consideration than they have in the past. Many high priority regional problems may not be addressed if all priorities are derived from a generalized national viewpoint. Often the research needs of the operating groups within the agency have associated short time requirements and a coordination mechanism is needed to allow OR&D to be more responsive to these time dependent needs. It is also recommended that OR&D become better aligned with the operational activities to improve its overall responsiveness to the agencies total research requirements.

COMMUNICATION OF RESEARCH FINDINGS

The region's work with state and local agencies in solving air pollution problems requires the use and implementation of scientific information and technology that has been developed by ORD. Many of the ORD research reports do not provide the information needed to translate research findings into problem solutions. It would be most beneficial if research findings could be reported with greater emphasis on implementation and solutions to specific problems. Additionally, state-of-the-art summaries, seminars and executive reports to provide and update technical information are needed. Design manuals, and technical information transfer documents were mentioned as being particularly useful in this regard.

TECHNICAL ASSISTANCE

Periodically the regions require technical assistance from a variety of R&D programs. This assistance usually consists of technical consultation or providing expert witnesses for hearings or court cases. Many problems requiring technical assistance are industry rather than scientific discipline related. As such designating focal points of expertise for specific industries with OR&D would also be desirable. (Note: the technical assistance mentioned here is only that required in the control technology area and does not include the requirements for the greater technical assistance required for monitoring activities.)

REGION I

REDUCTION OF OXIDANT CONCENTRATIONS

Oxidant concentrations exceeding national ambient air quality standards have been recorded in early morning hours in metropolitan Boston. It is unknown if the oxidant is being transported from other industrialized areas. An extensive oxidant monitoring and formation study is needed to identify the source of this problem. Study results will also help speed a final decision of Region I's Transportation Control Plan, presently tied up in litigation.

SULFATE ISSUE

Region I is concerned with the sulfate issue as they have measured sulfate levels of 20-30 mg/m^3 per cubic meter and once as high as 70 mg/m^3. More information is needed to strengthen the weak data base which the Agency used to set SO_x standards.

RELIABILITY OF FLUE GAS DESULFURIZATION

Of the approximately 35-40 power plants in this region all but three are relying on low sulfur oil to meet compliance schedules. The switch back to coal is being retarded by the belief that FGD systems are not reliable.

INCINERATOR EMISSIONS

Emissions from incinerators, although not a problem today, is anticipated to be a major problem in the future.

ROLE OF INDUSTRY

Policies should be developed to induce industry to undertake technology development rather than government.

REGION II

RELATIONSHIP BETWEEN HC EMISSIONS AND OZONE CONCENTRATIONS

The data which has been collected over the past two years shown that the ozone standard in Region II is exceeded approximately 70% of the time. A better understanding of hydrocarbon and ozone sources, distribution, and transport is needed.

FORMATION OF ATMOSPHERIC SULFATES

It is believed that reactions take place in the atmosphere whereby sulfur oxidesare oxidized, possibly with suspended fine metal particulates acting as catalysts, to form sulfates which are suspected of presenting even greater health consequences. The effect of various area and point emission rates and the interaction of SO_x and fine particulates in the light of a given terrain on meteorology need to be determined and effective control strategies developed.

NATURE AND ORIGINS OF THE NEW YORK CITY AEROSOL

A summary of quantitative relationships between particulate characteristics and combustion parameters is needed. A description is needed of the effects on local concentrations of topography, buildings, surfaces, etc. as well as source position and meterological conditions. A catalogue of in-situ processes which produce morphological and chemical changes in the aerosol specific to the New York City atmosphere is also needed. Recommendations of preferred sampling techniques are needed to determine the ambient air quality.

INDUSTRIALIZATION OF PUERTO RICO AND ST. CROIX

It has been pointed out that with increasing industrialization of Puerto Rico there was a good possibility that standards for SO_2, particulates and carbon monoxide would be exceeded regularly. A similar situation is anticipated in the industrialization of St. Croix. Both cases could result in urban pollution problems. The control of particulates is likely to be the first priority. Control technology is needed to alleviate these potential problems

PARTICULATE MATTER FROM TIRES

Vehicle tire particulate matter pose a potential problem. A tire is only one third rubber by weight and the health effects of carbon black and other components of tires needs to be established. Appropriate monitoring and control of this particulate source may be needed.

REENTRAINED DUST IN CITIES

Reentrained dust in major cities is creating a situation where particulate standards may not be met. Consequently, it is possible that control of stationary sources alone will not allow the particulate ambient standards in major cities to be met.

URBAN "BACKGROUND" PARTICULATE MATTER

Background levels of particulate matter, consisting mainly of tire rubber and ground dust, are reaching Air Quality Standards. Should health effects research indicate a need for reducing this background, appropriate control technology will be required. If health effects research shows no significant impact, a new reference method for sampling suspended particulate matter will have to be developed.

PHOTOCHEMICAL OXIDANT, HYDROCARBONS AND NOx RELATIONSHIP

The relationship of ozone levels to hydrocarbon emissions and concentration of nitrogen oxides is not well understood. These relationships are further complicated by a lack of understanding of ozone precursor transport between urban areas and rural locations. New Air Quality Criteria are needed for photochemical oxidants, hydrocarbons and oxides of nitrogen along with a new standard for oxidants. The results of these efforts may lead to the need for new control strategies and technology.

HEAVY METALS AND TOXIC COMPOUNDS FROM SEWAGE SLUDGES

Incineration of sewage sludges, considered by many communities as a viable approach, may lead to emissions of mercury, cadmium, lead, copper, chromium pesticides and other toxic substances. Information is needed on collection efficiencies for various scrubber configurations to deal with this potential problem. Ash retention for various incineration temperatures also needs to be defined.

UTILIZATION OF MUNICIPAL BY-PRODUCTS

Composting has been identified by the Region as the most desirable process for resource recovery from waste treatment plants and raw chemical sludges. However, odors generated by the composting process are a major problem in its use requiring the development of odor control techniques.

FIRE PREVENTION AND EXTINCTION IN LANDFILLS

Methods are needed to reduce the risk and to extinguish fires that develop via spontaneous combustion - particularly a problem with landfills receiving construction debris and where old strip mines are used as landfill sites. Carbon monoxide resulting from such fires is a particularly severe problem.

REGION IV

STUDY OF TEXTILE INDUSTRY EMISSIONS

For effective control, more needs to be known about emissions in textile and textile-related industries. Areas to investigate include the following:

- Fiber manufacture (e.g., polyester, polyamide, acrylic)
- Dyeing processes
- Bleaching processes
- Finishing processes

IDENTIFICATION OF PULP AND PAPER INDUSTRY EMISSIONS

A number of exotic chemicals are introduced into plant streams in the pulp and paper industry. For standards setting and control, more specific information is needed on whether these chemicals exit from the stack.

PHOSPHATE INDUSTRY EMISSIONS

Measurement and control of fluoride emissions from the phosphate and fertilizer industries is a major problem.

SO_2

More research and development is needed for SO_2 control in order to obviate the need for tall stacks and supplementary control systems.

OXIDANT

The phenomena of oxidant transport is thought to be a very important aspect of the oxidant problem in this area. It is suspected that high oxidant levels are caused by emissions from other parts of the country being transported to Region IV.

REGION V

INDUSTRIAL EMISSIONS

The present technology is not sufficient to control emissions from the following sources.

1. Coke battery doors
2. Blast Furnaces - casting and hot metal transfer operations
3. Basic Oxygen Furnaces - charging, tapping and blowing operations
4. Secondary Aluminum smelters

PUBLIC UTILITY PARTICULATE EMISSIONS

There is an indication that public utilities may not achieve particulate emission standards. Research is needed in determining the effect of sulfur in fuel changes on precipitator efficiency.

WASTE WATER TREATMENT PLANT EMISSIONS

There is a problem resulting from the proposed construction of a waste water treatment plant in the city of Des Plains. The problem relates to possible atmospheric transport for virus and odors from the plant to the surrounding residential area.

ENERGY

Consideration of air pollution in the form of particulates and gaseous emissions is needed for coal gasification development. This is increasingly important when it is considered that the high sulfur coal in the Region V States will be used for this purpose.

Development of alternate and more effective methods of sulfur removal from raw coal before shipment to a power plant or other user should be encouraged.

OXIDANTS

A better understanding of the oxidant, hydrocarbon, NOx relationship is needed. In considering this problem, differentiation between reactive and non-reactive hydrocarbons should be made as this may impact the value of current control technology.

RELIABILITY OF STEEL MILL CONTROL TECHNOLOGY

The Region feels that even if the steel mills were completely equipped with esp's, scrubbers, and baghouses, the standards still would not be met because of lack of proper maintenance and operation. A need exists for studies in the area of control equipment performance decrease with its operation.

INTERMEDIA

Research has indicated that much of the trace metals found in the lake waters do not result from industrial point sources but result from fallout of air pollutants. Coordinated research in this area is needed.

REGION VI

SMELTERS

In both stack emissions of toxic materials such as lead, and in fugitive emissions, several large smelters are a major control problem, in the Region. Until cause-and-effect of emissions and, for example, high blood lead levels are proved, effective control can't be instituted.

FINE PARTICULATE CONTROL

Fine particulate emission control and specifically control of emissions from ammonium nitrate prilling towers, is a major problem.

OXIDANTS

The hydrocarbon/ozone/NOx formation interaction and transport is not understood and the approach to control by TCP and other regulations is hindered.

FUGITIVE DUST

There is a real need for a better mass loading measurement system, especially for short time periods. There is a problem of unknown magnitude with fugitive dusts.

REGION VII

EMISSION-AMBIENT RELATIONSHIPS

There is a lack of well-defined relationships between ambient air quality and stationary source emissions. This is creating problems relative to implementation of control strategies.

FERTILIZER INDUSTRY

There is a need for improved stack gas sampling of gas streams from prilling towers and NOx sampling from nitric acid plants associated with the fertilizer industry. Pollutant characterization is needed and possibly new control methods.

ALUMINUM MILL FLUORIDE EMISSIONS

Characterization of the emissions and control of fluorides from aluminum mills is needed.

LEAD SMELTING

An epidemiological study indicates there are excessive deaths in horses around the areas of lead smelters. A study is needed to determine the forms of lead emitted. Control methods for lead sulfate from smelters may be warranted.

ODORS FROM FEEDLOTS AND AGRICULTURE

Methods are needed for characterization of odors from agricultural activities, particularly feed lots.

WASTE RECOVERY

Solid waste burning facilities for energy recovery constitute a new class of source. Some of these facilities (e.g., the St. Louis project) burn a combination of coal and solid waste. Potential emissions of trace pollutants exist for these new plants.

Many utilities are now using oil and gas to meet standards. If a switch back to coal is necessary then better control for utilities will be needed.

CHARCOAL KILNS

There is a need for emissions measurement, analysis and possible emission control for the large number of charcoal kilns in the region. Many of these are small "Mom and Pop" facilities with varying degrees of sophistication and control may be difficult if at all possible.

OXIDANTS

Problems associated with oxidants are the high rural backgrounds and the averaging time for the NAAQS relative to health effects and control programs.

SULFATE ISSUE

The region is concerned with the sulfate issue and how it may impact the SO_2 standard and mobil and stationary sources in the region.

REGION VIII

ENERGY

Strip Mining of coal and construction on western land will cause a serious fugitive dust problem in the Region. Control technology is needed to combat this problem.

Region VIII is trying to stay ahead of the coal situation. More research by ORD on coal gasification emissions and control is needed. Control technology for hydrocarbons should be stressed.

The increase in residential and commercial development with an expanding energy industry is expected to have an impact on air quality.

RECREATIONAL ACTIVITIES

There is a need for low cost control technology to control particulates from fireplaces in congested resort areas. Serious visibility problems result in some resort areas from fireplaces, automobiles not properly tuned for high altitude, and recreational activities.

TRACE ELEMENTS

Trace elements are a problem. Research should be done on the toxicity of trace elements.

INTERMEDIA AND DISCIPLINARY PROBLEMS

Research is needed to solve media and disciplinary problems. OR&D has given no response on these problems. Region VIII has set up a task force to attack inter-disciplinary problems - recreation, agriculture and other industry, smelters and mining.

SMELTERS

A major problem in this region is to bringing the smelter industry into compliance with the SIP. The data base to determine the capabilities of current control technology to smelters is considerably less than adequate.

ALFALFA PLANTS

Considering the present shortage of natural gas, presently used to control particulate emissions from alfalfa dehydrating plants, fuel switching that will diminish present control capability may become necessary.

ENVIRONMENTAL EFFECTS OF MOLYBDENUM MINING AND PROCESSING

There is a need to control windblown mine tailings from molybdenum mining and processing. High velocity winds (up to 100 m/h) contribute to high background particulate levels.

REGION IX

SULFATES

The issue of sulfates needs to be clarified. Without firm guidelines from the Agency regarding its position on sulfates, regional decisions concerning SO_x control by way of tall stacks and supplementary controls cannot be firmly made.

COPPER SMELTERS

The emissions from smelters include SO_x, lead, arsenic, zinc and other pollutants. The Region needs to know what the best available control technology is and what reduction in emissions can be expected by application of best available control technology in order to determine if AAQS will be met.

FUGITIVE DUSTS

The particulate standard will not be met in some areas because the background concentration of windblown dust is very high.

OXIDANTS

The Region has experienced high oxidant concentrations in remote areas and has been unable to determine if the high oxidant levels are the result of transport factors or natural background levels. Further, the Region feels that a better inventory of oxidant emissions is needed to facilitate control.

The Region also feels that total emissions of hydrocarbon in the Los Angeles area are too high and that all sources of hydrocarbons should be identified in order to come up with a control plan.

NO_x

NO_x in the Los Angeles area exceed the NAAQS. City and state officials are presently developing a control stategy.

SO_x

Since most power plants burn natural gas, SO_2 emissions are not a major problem. However, since natural gas is in short supply, low sulfur crude oil will be burned in the future resulting in higher emissions of SO_2.

ENERGY

It is anticipated that emissions of hydrogen sulfide and mercury from geothermal energy production will be a problem. Better data is needed to quantify control requirements.

Control technology for krypton 85 and tritium emissions from nuclear power plants will be needed.

INTERMEDIA

The ORD system should be able to better respond to intermedia problems and to provide technology that fully considers intermedia problems. The disposal of pathogenic hospital wastes, residuals from control devices and municipal sludge incineration are examples of intermedia problems.

PARTICULATES

The Region would like to have further analysis to determine the particle size distribution of ambient particulates in order to determine if the standards can be met with traditional control equipment.

REGION X

SMELTERS

The American Smelter and Refining Company owns a Cu smelter which is located in Tacoma, Washington and it has been identified as the largest single source of SO_x in the area. There is also a lead smelter in Kellogg, Idaho which is the primary source of sulfur and lead emissions.

The region has identified areas within the region where heavy metals and/or arsenic contamination pose potentially hazardous exposure to populations near the respective plants. From preliminary studies the following associations have been made 1) cadmium with lead and zinc smelting in Kellogg, Idaho and copper smelting in Tacoma, Washington; 2) Arsenic with copper smelting in Tacoma, Washington; 3) Lead with lead smelting in Kellogg, Idaho, and copper smelting in Tacoma, Washington.

AGRICULTURAL AND SLASH BURNING

The grass seed industry routinely burns their fields for weed and disease control and thus creates a serious pollution problem in this region. As of now no solution for control has been discovered and if an extension is not granted, the industry faces a shutdown.

Slash burning is also a problem since a good portion of the lumber industry is included in this Region. The unusable parts of trees are routinely burned as a means of disposal and cleaning the land for replanting. This type of open burning along with that practiced by the grass seed industry poses a significant fugitive particulate problem.

PARTICULATES

Asphalt batch plants and sawmill operations are a source of particulate matter and require control.

CHARACTERIZATION OF PUGET SOUND AND WILLAMETTE VALLEY HAZE

The problem of haze in the Willamette Valley and Puget Sound is increasing each year. Major polluters are in compliance schedules and their emissions are decreasing; however, the haze especially over major metropolitan areas does not appear to be decreasing and is in fact getting worse. A physical and chemical characterization of particulate components is needed to ascertain the relative contribution of diverse sources.

SULFITE PLANTS

There are several old sulfite plants in this region for which control is lacking and ORD has not responded to requests for assistance. Area Source SO_x control is not being considered.

CADMIUM FROM PHOSPHATE FERTILIZER PRODUCTION

A fertilizer plant is now marginally meeting the AAQ standard with one uncontrolled old unit and another unit which meets NSPS. If the fertilizer industry expands as expected, the AAQS will be violated.

CARBON MONOXIDE

TCP are in effect in an effort to control CO emissions emitted from the automobiles. CO emissions are often aggravated by ground-level inversions.

ICE FOG

Ice fog is in Alaskan cities frequently during the winter months. Sources are automobiles, cooling towers and warm water discharges.

INDUSTRIAL PROBLEMS

The industrial community is one of the principal users of air pollution control technology and as such is considered to be one of the clients of Agency R&D. This appendix catalogues the air pollution control technology problems and research needs as identified by a number of industrial trade and professional organizations. Only a few of the many organizations that could contribute were contacted. Therefore, the needs listed here are not the result of a complete survey but they are felt to be a good sample and indicate the nature of the industrial needs for air pollution control technology. Although some industrial groups included areas other than control technology in their response, for the purpose of this strategy only problems related to control technology have been included.

The American Iron and Steel Institute

- Develop methods for reuse, recycling, recovery or disposal of melt shop dust.

- Develop processes for practical control of fugitive emissions from steelmaking shops.

- Develop processes for practical control of fugitive emissions from blast furnace cast houses.

- Develop practical methods to continuously monitor emissions from open baghouses.

- Develop practical instrumentation to determine particle size in exhaust gases.

- Develop low pressure drop devices to control fugitive emissions.

- Develop processes for practical control for collection or suppression of oil vapors from charging of oily scrap in electric furnaces and BO vessels.

- Develop processes for practical control of CO from sinter machines.

- Develop processes for practical control of NO_x from steelmaking processes.

- Develop processes for practical control of H_2S from coke oven gas and disposal of H_2S.

- Develop methods of modeling both new and oil steel producing facilities to show the best overall control strategy considering cost/benefit analysis, cost effectiveness, energy, and total environmental impact (air, water, and land).

Air Pollution Control Association

The Division of Basic Science and Technology submitted a list of research problems which covers the entire field of air pollution. The list attached considers only related control technology.

Control Technology

A. For specific pollutants

1. Particles

   a. Cost effectiveness of methods for fine particle control should be determined.

   b. Effects of particle properties need more study.

   c. Better modeling procedures are needed for control equipment.

d. Scale-up factors to permit pilot plant data to be used for full-scale system design are needed.

e. Improved understanding of all parameters involved in apparatus is needed.

f. Lower cost systems are needed.

2. Gases

a. Energy conserving methods are needed to replace incineration.

b. Improved SO_2 systems are needed for small installations.

B. By equipment type

1. Scrubbers

a. Better, cheaper materials of construction are needed.

b. SO_2 scrubber chemistry needs more study to define role of chlorides, pH, etc.

c. Entrainment separators less susceptible to plugging are required and more information on the nature of solids emission in entrained mist is needed.

d. Sludge and sludge-fly ash mixture.

e. Disposal methods which are acceptable over the long range are needed. Slurry pumps less susceptible to erosion are needed.

f. Effects of particle composition on condensation and growth need research.

2. Electrostatic Precipitators

   a. Develop correlations between coal composition and fly ash resistivity.

   b. A data bank on fly ash resistivity would be useful

Manufacturing Chemists Association

The Air Quality Committee, identified the following research and development needs in air pollution control:

The most frequently mentioned need for improved technology is that of fine particle collection, particularly as it relates to the ability to design collection systems to meet tight standards of plume opacity. Emissions of sticky or hygroscopic particulates, that clog either mist eliminator pads or baghouse filters, seem to be especially troublesome. In general, some better collection device is necessary than the very energy-demanding high pressure-drop wet scrubbers.

Improving filter fabrics is another frequently mentioned subject for research. Improvements are needed in service temperature limits, mechanical strength and resistance to abrasion, and freedom from blinding.

A matter of great practical and immediate interest to the chemical industry is the anticipated shift from oil and gas to coal as a fuel for industrial boilers. Such boilers, in the size range from approximately 50,000 to 250,000 pounds of steam per hours, are large enough to make the cost premium for low-sulfur coal an unattractive means of compliance with sulfur dioxide emission standards, and small enough that the capital costs for the installation of flue-gas scrubbers, of current design, become an

- More work is needed on fly ash utilization. Very few utilities have found market for all of their fly ash.
- There is a need to develop fabric filters which can function with high temperature but are not costly. Presently high temperature bags are too expensive and cost of cooling hot gasses is significant.

There is a great need for a library of
- coal analysis
- ash analysis
- dust size analysis

Even though a handbook of coal analysis presently exists, it does not account for coals from new sources in the West and East. The data are available but scattered and not organized. Builders of the electrostatic precipitators are taking chances in design if they do not have exact data on the coal to be used. Boiler manufacturers face a similar problem. Several members of IGCI would expect to contribute to the work but the lead should come from EPA.

ELECTRIC POWER RESEARCH INSTITUTE

Guidelines and technology need to be developed for the implementation of supplementary controls.

excessive portion of total facilities costs. Additionally, the non-regenerative processes generate huge quantities of sludge that is expensive to haul away, and difficult to dispose of without creating water pollution or soil pollution problems.

Scaling and corrosion of flue gas desulfurization equipment to which no completely satisfactory solutions have been found.

Small boilers, usually with stacks of only moderate heights, and located in closely built-up industrial areas, must employ flue-gas reheat to avoid plume down-wash problems if they use wet-scrubbing for SO_2 control. In spite of the difficulties associated with current dry-adsorbent treatment systems, the value of a successful process of this type justifies continued effort.

Acceptable controls for organic vapor from large-volume, low-strength gas streams remain elusive. Fume incineration requires expensive and/or unavailable preium fuels, such as natural gas, and waste precious natural resources. The capacity of solid adsorbents is often grossly inadequate achieve a high reductions in emissions.

If present proposals for more stringent limitations on nitrogen oxide emissions from combustion operations become final, improved means of preventing the formation of, or removing. NOx from flue gases will be of immediate importance. The interest of the chemical industry in this problem are not unique.