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OFFICE OF
AIR AND WASTE MANAGEMENT

NATIONAL STRATEGY FOR CONTROL OF SULFUR OXIDES FROM ELECTRIC POWER PLANTS

The attached paper was prepared by EPA to explain Agency policy and practice in controlling sulfur oxide emissions by discussing the available data on health effects, ambient conditions, atmospheric processes, control technology, fuel availability, and other relevant factors. We hope this helps to elucidate an obviously important and difficult issue of public policy. We are sharing the paper with key members of Congress, industry executives, environmentalists and others. Your comments are welcomed.

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Attachment

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SYNOPSIS

As part of the Clean Air Act's mandate to protect and enhance the environment, an extensive national effort is underway to attain the current ambient air quality standards for sulfur dioxide. This effort includes a comprehensive program for control of sulfur oxides from steam electric power plants. The objective of the program is to attain the primary (health related) sulfur dioxide standards as rapidly as possible without disruption of electrical power generation capability and through use of domestic energy resources. In order to accomplish this objective, it will be necessary to delay application of control measures on some power plants in order to give priority consideration to the plants which cause the current standards to be exceeded. Of the approximately 1000 existing plants some 100 coal fired plants (representing 67,000 megawatts) require additional controls to meet the primary ambient air quality standards for sulfur dioxide.

The strategy incorporates the following major features:

Emissions from new plants will be minimized by incorporating the best demonstrated control measures during construction. (Currently available techniques include use of low sulfur fuels and stack gas cleaning systems).

In cases where control measures must be applied to existing plants in order to attain the current primary standards, these measures will be of the type capable of minimizing the adverse effects of acid and particulate sulfates as well as sulfur dioxide.

When extended periods of time are necessary to apply appropriate emission control measures, measures such as intermittent control will be utilized on a temporary basis where attainment of the sulfur dioxide standards can be expedited by their use.

Immediate application of control measures to existing plants which do not cause violations of the current primary ambient standards will be given lower priority until attainment of the primary standards in other areas is assured.

Federal enforcement orders will be issued under Section 113 of the Clean Air Act where necessary to ensure that available control measures are applied under optimum time schedules nationwide. Where temporary shortages of permanent control alternatives make attainment of emission limits impossible, these enforcement orders will extend beyond the attainment dates under the Act, in such a manner as to ensure early installations in priority locations.

The strategy will not require or authorize use of intermittent controls as a permanent substitute for constant emission controls because:

In certain situations (e.g., urban areas) these systems can't be used in a manner that is enforceable and that will reliably attain health standards.

There is a growing body of health effects data which links the sulfate particulates associated with sulfur dioxide emissions to serious health problems. We do not believe these problems will be averted by the use of tall stacks or intermittent control systems, even if such techniques are successful in achieving the existing air quality standards for sulfur dioxide.

However, temporary use of intermittent controls in carefully selected circumstances will facilitate more rapid attainment of the current primary sulfur dioxide standards without the necessity for power plant shutdown, will allow the continued use of the nation's high sulfur coal reserves while control technology, which will make it environmentally acceptable is being installed, and will also allow time to increase the availability of low sulfur fuels.

The end result of this strategy will be to attain the current primary sulfur dioxide standards as rapidly as possible, while ensuring that the health effects from sulfate particulates are minimized. This approach will also allow electric utilities to continue to use available high sulfur coal production to meet the nation's energy demands. However, under certain limited circumstances, conversion to oil on a temporary basis may be required.

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NATIONAL STRATEGY FOR CONTROL OF SULFUR OXIDES FROM ELECTRIC POWER PLANTS

This paper provides a brief explanation of the Environmental Protection Agency's long range program for control of sulfur oxides emissions from fossil fuel-fired electric power plants. It explains the need for control of sulfur oxides, the currently available measures for that control, and the basic strategy for application of those measures.

Impact of Sulfur Oxides in the Atmosphere

Sulfur oxides in the atmosphere consist primarily of gaseous sulfur dioxide, particulate sulfates, and sulfuric acid aerosols. Fuel combustion contributes approximately 80 percent of the total emissions of sulfur oxides in this country. Power plants alone contribute over one half of these emissions, of which the vast majority are in the form of sulfur dioxide.

The majority of the sulfur dioxide emitted is eventually converted into sulfates, including both acid and other particulate sulfates. However, conversion of sulfur dioxide into sulfates

involves complex photochemical and catalytic processes in the atmosphere. The conversion process may require from a few hours to as long as a week. Since these substances are transported widely in the atmosphere during these periods, the emissions from an individual power plant often significantly affect concentrations of sulfates over thousands of square miles for relatively long time periods.

Adverse Effects of Sulfur Dioxide

Epidemiological studies (studies of large populations exposed to ambient air) and other research studies indicate that sulfur dioxide concentrations in the ambient air are associated with both morbidity (illness rate) and mortality (death rate), due primarily to damage to the upper respiratory tract, damage to lung tissue, and aggravation of respiratory systems and lung disease. The adverse effects are most pronounced in the young, the aged, and those with existing respiratory ailments such as bronchitis and emphysema.

It is difficult to identify conclusively the level of ambient sulfur dioxide below which adverse health effects will not occur, and research studies indicate that such a "threshold level" may not, in fact, exist. However, primary (health related) national ambient air quality standards for sulfur dioxide have been established under Section 109 of the Clean Air Act on the basis of criteria developed

from over a hundred studies conducted over many years, including clinical research, laboratory studies, and epidemiological studies of several hundred thousand individuals. These criteria have been reviewed and approved by the National Air Quality Advisory Committee composed of recognized authorities from the government, medical, industrial, and academic communities. The criteria and the resulting standards have recently been reaffirmed by independent reviews by the National Academy of Sciences and the U.S. Department of Health, Education and Welfare. The standards are necessary to protect the health of the 3 to 5 percent of the population with existing respiratory ailments, as well as the very young and the aged in the general population.

Secondary national ambient air quality standards have also been established to protect the public welfare from known adverse effects caused by sulfur dioxide. These standards are based on criteria developed from over 150 scientific studies of effects of atmospheric sulfur oxides on materials, vegetation, and animals. These criteria have also been subjected to similar comprehensive review and approval procedures.

In addition to the ambient air quality standards, standards of performance for new power plants have been established under Section 111 of the Clean Air Act to limit new emissions to the level

achievable by the best demonstrated techniques for emission reduction considering cost. These standards require that all new power plants use either low sulfur fuel or flue gas desulfurization, irrespective of whether the surrounding ambient air meets the current ambient standards for sulfur dioxide.

Adverse Effects of Sulfates

There currently are no national ambient air quality standards established for sulfates. However, recent research studies conducted by EPA and other agencies provide strong, albeit preliminary, evidence of adverse health effects associated with sulfate levels which currently exist in many areas of the country, particularly in the heavily populated areas.

This evidence is only tentative, but it provides strong indications that: (1) when daily sulfate levels exceed approximately 6 to 10 ug/m^3, asthma attacks increase in frequency; (2) when daily levels exceed 9 ug/m^3, the elderly experience aggravation of heart and lung disease; (3) when daily levels exceed 25 ug/m^3, daily mortality (death rate) increases; and (4) when sulfate levels exceed approximately 13 ug/m^3 for several years, acute lower respiratory disease increases in children.

These levels are currently exceeded in many areas of the country. Excessive levels are most frequent in the major urban areas of the northeast; non-urban areas of the northeast exhibit somewhat lower, but still excessive, levels. Most western areas exhibit relatively low, and apparently safe, levels although there are indications in some regions of the west that sulfate levels are sufficiently high to pose a threat to public health.

Due to the complex and variable nature of the atmospheric reactions which convert sulfur dioxide emissions into acid and particulate sulfates, it is not yet possible to determine precisely the degree of sulfur dioxide emission reduction which will be required to reduce existing sulfate concentrations to acceptable levels.

However, preliminary evidence now exists that: (1) current sulfate levels in many areas of the country are associated with adverse effects on the public health; and that (2) substantial reductions in sulfur dioxide emissions over large areas will be required to reduce sulfate concentrations to acceptable levels, although little or no reductions may be required in others.

Additionally, world wide attention is beginning to focus on the severe long range welfare impacts of sulfates. Particulate sulfates and acid aerosols from the atmosphere are known to accelerate the corrosion of materials, inhibit growth of vegetation, reduce crop

yields, restrict visibility, reduce sunlight, and through acidification of soil and water (the "acid rain" phenomenon), contribute to long term adverse impacts on many activities related to living organisms, including agriculture, forestry, fishing, etc.

These effects are being extensively researched in Europe due to the adverse economic impact which has been attributed to increased acidity of soil and water. Research is being conducted in the U. S. but more extensive data are available from abroad (especially from Sweden) than from work in this country, so we do not yet know whether the negative effects of acid soil and water in the United States have reached the levels reported elsewhere. Although these long range impacts are not addressed by our current ambient standards, it would be imprudent to ignore these effects during formulation of a long term strategy for control of sulfur oxides.

Available Sulfur Oxides Control Measures

For fossil fuel-fired power plants, there are five basic methods capable of attaining the current ambient standards for sulfur dioxide: 1) use of naturally low sulfur fuel; (2) removal of sulfur from the fuel prior to combustion; (3) removal of sulfur oxides from the flue gas after combustion; (4) intermittent or periodic reductions in short term emissions based upon meteorologic conditions or forecasts;

and (5) dispersing the sulfur oxides resulting from combustion throughout the atmosphere through the use of tall stacks.

Use of naturally low sulfur fuel results in minimal byproducts; desulfurization of either the fuel or the flue gas results in by-products which must either be sold, or disposed of as waste at deliberately selected sites; and dispersion techniques simply distribute the waste products over wide areas. Since no single method may be universally applicable to all situations, it is necessary to consider the salient features of each in order to properly assess their application in an effective long range control strategy.

Low Sulfur Fuel

Gas-fired and most oil-fired power plants can be expected to experience little difficulty in controlling sulfur oxides emissions. Except for those plants which convert to coal because of the unavailability of gas or oil as part of the mandatory coal conversion program under the Energy Supply and Environmental Coordination Act of 1974, gas and oil-fired plants are of relatively minor concern. Conversions under the 1974 Act, of course, are subject to strict clean air conditions.

Over one half of the nation's coal reserves are of low sulfur content, and much of this coal is adequate to attain the ambient

standards. Insufficient quantities of low sulfur coal are currently being mined, but the deficiency can be largely overcome through long term contracts for low sulfur coal which commercially justify opening new or expanding existing mines.

However, about 15% of the coal-fired utility capacity is unable to use most low sulfur coals unless the plants' boilers are completely rebuilt. Also, since coal with low sulfur content reduces the efficiency of electrostatic precipitators commonly used to control particulate emissions; the reduction in sulfur oxides emissions is often achieved at the cost of increased expenditures to maintain acceptable efficiency of control of particulate emissions.

Despite these problems, demand for low sulfur coal has significantly increased in recent years. The price, which is highly dependent on geographic location with respect to the reserves, has escalated; and low sulfur coal is currently in short supply.

Desulfurization of Fuel

Desulfurization of coal has not yet reached the level of effectiveness achieved by desulfurization of oil. Nevertheless, limited coal desulfurization is a currently demonstrated practice. Unlike oil desulfurization, which can reduce sulfur content to extremely low levels, current commercially feasible coal cleaning

practices can generally reduce the sulfur content by about one-third; the exact level depending upon the type of coal and other factors.

The current level of technology is adequate for the large number of plants which need relatively small reductions in sulfur content of coal amenable to current forms of desulfurization to attain the ambient standards. However, for the many plants which require major reductions, practical desulfurization of coal must await further development of chemical coal cleaning, coal gasification, and coal liquefaction technology. These technologies are not expected to be sufficiently developed for widespread commercial use until the 1980's. Even when they are developed, they will not be appropriate for all uses due to the water and energy requirements, the type of coal required, and the heating quality of the resulting product.

Flue Gas Desulfurization

Flue gas desulfurization technology represents the most practical medium or long term solution to the sulfur oxides problem for a large number of coal-fired power plants. Flue gas desulfurization removes the sulfur oxides from the flue gas after combustion of the fuel. Depending upon the technology used, the by product is either sold (generally as sulfur or sulfuric acid) or is disposed of as waste.

Techniques are commercially available for processing the waste into stable, non-leaching landfill, or for converting it into various construction materials such as aggregate. Although waste disposal represents a problem for some plants, it is more desirable to dispose of the waste products at deliberately selected sites under adequate environmental controls, rather than to distribute them randomly over the countryside through atmosphere dispersion which will cause adverse health and other effects.

Flue gas desulfurization requires approximately $50 to $70 per killowatt in capital costs, or $25 to $35 million for complete retrofit of a 500 megawatt plant. Many American utilities have little or no experience with the technology, and it typically requires approximately 3 years to design, install, and check out an individual system. However, EPA's recently conducted "National Public Hearings on Power Plant Compliance with Sulfur Oxide Air Pollution Regulations" substantiate that the technology has been sufficiently demonstrated on full scale units to warrant widespread utility industry commitments for use. Although some scrubbers tested in the United States have encountered reliability problems, it is important to realize that each of these problems has a known solution. Further, these systems can be installed so that the reliability of power generation itself is not threatened

by any start up problems experienced in getting the "scrubber" system operating successfully. It is important to realize that nearly 50 individual units in this country are in various stages of planning for, installing, or operating flue gas desulfurization systems.

The energy required to operate a flue gas desulfurization unit varies from approximately 3 to 7 percent of the power produced by the plant needing control. If flue gas desulfurization were applied to all of the some 100 power plants which clearly require additional control by either scrubbers or low sulfur coal, less than one percent of the nation's electrical generating capactiy would be consumed. In cases where low sulfur coal is unavailable, or impractical for use, flue gas desulfurization represents an available method for meeting the nation's energy needs without adversely impacting on the public health and welfare. Moreover, its use will permit maximum utilization of the nation's reserves of high sulfur coal.

Intermittent or Supplementary Control Systems

The preceding three measures would attain the current ambient standards by reducing total emissions of sulfur oxides. Intermittent control is a concept which, at least in theory, permits

careful tailoring of emissions to avoid violating the current ambient standards for sulfur dioxide without significantly reducing total emission of sulfur oxides. These systems are based on the fact that, in the vicinity of many plants, the current short term sulfur dioxide ambient standards are threatened only during specific types of meteorological conditions. In the absence of other sources in the vicinity, it is sometimes possible to predict the onset of meteorological conditions which will cause the standards to be exceeded and to predict and implement the degree of emission reduction required to protect the standards. The rest of the time emissions are virtually uncontrolled because atmospheric dispersion would prevent the current sulfur dioxide standards from being exceeded at ground level.

Intermittent control represents a comparatively inexpensive (approximately $.5 to 1.5 million capital investment per plant) interim method by which some isolated plants could attain the current sulfur dioxide ambient standards.

The concept requires that a plant be capable of temporarily reducing emissions on short notice. This must normally be accomplished in power plants by either: 1) shifting the electrical load to another power plant; or 2) using a temporary supply of low sulfur fuel. The first alternative is available to only a limited

number of plants because many power pools in the country have insufficient spare generating capacity to accommodate the necessary degree of load shifting at the time when emissions must be reduced. The second alternative is impractical in many cases due to problems involving rapid switching of fuel type, increased particulate emissions, and basic system configuration.

A major operating constraint on use of intermittent control is the inability to operate an enforceable control system in a multi-source environment. It is not normally possible for an individual source to reliably maintain ambient air quality with intermittent control when other sources are affecting the air quality also, because the source using intermittent control cannot control the emissions from the other sources. Since there is no known way to operate a reliable and enforceable intermittent control system in a multi-source environment, the systems are at most generally feasible only for relatively "isolated" plants.

Intermittent control does not significantly reduce total emissions of sulfur oxides, and therefore even if it permits attainment of current ambient standards for SO_2 at ground level it may cause or exacerbate areawide sulfate and "acid rain" problems. Moreover, the concept is not compatible with the Clean Air Act requirement that constant emission limitations be used whenever

possible. This view recently has been confirmed by a decision of the Fifth Circuit U.S. Court of Appeals, NRDC vs. EPA, and by a Congressional decision to require constant emission controls to be installed eventually on power plants that switch from oil to coal.

Accordingly, intermittent control is currently considered an acceptable control measure only in cases where constant emission reduction measures are unavailable, and only until such measures become available. Under this philosophy, authorized intermittent control systems are referred to as "Supplementary Control Systems," meaning that they are intended to supplement available constant emission controls.

Increased Stack Height

The use of increased stack height (the so-called "Tall Stack" issue) is one frequently misunderstood aspect of the sulfur oxide control problem. Stack height is a necessary feature of most air pollution control strategies even with best available controls applied. Since it is not normally possible to totally eliminate pollutant emissions, stacks must be constructed so as to reduce the possibility of the plume impacting in the immediate vicinity of the plant.

EPA's "Tall Stack Policy" encourages the use of stacks conforming to good engineering practice, which is a function of the

individual facility configuration and local terrain features. In general, this policy results in stack heights suffciently tall to minimize ground level effects caused by aerodynamic wakes, eddies, and downwash, and those caused by high winds during neutral atmospheric stability conditions. In some cases good engineering practice requires a relatively tall stack to overcome adverse terrain features.

However, use of excessively tall stacks in an attempt to avoid reducing emissions merely results in dispersion of sulfur dioxide, sulfates, and acid aerosols over wide areas. Their use as a substitute for permanent emission controls, in addition to a harmful effect on health and welfare, would be inconsistent with the aforementioned Fifth Circuit decision.

CURRENT SULFUR OXIDES CONTROL STRATEGY

The sulfur oxides control strategy is oriented toward two basic objectives: 1) to attain the current primary ambient air quality standards for sulfur dioxide as rapidly as possible and 2) where additional control measures are required on existing sources, to ensure that as rapidly as possible those measures reduce overall levels of sulfur oxide emissions. This second objective is necessary to minimize threats to the public health

and welfare from dispersion of dangerous levels of particulates in the atmosphere.

The strategy will be implemented through a combination of State Implementation Plans and Federal Enforcement Orders. Implementation is of necessity, a joint effort of the States and EPA in order to expedite attainment of the national ambient air quality standards, new source performance standards, and State emission limitations under a national priority system which considers the limited availability of resources as well as the finite time required to apply available resources.

There are currently slightly over one hundred coal fired power plants which will be directly impacted by the strategy, and among the more significant problems which must be accommodated are: 1) the current temporary deficit of low sulfur coal; 2) the inability to install flue gas desulfurization technology nationwide in time to meet the statutory attainment date; 3) the limited experience of many utilities with flue gas desulfurization technology; 4) the need to give priority to protection of the public health; and 5) the current U.S. energy policy which virtually precludes widespread substitution of oil or natural gas for coal as a viable means for protecting the public health.

Summary of the Strategy

The strategy contains the following major features:

1) The best demonstrated control measures -- either low sulfur fuel or flue gas desulfurization -- are required for new plants in order to hold new emissions to the lowest practical level, pursuant to Section 111 of the Clean Air Act.

2) The requirement to immediately apply control measures to existing plants is minimized by placing lower priority on compliance with State regulations which are more stringent than required to attain the current primary ambient standards.

3) The states are encouraged to revise the emission regulations where they are more stringent than necessary to attain primary standards.

4) All available control measures are applied as rapidly as possible to existing plants which violate the current primary ambient standards, including temporary measures such as intermittent or supplementary controls where necessary to minimize ambient concentrations.

5) Enforcement orders are used to ensure that application of interim and permanent control measures is time phased in accordance with technical practicality and nationwide priorities.

6) Application of additional control measures to existing

plants where there is no violation of current ambient standards is generally deferred until attainment of the primary standards by other plants is assured.

7) Research and development of improved sulfur oxides control measures is actively encouraged and supported as a long range policy.

Application to New Plants

Current estimates are that electric utilities will install approximately 24,000 megawatts of new capacity per year over the near term. Of this new capacity, approximately 14,500 megawatts will be coal-fired and will require either low-sulfur coal or flue gas desulfurization to achieve the best demonstrated level of control as required by the Clean Air Act.

The requirement for adequate emission controls on new sources is accomplished by the existing New Source Performance Standards, and it is a major consideration in the sulfur oxides control strategy only to the extent that new sources require low sulfur coal and flue gas desulfurization systems which could otherwise be made available to existing sources. Recognizing that existing sources can generally convert to low sulfur coal more easily than retrofit flue gas desulfurization technology and that new facilities

can more easily install such technology, use of low sulfur coal by new plants at the expense of existing plants that need it should not be encouraged.

Application to Plants Switching Fuels

Some existing gas-fired or oil-fired power plants are expected to convert to coal but the exact number of plants and timing of conversions is currently uncertain. Plants are prohibited from conversion if the conversion would cause the primary ambient standards to be exceeded. Some plants may convert for only a short, specified time period; those plants will be granted variances from the State emission limitations during the coal-burning period if conforming fuels are not available. Plants undergoing permanent conversion will be placed on compliance schedules to incorporate adequate emission reduction measures within a specified time period, and might be required to employ interim control measures such as intermittent control where appropriate.

Application to Existing Plants

There are currently nearly 1000 power plants operating in the country, with a generation capacity of approximately 300,000 megawatts. The vast majority of these plants are currently meeting or

coming into compliance with State emission limitations and will not threaten the current sulfur dioxide standards.

However, some plants are subject to State emission limitations which are more stringent than required to attain the current primary ambient standards. These emission limitations often require low-sulfur coal which, if diverted, could be used in other areas to reduce the threat to the primary standards. Since the fall of 1972, EPA has been implementing a "Clean Fuels Policy" of asking the States to give priority for low-sulfur fuel to plants which are threatening the primary (health-related) ambient standards, and defer or modify excessively stringent emission limitations* in other areas. Currently, major coal-burning States are in the process of changing their regulations for this purpose, in compliance with requests by the EPA Administrator and the President.

Of the approximately 1000 existing plants, approximately 100 coal-fired plants (representing about 67,000 megawatts) require additional emission controls to attain the current primary ambient standards.

Approximately 25 of these plants (about 12,000 megawatts) require only moderate additional control to attain the standards.

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*i.e. More stringent than needed to attain the primary ambient standards, or set to meet the secondary standards in an unreasonably short time in view of the available supplies of low sulfur fuels and control technology.

The necessary degree of control can be achieved through coal desulfurization, limited blending of low-sulfur coal with the coal currently being used, and possible increases in some stack heights up to the level of good engineering practice. In general, these plants do not represent a major problem, and most will be brought into compliance with little difficulty.

The remaining plants (55,000 megawatts) require substantial control to attain the primary standards. It is these plants which represent the major problem because, although many of these plants could attain the standards with low-sulfur coal, there are currently insufficient supplies of low-sulfur coal available. Further, there is not sufficient time remaining prior to the statutory attainment date (1975-1977) to install flue gas desulfurization systems on all remaining plants due to a combination of reasons, including design and installation times, insufficient vendor capacity and experience, insufficient experience within many utility systems, and the reluctance of many utilities to apply control systems which are available.

Approximately ten of these existing plants are currently committed to installation of flue gas desulfurization technology*, although some of these have only partial commitments which will be finalized as soon as possible.

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*There are nearly 50 individual flue gas desulfurization units currently in or committed to operation. However, most of those not yet in operation are planned for new, as opposed to existing, plants.

Of the approximately 65 plants remaining (a capacity of 53,000 megawatts), a very few are currently incapable of installing flue gas desulfurization systems or using low-sulfur fuel. Regulations are being developed to specify the conditions and criteria under which these plants could use Supplementary Control Systems for an indefinite period while adequate emission control measures are being developed. These regulations would insure reliable and enforceable methods for attaining and maintaining the ambient standards, although they would not significantly alleviate the adverse impact attributed to atmospheric sulfates.

However, the vast majority of the remaining plants could apply either low-sulfur coal, or flue gas desulfurization systems, or both. Federal enforcement orders will be issued to these plants requiring time-phased application of available low-sulfur fuels and flue gas desulfurization systems, with selected interim measures as appropriate to attain the current ambient standards as rapidly as possible. Each order will generally apply to an individual plant, but the compliance times specified in each order will be prepared in accordance with criteria based on minimizing the nationwide adverse impact of sulfur oxides emissions. These criteria include a general priority system based on magnitude of the health impact on the affected population, and are supplemented by a variety of secondary considerations.

Basic Priority System for Scheduling Controls

First priority will be given to plants which severely impact on major urban, heavily populated areas which are currently in violation of primary standards for sulfur dioxide. Enforcement orders will generally require flue gas desulfurization where low sulfur fuel is not practical, and low sulfur fuel where flue gas desulfurization is not practical. Secondary considerations (as outlined below) will be used to suggest the appropriate control measures in other cases.

A lower priority will be given to those plants with a lesser impact on attainment of air quality standards in urban areas. For many of these plants, it may be necessary to extend the compliance dates until the late 1970's because higher priority plants may be fully utilizing the available resources until that time. For some of these plants, it will be necessary to reduce the health impact of the extended compliance times by requiring some form of supplementary control during the interim period.

The lowest priority will be given to plants in non-urban environments now meeting air quality standards for sulfur dioxide where intermittent control could serve as a reasonably reliable and enforceable means of maintaining these standards. Enforcement orders for these plants will contain compliance dates for

application of constant emission controls which might, in some cases, extend into the early 1980's. Extension beyond this time is considered unnecessary due to the projected availability of control systems and low sulfur fuel.

Secondary Consideration for Scheduling Controls

Development of the enforcement orders requires detailed evaluation of each plant on a case-by-case basis, and in many cases will require considerable negotiation to ensure that the compliance schedules can be met. In addition to the broad priorities outlined above, there are several secondary considerations which will influence compliance schedules for many plants.

Very few electric utilities have adequate experience with flue gas desulfurization technology at this time. Early installation of flue gas desulfurization on at least one facility in each appropriate utility system will be encouraged in order to apply the technology more effectively to subsequent facilities.

Because prior experience with desulfurization technology permits more effective application of the technology, a time phased approach will be adopted in some cases, so that a desulfurization system can be installed on one unit of a facility for checkout and optimization purposes, and installation on any additional units would be deferred until experience is gained from the initial unit.

Installation of flue gas desulfurization equipment and plant modifications to use low-sulfur coal often require a period of time when the facility cannot produce power. Similar off-line periods are routinely scheduled to permit normal maintenance of the boiler and generation equipment. To the extent possible, off-line periods required for application of emission controls will be integrated into the normal plant maintenance schedules.

Individual plant characteristics and locations result in differing requirements for and problems with disposal; and hence, some types of flue gas desulfurization are more desirable than others at an individual plant. The availability of individual types of systems is variable, and time-phased application will be used to ensure that the optimum system is applied to each facility.

And finally, intermittent control offers a potential for temporarily reducing threats to the current sulfur dioxide standards until constant control measures can be applied. Because intermittent control does not alleviate the threat from excessive sulfates and does not significantly reduce total emissions of sulfur oxides, its use will be discontinued as soon as possible.

Long Range Activities for Control of Sulfur Oxides

The combined use of flue gas desulfurization, low-sulfur fuels, and good engineering practice stacks, supplemented where necessary

by interim use of supplementary control systems, will permit attainment of the current primary sulfur dioxide standards in the relatively near future. However, increasing energy demands will eventually overwhelm the ability of control measures to protect the public health and welfare unless more efficient control measures are made available.

For this reason, EPA strongly supports and encourages research and development in diverse areas such as coal desulfurization, gasification, and liquefaction; more efficient flue gas desulfurization systems with reduced waste disposal requirements; increased availability of low-sulfur fuels; and more efficient methods for extracting energy from the nation's available fuel reserves. The nation must depend on fossil-fuels as a major energy source for the foreseeable future, but unless major improvements are made in controlling the sulfur oxides emissions, our reliance on domestic fossil fuels will be maintained only at the expense of the health and welfare of large segments of the population.

Anticipated Results of Control Strategy Application

Application of EPA's sulfur oxides control strategy will have the following results:

All new plants will come on line with best demonstrated emission control measures. New emissions growth will thereby be held to the

lowest practical level, thus providing for maximum future economic and industrial growth consistent with protection of the public health and welfare.

Application of emission control measures to existing sources which are not required to meet the primary ambient standards, but are required solely to meet State or local emission limitations, will generally be deferred until attainment of the primary standards in other areas is assured. This will allow primary standards to be met as rapidly as possible while allowing the continued use of the nation's plentiful high-sulfur coal reserves.

Control measures which are required on existing plants will result in continuous reduction of emissions, thereby minimizing the adverse effects of sulfates as well as sulfur dioxide.

Control measures will be applied to existing sources on a time phased basis under enforcement orders which consider nationwide availability of control measures, degree of impact on the public health, and secondary considerations which influence the efficiency with which the ambient standards can be attained throughout the nation.

For a variety of reasons, it will be necessary to apply intermittent controls or tall stacks temporarily on some plants to minimize public health impacts from sulfur dioxide until adequate emission control measures can be applied. In a few cases, interim