Illinois State Water Survey Division

ATMOSPHERIC CHEMISTRY SECTION

SWS Contract Report 464

MEASUREMENTS OF AIRBORNE PARTICULATE MATTER (PM-10) AT THE PROPOSED ILLINOIS SUPERCONDUCTING SUPER COLLIDER SITE

by Donald F. Gatz

Prepared for the
Illinois Department of Energy and Natural Resources

Champaign, Illinois
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INTRODUCTION

An assessment of possible air quality impacts from construction and operation of the proposed Superconducting Super Collider (SSC) was carried out for the project's Draft Environmental Impact Statement (DEIS). This assessment (USDOE, 1988), as well as our own (Appendix A), indicated that construction dust would be the only likely cause of detrimental air quality impacts associated with the construction and operation of the SSC. Construction activities were expected to cause local particulate mass concentrations to exceed National Ambient Air Quality Standards temporarily at all seven proposed SSC sites, including the one in Illinois (USDOE, 1988).

The general goal of this work was to characterize existing airborne particle concentrations in the vicinity of the Illinois SSC site, so that possible air quality impacts during construction could be quantified.

Specific objectives of the work were: (1) to provide pre-construction measurements of PM-10 concentrations in the vicinity of the Illinois SSC site, (2) to identify likely sources of particles contributing to the measured concentrations (especially the highest concentrations), and (3) to assess whether these sources would be likely to affect SSC construction sites in the same way as they affect the current measurement site.

METHODS

The map in Figure 1 shows the location of the proposed Illinois site for the SSC. The map also shows the locations of the special air quality measurements described in this report and the nearest comparable monitoring sites of the Illinois Environmental Protection Agency (IEPA).

Aerosol samples were collected in two size ranges (0-2.5 pg and 2.5-10 pg aerodynamic diameter) using an Andersen Model 245 automatic dichotomous virtual impactor. Particles were collected on tared Gelman 37 mm diameter, 2 pg pore size Teflo ultrathin polytetrafluoroethylene (PTFE) membranes with polymethylpentene support rings. By combining fine and coarse particle concentrations, this sampler gives PM-10 concentrations that compared well with EPA-designated reference methods (Purdue, 1988) in recent sampler intercomparison tests (Hoffman et al., 1988). In addition, the collection of separate fine and coarse particle concentrations helps to identify sources.

Individual sample pairs were collected for 24 hours, from midnight to midnight, every 6th day, synchronized with the PM-10 sampling schedule of the IEPA. The sampling site was the University of Illinois College of Agriculture St. Charles Horticultural Research Center, located about 2 km west of St. Charles, Illinois, at the intersection of State Highway 38 and Peck Road. The sampler was located approximately 130 m north of the highway on a plot of mown grass. The site was primarily surrounded by agricultural fields to a distance of at least 1 km in all directions. A field office and greenhouse building stands 40 m northeast of the sampling site. A state highway garage and yard are located directly south of the sampling site, across Highway 38. Meteorological parameters, including wind speed and direction, temperature, relative humidity, and solar insolation, are also measured at this site by the Water Survey.

Filters were weighed before and after sampling, after conditioning for at least 24 hours at a relative humidity of 47% or less, on a Cahn Model C-31 microbalance. The precision (standard deviation) of the filter mass measurements, as determined by duplicate measurements, is ± 5 μg (Sweet and Gatz, 1988). Even for a rather minimum fine or coarse particle concentration of 5 μg/m^3 (see Figure 4), at a flow rate of about 1 m^3/hr for a 24 hr sample, this corresponds to less than 5% of the sampled particle mass.

Supplemental meteorological data for 1987 and 1988 were obtained for O'Hare Airport (NOAA, 1987a, 1988a) and Aurora (NOAA, 1987b, 1988b).

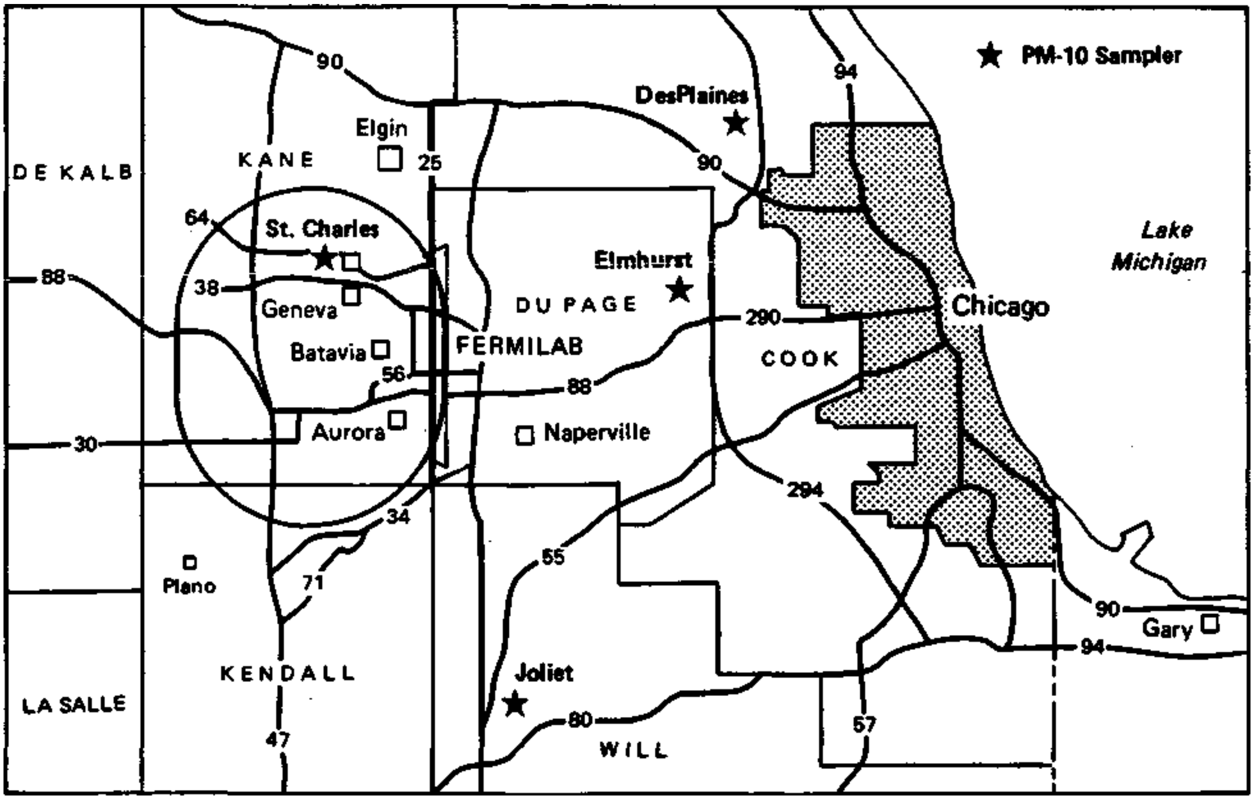

Figure 1. Location of proposed Illinois SSC site, special FM-10 monitoring site at St. Charles, and IEPA PM-10 monitoring sites at Joliet, Elmhurst, and Des Plaines.

RESULTS

Between 1 August 1987 and 31 December 1988, 55 valid PM-10 measurements were made at the St. Charles site. Mean and median PM-10 concentrations for these measurements were 24 and 20 µ g/m^3, respectively. The minimum and maximum concentrations were 8 and 73 µ m/m^3, respectively. The mean value agrees closely with a mean of 27 ug/nr measured recently at a rural agricultural site near Champaign, IL (Vermette et al., 1988).

Figure 2 shows a cumulative distribution of PM-10 concentrations, in which the PM-10 concentrations are plotted on a log scale and the abscissa is proportional to the probability scale on probability paper. A straight line on this graph represents a lognormal distribution of data. The figure shows that the observed distribution of PM-10 concentrations indeed approximates a lognormal distribution.

In anticipation of SSC construction, we wanted to determine the existing sources of aerosol, especially those that cause ambient concentrations greater than the mean value of 24 ug/nr^{3,} so that we could assess whether these sources would affect the SSC construction sites.

To aid in identifying sources of particles, we examined how aerosol concentrations varied with time, in space (by comparing them to nearby IEPA PM-10 measurements), and as functions of various meteorological parameters, especially wind and precipitation.

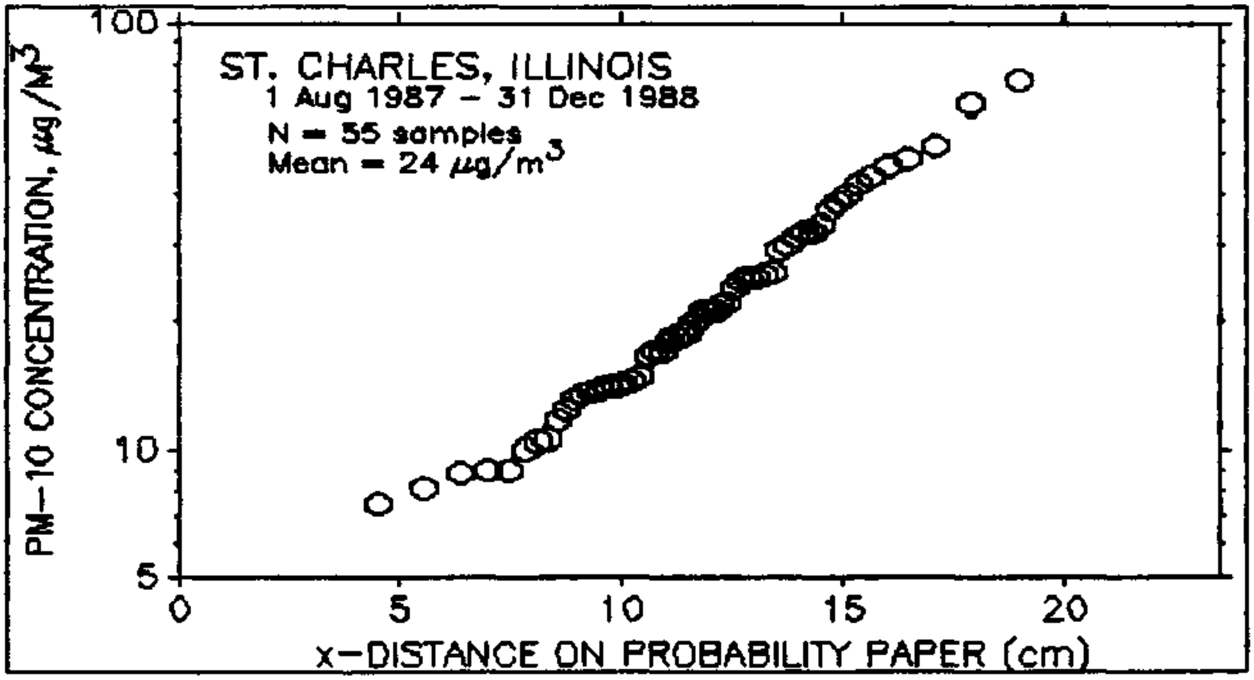

Figure 2. Probability distribution of St. Charles PM-10 concentrations. The data suggest a lognormal distribution of PM-10 concentrations.

Temporal and Spatial Variations

The variations in PM-10 concentrations with time between 1 August 1987 and 31 December 1988 are shown in Figure 3. The corresponding variations in the fine and coarse components are shown in Figure 4. Data gaps were caused by sampler

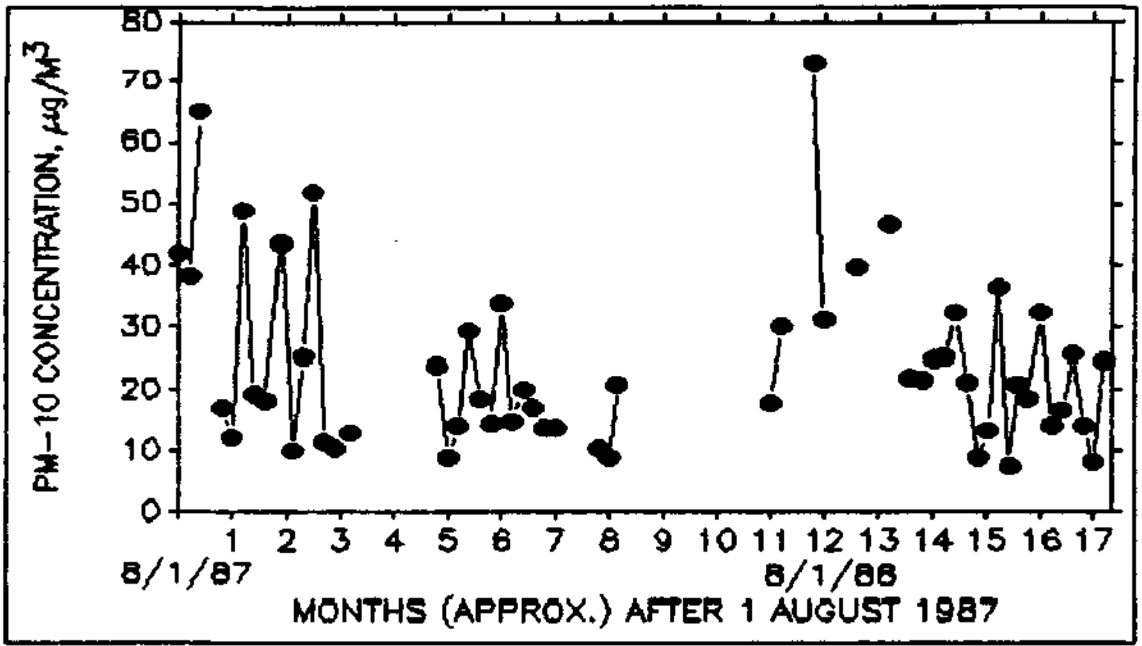

Figure 3. St. Charles PM-10 concentrations, August 1987 - Decenber 1988.

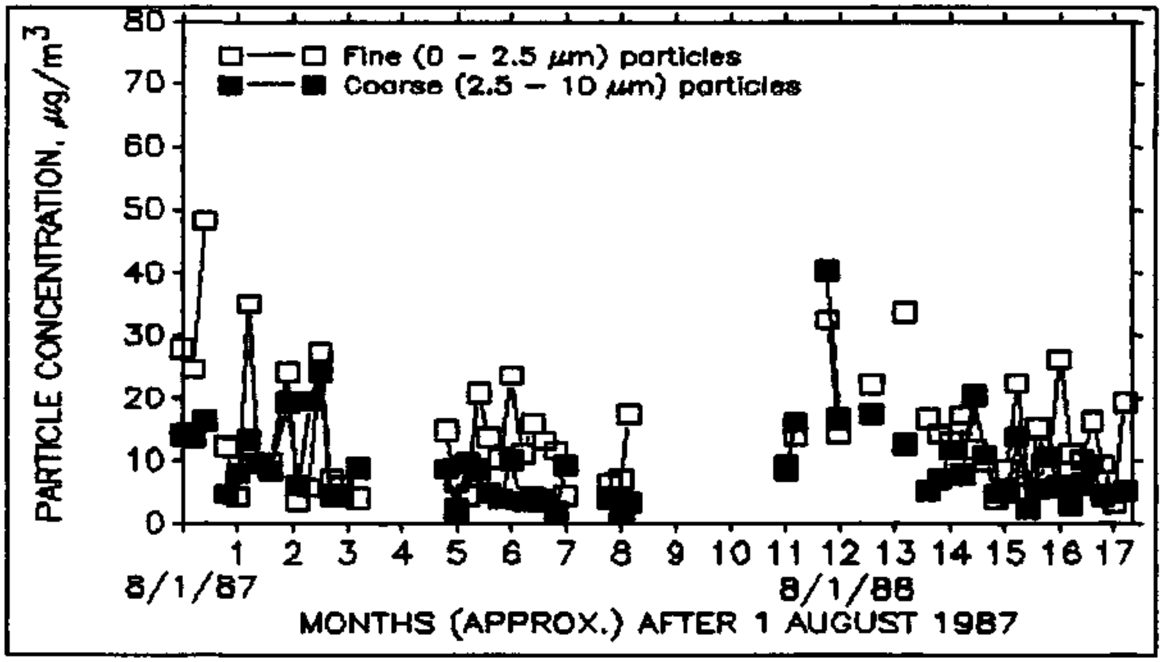

Figure 4. St. Charles fine and coarse aerosol concentrations, August 1987-Deceaber 1988.

malfunctions. The available data show generally lower concentrations of PM-10 during the colder half of the year, and higher concentrations during the warmer half of the year. Concentrations of the fine component were usually higher than those of the coarse component.

Spatial-temporal variability also provides useful clues to the sources of aerosol. Local sources would cause episodic high concentrations at individual sites; distant sources lead to parallel variations in pollutant concentrations at many sites. Figure 5 shows St. Charles PM-10 measurements along with data for the nearest three IEPA PM-10 sites for August and September 1987. The variations are very similar at all four locations, indicating a regionally uniform aerosol from distant sources during this period. Because of St. Charles sampler malfunctions and IEPA site relocations beginning in January 1988, similar comparisons were not possible for other times of the year.

Variations with Wind Direction

Figure 6 shows the variation of mean PM-10 concentrations in low- and high-concentration groups with wind direction sector. Within the low-concentration group, the sector mean concentrations showed almost no variation with wind direction. In the high-concentration group, mean concentrations were highest with winds from the 120-299° sector and the 0-59° degree sector. Note that there were no samples with winds from the direction of the Chicago metropolitan area (60-119°).

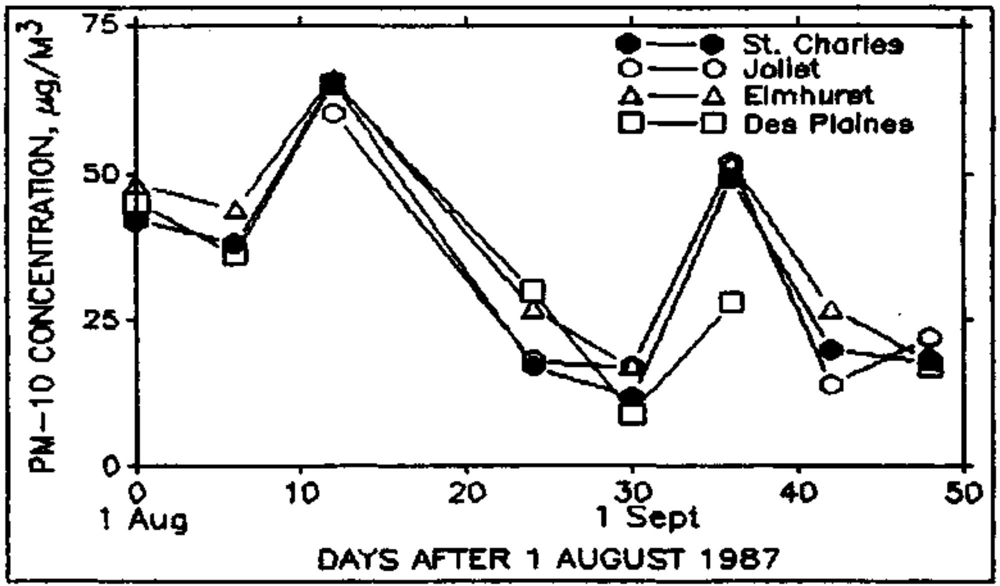

Figure 5. PM-10 tine variations at St. Charles and three IEPA sites, August-September 1987.

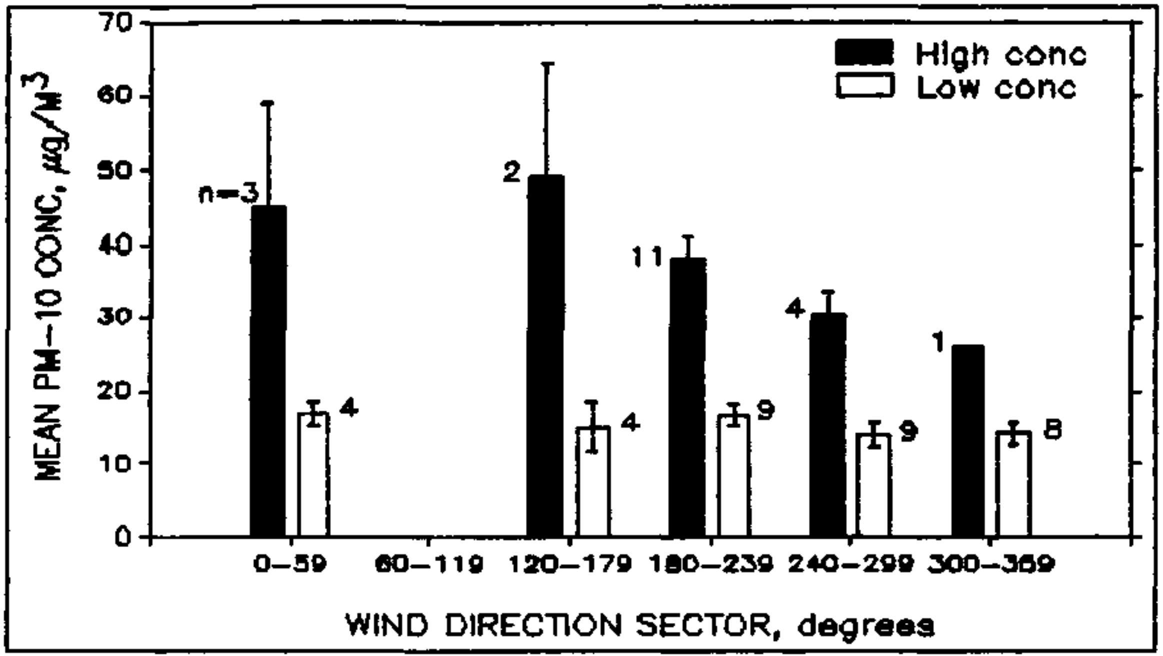

Figure 6. St. Charles nean PM-10 concentrations in wind direction sectors, for high- and low-concentration groups.

It is instructive to examine variations in fine/coarse proportions to see whether either fraction was dominant when the higher concentrations were observed. The variation in mean coarse fraction in both high and low-concentration groups is shown as a function of wind direction in Figure 7. Small differences (in

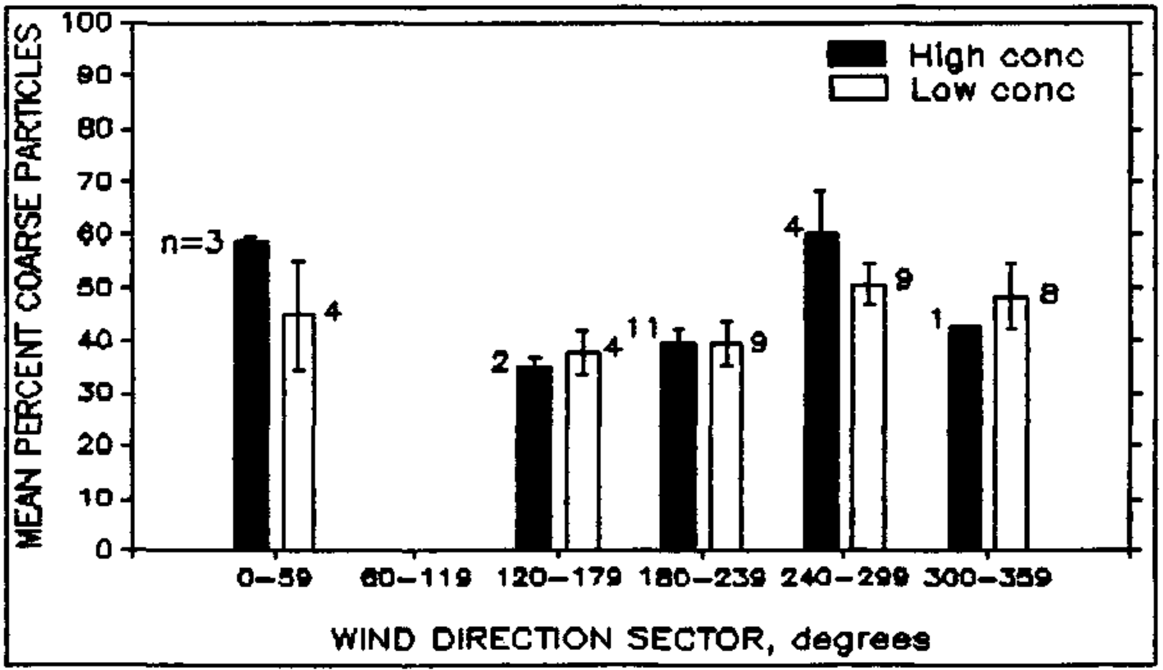

Figure 7. St. Charles nean coarse fraction in wind direction sectors, for high- and low-concentration groups.

both directions) occurred in the various wind sectors; however, over all wind directions, no difference in coarse fraction is apparent between the high and low concentration groups. Thus there is no suggestion from these data, either, that high concentrations were caused by local sources of either coarse or fine particles.

Variations with Wind Speed

It is also useful to consider variations of particle concentrations with wind speed on wet and dry days. The hypothesis is that if wind erosion of local soils is the source of the coarse particles, their concentrations should increase with peak gust or fastest minute on dry days, but not on wet days. Unfortunately, the relationship between wind speed and particle concentration is ambiguous. Even if soil dust emissions increase with speed or peak gust, dilution through vertical dispersion may also increase, so the net effect on airborne concentrations near the surface cannot be predicted.

Figures 8 through 13 show relationships between wind speed and particle concentrations for fine, coarse, and PM-10 particles, respectively. Both peak gust and fastest 1-min average wind speed (observed at O'Hare Airport) are used as measures of wind speed.

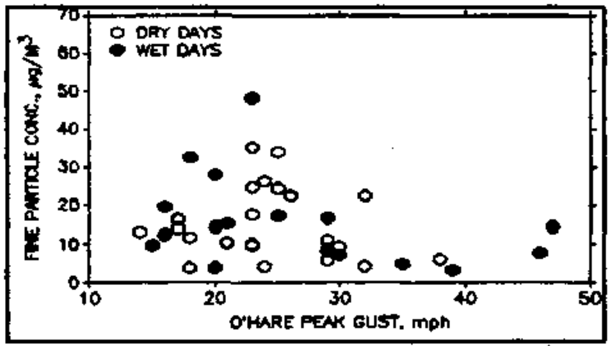

Figure 8. St Charles fine particle concentrations as a function of O'Hare peak gust.

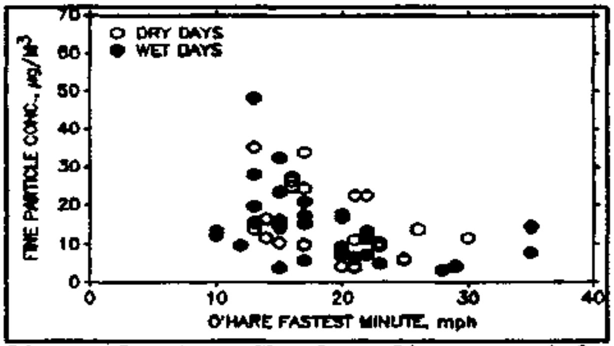

Figure 9. St. Charles fine particle concentrations as a function of O'Hare fastest 1-min wind speed.

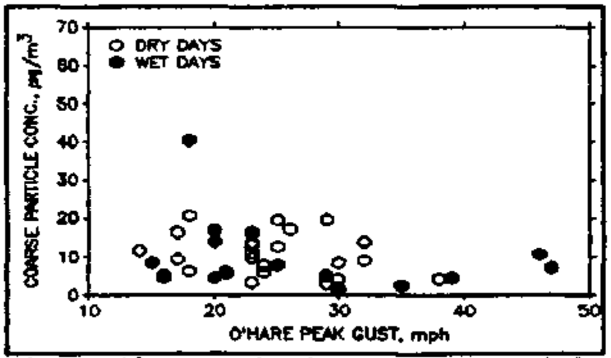

Figure 10. St. Charles coarse particle concentrations as a function of O'Hare peak gust.

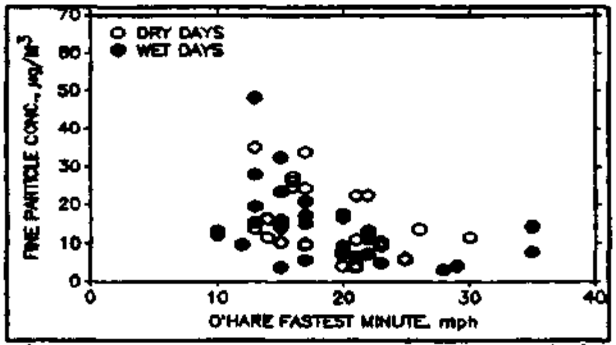

Figure 11. St. Charles coarse particle concentrations as a function of O'Hare fastest 1-min wind speed.

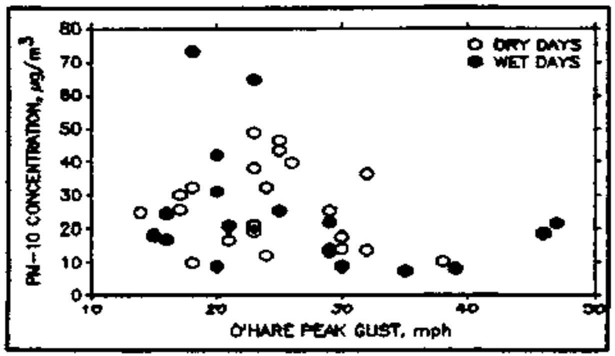

Figure 12. St. Charles PM-10 concentrations as a function of O'Hare peak gust.

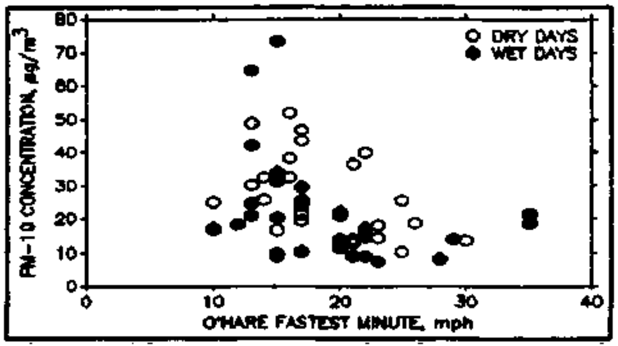

Figure 13. St. Charles PM-10 concentrations as a function of O'Hare fastest 1-min wind speed.

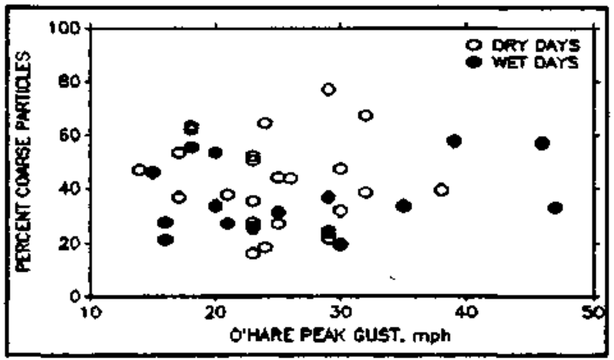

Figure 14. St. Charles coarse fraction as a function of O'Hare peak gust.

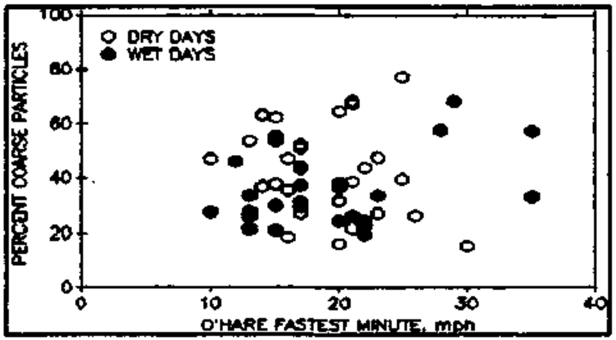

Figure 15. St. Charles coarse fraction as a function of O'Hare fastest 1-ain wind speed.

Maximum fine particle concentrations occurred at moderate values of peak gust (20-30 mph) (Figure 8) and fastest minute (Figure 9) on both wet and dry days.

Coarse particle concentrations showed little relationship to either peak gust values (Figure 10) or fastest minute (Figure 11) on either wet or dry days.

The relationships between PM-10 concentrations and wind speed show features of both the fine- and coarse-particle patterns. Peak concentrations occurred with moderate peak gusts (Figure 12), but no relationship to fastest minute is apparent (Figure 13).

Examination of coarse particle fraction as a function of peak gust and fastest minute on both wet and dry days may enable one to assess the role of soil erosion as a source of coarse particles while avoiding the ambiguities associated with the relationship between concentration and wind speed. Figure 14 shows percent coarse particles as a function of O'Hare peak gust. Figure 15 shows the relationship between coarse fraction and fastest minute of wind. No relationship between coarse particle fraction and wind speed is apparent in either figure.

Aerosol Concentration Distributions on Dry and Wet Days

To examine the possible influence of wet surfaces on aerosol concentrations, we compared concentration distributions on wet and dry days by using percentile plots (Cleveland, 1985), in which percentiles of one distribution are plotted against corresponding percentiles of the other. Figures 16 through 18 compare distributions on dry days to those on wet days for PM-10 concentrations, coarse particle concentrations, and coarse fraction, respectively.

Up to about 20 µ g/m^3, PM-10 concentrations at corresponding percentiles (Figure 16) were very similar, but they were slightly higher on dry days than on wet days. Between 20 and 40 µ g/m^3, the dry-day percentiles were higher by 5-10 µ g/m^3 Above 40 µ g/m^3, the wet-day percentiles were higher by 15-20 µ g/m^3, but this result for the extreme upper end of the distribution is derived from too few measurements to be meaningful.

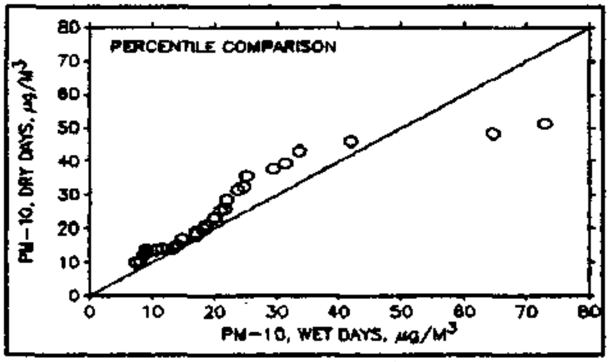

Figure 16. Comparison of St. Charles PM-10 concentration distributions on wet and dry days.

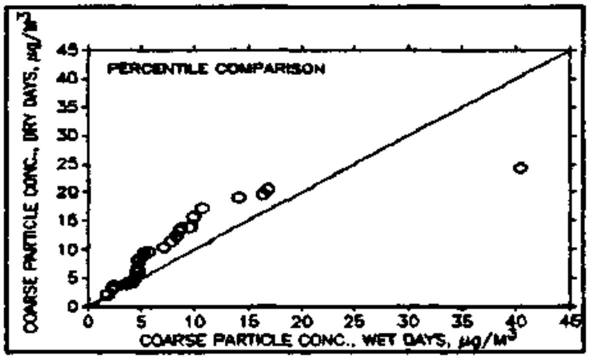

Figure 17. Coaparison of St. Charles coarse particle concentration distributions on wet and dry days.

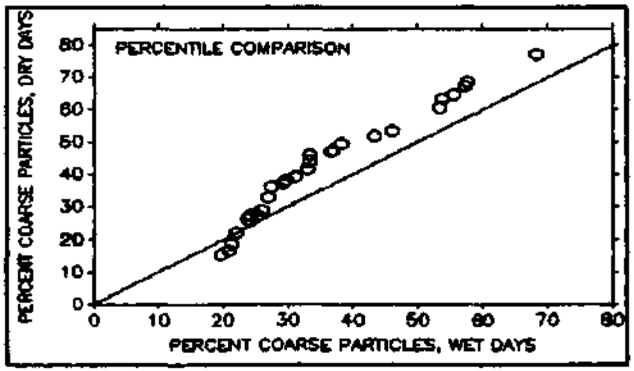

Figure 18. Comparison of St. Charles coarse fraction distributions on wet and dry days.

Up to about 5 pg/m^3, the coarse particle concentrations at corresponding percentiles (Figure 17) were about the same on wet and dry days; for the 5-15 pg/nr range coarse particle concentrations on dry days exceeded those on wet days by about 5 pg/nr at corresponding percentiles. Thus, the higher coarse particle concentrations tended to occur on dry days, at least up to the extreme tail of the distribution.

At the very low end of the distribution of coarse particle fractions (Figure 18), values were higher on wet days than on dry days. Above 25%, however, the reverse was true. Thus, the larger coarse particle fractions tended to occur on dry days, consistent with a coarse particle open source that is inhibited by wet surface conditions.

DISCUSSION AND CONCLUSIONS

The available measurements, although fewer than expected because of equipment malfunctions, provide a data set adequate to fulfill the objectives of this work. We observed a mean PM-10 concentration of 24 µ g/m^3, well below the primary standard of 50 pg/m^3 for the annual mean. PM-10 concentrations were somewhat higher and more variable during the warmer half of the year. The frequency distribution of PM-10 concentrations fits the lognormal distribution frequently observed for pollutant concentrations.

Several observations about the behavior of the aerosol concentrations offer clues to the nature of the main sources. These observations and their implications are discussed in the following paragraphs.

First, the PM-10 concentrations less than the mean were uniformly distributed with wind direction. PM-10 concentrations greater than the mean were highest in winds approaching the site from 120-239° (ESE to WSW) and from the NNE. Second, very similar time variations in PM-10 concentrations occurred at four separate locations in the suburban Chicago area during a two-month period in late summer 1987. Taken together, these observations suggest that distant sources somewhere to the south of the Chicago area contribute strongly to the higher observed PM-10 concentrations in the vicinity of the proposed SSC site.

The nature of these sources is suggested by the observation that both coarse and fine aerosols were important components of the observed PM-10 concentrations. Coarse aerosol accounted for 40-50% of the PM-10 mass. The lowest coarse fractions occurred with winds from the 120-239° sector. Thus, the high concentrations observed from this sector tended to be dominated by fine-particles. The observation that higher coarse fractions tended to occur preferentially on dry days suggests that soil wind erosion and unpaved road emissions are possible sources of the coarse aerosol. These sources would be regional, as opposed to local.

Possible local sources of coarse aerosol include the highway garage and yard to the south of the sampling site and, particularly during tilling and harvesting operations in the spring and fall, agricultural fields in all directions from the site. The wind sector where the high concentrations occurred includes that of the highway garage, but samples from that sector tended to be dominated by fine, not coarse, particles. On the other hand, the high concentrations occurred only in a limited sector, while agricultural fields are located in all directions from the site. Further, the coarse fraction was about the same in low- and high-concentration samples, contrary to what would be expected if local soils or unpaved roads contributed strongly to the higher concentrations.

Likely sources of fine aerosol include secondary sulfate from distant fossil fuel burning. The observation of highest PM-10 and fine particle concentrations from the S and SW is consistent with the episodes of high airborne sulfate concentrations described by Altshuller (1982, 1984, 1985).

The same sources that determine the ambient air quality at the St. Charles site would very likely affect potential Illinois SSC construction sites as well.

ACKNOWLEDGMENTS

This work was directed by William R. Barnard until his departure from the Water Survey in March 1988. Field and laboratory operations were carried out by Paul Nelson. Location of the sampler at the St. Charles Horticultural Research Center was made possible through the cooperation of William Shoemaker. Gail Taylor edited the manuscript.

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APPENDIX A

ASSESSMENT OF THE POTENTIAL AIR QUALITY IMPACTS RESULTING FROM SITING THE SUPERCONDUCTING SUPER COLLIDER IN ILLINOIS

by

William R. Barnard
Donald F. Gatz
Atmospheric Chemistry Section
Illinois State Water Survey

April 1986

TABLE OF CONTENTS

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IV 4. AIR QUALITY

Introduction

Evaluation of the air quality impacts associated with the construction and operation of the Superconducting Super Collider (SSC) in northern Illinois requires an assessment of the following:

1. Typical meteorologic conditions at the proposed site.
2. Current site ambient air quality.
3. Historical data on ambient air quality including an assessment of the attainment status for priority pollutants in the site area.
4. Determination of the potential for emission of priority pollutants due to construction and operation of the SSC.
5. Consideration of air quality control measures that may be needed as a result of SSC construction at the proposed site.

The evaluation tht follows was based on published data available concerning the proposed site area, estimated siting parameters and previous studies of the impacts on air quality from typical construction activities.

Our findings show that particulate emissions from fugitive dust sources during construction of the SSC represent the only potential air quality impact associated with the development of the SSC. Our estimates show that surface construction and travel on unpaved access and haul roads are the major activities responsible for particulate emissions. Unpaved roads emit larger amounts of material than construction activities and should be the focus of any emission control strategies. Worst case estimates show that paving all unpaved roads coupled with reductions in construction activity emissions could reduce emission levels below regulated levels. However, the costs associated with this would be in excess of $1.5 million. Levels of particuate emissions that are more likely to occur indicate that, if necessary, emission levels could be reduced below regulated levels for a cost of about $150,000. It is also shown that the most cost-effective control method would be to obtain a temporary permit from a regulatory agency since emissions will only occur during construction of the SSC not during operation.

IV 4. (i) AIR QUALITY IN THE SSC STUDY AREA

Ambient Air Quality at the Proposed Site

Any evaluation of the potential air quality impacts due to construction of the SSC requires a knowledge of regulated pollutants and their sources, current ambient air quality, historical trends in ambient air quality, the attainment status of the proposed site area and the site meteorology.

Current air quality standards were developed as part of the Clean Air Act of 1970 and the Clean Air Act Amendments in 1977. A series of primary and secondary standards were developed for sulfur dioxide (SO_2), total suspended particulates (TSP), carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (C_3) and lead (Pb). A summary of national and Illinois standards is presented in Table 1. Primary air quality standards are designed to protect public health while secondary standards are designed to protect public welfare (vegetation, materials, property, visibility and climate). The sources and health and welfare effects of these pollutants are outlined in Table 2.

Current and Historic Data on Air Quality at the Proposed SSC Site

Table 3 shows the annual concentrations for TSP, SO_2, O_3 and Pb as derived from Illinois Annual Air Quality Reports, 1976-1984 (Illinois

TABLE 1

SUMMARY OF NATIONAL AND ILLINOIS[1]
AMBIENT AIR QUALITY STANOARDS

POLLUTANT	TIME OF AVERAGE	PRIMARY STANDARD (AT 25^{0}C and 760 mm of HG)	SECONDARY STANDARD
PARTICULATE MATTER (TSP)	Annual Geometric Mean 24 hour	75 ug/m^3 260 uq/m3	60 ug/m^3 150 uq/m^3
SULFUR DIOXIDE (SO2)	Annual Arithmetic Mean 24 hour 3 hour	0.03 ppm (80 ug/m3) 0.14 ppm (365 ug/m3) None	None None 0.5 ppm (1300 ug/m3)
CARBON MONOXIDE (CO)	8 hour 1 hour	9 ppm (10 mg/m^3) 35 ppm (40 ng/m^3)	Same as Primary Same as Primary
OZONE (O_3)	1 hour/day	0.12 ppm (235 ug/m^3)	Same as Primary
NITROGEN DIOXIDE (NO2)	Annual Arithmetic Mean	0.053 ppm (100 ug/m^3)	Same as Primary
LEAD (Pb)	Quarterly Arithmetic Mean	1.5 un/m^3	Same as Primary

[1] Illinois Air Quality Standards are Identical to National Air Quality Standards with the exception of lead for which no state standard exists.

NOTE: All standards with averaqinq time of 24 hours or less are not to be exceeded more than once per year.

Table 2. Sources and Health and Welfare Effects of Regulated Pollutants.

POLLUTANT	SOURCES	HEALTH AND WELFARE EFFECTS
TSP	1. COMBUSTION OF FOSSIL FUEL 2. INDUSTRIAL PROCESSES 3. FUGITIVE DUST (WIND EROSION. UNPAVED ROADS. STORAGE PILES. CONSTRUCTION ACTIVITY) 4. PHOTOCHEMICAL REACTIONS	1. LOCAL NUISANCE EFFECTS 2. INCREASED CLOUDINESS 3. PARTICLE DEPOSITION IN LUNGS 4. CORROSION OF METALS 5. SOILING OF TEXTILES AND BUILDINGS 6. DIMINISHED GROWTH RATES OF PLANTS
SO_2	1. COMBUSTION PROCESSES 2. PETROLEUM REFINING 3. SULFURIC ACID MANUFACTURE 4. SMELTING OF METAL ORES	1. IRRITATION AND INFLAMMATION OF TISSUE 2. BRONCHIAL CONSTRICTION 3. EXACERBATION OF PRE-EXISTING RESPIRATORY DISEASES 4. CONVERSION TO SULFURIC ACID IN THE PRESENCE OF WATER VAPOR (ACID RAIN)
CO	1. INCOMPLETE COMBUSTION OF FOSSIL FUELS IN MOTOR VEHICLES 2. DEMOLITION BLASTING	1. TOXIC AT HIGH CONCENTRATIONS 2. AGGRAVATES CARDIOVASCULAR DISEASE BY REDUCING THE OXYGEN CAPACITY OF BLOOD CELLS
NO_2	1. HIGH TEMPERATURE COMBUSTION PROCESSES (SUCH AS BURNING FOSSIL FUELS IN MOTOR VEHICLES)	1. CAN CAUSE HAZE AND VISIBILITY REDUCTION 2. DAMAGE VEGETATION 3. CAUSE DEEP LUNG IRRITATION 4. COMBINES WITH WATER VAPOR TO FORM HIGHLY CORROSIVE NITRIC ACID 5. COMBINES PHOTOCHEMICALLY WITH OTHER POLLUTANTS
O_3	1. PRODUCED PHOTOCHEMICALLY THROUGH REACTION OF NON-METHANE HYDROCARBONS AND NITROGEN OXIDES. 2. PRODUCED NATURALLY BY ELECTRICAL DISCHARGES	1. INJURY TO VEGETATION 2. DEGRADATION OF MATERIALS (ESPECIALLY RUBBER) 3. PULMONARY IRRITANT
Pb	1. COMBUSTION OF LEADED GASOLINE 2. LEAD SMELTERS 3. BATTERY MANUFACTURE 4. IRON AND STEEL PRODUCTION	1. INTERFERENCE WITH ENZYME PRODUCTION 2. KIDNEY AND NEUROLOGIC CELL DAMAGE 3. POISONING AT HIGH LEVELS

Environmental Protection Agency). Where possible data are presented from monitoring sites closest to and surrounding the proposed SSC site. When this was not possible (due to only a limited number of monitoring sites for some pollutants) values from sites in the counties that will contain the SSC and from DeKalb County, which represents conditions outside of the metropolitan Chicago influence, are presented. Kendall County, in which part of the SSC will be constructed, is not included because there have been no monitoring sites there since 1978.

From Table 3 it can be clearly seen that TSP values have decreased slightly and are generally below the secondary standard of 60 ug/m^3. TSP has generally decreased from the mid to upper 50's down to the mid to upper 40's. There appears to be a dramatic drop between 1981 and 1982 (with the exception of the West Chicago site) with values dropping by about 8-10 ug/m^3.

SO_2 trends are much harder to discern primarily due to the paucity of data. Values are typically between .003 and .007 ppm. No values are available for DeKalb County. These values are typically far below the .03 ppm primary standard.

Ozone shows a great deal of year-to-year variability. The values presented in Table 3 are the annual highest 1-hour value and thus do not represent average conditions. However, the ozone standard is based on 1 hour/day measurements and any values above the .12 ppm level would represent violations of the primary and secondary standards. The data shows that all these counties frequently are in non-attainment of the standard.

Data for lead has been collected since 1979. The data show that lead levels are significantly below the 1.5 ug/m^3 standard and seem to be

Table 3

Total Suspended Particulate Trends (Annual Mean, ug/nr)

Station (County)	1976	1977	1978	1979	1980	1981	1982	1983	1984
Naperville (DuPage)	58	58	53	62	54	58	47	48	50
West Chicago (DuPage)	59	56	49	53	56	52	51	47	44
Wheaton (DuPage)	58	59	53	59	52	53	43	49	44
Aurora (Kane)	-	-	-	-	-	52	40	45	40
Elgin (Kane)	59	56	50	57	57	55	+	42	42
DeKalb (DeKalb)	+	56	+	+	+	53	36	36	33

SO_2 Concentration Trendsi (Annual Mean, ppm)

County	1976	1977	1978	1979	1980	1981	1982	1983	1984
DuPage	.005	.007	-	-	-	.006	.006	.006	.006
Kane	-	-	-	-	-	.004	.003	.005	.005
DeKalb	-	-	-	-	-	-	-	-	-

O3 Concentration Trends (Annual Highest 1 Hour Value, ppm)

County	1976	1977	1978	1979	1980	1981	1982	1983	1984
DuPage	.109	.155	.125	.112	.153	.113	.092	.153	.136
Kane	-	-	-	.140	.107	.138	.085	.133	.110
DeKalb	.120	.172	.105	—	_	-	-	-	-

Pb Concentration Trends (Annual Mean, ug/m^3)

Station (County)	1979	1980	1981	1982	1983	1984
Naperville (DuPage)	.41	.28	.24	—	—	—
West Chicago (DuPage)	.35	.26	.18	-	-	-
Wheaton (DuPage)	.40	.26	.19	-	-	-
Elgin (Kane)	.52	.65	.58	+	18	.18
Aurora (Kane)	-	-	.19	-	-	-
DeKalb (DeKalb)	+	+	.14	-	-	-

No lead measurements made in 1976, 1977 or 1978

- Station not in operation during year shown.

\+ Minimum statistical criteria not met to determine annual statistics.

decreasing with time. This is primarily due to the decreased usage of leaded gasoline.

Data for CO and NO_2 are virtually nonexistent for the counties of interest, at least from the IEPA monitoring network. Fortunately there are some data available for all of the priority pollutants from a baseline air quality study conducted in 1978-80 at Fermilab (Dave and Charboneau, 1980). Their study examined the concentrations of SO_2, O_3, $N0_X$, CO and TSP as well as site meteorology for a one-year period of continuous monitoring. Their results showed that only ozone was in non-compliance with the standards. This is consistent with the data presented in Table 3.

Dave and Charboneau (1980) also analyzed their data with respect to wind direction and time period (time of day or season). Their data for sulfur dioxide indicated that the highest concentrations were typically encountered when the winds were from the east or south and primarily attributed this to sources in the Chicago, Gary and Joliet areas. Their data also showed that average SO_2 values were higher from 6 AM to midnight than from midnight to 6AM and attributed this to the diurnal demand for space heating and cooling as well as to the diurnal operation of industrial plants and vehicle combustion.

Ozone was fairly evenly distributed over the 16 wind sectors although slightly higher levels were noticed when winds were from the SSE, S and SSW. This effect seems to be related to the fact that these are the prevailing wind directions during warm weather conditions which are favorable for ozone production. This fact is clearly demonstrated when examining diurnal and seasonal levels. Daytime values were typically 250% higher than nighttime values and spring and summer (warm weather) values were greater than winter values. These patterns are primarily related to the photochemical production mechanism for ozone.

Nitrogen dioxide showed highest concentrations when winds were from the NE, E and SE which is consistent with an automobile combustion source in the metropolitan Chicago area. NO_2 values were higher at night than during the day and slightly higher on weekdays than weekends, which is probably due to traffic effects. NO_2 levels show little seasonal variation which also reflects its nearly constant input from vehicle fuel combustion.

Carbon monoxide was slightly higher when winds were from the NE, ENE and E and probably reflects local traffic conditions (transport from the western suburbs of Chicago). Winter CO values were twice that of other seasons and were primarily associated with SSE, SW and WSW winds. Dave and Charboneau attributed these high levels to the Aurora laundry and the city of Aurora.

TSP levels were typically highest when winds were from the E and NE. Lowest levels were found when winds were from the N and W. This is consistent with the TSP data given in Table 3. DeKalb (located to the west of Fermilab) typically has lower annual average values than Naperville, West Chicago or Wheaton which are located southeast, northeast and east of Fermilab, respectively. Aurora and Elgin have intermediate TSP values and are located SW and NW respectively.

The lowest TSP values occurred during the winter when the winds are typically from the west. Highest levels were observed during the summer when winds are typically from the southeast.

Lead levels were also determined as part of the baseline air quality study and data indicated that lead levels were typically far below the current standard, averaging .17 ug/m^3. This value is lower than the levels measured in Naperville, West Chicago and Wheaton in 1979 and 1980 (see Table 3).

Attainment Status of the Proposed SSC Site Area

The Clean Air Act of 1970 required that national air quality standards be set to protect public health and welfare and that those standards be attained by 1975 (with possible extensions to 1977 for carbon monoxide and ozone). By 1975 it became evident that many areas of the country would not meet standards by the statutory deadlines. In the 1977 Amendments, Congress extended the deadlines for attainment to 1982 with possible further extension to 1987 for ozone and carbon monoxide. The 1977 amendments also required U.S. EPA to determine whether each area of the nation was meeting the different air quality standards and that each state submit a plan (state implementation plan - SIP) for attaining the standards by the revised deadlines. Designation of areas can be either attainment, non-attainment or unclassified (National Commission on Air Quality, 1981).

Attainment status is given when the ambient air quality for a particular pollutant is below the designated standard. Attainment is determined on a pollutant-by-pollutant basis. Any pollutant whose monitored values are found to be higher than the standards causes that area (i.e., county, township, air quality region) to be designated as a non-attainment area. Since this designation is only for a specific pollutant, areas can be designated attainment for some pollutants and non-attainment for others. Also, areas that have ambient air quality levels above the secondary standard but below the primary standard can be designated as secondary non-attainment.

In order to understand what permitting regulations may apply to any potential sources of priority pollutants associated with the development of the SSC, one must first determine the attainment status for the areas impacted by the SSC installation.

Table 4 summarizes the current attainment status obtained from the Illinois EPA (Linda Bennett, personal communication), for the three counties containing the proposed SSC site as well as DeKalb County, an area to the west of the proposed site and outside of the metropolitan Chicago influence. Sulfur dioxide, nitrogen dioxide, carbon monoxide and lead are all in attainment in all four counties.

Most areas of the four counties are in attainment for TSP although there are exceptions. Elgin and Aurora townships in Kane County are currently secondary non-attainment for TSP. This situation is likely to change, however. Table 3 shows that the Aurora and Elgin TSP stations have had annual mean TSP values less than the 60 ug/m^3 secondary standard for the last two years (1983 and 1984). As a result, Illinois EPA has petitioned the U.S. EPA to change the attainment status of Aurora and Elgin for TSP from secondary non-attainment to attainment. It will probably take about a year before the change is implemented, but in all likelihood all of Kane County will be attainment for TSP by 1987.

A similar situation exists for Little Rock township in northwestern Kendall County. Little Rock is currently secondary non-attainment for TSP but again Illinois EPA has petitioned the U.S. EPA to change this to attainment status, and this should take approximately a year for implementation. So, once SSC construction begins, all of Kendall County should be attainment for TSP (Linda Bennett, IEPA, personal communication).

Table 4 shows that DuPage and Kane Counties are currently non-attainment for ozone. This is unlikely to change before construction of the SSC begins. Many metropolitan areas of the United States were in non-attainment of the ozone standard when it was initiated and most states complained to the U.S. EPA that they had little chance of reaching

Table 4

Attainment Status for Proposed SSC Site

County	TSP	SO_2	NO_2	CO	O_3	Pb
DuPage	A[1]	A	A	A	NA	A
Kane	A[2]	A	A	A	NA	A
Kendall	A[3]	A	A	A	A	A
DeKalb	A	A	A	A	A	A

A = attainment
NA = non-attainment

[1] Addison township is non-attainment for TSP, the rest of the county is attainment.

[2] Elgin and Aurora townships are secondary nort-attainment for TSP, the rest of the county is attainment.

[3] Little Rock townsship is secondary non-attainment for TSP', the rest of the county is attainment.

attainment. The metropolitan Chicago area has been given an extension until 1987 to reach attainment but attainment status may not be granted until after SSC construction has begun.

Regulations Governing New Sources in Attainment/Non-Attainment Areas

Major new sources of priority pollutants have two sets of regulations that must be met in order to begin construction, depending on whether the source is located in an attainment area or in a non-attainment area. A major new source in a non-attainment area is any source which has the potential to emit 100 tons or more annually of any regulated pollutant or, if already a major source, then any *de minimis* increase in emissions requires regulatory agency review. Non-attainment area rules only apply for interim periods between the time an area is designated non-attainment and the time an approved non-attainment SIP is approved. These rules do not apply once the SIP is approved or if there is a construction moratorium in effect because an approvable SIP has not been submitted.

There are four conditions for a permit in a non-attainment area:

1. New sources must limit emissions to the "Lowest Achievable Emission Rate" (LAER).
2. All sources in the state that are wholly or partially owned by the applicant must be in compliance.
3. Emission offsets. Emission reductions for existing sources in the area must be greater than emissions from the new source. It should be noted that this must be on a pollutant-by-pollutant basis, i.e., particulate emission reductions must be greater than new particulate emissions.

4. A positive net air quality benefit must occur in the non-attainment area.

New sources in attainment areas are subject to Prevention of Significant Deterioration (PSD) regulations if emissions of a regulated pollutant increase by a certain amount. New sources that have the potential to emit more than 250 tons per year of any pollutant require PSD review precedures. If the new source is on a list of 28 types of plants then the emission requirement for PSD review is lowered to 100 tons annually. The PSD permit process is lengthy (4-18 months) and additional state and local permits may be required if PSD is applicable to a source.

In some cases tgemporary permits may be obtained to avoid PSD review. For existing major plants that emit more than 250 tons/year (100 tons/year if on the list of 28 types of plants) PSD review occurs if actual emissions from the new source are greater than a de minimis level.

The following section looks at the potential sources and emission levels of regulated pollutants from construction of the SSC, examines sources that could potentially require permits and suggests ways that these emissions could be controlled in order to avoid having to obtain these permits and still maintain air quality. The final section provides cost estimates for various control methods.

IV 4.(ii) POLLUTANT EMISSIONS ESTIMATES AND CONTROL STRATEGIES

Sources of Regulated Air Pollutants Resulting from SSC Construction and Operation

Development of the SSC will be unimpeded, from an air quality perspective, if it can be demonstrated that the SSC will not emit significant quantities of regulated air pollutants. The previous section delineated the current and historic ambient air quality at the proposed site and also discussed the main sources of priority pollutants.

An examination of the types of sources that emit SO_2, O_3, CO, NO_2 and Pb shows that the SSC should not be a major source of these materials to the atmosphere. The major source of SO_2 is fossil fuel combustion. The major source of power for operation of the SSC is to be drawn from the existing electric power grid, so no major fossil fuel combustion facility for generating power at the site would be required. Space heating of the SSC facility will be accomplished by either natural gas-fired boilers or from electric heat. Between 55 and 73 MBtu/hr may be required for space heating. If all space heating is supplied by natural gas fired boilers and if these boilers are maintained to meet New Source Performance Standards (NSPS) of 0.8 lbs $S0_2$/million Btu and 0.2 lbs $N0_2$/million Btu then only 1,402 lbs/day of $S0_2$ and 350 lbs/day of $N0_2$ would be released for a 73 MBtu/hr heating rate. Assuming 90 days of heating at the maximum rate of 73 MBtu/hr, then 63 tons of $S0_2$ and 16 tons of $N0_2$ would be released each year. This is well below the 100 tons/yr from fossil fuel powered boilers that would necessitate PSD review. Emissions from these boilers are likely to be much lower since operation at maximum capacity is unlikely.

The main source of CO is motor vehicles (which are also a major source of $N0_2$) and the construction and operation of the SSC will not substantially increase the vehicle traffic enough to raise CO or $N0_2$ levels.

No production mechanism for non-methane hydrocarbons exists at the SSC site either during construction or operation. Since these precursors for ozone production are absent, ozone concentrations should not be affected. Some ozone is produced during particle collisions but this amount is minimal and could be diluted to ambient background levels within the ventilation system of the target area causing no increase in ambient atmospheric levels.

Increased lead levels are also not expected since there are no lead production sources associated with the SSC.

The only conceivable problem with regard to air quality that may be encountered with the SSC could be large increases in TSP from fugitive dust sources associated with the construction phase of SSC development.

Table 5 outlines potential fugitive particulate sources associated with construction activities at the SSC site. These sources include vehicular traffic on haul or access roads and in and around material storage piles, loading and removal of aggregate storage piles, wind erosion of storage piles and general surface construction (non-tunnel) activities.

Since the exact design details of the construction of the SSC have not been finalized it is difficult to assess quantitatively some aspects of the fugitive dust generated by the processes outlined in Table 5. For example, data are not available on how many miles of access roads will be needed to the site and how many of these miles will be unpaved. Therefore the estimates of the amount of dust generated from these sources that follows must be considered order of magnitude estimates at best. Other dust producing processes can be evaluated more accurately. In all cases estimates of dust generated from the SSC will be evaluated on a worst case basis. If a worst case evaluation can be shown not to have substantial air quality impacts, then development of the SSC would be unimpeded, from an air quality standpoint.

Table 5. Potential Sources of Particulate Matter Due to SSC Construction

1) Roads
   - a) from paved or unpaved haul roads used to transport material to and from construction site(s)
   - b) unpaved haul roads contribute considerably larger dust loads than paved roads

2) Aggregate storage piles and handling of tunneled material
   - a; Dust from tunneled material can be caused by four source operations in the storage cycle
     - 1) loading of aggregate onto storage piles
     - 2) equipment traffic in storage areas
     - 3) wind erosion of pile surfaces
     - 4) loadout of aggregate for shipment

3) Construction
   - a) Earth movement or blasting for surface construction

Our estimates showed that over 660 tons/yr of particulate matter could be emitted due to the processes outlined in Table 5 during the construction phase of SSC development. This amount would be enough to initiate PSD review. The estimation procedures used to determine this number, suggestions for control measures and the estimated costs of these controls are outlined below.

Estimated Amounts of Particulate Material Due to SSC Construction

As indicated in Table 5 there are several different types of activities associated with the construction of the SSC that can generate particulate material. This section will analyze these activities to determine the expected amounts of material generated by each and whether the sum of these estimates exceeds the 250 ton/yr value necessary to initiate PSD review.

Assessment of each source in Table 5 requires an understanding of the generation mechanism as well as typical conditions necessary to estimate the potential impacts. Development of emission factors for these activities has been performed by the United States Environmental Protection Agency and are published in U.S. EPA publication AP-42, Compilation of Air Pollutant Emission Factors (third edition) and its supplements. Some assumptions are necessary since the final configuration and construction practices for the SSC are yet to be determined. When assumptions are necessary to derive emission estimates they are clearly stated.

Particulate Emissions Due to Aggregate Storage Piles

Table 5 lists four activities that can generate particulate matter from aggregate storage piles. It is assumed that storage piles will be necessary because of the large volume of material generated from tunneling activities. According to the current design criteria, the tunnel will be 10 ft in diameter (radius = 1.67 yds) and 60 miles in circumference

(105,600 yds). This represents the removal of 9.3 x 10^5 yds^3 of material. This material is predominantly limestone. Using an average density for limestone of 2.8 g cm^{-3}, this material weighs 4,720 lbs yd^{-3} or approximately 2.2 x 10° tons.

We are assuming that this material will be loaded onto storage piles from the tunnel, stored and then loaded out via truck to the ultimate storage site. This activity represents items 2.a.l and 2.a.4 in Table 5.

The following equation has been developed for batch drop loading/ unloading operations (such as aggregate storage pile formation by front end loader).

$$E = 0.0018 \frac{(s/5)(U/5)(H/5)}{(M/2)^2 \; (Y/6)^{.33}} \tag{1}$$

where: E = Emission rate (lb/ton)

s = Silt content

U = Mean wind speed (mph)

H = Average drop height (ft)

M = Moisture content (%)

Y = bucket capacity (yd^3)

For the proposed SSC site we assumed that the silt and moisture content were the same as average values for crushed limestone reported by Midwest Research Institute (1983) of 1.6 and 0.7 percent, respectively. The mean wind speed used was 10 mph. The average drop height and bucket capacity were assumed to be 5 ft and 10 yds , respectively. Substituting these values into equation 1 yields an emission rate of .0079 lb/ton. This means that removal of tunneled material and loading into storage piles will generate 8.7 tons of material. If tunnel activities take three years to complete, then 2.9 tons of material will be generated each year. This value represents dust generated from formation of storage piles. Removal of the stored material will also generate dust and since the same equation applies to removal activities, both dust generation procedures can be estimated by doubling the calculated emissions. Therefore, aggregate storage pile formation and removal can be expected to generate 5.8 tons/yr.

Midwest Research Institute (1983) has also developed an equation for predicting wind erosion emissions from storage piles. The following equation was used to predict wind erosion emissions from storage piles:

$$E = 1.7\ (s/1.5)(d/235)(f/15) \qquad (2)$$

where: E = Wind erosion emissions (lb/acre/day)
s = Silt content (%)
d = number of dry days (days with <.01 inch precipitation)
f = Frequency of winds exceeding 12 mph at pile height

A silt content of 1.6% was used (average for crushed limestone) to estimate emissions. The number of dry days, 250, was obtained from the Illinois State Water Survey Climate and Information Unit. Moses and Bogner (1967) reported the monthly frequency of winds in various wind speed increments for 15 years of data at Argonne National Laboratory and this data was used to calculate the frequency of winds exceeding 12 mph. This value was 15%. Our calculations show that approximately 2.0 lbs/acre/day will be emitted using these values for the variables in equation 2.

Assuming that at any one time there are six piles which are roughly conical in shape and approximately 10 yds high and that material is generated from tunnel activities over three years then each pile will contain 51,667 yds^3/pile/year. This amounts to 15,516 yd^2 of surface area for each pile or 3.21 acres/pile. Therefore wind erosion emissions from storage pile activities will produce 7.0 tons/yr of particulate matter.

If the tunneled material was simply loaded onto trucks and hauled away to a final dump site then the wind erosion and loadout components of emissions from storage piles would be eliminated. Dust would still be generated from loading the material onto the trucks. In this case the amount of dust generated would be 2.9 tons/yr rather than 12.8 tons/yr (due to both wind erosion and loading/unloading activities).

Vehicle traffic around the storage piles as well as on access roads to construction sites can produce significant quantities of dust especially if the traffic is on unpaved roads. Particulate emissions from unpaved road vehicle traffic can be predicted using the following equation developed by Bohn et al (1978):

$$E = 5.9(s/12)(S/30)(W/3)^{0.7}(w/4)^{0.5}(d/365) \tag{3}$$

where: E = Emissions (lb/veh. mi.)

s = Silt content (%)

S = Vehicle speed (mph)

W = Vehicle weight (tons)

w = Number of wheels

d = Number of dry days (days with <.01 inches of precipitation)

Assuming a silt content of 5% for Illinois unpaved roads (Barnard, Stensland and Gatz, unpublished data), an average vehicle speed of 25 mph, average vehicle weight of 10 tons, average number of wheels of 10 and 250 dry days/year we calculate emissions from unpaved roads to be 5.2 lbs/veh. mi. If we also assume that the road grid system has one road/mile and there are 12 construction sites then we estimate that the total mileage of access roads needed to the SSC site would be 15 miles. Additionally, we are assuming an average daily traffic volume of 48 (6 trucks over an 8-hour work day) and that there are approximately 250 work days/year. These values give estimated particulate emissions for travel on unpaved access roads of 468 tons/year.

The last particulate source in Table 5 is surface construction. Cowherd _et al_. (1974) evaluated fugitive dust emissions from heavy construction activities and determined that 1.2 tons/acre/month are released from these activities. The current SSC design criteria calls for a total of 8300 acres for the collider, injector, experimental areas, service areas and campus. However, the majority of this acreage is required for radiation attenuation. Actual surface construction acreage can be better estimated by considering the gross area required for above ground buildings. This value is 1,060,000 sq. ft. or 24.3 acres. For our estimates of particulate emissions due to construction activities we will use 50 acres. This was done to account for construction activities that will be occurring around the actual space allocated for the buildings themselves (such as parking lots, construction supply storage, etc.). Assuming that construction activity will occur over 3 years and that work will only take place from March to November of each year, then construction activities could be expected to contribute 180 tons/yr of particulates.

Table 6 summarizes the estimated emissions of particulates from various construction activities. Unpaved road emissions and surface construction are the major contributors to particulate emissions.

Table 6 reflects a conservative (i.e., worst case) estimate of the potential particulate emissions from SSC construction activities. Values that would be more typical are given in Table 7. These values reflect the following assumptions:

Table 6. Particulate Emissions Estimates from SSC Construction.

		Tons/Yr
Unpaved Roads		468
Surface Construction		180
Removal of aggregate onto storage piles		2.9
Loadout of aggregate from storage piles for shipment		2.9
Wind erosion of aggregate storage piles		7.0
	Total	660.8

Table 7. Probable Particulate Emissions from SSC Construction.

		Tons/Yr
Unpaved Roads		234
Surface Construction		90
Loading aggregate onto storage piles		2.9
Loadout of aggregate from storage piles for shipment		2.9
Wind erosion of aggregate storage piles		7.0*
	Total	336.8

*If the aggregate material is loaded directly onto the trucks and taken to the disposal site(s) then only dust generated from the loading procedure will be generated. This would equal 2.9 tons/yr and would reduce the total emissions to 326.9 tons/yr.

1. Some of the proposed surface construction would be unnecessary because of the existing Fermilab facility.
2. Not all access roads to the construction site or to loading points for removal of tunneled material will be unpaved.

If we assume that the existing Fermilab facilities encompass one-half of the proposed surface building construction, then a more reasonable estimate of surface construction acreage might be 25 acres which would mean that particulate emissions from surface construction would be 90 tons/yr.

If we also assume that the number of miles of unpaved roads is one-half the original value then the particulate emissions from this source would fall to 234 tons/yr.

Air Quality Control

From the previous section it is clear that the only anticipated pollutant problem associated with construction and operation of the SSC is large emissions of particulate matter during the construction phase of the SSC. We have estimated that between 326.9 and 660.8 tons/yr of particulate matter could be emitted from SSC construction (see Tables 6 and 7). These values are well beyond the 250 tons/yr that constitutes a major source and would be subject to PSD permit requirements. However there are a number of pollution control measures that could be instituted that would lower these emission levels below the 250 tons/yr limit. It is important to remember that the values listed in Table 6 represent the worst case and in all likelihood the actual emissions are apt to be closer to the values found in Table 7.

The two major sources of particulate emissions based on our estimates are unpaved roads and surface construction. Unpaved road emissions can be controlled using various control methods. Table 8 lists the control efficiency for various unpaved road treatments. Clearly the best available control method is paving. This method results in approximately 85 percent reduction of initial emissions. Paving the unpaved access roads would result in enough reduction of particulate emissions to reach or almost reach the 250 tons/yr major source limit. Total estimated emissions from all sources of particulate material assuming all unpaved roads were paved would be 227.9-291.9 tons/yr.

Various control methods for the other sources could then easily reduce the total emissions below the 250 ton/yr level. It is important to remember that our conservative estimates (Table 6) are based on all of the access roads being unpaved. If there are existing paved roads that could be used for access to the construction areas then emissions and the number of miles of unpaved roads that would require paving would be reduced. The emission values in Table 7 reflect this. Paving is very expensive and other combinations of control methods for the various sources could possibly result in lowering emissions below the 250 tons/yr level at a much lower cost (see following section). It should also be noted that speed control will not result in the control efficiencies listed in Table 8 because our emissions estimates were calculated at 25 mph rather than at the "uncontrolled" speed of 40 mph assumed in Table 8.

For our worst case assumption (i.e., that all access roads are unpaved), the use of a dust palliative instead of paving to control dust emissions from unpaved roads would also require reductions from other sources in order to avoid PSD review and permit application. The use of some type of chemical or stabilizing compound would require construction emissions to be controlled at a 91% control efficiency, an efficiency that is not feasible with current technology. It should be noted again that these values are using our worst case estimates. The use of a dust palliative on unpaved roads alone would be sufficient to reduce emissions below the 250 tons/yr level using the more reasonable emission values found in Table 7. A possible alternative to avoid the PSD permit process and avoid the cost of paving unpaved roads would be to try and have each construction site classified under separate Standard Industrial Classification (SIC) codes. If possible, this would allow each

Table 8. Control Methods for Unpaved Roads.

Control method	Approximate control efficiency (%)
Paving	85
Treating surface with penetrating chemicals	50
Working soil stabilizing chemicals into roadbed	50
Speed control[a]	
48 kph (30 mph)	25
32 kph (20 mph)	50
24 kph (15 mph)	63

[a] Based on the assumption that "uncontrolled" speed is typically 64 kph (40 mph). Between 21 and 64 kph (13 and 40 mph), emissions are linearly proportional to vehicle speed.

construction site to release up to 250 tons/yr (i.e., be a separate source).

Another alternative would be to use phased construction. PSD applies to new sources which will become major when operations start, existing major sources which increase emissions by a de *minimis* amount and minor sources which increase emissions of any one regulated pollutant by more than 250 tons/yr. Under phased construction you would create a minor source (less than 250 tons/yr) and then in the second phase of construction you could add further emissions up to 250 tons/yr. Therefore if your total output would be greater than 250 tons/yr but less than 500 tons/yr you would avoid PSD by using phased construction to build a minor source and then increase emissions during the second phase up to 250 tons/yr. This approach could be used easily at Fermilab since Fermilab is a minor source for regulated pollutants. Fermilab has the additional benefit of avoiding some of the construction site activity and access roads because parts of the SSC configuration are already there. For instance, there are already some shop buildings, warehouses, and service buildings at Fermilab which would lower the actual construction acreage.

Perhaps the easiest method of avoiding PSD review would be to contact either the U.S. EPA or Illinois EPA and try and obtain a temporary permit. Since particulate emission will only be a problem during the construction phase it is very possible that no PSD permit will be required since after the completion of construction the SSC will no longer be a major source. Preliminary conversations with Illinois EPA personnel have indicated that fugitive dust emissions from construction activities would not require a permit as long as good "housekeeping" procedures were followed and the emissions provided no local nuisance problems. Good "housekeeping" procedures would encompass such things as watering unpaved roads, watering storage pile materials, or using wind screens to reduce storage pile emissions. As stated above, PSD applies mainly to when operations start and there appears to be some basis for exempting temporary emissions. For existing major sources, temporary emissions are exempted in determining PSD applicability. They are also exempted from monitoring activities if a PSD permit is required. On this basis it would appear that temporary fugitive dust emissions during the SSC construction phase, while probably a substantial source of material, may not require any special permits that would inhibit development of the SSC in Illinois.

IV 4. (iii) CONTROL TECHNOLOGY COSTS

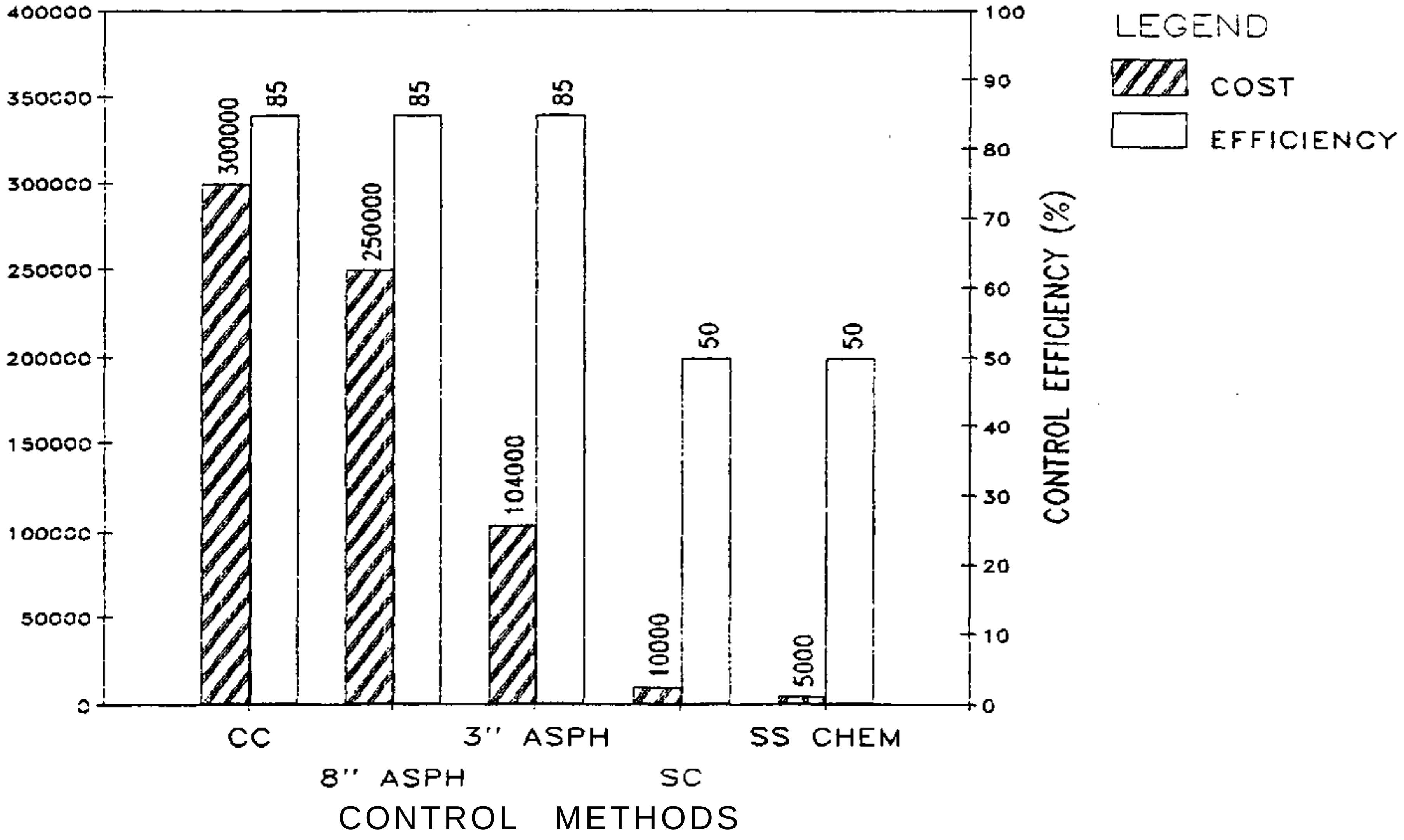
Particulate emissions from vehicle travel on unpaved roads was found to be the major source of pollutant material due to construction and operation of the SSC. Paving unpaved roads offers the most efficient control of these emissions, although other control strategies are available at lower efficiencies. Our results in the previous section showed that paving all unpaved roads would result in a lowering of emissions to a level that would eliminate or greatly reduce the need to regulate other particulate emission sources. However, the cost of paving unpaved roads may be prohibitively expensive. Figure 1 shows the relative costs of treating unpaved roads to suppress dust emissions. From this figure it is clear that paving is much more expensive than using a seal coat. A seal coat would correspond to treating the surface with penetrating chemicals (see Table 8). From the data presented in Figure 1 and using the values for our worst case estimates (15 miles of unpaved roads) the following costs for controlling unpaved road emissions would be anticipated:

Paving with concrete	$4,500,000
Paving with 8" asphalt	$3,750,000
Paving with 3" asphalt	$1,560,000
Seal coat	$ 150,000
Soil Stabilizing chemical	$ 75,000

It is obvious that either seal coating or chemically stabilizing the road would be the cheapest control strategy, however it must be remembered that the control efficiency for these two methods is only 50% whereas the efficiency for paving is 85%. It is also important to remember that using a method which only gives a 50% control efficiency would require other emissions to be reduced to levels that are not currently possible with available technology.

Figure 1.

RELATIVE COSTS AND EFFICIENCIES OF VARIOUS UNPAVED ROAD DUST EMISSION CONTROL TECHNOLOGIES



CC = CONCFETE. ASPH = ASPHALT. SC=SEAL COAT, SS CHEM=SOIL STABILIZING CHEMICAL

If our more reasonable emission estimates are used (see Table 7) then it would be practical to use seal coating to reduce emissions from unpaved roads at a reasonable cost. Stabilizing chemicals are less expensive but there is some doubt as to whether their control efficiency is maintained over long periods of time as would be required for the SSC project.

The least expensive control technique that could be employed would be to obtain a temporary permit from the U.S. EPA or IEPA during the construction phase (see previous section). This seems to offer the most cost effective way of insuring that air quality has been considered and that every effort to assess the potential air quality impacts of the construction and operation of the SSC has been made. The use of good housekeeping practices (as described in the previous section) would help make these agencies realize that every effort was being made to insure that fugitive dust emissions were being minimized.

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