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Volume IV, Appendix 8

FINAL ENVIRONMENTAL IMPACT STATEMENT

SUPERCONDUCTING SUPER COLLIDER

Volume IV
Appendix 8

December 1988

U.S. Department of Energy

UNITED STATES
DEPARTMENT OF ENERGY
WASHINGTON, D.C. 20545
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APPENDIX 8 AIR QUALITY ASSESSMENTS

This appendix is divided into four sections: 8.1, Purpose and Scope; 8.2, Technical Approach and Methodology; 8.3, Overview of Assessments; and 8.4, Resource Assessments.

The health risks associated with ground level pollutants are evaluated in Appendix 12. Impacts of possible airborne radiological emissions are addressed in Appendices 10 and 12, while potential impacts of hazardous and toxic materials are addressed in Appendix 12.

The assessment of air quality impacts in the DEIS was intended as a worst case analysis. This resulted in the DEIS evaluation that there would be some violations of ambient air quality standards (AAQS). These projected violations were raised as a major concern by commenters on the DEIS. The DOE will comply with all AAQS in the construction and operations of the SSC. Therefore, the final EIS analysis has been revised to include more efficient mitigation measures to bring the emissions from the SSC within standards. This Appendix also identifies additional mitigation measures (to further reduce emissions) that are available to the DOE if required. These measures can be considered as necessary after the selection of the SSC site, when more detailed analyses are performed for the Supplement to the EIS and permitting coordination with the State begins. Additional changes in the final EIS resulted from comments received on the DEIS and further refinements in analyses.

8.1 PURPOSE AND SCOPE

These assessments identify and evaluate impacts to air quality at the seven proposed sites during preconstruction, construction, and operations of the SSC project. Generally, the assessments follow the regulatory approach pursuant to the Clean Air Act (CAA). The CAA sets national primary and secondary ambient air quality standards (40 CFR Part 50), requires that specific emission increases be evaluated so as to prevent a significant deterioration in air quality (40 CFR Part 52), and provides authority to the Environmental Protection Agency (EPA) to set national standards for performance of new stationary sources of air pollutants and standards for emissions of hazardous air pollutants (40 CFR Part 61). Where states have regulatory programs in place with stricter requirements than the Federal requirements, these programs have also been considered in the assessments.

The analysis focuses on the requirements of Federal or state Ambient Air Quality Standards (AAQSs) for the following criteria pollutants:

- Total suspended particulates (TSP)
- Fine particulate matter with an equivalent aerodynamic diameter of 10 microns or less (PM_{10})
- Oxides of nitrogen (NO_x)

- o Carbon monoxide (CO)
- o Hydrocarbons (HC) (as precursor to ozone)
- o Sulfur dioxide (SO_2).

Since lead is not expected to be emitted in any significant amount, no impact analysis is conducted. Ozone is not assessed since the current ozone problem is a complex regional air pollution problem with national scope and since no significant impacts on ozone concentrations from SSC construction or operations are expected to occur.

Requirements of the Federal Prevention of Significant Deterioration of Air Quality (PSD) and the New Source Review (NSR) were examined. PSD applicability for a new source such as the SSC would be triggered only if the project would emit 250 ton/yr or more of any pollutant subject to regulation under the CAA. Secondary emissions, e.g., mobile sources and construction emissions, are excluded from the 250 ton/yr trigger. Because the air pollutant emissions pursuant to the PSD requirements are so small (less than 20 ton/yr), the SSC would not be considered a major source under the Federal PSD regulations and would be exempt from full PSD review.

Regarding NSR, after site selection the State agency responsible and/or the regional EPA office will be consulted to determine whether offsets are required for any nonattainment pollutants. A state-by-state description of attainment status is presented in Appendix 5. With several exceptions, as discussed later in this Appendix, most of the potential alternative sites are attainment for all pollutants.

In response to public comment, state air pollution control rules and regulations were reviewed for each of the site alternatives to determine if state delegated or adopted PSD regulations differ from Federal rules with respect to key provisions pertinent to PSD applicability determinations. Table 8-A summarizes the results. The rules and regulations of all seven states and the Federal regulations are similar in the following logic:

- o PSD applicability for the SSC would be triggered only if the project had a potential to emit 250 ton/yr or more of any pollutant subject to regulation under the Clean Air Act.
- o Potential to emit by definition specifically excludes secondary emissions.
- o Secondary emissions by definition include construction emissions.

Because of the exclusion of secondary emissions from PSD applicability determinations and because all other SSC-related estimated potential emissions are less than 20 ton/yr, the SSC would not be subject to full PSD review. However, it may be subject to an Increment Consumption Review. After site selection the state agency responsible and/or the EPA regional office will be consulted to determine if increment consumption review is required.

Table 8-A

COMPARISON OF STATE REGULATIONS ON PREVENTION OF SIGNIFICANT DETERIORATION

State[1]	AZ	CO	TN
Delegated PSD	Yes	Yes	Yes
Definition of Major Source	Potential to Emit ≥ 250 TPY R9-3-101-91	Potential to Emit ≥ 250 TPY Reg No. 3 I(B)(3)(b)(iii)	Potential to Emit ≥ 250 TPY Chapter 1200-3-9-.01(4)(b)(1)(iii)
Does Potential to Emit Definition Exclude Secondary Emissions?	Yes R9-3-101-126	Yes Part I Subpart G	Yes Chapter 1200-3-9-.01(5)
Does Definition of Secondary Include Construction?	Yes R9-3-101-143	Yes Part I Subpart G	Yes Chapter 1200-3-9-.01(19)

[1] Illinois and Michigan have adopted the Federal PSD rules by reference in their PSD delegation letters signed with U.S.EPA. North Carolina does the same at Subchapter 2D Section 0503 of their Air Pollution Control Regulations and so does Texas at Reg VI paragraph 116.3(a)(13).

The National Emission Standards for Hazardous Air Pollutants (NESHAP) (40 CFR Part 61) are applicable to the SSC. These regulations establish air emission standards for beryllium, mercury, asbestos, vinyl chloride, and other hazardous materials, including radioactive materials. Emissions of most of these hazardous pollutants are not expected to occur in significant amounts. Asbestos may be contained in some of the buildings requiring demolition. If so, demolition will be performed in accordance with NESHAP. The SSC will emit small amounts of radionuclides, as discussed in Volume IV, Appendix 10, and will be subject to Subpart H of 40 CFR Part 61 which regulates radionuclide emissions from DOE facilities.

8.2 TECHNICAL APPROACH AND METHODOLOGY

8.2.1 Conceptual Basis

This assessment estimates the proposed project's air quality impacts through the following steps: 1) identifies the air pollutant emissions associated with activities related to the project, 2) quantifies those emissions, considering the use of normal emission control equipment or methods, 3) determines the location of these emissions within the project area, and 4) provides a quantitative comparison between the proposed SSC project and existing emission inventories. If required by the magnitude of the emissions inventory, the resulting ground-level concentrations are determined through established air dispersion modeling techniques, added to area background concentrations, and compared to AAQS.

In order to focus on those pollutants of most concern, a screening approach was used throughout this assessment: once an item was determined to be of little environmental consequence, it was dropped from further analysis. For example, if preconstruction activities were determined to produce little fugitive dust (particulate emissions that do not pass through a stack, chimney, or equivalent opening), no further analysis was done to quantify those emissions rigorously, perform air dispersion modeling, calculate resulting air quality, or compare the resulting concentrations to AAQS or PSD increments. This approach carries the more consequential impacts through to final conclusions.

Comparisons of the air quality impacts among the seven proposed sites are made in Volume I, Chapter 5.

8.2.1.1 <u>Level of Resolution</u>

A. <u>Temporal</u>

Air pollutant emissions are considered for preconstruction, construction, and operations. Impacts are assessed over the time that their pollutant emissions and resulting ground-level concentrations persist. Concentrations are determined for all averaging times addressed in applicable regulations.

B. <u>Spatial</u>

The spatial scale and resolution of air quality impacts are largely determined by regulations defining air quality criteria. Air quality effects of specific pollutant-generating activities are modeled to determine the highest ground-level concentrations (in this case occurring immediately adjacent to the source). The regional effects of the SSC are addressed with respect to the limits of the counties potentially hosting the SSC or, as in the case of Arizona and Texas, expected to host most of the SSC work force.

8.2.1.2 <u>Detail of Analysis</u>

Activities that produce air pollutant emissions are identified for each phase of the proposed project. Those activities producing small quantities of pollutants that would have little consequence on air quality are not quantified and not carried further in the analysis. The remaining activities are quantified and presented by phase, pollutant, and location. Quantified emission inventories that indicate a sizable amount of pollutants, by comparison either to regulations or to existing emissions, are further analyzed by modeling their expected ground-level concentrations. Because of the low level of other air quality emissions from preconstruction and operations activities, the only concentrations calculated would occur during construction. These predicted concentrations are compared to the AAQS standards.

8.2.2 Referenced Data Used in Assessments

Source terms are developed based on preconstruction, construction, and operations scenarios provided in the SSC Conceptual Design Report (RTK 1986), taking into consideration proposed control equipment or method (see Table 8-3, Section 8.3.2.1 below).

These source terms were developed using methodologies consistent with the following documents:

- AP-42, "Compilation of Air Pollutant Emission Factors," Supplement A. Volume I, Stationary Point and Area Sources. October 1986.
- AP-42, "Compilation of Air Pollutant Emission Factors" (Fourth Edition). Volume II, Mobile Sources. September 1985.
- EPA 600/8-86-023, "Identification, Assessment, and Control of Fugitive Particulate Emissions," November 1986.
- EPA 450/3-77-010, "Technical Guidance for Control of Industrial Process Fugitive Particulate Emissions," March 1977.
- PEDCo 1976, "Evaluation of Fugitive Dust Emissions from Mining," April 1976.

Meteorological data were obtained from the National Climatic Data Center of the National Oceanic and Atmospheric Administration (NOAA). These data were for the weather year 1986 and came from the weather station or stations most representative of the regional meteorology.

Existing ambient pollutant concentrations were taken from the most recent published state compilations of air quality data.

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8.2.3 Assessment Methodologies

Emission factors from AP-42 (EPA 1985 and 1986) were used to quantify air pollutant emissions from combustion of fuel in equipment and to quantify fugitive dust emissions from materials handling or traffic. Table 8-1 contains the fugitive dust emission factors used. It also identifies how each emission factor was used in relation to the various dust-generating operations.

The Industrial Source Complex Short Term (ISCST) (through change no. 5) air dispersion model from the EPA's Users Network for Applied Modeling of Air Pollution (UNAMAP), Version 6, was used for all analyses. Model selection and application was in accordance with EPA's guidelines on Air Quality Models (revised) (EPA 450/2-78-27R 1986).

8.3 OVERVIEW OF ASSESSMENTS

This overview discusses site-independent aspects of the analysis; site-dependent results are discussed in Section 8.4. Whereas previous sections in this appendix discussed the methodologies used, this and following sections address results of the analysis.

8.3.1 Identification of Emissions

The analysis began with the preparation of an air pollutant emissions inventory. This involved identifying those activities at the SSC from all activities included in AP-42 (EPA 1985 and 1986) that could produce air pollutants and then determining the possible magnitude of the air pollutant emissions. As a cross check, the type and magnitude of operational emissions also were examined at Fermi National Accelerator Laboratory (Fermilab); activities at Fermilab that required permits for air pollutant emissions were compared to those activities planned for the SSC operations period.

The SSC does not involve major air polluting activities such as power generation or major industrial processes.

Table 8-2 lists air polluting activities from AP-42 and identifies which, if any, SSC project phase to which they apply.

Table 8-1

EMISSIONS FACTORS USED FOR EACH FUGITIVE DUST SUBACTIVITY

Subactivity	Factor Used	
1. General site	E_1	
2. Final storage of spoils	E_2	
3. Excavation and cut-and-cover construction	E_3 x 4 operations:	excavate stockpile reclaim replace
4. Shaft site spoils unloading to stockpile	E_3	
5. Shaft site spoils transfer to haul truck	E_3 x 2 operations:	reclaim load
6. Spoils hauling (truck box losses)	E_2	
7. Spoils unloading at final disposal site	E_3 x 3 operations:	unload reclaim unload
8. Construction vehicle road traffic (spoils hauling road dust)	E_1	
9. Concrete batch plants	0.2 lb/yd^3 0.2 lb/yd^3 0.1 lb/yd^3	Cement batching Vehicle traffic Pile wind erosion
10. Commute traffic	0.016 lb/VMT	

1. Unpaved roads: $E_1 = (k)\,(5.9)\,\left(\frac{s}{12}\right)\left(\frac{S}{30}\right)\left(\frac{W}{3}\right)^{0.7}\left(\frac{w}{4}\right)^{0.5}\left(\frac{365-p}{365}\right)$ lb/VMT

2. Wind erosion: $E_2 = (1.7)\left(\frac{s}{1.5}\right)\left(\frac{365-p}{365}\right)\left(\frac{f}{15}\right)$ lb/day-acre

3. Material transfer: $E_3 = (k)\,(0.0018)\,\frac{\left(\frac{s}{5}\right)\left(\frac{U}{5}\right)\left(\frac{H}{5}\right)}{\left(\frac{M}{2}\right)^{2}\left(\frac{Y}{6}\right)^{0.33}}$ lb/ton

where:
- E = emissions factor
- k = particle size factor
- s = material silt content, %
- S = mean vehicle speed, mph
- w = average number of wheels
- W = average vehicle weight, tons
- p = number of days with greater than 0.01 inch rain
- f = time winds greater than 12 mph, %
- M = material moisture, %
- Y = dumping device capacity, yd^3
- U = mean wind speed, mph
- H = drop height, ft
- VMT = Vehicle miles traveled

Source: EPA 1985 and EPA 1986.

Table 8-2

IDENTIFICATION OF AP-42 AIR POLLUTANT PRODUCING ACTIVITIES WHICH APPLY TO THE SSC

AP-42 Activity	SSC Project Phase		
	Preconstruction	Construction	Operations
Combustion of fuels:			
Power generation (emergency)	-	-	x
Space heating	-	x	x
Highway traffic	x	x	x
Off-road/construction vehicles	x	x	x
Waste incineration	-	x	-
Evaporation loss	-	x	x
Industrial processes	-	-	-
Fugitive dust	x	x	x

Obviously not all of the activities identified in Table 8-2 would have the same magnitude of pollutant emissions, nor would the significance of these emissions be the same. The identified activities can be categorized into two groups: 1) those with the potential to cause significant environmental consequences, and 2) those with little potential for environmental consequences because their emissions either are small or do not routinely occur.

8.3.1.1 Activities with Potentially Significant Environmental Consequences

Pollutant-generating activities identified as having emissions rates of potential environmental consequence and requiring further assessment are:

(1) Combustion of fuels in vehicles and equipment during construction of the facility and its associated roads. Gasoline and diesel fuel used in the scrapers, graders, bulldozers, haul trucks, cranes, compressors, pick-up trucks, and all other construction equipment would produce "tail pipe" emissions of CO, HC, NO_x, SO_2, TSP, and PM_{10}. Also included are tail pipe emissions of the vehicles of commuting construction workers.

(2) Fugitive dust generated by facility and road construction. This includes dust (TSP and PM_{10}) generated by earth-moving and earth-disturbance activities as well as dust resuspended by vehicle and equipment traffic on unpaved or dirty paved surfaces.

(3) Combustion of fuels during operations for space heating. These are emissions from natural gas-fired furnaces used to heat numerous buildings. Emissions consist primarily of CO, HC, and NO_x.

(4) Combustion of fuels and generation of fugitive dust during operations from highway traffic. These are the tail pipe emissions of the vehicles of commuting workers and the fugitive dust generated from tire and road surface wear and dust on the road surface.

Of the four types of emissions described above, (1), (2), and (4) are not required to be included in an air quality impact analysis under the stationary source rules and regulations promulgated under the CAA. However, all four types were analyzed to determine their environmental consequences as part of this NEPA-related assessment.

8.3.1.2 Activities with Little Potential for Environmental Consequences

The balance of pollutant-generating activities identified in Table 8-2 would have small or negligible emissions, with correspondingly small or negligible impact on air quality.

A. Preconstruction

The limited on-site activities during preconstruction - including land surveying for design and acquisition purposes, borehole drilling for geotechnical investigations, and environmental surveys - would generate some traffic and temporarily emit very small amounts of pollutants. Resultant impacts to the ambient air quality would be insignificant; therefore, no further analysis was made.

B. Construction

During construction there will be evaporation of solvents used in paints, adhesives, lubricants, coatings, etc., that are subject to EPA restrictions placed upon the manufacturers. Only small amounts of solvents would be used at any one time, and resultant impacts to ambient air quality would be insignificant. At some sites, foliage cleared from construction areas may be burned on site, creating emissions. Such a one-time occurrence would be required to comply with local air pollution control regulations and, therefore, in meeting these requirements would have an insignificant impact on short-term and long-term air quality. During construction on-site power generation is not anticipated, because provisions would have been made for electric service to all areas of major construction from the power grid.

C. Operations

Emissions during operations are expected to be small (less than 20 ton/yr), roughly equivalent to those from small industrial or light commercial businesses, research centers, or universities. Fugitive dust should occur only at small, temporary construction sites.

SSC conceptual design includes five emergency diesel-fired electric generators rated at 100 kW each plus 22 rated at 50 kW each, resulting in a total project capacity of 1,600 kW. Nonemergency use of these generators is expected to consist of one hour of operation every two weeks, to demonstrate readiness.

Other sources of emissions at the site include painting operations, a very small amount of particulate matter associated with cooling tower drift loss, solvent evaporation from hand wipe cleaning and degreasing operations in the vehicle maintenance and machine shops, laboratory fume hood vents, sawdust emissions from the carpentry shop, and fugitive hydrocarbon emissions from the cryogenics plants.

The emission points would be provided with the required air pollution control equipment. Each of these sources would be very small. Several may require local air pollution control permits but resultant impacts to the air quality should be local and of little consequence.

The generation and release of airborne radioactive emissions is discussed in Appendices 10 and 12.

8.3.2 Quantification of Emissions

Emissions of such magnitude that they should be quantified and assessed are fugitive dust during construction and combustion of fuels during both construction and operations.

8.3.2.1 Construction

Site-specific differences cause different emission rates at each proposed site. These differences include whether cut-and-cover construction is used for part of the collider ring, and whether the experimental facilities are mined or cut and covered. Other site-specific differences result from the method, location, road access, and other factors associated with spoils disposal. Although some states have proposed several spoils disposal alternatives, for purposes of quantification the worst case alternative (as identified later in this Appendix for each state assessment) was analyzed for each site. The average commute distance estimated for the construction work force also varies by state, as does the amount and type of new road construction and road improvements. In Illinois, the injector area is virtually complete, so emissions associated with its construction are not considered.

To better quantify emissions from construction activities, the following subactivities were defined for combustion of fuels:

- General site activity
- Off-site road construction
- Campus area construction
- Injector construction
- Collider area ring construction
- Experimental hall construction
- Construction traffic
- Construction commute traffic.

Information developed for the conceptual design included estimates of fuel consumption for all the anticipated types of construction equipment, such as scrapers, dozers, dump trucks, pick-up trucks, etc. Emissions factors from AP-42 (EPA 1985) were used to calculate emission rates of pollutants resulting from combustion of this fuel by equipment. Fuel consumption was also used in conjunction with estimates of average miles per gallon to calculate vehicle miles traveled (VMT). The VMT numbers were then used in equations from AP-42 (EPA 1986) that estimate fugitive dust emissions. The subactivities defined for fugitive dust generation and their applicable emission factors are shown in Table 8-1.

Emissions for new road construction and road improvements were made site-specific by multiplying the generic road emissions estimated from fuel consumption by the ratio of costs between the site proposed amount of roadwork and the generic cost. This is based on an assumption that the cost ratios reflect material use and placement ratios, which in turn reflect emissions ratios.

A peak year factor, equal to the largest annual capital expenditure over the total construction cost for each subactivity, was used for all emissions during the construction period. The approach has some conservatism built in because it assumes that the peak year of each of the subactivities coincide. Such a peak year is extremely unlikely to ever coincide with any given calendar year. Emissions values given in units of tons per peak year should not be assumed to persist for each year of construction.

Results of the socioeconomic analysis (Appendix 14), which identified expected number and locations of the work force for the construction period, were used in conjunction with the vehicle emission factors in AP-42 (EPA 1985) to develop emission inventories for commute traffic.

The fugitive dust emissions inventory varies from state to state because of the differences in parameters used in emission factor equations. In Section 8.4 a table of these parameters is provided for each state.

Table 8-3 presents the air pollution control measures and associated control efficiencies assumed in place when calculating the fugitive dust emission inventory for construction. Based on a number of comments on the DEIS regarding TSP AAQS violations, the air pollution control method for fugitive dust emissions resulting from general site activity was upgraded as a mitigation from DOE's proposed twice daily watering (50 percent efficient) to one of a number of chemical soil stabilization methodologies (95 percent efficient). This reduced emissions for this activity by a factor of 10, which reduced resulting particulate concentrations.

Two fugitive dust control methods are available when twice daily watering is not adequate to comply with applicable standards. The first method, chemical soil stabilization, is a temporary method that involves the application of a very thin coating of chemical agents to the ground surface to bind soil particles together. The method is temporary because the mechanical action of equipment on the stabilized soil tends to separate soil particles. The occasional reapplication of the chemical agents is often required where there is a lot of activity on the stabilized soil. The second method, paving, is more permanent, more efficient and often more expensive than chemical soil stabilization. Paving also tend to cause more impacts because it is more difficult to reclaim areas that have been paved than areas where chemical stabilization has been used. Chemical soil stabilization was selected for control of fugitive dust emissions from general site activity because it is not practical to pave large areas, because chemical soil stabilization would cause fewer impacts than paving and because chemical soil stabilization should be adequate to comply with the applicable standards.

Three different types of stabilizers are typically used. These are wetting agents, hygroscopic salts, and surface crusting agents. Wetting agents reduce surface tension and enable water or a chemical stabilizer to spread more evenly over a greater surface area. Hygroscopic salts increase the moisture content of the dust by attracting moisture out of the air. Surface crusting agents are applied wet, and form a hard crust when dry. These agents can be composed of various compounds, typically styrene/butadiene or acrylic lattices, vinyl compounds, synthetic polymers, lignosulfonates or petroleum-based resins. These compounds are nontoxic and should not pose a ground- or surface-water contamination problem, when properly applied.

The emission factors used to calculate emissions from combustion of fuel in construction equipment and commute vehicles are based on the use of air pollution control equipment as required by regulations.

8.3.2.2 Operations

AP-42 (EPA 1986) was also the source of the emission factors used to convert natural gas consumption during operations into pollutant emissions. The annual natural gas consumption was adjusted to each climate

by a factor representing the ratio of the site's heating degree-days to the site-independent design value of 900 heating degree-days.

Routine testing of the small emergency diesel generators will also contribute emissions.

The average commute distance for operations staff also varies. Results of the socioeconomic analysis (Appendix 14), which identified expected number of and locations of the work force for operations, were used in conjunction with the vehicle emission factors in AP-42 to develop emission inventories for commute traffic.

Table 8-3

AIR POLLUTION CONTROL MEASURES/EFFICIENCIES

Control Measure	Efficiency %	Activity
Twice daily watering	50	Off-site road construction
		Cut-and-cover excavation
		Batch plant roads
As required watering	90	Final spoils storage
		Batch plant storage piles
Chemical soil stabilizer	95	Spoils haul roads[1]
		General site activity
Tarpaulin cover	90	Spoils haul trucks
Paving	99+	Haul roads[2]
Baghouse	99+	Tunnel ventilation

1. In Illinois, Michigan, and Tennessee.
2. In Arizona, Colorado, North Carolina, and Texas.

Source: EPA 1977, EPA 1986a and PEDCO 1976.

8.3.3 Location of Emissions

Because of the size of this project, activities would be spread out and not contiguous over the whole 53-mi ring. From an air pollution standpoint, the SSC project can be viewed as a number of smaller projects. Impacts from one area are not expected to contribute significantly to impacts from another area, because the pollutant releases would be primarily at or near ambient temperatures and at or near ground level.

To better quantify emissions, the inventory for emissions was developed by location. The locations are defined as follows:

- Near cluster: campus (A), the injector (B), future expansions (C), and the near cluster surface acquisition area (G).
- Far cluster: far cluster surface acquisition (H).
- Satellite E and F sites: the twelve remaining E and F sites not in either (G) or (H) - specifically, E2, F2, E3, F3, E4, F4, F6, E7, F7, E8, F8, and E9. The E and F sites are quantified as pairs during construction, accounting for relocation of activities, including tunnel ventilation and spoils removal from the F site to the E site after tunnel excavation has progressed past the E site.
- Off site: all activities outside the preceding three groupings.

8.3.4 Pollutant Concentrations

Site-specific emissions inventories are discussed in Section 8.4. These inventories were used in conjunction with the Industrial Source Complex Short Term (ISCST) model (through change no. 5) from the User's Network for Applied Modeling of Air Pollution (UNAMAP) package, Version 6, and regionally representative meteorological data (NCDC 1988) to estimate worst case ground-level pollutant concentrations using guidelines from EPA's Guideline on Air Quality Models (revised) (EPA 450/2-78-27R, 1986).

Computer modeling analysis confirmed that even though activities in the near cluster emit larger quantities of pollutants than at the E and F sites, the larger property buffer allows for more dispersion and lower off-site concentrations. For modeling purposes, the E and F sites have identical worst case emissions (occurring during tunnel construction) and identical resulting off-site concentrations.

Ground-level pollutant concentrations resulting from these emissions would all be highest immediately adjacent to the emissions source, because the ambient temperature, near-ground-based release of the pollutants results in very little or no plume rise. The plume centerline,

which has the highest pollutant concentrations, stays at ground level. In general, this effect also results in a more rapid diminishing of the ground-level concentrations with downwind distance than occurs around the point of maximum ground-level concentration of an elevated plume. The highest ground-level concentrations can be expected in areas where emissions are the highest and the intervening distance between the activity and the public is short. This combination occurs during construction primarily at the E and F sites and secondarily at the campus injector area. Neither the cut-and-cover collider ring construction in Arizona nor road construction in any state would produce higher off-site ground-level concentrations. Worst case emission inventory activities at the E and F sites include tunnel ventilation, spoils removal and stockpiling by cranes, spoils reclaim, truck loading, truck traffic, and the maintenance yard. The air dispersion model predicted a 70% decrease in annual concentrations from a distance of 150 m (0.1 mi) to a distance of 440 m (0.27 mi) downwind from an E or F site.

Resulting model-predicted ground-level concentrations are added to background concentrations and compared to the air quality standards. High backgrounds of CO concentrations (existing levels from man-made and natural sources) for Michigan, North Carolina, and Tennessee, as presented in Volume I, Chapter 4, Section 4.4 and in Volume IV, Appendix 5, are from urban monitors in downtown Detroit, Durham, and Nashville. These values are not representative of these SSC sites, all rural. Representative background CO concentrations are not available but are expected to be much lower and well within NAAQS limits. The SSC-related contributions to background concentrations are therefore not expected to result in NAAQS violations.

Standard industrial practice for control of fugitive dust was assumed during development of the emissions inventory. If additional air quality impact analysis is performed on a site specific basis, with the result that this might not be satisfactory during peak year construction at the E and F sites where residences are nearby, identified possible mitigation (including wind screens, enclosures, construction scheduling, add-on pollution control equipment, etc.) would be considered on a case-by-case basis during detailed construction planning.

Pollutant concentrations resulting from commute traffic were not modeled because the incremental increase over existing traffic levels is small and extends over a large area, a situation not amenable to modeling. Also, the small amount of emissions caused by natural gas combustion does not allow a meaningful analysis by modeling.

The impact of SSC site CO emissions is negligible on the metropolitan areas' air quality because of low project CO emissions rates, and because the site alternatives are relatively distant from the metropolitan centers.

8.4 RESOURCE ASSESSMENTS

This section contains state-by-state results of the air quality assessments and quantifies construction and operations emission inventories for combustion of fuels and fugitive dust. The cumulative impact sections for each state compare construction and operations estimated emission inventories to existing air pollutant emissions data provided by the EPA.

8.4.1 Arizona

The design and site information used in, and forming the basis of, the Arizona emissions inventory calculation, is presented in Table 8-4. Data used in developing the emissions inventory calculation reflect the influence of local conditions on the design, control methods, and operations of the SSC in Arizona.

The State's proposal included several alternatives for spoils disposal (see Appendix 10), including the following: transport spoils 1) an average of 70 mi to the Sacaton mine, 2) an average of 80 mi to the New Cornelia mine, 3) to the SSC booster area for surface disposal, and 4) an average of 70 mi to Phoenix for sale as construction/fill material. Analysis determined that the second alternative was the worst case.

Arizona is unique in that it is the only proposed site where cut-and-cover construction is used for a portion of the collider ring. As a result, there would be an increase in fuel combustion and fugitive dust emissions. Fugitive dust from haul roads poses a problem because of the long haul distance. This will be mitigated if the haul roads are paved to reduce surface silt content. Of the seven sites, Arizona has the most moderate climate, requiring the least natural gas consumption for heating during operations.

8.4.1.1 <u>Construction</u>

During construction the following types of activities would produce measurable quantities of air pollutant emissions: 1) combustion of fuels from construction equipment and worker commute vehicles and 2) fugitive dust generated from vehicle and material handling activities.

A. <u>Emissions</u>

A peak-construction-year approach was used to define emissions, which produces a conservatively high estimate.

1. <u>Combustion of Fuels</u>

Fuel combustion emissions by construction subactivity are presented in Table 8-5. This was done by using the methodology presented in Section 8.2.3 and data from Table 8-4. Also shown in Table 8-5 are the emissions from construction worker commute traffic.

2. <u>Fugitive Dust</u>

Table 8-6 lists the fugitive dust emission factor parameters used in calculating emissions during construction. Some of the symbols, such as silt content, appear several times. This is because different values were needed to produce emissions estimates for surface soil material transfer as opposed to, for example, spoils material transfer. Applying these factors to the fugitive dust equations produces the emissions inventory shown in Table 8-7.

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Table 8-4

EMISSIONS INVENTORY BASIS - ARIZONA SSC SITE

Phase	Value
CONSTRUCTION	
Design	
Tunneled collider ring, %	89
Cut-and-cover collider ring, %	11
No. of mined experimental halls	0
No. of cut-and-cover experimental halls	4*
Spoils disposal method	mine
Average spoils haul round trip, miles	160
Spoils haul on paved roads, %	100
Spoils haul on unpaved roads, %	0
Average commute round trip, miles	92.1**
Roadwork ratio	1.28
Control Methods	
Spoils Storage	
Efficiency, %	100
General Dirt Roads	
Control method	chem. soil stab.
Efficiency, %	95
Haul Roads	
Control method	paving
Efficiency, %	99+
OPERATIONS	
Design	
Natural gas consumption factor	1.96
Average commute round trip, miles	92.1**

* Two future experimental halls not included.
** Reduced from 116.1 in DEIS based on refined analysis.

Table 8-5

FUEL COMBUSTION EMISSIONS BY CONSTRUCTION SUBACTIVITY ARIZONA SSC SITE

	tons per peak year					
Subactivity	CO	HC	NOx	SO_2	TSP	PM_{10}
General site activity	11	1	7	1	0	0
Off-site road construction	18	4	21	2	2	2
Campus area construction	17	2	27	2	2	2
Injector area construction	56	6	68	7	5	5
Collider ring construction	264	36	263	30	19	19
Experimental hall construction	42	5	69	7	5	5
Construction traffic*	104	11	241	26	15	15
Construction commute traffic	942	77	100	0	0	0

* Inadvertently omitted from DEIS.

Table 8-6

FUGITIVE DUST EMISSION FACTOR PARAMETERS ARIZONA SSC SITE

Parameter	Symbol	Units Used	Value
Spoils silt content	s	%	25
Days/yr >0.01" rain	p	#	50
Winds >12 mph	f	%	6.5
Spoils density	P	lb/ft^3	105
Spoils moisture	M	%	5
Road dust silt	s	%	14
Paved road dust	sL	$grains/ft^2$	2.02
Vehicle speed (unpaved)	S	mph	20
Vehicle speed (paved)	S	mph	35
Vehicle weight (heavy truck)	W	tons	25
No. of wheels (heavy truck)	w	#	8
Vehicle weight (passenger)	W	tons	1.5
No. of wheels (passenger)	w	#	4
Surface soil silt	s	%	35
Dump device capacity (small)	Y	yd^3	2
Dump device capacity (large)	Y	yd^3	10
Haul device capacity	Y	yd^3	20
Mean wind speed	U	mph	5
Spoils volume	N/A	10^6 yd^3	2.5

Source: AP-42; NCDC; Climatic Atlas

Table 8-7

FUGITIVE DUST EMISSIONS BY CONSTRUCTION SUBACTIVITY ARIZONA SSC SITE

	tons per peak year	
Subactivity	TSP	PM_{10}
General site	52	24
Off-site road construction	65	31
Spoils storage	<1	<1
Cut excavation	75	35
Spoils dumping	<1	<1
Spoils loading	<1	<1
Spoils hauling	<1	<1
Spoils unloading	<1	<1
Vehicle traffic	182	86
Batch plants	241	113
Commute traffic	635	298

3. Total Construction Emissions

The construction emissions inventory, encompassing both combustion of fuels and fugitive dust, is presented by location in Table 8-8.

Table 8-8

EMISSIONS INVENTORY FOR CONSTRUCTION ARIZONA SSC SITE

	tons per peak year				
Pollutant	Near Cluster	Far Cluster	Each of 6 Satellite E & F Site Pairs	Cut-and-Cover	Off Site
COMBUSTION OF FUELS					
CO	128	77	26	27	1,064
HC	15	10	4	3	92
NOx	158	85	24	44	363
SO_2	16	9	3	5	28
TSP	11	6	2	3	17
PM_{10}	11	6	2	3	17
FUGITIVE DUST					
TSP	90	39	35	29	882
PM_{10}	42	18	16	14	415

B. Concentrations

Emissions that produce the worst case off-site ground-level concentrations were determined using the ISCST dispersion model. Regionally representative meteorological data were obtained from the National Climatic Data Center and used in the model. Surface weather observations from weather station No. 23138 (Phoenix) and upper air data from weather station No. 23160 (Tucson) for weather year 1986 were used. The resultant worst case ground-level pollutant concentrations are presented in Table 8-9. These impacts occur only during construction and concentrations drop off rapidly with distance from source.

Table 8-9

WORST CASE POLLUTANT CONCENTRATIONS RESULTING FROM CONSTRUCTION ARIZONA SSC SITE

Pollutant	Average Time	Background	$\mu g/m^3$ SSC Contribution*	Total	More Stringent of National or State AAQS
CO	1-hour	13,752	1,058	14,810	40,000
CO	8-hour	6,876	867	7,743	10,000
NOx	Annual	15	76	91	100
SO_2	24-hour	33	38	71	365
SO_2	Annual	2	8	10	80
TSP	24-hour	91	58	149	260[1]
TSP	Annual	70	13	83[2]	75[1]
PM_{10}	24-hour	N/A	40	>40	150
PM_{10}	Annual	N/A	9	>9	50

* Receptor location 150 meters from edge of E or F area.
1. Also enforced are secondary TSP standards of 150 $\mu g/m^2$ 24-h avg. and 60 $\mu g/m^3$ Annual Geometric Mean.
2. Exceedance result of high background measured in 1978 and not representative of current site conditions. More recent monitoring data, currently incomplete, indicate site will comply with both primary and secondary standards.

8.4.1.2 Operations

A. Emissions

Three types of activities would generate air pollutant emissions during operations: 1) combustion of natural gas for building heating and cooling, 2) testing of the emergency diesel generators, and 3) operations staff commute traffic.

1. Natural Gas Combustion

Natural gas combustion emissions were calculated by using AP-42 (EPA 1986) emission factors and by adjusting the site-independent design basis of 55 x 10^6 Btu/h by the ratio of heating degree days for the site to that of the design basis as shown in Table 8-4. The emissions are shown in Table 8-10.

2. Emergency Diesel Generators

Emergency diesel generator emissions were calculated using AP-42 (EPA 1986) emissions factors and an annual generation of 41,600 kWh.

3. Operations Commute Traffic

Table 8-10 also shows the emissions resulting from operations staff commute traffic.

Table 8-10

EMISSIONS INVENTORY FOR OPERATIONS
ARIZONA SSC SITE

Pollutant	Near Cluster (tons per year)	Far Cluster (tons per year)	Satellite F Sites (tons per year)	Off Site (tons per year)
CO	1	<1	<1	660
HC	<1	<1	<1	54
NOx	4	<1	<1	70
SO_2	<1	<1	<1	0
TSP	<1	<1	<1	444
PM_{10}	<1	<1	<1	209

B. Concentrations

Because of the small magnitude of the stationary emissions and the large spatial and temporal extent of the mobile emissions, neither was subjected to rigorous air dispersion modeling. Both types of sources are expected to cause only small impacts to air quality with little, if any, environmental consequence.

C. Regulations

Due to Maricopa County's inability to meet CO attainment by regulatory deadlines, a ban on new construction of "major" stationary sources of CO in the county has been imposed by the EPA. Based on the emissions of CO shown in Table 8-10, this ban would not apply to the SSC because emission levels do not classify it as a "major" stationary source.

8.4.1.3 Cumulative Impact in Region of Influence

Table 8-11 compares SSC emissions to those currently existing. As shown in the table, increases due to SSC construction and operations are negligible.

Except for CO nonattainment in metropolitan Phoenix, existing air quality is good. The trend is for little development in the site area proposed for SSC construction, with the highest potential for an increase in air pollutant emissions from mining and minerals development. The SSC project would make a negligible contribution to air pollutants in the region.

Table 8-11

COMPARISON OF EMISSIONS WITH ESTIMATED
EXISTING BACKGROUND EMISSIONS
ARIZONA SSC SITE

County/ Pollutant	Existing Emissions	Construction SSC Emissions	Construction Percent of Existing	Operations SSC Emissions	Operations Percent of Existing
PRIMARY IMPACT COUNTY - MARICOPA					
CO	265,095	1,244	0.47	514	0.19
HC	102,522	124	0.12	42	0.04
NO_x	98,075	774	0.79	57	0.06
SO_2	16,090	75	0.47	<1	<0.001
TSP*	295,251	1,158	0.39	346	0.12
SECONDARY IMPACT COUNTY - PINAL					
CO	25,640	209	0.82	146	0.57
HC	6,151	17	0.28	12	0.20
NO_x	7,990	22	0.28	16	0.20
SO_2	192,188	<1	<0.001	<1	<0.001
TSP*	32,902	141	0.43	99	0.30

Note: Emissions = tons/yr.
* Includes PM-10.

Source: EPA 1988a and 1988b.

8.4.2 Colorado

The design and site information used in, and forming the basis of, the Colorado emissions inventory calculations, is presented in Table 8-12. Data used in developing the emissions inventory calculation reflect the influences of local conditions on the design, control methods, and operations of the SSC in Colorado.

The state's proposal included several alternatives for spoils disposal (see Appendix 10), including the following: 1) transport an average of 20 mi to the City of Brush, 2) transport an average of 10 mi to state school land, 3) use as aggregate, and 4) use to line reservoirs. Analysis determined that the first alternative was the worst case.

8.4.2.1 Construction

During construction two types of activities would produce large quantities of air pollutant emissions: 1) combustion of fuels from construction equipment and worker commute vehicles and 2) fugitive dust generated from vehicle and material handling activities.

A. Emissions

A peak-construction-year approach was used to define emissions, which produces a conservatively high estimate.

1. Combustion of Fuels

Fuel combustion emissions by construction subactivity are presented in Table 8-13. This was done by using the methodology presented in Section 8.2.3 and data from Table 8-12. Also shown in Table 8-13 are emissions from construction worker commute traffic.

2. Fugitive Dust

Table 8-14 lists the fugitive dust emission factor parameters used in calculating emissions during construction. Some of the symbols, such as silt content, appear several times. This is because different values were needed to produce emission estimates for surface soil material transfer as opposed to, for example, spoils material transfer. Applying these factors to fugitive dust equations produces the emissions inventory shown in Table 8-15.

Table 8-12

EMISSIONS INVENTORY BASIS
COLORADO SSC SITE

Phase	Value
CONSTRUCTION	
Design	
Tunneled collider ring, %	100
Cut-and-cover collider ring, %	0
No. of mined experimental halls	0
No. of cut-and-cover experimental halls	4*
Spoils disposal method	City of Brush
Average spoils haul round trip, miles	40
Spoils haul on paved roads, %	100
Spoils haul on unpaved roads, %	0
Average commute round trip, miles	73
Roadwork ratio	3.64
Control Methods	
Spoils Storage	
Efficiency, %	90
General Dirt Roads	
Control method	chem. soil stab.
Efficiency, %	95
Haul Roads	
Control method	paving
Efficiency, %	99+
OPERATIONS	
Design	
Natural gas consumption factor	6.98
Average commute round trip, miles	73

* Two future experimental halls not included.

Table 8-13

FUEL COMBUSTION EMISSIONS BY CONSTRUCTION SUBACTIVITY
COLORADO SSC SITE

	tons per peak year					
Subactivity	CO	HC	NOx	SO_2	TSP	PM_{10}
General site activity	11	1	7	1	0	0
Off-site road construction	50	11	61	5	6	6
Campus area construction	17	2	27	2	2	2
Injector area construction	56	6	68	7	5	5
Collider ring construction	266	37	246	29	17	17
Experimental hall construction	42	5	69	7	5	5
Construction traffic*	27	3	63	7	4	4
Construction commute traffic	909	74	96	0	0	0

* Inadvertently omitted from DEIS.

Table 8-14

FUGITIVE DUST EMISSION FACTOR PARAMETERS COLORADO SSC SITE

Parameter	Symbol	Units Used	Value
Spoils silt content	s	%	10
Days/yr >0.01" rain	p	#	90
Winds >12 mph	f	%	14.6
Spoils density	P	lb/ft^3	105
Spoils moisture	M	%	18
Road dust silt	s	%	14
Paved road dust	sL	$grains/ft^2$	2.02
Vehicle speed (unpaved)	S	mph	20
Vehicle speed (paved)	S	mph	35
Vehicle weight (heavy truck)	W	tons	25
No. of wheels (heavy truck)	w	#	8
Vehicle weight (passenger)	W	tons	1.5
No. of wheels (passenger)	w	#	4
Surface soil silt	s	%	65
Dump device capacity (small)	Y	yd^3	2
Dump device capacity (large)	Y	yd^3	10
Haul device capacity	Y	yd^3	20
Mean wind speed	U	mph	11
Spoil volume	N/A	10^6 yd^3	2.6

Source: AP-42; NCDC; Climatic Atlas

Table 8-15

FUGITIVE DUST EMISSIONS BY CONSTRUCTION SUBACTIVITY COLORADO SSC SITE

	tons per peak year	
Subactivity	TSP	PM_{10}
General site	73	34
Off-site road construction	299	141
Spoils storage	19	9
Cut excavation	61	29
Spoils dumping	<1	<1
Spoils loading	<1	<1
Spoils hauling	<1	<1
Spoils unloading	<1	<1
Vehicle traffic	47	22
Batch plants	256	120
Commute traffic	612	288

3. Total Construction Emissions

The construction emissions inventory, encompassing both combustion of fuels and fugitive dust, is presented by location in Table 8-16.

Table 8-16

EMISSIONS INVENTORY FOR CONSTRUCTION COLORADO SSC SITE

	tons per peak year			
Pollutant	Near Cluster	Far Cluster	Each of 6 Satellite E & F Site Pairs	Off Site
COMBUSTION OF FUELS				
CO	181	50	27	986
HC	22	6	4	88
NOx	208	61	25	220
SO_2	22	7	3	12
TSP	15	4	2	10
PM_{10}	15	4	2	10
FUGITIVE DUST				
TSP	137	42	35	978
PM_{10}	64	20	16	460

B. Concentrations

Emissions that produce the worst case off-site ground-level concentrations were determined using the ISCST dispersion model. Regionally, representative meteorological data were obtained from the National Climatic Data Center and used in the model. Surface weather observations and upper air data from weather station No. 23062 (Denver) for weather year 1986 were used. The resultant worst case ground-level pollutant concentrations are presented in Table 8-17. These impacts occur only during construction and concentrations drop off rapidly with distance from source.

Table 8-17

WORST CASE POLLUTANT CONCENTRATIONS RESULTING FROM CONSTRUCTION COLORADO SSC SITE

Pollutant	Average Time	Background	$\mu g/m^3$ SSC Contribution*	Total	More Stringent of National or State AAQS
CO	1-hour	2,292	1,168	3,460	40,000
CO	8-hour	1,146	470	1,616	10,000
NO_x	Annual	4	33	37	100
SO_2	24-hour	21	23	44	365
SO_2	Annual	3	4	7	80
TSP	24-hour	160	47	207[2]	260[1]
TSP	Annual	58	8	64[2]	75[1]
PM_{10}	24-hour	N/A	30	>30	150
PM_{10}	Annual	N/A	5	>5	50

* Receptor location 150 meters from edge of E or F area.
1. Also enforced are secondary TSP standards of 150 $\mu g/m^3$ 24-h avg. and 60 $\mu g/m^3$ Annual Geometric Mean.
2. Exceedance of secondary standard results from high background concentration which may not be representative of the SSC site.

8.4.2.2 Operations

A. Emissions

Three types of activities would generate air pollutant emissions during operations: 1) combustion of natural gas for building heating and cooling, 2) testing of the emergency diesel generators, and 3) operations staff commute traffic.

1. Natural Gas Combustion

Natural gas combustion emissions were calculated by using AP-42 (EPA 1986) emission factors and by adjusting the site-independent design basis of 55 x 10^6 Btu/h by the ratio of heating degree days for the site to that of the design basis as shown in Table 8-12. The emissions are shown in Table 8-18.

2. Emergency Diesel Generators

Emergency diesel generator emissions were calculated using AP-42 (EPA 1986) emission factors and an annual generation of 41,600 kWh.

3. Operations Commute Traffic

Table 8-18 also shows the emissions resulting from operations staff commute traffic.

Table 8-18

EMISSIONS INVENTORY FOR OPERATIONS COLORADO SSC SITE

Pollutant	tons per year Near Cluster	Far Cluster	Satellite F Site	Off Site
CO	3	<1	<1	635
HC	1	<1	<1	52
NOx	13	<1	<1	67
SO_2	<1	<1	<1	0
TSP	<1	<1	<1	428
PM_{10}	<1	<1	<1	201

B. Concentrations

Because of the small magnitude of the stationary emissions and the large spatial and temporal extent of the mobile emissions, neither was subjected to rigorous air dispersion modeling. Both types of sources are expected to cause only small impacts to air quality with very little, if any, environmental consequence.

8.4.2.3 Cumulative Impact in Region of Influence

The SSC would be a small, incremental addition to pollutant emissions affecting air quality of the region. Table 8-19 compares SSC emissions to those emissions currently existing in the region.

Because of the distance from suitable population centers, the SSC would require infrastructure development. Some farming operations would be displaced, resulting in reduced soil erosion from wind.

Table 8-19

COMPARISON OF EMISSIONS WITH ESTIMATED EXISTING BACKGROUND EMISSIONS COLORADO SSC SITE

County/ Pollutant	Existing Emissions	Construction SSC Emissions	Construction Percent of Existing	Operations SSC Emissions	Operations Percent of Existing
PRIMARY IMPACT COUNTIES - ADAMS, MORGAN, WASHINGTON					
CO	102,024	1,264	1.24	558	0.55
HC	25,729	129	0.50	45	0.17
NO_x	52,758	624	1.18	72	0.14
SO_2	32,639	58	0.18	<1	<0.01
TSP*	111,648	1,331	1.19	374	0.33
SECONDARY IMPACT COUNTY - ARAPAHOE					
CO	66,621	60	0.09	42	0.06
HC	18,768	5	0.03	3	0.02
NO_x	11,635	6	0.05	4	0.03
SO_2	1,038	<1	<0.01	<1	<0.01
TSP*	27,005	41	0.15	28	0.10
SECONDARY IMPACT COUNTY - DENVER					
CO	206,731	6	0.003	4	0.002
HC	48,728	0.5	0.001	0.4	0.001
NO_x	37,777	0.7	0.002	0.5	0.001
SO_2	4,806	<1	<0.02	<1	<0.02
TSP*	15,662	4	0.03	3	0.02
SECONDARY IMPACT COUNTY - JEFFERSON					
CO	70,605	13	0.02	9	0.01
HC	21,337	1	0.005	0.8	0.004
NO_x	17,309	1.0	0.006	1.0	0.006
SO_2	3,872	<1	<0.026	<1	<0.026
TSP*	46,039	9	0.019	6	0.013

Note: Emissions = tons/yr.
* Includes PM-10.

Source: EPA 1988a and 1988b.

8.4.3 Illinois

The design and site information used in, and forming the basis of, the Illinois emissions inventory calculation, is presented in Table 8-20. Data used in developing the emissions inventory calculation reflect the influence of local conditions on the design, control methods, and operations of the SSC in Illinois.

Four quarries have been proposed by the State as disposal sites for the excavated material. These quarries would stockpile the excavated material gradually blend them with their own produced material, and sell the combined product.

8.4.3.1 <u>Construction</u>

During construction, the following types of activities would produce large quantities of air pollutant emissions: 1) combustion of fuels in construction equipment and in construction worker commute vehicles and 2) fugitive dust generated from vehicle and material handling activities.

A. <u>Emissions</u>

A peak construction year approach was used to define emissions, which produces a conservatively high estimate.

1. <u>Combustion of Fuels</u>

Fuel combustion emissions by construction subactivity are presented in Table 8-21. This was done by using the methodology presented in Section 8.2.3 and data from Table 8-20. Also shown in Table 8-21 are emissions from construction worker commute traffic.

2. <u>Fugitive Dust</u>

Table 8-22 lists the fugitive dust emission factor parameters used in calculating emissions during construction. Some of the symbols, such as silt content, appear several times. This is because different values were needed to produce emission estimates for surface soil material transfer as opposed to, for example, spoils material transfer. Applying these factors to the fugitive dust equations produces the inventory emissions shown in Table 8-23.

3. <u>Total Construction Emissions</u>

The construction emission inventory, encompassing both combustion of fuels and fugitive dust, is presented by location in Table 8-24.

Table 8-20

EMISSIONS INVENTORY BASIS - ILLINOIS SSC SITE

Phase	Value
CONSTRUCTION	
Design	
Tunneled collider ring, %	100
Cut-and-cover collider ring, %	0
No. of mined experimental halls	4*
No. of cut-and-cover experimental halls	0
Spoils disposal method	quarries
Average spoils haul round trip, miles	20
Spoils haul on paved roads, %	90
Spoils haul on unpaved roads, %	10
Average commute round trip, miles	30
Injector Facility	in place
Roadwork ratio	0.39
Control Methods	
Spoils Storage	
Efficiency, %	100
General Dirt Roads	
Control method	watering
Efficiency, %	50
Haul Roads	
Control method	chem. soil stab.
Efficiency, %	95
OPERATIONS	
Design	
Natural gas consumption factor	7.22
Average commute round trip, miles	30

* Two future experimental halls not included.

Table 8-21

FUEL COMBUSTION EMISSIONS BY CONSTRUCTION SUBACTIVITY ILLINOIS SSC SITE

Subactivity	tons per peak year					
	CO	HC	NOx	SO_2	TSP	PM_{10}
General site activity	11	1	7	1	0	0
Off-site road construction	5	1	7	1	1	1
Campus area construction	17	2	27	2	2	2
Injector area construction	0	0	0	0	0	0
Collider ring construction	266	37	246	29	17	17
Experimental hall construction	29	5	60	6	4	4
Construction traffic*	16	2	36	4	0	0
Construction commute traffic	278	23	29	0	0	0

* Inadvertently omitted from DEIS.

Table 8-22

FUGITIVE DUST EMISSION FACTOR PARAMETERS ILLINOIS SSC SITE

Parameter	Symbol	Units Used	Value
Spoils silt content	U	%	17
Days/yr >0.01" rain	p	#	115
Winds >12 mph	f	%	29.4
Spoils density	p	lb/ft^3	105
Spoils moisture	M	%	5
Road dust silt	s	%	14
Paved road dust	sL	$grains/ft^2$	2.02
Vehicle speed (unpaved)	S	mph	20
Vehicle speed (paved)	S	mph	35
Vehicle weight (heavy truck)	W	tons	25
No. of wheels (heavy truck)	w	#	8
Vehicle weight (passenger)	W	tons	1.5
No. of wheels (passenger)	w	#	4
Surface soil silt	s	%	70
Dump device capacity (small)	Y	yd^3	2
Dump device capacity (large)	Y	yd^3	10
Haul device capacity	Y	yd^3	20
Mean wind speed	U	mph	10
Spoils volume	N/A	10^6 yd^3	3.0

Sources: AP-42; NCDC; Climatic Atlas

Table 8-23

FUGITIVE DUST EMISSIONS BY CONSTRUCTION SUBACTIVITY ILLINOIS SSC SITE

Subactivity	tons per peak year	
	TSP	PM_{10}
General site	50	24
Off-site road construction	32	15
Spoils storage	<1	<1
Cut excavation	61	29
Spoils dumping	<1	<1
Spoils loading	<1	<1
Spoils hauling	<1	<1
Spoils unloading	1	<1
Vehicle traffic	64	30
Batch plants	256	120
Commute traffic	187	88

Table 8-24

**EMISSIONS INVENTORY FOR CONSTRUCTION
ILLINOIS SSC SITE**

Pollutant	Near Cluster (tons per peak year)	Far Cluster (tons per peak year)	Each of 6 Satellite E & F Site Pairs (tons per peak year)	Off Site (tons per peak year)
COMBUSTION OF FUELS				
CO	119	44	27	299
HC	16	6	4	25
NOx	136	56	25	72
SO_2	14	6	3	5
TSP	10	4	2	3
PM_{10}	10	4	2	3
FUGITIVE DUST				
TSP	116	42	35	284
PM_{10}	55	20	16	133

B. Concentrations

Emissions that produce the worst case off-site ground-level concentrations were determined using the ISCST dispersion model. Regionally representative meteorological data were obtained from the National Climatic Data Center and used in the model. Surface weather observations from weather station No. 94846 (Chicago-O'Hare) and upper air data from weather station No. 14842 (Peoria) for weather year 1986 were used. The resultant worst case ground-level pollutant concentrations are presented in Table 8-25. These impacts occur only during construction and concentrations drop off rapidly with distance from source.

Table 8-25

**WORST CASE POLLUTANT CONCENTRATIONS RESULTING FROM CONSTRUCTION
ILLINOIS SSC SITE**

Pollutant	Average Time	Background ($\mu g/m^3$)	SSC Contribution* ($\mu g/m^3$)	Total ($\mu g/m^3$)	More Stringent of National or State AAQS ($\mu g/m^3$)
CO	1-hour	8,300	1,175	9,475	40,000
CO	8-hour	5,400	793	6,193	10,000
NOx	Annual	26	21	47	100
SO_2	24-hour	168	31	199	365
SO_2	Annual	8	2	10	80
TSP	24-hour	130	64	194[2]	260[1]
TSP	Annual	46	5	51	75[1]
PM_{10}	24-hour	N/A	40	>40	150
PM_{10}	Annual	N/A	3	>3	50

* Receptor location 150 meters from edge of E or F area.
1. Also enforced are secondary TSP standards of 150 $\mu g/m^3$ 24-hr avg. and 60 $\mu g/m^3$ Annual Geometric Mean.
2. Exceedance of secondary standard results from high background concentrations which may not be representative of SSC site.

8.4.3.2 Operations

A. Emissions

Three types of activities would generate air pollutant emissions during operations: 1) combustion of natural gas for building heating and cooling, 2) testing of the emergency diesel generators, and 3) operations staff commute traffic.

1. Natural Gas Combustion

Natural gas combustion emissions were calculated by using AP-42 (EPA 1986) emission factors and by adjusting the site-independent design basis of 55 x 10^6 Btu/h by the ratio of heating degree days for the site to that of the design basis as shown in Table 8-20. The emissions are shown in Table 8-26.

2. Emergency Diesel Generators

Emergency diesel generator emissions were calculated using AP-42 (EPA 1986) emission factors and an annual generation rate of 41,600 kWh.

3. Operations Commute Traffic

Table 8-26 also shows the emissions resulting from operations staff commute traffic.

Table 8-26

EMISSIONS INVENTORY FOR OPERATIONS
ILLINOIS SSC SITE

Pollutant	Near Cluster (tons per year)	Far Cluster (tons per year)	Satellite F Sites (tons per year)	Off Site (tons per year)
CO	3	<1	<1	224
HC	1	<1	<1	18
NOx	14	<1	<1	24
SO_2	<1	<1	<1	0
TSP	<1	<1	<1	151
PM_{10}	<1	<1	<1	71

B. Concentrations

Because of the small magnitude of the stationary emissions and the large spatial and temporal extent of the mobile emissions, neither was subjected to rigorous air dispersion modeling. Both types of sources are expected to cause only small impacts to air quality with little, if any, environmental consequences.

8.4.3.3 Cumulative Impact in Region of Influence

Table 8-27 compares SSC emissions to those currently existing in the region. The SSC would produce a negligible, incremental addition to air emissions in the region.

The site is in an area designated nonattainment for O_3, although monitoring data shows current compliance. SSC contributions to emissions of precursors of this pollutant would be 0.12 percent or less.

Almost all infrastructure required to support the SSC is currently in place. In the far cluster area, some farming operations would be eliminated, thus reducing TSP and fuel combustion emissions by a negligible increment.

Table 8-27

COMPARISON OF EMISSIONS WITH ESTIMATED
EXISTING BACKGROUND EMISSIONS
ILLINOIS SSC SITE

County/ Pollutant	Existing Emissions	Construction SSC Emissions	Construction Percent of Existing	Operations SSC Emissions	Operations Percent of Existing
PRIMARY IMPACT COUNTIES - DUPAGE, KANE, KENDALL					
CO	175,172	598	0.34	208	0.12
HC	64,250	68	0.11	17	0.03
NO_x	35,610	409	1.15	36	0.10
SO_2	5,152	42	0.82	<1	<0.02
TSP*	33,850	663	1.96	139	0.41
SECONDARY IMPACT COUNTY - COOK					
CO	776,797	14	0.0018	12	0.0015
HC	307,423	1	0.0003	1	0.0003
NO_x	163,525	2	0.0012	1	0.0006
SO_2	60,288	<1	<0.0017	<1	<0.0017
TSP*	161,825	10	0.0062	8	0.0049
SECONDARY IMPACT COUNTY - WILL					
CO	63,940	13	0.0203	10	0.0156
HC	27,995	1	0.0036	1	0.0036
NO_x	84,119	1	0.0012	1	0.0012
SO_2	111,725	<1	<0.0009	<1	0.0009
TSP*	24,791	8	0.0323	7	0.0282

Note: Emissions = tons/yr.
* Includes PM-10.

Source: EPA 1988a and 1988b.

8.4.4 Michigan

The design and site information used in, and forming the basis of, the Michigan emissions inventory calculation, is presented in Table 8-28. Data used in developing the emissions inventory calculation reflect the influence of local conditions on the design, control methods, and operations of the SSC in Michigan.

The state's proposal included several alternatives for spoils disposal (see Appendix 10), including the following: 1) use as aggregate with an average transport of 10 mi, 2) transport an average of 10 mi to quarry, and 3) use locally for road beds. Analysis determined that the first alternative was the worst case.

8.4.4.1 Construction

During construction two types of activities would produce large quantities of air pollutant emissions: 1) combustion of fuels from construction equipment and worker commute vehicles and 2) fugitive dust generated from vehicle and material handling activities.

A. Emissions

A peak-construction-year approach was used to define emissions, which produces a conservatively high estimate.

1. Combustion of Fuels

Fuel combustion emissions by construction subactivity are presented in Table 8-29. This was done by using the methodology presented in Section 8.2.3 and data from Table 8-28. Also shown in Table 8-29 are emissions from construction worker commute traffic.

2. Fugitive Dust

Table 8-30 lists the fugitive dust emission factor parameters used in calculating emissions during construction. Some of the symbols, such as silt content, appear several times. This is because different values were needed to produce emission estimates for surface soil material transfer as opposed to, for example, spoils material transfer. Applying these factors to the fugitive dust equations produces the emissions inventory shown in Table 8-31.

3. Total Construction Emissions

The construction emissions inventory, encompassing both combustion of fuels and fugitive dust, is presented by location in Table 8-32.

Table 8-28

**EMISSIONS INVENTORY BASIS
MICHIGAN SSC SITE**

Phase	Value
CONSTRUCTION	
Design	
Tunneled collider ring, %	100
Cut-and-cover collider ring, %	0
No. of mined experimental halls	0
No. of cut-and-cover experimental halls	4*
Spoils disposal method	aggregate
Average spoils haul round trip, miles	20
Spoils haul on paved roads, %	90
Spoils haul on unpaved roads, %	10
Average commute round trip, miles	38
Roadwork ratio	1.17
Control Methods	
Spoils Storage	
Efficiency, %	100
General Dirt Roads	
Control method	chem. soil stab.
Efficiency, %	95
Haul Roads	
Control method	chemical stabilization
Efficiency, %	95
OPERATIONS	
Design	
Natural gas consumption factor	6.92
Average commute round trip, miles	38

* Two future experimental halls not included.

Table 8-29

FUEL COMBUSTION EMISSIONS BY CONSTRUCTION SUBACTIVITY MICHIGAN SSC SITE

	tons per peak year					
Subactivity	CO	HC	NOx	SO_2	TSP	PM_{10}
General site activity	11	1	7	1	0	0
Off-site road construction	16	3	20	2	2	2
Campus area construction	17	2	27	2	2	2
Injector area construction	56	6	68	7	5	5
Collider ring construction	266	37	246	29	17	17
Experimental hall construction	42	5	69	7	5	5
Construction traffic*	14	1	31	3	2	2
Construction commute traffic	343	28	36	0	0	0

* Inadvertently omitted from DEIS.

Table 8-30

FUGITIVE DUST EMISSION FACTOR PARAMETERS MICHIGAN SSC SITE

Parameter	Symbol	Units Used	Value
Spoils silt content	s	%	17
Days/yr >0.01" rain	p	#	135
Winds >12 mph	f	%	29.1
Spoils density	p	lb/ft^3	105
Spoils moisture	M	%	15
Road dust silt	s	%	14
Paved road dust	sL	$grains/ft^2$	2.02
Vehicle speed (unpaved)	S	mph	20
Vehicle speed (paved)	S	mph	35
Vehicle weight (heavy truck)	W	tons	25
No. of wheels (heavy truck)	w	#	8
Vehicle weight (passenger)	W	tons	1.5
No. of wheels (passenger)	w	#	4
Surface soil silt	s	%	40
Dump device capacity (small)	Y	yd^3	2
Dump device capacity (large)	Y	yd^3	10
Haul device capacity	Y	yd^3	20
Mean wind speed	U	mph	10
Spoils volume	N/A	10^6 yd^3	2.6

Table 8-31

FUGITIVE DUST EMISSIONS BY CONSTRUCTION SUBACTIVITY MICHIGAN SSC SITE

	tons per peak year	
Subactivity	TSP	PM_{10}
General site	38	18
Off-site road construction	49	23
Spoils storage	<1	<1
Cut excavation	61	29
Spoils dumping	<1	<1
Spoils loading	<1	<1
Spoils hauling	<1	<1
Spoils unloading	<1	<1
Vehicle traffic	53	25
Batch plants	256	120
Commute traffic	231	109

Table 8-32

EMISSIONS INVENTORY FOR CONSTRUCTION MICHIGAN SSC SITE

	tons per peak year			
Pollutant	Near Cluster	Far Cluster	Each of 6 Satellite E & F Site Pairs	Off Site
COMBUSTION OF FUELS				
CO	181	50	27	372
HC	22	6	4	33
NOx	208	61	25	87
SO_2	22	7	3	5
TSP	15	4	2	4
PM_{10}	15	4	2	4
FUGITIVE DUST				
TSP	117	37	33	333
PM_{10}	55	17	16	157

B. Concentrations

Emissions that produce the worst case off-site ground-level concentrations were determined by using the ISCST dispersion model. Regionally representative meteorological data were obtained from the National Climatic Data Center and used in the model. Surface weather observations from weather station No. 14836 (Lansing) and upper air data from weather station No. 14862 (Flint) for weather year 1986 were used. The resultant worst case ground-level pollutant concentrations are presented in Table 8-33. These impacts occur only during construction and concentrations drop off rapidly with distance from source.

Table 8-33

WORST CASE POLLUTANT CONCENTRATIONS RESULTING FROM CONSTRUCTION MICHIGAN SSC SITE

Pollutant	Average Time	Background	μg/m³ SSC Contribution*	Total	More Stringent of National or State AAQS
CO	1-hour	23,700	1,176	24,876	40,000
CO	8-hour	10,400	948	11,348[1]	10,000
NOx	Annual	34	42	76	100
SO_2	24-hour	99	38	137	365
SO_2	Annual	15	5	20	80
TSP	24-hour	107	52	159[3]	260[2]
TSP	Annual	45	6	51	75[2]
PM_{10}	24-hour	N/A	37	>37	150
PM_{10}	Annual	N/A	5	>5	50

* Receptor location 150 meters from edge of E or F area.
1. Exceedence caused by high background not representative of SSC site.
2. Also enforced are secondary TSP standards of 150 μg/m³ 24-hr avg. and 60 μg/m³ Annual Geometric Mean.
3. Exceedance of secondary standard is result of high background concentrations which may not be representative of SSC site.

8.4.4.2 Operations

A. Emissions

Three types of activities would generate air pollutant emissions during operations: 1) combustion of natural gas for building heating and cooling, 2) testing of emergency diesel generators, and 3) operations staff commute traffic.

1. Natural Gas Combustion

Natural gas combustion emissions were calculated by using AP-42 (EPA 1986) emissions factors and by adjusting the site-independent design basis of 55 x 10^6 Btu/h by the ratio of heating degree-days for the site to that of the design basis as shown in Table 8-28. The emissions are shown in Table 8-34.

2. Emergency Diesel Generators

Emergency diesel generator emissions were calculated using AP-42 (EPA 1986) emission factors and an annual generation rate of 41,600 kWh.

3. Operations Commute Traffic

Table 8-34 also shows the emissions resulting from operations staff commute traffic.

Table 8-34

EMISSIONS INVENTORY FOR OPERATIONS MICHIGAN SSC SITE

Pollutant	tons per year Near Cluster	Far Cluster	Satellite F Site	Off Site
CO	3	<1	<1	249
HC	1	<1	<1	20
NOx	13	<1	<1	26
SO_2	<1	<1	<1	0
TSP	<1	<1	<1	168
PM_{10}	<1	<1	<1	79

B. Concentrations

Because of the small magnitude of the stationary emissions and the large spatial and temporal extent of the mobile emissions, neither was subjected to rigorous air dispersion modeling. Both types of sources are expected to cause only small impacts to air quality with little, if any, consequences.

8.4.4.3 Cumulative Impacts in Region of Influence

Table 8-35 compares SSC emissions to those currently existing in the region. The SSC would make a negligible, additive contribution to air emissions in the region.

The site is located in an area currently designated as nonattainment for O_3, primarily because of air pollution sources outside the region.

Table 8-35

COMPARISON OF EMISSIONS WITH ESTIMATED EXISTING BACKGROUND EMISSIONS MICHIGAN SSC SITE

County/ Pollutant	Existing Emissions	Construction SSC Emissions	Construction Percent of Existing	Operations SSC Emissions	Operations Percent of Existing
PRIMARY IMPACT COUNTIES - INGHAM, JACKSON					
CO	116,742	636	0.54	160	0.14
HC	31,425	73	0.23	13	0.04
NO_x	22,729	490	2.16	29	0.13
SO_2	14,969	51	0.34	<1	<0.01
TSP*	34,873	636	1.82	105	0.30
SECONDARY IMPACT COUNTY - WASHINGTON					
CO	46,588	120	0.26	87	0.19
HC	21,512	10	0.05	7	0.03
NO_x	10,464	13	0.12	9	0.09
SO_2	1,916	<1	<0.05	<1	<0.05
TSP*	21,814	81	0.37	59	0.27

Note: Emissions = tons/yr.
* Includes PM-10.

Source: EPA 1988a and 1988b.

8.4.5 North Carolina

The design and site information used in, and forming the basis of the North Carolina emissions inventory calculation, is presented in Table 8-36. Data used in developing the emissions inventory calculations reflect the influence of local conditions on the design, control methods, and operations of the SSC in North Carolina.

The state's proposal included several alternatives for spoils disposal (see Appendix 10), including the following: 1) dispose of at 17 locations with an average transport of 2 mi, and 2) use to produce aggregate. Analysis determined the first alternative to be the worst case.

8.4.5.1 Construction Phase

During construction two types of activities would produce large quantities of air pollutant emissions: 1) combustion of fuels from construction equipment and worker commute vehicles and 2) fugitive dust generated from vehicle and material handling activities.

A. Emissions

A peak-construction-year approach was used to define emissions, which produces a conservatively high estimate.

1. Combustion of Fuels

Fuel combustion emissions by construction subactivity are presented in Table 8-37. This was done by using the methodology presented in Section 8.2.3 and data from Table 8-36. Also shown in Table 8-37 are emissions from construction worker commute traffic.

2. Fugitive Dust

Table 8-38 lists the fugitive dust emission factor parameters used in calculating emissions during construction. Some of the symbols, such as silt content, appear several times. This is because different values were needed to produce emission estimates for surface soil materials transfer as opposed to, for example, spoils materials transfer. Applying these factors to the fugitive dust equations produces the emissions inventory shown in Table 8-39.

3. Total Construction Emissions

The construction emissions inventory, encompassing both combustion of fuels and fugitive dust, is presented by location in Table 8-40.

Table 8-36

EMISSIONS INVENTORY BASIS NORTH CAROLINA SSC SITE

Phase	Value
CONSTRUCTION	
Design	
Tunneled collider ring, %	100
Cut-and-cover collider ring, %	0
No. of mined experimental halls	3*
No. of cut-and-cover experimental halls	1*
Spoils disposal method	mound on hills
Average spoils haul round trip, miles	4
Spoils haul on paved roads, %	100
Spoils haul on unpaved roads, %	0
Average commute round trip, miles	34
Roadwork ratio	1.28
Control Methods	
Spoils Storage Efficiency, %	90
General Dirt Roads	
Control method	chem. soil stab.
Efficiency, %	95
Haul Roads	
Control method	paving
Efficiency, %	99+
OPERATIONS	
Design	
Natural gas consumption factor	3.54
Average commute round trip, miles	34

* Two future experimental halls not included.

Table 8-37

FUEL COMBUSTION EMISSIONS BY CONSTRUCTION SUBACTIVITY NORTH CAROLINA SSC SITE

	tons per peak year					
Subactivity	CO	HC	NOx	SO_2	TSP	PM_{10}
General site activity	11	1	7	1	0	0
Off-site road construction	18	4	21	2	2	2
Campus area construction	17	2	27	2	2	2
Injector area construction	56	6	68	7	5	5
Collider ring construction	266	37	246	29	17	17
Experimental hall construction	32	5	63	6	4	4
Construction traffic*	3	0	7	1	0	0
Construction commute traffic	415	34	44	0	0	0

* Inadvertently omitted from DEIS.

Table 8-38

FUGITIVE DUST EMISSION FACTOR PARAMETERS NORTH CAROLINA SSC SITE

Parameter	Symbol	Units Used	Value
Spoils silt content	s	%	25
Days/yr >0.01" rain	p	#	120
Winds >12 mph	f	%	11.6
Spoils density	p	lb/ft^3	105
Spoils moisture	M	%	5
Road dust silt	s	%	14
Paved road dust	sL	$grains/ft^2$	2.02
Vehicle speed (unpaved)	S	mph	20
Vehicle speed (paved)	S	mph	35
Vehicle weight (heavy truck)	W	tons	25
No. of wheels (heavy truck)	w	#	8
Vehicle weight (passenger)	W	tons	1.5
No. of wheels (passenger)	w	#	4
Surface soil silt	s	%	50
Dump device capacity (small)	Y	yd^3	2
Dump device capacity (large)	Y	yd^3	20
Haul device capacity	Y	yd^3	10
Mean wind speed	U	mph	8
Spoils volume	N/A	$10^6\ yd^3$	2.7

Sources: AP-42; NCDC; Climatic Atlas

Table 8-39

FUGITIVE DUST EMISSIONS BY CONSTRUCTION SUBACTIVITY NORTH CAROLINA SSC SITE

Subactivity	tons per peak year TSP	PM_{10}
General site	49	23
Off-site road construction	72	34
Spoils storage	20	10
Cut excavation	61	29
Spoils dumping	<1	<1
Spoils loading	1	<1
Spoils hauling	<1	<1
Spoils unloading	1	<1
Vehicle traffic	5	2
Batch plants	256	120
Commute traffic	280	132

Table 8-40

EMISSIONS INVENTORY FOR CONSTRUCTION NORTH CAROLINA SSC SITE

Pollutant	tons per peak year Near Cluster	Far Cluster	Each of 6 Satellite E & F Site Pairs	Off Site
COMBUSTION OF FUELS				
CO	176	45	27	435
HC	22	6	4	38
NOx	204	58	25	72
SO_2	21	6	3	3
TSP	14	4	2	3
PM_{10}	14	4	2	3
FUGITIVE DUST				
TSP	124	39	34	378
PM_{10}	58	18	16	178

B. Concentrations

Emissions that produce the worst case off-site ground-level concentrations were determined by using the ISCST dispersion model. Regionally representative meteorological data were obtained from the National Climatic Data Center and used in the model. Surface weather observations from weather station No. 13722 (Raleigh-Durham) and upper air data from weather station No. 13723 (Greensboro) for weather year 1986 were used. The resultant worst case ground-level pollutant concentrations are presented in Table 8-41. These impacts occur only during construction and concentrations drop off rapidly with distance from source.

Table 8-41

WORST CASE POLLUTANT CONCENTRATIONS RESULTING FROM CONSTRUCTION NORTH CAROLINA SSC SITE

Pollutant	Average Time	Background	$\mu g/m^3$ SSC Contribution*	Total	More Stringent of National or State AAQS
CO	1-hour	26,000[1]	1,144	27,144	40,000
CO	8-hour	15,000[1]	958	15,958[2]	10,000
NOx	Annual	28	43	71	100
SO_2	24-hour	90	46	136	365
SO_2	Annual	15	5	20	80
TSP	24-hour	81[1]	74	155[4]	150
TSP	Annual	47	8	55	75[3]
PM_{10}	24-hour	N/A	50	>50	150
PM_{10}	Annual	N/A	5	>5	50

* Receptor location 150 meters from edge of E or F area.
1. Background concentration representative of Durham, N.C., not representative of SSC site.
2. Exceedance caused by high background not representative of SSC site.
3. Also enforced is secondary TSP standard of 60 $\mu g/m^3$ Annual Geometric Mean.
4. Exceedance of standard is result of high background concentration which may not be representative of site.

8.4.5.2 Operations

A. Emissions

Three types of activities would generate air pollutant emissions during operations: 1) combustion of natural gas for building heating and cooling, 2) testing of emergency diesel generators, and 3) operations staff commute traffic.

1. Natural Gas Combustion

Natural gas combustion emissions were calculated by using AP-42 (EPA 1986) emission factors and by adjusting the site-independent design basis of 55 x 10^6 Btu/h by the ratio of heating degree days for the site to that of the design basis as shown in Table 8-36. The emissions are shown in Table 8-42.

2. Emergency Diesel Generators

Emergency diesel generator emissions were calculated using AP-42 (EPA 1986) emission factors and an annual generation rate of 41,600 kWh.

3. Operations Commute Traffic

Table 8-42 also shows the emissions resulting from operations staff commute traffic.

Table 8-42

**EMISSIONS INVENTORY FOR OPERATIONS
NORTH CAROLINA SSC SITE**

	tons per year			
Pollutant	Near Cluster	Far Cluster	Satellite F Site	Off Site
CO	2	<1	<1	299
HC	<1	<1	<1	24
NOx	7	<1	<1	32
SO_2	<1	<1	<1	0
TSP	<1	<1	<1	202
PM_{10}	<1	<1	<1	95

B. Construction

Because of the small magnitude of the stationary emissions and the large spatial and temporal extent of the mobile emissions, neither was subjected to rigorous air dispersion modeling. Both types of sources are expected to cause only small impacts to air quality with little, if any, consequences.

8.5.5.3 Cumulative Impacts in Region of Influence

Table 8-43 compares SSC emissions to those existing. The SSC project in North Carolina would make a negligible, additive contribution to air emissions in the region.

Table 8-43

**COMPARISON OF EMISSIONS WITH ESTIMATED
EXISTING BACKGROUND EMISSIONS
NORTH CAROLINA SSC SITE**

		Construction		Operations	
County/ Pollutant	Existing Emissions	SSC Emissions	Percent of Existing	SSC Emissions	Percent of Existing
PRIMARY IMPACT COUNTIES - DURHAM, GRANVILLE, PERSON					
CO	56,430	750	1.33	253	0.45
HC	20,283	83	0.41	21	0.10
NO_x	81,954	475	0.58	33	0.04
SO_2	114,390	47	0.04	<1	<0.01
TSP*	25,893	731	2.82	169	0.65
SECONDARY IMPACT COUNTY - WAKE					
CO	90,007	55	0.06	39	0.04
HC	24,654	4	0.02	3	0.01
NO_x	14,531	6	0.04	4	0.03
SO_2	2,165	<1	<0.05	<1	<0.05
TSP*	24,743	37	0.15	27	0.11

Note: Emissions = tons/yr.
* Includes PM-10.

Source: EPA 1988a and 1988b.

8.4.6 Tennessee

The design and site information used in, and forming the basis of, the Tennessee emissions inventory calculations, is presented in Table 8-44. Data used in developing the emissions inventory calculations reflect the influence of local conditions on the design, control methods, and operations of the SSC in Tennessee.

The state's proposal included several alternatives for spoils disposal (see Appendix 10), including the following: 1) use in SSC construction, 2) sell to local industry, and 3) on-site disposal. While none of the three alternatives were specific, the third alternative was analyzed as the worst case for air quality.

8.4.6.1 Construction

During construction two types of activities would produce large quantities of air pollutant emissions: 1) combustion of fuels from construction equipment and worker commute vehicles and 2) fugitive dust generated from vehicle and material handling activities.

A. Emissions

A peak-construction-year approach was used to define emissions, which produces a conservatively high estimate.

1. Combustion of Fuels

Fuel combustion emissions by construction subactivity are presented in Table 8-45. This was done by using the methodology presented in Section 8.2.3 and data from Table 8-44. Also shown in Table 8-45 are emissions from construction worker commute traffic.

2. Fugitive Dust

Table 8-46 lists the fugitive dust emission factor parameters used in calculating emissions during construction. Some of the symbols, such as silt content, appear several times. This is because different values were needed to produce emission estimates for surface soil material transfer as opposed to, for example, spoils material transfer. Applying these factors to the fugitive dust equations produces the emissions inventory shown in Table 8-47.

3. Total Construction Emissions

The construction emissions inventory, encompassing both combustion of fuels and fugitive dust, is presented by location in Table 8-48.

Table 8-44

EMISSIONS INVENTORY BASIS
TENNESSEE SSC SITE

Phase	Value
CONSTRUCTION	
Design	
Tunneled collider ring, %	100
Cut-and-cover collider ring, %	0
No. of mined experimental halls	4*
No. of cut-and-cover experimental halls	0
Spoils disposal method	place in gullies
Average spoils haul round trip, miles	2.0
Spoils haul on paved roads, %	0
Spoils haul on unpaved roads, %	100
Average commute round trip, miles	56
Road work ratio	0.39
Control Methods	
Spoils Storage	
Efficiency, %	90
General Dirt Roads	
Control method	chem. soil stab.
Efficiency, %	95
Haul Roads	
Control method	chemical stabilization
Efficiency, %	95
OPERATIONS	
Design	
Natural gas consumption factor	3.98
Average commute round trip, miles	56

* Two future experimental halls not included.

Table 8-45

FUEL COMBUSTION EMISSIONS BY CONSTRUCTION SUBACTIVITY TENNESSEE SSC SITE

Subactivity	CO	HC	NOx (tons per peak year)	SO_2	TSP	PM_{10}
General site activity	11	1	7	1	0	0
Off-site road construction	5	1	6	1	1	1
Campus area construction	17	2	27	2	2	2
Injector area construction	56	6	68	7	5	5
Collider ring construction	266	37	246	29	17	17
Experimental hall construction	29	5	60	6	4	4
Construction traffic*	2	0	4	0	0	0
Construction commute traffic	462	38	49	0	0	0

* Inadvertently omitted from DEIS.

Table 8-46

FUGITIVE DUST EMISSION FACTOR PARAMETERS TENNESSEE SSC SITE

Parameter	Symbol	Units Used	Value
Spoils silt content	s	%	17
Days/yr >0.01" rain	p	#	120
Winds >12 mph	f	%	17.7
Spoils density	p	lb/ft^3	105
Spoils moisture	M	%	2
Road dust silt	s	%	14
Paved road dust	sL	$grains/ft^2$	2.02
Vehicle speed (unpaved)	S	mph	20
Vehicle speed (paved)	S	mph	35
Vehicle weight (heavy truck)	W	tons	25
No. of wheels (heavy truck)	w	#	8
Vehicle weight (passenger)	W	tons	1.5
No. of wheels (passenger)	w	#	4
Surface soil silt	s	%	85
Dump device capacity (small)	Y	yd^3	2
Dump device capacity (large)	Y	yd^3	10
Haul device capacity	Y	yd^3	20
Mean wind speed	U	mph	8
Spoils volume	N/A	$10^6\ yd^3$	3.0

Sources: AP-42; NCDC; Climatic Atlas

Table 8-47

FUGITIVE DUST EMISSIONS BY CONSTRUCTION SUBACTIVITY TENNESSEE SSC SITE

Subactivity	TSP (tons per peak year)	PM_{10}
General site	84	39
Off-site road construction	37	17
Spoils storage	54	26
Cut excavation	61	29
Spoils dumping	<1	<1
Spoils loading	1	<1
Spoils hauling	<1	<1
Spoils unloading	1	<1
Vehicle traffic	39	18
Batch plants	256	120
Commute traffic	311	146

Table 8-48

EMISSIONS INVENTORY FOR CONSTRUCTION TENNESSEE SSC SITE

Pollutant	Near Cluster	Far Cluster (tons per peak year)	Each of 6 Satellite E & F Site Pairs	Off Site
COMBUSTION OF FUELS				
CO	175	44	27	469
HC	22	6	4	39
NOx	203	56	25	59
SO_2	21	6	3	1
TSP	14	4	2	1
PM_{10}	14	4	2	1
FUGITIVE DUST				
TSP	144	44	36	443
PM_{10}	68	21	17	208

B. Concentrations

Emissions that produce the worst case off-site ground-level concentrations were determined by using the ISCST dispersion model. Regionally representative meteorological data were obtained from the National Climatic Data Center and used in the model. Surface weather observations and upper air data from weather station No. 13897 (Nashville) for weather year 1986 were used. The resultant worst case ground-level pollutant concentrations are presented in Table 8-49. These impacts occur only during construction and concentrations drop off rapidly with distance from source.

Table 8-49

WORST CASE POLLUTANT CONCENTRATIONS RESULTING FROM CONSTRUCTION TENNESSEE SSC SITE

Pollutant	Average Time	Background	μg/m³ SSC Contribution*	Total	More Stringent of National or State AAQS
CO	1-hour	17,000	1,119	18,119	40,000
CO	8-hour	12,000	681	12,681[1]	10,000
NOx	Annual	49	31	80	100
SO_2	24-hour	111	29	140	365
SO_2	Annual	32	3	35	80
TSP	24-hour	90	66	156[3]	260[2]
TSP	Annual	44	8	52	75[2]
PM_{10}	24-hour	N/A	41	>41	150
PM_{10}	Annual	N/A	5	>5	50

* Receptor location 150 meters from edge of E or F area.
1. Exceedance caused by high background not representative of SSC site.
2. Also enforced are secondary TSP standards of 150 μg/m³ 24-hr avg. and 60 μg/m³ Annual Geometric Mean.
3. Exceedance of secondary standard caused by high background concentration which may not be representative of site.

8.4.6.2 Operations

A. Emissions

Three types of activities would generate air pollutant emissions during operations: 1) combustion of natural gas for building heating and cooling, 2) testing of emergency diesel generators, and 3) operations staff commute traffic.

1. Natural Gas Combustion

Natural gas combustion emissions were calculated by using AP-42 (EPA 1986) emission factors and by adjusting the site-independent design basis of 55 x 10^6 Btu/hr by the ratio of heating degree days for the site to that of the design basis as shown in Table 8-44. The emissions are shown in Table 8-50.

2. Emergency Diesel Generators

Emergency diesel generator emissions were calculated using AP-42 (EPA 1986) emission factors and an annual generation rate of 41,600 kWh.

3. Operations Commute Traffic

Table 8-50 also shows the emissions resulting from operations staff commute traffic.

Table 8-50

EMISSIONS INVENTORY FOR OPERATIONS TENNESSEE SSC SITE

Pollutant	Near Cluster (tons per year)	Far Cluster (tons per year)	Satellite F Sites (tons per year)	Off Site (tons per year)
CO	2	<1	<1	341
HC	<1	<1	<1	28
NOx	8	<1	<1	36
SO_2	<1	<1	<1	0
TSP	<1	<1	<1	230
PM_{10}	<1	<1	<1	108

B. Concentrations

Because of the small magnitude of the stationary emissions and the large spatial and temporal extent of the mobile emissions, neither was subjected to rigorous air dispersion modeling. Both types of sources are expected to cause only small impacts to air quality with little, if any, environmental consequences.

8.4.6.3 Cumulative Impact in Region of Influence

Table 8-51 compares SSC emissions to those existing. The SSC would produce a small, incremental addition to air emissions in the region.

Current O_3 noncompliance is attributed to sources outside the immediate SSC area, and would not be affected by the SSC. During construction, SSC air emissions will add from less than 1 percent to 4.15 percent to the regional emissions. These changes would be temporary and not contribute to regional exceedences of any standards.

Table 8-51

COMPARISON OF EMISSIONS WITH ESTIMATED EXISTING BACKGROUND EMISSIONS TENNESSEE SSC SITE

County/ Pollutant	Existing Emissions	Construction SSC Emissions	Construction Percent of Existing	Operations SSC Emissions	Operations Percent of Existing
PRIMARY IMPACT COUNTIES - BEDFORD, MARSHALL, RUTHERFORD, WILLIAMSON					
CO	49,812	724	1.45	253	0.51
HC	25,571	79	0.31	21	0.08
NO_x	10,950	454	4.15	33	0.30
SO_2	3,855	45	1.17	<1	<0.03
TSP*	24,010	792	3.30	69	0.29
SECONDARY IMPACT COUNTY - DAVIDSON					
CO	78,190	97	0.12	71	0.09
HC	38,613	8	0.02	6	0.02
NO_x	25,449	10	0.04	8	0.03
SO_2	11,198	<1	<0.01	<1	<0.01
TSP*	13,926	65	0.47	48	0.34

Notes: Emissions = tons/yr.
* Includes PM-10.

Source: EPA 1988a and 1988b.

8.4.7 Texas

The design and site information used in, and forming the basis of the Texas emissions inventory calculations, is presented in Table 8-52. Data used in developing the emissions inventory calculations reflect the influences of local conditions on the design, control methods, and operations of the SSC in Texas.

The state's proposal included several alternatives for spoils disposal (see Appendix 10), including the following: 1) transport an average of 20 mi and use in the manufacture of cement, 2) use in local construction, 3) give to local farmers for landfill, 4) transport an average of 8 mi and dispose marl at landfill, and 5) dispose marl close to site. Analysis determined the first alternative to be the worst case.

8.4.7.1 Construction

During construction two types of activities would produce large quantities of air pollutants: 1) combustion of fuels from construction equipment and worker commute vehicles and 2) fugitive dust generated from vehicle and material handling activities.

A. Emissions

A peak-construction-year approach was used to define emissions, which produces a conservatively high estimate.

1. Combustion of Fuels

Fuel combustion emissions by construction subactivity are presented in Table 8-53. This was done by using the methodology presented in Section 8.2.3 and data from Table 8-54. Also shown in Table 8-53 are emissions from construction worker commute traffic.

2. Fugitive Dust

Table 8-54 lists the fugitive dust emission factor parameters used in calculating emissions during construction. Some of the symbols, such as silt content, appear several times. This is because different values were needed to produce emission estimates for surface soil material transfer as opposed to, for example, spoils material transfer. Applying these factors to the fugitive dust equations produces the emissions inventory shown in Table 8-55.

3. Total Construction Emissions

The construction emissions inventory, encompassing both combustion of fuels and fugitive dust, is presented by location in Table 8-56.

Table 8-52

EMISSIONS INVENTORY BASIS
TEXAS SSC SITE

Phase	Value
CONSTRUCTION	
Design	
Tunneled collider ring, %	100
Cut-and-cover collider ring, %	0
No. of mined experimental halls	0
No. of cut-and-cover experimental halls	4*
Spoils disposal method	cement mfg.
Average spoils haul round trip, miles	40
Spoils haul on paved roads, %	100
Spoils haul on unpaved roads, %	0
Average commute round trip, miles	58
Roadwork ratio	0.73
Control Methods	
Spoils Storage	
Efficiency, %	100
General Dirt Roads	
Control method	chem. soil stab.
Efficiency, %	95
Haul Roads	
Control method	paving
Efficiency, %	99+
OPERATIONS	
Design	
Natural gas consumption factor	2.78
Average commute round trip, miles	58

* Two future experimental halls not included.

Table 8-53

FUEL COMBUSTION EMISSIONS BY CONSTRUCTION SUBACTIVITY
TEXAS SSC SITE

Subactivity	CO	HC	NOx	SO_2	TSP	PM_{10}
	tons per peak year					
General site activity	11	1	7	1	0	0
Off-site road construction	10	2	12	1	1	1
Campus area construction	17	2	27	2	2	2
Injector area construction	56	6	68	7	5	5
Collider ring construction	266	37	246	29	17	17
Experimental hall construction	42	5	69	7	5	5
Construction traffic*	27	3	63	7	4	4
Construction commute traffic	566	45	59	0	0	0

* Inadvertently omitted from DEIS.

Table 8-54

FUGITIVE DUST EMISSION FACTOR PARAMETERS
TEXAS SSC SITE

Parameter	Symbol	Units Used	Value
Spoils silt content	s	%	15
Days/yr >0.01" rain	p	#	85
Winds >12 mph	f	%	38.5
Spoils density	p	lb/ft^3	105
Spoils moisture	M	%	9
Road dust silt	s	%	14
Paved road dust	sL	$grains/ft^2$	2.02
Vehicle speed (unpaved)	S	mph	20
Vehicle speed (paved)	S	mph	35
Vehicle weight (heavy truck)	W	tons	25
No. of wheels (heavy truck)	w	#	8
Vehicle weight (passenger)	W	tons	1.5
No. of wheels (passenger)	w	#	4
Surface soil silt	s	%	60
Dump device capacity (small)	Y	yd^3	2
Dump device capacity (large)	Y	yd^3	10
Haul device capacity	Y	yd^3	20
Mean wind speed	U	mph	13
Spoils volume	N/A	10^6 yd^3	2.6

Sources: AP-42; NCDC; Climatic Atlas

Table 8-55

FUGITIVE DUST EMISSIONS BY CONSTRUCTION SUBACTIVITY TEXAS SSC SITE

Subactivity	tons per peak year TSP	PM_{10}
General site	69	32
Off-site road construction	56	26
Spoils storage	<1	<1
Cut excavation	61	29
Spoils dumping	<1	<1
Spoils loading	<1	<1
Spoils hauling	<1	<1
Spoils unloading	<1	<1
Vehicle traffic	47	22
Batch plants	256	120
Commute traffic	375	176

Table 8-56

EMISSIONS INVENTORY FOR CONSTRUCTION TEXAS SSC SITE

Pollutant	tons per peak year Near Cluster	Far Cluster	Each of 6 Satellite E & F Site Pairs	Off Site
COMBUSTION OF FUELS				
CO	181	50	27	593
HC	22	6	4	50
NOx	208	61	25	134
SO_2	22	7	3	8
TSP	15	4	2	5
PM_{10}	15	4	2	5
FUGITIVE DUST				
TSP	135	42	35	479
PM_{10}	63	20	16	225

B. Concentrations

Emissions that produce the worst case off-site ground-level concentrations were determined by using the ISCST dispersion model. Regionally representative meteorological data were obtained from the National Climatic Data Center and used in the model. Surface weather observations from weather station No. 03927 (Dallas) and upper air data from weather station No. 13901 (Stephensville) for weather year 1986 were used. The resultant worst case ground-level pollutant concentrations are presented in Table 8-57. These impacts occur only during construction and concentrations drop off rapidly with distance from source.

Table 8-57

WORST CASE POLLUTANT CONCENTRATIONS RESULTING FROM CONSTRUCTION TEXAS SSC SITE

Pollutant	Average Time	Background	$\mu g/m^3$ SSC Contribution*	Total	More Stringent of National or State AAQS
CO	1-hour	11,110	1,170	12,280	40,000
CO	8-hour	8,360	842	9,202	10,000
NOx	Annual	28	32	60	100
SO_2	24-hour	50	37	87	365
SO_2	Annual	8	4	12	80
TSP	24-hour	55	75	130	260[1]
TSP	Annual	32	7	39	75[1]
PM_{10}	24-hour	N/A	48	>48	150
PM_{10}	Annual	N/A	4	>4	50

* Receptor location 150 meters from edge of E and F area.
1. Also enforced are secondary TSP standards of 150 $\mu g/m^3$ 24-hr avg. and 60 $\mu g/m^3$ Annual Geometric Mean.

8.4.7.2 Operations

A. Emissions

Three types of activities would generate air pollutant emissions during operations: 1) combustion of natural gas for building heating and cooling, 2) testing of emergency diesel generators, and 3) operations staff commute traffic.

1. Natural Gas Combustion

Natural gas combustion emissions were calculated by using AP-42 (EPA 1986) emission factors and by adjusting the site-independent design basis of 55 x 10^6 Btu/hr by the ratio of heating degree days for the site to that of the design basis as shown in Table 8-52. The emissions are shown in Table 8-58.

2. Emergency Diesel Generators

Emergency diesel generator emissions were calculated using AP-42 (EPA 1986) emission factors and an annual generation rate of 41,600 kWh.

3. Operations Commute Traffic

Table 8-58 also shows the emissions resulting from operations staff commute traffic.

Table 8-58

EMISSIONS INVENTORY FOR OPERATIONS TEXAS SSC SITE

	tons per year			
Pollutant	Near Cluster	Far Cluster	Satellite F Sites	Off Site
CO	1	<1	<1	405
HC	<1	<1	<1	33
NOx	5	<1	<1	43
SO_2	<1	<1	<1	0
TSP	<1	<1	<1	273
PM_{10}	<1	<1	<1	128

B. Concentrations

Because of the small magnitude of the stationary emissions and the large spatial and temporal extent of the mobile emissions, neither was subjected to rigorous air dispersion modeling. Both types of sources are expected to cause only small impacts to air quality with little, if any, environmental consequences.

8.4.7.3 Cumulative Impacts in Region of Influence

Table 8-59 compares SSC emissions to those existing. The SSC in Texas would produce a small, incremental addition to regional air emissions.

Regional fugitive dust emissions during construction would increase approximately 3 percent due to the SSC, but these effects will be temporary.

Table 8-59

COMPARISON OF EMISSIONS WITH ESTIMATED EXISTING BACKGROUND EMISSIONS TEXAS SSC SITE

		Construction		Operations	
County/ Pollutant	Existing Emissions	SSC Emissions	Percent of Existing	SSC Emissions	Percent of Existing
PRIMARY IMPACT COUNTY - ELLIS					
CO	24,780	714	2.88	209	0.84
HC	5,807	79	1.36	17	0.29
NO_x	26,830	521	1.94	27	0.10
SO_2	15,302	53	0.35	<1	<0.01
TSP*	22,847	717	3.14	139	0.61
SECONDARY IMPACT COUNTY - DALLAS					
CO	429,351	158	0.037	115	0.027
HC	131,767	13	0.010	9	0.007
NO_x	173,083	17	0.010	12	0.007
SO_2	47,172	<1	<0.002	<1	<0.002
TSP*	295,858	107	0.036	78	0.026
SECONDARY IMPACT COUNTY - TARRANT					
CO	257,246	33	0.013	24	0.009
HC	84,224	3	0.004	2	0.002
NO_x	109,813	4	0.004	3	0.003
SO_2	30,210	<1	<0.003	<1	<0.003
TSP*	165,808	22	0.013	16	0.010

Notes: Emissions = tons/yr.
* Includes PM_{10}.

Source: EPA 1988a and 1988b.

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