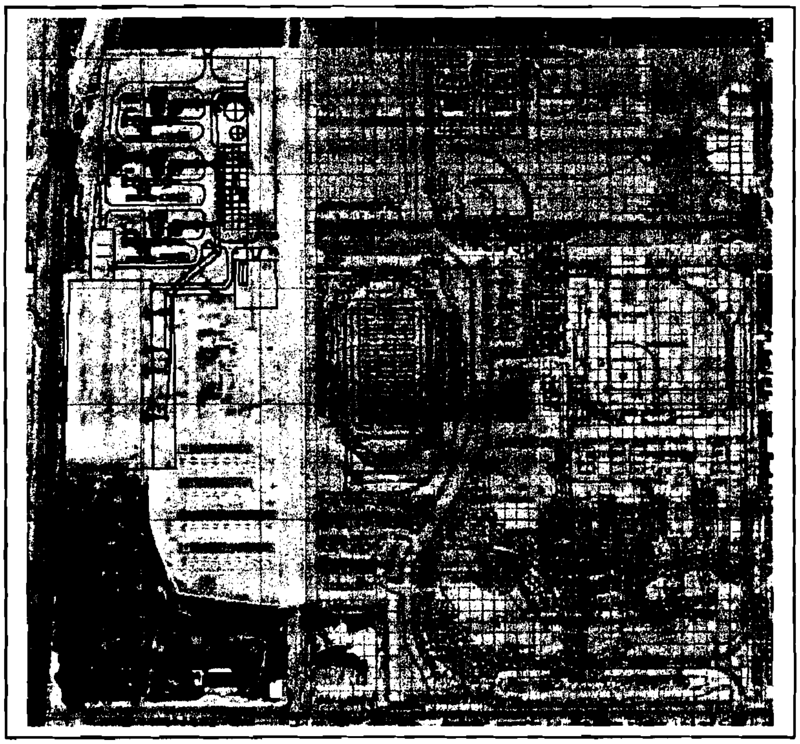
ASSESSMENT OF AIR QUALITY IMPACTS AND HEALTH RISKS FROM THE PROPOSED AES HIGHGROVE GAS TURBINE ENERGY FACILITY ON THE SCHOOL POPULATION OF THE PROPOSED COLTON JOINT UNIFED SCHOOL DISTRICT HIGH SCHOOL #3

Submitted to the Colton Joint Unified School District



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Summary and Findings

The Colton Joint Unified School District (CJUSD) commissioned this study to assess the potential air quality and health risk impacts associated with the operation of a proposed gas turbine electric generating facility which is to be located immediately west of a proposed CJUSD high school in the City of Grand Terrace. The proposed generating facility, identified as the AES Highgrove Energy Facility, is expected to be comprised of 3-100MW simple cycle gas turbines fueled by natural gas.

This assessment was comprised of four components: 1) a description of the prevailing meteorological and ambient air quality conditions in the facility area; 2) quantification of emissions of criteria air pollutant emissions and toxic air contaminant emissions from the facility operations; 3) quantification of the resultant air quality and health risk impacts using an air quality dispersion model; and 4) comparison of the resulting impacts with regulatory standards and limits.

A major focus of this assessment was centered on quantifying the expected emissions since little information was available for that purpose. For purposes of this assessment, reliance was placed on identifying emission rates characteristic of other gas turbine projects that have been approved in California during the past few years with the assumption that the AES facility would be equipped with Best Available Control Technology for stationary gas turbines similar to the BACT controls employed on other similar projects.

The results of the air quality assessment indicate the following findings as derived for the geographical area encompassing the location of the proposed CJUSD proposed high school:

1) The criteria pollutant emissions from the AES Highgrove facility are not expected to exceed any ambient air quality standards for Nitrogen Dioxide (NO_2), Carbon Monoxide (CO), or Sulfur Dioxide (SO_2) as established by the California Air Resources Board or the US Environmental Protection Agency
2) The criteria pollutant emissions from the AES Highgrove facility are not expected to exceed the South Coast Air Quality Management District Regulation XIII significance levels for PM_{10} particulate matter
3) The toxic air contaminant emissions from the AES Highgrove facility are not expected to exceed the excess cancer, chronic noncancer, or acute noncancer risk limits set by the South Coast Air Quality Management District under their Regulation XIV limits
4) The findings above are predicated on assumption that the AES Highgrove facility will employ Best Available Control Technology in it operations in a manner similar to that assumed in this assessment.

1.0 Introduction

The Colton Joint Unified School District (CJUSD) is proposing to construct a new high school (High School #3) in the City of Grand Terrace, CA. To the west of the proposed high school, AES Corporation is also proposing to construct a new simple cycle gas turbine electric generating facility with an electrical generating capacity of 300 MW. The CJUSD commissioned this study to assess the potential health risks associated with the air emissions from the generating station on the student population who will be attending the proposed school.

The generating station, noted as AES Highgrove, is expected to be located at AES' existing Riverside Canal Power Company's site in the City of Grand Terrace. This site is the location of an existing gas/oil fired powerplant which has seen very limited operations during the past several years. AES is contemplating removing the existing equipment and rebuilding the site with the new gas turbine facility. The existing site location is shown in Figure 1-1.

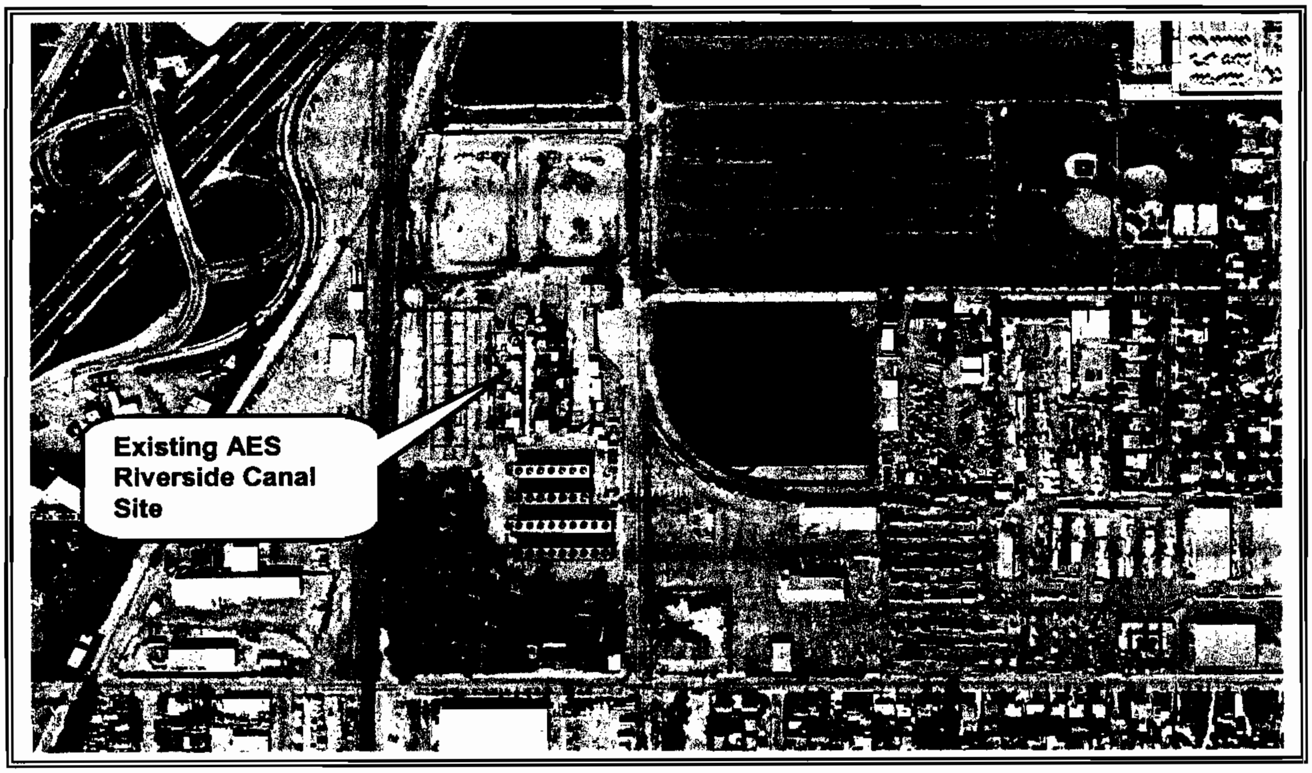

Figure 1-1 Location of the Existing AES Riverside Canal Site (shown is the existing Highgrove gas/oil Generating Station)

Figure 1-2 shows the locations of both the proposed AES Highgrove facility and the proposed high school as received from the CJUSD. As can be seen in this figure, the school property is immediately adjacent to the gas turbine facility.

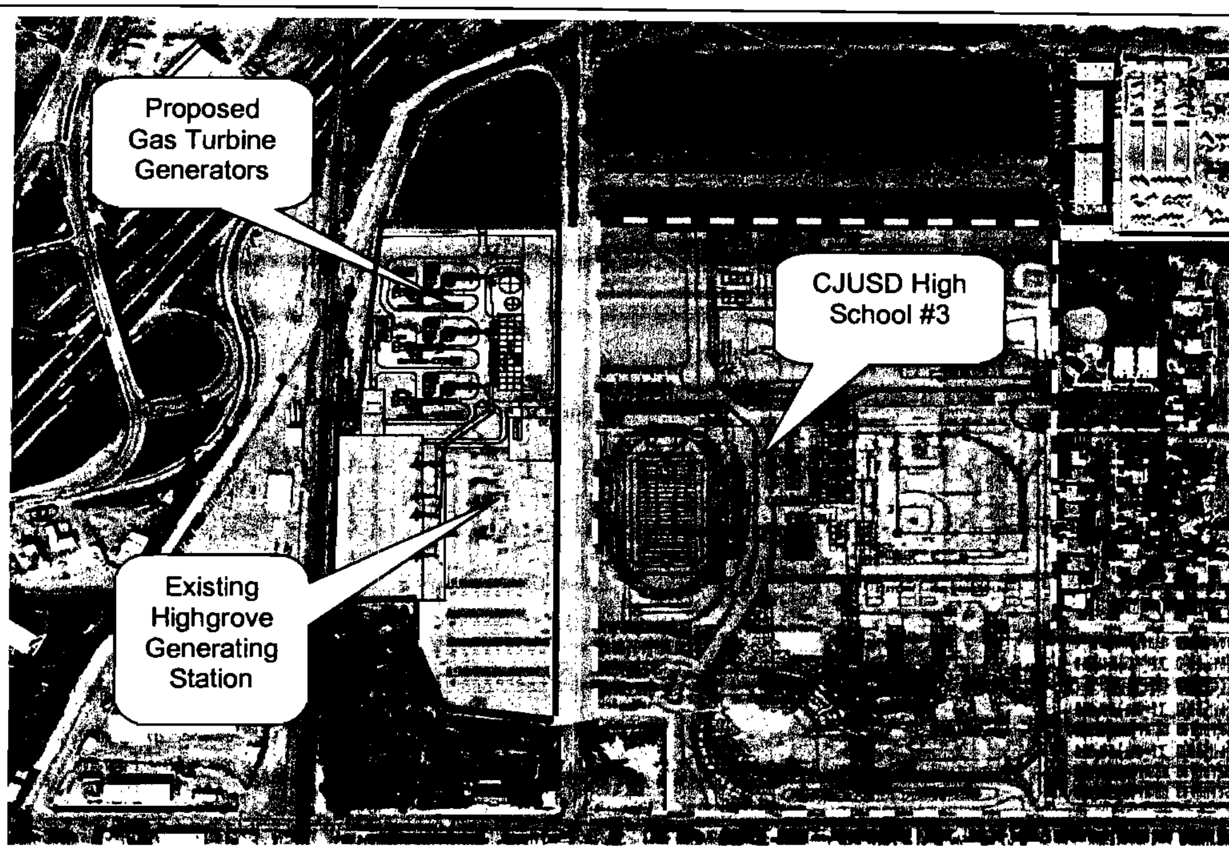

Figure 1-2. Location of the Proposed CJUSD High School and AES Highgrove Facility

The assessment which follows provides the following information:

1) An introduction to the climate, meteorology, and background air quality of the project region that affect the impact levels from the AES Highgrove emissions,
2) Quantification the air emissions from the operational activities of the facility,
3) Quantification of the resulting air quality and risk impacts from those facility emissions
4) Comparison of the calculated air quality and risk impacts with regulatory standards and limits established by the South Coast Air Quality Management District (SCAQMD), California Air Resources Board (CARB), and the US Environmental Protection Agency (USEPA).

2.0 Environmental Setting

Ambient air quality is affected by the rate and location of pollutant emissions and by meteorological conditions that influence the movement and dispersion of pollutants in the atmosphere. Atmospheric conditions such as wind speed, direction, atmospheric mixing, and temperature, along with local topography provide the link between air pollutant emissions and resulting air quality impacts.

2.1 Climate and Meteorology

AES Highgrove and CJUSD High School #3 site lie within the South Coast Air Basin, a 6,000 square mile area including the counties of Orange, Los Angeles, Riverside and the western portion of San Bernardino. The South Coast Air Basin traditionally lies within a semi-permanent high pressure weather zone present over the eastern Pacific. As a result, the climate is mild, relatively dry, and tempered by cool sea breezes. This usually mild climatic pattern is interrupted by occasional periods of extreme hot weather, winter storms, and Santa Ana wind conditions. Annual rainfall in the basin amounts to, on average, less than 15 inches per year with the "rainy" season lasting from October to March. Rain accumulations may also occur during the summer as a result of infrequent summer thunderstorms.

Pollutant dispersion is affected by the ability of the atmosphere to disperse pollutants in both the horizontal and vertical directions. With light average wind speeds and mountainous terrain along the basin's northern, western, and eastern boundaries, the South Coast Air Basin often times experiences periods of limited capacity to disperse air pollutants horizontally across the Basin. Typically, pollutants exit the basin through the Cajon Pass and Banning Pass at the eastern end of the basin, through the Grapevine at the western end of the basin, and, at night and during Santa Ana conditions, over the ocean. The average wind speed in the Los Angeles area is less than 5 miles per hour. The vertical dispersion of pollutants is often restricted by the presence of persistent elevated temperature inversions especially during the summer and fall months. High pressure systems over the region are characterized by an upper layer of dry air that warms as it descends, confining the movement of cooler marine air near the ground surface. This condition restricts the vertical dispersion of air pollutants released into the marine layer and, together with strong sunlight and light winds, produces photochemical smog.

Air patterns in the facility site area indicate that on average the most frequent winds are from west-southwest and west directions associated with the daily daytime sea breeze that moves air from the Pacific Ocean to the inland valleys. A secondary direction is indicated from the north-northeast and northeast associated with the daily land breeze which moves from the inland valleys to the Pacific Ocean at night. These patterns are shown in Figure 2-1 below.

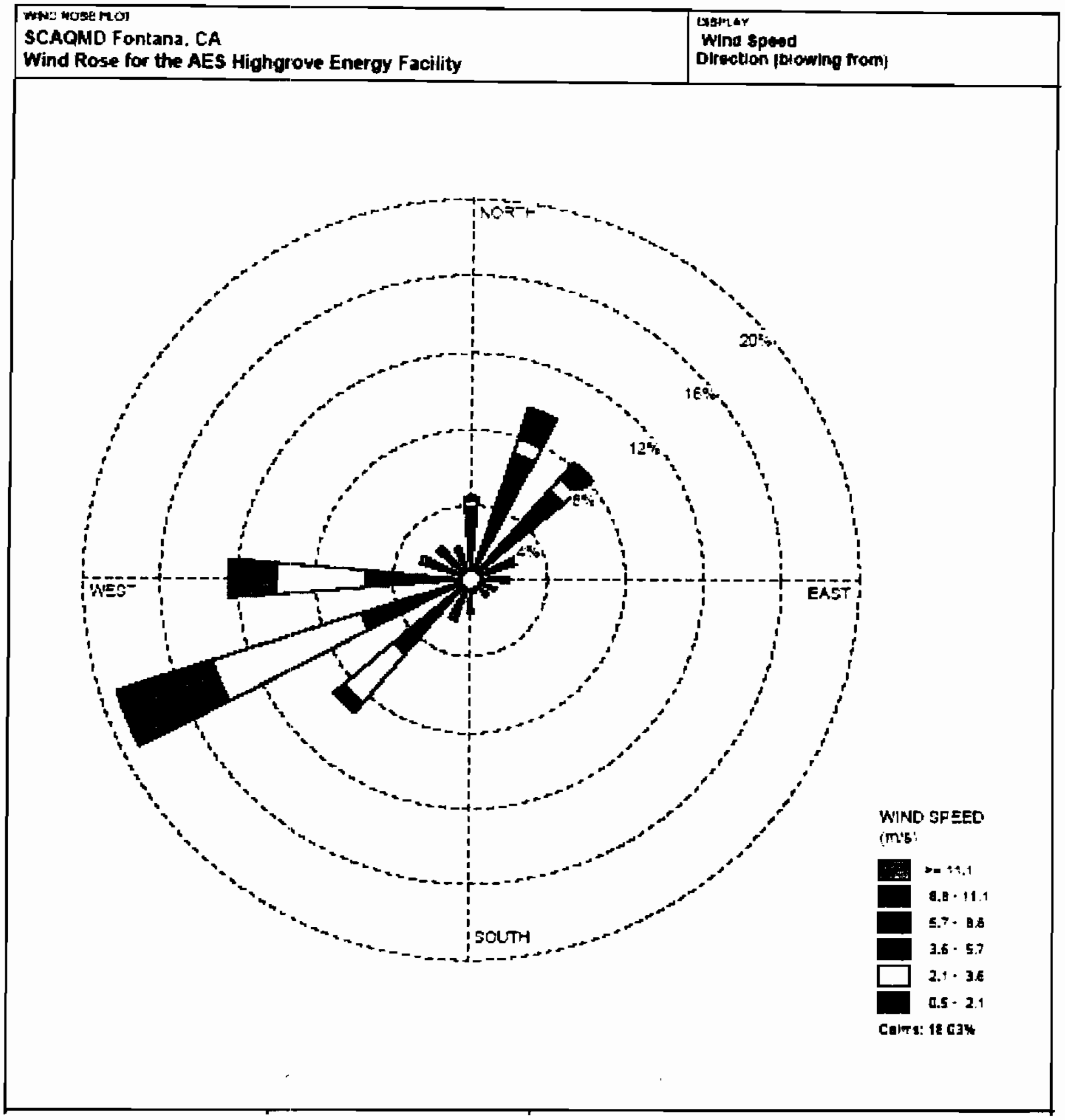

Figure 2-1 Wind Rose for the Project Site (SCAQMD Fontana station)

The average wind speed in the facility area is about 4 miles per hour.

2.2 Ambient Air Quality

Existing air quality within the vicinity of the proposed AES facility can be documented from the air monitoring conducted by the SCAQMD. The SCAQMD has an extensive air monitoring network which measures levels of several air pollutants throughout the basin. The SCAQMD has subdivided the basin into 38 source-receptors areas each containing one or more monitoring stations. These source-receptor areas have been designated to provide a general representation of the local meteorological and air quality conditions within the particular area.

The facility site is located within Source-Receptor area 34 and contains two monitoring stations: Fontana and San Bernardino.

Both the CARB and USEPA have established air quality standards which are designed to protect those individuals susceptible to respiratory distress such as asthmatics, the young, the elderly, and those with pre-existing health conditions that may be affected by increased pollutant concentrations. Generally, healthy individuals can tolerate occasional exposure to pollutants above these regulatory standards before adverse health effects are observed. However, recent research has shown that unhealthful respiratory responses occur with exposures to pollutants at levels that only marginally exceed clean air standards.

State and federal ambient air quality standards have been defined for six "criteria" pollutants whose standards are presented in Table 2-1.

Table 2-1
Federal and State Ambient Air Quality Standards

Air Pollutant	Federal Standards	State Standards	Relevant Health Effects
Ozone	>0.12 ppm (1hr avg.) >0.08 ppm (8hr avg.)	> 0.09 ppm (1hr avg.)	1) Pulmonary function decrements and localized lung edema. 2) Alterations in connective tissue metabolism and altered pulmonary morphology
Carbon Monoxide	>9.0 ppm (8hr avg.) (10,000 ug/m^3) >35.0 ppm (1hr avg.) (39,000 ug/m^3)	>9.0 ppm (8hr avg.) (10,000 ug/m^3) >20.0 ppm (1hr avg) (22,000 ug/m^3)	1) Aggravation of angina pectoris and other aspects of coronary heart disease 2) Decreased exercise tolerance in persons with peripheral vascular disease and lung disease 3) Impairment of central nervous system functions 4) Possible increased risk to fetus
Oxides of Nitrogen	>0.053 ppm (ann. Avg.) (100 ug/m^3)	>0.25 ppm (1hr avg.) (470 ug/m^3)	1) Potential to aggregate chronic respiratory disease and respiratory symptoms in sensitive groups. 2) Risk to public health implied by pulmonary and extra-pulmonary biochemical and cellular changes and pulmonary structural changes.
Oxides of Sulfur	>0.03 ppm (ann. avg.) (80/ug/m^3) >0.14 ppm (24hr avg.) (365 ug/m^3) >0.50 ppm (3hr avg.) (655 ug/m^3)	>0.25 ppm (1hr avg (328 ug/m$_3$) >0.04 ppm (24hr avg (105 ug/m^3)	1) Bronchoconstriction accompanied by symptoms which may include wheezing, shortness of breath and chest tightness during exercise or physical activity in persons with asthma.
Particulate Matter – 10 microns in diameter or less	>50 ug/m^3 (ann. avg.) >150 ug/m^3 (24hr avg.)	>20 ug/m^3 (ann. avg) >50 ug/m^3 (24hr avg)	1) Prevention of excess deaths from short-term exposures and exacerbation of symptoms in sensitive patients with respiratory disease. 2) Prevention of excess seasonal declines in pulmonary function especially in children.
Particulate Matter – 2.5 microns in diameter or less	>15 ug/m^3 (ann. avg.) >65 ug/m^3 (24hr avg.)	>12 ug/m^3 (ann. avg)	1) Prevention of excess deaths from short-term exposures and exacerbation of symptoms in sensitive patients with respiratory disease. 2) Prevention of excess seasonal declines in pulmonary function especially in children.

Abbreviations: ppm: parts per million; ug/m3: microgram per cubic meter; ann. avg.: annual average

Source: California Code of Regulations, Title 17, Section 70200

Table 2-2 provides the relevant air pollutant concentrations collected within Source-Receptor Area #34. based on a three-year summary covering the period from 2001-2003. Also shown in the table is a comparison with the most stringent ambient air quality standard for each air pollutant as taken from Table 2-1. The highest ambient air pollutant concentrations measured at either the Fontana and San Bernardino air monitoiring stations within Area #34 were used to characterize the air quality in the site area.

Table 2-2
Compliance with Ambient Air Quality Standards in SCAQMD
Source Receptor Area #34
(2001-2003)

Air Pollutant/ Averaging Time	Most Restrictive Air Quality Standards	Year			Meets Ambient Standards?
		2001	2002	2003	
Ozone (O_3)					
1-hour	0.09ppm	0.184 (56)	0.159 (43)	0.176 (65)	NO
8-hour	0.08ppm	0.144 (38)	0.123 (29)	0.148 (45)	NO
Carbon Monoxide (CO)					
1-hour	20ppm (23,000 ug/m^3)	4 (0) (4600 ug/m3)	5 (0) (5750 ug/m3)	5 (0) (5750 ug/m3)	YES
8-hour	9ppm (10,000 ug/m^3)	3.3 (0) (3795 ug/m3)	3.3(0) (3795 ug/m3)	4.5 (0) (5175 ug/m3)	YES
Nitrogen Dioxide (NO_2)					
1-hour	0.25ppm (470 ug/m^3)	0.13 (0) (244 ug/m3)	0.120 (0) (226 ug/m3)	0.117 (0) (220 ug/m3)	YES
Annual Mean	0.053ppm (100 ug/m^3)	0.036 (68 ug/m3)	0.033 (62 ug/m3)	0.030 (56 ug/m3)	YES
Sulfur Dioxide (SO_2)					
1-hour	0.25ppm (328 ug/m3)	0.01 (0) (13 ug/m3)	0.03 (0) (39 ug/m3)	0.01 (0) (13 ug/m3)	YES
24-hour	0.04ppm (105 ug/m3)	0.01 (0) (13 ug/m3)	0.01 (0) (13 ug/m3)	0.004 (0) (5 ug/m3)	YES
Annual	0.03ppm (80 ug/m3)	ND	ND	0.001 (1.3 ug/m3)	YES
Particulates (PM_{10})					
24-hour	50 ug/m^3	106 (57)	102 (56)	101 (27)	NO
Annual Mean	20 ug/m^3	51.7	50.4	44.9	NO
Particulates ($PM_{2.5}$)					
24-hour	65 ug/m^3	78.5 (4.5)	82.1 (3)	98.1 (1)	NO
Annual Mean	12 ug/m^3	24.8	24.3	22.2	NO

YES = meets federal and state ambient standards

NO = violates state or federal standards

Source: SCAQMD Annual Data Summaries, for the Fontana and San Bernardino air monitoring stations (the highest pollutant value was selected from these two locations) for 2001 - 2003

ND = no data reported

Values in parentheses represent the number of times the applicable standard was exceeded or percentage of samples for PM_{10} and $PM_{2.5}$

As shown in the table above, ozone and particulate matter levels currently violate the state and federal air quality standards in the facility area and as such the South Coast Air Basin has been designated by the CARB as "non-attainment" areas for these pollutants..

3.0 Regulatory Compliance

The proposed AES Highgrove facility will be required to comply with a number of rules, regulations, and guidelines as promulgated by the SCAQMD and the USPEA. For purposes of this assessment, focus was placed on examining the compliance requirements for SCAQMD Regulation XIII (New Source Review) which limits both the rate of emissions from a new facility as well as assesses the significance of the air quality impacts arising from those emissions and Regulation XIV (New Source Review for Toxic Air Contaminants) which limits the maximum cancer and noncancer risks from new sources emitting toxic air contaminants.

3.1 Regulation XIII – New Source Review

Regulation XIII and its attendant Rule 1300 series sets forth preconstruction requirements for new, modified, or re-located facilities to insure that the operation of these facilities does not interfere with progress in the attainment of the national and state ambient air quality standards. Regulation XIII places limits on emissions of those pollutants that cause or contribute to the exceedance of ambient air quality standards within an air basin. As indicated earlier, the South Coast Air Basin where the AES Highgrove facility is located has been designated by the CARB as non-attainment for ozone and PM_{10}. Such areas, therefore, are required to use Best Available Control Technology (BACT) to minimize air emissions as a necessary condition for gaining approval of any project.

For purposes of this assessment, the BACT requirements for gas turbines was based on the CARB's guidance as contained in the report "Guidance for Power Plant Siting and Best Available Control Technology" (CARB, 1999). A summary of the BACT requirements for gas turbines is provided in the table below. These requirements formed the basis for developing the emission estimates for the AES Highgrove facility as described in Section 4.

TABLE 3-1. Summary of BACT Requirements for Gas Turbines

NO_x	CO	VOC	PM_{10}/SO_x	NH_3
5 ppmvd @ 15% O_2, 1-hour rolling average	6 ppmdv @ 15% O_2, 1-hour rolling average	2 ppmdv @ 15% O_2, 1-hour rolling average	Exclusive use of PUC quality natural gas with max sulfur content of 1 grain per 100 cubic feet	5 ppmdv @ 15% O_2, 1-hour rolling average

Source: Guidance for Power Plant Siting and Best Available Control Technology" (CARB, 1999)

The BACT requirements shown in this table are consistent with the requirements set forth for other gas turbine peaker projects that have been approved in California by the California Energy Commisson since 2000. Even though ambient air quality levels in the South Coast Air Basin do not violate standards for NO_2, CO, and SO_2, BACT is still required for emissions of

NO_x, VOC, SO_x, and PM_{10} since NO_x and VOC emissions contribute to the ozone nonattainment, and NO_x, VOC, SO_x, and PM_{10} all contribute to the PM_{10} nonattainment in the South Coast Air Basin. In addition, it was also assumed that BACT would also be required for CO emissions in keeping with regulatory approval actions taken on similar gas turbine projects.

In addition to the BACT requirements, Regulation XIII also requires that there be an assessment through the use of air quality modeling to demonstrate that project emissions will not cause a significant increase in ground-level air quality concentrations in areas where ambient air quality standards are currently violated. The State CEQA Guidelines define a significant effect on the environment as "a substantial adverse change in the physical conditions which exist in the area affected by the proposed project." In order to determine whether or not the proposed facility would cause a significant effect on the environment, the impact of the facility must be determined by examining the types and levels of emissions generated and their impacts on factors that affect air quality. To accomplish this determination of significance, the SCAQMD has established air pollution thresholds against which a proposed project can be evaluated and assist lead agencies in determining whether or not the proposed project is potentially significant. Project-related emissions are considered to have a significant effect on the environment if they result in ambient air concentrations that either create a new violation of an ambient air standard or contribute to an existing air quality violation.

Table 3-2 outlines the relevant significance thresholds considered to affect the frequency and severity of an existing local air quality violation. Project-related impacts less than the indicated significance thresholds are not considered significant. If the lead agency finds that the proposed project has the potential to exceed these air pollution thresholds, the project impacts should be considered significant. These thresholds have been defined by SCAQMD for the South Coast Air Basin based on scientific data the SCAQMD has obtained and factual data within the federal and state Clean Air Acts.

Table 3-2
Allowable Change in Ambient Air Concentration In Areas Where Air Quality Standards are Violated

Air Pollutant	Averaging Time	Air Pollutant Concentration
Carbon Monoxide (CO)	8 Hours 1 Hour	0.45 ppm (500 ug/m^3) 1.0 ppm (1100 ug/m^3)
Nitrogen Dioxide (NO_2)	Annual 1 Hour	0.0005 ppm (1 ug/m^3) 0.01 ppm (20 ug/m^3)
Particulates (PM_{10})	Annual 24 Hours	1 ug/m^3 2.5 ug/m^3

Abbreviations: ppm: part per million; ug/m^3: micrograms per cubic meter
Source: SCAQMD Rule 1303, Table A-2

As shown earlier in Table 2.2 above, maximum background particulate matter concentrations (less than 10 microns in diameter) within the Source-Receptor Area containing the AES site may at times exceed the California or USEPA Ambient Air Quality Standards (AAQS). Therefore, a significant impact is achieved when project impacts produce a "measurable change" over existing background concentrations as indicated by the significance thresholds shown in Table 3-2 above. Maximum background concentrations for nitrogen dioxide (NO_2), carbon dioxide (CO), and sulfur dioxide (SO_2) do not exceed the applicable standards for these latter pollutants. As such, significance is achieved when project-related impacts add a "measureable change" to existing levels and create an exceedance of the AAQS for those pollutants.

3.2 Regulation XIV - New Source Review of Toxic Air Contaminants

Regulation XIV and its attendant Rule 1401 specifies limits for maximum individual cancer risk (MICR) as well as exposures that may cause acute and chronic noncancer risks for new, modified, or relocated equipment which emits toxic air contaminants (TAC). The rule applies to the emission of specified pollutants that are carcinogenic and well as noncarcinogenic compounts as listed by the California Office of Environmental Health Hazards Assessment (OEHHA). A risk assessment study is required for facilities that emit TACs contained in the OEHHA toxic compound listings to quantify potential cancer and noncancer risks.

The following requirements must be met before a permit can be granted for affected equipment

Table 3-3
SCAQMD Rule 1401 Health Risk Limits

Health Risk	Limit
MICR	• 1 in 1 million at any receptor location if constructed without T-BACT (*) • 10 in 1 million at any receptor location if constructed with T-BACT (*)
Cancer Burden	0.5
Chronic Hazard Index	1.0
Acute Hazard Index	1.0

Source: SCAQMD Rule 1401
T-BACT = Toxic Best Available Control Technology

Any project whose emissions exceed the above limits would be considered a significant emission source and be require to make public notification of same under SCAQMD Rule 212.

4.0 Air Emissions from AES Highgrove

From the information readily available, the AES Highgrove facility is to be comprised of 3-100MW single cycle natural gas-fired gas turbine generating units connected to three electric generators, one for each gas turbine. The nominal total electrical output is 300MW. Estimates of emissions for the AES Highgrove facility were derived from a review of the Indigo Energy Facility which began operation in 2001 north of Palm Springs. (SCAQMD, 2001). This energy facility is comprised of 3-45MW simple cycle gas turbines firing natural gas as its fuel. This particular facility was selected since its BACT-controlled pollutant emission rates are typical of number of other gas turbine projects that have been approved by the California Energy Commission since 2000. This facility was also approved under the SCAQMD Regulation XIII BACT requirements. As noted above, the size of the Indigo gas turbines is 45MW, about 50% of the size proposed for the AES Highgrove facility. It was necessary, therefore, to scale up the Indigo emission results to be representative of a 100MW unit size using the Indigo emission factors as a basis.

In order to meet the SCAQMD BACT requirements, the Indigo facility employs the following emission control requirements. These same requirements were assumed for the AES Highgrove facility.

- NO_X emission control: water or steam injection into the turbine combustors and application of a Selective Catalytic Reduction (SCR) technology with aqueous ammonia for post combustion control - minimum of 80% control through the SCR System

- CO and VOC emission control: oxidation catalyst technology post combustion control.- minimum of 90% CO emission control and 43% VOC control through the oxidation catalyst system

- SO_X and PM_{10} emission control: these pollutants are controlled through the use of natural gas and controlled levels of fuel sulfur content.

In computing the emissions that serve as input to the AES Highgrove air quality impact assessment, emissions were calculated for two operational modes:

- Full load normal operations, and
- Equipment startup/shutdown

4.1 Full Load Normal Operations

Using the emission data available for the Indigo project, the following full load normal operational emissions were calculated for the AES Highgrove facility as shown below.

TABLE 4-1
Criteria Pollutant Emission Rates for Indigo and AES Highgrove Facilities – Normal Operations
(per gas turbine unit)

	Indigo	**AES Highgrove**
Size (MW)	45	100
Controlled NO_x Emission Factor (lb/MMBTU)	0.0214	.0214
Controlled NO_x Emission Rate (lb/hr)	9.5	18.9
Controlled CO Emission Factor (lb/MMBTU)	0.0158	0.0158
Controlled CO Emission Rate (lb/hr)	7.0	13.9
Controlled VOC Emission Factor (lb/MMBTU)	0.0007	0.0007
Controlled VOC Emission Rate (lb/hr)	0.3	0.6
Controlled SO_x Emission Factor (lb/MMBTU)	0.0016	0.0016
Controlled SO_x Emission Rate (lb/hr)	0.7	1.4
Controlled PM_{10} Emission Factor (lb/MMBTU)	0.0074	0.0074
Controlled PM_{10} Emission Rate (lb/hr)	3.3	6.5

Source: SCAQMD, 2001: Permit To Construct, Indigo Energy Facility, Wildflower Energy L. P
Heat Rates: Indigo (443 MMBTU/hr) and AES Highgrove: (883 MMBTU/hr)

4.2 Startup/Shutdown Emissions

Compared to normal operations, pollutant emissions of NO_x, CO, and VOC are typically higher during equipment startup due to the fact that the gas turbines must attain a specified temperature prior to the engagement of the emission control systems. SO_x and PM_{10} emisisons would be expected to be highest at full load operations since emissions of these latter pollutants depend on the rate of fuel consumption which is highest at full load operations.

Startups begin with the turbine's initial firing and continue until the unit meets the emission control concentration limits. The duration of a startup varies from 15-20 minutes. 16 minutes was assumed in this assessment as shown in the Indigo Permit to Construct. The NO_x, CO, and VOC emissions will be uncontrolled for the first 10 minutes, and the NO_x emissions will be partially controlled to 25ppm for the next 6 minutes. After 10 minutes, the CO and VOC emissions will be controlled at or below the BACT levels, and after 16 minutes, the NO_x emissions will be controlled to at or below BACT levels.

Shutdowns begin with the initiation of the turbine shutdown sequence and end with cessation of turbine firing. A shutdown will last about 9-10 minutes from full load to zero emissions Turbine shutdowns will start with a hot catalyst and will be executed in a manner that will not result in operations with catalyst temperatures below the SCR threshold for an appreciable length of time. Shutdown emissions were be assumed to be equal to emissions during normal operations.

To provide conservative results for the air quality modeling assessment which follows in Section 5, the following assumptions were made:

Table 4-2
Emission Rates – Startups and Shutdowns

Number of startups per day	Variable (on average 1)
Number of startups per year	365
Startup duration: CO and VOC	10 minutes
Startup duration: NO_x	16 minutes
Number of shutdowns per day	Variable (on average 1)
Number of shutdowns per year	365
Shutdown duration	Approximately 10 minutes

The resulting emission estimates are provided in Table 4-3.

Table 4-3
Maximum Hourly AES Highgrove Emissions (Including Startup Emissions) (per gas turbine)

Pollutant	Maximum Hourly Emission Rate (lb/hr)
NO_x	29.3
CO	17.5
VOC	0.7
SO_x	1.4
PM_{10}	6.6

Daily emissions were computed assuming 24 hours of operation with the shutdown values in Table 4-3 lasting for 1 hour and the hourly emissions shown in Table 4-1 for normal operations lasting for the remaining 23 hours of the day.

The maximum daily emissions calculated for AES Highgrove are shown in Table 4-4

Table 4-4
Maximum Daily AES Highgrove Emissions (Including Startup Emissions) (per gas turbine)

Pollutant	Maximum Daily Emission Rate (lb/day)
NO_x	464
CO	338
VOC	15
SO_x	34
PM_{10}	157

Table 4-5 provides estimates of annual emissions which assumed the facility operates at the daily rates shown in Table 4-4 for all 365 days of the year. This is likely a conservative assumption in that the facility will not likely operate every day of the year for all hours of the day.

Table 4-5
Annual AES Highgrove Emissions (Including Startup Emissions)
(per gas turbine)

Pollutant	Annual Emissions (tons/year)
NO_x	85
CO	62
VOC	3
SO_x	6
PM_{10}	29

5.0 Air Quality Impact Assessment of the AES Highgrove Operational Emissions

This section analyzes the impacts of the operation of the AES Highgrove facility on the air quality of the area containing the CJUSD High School #3 site location. This analysis makes use of the emissions calculated from the operation of the facility as contained in Section 4, relevant meteorological data that influence the transport and dispersion of materials emitted into the atmosphere, and the use of a mathematical dispersion model to provide quantitative estimates of the AES facility impacts on air quality.

5.1 Dispersion Modeling

Atmospheric dispersion modeling was conducted to determine the 1-hour, 8-hour, 24-hour, and annual average concentrations of criteria air contaminants (CO, NO_x, SO_2, and PM_{10}) and a risk assessment of cancer risk and non-cancer risk associated with the pollutants emitted from the facility's emission sources. These concentration and risk estimates were then compared to the applicable air and risk standards and limits to determine the significance of those impacts.

The atmospheric dispersion modeling methodology used is based on generally accepted modeling practices and modeling guidelines of both the USEPA and the SCAQMD. All dispersion modeling was performed using the Industrial Source Complex Short Term 3 (ISCST3) dispersion model (Version 0235) (USEPA 2002). The risk assessment methodology was based on the information contained in reports by the SCAQMD, (SCAQMD, 2000).

5.1.1 Model Selection

As mentioned above, the dispersion modeling methodology used follows both USEPA and SCAQMD guidelines. The ISCST3 model (Version 0235) is an USEPA model used for simulating the transport and dispersion of emission sources in areas of simple, complex, and intermediate terrain. For purposes of this analysis, complex terrain was assumed. That is, the actual terrain incorporating the proposed AES Highgrove and High School #3 was incorporated into the assessment.

5.1.2 Modeling Options

The options used in the ISCST3 dispersion modeling are summarized in Table 5-1. USEPA regulatory default modeling options were selected, except for the calm processing option. Since the meteorological data sets developed by the SCAQMD are based on hourly average wind measurements, rather than airport observations that represent averages of just a few minutes, the SCAQMD's modeling guidance requires that this modeling option not be used.

Table 5-1

Dispersion Modeling Options for the ISC3 Model

Feature	Option Selected
Terrain processing selected	Complex Terrain
Emission Source Configuration	Point Source
Meteorological data input method	Card Image
Rural-urban option	Urban
Wind profile exponents values	Defaults
Vertical potential temperature gradient values	Defaults
Program calculates Gradual Plume Rise	Yes
Program adjusts all stack heights for downwash	No
Concentrations during calm period set = 0	No
Aboveground (flagpole) receptors used	No
Buoyancy-induced dispersion used	Yes
Year of surface data	1981(*)
Year of upper air data	1981(*)

(*) The SCAQMD has prepared a comprehensive meteorological database suitable for use in dispersion modeling analyses. This database was constructed using data from the year 1981 and is the standard database used for such purposes.

5.1.3 Meteorological Data

For purposes of this assessment, the meteorological data available from the SCAQMD Fontana station were used in the dispersion modeling analysis. In this dataset, the surface wind speeds and directions were collected at the SCAQMD's Fontana monitoring station, while the upper air sounding data used to estimate hourly mixing heights were gathered at Ontario International Airport (Upper Air Station No. 99999). Temperatures and sky observations (used for stability classification) were taken from Fontana and Ontario Airport data.

5.1.4 Air Quality Impact Receptor Network

Appropriate model receptors at which air quality impacts will be assessed must be selected to determine the worst-case modeling impacts. For this modeling assessment, a receptor modeling network was defined that encompassed the CJUSD High School #3 site location. This network was identified as the CJUSDHS3 Network and was centered over much of the high school site using a grid spacing of 10 meters. Figure 5-1 displays the CJUSDHS3 Network used in the air quality analysis.

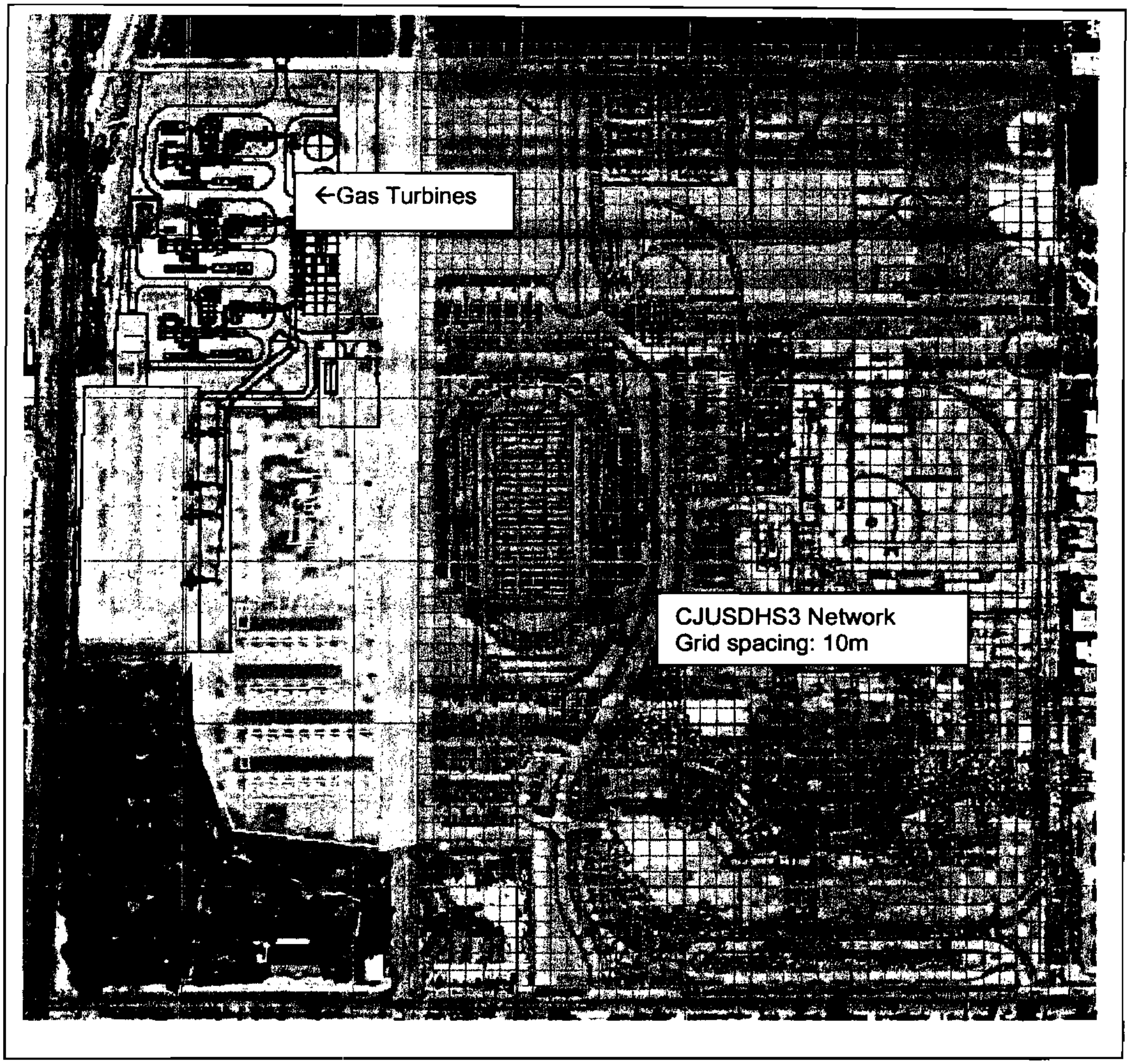

Figure 5-1. CJUSDHS3 Receptor Network for the AES Highgrove Facility Assessment

5.1.5 Source Parameters

Table 5-2 provides emission source parameters assumed in the air quality modeling calculations.

Table 5-2
AES Highgrove Emission Source Assumptions

Stack Height (m)	24.4 80'
Number of Stacks	3
Stack Gas Temperature (k)	850
Stack Gas Flow Rate (mps)	30
Stack Inside Diameter (m)	2,4
Hourly Emission Rates	Values in Table 4-3 were assumed to apply for hour 13 while the values shown in Table 4-1 apply for the remaining 23 hours (*); to be conservative all 3 turbines were assumed to startup at the same time (*)

(*) To maximize the impacts of startup emissions, the startup was assumed to take place during hour 13 since this hour was found to result in the highest 1-hour air quality impacts from the operation of the facility

5.2 Localized Air Quality Impacts

The dispersion modeling results and a determination of whether CO, PM_{10}, NO_2, and SO_2 operational emissions from the AES Highgrove facility exceed the air quality significance criteria are shown in Table 5-3 within the CJUSDHS3 receptor network (see Figure 5-1 above).

TABLE 5-3
Summary of Maximum Air Quality Impacts for the AES Highgrove Facility Within The CJUSDHS3 Network

Pollutant	Averaging Time	Facility Impact (ug/m3)	Background Air Quality (ug/m3)	Total Impact (ug/m3)	Limiting Standard (ug/m3) (***)	Facility Impacts Exceed Limiting Standard
NO_2	1-hour	28 ug/m^3 (*)	244 ug/m^3	272 ug/m^3	470 ug/m^3	NO
	Annual	2 ug/m^3 (**)	68 ug/m^3	70 ug/m^3	100 ug/m^3	NO
CO	1-hour	17 ug/m^3	5750 ug/m^3	5767 ug/m^3	23,000 ug/m^3	NO
	8-hour	8 ug/m^3	5175 ug/m^3	5183 ug/m^3	10,000 ug/m^3	NO
SO_2	1-hour	2 ug/m^3	39 ug/m^3	41 ug/m^3	328 ug/m^3	NO
	24-hour	0.4 ug/m^3	13 ug/m^3	13 ug/m^3	105 ug/m^3	NO
	Annual	0.1 ug/m^3	1.3 ug/m^3	1.4 ug/m^3	80 ug/m^3	NO
PM_{10}	24-hour	1.6 ug/m^3	106 ug/m^3	107.6 ug/m^3	2.5 ug/m^3	NO
	Annual	0.5 ug/m^3	52 ug/m^3	52.5 ug/m^3	1 ug/m^3	NO

(*) Assumes 100% NO_x converted in the atmosphere to NO_2
(**) Results obtained using the Ambient Ratio Method (ARM) default value of 0.75 (USEPA)
(***) For NO_2, CO, and SO_2, the limiting standards are the most restrictive ambient air quality standard for that pollutant and averaging time; for PM_{10} the limiting standards are the SCAQMD Regulation XIII limits

As shown in Table 5-3 above, the operation of the AES Highgrove facility is not expected to exceed any limiting ambient air quality criteria pollutant standards within the CJUSDHS3 Network which contains the proposed high school project area. Note that in the case of PM_{10}, the limiting standards are the SCAQMD Regulation XIII significance limits (see Table 3-2 above) since the PM_{10} ambient air quality standards are exceeded in the South Coast Air Basin. In this case, the incremental impacts from the facility must be less than 2.5 ug/m^3 for 24-hour average impacts and 1 ug/m^3 for annual average impacts in order for the facility emissions to be considered not significant. Table 5-3 indicates that the predicted PM_{10} impacts do not exceed these significance criteria.

6.0 Health Risk Assessment

6.1 Toxic Air Contaminant Emission Estimates

In addition to the assessment of ambient air quality impacts from AES Highgrove facility operations in relation to ambient air quality standards for criteria pollutants, an additional assessment was made of the health risks associated with the toxic air contaminant (TAC) emissions from the facility's operations in accordance with the SCAQMD's Regulation XIV Rule 1401 specifies limits for maximum individual cancer risk (MICR), cancer burden, and noncancer acute and chronic hazard indices (HI) from new permit units which emit toxic air contaminants. For purposes of this analysis, the health risks associated with the emissions from the AES Highgrove facility were estimated for activities within CJUSDHS3 Receptor Network – the geographical area are where students would be present at the proposed high school.

To determine whether the proposed AES Highgrove facility would be in compliance with the requirements of Rule 1401. a health risk assessment of TAC emissions from the AES Highgrove facility was conducted. The first step in the evaluation was to estimate emissions of TACs from the facility operations. The second step in the assessment was to estimate the maximum impacts within the CJUSDHS3 Receptor Network associated with the TAC emissions using air quality modeling. The final step in the assessment was to compare the estimated health risks associated with exposure to the maximum concentrations of TACs predicted for the facility's emissions with applicable exposure limits..

The AES Highgrove facility is proposed to be fired exclusively with natural gas. TAC emission factors for gas turbines were obtained by reviewing relevant databases for turbines firing natural gas. To estimate emissions of organic compounds from natural gas combustion, the USEPA's AP-42 emission factors (AP-42, Section 3-1, Stationary Gas Turbines, Table 3.1-3) were used. Table 5-5 provides estimated TAC emissions from the AES Highgrove facility.

It is believed that the emission factors from AP-42 are conservative because they were derived from tests for natural gas combustion in uncontrolled gas turbines. The gas turbines will have to be equipped with SCR and oxidation catalyst technologies in order to comply with BACT requirements. The oxidation catalyst will reduce the emissions of all organic compounds as well as CO and VOCs.

Table 5-5
Toxic Air Contaminant Emissions from the AES Highgrove Facility
(Total Foe All Three Turbines)

TAC	Emission Factor (lb/MMBtu)(*)	Maximum Hourly Emissions (lb/hr)(**)	Annual Emissions (lb/yr)(***)
Ammonia	5ppm Slip	7.8E-00	205000
Acetaldehyde	4.0E-05	1.06E-01	928
Acrolein	6.4E-06	1.69E-02	148
Benzene	1.2E-05	3.18E-02	278
1,3-Butadiene	4.3E-07	1.14E-03	10
Ethylbenzene	3.2E-05	8.47E-02	742
Formaldehyde	7.1E-04	1.88E-00	16500
Napthalene	1.3E-06	3.44E-03	30
PAHs	2.2E-06	5.82E-03	51
Propylene Oxide	2.9E-05	7.68E-02	673
Toluene	1.3E-04	3.44E-01	3020
Xylenes	6.4E-05	1.69E-01	1480

(*) Source: USEPA AP-42, Section 3.1, Stationary Gas Turbines, Table 3.1-3
(**) Assumes a heat input of 883 MMBTU/hr for each 100MW gas turbine as provided by CJUSD
(***) Conservatively assumes the facility operates 8760 hours per year

6.2 Health Risk Assessment - Methods

To estimate the potential health risks associated with exposure to TACs emissions emitted from the AES Highgrove facility, it was necessary to estimate concentrations of TACs within the area covering the school (CJUSDHS3 Receptor Network). The dispersion modeling approach used to estimate maximum concentrations for the risk assessment is the same as that used to derive local air quality impacts described earlier in Section 5 above. Health risk assessments were then calculated for excess cancer risks, chronic non-cancer risk (Chronic Health Index), and acute non-cancer risk (Acute Health Index) as prescribed in SCAQMD, 2000.

For this purpose, the source emission rate used in the health assessment was assumed to be 1 gm/sec. As a result, the predicted concentration at each receptor location is a dilution factor, X/Q, or a predicted concentration per 1 gm/sec of emission.

6.2.1 Excess Cancer Risk

For each TAC, cancer risk is estimated as follows:

$$\text{Excess Cancer Risk} = \Sigma [(X/Q) \times (Q) \times (URF) \times MP \times LEA] \qquad \text{(Eq 6-1)}$$

where:

Excess Cancer Risk: represents the number of excess cancers per million people per microgram per cubic meter of TAC concentration over a 70-year lifetime exposure; the calculated risk is the sum of the risks calculated from the individual TACs

X/Q: the maximum annual average dilution factor representing the predicted annual average concentration per unit emission which in this case is an emission rate of 1 gm/sec

Q: annual average emission rate for a TAC in units (gm/sec)

URF: Unit risk factor $(ug/m^3)^{-1}$

MP: Multi=pathway Adjustment Factor

LEA: Lifetime Exposure Adjustment Factor (assumed equal to one for the student population)

For multi-pathway pollutants, in this case PAHs, a multi-pathway factor was included in the risk calculations to account for the potential for multi-pathway health effects (ie., effects due to oral exposure and routes other than inhalation). The multi-pathway factor of 12.7 was assumed based on the factor for benzo(a)pyrene which is a major component of PAHs (SCAQMD, 2000, California OEHHA, 2003).

6.2.2 Chronic Health Index

The chronic health index was calculated as follows:

*Chronic HI – Σ [(X/Q) x (Q) * MP / REL]* *(Eq 6-2)*

where:

X/Q: the maximum annual average dilution factor representing the predicted annual average concentration per unit emission which in this case is an emission rate of 1 gm/sec

Q: annual average emission rate for a TAC (gm/sec)

MP: Multi=pathway Adjustment Factor

REL = Chronic Relative Exposure Level (ug/m^3)

The total Chronic Health Index is the sum of the health index calculated for each TAC

6.2.3 Acute Health Index

The acute health index was calculated as follows:

Acute Health Index = Σ [(X/Q) x Q / REL] *(Eq 6-3)* where:

X/Q: the maximum hourly average dilution factor representing the predicted 1-hour average concentration per unit emission which in this case is an emission rate of 1 gm/sec

Q: Maximum 1-hour average emission rate for a TAC (gm/sec)

REL = Acute Relative Exposure Level (ug/m^3)

The total Acute Health Index is the sum of the health index calculated for each TAC

6.2.4 Toxicity Values for TACs

The State of California OEHHA has published a listing of the toxicity values (URF and REL) for numerous TACs. Table 6-1 provides the relevant toxicity values for the gas turbine TACs identified above along with the target organs exposed.

Table 6-1
Toxicity Values for Gas Turbine TAC Emissions

TAC	URF (ug/m3)-1	Chronic REL (ug/m3)	Chronic Target Organ(s) (*)	Acute REL (ug/m3)	Acute Target Organ(s) (*)
Ammonia	N/A	200	RES	3200	RES,EYE
Acetaldehyde	2.7E-06	9	RES	N/A	
Acrolein	N/A	.06	RES,EYE	0.19	EYE,RES
Benzene	2.9E-05	60	CNS,REP,CV	1300	REP
1.3-Butadiene	1.7E-04	N/A	REP	N/A	
Ethylbenzene	N/A	2000	REP,LIV,KID	N/A	
Formaldehyde	6.00E-06	3	RES,EYE	94	EYE,RES
Napthalene	N/A	9	RES	N/A	
PAHs	1.1E-03	N/A		N/A	
Propylene Oxide	3.7E-06	30	RES	3100	RES,EYE,REP
Toluene	N/A	300	CNS,RES,REP	37000	CNS,RES,EYE
Xylenes	N/A	700	CNS,RES	22000	RES,EYE

Source: URF (OEHHA, 8/2004), Chronic REL (OEHAA, 2/2005), Acute REL (OEHHA, 5/2000)
(*) RES= respiratory system, CV=cardiovascular system, CNS=central nervous system, KID=kidney, LIV=liver, alimentary system, REP=reproductive system, developmental system, EYE=eyes
N/A = not applicable

6.3 Health Risk Assessment Results

The results of the health risk assessment are presented in table 6-2.

Table 6-2
Results of Health Risk Assessment
CJUSDHS3 Receptor Grid

	Risk Estimate	Rule 1401 Limits
Excess Cancer Risk	2.58 in 1 million	10 in 1 million
Chronic Hazard Index	0.03	1
Acute Hazard Index	0.05	1

The results of this assessment indicate that the TAC emissions from the operation of the AES Highgrove facility are not expected to exceed the Regulation XIV risk limits. Note that the BACT control technologies to be applied to this project do represent the Toxic Best Available Control Technology and thus the excess cancer risk limit of 10 in 1 million was used as the limiting standard.

7.0 Representativeness of the Assessment Results

During the progress of this assessment, several assumptions were employed to insure that the results were conservative, that is, overstating the levels of impacts and providing worst case estimates of those impacts. These assumptions were contained in several of the assessment steps as follows:

Emission Assumptions

1) The facility was assumed to operate at full load capacity, 365 days per year
2) Startup emissions were assumed to last for one hour and occur every day of the year
3) All three gas turbines were assumed to undergo startup during the same hour at the same time
4) The hour of the day during which the startup was to occur was assigned to 3pm in the afternoon as this hour was the time of day when the air quality impacts for the gas turbines were at their maximum
5) TAC emissions were estimated using gas turbine emission factors for operations on natural gas with no emission controls employed as per the USEPA AP-42 emission factors

Air Quality Modeling Assumptions

1) For the short-term averaging time periods, ie., 1-hour, all of the NO_x emitted by the facility was assumed to be instantaneously converted in the atmosphere on NO_2
2) The excess cancer risk assumed an exposure over 70 years, 24hours per day, 365 days per year. Actual exposures to students will be only during the 4 years and 8 hours per day while attending school
3) The selection of the location of the maximum air quality and health risk impacts was made regardless of whether any student was actually present at that location within the school area modeled in the assessment.
4) The maximum background air quality levels were added to the impacts from the facility emissions even though the meteorological conditions that cause the highest background levels may be completely different than those causing maximum impacts from the facility emissions and moreover the background and facility impacts can occur at different times of the day as well.

8.0 References

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