Air Quality Appendix B-2
for
Sempra Energy Resources
Termoeléctrica de Mexicali Power Project

APPENDIX B-2: SER AIR QUALITY MODELING ANALYSIS

An air dispersion modeling analysis was performed to estimate the off-site, ground-level ambient air concentrations of particulate matter (PM_{10}, comprised of airborne particles less than or equal to 10 microns in aerodynamic diameter), nitrogen dioxide (NO_2) and carbon monoxide (CO) resulting from the proposed combined cycle Termoeléctrica de Mexicali (TDM) plant located in Mexicali, Mexico.

In addition, one of the considerations that should be made in order to determine whether a pollution control project is considered environmentally beneficial, is to evaluate if potential emissions of hazardous pollutants meet existing rules or pose a threat to human health and welfare. To address this issue, an air dispersion modeling analysis was performed to estimate the off-site, ground-level ambient air concentrations of potential hazardous air pollutants (HAPs). Results of the analysis are compared with the U.S. EPA Reference Exposure Levels (RELs) and Unit Risk Factors (URFs) as indication of the potential health effects associated with the potentially hazardous air pollutants.

This section describes the modeling methodology, including the assumptions, the dispersion model, and the model input parameters that were used. The modeling methodology is based on the U.S. EPA's Guideline on Air Quality Models (incorporated as Appendix W of 40 CFR 51) and uses an U.S. EPA-approved air dispersion model.

I. AIR DISPERSION MODELING METHODOLOGY

The U.S. EPA 1999 Guideline on Air Quality Models (GAQM) specifies the use of the U.S. EPA Industrial Source Complex Short Term (ISCST3) model for computing downwind pollutant concentrations. If the highest predicted concentrations from the analysis are within the range of acceptable criteria, then it can be reasonably assumed that the actual concentrations are well within the acceptable criteria.

The ISCST3 model, described in "Appendix B: BCP Air Quality Modeling Analysis" was used to predict the ground-level ambient air concentrations of PM_{10}, NO_2, CO, and air toxics resulting from the proposed combined cycle TDM plant.

I.1 Model Input Parameters

The ISCST3 model requires source specific stack parameters as input to the model. These parameters include stack height, stack diameter, flue gas exit temperature, volumetric flow, and pollutant emission rate. Additional site-specific input parameters include building dimensions for the dominant building producing downwash and characterization of the surrounding terrain. Terrain elevation input to the model is discussed in subsection I.2. Both heat recovery steam generators (HRSG) were modeled to determine cumulative impacts. Table B-2.1 presents the stack parameters based on operation of both HRSGs.

I.2 Terrain

Modeling runs were performed with both simple terrain only and complex terrain only. Simple terrain does not take terrain elevations into consideration. Complex terrain allows for elevated terrain height. The terrain elevations used as input into the ISCST3 model were taken from a digital elevation map of the proposed site location. Modeling receptor locations were determined by using a multi-tier grid with different tier spacing. The grid was defined according to the 1998 U.S. EPA Office of Solid Waste (OSW) Human Health Risk Assessment Protocol (HHRAP) and the 1999 U.S. EPA OSW Screening Level Ecological Risk Assessment Protocol (SLERAP). The grid is defined by two tiers. The first tier is a 100-meter spaced grid from the centroid of the emission sources out to a radius of 3 km. The second tier is a 500-meter spaced grid extending from 3 km to 10 km.

I.3 Meteorology

The ISCST3 model was run using two years (1997 and 1998) of meteorological data from the four California Air Resources Board (CARB) Monitoring Stations located in Mexicali, Mexico. It was necessary to use four stations in order to obtain all of the required parameters for the modeling analysis, as none of the meteorological monitoring sites had a complete set of data. Specifically, the most complete set of data was used as the basis for the meteorological data set, and was augmented, where necessary, with data from the other three stations. Site specific meteorology is a key determinant in the identification of potential impacts. The analysis takes into account hourly wind data (i.e., direction and velocity) for each hour of the year and computes 24-hour concentrations for PM_{10}, and annual concentrations for PM_{10} and air toxics. Hourly concentrations for CO, NO_2, and air toxics and 8-hour concentrations for CO were also calculated.

II. RESULTS

The ISCST3 air dispersion model was used to perform an air dispersion analysis to estimate the off-site, ground-level ambient air concentrations of PM_{10}, NO_2, CO and air toxics resulting from the proposed combined cycle Termoeléctrica de Mexicali plant. Ground-level concentrations were determined, based on the simultaneous operation of both HRSGs at full load operation, when firing natural gas. The output data from the air dispersion modeling analysis are attached to the end of this Appendix and the results are summarized in Table B-2.2 with the applicable thresholds.

Table B-2.1
MODELING INPUT PARAMETERS [a]

Parameter	HRSG1	HRSG2
Stack Height (m)	51.8	51.8
Stack Diameter (m)	5.5	5.5
Exit Temperature (°C)	87	87
Stack Outlet Flow (m^3/hr)	1,711,200	1,711,200
Criteria Pollutant Emission rates (kg/hr)		
PM_{10}	12.3	12.3
NO_2	9.7	9.7
CO	9.4	9.4
Non-criteria Pollutant Emission Rates (kg/hr)[b]		
Acetaldehyde	0.061	0.061
Ammonia	14.3	14.3
Benzene	0.013	0.013
1,3-butadiene	0.00013	0.00013
Formaldehyde	0.010	0.010
Hexane	0.22	0.22
PAHs	0.00043	0.00043
Toluene	0.065	0.065
Xylene	0.022	0.022
Cyanide	0.000039	0.000039
Mercury	0.00000039	0.00000039

Downwash Building Dimensions

Building	Building Height (m)	Min. Horizontal Dimension (m)	Max. Horizontal Dimension (m)
HRSG	32.0	7.3	48.2
Cooling Tower	17.7	32.9	113
Control Building	4.0	22.0	27.5
Warehouse	7.0	18.0	28.0
Service Water/Fire Water Storage Tank	13.1	36.6 (diameter)	--
Combustion Turbine, ea.	18.6	14.6	31.7
Steam Turbine	17.1	14.0	32.6
Administration Building	4.0	22.0	22.0

[a] *All stack parameters are based on maximum load operation.*
[b] *Non-criteria pollutant emissions based on Ca Air Toxic Emission Factor (CATEF) Database, Ca Air Resources.*
Source: PCR Services Corporation, April 2001.

II.1 Comparison of Concentrations with Criteria Pollutant Standards

Modeling results and a comparison to Mexico's national air quality standards are summarized in Table B-2.2. The results indicate that the maximum project impacts are predicted to range from 0.09 to 7.1 percent of the applicable Mexican air quality standards for

Table B-2.2

RESULTS OF THE AIR DISPERSION MODELING ANALYSIS
COMPARED TO MEXICO AMBIENT AIR QUALITY STANDARDS

	Predicted Impacts and Thresholds				
Averaging Period	**Mexico National Standard**	**Project Peak Complex Terrain**	**% of Mexico Standard**	**Project Peak Simple Terrain**	**% of Mexico Standard**
MAXIMUM CONCENTRATIONS					
PM_{10}					
24-hour	150 µg/m3	7.17 µg/m3	4.78	1.212 µg/m3	0.81
Annual	50 µg/m3	0.75 µg/m3	1.50	0.0475 µg/m3	0.10
CO					
8-hour	11 ppm	0.010 ppm	0.09	0.0022 ppm	0.02
8-hour		11.51 µg/m3		2.54 µg/m3	
NO_2					
1-hour	0.21 ppm	0.015 ppm	7.14	0.00519 ppm	2.47
1-hour		27.47 µg/m3		9.76 µg/m3	
Annual		0.588 µg/m3		0.037 µg/m3	
MAXIMUM BORDER AND NORTH OF THE BORDER CONCENTRATIONS					
PM_{10}					
24-hour	150 µg/m3	1.198 µg/m3	0.79	0.885 µg/m3	0.59
Annual	50 µg/m3	0.114 µg/m3	0.23	0.038 µg/m3	0.076
CO					
8-hour	11 ppm	0.0019 ppm	0.02	0.00097 ppm	0.0088
8-hour		2.16 µg/m3		1.12 µg/m3	
NO_2					
1-hour	0.21 ppm	0.003 ppm	1.43	0.0019 ppm	0.90
1-hour		6.00 µg/m3		3.48 µg/m3	
Annual		0.0899 µg/m3		0.030 µg/m3	

Source: PCR Services Corporation, September 2001.

complex terrain and less than 2.5 percent of the standards for simple terrain. Therefore, this analysis has demonstrated that the project meets Mexico's air quality requirements. Figures B6 through B8 provide a graphic presentation of the modeling results with complex terrain. Peak concentrations for the annual averaging period occur approximately 5 kilometers to the northwest, and peak concentrations for 1-hour averaging period occur approximately 3 kilometers to the southwest. Both 8-hour and 24-hour concentrations occur approximately 4 kilometers due west of the project site. Table B-2.2 also presents maximum concentrations to be experienced at the International Border between the United States and Mexico.

II.2 Comparison of Maximum Air Pollutant Increases to Significance Levels (SLs)

The regulatory jurisdiction of the U.S. EPA does not pertain to air pollutant emissions in Mexico; nevertheless, a useful benchmark in U.S. EPA air permitting regulations and permitting guidance can be drawn upon to help assess the significance of these predicted increases from Mexican sources at the U.S. border and points north. In the context of permitting a major source or major modification in the U.S., the U.S. EPA has established significance levels (henceforth SLs) for the criteria pollutants NO_2, SO_2, and PM_{10} below which a major source or modification will not be considered to cause or contribute to a violation of a National Ambient Air Quality Standard (NAAQS) at any locality that does not meet NAAQS *(40 CFR 51.165)*. In addition, U.S. EPA permitting guidance describes the impact area required air quality analysis to be a geographical area that exceeds these SLs. Where air dispersion modeling is performed, the U.S. EPA does not require a full impact analysis when emissions of a pollutant from a proposed source or modification would not increase ambient concentrations by more than these prescribed SLs. Thus SLs may be generally regarded as thresholds of impact below which impact is not viewed to be significant.

Table B-2.3 presents the maximum air pollutant increases predicted by the ISCST3 complex terrain algorithm compared to U.S. EPA SLs.

Table B-2.3 Comparison of Maximum Air Pollutant Increases to SLs

Pollutant	Averaging Period	Significance Level (SL)	Concentration Increase at U.S. Receptors*
Nitrogen dioxide	1-hour	N/A	6.00 $\mu g/m^3$
Nitrogen dioxide	Annual	1.0 $\mu g/m^3$	0.09 $\mu g/m^3$
Carbon monoxide	8-hour	500 $\mu g/m^3$	2.16 $\mu g/m^3$
Particulate matter	24-hour	5.0 $\mu g/m^3$	1.12 $\mu g/m^3$
Particulate matter	Annual	1.0 $\mu g/m^3$	0.11 $\mu g/m^3$

As can be seen from the table, the ISCST3 air dispersion modeling analysis demonstrates that TDM's air quality impacts at the international border are below U.S. EPA SL values. Impacts further away from the international border and thus further away from the TDM facility would be lower than those along the border.

II.3 Potential Health Effects

Health effects resulting from exposure to toxic air contaminants can be categorized as either carcinogenic (cancer-causing), or non-carcinogenic. Health effects from carcinogenic air toxics are usually described in terms of individual cancer risk. "Individual cancer risk" is the likelihood that a person exposed to concentrations of toxic air contaminants (TACs) over a 70-year lifetime will contract cancer, based on the use of standard risk assessment methodology. These cancer risks are based on the best estimates of plausible cancer potencies as determined by industry standards. When exposure to more than one potential carcinogen is evaluated, the risks posed by the various individual air toxics are summed; this sum is the overall cancer risk estimate.

Non-carcinogenic health effects associated with air toxics vary depending on the types and quantities of air toxics exposure. Adverse effects on health, as well as the potential for nuisance and other forms of irritation, depend largely on the susceptibility of the individual, and are evaluated for two different periods of exposure: acute (short-term exposure) and chronic (long-term exposure). Non-cancer health effects (both acute and chronic) are considered by comparing estimated exposure levels to known or estimated thresholds (termed "reference exposure levels" or RELs).

For health risk assessments, computer modeling is carried out to determine the magnitude and location of the highest estimated ground-level concentrations of TACs emitted from the facility. The hypothetical maximum exposed individual (MEI), whose exposure is used to evaluate the worst-case exposure level, would be located at this point. In residential areas, this MEI is assumed to be exposed to TAC emissions for 24 hours per day, 365 days per year, for 70 years. These levels of exposure are highly unlikely in actual situations, and are typical of standard conservative health risk assessment assumptions.

For carcinogens, the health risk at the MEI receptor is expressed as ten chances in a million that an individual would contract cancer if he or she were exposed to the estimated concentration for 70 years. Health risks associated with exposure to carcinogenic compounds from a facility can be defined in terms of the probability of developing cancer as a result of exposure to a chemical at a given concentration. The cancer risk probability is determined by multiplying the chemical's annual concentration by its carcinogenic potential or unit risk factor (URF). The URF is a measure of the carcinogenic potential of a chemical when a dose is received through the inhalation pathway. It represents an upper bound estimate of the probability of contracting cancer as a result of continuous exposure to an ambient concentration of one microgram per cubic meter ($\mu g/m^3$) over a 70-year lifetime.

An evaluation of the potential non-cancer effects of chemical exposures was also conducted. For non-cancer health effects, the potential for human health hazards is evaluated by calculating ratios, also know as hazard indices, which compare the estimated level of exposure for various substances to reference doses. Reference doses for non-cancer contaminants are levels established by the scientific community and by governmental agencies responsible for protecting human health. Reference doses for some substances are based on observed effects on laboratory animals. The reference doses for humans are usually based on calculations, in which a 100-fold safety factor is applied to "no observed effects level" (NOEL). When the ratio of the estimated concentration to the reference dose is less than 0.5, no health effect would be anticipated. In a conservative analysis, the ratios for the various substances considered are added together to obtain a "hazard index," which, when less than 0.5, would indicate no health effect.

The analysis of project related health impacts was performed for potential acute, chronic and cancer health effects. Maximum emission rates of hazardous air pollutants, also referred to as non-criteria pollutants, that could be potentially emitted during operation of the proposed project are presented in Table B-2.2. The HAPs were modeled to determine their maximum potential ground level concentration for both the 1-hour and annual averaging period. The 1-hour concentration was then compared to the relevant reference exposure levels (RELs) to determine potential acute health effects.

III. CONCLUSIONS

The project will not cause substantial increases in any of the modeled pollutants in comparison to their relative standards. The project related maximum ambient increase is only 7 percent for the maximum 1-hour NO_2 concentration, and substantially smaller for all other pollutants and averaging periods. Predicted increases of air pollutants are less than U.S. EPA significance levels that can be viewed as benchmarks below which impact is not considered significant. Project related health effects for cancer risk, and both acute and chronic health effects, are substantially below their relative thresholds of 10 in 1 million, 0.5 and 0.5, respectively. Therefore, the proposed project will not have a substantial impact on ambient pollutant concentrations, nor is it expected to pose a significant health impact on the region surrounding the project site.