APPENDIX C

METHODOLOGY FOR ESTIMATING THE POTENTIAL HEALTH IMPACTS FROM DIESEL TRUCK IDLING OPERATIONS

Methodology

This appendix presents the methodology used to estimate the potential cancer risk from exposure to diesel particulate matter (diesel PM) from diesel truck engine idling operations. This methodology was used to assist in the development of the proposed *Airborne Toxic Control Measure for Measure to Limit Diesel-Fueled Commmercial Motor Vehicle Idling.* The assumptions used to determine the potential cancer risks are not based on diesel truck engine idling at a specific location, rather a generic (i.e. example) operating scenario was used. The source parameters selected include a broad range of possible operating scenarios. The estimated risks provide an approximate range of potential risk levels from diesel truck engine idling operations.

The methodology used in this risk assessment is consistent with the Tier-1 analysis presented in the OEHHA Air Toxics Hot Spots Program Risk Assessment Guidelines: The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments (OEHHA, 2003). The OEHHA guidelines and this assessment utilize health and exposure assessment information that is contained in the Air Toxics Hot Spot Program Risk Assessment Guidelines, Part II, Technical Support Document for Describing Available Cancer Potency Factors (OEHHA, 2003) and Part IV, Technical Support Document for Exposure Analysis and Stochastic Analysis (OEHHA 2000).

The cancer health risk estimates provide a "qualitative" assessment of the potential impacts due to the operation of idling diesel truck engines. The cancer health risk estimates for a particular location will depend on actual site specific parameters, including number of diesel truck engines idling at a location, diesel particulate emission rates, location of idling trucks in relation to other idling truck engines, and site meteorology. Risk will also vary depending on the distance a receptor is from the location of the idling truck engines, the duration of exposure, type of receptor (residential or worker), and the inhalation rate.

A. Source Description

Potential cancer health risks due to diesel truck engine idling result from emissions of diesel particulate matter (diesel PM) which is a toxic air contaminant. For these analyses, the emission sources (idling trucks) were characterized as area sources where diesel truck engines were expected to operate in the idle mode over a period of time. Sensitivity studies were done to show that the point of maximum impact showed little difference whether the idling emissions were treated as an area source or as numerous small point sources.

The area source is modeled using an elevated area release height due to the where the trucks congregate, and due to the relative location of exhaust stacks, while keeping engines idling to provide cab atmosphere comfort (powering comfort heat or air conditioning). This section describes the parameters used to model emissions from diesel truck engine idling and shows potential health risks due to these emission sources.

A diesel PM emission factor of 2.77 grams per hour (g/hr) per truck was used. This emission rate reflects the current ARB estimated average fleet emission rate. Analyses were also developed using a diesel PM emission rate of 0.3 g/hr. The 0.3 g/hr value reflects the projected 2007 and beyond model year fleet average idling emission factor. Idling of the diesel truck engines within the area source was assumed to occur 24 hours per day and 7 days per week.
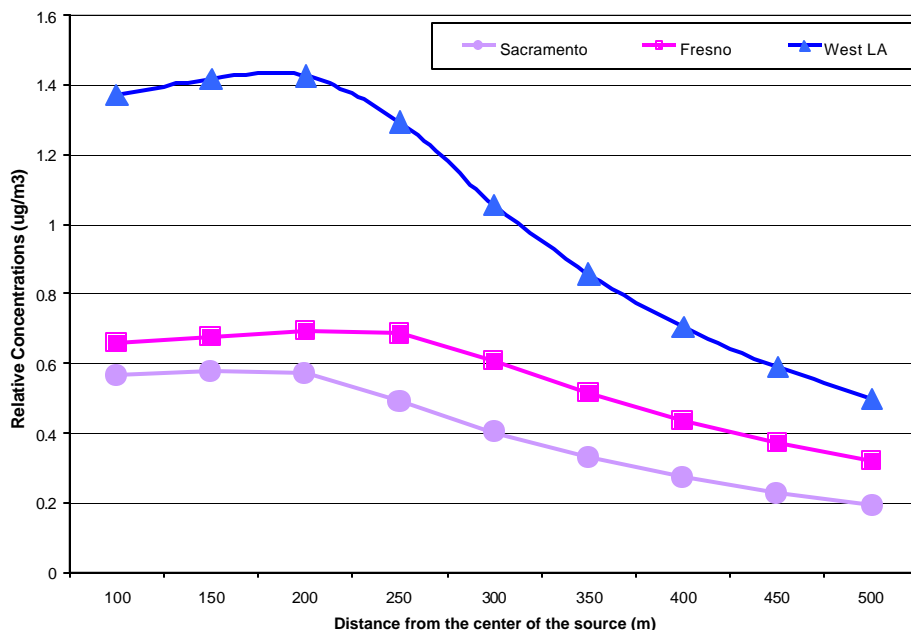
B.   Dispersion Modeling Methods

The diesel PM airborne concentrations due to the diesel PM emissions from idling were estimated using the United States Environmental Protection Agency (EPA) ISCST3 version 02035 dispersion model. ISCST3 uses EPA-approved algorithms to estimate potential ambient annual average concentrations of diesel PM as a result of diesel PM emissions from area sources.

The analyses used actual meteorological data collected at the West Los Angeles meteorological site during 1981. The West Los Angeles meteorological data provides a more conservative estimate of risk than most of the other 30 meteorological data sets available to ARB because this site tends to have lower average wind speeds predominantly from the same direction resulting in less dispersion of pollutants. Other representative meteorological data reviewed for these analyses include Sacramento and Fresno. Figure C-1 shows a comparison of the relative concentration for the three meteorological data sets reviewed for this assessment.

Figure C-1

Comparison of Meteorological Data Sets Ambient Concentrations

Sensitivity studies were done to determine buoyancy and the plume height achieved due to stack gas temperature and upward velocity. The EPA screening dispersion model, SCREEN3 version 96043 was used to determine this data. The engine parameters and plume (initial release) height data used in the analyses are shown in Table C-1.

Table C-1

Dispersion Modeling Parameters

Source Type	area
Dispersion Setting	urban
Initial Vertical Dispersion Parameter (s_z)	2.5 meters
Area Source Width and Length	320 meters
PM Emission Factor	2.77 grams/hr
Initial Release Height (from sensitivity studies)	5 meters

Polar coordinate receptors were placed at specific incremental distances from the area sources to determine the maximum off-site impacts. Receptors were placed at 50 meter increments from 100 meters to 500 meters and at 100 meter increments from 500 meters to 1500 meters.
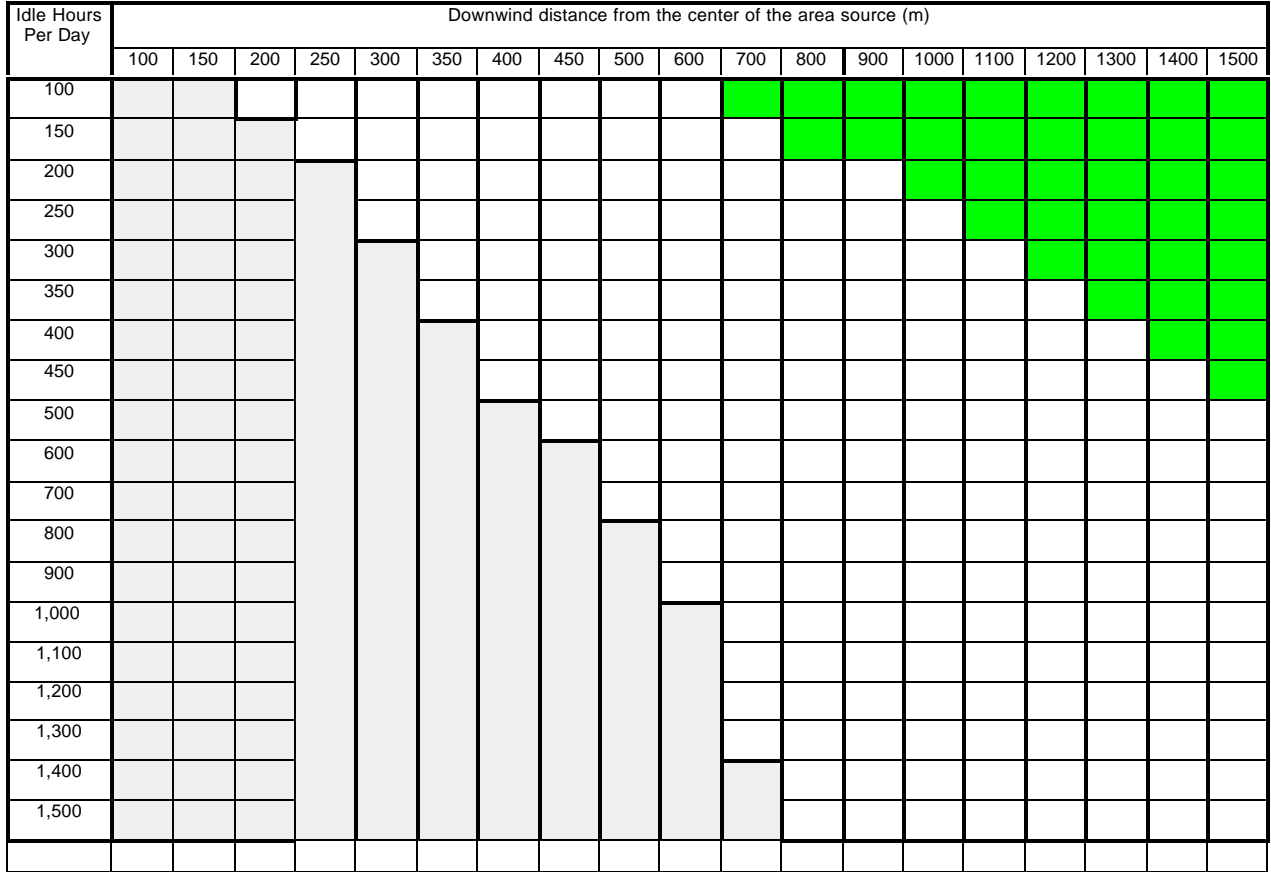
C.   Health Risk Assessment Methods

The dispersion model predicted maximum offsite concentrations were used to estimate potential cancer risk due to emissions of diesel PM. Under current OEHHA recommended risk assessment methodology, to estimate potential cancer risks, the estimated maximum annual ground level concentrations (GLCs), in micrograms per cubic meter (µg/m3), is converted to a pollutant dose. Multiplication of the average daily inhalation dose over 70 years, in milligrams per kilogram of body weight per day (mg/kg-d), with the inhalation cancer potency factor developed by OEHHA will give the inhalation cancer risk. Unit risk factors (URF), in the units of inverse concentration, (µg/m3)-1, used in previous assessments can be used for assessing cancer inhalation risk directly from air concentrations. However breathing rates, expressed in units of liters per kilogram of body weight-day coupled with the air concentrations to estimate dose in mg/kg-d is recommended for assessing cancer risks. The diesel exhaust PM inhalation cancer potency factor used for this analysis is 1.1 with units of inverse dose as a potency slope, (i.e., $(mg/kg-d)^{-1}$).

D.   Health Risk Assessment Results

Table C-2 and Table C-3 present the estimated range of potential cancer health risks at nearby receptor locations due to exposures to the two diesel PM emission rates, 2.77 g/hr and 0.3 g/hr due to diesel truck engine idling. The cancer health risks are shown based on hours of diesel engine idling operations and downwind distance of the receptor. The horizontal line shaded boxes show where potential cancer risks, based on OEHHA's 95th percentile breathing rates, are greater than or equal to (=) 100 per million. The grey shaded boxes show where potential cancer risks are less than (<) 10 per million. The unshaded boxes show where the potential cancer risk is = 10 and < 100 per million.

Table C- 2

Estimated Range of Potential Cancer Health Risks (per million) due to diesel truck engines idling at one location – 2.77 g/hr

Key for shaded cells below: **V** = Violet shading (Cancer Risks >/= 100/million), **G** = Green shading (Cancer Risks < 10/million)

Idle Hours Per Day	Downwind distance from the center of the area source (m)																		
	100	150	200	250	300	350	400	450	500	600	700	800	900	1000	1100	1200	1300	1400	1500
100	V	V									G	G	G	G	G	G	G	G	G
150	V	V	V									G	G	G	G	G	G	G	G
200	V	V	V	V										G	G	G	G	G	G
250	V	V	V	V											G	G	G	G	G
300	V	V	V	V	V											G	G	G	G
350	V	V	V	V	V												G	G	G
400	V	V	V	V	V	V												G	G
450	V	V	V	V	V	V													G
500	V	V	V	V	V	V	V												
600	V	V	V	V	V	V	V	V											
700	V	V	V	V	V	V	V	V											
800	V	V	V	V	V	V	V	V	V										
900	V	V	V	V	V	V	V	V	V										
1,000	V	V	V	V	V	V	V	V	V	V									
1,100	V	V	V	V	V	V	V	V	V	V									
1,200	V	V	V	V	V	V	V	V	V	V									
1,300	V	V	V	V	V	V	V	V	V	V									
1,400	V	V	V	V	V	V	V	V	V	V	V								
1,500	V	V	V	V	V	V	V	V	V	V	V								

Meteorological Data: West LA (1981)

Green Shading shows Cancer Risks < 10/million

Violet Shading shows Cancer Risks >/= 100/million

Annual emissions assume 52 weeks of operation

Table C- 3: Estimated Range of Potential Cancer Health Risks (per million) due to Diesel Truck Engines Idling with Emission Rate = 0.3 grams/hour

Trucks Idling Hours Per Day	Emission Rate = 0.3 grams/hour																		
	Downwind distance from the center of the area source (meters)																		
	100	150	200	250	300	350	400	450	500	600	700	800	900	1,000	1,100	1,200	1,300	1,400	1,500
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1,300																			
1,400																			
1,500																			

Meteorological Data: West LA (1981)

Cancer risks shown are at the OEHHA 95th percentile

Light Vertical Lines show Cancer Risks < 10/million

Light Horizontal Lines show Cancer Risks >/= 100/million

Annual emissions assume 52 weeks of operation

REFERENCES

OEHHA, 2000. Office of Environmental Health Hazard Assessment (OEHHA), *Air Toxics "Hot Spots" Program Risk Assessment Guidelines Part IV Technical Support Document for Exposure Assessment and Stochastic Analysis.* www.oehha.ca.gov/air/hot_spots/finalStoc.html. September 2000.

OEHHA, 2002. Office of Environmental Health Hazard Assessment (OEHHA), *Air Toxics Hot Spots Program Risk Assessment Guidelines: Part II Technical Support Document for Describing Available Cancer Potency Factors.* www.oehha.ca.gov/air/cancer_guide/TSD2.html. December 2002.

OEHHA, 2003. Office of Environmental Health Hazard Assessment (OEHHA), *The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments.* www.oehha.ca.gov/air/hot_spots/HRSguide.html. August 2003.