

## **Appendix B**

### **Methodology for Presenting Toxic Emissions From Facilities Subject to the Proposed Regulation**

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## Appendix B

### Methodology for Presenting Toxic Emissions From Facilities Subject to the Proposed Regulation

This appendix summarizes the methodology used for determining the more prevalent toxic substances that are associated with each source category (i.e., cement plants, electricity generation, hydrogen plants, mineral plants, oil and gas extraction, and refineries). For each of the source categories, staff used the 2008 emissions data reported to the ARB from the approximately 60 impacted facilities. The reported emissions for each substance were weighted based on their carcinogenic and non-carcinogenic health values and their potential for noninhalation impacts. Each substance was given a score and ranked within each source category. The substances with the highest score were chosen as the most prevalent toxic substances. The details of the methodology to determine the most prevalent toxic substances are described below.

#### **Methodology:**

To calculate the individual substance scores within each source category, the sum of the emissions (annual and maximum hourly) and OEHHA's health values (cancer, noncancer chronic and acute) were used to obtain a substance score. The emissions data were obtained from the California Emissions Inventory Database and Reporting System (CEIDARS) for the year 2008. The health values used in the scoring calculations came from the OEHHA Air Toxics Hot Spots Program Risk Assessment Guideline Manual for Preparation of Health Risk Assessments and the Hot Spots Analysis and Reporting Program (HARP) Software. (OEHHA, 2003) Table B-1 provides a summary of substance scores for each source category with a total weighted score greater than approximately 10 with the exception of Hydrogen Plants. The total score at Hydrogen Plants only includes scoring from annual emissions and may be higher if maximum hourly emissions were reported.

The reported emissions were weighted by their respective cancer and noncancer health factors using the equations below. The equations used to weight the emissions were obtained from the CAPCOA Facility Prioritization Guidelines. (CAPCOA, 1990) Note that no receptor proximity adjustments were included in these calculations and that acute and chronic noncancer scores were calculated separately as opposed to together as done in the prioritization guidelines.

This scoring procedure is intended to rank the reported substances based on emissions and associated health effects. This is a commonly used and simple method for prioritizing substances. The results from this scoring procedure do not reflect the potential health impacts one might be estimated to endure from exposure to facility emissions. Therefore, these scoring results should not be interpreted as a potential risk

estimate or as risk assessment results. Health risk assessments (HRAs) require additional information and must undergo further analysis and modeling. Examples of additional information that would be included in an HRA include the location and release characteristics of each substance and several exposure assumptions.

**Cancer Effects:**

$$CS = (Ec)(Pc)(1.7 \times 10^3)$$

Where:

CS = carcinogenic pollutant score

Ec = emissions of substance with carcinogenic health effects (lbs/year)

Pc = unit risk factor for substance

$1.7 \times 10^3$  = normalization factor (standardizes score to whole number scale)

**Noncancer Effects (Chronic):**

$$NCc = [(Et/8760)/Pt]/150]$$

Where:

NCc = noncancer chronic pollutant score

Et = emissions of substance (lbs/year) with noncancer chronic health effects  
(Note: 8760 hours assumes continuous operations)

Pt = Chronic Reference Exposure Level (REL) for substance

150 = normalization factor (standardizes score to whole number scale)

**Noncancer Effects (Acute):**

$$NCa = [(Et/Pt)/1500]$$

Where:

NCa = noncancer acute pollutant score

Et = emissions of substance (max lb/hr) with acute health effects  
(Note: not all facilities reported maximum hourly emissions)

Pt = Acute Reference Exposure Level (REL) for substance

1500 = normalization factor (standardizes score to whole number scale)

**Table B-1: Summary of Pollutant Scores for Each Source Category<sup>1</sup>**

Pollutant ID Number <sup>2</sup>	Pollutant Name	Reported Emissions (lbs/yr)	Reported Maximum Hourly Emissions	Total Score <sup>3</sup>	Cancer Score <sup>4</sup>	Chronic Score <sup>4</sup>	Acute Score <sup>4</sup>	Oral CSF <sup>5</sup>	Oral REL <sup>5</sup>
<b>Cement Plants</b>									
18540299	Chromium, hexavalent (& compounds)	18	0.001	4705	4703	1.6			X
7440382	Arsenic	438	0.004	2982	2456	500	26	X	X
9901	Diesel engine exhaust, particulate matter (Diesel PM)	3398	21	1745	1733	12			
71432	Benzene	23683	0.82	1176	1168	6.8	0.95		
7664417	Ammonia	63686	2403	1132		5.5	1126		
7440439	Cadmium	118	0.001	946	845	101			X
50000	Formaldehyde	68337	1.3	863	697	130	36		
10102440	Nitrogen dioxide	7171	254	809			809		
7647010	Hydrochloric acid	396728	48	789		755	34		
7439976	Mercury	1005	0.08	786		574	212		X
1080	Dibenzofurans (chlorinated) {PCDFs} [Treated as 2378TCDD for HRA]	0.01	0.00000003	750	745	4.9		X	X
7439965	Manganese	2057	0.04	391		391			
7440417	Beryllium	50	0.0001	326	204	122			X
1175	Silica, crystalline (respirable)	49379	52	282		282			
91203	Naphthalene	3262	0.04	195	189	6.2			
7446095	Sulfur dioxide	755	85	193			193		
32774166	3,3',4,4',5,5'-Hexachlorobiphenyl {PCB 169}	0.21	0.00003	139	138	0.91		X	X
106898	Epichlorohydrin	3001	Not reported	134	117	17			
7440020	Nickel	154	0.01	123	68	53	1.5		X

1. All numbers are rounded.
2. Pollutant identification (ID) number is the Chemical Abstract Service (CAS) number where available, or an ARB-assigned 4-digit emittent identification number. Source is ARB's CEIDARS Database and the Emission Inventory Criteria and Guidelines (September 2007).
3. Total Score = Cancer Score + Noncancer (Chronic) + Noncancer (Acute).
4. Scores are blank when no emissions are reported or no health value exists to score that substance.
5. Oral CSF = Oral Cancer Slope factor; Oral REL = Oral Reference Exposure Level. X indicates presence of a factor in the OEHHA Air Toxics Hot Spot Program Risk Assessment Guideline (August 2003).

**Table B-1: Summary of Pollutant Scores for Each Source Category<sup>1</sup> (Continued)**

Pollutant ID Number <sup>2</sup>	Pollutant Name	Reported Emissions (lbs/yr)	Reported Maximum Hourly Emissions	Total Score <sup>3</sup>	Cancer Score <sup>4</sup>	Chronic Score <sup>4</sup>	Acute Score <sup>4</sup>	Oral CSF <sup>5</sup>	Oral REL <sup>5</sup>
<b>Cement Plants (continued)</b>									
75070	Acetaldehyde	19474	0.97	95	89	2.4	3.1		
107028	Acrolein	674	0.08	82		33	49		
75014	Vinyl chloride	555	0.09	74	74		0.001		
106990	1,3-Butadiene	230	0.01	66	66	0.20			
1151	PAHs, total, w/o individ. components reported [Treated as B(a)P for HRA]	27	0.0004	51	51			X	
106934	Ethylene dibromide {EDB}	314	0.01	45	38	6.7			
1332214	Asbestos	60	Not reported	19	19				
7439921	Lead	866	0.02	18	18			X	
1086	Dioxins, total, w/o individ. isomers reported {PCDDs} [Treat as 2378TCDD for HRA]	0.0003	0.0000001	17	17	0.11		X	X
106467	p-Dichlorobenzene	873	0.01	16	16	0.02			
100447	Benzyl chloride	164	0.02	14	14		0.10		
57117314	2,3,4,7,8-Pentachlorodibenzofuran	0.0003	0.000000001	11	11	0.07		X	X
53703	Dibenz[a,h]anthracene	5.0	0.000002	10	10			X	
<b>Electricity Generation</b>									
7440020	Nickel	53	4.3	1124	24	18	1082		X
50000	Formaldehyde	44444	19	1055	453	85	517		
71432	Benzene	10039	1.2	499	495	2.9	1.4		

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4. Scores are blank when no emissions are reported or no health value exists to score that substance.
5. Oral CSF = Oral Cancer Slope factor; Oral REL = Oral Reference Exposure Level. X indicates presence of a factor in the OEHHA Air Toxics Hot Spot Program Risk Assessment Guideline (August 2003).

**Table B-1: Summary of Pollutant Scores for Each Source Category<sup>1</sup> (Continued)**

Pollutant ID Number <sup>2</sup>	Pollutant Name	Reported Emissions (lbs/yr)	Reported Maximum Hourly Emissions	Total Score <sup>3</sup>	Cancer Score <sup>4</sup>	Chronic Score <sup>4</sup>	Acute Score <sup>4</sup>	Oral CSF <sup>5</sup>	Oral REL <sup>5</sup>
<b>Electricity Generation (continued)</b>									
7440382	Arsenic	3.2	0.06	495	18	3.7	473	X	X
18540299	Chromium, hexavalent (& compounds)	1.3	0.01	342	342	0.11			X
1080	Dibenzofurans (chlorinated) {PCDFs} [Treated as 2378TCDD for HRA]	0.004	0.0000004	285	283	1.9		X	X
107028	Acrolein	1313	0.16	163		64	99		
91203	Naphthalene	2210	0.33	132	128	4.2			
7439965	Manganese	458	0.19	87		87			
1151	PAHs, total, w/o individ. components reported [Treated as B(a)P for HRA]	46	Not reported	87	87			X	
7664417	Ammonia	509725	36	61		44	17		
9901	Diesel engine exhaust, particulate matter (Diesel PM)	109	5.5	55	55	0.37			
7440439	Cadmium	4.7	0.003	37	33	4.0			X
106934	Ethylene dibromide {EDB}	232	Not reported	33	28	5.0			
7439976	Mercury	6.7	0.01	30		3.8	26		X
56235	Carbon tetrachloride	190	Not reported	14	14	0.08			
75014	Vinyl chloride	97	Not reported	13	13				
7783064	Hydrogen sulfide	6857	Not reported	12		12			
75070	Acetaldehyde	1872	0.29	9.8	8.6	0.23	0.94		

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3. Total Score = Cancer Score + Noncancer (Chronic) + Noncancer (Acute).
4. Scores are blank when no emissions are reported or no health value exists to score that substance.
5. Oral CSF = Oral Cancer Slope factor; Oral REL = Oral Reference Exposure Level. X indicates presence of a factor in the OEHHA Air Toxics Hot Spot Program Risk Assessment Guideline (August 2003).

**Table B-1: Summary of Pollutant Scores for Each Source Category<sup>1</sup> (Continued)**

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<b>Hydrogen Plants</b>									
1151	PAHs, total, w/o individ. components reported [Treated as B(a)P for HRA]	2.7	Not reported	5.1	5.1			X	
71432	Benzene	93	Not reported	4.6	4.6	0.03			
7440439	Cadmium	0.47	Not reported	3.8	3.4	0.40			X
7440020	Nickel	4.5	Not reported	3.5	2.0	1.5			X
50000	Formaldehyde	278	Not reported	3.3	2.8	0.53			
7440382	Arsenic	0.40	Not reported	2.7	2.2	0.46		X	X
7664417	Ammonia	13816	Not reported	1.2		1.2			
<b>Mineral Plants</b>									
7783064	Hydrogen sulfide	757956	97	4766		1298	3468		
7440439	Cadmium	26	0.005	204	182	22			X
1086	Dioxins, total, w/o individ. isomers reported {PCDDs} [Treat as 2378TCDD for HRA]	0.002	0.00002	100	99	0.65		X	X
1016	Arsenic compounds (inorganic)	5.8	0.01	99	33	6.7	59	X	X
7664939	Sulfuric acid	3557	0.44	66		61	5.6		
1080	Dibenzofurans (chlorinated) {PCDFs} [Treated as 2378TCDD for HRA]	0.001	0.00003	61	60	0.40		X	X
7439976	Mercury	5.9	0.01	24		3.4	21		X
50000	Formaldehyde	264	0.44	15	2.7	0.50	12		
71432	Benzene	146	0.97	8.3	7.2	0.04	1.1		

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3. Total Score = Cancer Score + Noncancer (Chronic) + Noncancer (Acute).
4. Scores are blank when no emissions are reported or no health value exists to score that substance.
5. Oral CSF = Oral Cancer Slope factor; Oral REL = Oral Reference Exposure Level. X indicates presence of a factor in the OEHHA Air Toxics Hot Spot Program Risk Assessment Guideline (August 2003).



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<b>Oil and Gas Production</b>									
9901	Diesel engine exhaust, particulate matter (Diesel PM)	23	2.1	12	12	0.08			
7664417	Ammonia	67762	3.5	7.4		5.8	1.6		
<b>Refineries</b>									
18540299	Chromium, hexavalent (& compounds)	14	0.00002	3557	3556	1.2			X
106990	1,3-Butadiene	6403	Not reported	1856	1850	5.5			
71432	Benzene	33097	0.07	1641	1632	9.4	0.08		
7440439	Cadmium	180	0.0003	1435	1282	154			X
7440020	Nickel	1610	0.21	1315	712	552	52		X
50000	Formaldehyde	107298	0.06	1300	1094	204	1.6		
50328	Benzo[a]pyrene	520	Not reported	973	973			X	
7440382	Arsenic	83	Not reported	563	468	95		X	X
1151	PAHs, total, w/o individ. components reported [Treated as B(a)P for HRA]	179	Not reported	335	335			X	
91203	Naphthalene	5487	0.07	328	317	10			
9901	Diesel engine exhaust, particulate matter (Diesel PM)	380	2.0	195	194	1.3			
7439965	Manganese	794	0.04	151		151			
7664417	Ammonia	1561712	0.29	134		134	0.14		

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2. Pollutant identification (ID) number is the Chemical Abstract Service (CAS) number where available, or an ARB-assigned 4-digit emittent identification number. Source is ARB's CEIDARS Database and the Emission Inventory Criteria and Guidelines (September 2007).
3. Total Score = Cancer Score + Noncancer (Chronic) + Noncancer (Acute).
4. Scores are blank when no emissions are reported or no health value exists to score that substance.
5. Oral CSF = Oral Cancer Slope factor; Oral REL = Oral Reference Exposure Level. X indicates presence of a factor in the OEHHA Air Toxics Hot Spot Program Risk Assessment Guideline (August 2003).

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<b>Refineries (continued)</b>									
1080	Dibenzofurans (chlorinated) {PCDFs} [Treated as 2378TCDD for HRA]	0.002	Not reported	122	121	0.80		X	X
7440417	Beryllium	19	0.00003	121	76	45			X
7439976	Mercury	125	0.002	77		71	6.0		X
7647010	Hydrochloric acid	18286	36	60		35	26		
7664939	Sulfuric acid	3208	Not reported	55		55			
7783064	Hydrogen sulfide	12011	0.17	27		21	6.2		
79016	Trichloroethylene	6345	Not reported	22	22	0.18			
7782505	Chlorine	219	0.004	19		19	0.03		
111308	Glutaraldehyde	84	Not reported	18		18			

1. All numbers are rounded.
2. Pollutant identification (ID) number is the Chemical Abstract Service (CAS) number where available, or an ARB-assigned 4-digit emitter identification number. Source is ARB's CEIDARS Database and the Emission Inventory Criteria and Guidelines (September 2007).
3. Total Score = Cancer Score + Noncancer (Chronic) + Noncancer (Acute).
4. Scores are blank when no emissions are reported or no health value exists to score that substance.
5. Oral CSF = Oral Cancer Slope factor; Oral REL = Oral Reference Exposure Level. X indicates presence of a factor in the OEHHA Air Toxics Hot Spot Program Risk Assessment Guideline (August 2003).