

combustion turbine operations. A unit risk estimate is defined as the upper-

bound excess lifetime cancer risk estimated to result from continuous

exposure to an agent at a concentration of 1 ug/m<sup>3</sup> in the air.

TABLE 3.—DOSE-RESPONSE ASSESSMENT VALUES FOR HAP REPORTED EMITTED BY THE COMBUSTION TURBINE SOURCE CATEGORY

Chemical name	CAS No.	Reference concentration <sup>a</sup> (mg/m <sup>3</sup> )	Unit risk estimate <sup>b</sup> (1/(ug/m <sup>3</sup> ))
Acetaldehyde .....	75-07-0	9.0E-03 IRIS	2.2E-06 IRIS
Acrolein .....	107-02-8	2.0E-05 IRIS	
Arsenic compounds .....	7440-38-2	3.0E-05 CAL	4.3E-03 IRIS
Benzene .....	71-43-2	6.0E-02 CAL	7.8E-06 IRIS
Beryllium compounds .....	7440-41-7	2.0E-05 IRIS	2.4E-03 IRIS
1,3-Butadiene .....	106-99-0	2.0E-03 IRIS	3.0E-05 EPA ORD
Cadmium compounds .....	7440-43-9	2.0E-05 IRIS	1.8E-03 IRIS
Chromium (VI) compounds .....	18540-29-9	1.0E-04 IRIS	1.2E-02 IRIS
Ethyl benzene .....	100-41-4	1.0E+00 IRIS	
Formaldehyde .....	50-00-0	9.8E-03 ATSDR	1.3E-05 IRIS
Lead compounds .....	7439-92-1		1.2E-05 CAL
Manganese compounds .....	7439-96-5	5.0E-05 IRIS	
Mercury compounds .....	HG CMPDS	9.0E-05 CAL	
Naphthalene .....	91-20-3	3.0E-03 IRIS	
Nickel compounds .....	7440-02-0	2.0E-04 ATSDR	9.1E-01 CAL
PAH (shown below as 7-PAH) .....			
Benzo (a) anthracene .....	56-55-3		1.1E-04 CAL
Benzo (b) fluoranthene .....	205-99-2		1.1E-04 CAL
Benzo (k) fluoranthene .....	207-08-9		1.1E-04 CAL
Benzo (a) pyrene .....	50-32-8		1.1E-03 CAL
Chrysene .....	218-01-9		1.1E-05 CAL
Dibenz (a,h) anthracene .....	53-70-3		1.2E-03 CAL
Indeno (1,2,3-cd) pyrene .....	193-39-5		1.4E-04 CAL
Propylene oxide .....	75-56-9	3.0E-02 IRIS	3.7E-06 IRIS
Selenium compounds .....	7782-49-2	2.0E-02 CAL	
Toluene .....	108-88-3	4.0E-01 IRIS	
Xylenes (mixed) .....	1330-20-7	4.3E-01 ATSDR	

<sup>a</sup> Reference Concentration: An estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups which include children, asthmatics, and the elderly) that is likely to be without an appreciable risk of deleterious effects during a lifetime. It can be derived from various types of human or animal data, with uncertainty factors generally applied to reflect limitations of the data used.

<sup>b</sup> Unit Risk Estimate: The upper-bound excess lifetime cancer risk estimated to result from continuous exposure to an agent at a concentration of 1 ug/m<sup>3</sup> in air. The interpretation of the Unit Risk Estimate would be as follows: If the Unit Risk Estimate =  $1.5 \times 10^{-6}$  per ug/m<sup>3</sup>, 1.5 excess tumors are expected to develop per 1,000,000 people if exposed daily for a lifetime to 1 ug of the chemical in 1 cubic meter of air. Unit Risk Estimates are considered upper bound estimates, meaning they represent a plausible upper limit to the true value. (Note that this is usually not a true statistical confidence limit.) The true risk is likely to be less, but could be greater.

#### Sources:

IRIS = EPA Integrated Risk Information System (<http://www.epa.gov/iris/subst/index.html>).

ATSDR = U.S. Agency for Toxic Substances and Disease Registry (<http://www.atsdr.cdc.gov/mrls.html>).

CAL = California Office of Environmental Health Hazard Assessment. ([http://www.oehha.ca.gov/air/hot\\_spots/index.html](http://www.oehha.ca.gov/air/hot_spots/index.html)).

HEAST = EPA Health Effects Assessment Summary Tables (#PB=(97-921199, July 1997).

To establish an applicability cutoff under CAA section 112(d)(4), EPA would need to define ambient air exposure concentration limits for any threshold pollutants involved. There are several factors to consider when establishing such concentrations. First we would need to ensure that the concentrations that would be established would protect public health with an ample margin of safety. As discussed above, the approach EPA commonly uses when evaluating the potential hazard of a threshold air pollutant is to calculate the pollutant's hazard quotient, which is the exposure concentration divided by the RfC. The EPA's "Supplementary Guidance for Conducting Health Risk Assessment of Chemical Mixtures" suggests that the

noncancer health effects associated with a mixture of pollutants ideally are assessed by considering the pollutants' common mechanisms of toxicity<sup>5</sup>. The guidance also suggests that when exposures to mixtures of pollutants are being evaluated, the risk assessor may calculate a HI. The recommended method is to calculate multiple hazard indices for each exposure route of interest, and for a single specific toxic effect or toxicity to a single target organ. The default approach recommended by the guidance is to sum the hazard quotients for those pollutants that induce the same toxic effect or affect the same target organ. A mixture is then assessed by several HI, each

<sup>5</sup> *ibid.*

representing one toxic effect or target organ. The guidance notes that the pollutants included in the HI calculation are any pollutants that show the effect being assessed, regardless of the critical effect upon which the RfC is based. The guidance cautions that if the target organ or toxic effect for which the HI is calculated is different from the RfC's critical effect, then the RfC for that chemical will be an overestimate, that is, the resultant HI potentially may be overprotective. Conversely, since the calculation of a HI does not account for the fact that the potency of a mixture of HAP can be more potent than the sum of the individual HAP potencies, a HI may potentially be underprotective in some situations.