In accordance with the provisions of Health and Safety Code section 39661, the Scientific Review Panel (SRP) has reviewed the report of the staffs of the ARB and DHS on the public exposure and biological and health effects of nickel, and the public comments on this report. Based on this review, the SRP finds that the report is without serious deficiencies and agrees with the staff of the ARB and DHS that:

1. The evidence for carcinogenicity in humans from inhaled nickel is strong. In 1984, the U.S. Environmental Protection Agency (EPA) concluded that nickel refinery dust and nickel subsulfide are human carcinogens. In 1990, the International Agency for Research on Cancer (IARC) concluded that nickel compounds are carcinogenic to humans and that metallic nickel is a possible human carcinogen. Based on available scientific data, we agree with the DHS and IARC's classification of nickel compounds as human carcinogens.

2. Nickel is present in many forms including soluble and insoluble compounds. Human epidemiology has shown that nickel sulfate and combinations of nickel subsulfide and nickel oxides are carcinogens in humans. Several nickel compounds are genotoxic or carcinogenic in animals. While there may be differences in the potency of these different forms of nickel, available evidence does not permit quantification of separate risk estimates. As a result, a single potency has been developed.

3. Because nickel was identified as a hazardous air pollutant under Section 112 of the United States Clean Air Act, identification of nickel as a toxic air contaminant is required by California Health and Safety Code Section 39655.

4. Nickel is emitted into the outdoor air by a variety of stationary sources in California.

5. Stationary sources such as fuel combustion, cement manufacturing, municipal refuse and sewage sludge incineration, secondary smelters, and electroplating contribute 18 to 353 tons per year of nickel into California's atmosphere. Mobile sources such as gasoline and diesel powered vehicles also contribute 5.4 to 7.2 tons per year of nickel emissions to the atmosphere.

6. Tobacco smoke is the major source of indoor exposure to nickel. Wood burning is another indoor source of nickel. In light of the high emissions of nickel in sidestream smoke and the amount of time most people spend indoors, it is apparent that environmental tobacco smoke may contribute much more to people's exposure to nickel than does inhaling ambient outdoor air.

7. Based on the average particle size, nickel has an estimated average atmospheric lifetime of seven days.

8. Approximately 20.3 million people in California represented by the ARB toxics monitoring network are estimated to be exposed outdoors to a population-weighted mean nickel concentration of 7.3 nanograms per cubic meter.

9. Adverse health effects other than cancer are not predicted to occur at known concentrations of nickel in ambient outdoor air.

10. Computer modeling of potential near source exposures to fuel oil combustion units indicate potential exposure to concentrations of nickel up to 10 times higher than the statewide ambient average.

11. Based on available scientific information, it is justified to assume that a nickel exposure level below which carcinogenic effects are not expected to occur cannot be identified.

12. Based on interpretation of available scientific evidence, the DHS staff estimated the range of unit risk is from 2.1×10^{-4} to 37×10^{-4} per ug/m^3. The lower end of this range is the human average estimate; the upper end is the 95% upper confidence bound for the animal study. We concur with the DHS staff that 2.6×10^{-4} per ug/m^3 is the best value unit risk factor. Table 1 compares the best value for nickel with those of other compounds recently reviewed by the SRP.

TABLE 1

Compound	Unit Risk (ppb-1)	Unit Risk (ug/m3)-1	Approved by SRP
Nickel	particulate	2.6×10^{-4}	05/15/91
Vinyl Chloride	20×10^{-5}	7.8×10^{-5}	10/19/90
Chloroform	2.6×10^{-5}	5.3×10^{-6}	08/14/90
Trichloroethylene	1.1×10^{-5}	2×10^{-6}	04/16/90
Inorganic arsenic	particulate	3.3×10^{-3}	04/16/90
Chromium VI	particulate	1.4×10^{-1}	09/18/85

13. Using the population-weighted annual nickel exposure concentration of 7.3 nanograms per cubic meter (California's population-weighted average ambient concentration) and the DHS value for unit risk, the DHS staff estimates 1.5 to 27 excess cancer cases per million are expected to result. Using the best value for unit risk, the DHS staff estimates the excess carcinogenic risk from a lifetime exposure is 2 cancer cases per million. Assuming that this applies to the California state population of 30 million people, this could result in up to 60 excess lifetime cancer cases statewide. Indoor exposure to nickel from tobacco smoke could add an unknown additional number of lung cancers to this risk estimate.

14. Based on the findings of nickel-induced carcinogenesis in humans and animals, as well as the results of the risk assessment, the SRP concurs with the staff of the DHS in finding that nickel compounds are air pollutants which may cause or contribute to an increase in mortality or an increase in serious illness, or which may pose a present or potential hazard to human health.