State of California
AIR RESOURCES BOARD

Staff Report: Initial Statement of Reasons for Proposed Rulemaking

Public Hearing to Consider the Adoption of a Regulatory Amendment Identifying Carbon Tetrachloride as a Toxic Air Contaminant

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(This report has been reviewed by the staffs of the California Air Resources Board and the California Department of Health Services and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Air Resources Board or the Department of Health Services, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.)

EXECUTIVE SUMMARY

INTRODUCTION AND RECOMMENDATION

Health and Safety Code section 39655 defines a toxic air contaminant as an air pollutant which the Air Resources Board or the Department of Food and Agriculture finds "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." The staffs of the Air Resources Board (ARB) and the Department of Health Services (DHS) have reviewed the available scientific evidence on the presence of carbon tetrachloride in the atmosphere of California and its potential adverse effect on public health. Based on the finding of carcinogenicity and the results of the risk assessment, the DHS staff finds that carbon tetrachloride meets the definition of a toxic air contaminant. Therefore, the staff of the Air Resources Board recommends that carbon tetrachloride be identified by the Board as a toxic air contaminant. In making this recommendation, the ARB and DHS staffs found that there is not sufficient available scientific evidence at this time to support the identification of an exposure level below which carcinogenic effects would not have some probability of occurring and recommend that carbon tetrachloride be treated as having no threshold.

The Scientific Review Panel (SRP), established by Health and Safety Code section 39670, reviewed the report in accordance with Health and Safety Code section 39661. The findings of the SRP are attached at the end of the Executive Summary.

Carbon tetrachloride was chosen for evaluation because: it has been identified by the International Agency for Research on Cancer (IARC) as an animal carcinogen and a potential human carcinogen; its presence in the atmosphere has been documented; and it is emitted from several sources in the state.

SOURCES OF CARBON TETRACHLORIDE

An emissions inventory compiled by the ARB staff indicates that in 1984, a minimum of 60 tons of carbon tetrachloride was emitted in California. The major identified emission sources of carbon tetrachloride in California are: 1) carbon tetrachloride production; 2) pesticide/grain fumigant usage; 3) chlorinated paraffin wax production; and 4) fluorocarbon production. Of these four sources, carbon tetrachloride production and pesticidal/grain fumigant usage accounted for over 80 percent of the estimated emissions. Other emission sources of carbon tetrachloride include oil companies, scientific laboratories, organic chemical manufacturing companies, and publicly owned treatment works. An effort was made by the ARB staff to estimate the emissions from these sources; however, the staff was unable to obtain the necessary information to do so. The ARB staff believes that emissions from these sources are not significant when compared to the emissions from the identified sources.

The Environmental Protection Agency (EPA) has canceled the registrations of pesticide products containing carbon tetrachloride as an active ingredient. Grain fumigants containing carbon tetrachloride will no longer be allowed for agricultural uses in the United States and thus, future emissions are expected to be reduced. Grain fumigant usages accounted for 30 percent of the 1984 estimated emissions in California. The ARB staff believes that this reduced usage would offset any increases in emissions that could result from possible increases in carbon tetrachloride use.

EXPOSURE TO CARBON TETRACHLORIDE

Once carbon tetrachloride is in the troposphere, it is a stable gaseous compound. Due to the lack of rapid tropospheric removal mechanisms, carbon tetrachloride accumulates in the lower atmosphere and has an estimated atmospheric lifetime* of 50 years.

* Atmospheric lifetime is defined as the time required for a given amount of compound to decrease 1/e (0.368) of its original value at time zero.

In 1985, the ARB established a twenty station monitoring network throughout California to measure levels of potentially toxic compounds, including carbon tetrachloride. From the toxic monitoring network, a statewide annual average carbon tetrachloride concentration of 0.13 parts per billion (ppb) (0.82 microgram per cubic meter ($\mu g/m^3$)) was estimated. This annual average concentration is comparable to the documented global background levels of 0.11 and 0.15 ppb (0.69 and 0.94 $\mu g/m^3$). Therefore, the ARB staff believes the statewide annual average carbon tetrachloride concentration reflects the global background concentration. This means that the most common source of exposure to ambient carbon tetrachloride is from the global background concentration which is not related to emission sources in California.

While everyone is exposed to at least the background concentration, people living or working near emission sources of carbon tetrachloride are likely to be exposed to concentrations several times greater than this. Based on dispersion modeling analysis, the ARB staff estimated that 550 people in the San Francisco Bay Area can be exposed to a maximum annual average concentration of 0.62 ppb (3.9 $\mu g/m^3$), with peak hourly levels as high as 170 ppb (1070 $\mu g/m^3$). In the South Coast Air Basin, 1,500 people can be exposed to a maximum annual average concentration of 0.32 ppb (2.0 $\mu g/m^3$). These maximum annual average concentrations are the sum of estimated annual average concentrations above background from modeled emission sources and the statewide annual average concentration of 0.13 ppb (0.82 $\mu g/m^3$) as estimated from the ARB monitoring network.

The ARB staff also estimated the annual average population-weighted concentrations for the modeled emission sources. This concentration is defined as the annual concentration that the "average" person in the modeling area is exposed to. Applying these concentrations and the population in the modeled areas to the DHS upper-bound risk estimates, the range of excess cancer cases that could possibly result from the release of carbon tetrachloride emissions in each area can be estimated. For the Bay Area sources, the annual average population-weighted concentration for 210,000 people within the modeling area is estimated to be 0.014 ppb

(0.09 $\mu g/m^3$) above the background concentration. The annual average population-weighted concentration for the South Coast Air Basin source is estimated to be 0.0016 ppb (0.01 $\mu g/m^3$) above background for the 2,270,000 people in this modeling area.

With respect to indoor levels of carbon tetrachloride, the ARB staff reviewed available draft reports and conference papers which assessed the carbon tetrachloride concentrations in the indoor (mostly homes) and the outdoor ambient environments. Because of uncertainties in the studies that were reviewed, the ARB staff could not establish the relationship between indoor and outdoor concentrations. Some of the monitoring data suggested that indoor and outdoor carbon tetrachloride concentrations within an area are similar, while other results showed differences between the two. Elevated indoor concentrations could be caused by indoor sources such as commercial cleaning products, consumer products, and water which may contain carbon tetrachloride. Elevated outdoor concentrations could be influenced by local emission sources in the area. At this time, there is not sufficient information to establish how emission sources contribute to elevated indoor or outdoor carbon tetrachloride concentrations.

In addition to inhalation of ambient air, another route of exposure for carbon tetrachloride is through the ingestion of water and grain products that contain carbon tetrachloride. Based on limited information, it appears that for a small percentage of the population in the South Coast Air Basin, ingestion of water containing carbon tetrachloride can be a significant exposure route. Intake of carbon tetrachloride at the maximum levels in drinking water can cause an estimated intake similar to that from the inhalation of ambient air at the maximum annual average concentrations from modeled emission sources. The ARB is currently sponsoring a study of publicly owned treatment works (POTWs) in California to determine the concentrations of selected compounds, including carbon tetrachloride. Preliminary results suggest that the carbon tetrachloride concentrations are lower than the concentrations found in an earlier POTWs study. The ARB staff believes that the lower concentrations reflect the reduced usage of carbon tetrachloride by industrial sources in California.

The usage of carbon tetrachloride as a grain fumigant is the likely cause of how this compound gets into food products. Ingestion of food products containing carbon tetrachloride at elevated levels may be an important exposure route. Available data was adequate only to determine an upper limit of potential intake and the ARB staff could not determine the percent of the population exposed to different levels of carbon tetrachloride. Therefore, the relative importance of ingestion of food products containing carbon tetrachloride cannot be determined at this time. The ARB staff believes that because of EPA's restrictions on the use of grain fumigants containing carbon tetrachloride, levels found in food products will likely be reduced significantly in the future.

HEALTH EFFECTS OF CARBON TETRACHLORIDE

Accidental acute exposure incidents and animal experiments indicate that carbon tetrachloride can produce liver and kidney damage and have numerous effects on the nervous system. Chronic exposure to carbon tetrachloride to humans in occupational settings has produced neurological effects and elevation of serum liver enzymes indicating liver damage. Long-term animal exposure to similar levels of carbon tetrachloride found in occupational settings has produced liver and kidney damage. The potential for reproductive effects due to carbon tetrachloride exposure cannot be ascertained since it has not been adequately studied at this time.

Adverse health effects other than cancer are not expected to occur due to inhalation of carbon tetrachloride at current or future atmospheric concentrations. Both peak exposure concentrations and measured ambient concentrations are at least two orders of magnitude lower than those concentrations which are associated with chronic adverse health effects in occupational settings or which have produced acute effects in animal experiments.

RISK DUE TO ATMOSPHERIC CARBON TETRACHLORIDE

The cancer risk assessment for carbon tetrachloride used by DHS was developed by EPA based on animal studies in which carbon tetrachloride was administered orally. For exposure to 0.16 ppb (1 $\mu g/m^3$) of carbon tetrachloride, the DHS staff estimated the upper limit risk to be between 10 and 42 excess lifetime cancers per million people continuously exposed over their lifetime. The DHS staff believes that this range represents the best estimate of the excess risk associated with inhalation exposure to carbon tetrachloride based on the available data.

The hazard posed by exposure to atmospheric carbon tetrachloride to California's population of 26,600,000 was estimated by applying the DHS unit risk estimate to the statewide annual mean concentration of 0.13 ppb (0.82 $\mu g/m^3$). The DHS estimated upper-bound excess lifetime cancer risk from exposure to the statewide annual mean concentration is between 8 and 34 cancer cases per million people exposed continuously over 70 years. Thus, the number of excess lifetime cancer incidences for Californians who are exposed to 0.13 ppb (0.82 $\mu g/m^3$) is estimated to be between 210 and 910.

However, people living near emission sources of carbon tetrachloride can be exposed to concentrations above the background level. Based on modeling analysis of emission sources in the San Francisco Bay Area and the South Coast Air Basin, the ARB staff estimated the population-weighted concentrations above background to be 0.014 ppb (0.09 $\mu g/m^3$) for 210,000 people in San Francisco Bay Area and 0.0016 ppb (0.01 $\mu g/m^3$) for 2,270,000 people in the South Coast Air Basin. The combined number of excess lifetime cancer incidences from exposure to these sources is estimated to range from less than one to two.

The DHS staff emphasizes that the risk estimates derived in conducting a risk assessment are not exact predictions, but rather represent best estimates based on current scientific knowledge and methods. The upper-bound excess lifetime risks that were estimated above are health-conservative estimates; the actual risks are likely to be below these values.

ALTERNATIVES

Government Code Section 11246.14 requires agencies to describe alternatives to the regulation considered by the agency and the agency's reasons for rejecting those alternatives. The only alternative to identifying carbon tetrachloride as a toxic air contaminant is to not identify it. The ARB staff is not recommending this alternative because the staff believes that carbon tetrachloride meets the statutory definition of a toxic air contaminant. There are no alternatives considered by the ARB staff which would be more effective in carrying out the purpose for which the regulation is proposed or would be as effective and less burdensome to affected private person than the proposed regulation.

SUMMARY OF ENVIRONMENTAL IMPACTS OF THE IDENTIFICATION OF CARBON TETRACHLORIDE AS A TOXIC AIR CONTAMINANT

The identification of carbon tetrachloride as a toxic air contaminant is not in itself expected to result in any environmental effects. The identification of carbon tetrachloride as a toxic air contaminant by the Board may result in the Board and air pollution control districts adopting toxic control measures in accordance with Health and Safety Code sections 39665 and 39666. Any such toxic control measures would result in reduced emissions of carbon tetrachloride to the atmosphere, resulting in reduced ambient concentrations, concurrently reducing the health risk due to carbon tetrachloride exposure. Therefore, the identification of carbon tetrachloride as a toxic air contaminant may ultimately result in environmental benefits. Environmental impacts identified with respect to specific control measures will be included in the consideration of such control measures pursuant to Health and Safety Code sections 39665 and 39666.