State of California
AIR RESOURCES BOARD

Resolution 98-78

December 11, 1998

Agenda Item No.: 98-15-3

WHEREAS, following a hearing in November 1991, the Air Resources Board (ARB or Board) adopted regulations for California phase 2 reformulated gasoline (CaRFG), applicable beginning March 1, 1996; these regulations, which are contained in sections 2260 - 2272, title 13, California Code of Regulations, include a comprehensive set of specifications affecting eight different gasoline properties — summertime Reid vapor pressure (RVP), T50, T90, and aromatic hydrocarbon, benzene, sulfur, olefin, and oxygen content — which result in significant reductions in emissions of ozone precursors and toxic air contaminants;

WHEREAS, section 2262.1, title 13, California Code of Regulations, imposes a maximum RVP standard of 7.00 pounds per square inch (psi) on motor vehicle gasoline sold in specified warmer-season months that vary by air basin; in the South Coast Air Basin the RVP standard applies from March 1 through October 31;

WHEREAS, the RVP standard in the CaRFG regulations is designed to reduce gasoline volatility and thereby reduce evaporative emissions of hydrocarbons (HC) from motor vehicles and from gasoline storage and transfer activities;

WHEREAS, HC emitted into the atmosphere from motor vehicles and other sources reacts with oxides of nitrogen (NOx) in the presence of sunlight to form ozone, the primary component of what is commonly known as smog;

WHEREAS, Health and Safety Code section 43830(g), enacted in 1991, conditionally exempts gasoline blends containing 10 percent by volume (vol.%) ethanol from the RVP standard in the CaRFG regulations; the statute makes the exemption inapplicable if the ARB determines, on the basis of independently verifiable automobile exhaust and evaporative emission tests performed on a representative fleet of automobiles, that the blend would result in a net increase in the ozone-forming potential of the total emissions, excluding emissions of NOx, when compared to the total emissions, excluding emissions of NOx, from the same automobile fleet using gasoline that meets all applicable specifications for CaRFG;

WHEREAS, when 10 vol.% ethanol is added to gasoline meeting the RVP standard of 7.00 psi, the RVP of the gasoline increases by approximately 1 psi and mass HC evaporative emissions from vehicles will increase significantly; the ozone-forming potential of the emissions other than NOx from RVP-exempt gasoline will accordingly increase unless the contribution to ozone

formation from the mass HC evaporative emissions increase is fully offset by any decreases in exhaust HC emissions, any decreases in the reactivity of the exhaust and evaporative HC emissions, and decreases in exhaust CO emissions to the extent CO contributes to ozone formation;

WHEREAS, the ARB staff has conducted a test program (the ARB Ethanol Test Program) to compare the emissions from motor vehicles operating on elevated RVP gasoline containing 10 vol.% ethanol with emissions from the same motor vehicles operating with fully complying CaRFG; in the test program, the two fuels were blended from the same base gasoline, and the fully complying gasoline was oxygenated with 11 vol.% methyl tertiary butyl ether (MTBE) to achieve an oxygen content of about 2.0 percent by weight;

WHEREAS, the ARB staff has presented a report recommending that, based on the ARB Ethanol Test Program and supporting evidence from other test programs, the Board determine that elevated RVP CaRFG that contains 10 vol.% ethanol will result in a net increase in the ozone-forming potential of automobile emissions, excluding emissions of NOx, compared to the emissions, excluding emissions of NOx, from the same automobiles operating on fully complying CaRFG;

WHEREAS, the public has been provided an opportunity to comment orally and in writing on the report, and the Board has considered the public comments; and

WHEREAS, the Board finds that:

The most appropriate fully complying gasoline to be evaluated in making the Health and Safety Code section 43830(g) comparison is one that is blended to be as close as possible to all of the flat limits in the CaRFG regulations, and that contains 2.0 wt.% oxygen using MTBE, which is currently the most widely-used oxygenate in CaRFG;

The most appropriate elevated RVP gasoline with ethanol to be evaluated in the comparison would be one in which 10 vol.% ethanol is added to the same base gasoline as was used in making the fully complying gasoline;

The two fuels compared in the ARB Ethanol Test Program meet the above criteria;

The results of the ARB Ethanol Test Program are based on exhaust emission tests on twelve in-use 1990 through 1995 model-year light-duty vehicles that were equipped with three-way catalysts and fuel injection, and diurnal and hot-soak evaporative emission tests on six of the twelve vehicles; because facilities were not available for measuring running loss evaporative emissions, the running loss emissions were estimated by use of evaporative emissions models and the speciated hot-soak data from the test program;

In the ARB Ethanol Test Program, when the reactivity of CO emissions is accounted for and running loss evaporative emissions are estimated, the elevated RVP gasoline containing 10 vol.% ethanol resulted in overall emissions (excluding NOx) having an

ozone-forming potential that was about 17 percent higher than the ozone-forming potential of the emissions from the fully complying CaRFG; if running loss evaporative emissions are disregarded, the gasoline containing 10 vol% ethanol still resulted in an overall increase in ozone-forming potential;

Given the results of the ARB Ethanol Test Program, there is a greater than 95 percent certainty that the ozone-forming potential of the emissions (excluding NOx) from vehicles represented by the test program fleet and operated on the elevated RVP gasoline containing 10 vol.% ethanol is greater overall than from the same vehicles operated on fully complying CaRFG;

The vehicles in the ARB Ethanol Test Program constituted a representative fleet in that they were representative of vehicle categories that account for about 70 percent of the vehicle miles traveled in California in 1998 and account for about 30 percent of the reactive organic gas emissions, about 40 percent of the CO emissions and about 50 percent of the NOx emissions from on-road gasoline-fueled motor vehicles in California; other test data indicate that "high-emitters" and earlier control technology vehicles will directionally respond to changes in oxygen content and RVP in the same way as the test fleet;

The ARB Ethanol Test Program was conducted under the guidance and review of an Ethanol Workgroup comprised of representatives of the ethanol, automotive, and oil refining industries, the U.S. Environmental Protection Agency, ARB staff and other interested parties;

The evaporative and exhaust emission tests conducted in the ARB Ethanol Test Program are independently verifiable in that they were conducted under the guidance and review of the Ethanol Workgroup, they were carefully documented, and the results were consistent with the results of other test programs;

The comparative ozone-forming potential for the two fuels in the test program was determined from a reactivity-adjusted emissions analysis applying the Carter maximum incremental reactivity (MIR) scale to each species of nonmethane organic gas and to the carbon monoxide (CO) measured in the exhaust and evaporative emissions from the tested vehicles; this is an appropriate methodology based on the approach in the ARB's low-emission vehicle regulations, and it is appropriate to additionally account for the reactivity of the CO emissions because the 10 vol.% ethanol blend has a higher oxygen content and therefore results in a significant decrease in CO emissions;

The results of the ARB Ethanol Test Program on comparative ozone-forming potential are directionally consistent with the complex models established by U.S. EPA for use in the federal reformulated gasoline regulations;

The results of the ARB Ethanol Test Program on comparative ozone-forming potential are also consistent with other test programs that have shown that the substantial increase

in mass evaporative emissions from the 1 psi increase in RVP associated with an elevated RVP gasoline containing 10 vol.% ethanol will overwhelm the mass exhaust emission reductions due to the higher oxygen content of such a fuel, and that the difference in the reactivity of evaporative and exhaust emissions is within the range seen in the ARB Ethanol Test Program and is not substantially affected by the use of oxygenates and the type of oxygenate; and

The determination made in this Resolution is not expected to result in a significant adverse impact on the environment.

NOW, THEREFORE, BE IT RESOLVED that the Board hereby determines, on the basis of independently verifiable automobile exhaust and evaporative emission tests performed on a representative fleet of automobiles, that elevated RVP gasoline containing 10 vol.% ethanol will result in a net increase in the ozone-forming potential of the total emissions, excluding emissions of NOx, when compared to the total emissions, excluding emissions of NOx, from the same automobile fleet using gasoline that meets all applicable specifications for CaRFG.

BE IT FURTHER RESOLVED that the determination made in this Resolution eliminates the Health and Safety Code section 43830(g) exemption from the ARB's RVP standard for gasoline containing 10 vol.% ethanol.

I hereby certify that the above is a true and correct copy of Resolution 98-78, as adopted by the Air Resources Board.

Pat Hutchens

Pat Hutchens, Clerk of the Board