

State of California  
AIR RESOURCES BOARD

Final Statement of Reasons for Rulemaking,  
Including Summary of Comments and Agency Response

PUBLIC HEARING TO CONSIDER AMENDMENTS TO THE FUEL SPECIFICATIONS FOR M100  
FUEL METHANOL

Public Hearing Date: December 8, 1994  
Agenda Item No.: 94-12-3

I. GENERAL

In 1992 the Air Resources Board (ARB) adopted commercial and certification fuel specifications for alternative motor vehicle fuels. That rulemaking established fuel specifications for M100, which is nominally 100 percent methanol fuel. Included in the specifications is a requirement that the fuel contain a luminosity additive because M100 burns without a readily visible flame under maximum daylight conditions. Since an additive had not yet been identified which would satisfy this criterion, the Board directed staff to investigate potential additives and delayed the deadline for compliance with the luminosity requirement to January 1, 1995.

To date, an acceptable additive has not been identified which does not increase emissions. However, there are several hundred M100 vehicles currently in operation in California for which fuel could be unavailable after December 31, 1994 in the absence of an acceptable additive. For this reason, staff proposed an interim solution which both satisfies staff's safety concerns with a fuel that has an invisible flame and allows these vehicles to continue in operation. Staff proposed an amendment under which a non-luminous M100 motor vehicle fuel could be sold as long as the vehicles in which it would be used are equipped with some type of automatic fire suppression system or luminosity-enhancing equipment. The staff proposal is more fully described in the Initial Statement of Reasons for Rulemaking entitled "Amendments to the Fuel Specifications for M100 Fuel Methanol" (staff report), which was made available for public inspection on October 21, 1994. The staff report included the text of the proposed amendment, and is incorporated by reference herein.

On December 8, 1994, the Board conducted a public hearing at which it received written and oral comments on the proposed amendment. At the conclusion of the hearing, the Board adopted Resolution 94-68, in which the amendment to section 2292.1 of Title 13, California Code of Regulations, was adopted as proposed. Based on the public comments, the Board also instructed the staff to evaluate existing risk assessments of the fire safety of M100 motor vehicle fuel compared to other motor vehicle fuels. If the staff concludes that relative fire safety of M100 shown by the existing data justifies deletion of the M100 luminosity requirement, the staff is to return to the Board with a regulatory proposal to repeal the requirement. Otherwise, the staff is to work with the California Energy Commission and

others in the preparation of an adequate comparative fire risk assessment, and to bring before the Board within two years a proposed amendment that would enable the Board to repeal the luminosity requirement if it chooses to do so.

The Board has determined that this regulatory action will not result in a mandate to any local agency or school district, the costs of which are reimbursable pursuant to Part 7 (commencing with section 17500), Division 4, Title 2 of the Government Code.

The Board has determined that no alternative considered by the agency would be more effective in carrying out the purpose for which the regulatory action was proposed or would be as effective and less burdensome to affected private persons than the action taken by the Board. The basis for this determination is as follows.

The purpose of the regulatory action is to avoid a situation in which implementation of the luminosity requirement in 1995 effectively precludes the use of M100 vehicles, and at the same time continue to reduce the risk of exposure to methanol fires with invisible flames. In preparing the regulatory proposal, the staff concluded that the alternative of eliminating the luminosity requirement would not be prudent because it would increase the risks associated with methanol fires.

Commenters stated that even with the amendment proposed by staff, the luminosity requirement will deter the development and introduction of M100 vehicles. As summarized in comments 13 through 17 below, they indicated that any increased fire risk associated with the non-luminous nature of M100 flames is more than offset by the fact that the fire risks of M100 vehicles are less than the fire risks of vehicles operated on gasoline. They urged repeal of the luminosity requirement as the preferable alternative, because it would remove a burdensome requirement and simultaneously promote the development of M100 vehicles that are safer than gasoline vehicles from an overall fire safety perspective.

Board members concluded that repeal of the luminosity requirement would be justified if a comparative risk assessment shows that the overall fire risk of M100 vehicles is less than the fire risk associated with vehicles operated on gasoline and other fuels. Thus, at the conclusion of the risk assessment, a regulatory proposal to consider the fate of the luminosity requirement will be brought before the Board. However, repealing the luminosity requirement in the current rulemaking may be ineffective in assuring the continued operation of the M100 vehicles now in use in California, because there is a danger that repeal could be invalidated on the grounds that it is beyond the scope of the hearing notice. This is discussed in the response to comments 1 through 3.

## II. SUMMARY OF COMMENTS AND AGENCY RESPONSES

Prior to or at the hearing, oral and written comments were received from the California Energy Commission (CEC), the American Methanol Institute (AMI), the South Coast Air Quality Management District (SCAQMD), the

National Renewable Energy Laboratory (NREL), and the Sacramento Metro Air Quality Management District (SMAQMD). Written testimony was received from Volkswagen of America, the American Lung Association (ALA), and the United States Environmental Protection Agency (U.S. EPA). Oral testimony was given by the Los Angeles County Metropolitan Transit Authority and the Jet Propulsion Laboratory.

## GENERAL

1. Comment: The flame luminosity requirement in the M100 specification is an excellent example of the kind of innocuous and almost insignificant clause which can, in fact, spell the death of a major technology. AMI believes that the luminosity requirement should be removed entirely. (AMI)

2. Comment: To restrict the development of M100 on luminosity alone seems short-sighted. Our recommendation is to eliminate the luminosity requirement from M100 fuel. (Volkswagen)

3. Comment: SMAQMD does not support the proposed regulation to require all M100 vehicles to be equipped with an automatic fire suppression. (SMAQMD)

Agency Response: Under the ARB's existing regulation, M100 motor vehicle fuel must meet the luminosity requirement starting January 1, 1995. At the time of this rulemaking, an acceptable luminosity additive has not been identified which could meet the M100 fuel specification. Without an amendment, therefore, the use of M100 as a motor vehicle fuel would be effectively prohibited starting January 1, 1995.

Since the existing luminosity provision was not intended to eliminate M100 as a motor vehicle fuel, staff proposed an interim solution that would allow the several hundred M100 vehicles that are currently operating in the state to continue to do so. The proposed amendment would allow vehicles that are equipped with a fire suppression or luminosity enhancement system to use an M100 fuel that did not contain a luminosity additive. All but four of the M100 vehicles currently in operation in the state are already equipped with fire suppression equipment and it is expected that those four vehicles will be eligible for an exemption from the luminosity requirement which is available to demonstration vehicles. This interim solution would give staff needed time to assess the luminosity requirement and make a follow-up proposal to the Board.

At the hearing on this matter, the Board received compelling information indicating that, on an overall fire-risk basis, non-luminous M100 is safer than M85 or gasoline. However, public acceptance of M100 as a motor vehicle fuel depends in large part on an understanding and accurate perception of the overall fire risks of M100 compared to those of other vehicle fuels. The action the Board is taking will enable the Board to consider repeal of the luminosity requirement in the context of a clearer comparative analysis of motor vehicle fuel risks. This approach will help

make the public aware of the relative fire safety of vehicles operated on non-luminous M100.

In addition, concerns were raised at the hearing that full repeal of the luminosity requirement might not be within the scope of the notice and the proposed regulatory amendments as required by Government Code section 11346.8(c). If the Board was to repeal the luminosity requirement and this action was subsequently found to be beyond the scope of the notice, the result would be that the existing luminosity requirement would apply starting January 1, 1995, without the exception for M100 used to fuel vehicles with an automatic fire suppression system or luminosity-enhancing equipment.

#### NEED FOR RISK ASSESSMENT

4. Comment: CEC believes that adoption of the proposed amendment to the flame luminosity requirement for M100 is adequate for the short term. However, the question of the long-term need for the M100 flame luminosity requirement should be explored in the broader context of a fire risk assessment. The compelling reason for this recommendation is the lack of a definitive comparative fire safety risk assessment for M100 and other alternative fuels relative to gasoline and diesel in motor vehicles. The real question that should be answered by such an assessment is whether alternative fuels (e.g., M100) provide a greater or lesser degree of fire risk and human injury in representative accident scenarios when compared to gasoline. The Board should direct staff to work with CEC and report back to the Board in two years after completion of a formal risk assessment for a variety of alternative fuels. (CEC)

5. Comment: The SCAQMD believes it is important to put this issue in a longer-term air quality context. The potential for M100 as a ULEV fuel for combustion engines and as a ZEV energy source in fuel cells is too important to overlook. All of the transportation fuels, conventional as well as the clean alternatives, have obvious trade-offs. Given the potential long-term importance of M100, it would be very constructive if a formal technical evaluation, as proposed by CEC, would be conducted on the relative fire safety of M100 compared to M85 and gasoline. The District would be pleased to join the ARB and CEC in support of such an evaluation. (SCAQMD)

6. Comment: Before any luminosity requirement becomes a permanent regulation, a thorough assessment of the inherent risks of different fuel formulations should take place. The risks associated with each fuel's physical properties are volatility, flammability, fire intensity, flame luminosity, and toxicity. The assessment should determine the risks associated with vehicle use (including on-road accidents and vehicle fires), public refueling, and fuel distribution. The fuel set should include but not be limited to M100, M85, reformulated gasoline, diesel fuel, and any methanol formulations blended specifically for the luminosity requirements. The risk assessment will also need to take into consideration how weathering may effect the fuel and cause the luminosity additive to be less effective in practice than during testing.

Along with the risk assessment, an engineering analysis of the problems and hazards associated with the transportation, public refueling, and end-use of methanol needs to be done. The analysis should include how refueling system design and user education along with fuel formulation could minimize a fuel's risks. The analysis should also address the potential safety benefits associated with each fuel.

For any luminosity additive, the additive's effect on vehicle emissions, material compatibility, and component durability will need to be investigated. Solving the luminosity requirement at the expense of another area, such as an increase in vehicle emissions, is probably not a viable long-term solution. (NREL)

7. Comment: The Board should move forward with a solution to the luminosity issue that does not compromise M100 emission performance. (ALA)

Agency Response: As indicated in the response to the first comments, we agree that the luminosity requirement should be evaluated in the context of a comparative analysis of the relative fire risks of different motor vehicle fuels, including non-luminous M100. We fully agree that a risk assessment would be useful, and the Board has directed the staff to work with the CEC on such an assessment. The amendment adopted in this rulemaking allows M100 to continue to be developed and used as a motor vehicle fuel while the comparative fire risks of different motor vehicle fuels are evaluated.

#### REGULATION MAY IMPEDE DEVELOPMENT OF M100 VEHICLE TECHNOLOGY

8. Comment: AMI believes that the proposed amendment is necessary but it is not sufficient. Insisting on M100 luminosity impedes the development of a clean fuel and seriously prejudices the development of M100 vehicles. Further development funds are not likely to be readily available for a fuel whose use will be declared illegal by the ARB. In addition, there are people in California currently doing research on developing a methanol fuel cell. Their research and their jobs would become meaningless if you were to insist on this flame luminosity requirement, because there wouldn't be any point in using a fuel whose eventual use is going to be illegal. (AMI)

9. Comment: If the proposed commercial restrictions on marketing M100 are maintained indefinitely, a significant barrier to future M100 research, development and commercialization will be created. A permanent requirement to utilize on-board fire detection and suppression systems would place a major cost disadvantage on the use of M100. In the interest of long-term air quality progress, it is therefore essential that a permanent barrier to M100 commercialization not be created. (SCAQMD, SMAQMD)

10. Comment: Any methanol formulation will need to consider the issues of cost and complexity because these issues might limit M100's use as an alternative transportation fuel. (NREL)

11. Comment: The Board should make an effort to avoid impeding or eliminating M100 fuel technology development through such regulations as the one establishing the luminosity requirement. (ALA)

12. Comment: A luminosity regulation for M100 fuel that requires an additive or additional equipment on a vehicle is not necessary, and will serve to inhibit development of a promising fuel technology. (Volkswagen)

Agency Response: M100 is an important potential alternative fuel which can help promote energy diversity as well as help meet the clean air goals of the State. However, it is important to recognize potential safety issues connected with a fuel that burns without a readily visible flame in bright sunlight. The approach taken by the Board will help inform the public regarding the comparative fire risks of M100 and other motor vehicle fuels such as gasoline. This could ultimately result in a greater public acceptance of M100 as a motor vehicle fuel.

Since all but four of the several hundred M100 vehicles currently operating in the State are already equipped with fire suppression equipment, the amendment adopted in this rulemaking will not require immediate action by operators of these vehicles. Rather it provides an interim solution that may be more cost-effective than having to retrofit these vehicles. The four M100 vehicles not currently equipped with fire suppression equipment are expected to ultimately qualify for an exemption available to vehicles used in test programs, so that these fleet owners would also not incur any costs to meet the amended requirement. In the longer term, the Board will consider repealing the luminosity requirement.

#### COMPARATIVE FIRE AND SAFETY RISKS OF M100

13. Comment: Compared with gasoline, the fire safety benefits resulting from methanol's smokeless combustion and advantageous physical properties in a fire situation completely outweigh any concerns associated with methanol's relatively non-luminous flame. M100 is difficult to ignite compared to gasoline, diffuses to non-ignitable levels in the atmosphere, has a low flame temperature, produces a smokeless flame, and has a high latent heat of evaporation which greatly reduces flame propagation. Methanol fires are easier to extinguish and harder to ignite compared to other liquid fuels. (AMI, U.S. EPA, SCAQMD, Volkswagen, SMAQMD)

14. Comment: The occurrence of a methanol-only smokeless fire would be extremely limited. To forego the advantages for the sake of a rare and relatively low hazard event is unjustified. If you forego the use of methanol in the future by insisting on a luminosity requirement that can't be met, you're forcing people to use other fuels which are a higher fire risk. (AMI)

15. Comment: The chance of a luminous fire occurring is extremely small. The risks associated with non-luminous flames are generally not with fires on vehicles but with separate pool fires in which no other carbonaceous material is burning. The possibility of producing a sustained invisible flame through the life of the fire with M100 on a vehicle is a

virtual impossibility based on the fact that other luminosity producing fuels on the vehicle (paint, rubber, plastic, etc.) will begin to burn. In addition, the incidence of vehicle fires in which there is a major fuel tank rupture as compared to the overall number of vehicle fires is quite low. The fire safety benefits of M100 overwhelm any possible added risk due to the luminosity issue. It is poor public policy to restrict a safer fuel from being used because of safety concerns.

Attempts to add luminosity to the M100 flame may result in a change of M100's flammability characteristics. A luminous flame can have greater radiative heat transfer thus increasing the likelihood of ignition of other objects, increasing the burning rate, creating a more vigorous fire and thus posing a greater hazard to humans. Luminosity additives can also increase M100's likelihood of ignition as is the case with the addition of gasoline to M100 to make M85. (U.S. EPA)

16. Comment: What is the probability that pure methanol will ignite and not involve any other type of material? We think the risk is very low, but the chances of killing the future industry are 100 percent if you keep the luminosity requirement. (AMI)

17. Comment: As an automobile manufacturer, Volkswagen is not concerned that an M100 vehicle would offer additional fire risk compared to a gasoline vehicle. Volkswagen believes that in the case of M100, a fuel related fire would quickly generate visible flame or smoke due to the ignition of other materials on the vehicle (plastic, rubber, paint, etc.).

It is Volkswagen's belief that M100, being liquid and not requiring storage under pressure, has safety merits in terms of handling, transportation and vehicle applications. Volkswagen is interested to hear if the ARB has concerns with the luminosity of other clean fuels, as it appears that M100 has been singled out as a fuel that requires extra caution. (Volkswagen)

Agency Response: The characterizations of the commenters are likely accurate. Conducting a comparative fire safety risk assessment will help inform the public of the relative risks of non-luminous M100 and other motor vehicle fuels. A determination that, on an overall fire safety basis, there is less fire risk associated with non-luminous M100 than there is with M85, gasoline, or an M100 containing a luminosity additive, would justify repeal of the luminosity requirement.

#### MISCELLANEOUS

18. Comment: Requiring suppression systems on M100 fueled vehicles is not a luminosity issue (because fires on the vehicle are luminous), but a fire suppression issue. If the risks are not great enough to warrant fire suppression systems on all gasoline and diesel vehicles then the decision as to whether to install any fire suppression systems resides with the manufacturer or vehicle purchaser. We can see little justification for any requirement for suppression systems on M100 powered vehicles while not including gasoline and diesel vehicles. (U.S. EPA)

Agency Response: This point can best be evaluated in the upcoming fire safety risk assessment comparing various motor vehicle fuels. As mentioned previously, the amendment adopted in this rulemaking is an interim solution which allows existing M100 vehicles to continue operating in California.

19. Comment: We would encourage the consideration of extending the requirement that M100 need not have a luminosity additive to M100 fuel that is used in light duty vehicles due to the inherent safety advantage of M100 over gasoline and diesel fuels. (U.S. EPA)

Agency Response: The adopted amendment applies to light-duty vehicles operating on M100 as well as heavy-duty vehicles. We expect that future Board action on the luminosity requirement will apply to M100 used in both classes of vehicles.

20. Comment: We do not believe that E100 should have a luminosity requirement either. (U.S. EPA)

Agency Response: Under current regulations, E100 (100 percent ethanol) does not have a luminosity requirement because it has been determined that the flame is visible under maximum daylight conditions.

21. Comment: It is critical to include vehicle hardware as possible solutions to the luminosity requirement. If the regulation is written without including possible hardware solutions, then funding of these hardware projects may be discontinued. (NREL)

Agency Response: If the Board concludes as a result of the risk assessment that a luminosity requirement is needed for M100, we expect that the hardware option adopted in this rulemaking would be retained.

22. Comment: Due to the new regulations for gasoline even M85 may have a hard time meeting the M100 luminosity requirement of a visible flame throughout the length of the burn. M85's flame may be even less visible if the fuel has weathered. What does the ARB plan to do if a M85 fuel doesn't meet their luminosity requirement? (NREL)

Agency Response: At the present time we do not have information which would indicate that M85 may have an invisible flame if the gasoline portion is Phase 2 reformulated gasoline. However, if information does become available, staff will review and make an assessment at that time.

23. Comment: The public will be better served and safer if more energy is spent on programs that increase the awareness of the characteristics and properties of all the future alternative fuels. (Volkswagen)

Agency Response: We agree that public awareness and education are very important elements for the successful introduction and implementation of alternative fuels. The ARB and CEC are working together to help facilitate the commercialization of alternative fuels.

24. Comment: If there is such a need for a bladder in the fuel tank, why don't we have them already in gasoline cars? It's the same principle. We don't and there isn't such a technology, nor can we allow the future of methanol to depend on the uncertain development of a successful technology of that kind. (AMI)

Agency Response: A bladder is not required in a gasoline fuel tank because it is not necessary as gasoline burns with readily visible flame. Staff acknowledges that bladder technology is still in a development stage; however, this option was proposed to demonstrate that there was flexibility in the proposed amendment that allows manufacturers to utilize the most cost-effective system.