National Transportation Safety Board

Office of the Chair

Washington, DC 20594

November 14, 2022

Dockets Operations
US Department of Transportation
1200 New Jersey Avenue SE
West Building Ground Floor
Room W12–140
Washington, DC 20590-0001

Re: Docket Number FMCSA-2022-0163

Dear Sir or Madam:

The National Transportation Safety Board (NTSB) has reviewed the Federal Motor Carrier Safety Administration (FMCSA) request for comments (RFC) titled "Human Factors Considerations in Commercial Motor Vehicle Automated Driving Systems," published at 87 *Federal Register* 57750 on September 21, 2022. The RFC invites comments on a proposed simulator study that will evaluate how commercial motor vehicle (CMV) drivers engage in SAE International Level 2 (L2) and Level 3 (L3) automated driving system (ADS)-equipped CMVs.[1] The purpose for obtaining data in this study is to: (1) determine the effect of distraction on CMV drivers of L2 vehicles; (2) determine the effect of transfer of control on CMV drivers in L3 vehicles; and (3) develop and evaluate a training program that is designed both to decrease the levels of distraction that were identified in CMV drivers in L2 vehicles as well as to improve the problems with the transfer of control that were identified in L3 vehicles. The FMCSA adds that the findings of the study will inform training materials to educate drivers on distraction and ADS functionality as well as policy pertaining to the implications of ADSs in CMVs.

The NTSB supports the FMCSA's study to learn more about the effects of distraction and drivers' interaction with automation-equipped CMVs. For more than 5 years, we have been responding to crashes involving both production-level L2 systems and developmental ADS test vehicles, and we have identified driver

[1] SAE International, initially established as the Society of Automotive Engineers, is a professional association and standards-developing organization. SAE classifies an L2 system as "partial driving automation." In an L2 system, it is the driver's responsibility to monitor the automation, maintain situational awareness of traffic conditions, understand the limitations of the automation, and be available to intervene and take full control of the vehicle at all times. An L3 system is classified as "conditional driving automation." An L3 ADS is responsible for the dynamic driving task within a designated operational design domain, with the expectation that a fallback-ready operator is receptive to requests from the ADS to intervene as well as to any system failures within the vehicle.

distraction, automation complacency, and lack of oversight of ADS testing as areas of significant concern.[2] Although the crashes investigated involved drivers and operators supervising automation in passenger vehicles and an autonomous shuttle, the lessons learned and implications of automation complacency translate directly to CMV operations. The research plan described in the RFC will help to better inform the FMCSA on future risk mitigation strategies, but it is also critical that the FMCSA act now to ensure that current ADS testing on public roads is conducted safely and that technology is appropriately leveraged to limit CMV operators from engaging in non-driving-related tasks.

The following sections will discuss some of the lessons learned from our crash investigations, with an emphasis on risk mitigation pertaining to monitoring driver engagement and on safeguards needed for ADS deployment.

Risk Mitigation Pertaining to Monitoring Driver Engagement

Based on system design of an SAE-defined L2 partial driving automation system, it is the driver's responsibility to monitor the automation, maintain situational awareness of traffic conditions, understand the limitations of the automation, and be ready to immediately intervene and take over from the automation system at all times. In practice, however, drivers tend to be ineffective at monitoring automation and performing tasks requiring continuous vigilance.[3] Research shows that drivers often become disengaged from the driving task for both momentary and prolonged periods during automated phases of driving.[4]

Between May 2016 and March 2019, the NTSB investigated four crashes involving vehicles operating with partial automation. Driver disengagement from supervising the partial automation system was a critical factor in all four crashes. In the Mountain View, California, and Culver City, California, crashes, both drivers were distracted and neither driver was supervising system performance nor monitoring the

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[2] Use the NTSB's CAROL Query to search for information on NTSB investigations and recommendations. In particular, our reports on the following crashes discuss investigations and recommendations related to vehicles operating with partial automation: Williston, Florida (NTSB/HAR-17/02); Culver City, California (NTSB/HAB-19/07); Delray Beach, Florida (NTSB/HAB-20/01); and Mountain View, California (NTSB/HAR-20/01). Our report on a crash in Las Vegas, Nevada (NTSB/HAR-19-06), examines a low-speed collision between a truck-tractor and an autonomous shuttle and concludes that the operator of the shuttle was not in position to take manual control of the automated vehicle in an emergency. Our Tempe, Arizona, crash investigation (NTSB/HAR-19/03) identifies deficiencies in oversight and management of safety risk in developmental ADS vehicles.

[3] See Parasuraman, R., and V. Riley. 1997. "Humans and Automation: Use, Misuse, Disuse, and Abuse." *Human Factors* 39(2): 230–253; Moray, N., and T. Inagaki. 2000. "Attention and Complacency." *Theoretical Issues in Ergonomics Science* 1: 354–365; and Parasuraman, R., and D. H. Manzey. 2010. "Complacency and Bias in Human Use of Automation: An Attentional Integration." *Human Factors* 52(3): 381–410.

[4] See Banks, V. A., A. Erickson, J. O'Donoghue, and N.A. Stanton. 2018. "Is Partially Automated Driving a Bad Idea? Observations from an On-Road Study." *Applied Ergonomics* 68: 138–145.

driving environment (detecting and recognizing roadway hazards) leading up to the crashes. Likewise, in the Williston, Florida, and Delray Beach, Florida, crashes, the drivers were inattentive and did not take any evasive action in response to semitrailer vehicles crossing the paths of their cars. The partial automation systems in the involved vehicles assessed the driver's level of engagement by monitoring his or her interaction with the steering wheel through changes in steering wheel torque. However, because driving is a highly visual task, a driver's touch or torque on the steering wheel gives little indication of where the driver is focusing his or her attention.

Following the investigation of the Williston crash, the NTSB concluded that the partial automation system's method of monitoring and responding to the driver's interaction with the steering wheel was not effective in ensuring driver engagement. As a result, the NTSB recommended that manufacturers of vehicles equipped with L2 partial driving automation systems develop applications to more effectively sense the driver's level of engagement and alert the driver when engagement is lacking while automated vehicle control systems are in use (Safety Recommendation H-17-42, issued to six manufacturers and currently classified "Open—Acceptable Response" overall).[5]

Because driver attention is an integral component of lower-level automation systems, a driver monitoring system must be able to assess whether and to what degree the driver is performing the role of automation supervisor. As highlighted by our recent investigations, drivers were able to disengage for prolonged periods of time. In the United States, no minimum performance standards exist for the appropriate timing of alerts, the type of alert (visual, auditory, or haptic [touch]), or the use of redundant monitoring sensors to ensure driver engagement. As a result of the Mountain View, California, crash, the NTSB recommended that the National Highway Traffic Safety Administration (NHTSA) work with SAE International to develop performance standards for driver monitoring systems that will minimize driver disengagement, prevent automation complacency, and account for misuse of automation (Safety Recommendation H-20-3). We further recommended that NHTSA, after developing performance standards for driver monitoring systems, require that all new passenger vehicles with L2 automation be equipped with a driver monitoring system that meets these standards (Safety Recommendation H-20-4). Safety Recommendations H-20-3 and -4 are currently classified "Open—Acceptable Response."

NTSB investigations and research continue to show that drivers routinely fail to maintain vigilance while relying on automation, and that automation systems'

[5] This recommendation is currently classified "Open—Acceptable Response" for five of the six manufacturers: Volkswagen Group of America, Inc.; BMW North America, LLC; Nissan Group of North America, Inc.; Mercedes-Benz USA, LLC; and Volvo Cars of North America, Inc. This recommendation is currently classified "Open—Unacceptable Response" for Tesla Motors.

mechanisms for monitoring driver attentiveness are often insufficient. Therefore, it is critical that the FMCSA recognize the implications of automation complacency when developing CMV training programs and prioritize the establishment of accurate performance standards for ensuring driver engagement.

Safeguards Needed for ADS Deployment

The NTSB sees potential in the ability of ADSs to mitigate or prevent crashes on our roadways. Unfortunately, there has been an absence of safety regulations and federal guidance on how to adequately evaluate an ADS. Although the Department of Transportation has published multiple iterations of automated vehicle guidance, it provides insufficient instructions on how ADS developers should accomplish the safety goals of the 12 ADS safety elements—for example, training vehicle operators, ensuring oversight, and evaluating whether an ADS has reached a level of safety functionality.[6]

In our investigation of a fatal crash involving a developmental ADS vehicle in Tempe, Arizona, we found significant deficiencies in the ADS developer's management of safety risk, as well as in the federal and state oversight of ADS testing. As a result, we recommended that NHTSA (1) require entities who are testing or intend to test a developmental ADS on public roads to submit safety self-assessment reports; and (2) establish an ongoing process for evaluating these reports to determine whether appropriate safeguards—such as adequate monitoring of vehicle operator engagement, if applicable—are being included in the testing (Safety Recommendations H-19-47 and -48, currently classified "Open—Unacceptable Response").

As CMV ADSs are being deployed and tested in real-world operations, drivers' ability to recognize automation failure and their readiness to assume immediate control of ADS-equipped vehicles are vital to ensuring the safety of all motorists and vulnerable road users. Because of the sheer size and weight of CMVs, these vehicles have significant potential to cause catastrophic damage, injury, and death if appropriate safeguards are not implemented before ADSs are deployed on public roadways. Although the FMCSA has stated that one of the objectives of the study is to develop and evaluate a training program designed to decrease levels of distraction, our investigations have shown that driver monitoring should be a critical component of any L2 and future ADS. Therefore, we encourage the FMCSA to also evaluate the tested systems' ability to maintain driver engagement and examine the most effective

[6] See the 2016 Federal Automated Vehicle Policy: Accelerating the Next Revolution in Roadway Safety, 2017 Automated Driving Systems 2.0: A Vision for Safety, and 2018 Automated Vehicles 3.0: Preparing for the Future of Transportation. The 12 safety elements described in ADS 2.0 are: system safety, operational design domain, object event detection and response, fallback (minimal risk condition), validation methods, human machine interface, vehicle cybersecurity, crashworthiness, post-crash ADS behavior, data recording, consumer education and training, and federal/state/local laws.

means of accomplishing that goal (for example, head or eye tracking). Finally, we encourage the FMCSA to evaluate the effectiveness of technology designed to prevent automation complacency and account for misuse of automation.

Summary

In conclusion, the NTSB supports the FMCSA's research effort to evaluate how CMV drivers engage in SAE L2- and L3-equipped CMVs. While the focus of the initiative is to develop a training program to improve driver readiness to operate an ADS-equipped CMV, it is important that any training developed be considered complementary to in-vehicle technology designed to minimize driver disengagement.

Thank you for the opportunity to provide comments.

Sincerely,

Jennifer Homendy
Chair