National Transportation Safety Board

Office of the Chair

Washington, DC 20594

March 17, 2023

Docket Management Facility, M–30
US Department of Transportation
1200 New Jersey Avenue SE
Room W12–140
West Building Ground Floor
Washington, DC 20590

Re: Docket Number FMCSA-2018-0037

Dear Sir or Madam:

The National Transportation Safety Board (NTSB) has reviewed the Federal Motor Carrier Safety Administration (FMCSA) supplemental advance notice of proposed rulemaking (SANPRM) titled "Safe Integration of Automated Driving Systems (ADS)-Equipped Commercial Motor Vehicles (CMVs)," published at 88 *Federal Register* 6691 on February 1, 2023.[1] In the notice, the FMCSA requests public comment about what amendments to the Federal Motor Carrier Safety Regulations (FMCSRs) may be necessary to reduce safety risk associated with the operation of ADS-equipped CMVs. This request for information is a follow-up to an advance notice of proposed rulemaking (ANPRM) published March 26, 2018, that posed specific questions on FMCSRs which may be a barrier to safe testing and operation of ADS.[2]

The NTSB supports the FMCSA's efforts to learn more about the potential risks associated with the deployment of higher levels of automation in CMVs. Our response to this SANPRM is based on the lessons learned from our investigations of crashes involving vehicles operating in partial automation mode—specifically, SAE International level 2 (L2)—and those involving developmental ADS vehicles. We offer comments in the following areas: (1) the FMCSA decision to deselect L2 and L3

[1] ADS, as used in the SANPRM, refers to SAE International-defined driving automation levels 4 and 5 (L4 and L5). An ADS is the hardware and software that are, collectively, capable of performing the entire dynamic driving task on a sustained basis. L4 can operate within a specific operational design domain (ODD), while an L5 system has no ODD restrictions.

[2] See Docket No. FMCSA-2018-0037 titled "FMCSRs which may be a Barrier to Safe Testing and Deployment of ADS-Equipped CMVs on Public Roads," accessed February 10, 2023. In this prior ANPRM, the FMCSA posed specific questions on the following topics: whether the FMCSRs should require a human driver; commercial driver's license endorsements; driver's hours of service rules; medical qualification standards for human operators; distracted driving and monitoring; requirements to ensure safe driving; inspection, repair and maintenance; roadside inspections; cybersecurity; and confidentiality of shared information.

systems from the future regulation, (2) the importance of driver/operator engagement in ADS operation, and (3) steps needed for the safe testing of ADS on public roads. Our response will then address the specific questions from the SANPRM related to the proposed notification requirements, vehicle inspection, and maintenance requirements for motor carriers operating ADS.

Lessons Learned from NTSB Crash Investigations

Although we have not investigated any crashes involving CMVs operating in L2 mode, the lessons learned from other crashes involving vehicles operating with partial automation are still applicable to this SANPRM. Between May 2016 and March 2019, the NTSB investigated four crashes—three resulting in fatalities—that involved vehicles operating in L2 mode.[3] In addition, in July 2019, the NTSB completed an investigation of a minor crash involving an autonomous shuttle on its first day of operation with passengers in Las Vegas, Nevada.[4] In November 2019, the NTSB completed its investigation of the first fatal crash involving a vehicle controlled by a developmental ADS and monitored by an in-vehicle human operator. That crash, which occurred in Tempe, Arizona, demonstrated the complexity of ADS testing and highlighted the need for ADS developers, operators, and state and federal agencies to play comprehensive and cooperative roles.[5]

One of the main lessons learned from the investigations of the L2 crashes relates to the criticality of human monitoring and the absolute necessity of developing an effective countermeasure for eliminating automation complacency. The investigations of the two crashes involving testing of ADS-equipped vehicles focused on safe testing on public roads and the National Highway Traffic Safety Administration's (NHTSA) critical role in establishing minimum safeguards. Lessons learned, as well as some of the issued safety recommendations from these six investigations, are further examined later in this response.

The attachment to this response lists open safety recommendations pertaining to automated vehicle (AV) safety that still require action by the US Department of Transportation (DOT) and others. Additionally, the NTSB has developed an "Automated Vehicle" webpage which contains more detailed information regarding our investigations and prior research on ADS.[6]

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[3] See our reports on crashes in 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).

[4] See our report about the Las Vegas, Nevada, crash (NTSB/HAB-19/06).

[5] See our report about the Tempe, Arizona, crash (NTSB/HAR-19/03).

[6] See the "Automated Vehicles" webpage on www.ntsb.gov.

Monitoring Driver and Operator Engagement with ADS

As ADS are being developed and tested, situations continually arise that necessitate a human operator to take control of the vehicle. In the Tempe crash, the ADS could not accurately predict the path of the detected pedestrian nor that the pedestrian was on a collision course with the test vehicle. This failure of automation occurred at the same time that the human operator inside the test vehicle was distracted by their phone. In that respect, the currently developed ADS have considerable similarities with the currently produced L2-capable vehicles, in that the human is a critical component of the system. In the Tempe crash and in the four crashes involving vehicles operating in L2 mode, the NTSB found that the drivers were disengaged and not appropriately supervising automation performance or monitoring the driving environment. In the Las Vegas crash, the NTSB found that although the attendant was engaged, the design of the autonomous shuttle—which did not include traditional vehicle controls—did not afford the attendant inside the shuttle sufficient means to take control of the vehicle.

In our investigations of the four crashes involving L2 systems and in the investigation of the Tempe crash, we examined the role of automation complacency. Research on this topic crosses numerous industries and spans more than half a century, with robust findings that we, as humans, often perform poorly in the role of automation monitor. Moreover, the nature of complacency is such that when an automated system behaves consistently and reliably for prolonged periods, the human monitor becomes complacent and may not respond appropriately or detect failures when they occur.

Because driver/operator attention is an integral component of an L2 system, a driver monitoring system is essential to ensure that the driver is engaged in the driving task. However, there are no minimum performance standards for such driver monitoring systems that would specify the adequate metric for assessing the level of engagement (for example, eye movements or steering wheel torque) or appropriate alerts for reorienting a driver's attention. As a result of our investigation of a crash in Mountain View, California, we recommended that NHTSA work with SAE International to develop performance standards for driver monitoring systems that will minimize driver disengagement, prevent automation complacency, and account for foreseeable misuse of the automation.[7]

The FMCSA has stated that it "does not believe there is a need to revise the FMCSRs to accommodate the integration of Levels 0-3 equipment because a licensed human CMV driver must be seated behind the wheel of these vehicles at all times to perform, or be ready to take over, dynamic driving tasks." The implicit assumption of this statement is that the CMV driver will be unaffected by automation complacency

[7] See Safety Recommendations H-20-03 and -04, currently classified Open—Acceptable Response.

and will take over control of the vehicle when the system fails, an assumption that is not supported by research or by the results of our investigations. Any system that relies on a human driver or operator as a fallback or to monitor performance of the system presents significant safety risks. It is for this reason that the NTSB supports the FMCSA's research effort to evaluate how CMV drivers engage in SAE L2- and L3-equipped CMVs.[8] It is premature for the FMCSA to conclude that simply having a licensed CMV driver in the driver's seat while operating in lower levels of automation provides sufficient mitigation of the crash risk associated with automation complacency. The results of NTSB investigations have demonstrated how poor design can impact a driver's tendency to over-rely on automation, sometimes with deadly results. NHTSA's actions on these NTSB recommendations will assist the FMCSA to ensure the safety of CMVs operating at lower levels of automation.

Additionally, the FMCSA has stated its position that hours-of-service (HOS) requirements, along with other requirements for CMV drivers, should apply to remote drivers. We presume that these HOS requirements would also apply to a human monitor inside the vehicle. While we support the agency in regulating HOS for human monitors, the FMCSA should examine whether the current HOS requirements are suitable for the task of automation monitoring. Considerable research exists in this area that can inform the agency about suitable requirements that would minimize the risk of automation complacency, including the number of total hours, frequency of breaks, and engagement strategies.

Safe Testing of ADS on Public Roads

In our investigation of the Tempe crash, 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. We stressed that NHTSA needs to require basic information from developers to ensure the safe testing of ADS-equipped vehicles on public roads. We also argued that NHTSA and the DOT should make more effective use of an already established basic framework for safe ADS testing: the DOT's AV policy.

In the second iteration of its AV policy (AV 2.0), the DOT provided guidance in the form of 12 safety-relevant elements and encouraged ADS developers and operators to submit voluntary safety self-assessment reports describing their approach to safety.[9] Although these components of the DOT's AV policy provide a promising framework for the safe testing of ADS, challenges remain—specifically, the

[8] FMCSA. 2022. "Human Factors Considerations in Commercial Motor Vehicle Automated Driving Systems." Notice and request for comments. 87 *Federal Register* 57750. Docket No. FMCSA-2022-0163. September 21, 2022. https://www.govinfo.gov/content/pkg/FR-2022-09-21/pdf/2022-20405.pdf

[9] The 12 safety elements described in AV 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, postcrash ADS behavior, data recording, consumer education and training, and federal/state/local laws.

lack of a requirement for mandatory submission of the safety self-assessment reports and the absence of a process for NHTSA and the DOT to evaluate their adequacy.

As a result of our Tempe investigation, we recommended that NHTSA require the submission of safety self-assessment reports and establish an ongoing process for evaluating them, determining whether appropriate safeguards—such as adequate monitoring of vehicle operator engagement, if applicable—are included for testing a developmental ADS on public roads.[10] Additionally, because states would benefit from adopting regulations that require a thorough review of ADS developers' safety plans, including methods of risk management, we recommended that the American Association of Motor Vehicle Administrators encourage states to (1) require developers to submit an application for testing ADS-equipped vehicles that, at a minimum, details a plan to manage the risk associated with crashes and operator inattentiveness and establishes countermeasures to prevent crashes or mitigate crash severity within the ADS testing parameters; and (2) establish a task group of experts to evaluate the application before granting a testing permit.[11] NHTSA's failure to require ADS developers to submit safety self-assessment reports, as well as its failure to evaluate these reports, means that it is failing to provide the safeguards necessary to ensure that ADS testing on public roads is conducted with minimal safety risk.

Notification by Motor Carriers Operating ADS-Equipped CMVs

The FMCSA is considering establishing a requirement for motor carriers to notify the FMCSA if they plan to operate CMVs in interstate commerce without a human driver behind the wheel. Specifically, the FMCSA is seeking input from stakeholders on what information, data, or other evidence should be required before motor carriers are allowed to operate ADS-equipped CMVs.

Due to the increased size, weight, and damage-inflicting potential of heavy vehicles, the safety risks of testing and operating ADS-equipped heavy vehicles on public roads should necessitate a cautious approach. Our safety recommendations regarding the roles of federal and state governments in testing ADS-equipped vehicles are intended to reduce the safety risk of deploying these vehicles on public roads. Although the Tempe investigation was based on a robotaxi, which is a light vehicle, the FMCSA should consider adhering to these recommendations for safe testing and deployment of ADS-equipped CMVs. This approach would include the FMCSA developing a basic framework that characterizes safe testing and deployment, establishes methods of assessment, and defines the roles of the human component of the system (for example, a human inside the vehicle and a remote monitor and/or a remote assistant). Considering that ADS developers for any vehicle

[10] See Safety Recommendations H-19-47 and -48, currently classified Open—Unacceptable Response.

[11] See Safety Recommendation H-19-51, currently classified Closed—Acceptable Action.

types submit voluntary safety self-assessment reports to the DOT, the FMCSA's approach to monitoring ADS-equipped CMVs should also be coordinated with the DOT.

The SANPRM includes numerous questions related to inspection of CMVs and the extent to which regulations pertaining to CMV drivers should apply to operators of ADS-equipped vehicles as well as to remote operators and assistants. Considering that the NTSB has not investigated any crashes involving a CMV with partial or advanced levels of automation, we cannot reference specific safety recommendations related to ADS in heavy vehicles. However, certain lessons are universal, such as the risks of automation complacency and the criticality of maintaining functional sensors.

Vehicle Inspection and Maintenance

The SANPRM states that "motor carriers operating L4 or L5 ADS-equipped CMVs must comply with existing vehicle inspection and maintenance regulations, including the requirements for pre-trip, post-trip, periodic, and roadside inspections, unless and until those regulations are revised through an FMCSA final rule." The FMCSA is soliciting comments to better inform potential rulemaking proposals in the areas of inspection and maintenance of ADS-equipped CMVs.

The FMCSA should examine methods of performing a pre-trip inspection of ADS, such as a sensor calibration report. While pre- and post-trip inspections will continue to be critical to ensuring safe operations, no ADS should be permitted to operate unless it can be assured to operate with the same level of safety with which it was originally designed and required by regulation.

Recently, the NTSB concluded an investigation of a multi-vehicle collision involving multiple CMVs in Mt. Pleasant Township, Pennsylvania.[12] Three of the four CMVs in that crash were equipped with collision avoidance technologies, yet one vehicle—a United Parcel Service of America truck-tractor—had a radar sensor misalignment for its active brake assist system for over 6 months prior to the crash. The misalignment of the radar sensor meant that the collision avoidance system was non-functional at the time of the crash. The NTSB determined that although collision avoidance and automatic emergency braking (AEB) systems are designed to prevent crashes, the FMCSA does not require them to be reported as safety systems necessary for safe operation on driver vehicle inspection report (DVIR) forms because NHTSA has not yet designated collision avoidance systems as required equipment. The NTSB is concerned that, if safety technologies such as collision avoidance systems are not specifically identified on DVIR forms as safety systems, drivers may fail to report faults concerning them on the form, as occurred in this case. Without specific guidance on the form and associated training, drivers might not document

[12] See our report on the Mt. Pleasant Township, Pennsylvania, crash (NTSB/HIR-22/01).

defects in forward collision avoidance or AEB systems on DVIR forms. Without the notification for intervention (and repair) provided by a DVIR, a malfunctioning safety system could remain inoperative or faulty until a crash occurs. The NTSB recommended that the FMCSA add collision avoidance systems, including AEB, to the parts and accessories listed at 49 *Code of Federal Regulations* section 396.11 (a)(1) that the DVIR form will include.[13] We continue to be concerned that the FMCSA considers these L2 technologies to be optional equipment because they are not mandated by NHTSA; if other ADS equipment is also considered to be optional, then the maintenance requirements will not appropriately cover them.

Summary

Although ADS may improve CMV safety by reducing crashes and mitigating the severity of crashes that do occur, the FMCSA should proceed with extreme caution. We are pleased that the FMCSA is evaluating next steps to address complex issues related to operation of ADS and vehicle inspection requirements. We urge the FMCSA to reconsider its "hands-off" approach to lower levels of automation, which are being deployed in motor carriers' fleets today. Without further regulation of L2 and L3 CMVs to ensure that truck drivers are appropriately engaged in supervising automation, and without a means of ensuring that proper maintenance of these systems occurs, the potential benefits of these systems will not be realized.

Thank you for the opportunity to provide comments.

Sincerely,

[Original Signed]

Jennifer Homendy
Chair

[13] See Safety Recommendation H-22-5, currently classified Open—Acceptable Alternate Response.

Attachment: Pertinent NTSB Safety Recommendations that Require Action

H-17-37: To the US Department of Transportation – Define the data parameters needed to understand the automated vehicle control systems involved in a crash. The parameters must reflect the vehicle's control status and the frequency and duration of control actions to adequately characterize driver and vehicle performance before and during a crash. (Status: Open–Unacceptable Response)

H-17-38: To the National Highway Traffic Safety Administration – Develop a method to verify that manufacturers of vehicles equipped with Level 2 vehicle automation systems incorporate system safeguards that limit the use of automated vehicle control systems in those conditions for which they were designed. (Status: Open–Unacceptable Response)

H-17-39: To the National Highway Traffic Safety Administration – Use the data parameters defined by the US Department of Transportation in response to Safety Recommendation H-17-37 as a benchmark for new vehicles equipped with automated vehicle control systems so that they capture data that reflect the vehicle's control status and the frequency and duration of control actions needed to adequately characterize driver and vehicle performance before and during a crash; the captured data should be readily available to, at a minimum, NTSB investigators and NHTSA regulators. (Status: Open–Unacceptable Response)

H-17-41: To the manufacturers of vehicles equipped with Level 2 vehicle automation systems (Volkswagen Group of America, BMW of North America, Nissan Group of North America, Mercedes-Benz USA, Tesla Inc., and Volvo Group of North America) – Incorporate system safeguards that limit the use of automated vehicle control systems to those conditions for which they were designed. (Overall Status: Open–Acceptable Response)

H-17-42: To the manufacturers of vehicles equipped with Level 2 vehicle automation systems (Volkswagen Group of America, BMW of North America, Nissan Group of North America, Mercedes-Benz USA, Tesla Inc., and Volvo Group of North America) – 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. (Overall Status: Open–Acceptable Response)

H-19-47: To the National Highway Traffic Safety Administration – Require entities who are testing or who intend to test a developmental automated driving system on public roads to submit a safety self-assessment report to your agency. (Status: Open–Unacceptable Response)

H-19-48: To the National Highway Traffic Safety Administration – Establish a process for the ongoing evaluation of the safety self-assessment reports as required in Safety Recommendation H-19-47 and determine whether the plans include appropriate safeguards for testing a developmental automated driving system on public roads, including adequate monitoring of vehicle operator engagement, if applicable. (Status: Open–Unacceptable Response)

H-19-49: To the state of Arizona – Require developers to submit an application for testing automated driving system (ADS)-equipped vehicles that, at a minimum, details a plan to manage the risk associated with crashes and operator inattentiveness and establishes countermeasures to prevent crashes or mitigate crash severity within the ADS testing parameters. (Status: Open–Await Response)

H-19-50: To the state of Arizona – Establish a task group of experts to evaluate applications for testing vehicles equipped with automated driving systems, as described in Safety Recommendation H-19-49, before granting a testing permit. (Status: Open–Await Response)

H-20-1: To the National Highway Traffic Safety Administration – Expand New Car Assessment Program testing of forward collision avoidance system performance to include common obstacles, such as traffic safety hardware, cross-traffic vehicle profiles, and other applicable vehicle shapes or objects found in the highway operating environment. (Status: Open–Acceptable Response)

H-20-2: To the National Highway Traffic Safety Administration – Evaluate Tesla Autopilot-equipped vehicles to determine if the system's operating limitations, the foreseeability of driver misuse, and the ability to operate the vehicles outside the intended operational design domain pose an unreasonable risk to safety; if safety defects are identified, use applicable enforcement authority to ensure that Tesla Inc. takes corrective action. (Status: Open–Acceptable Response)

H-20-3: To the National Highway Traffic Safety Administration – For vehicles equipped with Level 2 automation, work with SAE International to develop performance standards for driver monitoring systems that will minimize driver disengagement, prevent automation complacency, and account for foreseeable misuse of the automation. (Status: Open–Acceptable Response)

H-20-4: To the National Highway Traffic Safety Administration – After developing the performance standards for driver monitoring systems recommended in Safety Recommendation H-20-3, require that all new passenger vehicles with Level 2 automation be equipped with a driver monitoring system that meets these standards. (Status: Open–Acceptable Response)