Office of the Chairman

National Transportation Safety Board

Washington, DC 20594

February 1, 2021

Docket Management Facility, M-30
US Department of Transportation
1200 New Jersey Avenue SE
West Building, Ground Floor
Room W12-140
Washington, DC 20590-0001

Attention: Docket No. DOT-NHTSA-2020-0106

Dear Sir or Madam:

The National Transportation Safety Board (NTSB) has reviewed the National Highway Traffic Safety Administration (NHTSA) advance notice of proposed rulemaking (ANPRM) titled "Framework for Automated Driving System Safety," published at 85 *Federal Register* 78058 on December 3, 2020. In its notice, NHTSA requests comments on the development of a framework for automated driving system (ADS) safety.[1] Specifically, the agency seeks input on its role in facilitating ADS risk management through guidance, regulation, or both. NHTSA also requests guidance on how it should select and design the structure of a safety framework and the appropriate administrative mechanisms for improving safety, mitigating risk, and enabling the development and introduction of innovative safety technology.

The NTSB recognizes NHTSA's efforts to develop a framework for ADS safety. However, we believe that the Department of Transportation (DOT) and NHTSA must act first to develop a strong safety foundation that will support the framework envisioned for automated vehicles (AVs) of the future. The foundation should include sensible safeguards, protocols, and minimum performance standards to ensure the safety of motorists and other vulnerable road users. We also call for the standardization of AV data collection to better understand automated control systems, a requirement for safety critical information to be available and evaluated for developmental ADSs, the development of performance standards to evaluate driver engagement, the improved oversight of systems that may operate outside a vehicle's operational design domain (ODD), and the incorporation of more robust collision avoidance test procedures into the New Car Assessment Program (NCAP).

[1] ADS, as defined by SAE International and as used in the ANPRM, refers to driving automation levels 3, 4, and 5. An ADS is the hardware and software that are, collectively, capable of performing the entire dynamic driving task on a sustained basis, regardless of whether it is limited to a specific operational design domain.

The ANPRM specifically asks for comments on 25 questions related to the safety framework, NHTSA research, administrative mechanisms, and the agency's statutory authority. The NTSB's response is not specific to each question, but rather, expresses key safety principles that underlie the questions, based on knowledge gained from our investigations of crashes involving vehicles equipped with various levels of automation. Our response first addresses the importance of incorporating the lessons learned from NTSB crash investigations into the safety framework. We then discuss the following eight foundational safety issues:

- *Collision Avoidance Technologies—Foundational Building Blocks for Safety*
- *Safety Risk Management Requirements for Testing AVs on Public Roads*
- *State Oversight of AV Testing*
- *Risk Mitigation Pertaining to Monitoring Driver Engagement*
- *Risk Mitigation Pertaining to Operational Design Domain*
- *NHTSA Enforcement of AV Safety-Related Defects*
- *Event Data Recorders for AVs*
- *Enhancements to New Car Assessment Program*

Lessons Learned from NTSB Crash Investigations

Although much attention and federal efforts have focused on highly automated SAE International (SAE) Level 3–5 vehicles, lessons can be learned from the deployment of AVs on our nation's highways today. Between May 2016 and March 2019, the NTSB investigated four crashes—three resulting in fatalities—that involved vehicles operating in partial automation mode.[2] In addition, in July 2019, the NTSB completed an investigation of a minor crash involving a highly automated shuttle on its first day of operation in Las Vegas, Nevada.[3] In November 2019, the NTSB completed its investigation of the first fatal crash involving a test vehicle controlled by a developmental ADS. 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, specifically NHTSA, to play comprehensive and cooperative roles.[4]

The lessons learned from the NTSB's crash investigations contain important information regarding the safe testing of AVs on public roads; the importance of driver/operator engagement in AV operation; risk mitigation pertaining to the appropriate ODD for an AV; and other improvements needed to establish a strong ADS safety foundation. An attachment to this response lists open safety recommendations pertaining to AV safety that still require action by the DOT, NHTSA, and others. The recommendations are discussed in more detail below.

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[2] See our recent reports on crashes in Williston, Florida (Highway Accident Report NTSB/HAR-17/02); Culver City, California (Highway Accident Brief NTSB/HAB-19/07); Delray Beach, Florida (Highway Accident Brief NTSB/HAB-20/01); and Mountain View, California (Highway Accident Report NTSB/HAR-20/01).

[3] See our report about the Las Vegas crash (Highway Accident Brief NTSB/HAB-19/06).

[4] See our report about the Tempe crash (Highway Accident Report NTSB/HAR-19/03).

Collision Avoidance Technologies—Foundational Building Blocks for Safety

Section III of the ANPRM describes the core elements of ADS safety performance as sensing, perception, planning, and control.[5] Although those functions are necessary for ADS performance, they are not sufficient to ensure ADS safety, which depends on an array of other functions and system capabilities and how the system interacts with the humans both inside and outside an ADS-equipped vehicle. While a mature ADS may avoid many of the human driver errors or poor choices that lead to crashes, an ADS can still find itself in crash-imminent scenarios that warrant emergency maneuvering. Crash avoidance will depend on a vehicle's mechanical abilities and the underlying crash avoidance technologies. Certain advanced safety technologies, which will likely serve as foundational "building block" technologies for AVs, have already proven effective at preventing and mitigating crashes across all modes of highway transportation.

Since 1995, the NTSB has called for installing collision avoidance technology on passenger cars and trucks.[6] Collision avoidance technologies, especially forward collision warning and automatic emergency braking systems, have shown safety benefits in reducing the frequency and severity of crashes.[7] Although the effectiveness of the technologies has been demonstrated, their incorporation into vehicle fleets remains slow. As a result, in May 2015, the NTSB issued recommendations to vehicle manufacturers to install the systems as standard equipment in all new vehicles.[8] In the same report, the NTSB issued recommendations to NHTSA to incorporate a rating system into the NCAP for forward collision avoidance systems and to include those ratings on the Monroney label.[9]

As NHTSA moves toward an ADS safety framework, it is important that the agency prioritize the development of minimum performance standards for collision avoidance technologies and require the systems as standard equipment on all new vehicles. Independently of whether a vehicle is driven by a human driver or an ADS, NHTSA should focus on performance standards for collision avoidance systems. The standards could be technology-neutral and would address NHTSA's mission to prevent, reduce, or mitigate crashes. In cars with human drivers, collision avoidance technologies are redundant systems intended to aid drivers in situations where their performance is not ideal. For an ADS, collision avoidance technologies could similarly function as redundant systems to avoid or mitigate crashes when the ADS cannot react on its own

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[5] "Sensing" refers to the ability of an ADS to receive adequate information from the vehicle's internal and external environment through connected sensors. "Perception" refers to the ability of an ADS to interpret information about its environment obtained through its sensors. "Planning" refers to the ability of an ADS to establish and navigate the route it will take on the way to its destination. The "control" function of an ADS refers to the system's ability to execute the driving functions necessary to carry out a continuously updated driving plan by delivering appropriate control inputs such as steering, propulsion, and braking.

[6] In 1995, the NTSB issued Safety Recommendation H-95-44 to the DOT, asking it to begin testing collision warning systems in commercial fleets. Because of the DOT's lack of progress, the NTSB classified the recommendation "Closed—Unacceptable Action" in August 1999.

[7] The NTSB discussed the safety benefits of collision avoidance technologies in a special investigation report published in May 2015 (*The Use of Forward Collision Avoidance Systems to Prevent and Mitigate Rear-End Crashes*, Special Investigation Report NTSB/SIR-15/01).

[8] The recommendations (Safety Recommendations H-15-8 and -9, currently classified "Open—Acceptable Response") were issued in NTSB/SIR-15/01. For more information about NTSB safety recommendations, see the Safety Recommendation Database at www.ntsb.gov.

[9] See Safety Recommendation H-15-6, currently classified "Open—Acceptable Response."

to a hazardous situation. In the Tempe crash investigation, the NTSB found that Uber Advanced Technologies Group's (ATG) deactivation of the Volvo forward collision warning and automatic emergency braking systems without replacing their full capabilities removed a layer of safety redundancy and increased the risks associated with testing ADSs on public roads. Uber ATG did not violate any *Federal Motor Vehicle Safety Standards* (FMVSSs) because none exist that require a minimum level of collision avoidance performance. Postcrash, Uber ATG worked with Volvo to ensure that the Volvo collision avoidance system was independent and functional when the Uber ATG ADS was operational, thereby adding a layer of safety redundancy.

Widespread deployment of collision avoidance technologies now will help save lives and can be instrumental in building public confidence in the capabilities of new technologies as higher levels of automation are introduced.

Safety Risk Management Requirements for Testing AVs on Public Roads

Section II of the ANPRM describes at length NHTSA's perception of how prototype ADSs are being tested on public roads. The discussion illustrates NHTSA's belief that before public road testing is conducted, companies undertake a rigorous engineering and safety analysis, with mitigation strategies in place to address potential risks. However, the NTSB has found that NHTSA's perception of the safety of ADS testing is probably unrealistic. In the Las Vegas investigation, the NTSB learned that as part of its declaration for importing a vehicle without traditional driving controls (such as steering wheels), the shuttle operator (Keolis North America) stated to NHTSA that drivers (attendants) who had been trained in all aspects of the vehicle's operation would be in the vehicle whenever it was operating and that they would be positioned where they could take control if necessary.[10] The company also reported that the vehicle was fully equipped for manual operation. Nevertheless, the NTSB determined that the shuttle attendant did not have easy access to the manual controller, which limited his ability to take control of the vehicle before the crash.

Further, in our investigation of the fatal crash involving a developmental ADS vehicle in Tempe, the NTSB found significant deficiencies in the ADS developer's management of safety risk, as well as in NHTSA's and the state's oversight of ADS testing. The NTSB 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 should make more effective and broader use of an already established basic framework for safe ADS testing—NHTSA's AV policy.

In the second iteration of its AV policy (AV 2.0), NHTSA 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.[11] Although these components of

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[10] Title 49 *Code of Federal Regulations* Part 591 ("Importation of Vehicles and Equipment Subject to Federal Safety, Bumper and Theft Prevention Standards") requires importers to file a declaration about a vehicle's eligibility for importation.

[11] 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.

NHTSA's AV policy are promising, challenges remain—specifically, the lack of a requirement for mandatory submission of the safety self-assessment reports and the absence of a process for NHTSA to evaluate their adequacy.

As a result of its investigation of the Tempe crash, the NTSB 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.[12] We view such an evaluation as establishing a minimum level of safety for testing that developers can achieve and that states can use when determining whether to allow ADS testing in their state. As the NTSB has previously stated to NHTSA, NHTSA's general and voluntary guidance of emerging and evolutionary technological advancements shows a willingness to let manufacturers and operational entities define safety. We urge NHTSA to lead with detailed guidance and specific standards and requirements.[13]

The traditional division of oversight, in which NHTSA regulates vehicle safety and the states monitor drivers, may not apply to a developmental ADS. It might not be immediately apparent who controls the vehicle, or whether vehicle control and supervision are shared between the computer (the vehicle) and the human operator. A lack of appropriate policy from NHTSA and the states leaves the public vulnerable to potentially unsafe testing practices.

To ensure that testing of AVs on public roads is conducted with minimal risk, meaningful action from both NHTSA and the states is critical. Additionally, manufacturers must ensure that the design, development, verification, and validation of safety-related underlying electronics and software are reliable and safe for the conditions a vehicle is designed to encounter.

State Oversight of AV Testing

In the absence of federal ADS safety standards or specific ADS assessment protocols, states have begun legislating requirements for AV testing, resulting in a patchwork of laws and state-level requirements. The development of state-based requirements can be attributed to states' concerns about the safety risk of introducing ADS-equipped vehicles on public roads. The requirements vary. Some states, such as Arizona, impose minimal restrictions. Other states have established requirements that include an in-depth application and review process. In the Tempe crash investigation, we determined that Arizona's lack of a safety-focused application-approval process for ADS testing at the time of the crash, and its inaction in developing such a process after the crash, demonstrated the state's shortcomings in improving the safety of ADS testing and safeguarding the public.

States that have no, or only minimal, requirements related to AV testing can improve the safety of such testing by implementing a thorough application and review process before granting testing permits. Because states would benefit from adopting regulations that require a thorough review of ADS developers' safety plans, including methods of risk management, we recommended

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

[13] See NTSB response dated December 20, 2018, to notice of request for comments: Preparing for the Future of Transportation: Automated Vehicles 3.0 (AV 3.0), Docket No. DOT–OST–2018–0149.

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.[14]

The ANPRM discusses NHTSA's recent launch of the Automated Vehicle Transparency and Engagement for Safe Testing (AV TEST) initiative. The NTSB commented on the initiative and expressed concern about the lack of a requirement for specificity in testing information.[15] Because the initiative is voluntary for ADS developers, it provides only a partial perspective into ADS testing across the country. In addition, because NHTSA does not evaluate the information provided by initiative participants, ADS developers largely ignore the response guidelines, and their reports are generally devoid of technical and safety-relevant information. Such foundational deficiencies require attention in NHTSA's efforts to establish a safety framework for ADS.

Risk Mitigation Pertaining to Monitoring Driver Engagement

Section III of the ANPRM discusses the safety standard called "Safety of the Intended Functionality" (SOTIF) as it relates to human-machine interaction and conceivable misuse of the system, performance limitations of sensors or systems, and unanticipated changes in an automated vehicle's environment. As ADSs are developed and deployed, situations are likely to arise that necessitate a vehicle-initiated handover or an operator-initiated takeover of vehicle control. In the Tempe crash of a prototype ADS vehicle and in the four crashes involving partially automated vehicles, the NTSB found that the drivers were distracted 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 ADS vehicle did not enable an operator-initiated takeover of vehicle control.

Driver/operator situational awareness and engagement are needed to ensure the safety of ADS deployment, especially during on-road testing. SAE Level 2 partial automation systems, and in some respects Level 3 ADSs, require the driver or operator to monitor the highway and remain able to take control of the vehicle at any time or when signaled by the vehicle. The success of these AVs depends on the driver completing a monitoring task that requires sustained attention; however, humans generally perform poorly in the role of monitor. Also, if the automated control system behaves consistently and reliably for prolonged periods, the user of that system can become complacent about its operation and may not respond appropriately when a situation requires him or her to act.

Because driver/operator 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. No minimum performance standards exist for the appropriate timing of alerts, the type of alert (visual, auditory, or haptic [touch]), or the use of

[14] See Safety Recommendation H-19-51, classifed "Closed—Acceptable Action."

[15] See NTSB response dated August 21, 2020, to notice of request for comments: Automated Vehicle Transparency and Engagement for Safe Testing (AV TEST) Initiative, Docket No. DOT–NHTSA-2020–0070.

redundant monitoring sensors to ensure driver/operator engagement. As a result of its investigation of a crash in Mountain View, California, involving a vehicle operating with partial driving automation, the NTSB recommended that NHTSA work with SAE to develop performance standards for driver monitoring systems that will minimize driver disengagement, prevent automation complacency, and account for foreseeable misuse of the automation.[16]

NHTSA should include user monitoring in the development of an AV safety framework. AVs must give alerts to capture the attention of a driver or operator and allow sufficient time for the person to respond and assume the dynamic driving task for any level of automation that may require human intervention. Driver/operator monitoring is critical during on-road testing of a developmental ADS.

Risk Mitigation Pertaining to Operational Design Domain

The ANPRM describes one of NHTSA's key research tracks, which focuses on identifying methods, metrics, and tools to assess how well an ADS-equipped vehicle performs both normal driving tasks and crash avoidance. Such assessments include system performance and behavior relative to the system's stated ODD and event detection and response capabilities, as well as fail-safe capabilities if the system is confronted with conditions outside its ODD.[17] The NTSB supports this research track and strongly recommends that the research extend to all levels of automation, including partial driving automation systems. Lessons learned from lower levels of automation can be applied to ADSs.

Today's Level 2 partial driving automation systems can assess a vehicle's location and the roadway type or classification and determine whether the roadway is appropriate to the system's ODD. After a crash in Williston, Florida, that involved a driver operating outside the manufacturer's ODD in a vehicle with a partial driving automation system, the NTSB recommended that NHTSA 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 to the conditions for which they were designed.[18]

In response to the NTSB's recommendation, NHTSA responded that "the agency has no current plans to develop a specific method" to address the NTSB's concern. Because of NHTSA's failure to act on this important safety recommendation, Tesla (the manufacturer of the Williston crash vehicle) continued to permit AV operation outside the ODD. Contrary to SAE J3016 guidance, which considers the ODD for Level 2 systems to be limited, Tesla advised the NTSB that it believes that "ODD limits are not applicable for Level 2 driver assist systems, such as Autopilot, because the driver determines the acceptable operating environment." In March 2019, because of Tesla's lack of appropriate safeguards and NHTSA's inaction, another fatal crash occurred in Delray Beach, Florida, under circumstances very similar to the Williston crash. The NTSB found that a contributing causal factor in the Delray Beach crash was NHTSA's failure "to

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[16] See Safety Recommendations H-20-3 and -4, currently classified "Open—Initial Response Received."

[17] ODD refers to the conditions in which the automation system is intended to operate. Examples of such conditions include roadway type, geographic location, clear roadway markings, weather conditions, speed range, lighting conditions, and other manufacturer-defined system performance criteria or constraints.

[18] See Safety Recommendation H-17-38, currently classified "Open—Unacceptable Response."

develop a method of verifying manufacturers' incorporation of acceptable system safeguards for vehicles with Level 2 automation capabilities that limit the use of automated vehicle control systems to the conditions for which they were designed."

The NTSB remains concerned about NHTSA's continued failure to recognize the importance of ensuring that acceptable safeguards are in place so that vehicles do not operate outside their ODDs and beyond the capabilities of their system designs. As manufacturers advance the development of automated control systems, it is evident that there is a fluid progression of capabilities and that the SAE levels of automation may not adequately reflect how control systems are actually used. Because NHTSA has put in place no requirements, manufacturers can operate and test vehicles virtually anywhere, even if the location exceeds the AV control system's limitations. For example, Tesla recently released a beta version of its Level 2 Autopilot system, described as having full self-driving capability. By releasing the system, Tesla is testing on public roads a highly automated AV technology but with limited oversight or reporting requirements. Although Tesla includes a disclaimer that "currently enabled features require active driver supervision and do not make the vehicle autonomous," NHTSA's hands-off approach to oversight of AV testing poses a potential risk to motorists and other road users.

NHTSA refuses to take action for vehicles termed as having partial, or lower level, automation, and continues to wait for higher levels of automation before requiring that AV systems meet minimum national standards. As a result of its Mountain View crash investigation, the NTSB concluded that NHTSA's failure to ensure that vehicle manufacturers of SAE Level 2 driving automation systems incorporate appropriate system safeguards to limit operation of these systems to the ODD compromises safety. Policy direction needs to apply seamlessly as AV development proceeds. NHTSA must take regulatory action now to minimize the risks associated with the ODD of all levels of vehicle automation.

NHTSA Enforcement of AV Safety-Related Defects

NHTSA has informed the NTSB that it plans to ensure the safety of lower levels of driving automation systems through its enforcement authority and a surveillance program aimed at identifying safety-related trends in design or performance defects, and not through regulations.[19] This approach is misguided because it relies on waiting for problems to occur rather than addressing safety issues proactively. For an acceptable level of safety to be achieved, a robust surveillance program must be in place, so that safety-related vehicle defects can be identified in a timely manner.

NHTSA's enforcement guidance states that when an automated safety technology causes crashes or injuries, or poses other safety risks, the agency will evaluate such technology through its investigative authority to determine whether the technology presents an unreasonable risk to

[19] In response to Safety Recommendation H-17-38, NHTSA informed the NTSB that "the agency has no current plans to develop a specific method to verify manufacturers of vehicles equipped with Level 2 systems incorporate safeguards limiting the use of automated vehicle control systems to those conditions for which they were designed. Instead, if NHTSA identifies through its research or otherwise, any incidents in which a system did not perform as designed, it will exercise its *enforcement authority* as appropriate."

safety.[20] The guidance also states that manufacturers should take the necessary steps to ensure that technology introduced on US roadways accounts for any foreseeable misuse, particularly in circumstances that require driver interaction while a vehicle is in operation.[21]

Included in the enforcement guidance is information directly relevant to the AV crashes investigated by the NTSB. The NHTSA guidance states that "a semi-autonomous driving system that allows a driver to relinquish control of the vehicle while it is in operation but fails to adequately account for reasonably foreseeable situations where a distracted or inattentive driver must retake control of the vehicle at any point may be an unreasonable risk to safety."

In determining whether a vehicle design poses an "unreasonable risk" to safety, NHTSA is charged with answering the question through a forward-looking risk analysis. According to NHTSA's enforcement guidance, the purpose of a forward-looking risk analysis "is not to protect individuals from the risks associated with defective vehicles only after serious injuries have already occurred; it is to prevent serious injuries stemming from established defects *before* they occur."

On June 28, 2016, NHTSA's Office of Defects Investigation (ODI) opened a preliminary investigation into the design and performance of the Tesla automation systems in use at the time of the Williston crash.[22] An NTSB review of the ODI investigation report identified shortfalls in the agency's evaluation of Tesla's Autopilot.[23] The NTSB concluded that the NHTSA ODI had failed to thoroughly investigate the degree to which drivers misuse the Autopilot system, the foreseeable consequences of its continued use by drivers beyond the system's ODD, and the effectiveness of the driver monitoring system in ensuring driver engagement.

As a result of the Mountain View crash investigation, which incorporated lessons learned from the crashes in Williston, Delray Beach, and Culver City, the NTSB recommended that NHTSA 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 ODD pose an unreasonable risk to safety; and that if safety defects are identified, the agency should use its enforcement authority to ensure that Tesla takes corrective action.[24] To date, NHTSA has shown no indication that it is prepared to respond effectively and in a timely manner to potential AV safety-related defects. This deficiency requires immediate attention if NHTSA's enforcement authority is to be one of the primary mechanisms that the agency plans on using to ensure ADS safety.

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[20] NHTSA Enforcement Guidance Bulletin 2016-02: "Safety-Related Defects and Automated Safety Technologies," 81 *Federal Register* 65705.

[21] NHTSA has defined misuse as when an operator, having knowledge and understanding of the system's limitations and operational use instructions, deliberately chooses not to act according to the intent and design of the automated component. When a driver, having full knowledge of the responsibility to supervise and monitor the roadway, engages in a secondary task that may disrupt or eliminate the capability to effectively perform monitoring duties, such disengagement can qualify as misuse.

[22] NHTSA ODI investigation PE 16-007 (Automated vehicle control systems), closed January 19, 2017.

[23] See our report on the crash in Mountain View, California (Highway Accident Report NTSB/HAR-20/01).

[24] Safety Recommenation H-20-2, currently classified "Open—Initial Response Received."

Event Data Recorders for AVs

On December 13, 2012, NHTSA issued an NPRM that proposed a new FMVSS mandating that an event data recorder (EDR) that meets 49 *Code of Federal Regulations* Part 563 requirements be installed on most light vehicles. On February 8, 2019, NHTSA withdrew the NPRM because the agency determined that a mandate was not necessary: NHTSA's internal analysis showed that over 99 percent of light vehicles sold were already being equipped with EDRs that met Part 563 requirements. NHTSA added that, given the near-universal installation of EDRs in light vehicles, it no longer believed that the safety benefits of mandating EDRs justified expending limited agency resources.

In withdrawing the final rule, NHTSA said that it would continue its efforts to modernize and improve EDR regulations, including fulfilling the agency's statutory mandate to promulgate regulations establishing an appropriate recording duration for EDR data to "provide accident investigators with vehicle-related information pertinent to crashes involving such motor vehicles."[25] Because the 49 *Code of Federal Regulations* Part 563 data recording requirements codified more than a decade ago are limited (only 15 data elements require reporting), NHTSA stated in withdrawing the final rule that it is actively investigating whether the agency should consider revising the data elements covered by Part 563 to account for advanced safety features.

In recent AV crash investigations, NTSB investigators retrieved data from the EDR, but the data did not address the status of AV activation, engagement, or object detection and classification. As a result, the NTSB coordinated with the manufacturer and operator to use other proprietary data to interpret the automated system's functionality. However, this type of data is not available on many vehicles operating with automated systems. Further, there are currently no commercially available tools for independently retrieving and reviewing non-EDR vehicle data, and many manufacturers maintain tight control and access to postcrash proprietary information associated with their vehicles.

As more manufacturers deploy automation systems in their vehicles, it will be necessary to develop detailed information about how the automated systems, and possibly drivers or vehicle operators, perform and respond in a crash. Manufacturers, regulators, and crash investigators all need specific data in the event of a system malfunction, near-crash, or crash. Recorded data can be used to improve the automated systems and to understand situations that may not have been considered in the original design. Further, data are needed to distinguish between automated control and driver action.

After the Williston crash, the NTSB recommended that the DOT define the parameters necessary to understand AV control systems.[26] Another recommendation was made to NHTSA to, using the parameters defined by the DOT as necessary to understand AV control systems, define a benchmark for new vehicles equipped with automated vehicle control systems so that they capture

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[25] See the Fixing America's Surface Transportation (FAST) Act, Public Law 114-94 (December 4, 2015), section 24303.

[26] See Safety Recommendation H-17-37, currently classifed "Open—Unacceptable Response."

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.[27]

With the increasing number of AVs using different automated technologies being tested and in some cases being sold to the public, standardized data elements, recording, and access to safety event data are essential to the development of a framework for ADS safety. NHTSA needs to advance its efforts to modernize and improve EDR regulations so that they focus on the performance of advanced safety features.

Enhancements to New Car Assessment Program

Section IV of the ANPRM describes voluntary mechanisms that could be used to implement a safety framework. Short of setting a safety standard, NHTSA discusses the potential for adding an ADS competency evaluation to the NCAP. NHTSA envisions that an evaluation could be used to measure the performance of an ADS in navigating a variable environment and a complex set of interactions with other road users. Rather than evaluating the driving performance of an ADS system through the NCAP, the NTSB believes that NHTSA should focus on the development and application of testing procedures to assess the performance of forward collision avoidance systems.[28] All ADS-equipped vehicles should be expected to avoid collisions while adhering to a driving model that minimizes the risks of being involved in crash-imminent situations and observes operational limitations. The information the NCAP provides would enable consumers to compare the safety of new vehicles and make informed purchasing decisions, while providing ADS developers with performance targets for collision avoidance systems. Moreover, the information would encourage automakers to compete on the basis of safety.

For years, the NTSB has supported the concept of the NCAP being an incentive for deploying collision avoidance technology. However, in 2015 we concluded that NHTSA's existing testing scenarios and protocols for the assessment of forward collision avoidance systems in passenger vehicles do not adequately represent the range of velocity conditions seen in crashes.[29] As a result of its Mountain View crash investigation, the NTSB reiterated Safety Recommendation H-15-4 and also recommended that NHTSA expand NCAP testing of forward collision avoidance systems to address common obstacles found in the highway operating environment.[30]

On November 21, 2019, NHTSA published a request for comments (RFC) on nine draft test procedures to assess the performance of intersection safety assist systems in cross-traffic and left-turn, across-path driving situations, as well as pedestrian automatic emergency braking systems in daytime scenarios, both of which relate to forward collision avoidance. Nevertheless, the NTSB remains concerned about NHTSA's approach and continued delays in implementation. As we stated in our response to the RFC, we remain very concerned by language used in the RFC stating that NHTSA's work is intended "for research purposes only" and not to support rulemaking

[27] See Safety Recommendations H-17-39, currently classifed "Open—Unacceptable Response."

[28] See Safety Recommendation H-15-4, currently classified "Open—Unacceptable Response."

[29] See our special investigation report, *The Use of Forward Collision Avoidance Systems to Prevent and Mitigate Rear-End Crashes* (NTSB/SIR-15/01).

[30] See Safety Recommendation H-20-1, currently classified "Open—Initial Response Received."

or the NCAP. Since receiving the NTSB's safety recommendations in 2015, NHTSA still has not made any enhancements to the NCAP to address the performance of collision avoidance systems.[31]

Evaluation by the NTSB has found that the European NCAP is much more robust than NHTSA's NCAP, includes many more testing scenarios and a wider range of speeds, and has begun assessing the performance of partial driving automation systems. US consumers should be provided with the same level of information about the safety of new vehicles as consumers in Europe receive. Furthermore, manufacturers and ADS developers would benefit from a consistent level of safety in the global environment. The NTSB supports the concept of enhancing NHTSA's NCAP and using it as a tool to improve ADS safety. However, the NTSB remains concerned about NHTSA's lack of progress on the performance of the building blocks for future automation systems.

Summary

This response focuses on some of the foundational safety issues we believe must be addressed before NHTSA can develop an effective framework for ADS safety. Even though we do not comment specifically on other issues that complicate the development of a safe ADS (such as cybersecurity standards, electronic safety standards, over-the-air update standards, and the FMVSS revision process), we plan to continue using our crash investigations to make commonsense recommendations for preventing future crashes and, we hope, improving consumer confidence in AV safety. The NTSB appreciates the opportunity to comment and recognizes the challenges that lie ahead for the DOT and NHTSA in developing a framework for ADS safety.

Sincerely,

[Original Signed]

Robert L. Sumwalt, III
Chairman

Attachment: NTSB Safety Recommendation List

[31] See NTSB response dated January 15, 2020, to notice of request for comments: Advanced Driver Assistance Systems Draft Research Test Procedures, Docket No. DOT–NHTSA-2019–0102.

NTSB Safety Recommendation List

H-15-4: To the National Highway Traffic Safety Administration—Develop and apply testing protocols to assess the performance of forward collision avoidance systems in passenger vehicles at various velocities, including high speed and high velocity-differential. (Status: Open—Unacceptable Response)

H-15-6: To the National Highway Traffic Safety Administration—Expand the New Car Assessment Program 5-star rating system to include a scale that rates the performance of forward collision avoidance systems. (Status: Open—Acceptable Response)

H-15-7: To the National Highway Traffic Safety Administration—Once the rating scale, described in Safety Recommendation H-15-6, is established, include the ratings of forward collision avoidance systems on the vehicle Moroney labels. (Status: Open—Acceptable Response)

H-15-8: To Passenger Vehicle, Truck-Tractor, Motorcoach, and Single-Unit Truck Manufacturers—Install forward collision avoidance systems that include, at a minimum, a forward collision warning component, as standard equipment on all new vehicles. (Status: Open—Acceptable Response)

H-15-9: To Passenger Vehicle, Truck-Tractor, Motorcoach, and Single-Unit Truck Manufacturers—Once the National Highway Traffic Safety Administration publishes performance standards for autonomous emergency braking, install systems meeting those standards on all new vehicles. (Status: Open—Acceptable Response)

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. (Status: Open—Acceptable Response; Tesla Status: Open—Unacceptable 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. (Status: Open—Acceptable Response; Tesla Status: Open—Unacceptable 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-19-52: To the Uber Technologies, Inc., Advanced Technologies Group—Complete the implementation of a safety management system for automated driving system testing that, at a minimum, includes safety policy, safety risk management, safety assurance, and safety promotion. (Status: Open—Acceptable 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—Initial Response Received)

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—Initial Response Received)

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—Initial Response Received)

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—Initial Response Received)