May 10, 2018

Docket Management Facility
U.S. Department of Transportation
Room W12-140
1200 New Jersey Avenue SE
Washington, DC 20590-0001

Re: Docket no. FMCSA–2018–0037; Request for Comments Concerning Federal Motor Carrier Safety Regulations (FMCSRs) Which May Be a Barrier to the Safe Testing and Deployment of Automated Driving Systems-Equipped Commercial Motor Vehicles on Public Roads

On behalf of Embark, we would like to offer the following comments as the Federal Motor Carrier Safety Administration considers how existing regulations may interact with the safe introduction of Automated Driving System (ADS) equipped Commercial Motor Vehicles (CMVs).

Automated Commercial Motor Vehicles (A-CMVs) have the potential to provide the American public with significant safety, mobility, and sustainability benefits on our nation's highways at a time when traffic fatalities remain tragically high and continue to increase.

Introduction

Embark is a San Francisco Bay Area-based company developing the software that will allow CMVs, specifically Class 8 tractor-trailers, to operate safely on America's highways *without the presence of a human driver* through the use of *Level 4 highway-specific ADS*. Our technology leverages advanced sensors and state of the art machine intelligence to perceive the driving environment and control the vehicle beyond human capability to maximize operational safety and efficiency. In order to develop a Level 4 highway-specific ADS, we are currently testing a Level 2 automation system that requires a professional driver to be sitting at the wheel actively monitoring the road, supervising the system, and ready to take control at any time.

In November 2017, Embark partnered with multinational appliance manufacturer Electrolux and Fortune 500 transportation company Ryder to conduct first of its kind proof of concept tests for transporting consumer products using an automated truck. During these tests, we were able to demonstrate the promise of highway-only exit-to-exit automation by using our Level 2 system to transport 20,000 lbs of Frigidaire refrigerators across 700 miles of Interstate 10, from El Paso, Texas to Ontario, California, transiting through New Mexico and Arizona. Ryder provided transport of the trailer loads on manually-driven trucks at both ends of the journey to support the exit-to-exit automated system.

In February 2018, Embark completed the first-ever coast-to-coast trip of an automated commercial vehicle, using our Level 2 system to travel 2,400 miles from Los Angeles, CA to Jacksonville, FL on Interstate 10. By operating our Level 2 system in real-world freight trucking contexts and working with state and federal government partners, we are developing best practices for how a Level 4 ADS will eventually be deployed safely into the freight transportation ecosystem, including the logistics required to support automated long-haul routes and ensure compliance with Federal Motor Carrier Safety Regulations (FMCSRs).

Summary

This comment seeks to provide FMCSA with our perspective as one of the few technology companies leading the commercial development of Level 4 highway-specific ADS specifically for CMV use.

In brief, after detailed review of the FMCSRs and the Volpe Report, and based on our technology development roadmap, we believe FMCSA *can* allow deployment of some types of Level 4 automation under existing regulations. Specifically, we believe highway-specific Level 4 A-CMV operation *without a driver onboard* is both the most likely first-generation commercial use of ADS for CMVs and can be compliant with existing regulations.

The first section of this comment will provide useful background, context, and suggestions for how FMCSA can most effectively focus its resources to prepare for the most likely near-term A-CMV operational scenarios.

The second section will provide a part-by-part review of the Federal Motor Carrier Safety Regulations highlighted in "Review of the Federal Motor Carrier Safety Regulations for Automated Commercial Vehicles" published by the Volpe National Transportation Systems Center (Volpe Report).

The final section will provide additional comment in response to various questions posed throughout the Request for Comments.

Section 1: Background, Definitions, and Context

Vehicle automation is a complex topic that ranges from the Level 1 systems commercially available today to Level 4 systems enabled by the cutting-edge technologies. An important consideration in regulating vehicle automation is that, for the foreseeable future, ADS may be highly varied in terms of hardware, software, and intended use cases. This will make it hard to use traditional regulatory mandates and other tools to attempt to standardize what will continue to be a dynamic and rapidly evolving industry. It also poses challenges providing a simple answer to the question, "are automated commercial vehicles allowed?" SAE J3016 is a useful start to understanding the broad levels of automation, however different ADS designs, features, and Operational Design Domains (ODDs) can interact differently with existing regulations, *even within a single level of automation.*

Focus on Real-World Concepts

Given the sheer variety of possible operating concepts that could be imagined, we encourage FMCSA to focus its efforts on preparing for, and facilitating, the safe testing and deployment of the *most likely* ADS operating concepts based on input from ADS technology developers. We would define "most likely" as operating concepts that are 1) technically feasible, 2) present a commercially viable value proposition, and 3) are the subject of active investment and development by the private sector. Thus, while the Volpe report analyzed FMCSR applicability across a broad range of generic "Automated CMV Operating Concepts", we would urge FMCSA to apply its efforts to exploring approaches to specific operating concepts reflected in private sector development efforts.

The development pathway of passenger vehicle automation can be an instructive example in assessing how FMCSA should prepare for A-CMVs. Most of the leading passenger vehicle ADS developers have followed a similar path of building a growing fleet of prototype vehicles, which can be operated with a licensed and trained driver supervising the road environment and system. These vehicles are generally tested on closed tracks in the early stages, and then operated on public roads where safety drivers remain engaged in completing the Object and Event Detection Response (OEDR) portion of the Dynamic Driving Task (DDT) and monitor system operation. The goal of most of these companies is to compile the data and experience necessary to conclude that such system is able to operate safely without requiring human intervention, including responding appropriately to low-likelihood events and achieving a minimal risk condition in the event of malfunction. Once this conclusion is reached, then companies will transition to operating vehicles without any human driver on board.

While incumbent vehicle OEMs, large technology corporations, industry suppliers, and startups all have views on likely timelines and use cases for CMV automation, we encourage FMCSA to consider where companies are along the above described prototype vehicle pathway as a means of determining how closely their views reflect the "on the ground" reality of A-CMVs. Furthermore, of the companies that currently have prototype A-CMVs operating on public roads with human safety drivers, commonalities among their stated ODDs, business models, and operating concepts can offer evidence as to the direction that A-CMV development will likely take.

Addressing Common Truck Automation Misconceptions

Unfortunately, there exist two misconceptions of CMV automation that may lead to inefficient allocation of regulatory efforts and attention. The first misconception is that Level 5 automation is

the only level of automation that does not require a human presence in the vehicle. This is reflected to some extent in the Volpe report, which lists its Level 4 operating concepts as having either active driver involvement or "onboard technicians," while only Level 5 operation concepts involve a "remote supervisor." Per SAE J3016:

> *At levels 4 and 5, the ADS must be capable of performing the DDT fallback, as well as achieving a minimal risk condition. Level 4 and 5 ADS-equipped vehicles that are designed to also accommodate operation by a driver (whether conventional or remote) may allow a user to perform the DDT fallback if s/he chooses to do so. However, a Level 4 or 5 ADS need not be designed to allow a user to perform DDT fallback and, indeed, may be designed to disallow it in order to reduce crash risk (see 8.3).*

Thus, a Level 4 system, when operated exclusively within its ODD, may not include a human onboard the vehicle, as by definition a human is not needed to perform the DDT fallback. This is an important concept to clarify when considering the types of A-CMV use cases for which FMCSA should prepare. While an oft-misused term, for the remainder of this comment we will refer to the concept of an ADS operating without a human presence in the vehicle as "driverless."

Evolutionary vs. Revolutionary CMV ADS Development

The second misconception, related to the first, is that the development of CMV-specific ADS will be evolutionary as opposed to revolutionary. The evolutionary view of CMV automation posits that automation systems will progress from the Level 1 "driver assistance" and Level 2 "partial driving automation" systems available today, to Level 3 "autopilot systems" that can be used to support human drivers but require the driver to be available as fallback, and finally to Level 4 and 5 systems in the distant future. In contrast, the revolutionary view is that Level 4 systems will leapfrog any theoretical Level 3 "autopilot systems" to market. Many leaders in ADS development believe the revolutionary view of CMV automation is more likely for both safety and economic reasons.

Challenges of Level 3 Automation

From a safety perspective, the use of Level 3 systems presents a host of complex challenges regarding system handoff and effectiveness of human-provided fallback in safety critical situations. Developing solutions to these challenges may not be viable when taking into consideration human behavior, attention spans, and reaction times to system requests for intervention, especially at highway speeds.

From a business perspective, a Level 3 system would significantly increase truck equipment cost due to the sophisticated computers and sensors required for such a system, without significant operational cost savings. A qualified human driver would still need to be present and responsive to ADS requests for takeover for the entire trip. Furthermore, because that person would be serving a safety critical function, Hours of Service rules would still be a limiting factor in the operation of the vehicle.

Trucking fleets often operate on margins of roughly 2-4%, constraining their ability to increase capital expenditures without some assured offset in operating costs. This economic reality is reflected in the relatively low adoption rate of radar-based collision mitigation systems throughout the industry. Despite data suggesting such systems can reduce the frequency and severity

crashes, it is difficult to measure their highly variable return on investment. If many in the trucking industry cannot be persuaded to invest a few thousand dollars in a collision mitigation system, it seems unlikely these same actors would elect to buy Level 3 automation systems that could cost several times as much, with no clear return on investment beyond safety benefits. While Level 3 systems may find demand in the passenger vehicle market for convenience reasons (assuming the above safety challenges can be overcome), such concepts do not seem economically viable for the freight trucking business.

In contrast, "driverless" Level 4 ADS would provide highly significant economic benefits, both in the form of reduced operating costs, and increased efficiency. Separated from the constraints of human fatigue, such a system could be safely operated beyond the standard 11-hour limit, potentially moving freight across the country in less than half the time currently required in freight trucking. The value proposition of Level 4 ADS could create significant positive economic impacts in the trucking industry as well as adjacent industries including agriculture, retail, and manufacturing.

"Exit-to-exit Driverless" Level 4 ADS

We believe the most likely first implementation of an ADS for commercial vehicles will be a Level 4 system designed to operate exclusively on multi-lane divided, limited-access highways and interstates without the presence of a human driver or supervisor on board ("exit-to-exit driverless").

The A-CMV would begin and end long-haul trips at transition points directly off a highway or interstate, similar to long-combination vehicle marshalling yards. At these transition points, the A-CMV would pick up and hand off trailers to manually driven trucks that are better suited to navigate complex driving environments outside of the A-CMV's ODD, such as city streets. This model is the "low hanging fruit" of A-CMV operational scenarios, delivering the bulk of safety and efficiency benefits of automation for the majority of a long-haul route without needing to solve the most complex driving environments. Several leading CMV ADS developers, including Embark, are pursuing this operational concept.

Therefore, we strongly urge FMCSA to focus its efforts on clarifications and other actions that will support this and any other A-CMV operation concepts currently under development that demonstrate technical feasibility, commercial viability, and private sector investment. Addressing regulatory issues sequentially by automation level, which an evolutionary view of trucking automation would suggest, will create a fundamental mismatch between FMCSA's work and the cutting-edge developments of automation technology. Furthermore, many of the safety issues posed by Level 3 automation could consume significant resources to research and explore with little real-world applicability based on industry development efforts. Many of the questions posed in the Request for Comments are specific to the challenges of Level 3 ADS and have no easy answers. We encourage FMCSA to continue its outreach and dialogue with the leading developers of truck automation technology, who are best positioned to share the reality of how automated driving technology will be developed and deployed.

Section 2: FMCSR Interaction with "Exit-to-exit Driverless" Level 4 ADS

Based on Section 1, we present the following review of FMCSRs in the context of exit-to-exit driverless operation. Please note that many operational questions remain regarding how exit-to-exit driverless will specifically comply with certain provisions. However, we believe these questions can be answered with industry, state, and federal government cooperation and do not constitute regulatory prohibitions on such activity. We hope such cooperation can occur in parallel with the engineering progress toward Level 4 ADS such that when the technology is ready, the regulatory and operational considerations do not pose unreasonable obstacles to safe deployment. To this end, Embark has ongoing efforts with a number of state government counterparts to begin to survey and develop solutions to these operational issues, and we welcome FCMSA involvement in these efforts as appropriate.

ADS as Outside Scope of "Driver" Definition

We agree with the Volpe study that "the FMCSRs do not appear to contain an explicit requirement that CMVs be operated by a human driver, but instead present requirements that apply to human drivers." Furthermore, we believe the term "driver" as it is used throughout the FMCSRs should *not* be extended to refer to an Automated Driving System. We believe the definitions presented in Part 390 are generally appropriate for the instances in which a "driver" is referenced in the FMCSRs:

> *§390.5 Definitions*
> *Driver means any person who operates any commercial motor vehicle.*
> *Person means any individual, partnership, association, corporation, business trust, or any other organized group of individuals.*

FMCSRs referencing a driver generally fall into two categories:

1) Regulations that explain tasks or responsibilities the driver or motor carrier must complete to ensure the safe operation of the truck

2) Regulations that manage the knowledge and behaviors of the driver to mitigate human shortcomings or guarantee a basic level of competency

For category 1, we believe initial use cases for truck automation will allow these tasks and responsibilities to be completed by individuals, motor carriers, or ADS developers supporting the ADS in a way that is compatible with existing regulations.

For category 2, we believe regulations meant to managing specifics of individual human behavior and knowledge should not be applicable to automated driving systems. We do believe such regulations should be applied to any humans responsible for safety critical aspects of A-CMV operation.

By using §390.5 as a guide for how the term "driver" is interpreted throughout the regulations, FMCSA can continue to link these important safety roles and responsibilities to accountable individuals and groups, as opposed to sensors, computers, or other implementations of technology. Conversely, broadening the definition of driver beyond what is stated in §390.5 to include ADS presents significant barriers to the development and deployment of truck automation

by applying regulations intended for humans to equipment in a way that would not contribute to safety, while creating regulatory uncertainty and enforcement challenges.

Waivers, Pilots, and Exemptions

We agree that, to the extent that certain regulations may be seen by FMCSA to be barriers to deployment of particular automation use cases for commercial vehicles, existing waiver, pilot, and exemption authorities are a sensible pathway to ensure technology can be deployed safely without initiating a rulemaking process. Given the early stage of commercial vehicle automation, and the diverse approaches being pursued by automated driving companies, we believe rulemaking to be a premature tool that should only be pursued once a significant amount of A-CMVs are deployed and data can be used to inform standards and best practices.

FMCSR Review

The following is a list of specific FMCSR parts identified in the Volpe report as raising potential obstacles to automated commercial vehicle operation and our suggestions of how these FMCSRs can be compatible with exit-to-exit Level 4 driverless operation of A-CMVs.

Part 325: Compliance with Interstate Motor Carrier Noise Emission Standards

This section is part of a broader topic of commercial vehicle inspection, and how existing inspection regimes can be compatible with A-CMVs. We believe these, and similar regulations, can be met in the short term with a combination of technology and human resource solutions in a way that satisfies both the letter and spirit of the regulations.

For example, the requirement that "a motor carrier…must, at any time, submit a motor vehicle used in its operations for inspection, examination, and testing" can be met in two parts by an exit-to-exit L4 system. A "driverless" A-CMV must necessarily be able to understand and respond to a request by enforcement officers to stop at any point along its journey, whether at static inspection and weigh stations, or at a suitable area on the side of the road. In terms of executing the actual test and managing documentation, this could be accomplished by some combination of remote monitoring by human supervisors, remote operation, pre-determined behavior, or local human support. While there are certainly engineering and procedural details that need to be defined, we do not see this or similar regulations and incompatible with initial use cases of exit-to-exit Level 4 driverless operation.

In the medium to long term, new regulations and inspection procedures intended specifically for automated and driverless truck operation could both streamline and strengthen the commercial vehicle inspection regime. However, such solutions would be likely be developed only once the first generation of automated trucks is operating, and real-world learnings could be brought to bear on that process.

Part 350: Commercial Motor Carrier Safety Assistance Program and
Part 355: Compatibility of State Laws and Regulations Affecting Interstate Motor Carrier Operations

We agree with Volpe that neither section presents a direct challenge to automated commercial vehicle operation. However, we encourage FMCSA to clarify its views on commercial vehicle

automation as soon as possible for the benefit of both state governments and industry. Furthermore, by taking a leadership position on these issues and asserting preemption, FMCSA can discourage states from implementing significantly different regulations or restrictions on the use of automation by interstate motor carriers, creating a "patchwork" of state rules and thus raising unnecessary barriers to interstate commerce and ADS deployment.

Part 365: Rules Governing Applications for Operating Authority

Volpe raises the issue of the definition of "disabling damage" and how this may materially lower the threshold of what is included in a motor carrier's accident history. We believe that for the foreseeable future, and certainly for our own technology pathway as we see it today, exit-to-exit Level 4 capable trucks will retain full manual controls that are able to be operated by appropriately licensed human drivers as needed. In addition to ensuring that such vehicles are verifiably compliant with the wide range of applicable Federal Motor Vehicle Safety Standards, this would allow human drivers to be dispatched to trucks that are no longer able to be operated by the ADS, but still able to function manually. Thus, we are not concerned with the issues Volpe raised for Part 365.

Part 368: Application for a Certificate of Registration to Operate in Municipalities in the United States on the United States-Mexico International Border or Within the Commercial Zones of Such Municipalities

This section raises similar issues to our discussion of Part 325. Providing an enforcement officer with a certificate of registration for an exit-to-exit Level 4 driverless commercial vehicle is technically trivial, whether such documentation is made available electronically or physically through a document lock-box or some other solution.

The important aspect of compliance with Part 368 and other similar regulations is an agreed-upon solution with relevant enforcement agencies at the state and federal level. We encourage FMCSA to work with state government agencies and automated commercial vehicle developers currently developing law enforcement interaction plans to adopt solutions to these types of operational issues. We believe it is important for such solutions to be developed to enforcement agencies' satisfaction with inputs from industry and adopted as best practices across states to avoid restricting interstate commerce. We believe multi-state organizations such as the American Association of State Highway Transportation Officials, American Association of Motor Vehicle Administrators, and the Commercial Vehicle Safety Alliance will play important roles in developing solutions and elevating best practices to these types of operational issues for driverless commercial vehicles.

Part 374: Passenger Carrier Regulations

As Embark is focused on developing exit-to-exit Level 4 ADS specifically tailored for freight trucking, Part 374 would not apply to our operational concepts.

Part 375: Transportation of Household Goods in Interstate Commerce; Consumer Protection Regulations

As illustrated in our work with Electrolux and Ryder, exit-to-exit automation is intended to be supported on either end of the journey by professional drivers operating manually driven trucks.

These drivers can fulfil many of the freight trucking tasks well-suited for human drivers, including navigating complex off-interstate environments, cargo loading and unloading, and providing customer service and administrative duties at origin and termination points of cargo movement. Such drivers would be able to fulfill the administrative requirements of Part 375 when applicable to the freight being transported, including preparing inventory and documenting damage to cargo.

Part 380: Special Training Requirements

Part 380 and subsequent sections seek to impose certain standards and constrain behavior of persons that drive or otherwise are responsible for the safe conduct of commercial vehicles on public roads. As such, they provide an important minimum set of criteria by which we judge the suitability of persons to operate commercial vehicles, including specific use cases such as long-combination vehicles (LCVs).

As this early stage in the development and deployment of automated commercial vehicles, we believe any person (as defined in §390.5) involved in any safety critical aspect of automated commercial vehicle operation, including testing, remote monitoring, or inspection, should meet the currently existing requirements of any commercial vehicle driver, including holding an appropriate commercial driver's license and applicable special training certifications.

Part 381: Waivers, Exemptions, and Pilot Programs

We believe exit-to-exit Level 4 operation can be compliant with existing FMCSRs. However, if it is determined that some automated commercial vehicle use cases require the programs outlined in Part 381, it will be important for industry to work with FMCSA to define the type and quantity of data that can demonstrate a level of safety equivalent to, or greater, than that obtained by complying with existing regulations. Utilizing existing pilot program authority could create the conditions necessary to gather sufficient data to qualify for an exemption.

Part 382: Controlled Substances and Alcohol Use and Testing

Similar to Part 380, we believe Part 382 should continue to apply to all people involved in the operation of automated commercial vehicles as defined in §390.5, including those responsible for any duties required by law or regulation to ensure the safety of commercial vehicles, such as pre-trip inspections or remote supervision. Part 382 should not be applied to an Automated Driving System, as it is intended to ensure safety by managing human-specific behavior.

Part 383: Commercial Driver's License Standards; Requirements and Penalties and Part 384: State Compliance with Commercial Driver's License Program

Part 383 applies to "every person who operates a commercial motor vehicle (CMV) in interstate, foreign, or intrastate commerce, to all employers of such persons, and to all States." Using the definition of person in §390.5, we believe exit-to-exit Level 4 automated commercial vehicles can be compliant with these parts. At this early stage, we believe it is appropriate to continue to apply these and other driver-focused regulations to any person involved in the operation of an automated commercial vehicle, including an onboard technician who many never directly "drive" a CMV. As with Part 382, licensing rules as currently promulgated should not apply to an ADS, which falls outside of the definition of "driver" and "person" per §390.5. Assuming FMCSA agrees, states should not face challenges in enforcing requirements per Part 384.

Part 385: Safety Fitness Procedures

We agree with the Volpe report that this part does not present a direct issue for exit-to-exit Level 4 driverless operation.

Part 387: Minimum Levels of Financial Responsibility for Motor Carriers

We believe this part does not present a direct issue for exit-to-exit Level 4 driverless operation, including §387.313(c) and similar provisions related to insurance documentation.

Part 390: Federal Motor Carrier Safety Regulations; General

As mentioned above, we believe the existing definitions in Part 390 are useful in guiding how FMCSRs should apply to A-CMVs. Specifically, commercially viable operating concepts for CMV ADS, such as exit-to-exit Level 4 driverless operation, may be able to comply with existing FMCSRs by maintaining the current definition of "driver" and "person" under §390.5, and not expanding these definitions to include the ADS itself.

We believe the definition of "driver" should encompass any human safety critical role in the operation of an A-CMV, including remote supervisors who do not directly complete the Dynamic Driving Task from within the vehicle. This approach is consistent with existing regulatory language and ensures current regulatory standards and mandated duties are still met by some combination of roles performed by humans in support of exit-to-exit Level 4 driverless operation.

Part 391: Qualifications of Drivers and Longer Combination Vehicle (LCV) Driver Instructors

See Part 390 discussion.

Part 392: Driving of Commercial Motor Vehicles

We believe exit-to-exit Level 4 driverless operation of A-CMVs can be compliant with the letter and spirit of Part 392 by implementing appropriate technology and procedural solutions. For example, cargo securement requirements could be met by a combination of licensed human drivers supporting automated freight routes, as well as remote supervisors and monitoring technology that allow remote examination of cargo and load securement devices during the course of transportation. Readjustment of loads could be managed by dispatching qualified personnel to truck location. Additionally, driving behavior of A-CMVs will necessarily incorporate solutions to comply with operational requirements, including those in Subparts B, C, and D. As in other sections, safety requirements and limitations on human driver behavior, such as those in Subpart H, should continue to apply to any human in a safety critical role in the operation of an A-CMV, including remote supervisors.

Part 393: Parts and Accessories Necessary for Safe Operation

Installation of ADS to a commercial vehicle does not necessarily interfere with compliance to any aspect of Part 393. For an ADS to be compliant with §393.3, we believe an ADS developer should provide FMCSA with data that supports an assertion that the system does not decrease safety of operation of the vehicle. In lieu of testing, licensing, or imposing specific requirements on ADS at

this early stage, we believe test data on the operational capabilities of an ADS, generated with appropriate human supervision across a large number of road miles, can provide a much better set of evidence to demonstrate compliance with §393.3. Importantly, this preserves FMCSA's authority to determine the safety impact of an ADS and prohibit operation of an A-CMV if the ADS is considered to decrease the safety operation of the vehicle.

Part 395: Hours of Service of Drivers

See Part 390 discussion. We encourage FMCSA to clarify that Hours of Service regulations, intended to manage human fatigue, do not apply to ADS. We believe Hours of Service should continue to apply to any human fulfilling a safety critical role in the operation of an A-CMV. Vehicles would continue to comply with ELD requirements in order to log and assign any time during which the vehicle is operated. Driving time by an exit-to-exit Level 4 driverless ADS could be assigned to a unique account for the ADS, or to the "Unidentified Driver Account" with annotations as appropriate.

Part 396: Inspection, Repair, and Maintenance

Specific to §396.7 compliance, see Part 393 discussion above. As exit-to-exit Level 4 driverless commercial vehicles will be supported by licensed human drivers at transition points, we believe these drivers can fulfill inspection requirements under §396.11, §396.13, and other sections as pre and post-trip inspections contribute to "operating" the A-CMV.

Part 397: Transportation of Hazardous Materials; Driving and Parking Rules

The ODD of an A-CMV can include limitations on the type of cargo appropriate for use with the ADS. We believe early versions of A-CMVs will likely exclude placarded hazardous materials hauling from the ODD, rendering this section not applicable to such A-CMV operating concepts. Furthermore, driverless operation may not be well suited for hauling material that is deemed to require constant on-site human supervision by a qualified representative, such as explosive material. This section does not pose an issue for CMV ADS that do not include hazardous material hauling within its ODD.

Section 3: Additional Responses to Request for Comment

Inspection, Repair, and Maintenance

Should the Agency consider minimum requirements for motor carrier personnel responsible for maintaining the equipment used to achieve certain levels of automated operations (for example, a requirement that technicians be trained by the ADS developers, etc.)?

We believe at this stage in A-CMV development, it is appropriate to apply the current requirements for commercial vehicle drivers to any personnel responsible for any safety critical aspects of A-CMV operation. Similar to the "Consumer Education and Training" section of "Automated Driving Systems 2.0: A Vision for Safety" federal guidance document, we believe it appropriate for A-CMV developers to include details on ADS-specific training for personnel involved in maintaining and operating A-CMV equipment in any Voluntary Safety Self-Assessment.

What Information Technology (IT) security/safety assurances can be provided by maintenance personnel and CMV drivers/operators that the ADS systems are functioning properly?

A-CMVs represent a significant opportunity to increase the level of diagnostic information available to maintenance personnel and supervisors on the functioning of the vehicle systems. Electronic systems on today's CMVs already provide simple self-diagnostic capability. One familiar example is a vehicle's anti-lock brake system, which on today's CMVs provide a binary indicator of whether or not a fault is detected in the system. When a vehicle is turned on, the ABS malfunction lamp is designed to illuminate and then turn off. If the light does not turn on at all, or turns on and remains on, this indicates a fault in the ABS system.

We are ensuring our system is designed with self-diagnostic capability that can be conveyed to maintenance personnel, as well as enforcement personnel as needed. The exact nature and implementation of this diagnostic capability is still under development. Given the early stage of the technology, we encourage FMCSA to seek this type of specific information through Voluntary Safety Self-Assessments or direct dialogue with developers, as opposed to setting standards at this time.

Do you have any additional comments regarding inspection, repair, and maintenance?

As discussed under Part 325, A-CMVs today must be capable of operating within the existing inspection and enforcement regime governing interstate commercial vehicle operation. While changes to this regime may occur in the future to accommodate driverless A-CMVs in a way that provides regulatory relief while improving enforcement outcomes and public safety, there does not yet exist enough real-world information on A-CMV operation to have a basis for such changes.

Therefore, we believe it is important to work closely with state and federal government officials to determine how A-CMVs, including exit-to-exit Level 4 driverless vehicles, can best integrate into the existing enforcement system. We do not believe this is an obstacle to regulatory compliance that necessitates a rule change today, but rather an operational obstacle that can be overcome by developing broadly accepted law enforcement interaction protocols that ensure clarity and predictability between enforcement officers and A-CMVs.

Roadside and Annual Inspections

How could an enforcement official identify CMVs capable of various levels of automated operation? For example, should CMVs with ADS be visibly marked to indicate the level of automated operation they are designed to achieve, or would making these vehicles so easily identifiable cause other road users to interact unfavorably with CMVs with ADS?

At this time, we do not believe there is a basis to support requirements for exterior marking that denotes automation level on A-CMVs. We are open to such a possibility if on-road experience by A-CMV operators or enforcement officials suggests it would be useful to public acceptance or safety.

If an ADS-equipped CMV is to be deployed without a human driver onboard, should the computer system be required to demonstrate autonomous capabilities for the same maneuvers included on the CDL skills test?

In order to satisfy §393.3, developers of ADS intended for use without a human driver onboard, such as exit-to-exit Level 4 driverless operation, will have to produce significant data demonstrating the safety and reliability of the ADS within its ODD under the supervision of a human driver. We encourage FMCSA to work together with industry to determine the type and quantity of data necessary to demonstrate safety to the satisfaction of FMCSA. If such data can be produced by an ADS developer, we believe this is a far better measure of capability than a limited skills test. Furthermore, variations in ODD at this early stage in technology development and deployment can make it difficult to develop a standardized test that would provide FMCSA with a true measure of system capability. If FMCSA were to develop an ADS skills test requirement, we would encourage a flexible approach that requires an ADS to demonstrate only maneuvers relevant to the ODD as defined by the ADS developer.

Data Sharing

Many of the data sharing questions posed touch on business confidential information. ADS operation creates a massive data set. As ADS development progresses, so will our own understanding of what data are most useful and what data are unnecessary. As we progress in this, we are open to creating a dialogue with FMCSA that can ensure business confidentiality.

Testing and Interstate Operations of CMVs with ADS on Public Roadways

Do vehicles currently being tested have operational limitations to ensure safe operations? Examples of operational limitations might include time of day, weather conditions, types of roads, specific routes within an ODD, maximum allowable operational speed, markings showing that the vehicle is capable of highly automated operations, etc.

As discussed above, our testing efforts on public roads involve a prototype Level 2 system with a properly licensed driver at the wheel, monitoring the road as well as system functionality. We have operated this system safely in a number of operational scenarios, including at night, in rain, and in fog. The system is designed to operate only on multi-lane, limited access, divided highways and is speed limited based on the prevailing speed limit for commercial vehicles.

In moving forward what actions, if any, should FMCSA consider to ensure the safe operation of ADS-equipped CMV's in various ODDs?

Given the relatively small number of developers of ADS-equipped CMVs, we encourage FMCSA to create direct relationships with these companies to understand the similarities and differences in each approach and how each company proactively ensures safe operation of their vehicles within a stated ODD. This would also allow FMCSA to begin to see commonalities among developers that could inform future standards. It would also allow FMCSA to understand if a company is pursuing a significantly different approach to ensuring safe operation and provide an opportunity for dialogue on why their approach differs.

In addition to information provided by ADS developers, FMCSA already has broad authority to require motor carrier assistance in investigating accidents involving CMVs per 49 CFR Part 390, and motor carriers are required to maintain accident records. This would apply as well to any accidents involving ADS-equipped CMV.

How can FMCSA assess whether a CMV with ADS operating within its ODD can perform on certain maneuvers, such as emergency brake performance, crash avoidance maneuvers, etc.?

An ADS developer may provide data to satisfy compliance with §393.3, demonstrating that the ADS does not decrease safety of a commercial vehicle. Data from public road operations, as well as private test tracks and simulations, can conclusively illustrate the capabilities of an ADS to perform maneuvers necessary for the safe operation within its defined ODD. We look forward to working with FMCSA to develop specifics around the quantity and type of data required to satisfy §393.3 compliance.

Should FMCSA consider approaching CMVs that carry persons or hazardous materials differently than other CMVs?

FMCSRs include provisions specific to CMVs carrying persons or hazardous materials. If an ADS is not intended to carry persons or hazardous materials as part of its ODD, such provisions should not apply.

To what extent, if any, should the various levels of automation be considered as part of the Beyond Compliance Program?

The introduction of ADS to CMV operations presents a significant opportunity to ensure a level of safety much higher than what the existing regulatory and inspection regime can provide. We encourage FMCSA to work with industry to develop incentives that encourage the adoption of new safety technology, including ADS.

Conclusion

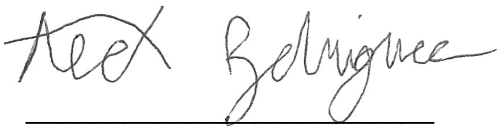
We urge FMCSA to take a pragmatic approach to its automated vehicle efforts by focusing the most attention on viable ADS concepts, such as exit-to-exit driverless operation. The many regulatory questions surrounding Level 3 operation, while interesting to consider, may not be relevant to industry efforts.

We believe exit-to-exit driverless operation can be compliant with the existing commercial vehicle regulatory regime. The specifics of how an exit-to-exit driverless ADS is implemented, including procedures around law enforcement interactions, inspections, and other operational considerations, will be important to demonstrating compliance. Such efforts will require the close coordination between FMCSA, state governments, and ADS developers, but we believe do not require significant alterations to regulations.

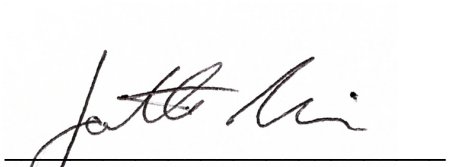
In closing, we look forward to continuing to work with FMCSA, as well as the other branches of USDOT, as we collectively determine the best way for automated commercial vehicles to render safety and efficiency benefits to the U.S. economy and road-faring public.

Please direct any questions or communications regarding this comment to Jonny Morris (jonny@embarktrucks.com).

Sincerely,



Alex Rodrigues
CEO and Co-founder
Embark



Jonathan Morris
Head of Public Policy
Embark