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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; Safe Integration of Automated Driving Systems-Equipped Commercial Motor Vehicles

On behalf of Embark, we would like to offer the following comments as the Federal Motor Carrier Safety Administration considers how regulations may be amended, revised, or eliminated to support the safe introduction of Automated Driving System (ADS) equipped Commercial Motor Vehicles (CMVs) onto the Nation's roadways. We appreciate the 30-day extension granted by FMCSA for this ANPRM comment period, which has allowed Embark and many other stakeholders valuable time to analyze these important and complex issues.

Introduction

Embark is a San Francisco-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. ADS-equipped 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.

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 keep hands on the wheel, actively monitor the road, supervise the system, and take control at any time as needed.

Embark has been a strong advocate of developing technology through proactive engagement with the freight industry, based on the belief that our ADS technology must be tailored to the needs and demands of the broader freight ecosystem. Because of this, Embark has built freight partnerships with a number of Fortune 500 companies. During the course of system testing and development we move freight for these partners on a daily basis from an operations hub in Ontario, CA. 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 on long-haul

interstate routes while ensuring compliance with Federal Motor Carrier Safety Regulations (FMCSRs).

Embark's Policy Team proactively engages with our government partners at the state and local levels, including regulators, legislators, and law enforcement, to ensure the safe and timely deployment of ADS-equipped CMVs. In the course of our engagement, we have appreciated the effort USDOT and its modal administrations have put in to solicit views from a wide range of stakeholders and develop the AV 3.0 guidance released in 2018. We believe AV 3.0 struck the correct balance of removing unneeded barriers to ADS development while emphasizing USDOT's clear authority to continue its safety mission in the context of automated vehicles, including CMVs. The guidance has removed significant regulatory uncertainty for the industry and provided clear direction for ADS developers to move forward while complying with safety regulations. We appreciate that FMCSA is now exploring how specific amendments or changes to FMCSRs can provide further certainty and clarity around how ADS can be used to operate CMVs safely.

Summary

This comment begins with several sections that explore important cross-cutting concepts applicable to a number of questions posed in the ANPRM. Because having a shared vocabulary of terms is the first step to contemplating any potential amendments to regulation, we present four defined terms we believe are an important foundation for this discussion in the **Definitions** section. We have observed a lack of consensus among industry and government in understanding the range of remote roles supporting ADS operation and attempt to provide some clarity on these issues in the **Discussion of Remote Roles** section. Finally, we provide some thoughts in response to the ANPRM's discussion of state regulations in the **Motor Carrier Safety Assistance Programs** section. Following these sections, we provide specific responses to the questions posed across the ANPRM's ten categories.

Definitions

If any amendments to existing FMCSRs are to be considered, the first step is to accurately define the necessary ADS-related terms. Embark has considered the existing set of definitions offered by industry standards, such as SAE J3016, as well as definitions that exist in various state legislation and regulation. The following is a minimum set of terms that we suggest FMCSA could adopt as part of §390.5 and §390.5T. Such definitions would provide FMCSA a working vocabulary with which key amendments could be made throughout the FMCSRs that would support the testing and deployment of automated CMVs. Where possible, definitions have been based on SAE J3016, AV 3.0, or consensus among leading automated CMV developers. These definitions attempt to balance the need for specificity and precision in regulation with the reality that the underlying technology is rapidly developing. Additionally, it should be noted that standards such as SAE J3016 will likely be subject to future revisions.

> **Automated Driving System (ADS):** The hardware and software that are collectively capable of performing the entire DDT on a sustained basis, regardless of whether it is limited to a specific operational design domain (ODD); this term is used specifically to

describe a level 3, 4, or 5 driving automation system, as defined in SAE J3016. For the purpose of this subchapter, an ADS is not a person.

The definition of ADS above is essentially identical to the definition in both AV 3.0 and SAE J3016. The second sentence is added to clarify that human-specific FMCSRs related to persons do not apply to ADS, which is consistent with AV 3.0's view that "in the case of vehicles that do not require a human operator, none of the human-specific FMCSRs...apply." This is also consistent with the view we put forward in our 2018 comment in response to Docket no. FMCSA–2018–0037, where we recommended that "person" focused FMCSRs should not apply to the ADS itself, but rather the person (as defined in §390.5/§390.5T, including individual, corporation, or other organized group of individuals) involved in the operation of the ADS-equipped CMV.

Highly Automated Driving System (H-ADS): The hardware and software that are collectively capable of performing the entire DDT on a sustained basis, regardless of whether it is limited to a specific operational design domain (ODD), and capable of achieving a minimal risk condition without the input or presence of a human driver; this term is used specifically to describe a level 4 or 5 driving automation system, as defined in SAE J3016. For the purpose of this subchapter, an H-ADS is not a person.

The above definition of H-ADS is a novel term that we believe is essential for certain amendments to FMCSRs suggested later in this comment. The term here is closely related to the definition of ADS but is specifically limited to Level 4 ("High Driving Automation") and Level 5 ("Full Driving Automation") systems. While no term exists in J3016 to refer specifically to Levels 4 and 5, we believe the ability to operate such systems without human involvement creates a distinct and notable separation between such systems and Levels 3 and below, which require an onboard or remote human to be a "DDT fallback-ready user". In layman's terms, Levels 4 and 5 are the only levels that can be considered truly "driverless" insofar as such systems must have the ability to achieve a minimal risk condition without the intervention of a human. As the ANPRM notes, "FMCSA's primary focus is SAE Levels 4-5 because its only at those levels where the ADS can control all aspects of the driving task, without any intervention from a human driver." This qualitative difference of Level 4 and 5 automation provides the basis for certain amendments to the FMCSRs that reflect H-ADS independence from human operation, and therefore from human-focused regulations. The definition includes the final clause regarding non-personhood for the same reasons explained above in the ADS definition.

Dynamic Driving Task: All of the real-time operational and tactical functions required to operate a vehicle in on-road traffic, excluding the strategic functions such as trip scheduling and selection of destinations and waypoints.

The above definition of DDT is identical to that of AV 3.0 and closely related to the definition of J3016. To be more concise, the definition excludes a specific list of DDT functions spelled out in J3016. This is the same approach taken in AV 3.0.

Remote Driver: A driver who is not seated in a position to manually exercise in-vehicle braking, accelerating, steering, and transmission gear selection input devices (if any) but is able to operate a commercial motor vehicle by performing in real-time part or all of the DDT and/or DDT fallback.

The above definition of Remote Driver is based on both SAE J3016 and AV 3.0 with some modifications. The SAE J3016 definition of “Remote Driver” concludes “but is able to operate the vehicle”. This recommended definition adds more specific clause that references the real-time performance of the previously defined DDT. We believe this definition provides a more precise definition of “Remote Driver” for the purposes of regulation while still retaining the concept of “operating,” which is referenced throughout the FMCSRs. By doing this, we ensure the Remote Driver is held to the same qualifications and requirements as conventional drivers by fitting the definition within the existing scope of Parts 382, 383, and 395, which often reference a “person who operates a commercial motor vehicle.”

The FMCSR amendments recommended in the rest of this comment rely exclusively on these four terms being added to §390.5 and §390.5T. While there are other important terms used in the automated vehicle industry, there is no clear need to define additional terms in regulation at this point. We recommend FMCSA take an approach of defining the fewest terms in regulation necessary to accomplish its goals, in order to reflect the rapidly changing nature of the automated vehicle industry.

Discussion of Remote Roles

The ANPRM makes multiple references to the concepts of “remote monitor” or “remote monitoring” and “remote operator” or “remote operation” without specific definitions of these terms. In AV 3.0, the definition of “Remote Driver,” also defined in J3016, is combined with “Remote Operation,” which is a term that does not specifically appear in J3016. Significantly, the discussion of “3.21 Operate [A Motor Vehicle]” in J3016 includes the note “Although use of the term operate/operating implies the existence of a vehicle “operator,” this term is not defined or used in this document, which otherwise provides very specific terms and definitions for the various types of ADS-equipped vehicle users (see 3.29).”

We point this out to demonstrate that there is significant ambiguity around the types of remote roles that would be related to the operation of ADS-equipped CMVs. Based on our experience as an ADS developer, as well as discussions with other developers focused on CMV applications, we believe there is a broad spectrum of potential roles that could be performed remotely to support operation of ADS-equipped CMVs.

At one end of the spectrum could be what is colloquially referred to as “teleoperation,” in which a human performs the entire DDT from a remote location through the use of steering wheel, pedals, displays, and other controls meant to simulate the experience of being in the driver’s seat of the vehicle. It should be noted that such a role as described would not be vehicle *automation*, in that a human would be entirely responsible for performing the DDT.

At the other end of the spectrum, a human could observe certain types of real-time data from one or many ADS-equipped vehicles but have no direct control over any aspect of the dynamic driving task or real-time safety critical responsibilities. Such roles might be akin to a network administrator and not linked to the operation of any one vehicle.

In between these two roles are likely a number of positions that have varying responsibilities related to the operation of an ADS-equipped CMV under varying circumstances. Because of the

wide range of responsibilities and scenarios, many of which are still undefined, we believe at this point it is prudent to draw a line between “Remote Driver,” which can perform some or all of the DDT, and any other remote roles that do not include DDT responsibilities. Furthermore, we suggest that while “Remote Driver” can be clearly defined in regulation, it would be premature to define non-DDT remote roles or place limitations on the number of vehicles that can be related to such roles. As industry moves closer to deployment of H-ADS-equipped CMVs, and the types of remote roles involved in the operation of H-ADS-equipped CMVs within freight networks come into focus, the automated CMV industry will proactively work with FMCSA to ensure the proper requirements are placed on such roles.

Because “Remote Driver” has either partial or complete responsibility for the DDT, we believe it is prudent and appropriate that standard CDL, Hours of Service, and other human-specific FMCSRs should continue to apply to such roles.

Motor Carrier Safety Assistance Programs (MCSAP)

Embark has been a strong advocate for a federal approach to ADS-equipped CMV regulation that recognizes the fundamental interstate nature of operation and avoids a patchwork of different requirements. We recognize the role of states as laboratories for different approaches to managing safe ADS operation. However, we encourage FMCSA and USDOT to actively engage with states to consider the compatibility of their automated vehicle laws and regulation with federal rules. Where it is determined that state laws and regulations prohibit the operation of ADS-equipped CMVs or otherwise impose more stringent rules that create unreasonable burdens on interstate commerce, we encourage FMCSA to work with its state partners to implement amendments and resolve the incompatibility in a timely fashion, including through use of the MCSAP and any other relevant authorities meant to preserve uniform safety programs across states.

Embark Reponses to Section XI Questions

The diversity of potential deployment models and technology pathways at this early stage in automated trucking makes some of the ANPRM questions difficult to answer, however we believe FMCSA is generally asking the right questions. Where we can provide specific answers, we have attempted to suggest regulatory amendments or approaches that we believe meet with FMCSA’s stated goal of facilitating the safe integration of ADS-equipped CMVs into interstate commerce.

1.1 (How) should FMCSA ensure that an ADS-equipped CMV only operates consistent with the ODD for the ADS equipped on the vehicle?

At this point, we do not believe FMCSA should seek to limit ADS operation to an ODD due to the challenges in implementing such a prohibition. We believe sufficient incentives exist for ADS developers to self-regulate on this point, including by building in hardware or software features that would not allow the system to operate outside of its ODD. Additionally, federal criminal penalties already exist for malicious operation of an ADS outside of its ODD.

In principle, Embark fully agrees that no ADS should be operated outside of its ODD, whether on a CMV or any other vehicle. ADS are highly sophisticated systems of hardware and software that have been specifically designed for certain operations, and abuse of such systems could be unsafe. In terms of FMCSA's role in such a prohibition, the questions of how an ODD is defined, and how such a prohibition against operation outside of the ODD can be enforced, pose implementation challenges.

Some of the general categories associated with an ODD are easy enough to define and measure against, such as a defined geographic zone, time of day, or specific road type. However, other environmental, weather, or traffic conditions are more difficult to specifically define and measure against. For example, if "rain" is outside of a system's ODD, exactly what rate of rainfall is meant, and how could such a compliance assessment be made in real time by an enforcement officer to determine whether the ADS was being operated outside of its ODD? Furthermore, such conditions could be transient or rapidly changing.

Additionally, ADS often leverage sophisticated machine intelligence that could make a determination that a certain combination of weather or environmental conditions is outside its ODD based on a number of different input factors. However, such factors may not be evident or lend themselves to simple quantification. In such instances, it would be expected from a Level 4 system that, once the ADS made a determination that conditions exceeded the ODD, it would be able to safely guide the CMV to a minimal risk condition.

It is important to understand that an ADS developer may also alter a system's ODD many times during the course of testing and development, or through software updates once deployed, making some type of ODD reporting or registration unrealistic at this stage in the industry's development.

Ultimately, ADS developers are best positioned to define the ODD for their own systems and highly incentivized to prevent any operation of a system outside its ODD, even without a regulatory requirement. We fully expect that any partners or third parties involved in the operation of ADS-equipped CMVs would be prohibited via licensing or other business agreements from non-ODD operation of such systems. Additionally, software or hardware solutions can be implemented that do not allow the system to be activated unless within its ODD.

Finally, intentional or malicious operation of an ADS outside of its ODD by a bad actor is likely already an offense based on "hacking" laws that are part of the U.S. Code. Specifically, 18 U.S. Code §1030 on "Fraud and related activity in connection with computers" details fines and imprisonment guidelines related to activity that:

> (a)(5) (A) knowingly causes the transmission of a program, information, code, or command, and as a result of such conduct, intentionally causes damage without authorization, to a protected computer;
> (B) intentionally accesses a protected computer without authorization, and as a result of such conduct, recklessly causes damage; or
> (C) intentionally accesses a protected computer without authorization, and as a result of such conduct, causes damage and loss.

For the purposes of this section, a "protected computer" is defined in 18 U.S. Code §1030 (e)(2)(B) as a computer "which is used in or affecting interstate or foreign commerce or communication, including a computer located outside the United States that is used in a manner that affects interstate or foreign commerce or communication of the United States." An ADS operating on a CMV engaged in interstate commerce could certainly fall under this definition. Thus, while not solving the enforceability challenges associated with ODD limits, abuse of an ADS-equipped CMV is likely already a federal crime, especially if such abuse led to any damage or loss.

1.2 What are manufacturers' and motor carriers' plans for when and how Levels 4 and 5 ADS-equipped CMVs will become commercially available?

Embark is pursuing development of 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.

The ADS-equipped CMV would begin and end long-haul trips at transfer hubs directly off a highway or interstate. At these transfer hubs, the ADS-equipped CMV would pick up and drop 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 would deliver 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.

We generally decline to publicly state a specific timeline for deployment of this technology, as the development and safety validation of such systems should not be rushed to meet expectations of an arbitrary, publicly stated date. However, we believe, along with a growing consensus of industry experts, that the economic and technological advantages of this particular model mean L4 ADS-equipped CMVs are likely to be one of the first widespread applications of vehicle automation technology.

We will continue to share with FMCSA more details about the timing and specific business models associated with operation of L4 ADS-equipped CMVs as these details come into focus in the coming years.

Level 5 ADS, which can operate unconditionally in any driving environment and is not limited to any ODD, is likely decades away. Realistically, ADS-equipped vehicles will be constrained to certain ODDs for the foreseeable future.

1.3 Should FMCSA consider amending or augmenting the definition of "driver" and/or "operator" in 49 CFR 390.5 or define a term such as "ADS driver" to reduce the potential for misinterpretation of the requirements?

AV 3.0 provided industry with vital clarification on how FMCSR requirements interact with ADS-equipped CMVs. Significantly, FMCSA noted "FMCSA regulations will no longer assume that the CMV driver is always human or that a human is necessarily present onboard a commercial vehicle during its operation" and "in the case of vehicles that do not require a human operator, none of the human-specific FMCSRs (i.e. drug testing, hours-of-service, commercial driver's licenses(CDL)s, and physical qualification requirements) apply."

We support any amendments to the FMCSRs that codify this interpretation and reduce the potential for future misinterpretation. Specifically, Embark suggests two amendments that are dependent on adopting the terms listed in the above "Definitions" section into §390.5/§390.5T. These amendments would apply only to H-ADS (Level 4 or 5 ADS) that do not require any human role when operating within the system's ODD or falling back to a minimal risk condition.

The first amendment we suggest would clarify the non-applicability of Hours of Service (HOS) provisions for H-ADS. Since the term ADS includes Level 3 automation, and such systems require a human driver to be prepared to respond to a takeover request by the system, HOS provisions should continue to apply to Level 3 ADS operation. However, for H-ADS (Levels 4 and 5), HOS provisions are unnecessary given that the H-ADS would perform the entire DDT, be capable of performing the DDT fallback and achieve minimal risk condition, and not be susceptible to fatigue or distraction.

> **§395.1 Scope of rules in this part (HOS)**
> (y) Highly Automated Driving System. For a commercial vehicle equipped with a Highly Automated Driving System as defined in 390.5/390.5T, and operating without the physical presence of a human on board the vehicle,
>
> (1) the rules in this part shall not apply to the H-ADS or to the commercial vehicle when operated by the H-ADS.
>
> (2) the rules in this part shall continue to apply to any Remote Driver as defined in 390.5/390.5T that may be required to complete any aspect of the Dynamic Driving Task during the course of ADS operation.

49 CFR Part 395 establishes hours of service limits for drivers of commercial vehicles. §395.1 outlines a number of scenarios and conditions in which HOS do not apply to CMV operation. This seems like a logical place to clarify the non-applicability of HOS to H-ADS operation given such operation does not rely on human performance to determine safety. Because of the broad nature of the requirements in Part 395, it may be important to note HOS would continue to apply to any Remote Drivers (as defined in the above "Definitions" section) during the course of CMV operation.

In order to codify the non-applicability of human-specific FMCSRs to H-ADS, FMCSA may consider the following addition to Part 391:

> **§ 391.2 General exceptions.**
> (f) Highly Automated Driving System. The rules in this part do not apply to a Highly Automated Driving System as defined in 390.5/390.5T operating a Commercial Motor Vehicle and capable of achieving a minimal risk condition without the input or presence of a human driver.

49 CFR Part 391 establishes minimum qualifications for persons who drive commercial motor vehicles, as well as minimum duties of motor carriers with respect to qualifications of their drivers. §391.2 - General Exceptions lists a number of categories that are excepted from the driver qualifications listed in Part 391, including farm custom harvesting operations, beekeepers during seasonal transportation of bees, pipe welding trucks, and covered farm vehicles. This seems a viable and minimally invasive approach to further clarifying how Part 391 are applied with respect to H-ADS.

Analogous clarifications could be considered for Part 382 Controlled Substances and Alcohol Use and Testing and Part 383 Commercial Driver's License Standards; Requirements and Penalties. However, the recommended definition of H-ADS in §390.5/§390.5T, which specifically states such systems are not considered "persons," may be sufficient to clearly place H-ADS outside the scope of these human-focused sections of the FMCSRs. Such requirements would continue to apply to persons who are considered "Remote Drivers."

Embark believes these amendments would provide additional clarification and reduce the chance for misinterpretation of human-specific FMCSRs as they relate to H-ADS operation.

2.1 Should a CDL endorsement be required of individuals operating an ADS-equipped CMV?

We do not believe a specific endorsement should be required for individuals operating a Level 4 or 5 ADS-equipped CMV at this time.

Since the ANPRM specifically focuses on Levels 4 and 5, we would note that by definition no individual is necessary to perform the DDT or DDT fallback on a Level 4 or 5 ADS-equipped CMV, since the ADS is capable of performing both tasks. However, there may be individuals involved in the operation of a Level 4 or 5 ADS-equipped CMV during operation outside of the intended ODD when the ADS is not activated. These individuals could be remote or onboard the CMV. In these instances, we agree with FMCSA's response from the ANPRM that the Agency should "maintain the CDL rules, essentially as written, but...clarify that these rules apply to any person who may be relied upon to control any aspect of operation of the ADS-equipped vehicle on a public road." To add specificity in future guidance, FMCSA could replace "any aspect of operation" with a more technically quantifiable reference to the DDT, as is done in the Remote Driver definition outlined earlier in this comment.

In our 2018 public comment for Docket FMCSA–2018–0037, Embark expressed skepticism of the feasibility of developing Level 3 ADS given the complex challenges around managing driver engagement and handoffs in safety critical situations. We continue to believe Level 3 automation raises a host of real-world operational challenges and are not pursuing such technology. However, if commercially-available Level 3 systems were to be deployed, a CDL endorsement specifically for Level 3 automation may be appropriate considering the human driver is required to provide the DDT fallback and must understand exactly how the system would request human intervention and what would be required to respond appropriately and safely.

2.2 If so, what should be covered in the knowledge and/or skills test associated with an ADS endorsement?

We agree with FMCSA's response in the ANPRM that "at this time, it would be very difficult to establish uniform knowledge and/or skills tests to adequately assess a CDL holder's understanding of the vehicle's ADS and the specific operating scenarios under which human control may be needed, versus those scenarios where relying solely on the ADS is appropriate. Therefore, it is premature for the Agency to consider proposing rules in this regard."

2.3 What would be the impacts on SDLAs?

We would defer to SDLAs to respond.

2.4 Should a driver be required to have specialized training for ADS-equipped CMVs?

To reiterate from earlier answers, the premise of this question could be interpreted as assuming a human driver would have some role in the operation of an ADS-equipped CMV. Given the ANPRM's stated focus on Level 4 and 5 automation, we reiterate that by J3016 definition, no human individual is necessary to operate a Level 4 or 5 ADS-equipped CMV.

Embark's current testing operations are most accurately described as Level 2, where test drivers are used to complete certain object and event detection and response aspects of the DDT, as well as monitor the system and provide fallback as appropriate whether requested by the system or not. Embark exclusively hires experienced professional drivers for such roles using criteria drawn from the most well-regarded national fleets. Furthermore, Embark provides extensive training for our drivers, including a classroom-based theoretical component, simulated fault training on closed courses, ride-alongs with experienced Embark drivers, and a DMV-style exam prior to assuming any driving duties on public roads. Our training is thorough and specifically tailored to the capabilities of our system. While Embark believes any safety-oriented ADS developer should provide analogous training, the diversity of development approaches means standardizing such training in order to create a requirement is premature.

2.5 In an operational model that has an individual remotely monitoring multiple CMVs, should the Agency impose limitations on the number of vehicles a remote driver monitors?

Please refer to the above section "Discussion of Remote Roles." The concept of "remotely monitoring" is ill-defined and could cover a range of roles and responsibilities with different implications for safety. Prior to imposing any limitations on the number of vehicles, the concept of "remote monitoring" would need to be defined, and we believe such a definition and associated limitations would be premature.

2.6 Is there any reason why a dedicated or stand-by remote operator should not be subject to existing driver qualifications?

Please refer to the above section "Discussion of Remote Roles." We believe a Remote Driver, as defined earlier in this document as having the ability to perform some or all of the DDT, should be subject to existing driver qualifications at this time. As the industry matures, data could suggest amending certain qualifications for Remote Driver roles, but such data is not yet known. Furthermore, we believe other remote roles that do not require performing any of the DDT are not yet sufficiently well-defined to determine what requirements should apply.

3.1 Should HOS rule changes be considered if ADS technology performs all the driving tasks while a human is on-duty, not driving; off-duty or in the sleeper berth; or physically remote from the CMV?

We agree with FMCSA's preliminary regulatory approach outlined in the ANPRM:

> ...any time a human is at the controls of an ADS-equipped CMV, either in the driver's seat or operating it remotely, the time should be recorded as on-duty, driving. Any time the human is working without having the responsibility for taking control of the ADS-equipped vehicle (because it is operating in a fully autonomous mode within its intended ODD) should be considered on-duty, not driving. For scenarios in which the human is in a sleeper-berth on a vehicle controlled by ADS technology, the human may record his/her duty status in the same manner as a team driver with hours off-duty in the passenger seat or sleeper -berth time.

3.2 Should the HOS requirements apply to both onboard and remote operators?

See the answer for 2.6. We believe HOS requirements should apply to Remote Drivers. We also believe there is not enough information on other types of remote roles aside from Remote Driver to know whether HOS should apply.

3.3 If so, how should HOS be recorded when an individual is not physically in control of the vehicle?

Since a Remote Driver (as defined earlier in the "Definitions" section) should still be under HOS but not able to access the ELD onboard the vehicle being controlled, we would suggest an amendment to 395.8 that would allow a driver to manually record hours:

> **§ 395.8 Driver's record of duty status.**
> (a)(1)(iii)(A) (A) A motor carrier may require a driver to record the driver's duty status manually in accordance with this section, rather than require the use of an ELD, if the driver is operating a commercial motor vehicle:
> (3) as a Remote Driver as defined in 390.5 and not physically located in the commercial motor vehicle

This amendment would add on to a limited number of ELD exemptions that currently exist for occasional drivers operating no more than 8 days in a 30-day period for a particular motor carrier, as well as certain drive-away/tow-away operations where the vehicle driven is part of a shipment. Eventually it is assumed such hours tracking would not be done manually, but given the early stage of the industry and the specificity of existing ELD equipment requirements, a manual accounting of hours seems like the best approach for remote operators.

4.1 Should some of the physical qualification rules be eliminated or made less stringent for humans remotely monitoring or potentially controlling ADS-equipped CMVs?

One of the benefits of ADS-equipped CMVs is the potential for new jobs to be created that improve the quality of life over traditional long-haul driving jobs. Such jobs include a potential increase in higher quality local haul jobs that feed automated long-haul routes, as well as a range of remote driving and other remote positions (see "Discussion of Remote Roles"). These

jobs would leverage many of the same skills as drivers today, but without requiring the physical and emotional burdens of being away from home for long periods of time.

Remote Driving roles, as defined earlier in this comment, could potentially have less stringent physical qualifications than traditional driving roles, making this type of work available to a wider range of candidates. However, until such roles are more prevalent and available for study, we agree with the Agency's statement that "individuals responsible for taking control of an ADS-equipped vehicle on a public road should be subject to the current physical qualification standards" insofar as "taking control" means performing some or all of the DDT.

4.2 If so, which of the requirements should be less restrictive for human operators who would take control of an ADS-equipped CMV remotely?

See 4.1. No requirements should be made less restrictive at this time.

4.3 Should the Agency consider less restrictive rules for humans who have the benefit of ADS technology to assist them in controlling the vehicle (e.g., technologies that would enable individuals with limb impairments to operate at a level comparable to individuals without such impairments)?

Our technology is not specifically designed to assist drivers in controlling the vehicle in a way that compensates for an impairment that would otherwise preclude them from operating a CMV. If such technology existed, its effects on driver performance should be studied, potentially through FMCSA's pilot program authority, prior to easing any existing physical requirements via rulemaking.

5.1 How should the prohibition against distracted driving (i.e., texting, hand-held cell phone) apply to onboard operators responsible for taking control of the CMV under certain situations, and to remote operators with similar responsibilities?

The response to this question depends on the level of automation being discussed.

FMCSA noted its intention to focus on Level 4 and 5 ADS. Notably, by definition in J3016, a Level 4 system operates "without any expectation that a user will respond to a request to intervene." Thus, applying distracted driving prohibitions to a human on board a Level 4 equipped vehicle would not improve safety, as the human is not driving or expected at any point to complete any part of the DDT or fallback. From a practical perspective, it may be hard to distinguish a driver from a non-driver in a Level 4 vehicle if the person is sitting in the driver's seat. Therefore, it may be more straightforward to use a similar approach to FMCSA's view of HOS applicability, that a human at the controls of a CMV, either seated in the driver's seat or remotely located, should be subject to distracted driving prohibitions.

For a Level 1-3 system, which expects a human to perform some role related to the safe operation of the vehicle, all distracted driving prohibitions should still apply and be rigorously enforced.

For any Remote Drivers, we believe all distracted driving prohibitions should still apply. Per our discussion on Remote Roles, we believe it is too early to accurately define positions other than "Remote Driver" and determine what requirements and prohibitions apply.

We believe §392.80 and §392.82 as currently written are compatible with the above stated views without amendment.

6.1 Should FMCSA consider revising its rules to ensure that (1) any human exercising control of an ADS-equipped vehicle must continue to comply with all the rules under Part 392, and (2) a CMV under the control of a Level 4 or Level 5 ADS must satisfy the operational rules?

Embark believes any human exercising control of an ADS-equipped vehicle must continue to comply with all rules under Part 392, insofar as "exercising control" means performing some or all of the DDT. We believe §392.1(a) is sufficiently broad to cover humans performing some or all of the DDT on an ADS-equipped vehicle without amendment.

In general, we agree that a H-ADS-equipped CMV must also continue to comply with all the rules under Part 392 as well. However, there may be certain rules that are specific to scenarios outside of a particular ODD. In those cases, the H-ADS should not need to be capable of handling such scenarios (See 6.2 below).

6.2 For example, should FMCSA require that the ADS be capable of identifying highway-rail grade crossings and stopping the CMV prior to crossing railroad tracks to avoid collisions with trains, or going onto a highway-rail grade crossing without having sufficient space to travel completely through the crossing without stopping?

Picking up on the answer from 6.1, an ADS should be capable of identifying highway-rail grade crossings if such features could be present within the system's ODD. However, if an ADS is geofenced to an area that has no highway-rail grade crossings, managing such crossings should not be a requirement of the ADS.

6.3 For scenarios in which the control of the ADS-equipped CMV alternates, or may alternate between a human and the technology, should FMCSA require that both the human operator and ADS comply with the applicable operational rules?

We agree that an individual that performs some or all of the DDT of a CMV, whether remote or onboard the vehicle, should be required to comply with all operational rules. An ADS should be required to comply with all operational rules applicable to the system's ODD, as discussed in 6.2.

7.1 What qualifications should be required of the individual performing the pre-trip inspection?

At this early stage in the industry, we believe it is appropriate for individuals performing the pre-trip inspection to hold CDLs and otherwise meet the qualifications to drive CMVs. In the future there may be opportunities to revisit this question as the operations support roles for ADS-equipped CMVs come into focus.

7.2 What kind of routine or scheduled inspections should be performed and what types of ADS-related maintenance records should be required?

Given the early stage of the technology, we suggest FMCSA requirements for routine or scheduled inspections and maintenance records for ADS-equipped CMVs should be no different that the requirements for regular CMVs. In practice, ADS are much more closely monitored, inspected, and maintained that conventional truck systems within normal fleet operations. However, until the systems reach a more mature development point, there is a lack of data to inform a broad requirement.

As the technology develops, we intend to work directly with FMCSA, as well as other companies in the industry and industry fora, such as the ATA Technology and Maintenance Council, to surface appropriate maintenance and inspection schedules and methods.

7.3 Should the inspection period be more or less frequent than annual for an ADS-equipped CMV?

See 7.2

7.4 Should inspections be mileage-based or time-based (e.g., 1,000 miles, 3 months or 1,000 hours of operation)?

See 7.2

7.5 Should FMCSA impose general requirements for motor carrier personnel responsible for ADS-related inspection, repair, and maintenance tasks similar to the Agency's brake inspector qualification requirements?

While brake systems are largely standardized, the proprietary nature of ADS technology means ADS developers are best positioned to determine who is qualified to work with their own ADS. We do not believe FMCSA general requirements for ADS-related inspection, repair, and maintenance tasks are appropriate or helpful at this time.

7.6 How could FMCSA ensure that motor carriers apply safety-critical software updates?

How this question is answered depends largely on the relationship between ADS developer and motor carrier. Some ADS developers may choose to operate their own trucks exclusively, especially in early deployments of the technology, to ensure full oversight and control of the systems. In such cases, the motor carrier and ADS developer would be the same entity and thus applying safety critical updates would be trivial. In other cases, an ADS developer may partner with a motor carrier or otherwise license its technology for operation by a third party. In such instances, the ADS developer has immense incentive to ensure any ADS-equipped CMVs operate only with the most up-to-date software. This could be accomplished through a combination of licensing terms, mandatory over-the-air updates, or other technical methods by which an ADS-equipped CMV would be rendered inoperable until a safety-critical software update is applied.

8.1 Should motor carriers be required to notify FMCSA that they are operating Level 4 or 5 ADS-equipped CMVs?

Embark acknowledges FMCSA has a legitimate interest in knowing what types of ADS technology are being used on CMVs and in what quantity. Collecting data can help FMCSA better understand how automation is changing the freight trucking industry and inform more specific answers to many of the questions posted in this ANPRM. Therefore, we have been, and will continue to be open in sharing relevant data. We also recognize that it is broadly in the automated trucking industry's interest to ensure FMCSA has comparable insight into all ADS developers. Therefore, we are open to a requirement to notify FMCSA of Level 4 or 5 ADS operation of CMVs.

8.2 If so, how should the carrier notify FMCSA?

An addendum or update to the MCS 150 form could be a simple way for motor carriers to indicate how many of their CMVs are equipped with H-ADS.

8.3 Should FMCSA require markings identifying the ADS Level of a vehicle?

Embark is open to a requirement for markings for law enforcement, inspectors, or other officials to identify ADS-equipped CMVs. There are many operational circumstances in which it would be important for enforcement personnel to make a quick determination as to whether a CMV is equipped with an ADS. Such markings would need to be developed in cooperation with ADS developers and federal and state government stakeholders to ensure a solution that was acceptable to all parties.

We believe more information is required before determining whether such markings should be easily decipherable by the general motoring public. Calling other road users' attention to the automated nature of a CMV may cause them to drive differently, and this altered behavior could be a net positive or negative. This issue warrants more study before a final determination is made.

8.4 Should the Agency require motor carriers to utilize ADS-equipped CMVs that have a malfunction indicator?

We believe any ADS used on a CMV should have the ability to self-diagnose and report on system health. While current CMV safety systems such as ABS rely on a simple light to indicate malfunction, ADS are much more complex systems with the potential to provide a much fuller picture of system health. We would generally support a requirement that is not overly prescriptive on how malfunctions are reported, so as not to preclude more effective ways of reporting malfunctions that leverage advanced ADS technology.

8.5 Should the Agency require that motor carriers deploying ADS-equipped CMVs ensure the vehicle can pull over in response to Federal and State officials or move out of the way of first-responders?

Specifically for H-ADS, we believe this is a reasonable requirement and something any Level 4 or 5 ADS should be capable of doing without human intervention.

8.6 How might that be achieved, and at what cost?

Approaches may include ADS developers working with law enforcement and first responders to train perception systems to recognize first responder vehicles and respond appropriately. It is difficult to assign a cost to this specific feature as it is an integral part of developing an H-ADS. We look forward to working with state law enforcement and federal partners to develop appropriate and predictable behaviors for our systems.

8.7 How would roadside enforcement personnel know that a vehicle can no longer operate safely?

ADS developers have a wide range of sensors, systems, and tools to assess and report on the health of an ADS system, as well as other safety critical vehicle systems. As we continue to develop the technology, we plan to work with appropriate state personnel, as well as relevant groups such as CVSA, to build consensus on the best ways for roadside enforcement personnel to determine whether or not an ADS-equipped CMV can operate safely.

8.8 Absent an FMVSS, how could standard indications be provided to enforcement personnel?

See 8.7. We believe that before an FMVSS is considered, industry should work with relevant stakeholders to develop consensus on the best methods for indicating ADS health. These best practices could then be codified in an FMVSS if necessary.

9.1 What types of safety and cargo security risks may be introduced with the integration of ADS-equipped CMVs?

We believe ADS-equipped CMVs will not introduce significant new safety and cargo security risks that are not already present on today's modern CMVs that rely on electronic systems that often feature some connectivity. While some have made the point that a human driver may no longer be on board to monitor the security of cargo, ADS-equipped CMVs will be equipped with sophisticated perception systems, including cameras, that could deter or monitor threats to cargo.

9.2 What types of rules should FMCSA consider to ensure that motor carriers safety management practices adequately address cybersecurity?

Cybersecurity is an important consideration for all modern electronic systems on a CMV, including ADS. Cybersecurity should be considered during the design, operation, and management of ADS and incorporate relevant ISO, SAE, and NIST cybersecurity-related standards and TMC best practices. Information sharing groups such as Auto-ISAC and ATA's Fleet CyWatch Program, can also be an important component in addressing vulnerabilities and mitigating cybersecurity-related risks.

While it is difficult to suggest specific cybersecurity rules at this early stage of ADS development, FMCSA should continue to encourage ADS developers to share their approaches for cybersecurity either directly with the Agency or through Voluntary Safety Self-Assessments.

10.1 As the development of ADS technology continues, the Agency believes there is a need to learn about the performance limitations of these systems. FMCSA draws a distinction between information about performance limitations (e.g., how well does the ADS keep the vehicle in its lane and under what environmental conditions, etc.) and details about the system design (e.g., the specific types of sensors, or the arrays of sensors and cameras used for input to the central processing unit for the ADS). To what extent do ADS developers believe performance data should be considered proprietary and withheld from the public?

A distinction should be made between the development and deployment stages of ADS. During the testing and development stage, which generally includes operation of systems at Level 2 with human drivers completing the DDT, data generated by the system may be considered proprietary by ADS developers. Such data also may not reflect the full capability of a system given that safety drivers may be intervening during the testing phase in ways that would not occur during commercial deployment. During this stage, we encourage FMCSA to work directly with ADS developers to understand the performance characteristics and goals of pre-commercial ADS technology in a way that allows for protection of proprietary information.

However, prior to commercial deployment of Level 4 H-ADS, where the system is responsible for the entire DDT as well as performing DDT fallback and achieving minimal risk condition, we believe sharing publicly available performance data will be an important component of satisfying the §393.3 requirement that equipment added to a CMV does not decrease the safety of that vehicle, as well as winning public acceptance for the technology.

10.2 Are the Agency's current processes under 49 CFR 389.9 for submission and protection of confidential business information in the context of a rulemaking sufficient to allow ADS developers and motor carriers to communicate essential information to the Agency regarding the operation of ADS?

While we have not used these processes specifically, we have no reason to think they are insufficient.

10.3 If not, how should those processes be modified?

See 10.2

Conclusion

We appreciate the thoughtful consideration by FMCSA of how potential regulatory amendments can support the safe deployment of ADS-equipped CMVs. We recognize that many of these

issues are novel, highly complex, and made more challenging by the fact that ADS technology has not yet been broadly deployed. As we continue to develop our technology with the goal of deploying Level 4 ADS-equipped CMVs, we look forward to maintaining close communication with FMCSA, USDOT, and other federal and state government stakeholders on these issues.

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

Sincerely,

Alex Rodrigues
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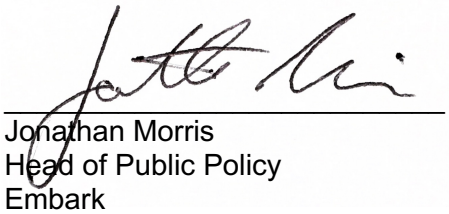

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