MOTOR CARRIER SAFETY ADVISORY COMMITTEE

C/O: Federal Motor Carrier Safety Administration

1200 New Jersey Avenue, SE

Room W64-232

Washington, DC 20590

October 16, 2018

The Honorable Raymond P. Martinez

Administrator

Federal Motor Carrier Safety Administration

1200 New Jersey Avenue, SE

Washington, DC 20590

Dear Administrator Martinez:

The Motor Carrier Safety Advisory Committee (MCSAC) commenced work on Task 17-1 at its June 2017 meeting. The Federal Motor Carrier Safety Administration (FMCSA) tasked the Committee with presenting recommendations concerning the issues the Agency should consider to ensure that the Federal Motor Carrier Safety Regulations (FMCSRs) provide appropriate standards for the safe operation of highly automated commercial vehicles (HACVs). FMCSA also tasked the MCSAC with providing recommendations regarding prospective requirements for entities requesting a pilot program and/or a temporary exemption to operate an HACV without a person in the driver’s seat on a public roadway. In addition, the Agency asked the MCSAC to identify data needs that FMCSA should consider in developing a framework for a potential HACV pilot program.

The MCSAC met in public meetings on June 12-13, 2017, and July 30-31, 2018, to discuss the task. The Committee considered several sources of information on HACVs, including multiple presentations on automated technologies from FMCSA, the Society of Automotive Engineers (SAE) International, and the Motor & Equipment Manufacturers Association (to consider supplier perspectives). The resulting ideas and recommendations are attached as the Task 17-1 Report.

On behalf of the MCSAC, I respectfully submit this report to FMCSA for its consideration.

Sincerely,



John Lannen

Chairman

Enclosure

**MCSAC Task 17-01: Highly Automated Commercial Vehicles**

Introduction

In Task 17-1, the Federal Motor Carrier Safety Administration (FMCSA) requested that the Motor Carrier Safety Advisory Committee (MCSAC) provide recommendations concerning the issues the Agency should consider to ensure that the Federal safety regulations provide appropriate standards for the safe operation of highly automated commercial vehicles (HACVs) from design and development through testing and deployment. Specifically, FMCSA directed the MCSAC to consider the application of the following regulatory provisions in title 49 CFR to HACV operations:

1. Part 383, Commercial Driver’s Licenses;
2. Part 391, Qualifications of Drivers;
3. Sections 392.80 and 392.82, use of electronic devices;
4. Part 395, Hours of Service of Drivers; and
5. Part 396, Inspection, Repair, and Maintenance.

Because the Federal Motor Carrier Safety Regulations (FMCSRs) include certain requirements that could be considered an obstacle to the on-road testing of HACVs, the operation of some HACVs on a public roadway without a person in the driver seat may occur only after some form of regulatory relief has been granted by FMCSA. In Task 17-1, FMCSA tasked the MCSAC with providing recommendations regarding prospective requirements for manufacturers or other entities requesting a pilot program and/or a temporary exemption to operate an HACV without a person in the driver’s seat on a public roadway. The Agency asked the MCSAC to identify data needs that the FMCSA should consider in developing the framework for a potential pilot program that would ensure an equivalent level of safety for HACVs as compared to having a driver operating the vehicle in the same operational design domain.

This report from the MCSAC refers throughout to the Society of Automotive Engineers International (SAE) J3016 standard’s definitions for levels of automation. The SAE definitions divide vehicles into levels based on “who does what, when” and range from Level 1 (Driver Assistance) to Level 5 (Full Driving Automation).

1. **Issues FMCSA Should Consider When Allowing HACVs to Operate**
	1. Regulatory Issues
		1. States seem eager to change rules to allow demonstration projects.
		2. FMCSA needs to gather information from States and other entities that are already in the process of developing requirements for autonomous vehicles.
			1. FMSCA should work with the States to determine what the regulations should entail prior to enacting legislation and regulations.
			2. The American Association of Motor Vehicle Administrators (AAMVA) has an autonomous vehicles working group.
		3. As technology transitions to more fully autonomous vehicles, regulations will need to progress with the technology.
			1. Changing technology will create training issues for law enforcement.
			2. The Commercial Vehicle Safety Alliance (CVSA) needs to know the technology that is available in order to develop standards for inspections.
		4. Should FMCSA always require a driver to be present, even in Level 5 HACVs?
			1. On one hand, a driver should not be necessary if the technology shows to be effective and just as safe as a driver (e.g., a Level 5 HACV).
			2. On the other hand, some Committee members expressed concern that there should always be a driver present in an HACV to retake control of the vehicle, if necessary.
				1. If there must always be a driver or operator, how do you keep the operator engaged and paying attention?
			3. How would FMCSA remove regulatory obstacles in place, if the technology advances to allow for completely driverless vehicles?
			4. FMCSA should conduct research into these questions above.
		5. Some types of automation are similar to autopilot used in aircraft. FMCSA should review the Federal Aviation Administration (FAA) regulations on automation.
	2. FMCSA and the industry should ensure that they have acceptance from the public and from drivers whose role may change over time as the technology develops.
	3. Impacts on Drivers
		1. Driving in a platoon is different from the way commercial motor vehicle (CMV) drivers have been trained to drive or are used to driving.
		2. Training will be essential for drivers to understand how and when to take back control.
		3. Driver Fatigue and Attention
			1. How do you keep a driver from getting fatigued if he or she is not fully in control of the vehicle?
			2. Fatigue may be more of an issue for automation Levels 1 through 4 and less of an issue with fully automated vehicles (Level 5) that do not require an attentive driver at all times.
	4. Design and Development Considerations
		1. Regulations will need to cover issues such as what equipment is being used, how to mount the equipment, and how an inspector can ensure that a sensor or other item is working.
		2. FMCSA will need to review each piece of equipment on the truck that the new technology interacts with and determine how to inspect them.
		3. FMCSA should collaborate with the industry to understand how stakeholders want to use this technology and when different technologies will be available.
			1. Does industry want to use it only in some limited circumstances (e.g., short point-to-point routes that are used frequently)?
			2. A lot of companies are interested in platooning.
			3. FMCSA should address safety rules for the technologies that are likely to be available the soonest.
		4. How can the public be involved in this process when the industry does most of the research?
	5. Should certain types of loads be prohibited on higher levels of HACVs?
		1. What requirements should be on the systems in order to allow various levels of automation?
			1. Permissibility may depend on the level of automation and road conditions.
			2. Cybersecurity issues are of paramount concern for certain materials.
		2. Some Committee members suggested that radioactive materials (e.g., waste isolation pilot plant (WIPP) shipments) should not be transported using Level 4 or 5 automation.
		3. Other Committee members suggested that extended loads should not be on automated vehicles.
		4. Some Committee members expressed concern with limiting types of loads that could be carried on HACVs.
			1. If the technology is not safe enough for hazardous materials, why should it be considered safe enough for any load?
	6. FMCSA will need to determine which technologies work with different infrastructure setups.
2. **How Could Current Regulations Apply to HACVs?**
	1. **Commercial Drivers Licenses (CDLs) (49 CFR Part 383)**
		1. Recommendations:
			1. For all levels of automation, CMV drivers might need training about how to use the automation technology and how to know it is operating correctly.
			2. Pre-trip inspection requirements will need to be updated for all levels of automation.
		2. Questions FMCSA should consider:
			1. Would a driver need an endorsement to drive vehicles with certain levels of automation?
			2. If there is a driver in the vehicle, should that person be required to have a CDL?
			3. Could a commercial passenger carrier vehicle have a passenger manager who is able to stop the vehicle, instead of someone with a CDL, if operated in a limited domain?
		3. The need for a CDL or endorsement could depend on the definition of the driver and his or her role.
	2. **Driver Qualifications (49 CFR Part 391)**
		1. Theoretically, a driver that is medically unqualified now could be qualified to drive an HACV under certain levels of automation.
		2. Recommendation: For Level 3 and Level 4 HACVs, the Agency should retain all current driver qualifications because the driver needs to be ready to take back control.
	3. **Use of Electronic Devices (49 CFR §§ 392.80, 392.89)**
		1. The use of electronic devices probably should not be allowed during the operation of an HACV at any level of automation.
		2. Maybe electronic devices could be allowed with Level 5 automation technologies if the driver does not need to be able to take control.
		3. If a vehicle with Level 4 automation technology stays within the approved domain, should it be treated like Level 5 with regard to using electronic devices?
		4. Recommendation: If FMCSA determines that any level of HACV could be operated safely while the driver uses an electronic device, the Agency should consider revising the regulation to create a distinction between operators and drivers for purposes of the use of electronic devices.
	4. **Hours of Service (49 CFR Part 395)**
		1. Theoretically, hours-of-service regulations may not be needed if a driver is not operating the vehicle.
		2. However, fatigue and the need to reengage as a driver (in Level 2 and 3 HACVs) is an important issue.
			1. Canada has been conducting studies and has found that more automation leads to increased driver fatigue.
			2. However, there are no field studies to measure various levels of automation as it relates to driver performance (i.e., fatigue and alertness) against varying levels of automation.
		3. Other potential sources of data:
			1. Farmers using global positioning system (GPS) automated tractors.
			2. Miners that use automated technologies.
		4. Recommendation: FMCSA should collect more data to determine what hours-of-service regulation changes need to be made (if any) for HACVs to ensure that changes are data-driven.
	5. **Inspection, Repair, and Maintenance (49 CFR Part 396)**
		1. Recommendation: Inspections will need to be changed to include new technologies, with substantially more detailed inspections for fully automated vehicles.
			1. Rationale: There will need to be a way to know that all of the technologies are working.
		2. Regulations for Testing and Metrics
			1. Recommendation: FMCSA should standardize language and a data dictionary for reporting records and data from HACV systems.
				1. Rationale: Those performing testing must do them in the same way and report results in the same way.
			2. Recommendation: FMCSA should require HACVs to record safety-critical events for operation on public roads.
		3. Inspections
			1. Recommendations:
				1. FMCSA should require HACVs to have smart sensors that check themselves.
				2. FMCSA should distinguish between a critical failure versus a minor failure to determine whether the HACV can continue to be operated without the automated system.
			2. Questions for FMCSA consideration:
				1. How would pre-trip inspections have to change with HACVs? Where would that information be stored for inspectors?
				2. If a law enforcement official needs to pull over an HACV, how would the officer know that it was an HACV? How would the truck know to pull over?

Who would be responsible when the truck messes up? Who would get the ticket if one is issued? How would that be documented? What database would that be held in?

For example, would a speeding ticket go against vehicle U.S. DOT number?

What happens if the truck needs to be put out of service?

One option would be for law enforcement to communicate what is happening roadside to a responsible dispatch vendor so that corrective action can be taken or vehicle can remain off the road.

Communication would need to be real-time.

* + - * 1. Will the inspector use an emission tests-like system? How will the inspector and technician work together?

Wireless roadside inspection locations could check that HACV systems are operable and indicate to law enforcement that that the HACV does not need be stopped.

* + - 1. Comments:

i. Inspections for lower-level HACVs would need some changes as well.

ii. Data collection is critical; the better the data (good, bad, and why), the better the automated system will work.

* + 1. Cybersecurity
			1. What would happen if an HACV is hacked?
			2. Recommendations:
				1. FMCSA should require some minimal level of cybersecurity to prevent HACVs from being hacked and weaponized.
				2. The Agency should consider collaborating with the following entities on the issue of HACV cybersecurity:

U.S. Department of Defense.

Vendors that have adopted voluntary consensus standards.

Federal Aviation Administration – What kind of preventive cybersecurity requirements are currently in place to avoid the hacking of aircraft?

National Institute of Standards and Technology (NIST).

Department of Homeland Security (DHS).

American Trucking Associations Fleet CyWatch works with DHS and other agencies to identify shared issues and vulnerabilities.

Financial sector has advanced cybersecurity requirements and has a standard for developing across sectors for preventative efforts.

* 1. **Parts and Accessories Necessary for Safe Operation (49 CFR Part 393)**
		1. FMCSA may need to change these requirements based on the technologies used.
		2. For example, the ideal location of a camera is outside of the currently allowed 4 inches above the top of the wiper zone.
1. **Recommendations on Requirements for Pilot Programs**
	1. Operational Design Domains
		1. Recommendation: Any HACV pilot program should define the operational domain of an HACV, along with the appropriate system and human response when vehicle is no longer operating within operational domain.
		2. A graduated program could allow technologies to operate in highly controlled domains and then move to less controlled domains as the technology is proven to work.
		3. Testing with drivers versus without a driver (individual HACV technology versus a HACV system):
			1. Does there need to be a different process when looking at a whole system versus individual technology?
	2. Self-certification versus government testing:
		1. Requiring that all individual technologies be tested by the government could be creating barriers instead of improving safety.
		2. There should be a common standard to which technology manufacturers or motor carriers could self-certify.
		3. A voluntary testing standard with performance criteria would need to be developed (in conjunction with manufacturers) to determine if self-certification is reasonable.
	3. Test facility versus open road:
		1. For test facilities, a pilot would have to develop standards that the test facility must meet.
			1. Then, HACV systems would be required to meet certain standards to graduate from the test facility to the open road.
		2. Testing on open road should be done within a controlled environment (e.g., shut down roads for testing).
	4. Data needs for developing a pilot program framework:
		1. Pilot programs will need data that demonstrate a technology’s ability to operate in certain operational domains before moving to less controlled domains.
			1. Must define “success” and “failure.”
		2. Data on how frequently a technology fails or passes will be needed.
			1. Drill down to “why?”
		3. There will need to be a variety of test environments of roadway conditions to gather data on performance on different pavement conditions.
		4. Data will need to demonstrate the ability to achieve safety objectives with a gradual progression toward less driver interaction with the vehicle.
		5. The data needs will be different for pilots that are testing different technologies in various stages.
		6. FMCSA should require technology providers to share available data to prove their technology works.
		7. Details on equipment failures:
			1. Communication software glitches.
			2. How many times a road regulation was violated or a crash would have occurred.
			3. Why a driver/operator had to take back control.
			4. The number of miles driven/hours operated within the operational design domain or any system failures while in the operational design domain and the reasons for those failures.
			5. What happens when there is a failure? What is the expectation with the individual technology?
		8. Data on the durability, reliability, and maintainability testing of system:
			1. What happens when HACV equipment needs to be replaced? Is it field replaceable or not?
			2. If testing is only performed on new technology, what happens when the equipment wears?
			3. What are the manufacturers recommended preventive measures and/or maintenance program for the relevant equipment?
		9. Recommendation: FMCSA should observe a multi-day demonstration and not just review data.
	5. Additional Driver Requirements
		1. FMCSA might need to develop additional requirements for drivers in pilot programs.
		2. Drivers of HACVs will need to be trained how to respond when they are stopped or have to interact with law enforcement.
		3. Recommendation: Any pilot program should make sure that drivers are properly trained on the systems to be used, i.e., how they operate, their limitations, and how the driver will be alerted when the human operator must resume control of the vehicle.
	6. Product Liability and Minimum Levels of Financial Responsibility
		1. For a pilot test in Colorado, the technology company (Otto) was asked to increase their liability coverage significantly above the FMCSR requirements.
		2. Recommendation: Any pilot program should require minimum levels of financial responsibility for carriers not already covered by 49 CFR part 387.
			1. Additional financial responsibility should be required from either carriers or the technology manufacturer.
	7. Public Awareness
		1. Recommendation: Any pilot should require public notice of the pilot that indicates which roads would be used by the HACV and research the best way to inform public about the kind of testing occurring.
			1. It may be difficult to keep up with changes if domains grow very quickly.
		2. Recommendation: FMCSA should perform research on the safest, most effective way to indicate on a CMV that an automated system is operating.
			1. Consider including a light or some kind of notification on a CMV to indicate automated operations.
			2. FMCSA should keep in mind the potential for an HACV to cause distraction.
		3. Recommendation: Testing vendors should notify local Motor Carrier Safety Assistance Program (MCSAP) agencies, State Departments of Transportation (DOTs), or Public Utilities Commissions (PUCs) that a pilot is occurring.
		4. Law enforcement and the public need to become educated about truck platooning so they are less alarmed when they see trucks following so closely.
			1. Knowing that platooning is safer could help increase public assurance.
			2. Education will be needed to change how cars interact with those vehicles.
			3. Ports of entry and State agencies will need to be aware of how platooning vehicles work.
	8. Recommendation: FMCSA should develop a list of current state-approved pilot programs, including timelines and requirements.
	9. Recommendation: FMCSA should evaluate HACV technology effects on passive fatigue and consider a Fatigue Measurement, Fatigue Mitigation, and Fatigue Management Program.
		1. Data should be collected on the alertness of drivers and testers.
2. HACV Liability Discussion
	1. The determination/division of liability between HACV technology manufacturers and the motor carrier in the event of a crash is a complex issue that depends on where the failure occurred.
		1. An HACV would need to capture a significant amount of data to make a liability determination.
	2. Recommendation: FMCSA should leave liability determinations to the court.
		1. However, the Agency will have to consider what minimum insurance levels are appropriate for an HACV.