



May 20, 2019

NHTSA Administrator  
c/o Deputy Administrator Heidi King  
National Highway Traffic Safety Administration  
1200 New Jersey Avenue SE, West Building  
Washington, D.C. 20590

Submitted electronically via [www.regulations.gov](http://www.regulations.gov)

**RE: Request for Comment, Docket No. NHTSA-2019-0016, General Motors, LLC—  
Receipt of Petition for Temporary Exemption From Various Requirements of the  
Safety Standards for an All-Electric Vehicle With an Automated Driving System**

Dear Deputy Administrator King:

The Center for Auto Safety (the Center) appreciates the opportunity to comment on the National Highway Traffic Safety Administration's (NHTSA) request for comments on General Motors' (GM) petition for temporary exemptions from Federal Motor Vehicle Safety Standards for an electric vehicle with an automated driving system. The Center, founded in 1970, is an independent, non-profit consumer advocacy organization dedicated to improving vehicle safety, quality, and fuel economy. On behalf of our members, and all drivers, passengers, and pedestrians nationwide, the Center requests that NHTSA deny the GM Petition as it fails to sufficiently demonstrate it has addressed the safety concerns that may arise as a result of the requested exemptions. Further, because NHTSA has acted unlawfully by crafting a new temporary exemption process that skirts long-standing notice and comment requirements, thus creating the potential for an incomplete petition, review of this petition should be suspended until such time as NHTSA conforms with the law.

**I. NHTSA's Current Temporary Exemption Rule was Unlawfully  
Issued in Violation of the Administrative Procedure Act and  
NHTSA's own Published Procedures Governing Rulemaking**

On December 26, 2018, NHTSA published a Final Rule amending 49 CFR Part 555, "Temporary Exemption From Motor Vehicle Safety and Bumper Standards." The amendment was intended to eliminate a long-standing requirement that the Agency make a determination that a temporary exemption application is complete before publishing a notice and seeking public comment, and prior to deciding whether to grant or deny the petition. The amendment removes the public's right to review and comment on the full range of materials submitted by manufacturers in support of a temporary exemption

petition, and limits public participation in agency decisions to grant or deny petitions for exemption from Federal Motor Vehicle Safety Standards (FMVSS).

NHTSA did not issue a Notice of Proposed Rulemaking to seek public comments on this amendment to Part 555. Therefore, either NHTSA violated the Administrative Procedure Act requirements for notice and comment, or the agency intended for this rulemaking to be considered a Direct Final Rule (DFR) and subject to the agency's direct final rulemaking regulation at 49 CFR 553.14. A review of this regulation provides ample evidence that the agency should only be using the DFR process when a rule is non-controversial, routine, and where little-to-no adverse public comment is expected.<sup>1</sup>

In fact, NHTSA's only stated justification for issuing the rule without formal notice and comment is: "This rule does not impose any additional requirements on exemption applicants or the public. Therefore, NHTSA has determined that notice and public comment are unnecessary."<sup>2</sup> Not only does this statement fail to justify issuance of a direct final rule under the agency's own regulations, it is also demonstrably false. The amended rule places a significant additional burden on the public, who would be unable to provide meaningful comments in response to an incomplete application prior to the agency making a final decision regarding a temporary exemption petition.

NHTSA's final rule set a deadline of February 11 for petitions for reconsideration. On February 11, the agency received a petition for reconsideration from Advocates for Highway and Auto Safety, the Center for Auto Safety, Consumer Federation of America, Consumer Reports, and former NHTSA Administrator Joan Claybrook. The petition requested a stay on the effective date of the final rule until NHTSA addresses the issues raised in the petition.

As the agency has received adverse comments within the prescribed period, NHTSA must withdraw the final rule and suspend all temporary exemption proceedings subject to Part 555 until a proper notice-and-comment rulemaking has been conducted. To date, NHTSA is in violation of 49 CFR 553.14(d) by failing to withdraw the December 26 Final Rule. Further, it has not indicated that it is taking any steps to suspend consideration of active temporary exemption petitions. The deadline for agency action has now passed without publication of a notice in the Federal Register explaining the

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<sup>1</sup> See 49 CFR 553.14 "If the Administrator, for good cause, finds that notice is unnecessary, and incorporates that finding and a brief statement of the reasons for it in the rule, a direct final rule may be issued according to the following procedures. (a) Rules that the Administrator judges to be non-controversial and unlikely to result in adverse public comment may be published as direct final rules. These may include rules that:

- (1) Are non-substantive amendments, such as clarifications or corrections, to an existing rule;
- (2) Update existing forms or rules, such as incorporations by reference of the latest technical standards where the standards have not been changed in a complex or controversial way;
- (3) Affect NHTSA's internal procedures, such as filing requirements and rules governing inspection and copying of documents;
- (4) Are minor substantive rules or changes to existing rules on which the agency does not expect adverse comment.

<sup>2</sup> 83 FR 66158 at 66160.

delay, or even publication at Regulations.gov of the petition for reconsideration, both of which demonstrate NHTSA's inability to follow the agency's own policy.<sup>3</sup>

At present, the agency is considering whether to grant or deny two temporary exemption petitions pertaining to autonomous vehicles, one from General Motors<sup>4</sup> and another from Nuro.<sup>5</sup> NHTSA maintains that it will continue to accept information to support temporary exemption applications from both manufacturers. However, the agency has been silent on whether it will provide for another notice and comment period once this new information has been submitted, as well as whether any new information will be made public prior to an agency decision. Keeping in mind that NHTSA waited over one year before making the GM petition public, despite multiple informal and formal FOIA requests and a FOIA appeal from the Center, there are no guarantees that the public will be apprised of any new submission by GM or Nuro prior to the agency's decisions in those matters.

While NHTSA asserts that the Part 555 amendment would "expedite the publishing of notices soliciting public comment on exemption petitions," the Center believes that this amendment and subsequent issuance of the Nuro and GM notices is part of an unlawful effort to limit public participation as dozens of manufacturers prepare to file petitions for temporary exemption of autonomous vehicles incapable of meeting the FMVSS. The amendment's main purpose appears to be to allow manufacturers to file incomplete temporary exemption applications, at which point NHTSA could provide the pretense of a notice and comment period while continuing to receive supporting materials from the applicant. NHTSA provides no guarantee that it will properly apprise the public of the full contents of these applications before making the decision to grant or deny these petitions, thus cutting public input out of the process of evaluating exemptions to standards that are critical to public safety.

In sum, the Final Rule hinders the public's ability to thoroughly review issues of great importance to safety and imperils road users by allowing incomplete applications to move forward for exemptions from critical federal safety standards.

## **II. GM's Petition is Littered with Deficiencies and Should be Denied as a Matter of Public Safety**

Since the Center's founding in 1970 we have supported the introduction of effective advanced safety technology in both consumer and commercial vehicles. In fact, the Center has long advocated for mandating proven safety technology, often over the objections of manufacturers who preferred to keep such safety devices as premium or luxury features available only as options on their vehicles. From airbags to electronic

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<sup>3</sup> 49 CFR Part 553, Appendix A, Statement of Policy: Action on Petitions for Reconsideration.

<sup>4</sup> Safety Petition Submitted By General Motors - Petition Under 49 U.S.C. § 30113 And 49 C.F.R. Part 555 To Advance Safety And Zero-Emission Vehicles Through Technology That Achieves The Safety Purpose of the FMVSS, USG 4708, Jan. 11, 2018.

<sup>5</sup> Petition for Exemption from Certain Provisions of Federal Motor Vehicle Safety Standard, No. 500, October 19, 2018, Submitted by Nuro, Inc.

stability control, from rear view cameras to automatic emergency braking, the Center believes that proven safety technology should be standard not optional.

Yet, built into the proposition of such advancements in safety technology is a need to demonstrate its safety and functionality before using unsuspecting consumers, be they motorists or pedestrians, as guinea pigs. Public roads should not be proving grounds any more than they should be the site of unannounced NASCAR races. The Center is hopeful that manufacturers, including GM, will achieve the promises of their marketing departments when it comes to driverless vehicle technology. Simultaneously the Center remains firm in its support for mandatory performance standards to avoid unintended consequences from unmanned vehicles dependent upon unproven technology.

**1. NHTSA's failure to act on the Center's petition for rulemaking to mandate companies testing automated vehicle systems on public roads submit safety information dramatically impacts the agency and NHTSA's ability to evaluate this petition.**

On October 19, 2018, the Center for Auto Safety petitioned NHTSA to immediately mandate the submission of safety information by companies testing automated vehicle system technology on public roads.<sup>6</sup> Seven months later, and three months past NHTSA's own published deadlines,<sup>7</sup> the agency has yet to respond. Thus, there is no uniform data collection process that addresses the scope of public testing and the success, failures, and lessons learned from that testing. Accordingly, NHTSA has missed a golden opportunity to create a fact-specific baseline from which to consider petitions such as those submitted by GM and Nuro.

In short, the Center's petition, which was based on NHTSA's own Highly Automated Vehicle policy, seeks a rulemaking to allow the agency to, at a minimum, acquire enough documentation, detail, or data to demonstrate the autonomous vehicle technology currently being tested, or planning to be tested, on public roads, is at least as safe as vehicles which currently meet all applicable FMVSS. In instances where no current FMVSS exists, the petition recommended that those companies testing or wishing to test autonomous vehicle technology on public roads must provide enough documentation, detail, or data to demonstrate how the safety of the vehicle occupants and those sharing public roads with the vehicle will be safeguarded.

NHTSA has not only chosen to ignore the Center's petition but has irresponsibly, and in dereliction of the agency's basic public safety mission, failed to create any mechanism to collect the type of data that could help to provide the basic information needed to prevent unsafe technology from being tested on our streets. Accordingly, in addition to intentionally undermining the critical task of writing safety standards for autonomous vehicle technology, NHTSA has deprived the agency and the public from having safety critical data at its disposal to use in evaluating GM and Nuro's petitions.

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<sup>6</sup> <https://www.autosafety.org/wp-content/uploads/2018/10/Center-for-Auto-Safety-Petition-for-Rulemaking-to-mandate-Safety-Assessment-Letter.pdf>, submitted October 19, 2018.

<sup>7</sup> Deadline for responding to rulemaking petitions is 120 days. 49 CFR § 552.8.

**2. The petition fails to establish that the ZEAV with FMVSS exemptions provides an equivalent or greater level of safety than human-driven vehicles certified to the FMVSS.**

Despite a petition of 97 pages, and 78 footnotes, GM has provided no data that establishes either the absolute value of safety offered by the ZEAV, nor has it shown that the ZEAV with exceptions to the FMVSS is relatively as safe as a conventional vehicle. In fact, GM has not even established that its program of human-driven analogues to train the autonomous driving system is directly applicable to the subsequent autonomous operation of the ZEAV.

**3. The petition fails to establish criteria that would allow GM to make an objective showing of operative safety during autonomous use.**

The petition states, “We will plan to provide this data, designated as confidential where appropriate, at the conclusion of the exemption period, but also may be able to provide interim reviews, if requested. For GM’s ZEAV, this data will be representative of a vehicle that, as certified to meet the applicable FMVSS, includes its integrated ADS computer, sensor, and control components.”<sup>8</sup> GM plans to introduce the data produced during the ZEAV project as a rationale for future approval of AV operations. Yet, the petition had previously stated, “**GM’s program parameters will reduce the number of miles that the ZEAVs will be driven in higher risk situations, so the ZEAV is not likely to encounter many of the risk scenarios that other vehicles encounter.**”<sup>9</sup> This statement reveals that the ZEAV program has a clear bias toward unrepresentative, success oriented operational data and suggests that the entire ZEAV project is a publicity stunt intended to create an illusion of AV safety and inappropriately encourage AV acceptance. Creating an illusion of safety to serve corporate interests rather than demonstrating real operational safety is not in the public interest.

GM’s petition also states, “GM’s development of the ZEAV’s systems will allow the vehicle to: operate safely on the roads on which the ZEAV will be deployed...”<sup>10</sup> This tautology proves nothing. The petition fails to include a schedule or the milestones to be accomplished before the ZEAV systems will allow the vehicle to operate safely on the roads. The petition does not allow for an assessment of the current safety posture, the meaning of ‘safely’, or the means by which GM will verify safe operational capability. All of GM’s discussions of ZEAV safety lack meaningful definitions, process descriptions, or quantitative data necessary to evaluate the absolute value of public safety available from the ZEAV’s or whether it might provide a relative improvement compared with current technology.

**4. The petition fails to adequately define the ZEAV Operational Design Domain, and the boundaries or limits on operation that are provided suggest that the ZEAV will avoid situations that would provide for a meaningful data set to prove operational safety.**

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<sup>8</sup> GM petition, pg. 37.

<sup>9</sup> GM petition, pg. 13 (emphasis added).

<sup>10</sup> GM petition, AIII-9.

GM's petition does not define the boundaries or limits, so their suitability cannot be evaluated, making the petition deficient. The proposed ZEAV project is intentionally biased against challenging traffic situations, so will not yield a meaningful data set for justifying unrestricted ZEAV use on public roads. It is apparently designed to accomplish corporate goals, not confirmation of ZEAV safety.

GM's petition argues that "GM's program parameters will reduce the number of miles that the ZEAVs will be driven in higher risk situations, so the ZEAV is not likely to encounter many of the risk scenarios that other vehicles encounter."<sup>11</sup> Again, GM is biasing the ZEAV test for the appearance of success rather than a true evaluation of operational safety. This calls into question statements in other parts of the petition that the proposed test will provide "statistically valid" proof of operational safety. GM cannot expect to provide useful data by conducting tests designed to avoid high risk situations.

The petition does not contain any information describing the intended operational design domain. Information needed to assess the ZEAV system safety must include the geographical limits, environmental limits, how the ODD would be established and approved, and how allowed deviations from the approved ODD would be enabled and proliferated to the fleet. It is not clear whether the vehicle can be operated remotely in the event of a disabling event, e.g., "...an unexpected construction zone with barriers or a cone configuration that it does not recognize."<sup>12</sup> A remote operator apparently has access to vehicle-generated video, but it is not clear how the remote operator manages or implements continued ZEAV motion after establishing communication. Since such events can have a material impact on the safety of the ZEAV itself and on pedestrians and vehicles in its vicinity, the GM petition is deficient through absence of a clear description of such events and their resolution.

The GM petition provides no meaningful support for the ZEAV's ability to navigate through a condition that violates its original ODD. This presents an unprecedented public safety hazard since it would result in blocked streets and the inability of a vehicle using public roads to respond appropriately to temporary traffic controls, or potentially hand or acoustic signals from public safety officials.

The petition asserts: "To introduce the ZEAV safely and to enable continuous learnings and improvements, GM intends to deploy its ZEAV in a GM-controlled fleet ride-share program. That controlled deployment will ensure the ZEAVs are driven within known, geo-fenced boundaries and under known operational conditions and constraints that apply to the entire fleet."<sup>13</sup> It is not clear from the petition why, if the ZEAVs are already safe to use on public roads, GM feels the need to control deployment within geographical limits to assure safety. Either they are safe, or they are not. GM cannot have it both ways. If they are safe, GM must provide the evidence that supports their safe use on public roads, and the petition does not. If they are not safe, GM must show how they will transition to, measure, and validate their safe operation. The petition does not.

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<sup>11</sup> GM petition, pg. 13.

<sup>12</sup> GM petition, AII-14.

<sup>13</sup> GM petition, AIII-4.

**5. The petition fails to address the ability for a ZEAV to detect a collision and operate in a manner that is appropriate for post-collision response.**

The petition does not address a ZEAV's ability to detect that it has been involved in a collision, nor what would happen after a collision when the law requires assistance to the injured, recording details of the incident, exchanging driver/registration/insurance information after a collision, and reporting the incident to law enforcement. Collisions and post collision responses have a material impact on public safety. GM has failed to establish that the ZEAV will conform to the law and preserve or enhance public safety after a collision.

**6. The petition does not appropriately distinguish between ZEAVs operated with a human driver and those operated autonomously**

GM's petition claims, "In the ZEAV, GM has adapted driver controls and information requirements for operation exclusively by its automated driving system ("ADS") instead of a human ..." <sup>14</sup> but GM plans to use a vehicle with human drivers for certain validating tests (notably FMVSS Nos.126 and 135 tests) and as Autonomous Vehicle Trainers for initial ZEAV operations on public roads. The criteria established to transition this human driving experience into 'safe' autonomous ZEAV operation were not disclosed. The GM petition is inadequate because of the failure to describe plans to validate ZEAV autonomous operation based on the human-driven experience of a differently configured vehicle. This proposal contradicts the basic rule of system development that you should 'test like you fly and fly like you test.' <sup>15</sup> Developers violate that rule at their peril.

The petition discusses the ZEAV, but it does not discuss the analogues used for human-driver tests and human autonomous vehicle trainers ("AVTs") that are involved in the program. GM does not discuss whether the exemptions sought for the ZEAV also pertain to the human-driven analogues. The petition is deficient as it fails to discuss the application of exemptions to the human-driven portion of the program.

The petition contends, "Ultimately, the ZEAV development process enables the ZEAV to perform its mission: safe self-driving operation in its driving environment." <sup>16</sup> If safe self-driving operation is the ultimate goal of the project resulting from the ZEAV petition, then safe self-driving operation has not been established at the beginning of the program, or there would be no need for the program. The GM petition does not discuss how the ZEAV will transition from initial operations apparently using human drivers <sup>17</sup> to 'train' the vehicles for self-driving operations. The transition from human to machine driving is not discussed, and without that discussion, any claims of enhanced public safety are moot.

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<sup>14</sup> GM petition, pg. 3.

<sup>15</sup> Test Like you Fly, at: <https://www.evaluationengineering.com/home/article/13004176/test-like-you-fly>.

<sup>16</sup> GM petition, pg. AIII-6.

<sup>17</sup> Autonomous vehicle trainers, (AVTs), GM petition AIII-13.

The petition also maintains that “GM’s testing and validation program includes on-road testing with a test fleet of autonomous vehicles with human autonomous vehicle trainers (“AVTs”) who can take-over driving from the ADS to prevent potential crashes.”<sup>18</sup> The petition fails to describe the transition from human drivers to automated drivers. The petition also fails to explain whether the human drivers will use modified versions of the ZEAVs or a completely different vehicle. The petition does not provide the basis for asserting equivalence of the human-driven vehicles to the ZEAV, nor the equivalence of the human-driven experience to autonomous control system algorithms or capabilities. The petition does not state whether the requested FMVSS exemptions include the human-driven vehicles proposed as AVTs. The petition needs to address these important safety issues.

**7. The petition fails to establish that ZEAV occupants will both be alerted to potentially dangerous vehicle conditions and have the ability to discontinue operation**

The GM petition states, “With the ADS as the driver, there is no need for features designed to interface with a human driver, such as ... human-driver-specific information systems (e.g., telltales and indicator lamps).”<sup>19</sup> There is certainly a need for the vehicle occupants to have situational awareness of the vehicle state so that they can decide to continue their route, change their destination, or abandon the vehicle. Telltales and indicator lamps or equivalent displays are an important means for providing needed situational awareness. A blanket rejection of such telltales and indicator lamps without appreciation of their significance to occupants is inadequate and unsafe.

Moreover, the petition claims, “By removing human input from the formula, these changes (removing audible and visual warnings, as well as other information displays) provide the safety advantages of autonomous transportation while ensuring that passengers cannot interfere, purposefully or inadvertently, with the safe operation of the vehicle.”<sup>20</sup> Those changes also limit the situational awareness of occupants and limit their ability to monitor the safe operation of the vehicle. Occupants should have that awareness and always be able to make informed decisions as to whether to begin, continue, or end their ride.

The petition also asserts that “GM’s ZEAV provides the ADS with all of the same information provided to a human driver in a conventional motor vehicle.”<sup>21</sup> This statement is correct, but points to a display inadequacy. The ZEAV relies on safety-critical state information that is unique to autonomous operation and important to occupants. Displays that merely replicate the information on a human driven FMVSS-compliant vehicle do not adequately inform ZEAV occupants of status of unique autonomous vehicle safety features. Specifically, the operational status of primary and secondary data processors, communication links necessary for operation, cybersecurity indicators and any other indicators of compromised safety beyond occupant control

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<sup>18</sup> GM petition, pg. AIII-13.

<sup>19</sup> GM petition, pg. 12.

<sup>20</sup> GM petition, pg. 12.

<sup>21</sup> GM petition, pg. 12.

should be displayed so that the occupants can decide whether to abort the trip because of reduced safety. The petition should address the information needs of the occupants to assess their own safety, rather than merely asserting, "...control interfaces to the ADS; GM's control of vehicles in deployment; and daily inspections and maintenance together provide assurance that the ZEAV will provide equivalent safety."<sup>22</sup> GM should not compromise occupant safety or agency in favor of availability for revenue service.

The petition claims, "The safety need for these controls and displays is obviated by the absence of a human driver. Additionally, the control interfaces to the ADS; GM's control of vehicles in deployment; and daily inspections and maintenance together provide assurance that the ZEAV will provide equivalent safety."<sup>23</sup> The need for control and displays should also respond to the need for occupant situational awareness of safety system status and vehicle operational state so that they can make an informed decision about starting, continuing, or aborting ZEAV transportation. GM has not established an acceptable rationale for eliminating such information based on the needs of the ADS itself. Neither has it adequately supported the rationale for accepting the human driver-based tests and ADS learning as a basis for passenger operational state blindness. GM has not provided any support for the adequacy of its daily maintenance plans including staffing, training, and facilities. If in fact such support is provided, it can only assure nominal performance, not equivalent safety, and GM has not established that nominal performance provides adequate safety.

The petition makes the conclusion, "So the ZEAV meets the safety purpose of the telltale requirements by providing the operational status of the ESC electronically to the ADS."<sup>24</sup> The GM petition does not provide adequate justification for denying occupants information related to the status of critical safety systems such as the ESC.

GM's petition also states, "The purpose of this readiness indicator is to alert a driver when the airbags may not function properly, and vehicle service may be required. In GM's ZEAV, there is no human driver, and the intent of the readiness indicator requirement is satisfied by providing the readiness indicator information to the ADS instead of a visible indicator to a human driver."<sup>25</sup> GM has not established that there is no value in providing ZEAV occupants with an indication of the operational status of protective air bags and related components. Their absence degrades user safety. Air bag operational status is a potentially important determinant of whether an occupant wishes to start or continue travel in a vehicle.

The petition asserts, "The ADS will monitor the readiness of the roof rail airbags. Instead of an indicator light as described in S4.2.2, the ZEAV will meet the safety purpose of this requirement by monitoring the underlying conditions and alerting the fleet operator (GM) to any needed repairs."<sup>26</sup> Alerting the GM operator to deficient air bag readiness which is the only stated consequence of air bag deficiency detection is an inadequate safety

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<sup>22</sup> GM petition, pg. 22.

<sup>23</sup> GM petition, pg. 22.

<sup>24</sup> GM petition, pg. 28.

<sup>25</sup> GM petition, pg. 31.

<sup>26</sup> GM petition, pg. 32.

measure. Air bag deficiencies should cause a vehicle to be taken out of service until repaired. The petition does not state that notification of air bag deficiency will either cause immediate repair or that deficient vehicles will be quarantined from public use and is therefore an unacceptable plan. Passengers should also be alerted to the compromised vehicle safety caused by degraded or inoperable roof rail airbags so that they can make an informed decision about starting or continuing travel in a ZEAV.

The GM petition claims, “The foregoing discussion also demonstrates that this Petition satisfies the safety showing required to grant a petition under 49 U.S.C. § 30113(b)(3)(B)(iii).72.”<sup>27</sup> GM does not provide any convincing evidence that ZEAV operation upon receiving waivers of FMVSS will be either at least as safe as or safer than vehicles that fully conform to the FMVSS. GM’s arguments are qualitative rather than quantitative and are based on the unsupported claim that, “Because human error or behavior leads to 94 percent of vehicle crashes, technology that eliminates the human driver has the potential to save tens of thousands of lives and to avoid or mitigate hundreds of thousands of vehicle crashes every year in the United States alone.”<sup>28</sup> GM implicitly asserts that automation of driving functions alone is therefore equivalent to enhancing safety. That assertion is based on a misreading of a foundation document researching critical reasons for crashes, which states, “Although the critical reason is an important part of the description of events leading up to the crash, **it is not intended to be interpreted as the cause of the crash nor as the assignment of the fault to the driver, vehicle, or environment.**”<sup>29</sup> Since automation alone cannot justify claims of enhanced safety, the petition should, but does not, establish what its safety goals are for ZEAVs with FMVSS exemptions, how they compare with human-driven FMVSS-compliant cars, and how they plan to measure and meet objective safety goals.

GM also plans to isolate users from potentially life-saving vehicle operational status warnings that would otherwise allow users to detect hazards and evacuate the vehicle in the event of critical faults. The petition fails to establish that minimizing safety status information provided to vehicle occupants enhances their safety.

**8. The petition fails to establish that the ZEAV sensor system provides a level of coverage sufficient to protect various categories of road users, including pedestrians, cyclists, and other vehicles.**

GM’s petition states, “GM’s ZEAV has an array of sensors, including LiDAR, cameras, and radar, which provide the ADS with continuous 360-degree information on the environment outside the vehicle.” This statement is incorrect as well as misleading. The mere existence of a LiDAR or RADAR is inadequate to establish sensor capability equivalent or superior to a human driver. To evaluate claimed sensor competency, the petition must include at a minimum the LiDAR and RADAR fields of view (FOV),

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<sup>27</sup> GM petition, pg. 33.

<sup>28</sup> GM petition, page 3.

<sup>29</sup> NHTSA Traffic Safety Facts, February 2015, “Critical Reasons for Crashes Investigated in the National Motor Vehicle Crash Causation Survey”, <https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812115> (emphasis added).

resolution, sensor frequency, scene revisit interval, and overall latency<sup>30</sup>. LiDAR inherently provides intermittent, not continuous information. Most RADARs, and RADARs typically used in automotive application, also provide intermittent, not continuous information. Neither LiDAR nor RADAR provide continuous scene coverage. Instead, periodically repeated scanned data is processed with finite lag times to produce image information ultimately usable by an ADS controller. Additional processing time is required to process the images received from LIDAR or RADAR. The LIDAR and RADAR scene scanning repeat intervals are specific to the selected component and may only be suitable within specific operational limits. Neither component requirements or specifications nor attendant operational limits are included in the petition. Neither scene repeat intervals nor image processing lag times nor overall latency are provided for any of the sensors associated with the ZEAV in the petition, consequently, their efficacy cannot be evaluated. It is clear, however, that the sensors do not provide ‘continuous’ 360 degree coverage in the same manner as human vision provides continuous input. The petition is deficient in neglecting to provide critical sensor and latency specifications necessary to evaluate their potential suitability for replacing human capabilities.

While overlapping sensors can provide a full 360 degree field of view, the data provided in the petition shows that there are gaps close to the vehicle boundaries that can provide safety risks with respect to pedestrians and other road users, particularly curious children near the vehicle. Further, limits on sensor elevation angles can provide problematic coverage gaps particularly when cresting hills.<sup>31</sup> Some of these gaps are also shown in the petition’s Appendix II, Fig 1, 2, 3. GM does not establish the adequacy of sensor coverage in the petition, does not acknowledge the associated hazard associated either with vehicle proximity or elevation angle, and does not assess its impact on safety

The petition asserts, “The LiDARs also support locating and identifying static and dynamic objects in space around the vehicle (e.g., bicycles, cars, and pedestrians)...The cameras aid in classifying objects and tracking them over time...They help differentiate various types of motor vehicles, pedestrians, bicycles, and free space...The radars (sic) aid in a variety of functions, such as detecting the speed and distance of various objects. They are used to detect motor vehicles and bicycles nearby...”<sup>32</sup> GM has failed to establish that the ZEAV RADAR’s ability to detect and avoid pedestrians advances the state of the art which has been previously shown to be woefully inadequate.<sup>33</sup> GM does

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<sup>30</sup> Latency is the interval between stimulus and response. For the ZEAV, the overall latency between stimulus and response includes the time between illuminating a scene with light or RF radiation and the end point of the entire sequence of receiving analog LiDAR or RADAR sensor data from the illumination, digitizing the analog sensor data, transferring the digital information to an image processor, processing the raw data into a digital scene, interpreting the scene using image processing algorithms, commanding control system actions based on the scene interpretation, and executing those commands.

<sup>31</sup> IIHS examines driver assistance features in road, track tests,

<https://www.iihs.org/iihs/news/desktopnews/evaluating-autonomy-iihs-examines-driver-assistance-features-in-road-track-tests>.

<sup>32</sup> GM petition, pg. AII-3.

<sup>33</sup> <https://spectrum.ieee.org/cars-that-think/transportation/self-driving/the-selfdriving-cars-bicycle-problem>

not state any objective safety criterion for evaluating state of the art advancement that would satisfy any safety objective. Further, the petition fails to quantify a safety objective that it would deem acceptable. The petition should be rejected until GM provides convincing evidence that the ZEAV will improve pedestrian, bicyclist, and other road user's safety.

The petition also claims, "As these figures (1, 2, and 3) illustrate, the cameras, radars, and LiDARs all provide capability for a complete 360-degree field of view to the computer driver."<sup>34</sup> The figures do not show an accurate picture of instantaneous coverage, and do not in any case show complete 360-degree field of view at any time. The figures actually show gaps in coverage close to the vehicle that cannot be further evaluated because of the absence of a scale. The figures do not show complete continuous 360-degree sensor coverage. The figures also do not address revisit time of LIDAR or RADAR or image processing lag time or overall latency, incorrectly showing continuous coverage that in fact does not exist.

LiDAR and RADAR both sweep their fields of regard, and so provide intermittent, not continuous coverage. And, the figures 1, 2, and 3 do not address gaps due to sensor field of view elevation limits, causing coverage gaps for small objects close the vehicle (such as children and animals), and gross coverage gaps that occur most prominently when a vehicle is cresting a hill. In this latter event, tests have shown meaningful defects in automatic car navigation logic that required intervention of human drivers to maintain control.<sup>35</sup> GM's petition needs to address these coverage gaps and control scope issues before it can credibly claim to sustain or improve safety.

GM's petition states that "Once the computer knows an object's location in space, it can measure its speed/kinematics and classify the object based on its motion, kinematic measurements, visual characteristics, location, and other considerations."<sup>36</sup> This is an aspirational, qualitative comment that provides no meaningful information about what a ZEAV will actually do in the vicinity of an object outside of the vehicle. Quantitative information about sensor performance, revisit intervals, resolution, algorithm performance, and processing lag time not provided by GM in the petition are critical to an evaluation of LiDAR and RADAR contributions to ZEAV safety. Kinematic information alone is inadequate to solve equations of motion, so the sensors, however accurate, do not have the ability to provide the data necessary to unambiguously resolve the future position of any dynamic object. The GM petition should be denied until GM provides meaningful quantitative evidence that it will not create unsafe conditions for either its occupants or other road users.

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<https://slate.com/technology/2018/02/self-driving-cars-struggle-to-detect-cyclists-bicycle-to-vehicle-communications-arent-the-answer.html>; see also: <https://www.iihs.org/iihs/ratings/Pedestrian-crash-prevention>.

<sup>34</sup> GM petition, pg. AII-5.

<sup>35</sup> Evaluating Autonomy: IIHS examines driver assistance features in road, track tests, <https://www.iihs.org/iihs/news/desktopnews/evaluating-autonomy-iihs-examines-driver-assistance-features-in-road-track-tests>.

<sup>36</sup> GM petition, pg. AII-6.

The petition further asserts, “If the computer detects a pedestrian, it similarly calculates potential paths of the person based on the person’s current speed and direction and expected behavior. This supports crucial safe driving interactions between the vehicle and people in the vehicle’s external environment.”<sup>37</sup> ‘Supporting’ crucial safe driving interactions is different than ‘assuring’ crucial safe driving interactions. Pedestrian and bicycle trajectories are not deterministic, and not nearly as predictable as massive objects such as other vehicles, and extrapolations from current to future positions are unreliable because pedestrians and bicycles do not follow readily predictable paths. Kinematic information alone as provided by the ZEAV sensor suite is inadequate to accurately predict the future location of pedestrians or human-powered vehicles such as bicycles. GM needs to provide convincing quantitative information that the ZEAV will be safe to operate in the vicinity of other vulnerable road users including pedestrians and bicyclists.

GM’s petition claims, “Simulations and on-road testing show that the ZEAV can detect and react faster than a human when it senses a hazard around the perimeter of the vehicle.”<sup>38</sup> It is not clear which hazards are contained within the scope that a ZEAV can ‘...detect and react faster than a human.’ A human would clearly react faster to a whistle or a shout than a ZEAV that does not have acoustic sensors or processing capability. Further, the data provided by GM shows sensor coverage gaps in the vicinity of the ZEAV. The extent of the gaps is not clear from the petition. It also is not clear whether the elevation FOV limits of the sensors prevent detection of objects either close to the vehicle or below the field of view when cresting a hill. No quantitative data is provided that allows meaningful assessment of the quoted statement, either in terms of detection or in terms of appropriate vehicular response. The petition is inadequate for its frequent reliance on unsupported aspirational assertions of safety rather than empirical data.

#### **9. The petition fails to establish that the ZEAV contains failsafe features sufficient to protect occupants and other road users**

The petition states, “The control information from the Primary ADSC<sup>39</sup> is normally utilized, while the Secondary ADSC is available to assume this role within milliseconds if a fault is detected in the Primary ADSC.”<sup>40</sup> This is a qualitative statement that cannot be evaluated for its contribution to safety, making the GM petition deficient. The petition is silent on whether the control system been proven free of systematic failure modes that could disable both primary and secondary ADSCs. It does not discuss how many milliseconds elapse before the ADSC fails over to the secondary system; whether the secondary system has identical or degraded capabilities; or how the gap between primary ADSC failure and failover to secondary system potentially impacts the safety of ZEAV users. It does not assert that the occupants are notified that a primary control system component has failed as they should be, or whether their overall safety has been degraded. These issues have material impact on safety and must be addressed before the overall ZEAV safety can be evaluated.

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<sup>37</sup> GM petition, pg. AII-6.

<sup>38</sup> GM petition, pg. AIII-18.

<sup>39</sup> Automated Driving System Computers.

<sup>40</sup> GM petition, pg. AII-8.

The petition says, “Each ADIM<sup>41</sup> sends the Low Level Control commands, as vehicle control signals, over the Control Area Network (“CAN”) buses.”<sup>42</sup> CAN bus security breaches have been demonstrated that allow third parties to maliciously take over vehicles<sup>43</sup>. GM does not address this possibility and its consequent jeopardy to occupant safety. The petition does not state whether the emergency stop button or user panel(s) are isolated from the CAN bus. This CAN bus cybersecurity vulnerability needs to be addressed to assure public safety as part of the ZEA V safety portfolio before petition approval.

The petition asserts, “Brake System: The brake system is fail-operational, with redundant controllers, actuators, and sensors. Even in the event of the complete loss of a single brake controller or actuator, the vehicle is able to maintain safe lateral and deceleration control.”<sup>44</sup> GM does not plan to notify occupants of the failure of even such an important safety component as the primary braking system. ZEA V occupants should be notified of important safety component failures even when they are designed to fail over to an alternate operational state so that the occupants can make an informed decision about whether they elect to begin or continue transportation in a vehicle with compromised safety systems.

GM’s petition also states, “Through the (dashboard) tablets or through a hard button, passengers may choose to end the ride. While instructions will indicate that the hard button is for emergencies, passengers may use either the tablet or the hard button to end the ride at any time, for any reason.”<sup>45</sup> The petition does not show or discuss how a customer request to stop the vehicle has higher priority than any other input to the control system. Public safety demands that such a request has the highest priority and that it is isolated from and independent of any hardware, software, communications, or data processing fault that might occur. Such a user stop request also needs to be protected from all cybersecurity threats. The petition is deficient for its failure to discuss the architecture or means necessary to provide this needed user-commanded stop request priority.

The petition contends, “Furthermore, GM’s combination of Deep Integration with the Comprehensive Risk Management approach allows us to meet two key performance objectives: First, no single-point-, plausible dual-point-, or common-cause-malfunctions cause safety hazards; and, Second, the ADS’s driving behavior demonstrates a statistical improvement to overall vehicle safety in the intended driving environment.”<sup>46</sup> The GM petition does not define the key term ‘plausible’ in regard to their safety posture nor any criterion for determining what plausible might mean. Considerable aerospace experience

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<sup>41</sup> Advanced Driving Integration Module.

<sup>42</sup> GM petition, pg. AII-9.

<sup>43</sup> <https://www.wired.com/2016/08/jeep-hackers-return-high-speed-steering-acceleration-hacks/>, and <https://www.forbes.com/sites/jamiecartereurope/2019/03/05/hacked-driverless-cars-could-cause-collisions-and-gridlock-in-cities-say-researchers/#30339ee62a09>.

<sup>44</sup> GM petition, pg. AII-10.

<sup>45</sup> GM petition, pg. AII-16.

<sup>46</sup> GM petition, pg. AIII-3.

has shown that dual fault tolerance is a necessary prerequisite for adequate safety in similar safety-critical systems, and that neglecting that standard introduces deadly peril (as apparently was a root cause of recent catastrophic Boeing 737 Max 8 crashes).<sup>47</sup> The GM petition should clearly explain the difference between ‘plausible’ dual point failures and any other dual point failures, particularly in regard to safety critical components or systems. Further, the assertion that ‘...the ADS’s driving behavior demonstrates a statistical improvement to overall vehicle safety in the intended driving environment.’ is unsubstantiated. The ‘intended driving environment’ is undefined in the petition which makes any derivative assertion such as ‘statistical improvement to overall vehicle safety’ similarly undefined and impossible to evaluate. The petition does not provide convincing evidence of statistical improvement to overall vehicle safety for any driving environment. In fact, the petition does not contain any relevant statistics at all.

#### **10. The petition fails to establish that the ZEAV is capable of following traffic laws**

GM’s petition states, “ADS is programmed to consistently follow traffic laws.”<sup>48</sup> It is not clear what laws are included. Further, “consistently” is not the same as the necessary comprehensively. No geographical area or political entity is identified in the petition. It is not clear who will approve such an area of operation, nor is it clear who will approve the transformation of potentially ambiguous traffic laws into algorithms that will be executed by the ADS. Moreover, GM does not explain how the ZEAV will respond to poorly maintained infrastructure when it comes to local traffic ordinances such as speed limits in general, or in school or hospital zones specifically. GM should state whether and how it is assuming those tasks and associated liabilities will be addressed.

The petition further states, “The ADS is the ‘driver.’”<sup>49</sup> Because the ADS is the driver and traffic laws are based on the existence of a ‘driver’, the ZEAV ADS should be licensed in a progressively more demanding licensing regimen just like any other driver. There should be no exception because of the illusory magic of autonomy. The petition is inadequate since it does not discuss how GM will assume the legal liabilities of a driver by its ZEAV, how ‘the driver’ will exchange license, registration, and insurance information with other drivers after a crash, nor how law enforcement can treat the ZEAV control system as ‘the driver’ in the event of a motor vehicle law infraction.

#### **11. The petition contains other notable deficiencies**

There is no description or depiction of the ZEAV’s apparently crucial vehicle health manager component in the ZEAV petition.<sup>50</sup> In fact, the ‘vehicle health manager’ is

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<sup>47</sup> Boeing 737 MAX-8 Scandal Grows: Doomed Lion Air Flight Should Never Have Flown, <https://www.thedailybeast.com/boeing-737-max-8-scandal-grows-doomed-lion-air-flight-should-never-have-flown>.

<sup>48</sup> GM petition, pg. 11.

<sup>49</sup> GM petition, pg. 11.

<sup>50</sup> “...and the vehicle health manager has determined that there is no vehicle fault that would place the vehicle in a Response State 3, 4, or 5.” - GM petition, pg. AII-14.

undefined. A description is required to allow assessment of ZEAV safety, particularly when compared with conventional vehicles. The GM petition is deficient without a description.

GM's petition states, "The ZEAV will provide on-demand transportation services in geofenced areas to customers who download a mobile application (app) and acknowledge a user agreement."<sup>51</sup> The public interest demands that the user agreement does not include any limitation on the public's right to avail themselves of their rights to the civil justice system as a result of injuries or death arising from their use of the ZEAV. Moreover, such an agreement specifically cannot include a requirement for forced arbitration and must indemnify passengers from liability claims in the event of a ZEAV traffic law violation, injury to third parties, or damages from ZEAV collision. The public interest also demands that GM carry insurance sufficient to settle claims brought as a result of damage or injury caused by the ZEAV. The petition does not discuss insurance or plans to compensate victims of ZEAV operations.

The petition claims, "Requirements traceability analysis manages the relationships between engineered systems and the safety thresholds and attendant requirements."<sup>52</sup> This is a nearly impossible task since the ZEAVs use machine learning that is essentially opaque to traceability, and would be impossible to evaluate in any case because the petition does not reveal the safety thresholds or attendant requirements, nor even references a source for them. Establishing causality is the reason for requirements traceability. The petition does not adequately describe how GM will accomplish requirements traceability in the machine learning environment it employs. The petition is deficient because it is inadequate to evaluate any of ZEAV's current, future, or planned safety profiles or requirements traceability.

The petition asserts, "GM's system safety approach blends aspects of both MIL-STD-882 and ISO 262629..."<sup>53</sup> GM does not state which aspects of either standard are incorporated, and which are neglected in their safety approach, so this statement does not provide meaningful support to their assertion of safety improvements.

While there is passing reference to cybersecurity in GM's appendix,<sup>54</sup> the potential effects of cyber threats on the safety of ZEAV passengers and other road users should be included in a safety plan and ongoing assessments of compliance with the plan. The petition did not include a robust cybersecurity safety plan.

Generally speaking, 'end-to-end encryption' is a typical component of a cybersecurity plan but is insufficient in and of itself to assure cybersecurity and is therefore an inadequate basis for granting an exemption. GM should provide a cybersecurity plan that addresses the full scope of responses to cyber intrusion as well as spontaneous executable errors that might arise from, for example, single event upsets or component failures. A

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<sup>51</sup> GM petition, pg. AII-16.

<sup>52</sup> GM petition, pg. AIII-7.

<sup>53</sup> GM petition, pg. AIII-7.

<sup>54</sup> GM petition, pg. AIII-10.

Failure Modes and Effects Criticality Analysis would be a useful tool for assessing the safety impacts of such event and should be included in any ADS exemption petition.

### III. Conclusion

Preclusion of full public review of critical exemption applications is perhaps the worst possible choice if the agency's ultimate goals are safety and consumer acceptance of potentially life-saving AV technology. Drivers, riders, and pedestrians already concerned the safety of autonomous vehicles<sup>55</sup> are provided no solace by a government that refuses to issue any standards of performance or requirements for AV manufacturers. They should be even more concerned by NHTSA's attempts to keep the public in the dark as the agency maneuvers to allow these vehicles on the road without concern for the agency's own regulations.

NHTSA's unlawful issuance of a new temporary exemption rule at the same time as it considers the first applications on autonomous vehicle exemptions from the FMVSS is more than just poor planning, it suggests a bias against public participation in rulemakings, and towards expedited approvals for manufacturers who have not performed the work required to demonstrate that their vehicles can be trusted on American roads.

Further comment from the Center in the form of answers to NHTSA's particular questions regarding the GM exemption petition is contained in the appendix to this comment.

Finally, the Center reiterates its request that NHTSA withdraw its temporary exemption rule and proceed with a proper notice-and-comment rulemaking. Incoming temporary exemption petitions should not be processed until the agency has clarified the regulation governing these petitions.

Sincerely,

A handwritten signature in black ink, appearing to read "Jason Levine". The signature is written in a cursive style with a large, sweeping initial "J".

Jason Levine  
Executive Director

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<sup>55</sup> *Three in Four Americans Remain Afraid of Fully Self-Driving Vehicles*, AAA, March 14, 2019, available at: <https://newsroom.aaa.com/2019/03/americans-fear-self-driving-cars-survey/>.

## **Appendix: Responses to Select NHTSA Questions**

**2. If the agency determines that its authority to grant exemptions to facilitate the development or field evaluation of a new motor vehicle safety feature is the more appropriate basis under which to evaluate GM's petition, does the petition provide sufficient information to enable the agency to make the required statutory finding as to whether the level of safety is equivalent to or exceeds the level of safety established in the FMVSS from which exemption is sought? If not, what additional information should the agency seek prior to rendering its final determination and why?**

The petition does not provide sufficient information to enable the agency to make the required statutory finding as to whether the level of safety is equivalent to or exceeds the exceeds the level of safety established in the FMVSS from which exemption is sought. It does not define 'safe.' The petition does not address the manner by which the human-driven 'learning' will transition to automated driving. It does not state any metrics for safety measurement in either relative or absolute terms. It does not establish timelines or criteria for establishing that safety goals have been met. The petition specifically excludes ZEAV operation in challenging situations with the apparent goal of appearing to be safe while avoiding situations that might challenge that appearance. With its bias against operation in challenging traffic situations, no conclusions can be drawn from the proposed ZEAV program about overall operational safety.

Before rendering its final determination, to assure that petitioner can objectively establish ZEAV safety, the agency should require that the petition include as a minimum:

- the definition of 'safe.'
- the metrics by which safety will be measured.
- the objective criteria underlying the safety metrics for ZEAV operation.
- the target safety metrics for the FMVSS from which exemption is sought.
- the statistical bases for the safety targets, and the plan for developing sufficient statistical confidence in ZEAV's compliance with the safety targets.
- the criteria to be satisfied before transitioning from human-driven to autonomously-driven operation.
- the approval process for transitioning from human-driven to autonomously-driven operation.
- the operational design domain (ODD) that is consistent with ZEAV safe operation.
- the appropriate government ODD approval.
- the means by which the ZEAV will be constrained to operation only with the approved ODD.
- the alternative means by which the ZEAV will execute the implied human content of the FMVSS for which exemptions are sought. For example, there is no FMVSS standard for driver visual sensory perception. Instead, the FMVSS standards 103, 104, 107, and 205 are designed to preserve the visual sensory capability necessary for safe operation of the human driver in all operational domains. The human driver's visual sensory capability sufficiency and responsive capabilities are implicit. The petition must establish, based on

empirical data, that the ZEAV includes sufficient sensors, resources, data processing and responsive operational capabilities to substitute for the human capabilities implied in the FMVSS standards.

- the plans to mitigate hazardous operation where the sensor design is inadequate to assure safety, especially related to gaps in sensor coverage close to the vehicle as shown in figures 1, 2, and 3 where children or other objects would be undetectable to the sensors but would be readily visible to human drivers (not addressed by FMVSS with its human-operator bias).
- objective evidence that in situations such as cresting a hill where the sensor elevation angles do not conform to the road surface or in congested environments where sensors may be blocked by proximity to many stationary or moving objects that the ZEAV under autonomous control nevertheless may be operated safely.
- objective, empirical, and statistically significant evidence that the ZEAV operates safely in the presence of pedestrians, bicyclists, and other vulnerable road users.

**3. If the agency determines that its authority to grant exemptions to facilitate the development or field evaluation of a low-emission motor vehicle is the more appropriate basis under which to evaluate GM's petition, does the petition provide sufficient information to enable the agency to determine whether exempting the vehicle would unreasonably degrade the safety of the vehicle? If not, what additional information should the agency seek prior to rendering its final determination and why?**

*See response to question 2 above.*

**5. What studies, data, assumptions, scientific reasoning, and methodologies are needed for the agency to evaluate and compare the ZEAV and a FMVSS-compliant non-ADS vehicle? For example, should the agency assess whether an ADS steers, brakes, and accelerates at least as effectively and safely (e.g., as quickly) as the average human driver? If so, what methodology should it use? Are there other approaches to making the safety evaluation and comparison? Please provide specific references to all sources of such tools or evaluation approaches.**

The Center is unaware of a database of anthropometric data that can be used to establish a baseline for safe visual or auditory stimulus and response appropriate for establishing safety standards for equivalent ADS behavior. Compliance with FMVSS alone is inadequate to validate safe ADS operation since the FMVSS have a human-operator bias and do not provide a standard for throughput of stimulus to response. Standards for human driver stimulus and response are implicit in state driver licensing requirements and examinations. The Center believes that it is incumbent upon NHTSA to establish such data and standards so that it can objectively determine the safety of autonomous vehicles before approving or licensing their operation on public roads. Petitions that merely address FMVSS are inadequate because they do not address the central issue of replacing human sensory perception, responses, and judgment with electronic sensors, processors, kernels, and machinery.

The Center has provided to NHTSA a methodology it believes is a reasonable approach to evaluating and approving autonomous vehicle operation in specific ODDs. That methodology may be found in its response to NHTSA's Advanced Notice of Proposed Rulemaking: Pilot Program for Collaborative Research on Motor Vehicles with High or Full Driving Automation.<sup>1</sup>

Further, the Center submitted a petition to NHTSA on October 19, 2018, to immediately mandate the submission of safety information by companies testing automated vehicles system technology on public roads.<sup>2</sup> Seven months later, and three months past NHTSA's own published deadlines,<sup>3</sup> the agency has yet to respond. Thus, there is no uniform data collection process that addresses the scope of public testing and the success, failures, and lessons learned from that testing. Accordingly, NHTSA has missed a golden opportunity to create a fact-specific baseline from which to consider petitions such as those submitted by GM and Nuro.

**6. Given that the ZEAV is expected to evolve over its full-service life, how should the effects of that evolution be taken into consideration in assessing the safety of the exempted vehicle relative to the FMVSS-compliant vehicle?**

The petition does not include a methodology for assessing either the absolute or relative safety of the ZEAV at any point in its development, particularly at the inception of automated operation on public roads. The presumption that the ZEAV evolution will have beneficial safety impacts is irrelevant without a means for objectively assessing safety. ZEAV safety is driven much more by capabilities and functionality for which there are no FMVSS standards than by its compliance with FMVSS standards. Therefore, the ZEAV evolution and potentially improved safety should not be a consideration in petition approval since the petition is deficient in its disregard of safety definition and safety assessment methodology.

**7. What studies, data, assumptions, scientific reasoning, and methodologies should a petitioner submit to the agency to substantiate its record of research, development, and testing establishing the innovative nature of the safety feature?**

The Center has provided to NHTSA a methodology it believes is a reasonable approach to evaluating and approving autonomous vehicle operation in specific ODDs. That methodology may be found in its response to NHTSA's Advanced Notice of Proposed Rulemaking: Pilot Program for Collaborative Research on Motor Vehicles with High or Full Driving Automation.<sup>4</sup> Any individual safety feature needs to be evaluated in the contexts of overall vehicle capability, approved ODD, and operational conformance to

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<sup>1</sup> Center for Auto Safety comments on NHTSA's ANPRM: Pilot Program for Collaborative Research on Motor Vehicles with High or Full Driving Automation, <https://www.regulations.gov/document?D=NHTSA-2018-0092-0040>, submitted December 10, 2018.

<sup>2</sup> <https://www.autosafety.org/wp-content/uploads/2018/10/Center-for-Auto-Safety-Petition-for-Rulemaking-to-mandate-Safety-Assessment-Letter.pdf>, submitted October 19, 2018.

<sup>3</sup> Deadline for responding to rulemaking petitions is 120 days. 49 CFR § 552.8.

<sup>4</sup> *Supra*, footnote 1.

the ODD. The petitioner should reveal enough objective safety data based on its research, development, and testing to allow third party review and concurrence with safety projections.

Further, the Center submitted a petition to NHTSA on October 19, 2018, to immediately mandate the submission of safety information by companies testing automated vehicles system technology on public roads.<sup>5</sup> Seven months later, and three months past NHTSA's own published deadlines,<sup>6</sup> the agency has yet to respond. Thus, there is no uniform data collection process that addresses the scope of public testing and the success, failures, and lessons learned from that testing. Accordingly, NHTSA has missed a golden opportunity to create a fact-specific baseline from which to consider petitions such as the one submitted by GM.

**8. What studies, data, assumptions, validation test results, scientific reasoning, methodologies, and analyses should a petitioner submit to the agency to validate that its ADS provides safety at least equal to the level of the standards for which an exemption is sought?**

Because the FMVSS have an implicit human-operator bias, the petitioner should submit to the agency objective, statistically significant evidence that automated components and especially autonomous systems when operated in the context of the requested FMVSS exemptions provide levels of safety at least equal to the levels of safety provided by human-operated vehicles without any FMVSS exemptions. The petitioner should provide the definition of safety, criteria by which safety is evaluated, the objective safety evidence, and evidence of statistically significant conformance to those criteria.

**9. What studies, data, assumptions, validation test results, scientific reasoning, methodologies, and analyses should a petitioner submit to the agency to validate that its ADS during its operation will have sufficient reliability to accomplish its designed intent, e.g., timely and sufficiently applying the service brakes when braking is needed for safety purposes?**

The Center is unaware of studies, a database, validation tests, scientific reasoning, methodologies or analyses which would allow the agency to validate a petitioner's ADS during operation on public streets, putting the public in danger, that will have sufficient reliability to accomplish its designed intent. The Center would recommend that it is incumbent upon NHTSA, as part of its public safety mission, to create mechanisms for such validation. In the interim, no such study, database, validation test, scientific reasoning, methodologies or analyses was provided by the petitioner.<sup>7</sup>

**10. The test procedures of some FMVSS listed in the exemption petition involve the use of human drivers and controls (e.g., light vehicle braking). GM indicated that it plans to perform tests with a human driver operating a version of the ZEAV modified to include**

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<sup>5</sup> *Supra*, footnote 2.

<sup>6</sup> *Supra*, footnote 3.

<sup>7</sup> At least in the information made public by NHTSA as of this date.

**human controls. Would performance of tests with such a modified vehicle be appropriate, or would programming the ADS of the ZEAV to perform test maneuvers be a better means of evaluating compliance with performance requirements?**

An honored rule for flight vehicle development is “Test like you fly and fly like you test.” Programming the ADS of the ZEAV to perform test maneuvers would be a better means of evaluating compliance with performance requirements because it would be representative of the actual ADS performance. Use of human test experience and data as a surrogate for ADS machine responses inevitably leads to questions of authenticity and similarity. The petition is deficient in ignoring this problem and in not discussing means or criteria for justifying human-driven experience as a basis for evaluating automated ZEAV performance. The petition’s stated intention to avoid challenging traffic situations that might stress the automated driving system, without justification or discussion of that omission’s impact on safety in specific situations or in general, is particularly troubling and is sufficient rationale for petition rejection.

**11. 49 CFR 555.6(b)(iii) requires the petitioner to submit “results of tests conducted on the safety or impact protection features that demonstrates performance which meets or exceeds the requirements of the standard” from which temporary exemption is sought. In the case of a petition submitted for a vehicle that has not yet been produced, and therefore, cannot be tested in order to compare its performance to that of existing vehicles, how should the agency evaluate the safety level of the vehicle? On what preliminary analyses, assumptions, and methodologies should the agency rely to assess whether such performance has been persuasively demonstrated? How would the answers to those questions change if a petitioner could demonstrate that the safety features and systems on the vehicle to be exempted are comparable in performance to those in a non-exempted vehicle and that the addition of the ADS to the vehicle to be exempted did not adversely affect the performance of those safety features and systems?**

For vehicles with automatic driving systems, petitions for FMVSS exemptions should be evaluated based on statistically significant objective safety data conformance to meaningful safety criteria including the entire vehicle control system response to external stimulus (e.g., a traffic situation that ordinarily requires a driver response). The FMVSS in many cases have an implicit human operator bias. They have not been updated for high or full automation. For example, if a petitioner requests exemption from some portion of FMVSS 205 because a vehicle’s LIDAR has its own light source, the petitioner must demonstrate that the purpose of the standard, visual identification of objects in the field of view in sufficient time to allow driver response and appropriate vehicle control and response, are satisfied by the automated system control chain including LiDAR imaging, automated object identification and tracking, automated vehicle control response to LiDAR imaging, and safe operation of the vehicle in response to those stimuli including operation of steering or brakes and other safety-critical components. The individual FMVSS exemptions must be evaluated in the complete ADS operational context. To be acceptable the petition must provide statistically significant evidence, potentially including validated simulation and test, that the overall vehicle response including the

requested FMVSS exemption provides safety at least as good as comparable non-exempt vehicles with human drivers in the same traffic situations.

**12. It could be argued that some FMVSS may either not be needed for safety or at least less needed for safety in the case of a vehicle that can be driven by only an ADS. Examples of potentially unnecessary features include inside and outside mirrors as well as the display of images from the rearview camera. Should test results or data be required to justify such an argument? If yes, what would be the most appropriate types of test results or data, and why?**

For vehicles with automatic driving systems, petitions for FMVSS exemptions should be evaluated based on statistically significant objective safety data conformance to meaningful safety criteria including the entire vehicle control system response to external stimulus (e.g., a traffic situation that ordinarily requires a driver response). The FMVSS in many cases have an implicit human operator bias. They have not been updated for high or full automation. For example, if a petitioner requests exemption from some portion of inside and outside mirrors FMVSS, the individual exemptions must be evaluated in the complete ADS operational context. The petition must provide statistically significant evidence, potentially including simulation and test, that the overall vehicle response including the requested FMVSS exemption provides safety at least as good as comparable non-exempt vehicles with human drivers in the same traffic situations. In the stated example, a human driver might use the information provided by mirrors to respond to following police or emergency vehicles, to take evasive action to avoid or prepare for an imminent accident, or to reach a state of increased driving vigilance because of unusual behavior seen in those mirrors. The FMVSS exemption petition must be evaluated in all contexts of human responses to information provided by the feature of interest, and whether the automatic driving system provides equivalent responses with potential impacts on vehicle or occupant safety. The FMVSS exemption petition should be accepted only upon presentation of statistically significant objective evidence that all meaningful responses of the implicit human driver that either receives information from or provides vehicular control inputs based on the information or capability provided by the feature in question are adequately replicated by the alternative automated driving system.

**13. GM asserts that a FMVSS that requires telltales to provide drivers with information is not applicable because the ADS would be receiving that information. The agency requests comment on whether and to what extent the telltales might serve a safety purpose for passengers in the vehicle, regardless of whether the information would be transmitted to the ZEAV's ADS and whether the ADS would act on that information in a timely and appropriate way. <sup>(94)</sup> What weight should the agency give to the extent of the ADS' ability to respond in appropriate ways to the information it receives?**

Vehicle occupants are entitled to know whether their vehicle is operating safely or in a degraded safety condition, and at a minimum must have the right to safely terminate the transportation and exit the vehicle if they feel that they are in an unsafe situation. GM has included several means for occupants to terminate transportation, including a touch

screen control device and a STOP button. It would be deceitful for GM to allow operation of a ZEAV in a known degraded safety state while not informing its occupants of its compromised safety. Telltales can be an effective way of alerting occupants to failures or other situations that compromise safety. GM should prioritize informing ZEAV occupants of the vehicle safety state using telltales or alternative methods so that they can elect to not begin, to discontinue, or to abort transportation based on the ZEAV safety systems operational readiness and safety state. In the absence of an affirmative, comprehensive passenger safety state notification system, potentially involving telltales, the ZEAV petition should be rejected. The petition should also be rejected unless GM convincingly demonstrates the ADS' ability to respond in appropriate ways to the information it receives, including comprehensive passenger notification. The weight the agency should give to the extent of the ADS' ability to respond in appropriate ways to the information it receives should always be subordinate to protecting passengers by informing them of any compromised safety component or state.

**14. For a FMVSS whose benefits depend, in part, on the attentiveness, judgment, and responsiveness of a human driver (e.g., FMVSS No. 135, which requires that a foot control be provided to activate service brakes), how should the agency, in considering a petition for the exemption of a vehicle equipped with ADS and with no human driver controls, evaluate the safety effects of substituting an ADS for a human driver? What types of testing and data, and how much, would the agency need to evaluate those effects?**

For vehicles with automatic driving systems, petitions for FMVSS exemptions should be evaluated based on statistically significant objective safety data conformance to meaningful safety standards including the entire vehicle control system response to external stimulus (e.g., a traffic situation that requires a driver response). The FMVSS in many cases have an implicit human operator bias. They have not been updated for high or full automation. The petition must provide statistically significant evidence, potentially including simulation and test, that the overall vehicle response including the requested FMVSS exemption provides safety at least as good as comparable non-exempt vehicles with human drivers in the same traffic situations. The FMVSS exemption petition must be evaluated in all contexts of human responses to information provided by the feature of interest, and whether the automatic driving system provide equivalent responses with potential impacts on vehicle or occupant safety. In this example, the need to apply foot brakes may also be associated with a need to prepare for imminent collision, and the physiological response of the human driver in that situation would be much more complex than merely depressing the foot pedal. The FMVSS exemption petition should be accepted only upon presentation of statistically significant objective evidence that all meaningful responses of the implicit human driver that either receives information from or provides vehicular control inputs based on the information or capability provided by the feature in question are adequately replicated by the alternative automated driving system.

The Center has provided to NHTSA a methodology it believes is a reasonable approach to evaluating and approving autonomous vehicle operation in specific ODDs. That methodology may be found in its response to NHTSA's Advanced Notice of Proposed

Rulemaking: Pilot Program for Collaborative Research on Motor Vehicles with High or Full Driving Automation.<sup>8</sup>

Further, the Center submitted a petition to NHTSA on October 19, 2018, to immediately mandate the submission of safety information by companies testing automated vehicles system technology on public roads.<sup>9</sup> Seven months later, and three months past NHTSA's own published deadlines,<sup>10</sup> the agency has yet to respond. Thus, there is no uniform data collection process that addresses the scope of public testing and the success, failures, and lessons learned from that testing. Accordingly, NHTSA has missed a golden opportunity to create a fact-specific baseline from which to consider petitions such as the one submitted by GM.

**15. Would it be appropriate to use computer simulation as one of the methods to determine equivalent safety? If yes, why and how? If not, why not? Are there adequately validated simulation models that could be used for this purpose?**

It may be appropriate to use simulations of validated models to augment test-based demonstration of vehicular safety. There is an extensive literature on how, when, and why to validate system and component simulations. The Center is unaware of any simulation that is prospectively validated for all vehicles in all situations. Typically, models are validated for specific units under test in specific test conditions that can then serve as a basis for developing statistical confidence in related operational conditions. In this latter approach, there are many computational models that suffice for specific modeling needs. The Center is unaware of any model that can satisfy all modeling needs in all conditions.

**16. If the ADS is responsible for decision-making aspects of driving that a human driver otherwise would control, is it appropriate for the agency to evaluate the responsiveness and driving skills of the ADS in relation to the component, system, test procedure, or performance requirement from which an FMVSS exemption is sought? If so, how should the agency evaluate the safety of the ADS in different scenarios, e.g., negotiating a path through oncoming traffic when making a left turn, stopping when a pedestrian crosses the vehicle's path, and yielding to emergency vehicles? What kind of data would be needed for the agency to evaluate the performance of the ADS in these and other scenarios? How should the performance of the ADS be compared to that of a human driver in a nonexempt vehicle?**

Yes, it is appropriate for the agency to evaluate the responsiveness and driving skills of the ADS in relation to the component, system, test procedure, or performance requirement from which an FMVSS exemption is sought. In fact, it is essential to evaluating ADS safety. The first step, and one that has not been taken by NHTSA, is establishing the safety standards and criteria to which an ADS must conform, e.g., requirements to negotiate a path through oncoming traffic when making a left turn, stop

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<sup>8</sup> *Supra*, footnote 1.

<sup>9</sup> *Supra*, footnote 2.

<sup>10</sup> *Supra*, footnote 3.

when a pedestrian crosses the vehicle's path, and yield to emergency vehicles. Petitions for FMVSS exemption on vehicles with automatic driving systems should be evaluated based on statistically significant objective safety data conformance to meaningful safety criteria including the entire vehicle control system response to external stimulus (e.g., a traffic situation that requires a driver response). The FMVSS in many cases have an implicit human operator bias, and ADS developers need to show that they have successfully replicated in their automatic systems the human sensory capability, responses, and judgment implicit in the specific FMVSS for which exemption is sought. The FMVSS have not been updated as required for high or full automation to remove the human operator bias.

The Center has provided to NHTSA a methodology it believes is a reasonable approach to evaluating and approving autonomous vehicle operation in specific ODDs. That methodology may be found in its response to NHTSA's Advanced Notice of Proposed Rulemaking: Pilot Program for Collaborative Research on Motor Vehicles with High or Full Driving Automation.<sup>11</sup>

Further, the Center submitted a petition to NHTSA on October 19, 2018, to immediately mandate the submission of safety information by companies testing automated vehicles system technology on public roads.<sup>12</sup> Seven months later, and three months past NHTSA's own published deadlines,<sup>13</sup> the agency has yet to respond. Thus, there is no uniform data collection process that addresses the scope of public testing and the success, failures, and lessons learned from that testing. Accordingly, NHTSA has missed a golden opportunity to create a fact-specific baseline from which to consider petitions such as the one submitted by GM.

**17. To what extent and how should GM's contemplated limited deployment (e.g., in a petitioner-controlled rideshare program, with established ODD constraints and the ability to pull vehicles off the street to remedy, including through software updates, any potential safety issues that might arise) be considered when evaluating safety equivalence? Does GM's continuous control over the exempted vehicles and the ability to make continual improvements in vehicle safety performance through software updates argue for acceptance of a greater degree of uncertainty about safety effects than in the case of a petition for exemption of vehicles to be sold to the public?**

GM's continuous control over the exempted vehicles and the promised ability to make continual improvements in vehicle safety performance through software updates could argue for acceptance of a greater degree of uncertainty about safety effects than in the case of a petition for exemption of vehicles to be sold to the public if the petition first established that the initial operations provided adequate safety, but the petition fails that test.

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<sup>11</sup> *Supra*, footnote 1.

<sup>12</sup> *Supra*, footnote 2.

<sup>13</sup> *Supra*, footnote 3.

GM's petition is deficient because it did not include any safety requirements, compliance standards, or processes to assure compliance with requirements. It is simply not possible to evaluate safety equivalence without safety reference criteria and projected ZEAV conformance to those criteria.

**18. If some of the constraints of the ZEAV's initial deployment would eventually be progressively relaxed by GM, what types of data should the agency use in evaluating the safety of the ZEAV over its lifetime and deciding whether to grant or deny the petition? If an exemption is granted, should the agency monitor and periodically validate these data throughout the ZEAV's service life?**

The agency should establish objective safety compliance criteria for petitions by GM and other autonomous vehicle technology developers. Compliance should be verified at critical points in the program development, e.g., before introduction of the human-operated ZEAV analog on public roads, again before introduction of autonomous ZEAV onto public roads, and yet again at the conclusion of the demonstration program. The autonomous control 'driver' should be progressively examined and licensed throughout the program's life until safe operation within its approved ODD is definitively established and validated by experience. Due to a current lack of national safety compliance standards, the Center has provided to NHTSA both safety criteria that it believes are a meaningful and actionable set for evaluating ADS safety and a methodology it believes is a reasonable approach to evaluating and approving autonomous vehicle operation in specific ODDs. That methodology may be found in its response to NHTSA's Advanced Notice of Proposed Rulemaking:

Pilot Program for Collaborative Research on Motor Vehicles with High or Full Driving Automation.<sup>14</sup>

Further, the Center submitted a petition to NHTSA on October 19, 2018, to immediately mandate the submission of safety information by companies testing automated vehicles system technology on public roads.<sup>15</sup> Seven months later, and three months past NHTSA's own published deadlines,<sup>16</sup> the agency has yet to respond. Thus, there is no uniform data collection process that addresses the scope of public testing and the success, failures, and lessons learned from that testing. Accordingly, NHTSA has missed a golden opportunity to create a fact-specific baseline from which to consider petitions such as the one submitted by GM.

**19. NHTSA requests comment on how NHTSA should evaluate whether granting this exemption would be consistent with the "public interest" and the Vehicle Safety Act. What elements of the public interest and the Act would be most important in that evaluation?**

As discussed in our comment, NHTSA's unlawful actions in furtherance of a new temporary exemption petition regime raise serious questions as to whether the agency is even capable of evaluating what actions would be consistent with the public interest and the Safety Act. A grant

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<sup>14</sup> *Supra*, footnote 1.

<sup>15</sup> *Supra*, footnote 2.

<sup>16</sup> *Supra*, footnote 3.

of the GM petition under the December temporary exemption process change is quite clearly not in the public interest, as it removes any guarantee that the public is apprised of critical information prior to an agency decision on a petition.

Additionally, a grant of the GM Petition would not be consistent with the public interest because GM has not provided sufficient data to demonstrate safe operation. The Safety Act provides the agency with suitable authority to craft effective rules that would mandate a demonstration of safety prior to introduction of autonomous vehicles to public roads, yet NHTSA has chosen not to undertake this process. Rather, the agency has chosen to entertain temporary exemption petitions, a process which was never intended to be used for mass exemptions of autonomous vehicles that are incapable of complying with the FMVSS. Were NHTSA truly concerned with the public interest, the Safety Act, and the agency's own regulations, it would take transparent and meaningful rulemaking steps to ensure the safety of these vehicles prior to introduction on public roads.

**20. In the absence of real-world demonstration of quality of the decision-making by the ZEAV's ADS, if the petition were to be granted, what terms and conditions, if any, should the agency place on the exemption, and any similar future requests, to protect public safety, facilitate agency efforts to monitor the operations of exempted vehicles, and maximize the learning opportunities presented by the on-road experience of the exempted vehicles during the exemption period and thereafter?**

The petition should not be granted in the absence of real-world demonstration of quality of the decision-making by the ZEAV's ADS, first in controlled but representative private tests, second under human control while ADS 'learning' is taking place, and again before autonomous operations commence. The Center has provided to NHTSA both safety criteria that it believes are a meaningful and actionable set for evaluating ADS safety and a methodology it believes is a reasonable approach to evaluating and approving autonomous vehicle operation in specific ODDs. This includes a graduated licensing program from the ADS 'driver.' The criteria and methodology and a description of the licensing program may be found in its response to NHTSA's Advanced Notice of Proposed Rulemaking: Pilot Program for Collaborative Research on Motor Vehicles with High or Full Driving Automation.<sup>17</sup> The Center believes that its proposal protects public safety, facilitates agency efforts to monitor the operations of exempted vehicles, and maximizes the learning opportunities presented by the on-road experience of the exempted vehicles during the exemption period and thereafter.

Further, the Center submitted a petition to NHTSA on October 19, 2018, to immediately mandate the submission of safety information by companies testing automated vehicles system technology on public roads.<sup>18</sup> Seven months later, and three months past NHTSA's own published deadlines,<sup>19</sup> the agency has yet to respond. Thus, there is no uniform data collection process that addresses the scope of public testing and the success, failures, and lessons learned from that testing. Accordingly, NHTSA has missed a golden

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<sup>17</sup> *Supra*, footnote 1.

<sup>18</sup> *Supra*, footnote 2.

<sup>19</sup> *Supra*, footnote 3.

opportunity to create a fact-specific baseline from which to consider petitions such as the one submitted by GM.

**21. Should NHTSA consider how the ZEAV would respond if it needed to deal with an unusual situation, e.g., cross the yellow line to pass a stopped vehicle blocking the way forward for a prolonged period of time or obey a policeman giving instructions instead of obeying a traffic light?**

Yes, NHTSA should consider how the ZEAV would respond if it needed to deal with an unusual situation such as those postulated in the question. Such situations are likely to occur and are a commonplace for human drivers. Such considerations should be prominent in any jurisdiction's approval of autonomous vehicle operation. There should also be visibility into, and approval of the way traffic regulations are transformed into algorithms that are executable by the ADS control system. For just one example, laws that require drivers to stop the vehicle, tend to any injured, and exchange driver's identification, insurance, and registration information after a collision will be very challenging for autonomous driving system compliance, yet must be demonstrated to show compliance with motor vehicle laws. The governing jurisdiction and NHTSA should be fully informed about the ADS algorithms related to all motor vehicle laws, not just those easily programmed into an ADS.

**22. Please comment on the potential utility of NHTSA's placing terms and conditions on an exemption requiring the submission of the following categories of data. (Answer below applies to subparts of question 22 a-f):**

NHTSA should establish appropriate operational safety criteria and metrics to track compliance with those safety criteria as part of a graduated autonomous vehicle licensing program, as described in the Center's response to NHTSA's Advanced Notice of Proposed Rulemaking: Pilot Program for Collaborative Research on Motor Vehicles with High or Full Driving Automation.<sup>20</sup>

Further, the Center's October 2018 petition,<sup>21</sup> which was based on NHTSA's own Highly Automated Vehicle policy, seeks a rulemaking to allow the agency to, at a minimum, acquire enough documentation, detail, or data to demonstrate the autonomous vehicle technology currently being tested, or planning to be tested, on public roads, is at least as safe as vehicles which currently meet all applicable FMVSS. Such a rule would also be of assistance in response to these data categories.

**g. For all categories of information, how should any concerns about confidential business information and privacy be addressed?**

While legitimate claims of confidential business information and privacy must be respected, due both to statutory mandate and good business practices, the current review regime makes overprotection and delayed public inspection the norm instead of the

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<sup>20</sup> *Supra*, footnote 1.

<sup>21</sup> *Supra*, footnote 2.

exception. Where technical information submitted by manufacturers is critical to the public understanding of the plans to deploy autonomous technology on public roads, the prevailing standard must be expedited release of redacted information instead of holding it past the point of utility to the outside world.

Unfortunately, the current methodology being followed, as evidenced by the failure to provide the public with GM's petition for 14 months after submission, prevents the public from having proper access to critical information prior to agency decisions. At the very least, the current practice prevents the public from being able to provide helpful comments for the agency to consider. The goal must be to quickly release as much as is possible in a manner that provides the legal protections required by the agency's confidential business information regulations.

**23. If there would be other categories of data that should be considered, please identify them and the purposes for which they would be useful to the agency in carrying out its responsibilities under the Safety Act.**

For purposes of establishing root cause of collisions and acknowledging the absence of a human driver who could provide supporting information, ADS data recorders should be enhanced relative to the existing standard in Title 49: Chapter V, part 563. The event data record, which should be required on all vehicles, should include the vehicle physical configuration and state (such as tire pressure, sensor status, and built-in-test/built-in-diagnostic information) of the vehicle; the software configuration of the vehicle; the vehicle sensor data, V2V and V2X information, and CAN/any other data bus information from one minute before the collision through the time of collision until at least 10 seconds after the vehicle comes to rest; and any other information necessary for collision reconstruction and root cause resolution. The data should be recorded in flat files in non-proprietary formats and accessible through commonly used connectors so that the data can be extracted and used without intervention of the developer, with appropriate protections for proprietary data and personal information.

**27. Are there any mechanisms that may help further mitigate the underlying safety risks, if any, presented by this petition? For example, what additional safety and engineering redundancies, if any, should NHTSA consider requiring as a condition to granting the exemption?**

NHTSA should establish and define a minimum set of safety critical functions and establish reliability compliance standards for safety-critical functions performed by an ADS. The safety-critical functions should consider both vehicle occupant and vulnerable road user safety. There is an extensive literature on autonomous system safety for crewed aircraft and space systems that prescribe specific design solutions for accomplishing the needed safety levels. ADS have similar requirements but are in some respects even more demanding because of the proximity of an autonomous vehicle to hazards and the hazard posed by autonomous vehicles to vulnerable road users. The timelines for autonomous vehicle hazards are much shorter than typical for aircraft or spacecraft. By setting reliability standards but not imposing specific design solutions

NHTSA would provide developers with the most possible engineering flexibility while still preserving public safety.

**28. Over the history of the Agency, exemption petitions based on some form of safety analysis, as opposed to the much more common type of petition based on a claim of economic hardship, have averaged only 1-2 per year. Typically, these safety-based petitions have involved technologies that affect only a single vehicle function or at least a very narrow range of functions and that were well described and tested. Such petitions were resolved by the Agency's either granting or denying them after soliciting and considering public comments. In some cases, the Agency sent requests to the applicant for additional test data. In most cases, this second group of petitions were either granted or denied, again after public comment. In a few instances, the petition remained as "pending." In our current innovative environment, such an approach presents challenges for technologies, e.g., automated driving systems for vehicles without manual driving controls, that affect a broad range of functions and that have not been developed sufficiently to incorporate them in vehicles in order to generate the real-world test data that has typically been required for granting petitions. The lack of real-world test data could result in lengthy delays and even non-approval.**

To address this problem, NHTSA solicits public comment on alternative approaches to analyzing and resolving petitions for exemption from FMVSS in a timely and appropriate way, including but not limited to:

- After public comment, exercising our discretion to rely upon other forms of evidence in making the statutorily required findings quickly for petitions related to technology with significant lifesaving potential to allow for expedited approval for testing and development of a very limited number of vehicles <sup>(95)</sup> under well-defined, risk-managed conditions;
- Deny petitions if applicants are unable to respond adequately to NHTSA requests for further information within a specified time period;
- For vehicles that would be deployed only within very limited operating areas, go beyond seeking public comment by hosting public meetings or otherwise providing for targeted and transparent public engagement in the intended geographical operating area to allow for full and transparent public discussion of novel safety issues and concerns, emergency response considerations, or other issues of interest to state and local stakeholders regarding the exemption requested and relevant to NHTSA's review of the petition;
- Any other options to process petitions in a way that is timely, transparent and supportive of the safety goals of the FMVSS from which exemption is sought.

The Center's October 2018 petition,<sup>22</sup> which was based on NHTSA's own Highly Automated Vehicle policy, seeks a rulemaking to allow the agency to, at a minimum, acquire enough documentation, detail, or data to demonstrate the autonomous vehicle technology currently being tested, or planning to be tested, on public roads, is at least as safe as vehicles which currently meet all applicable FMVSS. Such a rule would also be of assistance in response to exactly the problem the question above describes.

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<sup>22</sup> *Supra*, footnote 2.