



DEPARTMENT OF TRANSPORTATION

National Highway Traffic Safety Administration

[Docket No. NHTSA-2019-0017]

Nuro, Inc.; Receipt of Petition for Temporary Exemption for an Electric Vehicle with an Automated Driving System

AGENCY: National Highway Traffic Safety Administration (NHTSA), Department of Transportation (DOT).

ACTION: Notice of receipt of petition for temporary exemption; request for public comment.

SUMMARY: Nuro, Inc. (Nuro) has petitioned NHTSA for a temporary exemption from certain requirements in Federal Motor Vehicle Safety Standard (FMVSS) No. 500, which establishes standards for “Low-speed vehicles,” on the basis that an exemption would make the development or field evaluation of a low-emission vehicle easier without unreasonably lowering the safety of that vehicle. The vehicle for which Nuro requests an exemption is a low-speed, highly automated delivery vehicle intended to be operated without any human occupants and thus designed without any seating. Specifically, Nuro requests exemptions from the requirements in FMVSS No. 500 that its vehicle be equipped with rearview mirrors, a windshield that complies with FMVSS No. 205, and a rear visibility (backup camera) system that complies with FMVSS No. 111. Nuro states that the absence of human occupants, combined with the vehicle’s various safety design features, including the vehicle’s Automated Driving System (ADS), make compliance with these provisions of FMVSS No. 500 either unnecessary for, or detrimental to, the safety of pedestrians and cyclists.

NHTSA is publishing this document in accordance with statutory and administrative provisions, and requests comments on this document and the petition submitted by Nuro.

NHTSA will assess the merits of the petition and decide whether to grant or deny it after receiving and considering the public comments on this notice, the petition, public responses to the questions in this notice and such additional information as Nuro may provide.

DATES: Comments on this petition must be submitted by **[INSERT DATE 60 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**.

FOR FURTHER INFORMATION CONTACT: Stephen Wood or Daniel Koblenz, Office of Chief Counsel, National Highway Traffic Safety Administration, 1200 New Jersey Avenue S.E., Washington, D.C. 20590. Telephone: 202-366-2992; Fax: 202-366-3820.

Comments: NHTSA invites you to submit comments on the petition described herein and the questions posed below. You may submit comments identified by docket number in the heading of this notice by any of the following methods:

- *Fax:* 202-493-2251.
- *Mail:* U.S. Department of Transportation, Docket Operations, M-30, Room W12-140, 1200 New Jersey Avenue, S.E., Washington, D.C. 20590.
- *Hand Delivery:* 1200 New Jersey Avenue, S.E., West Building Ground Floor, Room W12-140, Washington, D.C., between 9 a.m. and 5 p.m., Monday through Friday, except Federal Holidays.
- *Federal eRulemaking Portal:* Go to <http://www.regulations.gov>. Follow the online instructions for submitting comments.

Instructions: All submissions must include the agency name and docket number. Note that all comments received will be posted without change to <http://www.regulations.gov>, including any personal information provided. Please see the Privacy Act discussion below. NHTSA will consider all comments received before the close of business on the comment closing date

indicated above. To the extent possible, NHTSA will also consider comments filed after the closing date.

Docket: For access to the docket to read background documents or comments received, go to <http://www.regulations.gov> at any time or to 1200 New Jersey Avenue, S.E., West Building Ground Floor, Room W12-140, Washington, D.C. 20590, between 9 a.m. and 5 p.m., Monday through Friday, except Federal Holidays. Telephone: 202-366-9826.

Privacy Act: In accordance with 5 U.S.C. 553(c), DOT solicits comments from the public to better inform its rulemaking process. DOT posts these comments, without edit, to www.regulations.gov, as described in the system of records notice, DOT/ALL-14 FDMS, accessible through www.dot.gov/privacy. In order to facilitate comment tracking and response, we encourage commenters to provide their name, or the name of their organization; however, submission of names is completely optional. Whether or not commenters identify themselves, all timely comments will be fully considered. If you wish to provide comments containing proprietary or confidential information, please contact the agency for alternate submission instructions.

Confidential Business Information: If you wish to submit any information under a claim of confidentiality, you should submit three copies of your complete submission, including the information you claim to be confidential business information, to the Chief Counsel, NHTSA, at the address given under FOR FURTHER INFORMATION CONTACT. In addition, you should submit two copies, from which you have deleted the claimed confidential business information, to Docket Management at the address given above. When you send a comment containing information claimed to be confidential business information, you should include a cover letter setting forth the information specified in our confidential business information regulation (49

C.F.R. Part 512).

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I. Introduction

This document notifies the public that NHTSA has received from Nuro Inc. (“Nuro”) a petition for a temporary exemption from three requirements of FMVSS No. 500, which establishes standards for “Low-speed vehicles.” Nuro submits its request on the basis that an exemption would make the development or field evaluation of a low-emission vehicle easier without unreasonably lowering the safety of that vehicle.¹ The vehicle that is the subject of the petition is the “R2X,” which Nuro describes as a highly automated (SAE Level 4 or simply L4),² low-speed (25 mph maximum), electric-powered delivery robot. According to Nuro, the R2X would be designed to carry cargo exclusively, and accordingly would not have any passenger compartment or designated seating positions. The provisions of FMVSS No. 500 from which Nuro requests an exemption are the requirements that low speed vehicles (LSVs) be equipped with (1) rearview mirrors, (2) an FMVSS No. 205-compliant windshield, and (3) an FMVSS No. 111-compliant rear visibility (backup camera) system. Because this vehicle would not have any designated seating positions, Nuro states that the vehicle should not be required to have any seatbelts, and, thus, does not need an exemption from that requirement. Nuro requests a two-

¹ In the balance of this document, we will refer to this as the “low-emission vehicle exemption basis.” For more information, *see* 49 U.S.C. 30113(b)(3)

² The SAE International automation levels are commonly used to describe the degree to which a motor vehicle can operate autonomously. The levels of automation range from Level 0 (no automation) to Level 5 (complete automation with no limitations). A Level 4 (L4) vehicle such as the R2X is considered to have “high driving automation” which means that the vehicle can perform 100 percent of the driving task within the vehicle’s operational design domain.

year exemption, during which it seeks to be allowed to introduce fewer than 2,500 exempted vehicles into interstate commerce for each 12-month period covered by the exemption.³

This notice solicits comments from the public to inform NHTSA's analysis of the merits of Nuro's petition under the low-emission vehicle exemption basis in 49 U.S.C. 30113. To this end, this notice includes requests for comments and poses specific questions regarding issues that NHTSA believes could be relevant in deciding whether to grant the petition. If commenters believe that there are other potentially relevant issues, NHTSA invites them to identify those issues and explain their potential relevance.

II. Background

a. Statutory Authority and Regulatory Requirements for Temporary Exemption Petitions

The National Traffic and Motor Vehicle Safety Act (Safety Act), codified at Chapter 301 *et seq.*, of title 49, United States Code, authorizes the Secretary of Transportation to exempt, on a temporary basis, under specified circumstances, and on terms the Secretary deems appropriate, motor vehicles from a FMVSS or bumper standard. This authority is set forth at 49 U.S.C. 30113. The Secretary has delegated the authority for implementing this section to NHTSA.⁴

The Safety Act authorizes the Secretary (by delegation, NHTSA) to grant, in whole or in part, a temporary exemption to a vehicle manufacturer if certain specified findings are made. The Secretary must look comprehensively at the request for exemption and find that the exemption is consistent with the public interest and with the objectives of the Vehicle Safety Act.⁵

³ Nuro has requested that the agency withhold as confidential business information the precise number of vehicles it expects to deploy if an exemption is granted.

⁴ 49 C.F.R. 1.95.

⁵ 49 U.S.C. 30113(b)(3)(A).

In addition, the Secretary must make one of the following more-focused findings:

- (i) compliance with the standard[s] [from which exemption is sought] would cause substantial economic hardship to a manufacturer that has tried to comply with the standard[s] in good faith;
- (ii) the exemption would make easier the development or field evaluation of a new motor vehicle safety feature providing a safety level at least equal to the safety level of the standard;
- (iii) the exemption would make the development or field evaluation of a low-emission motor vehicle easier and would not unreasonably lower the safety level of that vehicle; or
- (iv) compliance with the standard would prevent the manufacturer from selling a motor vehicle with an overall safety level at least equal to the overall safety level of nonexempt vehicles.⁶

The third of these additional findings is the basis for Nuro's request for exemption. Nuro requests the Secretary to grant its petition based on a finding that the exemption is consistent with the public interest and with the Safety Act, and that the exemption would facilitate the development or field evaluation of a low-emission motor vehicle and would not unreasonably reduce the safety level of that vehicle.⁷ The statute further states that, for exemptions under this subsection, "a record of the research, development, and testing establishing that the motor vehicle is a low-emission motor vehicle and that the safety level of the vehicle is not lowered unreasonably by exemption from the standard" must also be included in the application.

⁶ 49 U.S.C. 30113(b)(3)(B).

⁷ 49 U.S.C. 30113(b)(3)(B)(iii).

NHTSA established 49 C.F.R. Part 555, “Temporary Exemption from Motor Vehicle Safety and Bumper Standards,” to implement the statutory provisions concerning temporary exemptions. The requirements in 49 C.F.R. 555.5 state that the petitioner must set forth the basis of the petition by providing the information required under 49 C.F.R. 555.6, and the reasons why the exemption would be in the public interest and consistent with the objectives of the Safety Act.

A petition justified on the low-emission vehicle exemption basis must include the following information specified in 49 C.F.R. 555.6(c):

- (1) Substantiation that the vehicle is a low-emission vehicle;
- (2) Research, development, and testing documentation establishing that a temporary exemption would not unreasonably degrade the safety or impact protection of the vehicle;
 - (i) A detailed description of how the motor vehicle equipped with the low-emission engine would, if exempted, differ from one that complies with the standard;
 - (ii) If the petitioner is presently manufacturing a vehicle conforming to the standard, the results of tests conducted to substantiate certification to the standard;
 - (iii) The results of any tests conducted on the vehicle that demonstrate its failure to meet the standard, expressed as comparative performance levels; and
 - (iv) Reasons why the failure to meet the standard does not unreasonably degrade the safety or impact protection of the vehicle.
- (3) Substantiation that a temporary exemption would facilitate the development or field evaluation of the vehicle; and
- (4) A statement of whether the petitioner intends to conform to the standard at the end of the exemption period; and
- (5) A statement that not more than 2,500 exempted vehicles will be sold in the U.S. in any 12-month period for which an exemption may be granted.

b. Low-speed Vehicles and FMVSS No. 500

Nuro states that the R2X would be a LSV. NHTSA defines an LSV as a motor vehicle: (1) That is 4-wheeled; (2) Whose speed attainable in 1.6 kilometers (1 mile) is more than 32 kilometers per hour (20 miles per hour) and not more than 40 kilometers per hour (25 miles per hour) on a paved level surface; and (3) whose gross vehicle weight rating (GVWR) is less than 1,361 kilograms (3,000 pounds).⁸

Unlike other vehicle categories that must meet a wide array of FMVSSs and other standards, LSVs are only required to meet a single standard: FMVSS No. 500.⁹ Currently, FMVSS No. 500 requires that LSVs be equipped with headlamps, stop lamps, turn signal lamps, taillamps, reflex reflectors, parking brakes, rearview mirrors, windshields, seat belts for all designated seating positions, a vehicle identification number and a rear visibility (backup camera) system.

NHTSA created the LSV classification and FMVSS No. 500 in June 1998 in response to safety concerns over the growing use of golf carts and other similar-sized, 4-wheeled “Neighborhood Electric Vehicles” (NEVs) on public roads.¹⁰ In developing FMVSS No. 500, NHTSA determined that, given the speed and weight limitations of the LSV classification, and the closed or controlled environments in which LSVs typically operate (usually planned communities and golf courses), there was not a safety need to apply the full range of FMVSS to them. Thus, the safety equipment required under FMVSS No. 500 is far more limited than what is required for other vehicle categories. Examples of FMVSS that are not applicable to LSVs include but are not limited to requirements related to antitheft, structural integrity, and flammability.

⁸ 49 CFR 571.3

⁹ FMVSS No. 141, “Minimum sound requirements for hybrid and electric vehicles,” will apply to LSVs once it is phased in on September 1, 2020.

¹⁰ 63 FR 33194 (June 17, 1998).

Of the eleven requirements in FMVSS No. 500, Nuro states that it intends to meet seven requirements, believes that the requirement related to seat belts is inapplicable as the vehicle lacks any designated seating positions, and petitions for exemption from the remaining three requirements. First is S5(b)(6), which requires that LSVs be equipped with an exterior (rearview) mirror mounted on the driver's side, and either an exterior mirror mounted on the passenger's side of the vehicle or an interior mirror.¹¹ Second is S5(b)(8), which requires that LSVs be equipped with a windshield that conforms to FMVSS No. 205. Third is S5(b)(11), which requires that LSVs be equipped with a rear visibility (backup camera) system that conforms to the requirements of S6.2 of FMVSS No. 111.

III. Nuro's Petition

The following discussion provides: an overview of the R2X based on information submitted in Nuro's petition; Nuro's explanation of why it believes exemption is justified under the low-emission vehicle exemption basis; and the information that Nuro provided regarding the safety of its vehicle.¹²

a. Overview of the "R2X" Low-Speed Automated Delivery Robot

Nuro contends that the R2X would be fundamentally different from any other vehicle with motive power currently regulated by NHTSA. Intended to provide retailers with local "last-mile" delivery services, the R2X would be designed without an occupant compartment (and thus, without any designated seating positions), nor is there any clear way for a human to enter the interior of the vehicle to use it for transportation. Instead, the R2X would be equipped with storage compartments in which goods, such as groceries, home goods, and hardware, may be placed for delivery to customers in urban or suburban "neighborhood" environments. See Figure

¹¹ These rearview mirrors are not required to conform to FMVSS No. 111.

¹² NHTSA notes that the statements in the description of Nuro's petition are attributable to Nuro. NHTSA will review and assess those statements in deciding whether to grant the petition.

1 below showing the R2X with its gull wing cargo hatch covers open. To enable the operation of a vehicle lacking any occupant compartment, the R2X would be driven entirely by an L4 Automated Driving System (ADS), described in more detail below.

Figure 1. Picture of R2X (Source: <https://nuro.ai/product/>)



Nuro states that the R2X’s propulsion system would be electric, and states it would be a low-emission vehicle as defined under Section 202 of the Clean Air Act because it would be a zero-emission vehicle that emits regulated air pollutants at levels “significantly below” what is permitted for new motor vehicles. Nuro also avers that the R2X would meet the elements of the LSV definition as follows:

- (1) An LSV must be 4-wheeled – Nuro states that the R2X would have 4 wheels;
- (2) An LSV must be capable of attaining a maximum speed of between 32 kilometers per hour and 40 kilometers per hour (20 miles per hour and 25 miles per hour) within 1.6 kilometers (1 mile) on a paved level surface – Nuro states that the R2X would be able to achieve a maximum speed of not more than 40 kilometers per hour (25 miles per hour);¹³ and

¹³ We note that Nuro does not state whether the R2X is physically incapable of going faster, or whether its speed is limited by something that can be readily modified, such as software. As NHTSA has noted in prior interpretation letters, some modifications to vehicles are so fundamental that the agency would consider the act of modifying the vehicle to be the manufacture of a new vehicle. See letter to Susan Gabel (Feb. 16, 2005), available at <https://isearch.nhtsa.gov/files/GF009529.html>. Modifying a vehicle in such a way as to change its vehicle classification category arguably arises to that level of importance. In NHTSA’s view, because the safety features of an LSV are so fundamentally tied to its low speed and weight, changing its maximum speed or its weight to exceed

(3) An LSV must have a GVWR less than 1,361 kilograms (3,000 pounds). 49 CFR 571.3. Nuro also states that the vehicle would have an “unladen” weight (i.e., curb weight) of 1,134 kilograms (2,500 pounds), and that the vehicle’s GVWR would be less than the 1,361-kilogram (3,000-pound) limitation in the LSV definition. (A vehicle’s “curb weight” is its unloaded weight, whereas a vehicle’s GVWR is its loaded weight rating as specified by the manufacturer.) We note that Nuro does not provide the precise GVWR of the R2X, which is needed to determine whether the R2X would properly be classified as an LSV.

Nuro also describes the aspects of the R2X that would permit automated driving, namely the L4 ADS and the suite of cameras, LIDAR¹⁴ and radar sensors which provide the ADS information about the driving environment. As noted above, one of the key features that would make the R2X unique is that the driving task would be automated through the use of an L4 ADS. Nuro indicates throughout its petition that it has designed the R2X’s ADS to operate the vehicle on low-speed surface roads in “neighborhood” environments.¹⁵ According to Nuro, the R2X would be equipped with 12 high definition cameras, radar sensors, and a top-mounted LIDAR that together provide the ADS with a 360° view of the vehicle’s surroundings. Nuro states that these cameras would be waterproof, rated to International Electrotechnical Commission (IEC) standard IP69K,¹⁶ and able to operate in temperatures between -40°Celsius (C) and 85°C. However, Nuro does not provide information on the operational capabilities of the radar and LIDAR systems.

the limits in the definition could be regarded as tantamount to the manufacture of a new vehicle of another classification.

¹⁴ A LIDAR system, or a Light Detection And Ranging system, measures distance to objects by sending out pulses of light and measuring the time it takes for pulses to be reflected off objects back to the LIDAR system.

¹⁵ Nuro petition at 2, 3, 4, 8, 10, & 18.

¹⁶ Conformity to IEC IP69K indicates resistance to dust, steam, and high-pressure water.

Regarding the ADS itself, Nuro states that its software would rely on “advanced machine learning” to improve its driving capabilities.¹⁷ Nuro explains this to mean that the driving performance of the ADS would improve as the system is exposed to new or unfamiliar driving situations, which Nuro has thus far done using on-road testing and simulations. Nuro states it has conducted two on-road testing programs to develop the ADS used in the R2X.¹⁸ For the first program, Nuro retrofitted FMVSS-certified passenger vehicles with its ADS, and states that it has “continuously operated” these retrofitted vehicles (with a safety driver backup) on public roads for the past year. For the second program, Nuro operated a prototype of the R2X on the company’s private testing facility, which Nuro says is intended to simulate driving conditions in urban and suburban neighborhood settings. Nuro’s petition did not include additional information concerning either of these programs, including how many miles were driven and in what conditions. In addition, Nuro says that it has supplemented these real-world testing programs with testing in a wide variety of simulated environments. Nuro states that these testing programs have led to continuous safety improvements to the ADS, although Nuro does not provide the metrics by which the company measures the safety of the ADS, nor does Nuro provide specific information about how the ADS’s decision-making process works beyond general statements that the ADS would avoid collisions with obstacles.

Nuro states that the R2X is intended to make “short neighborhood trips” to provide last-mile delivery services for retailers in urban or suburban neighborhood settings. Nuro states that the R2X would have “built-in” operational limits that are consistent with this intended use, such as a maximum speed of 25 mph, and being restricted to marked surface streets that Nuro has

¹⁷ Nuro petition, at 5.

¹⁸ Nuro petition, at 18-19.

extensively pre-mapped.¹⁹ (Nuro specifically notes that it does not intend to relax these operational restrictions to permit Level 5 automation for the R2X.) Nuro states that, to ensure the safety and reliability of exempted vehicles, it does not intend to lease or sell them.²⁰ Instead, Nuro intends to own and centrally operate the entire fleet of R2Xs through partnerships with local businesses such as retailers. The petition, though, does not provide further information about what Nuro means by “short neighborhood trips” or the operational limits Nuro would place on the R2X vehicles.

For additional background information on Nuro’s vehicle, see Nuro’s report “Delivering Safety: Nuro’s Approach” at https://static1.squarespace.com/static/57bcb0e02994ca36c2ee746c/t/5b9a00848a922d8eaeacf65a2/1536819358607/delivering_safety_nuros_approach.pdf.

b. Why Nuro Believes that Granting its Petition Would Facilitate the Development or Field Evaluation of a Low-Emission Motor Vehicle

Nuro requests an exemption on the basis that an exemption is necessary to facilitate the development and field evaluation of a low-emission vehicle²¹ (its R2X vehicle) and would not unreasonably lower the safety of that vehicle as compared to a vehicle that complies with the standard. Nuro claims that the exemption would facilitate the development the R2X’s ADS, which is necessary for developing and evaluating its low-emission R2X.

¹⁹ Nuro petition, at 8.

²⁰ Nuro petition, at 3.

²¹ The legislative history of the low-emission vehicle exemption basis indicates the purpose of the basis was to encourage the development of new vehicle propulsion technologies. First, according to the Congressional Record, Congress enacted the predecessor to the low-emission vehicle basis (which temporarily authorized NHTSA to grant an exemption if it “would facilitate the development of vehicles utilizing a propulsion system other than or supplementing an internal combustion engine”) as part of the 1968 Amendment to the Safety Act, Pub. L. 90-283 (April 10, 1968), to encourage the development of new propulsion technologies to address problem of urban air pollution. *See* 114 Cong. Rec. 7285 (1968) (Statement of Rep. Murphy). In 1972, Congress replaced this temporary exemption authority with permanent authority, and revised the language to what is currently found in 49 U.S.C. 30113(b)(3)(B)(iii), Pub. L. 92-548 (October 25, 1972), so as “not to stifle the development and evaluation of low-emission vehicles.” 118 Cong. Rec. 34209 (1972) (Statement of Sen. Hartke).

Nuro states that because the R2X's ADS relies on advanced machine learning to improve its level of safety, the R2X must be exposed to new driving scenarios. Nuro's existing testing programs have consisted of operating its FMVSS-compliant vehicle on public roads autonomously, and operating the R2X in its private test track. Nuro argues that this testing has led to consistent improvements in the ADS's driving performance, but that it has "nearly exhausted the safety gains" it can accrue from its existing research and testing programs. Accordingly, Nuro argues that an exemption is needed to enable Nuro to perform a greater volume of real-world testing on public roads, which the company says would "expose the R2X to a greater variety of real-world situations than can be achieved in simulation or through the use of other FMVSS-compliant hardware platforms."²² In addition, Nuro states that testing with ADS-equipped traditional passenger vehicles does not provide Nuro with information on how other road users would react to the R2X's unique design, which is a critical element of the vehicle's safety.

c. Why Nuro Believes that Granting its Petition Would Not Unreasonably Degrade Safety

For each of the three FMVSS No. 500 requirements from which Nuro requests an exemption, Nuro provides an analysis explaining why granting an exemption would not unreasonably degrade the safety of the R2X. Nuro's safety analyses focus on the specific safety purposes that underlie the three individual requirements from which an exemption is sought, and discuss whether there is a safety need for each requirement on a vehicle that is controlled by an ADS. Using this framework, Nuro argues that an exemption from the three requirements in the petition would either not affect vehicle safety, or would improve vehicle safety. Nuro's analyses of the safety impacts of granting its three requested exemptions are summarized below.

²² Nuro petition, at 19.

i. Exterior Mirror Requirement

Per FMVSS No. 500, S5(b)(6), all LSVs must be equipped with “an exterior mirror mounted on the driver’s side of the vehicle and either an exterior mirror mounted on the passenger’s side of the vehicle or an interior mirror.” Nuro states the R2X would differ from a compliant LSV because it would not be equipped with either exterior or interior mirrors for rear visibility. Nuro explains that the R2X would instead use a sensor-based system to detect obstacles and other objects in the surrounding environment.

Nuro argues that an exemption from the mirror requirement would not unreasonably lower the safety of the R2X because the ADS does not use mirrors to perceive its surroundings for purposes of operating the vehicle.²³ Rather, the R2X’s ADS perceives its surroundings using a suite of sensors that provide a continually-updated, complete 360-degree view of the area around the vehicle. Thus, Nuro argues that mirrors would not serve any safety purpose on the R2X, and that removing them would not lower safety.

Beyond not serving any safety function on the R2X, Nuro further argues that the presence of exterior mirrors may actually present a safety risk to pedestrians, and that removing them would improve the safety of the R2X. First, Nuro explains that because the R2X is designed to operate in pedestrian-heavy environments (neighborhood streets), it would contain various features that are intended to protect pedestrians in a crash. These features would include design elements such as rounded edges that avoid direct strikes, and pedestrian “crumple zones” to reduce the severity of impacts. Nuro states that equipping the R2X with the required mirrors would interfere with these features. Nuro also states that mirrors might increase the likelihood of pedestrian impacts because they would widen the R2X’s profile, which may increase the risk of a collision in certain situations, such as when other road users pass the R2X too closely.

²³ Nuro petition, at 8-10.

ii. Windshield Requirement

Per FMVSS No. 500, S5(b)(8), all LSVs are required to be equipped with “a windshield that conforms to the Federal motor vehicle safety standard on glazing materials (49 C.F.R. 571.205).” Nuro states that the R2X would differ from a compliant LSV because it would not be equipped with a windshield of any kind. Instead, the front face of the R2X would be equipped with the various pedestrian safety features described in the previous section.

Nuro argues that exempting the R2X from the windshield requirement would not unreasonably lower the safety of the R2X principally for two reasons.²⁴ First, Nuro argues that the absence of human occupants in the R2X would make the windshield unnecessary for occupant protection because there would not be any risk that human occupants would be injured by an impact with glazing or ejected from the R2X. Second, Nuro argues that there is not any need for a windshield to ensure driver visibility because the driving task would be performed by the ADS, which would not require a transparent windshield to observe the driving environment.²⁵

Nuro further states that meeting the windshield requirement could lower the safety of the R2X because the presence of a windshield made from FMVSS No. 205-compliant glazing could injure pedestrians in a collision due to its rigidity (if the glazing does not break), or due to the harm that could result if the glazing shatters. As noted in the previous section, Nuro argues that one of the primary pedestrian protection features of the R2X is that its design incorporates energy-absorbing pedestrian “crumple zones” that reduce collision impact severity. Nuro states

²⁴ Nuro petition, at 10-12.

²⁵ We note that NHTSA stated in the final rule establishing FMVSS No. 500 that the agency had decided to require LSVs to use passenger vehicle glazing (as opposed to other materials that may be more durable) due to concerns that the visibility provided by other materials might degrade over time. 63 FR at 33211.

that equipping the R2X with an FMVSS No. 205-compliant windshield would reduce the effectiveness of these pedestrian impact mitigation features.

Finally, Nuro notes that, while the R2X would not be equipped with a windshield, the front of the vehicle would be equipped with a “plate” that resembles the appearance of a windshield. Nuro states that this design is intended to indicate to other road users the front of the vehicle, which would provide visual cues as to the R2X’s potential driving behavior, reducing confusion.

iii. Rear Visibility (Backup Camera) Requirement

FMVSS No. 500, S5(b)(11), requires that all LSVs “comply with the rear visibility requirements specified in paragraph S6.2 of FMVSS No. 111 [Rear visibility].” This requirement states that vehicles to which it applies must be equipped with a rear visibility (i.e., backup camera) system that produces an image of the area immediately behind the vehicle under specified test conditions. The standard includes a number of provisions that are designed to minimize the risk of backover crashes, such as requirements for minimum image size and quality.²⁶ Nuro states that the R2X meets the “field of view” and “image size” requirements for rear visibility systems (FMVSS No. 111, S6.2.1-2),²⁷ but requests an exemption from the “linger time” and “deactivation” requirements (FMVSS No. 111, S6.2.4-5), which require that the rear visibility image be deactivated under certain specified conditions.

Nuro argues that exemption the R2X from the “linger time” and “deactivation” requirements would not unreasonably lower the safety of the vehicle because those requirements

²⁶ 79 FR 19177

²⁷ Nuro’s basis for stating that the R2X meets the Field of View and Image Size requirements is that the vehicle’s extensive array of cameras and sensors “display” a constant live image of the entire area surrounding the vehicle to the ADS, including the area behind the vehicle that must be displayed by the rear visibility system. Nuro provides an illustration of the area observed by the R2X’s rear-facing camera, which includes the area that must be displayed per FMVSS No. 111.

are intended to address a safety need that would not exist for the R2X. According to Nuro, the aspect of the “linger time” and “deactivation” requirements that is relevant to its request is that they both specify that the rear visibility image not be displayed when certain conditions are met. According to Nuro, the purpose of these requirements is to protect against the possibility that a driver would be distracted by the rear visibility image when travelling in the forward direction. Nuro states that this risk would not exist for the R2X because the R2X’s ADS is not susceptible to distraction. Moreover, Nuro states that compliance with these requirements would be detrimental to the safety of the R2X, because compliance would require the R2X’s rear-facing camera and sensors to be deactivated under certain conditions, effectively partially blinding the ADS.

In addition, while Nuro states that the R2X would meet the “field of view” and “image size” requirements, Nuro requests an exemption from four of the conditions in the test procedures that are used to verify compliance with those requirements because, according to Nuro, the R2X’s various unconventional design features would make the test conditions impossible to perform. These four test conditions are “fuel tank loading” (S14.1.2.2), “driver’s seat positioning” (S14.1.2.5), “steering wheel adjustment” (S14.1.7), and a portion of the “image response time test procedure” (S14.2). Although Nuro requests exemptions from these conditions, Nuro also suggests ways in which each of these four test conditions could be modified so that compliance could be verified using the R2X’s remote operation capability. The following table summarizes Nuro’s explanations for why these four required test conditions cannot be achieved with the R2X, and describes Nuro’s suggestions for modifying the test conditions for the purpose of compliance verification:

| Required Test Condition | Reason it cannot be achieved | Proposed Modification |
|-------------------------|------------------------------|-----------------------|
|-------------------------|------------------------------|-----------------------|

| | | |
|---|---|---|
| S14.1.2.2 “Fuel tank loading.” | The R2X would be an electric vehicle runs on a charge in a battery, not on fuel in a fuel tank. | Conduct the test with the battery at full charge capacity. |
| S14.1.2.5 “Driver’s seat positioning.” | The R2X would not have a driver’s seat, or designated seating position of any kind. | Treat a remote operator’s seat as the driver’s seating position. |
| S14.7 “Steering wheel adjustment.” | The R2X would not have a steering wheel. | Conduct the test with the wheels pointed in the forward direction, as would be consistent with the test state in the standard. |
| S14.2 “Image response time test procedure.” | The R2X would not have a driver’s door to open or close. | Perform the test procedure using the cargo compartment doors, which are the primary method for accessing the interior of the R2X. |

d. Why Nuro Believes that its Vehicle is a Low Emission Vehicle

In order to petition successfully under the low-emission vehicle exemption basis, the vehicle for which exemption is sought must meet the definition of “low-emission motor vehicle” at 49 U.S.C. 30113(a), meaning that it must be “a motor vehicle meeting the standards for new motor vehicles applicable to the vehicle under section 202 of the Clean Air Act when the vehicle is manufactured and emitting an air pollutant in an amount significantly below one of those standards.”²⁸

Nuro argues that its vehicle would meet that definition:

The R2X is a zero-emission vehicle. It will emit no hydrocarbons, carbon monoxide, oxides of nitrogen, or particulate matter, which are four of the air pollutants regulated under the Clean Air Act. Its emissions are therefore significantly below the Clean Air Act standards.²⁹

²⁸ “Motor vehicle,” for Clean Air Act purposes, means “any self-propelled vehicle designed for transporting persons or property on a street or highway,” so it appears that the R2X would qualify. 42 U.S.C. 7550.

²⁹ Nuro Petition, at 7.

e. Why Nuro Believes that Granting its Petition Would Be in the Public Interest

Nuro argues that an exemption would be in the public interest because it states that the R2X would incorporate several design features to enable the ADS to operate reliably, and to minimize safety risks that may occur if the ADS malfunctions or otherwise encounters a driving situation it cannot handle. Further, according to Nuro, by allowing the company to develop a safer ADS, an exemption would lead to downstream environmental improvements and economic productivity.

i. ADS Safety

Throughout its petition, Nuro describes several design features or characteristics that it says illustrate the high level of safety that the R2X's ADS would provide. First would be the ADS's maneuvering capability. Nuro argues that the R2X's low GVWR, combined with the absence of human passengers, would make the R2X capable of stopping or performing emergency maneuvers that are not possible for heavier vehicles with passengers. Moreover, Nuro states that the fact that the R2X would not have any human occupants means that it "has the unique opportunity to prioritize the safety of humans, other road users, and occupied vehicles over its own contents and chassis."³⁰ We note, however, that the petition does not provide information regarding the quality of the ADS's decision-making process when performing the driving task.

Nuro also states that the R2X would continuously perform self-diagnostics of vehicle systems. Nuro further states that safety-critical vehicle systems, including computing, steering, braking, and sensing systems would include redundancies for reliability, so that if a system or critical piece of equipment failed, the vehicle (including the ADS) would be able to continue

³⁰ Nuro petition, at 5.

operation. In the event that the R2X experienced a malfunction, the ADS' programming would enable it to identify and pull over to a safe location nearby. Nuro states that the ADS would continuously map the area surrounding the R2X to track pull over locations, and that, should the R2X's sensors fail, the ADS would pull the vehicle over using a trajectory calculated with data collected before the failure.

In addition to these on-board features, Nuro states that the R2X would at all times be monitored by "experienced human operators who are extensively trained in the vehicle's systems," and would be able to take over driving control from the ADS if needed.³¹ According to Nuro, these remote operators would play a similar backup safety role as safety drivers utilized in other ADS vehicle testing programs. Nuro states that situations in which a human operator might take over include the detection of a sensor malfunction, a "pullover event," or the alerting by the ADS of the remote operator that it has encountered a situation for which human operator control is recommended. Nuro states that the remote operation system would ensure connection reliability by using "several redundant, independent cellular connections with end-to-end encryption." Moreover, Nuro states that the R2X would avoid areas known to have weak cellular service by relying on Nuro's custom-built maps.

Nuro also identifies additional design features that it states would further support the safe operation of the ADS. For example, Nuro states that a number of vehicle components, including the braking system, would perform at the same level as full-speed passenger cars. In addition, Nuro states that the R2X would be equipped with a sound generator to alert other road users to the vehicle's presence and intent. These sounds are designed to mimic an internal combustion engine, and modulate based on the driving actions the R2X would take to indicate when the vehicle is accelerating and/or slowing down.

³¹ Training program described in the VSSA.

ii. Environmental and Economic Benefits

Nuro provides two additional non-safety based arguments for why granting its petition would be in the public interest. First, Nuro argues that the R2X would provide environmental benefits by reducing pollution. According to Nuro, the electricity that would power the R2X can come from a wide-variety of sources, including alternative fuels, and because the deliveries it would displace are trips that would otherwise likely be made in gasoline-powered privately-owned passenger vehicles. Nuro believes that the R2X could also decrease the number of total trips by efficiently combining trips. Nuro, however, does not provide further information about the capabilities of the R2X's propulsion system, such as its battery life, range, or efficiency. Second, Nuro argues that the R2X would increase economic productivity by, among other things, providing businesses with an additional option for delivering goods to local customers. These justifications are discussed in further detail in Nuro's petition.

IV. Agency Review

NHTSA has not yet made any judgment on the merits of Nuro's petition nor on the adequacy of the information submitted. NHTSA will assess the merits of the petition after receiving and considering the public comments on this notice and the petition and responses to the questions in this notice, as well as any additional information that the agency receives from Nuro. NHTSA is placing a non-confidential copy of the petition in the docket in accordance with statutory and administrative provisions. The agency will update the docket with any additional information it receives from Nuro and will extend or reopen the comment period for this petition as needed.

V. Terms

Once a manufacturer receives an exemption from the prohibitions of 49 U.S.C. 30112(a)(1), NHTSA can affect the use of those vehicles produced pursuant to the exemption only to the extent that NHTSA either has set terms in partially or fully granting the exemption or exercises its enforcement authority (e.g., its safety defect authority). The agency's authority to set terms is broad. Since the terms would be the primary means of monitoring and affecting the safe operation of the exempted vehicles, the agency would consider carefully whether to establish terms and what types of terms to establish if it were to grant a petition. The manufacturer would need to agree to abide by the terms set for that exemption in order to begin and continue producing vehicles pursuant to that exemption.

Nothing in either the statute or implementing regulations limits the application of these terms to the period during which the exempted vehicles are produced. NHTSA could set terms that continue to apply to the vehicles throughout their normal service life if it deems that such application is necessary to serve the interests of safety.

Thus, if NHTSA were to grant an exemption, in whole or in part, it could establish, for example, reporting terms to ensure a continuing flow of information to the agency throughout the normal service life of the exempted vehicles, not just during the two-year period of exemption. Given the uniqueness of Nuro's vehicle, its petition, the myriad of public safety concerns surrounding an occupant-less vehicle operating on public roads, and the fact only a small portion of the total mileage that the vehicles (if exempted) could be expected to travel during their normal service life would have been driven by the end of the exemption period, NHTSA could require data to be reported over a longer period of time to enable the agency to make sufficiently reliable judgments. Such judgments might include those made in a retrospective review of the agency's determination about the anticipated safety effects of the exemption.

NHTSA could also establish terms to specify what the consequences would be if the flow of information were to cease or become inadequate during or after the exemption period. Other potential terms could include limitations on vehicle operations (based upon ownership and management, identified aspects of the operational design domains (ODD) such as speed, weather, road types, etc.). Conceivably, some terms could be graduated, i.e., restrictions could be progressively relaxed after a period of demonstrated safe driving performance. Further, as with data-sharing, it may be necessary to specify that these terms would apply to the exempted vehicles beyond the two-year exemption period.

NHTSA notes that its regulations at 49 CFR Part 555, “Temporary exemption from motor vehicle safety and bumper standards,” provides that the agency can revoke an exemption if a manufacturer fails to satisfy the terms of the exemption. NHTSA could also seek injunctive relief.

VI. Request for Comments and Information

NHTSA has set forth below a list of questions to elicit public feedback to aid the agency in determining how to address and resolve the variety of novel and important issues presented in the petition and how to promote, through the setting of terms, the safe operation of such vehicles if the agency ultimately decides to grant an exemption. Please note that answers supported by data and analysis will be given greater weight.

Nuro is also encouraged to submit any supplemental information to the agency that the petitioner may deem persuasive. Commenters are requested to provide specific references to all sources for all studies, data, assumptions, scientific reasoning, and methodology they cite or submit.

Statutory Basis for Exemption

The choice of the basis for an exemption petition can significantly affect the scope and depth of the safety analysis and finding that NHTSA must make in order to grant an exemption.

In view of this, the agency asks the following questions:

1. To what extent and in what ways does the choice of the basis affect the scope, depth and appropriateness of the safety analysis and finding?
2. Is the basis for exemption (field evaluation of a low-emission vehicle (30113(b)(3)(B)(iii)) chosen by Nuro in its petition appropriate for the agency to use in determining whether to grant or deny an exemption for Nuro's vehicle? If not, what basis would be appropriate, and why?
3. In lieu of the low-emission basis, would it be more appropriate to consider Nuro's petition under 49 U.S.C. 30113(b)(3)(B)(ii) (field evaluation of a new motor vehicle safety feature) or 30113(b)(3)(B)(iv) (authority to grant exemptions from FMVSS for vehicles with an overall safety level at least equal to the overall safety level of nonexempt vehicles)? If so, why?
4. Independent of the agency's disposition of this petition, NHTSA seeks comment on whether, and if so how, the agency should also consider creating a new vehicle classification category for light and/or low-speed passengerless ADS vehicles like the R2X to which a subset of FMVSS requirements would apply.

The Development of a Low-Emission Vehicle

5. Nuro contends that an exemption is necessary facilitate the development of and LEV because it has "exhausted the safety gains that can accrue" from its current testing. Does the petition provide sufficient information to enable the agency to determine whether exempting the vehicle would make the development or field evaluation of a

low-emission motor vehicle easier? If not, what additional information should the agency seek prior to rendering its final determination and why?

6. Does Nuro ADS's reliance on "advanced machine learning" to improve driving performance justify public on-road testing to obtain additional ADS safety gains? Are there diminishing returns to continued testing with passenger cars retrofitted with ADS functionality? If AI machine learning is being used to continuously change its ADS software, how should the safety of the ADS be monitored and evaluated?

Safety – General Questions

7. In determining whether to grant the petition, how should NHTSA consider whether an exemption would "unreasonably lower the safety level"? Should this consideration be solely limited to safety level provided by the exempted standards or the safety of the vehicle more generally?
8. Is it appropriate for the agency to give any consideration to the quality of the performance of Nuro's ADS as part of its assessment whether granting Nuro's petition is in the public interest and consistent with the Safety Act?
9. How should safety considerations, including the performance of the ADS, be included in the "terms" of a granted exemption?
10. 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?

Safety – Exempted Standards

11. Is Nuro correct in its conclusion that the safety purposes of the three requirements from which it is requesting an exemption are not relevant to the R2X because it would not have any occupants? Do these requirements serve any safety purposes beyond those discussed in the petition?
12. Regarding the rear visibility requirement, how would the agency assess whether the R2X actually would meet the “field of view” and “image size” requirements?

Safety – Performance of the ADS

13. To what degree could the R2X’s capabilities or ODD be changed through post-deployment software updates over the lifetime of the R2Xs for which Nuro is seeking an exemption? While Nuro states that it does not intend to “upgrade” the R2X’s ADS to L5, are there ODD or other changes Nuro should be able to make to the R2X over the lifetime of the vehicles? How should NHTSA address the possibility of such changes in conducting its safety analysis?
14. Did Nuro provide sufficient information about how the R2X would interact with human-controlled vehicles on the road? Should the agency be concerned about the front-end stiffness of the R2X and its impact on collision partners?
15. Did Nuro provide enough information about its design features to enable the ADS to operate reliably and to minimize safety risks that may occur if the ADS malfunctions or otherwise encounters a driving situation it cannot handle? If not, what should the agency ask to see?
16. Did Nuro provide enough information on development and testing to support the safety performance of the vehicle? Should more specificity on the types of sensors and their limitations be provided?

17. Did Nuro provide enough information about pedestrian detection and mitigation strategies? Would the R2X be able to sense and respond appropriately around school buses, emergency vehicles, neighborhood construction, etc.? Would the R2X be able to understand traffic laws?
18. What communication protocols should the R2X follow when faced with unexpected human interactions, such as being pulled over by a police officer or being directed through a construction zone by a road worker?
19. How should the R2X's ADS "prioritize" the safety of other road users?
20. What importance should NHTSA place on Nuro's statement that some safety-critical components in the R2X perform at the levels required under the FMVSS, even though those requirements are not applicable to LSVs?
21. Would the pedestrian safety features described in the petition (rounded edges, pedestrian "crumple zones") be effective in the environment in which the R2X would be used? Can the effectiveness of these measures be validated? If so, should NHTSA require Nuro to provide testing data to demonstrate the effectiveness of these measures?
22. Did Nuro's petition provide enough information regarding what types of "trigger" events would require the remote operator to take over? What sorts of events should "trigger" the remote operator to take over? Should these be specifically articulated as a term if the petition is granted? If so, did the petition provide sufficient information for the agency to establish such terms?
23. What additional situations and risk events (e.g., weather) should NHTSA consider when assessing the safe operation of the vehicle?

24. Would the various fail-safe protocols described in the petition provide a sufficient level of safety? What criteria/methodology should be used to assess their sufficiency? If the protocols are believed to be sufficient, explain why. If the protocols are not believed to be sufficient, explain why and discuss how the fail-safe protocols could be improved to deal with both expected and unexpected situations and events, so that they would provide a sufficient level of safety?
25. Did Nuro provide sufficient information concerning the training of the remote operators? What should be the level of training of remote operators? How should they be trained? How should be they evaluated?
26. How should remote operators “monitor” the R2X’s operation to detect reductions in or complete losses of its ADS’ functionality (i.e., could they observe the R2X’s sensor readings in real time, or would they simply wait for the ADS to send an alert)? How much discretion should the remote operator have in deciding whether to take control or decommission the vehicle? For the range of circumstances in which the remote operator is free to exercise discretion, what guidance should Nuro provide regarding whether it would be appropriate to take control?
27. Nuro states, if it receives the exemptions, it “would take a highly incremental and controlled approach to deployment” which would include extensive evaluation and mapping of any area where the vehicles would be deployed, and that “any early on-road tests would occur with human-manned professional safety drivers with override abilities supervising the vehicle for any anomalies in behavior.”³² Over what portion of the R2X’s life would this level of supervision be provided? What would be the circumstances under which Nuro would reduce or eliminate its supervision? Once

³² Nuro petition, at 19.

- this initial testing period is over, what is the expected ratio of remote operators to R2Xs, and would this ratio change over time? What would be the human oversight protocol for the R2X once it is past the initial testing stage?
28. How frequently should Nuro update its maps for accuracy, especially with regard to the reliability of cellular data? What other information is mapped?
29. How should Nuro address the issue of the potential effects of cyber threats on safety? In particular, is Nuro's assurance of "end-to-end encryption" sufficient for the agency to grant an exemption? If not, what additional assurances should Nuro provide?
30. Are there any additional safety considerations that the agency should analyze in deciding whether to grant Nuro's petition?

Other Public Interest Considerations

31. We seek comment on whether the potential environmental and economic benefits described by Nuro in its petition are sufficient (or sufficiently likely to occur) to enable NHTSA to make a finding that an exemption is in the public interest and is consistent with the Safety Act, per 49 U.S.C. 30113(b)(3)(A).
32. In particular, we seek comment on whether a petitioner under the low-emission vehicle exemption basis must cite benefits that are directly related to the original purpose of 30113(b)(3)(B)(iii), which was to encourage the development of vehicles with low-emission propulsion technologies.³³

Terms

33. If NHTSA were to grant Nuro's petition, what would be the potential utility of NHTSA's placing terms requiring the submission of the following categories of data?

³³ See footnote 21.

- a. Statistics on use (e.g., for each functional class of roads, provide the number of miles, speed and hours of operation, climate/weather and related road surface conditions).
- b. Statistics and other information on performance (e.g., type, number, and causes, and results of collisions or near misses, disengagements, and transitions to fallback mechanisms, if appropriate). How can the term “near miss” best be defined so that there is uniform understanding of the term and consistent practices across manufacturers in the identifying and reporting of “near misses”?
- c. Metrics that the manufacturer is tracking to identify and respond to progress toward higher levels of safety (e.g., miles without a crash and software updates that increase the ODD).
- d. Information related to measures to be taken by Nuro to address community, driver and pedestrian awareness, behavior, concerns, and acceptance related to vehicles with an ADS.
- e. Metrics or information concerning the durability of the ADS equipment and calibration, and need for maintenance of the ADS. For example, does the ADS work in all identified operating conditions or are there additional limitations? How are any limitations addressed and managed?
- f. Data on the initial and subsequent ODDs and software updates.
- g. For all categories of information, how should any concerns about confidential business information and privacy be addressed?

34. If there are 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.
35. If the agency were to require the reporting of data, for what period should the agency require it to be reported--the two-year exemption period, the R2X's entire normal service life, or a time period in between?
36. Given estimates that vehicles with high and full driving automation would generate terabytes of data per vehicle per day, how should the need for data be appropriately balanced with the burden on manufacturers of providing and maintaining it and the ability of the agency to absorb and use it effectively?
37. If supporting information (including analysis, methodology, data, and computer simulation results involving proprietary systems or specialized computer programs) were submitted by Nuro under a request for confidential treatment and relied upon by the agency in its determination whether to grant or deny a petition, how can the public be provided with an evaluation and a justification for the determination that are transparent, readily understandable and persuasive?
38. Are there any mechanisms that may help further mitigate the underlying safety risks, if any, that might result from granting this petition? For example, what additional safety redundancies, if any, should NHTSA consider requiring as a condition to granting the exemption?
39. In the absence of information demonstrating the safe real-world operation of the Nuro vehicle, would it be prudent for NHTSA to place terms on the exemption to protect public safety? If so, what terms would be appropriate? In addition, what terms, if

any, should the agency consider placing on an exemption to 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?

VII. Comment Period

The agency seeks comment from the public on the merits of Nuro's petition for a temporary exemption from three requirements in FMVSS No. 500, "Low-speed vehicles." We are providing a 60-day comment period. After considering public comments and other available information, we will publish a notice of final action on the petition in the **Federal Register**.

Please note that even after the comment closing date, we will continue to file relevant information in the docket as it becomes available. Further, some people may submit late comments. Accordingly, we recommend that you periodically check the Docket for new material. You can arrange with the docket to be notified when others file comments in the docket. See www.regulations.gov for more information. We will reopen or extend the comment period for this petition, as needed.

Authority: 49 U.S.C. 30113 and 49 U.S.C. 30166; delegations of authority at 49 C.F.R. 1.95 and 49 C.F.R. 501.8.

Issued in Washington, D.C., under authority delegated in 49 CFR 1.95 and 501.8.

Heidi Renate King,
Deputy Administrator.

Billing Code: 4910-59-P

[Signature Page for Receipt of Petition for Temporary Exemption for an Electric Vehicle with an Automated Driving System]

[FR Doc. 2019-05121 Filed: 3/18/2019 8:45 am; Publication Date: 3/19/2019]