Non-Conventional Vehicles Study

2014 Report

Virginia Department of Motor Vehicles
November 2014

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Executive Summary

In September 2011, Delegate Joe May, former chairman of the House Transportation Committee, and then Chairwoman Senator Yvonne Miller, Senate Transportation Committee, called upon the Department of Motor Vehicles (DMV) to establish an ongoing work group to address the increasing consumer demand for vehicles that do not fit into the current motor vehicle definitions provided in the *Code of Virginia*.[1] During 2012, the first year of the Non-Conventional Vehicles Study, the work group focused on low-speed vehicles, motorcycle classifications, mopeds, and all-terrain vehicles. Those proposed recommendations passed the General Assembly during the 2013 session (see Chapter 783 of the Virginia Acts of Assembly of 2013).

During 2013, the second year of the Non-Conventional Vehicles Study, in addition to the issues carried over from the first year of the study, the current chair of Senate Transportation, Chairman Steve Newman, referred several issues to the group for further review. The group was divided into six separate committees, each with its own charge. After meetings and discussions the work group elected not to propose additional changes in the areas of: definitions for all-terrain vehicles and recreational off-highway vehicles; moped passenger restrictions, penalties, or road restrictions; moped dealer licensing requirements; or the taxation structure of all-terrain vehicles, off-road motorcycles, and mopeds.

The 2013 work group did make recommendations for legislation proposing creation of a separate definition ("autocycle") and requirements for those three-wheel vehicles that operate and handle more as automobiles than motorcycles. This recommendation was in line with the American Association of Motor Vehicle Administrators (AAMVA) best practices for regulating operation and registration of three-wheel vehicles. Those proposed recommendations passed the General Assembly during the 2014 session (see Chapters 53 and 256 Virginia Acts of Assembly 2014).

In addition to the above, during the 2013 study a Specially Constructed Vehicle Committee was formed and a procedure was developed for reviewing specially constructed vehicles presented to DMV for registration. With this process, if a specially constructed vehicle is denied registration by the DMV Office of Vehicle Services and the customer wishes to appeal the decision, or if the Vehicle Services office cannot upon initial review determine whether the vehicle is roadworthy and should be registered, that vehicle can be submitted to the Specially Constructed Vehicles Committee for further review. The Specially Constructed Vehicles Committee will review the registration request and may affirm the Office of Vehicle Services denial of registration or determine that registration should be granted. This committee and process were established during the 2013 study; however, no vehicles were presented to this committee during this timeframe.

It was also the consensus of the 2013 work group that another stakeholder group, to include those familiar with the mechanics of these types of vehicles (such as representatives from body shops), should be formed to develop an enhanced inspection program for these specially

[1] Appendix A: Charge letters from Delegate May and Senator Miller

constructed vehicles to determine roadworthiness. The work group felt that this enhanced inspection program may also include reconstructed, rebuilt, replica, and salvaged vehicles and should include guidelines to inspect for roadworthiness. This was an area to be studied in 2014. The group recommended that meanwhile DMV Vehicle Services should continue to review specially constructed vehicle requests for registration and refer those requests that were denied and appealed or that they could not act upon to the Specially Constructed Vehicles Committee.

During the 2014 Non-Conventional Vehicles Study a new vehicle type was presented to the Specially Constructed Vehicle Committee for review. This new vehicle type involved the conversion of off-road motorcycles to on-road use. DMV's Vehicle Services often receives requests from customers to register off-road motorcycles that owners or dealers have added equipment to in order to convert the motorcycle for on-road use. However, there is no statutory authority that permits DMV to register an off-road motorcycle that has been converted for on-road use. DMV met with stakeholders from the Motorcycle Dealers Association and motorcycle dealerships to discuss creating statutory authority to allow dealers or individuals who purchase off-road vehicles to convert them to on-road use and register them with DMV. Based on discussions with the Motorcycle Dealers Association and individual dealers, DMV agreed to develop legislation, which is included at Appendix B.

Based on the 2013 work group's recommendation, the 2014 study looked at the development of an enhanced inspection program for specially constructed vehicles to determine roadworthiness. Currently, the DMV examines specially constructed vehicles for documentation of its parts to prevent use of stolen parts and they also undergo a Virginia safety inspection. An enhanced inspection program would examine the structural integrity, mechanical safety and roadworthiness of specially constructed vehicles. DMV convened another stakeholder group consisting of members from law enforcement, the insurance industry, and automobile rebuilders to discuss an enhanced inspection program for specially constructed, reconstructed, replica, rebuilt, and salvaged vehicles. After much discussion with the rebuilders and the salvage industry, the group decided not to require an enhanced inspection for rebuilt and salvaged vehicles.

With the idea of an enhanced inspection program remaining for specially constructed, reconstructed, and replica vehicles, DMV determined that annually there are only about 1,000 or less specially constructed, reconstructed, and replica vehicles whose owners apply for registration. This determination was based on data from 2011-2013. DMV staff then met with staff from the Virginia State Police (VSP) to determine whether an enhanced inspection program for specially constructed, reconstructed, and replica vehicles was feasible or necessary. After discussion with VSP staff it was determined that an enhanced inspection program for specially constructed, reconstructed, and replica vehicles is not feasible or necessary at this time. DMV surveyed other states and did not find any states with a program that addressed the agency's needs for development of a program in the Commonwealth. In addition, DMV has no specific data to illustrate a need for an enhanced inspection program. Further, DMV and VSP were unable to determine an appropriate mechanism for conducting enhanced inspections, what heightened standards for structural integrity, mechanical safety and roadworthiness should be applied, or how to go about developing such standards. Without specific data to support the need for an enhanced safety inspection DMV and VSP also determined that identifying and obtaining

resources and staff to create and maintain an enhanced inspection program could not be justified. Therefore, no further recommendations are made regarding an enhanced inspection program; however, DMV will continue to monitor the number of specially constructed, reconstructed, and replica vehicles registered each year to determine if there is such a growth in the numbers to warrant revisiting an enhanced inspection program in later years.

Lastly, at the final stakeholder meeting of the 2013 Non-Conventional Vehicles Study, the Commissioner of DMV identified the need for the work group to examine the testing and operation of autonomous, or automated, vehicles on Virginia's public highways. Autonomous and automated vehicles have been tested at the Smart Road operated by the Virginia Tech Transportation Institute, and the Commonwealth is interested in ensuring that there are no statutory or regulatory barriers to the members of the automotive industry that may desire to test automated and autonomous vehicles in the Commonwealth.

In October of 2013, DMV met with other state agencies including VSP and VDOT, the Virginia Tech Transportation Institute Center for Automated Vehicle Systems, and the Virginia Center for Transportation Innovation and Research. The role of this group was to consider formulating proposals that would support the testing of autonomous vehicles on the public roads in Virginia and consider draft legislation. The consensus of the group was that Virginia should be in a posture to support autonomous vehicle testing without being too restrictive, which may push manufacturers to other states. The group considered whether some type of permitting process should be implemented to review and approve autonomous vehicles to be tested on the open roads. This would include travel routes and conditions. It was the consensus of the group that VDOT, VSP and DMV would need to work together on this process and contact other states for more information. The group determined that it was not in a position to submit legislation for 2014 as there was still work to be done. The group decided to examine what other states were doing in the area of testing and reconvene after the legislative session in 2014.

In August of 2014, DMV again met with the other state agencies including VSP and the Virginia Department of Transportation (VDOT), the Virginia Tech Transportation Institute Center for Automated Vehicle Systems, the Virginia Center for Transportation Innovation and Research, and the Center for Transportation Studies at the University of Virginia. Jay Swanson, Deputy Policy Director for Governor Terrance R. McAuliffe also attended the meeting. The purpose of the meeting was to discuss the status of current autonomous and automated vehicle research in the Commonwealth, the pace of technology changes in the automotive industry, and the best ways to attract the automated technology industry, automobile manufacturers, and automotive industry suppliers to the Commonwealth to position Virginia to be at the forefront of the development, testing, and deployment of safe, reliable, autonomous vehicles. This work group decided that it needed to hear from the industry members to determine whether the agencies should propose legislation like other states have done to bring testing of autonomous and automated vehicles to Virginia.

In October of 2014, the work group described above met with stakeholders from the automotive industry, Governor's policy office and the Office of the Attorney General. Stakeholders from the automotive industry included Continental, Volkswagen Group of America, Daimler, General Motors, Nissan, Toyota, Honda, Delphi, the Alliance of Automobile

Manufacturers, ITS America, Kemper Consulting, SAE International, and the Association of Global Automakers. The work group asked for the industry members to identify and discuss any statutory or regulatory barriers that they perceived would prevent them from testing autonomous or automated vehicles in the Commonwealth. Stakeholders provided insightful information and recommendations regarding the infrastructure and support needed from the Commonwealth to prevent barriers to the automotive industry coming to the Commonwealth to test automated and autonomous vehicles. The industry members were adamant that legislation at this time would be more of a hindrance than a help in bringing testing to Virginia.

Based on the information provided, the work group decided not to recommend pursuing legislation regarding automated and autonomous vehicles during the 2015 General Assembly session. However, the work group will continue to meet with automotive industry stakeholders to monitor developments in the technology and testing of automated and autonomous vehicles. In addition, the work group asked that members of the automotive industry continue to submit their written comments on any statutory or regulatory barriers they may identify and any reasonable infrastructure needs they may have for testing of autonomous or automated vehicles in the Commonwealth.

DMV is pleased to report to the transportation committees of the General Assembly that DMV and the Non-Conventional work group have examined all issues originally referred to the working group by former Delegate May and the late Senator Miller. In addition, over the past three years the work group has also addressed other issues raised by the work group. While this report is the third and final installment for the Non-Conventional study, DMV has developed a process for ongoing stakeholder input on non-conventional vehicles and will continue to refer vehicles to the Specially Constructed Vehicles Committee as the need arises.

Introduction

Seeing an increase in consumer demand for vehicles that do not fit into the current motor vehicle definitions provided in the *Code of Virginia*, in September 2011, former Chairman Joe May, House Transportation Committee, and then-Chairwoman Yvonne Miller, Senate Transportation Committee, called upon the Department of Motor Vehicles (DMV) to establish an ongoing work group to address these non-conventional vehicles. The charge was to meet no fewer than two times a year and to propose legislation as needed regarding the definition, titling, registration, and licensing of drivers of these vehicles.[2]

The work group was led by DMV staff and includes, among others, representatives from the Virginia Automobile Dealers Association, Virginia Motorcycle Dealers Association, Virginia Coalition of Motorcyclists, the insurance industry, Virginia State Police (VSP), Virginia Department of Environmental Quality, Virginia Department of Transportation (VDOT), Virginia Department of Aviation, Virginia Department of Game and Inland Fisheries, Virginia Sheriff's Association, Virginia Association of Chiefs of Police, Motor Vehicle Dealer Board, American Automobile Association, Motorcycle Safety League of Virginia, Farm Bureau, the Virginia Municipal League, and the Virginia Agribusiness Council. Specific work group members are included on an as needed basis depending on the issues under discussion.

In 2012, the first year of the study, the group made recommendations relating to motorcycle operator classifications, mopeds, all-terrain vehicles, and low-speed vehicles.[3] Those proposed recommendations passed the General Assembly during the 2013 session (see Chapter 783 of the Virginia Acts of Assembly of 2013). During 2013, the second year of the Non-Conventional Vehicles Study, in addition to the issues carried over from the first year, the chair of Senate Transportation, Chairman Steve Newman, referred several issues to the work group for further review. The group was divided into six separate committees, each with its own charge. After meetings and discussions the work group elected not to propose additional legislative changes in the areas of: definitions for all-terrain vehicles and recreational off-highway vehicles; moped passenger restrictions, penalties, or road restrictions; moped dealer licensing requirements; or the taxation structure of all-terrain vehicles, off-road motorcycles, and mopeds.[4]

The 2013 work group did make recommendations for legislation proposing creation of a separate definition ("autocycle") and requirements for those three-wheel vehicles that operate and handle more as automobiles than motorcycles. This recommendation was in line with the American Association of Motor Vehicle Administrators (AAMVA) best practices for regulating operation and registration of three-wheel vehicles. Those proposed recommendations passed the General Assembly during the 2014 session (see Chapters 53 and 256 Virginia Acts of Assembly 2014).

[2] Appendix A: Charge letters from Delegate May and Senator Miller
[3] A copy of the 2012 Non-Conventional Vehicles Report may be found at the following link: http://leg2.state.va.us/dls/h&sdocs.nsf/By+Year/RD3802012/$file/RD380.pdf
[4] A copy of the 2013 Non-Conventional Vehicles Report may be found at the following link: http://leg2.state.va.us/dls/h&sdocs.nsf/By+Year/RD3862013/$file/RD386.pdf

In addition to the above, during the 2013 study a Specially Constructed Vehicle Committee was formed and procedure was developed for reviewing specially constructed vehicles presented to DMV for registration. With this process, if a specially constructed vehicle is denied registration by the DMV Vehicle Services and the customer wishes to appeal the decision, or if the Vehicle Services office cannot upon initial review determine whether the vehicle is roadworthy and should be registered, that vehicle can be submitted to the Specially Constructed Vehicle Committee for further review. The Specially Constructed Vehicle Committee will review the registration request and may affirm the Vehicle Services denial of registration or determine that registration should be granted. This committee and process were established during the 2013 study; however, no vehicles were presented to this committee during this timeframe. In 2014 a new vehicle type was presented to the Specially Constructed Vehicle Committee for review. This new vehicle type involved the conversion of off-road motorcycles to on road use.

The 2013 work group also recommended that DMV convene another stakeholder group involving those familiar with the mechanics of specially constructed vehicles (such as representatives from body shops) to develop an enhanced inspection program for specially constructed vehicles to determine roadworthiness. Lastly, at the final stakeholder meeting of the 2013 study, the Commissioner of DMV identified the need for the work group to examine the testing and operation of autonomous, or automated, vehicles on Virginia's public highways.

This report summarizes the recommendations and actions on the issues of the conversion of off-road motorcycles to on-road use, enhanced inspections for specially constructed, reconstructed and replica vehicles, and the testing and operation of autonomous and automated vehicles.

Off-Road Motorcycles Converted to On-Road Use

During the 2014 Non-Conventional Vehicles study, the Specially Constructed Vehicle Committee was presented with a new vehicle type for review. This new vehicle type involved the conversion of off-road motorcycles to on-road use. *Virginia Code* § 46.2-100 defines an off-road motorcycle as "every motorcycle designed exclusively for off-road use by an individual rider with not more than two wheels in contact with the ground. Except as otherwise provided in this chapter, for the purposes of this chapter off-road motorcycles shall be deemed to be 'motorcycles'."

DMV's Vehicle Services often receives requests from customers to register off-road motorcycles that owners or dealers have added equipment to in order to convert the motorcycle for on-road use. However, there is no statutory authority that permits DMV to register an off-road motorcycle that has been converted for on-road use. DMV met with stakeholders from the Motorcycle Dealers Association and motorcycle dealerships to discuss creating statutory authority to allow dealers or individuals who purchase off-road vehicles to convert them to on-road use and register them with DMV. If statutory authority is created DMV's Vehicle Services would review the registration request. If registration is denied the customer could then request that the Specially Constructed Vehicles Committee review the request. Based on discussions

with the Motorcycle Dealers Association and individual dealers, DMV agreed to develop legislation to provide the necessary statutory authority to permit off-road motorcycles to be converted for on-road use and for DMV to issue the necessary vehicle registration for operation on the highways.

The legislation proposes to create a new code section numbered § 46.2-602.4 to define "off-road motorcycle converted to on-road use," and to address the titling and registration requirements for such a motor vehicle. The proposal sets forth the requirement that equipment modifications to the off-road motorcycle must meet Federal Motor Vehicle Safety Standards (FMVSS) for motor vehicles for the year in which the off-road motorcycle is converted for on-road use. The legislation also sets forth labeling and certification requirements in order to comply with FMVSS as well as liability and branding requirements. The draft legislation is included at Appendix B.

Enhanced Inspection Program

Pursuant to § 46.2-100 of the *Code of Virginia*, a specially constructed vehicle "means any vehicle that was not originally constructed under a distinctive name, make, model, or type by a generally recognized manufacturer of vehicles and not a reconstructed vehicle as herein defined."[5] Specially constructed vehicles do not resemble a specific manufacturer make or model, past or present. They may include so-called "kit cars."

In order to register a specially constructed vehicle, the owner must submit documentation to DMV's Vehicle Branding Work Center. This documentation includes a title, manufacturer's certificate of origin, or an affidavit in lieu of title, an application for an assigned vehicle number, the bill of sale for the frame body and transmission, and a notarized statement as to how the vehicle was constructed (including pictures). The owner also submits an Application for Certificate of Title and Registration (Form VSA-17A). Titles are issued to show ownership of the vehicle, but registration may or may not be approved for these vehicles. Once the paperwork is processed, the vehicle documentation is then sent to DMV's Law Enforcement Services for inspection of that vehicle. However, this inspection focuses on ensuring that no stolen parts have been used in that specially constructed vehicle – it does not determine the roadworthiness of the vehicle.

DMV will not register a vehicle if it does not meet federal safety standards. However, the owners of these specially constructed vehicles can self-certify that the vehicle does meet those standards. DMV has no mechanism for challenging that self-certification. Virginia State Police indicated they inspect "the items that are there" and that their stations do not have the expertise to inspect these vehicles for roadworthiness. It would require someone with extensive experience

[5] A reconstructed vehicle "means every vehicle of a type required to be registered under this title materially altered from its original construction by the removal, addition, or substitution of new or used essential parts. Such vehicles, at the discretion of the Department, shall retain their original vehicle identification number, line-make, and model year. Except as otherwise provided in this title, this definition shall not include a 'converted electric vehicle' as defined in this section." *See* Va. Code § 46.2-100.

to take the time to inspect these vehicles and know what to look for to establish the structural integrity, mechanical safety, and roadworthiness.

In November 2012, the American Association of Motor Vehicles Administrators (AAMVA) published its "Best Practices for Title and Registration of Rebuilt and Specially Constructed Vehicles" guide. AAMVA surveyed states and found that there is no uniform method of registering and titling these types of vehicles and that there is no clear way for one state to identify a specially constructed vehicle when it is transferred to another jurisdiction or to identify what inspections the vehicle has passed. Among the best practices, AAMVA recommends requiring a structural integrity inspection and mechanical safety inspection prior to titling or registration of specially constructed vehicles.

During the 2013 Non-Conventional Vehicles Study it was the consensus of the work group that another stakeholder group, to include those familiar with the mechanics of these types of vehicles (such as representatives from body shops), be formed to develop an enhanced inspection program for specially constructed vehicles. The work group felt that this enhanced inspection program may also include reconstructed, rebuilt, replica, and salvaged vehicles and should include guidelines to inspect for roadworthiness. It would be similar to the procedure used to develop inspection guidelines for converted electric vehicles and would be in line with AAMVA's best practices guidance.

As mentioned above, currently, the Department examines specially constructed vehicles to prevent use of stolen parts and the vehicle must also undergo a Virginia safety inspection. An enhanced inspection program would examine the structural integrity, mechanical safety and roadworthiness of specially constructed vehicles. Based on the 2013 work group's recommendation, DMV convened another stakeholder group consisting of members from law enforcement, the insurance industry, and automobile rebuilders to discuss an enhanced inspection program for specially constructed, reconstructed, rebuilt, replica, and salvaged vehicles. After much discussion with the rebuilders and the salvage industry, the group decided not to require an enhanced inspection for rebuilt and salvaged vehicles.

With the idea of an enhanced inspection program remaining for specially constructed, reconstructed, and replica vehicles DMV determined that annually there are only about 1,000 or less specially constructed, reconstructed, and replica vehicles whose owners apply for registration. This determination was based on data from 2011-2013. DMV staff then met with staff from the Virginia State Police to determine whether an enhanced inspection program for specially constructed, reconstructed, and replica vehicles was feasible or necessary.

After discussion with VSP staff it was determined that an enhanced inspection program for specially constructed, reconstructed, and replica vehicles is not feasible or necessary at this time. DMV surveyed other states and did not find any states with a program that addressed the agency's needs for development of a program in the Commonwealth. In addition, DMV has no specific data to illustrate a need for an enhanced inspection program. Further, DMV and VSP were unable to determine an appropriate mechanism for conducting enhanced inspections, what heightened standards for structural integrity, mechanical safety and roadworthiness should be applied, or how to go about developing such standards. Without specific data to support the need

for an enhanced safety inspection program DMV and VSP also determined that identifying and obtaining resources and staff to create and maintain an enhanced inspection program could not be justified. Therefore, no further recommendations are made regarding an enhanced inspection program; however, DMV will continue to monitor the number of specially constructed, reconstructed, and replica vehicles registered each year to determine if there is such a growth in the numbers to warrant revisiting an enhanced inspection program in later years. In addition, DMV will continue to gather stakeholder input on non-conventional vehicles and will continue to refer vehicles to the Specially Constructed Vehicles Committee as the need arises.

Autonomous and Automated Vehicles

The National Highway Traffic Safety Administration (NHTSA) has stated that "[a]utomated vehicles are those in which at least some aspects of a safety-critical control function (e.g., steering, throttle, or braking) occur without direct driver input." Autonomous or automated vehicles, which are often referenced as self-driving cars, are the next revolution in the automobile industry.[6] Because several states have enacted legislation and others are planning to do so to encourage the development, testing, and operation of autonomous or automated vehicles in those states, NHTSA released a policy statement in May 2013 to address this new vehicle technology. NHTSA's policy statement established an official classification system for autonomous or automated vehicles as follows:[7]

> NHTSA defines vehicle automation as having five levels:
>
> **No-Automation (Level 0):** The driver is in complete and sole control of the primary vehicle controls – brake, steering, throttle, and motive power – at all times.
>
> **Function-specific Automation (Level 1):** Automation at this level involves one or more specific control functions. Examples include electronic stability control or pre-charged brakes, where the vehicle automatically assists with braking to enable the driver to regain control of the vehicle or stop faster than possible by acting alone.
>
> **Combined Function Automation (Level 2):** This level involves automation of at least two primary control functions designed to work in unison to relieve the driver of control of those functions. An example of combined functions enabling a Level 2 system is adaptive cruise control in combination with lane centering.

[6] In reference to the use of the terms autonomous vs. automated. The term "autonomous" is the term that is currently in more widespread use and one that the general public is likely to be more familiar. The term "automated" is the one used by NHTSA and the automotive industry.

[7] Appendix C: National Highway Traffic Safety Administration Preliminary Statement of Policy Concerning Automated Vehicles, May 2013.

Limited Self-Driving Automation (Level 3): Vehicles at this level of automation enable the driver to cede full control of all safety-critical functions under certain traffic or environmental conditions and in those conditions to rely heavily on the vehicle to monitor for changes in those conditions requiring transition back to driver control. The driver is expected to be available for occasional control, but with sufficiently comfortable transition time. The Google car is an example of limited self-driving automation.

Full Self-Driving Automation (Level 4): The vehicle is designed to perform all safety-critical driving functions and monitor roadway conditions for an entire trip. Such a design anticipates that the driver will provide destination or navigation input, but is not expected to be available for control at any time during the trip. This includes both occupied and unoccupied vehicles.

At the final stakeholder meeting of the 2013 Non-Conventional Vehicles Study, the Commissioner of DMV identified the need for the work group to examine the testing and operation of autonomous, or automated, vehicles on Virginia's public highways. Autonomous and automated vehicles have been tested at the Smart Road operated by the Virginia Tech Transportation Institute, and the Commonwealth is interested in ensuring that there are no statutory or regulatory barriers to the members of automotive industry that may desire to test automated and autonomous vehicles in the Commonwealth.

In October of 2013, DMV met with other state agencies including VSP and VDOT, the Virginia Tech Transportation Institute Center for Automated Vehicle Systems, and the Virginia Center for Transportation Innovation and Research. The role of this group was to consider formulating proposals that would support the testing of autonomous vehicles on the public roads in Virginia and consider draft legislation. The consensus of the group was that Virginia should be in a posture to support autonomous vehicle testing without being too restrictive, which may push manufacturers to other states. The group considered whether some type of permitting process should be implemented to review and approve autonomous vehicles to be tested on the open roads. This would include travel routes and conditions. It was the consensus of the group that VDOT, VSP and DMV would need to work together on this process and contact other states for more information. The group determined that it was not in a position to submit legislation for 2014 as there was still work to be done. The group decided to examine what other states were doing in the area of testing and reconvene after the legislative session in 2014.

In August of 2014, DMV met with again met with the other state agencies including VSP and VDOT, the Virginia Tech Transportation Institute Center for Automated Vehicle Systems, the Virginia Center for Transportation Innovation and Research, and the Center for Transportation Studies at the University of Virginia. Jay Swanson, Deputy Policy Director for Governor Terrance R. McAuliffe also attended the meeting. The purpose of the meeting was to discuss the status of current autonomous and automated vehicle research in the Commonwealth, the pace of technology changes in the automotive industry, and the best ways to attract the automated technology industry, automobile manufacturers, and automotive industry suppliers to the Commonwealth to position Virginia to be at the forefront of the development, testing, and deployment of safe, reliable, autonomous vehicles. This work group decided that it needed to

hear from the industry members to determine whether the agencies should propose legislation like other states have done to bring testing of autonomous and automated vehicles to Virginia.

In October of 2014, the work group met with stakeholders from the automotive industry, Governor's policy office and the Office of the Attorney General. Stakeholders from the automotive industry included Continental, Volkswagen Group of America, Daimler, General Motors, Nissan, Toyota, Honda, Delphi, the Alliance of Automobile Manufacturers, ITS America, Kemper Consulting, SAE International, and the Association of Global Automakers. The work group asked for the industry members to identify and discuss any regulatory or statutory barriers that they perceived would prevent them from testing autonomous or automated vehicles on the public roadways of the Commonwealth. Stakeholders provided insightful information and recommendations regarding the infrastructure and support needed from the Commonwealth to prevent barriers to the automotive industry coming to the Commonwealth to test automated and autonomous vehicles. The industry members were adamant that legislation at this time would be more of a hindrance than a help in bringing testing to Virginia.

Based on the information provided, the work group decided not to recommend pursuing legislation regarding automated and autonomous vehicles during the 2015 General Assembly session. However, the work group will continue to meet with automotive industry stakeholders to monitor developments in the technology and testing of automated and autonomous vehicles. In addition, the work group asked that members of the automotive industry continue to submit their written comments on any statutory or regulatory barriers they may identify and any reasonable infrastructure needs they may have for testing of autonomous or automated vehicles in the Commonwealth.

Conclusion

DMV is pleased to report to the transportation committees of the General Assembly that DMV and the Non-Conventional work group have examined all issues originally referred to the working group by former Delegate Joe May and the late Senator Yvonne Miller. In addition, over the past three years the work group has also addressed other issues raised by the work group. While this report is the third and final installment for the Non-Conventional study, DMV has developed a process for ongoing stakeholder input on non-conventional vehicles and will continue to refer vehicles to the Specially Constructed Vehicle Committee as the need arises.

Appendices

Appendix A

Letters from
Delegate May
And
Senator Miller

COMMONWEALTH OF VIRGINIA
HOUSE OF DELEGATES
RICHMOND

JOE T. MAY
POST OFFICE BOX 2146
LEESBURG, VIRGINIA 20177-7538

THIRTY-THIRD DISTRICT

COMMITTEE ASSIGNMENTS:
TRANSPORTATION (CHAIRMAN)
APPROPRIATIONS
SCIENCE AND TECHNOLOGY

September 6, 2011

Mr. Richard D. Holcomb
Commissioner
Department of Motor Vehicles
2300 West Broad Street
Richmond, Virginia 23220

Dear Commissioner Holcomb:

As you are aware Virginia has begun to see an increase in demand by its citizens for so-called "non-conventional vehicles." These are vehicles which can be operated on the highways of the Commonwealth, yet do not cleanly fit into the current motor vehicle definitions provided by the code, and which require specialized legislation regarding definition, titling and registration, safety, title authority, and licensing of the driver.

Senator Yvonne Miller and I have agreed that in order to accommodate what is certain to be an ever-changing marketplace, we are directing you to establish a work group, to meet no fewer than two times a year, to propose legislation as needed regarding the definition, titling and registration, safety, title authority, and licensing of drivers for any vehicles introduced to the roadways of the Commonwealth which do not fit into current statutes. This would include, but not be limited to, three-wheeled motorcycles, three-wheeled automobiles, mopeds, and ATVs. The work group should be headed by you or your designee, and should include representatives from the Department of Motor Vehicles, the Virginia Department of Transportation, Virginia State Police, local law enforcement, the Virginia Auto Dealers Association, the Virginia Motorcycle Dealers Association, the insurance industry, safety groups, and others, as you may see fit.

In addition to the considerations listed above, the work group should take into account the statutes and regulations governing these

non-conventional vehicles in other states, particularly those that border Virginia, with the goal of promoting cross-border standardization.

The work group should submit a report to the Chairs of the House and Senate Transportation Committees in November of each year in which it details proposed legislation.

I anticipate you will receive a similar charge from Senator Miller in her role as Chair of Senate Transportation.

Sincerely,

Joe T. May

Joe T. May

SENATE OF VIRGINIA

YVONNE B. MILLER
5TH SENATORIAL DISTRICT
PART OF THE CITIES OF CHESAPEAKE, NORFOLK
AND VIRGINIA BEACH
POST OFFICE BOX 452
NORFOLK, VIRGINIA 23501

COMMITTEE ASSIGNMENTS:
TRANSPORTATION, CHAIR
COMMERCE AND LABOR
FINANCE
REHABILITATION AND SOCIAL SERVICES
RULES

September 2, 2011

Mr. Richard D. Holcomb
Commissioner
Department of Motor Vehicles
2300 West Broad Street
Richmond, Virginia 23220

Dear Commissioner Holcomb:

As you are aware Virginia has begun to see an increase in demand by its citizens for so-called "non-conventional vehicles." These are vehicles which can be operated on the highways of the Commonwealth, yet do not cleanly fit into the current motor vehicle definitions provided by the code, and which require specialized legislation regarding definition, titling and registration, safety, title authority, and licensing of the driver.

Delegate May and I have agreed that in order to accommodate what is certain to be an ever-changing marketplace, we are directing you to establish a work group, to meet no fewer than two times a year, to propose legislation as needed regarding the definition, titling and registration, safety, title authority, and licensing of drivers for any vehicles introduced to the roadways of the Commonwealth which do not fit into current statutes. This would include, but not be limited to, three-wheeled motorcycles, three-wheeled automobiles, mopeds, and ATVs. The work group should be headed by you or your designee, and should include representatives from the Department of Motor Vehicles, the Virginia Department of Transportation, Virginia State Police, local law enforcement, the Virginia Auto Dealers Association, the Virginia Motorcycle Dealers Association, the insurance industry, safety groups, and others, as you may see fit.

In addition to the considerations listed above, the work group should take into account the statutes and regulations governing these non-conventional vehicles in other states, particularly those that border Virginia, with the goal of promoting cross-border standardization.

The work group should submit a report to the Chairs of the House and Senate Transportation Committees in November of each year in which it details proposed legislation.

I anticipate you will receive a similar charge from Delegate May in his role as Chair of House Transportation.

Sincerely,

Yvonne B. Miller

Yvonne B. Miller

Appendix B

Draft Legislation
Off-Road Motorcycles
Converted to On-Road Use

Non-Conventional Vehicles
Draft Legislation

BILL NO. _____

A BILL to amend and reenact §46.2-625 of the Code of Virginia and to amend the Code of Virginia by adding a section numbered 46.2-602.4 relating to off-road motorcycles converted to on-road use.

Patron _____

Referred to Committee on _____

Be it enacted by the General Assembly of Virginia:
1. That § 46.2-625 of the Code of Virginia is amended and reenacted and that the Code of Virginia is amended by adding a section numbered 46.2-602.4 as follows:

§ 46.2-602.4. Titling and registration of off road motorcycle converted to on-road use.

A. For the purpose of this section

"Converter" means a person who, through the act of conversion, alters an off-road motorcycle for on-road use on the public highways by the addition, substitution, or removal of motor vehicle equipment creating a motor vehicle to which Federal Motor Vehicle Safety Standards for new motorcycles will become applicable at the time of the conversion. A converter shall be considered a manufacturer and responsible under 49 U.S.C. § 30112 for compliance of the motorcycle with Federal Motor Vehicle Safety Standards and the certification of compliance required by those standards.

"Manufacturer" means a person manufacturing or assembling motor vehicles or motor vehicle equipment.

''Motor vehicle equipment'' means (i) any system, part, or component of a motor vehicle as originally manufactured; or (ii) any similar part or component manufactured or sold for

replacement or improvement of a system, part, or component, or as an accessory or addition to a motor vehicle.

"Off-road motorcycle" shall have the meaning ascribed in § 46.2-100.

"Off-road motorcycle converted to on-road use" means every off-road motorcycle that (i) has been converted for use on the public highways with the addition of such necessary equipment to meet all applicable Federal Motor Vehicle Safety Standards for new motorcycles for the year in which it is converted.

B. Each converter as manufacturer of an off-road motorcycle converted to on-road use shall certify and affirm that the motorcycle meets all applicable Federal Motor Vehicle Safety Standards for new motorcycles for the year in which it is converted. Such Federal Motor Vehicle Safety Standards include but may not be limited to those in 49 C.F.R. §§ 571.105, 571.106, 571.108, 571.111, 571.119, 571.120, 571.122, 571.123, 571.135, 571.205, 571.207, 571.208, 571.209, 571.213, 571.305 and 571.403.

If the converter is unavailable or unknown, the owner shall certify and affirm that the converter is unavailable or unknown and that he assumes legal responsibility for all duties and liabilities for certification under the federal Motor Vehicle Safety Act.

If a converter or owner fails or refuses to provide the required certification the vehicle shall remain an off-road motorcycle.

C. Each converter, as the manufacturer of off-road motorcycles converted to on-road use, shall affix to each vehicle a label, of the type and in the manner described below, containing the

following statements lettered in block capitals and numerals not less than three thirty-seconds of an inch high, in the English language, and in the order shown:

1. Name of manufacturer: the full corporate or individual name of the actual assembler of the vehicle shall be spelled out, except that such abbreviations as ‘‘Co.’’ or ‘‘Inc.’’ and their foreign equivalents, and the first and middle initials of individuals, may be used. The name of the manufacturer shall be preceded by the words ‘‘Manufactured By’’ or ‘‘Mfd By.’’ If a vehicle is assembled by a corporation that is controlled by another corporation that assumes responsibility for conformity with the standards, the name of the controlling corporation may be used.

2. Month and year of manufacture: This shall be the time during which work was completed at the place of main assembly of the vehicle. It may be spelled out, as ‘‘June 2000’’, or expressed in numerals, as ‘‘6/00’’.

3. ‘‘Gross Vehicle Weight Rating’’ or ‘‘GVWR’’ followed by the appropriate value in pounds, which shall not be less than the sum of the unloaded vehicle weight, rated cargo load, and 150 pounds times the number of the vehicle’s designated seating positions.

4 ‘‘Gross Axle Weight Rating’’ or ‘‘GAWR,’’ followed by the appropriate value in pounds, for each axle, identified in order from front to rear (e.g., front, first intermediate, second intermediate rear). The ratings for any consecutive axles having identical gross axle weight ratings when equipped with tires having the same tire size designation may, at the option of the

manufacturer, be stated as a single value, with the label indicating to which axles the ratings apply.

5. This vehicle conforms to all applicable Federal Motor Vehicle Safety Standards in effect on the date of manufacture in subsection B. The expression ‘‘U.S.’’ or ‘‘U.S.A.’’ may be inserted before the word ‘‘Federal’’.

6. Vehicle identification number.

7. The vehicle classification type listed as motorcycle.

The label shall be riveted or permanently affixed in such a manner that it cannot be removed without destroying or defacing it, and does not obscure any previously applied labels. The label for motorcycles shall be affixed to a permanent member of the vehicle as close as is practicable to the intersection of the steering post with the handle bars, in a location such that it is easily readable without moving any part of the vehicle except the steering system. The lettering on the label shall be of a color that contrasts with the background of the label.

If the converter is unavailable or unknown the owner shall affix such label.

D. Upon receipt of an application and such evidence of ownership as required by the Commissioner pursuant to § 46.2-625, the Department shall issue a certificate of title for an off-road motorcycle converted to on-road use. The first certificate of title issued for an off-road motorcycle converted to on-road use shall be an original certificate of title, regardless of the

submission of a Virginia certificate of title issued for the off-road motorcycle prior to conversion.

E. No off-road motorcycle converted to on-road use shall be registered or operated on the highways of the Commonwealth until the owner submits to the Department (i) certification that the motor vehicle has passed a Virginia safety inspection subsequent to the conversion; (ii) certification from the converter or if the converter is unavailable or unknown a certification from the owner that the motor vehicle meets such Federal Motor Vehicle Safety Standards; (iii) certification that the motor vehicle has been labeled in accordance with 49 CFR § 567.4.

F. When necessary and upon application, the Department shall issue temporary trip permits in accordance with § 46.2-651 for the purpose of transporting the off-road motorcycle converted to on-road use to and from an official Virginia safety inspection station.

G. Any certification required by this section found to be knowingly given falsely shall be punishable as a Class 6 felony.

§ 46.2-625. Specially constructed, reconstructed, replica, converted electric, off-road motorcycle converted to on-road use, or foreign vehicles.

If a vehicle for which the registration or a certificate of title is applied is a specially constructed, reconstructed, replica, converted electric, off-road motorcycle converted to on-road use, or foreign vehicle, the fact shall be stated in the application and, in the case of any foreign vehicle registered outside the Commonwealth, the owner shall present to the Department the

certificate of title and registration card or other evidence of registration as he may have. The Commissioner may require such other evidence of ownership as he may deem advisable and promulgate regulations establishing what additional evidence of ownership, if any, shall be required for titling and registration of specially constructed, reconstructed, replica, converted electric, off-road motorcycle converted to on-road use, or foreign vehicles. All titles and registrations for specially constructed, reconstructed, replica, ~~and~~ converted electric vehicles, and off-road motorcycle converted to on-road use, shall be branded with the words "specially constructed," "reconstructed," "replica," ~~or~~ "converted electric," or “off-road motorcycle converted to on-road use,” as appropriate. Titles for vehicles that are both converted electric vehicles and reconstructed vehicles shall be branded with the words "reconstructed" and "converted electric."

Appendix C

National Highway Traffic Safety Administration Preliminary Statement of Policy Concerning Automated Vehicles
May 2013

National Highway Traffic Safety Administration

Preliminary Statement of Policy Concerning Automated Vehicles

America is at a historic turning point for automotive travel. Motor vehicles and drivers' relationships with them are likely to change significantly in the next ten to twenty years, perhaps more than they have changed in the last one hundred years. Recent and continuing advances in automotive technology and current research on and testing of exciting vehicle innovations have created completely new possibilities for improving highway safety, increasing environmental benefits, expanding mobility, and creating new economic opportunities for jobs and investment. The United States is on the threshold of a period of dramatic change in the capabilities of, and expectations for, the vehicles we drive. In fact, many are inspired by the vision that the vehicles will do the driving for us.

Although this Statement focuses on the enormous safety potential of these new technologies, they offer an even wider range of possible benefits. Vehicle control systems that automatically accelerate and brake with the flow of traffic can conserve fuel more efficiently than the average driver. By eliminating a large number of vehicle crashes, highly effective crash avoidance technologies can reduce fuel consumption by also eliminating the traffic congestion that crashes cause every day on our roads. Reductions in fuel consumption, of course, yield corresponding reductions in greenhouse gas emissions. To the extent vehicles can communicate with each other and with the highway infrastructure, the potential for safer and more efficient driving will be increased even more. Drivers—or vehicles themselves—will be able to make more intelligent route selections based on weather and traffic data received by the vehicle in real time. Mobility for those with a range of disabilities will be greatly enhanced if the basic driving functions can be safely performed by the vehicle itself, opening new windows for millions of people.

Preventing significant numbers of crashes will, in addition to relieving the enormous emotional toll on families, also greatly reduce the enormous related societal costs—lives lost, hospital stays, days of work missed, and property damage—that total in the hundreds of billions of dollars each year. Moreover, these dramatic changes will offer significant new opportunities for investments in the underlying technologies and employment in the various industries that develop, manufacture, and maintain them.

To help ensure that these economic, environmental, mobility, and safety benefits are more likely to emerge from the current streams of innovation, all interested parties need to work cooperatively. The National Highway Safety Administration (NHTSA) looks forward to working with other stakeholders to engender that cooperation and chart a steady course forward. This statement, however, focuses on the related safety issues that NHTSA is responsible for addressing.

We are issuing this statement to help states implement this technology safely so that its full benefits can be realized. Articulating our views on these safety issues now is, we believe, a very important element of charting that course, for confusion or disarray on the safety issues would be a significant impediment to the development of these technologies. Moreover, as several states

step forward to become test beds for some of the most innovative automotive technologies, they, as well as companies seeking to develop the technologies, have asked NHTSA to provide recommendations on how to safely conduct such testing on public highways. Accordingly, while the larger dialogue with the many stakeholders progresses and takes further shape, we present here our views on the major safety issues related to the development of vehicle automation.

A. NHTSA's Safety Role and the Purposes of this Statement

NHTSA is responsible for developing, setting, and enforcing Federal motor vehicle safety standards (FMVSSs) and regulations for motor vehicles and motor vehicle equipment. NHTSA also is responsible for issuing and enforcing motor vehicle fuel economy standards and in exercising that authority works closely with the Environmental Protection Agency, which has parallel authority with regard to greenhouse gas emissions from vehicles.

The purpose of the agency's safety programs is to reduce or mitigate motor vehicle crashes and their attendant deaths and injuries. NHTSA is encouraged by the new automated vehicle technologies being developed and implemented by automakers and others. These technologies have the potential to reduce significantly the many thousands of fatalities and injuries that occur each year as a result of motor vehicle crashes. As NHTSA's research and experience develop, NHTSA will determine whether it should encourage and/or require application of the most promising crash avoidance technologies through regulation.

This document:

- Provides a description of developments in automated driving and explains the levels of automation defined by NHTSA.
- Provides an overview of NHTSA's automated research program.
- Provides recommended principles that States may wish to apply as part of their considerations for driverless vehicle operation, especially with respect to testing and licensing.

NHTSA intends to regularly review and update this document as necessary to provide additional clarity, reflect new findings, and outline any regulatory activity that the agency may pursue with respect to automated vehicles. As discussed above, we look forward to working with stakeholders on these issues.

Recently, research activities by several companies to develop "autonomous" (self-driving) vehicles that can perform certain driving functions automatically have captured the nation's attention. Several states have acted to encourage development of self-driving vehicles by enacting legislation that expressly permits their operation under certain conditions and a significant number of additional states are considering similar legislation.

At the same time, vehicle manufacturers have begun to offer or announced plans to offer in the next several model years certain types of automated crash avoidance safety systems as features on new vehicles. NHTSA has been actively involved in researching these advanced

technologies, which rely on in-vehicle sensors and cameras to obtain safety-critical data. For example, NHTSA is engaged in research to evaluate the effectiveness of currently available automated braking systems in avoiding or mitigating crashes. As part of this research, the agency is developing test procedures to evaluate the technologies and methods to assess their safety benefits.

Also, NHTSA and other Department of Transportation agencies, in conjunction with the auto industry, have been conducting in-depth research and demonstration of vehicle-to-vehicle (V2V) communications technology, which offers substantial crash avoidance possibilities, particularly when linked to active in-vehicle crash avoidance systems.

Accordingly, three distinct but related streams of technological change and development are occurring simultaneously: (1) in-vehicle crash avoidance systems that provide warnings and/or limited automated control of safety functions; (2) V2V communications that support various crash avoidance applications; and (3) self-driving vehicles.

Given the confluence of these three streams of innovation, a fair amount of confusion has developed in making distinctions between different concepts and in finding commonly understood descriptions of categories. NHTSA finds that it is helpful to think of these emerging technologies as part of a continuum of vehicle control automation. The continuum, discussed below, runs from vehicles with no active control systems all the way to full automation and self-driving. While the agency is conducting research along the entire automation continuum, our emphasis initially is on determining whether those crash avoidance and mitigation technologies that are currently available (or soon to be available) are not only safe, but effective. However, because these same technologies are the building blocks for what may one day lead to a driverless vehicle, we have also begun research focused on safety principles that may apply to even higher levels of automation, such as driver behavior in the context of highly automated vehicle safety systems. At this point, it is too soon to reach conclusions about the feasibility of producing a vehicle that can safely operate in a fully automated (or "driverless") mode in all driving environments and traffic scenarios. However, by ensuring that our research plan includes the entire automation continuum, the agency strives to remain knowledgeable about the full range of potential benefits and risks of increasing vehicle automation.

B. Automation Overview

Automated vehicles are those in which at least some aspects of a safety-critical control function (e.g., steering, throttle, or braking) occur without direct driver input. Vehicles that provide safety warnings to drivers (forward crash warning, for example) but do not perform a control function are, in this context, not considered automated, even though the technology necessary to provide that warning involves varying degrees of automation (e.g., the necessary data are received and processed, and the warning is given, without driver input). Automated vehicles may use on-board sensors, cameras, GPS, and telecommunications to obtain information in order to make their own judgments regarding safety-critical situations and act appropriately by effectuating control at some level. Accordingly, for purposes of this discussion, vehicles equipped with V2V technology that provide only safety warnings are not automated vehicles, even though such warnings by themselves can have significant safety benefits and can provide very valuable

information to augment active on-board safety control technologies. In fact, the realization of the full potential benefits and broad-scale implementation of the highest level of automation may conceivably rely on V2V technology as an important input to ensure that the vehicle has full awareness of its surroundings.

Definitions – Levels of Vehicle Automation

The definitions below cover the complete range of vehicle automation, ranging from vehicles that do not have any of their control systems automated (level 0) through fully automated vehicles (level 4). The agency has segmented vehicle automation into these five levels to allow for clarity in discussing this topic with other stakeholders and to clarify the level(s) of automation on which the agency is currently focusing its efforts.

- ***Level 0 – No-Automation.*** The driver is in complete and sole control of the primary vehicle controls (brake, steering, throttle, and motive power) at all times, and is solely responsible for monitoring the roadway and for safe operation of all vehicle controls. Vehicles that have certain driver support/convenience systems but do not have control authority over steering, braking, or throttle would still be considered "level 0" vehicles. Examples include systems that provide only warnings (e.g., forward collision warning, lane departure warning, blind spot monitoring) as well as systems providing automated secondary controls such as wipers, headlights, turn signals, hazard lights, etc. Although a vehicle with V2V warning technology alone would be at this level, that technology could significantly augment, and could be necessary to fully implement, many of the technologies described below, and is capable of providing warnings in several scenarios where sensors and cameras cannot (e.g., vehicles approaching each other at intersections).

- ***Level 1 – Function-specific Automation:*** Automation at this level involves one or more specific control functions; if multiple functions are automated, they operate independently from each other. The driver has overall control, and is solely responsible for safe operation, but can choose to cede limited authority over a primary control (as in adaptive cruise control), the vehicle can automatically assume limited authority over a primary control (as in electronic stability control), or the automated system can provide added control to aid the driver in certain normal driving or crash-imminent situations (e.g., dynamic brake support in emergencies). The vehicle may have multiple capabilities combining individual driver support and crash avoidance technologies, but does not replace driver vigilance and does not assume driving responsibility from the driver. The vehicle's automated system may assist or augment the driver in operating one of the primary controls – either steering or braking/throttle controls (but not both). As a result, there is no combination of vehicle control systems working in unison that enables the driver to be disengaged from physically operating the vehicle by having his or her hands off the steering wheel AND feet off the pedals at the same time. Examples of function-specific automation systems include: cruise control, automatic braking, and lane keeping.

- ***Level 2 - Combined Function Automation:*** This level involves automation of at least two primary control functions designed to work in unison to relieve the driver of control of those functions. Vehicles at this level of automation can utilize shared authority when the driver cedes active primary control in certain limited driving situations. The driver is still responsible for monitoring the roadway and safe operation and is expected to be available for control at all times and on short notice. The system can relinquish control with no advance warning and the driver must be ready to control the vehicle safely. An example of combined functions enabling a Level 2 system is adaptive cruise control in combination with lane centering. The major distinction between level 1 and level 2 is that, at level 2 in the specific operating conditions for which the system is designed, an automated operating mode is enabled such that the driver is disengaged from physically operating the vehicle by having his or her hands off the steering wheel AND foot off pedal at the same time.

- ***Level 3 - Limited Self-Driving Automation:*** Vehicles at this level of automation enable the driver to cede full control of all safety-critical functions under certain traffic or environmental conditions and in those conditions to rely heavily on the vehicle to monitor for changes in those conditions requiring transition back to driver control. The driver is expected to be available for occasional control, but with sufficiently comfortable transition time. The vehicle is designed to ensure safe operation during the automated driving mode. An example would be an automated or self-driving car that can determine when the system is no longer able to support automation, such as from an oncoming construction area, and then signals to the driver to reengage in the driving task, providing the driver with an appropriate amount of transition time to safely regain manual control. The major distinction between level 2 and level 3 is that at level 3, the vehicle is designed so that the driver is not expected to constantly monitor the roadway while driving.

- ***Level 4 - Full Self-Driving Automation (Level 4):*** The vehicle is designed to perform all safety-critical driving functions and monitor roadway conditions for an entire trip. Such a design anticipates that the driver[1] will provide destination or navigation input, but is not expected to be available for control at any time during the trip. This includes both occupied and unoccupied vehicles. By design, safe operation rests solely on the automated vehicle system.

C. NHTSA's Research Plan for Automated Vehicles

NHTSA has been conducting research on vehicle automation for many years, and this research has already led to regulatory and other policy developments. Our work on electronic stability control (ESC), for example, led us to develop and issue a standard that made that Level 1 technology mandatory on all new light vehicles since MY 2011. More recently, we issued a proposal that would require ESC on heavy vehicles. We have done significant work on a range of crash avoidance technologies such as lane departure warning and forward collision warning

[1] Several State automated vehicle laws consider the person who activates the automated vehicle system to be the "driver" of the vehicle even if that person is not physically present in the vehicle. NHTSA, however, is not aware of any prototype automated vehicle systems that are capable of operating on public roads without the presence of a driver in the driver's seat who is ready to control the vehicle.

(FCW). Along with ESC, we have included these two technologies as crash avoidance features that are noted on equipped models in our New Car Assessment Program (NCAP) to encourage consumers to consider choosing models with those technologies. We are currently engaged in extensive research on automatic braking technologies (dynamic brake support and crash imminent braking),[2] which can be considered Level 1 technologies. Within the next year, the agency will make a determination on whether either or both of these two automatic braking technologies should be considered for rulemaking or for inclusion within the NCAP program. Our current work involves development of test procedures and assessment of benefits for these Level 1 technologies. Of course, we are also working very hard on V2V communications technology, which may offer significant crash reduction benefits on its own or when coupled with on-board warning and automated control systems.

As we continue our work on Level 1 automation and our efforts to calculate the safety benefits that those single-function systems may offer in the near term, we have begun or are planning research on Levels 2 through 4 automation as well. NHTSA is working cooperatively with other DOT agencies on this research, given its relevance to the intermodal intelligent transportation systems program. Initially, the agency has identified three key areas where it has begun or plans to conduct research for these more advanced automated vehicle systems. These areas are human factors research, development of system performance requirements, and addressing electronic control system safety. NHTSA's research will inform agency policy decisions, assist in developing an overall set of requirements and standards for automated vehicles, identify any additional areas that require examination, and build a comprehensive knowledge base for the agency as automated system technologies progress.

(1) ***Human Factors Research:*** This area of research will focus on human factors with the goal of developing requirements for the driver-vehicle interface (DVI) such that drivers can safely transition between automated and non-automated vehicle operation and that any additional information relevant to the safe operation of the vehicle is effectively communicated to the driver. The research will primarily focus on level 2 and 3 systems. In addition, with new automated driving concepts emerging in which the driver is interacting in potentially much different ways than is typical with current vehicles, driver training needs will be evaluated.

Main topics to be addressed as part of human factors research include:

- Driver/vehicle interaction – Evaluating communication methods between driver and vehicle to ensure safe vehicle operation
- Ensuring proper allocation of vehicle control functions between the driver and the vehicle
    - Division of labor and control authority – assuring that either the driver and/or vehicle are in control all the time
    - Transitions – investigating appropriate means of transferring control from driver to vehicle and vice versa

[2] Further information on the agency's research into automatic braking is available in NHTSA's public docket. *See* Docket No. NHTSA-2012-0057. The public docket can be accessed at http://www.regulations.gov.

    - Override - evaluating override requirements such that the driver can always or when appropriate override the automated system and regain control
- Driver acceptance – Factors leading to driver acceptance (false alarm rates, nuisance warnings, automation system availability and reliability)
- Driver training – Evaluating training requirements that may be needed for level 2 and 3 systems
- Developing human factors research tools – Developing the appropriate test and evaluation tools (e.g. simulators, test vehicles, etc.) to evaluate driver and system performance for various automated vehicle concepts

As a first step toward completing research on these issues, the agency has initiated an evaluation of emerging level 2 and level 3 system concepts to answer fundamental human factors questions. The evaluation will examine how drivers react and perform in these types of automated vehicles. In addition, it will consider DVI concepts that may be needed to ensure that drivers safely transition between automated driving and manual operation of the vehicle. The initial research should address the following human factors questions:

- What is the driver performance profile over time in sustained (longer term) and short-cycle (shorter term) automation?
- What are the risks from interrupting the driver's involvement with secondary tasks when operating a Level 3 type automated vehicle?
- What are the most effective hand-off strategies between the system and the driver including response to faults and failures?
- What are the most effective human-machine interface concepts, guided by human factors best practices, which optimize the safe operation?

One of the main end products of this initial research program would be recommendations for what requirements are needed for the driver-vehicle interface to allow safe operation and transition between automated and non-automated vehicle operation. We plan to complete the first phase of this research in the next two years.

(2) ***Electronic Control Systems Safety:*** A common element in all levels of automation is safety-critical electronic control systems. While NHTSA generally regulates by developing performance standards for specific vehicle systems or sub-systems to address a specific type of safety risk (e.g., frontal collision), the centrality of electronic systems to nearly all vehicle controls may require the agency to develop some type of requirements for electronic control systems more generally to ensure their reliability and security. NHTSA is well aware of relevant voluntary industry standards such as ISO 26262 (which establishes uniform practices for achieving specific levels of safety integrity in complex embedded control systems) and their importance in developing safety-critical systems. Specifically, the agency's work will focus on developing functional safety requirements as well as potential reliability requirements in the areas of diagnostics, prognostics, and failure response (fail safe) mechanisms. In addition, NHTSA has initiated research on vehicle cybersecurity, with the goal of developing an initial baseline set of requirements. The first phase of this work, as funds permit, will take three to four years. At that time,

NHTSA expects to be in a position to determine the need for standards for these safety-critical electronic control systems. This work will complement and support the agency research to develop appropriate safety performance requirements for automated vehicles.

Within the areas of safe reliability and cybersecurity of control systems, the following topics will need to be addressed:

Safe Reliability

- Functional safety - Defining functional safety requirements for electronic control systems
- Failure modes – Evaluating failure modes and associated severities
- Failure probability – Evaluating the likelihood of a failure to occur
- Diagnostics/prognostics – Evaluating the need and feasibility of enhanced capabilities that can self-detect or predict failures and investigating how to communicate potential system degradation to the driver
- Redundancy – Investigating what additional hardware, software, data communications, infrastructure, etc. may be needed to ensure the safety of highly automated vehicles
- Availability (of the automated system) – Ability to perform even at a degraded level in case of failure
- Certification – Requirements and processes to validate that the system is safe at deployment and remains safe in operation, including vehicle software

Cybersecurity

- Security – Capability of system to resist cyber attacks
- Risks – Potential gaps in the system that can be compromised by cyber attacks
- Performance – Effectiveness of security systems
- Unintended consequences – Impact of cybersecurity on performance of the system
- Certification – Method to assure that critical vehicle subsystems such as communications are secure

(3) ***Develop System Performance Requirements:*** Research will be performed to support the development of any potential technical requirements for automated vehicle systems. This effort is expected to involve an analysis of the levels described above (levels 2-4) to develop functional descriptions for automation systems that map to each of these levels. Based on these functional descriptions, research to develop requirements will focus on identifying applicable scenarios (use cases) for the automated system levels 2-4. Based on a detailed analysis of the use cases, appropriate safety performance requirements would be developed to ensure a minimum safe level of performance. As funding permits, we would like to complete the first phase of this research in the next four years. In that period, the aim is to develop basic safety requirements that we could consider for adoption as standards applicable to any such systems that would be available for sale to the public at that time. This research is complicated by the fact that only a few level 2 systems currently exist, even fewer level 3 systems exist and their technical details are constantly in flux, and no level 4 systems are known to exist at this time. It is expected

that this area of research will leverage the results from both the human factors and electronic control systems programs outlined above.

The main topics that will need to be addressed include:

- Developing detailed functional descriptions for emerging level 2 and 3 operational concepts.
- Data Analysis - Evaluate naturalistic data and crash data to determine the array of real-world scenarios (use cases) that match to the functional descriptions of emerging level 2 and 3 automated vehicle systems.
- Evaluate constraints on level 2 and 3 system performance - Based on the functional descriptions of emerging system concepts and the data analysis results, evaluate the constraints on level 2 and 3 system performance that will result from various operating scenarios (traffic dynamics), driver capabilities, environmental variations (rain, snow, etc.), and roadway types/configurations. This work will leverage results from the human factors research area particularly with respect to evaluating driver capabilities and the resulting constraints that may impose on level 2 and 3 systems.
- Development of test and evaluation methods - Based on the real world scenarios (use cases) that map to the functional description of the automated system, develop test track tests and/or simulation approaches that can evaluate the performance of the level 2 or level 3 systems relative to these use cases.
- Determine the performance and operating envelope for emerging level 2 and 3 systems: Based on testing and/or simulation efforts, characterize the performance envelope (i.e., appropriate operating boundaries) for each level 2 or 3 system. This will include items like testing to determine maximum deceleration authority, maximum lateral velocity, maximum yaw moment, and other vehicle dynamic properties that are actively controlled by the automated system. This will help determine the level of autonomous authority that the vehicle is capable of achieving.
- Leverage results from the electronic control systems research:
    - Understand system failure modes for each automated system including active safety technologies installed on the vehicle.
    - Identify points of failure for each automated system (braking, steering, etc.) installed on the vehicle and determine how the systems react in both static and dynamic situations.
- Develop objective performance tests and associated pass/fail criteria.

This research will inform the development of preliminary requirements for level 2 automation and potentially for level 3 systems as well to the extent these systems are available. It will also provide the basic groundwork for understanding any additional level 3 and level 4 systems that may be developed, since these will likely be based on level 2 technologies but be more highly integrated and involve greatly advanced sensing capabilities. As level 3 and 4 systems become available, similar research steps would be performed.

We note that this research program is not as yet separately funded and its full implementation will depend on using available research funds unless additional funding is granted in accordance with the administration’s budget request.

D. Recommendations Concerning State Activities Related to Self-Driving Vehicles

Several states have enacted legislation expressly authorizing operation of "autonomous" vehicles within their borders under certain conditions. Generally, these laws seem to contemplate vehicle automation at Levels 3 and 4, as discussed above, i.e., some form of self-driving operation. Accordingly, these recommendations are tailored to Levels 3 and 4 automation.

Further research is needed to fully understand the technical and human factors issues implicated by self-driving vehicles. This guidance is therefore provisional and subject to reconsideration and revision as appropriate, especially before any potential regulatory action – which must appropriately balance the need to ensure motor vehicle safety with the flexibility to innovate.

We offer these recommendations to state drafters of legislation and regulations governing the licensing, testing, and operation of self-driving vehicles on public roads in order to encourage the safe development and implementation of automated vehicle technology, which holds the potential for significant long-term safety benefits. In general, we believe that states are well suited to address issues such as licensing, driver training, and conditions for operation related to specific types of vehicles. NHTSA has considerable concerns however about detailed state regulation on safety of self-driving vehicles, and does not recommend at this time that states permit operation of self-driving vehicles for purposes other than testing. Thus, the below recommendations all assume that the human driver of the vehicle will be employed by, or otherwise the agent of, a business or some other institution engaged in testing and will only be using the self-driving vehicle in that capacity.

The agency is not aware of any systems intended for wide scale deployment currently under development for use in motor vehicles that are capable of Level 4 automation. As we stated previously, very few Level 3 automated systems exist and the systems that do exist are still at the earlier stages of testing/development. Because Level 4 automated systems are not yet in existence and the technical specifications for Level 3 automated systems are still in flux, the agency believes that regulation of the technical performance of automated vehicles is premature at this time. While NHTSA's authority, expertise, and mandate is to establish uniform, national standards needed for vehicle safety, the agency recognizes that premature regulation can run the risk of putting the brakes on the evolution toward increasingly better vehicle safety technologies.

While the agency does not believe that self-driving vehicles are currently ready to be driven on public roads for purposes other than testing, the agency would like to emphasize that it is encouraged by innovations in automated driving and their potential to transform our roadways. The agency is confident that the development and testing of Level 3 automated systems will provide answers to many of the technical and human factors questions presented by the technology.

NHTSA has decades of experience in matters of highway safety and vehicle safety, including issues related to driver licensing and vehicle safety standards. NHTSA also has extensively studied and exercised its regulatory authority over various aspects of vehicle automation and has

closely observed recent developments in self-driving technologies, including in-depth discussions with developers of those technologies and direct experience with several of the vehicles under development. Based on all of this, and knowing that some states are anxious for guidance on how to proceed with regard to self-driving vehicles, NHTSA offers the recommendations below.

I—Recommendations for Licensing Drivers to Operate Self-Driving Vehicles for Testing

A--Ensure that the Driver Understands How to Operate a Self-Driving Vehicle Safely

- A driver licensing program should provide for driver's license endorsements (or separate driver's licenses) that authorize the operation of self-driving vehicles.
- The issuance of a driver's license endorsement (or separate driver's license) to a person should be conditioned upon certain prerequisites, such as that person's passage of a test concerning the safe operation of a self-driving vehicle and presentation of a certification by a manufacturer of self-driving vehicles (or the manufacturer's designated representative) that the person has successfully completed a training course provided by that manufacturer (or representative), or a certification by that manufacturer (or representative) that the person has operated a self-driving vehicle for a certain minimum number of hours. As used here, "manufacturer" includes a company that alters a vehicle manufactured originally by another company in order to give it self-driving capability.
- The training course should be submitted to the state agency that issues driving licenses for approval prior to the taking of that course by any person seeking a driver's license endorsement certification. The course should include providing an understanding of the basic operation and limits of self-driving vehicles, and knowledge of how to resume control of such a vehicle in the event that it cannot continue to operate automatically.

II—Recommendations for State Regulations Governing Testing of Self-Driving Vehicles

A--Ensure that On-road Testing of Self-driving Vehicles Minimizes Risks to Other Road Users

- Any state establishing regulations for self-driving vehicle testing should include provisions to ensure that businesses testing such vehicles conduct their testing in a way that minimizes risks to other road users, including provisions such as:
    - Requiring businesses to certify that the vehicle has already operated for a certain number of miles in self-driving mode without incident before businesses seeking the license can test the vehicle on public roads.
    - Requiring these businesses to submit data from previous testing involving the technology.
    - Requiring businesses to submit a plan to the state regulatory body describing how the business plans to minimize safety risks to other road users. The plan could include training for test drivers employed by the business seeking to conduct the

testing, fail safes in the design of the prototype automated vehicle, and/or aspects of the testing plan designed to ensure that risks to other road users are minimized.

- NHTSA strongly recommends that states require that a properly licensed driver be seated in the driver's seat and ready to take control of the vehicle while the vehicle is operating in self-driving mode on public roads.

B--Limit Testing Operations to Roadway, Traffic and Environmental Conditions Suitable for the Capabilities of the Tested Self-Driving Vehicles

- States should require that, as part of their testing plan, self-driving vehicle manufacturers inform the state of the operating conditions in which they wish to test. Manufacturers wishing to test self-driving vehicles should be required to supply states with test data or other information to demonstrate that their self-driving vehicles are capable of operating in these conditions with limited driver intervention.
- States are encouraged to consider appropriate limitations on the conditions in which a vehicle may be operated in self-driving mode. States are encouraged to tailor their regulations governing self-driving vehicle testing to limit the use of the self-driving mode to conditions conducive to safe operation in that mode.
- Regulations governing self-driving vehicle testing could limit testing to the operating conditions for which the self-driving system is specifically designed such as driving on a limited access highway. Likewise, depending on the self-driving vehicle, regulations could limit testing of the self-driving vehicle to roads in only certain geographical locations, e.g., those known for having light traffic or for having heavy traffic at low travel speeds.

C--Establish Reporting Requirements to Monitor the Performance of Self-Driving Technology during Testing

- To expand the body of data and support research concerning self-driving vehicles, states are encouraged to require businesses testing self-driving vehicles to submit to the state certain information, including:
    - instances in which a self-driving vehicle, while operating in or transitioning out of self-driving mode, is involved in a crash or near crash; and
    - incidents in which the driver of one of their self-driving vehicles is prompted by the vehicle to take control of the vehicle while it is operating in the self-driving mode because of a failure of the automated system or the inability of the automated system to function in certain conditions.

III—Recommended Basic Principles for Testing of Self-Driving Vehicles

NHTSA does not recommend that states attempt to establish safety standards for self-driving vehicle technologies, which are in the early stages of development. We believe there are a number of technological issues as well as human performance issues that must be addressed for self-driving vehicles. Particularly in light of the rapid evolution and wide variations in self-driving technologies, we do not believe that detailed regulation of these technologies is feasible

at this time at the federal or state level. However, until such time as NHTSA has developed vehicle safety standards pertinent to self-driving technologies, states may want to ensure that self-driving test vehicles in their states adhere to certain basic principles.

A--Ensure that the Process for Transitioning from Self-Driving Mode to Driver Control is Safe, Simple, and Timely

- During the testing phase of the development of self-driving vehicles, a driver familiar with the particular vehicle's automated systems is necessary to ensure that a failure of the automated system or the occurrence of conditions in which the automated system is not intended to operate does not put other road users at risk. The driver must be able to quickly and easily retake control of the vehicle from the automated system.
- A regulation may require that the driver be able to retake control of the test vehicle by an immediately over-riding, relatively simple, and non-distracting method such as pressing a button located within the driver's reach.
- Further, the automated functions of a test vehicle should defer to the driver's input by allowing the driver to retake control by using the brakes, the accelerator pedal, or the steering wheel.
- The self-driving vehicle should alert the driver when the driver must take control of the vehicle because the automated system cannot operate due to road conditions, environmental conditions, a malfunction, or any other condition or circumstance that would require manual driving for safe operation.

B—Self-Driving Test Vehicles Should Have the Capability of Detecting, Recording, and Informing the Driver that the System of Automated Technologies has Malfunctioned

- Self-driving test vehicles operating on the road should have the capability of detecting that their automated vehicle technologies have malfunctioned or are operating in a degraded state, and informing the driver in a way that enables the driver to regain proper control of the vehicle.
- Self-driving test vehicles should have the capability of recording the occurrence of such malfunctions, degradations, or failures in a way that can be used to establish the cause of any such malfunction, degradation and control failure.

C--Ensure that Installation and Operation of any Self-Driving Vehicle Technologies Does not Disable any Federally Required Safety Features or Systems

- Any regulation that allows for the operation of self-driving vehicles on public roads should ensure that entities installing automated technology in vehicles do not disable federally required safety systems.
- Federal law prohibits manufacturers of motor vehicles, dealers and motor vehicle repair businesses from making inoperative any federally required safety system.
- The installation of self-driving technologies should not degrade the performance of any of those federally required systems or the overall safety of the vehicle.

- States should consider requiring businesses offering self-driving vehicles for operation within their states to certify that they have not made any federally-required safety devices inoperative.

D--Ensure that Self-Driving Test Vehicles Record Information about the Status of the Automated Control Technologies in the Event of a Crash or Loss of Vehicle Control

- Self-driving test vehicles should record data from the vehicle's sensors, including sensors monitoring and diagnosing the performance of the automated vehicle technologies, in the event of a crash, or other significant loss of vehicle control. In addition to recording all the information from the sensors for the vehicle's automated technologies, the recording should note whether the automated technology system was in control of the vehicle at the time of the crash.
- Any regulation that allows for the operation of self-driving vehicles for testing purposes should also consider ensuring that the vehicle owner make available to the state all data recorded by the vehicle's event data recorder in the event of a crash.

IV--Regulations Governing the Operation of Self-Driving Vehicles for Purposes Other than Testing

NHTSA does not recommend that states authorize the operation of self-driving vehicles for purposes other than testing at this time. We believe there are a number of technological issues as well as human performance issues that must be addressed before self-driving vehicles can be made widely available. Self-driving vehicle technology is not yet at the stage of sophistication or demonstrated safety capability that it should be authorized for use by members of the public for general driving purposes. Should a state nevertheless decide to permit such non-testing operation of self-driving vehicles, at a minimum the state should require that a properly licensed driver (i.e., one licensed to drive self-driving vehicles) be seated in the driver's seat and be available at all times in order to operate the vehicle in situations in which the automated technology is not able to safely control the vehicle. As innovation in this area continues and the maturity of self-driving technology increases, we will reconsider our present position on this issue.

Appendix D

Study Participants

DMV Study Team

Richard Holcomb
Commissioner

Janet Smoot
Project Manager

Mike Baxter
Bruce Biondo
Dave Burhop
Greg Cavalli
William Childress
Wayne Davis
Linda Ford
Karen Grim
Ellen Marie Hess
Barbara Klotz
Patrick Harrison
Matt Martin
Sheila Stephens
Melissa Velazquez
Matt Wells

Other Participants

John Swanson
Office of Governor Terence R. McAuliffe

Nicholas Donohue
Office of the Secretary of Transportation

April Allen
Continental

Nicole Barranco
Volkswagen Group of America

Myra Blanco
Virginia Tech Transportation Institute

Gwendolyn Bluemich
Daimler

John Capp
General Motors

Alex Cardinali
Nissan

George Cook
Toyota

Captain Jerry Davis
Virginia State Police

Tom Dingus
Virginia Tech Transportation Institute

Laura Dooley
Alliance of Automobile Manufacturers

Paul Feenstra
ITS America

Charlie Finley
Virginia Motorcycle Dealers Association

Emily Franklin
Ken's Cycle Center

Captain Dan Glick
Virginia State Police

Noah Goodall
Virginia Center for Transportation Innovation & Research

Dean Gustafson
Virginia Department of Transportation

Fred Helm
Kemper Consulting

Eric Henning
General Motors

Geoff Hoekstra
SAE International

Elizabeth Hooper
Virginia Tech

Barry Horowitz
UVA &Commonwealth of Virginia Cyber Security Advisory Board

Charles Kawashima
Daimler

Mena Lockwood
Virginia Department of Transportation

JoAnne Maxwell
Virginia Department of Transportation

Cathy McGhee
Virginia Transportation Innovations Center

James Myers
Valley Cycle Center

Edward Mullen
Reed Smith

Craig Orlan
Honda

Paul Perrone
SAE International

Josh Pudnos
Association of Global Automakers

Michelle Satterlund
McGuire Woods

Michele Schmitt
Fredericksburg Motor Sports

Tammy Trimble
Virginia Tech Transportation Institute

Dina Vizzacarro
Delphi

Janet Westbrook
Office of the Attorney General of Virginia