United States Department of Transportation
Annual Modal Research Plans

Office of Vehicle Safety Research

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Office of Behavioral Safety Research

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Executive Summary

The Office of Vehicle Safety Research supports U.S. DOT's and NHTSA's safety goals through conducting motor vehicle and motor vehicle equipment safety testing and research. The Office performs testing and research related to crashworthiness, human injury/biomechanics, and crash avoidance. It also supports advanced vehicle safety technologies to combat human behavior including distracted and impaired driving. In addition, the Office conducts testing and research into the reliability and security of complex safety-critical electronic control systems, vehicle cyber security, and new and emerging technologies, including advanced driver assistance systems and automated vehicle technologies, that can help drivers further avoid crashes. Other research areas include developing enhanced computer modeling tools; along with the expertise to quickly and efficiently identify vehicle fleet changes with potential safety ramifications, particularly in areas related to alternative fuel vehicles; advanced battery control modeling and analysis; assessment of crash notification technology and emergency response; while supporting NHTSA's other cross-cutting initiatives.

The Office conducts research to continuously assess ways to seek alternative approaches that hasten the maturation and deployment of cost-effective, life-saving technologies by industry. When new vehicle designs and technologies are introduced, the Vehicle Safety Research program ensures that those technologies will indeed enhance safety and mitigate any unintended consequences. When a safety need exists for a Federal Motor Vehicle Safety Standard (FMVSS), it conducts research to understand the current conditions in detail, to develop and evaluate safety countermeasures, and to establish and validate performance tests that respond to the safety need. For safety problems that occur with high frequency and severity in the crash statistics, the Office uses research to evaluate new safety countermeasures that can address these issues, and/or new crash tests that can drive better occupant protection vehicle designs.

The Vehicle Safety Research program assures both market access and a fair competitive market, fostering a level playing field, while supporting consistency in the safety performance of new and innovative technologies when brought to market. Overall, as a result of the program, the introduction of new vehicles and safety technologies get accelerated into the U.S. fleet.

The Office of Behavioral Safety Research directly supports the Department and agency goals of reducing traffic crashes, fatalities, and injuries by providing the scientific basis for the development of effective behavioral countermeasures to reduce the occurrence of traffic crashes. The Office focuses on unsafe driving behaviors that contribute significantly to death and injury from crashes on the Nation's highways. Evaluation research documents the relative effectiveness of programs to reduce highway fatalities and injuries, and is critical to achieving further progress toward meeting national goals and performance targets. The Behavioral Safety Research program assesses existing and emerging highway safety problems. Results are distributed to the States to use in identifying effective traffic safety countermeasures for implementation through the highway safety formula grant (Section 402) funds and incentive grant funds (Section 405). NHTSA partners with other DOT modal agencies, such as the Federal Highway Administration, the Volpe Center, universities, research contractors, safety advocates, automotive manufacturers and other industry entities.

Section 1
Research, Development & Technology, FY 2018

FY 2018 RD&T Program Funding Details

RD&T Program Name	FY 2018 Pres. Budget	FY 2018 Basic	FY 2018 Applied	FY 2018 Development	FY 2018 Technology
Crashworthiness	16,079,000		16,079,000		
Crash Avoidance	11,743,000		11,743,000		
Alternative Fuels	1,349,000		1,349,000		
Vehicle Electronic and Emerging Technologies	3,469,000		3,469,000		
Vehicle Research & Test Center	482,000		482,000		
Highway Safety	11,748,000		11,748,000		5,625,000
Totals	44,748,000		44,870,000		5,625,000

FY 2018 RD&T Program Budget Request by Critical Transportation Topic Area

RD&T Program Name	FY 2018 Pres. Budget	Promoting Safety	Improving Mobility	Improving Infrastructure	Preserving the Environment
Crashworthiness	16,079,000	16,079,000			
Crash Avoidance	11,743,000	11,743,000			
Alternative Fuels	1,349,000	1,349,000			
Vehicle Electronic and Emerging Technologies	3,469,000	3,469,000			
Vehicle Research & Test Center	482,000	482,000			
Highway Safety	11,748,000	11,748,000			
Totals	44,748,000	44,748,000			

Office of Vehicle Safety Research

Crashworthiness
$16,079,000

Program Description: To focus on vehicle safety countermeasures to reduce the number of fatal and serious injuries that occur in the United States each year. This research program is responsible for developing and upgrading test procedures for evaluating motor vehicle safety and developing the test devices, such as crash test dummies, and appropriate injury metrics. Crashworthiness research encompasses new and improved vehicle design, biomechanics and injury causation, field data collection and analysis of serious injury cases, safety countermeasures and vehicle equipment to enhance occupant safety.

Program Objectives: The purpose of this research program is to investigate the problems of vehicle crash safety and associated factors (e.g., vehicle design, human response/injury tolerance) that contribute to serious injuries and fatalities. The near-term goal is to identify fatality and injury trends and to enhance safety requirements and best practices to improve crash occupant outcomes.

Anticipated Program Activities: Continue crash data evaluation, detailed field data collection and analysis, assessment of human injury response and tolerance, and safety test and test device (e.g., test dummy) development through laboratory testing, computer modeling and data evaluation programs. These research programs are designed to leverage private/public partnerships to assess the safety implications of current fleet crash data, vehicle design trends, and ongoing research efforts.

Expected Program Outcomes: Research in vehicle crashworthiness has shown substantial benefits in several recent rules. Improved roof strength (FMVSS 216) and ejection mitigation technologies (FMVSS 226) have been shown to save several hundred lives per year after full implementation. Current proposed rulemaking for side impact testing and improved ease-of-use of child restraint systems were developed through safety systems research as were the many new test devices (THOR and WorldSID) and test conditions (frontal oblique) being proposed for use in the NCAP program. The proposed efforts for 2018 will help support agency decisions in fuel economy, frontal and side crash safety, occupant containment, advanced occupant restraint performance. Additionally, 2018 efforts will support NCAP implementation of THOR and WorldSID front and side impact adult test dummies and associated new injury criteria, development of advanced child dummies, continued detailed field data collection of serious injury cases (CIREN) and publication of cases, research on injury mechanisms/tolerances for vulnerable populations, and the continued development and application of advanced mathematical models of human occupants and pedestrians.

Collaboration Partners: NHTSA reviews and uses FMCSA studies on motor coach and heavy-truck crashes and fires. NHTSA reviews PHMSA standards on lithium ion battery safety. NHTSA collaborates with FHWA on developing and conducting crash simulation models.

How Program meets Statutory Requirements: We will continue to collaborate with internal agencies on funding and other research programs. The program meets the annual funding appropriations act's requirement to conduct crashworthiness research.

Describe how public and stakeholder input have been utilized in the development of this research program: Conducted broad-based research meeting with automotive manufacturers, suppliers, and other stakeholders.

Crash Avoidance
$11,743,000

Program Description: NHTSA has identified the need for an increased emphasis on crash avoidance technologies with significant potential to reduce fatalities and injuries by preventing the crash from occurring, or significantly reducing the severity of crashes by providing timely warnings to the driver to take appropriate action. Such technologies also may support automatic braking or steering interventions to provide additional safety benefits. Further, crash avoidance systems are precursors, and necessary building blocks, for automated vehicle technologies which are beginning to appear in vehicle manufacturers' and other entities' product development plans—and are even emerging in the marketplace today in early forms.

Program Objectives: NHTSA will continue to fulfill its mission of saving lives, preventing injuries, and reducing traffic related health care and other economic costs, by facilitating the development, deployment, and evaluation of safety products and systems. Among other things, this involves research into the science of crash avoidance to enable the development and evaluation of safety-enhancing products. The agency will continue to establish the safety goals for crash avoidance technology, develop performance guidelines and specifications for crash avoidance systems, evaluate the safety performance of such systems, and work with industry to demonstrate the most promising ones and to facilitate their deployment in the marketplace. These activities will be accomplished through the combined efforts of NHTSA, the automobile industry, and other technology companies, contractors, and academia working together under cooperative programs and partnerships that are sponsored by NHTSA.

Anticipated Program Activities: In FY 2018, NHTSA requests $9.91 million for the Crash Avoidance research program. This funding reflects the agency's increased emphasis on understanding the safety potential of these new technologies, developing objective means for assessing performance, and addressing important human factors

issues related to driver inattention, warning the driver, and driver-vehicle interface issues. The research will encompass the following key projects:

- Continue research in assessing modern crash avoidance systems that include collision avoidance and mitigation technologies that react to vehicles and pedestrians.
- Complete field operational tests into researching the real-world experiences with available crash avoidance technologies through leveraging partnerships with OEMs that offer telematics connectivity to field units.
- Continue retrospective safety benefits assessment of modern day crash avoidance technologies via innovative data analytics approaches.
- Build upon past knowledge to initiate new human factors research into drivers' interaction with emerging driver assistance systems and evolving driver-vehicle interface approaches in relation to their impact on the real-world safety effectiveness of these systems.
- Continue research into the use of observational and naturalistic driving data to improve the agency's understanding on factors that affect distracted driving. The agency will also evaluate new vehicle systems relative to the distracted driving guidelines to ensure that these new technologies do not introduce new distractions for drivers and present new safety concerns.
- Complete research into seat belt interlock systems and initiate new research in new advancements in modern vehicle technologies such as electronic mirrors.
- Initiate research into new driver-vehicle interface approaches such as voice interface systems, gesture interfaces, heads-up displays, augmented reality displays, and electronic touch screens.

Expected Program Outcomes: This research program directly supports several critical areas of policy decisions related to passenger vehicle crash avoidance. The light-vehicle crash avoidance program is engaged in a large body of research on driver assistance technologies that present safety warnings to drivers; can take control of the vehicle in crash imminent situations; modify unsafe driving behaviors such as distraction and alcohol impairment; and enhance the safety of vulnerable and at-risk populations such as teen drivers, older drivers, and pedestrians. In the coming year, NHTSA's research in crash avoidance technology will continue to focus on identifying emerging safety technologies, partnering with industry to develop more efficient and comprehensive testing methods, and enhancing our understanding of vehicle-driver interface issues; and long-term safety implications of these advanced technologies. Through planned research in FY 2018, NHTSA will be leveraging advanced evaluation methods involving hardware-in-the-loop systems, driving simulators, computer modeling, and increasingly automated testing methods— all with a focus on improving the efficiency, thoroughness and accuracy of our crash avoidance evaluation programs. The output of this work will help automotive manufacturers, suppliers, and other entities with improving their products through more accurate and

efficient product evaluations, and provide insights for developing programs to promote adoption of crash avoidance systems.

Collaboration Partners: NHTSA reviews and uses FAA, FRA, and, Maritime research in the areas of automated vehicle technologies (for safety assessment, certification, standards), and cyber security (protections, approaches, policies, etc.). NHTSA collaborates with ITS JPO and FHWA on V2V and V2I research, DSRC spectrum testing, automated vehicle technology research (e.g. benefits assessment), and vehicle cyber security research (joint investment in NHTSA developing applied capabilities to develop best practices). Collaborates with FMCSA on heavy vehicle crash avoidance research and rulemaking considerations and research for heavy vehicles (e.g. Electronic Stability Control rulemaking for trucks).

How Program meets Statutory Requirements: We will continue to collaborate with internal agencies on funding and other research programs. The program meets the annual funding appropriations act's requirement to conduct crash avoidance research.

Describe how public and stakeholder input have been utilized in the development of this research program: Conducted broad-based research meeting with automotive manufacturers, suppliers, and other stakeholders.

Alternative Fuels Vehicle Safety
$1,349,000

Program Description: Recently introduced vehicle engine technologies including hydrogen and advanced lithium ion battery vehicles are evolving at a fast rate. Additionally, the recent increase in Compressed Natural Gas (CNG) fueled heavy trucks has caused concerns regarding the safety of these vehicle systems. NHTSA intends to continue the introduction of new requirements to address the unique safety considerations for these evolving vehicle types. Federal safety regulations have not kept pace with the introduction of the more established lithium ion battery and CNG-fueled vehicles. These technologies present new safety considerations not previously addressed in the FMVSSs.

Program Objectives: NHTSA is continuing the development of objective safety performance tests to support a global technical requirement for electric vehicles. NHTSA completed preliminary test procedure development for lithium-ion electric vehicles and is currently updating these test procedures based on international feedback. The agency will be conducting fleet testing using these test procedures to evaluate their impact on vehicle design and safety performance. NHTSA research is evaluating enhanced performance tests to ensure the highest levels of safety for future CNG and hydrogen vehicles. NHTSA must be at the forefront of research to assess the safety of these alternative fuels vehicles, and to develop safety performance requirements.

Anticipated Program Activities: In FY 2018, NHTSA requests $1.35 million for the Alternative Fuels Vehicle Safety research program. Specifically, the requested funding will allow the agency to pursue the following activities:

- Continue fleet safety validation testing of high voltage traction battery systems in support of harmonized requirements.
- Conduct Thermal Propagation testing at the pack and full vehicle level to assess test procedure suitability and evaluate performance criteria.
- Ensure Battery Management System functionality including all levels of charging.
- Continue the development of lithium ion battery diagnostics that can detect damage prior to battery fire initiation.
- Update the market trend and standards gap analysis report from 2013.
- Finalize updated safety performance test procedures for CNG and hydrogen gas containers.
- Initiate small fleet testing program for CNG containers.

Expected Program Outcomes: NHTSA is gathering information from all sources regarding the battery, stored gas, and fuel cell technologies that are emerging. This advanced knowledge is helping to focus the research projects, refine safety assessments, and develop performance tests. NHTSA is partnering with industry and other Federal agencies to develop appropriate safety levels for these alternative fuels vehicles.

Collaboration Partners: Continue working with National laboratories (Sandia, ORNL, INL, and Argonne) to evaluate safety and develop test procedures. NHTSA is also coordinating research with the Naval Surface Weapons center, Department of Energy, Underwriters Laboratories, and the Government Lithium Ion Safety Group

How Program Meets Statutory Requirements: We will continue to collaborate with internal agencies on funding and other research programs.

How Public and Stakeholder Input Have Been Utilized in the Development of This Research Program: Conducted broad-based research meeting with automotive manufacturers, suppliers, and other stakeholders.

Vehicle Electronic and Emerging Technologies
$3,469,000

Program Description: Provide overall planning, direction, and control for the increased use of electronic controls and connectivity to enhance transportation safety and efficiency. This program advances NHTSA's expertise in vehicle electronics and engineering to address safety and security of emerging electronics and software technologies and their implications to the safety of the motorists and other vehicle occupants. In this program area, research focus is on challenges related to the technical, human factors, safety assurance, testing and validation of road vehicles and their automation levels in addition to activities that support agency decisions on safety and cyber security requirements for vehicle control systems.

Program Objectives: Given the rapid, accelerated pace of vehicle technology advancement and the related issues that result such as cyber security, this program conducts the critical research activities that are necessary to maximize the safe deployment of Automated Driving Systems (ADSs - SAE Levels 3-5) and ensure that key electronics issues such as cyber security are addressed. In FY 2018, the Vehicle Electronics and Emerging Technologies program will build upon research completed in FY 2017 and initiate new projects to close identified gaps in support of agency decisions on automated vehicle technologies, as well as electronics reliability and cyber security.

Anticipated Program Activities: In FY 2018, NHTSA requests $3.47 million for the Vehicle Electronics and Emerging Technologies program. Funding provided in FY 2018 will allow NHTSA to pursue the following activities:

- Continue the development and enhancement of capabilities to facilitate in depth testing of vehicle electronic hardware and software systems.
- Continue the agency's close coordination with other stakeholders including: automotive manufacturers and other entities, DHS, DOD, NSF, and NIST on the cyber protection of vehicles and expanding ongoing projects to encompass the development of cyber security best practices for road vehicles.
- Continue research with key stakeholders, including the automotive industry, standards setting organizations, and government agencies to refine the safety elements for ADSs and develop test procedures and performance criteria for these systems.
- Complete initial human factors research on how a driver can safely transition between automated and manual (driver) operation of a vehicle.
- Build on previously completed electronics safety research on steering, throttle, and braking control systems, while initiating research on additional crash safety systems such as air bags and seat belts.
- Support the development of test procedures for new crash avoidance technologies that support automation.

- Initiate preliminary research to assess and develop test procedures for non-traditional vehicles.

Expected Program Outcomes: The focus of this effort will be to develop research findings and data to support and facilitate industry's safe testing and deployment ofADSs, address cyber security issues resulting from increased connectivity of modern vehicles, and identify new risks that may arise in emerging vehicle electronics before they are in production. Through advanced, proactive and collaborative research, these challenges can be addressed in a timely manner such that transformative automated vehicle technologies with proven safety benefits can be introduced sooner. Funding for this program area may also be used to investigate potential defects in electronics and software, and assist in recall or other consumer complaint issues. Agency data gathering and strategic planning efforts as well as incoming research results will continue to guide agency research priorities in this area.

Collaboration Partners: NHTSA will continue to collaborate with ITS JPO, FHWA and FMCSA on V2V, automated vehicle technologies (Human Factors research, standards research), and cyber security. We also plan to collaborate with FMCSA on cyber security best practices for heavy vehicle aftermarket devices.

How Program Meets Statutory Requirements: We will continue to collaborate with internal agencies on funding and other research programs. .

How Public and Stakeholder Input Have Been Utilized in the Development of This Research Program: Conducted broad-based research meeting with automotive manufacturers, suppliers, and other stakeholders.

Autonomous Vehicles - (Did not request funding for FY 2018)

Requested in FY 2019 and changed the name to Automated Driving Systems

Vehicle Research and Test Center - Ohio
$482,000

Program Description: The Vehicle Research and Test Center (VRTC) is NHTSA's in-house research, development, test, and evaluation facility located in East Liberty, Ohio. Activities conducted at VRTC support agency programs including safety defect investigations, updates to FMVSSs, test procedure development for new regulatory actions and agency consumer information programs, test dummy development, injury criteria development, advanced research into cutting-edge technologies and automated vehicle technologies, and safety issues that require quick reaction. The full range of testing and research capabilities available to NHTSA at VRTC allows the agency to address emerging technologies and safety issues through access to this world class testing facility similar to those used by automotive manufacturers, suppliers, and other industry entities.

Program Objectives: Modern vehicles have evolved greatly over the last 35 years, and the advent of modern electronic controls, automated vehicle technologies, alternative fuels, and electric powertrains will drive that evolution even farther in the very near future. NHTSA has recognized the need to enhance the capabilities at VRTC for testing and analyzing emergent advanced technologies and other vehicle electronic systems. While enhancement of research capabilities in several areas have been identified, the nearest term critical areas are in cyber security, electronics reliability, and automated vehicle technologies that span all of the agency's vehicle safety programs. Enhancement of capabilities for material composition and failure analysis, particularly of electronic components, is also critical. With this FY 2018 funding, NHTSA will work with the General Services Administration (GSA) to finalize a long-term lease that may include additional testing and vehicle preparation space. Funding will cover expenses associated with GSA's development of the lease, any architectural drawings, etc. Equipment needed to conduct research and analysis of advanced emergent technologies, electronics, cyber security and reliability assessments for establishment of performance requirements and defect investigations will also be procured. In addition, with alternative fuels systems of varying types and new sophisticated electronic control systems emerging in the market, NHTSA needs to maintain a well-equipped and dedicated center to test, monitor, and investigate these and other new technologies.

Anticipated Program Activities: In FY 2018, NHTSA requests $482,000 for the Vehicle Research and Test Center program. High-priority research programs that will be conducted at VRTC in FY 2018 include research supporting the critical area of Automated Driving Systems (ADSs – SAE Levels 3-5), including research into new test approaches and methods that can be applied to evaluate the safety of ADSs High-priority research also includes research to support improvements in frontal impact child safety, test procedure development for advanced technology and control systems, cyber security, defect investigations, and new sophisticated electronic control systems emerging in the market. VRTC will also use FY 2018 funding to procure equipment necessary to support these critical automotive safety areas. Considerations for upgrading testing capabilities include instrumentation, hardware, software, and equipment for the following:

- Material and component composition/failure analysis
- Advanced technology and controls
- Automated vehicle technologies, specifically ADSs
- Cyber security
- Electronics reliability

Expected Program Outcomes: The expertise and technical capability of NHTSA's VRTC has been well demonstrated over the past 40 years. Numerous high-profile programs have been successfully completed by the Center in an expeditious and thorough manner. However, providing the capability of advanced testing of emergent technologies is necessary to maintain pace with the rapid appearance of new electronics and advanced driver assistance and automated vehicle technologies. The FY 2018 request will enable the VRTC to maintain and update the equipment and state-of-the-art facilities necessary to assess and investigate the rapid emergence of advanced automotive electronics assure the highest level of automotive safety for the American public.

Collaboration Partners: NHTSA will collaborate with other federal agencies on automated vehicles, cyber security, and other advanced technologies for both passenger and commercial vehicles. Collaboration will continue with our DOT modal partners and well as others such as the FBI, DHS, NIST, DOD, and NASA.

How Program Meets Statutory Requirements: We will continue to collaborate with internal agencies on funding and other research programs. .

How Public and Stakeholder Input Have Been Utilized in the Development of This Research Program: Conducted broad-based research meeting with automotive manufacturers, suppliers, and other stakeholders.

Office of Behavioral Safety Research

Highway Safety Research
$11,521,000

Program Description: Recent estimates of the causes of crashes suggest that 94 percent of crashes are due to driver behavior rather than vehicle defects, roadway defects, or environmental factors. Highway Safety Research directly supports the Department and agency goals of reducing traffic crashes, fatalities and injuries by providing the scientific basis for the development of effective behavioral countermeasures to reduce the occurrence of traffic crashes. Behavioral Safety Research focuses on unsafe driving behaviors that contribute significantly to death and injury from crashes on our highways. These include such things as alcohol and drug impaired driving, speeding and speed management, occupant protection (seat belt use and child safety seats), pedestrian and bicyclist safety, school bus safety, distraction, drowsiness and fatigue, motorcycle safety, older drivers, young drivers, driver licensing, graduated driver licensing, driver education, and emergency medical services.

Highway Safety Research also funds the Driver Alcohol Detection System for Safety (DADSS) program which is a collaborative research partnership between the Automotive Coalition for Traffic Safety (ACTS), representing 17 automobile manufacturers in the United States, and NHTSA to assess and develop alcohol-detection technologies to prevent vehicles from being driven when a driver's blood alcohol concentration (BAC) exceeds the illegal per se limit of .08 grams per deciliter (g/dL). From its inception, the DADSS program has been, and continues to be, a voluntary, non-regulatory effort. The purpose is to explore the feasibility, the potential benefits of, and the potential challenges associated with a more widespread use of in-vehicle technology to prevent alcohol-impaired driving.

Evaluation research documents the relative effectiveness of programs to reduce fatalities and injuries on our highways, and is critical to achieving further progress toward meeting national goals and performance targets. The results of the Highway Safety Research program assess existing and emerging highway safety problems and document effectiveness at changing driver behavior and reducing crashes. The results are disseminated to the States to use to identify effective traffic safety countermeasures for implementation through the highway safety formula grant (Section 402) funds and incentive grant funds (Section 405). Our highway safety research studies can be found at: www.nhtsa.gov/Driving+Safety/Research+&+Evaluation.

Program Objectives: This research program is designed to find ways to change the behavior of drivers and other roadway users to increase safe behavior (seat belt use, child seat use, protective gear use by motorcycle riders, etc.) and reduce unsafe behaviors (alcohol- and drug-impaired driving, texting, speeding, etc.) that are critical to achieving further reductions in motor vehicle crashes, deaths and injuries. Behavioral research provides an evidence-based foundation for State and community traffic safety programs.

Research is needed to identify more effective and efficient countermeasures for existing traffic risks such as alcohol-impaired driving, drug-impaired driving, speeding, and nonuse of seat belts, and to develop new solutions for emerging and resurgent problems such as pedestrian and bicyclist safety, motorcycle safety, driver fatigue and distracted driving.

The objective of the DADSS program is to develop a system that can accurately and reliably detect when a driver is above the legal alcohol limit and that could be offered as original equipment in new cars on a voluntary, market-driven basis. The automatic system would be enabled every time the car starts, but unobtrusive so it would not pose an inconvenience to the non-intoxicated driver.

Anticipated Program Activities: During FY 2018 the Highway Safety Research Program will continue to build on the accomplishments of FY 2017. Below are examples of research activities planned for FY 2018:

Impaired Driving

- Complete studies documenting the State of Practice regarding the implementation and operation of ignition interlock programs and continue to examine strategies to increase use of ignition interlock devices for all DWI offenders.
- Initiate an evaluation of DWI Courts to identify evidence-based and promising practices, under the Ten Guiding Principles.
- Complete an evaluation of a demonstration of the "Community Oriented Policing" model as applied to alcohol-impaired-driving enforcement.
- Complete a National Survey on Attitudes and Behavior regarding Drinking, Drug Use and Driving.
- Initiate a study of the impact of Utah adopting a .08 BAC per se law on fatalities, crashes, and the criminal justice system.

Driver Alcohol Detection System for Safety

- In FY 2018, the Driver Alcohol Detection System for Safety (DADSS) research program will continue development and optimization of the next generation of breath-based and touch-based sensors. The program will also continue the pilot field operational trial for both sensors (to be initiated in 2017).

Drug-Impaired Driving

- Continue a study to develop a field test to detect drivers impaired by cannabis.
- Continue a large scale study of the effects of drugs and alcohol on crash risk in serious injury and fatal crashes.
- Conduct a series of studies to examine the feasibility of using new technology to detect marijuana or other drugs at roadside, which may use breath samples, oral fluid or other means for detection.
- Initiate a study of the role of marijuana use by drivers involved in crashes in which failures of executive function, cognition and reaction time appeared to play a role.

Occupant Protection

- Complete a study of part-time or occasional seat belt use using naturalistic driving data that will examine a variety of factors in determining when and where occasional users wear their seat belts.
- Continue to study the conditions surrounding correct and incorrect child restraint system use to develop responsive interventions to inform the annual cohort of new parents on the appropriate selection and proper use of restraints for their children.
- Complete an evaluation of a demonstration of the "Community Oriented Policing" model as applied to occupant protection enforcement.
- Continue research to help maintain seat belt use gains and inform effective occupant protection program resource allocation.
- Continue research to refine occupant protection programs by identifying psychological constructs and psychosocial factors related to seat belt use behavior.
- Conduct research on the awareness and availability of child passenger safety information resources to define and overcome barriers to use among child caregivers.
- Complete an evaluation of a demonstration of an integrated and sustainable seat belt enforcement program.

Pedestrian and Bicycle Safety

- Complete a study on the involvement of distraction in pedestrian crashes and continue a study of the impacts of high-visibility enforcement on driver compliance with bicycle right-of-way laws.
- Continue an effort to produce a report on the State of the Knowledge regarding Pedestrian and Bicycle Safety Research for use by State highway safety offices and other interested stakeholders.

Motorcycle Safety

- Complete a study that examines factors that may contribute to higher motorcycle helmet use rates in some States without universal helmet laws.
- Release initial results of a naturalistic riding study designed to better understand motorcycle riding behavior, risk taking, and willingness to engage in unsafe riding behaviors
- Complete and release a State of the Knowledge report regarding motorcycle safety for use by State highway safety offices and other interested stakeholders.

Safe Speeds

- Complete a study using data from the SHRP-2 Naturalistic Driving Data to better understand a number of questions related to speed-related behavior, including the relationship between speeding and crashes or near crashes.
- Complete and release a new National Traffic Speeds Survey and look at the trends in driving speeds across the country by roadway type and location.
- Continue a naturalistic study that involves the instrumentation of roadways to identify real-world speed-related problems.

Older Drivers

- Complete a naturalistic study of changes in older drivers' driving habits after the State imposes restriction on their driver licenses.
- Continue a study of older drivers' self-regulation and driving exposure focusing on the extent to which older drivers change their driving habits as their functional skills decline with aging.
- Continue studies of how older adults interact with in-vehicle technologies (such as navigation devices and rearview cameras) to determine whether these devices provide assistance in driving more safely or pose an unnecessary distraction.

Young and Novice Drivers

- Complete a study of monitoring and alerting technologies designed to assist novice drivers in improving their driving performance.
- Continue analysis to identify factors associated with teen crashes to support driver education.

Distracted Driving

- Continue research on how to convince drivers of the risks of multitasking while driving.
- Continue research on ways to measure and mitigate the lack of attention to the driving task (e.g., cognitive inattention).
- Continue analysis of the challenges faced by the police enforcing distracted-driving laws by identifying factors associated with law enforceability and defining practical enforcement strategies.

Driver Fatigue

- Continue research to quantify drowsy driving by exploring methods such as those used in alcohol data imputation to generate sound estimates of the magnitude of the problem.
- Complete a national survey of drowsy driving knowledge, attitudes, and behaviors to inform the development of education and other countermeasures for reducing the incidence of drowsy driving.
- Continue research to understand the current state of drowsiness detection and alerting systems as well as guide the future of such systems by determining what types of alerts are most effective.

EMS Research

- Continue research into the scope and nature of the fatigue problem in delivery of EMS services along with evidenced based guidelines on how to reduce the incidence of ambulance crashes and patient treatment errors in which fatigue played a role.

Cross-Cutting Research

- Release the latest version of Countermeasures That Work: A Highway Safety Countermeasure Guide for State Highway Safety Offices
- Initiate a multi-year effort to establish a national traffic citation and arrest tracking system. Police enforcement of traffic laws is a key component of past and current efforts to change driver behavior. However, the lack of a nationally representative database of traffic citations and arrests has prevented a clear evidence-based understanding of the relationship of the level of traffic enforcement to behavior change and crash reduction.

Expected Program Outcomes: Behavioral safety research has contributed significantly to the widespread adoption of numerous programs proven to reduce crashes. Examples include the national Click It or Ticket (CIOT) program, the adoption of Standardized Field Sobriety Tests (SFST) by law enforcement officers investigating potential impaired driving cases, passage of primary seat belt and distracted-driving laws, the national .08 BAC limit, advancement of Graduated Driver Licensing laws, greater understanding of older-driver issues, and development and testing of effective pedestrian and bicyclist safety programs. Proposed efforts in FY 2018 will continue to add evidence-based countermeasures.

Improved traffic behaviors by drivers and other roadway users are critical to achieving further reductions in motor vehicle fatalities. Behavioral research provides an evidence-based foundation for State and community traffic safety programs. Research undertaken in FY 2018 will identify more effective and efficient countermeasures for existing traffic risks such as alcohol-impaired driving, drugged driving, safe speeds and nonuse of seat belts, and to develop new solutions for emerging and resurgent problems such as pedestrian and bicyclist safety, motorcycle safety, driver fatigue and distracted driving.

The results of NHTSA's Highway Safety Research program are used to develop guidance for State and local highway safety programs. The research develops the data that help States and others prioritize their efforts toward the larger contributors to traffic crashes and

identifies new trends they should be aware of, while the results of our research and program evaluations help guide them toward spending scarce resources on programs with demonstrated effectiveness at reducing crashes, deaths and injuries and the cost of traffic crashes. While we make publicly available at no charge research reports for most individual research and program evaluation projects, this information is summarized biannually in a guidance document: Countermeasures That Work: A Highway Safety Countermeasure Guide for State Highway Safety Offices, www.nhtsa.gov/staticfiles/nti/pdf/812202-CountermeasuresThatWork8th.pdf.

For a more extensive list of research and program evaluation reports (with hyperlinks) we periodically put out a compendium of NHTSA's traffic safety research and evaluation project reports that covers hundreds of studies. The latest version of this compendium can be accessed by following this link: www.nhtsa.gov/staticfiles/nti/pdf/811847.pdf

Collaboration Partners: NHTSA collaborates with OST, FHWA and FMCSA on specific topics of driver behavior. Specifically, FHWA's Advanced Exploratory Research Program has been helpful to NHTSA. NHTSA is an active participant in the intermodal human factors coordinating committee. NHTSA also collaborates with FHWA and FMCSA on speed-related issues (the three agencies have an intermodal speed team that meets periodically to share project information and occasionally to more formally collaborate on joint projects). NHTSA shares responsibility for pedestrian and bicyclist safety in partnership with FHWA. We have funded a number of focus city grants (along with OST and FHWA) to address pedestrian and bicyclist safety. NHTSA works with the OST Office of Drug and Alcohol Policy and Compliance to ensure the accuracy of alcohol testing performed for the 60,000+ employees who work in safety sensitive positions, and to provide expert information on drug use by vehicle operators.

How Program Meets Statutory Requirements: The Behavioral Safety Research program meets the annual funding appropriations act requirements to conduct research into the behavioral causes of crashes (some 94% of crashes involve human error), to identity, develop, test and demonstrate new countermeasures to reduce the behavioral causes of crashes.

How Public and Stakeholder Input Have Been Utilized in the Development of This Research Program: The Highway Safety Research program receives input from our program offices, regional offices, State highway safety offices, non-governmental organizations, the Transportation Research Board Standing Committees that pertain to operator behavior, and a variety of other sources that factor into our research planning process.

Section 2
Research, Development & Technology, FY 2019

Office of Vehicle Safety Research

Crashworthiness

Program Description: To focus on vehicle safety countermeasures to reduce the number of fatal and serious injuries that occurs in the United States each year. This research program is responsible for developing and upgrading test procedures for evaluating motor vehicle safety and developing the test devices, such as crash test dummies, and appropriate injury metrics. Crashworthiness research encompasses new and improved vehicle design, biomechanics and injury causation, field data collection and analysis of serious injury cases, safety countermeasures and vehicle equipment to enhance occupant safety.

Program Objectives: The purpose of this research program is to investigate the problems of vehicle crash safety and associated factors (e.g., vehicle design, human response/injury tolerance) that contribute to serious injuries and fatalities. The near-term goal is to identify fatality and injury trends and to enhance safety requirements and best practices to improve crash occupant outcomes.

Anticipated Program Activities: Continue crash data evaluation, detailed field data collection and analysis, assessment of human injury response and tolerance, and safety test and test device (e.g., test dummy) development through laboratory testing, computer modeling and data evaluation programs. These research programs are designed to leverage private/public partnerships to assess the safety implications of current fleet crash data, vehicle design trends, and ongoing research efforts.

Expected Program Outcomes: NHTSA will continue to pursue the following activities in FY 2019 such as: Conduct vehicle design, simulation, and tests to leverage private/public partnerships to understand the safety implications for occupants of evolving light-weighted, fuel efficient vehicle designs. Complete assessment of the THOR 5th percentile female dummy in frontal, oblique, and rear seat test conditions. Evaluate the dummy's sensitivity to changes in crash type and restraint configurations. Current vehicle restraints provide reduced safety for obese and older occupants, which are becoming a larger portion of the population. Design and demonstrate occupant restraints to improve safety performance for vehicle occupants of these demographics. Evaluate how rear seat restraints could be improved for 10-year-old children. Assess how this safety would translate to other rear seat passengers. Complete research to reduce injuries from occupant contact with seat backs and other surfaces in the rear seats. Complete research to develop test procedures and demonstrate countermeasures to reduce occupant ejections through roof openings.

Collaboration Partners: NHTSA reviews and uses FMCSA studies on motor coach and heavy-truck crashes and fires. NHTSA reviews PHMSA standards on lithium ion battery safety. NHTSA collaborates with FHWA on developing and conducting crash simulation models.

How Program Meets Statutory Requirements: We will continue to collaborate with internal agencies on funding and other research programs.

How Public and Stakeholder Input Have Been Utilized in the Development of This Research Program: Conducted broad-based research meeting with automotive manufacturers, suppliers, and other stakeholders.

Crash Avoidance

Program Description: NHTSA has identified the need for an increased emphasis on crash avoidance technologies with significant potential to reduce fatalities and injuries by preventing the crash from occurring, or significantly reducing the severity of crashes by providing timely warnings to the driver to take appropriate action. Such technologies also may support automatic braking or steering interventions to provide additional safety benefits. Further, crash avoidance systems are precursors, and necessary building blocks, for automated vehicle technologies which are beginning to appear in vehicle manufacturers' and other entities' product development plans—and are even emerging in the marketplace today in early forms.

Program Objectives: NHTSA will continue to fulfill its mission of saving lives, preventing injuries, and reducing traffic related health care and other economic costs, by facilitating the development, deployment, and evaluation of safety products and systems. Among other things, this involves research into the science of crash avoidance to enable the development and evaluation of safety-enhancing products. The agency will continue to establish the safety goals for crash avoidance technology, develop performance guidelines and specifications for crash avoidance systems, evaluate the safety performance of such systems, and work with industry to demonstrate the most promising ones and to facilitate their deployment in the marketplace. These activities will be accomplished through the combined efforts of NHTSA, the automobile industry, and other technology companies, contractors, and academia working together under cooperative programs and partnerships that are sponsored by NHTSA.

Anticipated Program Activities: The program utilizes several methods and research tools to complete crash avoidance system development and evaluation. These include: development of objective test procedures for characterizing performance of production and/or prototype systems; establishing performance metrics for crash avoidance technologies that ensure a safety benefits are indeed realized; using modeling, simulation, and hardware-in-the-loop evaluation methods to accelerate testing as well as allow for examining system operations and performance under conditions that are either difficult or unsafe to complete using test-track methods; implementing real world field testing of the technologies to better understand system reliability, performance and customer acceptance aspects; and conducting a variety of market and technology research to better understand future developments and direction of crash avoidance technologies.

Expected Program Outcomes: The light-vehicle crash avoidance program is engaged in a body of research on driver assistance technologies that present safety warnings to drivers; can take control of the vehicle in crash imminent situations; modify unsafe driving behaviors such as distraction and alcohol impairment; and technologies to enhance the safety of vulnerable and at-risk populations such as teen drivers, older drivers, and pedestrians. NHTSA's research in crash avoidance technology will continue to focus on identifying emerging safety technologies, partnering with industry to develop more efficient and comprehensive testing methods, and enhancing our understanding of vehicle-driver interface issues; long-term safety impacts of these advanced technologies; and associated cyber security challenges and needs for architectural improvements. The result of this research investment will equip industry to build safety technologies that save lives and prevent injuries for all road users and mitigate potential unintended consequences.

The output of this work will help automotive manufacturers, suppliers, and other entities with improving their products through more accurate and efficient product evaluations. Furthermore, the field testing of new ADAS systems to be completed by NHTSA and industry partners will provide insights for further product refinements, as well as for developing programs to promote voluntary adoption of crash avoidance systems and enhance competitiveness among vehicle manufacturers and other entities for offering high value, high performance systems.

Collaboration Partners: NHTSA reviews and uses FAA, FRA, and Maritime research in the areas of automated vehicle technologies (for safety assessment, certification, standards), and cyber security (protections, approaches, policies, etc.). NHTSA collaborates with ITS JPO and FHWA on V2V and V2I research, DSRC spectrum testing, automated vehicle technologiesresearch (e.g., benefits assessment), and vehicle cyber security research (joint investment in NHTSA developing applied capabilities to develop best practices). Collaborates with FMCSA on heavy-vehicle crashworthiness research and rulemaking considerations and research for heavy vehicles (e.g., Electronic Stability Control rulemaking for trucks).

How Program Meets Statutory Requirements: We will continue to collaborate with internal agencies on funding and other research programs. The program meets the annual funding appropriations act's requirement to conduct crash avoidance research.

How Public and Stakeholder Input Have Been Utilized in the Development of this Research Program: Conducted broad-based research meeting with automotive manufacturers, suppliers, and other stakeholders.

Alternative Fuels Vehicle Safety

Program Description: Recently introduced vehicle engine technologies including hydrogen and advanced lithium ion battery vehicles are evolving at a fast rate. Additionally, the recent increase in Compressed Natural Gas (CNG) fueled heavy trucks has let to cause fueled concerns regarding the safety of these vehicle systems. NHTSA intends to continue the introduction new requirements to address the unique safety considerations for these evolving vehicle types. Federal safety regulations have not kept pace with the introduction of the more established lithium ion battery and CNG fueled vehicles.

Program Objectives: NHTSA is gathering information from all sources regarding the safety of emerging transportation fuels including battery, stored gas, and fuel cell technologies. This advanced knowledge is helping to focus the research projects, refine safety assessments, and develop performance tests. NHTSA is partnering with industry and other Federal agencies to develop appropriate safety performance for these alternative fuels vehicles.

Anticipated Program Activities: Continue fleet safety validation testing of high voltage traction battery systems; Conduct thermal propagation testing at the pack and full vehicle level to assess test procedure suitability and evaluate performance criteria; Assess battery management system functionality including all levels of charging; and Complete development and evaluation of lithium ion battery diagnostics that can detect damage prior to battery fire initiation.

Expected Program Outcomes: NHTSA is developing objective safety performance and diagnostic tests to enhance the safety of future electric drive vehicles. There has been frequent media attention to fires in lithium ion battery systems. NHTSA is partnering with several National Labs to develop and test diagnostic methods to detect damaged battery systems before fires can begin. NHTSA is developing test procedures to evaluate the safety of vehicles during charging operations. Additional testing is underway to examine the safety concerns for submerged vehicles. The agency will be conducting fleet testing to evaluate how vehicle designs can be affected by safety test practices. NHTSA works closely with the Department of Energy to anticipate safety considerations for new transportation fuel systems.

Collaboration Partners: Continue working with National laboratories (Sandia, ORNL, INL, and Argonne) to evaluate safety and develop test procedures. NHTSA is also coordinating research with the Naval Surface Weapons center, Department of Energy, Underwriters Laboratories, and the Government Lithium Ion Safety Group

How Program Meets Statutory Requirements: We will continue to collaborate with internal agencies on funding and other research programs.

How Public and Stakeholder Input Have Been Utilized in the Development of this Research Program: Conducted broad-based research meeting with automotive manufacturers, suppliers, and other stakeholders.

Vehicle Electronic and Emerging Technologies

Program Description: Driving automation systems have the potential to address the 94 percent of serious crashes that can be tied to human error or choices. Furthermore, highly automated driving systems (ADS) additionally offer efficient mobility to thousands of Americans currently lacking accessibility, and drive safety through innovation. On the automation spectrum, ADS refer to driving automation systems that perform the full dynamic driving task (SAE Automation Levels 3 – 5). The sooner these technologies are safely tested and deployed by the industry, the earlier the Nation can reap these benefits. The goal of the Vehicle Electronics and Emerging Technology research program is to advance the safe deployment of ADSs through advanced research that seeks to identify and remove regulatory barriers that hinder innovation while optimizing the safety benefits and mitigating inherent risks. Three rapidly emerging and related vehicle safety topics – highly automated driving systems, software intensive vehicles and vehicle cyber security – are main research trust areas within this program area.

Program Objectives: To keep pace with these rapidly changing and dynamic technologies, NHTSA will continue to perform collaborative, foundational research to facilitate industry's safe deployment of life-saving technologies with proven safety benefits and address emerging challenges associated with their safety and security assurance. This program conducts research to support agency decisions, leverage the unique role of government research to contribute to the aggregate body of knowledge on relevant advanced technologies that benefit the automotive community at large. Research is also performed to identify and assess the utility in facilitating, supporting and convening industry's collaboration to establish consensus based voluntary standards where needed. The transfer of vehicle control and the primary driving functions between the human to the machine highlight the needs for new methods for test, evaluation, validation and verification. In addition, this program performs research in emerging vehicle technologies with respect to electronics systems safety, software assurance and vehicle cyber security associated with ADS that build upon the knowledge gained in researching cyber security under the crash avoidance program area and expands to unique risks and vulnerabilities that emerge due to removal of the driver from the dynamic driving task.

Developing, testing, validating for purposes of deploying ADSs is a hard problem. As the technology providers are focused on pursuing multitude of approaches to get their technologies to work in differing ways, there are many overarching challenges that are emerging beyond the technology, such as the establishment of common safety principles, and generally accepted validation approaches with the objective of building public confidence in these technologies. NHTSA's research leverages industry's investments and technological innovation through close collaboration and frequent technical information

exchange and aims to fill the research gaps that benefit the broader and expanding industry at large.

In FY 2019, the Vehicle Electronics and Emerging Technologies program will focus on ADSs (technologies that are at SAE levels 3-5), build upon research completed in FY 2018 and initiate new projects to close identified gaps in support of agency decisions on automated vehicles, vehicle electronics reliability, safety-critical system software assessment, and cyber security. These activities aim to enhance the safety and security of automotive electronic control systems that employ automation, complex software and at-times, various forms of connectivity. This program also conducts research on emerging technologies that employ increasingly complex software systems and provide higher levels of vehicle automation which transfer increasing levels of the dynamic driving task from the human drivers to the automated driving system. Research will be performed to explore the multitude of human-machine-interface implications that arise from increasing levels of automation and the ultimate removal of all human control mechanisms. This division's work encompasses all fundamental control systems (e.g. steering, braking, throttle, motive power), as well as other safety critical systems.

Anticipated Program Activities: In FY 2019, NHTSA will pursue the following activities:

- Perform research into methods and performance metrics that can provide appropriate measure to assess the quality of risk management effectiveness for ADSs.
- Complete research on "takeover-ready driver" attributes and governing factors for SAE L3 systems and synthesize best practices.
- Establish research into the methods to measure and engender human trust and the mechanics of cognitive teaming in ADSs.
- Conduct preliminary research into potential applications of Cooperative Decision Making, Distributed Perception and Distributed Planning and how they might impact NHTSA's role and mission.
- Extend research into the complex distributed vehicle software as expanded to include the ADSs.
- Continue research with key stakeholders, including the automotive industry, standards setting organizations, and government agencies to refine safety principles for Automated Driving Systems and develop of test procedures and performance criteria for promising safety enhancing systems.
- Complete preliminary research to assess and update FMVSS test procedures for non-traditional vehicles.

Expected Program Outcomes: The focus of this effort will be to develop research findings and data to advance industry's safe testing and deployment of automated driving systems (SAE Levels 3-5). Through advanced, proactive and collaborative research, emerging challenges can be addressed in a timely manner such that transformative automated driving technologies with proven safety benefits can be introduced sooner. Agency data

gathering and strategic planning efforts as well as incoming research results will continue to guide agency research priorities in this area.

Collaboration Partners: This program will continue to carry out needed research in coordination with other offices and organizations and will also be closely coordinated with advanced crash avoidance and human factors research programs. Research collaboration is performed to leverage resources, knowledge and best practices with other Governmental entities including Department of Homeland Security (DHS), National Institute of Standards and Technology (NIST), Department of Defense (DOD), National Aeronautics and Space Administration (NASA), and the National Science Foundation (NSF).

How Program Meets Statutory Requirements: We will continue to collaborate with internal agencies on funding and other research programs.

How Public and Stakeholder Input Have Been Utilized in the Development of this Research Program: Conducted broad-based research meeting with automotive manufacturers, suppliers, and other stakeholders.

Vehicle Research and Test Center - Ohio

Program Description: The Vehicle Research and Test Center (VRTC) is NHTSA's in-house research, development, test, and evaluation facility located in East Liberty, Ohio. VRTC has access to world class testing facilities similar to those used by automotive suppliers and manufacturers. Research and testing activities conducted at the VRTC support agency decisions and actions with respect to new vehicle systems and issues; agency consumer information programs; test dummy development; injury criteria development; advanced research into cutting edge technologies; and safety issues that require quick reaction, including defect investigations. The full range of testing and research capabilities available to NHTSA at VRTC allows the agency to maximize its testing capabilities to more rapidly study emerging safety issues and more quickly provide benefits to the American public.

Program Objectives: In FY 2019, NHTSA requests $500 thousand for the Vehicle Research and Test Center program. Funding received in past years has been used to purchase cyber security test equipment, a limited amount of automated vehicle test equipment, pedestrian automatic emergency braking test apparatus, and a new tensile test machine (need for defects investigations and for crashworthiness and biomechanics research). Having this equipment at NHTSA's laboratory has allowed the agency to more quickly respond to cyber security incidents, defects, and consumer complaints and to better understand issues associated with automated vehicles and pedestrian automatic emergency braking.

Anticipated Program Activities: The FY 2019 funding will be used to procure equipment needed to conduct research and analysis of automated vehicles, cyber security, or other advanced technologies to support agency actions to improve safety on our Nation's roadways. With new sophisticated electronic control systems emerging in the market,

NHTSA needs to maintain a well-equipped and dedicated center to test, monitor, and investigate these and other emerging safety issues. Considerations for upgrading testing capabilities include instrumentation, hardware, software, and equipment for the following:

- Computer-aided tomography (CAT) scanner for cyber security research, defects investigations, and electronics reliability work
- Material and component composition/failure analysis
- Advanced technology and controls
- Automated vehicles
- Cyber security
- Electronics reliability

Expected Program Outcomes: Modern vehicles have evolved greatly over the last 35 years, and the advent of modern electronic controls, alternative fuels, and electric powertrains will drive that evolution even farther in the very near future. The expertise and technical capability of NHTSA's Vehicle Research and Test Center has been well demonstrated for over 40 years. Numerous high-profile programs have been successfully completed by VRTC in an expeditious and thorough manner. However, NHTSA has recognized the need to enhance the capabilities at VRTC for testing and analyzing emergent safety issues. Providing the capability of testing emergent technologies is necessary to maintain pace with the rapid advances in electronics and the resulting new safety issues. While enhancement of research capability in several areas has been identified, the most near-term critical are in cyber security, electronics reliability, and automated and connected vehicle systems. These are critical enhancements to keep pace with technology and to support the Agency's Office of Defects Investigations (ODI) when these emerging technologies become unsafe. It is critical that NHTSA's research, testing, and analysis capabilities be upgraded to ensure the safe implementation of new technologies and that potential defects in vehicles already out on U.S. roadways are quickly and comprehensively addressed. Enhancement of capabilities for material composition and failure analysis, particularly of electronic components, is also critical. The FY 2019 request will enable the VRTC to maintain and update the equipment and state-of-the-art facilities necessary to assess and investigate the rapid emergence of advanced automotive electronics technologies to assure the highest level of automotive safety for the American public.

Collaboration Partners: NHTSA will continue to collaborate with ITS JPO, FHWA and FMCSA on V2V, automated vehicle technologies (Human Factors research, standards research), and cyber security. We also plan to collaborate with FMCSA on cyber security best practices for heavy-vehicle aftermarket devices.

How Program Meets Statutory Requirements: We will continue to collaborate with internal agencies on funding and other research programs.

How Public and Stakeholder Input Have Been Utilized in the Development of This Research Program: Conducted Broad-based research meeting with automotive manufacturers, suppliers, and other stakeholders.

Automated Driving Systems

Program Description: To fulfill its mission, NHTSA needs a clear and comprehensive understanding of new vehicle designs and new technologies and how they perform in the real world with respect to safety. The Agency's research efforts are driven by its objective to ensure multi-industry, technology driven advances that requires a combination of public and private investments in technology, products, infrastructure, and standards. Particularly in disciplines that interface with public infrastructure and benefit a broad spectrum of the American public.

For safety problems that occur with high frequency and severity in the crash statistics, the Agency needs research to evaluate new safety countermeasures that can address these issues and/or new crash tests that can drive better occupant protective vehicle designs. Research efforts support Agency decisions with respect to new technologies and crash tests such that cost-effective life-saving technologies are adopted by industry. Research data also influences and supports industry decisions with respect to safety engineering of their vehicles, providing a neutral perspective and facilitating unbiased results on key issues to balance industry and safety advocate interests. On the other hand, when vehicles are deployed that develop a safety defect, Agency actions often need resources from its Office of Vehicle Safety Research to perform testing and analysis to support investigations.

Program Objectives: To accelerate the safe testing and deployment of Automated Driving Systems (ADSs – SAE Automation Levels 3-5) and other emerging technologies, NHTSA is planning a holistic approach to perform foundational research that builds upon the body of knowledge employed across the stakeholder community (including many new non-traditional, small startup companies who are developing novel and innovative designs), while coordinating a framework and prioritization for ADS sector-wide research needs. This strategy empowers private sector innovation and market competition while also employing an agile approach to facilitate collaboration, uniformity, and interoperability in a manner that accelerates the development, testing, validation, and deployment of promising life-saving technologies across the full spectrum of automated driving technologies. The principal objective is to focus on the most promising safety-enhancement segment of automation – ADSs – and align NHTSA activities to support and maintain the U.S.'s global leadership in their safe deployment through technological innovation and open market access.

This program area is focused on building the knowledge to support Agency decisions with respect to regulatory innovative updates needed to enable concepts, develop the necessary tools and knowledge to evaluate the safety of these systems, and perform the research necessary to determine if current tools can properly evaluate the safety of new vehicle designs. The research conducted under this program will also support the deployment of systems on commercial vehicles. NHTSA is addressing other core research associated with

these systems such as software safety, vehicle cyber security, and human factors needs under the Vehicle Electronics and Emerging Technologies program area.
Anticipated Program Activities: Specifically, with the $10 million per year incremental funding requested for 5 years, NHTSA plans to collaborate with industry to expeditiously and proactively address the visible (e.g., Federal Motor Vehicle Safety Standards (FMVSS) test procedures) and invisible (e.g., public confidence) barriers that challenge or may delay the rollout of ADSs on U.S. roadways. The increased funding level will involve work that will require multiple years to complete the research needs.

NHTSA anticipates the following funding and resource needs:

1) Enhance Research Efforts by Developing a Robust Program Geared Toward ADSs Designed for Use with Motor Vehicles or as Motor Vehicle Equipment ($10 million)

- Regulatory Barriers and Unnecessary Burdens ($4.5 million) - NHTSA sees a combination of both Agency and industry actions to address this issue. However, only NHTSA can directly change and amend FMVSS standards and/or associated compliance test procedures.

  i. Finalize updates to FMVSS test procedures that can be applied to vehicles with alternative designs that do not feature manual driving controls.
  ii. Support collaborative research with international stakeholders and governments to leverage research data from the international community to establish stronger basis for global standards and methods.

- Component and Systems Testing ($2 million) - Given the increasing use of complex electronics and software in safety critical vehicle control systems (steering, braking, and propulsion) and other vehicle systems that interact with them, NHTSA sees the need to take a leadership role in working with industry to make sure any new safety issues that are identified as potentially being caused by or in part by vehicle electronic systems, vehicle software, or otherwise, are well understood such that collectively government, industry, and the general public can assess what additional requirements, if any, may be needed in this area. Similarly, to Components Testing, NHTSA needs to be involved in Systems Testing for many of the same reasons, but also to develop objective repeatable performance tests that can be used by both government, industry, and other stakeholders to evaluate the safety performance of new vehicles and safety systems.

  i. Research on factors and metrics that differentiate “Perception systems’ capabilities” with respect to ADSs’ object and event detection and response (OEDR) needs independent of the control algorithms or actions.
  ii. New research to support and expedite the establishment of voluntary industry standards and approaches for novel simulation methods, tools, and testbeds beneficial to test and evaluate ADSs to address questions such as to identify a finite set of minimum test track tests that might be necessary.

iii. New research on mode specific considerations in collaboration with associated sister DOT agencies such as potential unique challenges of large trucks and buses.

- Alternative Designs ($3 million) – NHTSA's work on Alternative Designs will include collaboration with the industry to assist in developing the appropriate tests and new tools such that safety aspects can be comprehensively and accurately addressed.

  i. New research on unique Level 4+ vehicle design concepts such as on vehicles with non-standard seating configurations and implications on crashworthiness (Understanding of occupant protections in non-standard seating configurations).
  ii. New research on unique human-machine interaction (HMI) considerations such as monitoring of the state/fitness of occupants, whether there is such need and encouraging designs that minimize the need for driver interactions to ensure safety. Special emphasis will be made to spur innovation in this area.
  iii. Considerations for remote/wireless manual control of vehicle motions (teleoperations).
  iv. Implications on crashworthiness requirements if never intended to be occupied by humans (just for delivery).

- Continuous Improvement and Consumer Acceptance Efforts ($500,000) – As with any new technology, public trust and confidence needs to be instilled for acceptance. As lessons are learned, improvements can be made as necessary.

  i. New research towards consumer awareness, comprehension, and acceptance of automated driving technologies. This research will support the development of effective consumer educational materials and the need for an ongoing, comprehensive evaluation program as ADSs evolve.

Expected Program Outcomes: Due to flexible policies, proactive government involvement, public-private collaborative work, and innovation leadership inherent to the American culture and the market-driven investments, the US established an early worldwide leadership in ADSs development. NHTSA is particularly interested in researching key topics to enable the safe deployment of higher levels of ADSs that do not plan for a driver in the vehicle (or offer manual driving controls). Preliminary research indicates that there are significant safety enhancement potentials associated with the highest levels of ADSs (SAE Level 4 and Level 5 systems). The FY 2019 request and subsequent funding will enable expeditious and practical updates to FMVSS test procedures to accommodate non-standard vehicle design concepts and proactive mitigation of public perception concerns through improved transparency and a data-driven approach.

Collaboration Partners: NHTSA reviews and uses FAA, FRA, and, Maritime research in the areas of automated vehicle technologies (for safety assessment, certification, standards), and cyber security (protections, approaches, policies, etc.). NHTSA collaborates with ITS JPO and FHWA on V2V and V2I research, DSRC spectrum testing, automated vehicle technology research (e.g. benefits assessment, Human Factors research, standards research), and vehicle cyber security research (joint investment in NHTSA developing applied capabilities to develop best practices). The agency also collaborates with various other Federal agencies including DHS, FTC, etc.

How Program Meets Statutory Requirements: We will continue to collaborate with internal agencies on funding and other research programs.

How Public and Stakeholder Input Have Been Utilized in the Development of This Research Program: Conducted broad-based research meeting with automotive manufacturers, suppliers, and other stakeholders.

Office of Behavioral Safety Research

Highway Safety Research

Program Description: Highway Safety Research directly supports the Department and agency goals of reducing traffic crashes, fatalities and injuries by providing the scientific basis for the development of effective behavioral countermeasures to reduce the occurrence of traffic crashes. Behavioral Safety Research focuses on unsafe driving behaviors that contribute significantly to death and injury from crashes on our highways. Evaluation research documents the relative effectiveness of programs to reduce fatalities and injuries on our highways, and is critical to achieving further progress toward meeting national goals and performance targets. The results of the Highway Safety Research program assess existing and emerging highway safety problems and are disseminated to the States to use to identify effective traffic safety countermeasures for implementation through the highway safety formula grant (Section 402) funds and incentive grant funds (Section 405). Our highway safety research studies can be found at: www.nhtsa.gov/Driving+Safety/Research+&+Evaluation

Program Objectives: This research program is designed to find ways to change the behavior of drivers and other roadway users so increase safe behavior (seat belt use, child seat use, protective gear use by motorcycle riders, etc.) and reduce unsafe behaviors (alcohol- and drug-impaired driving, texting, speeding, etc.) that are critical to achieving further reductions in motor vehicle crashes, deaths and injuries. Behavioral research provides an evidence-based foundation for State and community traffic safety programs. Research is needed to identify more effective and efficient countermeasures for existing traffic risks such as alcohol-impaired driving, drugged driving, speeding and nonuse of seat belts, and to develop new solutions for emerging and resurgent problems such as pedestrian and bicyclist safety, motorcycle safety, driver fatigue and distracted driving.

Anticipated Program Activities: During FY 2019 the Highway Safety Research Program will start a number of new initiatives and continue to build on the progress made in several areas in FY 2018. Below are examples of research activities planned for FY 2019:

- **Impaired Driving –** The alcohol-impaired driving research program will continue to develop programs for law enforcement to reduce the incidence of alcohol impaired driving, use the results of current research on the impediments to increased use of ignition interlock devices to implement demonstration programs to increase utilization and evaluate their effectiveness, continue research evaluating the effectiveness of DWI Courts in reducing recidivism, and complete a study of the impact of Utah adopting a .05 BrAC law.

- **Driver Alcohol Detection System for Safety** – In FY 2019 the field test started in FY 2018 will continue. There will be continued analysis of the field operational test results as the program goes on there will be technology updates as appropriate.

- **Drug Impaired Driving –** The drug-impaired driving research program will continue research to develop a field test to detect drivers who have recently used marijuana (THC), complete data collection in three large Level 1 Trauma Centers in a large scale study of the role of drugs and alcohol in fatal and serious injury crashes, continue to examine development of model specifications for on-site drug screening devices.

- **Occupant Protection –** The occupant protection research program will complete research to evaluate how to better assist parents and caregivers on the correct installation of child restraint systems, continue to collect information on laws requiring rear seat belt use and analyze their relationship to restraint use, and continue research on the awareness and availability of child passenger safety information resources to define and overcome barriers to child safety seat use among child caregivers.

- **Pedestrian and Bicycle Safety** – The pedestrian and bicycle research program will complete a study of the impacts of high-visibility enforcement on driver compliance with bicycle right-of-way laws.

- **Motorcycle Safety –** The motorcycle safety research program will complete research to determine whether an exposure measure (vehicle miles traveled or VMT) can be developed in States that have an annual motorcycle safety inspection requirement and will complete research examining barriers to increasing the conspicuity of motorcycles and motorcycle riders.

- **Safe Speeds** – The speed research program will release the initial results of a naturalistic instrumentation of roadways study.

- **Older Drivers** – The older driver research program will complete research on older drivers' self-regulation and driving exposure that will focus on the extent to which older drivers change their driving habits as their functional skills (vision, cognition, reaction time, and other aspects of driving performance decline with aging),and continue studies of how older drivers interact with in-vehicle technologies (such as navigation devices and collision warning and active prevention systems.

- **Young and Novice Drivers** – The young and novice driver research program will continue a field evaluation of an enhanced hazard perception training program to determine whether it provides a greater reduction in subsequent crashes for novice drivers than a previous short-term program produced, and continue to analyses to identify factors associated with teen crashes.

- **Distracted Driving** – The distracted driving research program will continue research on how to convince drivers of the risks of multitasking while driving and continue to assess ways to measure and mitigate the lack of attention to the driving task (e.g., mind wandering).

- **Driver Fatigue** – The driver fatigue research program will complete an effort to quantify drowsy driving by examining alternative approaches to impute drowsiness as a crash factor and continue to assess drowsy driving alerting systems in order to guide future developments.

- **EMS Research** – The EMS research program will continue research to monitor and evaluate the adoption of evidence based guidelines on how to reduce the incidence of ambulance crashes and patient treatment errors in which fatigue played a role that were released in 2017 and continue research into the scope and nature of the fatigue problem in delivery of EMS service.

- **Cross-Cutting Research** – NHTSA will continue its partnership with the National Safety Council in an initiative called "Road to Zero" designed to eliminate traffic fatalities within 30 years. This involves a role on the coalition steering committee and funding for research. NHTSA will also continue a multi-year effort to establish a national traffic citation and arrest tracking system. Police enforcement of traffic laws is a key component of past and current efforts to change driver behavior. However, the lack of a nationally representative database of traffic citations and arrests has prevented a clear evidence-based understanding of the relationship of the level of traffic enforcement to behavior change and crash reduction.

Expected Program Outcomes: The results of NHTSA's Highway Safety Research program are used to develop guidance for State and local highway safety programs. The research develops the data that help states and others prioritize their efforts toward the larger contributors to traffic crashes and identifies new trends they should be aware of, while the results of our research and program evaluations help guide them toward spending scare resources on programs with demonstrated effectiveness at reducing crashes, deaths and injuries and the cost of traffic crashes. While we make publicly available at no charge research reports for most individual research and program evaluation projects, this information is summarized biannually in a guidance document: Countermeasures That Work: A Highway Safety Countermeasure Guide for State Highway Safety Offices, www.nhtsa.gov/staticfiles/nti/pdf/812202-CountermeasuresThatWork8th.pdf.

For a more extensive list of research and program evaluation reports (with hyperlinks) we put periodically put out a compendium of NHTSA's traffic safety research and evaluation project reports that covers hundreds of studies. The latest version of this compendium can be accessed by following this link: http://www.nhtsa.gov/staticfiles/nti/pdf/811847.pdf

Collaboration Partners: NHTSA will continue to provide guidance to the States as they design their state highway safety programs by providing critical data and other information they can use, as well as evidenced based programs to implement. We collaborate with other Federal agencies as appropriate (e.g., with FHWA and FMCSA on an

intermodal team focusing on speeding, with FHWA on pedestrian and bicycle safety, with FHWA, FMCSA, FTA and others on older adult safe mobility). NHTSA works with the OST Office of Drug & Alcohol Policy & Compliance to ensure the accuracy of alcohol testing performed for the 60,000+ employees who work in safety sensitive positions, and to provide expert information on drug use by vehicle operators.

How Program meets Statutory Requirements: The Highway Safety Research Program is conducted in full compliance with all statutory requirements provided in our authorizing legislation and annual appropriation bills.

Describe how public and stakeholder input have been utilized in the development of this research program: NHTSA solicits information needs from our primary and secondary customers. These include the States, our regional offices, non-governmental organizations (e.g., safety organizations like Mothers Against Drunk Driving, Safe Kids and the Network of Employers for Traffic Safety; law enforcement organizations like the International Association of Chiefs of Policy and National Sheriffs Association; and other interested parties) in preparing our annual research plans. We also communicate regularly and sometime collaborate with other Federal agencies that get involved in traffic safety like the Centers for Disease Control and Prevention, the National Institute for Drug Abuse, the National Institute for Alcoholism and Alcohol Abuse, the Substance Abuse and Mental Health Services Administration, the National Institute of Justice, and the Office of Drug Control Programs. We also collaborate with some other safety organizations like the National Safety Council ("Road to Zero" coalition), the Insurance Institute for Highway Safety, the Traffic Injury Research Foundation, and the American Automobile Association Foundation for Traffic Safety.