BUDGET ESTIMATES

FISCAL YEAR 2021

FEDERAL RAILROAD ADMINISTRATION

SUBMITTED FOR THE USE OF
THE COMMITTEES ON APPROPRIATIONS

DEPARTMENT OF TRANSPORTATION
FEDERAL RAILROAD ADMINISTRATION

FY 2021 PRESIDENT'S BUDGET JUSTIFICATION

TABLE OF CONTENTS

DEPARTMENT OF TRANSPORTATION
FEDERAL RAILROAD ADMINISTRATION

ADMINISTRATOR'S OVERVIEW

Every day, Americans take more than one billion trips, by car, bus, train, boat and aircraft. The U.S. Department of Transportation's (DOT) top priority is to help them make these trips safely. The mission of the DOT is to ensure our Nation has the safest, most efficient and modern transportation system in the world, which improves the quality of life for all American people and communities, from rural to urban, and increases the productivity and competitiveness of American workers and businesses.

Safe, reliable and affordable transportation boosts exports, enhances commerce and powers economic growth. It provides Americans access to employment, education, and recreation. It allows for easier travel, wider access to health care, and faster response of first responders during emergencies. Our multimodal transportation system has enabled the United States to become the most vibrant and powerful Nation in history. To improve safety, increase economic growth, and enhance quality of life, DOT is focused on rebuilding and refurbishing America's infrastructure. It partners with State and local governments to address infrastructure needs – from roads and bridges to aviation, rail, transit and pipelines.

This Administration would like to do even more, because while our transportation system has had many successes, it also faces significant challenges. For example, the 2019 Urban Mobility Report found congestion in urban areas cost commuters an estimated $179 billion in wasted fuel and time in 2017. The percentage of vehicle miles traveled on the National Highway System pavement in "good" condition was only 62 percent in 2018. There were 16,764 bridges on the Federal-aid highway system in poor condition in 2018. The transit maintenance backlog is projected to reach $116 billion by 2034. Many transportation projects, especially larger ones, still take too long to receive an environmental permitting decision, delaying their benefits. While showing recent signs of improvement, far too many fatalities and injuries continue to occur year after year on the Nation's roads, and pedestrian and bicyclist deaths are rising.

With the expiration of the Fixing America's Surface Transportation (FAST Act) in September, the time to take bold action to address these and other challenges is now. Therefore, the Fiscal Year (FY) 2021 President's Budget request includes $810 billion for a 10-year surface transportation reauthorization proposal for the DOT, Federal Highway Administration (FHWA), Federal Transit Administration (FTA), Federal Railroad Administration (FRA), the National Highway Traffic Safety Administration (NHTSA), the Federal Motor Carrier Safety Administration (FMCSA), and the Pipeline and Hazardous Materials Safety Administration (PHMSA) hazardous materials programs. The reauthorization would run from fiscal year 2021 through 2030—providing predictable funding levels for an entire decade.

In the coming months, the Administration will submit a comprehensive surface transportation reauthorization proposal to the Congress for consideration. The FY 2021 Budget includes an additional $190 billion for other infrastructure improvements, including bridges, freight bottlenecks and landside port infrastructure. It will also provide first responders with near real-time emergency response information.

This proposal will build upon the success of the FAST Act. Over the 10-year period, the 2021 Budget proposes an eight percent increase for highway and transit formula programs from the last year of the FAST Act. The Budget also provides for a 3.8 percent increase to NHTSA and FMCSA from the last year of the FAST Act. Similar to the FAST Act, the proposal also authorizes General Fund programs for NHTSA, FTA, FRA, PHMSA and OST. This unprecedented 10-year authorization will provide long-term stable and predictable investment that will help ensure that America has a safer, more reliable, and more efficient transportation system.

The Budget provides historic levels of funding to make our highways, bridges, tunnels, transit and rail systems the best in the world. This long-term funding commitment provides certainty to our State, local, and private partners, so that they can effectively plan, finance, and deliver vital projects. The proposal will build upon the gains of past reauthorizations from program consolidation, simplification, and flexibility, while re-focusing the Federal role on activities that advance National goals. This investment will enable people to travel more safely and efficiently, and support continued economic growth.

Improving Transportation Safety: Traffic fatalities have declined 32 percent since 1972. That's remarkable, especially considering that there has been a 153 percent increase in vehicle miles travelled. In fact, the fatality rate in 1972 was nearly four times higher than it is today. This reduction in fatalities is attributable in part to improvements in roadway and vehicle designs. It is estimated that projects implemented using Highway Safety Improvement Program funds save 600 lives every year. The Administration's proposed bill will help further reduce those fatalities, ensuring more Americans make it home safely.

Transportation safety and accessibility is improved by modernizing, expanding eligibility for, and standardizing existing successful programs. For example, updating the Highway Safety Improvement Program to include additional proven strategies for improving safety, modernizing the Railway-Highway Crossing Program to reflect changing technologies and to offer greater flexibility for States to enhance safety, and by ensuring that the safety practices of public transportation systems are considered for FTA-funded projects.

Building Infrastructure More Efficiently: Extensive project review times are preventing projects from being completed in a timely fashion. Reducing the environmental review and permitting timeline will reduce project costs, and help avoid delays to needed projects. These

reforms will improve the efficiency and transparency of the environmental review process while protecting critical environmental resources.

DOT is helping projects get started and completed more easily with a cohesive set of reforms to the environmental review and permitting process that will reduce regulatory burdens, increase government efficiency and empower State and localities. These reforms will protect the environment while delivering projects in a less costly and more timely manner by reducing duplication in Federal responsibilities, codifying aspects of One Federal Decision, and delegating more responsibility to State and local partners. In addition, the proposal includes resiliency provisions to codify efforts within current programs.

***Reducing Regulatory Burdens and Increasing Government Efficiency*:** Improvement of regulations is a continuous focus for the Department. There should be no more regulations than necessary, and those regulations should be straightforward, clear, and designed to achieve their objective and minimize burdens.

This legislative proposal will advance the work to update or reduce outdated, duplicative, and unnecessarily burdensome regulations that do not enhance safety. In addition, the legislation will reduce administrative burdens on grantees by consolidating grant programs at NHTSA and FTA. These commonsense updates will save, respectively, hundreds of millions of dollars a year that can be better spent on creating new jobs, training and safety.

***Investing in Both Urban and Rural America*:** The disparity in resources has safety and economic ramifications. Rural America comprises nearly 70 percent of roadways and those roads carry 47 percent of America's truck traffic. Though only 20 percent of Americans reside in rural areas, 46 percent of traffic fatalities occur on rural roads. The state of infrastructure in rural regions impacts the residents, travelers—44 percent of whom are urban dwellers—and regional and interstate commerce.

This legislation will ensure that communities Nationwide are supported by DOT program enhancements; refinements to passenger rail programs to enhance transparency and project development and delivery; and authorizing BUILD and INFRA Transportation grants, ensuring equity between rural and urban America.

Empowering State and Local Authorities: States and localities are best equipped to understand the infrastructure needs of their communities. The Federal Government should provide support and incentives for communities to achieve their local needs. DOT's surface transportation reauthorization proposal has been developed after listening to and working with our State and local partners to ensure that the Federal role is one of help, not hindrance. The proposal will right-size the Federal role in areas where States and localities can make more tailored and efficient decisions, and provide our State and local partners with funding certainty and programmatic continuity over the long-term.

States would be empowered to make more tailored and efficient decisions with NHTSA and FMCSA safety incentive and grant funding to address their local safety needs, including allowing States additional transfer authorities to focus on drug-impaired driving. In addition, the legislation reduces the Federal involvement in outdoor advertising leaving more of the decision making to the States.

***Taking Care of What You Have*:** Underinvestment in transportation has led to a backlog of needs throughout the transportation system. DOT will help restore and modernize existing infrastructure by focusing on State of Good Repair needs in public transportation, transforming the National passenger rail network to provide better transportation options to rural and urban areas, and enhancing PHMSA's hazardous materials inspection and investigation activities.

***Preparing for the Future*:** We have entered an historic period of transportation innovation that promises to boost economic growth and improve quality of life for all Americans. These innovations are occurring in all modes of transportation, including roads, rail, maritime, and aerospace. The Department is helping to chart a course for the safe integration of these innovations into our National transportation network.

The legislation includes provisions DOT supported in key automated vehicle bills proposed in Congress. In addition, the proposal would enhance PHMSA's ability to partner with its stakeholders and leverage automated vehicle technologies and other innovations with potential to improve hazardous materials transportation safety.

By incentivizing new investment in infrastructure, eliminating overly burdensome regulations, and encouraging innovation, the Department is helping to improve our quality of life and build a brighter future for all Americans.

Federal Railroad Administration: The Federal Railroad Administration's (FRA) mission is to enable the safe, reliable, and efficient movement of people and goods for a strong America, now and in the future. FRA executes this mssion by developing and enforcing minimum safety standards, promoting non-regulatory safety improvement initiatives, facilitating regional rail planning, managing Federal investments in rail services and infrastructure, and fostering research and development to advance innovative technologies and best practices.

Railroads were integral to making the United States the most vibrant and powerful nation in history, permitting westward expansion and connecting cities for a century before construction of the interstate system. Today, America's unrivaled freight rail network continues to be an indispensable part of our intermodal transportation system and national economy. Similarly, intercity passenger and commuter railroads provide safe and reliable access to employment, education, and recreation for millions of Americans every day. To improve safety, increase economic growth, and enhance quality of life, DOT is focused on rebuilding and refurbishing America's infrastructure. It partners with state and local governments to address infrastructure needs – from roads and bridges to aviation, rail, transit and pipelines.

Despite its success, America's multimodal transportation system faces significant challenges. In the coming months, the Administration will submit a comprehensive surface transportation reauthorization proposal to Congress for consideration. The FY 2021 Budget includes an additional $190 billion for other infrastructure improvements, including bridges, freight bottlenecks and landside port infrastructure. It will also refocus the Federal role on activities that advance national goals by incorporating successful changes in program consolidation, simplification, and flexibility, that empower and enable State, local, and private partners to more effectively plan, finance, and deliver vital projects. By incentivizing new investment in infrastructure, eliminating overly burdensome regulations, and encouraging innovation, the Department is helping to improve our quality of life and build a brighter future for all Americans. This unprecedented 10-year proposal will build upon the success of the FAST Act and past reauthorizations, by providing long-term stable and predictable funding, including authorization of FRA general fund programs.

The FY 2021 President's Budget requests $2.0 billion, offset by $50.0 million in rail safety user fees, including $1.8 billion for competitive and Amtrak grants, $225.6 million for the Safety and Operations account, and $41.0 million for the Research and Development account. This request and the initiatives proposed for funding include programs that are part of the Administration's surface transportation reauthorization proposal. The unprecedented 10-year proposal will authorize $16.6 billion for FRA-managed programs. Such predictable investment levels will enable our State, local, and private partners to plan, finance, and deliver vital projects effectively and efficiently. The FY 2021 President's Budget and the surface transportation reauthorization proposals support three Department-wide priorities.

Improving Transportation Safety: The FY 2021 President's Budget and the reauthorization proposal encourages innovation, data analysis and greater state flexibility to address grade crossing safety and trespassing on railroad rights-of-way—the leading causes of rail-related deaths. The reauthorization proposal will also include opportunities to evaluate positive train control (PTC) technologies as building blocks for continued innovation that advances railroad safety, reliability, and efficiency. In FY 2021, FRA will continue proactively overseeing the railroads' implementation of PTC systems through activities including technical assistance, testing oversight, and review of updated PTC implementation plans, type approvals, and safety plans. Additionally, the FY 2021 President's Budget requests funds to leverage stakeholder partnership programs, such as the Confidential Close Call Reporting System.

The FY 2021 President's Budget also requests $41.0 million in the Research and Development account to continue building the science-based understanding of railroad systems and deploying innovative technologies. FRA's request includes resources for ensuring PTC safety performance and reliability do not degrade as railroads begin using PTC systems to optimize rail system capacity and scheduling. The future of railroads includes automation of operations, inspections,

equipment, and safety processes. FRA is maintaining and building future capability to understand the safety implications of these significant technology changes in the railroad industry.

Transforming Passenger Rail: The surface transportation reauthorization proposal encourages greater federal, state and local collaboration regarding passenger rail services to meet the changing needs of the traveling public. Amtrak's national network routes serve the same markets today as they did when Congress created the corporation 50 years ago, and as such, Amtrak is challenged to provide customers with the services they need or demand. The proposal provides for the future of intercity passenger rail service, which will focus on high-performing regional corridor services connecting markets between 100 and 500 miles apart. Enabling States to play a larger role in shaping intercity passenger rail services will improve financial results and increase accountability for on-time performance. Additionally, FRA provides grants through the Consolidated Rail Infrastructure and Safety Improvement program to leverage private, state, and local investments that improve infrastructure for freight and intercity passenger rail.

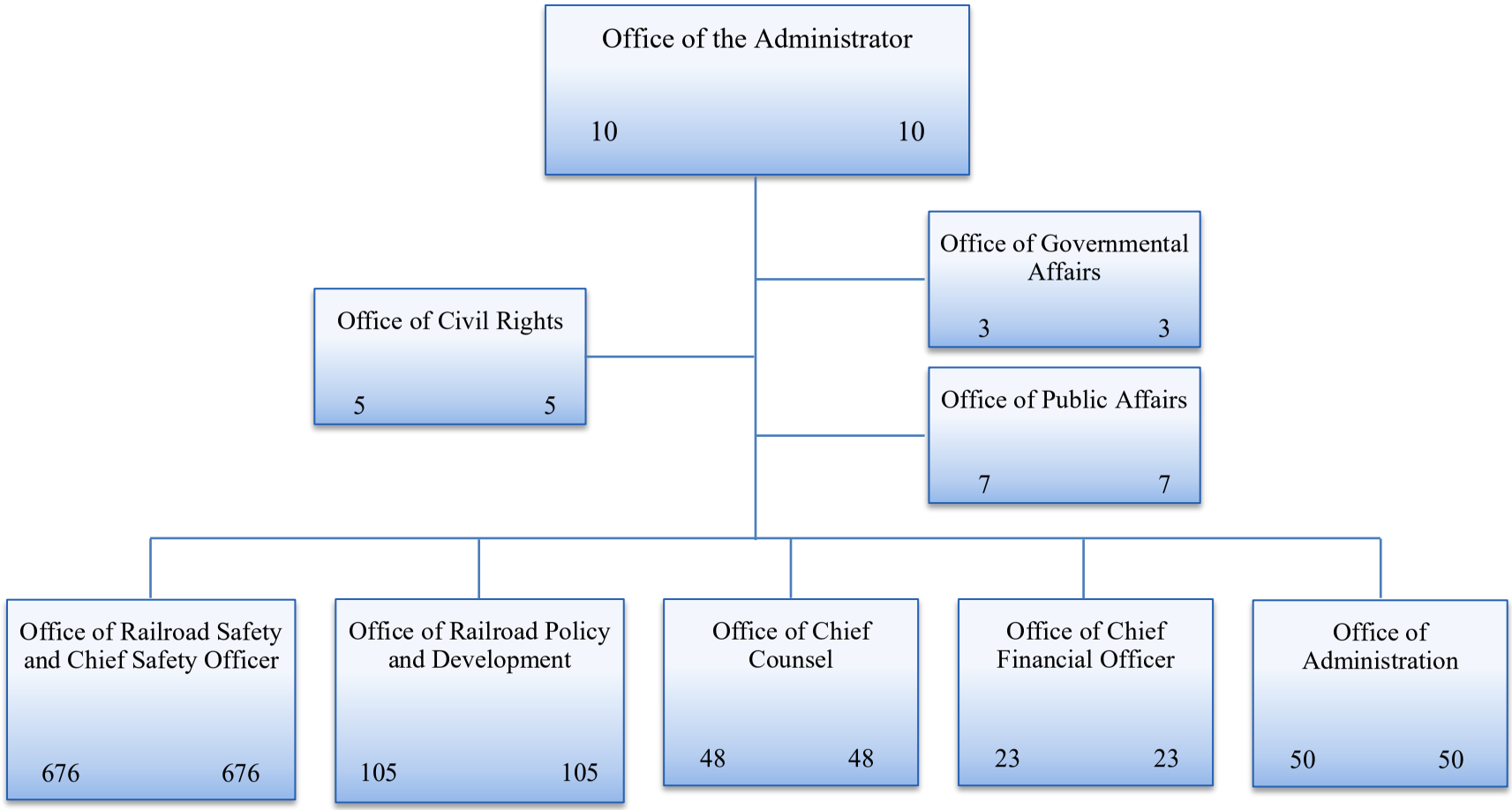
Reducing Regulatory Burdens and Increasing Government Efficiency: The surface transportation reauthorization proposal advances the Administration's project delivery streamlining efforts to harmonize FRA requirements with FHWA and FTA to reduce costs, uncertainty, and the length of project reviews. The proposal also evaluates whether existing regulations properly consider evolving technologies and operating practices within the railroad industry. FRA is actively reforming regulations to reduce the cost of compliance, while maintaining minimum safety standards. For example, FRA updated Federal regulations to establish alternate crashworthiness and occupant protection standards that enable development of advanced passenger equipment, increase safety, and reduce the regulatory burden by about $33 million per year. Regulatory projects that FRA expects to finalize in FYs 2020 and 2021 will further reduce the annual compliance burden significantly more.

The U.S. rail network is critical to national economic productivity and serves an indispensable role in fulfilling the freight and passenger mobility needs of a population projected to increase by more than 55 million people over the next 25 years. This FY 2021 budget request will help FRA continue to enable continuous safety, reliability, and efficiency improvements. The more effective we are in advancing rail safety with data-driven decision making and innovative technologies, the more likely we are to save lives; reduce the number of injuries, accidents, and transportation disruptions; and mitigate adverse economic impacts.

DEPARTMENT OF TRANSPORTATION
FEDERAL RAILROAD ADMINISTRATION

FY 2020 Organization Chart

927 Full-Time Positions (FTP); 927 Full-Time Equivalents (FTE)



DEPARTMENT OF TRANSPORTATION
FEDERAL RAILROAD ADMINISTRATION

FY 2021 Organization Chart

920 Full-Time Positions (FTP); 920 Full-Time Equivalents (FTE)

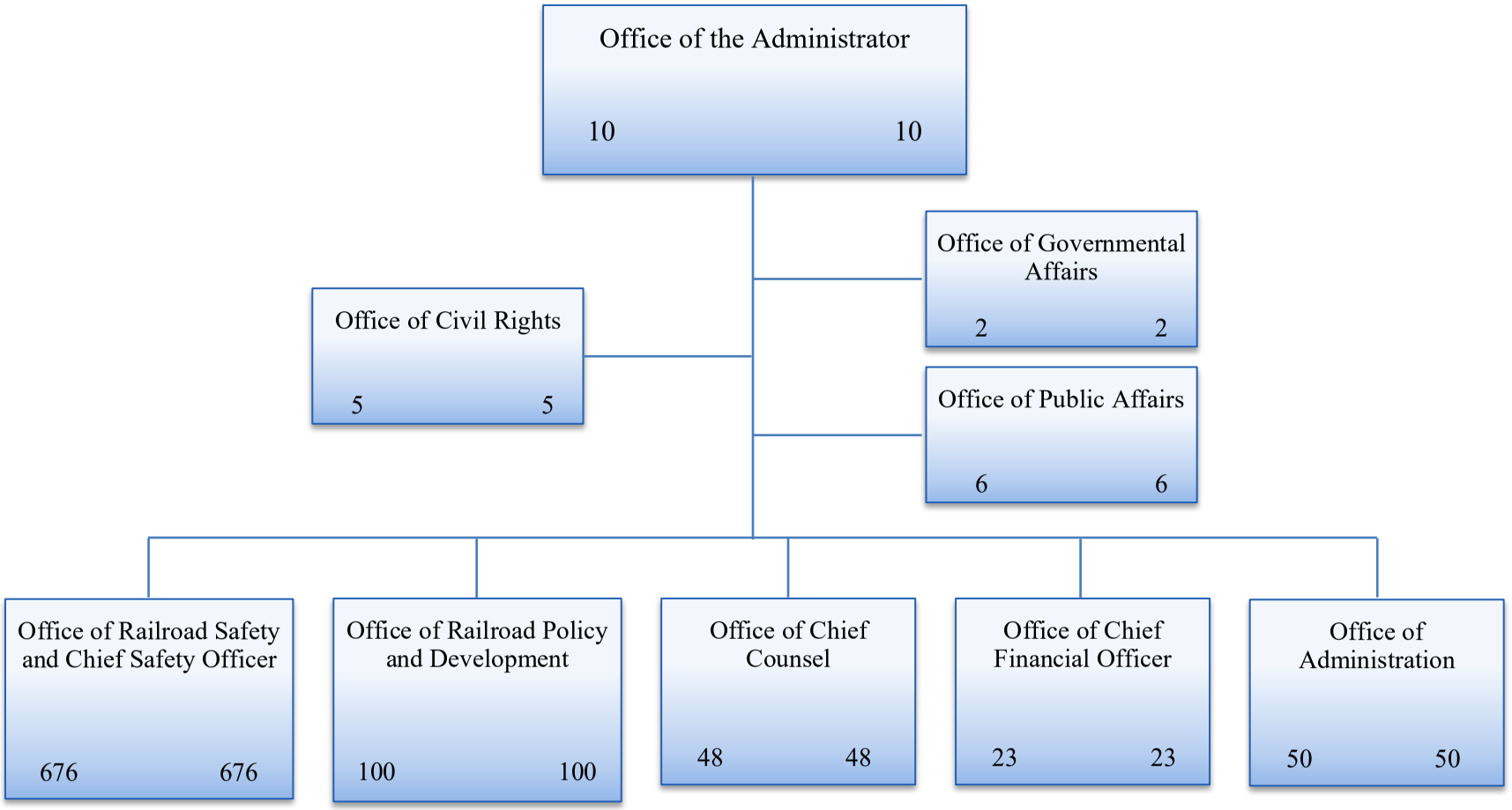


EXHIBIT II-1
FY 2021 BUDGET AUTHORITY
FEDERAL RAILROAD ADMINISTRATION
($000)

ACCOUNT NAME	M / D	(A) FY 2019 ACTUAL	(B) FY 2020 ENACTED	(C) FY 2021 REQUEST
SAFETY AND OPERATIONS	**D**	$ 221,698	$ 224,198	$ 175,634
Appropriations		$ 221,698	$ 224,198	$ 225,634
Rail Safety User Fee		$ -	$ -	$ (50,000)
RAILROAD RESEARCH AND DEVELOPMENT	**D**	$ 40,600	$ 40,600	$ 41,000
NORTHEAST CORRIDOR GRANTS TO THE NATIONAL RAILROAD PASSENGER CORPORATION	**D**	$ 650,000	$ 700,000	$ 325,466
NATIONAL NETWORK GRANTS TO THE NATIONAL RAILROAD PASSENGER CORPORATION	**D**	$ 1,291,600	$ 1,300,000	$ 611,000
NATIONAL NETWORK TRANSFORMATION GRANTS	**D**	$ -	$ -	$ 550,000
CONSOLIDATED RAIL INFRASTRUCTURE AND SAFETY IMPROVEMENTS	**D**	$ 255,000	$ 325,000	$ 330,000
FEDERAL-STATE PARTNERSHIP FOR STATE OF GOOD REPAIR	**D**	$ 400,000	$ 200,000	$ -
RESTORATION AND ENHANCEMENT GRANTS	**D**	$ 5,000	$ 2,000	$ -
MAGNETIC LEVITATION TECHNOLOGY DEPLOYMENT PROGRAM	**D**	$ 10,000	$ 2,000	$ -
RAILROAD REHABILITATION AND IMPROVEMENT FINANCING PROGRAM [1/]	**D**	$ -	$ -	$ -
CAPITAL ASSISTANCE FOR HIGH SPEED RAIL CORRIDORS AND INTERCITY PASSENGER RAIL SERVICE	**D**	$ -	$ -	$ (55,364)
Rescissions		$ -	$ -	$ (55,364)
RAIL LINE RELOCATION AND IMPROVEMENT PROGRAM	**D**	$ -	$ -	$ (12,650)
Rescissions		$ -	$ -	$ (12,650)
CAPITAL AND DEBT SERVICE GRANTS TO THE NATIONAL RAILROAD PASSENGER CORPORATION	**D**	$ -	$ -	$ (10,414)
Rescissions		$ -	$ -	$ (10,414)
RAILROAD SAFETY TECHNOLOGY PROGRAM	**D**	$ -	$ -	$ (613)
Rescissions		$ -	$ -	$ (613)
INTERCITY PASSENGER RAIL GRANT PROGRAM	**D**	$ -	$ -	$ (9,868)
Rescissions		$ -	$ -	$ (9,868)
NEXT GENERATION HIGH SPEED RAIL	**D**	$ -	$ -	$ (3,019)
Rescissions		$ -	$ -	$ (3,019)
TOTALS				
Gross New Budget Authority		**$ 2,873,898**	**$ 2,793,798**	**$ 2,083,100**
Rescissions		**$ -**	**$ -**	**$ (91,929)**
Transfers		**$ -**	**$ -**	**$ -**
Offsets		**$ -**	**$ -**	**$ (50,000)**
NET NEW BUDGET AUTHORITY:		**$ 2,873,898**	**$ 2,793,798**	**$ 1,941,171**
[Mandatory BA]		$ -	$ -	$ -
[Discretionary BA]		$ 2,873,898	$ 2,793,798	$ 1,941,171

[1/] For FY 2019 through FY 2021, the Railroad Rehabilitation and Improvement Financing Program account will be reflected in the Office of the Secretary's budget document.

EXHIBIT II-2
FY 2021 TOTAL BUDGETARY RESOURCES BY APPROPRIATION ACCOUNT
FEDERAL RAILROAD ADMINISTRATION
Appropriations, Obligation Limitations, and Exempt Obligations
($000)

ACCOUNT NAME	M / D	(A) FY 2019 ACTUAL	(B) FY 2020 ENACTED	(C) FY 2021 REQUEST
SAFETY AND OPERATIONS	**D**	$ 221,698	$ 224,198	$ 175,634
Appropriations		$ 221,698	$ 224,198	$ 225,634
Rail Safety User Fee		$ -	$ -	$ (50,000)
RAILROAD RESEARCH AND DEVELOPMENT	**D**	$ 40,600	$ 40,600	$ 41,000
NORTHEAST CORRIDOR GRANTS TO THE NATIONAL RAILROAD PASSENGER CORPORATION	**D**	$ 650,000	$ 700,000	$ 325,466
NATIONAL NETWORK GRANTS TO THE NATIONAL RAILROAD PASSENGER CORPORATION	**D**	$ 1,291,600	$ 1,300,000	$ 611,000
NATIONAL NETWORK TRANSFORMATION GRANTS	**D**	$ -	$ -	$ 550,000
CONSOLIDATED RAIL INFRASTRUCTURE AND SAFETY IMPROVEMENTS	**D**	$ 255,000	$ 325,000	$ 330,000
FEDERAL-STATE PARTNERSHIP FOR STATE OF GOOD REPAIR	**D**	$ 400,000	$ 200,000	$ -
RESTORATION AND ENHANCEMENT GRANTS	**D**	$ 5,000	$ 2,000	$ -
MAGNETIC LEVITATION TECHNOLOGY DEPLOYMENT PROGRAM	**D**	$ 10,000	$ 2,000	$ -
RAILROAD REHABILITATION AND IMPROVEMENT FINANCING PROGRAM [1/]	**D**	$ -	$ -	$ -
CAPITAL ASSISTANCE FOR HIGH SPEED RAIL CORRIDORS AND INTERCITY PASSENGER RAIL SERVICE	**D**	$ -	$ -	$ (55,364)
Rescissions		$ -	$ -	$ (55,364)
RAIL LINE RELOCATION AND IMPROVEMENT PROGRAM	**D**	$ -	$ -	$ (12,650)
Rescissions		$ -	$ -	$ (12,650)
CAPITAL AND DEBT SERVICE GRANTS TO THE NATIONAL RAILROAD PASSENGER CORPORATION	**D**	$ -	$ -	$ (10,414)
Rescissions		$ -	$ -	$ (10,414)
RAILROAD SAFETY TECHNOLOGY PROGRAM	**D**	$ -	$ -	$ (613)
Rescissions		$ -	$ -	$ (613)
INTERCITY PASSENGER RAIL GRANT PROGRAM	**D**	$ -	$ -	$ (9,868)
Rescissions		$ -	$ -	$ (9,868)
NEXT GENERATION HIGH SPEED RAIL	**D**	$ -	$ -	$ (3,019)
Rescissions		$ -	$ -	$ (3,019)
TOTALS				
Gross New Budgetary Resources		$ 2,873,898	$ 2,793,798	$ 2,083,100
Rescissions		$ -	$ -	$ (91,929)
Transfers		$ -	$ -	$ -
Offsets		$ -	$ -	$ (50,000)
TOTAL BUDGETARY RESOURCES:		**$ 2,873,898**	**$ 2,793,798**	**$ 1,941,171**
[Mandatory]		$ -	$ -	$ -
[Discretionary]		$ 2,873,898	$ 2,793,798	$ 1,941,171
[Obligation Limitation]		$ -	$ -	$ -

[1/] For FY 2019 through FY 2021, the Railroad Rehabilitation and Improvement Financing Program account will be reflected in the Office of the Secretary's budget document.

EXHIBIT II-3
FY 2021 BUDGET REQUEST BY DOT STRATEGIC AND ORGANIZATIONAL GOALS
Appropriations, Obligation Limitation, and Exempt Obligations
FEDERAL RAILROAD ADMINISTRATION
($000)

	Safety	Infrastructure	Innovation	Accountability	Total
SAFETY AND OPERATIONS	$ 146,299	$ 14,074	$ 3,938	$ 61,323	$ 225,634
RAILROAD RESEARCH AND DEVELOPMENT	$ 41,000	$ -	$ -	$ -	$ 41,000
NORTHEAST CORRIDOR GRANTS TO THE NATIONAL PASSENGER RAILROAD CORPORATION	$ -	$ 323,839	$ -	$ 1,627	$ 325,466
NATIONAL NETWORK GRANTS TO THE NATIONAL PASSENGER RAILROAD CORPORATION	$ -	$ 607,945	$ -	$ 3,055	$ 611,000
NATIONAL NETWORK TRANSFORMATION GRANTS	$ -	$ 544,500	$ -	$ 5,500	$ 550,000
CONSOLIDATED RAIL INFRASTRUCTURE AND SAFETY IMPROVEMENTS	$ -	$ 326,700	$ -	$ 3,300	$ 330,000
CAPITAL ASSISTANCE FOR HIGH SPEED RAIL COORIDORS AND INTERCITY PASSENGER RAIL SERVICE (CANCELLATION)	$ -	$ (55,364)	$ -	$ -	$ (55,364)
RAIL LINE RELOCATION AND IMPROVEMENT PROGRAM (CANCELLATION)	$ -	$ (12,650)	$ -	$ -	$ (12,650)
CAPITAL AND DEBT SERVICE GRANTS TO THE NATIONAL RAILROAD PASSENGER CORPORATION (CANCELLATION)	$ -	$ -	$ -	$ (10,414)	$ (10,414)
RAILROAD SAFETY TECHNOLOGY PROGRAM (CANCELLATION)	$ -	$ (613)	$ -	$ -	$ (613)
INTERCITY PASSENGER RAIL GRANT PROGRAM (CANCELLATION)	$ -	$ (9,868)	$ -	$ -	$ (9,868)
NEXT GENERATION HIGH SPEED RAIL (CANCELLATION)	$ -	$ -	$ (3,019)	$ -	$ (3,019)
RAIL SAFETY USER FEE	$ (50,000)	$ -	$ -	$ -	$ (50,000)
TOTAL	$ 137,299	$ 1,738,563	$ 919	$ 64,390	$ 1,941,171

EXHIBIT II-4
FY 2021 OUTLAYS
FEDERAL RAILROAD ADMINISTRATION
($000)

		(A)	(B)	(C)
	M / D	FY 2019 ACTUAL	FY 2020 ENACTED	FY 2021 REQUEST
SAFETY AND OPERATIONS	**D**	$ 229,898	$ 238,000	$ 193,000
RAILROAD RESEARCH AND DEVELOPMENT	**D**	$ 31,814	$ 51,000	$ 47,000
GRANTS TO THE NATIONAL RAILROAD PASSENGER CORPORATION	**D**	$ -	$ -	$ 3,000
NORTHEAST CORRIDOR GRANTS TO THE NATIONAL RAILROAD PASSENGER CORPORATION	**D**	$ 645,528	$ 702,000	$ 328,000
NATIONAL NETWORK GRANTS TO THE NATIONAL RAILROAD PASSENGER CORPORATION	**D**	$ 1,287,995	$ 1,303,000	$ 616,000
NATIONAL NETWORK TRANSFORMATION GRANTS	**D**	$ -	$ -	$ 550,000
CAPITAL AND DEBT SERVICE GRANTS TO THE NATIONAL RAILROAD PASSENGER CORPORATION	**D**	$ 1,955	$ 2,000	$ -
CONSOLIDATED RAIL INFRASTRUCTURE AND SAFETY IMPROVEMENTS	**D**	$ 5,724	$ 14,000	$ 112,000
FEDERAL-STATE PARTNERSHIP FOR STATE OF GOOD REPAIR	**D**	$ 76	$ 1,000	$ 127,000
RESTORATION AND ENHANCEMENT GRANTS	**D**	$ 45	$ 2,000	$ 1,000
RAILROAD SAFETY GRANTS	**D**	$ 15,968	$ 19,000	$ 9,000
CAPITAL ASSISTANCE TO STATES - INTERCITY PASSENGER RAIL SERVICE	**D**	$ 994	$ 10,000	$ 1,000
NORTHEAST CORRIDOR IMPROVEMENT PROGRAM	**D**	$ 1,173	$ 9,000	$ 10,000
PENNSYLVANIA STATION REDEVELOPMENT PROJECT	**D**	$ 14,994	$ 3,000	$ 2,000
CAPITAL ASSISTANCE FOR HIGH SPEED RAIL CORRIDORS AND INTERCITY PASSENGER RAIL SERVICE	**D**	$ 25,940	$ 86,000	$ 62,000
NEXT GENERATION HIGH-SPEED RAIL	**D**	$ 115	$ 1,000	$ -
RAIL LINE RELOCATION AND IMPROVEMENT PROGRAM	**D**	$ 227	$ 2,000	$ 1,000
RAILROAD SAFETY TECHNOLOGY PROGRAM	**D**	$ 6	$ -	$ -
MAGNETIC LEVITATION TECHNOLOGY DEPLOYMENT PROGRAM	**D**	$ -	$ -	$ -
RAILROAD REHABILITATION AND IMPROVEMENT FINANCING PROGRAM [1/]	**D**	$ -	$ -	$ -
RAILROAD REHABILITATION AND IMPROVEMENT FINANCING PROGRAM (UPWARD REESTIMATES) [1/]	**M**	$ -	$ -	$ -
TOTAL:		**$ 2,262,451**	**$ 2,443,000**	**$ 2,062,000**
Mandatory		$ -	$ -	$ -
Discretionary		$ 2,262,451	$ 2,443,000	$ 2,062,000

[1/] For FY 2019 through FY 2021, the Railroad Rehabilitation and Improvement Financing Program account will be reflected in the Office of the Secretary's budget document.

EXHIBIT II-5
SUMMARY OF REQUESTED FUNDING CHANGES FROM BASE
Federal Railroad Administration
Appropriations, Obligation Limitations, and Exempt Obligations
($000)

FRA Total			Baseline Changes									
	FY 2019 Actuals	FY 2020 Enacted	Annualization of Prior Pay Raises	Annualization of new FY 2020 FTE	FY 2021 Pay Raises	Adjustment for Compensable Days (261 days)	GSA Rent	WCF Increase/ Decrease	Inflation and other adjustments to base	FY 2021 Baseline Estimate	Program Increases/ Decreases	FY 2021 Request
PERSONNEL RESOURCES (FTE)												
Direct FTE	923	927	-	-	-	-	-	-	(2)	925	(5)	920
FINANCIAL RESOURCES												
ADMINISTRATIVE EXPENSES												
Salaries and Benefits	136,578	145,219	1,059	-	981	(548)	-	-	4,529	151,240	(891)	150,350
Benefits for Former Employees (AK RR)	857	600	-	-	-	-	-	-	-	600	-	600
Travel	12,111	11,186	-	-	-	-	-	-	(171)	11,015	75	11,090
Transportation	15	50	-	-	-	-	-	-	-	50	-	50
GSA Rent	6,979	6,934	-	-	-	-	-	-	-	6,934	-	6,934
Communications & Utilities	159	175	-	-	-	-	-	-	-	175	-	175
Printing	365	368	-	-	-	-	-	-	-	368	-	368
Other Services:												
-WCF	15,643	20,973	-	-	-	-	-	(280)	-	20,693	-	20,693
-ESC	2,671	2,719	-	-	-	-	-	-	-	2,719	-	2,719
-Other contracts	22,343	16,890	-	-	-	-	-	280	3,738	20,908	936	21,844
Supplies	478	475	-	-	-	-	-	-	-	475	-	475
Equipment	995	1,000	-	-	-	-	-	-	-	1,000	(100)	900
Admin Subtotal	**199,195**	**206,589**	**1,059**	**-**	**981**	**(548)**	**-**	**-**	**8,096**	**216,177**	**20**	**216,198**
PROGRAMS												
Safety and Operations	37,079	33,177	-	-	-	-	-	-	-	33,177	(8,041)	25,136
Railroad Research and Development	38,282	38,282	-	-	-	-	-	-	-	38,282	500	38,782
Grants to Amtrak	1,931,892	1,990,000	-	-	-	-	-	-	-	1,990,000	(1,058,216)	931,784
National Network Transformation Grants	-	-	-	-	-	-	-	-	-	-	544,500	544,500
Consolidated Rail Infrastructure and Safety Improvements	252,450	321,750	-	-	-	-	-	-	-	321,750	4,950	326,700
Federal-State Partnership for State of Good Repair	400,000	200,000	-	-	-	-	-	-	-	200,000	(200,000)	-
Restoration and Enhancement Grants	5,000	2,000	-	-	-	-	-	-	-	2,000	(2,000)	-
Magnetic Levitation Technology Deployment Program	10,000	2,000	-	-	-	-	-	-	-	2,000	(2,000)	-
Railroad Rehabilitation and Improvement Financing Program [1/]	-	-	-	-	-	-	-	-	-	-	-	-
Programs Subtotal	**2,674,703**	**2,587,209**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2,587,209**	**(720,307)**	**1,866,902**
TOTAL	**2,873,898**	**2,793,798**	**1,059**	**-**	**981**	**(548)**	**-**	**-**	**8,096**	**2,803,386**	**(720,287)**	**2,083,100**
CANCELLATIONS												
Capital Assistance for High Speed Rail Corridors and Intercity Passenger Rail Service	-	-	-	-	-	-	-	-	-	-	(55,364)	(55,364)
Rail Line Relocation and Improvement Program	-	-	-	-	-	-	-	-	-	-	(12,650)	(12,650)
Capital And Debt Service Grants to the National Railroad Passenger Corporation	-	-	-	-	-	-	-	-	-	-	(10,414)	(10,414)
Railroad Safety Technology Program	-	-	-	-	-	-	-	-	-	-	(613)	(613)
Intercity Passenger Rail Grant Program	-	-	-	-	-	-	-	-	-	-	(9,868)	(9,868)
Next Generation High Speed Rail	-	-	-	-	-	-	-	-	-	-	(3,019)	(3,019)
Cancellations Subtotal	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**(91,929)**	**(91,929)**
Offset - Rail Safety User Fee	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**(50,000)**	**(50,000)**
TOTAL with Cancellations and Offset	**2,873,898**	**2,793,798**	**1,059**	**-**	**981**	**(548)**	**-**	**-**	**8,096**	**2,803,386**	**(862,215)**	**1,941,171**

[1/] For FY 2019 through FY 2021, the Railroad Rehabilitation and Improvement Financing Program account will be reflected in the Office of the Secretary's budget document.

EXHIBIT II-5
SUMMARY OF REQUESTED FUNDING CHANGES FROM BASE
Federal Railroad Administration
Appropriations, Obligation Limitations, and Exempt Obligations
($000)

Safety and Operations	FY 2019 Actual	FY 2020 Enacted	Baseline Changes: Annualization of Prior Pay Raises	Annualization of new FY 2020 FTE	FY 2021 Pay Raises	Adjustment for Compensable Days (261 days)	GSA Rent	WCF Increase/ Decrease	Inflation and other adjustments to base	FY 2021 Baseline Estimate	Program Increases/ Decreases	FY 2021 Request
PERSONNEL RESOURCES (FTE)												
Direct FTE	913	915	-	-	-	-	-	-	(2)	913	-	913
FINANCIAL RESOURCES												
ADMINISTRATIVE EXPENSES												
Salaries and Benefits [1/, 2/, 3/, 4/]	134,752	143,194	1,045	-	961	(542)	-		4,446	149,103	-	149,103
Benefits for Former Employees (AK RR)	857	600	-	-	-	-	-	-	-	600	-	600
Travel	11,861	10,861	-	-	-	-	-	-	(171)	10,690	-	10,690
Transportation	15	50	-	-	-	-	-	-	-	50	-	50
GSA Rent	6,979	6,934	-	-	-	-	-	-	-	6,934	-	6,934
Communications & Utilities	159	175	-	-	-	-	-		-	175	-	175
Printing	347	350	-	-	-	-	-	-	-	350	-	350
Other Services:												
-WCF	14,043	19,373	-	-	-	-	-	(280)	-	19,093	-	19,093
-ESC	2,371	2,419	-	-	-	-	-	-	-	2,419	-	2,419
-Other contracts [5/]	12,061	5,891	-	-	-	-	-	280	3,738	9,909	-	9,909
Supplies	478	475	-	-	-	-	-	-	-	475	-	475
Equipment	695	700	-	-	-	-	-		-	700	-	700
Admin Subtotal	**184,619**	**191,021**	**1,045**	**-**	**961**	**(542)**	**-**	**-**	**8,013**	**200,498**	**-**	**200,498**
PROGRAMS												
Automated Track Inspection Program [6/]	16,282	16,199	-	-	-	-	-	-	-	16,199	(8,500)	7,699
Rail Safety Partnership	3,000	3,000	-	-	-	-	-	-	-	3,000	-	3,000
RSIS/Data Management [7/]	4,221	4,800	-	-	-	-	-	-	-	4,800	(400)	4,400
Rail Grade Crossing Safety	1,017	1,000	-	-	-	-	-	-	-	1,000	325	1,325
Bridge Inventory/Support Program	600	100	-	-	-	-	-	-	-	100	(100)	-
Washington Union Station	1,000	800	-	-	-	-	-	-	-	800	200	1,000
PTC Support [8/]	7,433	2,600	-	-	-	-	-	-	-	2,600	(1,816)	784
Drug and Alcohol Program	792	861	-	-	-	-	-	-	-	861	-	861
Security, Other Security Grants	548	555	-	-	-	-	-	-	-	555	-	555
RSAC	10	319	-	-	-	-	-	-	-	319	-	319
Technical Training Standards Division [9/]	1,067	700	-	-	-	-	-	-	-	700	(300)	400
Transportation Technology Center (TTC)	500	500	-	-	-	-	-	-	-	500	-	500
Cybersecurity Threat Assessment	-	-	-	-	-	-	-	-	-	-	500	500

EXHIBIT II-5
SUMMARY OF REQUESTED FUNDING CHANGES FROM BASE
Federal Railroad Administration
Appropriations, Obligation Limitations, and Exempt Obligations
($000)

Safety and Operations			Baseline Changes									
	FY 2019 Actual	FY 2020 Enacted	Annualization of Prior Pay Raises	Annualization of new FY 2020 FTE	FY 2021 Pay Raises	Adjustment for Compensable Days (261 days)	GSA Rent	WCF Increase/ Decrease	Inflation and other adjustments to base	FY 2021 Baseline Estimate	Program Increases/ Decreases	FY 2021 Request
Rail Enforcement System	109	593	-	-	-	-	-	-	-	593	-	593
Audit Management	-	500	-	-	-	-	-	-	-	500	400	900
Trespass Prevention	500	650	-	-	-	-	-	-	-	650	1,650	2,300
Safe Transportation of Energy Products [10/]	-	-	-	-	-	-	-	-	-	-	-	-
Programs Subtotal	**37,079**	**33,177**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**33,177**	**(8,041)**	**25,136**
Rail Safety User Fee	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**(50,000)**	**(50,000)**
TOTAL	**221,698**	**224,198**	**1,045**	**-**	**961**	**(542)**	**-**	**-**	**8,013**	**233,675**	**(58,041)**	**175,634**

1/ In the Salaries and Benefits row's FY 2019 Actual column, the amount of $134,752 includes salaries charged to the Programs of ATIP ($218), PTC ($2,567) and STEP ($2,074).

2/ In the Salaries and Benefits row's FY 2020 Enacted column, the amount of $143,194 includes estimated salaries charged to the Programs of ATIP ($301), PTC ($2,217) and STEP ($2,000).

3/ In the Salaries and Benefits row's FY 2021 Request column, the amount of $149,103 includes estimated salaries charged to the Programs of ATIP ($301) and PTC ($2,217).

4/ Consistent with OMB Memoranda M-19-24 dated July 2019, the amount shown above for Salaries and Benefits includes an estimated increase of $1,188 for awards spending, from $1,522 in FY 2020 to $2,710 in FY 2021. This increase is calculated by increasing the FY 2020 base award pay, relative to non-SES salaries, and increasing that percentage by one full percent. These percentages are 1.6 and 2.6 for FY 2020 and 2021, respectively. Additional increases shown on this line are attributable to various Pay Raise and FERS contribution percentage increases for FY 2020 and 2021 as prescribed by OPM and OMB guidance.

5/ In FY 2020, the decrease of $7,452 in Other Contracts (from ideal level of $13,343) will be covered by (a) vacancy savings from Payroll, (b) increased oversight costs moved to other accounts, and (c) undesignated S&O carryover.

6/ The Automated Track Inspection Program has additional resources from Payroll that are not reflected in this line: total FY 2019 amount is $16,500 (adding $218 from payroll), total FY 2020 amount is $16,500 (adding $301 from payroll), and total FY 2021 amount is $8,000 (adding $301 from payroll).

7/ The RSIS/Data Management line has additional resources from Working Capital Fund (WCF) that are not reflected in this line for FY 2019 only that brings the total to $4,800 (adding $579 from WCF).

8/ The PTC Support line has additional resources from Payroll that are not reflected in this line: total FY 2019 amount is $10,000 (adding $2,567 from payroll), total FY 2020 amount is $4,817 (adding $2,217 from payroll), and total FY 2021 amount is $3,001 (adding $2,217 from payroll). In FY 2020 and FY 2021, additional PTC contractual costs above $2,600 and $784 (respectively) will be covered by PTC carryover funds.

9/ The Technical Training Standards Division line has additional resources from Working Capital Fund (WCF) that are not reflected in this line for FY 2019 only that brings the total to $1,146 (adding $80 from WCF).

EXHIBIT II-5
SUMMARY OF REQUESTED FUNDING CHANGES FROM BASE
Federal Railroad Administration
Appropriations, Obligation Limitations, and Exempt Obligations
($000)

Railroad Research and Development	FY 2019 Actual	FY 2020 Enacted	Baseline Changes: Annualization of Prior Pay Raises	Annualization of new FY 2020 FTE	FY 2021 Pay Raises	Adjustment for Compensable Days (261 days)	GSA Rent	WCF Increase/ Decrease	Inflation and other adjustments to base	FY 2021 Baseline Estimate	Program Increases/ Decreases	FY 2021 Request
PERSONNEL RESOURCES (FTE)												
Direct FTE	-	-	-	-	-	-	-	-	-	-	-	-
FINANCIAL RESOURCES												
ADMINISTRATIVE EXPENSES												
Salaries and Benefits	-	-	-	-	-	-	-	-	-	-	-	-
Benefits for Former Employees (AK RR)	-	-	-	-	-	-	-	-	-	-	-	-
Travel	100	100	-	-	-	-	-	-	-	100	-	100
Transportation	-	-	-	-	-	-	-	-	-	-	-	-
GSA Rent	-	-	-	-	-	-	-	-	-	-	-	-
Communications & Utilities	-	-	-	-	-	-	-	-	-	-	-	-
Printing	18	18	-	-	-	-	-	-	-	18	-	18
Other Services:												
-WCF	1,600	1,600	-	-	-	-	-	-	-	1,600	-	1,600
-ESC	300	300	-	-	-	-	-	-	-	300	-	300
-Other contracts	-	-	-	-	-	-	-	-	-	-	-	-
Supplies	-	-	-	-	-	-	-	-	-	-	-	-
Equipment	300	300	-	-	-	-	-	-	-	300	(100)	200
Admin Subtotal	**2,318**	**2,318**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2,318**	**(100)**	**2,218**
PROGRAMS												
Track Research Program	11,279	11,279	-	-	-	-	-	-	-	11,279	(1,000)	10,279
Rolling Stock Program	10,322	10,322	-	-	-	-	-	-	-	10,322	-	10,322
Train Control & Communications	8,086	8,086	-	-	-	-	-	-	-	8,086	-	8,086
Human Factors Program	6,042	6,042	-	-	-	-	-	-	-	6,042	-	6,042
Railroad System Issues	2,553	2,553	-	-	-	-	-	-	-	2,553	1,500	4,053
Programs Subtotal	**38,282**	**38,282**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**38,282**	**500**	**38,782**
TOTAL	**40,600**	**40,600**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**40,600**	**400**	**41,000**

EXHIBIT II-5
SUMMARY OF REQUESTED FUNDING CHANGES FROM BASE
Federal Railroad Administration
Appropriations, Obligation Limitations, and Exempt Obligations
($000)

Grants to Amtrak	FY 2019 Actual	FY 2020 Enacted	Baseline Changes: Annualization of Prior Pay Raises	Annualization of new FY 2020 FTE	FY 2021 Pay Raises	Adjustment for Compensable Days (261 days)	GSA Rent	WCF Increase/ Decrease	Inflation and other adjustments to base	FY 2021 Baseline Estimate	Program Increases/ Decreases	FY 2021 Request
PERSONNEL RESOURCES (FTE)												
Direct FTE	10	12	-	-	-	-	-	-	-	12	(5)	7
FINANCIAL RESOURCES												
ADMINISTRATIVE EXPENSES												
Salaries and Benefits	1,826	2,026	14	-	20	(6)	-	-	83	2,137	(891)	1,247
Benefits for Former Employees (AK RR)	-	-	-	-	-	-	-	-	-	-	-	-
Travel	150	150	-	-	-	-	-	-	-	150	-	150
Transportation	-	-	-	-	-	-	-	-	-	-	-	-
GSA Rent	-	-	-	-	-	-	-	-	-	-	-	-
Communications & Utilities	-	-	-	-	-	-	-	-	-	-	-	-
Printing	-	-	-	-	-	-	-	-	-	-	-	-
Other Services:												
-WCF	-	-	-	-	-	-	-	-	-	-	-	-
-ESC	-	-	-	-	-	-	-	-	-	-	-	-
-Other contracts	7,732	7,824	-	-	-	-	-	-	-	7,824	(4,539)	3,285
Supplies	-	-	-	-	-	-	-	-	-	-	-	-
Equipment	-	-	-	-	-	-	-	-	-	-	-	-
Admin Subtotal	**9,708**	**10,000.000**	**14**	**-**	**20**	**(6)**	**-**	**-**	**83**	**10,112**	**(5,430)**	**4,682**
PROGRAMS												
Northeast Corridor Grants to Amtrak	646,750	696,500	-	-	-	-	-	-	-	696,500	(372,661)	323,839
National Network Grants to Amtrak	1,285,142	1,293,500	-	-	-	-	-	-	-	1,293,500	(685,555)	607,945
Programs Subtotal	**1,931,892**	**1,990,000**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1,990,000**	**(1,058,216)**	**931,784**
TOTAL	**1,941,600**	**2,000,000**	**14**	**-**	**20**	**(6)**	**-**	**-**	**83**	**2,000,112**	**(1,063,646)**	**936,466**

EXHIBIT II-5
SUMMARY OF REQUESTED FUNDING CHANGES FROM BASE
Federal Railroad Administration
Appropriations, Obligation Limitations, and Exempt Obligations
($000)

National Network Transformation Grants	FY 2019 Actual	FY 2020 Enacted	Baseline Changes: Annualization of Prior Pay Raises	Annualization of new FY 2020 FTE	FY 2021 Pay Raises	Adjustment for Compensable Days (261 days)	GSA Rent	WCF Increase/ Decrease	Inflation and other adjustments to base	FY 2021 Baseline Estimate	Program Increases/ Decreases	FY 2021 Request
PERSONNEL RESOURCES (FTE)												
Direct FTE	-	-	-	-	-	-	-	-	-	-	-	-
FINANCIAL RESOURCES												
ADMINISTRATIVE EXPENSES												
Salaries and Benefits	-	-	-	-	-	-	-	-	-	-	-	-
Benefits for Former Employees (AK RR)	-	-	-	-	-	-	-	-	-	-	-	-
Travel	-		-	-	-	-	-	-	-	-	-	-
Transportation	-	-	-	-	-	-	-	-	-	-	-	-
GSA Rent	-	-	-	-	-	-	-	-	-	-	-	-
Communications & Utilities	-	-	-	-	-	-	-	-	-	-	-	-
Printing	-	-	-	-	-	-	-	-	-	-	-	-
Other Services:												
-WCF	-	-	-	-	-	-	-	-	-	-	-	-
-ESC	-	-	-	-	-	-	-	-	-	-	-	-
-Other contracts	-	-	-	-	-	-	-	-	-	-	5,500	5,500
Supplies	-	-	-	-	-	-	-	-	-	-	-	-
Equipment	-	-	-	-	-	-	-	-	-	-	-	-
Admin Subtotal	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**5,500**	**5,500**
PROGRAMS												
National Network Transformation Grants	-	-	-	-	-	-	-	-	-	-	544,500	544,500
Programs Subtotal	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**544,500**	**544,500**
TOTAL	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**550,000**	**550,000**

EXHIBIT II-5
SUMMARY OF REQUESTED FUNDING CHANGES FROM BASE
Federal Railroad Administration
Appropriations, Obligation Limitations, and Exempt Obligations
($000)

Consolidated Rail Infrastructure and Safety Improvements	FY 2019 Actual	FY 2020 Enacted	Baseline Changes: Annualization of Prior Pay Raises	Annualization of new FY 2020 FTE	FY 2021 Pay Raises	Adjustment for Compensable Days (261 days)	GSA Rent	WCF Increase/ Decrease	Inflation and other adjustments to base	FY 2021 Baseline Estimate	Program Increases/ Decreases	FY 2021 Request
PERSONNEL RESOURCES (FTE)												
Direct FTE	-	-	-	-	-	-	-	-	-	-	-	-
FINANCIAL RESOURCES												
ADMINISTRATIVE EXPENSES												
Salaries and Benefits	-	-	-	-	-	-	-	-	-	-	-	-
Benefits for Former Employees (AK RR)	-	-	-	-	-	-	-	-	-	-	-	-
Travel	-	75	-	-	-	-	-	-	-	75	75	150
Transportation	-	-	-	-	-	-	-	-	-	-	-	-
GSA Rent	-	-	-	-	-	-	-	-	-	-	-	-
Communications & Utilities	-	-	-	-	-	-	-	-	-	-	-	-
Printing	-	-	-	-	-	-	-	-	-	-	-	-
Other Services:												
-WCF	-	-	-	-	-	-	-	-	-	-	-	-
-ESC	-	-	-	-	-	-	-	-	-	-	-	-
-Other contracts	2,550	3,175	-	-	-	-	-	-	-	3,175	(25)	3,150
Supplies	-	-	-	-	-	-	-	-	-	-	-	-
Equipment	-	-	-	-	-	-	-	-	-	-	-	-
Admin Subtotal	**2,550**	**3,250**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3,250**	**50**	**3,300**
PROGRAMS												
Consolidated Rail Infrastructure and Safety Improvements	252,450	321,750	-	-	-	-	-	-	-	321,750	4,950	326,700
Programs Subtotal	**252,450**	**321,750**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**321,750**	**4,950**	**326,700**
TOTAL	**255,000**	**325,000**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**325,000**	**5,000**	**330,000**

EXHIBIT II-6
WORKING CAPITAL FUND
FEDERAL RAILROAD ADMINISTRATION
($000)

	FY 2019 ACTUAL	FY 2020 ENACTED	FY 2021 REQUEST
DIRECT:			
Safety and Operations	$ 14,043	$ 19,373	$ 19,093
SUBTOTAL	$ 14,043	$ 19,373	$ 19,093
TOTAL	$ 14,043	$ 19,373	$ 19,093

EXHIBIT II-7
FEDERAL RAILROAD ADMINISTRATION
PERSONNEL RESOURCE -- SUMMARY
TOTAL FULL-TIME EQUIVALENTS

	FY 2019 ACTUAL	FY 2020 ENACTED	FY 2021 REQUEST
DIRECT FUNDED BY APPROPRIATION			
Safety and Operations	913	915	913
National Network Grants to Amtrak	10	12	7
SUBTOTAL, DIRECT FUNDED	923	927	920
TOTAL FTEs	**923**	**927**	**920**

Note-- FY 2019 Actual column represents year-end FTEs from the SF-113G report.

EXHIBIT II-8
FEDERAL RAILROAD ADMINISTRATION
RESOURCE SUMMARY – STAFFING
FULL-TIME PERMANENT POSITIONS

	FY 2019 ACTUAL	FY 2020 ENACTED	FY 2021 REQUEST
DIRECT FUNDED BY APPROPRIATION			
Safety and Operations	911	915	913
National Network Grants to Amtrak	9	12	7
SUBTOTAL, DIRECT FUNDED	920	927	920
TOTAL POSITIONS	**920**	**927**	**920**

Note-- FY 2019 Actual column represents year-end headcount from the SF-113G report.

FEDERAL RAILROAD ADMINISTRATION
HISTORY OF APPROPRIATIONS
FY 2011 - FY 2020
($000)

Account	FY 2011 [1/]	FY 2012	FY 2013 [3/]	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Safety and Operations	176,596	178,596	169,254	184,500	186,870	199,000	218,298	221,698	221,698	224,198
Safety and Operations	--	--	--	--	--	(6,710) [6/]	--	--	--	--
Railroad Research and Development	35,030	35,000	33,169	35,250	39,100	39,100	40,100	40,600	40,600	40,600
Railroad Research and Development	--	--	--	--	--	(1,960) [6/]	--	--	--	--
Rail Line Relocation and Improvement Program	10,511	--	--	--	--	(2,241) [6/]	--	--	--	--
Railroad Safety Grants	--	--	--	--	10,000	50,000	--	--	--	--
Consolidated Rail Infrastructure and Safety Improvements	--	--	--	--	--	--	68,000	592,547	255,000	325,000
Federal-State Partnership for State of Good Repair	--	--	--	--	--	--	25,000	250,000	400,000	200,000
Restoration and Enhancement Grants	--	--	--	--	--	--	5,000	20,000	5,000	2,000
Northeast Corridor Grants to the National Railroad Passenger Corporation	--	--	--	--	--	--	328,000	650,000	650,000	700,000
National Network Grants to the National Railroad Passenger Corporation	--	--	--	--	--	--	1,167,000	1,291,600	1,291,600	1,300,000
Operating Grants to the National Railroad Passenger Corporation	563,000	466,000	441,625	340,000	250,000	288,500	--	--	--	--
Capital and Debt Service Grants to the National Railroad Passenger Corporation	920,652	952,000	902,205	1,050,000	1,140,000	1,101,500	--	--	--	--
Capital and Debt Service Grants to the National Railroad Passenger Corporation	--	--	--	--	--	(5,000) [6/]	--	--	--	--
Grants to the National Railroad Passenger Corporation	--	--	297,100 [4/]	--	--	(267) [6/]	13,480 [8/]	--	--	--
Pennsylvania Station Redevelopment Project	--	--	--	--	--	40,200 [7/]	--	--	--	--
Next Generation High-Speed Rail	--	--	--	(1,973) [5/]	--	(4,945) [6/]	--	--	--	--
Northeast Corridor Improvement Program	--	--	--	(4,419) [5/]	--	19,163 [6/]	--	--	--	--
Capital Assistance for HSR Corridors and IPR	(400,000) [2/]	--	--	--	--	--	--	--	--	--
Magnetic Levitation Technology Deployment Program	--	--	--	--	--	--	--	--	10,000	2,000
Railroad Rehabilitation and Improvement Financing Program (discretionary)	--	--	--	--	--	1,960 [6/]	--	25,000	17,000	--
Railroad Rehabilitation and Improvement Financing Program (mandatory)	23,692	16,905	33,445	43,845	31,455	563	1,809	100,371	60,811	--
Total FRA Budget Authority	**1,329,481**	**1,648,501**	**1,876,798**	**1,647,203**	**1,657,425**	**1,718,863**	**1,866,687**	**3,191,816**	**2,951,709**	**2,793,798**

Notes:

1/ FY 2011 full-year CR appropriations (P.L. 112-10) reflect a 0.02% across-the-board rescission.

2/ FY 2011 appropriations (P.L. 112-10) reflect a $400M rescission of prior year unobligated balances.

3/ FY 2013 figures reflect 0.2% rescission and sequestered amounts excluded.

4/ The Disaster Relief Appropriations Act of FY 2013 (P.L. 113-2) provided funds to Amtrak for Hurricane Sandy, including $32 million for repair work and $86 million for disaster mitigation projects, less sequestration. Also in FY 2013, $185 million was transferred from FTA to FRA for the Hudson Yards Project.

5/ FY 2014 Omnibus (P.L. 113-76) reflects rescissions on prior year unobligated balances of $4.419M from the Northeast Corridor Improvement Program and $1.973M from the Next Generation High-Speed Rail.

6/ FY 2016 Omnibus (P.L. 114-113) reflects the following rescissions from prior year unobligated balances: $6,710,477 from Safety & Operations, $1,960,000 from Railroad Research and Development, $2,241,385 from Rail Line Relocation and Improvement, $5,000,000 from Capital and Debt Service Grants to the National Railroad Passenger Corporation (NEC 2015), $267,019 from Grants to the National Railroad Passenger Corporation, and $4,944,504 from Next Generation High-Speed Rail. These amounts were then reallocated to: $19,163,385 for Northeast Corridor Improvement Program and $1,960,000 to Railroad Rehabilitation and Improvement Financing Program.

7/ In FY 2016, $40.2M from the Disaster Relief Appropriations Act of FY 2013 (P.L. 113-2) was transferred from FTA to FRA for risk reduction projects at Pennsylvania Station, which was an area impacted by Hurricane Sandy.

8/ In FY 2017, $13.48M from the Disaster Relief Appropriations Act of FY 2013 (P.L. 113-2) was transferred from FTA to FRA for the MTA/LIRR River to River Rail Resilience project, which was an area impacted by Hurricane Sandy.

DEPARTMENT OF TRANSPORTATION
FEDERAL RAILROAD ADMINISTRATION

SAFETY AND OPERATIONS
APPROPRIATIONS LANGUAGE

SAFETY AND OPERATIONS

For necessary expenses of the Federal Railroad Administration, not otherwise provided for, [$224,198,000] *$225,634,000*, of which $20,000,000 shall remain available until expended*: Provided, That railroad safety fees collected in fiscal year 2021 as provided in section 151 of this Act, of which $25,000,000 shall remain available until expended for railroad safety activities, shall be credited as offsetting collections to this account: Provided further, That the one-year portion of the sum herein appropriated from the general fund shall be reduced dollar-for-dollar as such offsetting collections are received during fiscal year 2021, so as to result in a final appropriation from the general fund estimated at $175,634,000.*

Explanation: The President's Budget proposes to establish a user fee that would reimburse the Federal Railroad Administration for the operational costs of rail safety inspectors and activities. Like other regulated industries, railroads benefit directly and indirectly from the government's efforts to ensure high safety standards, and it is therefore appropriate for railroads to bear some of the cost. FRA will begin collecting an estimated $50 million in 2021.

EXHIBIT III-1

SAFETY AND OPERATIONS
Summary by Program Activity
Appropriations, Obligation Limitations, and Exempt Obligations
($000)

	FY 2019 ACTUAL	FY 2020 ENACTED	FY 2021 REQUEST
Safety and Operations	$ 221,698	$ 224,198	$ 225,634
Rail Safety User Fee	-	-	$ (50,000)
TOTAL	$ 221,698	$ 224,198	$ 175,634
FTEs			
Direct Funded	913	915	913

Program and Performance Statement

Funds requested in the Safety and Operations account support the Federal Railroad Administration's (FRA) personnel and administrative expenses, the cost of rail safety inspectors, and other program activities including contracts. Resources are also provided to fund information management, technology, safety education, and outreach.

EXHIBIT III-1a

SAFETY AND OPERATIONS
SUMMARY ANALYSIS OF CHANGE FROM FY 2020 TO FY 2021
Appropriations, Obligations, Limitations, and Exempt Obligations
($000)

	$000	FTE
FY 2020 ENACTED	$ 224,198	915
ADJUSTMENTS TO BASE:		
Annualization of FY 2020 FTE		
Annualization of Prior Pay Raise(s)	1,045	
FY 2021 Pay Raise	961	
Adjustment for Compensable Days	-543	
GSA Rent		
Working Capital Fund		
Inflation and other adjustments to base	16,897	-2
SUBTOTAL, ADJUSTMENTS TO BASE	**$ 18,360**	**-2**
PROGRAM REDUCTIONS		
Automated Track Inspection Program	-8,500	
RSIS/Data Management	-400	
Bridge Inventory/Support Program	-600	
PTC Support	-9,999	
Technical Training Standards Division	-300	
SUBTOTAL, PROGRAM REDUCTIONS	**$ -19,799**	**0**
PROGRAM INCREASES		
Rail Grade Crossing Safety	325	
Cybersecurity Threat Assessment	500	
Audit Management	400	
Trespass Prevention	1,650	
SUBTOTAL, PROGRAM INCREASES	**$ 2,875**	**0**
Rail Safety User Fee	**-50,000**	
FY 2021 REQUEST	**$ 175,634**	**913**

Detailed Justification for Railroad Safety and Operations

FY 2021 – Railroad Safety and Operations – Budget Request
($000)

Program Activity	FY 2019 Actual	FY 2020 Enacted	FY 2021 Request
Safety and Operations	$221,698	$224,198	$225,634
Total	**$221,698**	**$224,198**	**$225,634**
FTE	**920**	**915**	**913**

What is this program and what does this funding level support?

The appropriation for the Safety and Operations (S&O) account funds FRA's programs to improve railroad safety and execute financial assistance. It also funds FRA's organizational infrastructure—payroll, rent, telecommunications, information technology, and contract support—that enables the safety and development programs to achieve their goals.

FRA oversees, regulates, and enforces the safety of railroad operations nationwide. In addition, FRA supports the development of intercity passenger rail and freight rail services and new technologies to improve railroad safety and efficiency. S&O funding is the foundation for FRA to carrying out its mission of enabling the safe, reliable, and efficient movement of people and goods for a strong America, now and in the future.

FRA's programs align closely with the Department's priorities for FY 2021:

- **Safety**: FRA's focus is overseeing the safety of the nation's railroad system. FRA applies it resources to identify and address the rail industry's most pressing safety issues, including improving passenger railroad safety; supporting and overseeing to the railroads' implementation of positive train control (PTC); preventing trespassing on railroad property; and increasing safety at highway-rail grade crossings.

- **Infrastructure**: FRA's inspector workforce and other safety specialists monitor the safety of the nation's railroad infrastructure, including track, bridges and tunnels, rolling stock, train control and communications systems, and grade crossings.

- **Innovation**: In collaboration with FRA's Research and Development account, S&O-funded programs are innovating to implement new and transformative technologies that enhance safety, develop novel solutions to complex challenges, and better identify,

collect, and analyze information necessary to make data-driven decisions that advance FRA's mission.

- **Accountability**: FRA's S&O-funded personnel are working to address Administration goals to reduce regulatory burdens, efficiently implement critical safety programs, and streamline the project development and delivery process.

FRA's oversight, enforcement, and technical assistance helped make FY 2018 one of the safest years in recent record. The number of rail-related accidents and incidents decreased by more than 2 percent from the previous year. Between FY 2009 and FY 2018, railroad industry employee fatalities declined by 47 percent, derailments declined by almost 8 percent, and grade crossing incidents increased by less than 5 percent.

The following sections describe FRA's FY 2021 major cost categories and safety priorities.

Mission Support and Fixed Costs
FY 2019 Enacted: $184.62 million
FY 2020 Enacted: $191.02 million
FY 2021 Request: $200.50 million[1]

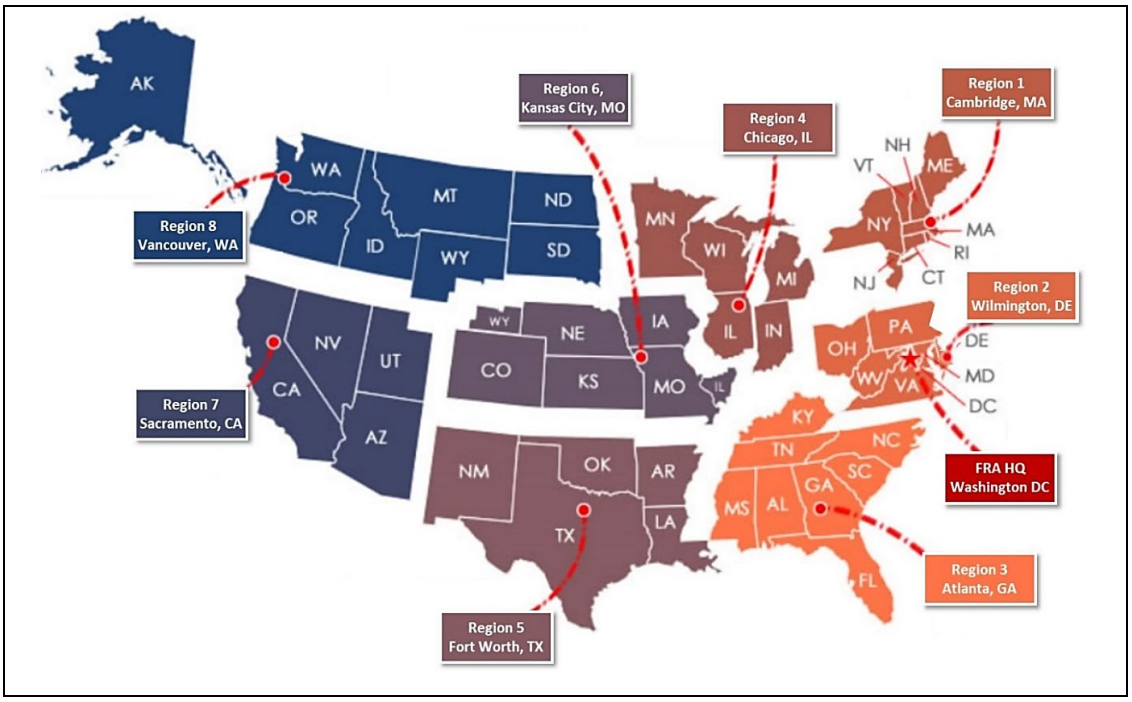
More than 85 percent of S&O funding covers salaries and benefits, travel and motor vehicle fleet, and other operating infrastructure costs, such as rent. FRA executes its railroad safety responsibilities through a diverse and highly skilled staff. FRA's field presence, where employees directly interact with railroads and other stakeholders, includes 390 rail safety inspectors and specialists in six safety disciplines: operating practices, motive power and equipment, signal and train control, track, hazardous materials, and grade crossing safety.

Additionally, FRA has personnel across the country who specialize in fields such as PTC, passenger rail, human performance, alcohol and drug programs, tank car quality assurance, rail and infrastructure integrity, bridge safety, occupational health, radioactive materials, and railroad management. FRA headquarters staff include technical experts, who manage the mission critical programs and provide technical guidance to field personnel, support development of minimum safety standards and regulations, and evaluate waiver petitions.

FRA's remaining S&O-funded personnel are in the Offices of Railroad Policy and Development, Chief Counsel, Chief Financial Officer, Administration, and the Administrator. These personnel include planners, project development and delivery specialists, engineers, economists, attorneys, budget and financial analysts, human resources, public and government affairs, and other professionals.

[1] The FY 2021 amount of $200.50 million includes salaries charged to the Programs of ATIP ($0.30 million) and PTC ($2.22 million).

FRA Safety Regions



FY 2021 Target Distribution of FRA Rail Safety Inspectors

By Safety Discipline and Geographic Region

	FRA Region								
Safety Discipline	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Total**
Motive Power and Equipment	7	13	12	14	12	10	7	8	83
Operating Practices	8	12	11	11	12	10	8	9	81
Track	9	11	12	9	13	9	8	10	81
Hazardous Materials	4	8	9	9	11	8	5	9	63
Signal and Train Control	7	9	9	7	6	7	7	6	58
Grade Crossing	3	3	3	3	3	3	3	3	24
Total Target	**38**	**56**	**56**	**53**	**57**	**47**	**38**	**45**	**390**

Automated Track Inspection Program
FY 2019 Enacted: $16.50 million
FY 2020 Enacted: $16.50 million
FY 2021 Request: $ 8.00 million[2]

Defective track is one of the most frequent causes of derailments. Identifying track defects and other precursor conditions is the primary focus of FRA's Automated Track Inspection Program (ATIP). FRA deploys its nine ATIP vehicles to collect data on the highest risk routes, including passenger and hazardous materials routes. FRA then uses the data to inform oversight and enforcement activities, audit railroad compliance with Federal Track Safety Standards, and assess the state-of-repair of U.S. railroads. FRA shares the infrastructure diagnostics with the track owners and notifies railroads of major safety risks. Additionally, ATIP supports FRA's railroad safety research program. During ATIP operations, FRA evaluates new technologies to improve track evaluation and other safety benefits.

FRA will use FY 2021 funding to maximize use of the ATIP fleet. FRA recently deployed its first ATIP hi-rail inspection vehicle, by which we obtain actionable data on short line railroads. Additionally, FRA is implementing state-of-the-art, vision-based systems. FRA is installing Light Detection and Ranging (LIDAR) systems on two vehicles to collect data that will aid in identifying humped crossings and other grade crossing features. As railroads develop and implement automated track inspection programs, ATIP will play a critical role in evaluating the effectiveness and compliance of the railroads' programs.

Positive Train Control Implementation
FY 2019 Enacted: $10.00 million
FY 2020 Enacted: up to $13.00 million
FY 2021 Request: $ 3.00 million[3]

The *Rail Safety Improvement Act of 2008* required certain railroads to install and implement PTC by December 31, 2015, on railroad main lines with more than five million gross tons of traffic annually that transport any quantity of poisonous- or toxic-inhalation hazard commodity and on any railroad's main lines over which regularly scheduled intercity passenger or commuter rail services operate. Subsequently, the *Positive Train Control Enforcement and Implementation Act of 2015* gave railroads until December 31, 2018, to implement PTC, and allowed them until December 31, 2020, if certain criteria are met. By December 31, 2018, four railroads had fully implemented PTC and 37 railroads qualified for an extension to December 31, 2020. As of March 31, 2019, railroads were operating PTC systems on more than 48,000 of the nearly 58,000 route miles subject to the statutory mandate. Continuing challenges for the railroads include completing testing, achieving interoperability between all tenant and host railroads (including operation across PTC

[2] The FY 2021 amount includes salaries related to ATIP ($0.30 million) review that are included above in Mission Support and Fixed Costs.

[3] The FY 2021 amount includes salaries related to PTC ($2.22 million) review that are included above in Mission Support and Fixed Costs.

boundaries), and preparing and obtaining FRA approval of each host's PTC safety plan, which provide detailed safety analysis to show that its PTC system is safe.

Since the 2008 statutory mandate, FRA's role has been to monitor the railroad's timely implementation, safe operation, and proper maintenance of PTC systems and enforce compliance with applicable statutes and regulations (including assessing penalties). FRA has actively facilitated and supported the railroads' PTC implementation—providing guidance, technical assistance, and approval of required documentation, including test requests, alternative schedules, and safety plans. PTC supports two of the U.S. Department of Transportation's (Department) strategic goals—safety and innovation—using industry-designed emerging technologies to monitor speed and automatically stop trains to prevent accidents due to some types of human error.

FRA will continue to monitor the status of railroads subject to the PTC mandate, provide technical assistance, and review and approve over 20 PTC safety plans in FYs 2019 and 2020. To review and approve these documents, FRA relies on safety engineering contractor support, including firms with specialized knowledge in advanced railroad signal technology and hazard analysis. FRA technical assistance will focus on supporting and overseeing the railroads' interoperability testing between the 42 hosts and 101 tenants. FRA's contractor-supported task force will continue to track implementation and prepare quarterly data releases.

PTC funding goes to supporting contractors that provide FRA with direct project and data management support, along with collecting, managing and displaying quarterly progress reports. It funds technical subject matter experts to review the interoperability of PTC systems between host and tenant railroads. And it covers FRA staff that provide direct management and oversight to the implementation effort. FRA has sufficient funding, that coupled with carryover balances, make it well-positioned to support railroads' efforts to meet the December 2020 implementation deadline.

In FY 2021, FRA will continue to monitor PTC status and will prepare for and begin auditing implemented PTC systems' performance, reliability, and adherence to safety plans. Advancements of PTC technology will begin to go into service, as the railroads use it to support automation of additional functions, such as system capacity management and scheduling. Railroads, with vendors and suppliers, will increase diagnostic capabilities through PTC systems. FRA will closely monitor these changes and advancements to ensure their implementation occurs without degrading system performance and reliability.

Rail Safety Partnerships
FY 2019 Enacted: $3.00 million
FY 2020 Enacted: up to $3.00 million
FY 2021 Request: $3.00 million

Confidential Close Call Reporting System (C^3RS)
The C^3RS enables railroad employees to report close calls and unsafe events and conditions in a safe environment. Employees who report a close-call event receive protection from railroad discipline and FRA enforcement. Railroads also receive protection from FRA enforcement for events reported within C^3RS. However, a close call does not involve willful, reckless, or criminal acts, nor does it involve any FRA-reportable accident resulting in harm to a person or property. Events that involve alcohol or drug impairment, or are witnessed in real-time by FRA personnel or a railroad manager or supervisor, are not close calls. Any incident resulting in a release of hazardous material is not a close-call event. Analyzing close calls is a proactive way to manage safety. When individual events are analyzed collectively through root cause analysis, railroads can identify safety hazards and develop solutions to mitigate or eliminate threats.

As with previous years' funding, FRA will use the FY 2021 funds to pay for third-party processing of close-call reports from safety-related railroad employees. NASA provides this service for FRA (and the Federal Aviation Administration). It supports FRA in achieving the highest level of close-call report processing. At the end of 2018, eight railroads were participating in C^3RS. At the end of August 2019, 15 passenger, commuter, and freight railroads—representing approximately 23,000 safety-related railroad employees—were participating.

Rail Information Sharing Environment (RISE)
FRA is taking the strategic approach of capturing, analyzing and sharing information with our partners in the rail industry to improve safety. We currently use Switching Operations Fatalities Analysis (SOFA) and Fatality Analysis of Maintenance-of-Way Employees and Signalmen (FAMES) committees to capture information resulting from individual cases involving injury and death of railroad employees. The FRA is planning to look at a higher level at this information and near-misses to capture and analyze data to identify trends and antecedent conditions using the RISE program. FRA is currently conducting a pilot that will continue from the first quarter of FY 2020 through the 3rd quarter of FY 2021. This pilot is being done with the railroads on the Northeast Corridor (NEC), include MTA, SEPTA and New Jersey Transit, along with Amtrak, to implement RISE and study its effectiveness. FRA believes wider dissemination of analytical results will help industry develop innovative safety strategies with measurable performance standards.

RISE is a new FRA initiative that is currently in a pilot phase with no direct funding. Future needs will be identified following the successful conclusion of the pilot.

Trespass Prevention
FY 2019 Enacted: $0.50 million
FY 2020 Enacted: $0.65 million
FY 2021 Request: $2.30 million

Trespassing on railroad rights-of-way is the leading cause of rail-related fatalities, accounting for 62 percent of U.S. rail-related deaths in FY 2018. In 2018, approximately 580 people died (an 18 percent increase compared to FY 2014) and 478 were injured trespassing not at grade crossings. An average of 448 trespassers died each year between FY 2009 and FY 2018. Since 1997, more people have been killed each year while trespassing than in motor vehicle collisions with trains at highway-rail grade crossings. Preventing trespassing will not only save lives but will also improve the efficiency of the rail transportation network.

FRA's 2018 *National Strategy to Prevent Trespassing on Railroad Property* focuses on four strategic areas: (1) data gathering and analysis; (2) community site trespass prevention assessments; (3) funding; and (4) partnerships with affected stakeholders. To continue executing the strategy, FRA's FY 2021 S&O request includes funding for the following initiatives.

- **Risk Model**: Maintain and upgrade the model; acquire leading indicator data.
- **Grants**: Fund mitigations, such as engineering solutions, law enforcement overtime, community and school resource officers, and outreach.
- **Summits**: Focus on locations most in need of attention based on data analysis; work with community leaders, law enforcement, railroads, and the public to identify hotspots and develop local mitigation ideas; provide information on Federal grants; and assist with outreach campaigns.

Highway-Rail Grade Crossing Safety
FY 2019 Enacted: $1.01 million
FY 2020 Enacted: $1.00 million
FY 2021 Request: $1.33 million

Collisions at highway-rail grade crossings are the second leading cause of rail-related fatalities, accounting for approximately 30 percent of all such fatalities. Each of the 209,000 U.S. highway-rail grade crossings has the potential for a collision between a train and highway vehicle. FRA expects the risk of highway-rail grade crossing incidents to remain a significant rail and public safety issue during the next decade.

FRA has a comprehensive approach to grade crossing safety. Following FRA's 2018 *Grade Crossing Fatality Prevention Summit* to gather stakeholder perspectives, FRA conducted listening sessions in 2019 on grade crossing safety technology. FRA convened a symposium in FY 2020 to review findings from the listening sessions and develop a three- to five-year strategy to implement and demonstrate promising technologies. The strategy also will address obtaining project approvals and funding, monitoring effectiveness, and

communicating project results. FRA is evaluating its annual funding of Operation Lifesaver, Inc., a national, non-profit organization dedicated to reducing grade crossing and trespassing incidents through public outreach, education, and law enforcement partnerships. The evaluation will help FRA identify alternatives that can increase the return on investment. FRA provides funding to enable active and retired law enforcement officers to raise awareness and enforce traffic laws at grade crossings and on railroad rights-of-way.

FRA will use the FY 2021 S&O funding for the following efforts.

- **Audits of Federally-Funded Grade Crossing Safety Projects**: Ensure completed projects comply with the Statements of Work and the approved engineering design plans.

- **Concept Study on Real-Time Crossing Equipment Operating Status**: PTC-equipped locomotives communicate in real time with railroad dispatchers. As these locomotives pass a grade crossing, their on-board cameras capture and record whether the grade crossing protection is functioning. The concept study would consider whether the locomotives could transmit crossing equipment status in real time in lieu of the periodic physical inspections Federal regulations currently require. If viable, this concept would enable railroads to deploy personnel to fix malfunctions rather than conduct scheduled inspections of all equipment.

Washington Union Station
FY 2019 Enacted: $1.00 million
FY 2020 Enacted: $1.00 million
FY 2021 Request: $1.00 million

As the statutory owner of Washington Union Station, FRA must ensure compliance with applicable building, fire, and life safety codes and requirements. FRA contracts to obtain the specialized knowledge to perform these duties, including inspections of the station, review of drawings and plans for new construction initiatives, and inspection of all repair work to ensure compliance with applicable building, fire, and life safety codes.

Audit Management Program
FY 2019 Enacted: $0.00 million
FY 2020 Enacted: $0.50 million
FY 2021 Request: $0.90 million

FRA created its audit management program to establish minimum standards and coordinate oversight of railroad compliance with regulations that require railroads to create and implement performance-based plans. The FY 2021 request will fund two FTEs, audit training for inspectors, and systems to coordinate, support, and evaluate the audit management program.

Data Management and Railroad Safety Information System
FY 2019 Enacted: $4.21 million
FY 2020 Enacted: up to $4.80 million
FY 2021 Request: $4.40 million

The Railroad Safety Information System (RSIS) is FRA's set of data management systems that collect, organize, process, visualize, and publish information on railroad accidents and incidents, safety inspections and violations, highway-rail crossing attributes, and other rail safety related information. FRA uses data from RSIS in trend analysis, safety performance measurement, and resource allocation. The information is available to the public and stakeholders.

In FY 2019, FRA undertook projects to increase RSIS capabilities, enable FRA to enforce safety regulations that have data collection and management requirements, and develop a user-friendly interface to access its data systems. FRA added an activation failure/false proceed database and tracking system, employee fatalities data input system, and externally facing portal for training institutions to submit their rail safety employee training programs for use by the railroads. FRA also initiated enhancements to its public website, safetydata.fra.dot.gov, to give users a more intuitive and visual capability. Lastly, FRA began a pilot program to combine internal and external data.

In FY 2020, FRA will begin moving RSIS funds to support the Department's enterprise shared information technology services through the Working Capital Fund. The Department will continue development and maintenance of FRA's data websites and systems.
For FY 2021, FRA will fund annual operations and maintenance and near-term projects to support data-driven decision-making. The request will support the pilot data science platform to integrate FRA's rail safety data with other data across FRA and the Department. New data initiatives include deployment of open source software to support data analytics; extraction, transformation, loading, and curation of internal and external source data; and software libraries and documentation to facilitate use of the data science platform.

Transportation Technology Center
FY 2019 Enacted: $0.50 million
FY 2020 Enacted: $0.50 million
FY 2021 Request: $0.50 million

Since its establishment in the 1970s, FRA's Transportation Technology Center (TTC) has been a vital resource in FRA's and the railroad community's pursuit of safer, more reliable, and more efficient rail services. Through FRA's unique partnership with the Association of American Railroads' subsidiary, Transportation Technology Center, Inc., TTC has matured, evolved, and prospered.

In 2015, FRA began offering technical training at TTC for its inspectors and safety specialists, state rail safety inspectors, and other government employees with an interest in rail safety, including the Department of Defense. Co-locating training and research and development provides opportunities for hands-on learning with rail technology, unavailable in traditional classroom settings. With rapid increases in rail technology, such as machine vision, surface and airborne autonomous inspection vehicles, and data analysis tools, there are significant synergies for collaboration between research and development and training. Continuing improvement and development of FRA's training staff and training capabilities at TTC are critical for preparing FRA for the future of safety oversight of the rail industry.

Transportation Technology Center	
Item	**FY 2021 Request**
Training Devices	$ 250,000
eLearning Improvements and Audiovisual Capabilities	$ 250,000
Total	**$ 500,000**

Cybersecurity Threat Assessment
FY 2019 Enacted: $0.00 million
FY 2020 Request: $0.00 million
FY 2021 Request: $0.50 million

As railroads introduce new technologies, the infrastructure becomes more vulnerable to cyber threats and hazards. In support of the *Cybersecurity and Infrastructure Security Agency Act of 2018*, and using the Department of Homeland Security's tools, capabilities, and services, FRA will assess the railroads' technologies as part of the FRA approval and certification process and regulatory reform initiative. With FY 2021 funds, FRA will contact experts to prepare the risk assessments and support the vulnerability analysis.

What benefits will be provided to the American public through this request and why is this program necessary?

U.S. passenger railroads transported 676 million passengers across 114 million passenger train miles in 2018, while the freight railroads completed 1.73 billion revenue ton miles. FRA's safety programs provide tangible safety and operational benefits to the American public and railroad industry by supporting the nation's economic productivity and ensuring the safety of its passenger and freight mobility needs. The FY 2021 request continues to target FRA's resources at the most pressing rail safety issues.

Preventing trespassing on railroad property and increasing safety at grade crossings. Preventing trespassing and increasing grade crossing safety will not only reduce the number of fatalities, but will also improve the efficiency of the transportation network. Trespassing on railroad property is the leading cause of rail-related fatalities, accounting for 62 percent of rail-

related deaths in FY 2018. An average of 448 trespassers died each year between FY 2009 and FY 2018. Grade crossing incidents are the second leading cause of rail-related deaths. The 209,000 at-grade highway-rail grade crossings in the United States each present the potential for a collision between a train and highway vehicle.

Protecting passengers and railroad crews on the more than 500 million annual rail passenger trips. The rate of rail-related accidents and incidents has fallen by 86 percent since 1980. Moreover, the number of employee on-duty fatalities in FY 2018 was about half the number in FY 2009. Nevertheless, fatal Amtrak accidents in 2015 and 2017 underscore that the railroad industry and FRA have hard work ahead.

Ensuring railroads operate safely to support economic productivity and meet passenger and freight mobility needs. FRA will remain diligent and examine new approaches to advance continuous safety improvement and make rail transportation as safe as possible.

Supporting the railroad's implementation of the most important rail safety technology in more than 100 years to improve system performance nationally. PTC systems are life-saving technology that stops certain railroad-related accidents and near accidents, and FRA has conditionally certified 13 PTC systems to date.

DEPARTMENT OF TRANSPORTATION
FEDERAL RAILROAD ADMINISTRATION

RAILROAD RESEARCH AND DEVELOPMENT
APPROPRIATIONS LANGUAGE

RAILROAD RESEARCH AND DEVELOPMENT

For necessary expenses for railroad research and development, [$40,600,000] *$41,000,000*, to remain available until expended.

EXHIBIT III-1
RAILROAD RESEARCH AND DEVELOPMENT
Summary by Program Activity
Appropriations, Obligation Limitations, and Exempt Obligations
($000)

	FY 2019 ACTUAL	FY 2020 ENACTED	FY 2021 REQUEST
Track	11,279	11,279	10,179
Rolling Stock	10,322	10,322	10,322
Train Control and Communication	8,086	8,086	8,086
Human Factors	6,042	6,042	6,042
Railroad Systems Issues	4,871	4,871	6,371
TOTAL	$40,600	$40,600	$41,000
FTEs			
Direct Funded	0	0	0

Program and Performance Statement

FRA's Research and Development Program is focused on improving railroad safety. It provides scientific and engineering support for the agency's safety enforcement and regulatory rulemaking efforts. It also identifies and develops emerging technologies for the rail industry to adopt voluntarily. The outcomes of the research and development are reduced railroad accidents and incidents. The program also supports intercity passenger rail development by providing technical assistance, equipment specifications, proposal evaluations, and Buy America compliance research. The focus of FRA's program is to fill the gaps in research not taken on by industry itself, and to partner with industry to leverage private R&D investment in a manner that ensures broader public safety benefits are achieved.

In addition to improving safety, the program contributes significantly towards activities to achieve and maintain a state of good repair and promote job creation and economic growth.

The program has the following areas of research:

- **Track Program** – Reducing derailments due to track related causes.
- **Rolling Stock Program** – Reducing derailments due to equipment failures, minimizing the consequences of derailments, and minimizing hazardous material releases.

- **Train Control and Communication Program** – Reducing train-to-train collisions and train collisions with objects on the line and at grade crossings.

- **Human Factors Program** – Reducing accidents caused by human error.

- **Railroad System Issues Program** – Prioritizing R&D projects on the basis of relevance to safety risk reduction and other DOT goals.

EXHIBIT III-1a

RAILROAD RESEARCH AND DEVELOPMENT
SUMMARY ANALYSIS OF CHANGE FROM FY 2020 TO FY 2021
Appropriations, Obligations, Limitations, and Exempt Obligations
($000)

	$000		FTE
FY 2020 ENACTED	$40,600		0
ADJUSTMENTS TO BASE:			
Equipment	-100		
SUBTOTAL, ADJUSTMENTS TO BASE	**-100**		**0**
PROGRAM REDUCTIONS			
Track	-1,000		0
SUBTOTAL, PROGRAM REDUCTIONS	**-1,000**		**0**
PROGRAM INCREASES			
Railroad Systems Issues	1,500		0
SUBTOTAL, PROGRAM INCREASES	**1,500**		**0**
FY 2021 REQUEST	**41,000**		**0**

Detailed Justification for the Railroad Research and Development

FY 2021 – Railroad Research and Development – Budget Request
($000)

Program Activity	FY 2019 Actual	FY 2020 Enacted	FY 2021 Request
Track	11,279	11,279	10,179
Rolling Stock	10,322	10,322	10,322
Train Control and Communication	8,086	8,086	8,086
Human Factors	6,042	6,042	6,042
Railroad Systems Issues	4,871	4,871	6,371
Total	**$40,600**	**$40,600**	**$41,000**

What is this program and what does this funding level support?

The mission of FRA's Research and Development (R&D) program is to ensure the safe, reliable, and efficient movement of people and goods by rail through applied research. FRA's R&D program aligns closely with the Department's key priorities for FY 2021:

- **Safety:** FRA's R&D efforts provide the scientific and engineering basis for safety enforcement, regulatory reform, and non-regulatory safety initiatives.
- **Infrastructure:** FRA's R&D program advances safety and performance of three types of railroad infrastructure – track, rolling stock, and train control and communications systems – while mitigating human factors risks to optimize the use of infrastructure through safe and efficient operations.
- **Innovation:** Historically, FRA's R&D program has invented new technologies that transformed railroad safety inspection, passenger rail crashworthiness, railroad automation. The FY 2021 proposal continues investment in the next generation of transformative technologies.
- **Accountability:** Project evaluations support the R&D program's goals of accountability and help gain insight on how to mature its performance measurement and evaluation efforts.

Work undertaken in the past 5 to 10 years contributes to today's safety performance. R&D projects typically follow one of these paths to implementation:

1. **Voluntary Industry Adoption:** R&D by FRA is necessary for conducting higher-risk and longer-term projects, which private industry would not otherwise undertake, to

develop advanced technologies and practices. In many cases, industry voluntarily adopts these safety practices and technology without the need for regulation.

2. **Enforcement:** R&D by FRA creates new technology for efficient and effective oversight of railroad compliance with safety regulations.
3. **Regulation:** R&D by FRA is necessary to develop the scientific and engineering foundation for valid, data-driven and performance based regulations and deregulatory actions.
4. **Incorporation into Industry Standards and Recommended Practices:** The results of research performed by FRA are often used to develop (or modify/update) relevant industry standards. These include those created by the American Public Transportation Association (APTA) and the Association of American Railroads (AAR). Industry standards can leverage the output of FRA R&D without the need for additional regulations and achieve equivalent safety benefits.

FRA's R&D program is organized around the following five rail safety disciplines:

- **Track Program**
  - Track and structures performance, inspection technology and processes, substructure assessment.
  - Rail Integrity assessment and defect detection technologies
  - System Performance and Analysis including predictive analytics.
  - Track and train interaction including wheel-rail interface, vehicle track modeling, simulation and validation.

- **Rolling Stock Program**
  - Rolling stock and components, onboard and wayside monitoring systems, material and design improvements.
  - Hazardous materials transportation risk reduction, tank car damage assessment, inspection, and integrity.
  - Safety research on energy efficiency technologies.
  - Liquefied Natural Gas (LNG) - Natural Gas Safety Research.
  - Train occupant protection, locomotive and passenger car safety and performance.

- **Train Control and Communication**
  - Development and testing of Positive Train Control (PTC) technologies and communication systems.
  - Interoperability standards.
  - Communication cybersecurity.
  - Automation and automated vehicle research.
  - Drone-based technology research.
  - Train control and grade crossing risk simulation and modeling.
  - Grade crossing safety technologies and pilot studies, including intelligent rail systems, blocked crossings, and trespass prevention.
  - Development and testing of train control and communication systems.

- **Human Factors Program**
  - Railroad trespass and suicide prevention.
  - Automation, operating personnel information management and control.
  - Human fatigue.
  - Project evaluation.
  - Motorist behavior at highway grade crossing.
  - Vigilance, attention and distraction.
  - Office of Railroad Safety Support.
  - Support for the Short Line Safety Institute.

- **Railroad System Issues Program**
  - Research, Development & Technology (RD&T) research strategy.
  - Safety risk analysis and performance-based regulations.
  - Research prioritization.
  - Strategic collaborations and partnerships.
  - Performance-based regulations.
  - Railroad environmental issues and locomotive efficiency research
  - Locomotive safety.
  - Rail Safety IDEA (Innovations Deserving Exploratory Analysis) program grants with the Transportation Research Board.
  - Program or Project evaluation, including the Transportation Research Board's independent review of FRA's R&D programs.
  - Railroad industry workforce development research.
  - Technology Transfer.
  - R&D facilities at the Transportation Technology Center (TTC) managed through a public-private partnership. Partnership RD&T related support services.

The FY 2021 Request includes $41 million for FRA's R&D program, an increase of $22 million from FY 2020 President's Budget, but in line with the $40.6 million in FY19 enacted funding. Funding requested in FY 2021 is dedicated towards transformative, next-generation safety technology initiatives, with a focus on projects that advance the safe automation of railroad operating and inspection functions.

All research products (including Technical Reports and Research Results) and data produced from FRA's R&D program are published to multiple sites according to RD&T's Research Portfolio Information Action Plan (documented in the FY 2019 – FY 2020 Annual Modal Research Plan).

Technology Transfer (T2) and deployment resources for all projects include:
- Stakeholder Engagement
  - Industry Conferences, Meetings, Presentations/Demonstrations
  - Workshops, Committees and Summits
  - Community Meetings
- Communications
  - Support for publications and reports

FRA will measure performance for T2 as part of the DOT Strategic Goal Innovation.
Development of Innovation:

- Increase Dissemination of DOT-Funded Research Reports (Office of the Assistant Secretary (OST))
- Increase Production of Tangible DOT-Funded Research Outputs (OST)
- Increase DOT Technology Transfer Activity (OST)

Deployment of Innovation:

- Increase Tangible Production of DOT-Funded Research (OST)

TRACK RESEARCH PROGRAM

The FY 2021 Request includes $10.174.9 million for FRA's Track Research Program. The amount reflects FRA's transfer of $1.1 million from Track Research to Railroad Systems Issues to consolidate funds for R&D facilities at TTC.TTC.

The number of accidents due to track-related causes decreased by 20 percent from 2009 to 2018. This reduction is due, in part, to the industry's adoption of technologies developed by FRA, such as:

- Gage restraint measurement system, a technology to assess the integrity of ties and fasteners.
- Vehicle-track interaction monitoring system developed for Amtrak and Class I freight railroads.
- Joint bar inspection system, an image-based technology that detects defects.
- Autonomous inspection technology used in Amtrak and freight assessment surveys.

The Track Research Program prepares for the future of rail transportation through applied research, development, and demonstration in the areas of rail performance, predictive analytics, track stability, track inspection, and vehicle track performance. FRA conducts applied research to test concepts and further understanding of safety problems causing accidents and incidents. Research topics that provide deeper understanding of technology, systems, practices or standards may lead to the development and testing of a prototype and demonstration with industry. Projects like Robotics for Bridge Inspection or Autonomous Internal Rail Flaw Inspection Device begin as applied research and are developed utilizing existing and new technologies.

As new technologies continue to emerge, and train axle loads and speeds increase, the timely development of technical information, data, and expertise is crucial to provide a basis on which to make decisions about issues affecting the safe operation of rail vehicles on U.S. track. The Track Research Program supports the goals and objectives of the DOT/FRA administration; conducts safety related research for new and in-service railroad system investments; develops and demonstrates new track condition assessment technologies; and coordinates research teams between railroads, universities, technology leaders, and the government.

The Track Research Program is trying to prevent high-consequence derailments that result in the loss of human life and cause significant damage to property and communities by:

- Identifying, understanding, and mitigating track-related failure modes that pose significant risk to safe Heavy Axle Load (HAL) operations and changes in track designs and/or materials.
- Ensuring the safe and effective implementation of new and innovative technologies and maintenance strategies intended to mitigate adverse effects of HAL operations on track infrastructure.
- Developing procedures for vehicle and track simulation building and validation.
- Providing guidelines for FRA Office of Railroad Safety, railroad industry, and consultants on how to build, model, and simulate different vehicle or track components to better understand the fundamentals of vehicle/track interaction and reduce derailment risk.
- Predicting, detecting, and preventing internal rail defects that lead to train derailments.
- Ensuring the safe and effective implementation of engineered-polymer composite ties and their fastening systems through the development of data-driven recommended practices.
- Preventing track buckles.
- Predicting adverse conditions and safety-related issues in the track infrastructure long before they become problematic.
- Understanding how changes in track infrastructure condition, operations, and/or regulations can affect the potential risk for track-related derailments.
- Increasing safety by reducing track support caused derailments.
- Supporting research partners in derailment investigations.
- Supporting research partners and the railroad manufacturing community in vehicle qualification and evaluation testing.
- Understanding the root cause of rolling contact fatigue in wheels and rails and developing methodologies, techniques, and inspection tools to identify problematic conditions before they become a safety threat.

Strategic collaboration partners for the Track Research Program include FRA's Office of Railroad Safety, American Short Line Regional Railroad Association (ASLRRA), Association of American Railroads (AAR), multiple railroads and universities.

Anticipated FY 2020 accomplishments for the Track Research Program include:

- Develop a device that 3D image internal rail flaws for better sizing and identification and develop remaining rail life calculation through experimental testing and theory.
- Develop a non-contact rail integrity inspection system utilizing acoustic sensors, doppler laser vibrometers, and signal processing.
- Quantify and evaluate Rail Flaw Inspection Practices and Modern Rail Steel Defect Growth Analysis.
- Support data and analysis requests from the FRA Office of Railroad Safety for rail performance issues.
- Finish the design and start building a test bed that can be used to validate the accuracy of track geometry measurement systems being used by FRA and the industry.

- Complete automated procedures for the alignment, processing, and reporting of Automated Track Geometry Measurement Systems (ATGMS) data for predicting areas approaching maintenance and safety limits.
- Support the development of procedures to include advanced friction models that examine the effects of falling friction, speed, and third body layer on wheel-rail contact forces, and 3D contact geometry.
- Successfully research into automated, solid-state frog repair technology with completion of field testing.
- Complete data collection to assess track fouling and the initiate development of safety criteria through understanding of subgrade failures.

Track and Structures……..$8.10 M

Track and Structures - Rail Performance

This research builds upon the FY 2019 first generation prototype with the second-generation prototype of flash thermography technology for detection of base defects.

Activities:

- Broken Rail Detection System on End of Train
  - Develop a cost-effective end of train device that can detect rail breaks utilizing a unique line laser approach.
- Non-contact rail integrity inspection prototype
  - Either laser or acoustic based or both.
- Continue to gather rail defect donations from at least three Class I railroads, characterize these defects, and add them to the FRA rail defect library at TTC for the entire research community to utilize in developing better detection systems.
- Refine towards commercialization a unique automation of detection protocol for ultrasonic rail inspection.
- Refine towards commercialization a unique 3D rail flaw imaging technology.
- Build a prototype to utilize flash IRT (infrared thermography) to detect anomalies in the rail base area.
- Automated, Solid-State Rail Joining Technology.
  - Research and development of friction welding technologies to join rail sections. Cooperative research at TTC with industry to reduce or eliminate performance issues associated with flash butt and thermite welding techniques.
- Innovative treatments for Rail Steel.
  - Research on heat treatment, coatings, and other technologies to improve the service life of running rails and special track work.
  - Continue research and development of automated methods to repair worn frogs, wings and other track appliances.

Expected Outcomes:

- Complete third-generation of broken rail detection system for the end of trains.
- Develop third-generation non-contact rail integrity inspection system prototype and complete a probability of detection study.

- Expanded FRA rail defect library at TTC for the entire research community.
- Complete field tests and assessment of automation of detection protocol for ultrasonic rail inspection. Generate list of needed improvements and research.
- Complete compact 3D rail flaw imaging prototype and rail life estimator software. Both are ripe for the commercial sector to develop the rest of the way and get out into industry where they can make a difference.
- Complete first field tests of flash IRT (Infrared Thermography) to detect anomalies in the rail base area.
- Restart research to develop a solid-state process to join full section rails in cooperative partnership with industry and other research organizations.
- Procure support for rail treatment and coatings research. Complete early development testing in the laboratory.
- Successfully close out research into automated, solid-state frog repair technology with completion of field testing and technology transfer to industry for commercialization.
- Re-start research and development of friction welding technologies to join rail sections. Cooperative research with industry, TTCI, and FRA to reduce or eliminate performance issues associated with flash butt and thermite welding techniques.
- Research on heat treatment, coatings and other technologies to improve the service life of running rails and special track work.
- Complete research and development of automated methods to repair worn frogs, wings and other track appliances. Transition technology to industry for commercialization.

Track and Structures – Track Inspection Technology and Processes

This research improves the track inspection process to automate the detection of conditions that causes track failure and report the conditions and location to the railroad for remediation.

Activities:

- Continue Research and development of change detection technology suitable for deployment on autonomous inspection platforms. In addition, developing automated data analysis of track inspections to determine safety related changes to the track structure, and reports this information to stakeholders with limited human intervention.
- Continue developing innovative approaches to imbed sensors and detection and communications technologies within the track structure to allow for a type of self-enunciation when conditions warrant remedial maintenance or pose a threat to safe rail operations.

Expected Outcomes:

- The long-range objective is to develop technology that permits railroad track to communicate its “state-of -repair” directly to the railroads, in a manner that is somewhat analogous to the way modern devices communicate via the internet of things (IoT).

R&D Facilities and Equipment – On-Track Research and Testing (FRA Research Assets)

This research seeks to conduct track research and testing to prevent derailments caused by track and structures.

Activities:
- Continue revenue service testing focused on the effects of cold weather on the integrity of the track system.
- Continue to investigate root causes of potential issues that may arise during FY20 affecting safe Heavy Axle Load (HAL) operations.

Expected Outcomes:
- Report results of expanded testing using the "rainy section" at TTC to investigate weld strains and failures associated with progressively deteriorated track support.
- Test results on the effects of cold weather on the integrity of the track system (e.g., effects of frozen ballast on Rail Neutral Temperature (RNT) loss and remediation).

Track and Structures – Track Support & Substructure
This research seeks to prevent derailments caused by track support and subgrade issues.

Activities:
- Develop reliable and automated method to assess track fouling and the development of safety criteria through understanding of subgrade failures.
- Develop characterization and further understanding of ballast mechanistic behavior and properties.
- Further develop vertical track deflection measurements to provide a structural indication of the track support structure with large deflection indicating weakness in the track support layers.
- Further refine Gage Restraint Measurement Systems (GRMS) technology to identify potential track strength weakness at the rail tie interface.

Expected Outcomes:
- Automated method to assess track fouling and the development of safety criteria through understanding of subgrade failures.
- Improved understanding of ballast mechanistic behavior and properties.
- Vertical track deflection measurements to provide a structural indication of the track support structure with large deflection indicating weakness in the track support layers.
- Refinement of GRMS technology to identify potential track strength weakness at the rail tie interface.

Track and Structures – Track Stability
This research builds upon the FY2020 first and second-generation prototypes for measuring rail stress without a zero reference.

Activities:
- Develop third generation prototypes to measure rail stress without a zero reference.
- Upgrade of Continuous Welded Rail (CWR)-Safe Software.
- Upgrade Rail Temperature and Buckling Prediction website.
- Initiate build of a rail stress and rail neutral temperature test bed at TTC.
- Finish the design and start building a test bed that can be used to validate the accuracy of track geometry measurement systems Research lateral stability and track buckling practices.

Expected Outcomes*:*

- Prototypes to measure rail stress without a zero reference that are robust and repeatable.
- Completion of CWR-Safe software upgrade. An asset to industry and track researchers trying to understand and prevent track buckles.
- Completion of upgrade of Rail Temperature and Buckling Prediction Website. An asset that will be valuable to field and management personnel, both in government and in industry, for preventing track buckle derailments.
- In-progress build of a rail stress and rail neutral temperature test bed at TTC.
- Quantified ways to build, monitor and maintain track to prevent track buckles.

Track-Train Interaction – Wheel-Rail Interface

The goal of this project is to continue research to understand the root cause of RCF and develop methodology, techniques and inspection tools, to identify problematic conditions before they become a safety threat.

Activities:

- Development of recommendations on third body layer influence and parameters, and operating conditions that can cause Rolling Contact Fatigue (RCF).

Expected Outcomes:

- Recommendations on third body layer influence and parameters, and operating conditions that can cause RCF.

Track-Train Interaction – Vehicle-Track Modeling, Simulation and Validation

Under the vehicle-track modeling research area of this program, TR will continue the work on all the areas related to vehicle-track modeling.

Activities:

- Continue support the development of procedures for both model building and model validation.
- Continue to support the development of procedures to include advanced friction models that examine the effects of falling friction, speed, and third body layer on wheel-rail contact forces, and 3D contact geometry.
- Support testing and modeling of vehicle suspension components.
- Support building of vehicle and track models for various equipment and operating practices to be used for derailment investigations or developing safety.
- Completion of the model perform simulation to see the response of the vehicle to multiple track input.

Expected Outcomes:

- Developed procedures for both model building and model validation.
- Developed procedures to include advanced friction models that examine the effects of falling friction, speed, and third body layer on wheel-rail contact forces, and 3D contact geometry.
- Test results and modeling of vehicle suspension components.

- Progress toward building of vehicle and track models for various equipment and operating practices to be used for derailment investigations or developing safety.
- Completion of the model perform simulation to see the response of the vehicle to multiple track input.

System Performance and Analysis …….……$2.07 M

System Performance & Analysis – Predictive Analytics
This research focuses on the utilization of "Big Data" sources as well as the automation of track-related data processing and analyses to improve track safety and decrease derailments.

Activities:
- Complete methodologies for the evaluation of track inspection technology effectiveness and initiate process to incorporate as recommend practice.
- Continue research efforts focused on the application of artificial intelligence (AI) into track-related safety inspection techniques.
- Complete automated procedures for the alignment, processing, and reporting of Automated Track Geometry Measurement Systems (ATGMS) data for predicting areas approaching maintenance and safety limits.
- Conduct field investigation into the root causes of track geometry degradation associated with observed/predicted accelerated deterioration trends.

Expected Outcomes*:*
- Continue to improve automated processing capabilities in order to move from near real-time to real-time analysis of track-related data.
- Establish a standardized procedure for evaluating the effectiveness of existing and emerging track inspection technologies prior to use in industry.
- Recommend remedial methods associated with observed/predicted deterioration trends that most improve track geometry stability and safety.

Deployment of Expected Outputs/Products:
Partnerships and stakeholder engagement form the foundation of RD&T's technology transfer (RDT2) methodology leading to the adoption of research products. Autonomous Track Geometry Monitoring System (ATGMS) is an example of Track's collaboration with industry and universities that is leading to the deployment of ATGMS systems throughout the industry.

ROLLING STOCK PROGRAM

The FY 2021 Request includes $10.32 million for FRA's Rolling Stock Research Program.

The number of accidents due to equipment-related causes has decreased by 2 percent from 2009 to 2018. This has been due, in part, to previous research resulting in new operating practices and equipment standards for conventional rail, high-speed rail, and hazardous material transportation.

The Rolling Stock Research Program performs research activities relating to critical transportation topics that promote rail safety, improve rail infrastructure and mobility of goods and passengers, as well as topics that focus on preserving the environment. The Rolling Stock Research program conducts research to reduce railroad accidents and incidents due to rolling stock related causes as well as research to reduce fatalities and injury severity to passengers and crew members involved passenger train accidents and incidents. The Rolling Stock Research program produces solutions contributing to all DOT strategic goals: safety, infrastructure, innovation, and accountability.

This Program's research helps determine criticality and methods for identifying, analyzing, and evaluating potential failure modes. Rolling Stock conducts applied research to test the concepts and further understanding of safety problems causing accidents and incidents. Research topics that provide deeper understanding of technology, systems, practices or standards may lead to the development and testing of a prototype and demonstration with industry.

The Rolling Stock Research Program helps mitigate potential risks of unexpected failures occurring in rolling stock that can cause delays and disruptions to transport services or even result in derailment or collision accidents by:

- Conducting research and testing pertaining to bulk packaging traveling by rail, such as: tank cars, rail cars and intermodal tanks.
- Testing and understanding the different types of hazardous materials to be considered for transportation over the rail network.
- Providing engineering support in the research, design, fabrication, and test planning of ISO tanks, tank car fire testing and the structural performance of this equipment when used as fuel tenders and energy products as commodity transport.
- Improving defect detection, monitoring, inspection and control of rolling stock equipment and components to help reduce risks through the prevention of above-track equipment and component failures to improve safety.
- Developing and demonstrating the effectiveness of designs, strategies, and technology solutions that address structural integrity of locomotives to decrease the risk of fatalities and injuries in the event of accidents.

Strategic collaboration partners for the Rolling Stock Research Program include FRA's Office of Railroad Safety, Pipeline and Hazardous Materials Safety Administration (PHMSA), Maritime Administration (MARAD), American Short Line Regional Railroad Association (ASLRRA), Association of American Railroads (AAR), multiple railroads and universities.

Anticipated FY 2020 accomplishments for the Rolling Stock Research Program include:

- Provide FRA with information on the survivability of tank cars under fire condition in case of train derailment accident.
- Determine cars' behavior and failure modes under normal transportation of tank cars.
- Provide a foundation for modifying, eliminating or creating standards by leading research and capturing the results.

- Disseminate information to the rail and tank car industry so it can be used for tank car designs.
- Provide a realistic fire exposure to the test assembly (tank on flatcar) and make several key measurements, including interior and external temperatures, tank pressure, blast pressure a (if applicable), and heat flux.
- Identify possible studies to address defects that affect the structural integrity of safety equipment and packages.
- Identify projects that can be proactive for existing and future safety equipment and packages.
- Provide RD&T and FRA Office of Railroad Safety (RRS) with information on the performance and durability of safety equipment for tank cars and portable tanks so DOT has the required information to justify, modify, eliminate and create safety standards.
- Better understanding of how failures occur and how to best prevent or manage the consequences of such failures through improved equipment design and protection.
- Assist FRA to evaluate and document damage to railroad tank cars, study and capture the results of the liquid/vapor release flow on pressure relief.
- Design and fabricate LNG tender with the cabinet that protects the enclosed valves and fittings in the event of a collision with a tractor-trailer.
- Evaluate the current computer models and improve the fire computer models
- Develop an online hazardous material (HazMat) release probabilistic risk assessment platform for real-time, local track risk analysis.
- Develop an alternate mechanism for rapid brake signal propagation, to be used on unit trains transporting energy products (High Hazard Flammable Trains).
- Evaluate and test equipment and components for increased integrity to withstand damage and failure that could increase risks and lead to accidents and incidents.
- Research methods to measure the predictability of equipment health and component wear life.
    - Conduct evaluations and demonstrations of advanced devices.
    - Research damage resistance models of freight components. (Tonnage carried per wheel has progressively increased thus increasing stress to railway equipment leading to increased risks).
    - Collaborate with the industry to evaluate failure modes and characteristics.
    - Evaluate and demonstrate advanced equipment and inspection and maintenance procedures.
    - Demonstrate the ability to develop, monitor, control, and evaluate integrated advanced components.
    - Develop a system to power advanced devices and systems.
    - Develop a reliable framework for a wheel life model.
    - Develop technologies to detect defects on rolling stock equipment and predict failures.
    - Collaborate and support the development, demonstration and implementation of advanced wayside and onboard monitoring and inspection of equipment and components to help reduce risks and ensure safe train operations.
    - Develop methods to identify and track defective equipment and component systems.
    - Assess and increase knowledge of advanced technology and its effectiveness in improving the safety of train operations and detection of defects.

    - Conduct data analysis to support the evaluation of the performance of equipment and component systems.
    - Improve the process for demonstrating and implementing new technology. Establish a standard process for wayside technology pilot demonstrations and implementation.
- Develop strategies to identify and quantify safety risks in train operations.
- Evaluate and encourage safe practices for train makeup and handling to reduce accidents and derailments. Develop train handling and operational strategies to help reduce adverse effects on train operations.
- Defining the network topology of the freight transportation system. Also, defining the nodal and linkage bottlenecks, and the investment strategies to be examined.
- Investigate the current passenger truck designs and diagnose the main issues that need improvement.
- Literature review is needed to analyze/investigate the current and previous state-of-the-art methods in Crash Energy Management (CEM) Technology and Implementations (world-wide).
- Conducting accurate and reliable feasibility analysis to improve the CEM capabilities of existing (in-service) passenger and critical HazMat equipment.
- Continued participation in the restarted APTA Passenger Rail Equipment Safety Standards committees to revise existing and/or develop new safety standards which are complementary to existing federal regulations.
- Conduct of train-to-train test to affirm the behavior of the prototype deformable anti-climber and pushback coupler system as an effective means for inhibiting vehicle-to-vehicle override in collisions.
- Complete the engineering analyses related to passenger car side structure requirements which are being performed to address the outstanding National Transportation Safety Board (NTSB) recommendation to FRA.
- Completion of testing to assess the efficacy of retrofit collision posts on older “legacy” locomotives which are not compliant with modern industry crashworthiness standards.
- Evaluating the results of the glazing retention test program to derive appropriate metrics for consideration in possible rulemaking and/or development of industry standards for enhanced glazing retention capacity.
- Leverage results from test program to make recommendations to the industry on most effective mechanisms from improving glazing retention capacity.
- Conduct room corner tests to validate scaling laws developed through simulations.
- Evaluate modern methods for measuring toxicity of burning materials.
- Simulation of other scenarios of fuel tank puncture using validated models
- Evaluate railExodus and other modern available emergency evacuation simulation tools for effectively predicting evacuation of passengers under various scenarios.
- Investigate integration of emergency evacuation tools such as railExodus with fire dynamics models for safety and emergency preparedness research.
- Educating the public and emergency responders on how to locate and use the Emergency Notification System (ENS) sign information.
- Development of standards for natural gas fuel tender.
- Review railroads natural gas fuel usage programs.

Hazardous Material (HazMat) Transportation……...$2.18 M

This research program focuses on improving the safety of rail transport of hazardous materials and is conducted in cooperation with the railroad industry, PHMSA and Transport Canada. This program seeks to develop new standards and methodologies to evaluate the safety and performance of current and new tank car designs used to transport hazardous material. Having a safe means of transportation is vital to growing domestic energy production, both for domestic use and export.

HazMat – Tank Car Research

This research develops and improves the packages that carry hazardous materials, helping to reduce the release of material during rail accidents and incidents.

Activities:

- Fire test on a LPG tank car.
- Side and head impact test on a DOT 113 tank car.

Expected Outcomes:

- Improve the computer model and update current regulation on thermos protection.
- Update computer model to include cryogenic tank cars.

HazMat – Structural Integrity

The goal of this project is to understand the performance and durability of safety equipment, and protective systems for tank cars and portable tanks. This research area focuses the current fleet, identifying problems with current equipment and packages.

Activities:

- Testing of different pressure relief valves used on tank cars.
- Perform a rollover protection test on a current DOT 117.

Expected Outcomes:

- Improve the performance of pressure relief devices.
- Improve the rollover protection for new tank cars.

HazMat – Accident Consequence Reduction

This research will study the loading and unloading practices of hazardous material to improve the operating practices and securement of packages for safe transportation and reducing non-accident releases.

Activities:

- Investigate accidents involving hazardous materials packages.
- Conduct forensic analysis on equipment.
- Procure and store equipment for further investigation.

Expected Outcomes:

- Better understanding of how failures occur and how to best prevent or manage the consequences of such failures through improved equipment design and protection.
- Help FRA evaluate and document damage to railroad tank cars, study and capture the results of the liquid/vapor release flow on pressure relief.

Rolling Stock Equipment and Component (RSEC)……$3.76 M

Research efforts in the Rolling Stock Equipment and Components (RSEC) program area focus on development and improvement of equipment defect detection and control. Both wayside and on-board detection and control systems offer diverse platforms for such research and demonstration.

RSEC - Rolling Stock Component Safety

The research comprised in this project proactively prevent above-track equipment and component failures (e.g., situational hazard prevention), and provide the analytical and technical basis to develop equipment safety standards while also improving safety, reliability, and respectability of rail equipment, technologies, and material.

Activities:

- Continue to evaluate and test equipment and components for increased integrity to withstand damage and failure that could increase risks and lead to accidents and incidents.
- Continue to research methods to measure the predictability of equipment health and component wear life.
    - Conduct evaluations and demonstrations of advanced devices.
    - Research damage resistance models of freight components. (Tonnage carried per wheel has progressively increased thus increasing stress to railway equipment leading to increased risks).
    - Collaborate with the industry to evaluate failure modes and characteristics.

Expected Outcomes:

- Research, development, and technology transfer of components and systems that reduce the risk of rail incidents and accidents and increase the safety of the nation's rail transportation network.
- Reduce the likelihood of derailments from equipment failures and mitigate the consequences should derailments occur through these or other causes. Strategic priorities include investigation of the effectiveness of wayside and onboard monitoring systems to detect equipment defects and analysis of component failure modes to identify necessary improvements in materials and construction methods.
- Design, develop, and demonstrate prototypes of effective wayside and onboard technologies that can provide component health monitoring.
- Increased understanding of equipment failure mechanisms and facilitate mitigation to reduce public safety risks.

RSEC - Rolling Stock Maintenance & Inspection

The focus of this research is to evaluate and demonstrate the effectiveness and efficiency of automated inspection and maintenance procedures and equipment. This project will demonstrate the ability to develop, monitor, control, and evaluate integrated advanced components to detect defects in real-time, predict and prevent future failures, improve rolling stock capabilities and performance, and improve overall rail operational safety. Developing a system for powering many advanced detection devices on freight trains will increase safety and security, and improve the efficiency of freight railroad operations. Technologies developed to detect defects on rolling stock equipment, and predict future failures that may be prevented, will substantially improve railroad safety. These investments keep the U.S. rail sector growing and improving to keep up with the latest efficiency and safety standards.

Benefits of this research include improved safety requirements, lower operating costs for railroads, reduced railroad accidents and fatalities, improved equipment service life for equipment, and increased safety, security and efficiency of freight railroad operations.

Activities:

- Analysis of broken axles trends and causes.

Expected Outcomes:

- Detailed analysis of broken axles trends and causes, and recommendation to eliminate or mitigate their hazards.

RSEC - Train Handling & Operating Practices

This research will develop simulation scenarios to evaluate different network and capacity related parameters with Electronically Controlled Pneumatic (ECP) brakes and PTC technologies, and compare these to the conventional signaling and braking applications. Simulation scenarios include network topology, traffic type, ECP scenarios, and PTC scenarios (with and without ECP scenarios).

This research will also focus on developing effective methodologies/models for evaluating the economic benefits of improving railroad network velocity and capacity. These tools will be critical in demonstrating the benefits of technologies such as ECP brakes, PTC, higher speed operations, and shared corridors.

This research will also address Topology-based Resilience of Freight Transportation Networks, mainly to enhance the national freight system to address key challenges corresponding to several major trends affecting freight transportation including: (1) expected growth in freight tonnage, (2) underinvestment in the freight system, (3) difficulty in planning and implementing freight projects, (4) continued need to address safety, security, and resilience, and (5) increased global economic competition.

This research will also improve passenger truck designs that can provide superior equalization and curving performance to better handle rough track geometry.
This research is in line with FRA's mission to improve safety and performance, and prevent derailments that cause injury and loss of life. Derailment prevention is a major safety issue. It

is in the FRA's best interest to enhance the economic benefits of improving railroad network velocity and capacity. The rail industry will benefit from this research through improved safety requirements, lower operating costs, reduced railroad accidents and fatalities, and overall improved railroad performance.

Activities:
- Continue to define the network topology of the freight transportation system. Also, defining the nodal and linkage bottlenecks, and the investment strategies to be examined.
- Continue to investigate current passenger truck designs and diagnose the main issues that need improvement.

Expected Outcomes:
- Continue to improve the network topology to have the topological structure to offer robustness, resiliency, efficiency and effectiveness. Enhancing the network to meet the current increasing challenges.
- Continue to improve passenger truck designs that can provide superior equalization and curving performance to better handle rough track geometry.
- Evaluate advanced bearing technology and testing that prevents water related failures due to various environmental exposure.

Train Occupant Protection .....$4.38 M

Research in this area will develop improved strategies and designs for rail rolling stock to reduce injuries and fatalities resulting from rail accidents (i.e., collisions and derailments). FRA needs to invest in this research to support its missions of improved safety, performance, and mitigation of the consequences of collisions and derailments that cause injury and loss of life. Crashworthiness and occupant protection continue to be major safety issues as evidenced by several recent, high-profile collisions and derailments.

<u>TOP - Locomotive Crashworthiness and Occupant Protection</u>
Research in this area will develop improved strategies and designs for rail rolling stock to reduce injuries and fatalities resulting from rail accidents (i.e., collisions and derailments). FRA needs to invest in this research to support its missions of improved safety, performance, and mitigation of the consequences of collisions and derailments that cause injury and loss of life. Crashworthiness and occupant protection continue to be major safety issues as evidenced by several recent, high-profile collisions and derailments.

Activities:
- Continue the literature review and analyzation/investigation of the current and previous state-of-the-art methods in crash energy management (CEM) technology and implementations (world-wide).
- Continue conducting accurate and reliable feasibility analysis to improve the CEM capabilities of existing (in-service) passenger and critical hazmat equipment.

- Continue to evaluate geometric compatibility between coach cars and locomotives in collisions. Translate these into additional potential load cases with appropriate evaluation criteria to ensure stable performance under moderate collision conditions
- Re-evaluation of traditional anti-climbing requirements if push-back couplers and CEM are present (may not need same load requirements to be sustained while achieving the same or better performance when compared to conventionally designed equipment).
- Re-evaluation of end frame elastic requirements for passenger vehicles with CEM. Some designs may prematurely activate crush zones but still have significant residual strength to function as intended.

Expected Outcomes:
- Improving the crash energy management (CEM) capabilities of existing (in-service) passenger and critical hazmat equipment, through cost-effective adaptations and retrofit technology.
- The re-evaluation activities described above will take advantage of more sophisticated modelling capabilities which exist and apply them to the structural analyses of alternative passenger equipment designs. Outcomes will be technical data which can be leveraged to inform potential improvements to existing safety standards.

TOP - Glazing Standards

In the last 44 years, at least 25 fatalities have been attributed to ejection through rail car window openings during passenger train accidents. The research in this area will comprehensively describe all the engineering requirements placed on glazing systems, survey existing glazing systems design strategies used throughout the world, and assess the effectiveness of these designs in meeting all of the engineering requirements. In addition to functioning as a window, glazing systems are also expected to be impact resistant, provide emergency egress, provide emergency access, be fire resistant, and provide occupant containment.

FRA needs to invest in this research as it has the responsibility for conceptualizing and demonstrating the effectiveness of technology solutions that improve safety and where safety regulations may or may not already exist. The private sector is not motivated to invest in research in areas where it is already compliant with existing federal regulations and industry standards, even when those regulations and standards do not yield the maximum possible safety.

Activities:
- Activities to be performed would concentrate on what may not have been completed and/or revising the scope to respond to NTSB's assessment of FRA's response to this safety recommendation.

Expected Outcomes:
- Final draft of proposed APTA safety standard for improved glazing retention capacity.

TOP - Fire Safety Research

The Fire Safety Research program will focus on improving current Federal regulations and industry standards for crashworthiness of passenger locomotive fuel tanks, fire performance of

materials and components used in passenger rail equipment through research activities. Modern, innovative, alternative methods for evaluating fire performance of materials and components will improve safety, yield cost-savings opportunities, and advancement of modern tools for the passenger rail sector. The FRA requirements for materials fire safety performance and fuel tank crashworthiness were developed over 20 years ago. Passenger locomotive fuel tank structural requirements are based on static loading. Research into the performance of passenger locomotive fuel tanks under dynamic loads such as those seen in derailments and collisions is needed. Smaller profile diesel multiple unit (DMU), which is not a traditional passenger locomotive, fuel tanks are being assessed for their ability to perform under these loads as well. The research allows the FRA to not only evaluate conventional and DMU fuel tanks under dynamics loads, it also validate test methods that can be for evaluation of these types of equipment. This research allows FRA to review the current requirements for equivalency with newer standards, possibly allowing for the application of newer industry standards, promoting innovation and safety. This research allows FRA to review the current requirements for equivalency with newer standards, possibly allowing for the application of newer industry standards, promoting innovation and safety

Activities:
- Conduct room corner tests to validate scaling laws developed through simulations
- Evaluate modern methods for measuring toxicity of burning materials
- Simulation of other scenarios of fuel tank puncture using validated models

Expected Outcomes:
- Validated scaling laws for modeling and simulation of rail car fire growth predictions
- List of toxicity measurement methods
- Final recommendations and reporting on performance of DMU under dynamic loads

TOP - Emergency Preparedness Research

Emergency Preparedness standards set forth the basic minimum requirement for communication and safe evacuation of passengers and crew in emergency situations. Understanding the dynamics of passenger interaction as evacuation ensues on a passenger train will provide FRA with quantitation data to make decisions for improving the current standards. This project will investigate and develop innovative safety technologies that improve emergency preparedness and egress features of passenger rail equipment. The Emergency Preparedness Research program supports initiatives that ensure passenger rail equipment and onboard crewmembers' training is modern, progressive, and effective. It also supports providing vital safety information in a central location for all interested parties; this includes producing training videos and distributing it among related stakeholders and on the FRA website.

Activities:
- Continue to evaluate railExodus and other modern available emergency evacuation simulation tools for effectively predicting evacuation of passengers under various scenarios.
- Investigate integration of emergency evacuation tools such as railExodus with fire dynamics model for safety and emergency preparedness research.

- Educating the public and emergency responders on how to locate and use the Emergency Notification System (ENS) sign information.

Expected Outcomes:
- Identification of modern effective evacuation modeling tool for rail applications.
- Develop plan for integration of evacuation simulation tool and fire dynamics models.
- A training video to be distributed to the public and emergency responders on how to locate and use ENS sign information. The format of the video should follow the same method as used for the rail safety videos. The video shall contain an overall safety message and details of the ENS signs.

TOP - Cab Displays, Controls, & Environment

This project will improve cab/locomotive visibility at night, provide extra alerting for track workers and attempting trespassers, provide extra visibility/alerting when approaching grade crossings, unify an optimized cab display across all railroad providers, increase freight and passenger rail safety, and reduce operating and maintenance costs for locomotives.

Activities:
- Continue to test and validate the candidate LED headlights for railroad application.

Expected Outcomes:
- Validate the new LED headlights and assist in adopting new standards and regulations for LED lights on locomotives.

Liquefied Natural Gas (LNG) - Natural Gas Safety Research

This research will investigate innovative safety technologies that will improve the transportation and use of natural gas, both liquefied and compressed (CNG), in the rail sector. The research provides the FRA RRS with the scientific basis for decision- making and development of standards and requirements.

Activities:
- Development of standards for natural gas fuel tender.
- Review of railroads' natural gas fuel usage programs.

Expected Outcomes:
- Guidance documents to RRS on natural gas fuel usage by nation's railroads.
- Grade-crossing impact test of LNG fuel tender.

Partnerships and stakeholder engagement form the foundation of RD&T's technology transfer (RDT2) methodology leading to the adoption of research products. The Rolling Stock Research Program is subject to continuous input and review from industry stakeholders. PMs are active contributors to industry committees and meetings overseen by the AAR, APTA, American Society of Mechanical Engineers (ASME), and others. Input from industry stakeholders at these meetings is solicited and appropriately addressed in on-going research efforts.

TRAIN CONTROL AND COMMUNICATION PROGRAM

The FY 2021 Request includes $8.08 million for FRA's Train Control and Communication (TC&C) Research Program.

The number of signal-related train accidents has decreased by 4 percent from FY 2009 to FY 2018 with steady incremental improvements each year. Further reduction is expected from the installation of Positive Train Control (PTC) on certain routes, as PTC is one of the most transformative technological changes in the history of railroad signal technologies.

The TC&C Research Program focuses on improving railroad operation safety through the development and testing of train control and communication systems and grade crossing safety technologies. TC&C conducts applied research to test concepts and further understanding of safety problems causing accidents and incidents. Research topics that provide deeper understanding of technology, systems, practices or standards may lead to the development and testing of a prototype and demonstration with industry. The program conducts pilot studies, creates prototypes, and demonstrates safety and security systems, including intelligent rail systems, blocked crossings, and trespass prevention.

FRA's TC&C Research Program is aimed at reducing train-to-train collisions and train collisions with objects on the line and at grade crossings by:

- Assisting railroads in meeting the Congressional mandate for PTC while maintaining safe and efficient rail operations. As a critical safety system, PTC must be highly reliable, interoperable, and secure.
- Working with railroads to define standards and the initial infrastructure for interoperability between the North American railroads.
- Developing and testing next generation PTC technology to maintain a high level of availability, improve capacity, maintain safe operations and evolve technological advances.
- Facilitating stakeholder coordination and investing in technology development to keep rail on pace with highway vehicle connectivity and automation.
- Developing, testing, and validating methods and means to reduce the number of casualties due to trespass activities.
- Developing technologies and tools to decrease accidents involving injuries and deaths at grade crossings.
- Developing and testing solutions that help prevent pedestrians from crossing the tracks in the presence of a moving train, leading to less incidents and accidents.
- Simulating and modeling non-invasive and non-destructive methods to predict traffic trends and accident reduction in a controlled environment.
- Creating education and awareness tools to increase public understanding and awareness of the risks involved when near railroad property to help decrease incidents and accidents.

Strategic collaboration partners for the TC&C include FRA's Office of Railroad Safety, Intelligent Transportation Systems Joint Program Office (ITS-JPO), Federal Highway Administration (FHWA), Association of American Railroads (AAR), multiple railroads, local DOTs and police departments.

The Train Control and Communication research activity has innovated PTC-related technologies for several years. Notable successes include:

- Freight and Passenger Braking Algorithm development and refinement to improve braking enforcement performance for passenger railroads;
- Cybersecurity protection and PTC communications messaging verification and validation;
- Rail Crossing Violation Warning Application Development, a cooperative vehicle and infrastructure system that assists drivers in avoiding crash-imminent situations at railroad crossings; and,
- Automated and autonomous vehicle research to develop interoperability standards and improve grade crossing safety.

Anticipated FY 2020 accomplishments include:

- Investigation and enhancement of Track Circuit technologies to increase the safety and throughput.
- Development of technologies to safely increase the capacity of freight and passenger railroad trains through densely populated areas.
- Development of improved PTC Adaptive Braking Algorithms.
- Positive Train Control Interoperability Testing Support.
- Monitoring and Analysis of Integrated Network (MAIN).
- Development of Interoperable Lifecycle Management (ILM) network.
- Early stage Automated Train Operation research and development.
- Development of advanced train location and positioning system.
- Investigation of innovative Rail Communication Security approaches.
- Research cooperative automation technologies to improve grade crossing safety.
- Evaluate effectiveness of connected vehicle technologies in a field environment.
- Develop rail industry driven standards for communicating grade crossing status to connected or automated vehicles.
- Continue the research on how artificial intelligence (AI) algorithms and related technologies can be used in reducing trespass occurrences along the railroad's ROW.
- Initiate the research on the effectiveness of mobile systems in monitoring unauthorized access to the railroad right of way. Mobile systems include but are not limited to unmanned aircraft vehicles or portable cameras.
- Explore the design and implementation of novel or improved warning devices.
- Investigate and test the integration of grade crossing locations into mapping providers.
- Investigate the use of enforcement tools to mitigate the risk of accidents by pedestrians at grade crossings.
- Develop a new grade crossing accident prediction and severity model for use by the states and local communities.
- Collaborate with organizations such as Operation Lifesaver.
- Assist the FRA Office of Railroad Safety in events such as the listening sessions ongoing this year for grade crossings, and listening sessions at the top 10 counties with the highest trespass problems, as outlined in the Trespass Strategic Report recently submitted to Congress.

- Conclude the pilot law enforcement grant and develop a final report for internal use as well as the public.

Train Control and Communication……..…….$6.24 M

PTC Technology
This research addresses problems associated with finalizing PTC development, deployment, and continued long-term evolution and maintenance. It supports the design and development of innovative systems to ensure PTC interoperability and reliability continue to evolve with the pace of technology development.

Activities:
- Testing of enhanced track circuit technologies to increase the safety and throughput.
- Continue development of technologies to safely increase the capacity of freight and passenger trains through densely populated areas.
- Testing of improved PTC adaptive braking algorithms.

Expected Outcomes:
- Validate increased efficiency of PTC without reducing safety.
- Increased rail capacity and throughput.
- Increased braking accuracy for freight and passenger trains.

PTC Interoperability
Interoperability is the requirement that all railroads have the ability to work anywhere on the North American railroad network. If railroads are not interoperable, all rail traffic must stop and transition between carriers at each individual railroad boundary. This would be extremely inefficient, costly and create extreme burden on the FRA, railroads, passengers and freight railroad customers.

Interoperability is a requirement of the Rail Safety Improvement Act of 2008 (RSIA ’08), as all railroads must have the ability to use the national network and transport goods and people on all lines. Multiple efforts are reviewed for viability, including radiofrequency spectrum allocation, infrastructure enhancements and modifications, and monitoring and analysis of the network. Interoperability will alleviate the regulatory burden requiring the FRA to check the interoperability between different railroads and will lead to development of an automated system that will ensure interoperability.

Activities:
- PTC interoperability testing support.
- Next phase development of Monitoring and Analysis of Integrated Network (MAIN).
- Development of Interoperable Lifecycle Management (ILM) network.

Expected Outcomes:
- Efficient and reliable interoperability controls between railroads.
- Automated interoperability verification between railroads.

- Automated file transfers between railroads to determine problem areas and corrections.
- Centralized test facilities that serve small freight and commuter railroads to streamline testing and validation of their PTC systems.

PTC Next Generation

This research will identify and develop the methods, facilities, equipment and capabilities required for providing future industry PTC development. Research will focus on providing additional functionality, improving reliability, and supporting integration with other technologies, all of which will support the objectives of improving safety and throughput. Multiple areas of consideration are under review for potential development, including signaling, communications, and infrastructure enhancements to reduce PTC burden and improve safety.

Activities:

- Applied automated train operation research and development.
- Testing of advanced train location and positioning system.
- Standardization of new rail communication security techniques.

Expected Outcomes:

- Improved rail network capacity and decreased delays caused by PTC.
- Rail network safety and efficiency improvements through interoperable automation.
- Increased cyber security of PTC systems.

Intelligent Transportation Systems (ITS)

Facilitate collaboration between railroads and automotive industry stakeholders to develop coordinated solutions for automated transportation systems. Accelerated development of connected and autonomous road vehicles must be mirrored by railroad investment in rail automation and connected highway-rail grade crossing technologies.

RD&T's research of ITS improves CFR 49 Part 234 Grade Crossing Safety and Part 924 Highway Safety Improvement Program. Most of the highway-grade crossing regulations, especially those pertaining to the interactions of highway users, fall under FHWA or the Federal Motor Carriers Safety Administration (FMCSA). The regulations that FRA puts forth on highway-grade crossing, in general, pertain to the requirements that the railroads must maintain regarding the safety devices and general upkeep of the highway-rail grade crossing. However, as the auto industry is pursuing autonomous vehicles, those vehicles will need to interact with highway-rail grade crossings and research needs to be conducted. Odds are that the current highway-rail grade crossing safety system will need to be altered to better communicate with autonomous vehicles so that the vehicles are "informed" of the position of the gates as well as informed about oncoming trains. A potential benefit that could come from the inclusion of autonomous vehicles at highway-rail grade crossings is the reduction of accidents caused by highway drivers moving around safety devices or by highway drivers misjudging the distance of an oncoming train and continuing to move through the crossing.

Activities:
- Develop automation technologies to improve grade crossing safety.
- Evaluate effectiveness of connected vehicle technologies in a field environment.
- Develop rail industry-driven standards for communicating grade crossing status to connected or automated vehicles.

Expected Outcomes:
- Advancement of connected and automated vehicle technologies with a focus on grade crossing safety.
- Communication standards tightly coordinated between rail and automotive industry groups.

Grade Crossing Safety and Trespass Prevention……$1.84 M

Grade Crossing Safety Research plays a vital role in reducing accidents and incidents around grade crossings, which has for decades been the rail industry's largest public safety concern. It continues the collaboration with State DOTs, local authorities, and communities to study and implement innovative solutions to improve safety around grade crossings. This research takes advantage of advancement in drones and UAV technologies to detect and prevent trespassers. In an effort to enhance and verify the accuracy of FRA grade crossing inventory database, this research uses LiDAR technology to map grade crossing profiles including elevation to identify hump crossings and prevent accidents resulting from low ground clearance vehicles being stuck at crossings.

Trespass Countermeasures
Continue to work with stakeholders in developing new tools and technologies to address trespassing on railroad Right-of-ways (ROW).

Activities:
- Continue and/or develop new work on AI applied to railroad trespassing.
- Continue working on the effectiveness of mobile systems used for detection of trespassing activities within any given railroad.
- Develop new research ideas based on the input of the several stakeholders involved in trespassing issues.

Expected Outcomes:
- The outcome of the research described at a high level above is then expected to be transferred to other stakeholders, such as railroads or local communities for further development and implementation, thus increasing public safety.

Grade Crossing Technology
Continue to work with universities, the industry, railroads and public sector in exploring new technologies geared toward innovative devices to increase safety at grade crossings.

Activities:
- Explore new areas where PTC can play a role in increasing safety at grade crossings.

Expected Outcomes:
- With the wide introduction and implementation of PTC, its inclusion of a grade crossing warning system will increase overall public safety and at the same time reduce accountability and liability.

Grade Crossing Pedestrian Safety

Continue to explore measures to address accidents at grade crossings and along railroad ROWs that involve pedestrians.

Activities:
- Explore new methods and techniques to improve pedestrian safety at rail grade crossings.
- Continue to explore enforcement and educational tools to reduce accidents at grade crossings involving pedestrians.

Expected Outcomes:
- TC&C expects to increase safety for pedestrians at crossings thanks to this research described at a high level above.

Grade Crossing Modeling and Simulation

Continue working on the new accident prediction and severity model for grade crossings, as well as developing models for studying behavior in general at grade crossings.

Activities:
- Explore new modelling and simulation to reproduce real scenarios of human behavior at crossings. This can create new testing solutions without intervening on the actual railroad property or grade crossing itself.

Expected Outcomes:
- Simulation and modeling can provide good insight into how safety can be improved before the solution is implemented.

Grade Crossing and Trespass Outreach and Education

Continue developing and disseminating educational tools to the public, including local and state governments, law enforcement agencies, and schools, among others.

Activities:
- Develop new research ideas based on the outcome of the listening sessions planned during FY20.
- Continue collaboration with organizations such as Operation Life Saver and others.
- Formation of an international working group on railroad trespass prevention.

Expected Outcomes:

- Increased safety overall in the railroad environment when interacting with grade crossing and trespass prevention.

Partnerships and stakeholder engagement form the foundation of RD&T's technology transfer (RDT2) methodology leading to the adoption of research products. Stakeholder input is a critical driver of TC&C's research planning. All the research and development activities conducted by the TC&C Research Program are done in partnership with government and non-government groups to target the research to solve rail transportation safety issues and needs. These partnerships benefit from technical and financial collaboration for a more efficient and effective research program. Multiple railroads are contributing in-kind support of the development of requirements, testing and providing technical guidance and intellectual resources.

HUMAN FACTORS PROGRAM

The FY 2021 Request includes $6.04 million for FRA's Human Factors (HF) Research Program.

There was a 4 percent increase in human factors-caused accidents from 2009 to 2018. Human error continues to be one of the primary causes of railroad accidents and incidents. FRA's Human Factors R&D program's priorities are automation and operating personnel information management and control, suicide prevention and motorist behavior at grade crossing.

Across the rail industry there is a distinct lack of attention to human requirements in the design and development of systems for safety and efficiency. Failure to include human factors requirements in the systems development of new technology, for example, will result in more error -prone systems acquired and used by railroads. The HF research program attempts to fill the gap in attention to human factors by providing the rail industry with knowledge about human behavior in operational settings, and research yielding human requirements for better design of technology and processes., Human factors concepts, behavioral models, and research derived tools are applied in research settings to define and understand human behavior related to safety issues that cause or contribute to accidents and incidents.

The FRA's Cab Technology Integration Laboratory (CTIL), developed under the Human Factors research program, provides the FRA and the rail industry the capability to examine the effect of man-machine collaborative automation, train controls, new and more meaningful displays and different operating procedures, on human and system performance. The CTIL research results are more easily visualized by labor and the operating railroads through the use of the same simulation and track environments provided for training to crews at their home railroads. The CTIL also provides a system development test and prototyping capability in a virtual environment more suitable for new system concepts, where there is less risk, before moving on to an operational testing environment.

The Human Factors Research Program is focused on improving railroad safety and reducing rail accidents caused by human error by:

- Developing interventions and solutions to mitigate fatigue and the effect of irregular work hours, the unpredictability of on-duty times associated with the U.S. rail industry.
- Understanding ways to improve the situational awareness of operating personnel that could improves vigilance and sustained attention.
- The application of research derived simulation and modeling tools to address crew attentiveness and situational awareness issues as well as the design of system safety technology, like Positive Train Control
- Guiding and supporting the development of the Short Line Safety Institute to improve safety and safety culture Class II and Class III railroads.
- Conducting project evaluations to ensure program success and holds contractors conducting government-funded research accountable for efficient and effective use of resources to serve the public good.
- Developing, testing, and validating methods and means to reduce the number of casualties due to trespass activities.
- Developing technologies and tools to decrease accidents involving injuries and deaths at grade crossings.
- Developing and testing solutions that help prevent pedestrians from crossing the tracks in the presence of a moving train, leading to less incidents and accidents.
- Simulating and modeling non-invasive and non-destructive methods to predict traffic trends and accident reduction in a controlled environment.
- Creating education and awareness tools to increase public understanding and awareness of the risks involved when near railroad property to help decrease incidents and accidents.
- Identifying and studying the causal factors that lead to trespassing and suicides incidents on railroad property.

Strategic collaboration partners for the Human Factors Program include FRA's Office of Railroad Safety, American Short Line Regional Railroad Association (ASLRRA), Association of American Railroads (AAR), and other rail safety organizations.

Anticipated FY 2020 accomplishments for the FRA's Human Factors R&D program include:

- Assistance to FRA RRS in executing the Implementation Milestones listed in its report to Congress, *National Strategy to Prevent Trespassing on Railroad Property* (https://www.fra.dot.gov/eLib/Details/L19817).
- Development of technology to identify suicide risks and behaviors, including detection and intervention.
- Training railway staff on trespasser strikes using a high-fidelity simulator.
- Development of a system for emergency service vehicles that predicts when grade crossings will be blocked, and develop an in-vehicle notification system to help emergency service vehicle drivers avoid blocked crossings. This technology may be used to re-route while traveling to/from an emergency and help reduce response time.

- Assessment of in-vehicle auditory alerts (IVAAs) and their effects on driver behaviors at grade crossings. Pilot test IVAA designs in the real-world environment to investigate feasibility and driver acceptance.
- Analysis of technologies such as HUDs, to help crews acquire and maintain situational awareness and maintain focus on the driving task.
- Determination of the extent to which commutes to and from work contribute to locomotive engineer fatigue.
- Assessment of the Information and Communications Technology (ICT) knowledge, attitudes, and skills of the railroad industry. The ICT survey results will provide information about the technologies that should be used for railroad audiences, when developing communication and outreach programs.
- Development and ongoing evaluation of a pilot study to explore a voluntary information sharing and reporting environment for the railroad industry.
- Human reliability studies following full implementation of PTC technology in the CTIL to understand the challenges of human computer interaction and integration of multiple interfaces.
- Development of a communication strategy to expand the use of "Railroaders' Guide to Healthy Sleep" website.
- Evaluation planning, administrative, technical, and other evaluation support services to the DOT Safety Council Evaluation Planning and Action Team.

Human Factors (HF)……...……$6.04 M

Rail Trespass and Suicide Prevention

Human Factors research on rail trespass and suicide addresses the two leading categories of rail fatalities in the U.S. Hundreds of people lose their lives every year on train tracks due to trespassing or suicide. HF will continue to examine the human behaviors associated with rail trespass and suicide.

Activities:

- Partner with non-profit organizations to help improve education and outreach related to rail suicide and trespassing.
- HF will continue its suicide prevention research program, with activities in the following areas:
    - Pilot projects to examine suicide countermeasures
    - Provide best practices to media outlets with regards to reporting on rail suicide incidents
    - Lead the Global Railway Alliance for Suicide Prevention, an international working group
    - Create GIS map of suicide hotspots
    - Examine and categorize the demographic and environmental characteristics of rail suicides.
- HF will lead trespasser prevention research that is identified after completing the milestones listed in *National Strategy to Prevent Trespassing on Railroad Property*.

Expected Outcomes:
The outcome goals of the trespasser and suicide prevention research topic area are to:

- Produce Technical Reports, Research Results reports, and presentations related to the program activities.

Automation, Operating Personnel Information Management and Control

HF addresses the integration of people with automation technology by conducting research particularly on automation and manpower, personnel, human factors engineering, safety, and training. These are the primary aspects where automation intersects with human behavior and human operational requirements. Application of research results in this area by the industry will yield better performing man-machine collaborative systems.

Activities:

- Research head-up display for passenger locomotives and operations.
- Research to develop new approach (human-automation teaming to accommodate the best characteristics of both) for operating displays.

Expected Outcomes:

- Enhanced locomotive crew vehicle and operating environment situational awareness precursor for accident prevention.
- Developed human-machine interface (HMI) producing reduced workload, ease of use, and improved operational performance as impacts safety.

Human Fatigue

Employees in the railroad industry are susceptible to the risk of injury and property damage caused by human fatigue and loss of attentiveness, due to around-the-clock operations. HF seeks to develop interventions or solutions to mitigate the effect of irregular work hours, long shifts, and the unpredictability of on-duty times associated with the U.S. rail industry. Railroad workers need knowledge, training, tools and alertness to do their jobs properly and to ensure the safety of the public, their coworkers, and themselves.

Activities:

- Gather and summarize research on physiological basis of human fatigue.
- Studies related to the measurement and assessment of human fatigue in railroad operations.

Expected Outcomes:

- Informed industry on physiological basis of fatigue and how human fatigue is measured or assessed
- Understanding of human fatigue and how to better manage it in railroad operations

Project Evaluation

HF will continue program evaluation activities related to the SLSI, a non-profit organization funded with Federal grants. Project evaluation activities for the SLSI promote accountability, as evaluation provides unbiased evidence about the extent to which the SLSI's programs are (or are not) working as intended. The SLSI receives a directed grant from FRA to fund its safety culture assessment programs. Built-in project evaluation provides evidence that these

funds are being spent on programs that improve the safety of small railroads. Project evaluation of the SLSI will continue as long as it receives FRA funding.

Activities:
- Provide feedback on the follow-up safety culture assessment process, which measures safety culture change over time.
- Conduct follow-up interviews to understand the level of influence, impact, and outcomes of the assessment process on participating railroads.

Expected Outcomes:

- Technical Reports, Research Results reports, and presentations to SLSI stakeholders.

Highway-Rail Grade Crossing

Human Factors research addresses human behavior at grade crossings, and the extent to which individuals understand new technologies to notify them of an approaching train. HF will continue to pursue solutions to highway-rail grade crossing because investment in research on new technologies at grade crossings does not completely address grade crossing safety; one must understand how drivers will react to new technologies at crossings.

Activities:
- Continue to address human behavior issues related to the integration of new technologies aimed at improving grade crossing safety.

Expected Outcomes:
- Technical Reports, Research Results reports, and presentations to stakeholders.

Vigilance, Sustained Attention, and Distraction

The goal of this research project is to understand ways to improve factors that affect vigilance and sustained attention. Research in this area includes conducting studies on cognitive and behavioral elements that affect human sustained attention and vigilance. Railroad operation requires operators to manage and understand information provided by multiple systems, including track and signal status. The problems this research is solving include:
- Loss of operator focus and distraction.
- Accidents caused by human error.

Activities:
- Summary research to examine the role of distraction in accident causation.
- Cross-modal comparative study of policy to manage distraction behaviors in transportation operations.

Expected Outcomes:
- Improved, more effective operating policy to mitigate distraction and its effects.
- Knowledge of cross modal prevalence of distraction behavior.
- Knowledge of the contribution of distraction to diminished operator performance to better inform policy to diminish this behavior.

Short Line Safety Institute

- Human Factors provides program monitoring and support of the Short Line Safety Institute. SLSI addresses the safety of Class II and Class III railroads, small railroads in rural locations with limited resources for safety training and education.
- Funding for this project should continue because small railroads do not have the budget or personnel to conduct safety culture assessments and training and education.
- The SLSI receives annual funding from the FRA.
- HF has learned that Class II and Class III railroads are committed to a strong safety culture, but could use assistance with leadership development training.

Activities:
The SLSI will continue its core program areas:

- The SLSI will conduct safety culture assessments on Class II and Class III freight railroads.
- The SLSI will use findings from the safety culture assessments to identify training and education needs for the Class II and Class III freight industry.

Expected Outcomes:

- Improved safety and safety culture in Class II and Class III freight railroads.
- Possible expansion of safety culture assessment to passenger railroads.
- Technical Reports, Research Results reports, and presentations related to safety culture.

Partnerships and stakeholder engagement form the foundation of RD&T's technology transfer (RDT2) methodology leading to the adoption of research products. The Human Factors Program provided funding to Michigan Technological University to perform a quantitative evaluation of driver behavior at highway rail grade crossings (HRGCs). The research resulted in several publications and presentations at conferences.

RAILROAD SYSTEMS ISSUES PROGRAM

The FY 2021 Request includes $6.37240 million for FRA's Railroad System Issues Program, including $1.10 million transferred from the Track Program to consolidate funds for R&D facilities at TTC. A small portion of this funding is for staff to oversee contractors' and grantees' performance and to witness testing, including travel.

FRA's Railroad System Issues Program improves railroad safety by evaluating risks and prioritizing RD&T projects to reduce safety risk and achieve DOT, Office of the Assistant Secretary for Research and Technology (OST-R), and FRA goals. Railroad System Issues objective is to determine strategic research needs and priorities through collaboration with internal and external partners and stakeholders, considering real time safety issues requiring subject matter expertise or long-term research solutions.

Strategic collaboration partners for the Track Research Program include FRA's Office of Railroad Safety, American Short Line Regional Railroad Association (ASLRRA), Association of American Railroads (AAR), multiple railroads and universities.

Anticipated FY 2020 accomplishments for the Railroad Systems Issues program include:

- Updating the safety risk model for guiding future R&D.
- Evaluating projects conducted by the four RD&T divisions.
- Supporting the Workforce Development Program covering: Council on Women and Girls, Transportation Career Pathway Model Development, Minority Serving Institutions Task Force, and the YES Mentoring Program.
- Conducting a railroad industry workforce assessment to gather data on trends, skill demands, training opportunities, industry best practices, cross-modal efforts, etc.

Funding requested in FY 2021 will advance a number of initiatives under the Railroad Systems Issues Research Program, including Rail Safety IDEA (Innovations Deserving Exploratory Analysis) program grants with the Transportation Research Board and Project Selection and Evaluation.

Railroad Systems Issues (RSI)……..……..$4.97M

Rail Safety Innovations Deserving Exploratory Analysis (IDEA)
The Transportation Research Board (TRB) initiated this effort in conjunction with FRA to address safety needs within the railroad industry. The focus of this project is to solicit innovation, ideas and advanced technology in railroad safety. Each research effort selected has a unique timeframe, generally lasting one to two years.

Activities*:*
With multiple activities each year, the outcomes vary based on the selected projects and duration of research. In 2021, the focus is on:

- Announcement - An IDEA Program Announcement will be issued annually to solicit proposals for Rail Safety IDEA program exploratory research projects. The announcement describes the program and criteria and provides guidelines for eligibility and preparing and submitting proposals.
- Evaluation of Proposals - Proposals will be evaluated on a competitive basis. The Rail Safety IDEA program committee will evaluate those proposals meeting the technical eligibility criteria.
- Widespread announcement of contract opportunities for rail inventors.
- Management of projects to completion.
- Tracking of successful implementation of completed projects.

Expected Outcomes:

- Detailed Project Work Plan, Budget, and Schedule.
- Project Agreement between TRB and Sub-awardees (Consultants/Contractors).
- Quarterly Progress Reports (using the FRA QPR template).
- Final Performance Report that should describe the cumulative activities of the Project, including a complete description of the Grantee's achievements with respect to the Project objectives and milestones.
- Final Report for each selected project will be posted on TRB's website/publication.

Project Selection

RD&T utilizes a software package (DecisionLens Software) and the Safety Risk Model as part of the prioritization process. This project includes the activities and costs associated to maintaining the license for the prioritization software, optimizing the Safety Risk Model and executing the prioritization process. RD&T conducts prioritization activities to effectively manage its budget and ensure that stakeholder and industry needs are inputs to the investment planning process.

Activities:

- Renew Decision Lens software license for an additional option year.
- Apply improved rating process to candidate research project for FY2022.
- Use results to support the FY2022 Annual Modal Research Plan.

Expected Outcomes:

- Robust FY2022 research portfolio.
- Quantifiable project prioritization plan.

Project Evaluation

The focus of this project is to educate and train program managers (PMs) about project evaluation techniques, develop performance measures, improve project progress, and reduce cost. PMs and external parties will evaluate projects conducted by the five RD&T divisions to measure success, improve project performance and railroad safety. Project evaluation processes will help RD&T better manage funding and meets the U.S. DOT Strategic Goal of Accountability.

Activities:

- Continue project evaluation training.
- Create project evaluation tools.
- Continue implementation of RD&T's project evaluation methodology.
- Conduct project evaluations.
- Optimize RD&T's performance management metrics.

Expected Outcomes:

- Increase maturity of project evaluation practices.
- Standardize performance measurement.
- Standardize project evaluation.
- Establish performance measurement baseline.

Program Support

This project provides technical editing, analyst and management support to RSI. FRA research produces various deliverables as part of RD&T technology transfer process and FRA works with technical editors to publish this content. Program management/analyst/subject matter experts provide project, program and portfolio management support.

Activities:
- Edited and published RD&T papers, reports, results and other material.
- Strategic planning, tracking, and management of RD&T's portfolio, information and data.

Transportation Technology Center……..$1.40 M

The primary objective of this funding is to develop unique R&D infrastructure to accommodate the testing and evaluation of intelligent railroad systems technologies and to provide the FRA with the type and quality of facilities and equipment needed to meet its R&D mission. . Focused on enhancing railroad safety, TTC drives national RR&D and application of new technology for railways, suppliers, governments, and others involved in rail transportation. This funding supports RD&T Facilities and Equipment Programs, which enhance rail transportation technology development, testing, and standards development.

Activities:
- FRA will fund selected site improvements and equipment at TTC that directly support RR&D projects.
- Initiate build of a rail stress and rail neutral temperature test bed.
- Finish the design and start building a test bed that can be used to validate the accuracy of track geometry measurement systems.
- Initiate construction of the curved test track.

Expected Outcome:
- These activities support conducting rail transportation technology development, testing, and standards development.
- Rail stress and rail neutral temperature test bed at TTC.
- Test bed to validate the accuracy of track geometry measurement systems.
- Constructed curved test track.

<u>Railroad Systems Issues</u>
This project conducts research focused on safety with secondary strategic alignment to innovation, infrastructure and accountability in the railroad industry. The problem addressed by this project will be selected based on industry need.

Activities:
Activities are dependent upon Broad Agency Announcements (BAA) selections.

Expected Outcomes:
Outcomes are dependent upon BAA selections.

<u>Workforce Development (WFD)</u>
This research provides support and domain expertise in the areas of railroad WFD to adequately identify suitable approaches for both the management and capture of rail workforce-related trends, and respond to DOT data calls. This research increases the awareness

of railroad industry WFD issues by establishing and/or participating in forums and research efforts to foster and support industry collaboration.

Activities:
- Participate in the DOT Education and Workforce Development Community of Practice on behalf of FRA.
- Conduct and publish a railroad industry workforce assessment (known as the Modal Profile).
- Capture and analyze data on trends, skill gaps, skill demands, training opportunities, industry best practices, and cross-modal efforts.

Expected Outcomes:
- Updated Modal Profile published.
- Research results of workforce development published.
- Continued stakeholder engagement.

Energy and Emissions Safety Research

In support of DOT strategic goals of safety and innovation and its research target of environmental stewardship, FRA undertakes research that will investigate efficacy of alternative fuels to improve energy efficiency and reduce emissions of rail transportation. This research area focuses on supporting activities related to real-world demonstration of alternative fuels, technologies and improvements in standards for noise emissions to ensure their implementation on rail systems across the nation.

Research provides data in support of the safe operation and use of alternative fuels and engine improvement technologies. Newer innovative solution for switching and passenger operations such as hydrogen and fuel cell technologies hold great potential for the US rail market. Research on the structural requirements for liquid and gaseous hydrogen containers and their structural design is needed. The efficacy of current CFR standards to address and ensure the safe use of such fuels will be analyzed and decisions made to adjust accordingly. The research provides FRA RRS with the scientific basis for decision-making and development of standards and requirements. FRA will collaborate with other federal agencies to ensure safe use of the energy products.

Activities:
- Continued impact and applicability study of hydrogen for rail applications.
- Identification of standards and best practices for hydrogen fuel usage for rail applications.
- Additional safety assessment of hydrogen and fuel cell technology for rail applications.

Expected Outcomes:
- Identification of safety research needed to progress hydrogen and fuel cell technologies in US.

Accessibility

Investigate universal and inclusive designs for accessibility on-board passenger trains. FRA is in a unique position to collaborate with stakeholders (other Federal agencies, disability

advocacy groups, passenger rail operators, and equipment manufacturer and industry groups) to ensure that new standards for accessibility are feasible and safe; balancing the requirements of the law with the capability of the equipment.

Activities:
- Continued testing of rear and forward-facing wheeled mobility devices (WMDs) and its occupant in low-speed train-to-train collision.
- Assessment of current state of art securement systems for WMDs on board trains.

Expected Outcomes
- Data on relative motion of wheeled mobility device and its occupant in non-contained spaces.

Locomotive Safety
The goal of this research is to investigate innovative locomotive engine technologies to ensure the safe and efficient transportation of goods and people. Areas of focus for this research program include; reduction in fuel consumption, improvement in engine component life, and improvement in the efficiency of older, less efficient locomotives. Research is conducted in collaboration with Class I railroads to demonstrate and develop prototype systems. This research area addresses the DOT Strategic Goal of safety and innovation and the DOT RD&T Critical Transportation Topics of promoting safety, and preserving the environment.

Activities:
- Complete assessment of technological innovation using high-pressure heat exchangers in a real-world environment.
- Complete development and prototype demonstration of hybrid systems.

Expected Outcomes:
- Knowledge of the performance of locomotive engine systems to improve efficiency while maintaining safety.
- Ensure that emerging, innovative locomotive engine efficiency improvement technologies are safe.

Partnerships and stakeholder engagement form the foundation of RD&T's technology transfer (RDT2) methodology leading to the adoption of research products. As part of technology transfer efforts, RD&T staff engages with both internal and external stakeholders throughout the research and development life cycle. An integral part of engagement includes collaborating with stakeholders to understand research needs and safety issues. RD&T conducts prioritization activities to effectively manage its budget and ensure that stakeholder and industry needs are included in the RD&T investment planning process. DOT priorities and safety priorities, especially those provided by the FRA Office of Railroad Safety, are a major input into the process.

Research with Universities on Intelligent Railroad Systems
This project will utilize funding from FY17 – FY19 provided to RD&T to support university research on intelligent railroad systems. FRA will use a broad agency announcement (BAA) to

solicit basic and applied technology research projects that will support DOT and FRA goals to advance automation and connected vehicle technology adoption in the rail industry. The BAA was produced in collaboration with the Intelligent Transportation Systems – Joint Program Office (ITS-JPO). FRA will review proposals with a preference for projects that advance these technologies for rural applications. Program objectives within this project include:

- Enabling safer vehicles and roadways
- Enhancing mobility
- Limiting environmental impacts
- Promoting innovation
- Supporting transportation connectivity

Activities:

- Publish the request for proposals.
- Review university proposals.
- Select prospective research projects.
- Fund and begin selected projects.

Expected Outcomes:

- Focus on advanced technology, automation, and connected vehicle technologies.
- Projects that advance these technologies for rural application.
- Intelligent transportation systems.
- Workforce development.

<u>Office of Railroad Safety Support</u>

All RD&T divisions support the Office of Railroad Safety (RRS) by providing subject matter expertise (SME) consultation, research, data, and tools to improve railroad safety and reduce accidents and incidents. RRS works closely with RD&T to provide insight into research needs throughout the fiscal year. RD&T needs the ability to support requests for research and expertise for time sensitive safety issues. RD&T plans to support the following RRS requested initiatives:

- RISE Developmental Evaluation Support.
- Periodic requests from RRS.

Activities:

- Partner with RRS and industry on RISE.
- Conduct research of urgent safety issues.
- Provide SME support to RRS.

Expected Outcomes:

- Analysis of safety risks and identifying mitigations to those risks.
- Growth and maturity of RISE including industry involvement.

Note: This funding will come from multiple divisions to support their research.

Public, Private, and University Cooperative Research Agreement

The Public, Private and University Cooperative Research Agreement is a collaboration of the Association of American Railroads (AAR) to provide research opportunities to American academic institutions and it attracts and funds proposals that have the potential of improving safety and performance in railroad systems in the following areas: track, rolling stock, train control & communication, and human factors.

Annually, the Public, Private and University Cooperative Research Agreement committee members will review and determine research themes that the railroad industry needs to address through this Agreement. These research themes will drive research topics. Through this Agreement, research topics will be announced and reviewed and the most promising proposals will be selected for funding.

All selected proposals have the ultimate goals of improving railroad safety and performance, enhancing the infrastructure conditions and services by stimulating economic growth, productivity and workforce development, and serving the nation with reduced regulatory burden and greater efficiency, effectiveness and accountability.

This effort includes a cost-share arrangement with AAR contributing approximately $800K annually and the railroad industry's significant in-kind support.

Activities:

- Publish the request for proposals.
- Review university proposals.
- Select prospective research projects.
- Fund and begin selected projects.

Expected Outcomes: The expected outcomes align with the DOT Strategic Goals of Safety, Innovation, Infrastructure, and Accountability. Expected outcomes include:

- Projects that focus on advanced technology, automation, and connected vehicle technologies.
- Projects that advance these technologies for rural application.
- Workforce development.

What benefits will be provided to the American public through this request and why is this program necessary?

As described above, FRA's research, development, and technology projects provide tangible safety and operational benefits to the railroad industry. FRA's applied research efforts help to develop innovative solutions to challenges facing the rail industry and ensures that the best available science and technology are the basis for FRA's safety rulemaking, enforcement, and programs. FRA also develops technology that the rail industry can adopt voluntarily to improve safety. FRA conducts research, development, and technology initiatives independently and collaboratively to:

- Ensure safety is the paramount consideration in exploring new technologies and practices;
- Leverage public resources, disperse costs, and reduce or eliminate redundant efforts;
- Assess new concepts and technologies that the railroad industry is using; and
- Promote industry adoption of promising research results.

Research into tank cars will benefit the American public by reducing the spillage of hazardous material. FRA's R&D program will help protect people who live in neighborhoods through which trains operate and reduce the likelihood of environmental damage due to hazardous material releases. Two areas of research that help achieve this are (1) reducing failures such as broken wheels and rails that cause derailments and (2) improving the strength of tank cars to better survive derailments that do occur.

Safe rail transportation directly benefits the public traveling by train. FRA's R&D program will reduce train collisions by facilitating the implementation of new technologies such as PTC. It will reduce collision risks when passenger trains share the same corridors as freight trains. The program will lay the foundation for regulatory reform and performance based approaches that will reduce the likelihood of derailments. FRA's R&D program will also improve occupant protection in collisions and derailments.

By addressing the root causes of grade crossing accidents, FRA's R&D program improves the safety of the American public that needs to cross railroad rights-of-way. Human factors research into driver behavior at highway-rail grade crossing and the effectiveness of alternative warning systems helps identify optimum solutions. Developing new technologies for crossing protection and train to vehicle communications leads to reduced incidents of grade crossings being blocked, which can delay emergency responders.

FRA's R&D program helps to reduce fatalities and injuries to trespassers on railroad property. Members of the public are known to take shortcuts across railroad property. Innovative solutions for warning people of the danger they face need to be researched and implemented.

By funding universities to conduct R&D, FRA supports a pipeline of future rail expertise by providing opportunity for students to prepare for rewarding jobs in the railroad industry. The age profile for railroad industry employees shows a growing demand for new entrants. University programs that offer railroad classes help provide the next generation of railroad professionals.

DEPARTMENT OF TRANSPORTATION
FEDERAL RAILROAD ADMINISTRATION

NATIONAL RAILROAD PASSENGER CORPORATION
APPROPRIATIONS LANGUAGE

NORTHEAST CORRIDOR GRANTS TO THE NATIONAL RAILROAD PASSENGER CORPORATION

Contigent upon enactment of multi-year surface transportation authorization legislation, for necessary expenses related to [To] [enable the Secretary of Transportation to make grants to] the National Railroad Passenger Corporation for activities associated with the Northeast Corridor, [as authorized by section 11101(a) of the Fixing America's Surface Transportation Act (division A of Public Law 114–94), $700,000,000]*$325,466,000*, to remain available until expended: *Provided*, That the Secretary may retain up to one-half of 1 percent of the funds provided under both this heading and the "National Network Grants to the National Railroad Passenger Corporation" heading to fund the costs of project management and oversight of activities. [authorized by section 11101(c) of division A of Public Law 114–94: *Provided further*, That in addition to the project management oversight funds authorized under section 11101(c) of division A of Public Law 114–94, the Secretary may retain up to an additional $5,000,000 of the funds provided under this heading to fund expenses associated with the Northeast Corridor Commission established under section 24905 of title 49, United States Code: *Provided further*, That of the amounts made available under this heading and the "National Network Grants to the National Railroad Passenger Corporation" heading, not less than $50,000,000 shall be made available to bring Amtrak-served facilities and stations into compliance with the Americans with Disabilities Act: *Provided further*, That of the amounts made available under this heading and the "National Network Grants to the National Railroad Passenger Corporation" heading, $100,000,000 shall be made available to fund the replacement of the single-level passenger cars used on Northeast Corridor, State Supported Corridor, and Long Distance routes.]

NATIONAL NETWORK GRANTS TO THE NATIONAL RAILROAD PASSENGER CORPORATION

Contigent upon enactment of multi-year surface transportation authorization legislation, for necessary expenses related to [To enable the Secretary of Transportation to make grants to] the National Railroad Passenger Corporation for activities associated with the National Network, [as authorized by section 11101(b) of the Fixing America's Surface Transportation Act (division A of Public Law 114–94), $1,300,000,000]*$611,000,000*, to remain available until expended.[: *Provided*, That the Secretary may retain up to an additional $2,000,000 of the funds provided under this heading to fund expenses associated with the State-Supported Route Committee established under section 24712 of title 49, United States Code:*Provided further*, That at least $50,000,000 of the amount provided under this heading shall be available for the development, installation and operation of railroad safety technology, including the implementation of a

positive train control system, on State-supported routes as defined under section 24102(13) of title 49, United States Code, on which positive train control systems are not required by law or regulation: *Provided further*, That none of the funds provided under this heading shall be used by Amtrak to give notice under subsection (a) or (b) of section 24706 of title 49, United States Code, with respect to long-distance routes (as defined in section 24102 of title 49, United States Code) on which Amtrak is the sole operator on a host railroad's line and a positive train control system is not required by law or regulation, or, except in an emergency or during maintenance or construction outages impacting such routes, to otherwise discontinue, reduce the frequency of, suspend, or substantially alter the route of rail service on any portion of such route operated in fiscal year 2018, including implementation of service permitted by section 24305(a)(3)(A) of title 49, United States Code, in lieu of rail service.]

Explanation: The President's Budget proposes to fund Amtrak grants through the account structure authorized by the FAST Act for the Northeast Corridor and the National Network. However, the President's Budget proposes greater cost sharing and route structure decision-making between states and the Federal Government for operations of Long Distance Routes by creating a new National Network Transformation Grants program.

EXHIBIT III-1
GRANTS TO THE NATIONAL RAILROAD PASSENGER CORPORATION
Summary by Program Activity
Appropriations, Obligation Limitations, and Exempt Obligations
($000)

	FY 2019 ACTUAL	FY 2020 ENACTED	FY 2021 REQUEST
Northeast Corridor Grants to the National Railroad Passenger Corporation	$650,000	$700,000	$325,466
National Network Grants to the National Railroad Passenger Corporation	$1,291,600	$1,300,000	$611,000
TOTAL	$1,941,600	$2,000,000	$936,466
FTEs			
Direct Funded	10	12	7

Program and Performance Statement

FRA's Grants to Amtrak provide capital, operating, and debt service funding to Amtrak, as well as support FRA's management and oversight of Amtrak. The FY 2021 President's Budget will mark the end of the Federal Government fully-subsidizing operating costs for Amtrak's Long Distance routes. Long Distance route decisions and costs will transition to states as the Department, Amtrak and states begin the process to restructure the long distance network over the next four years. To signify this important reform, Federal operating support for Long Distances routes is provided through the new National Network Transformation Grants program. States are encouraged to apply jointly with Amtrak for these funds in FY 2021.

EXHIBIT III-1a

GRANTS TO THE NATIONAL RAILROAD PASSENGER CORPORATION
SUMMARY ANALYSIS OF CHANGE FROM FY 2020 TO FY 2021
Appropriations, Obligations, Limitations, and Exempt Obligations
($000)

	$000		**FTE**
FY 2020 ENACTED	$2,000,000		12
ADJUSTMENTS TO BASE:			
Annualization of Prior Pay Raise(s)	14		
FY 2021 Pay Raises	20		
Adjustment for Compensable Days	-6		
Inflation and other adjustments to base	83		
SUBTOTAL, ADJUSTMENTS TO BASE	**111**		**0**
PROGRAM REDUCTIONS			
Salaries and Benefits	-890		-5
Other contracts	-4,539		
Northeast Corridor Grants to Amtrak	-372,661		
National Network Grants to Amtrak	-685,555		
SUBTOTAL, PROGRAM REDUCTIONS	**-1,063,645**		**-5**
FY 2021 REQUEST	**936,466**		**7**

Detailed Justification for the Grants to the National Railroad Passenger Corporation

FY 2021 – Grants to the National Railroad Passenger Corporation – Budget Request ($000)

Program Activity	FY 2019 Actual	FY 2020 Enacted	FY 2021 Request
Northeast Corridor Grants to the National Railroad Passenger Corporation	650,000	700,000	325,466
National Network Grants to the National Railroad Passenger Corporation	1,291,600	1,300,000	611,000
Total	**$1,941,600**	**$2,000,000**	**$936,466**
FTE	**12**	**12**	**7**

What is this program and what does this funding level support?

The Surface Transportation Reauthorization proposal reauthorizes grants to Amtrak. The Department is continuing to look at the appropriate approach for the Federal government to provide assistance on both the NEC and the National Network. The Department will soon release details of its legislative proposal and looks forward to working with the Congress to provide reforms to Amtrak to bring passenger rail into the future, make better use of Federal resources and provide a better transportation service to its passengers.

The National Railroad Passenger Corporation (Amtrak) operates three primary types of intercity passenger rail services:

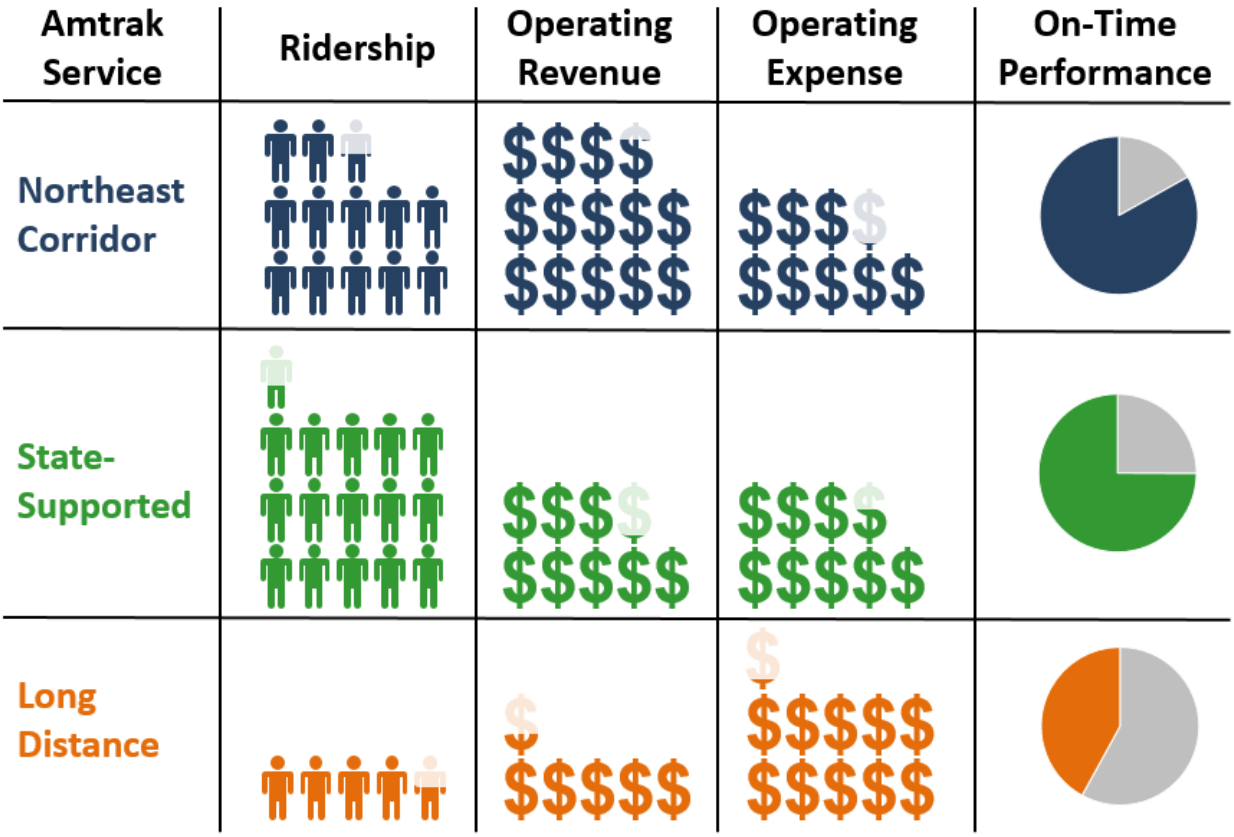
1. Higher speed, high frequency, **Northeast Corridor** (NEC) services;
2. **State-Supported**, short distance, corridor service on 28 routes that are located in densely populated regions; and
3. **Long Distance** services on 15 routes greater than 750 miles that connect rural areas and population centers.

Over the last 15 years, Amtrak ridership has increased by 35 percent and Amtrak has made significant strides to improve financial performance and cost recovery. This improvement is borne out by the corporation's FY 2019 performance metrics, which show Amtrak posting record

revenue and ridership of $3.3 billion and 32.5 million passengers, respectively, while also driving down net operating losses to an all-time low of $29.7 million.[1]

However, there are still opportunities for further improved performance, particularly as it relates to Amtrak's Long Distance service offerings. The majority of Amtrak's annual operating losses that are subsidized by the Federal Government are attributable to the operation of Long Distance trains (nearly $500 million in FY 2019). Amtrak's Long Distance routes account for only 14 percent of Amtrak ridership, but 30 percent of train system operating costs, while also suffering from poor on-time performance (OTP) due largely to delays on the freight-owned railroads that host Long Distance trains (42 percent OTP in FY 2019). Amtrak's Office of Inspector General estimates that Amtrak could save approximately $42 million in annual costs if OTP on Long Distance routes could improve to 75 percent.[2]

Amtrak FY 2019 Ridership, Operating Revenue, Operating Expense by Service Line[3]



*Ridership icon equals 1 million; revenue/expense icon equals $100 million; OTP percentage in pie chart

[1] Amtrak, Amtrak Delivers Best Operating Performance in Company History, November 2019.
[2] Amtrak Office of Inspector General, Train Operations: Better Estimates Needed of the Financial Impacts of Poor On-Time Performance, October 14, 2019.
[3] Amtrak, Monthly Performance Report, September FY 2019.

Long Distance Reform Proposal

Necessary Reforms	Transformative Outcomes
• Restructure network route system and funding through collaborative process • Provide competitive funds for route restructuring • Phase in decision-making for service and operations to states	• Modernize route network to meet market needs of 21st century • End federal subsidy of Long Distance train operations after transition period • Create opportunity for new private sector participants in passenger rail services

To effectuate this important reform, Federal support for Long Distance routes will now be provided through new National Network Transformation Grants. States are encouraged to apply jointly with Amtrak for this funding in FY 2021 so they can begin to make informed decisions about their routes and the elements they value to continue operating in the future. During this period of transition, the Department proposes that Congress create an independent National Network Improvement Commission to issue a report with recommendations to both improve and create more efficient intercity passenger rail service on the National Network.

The competitive grant funding for Long Distance routes will provide transition assistance to states as they assume control over their regional corridor services. The federal grant will cover 100 percent of net operating costs in FY 2021, 80 percent of net operating costs in FY 2022, 60 percent of net operating costs in FY 2023, and 40 percent of net operating costs in FY 2024. The phasing down and out of Federal funds is in recognition that major changes to intercity passenger rail service patterns can take time to build a ridership base and generate sufficient revenues against the service's capital and operating costs. By FY 2025, states will assume full responsibility for all operating costs associated with their new services. States should also look to utilize the Consolidated Rail Infrastructure and Safety Improvements Program for capital improvements that may be required to upgrade services on these new state routes.

Modern, Passenger-Focused Service Offerings

Amtrak's Long Distance network is a relic of the corporation's creation more than 49 years ago, largely serving the same markets today as they did in 1971 when Amtrak relieved freight railroads of their common carrier obligation to provide passenger rail service. The operating and financial performance metrics for these routes illustrate a struggling business model in need of reform. This situation was true when private railroads operated these services prior to Amtrak's creation, and remains so today.[4]

[4] The Association of American Railroads estimates freight railroads incurred annual losses of nearly $850 million in today's dollars for their passenger operations prior to the creation of Amtrak. Association of American Railroads, A Short History of U.S. Freight Railroads, May 2018.

The fundamental problem with Amtrak's Long Distance network is its inability to meet customer expectations and demand. The existing routes currently serve many promising city pairs and only 12% of Long Distance passengers are riding endpoint to endpoint, with most passengers traveling to and from intermediate markets, typically less than 500 miles apart.[5] The issue with serving these markets via the current Long Distance structure is infrequent service at inconvenient times that is often significantly delayed. Under the best of circumstances, these obstacles are difficult to overcome when operating a service that can span upwards of 2,400 miles; ideally scheduled departures/arrivals are impossible for all major markets and minor delays can have compounding effects along the route.

The Department of Transportation and Amtrak are aligned in the belief that the future of intercity passenger rail service should focus on high-performing, regional corridor services connecting markets between 100 and 500 miles apart. Passenger trends on the Amtrak network support this assertion, with ridership on the corridor-based State-Supported and NEC increasing by 11 percent and 21 percent, respectively, over the last decade, versus only 2 percent on Long Distance routes – where ridership has actually declined in recent years.

Improved Governance, Accountability, and Investment

The enactment of the Passenger Rail Investment and Improvement Act (PRIIA) of 2008 and the Fixing America's Surface Transportation Act (FAST) of 2015 significantly changed the nature and relationships by which Amtrak is funded. As a result of this legislation, 23 states and Amtrak developed and implemented cost-allocation policies for the NEC and State-Supported routes, as well as established formal governance bodies to promote mutual cooperation and planning among the respective NEC and State-Supported stakeholders. These achievements have helped to infuse new and increased sources of funding from States and local governments for infrastructure, equipment, and operations on these routes.

The benefits these two service lines have realized as a result of these legislative reforms have also further illustrated the incongruity of the performance and governance of the Long Distance routes. Reforming the Federal subsidy for Long Distance routes and enabling states to play a larger role in shaping the delivery of these services will improve financial performance and increase accountability over Amtrak and the host freight railroads for the on-time performance of these trains.

Amtrak's existing Long Distance network presents a significant barrier for growth and future success for the company and intercity passenger rail in general. Intercity passenger rail is most effective when connecting communities that are within 100 to 500 miles from one another, and when individual corridors connect to form integrated regional networks that enhance ridership and financial performance. Rationalizing the Amtrak network will result in higher-performing services based on market demands and state/regional priorities that provide more relevant transportation choices to passengers.

[5] Comments of the National Railroad Passenger Corporation (Amtrak), Surface Transportation Board Docket No. EP 726, February 8, 2016.

In addition to the considerable operating losses incurred annually on the Long Distance network, there is a pending multi-billion dollar need to replace Amtrak's Long Distance equipment, which is well past its useful life. Working with states to rationalize the National Network will allow these funds to instead be invested in services that meet state and regional priorities.

FY 2020 Accomplishments

Anticipated FY 2020 accomplishments for FRA's funding of Amtrak include:

- Continued support of Amtrak's annual capital program to reduce their maintenance backlog and improve infrastructure, equipment, stations, facilities, information technology, and other support services required to provide intercity passenger rail operations.

- Continued manufacturing and testing of next-generation high-speed trainsets for the Acela service on the NEC and ongoing major station improvements at Moynihan Station in New York City, Washington Union Station, Baltimore Penn Station, and New Carrollton Station in Maryland. These projects were financed by the Department's Build America Bureau in 2016 through the Railroad Rehabilitation and Improvement Financing (RRIF) Program.

- Continued implementation of 5-year asset and service line plans as required by Section 11203 of the FAST Act. Amtrak's asset lines include Transportation, Infrastructure, Equipment, Stations, and National Assets and Corporate Services. These plans complement the 5-year service line plans for NEC Intercity Operations, State-Supported, Long Distance, Infrastructure Access, and Ancillary Services. Asset lines provide resources and deliver transportation and related services to the service lines. The service line and asset line plans help to inform Amtrak's decision-making process and more clearly communicate with the Department, Congress, States, passengers and other partners on Amtrak's business priorities and financial performance.

The FY 2021 President's Budget requests $936.47 million for Amtrak, including:

Northeast Corridor ($325.47 million): The Northeast Corridor is one of the most important transportation assets in the United States. The lifeblood to the regional economy, the NEC carries more than 800,000 people each day on Amtrak and commuter services. Amtrak's NEC train operations account for 38 percent of its ridership (12.5 million) and more than 40 percent of its operating revenue ($1.3 billion).[6]

National Network ($611.00 million): Statute defines the National Network to include capital, operating, and debt service for Amtrak's State-Supported routes, Long Distance routes, and other activities not allocated to the Northeast Corridor.

[6] Amtrak, Monthly Performance Report, September FY 2019.

What benefits will be provided to the American public through this request and why is this program necessary?

The United States' population is projected to increase by more than 55 million people over the next 25 years. Demand for intercity passenger rail service will continue to grow as the public seeks transportation alternatives to complement our increasingly congested highways and airports. A rationalized Amtrak network focused on operating corridor services that meet state and regional priorities will more efficiently utilize taxpayer funds and be better positioned to serve the markets where the majority of the nation's projected population growth is expected to be concentrated. Through the cost allocation policy developed for the State-Supported routes under Section 209 of PRIIA, States have made a strong financial commitment that affirms the importance of these National Network services and infrastructure to state transportation systems, economies, and communities' quality of life.

Vital Infrastructure – Service disruptions caused by infrastructure failures, rail traffic congestion, and other factors already cost the economy $500 million per year in lost productivity. A loss of all NEC services for just one day would cost the economy an estimated $100 million.[7]

Helps Meet Current Travel Demand – More than two times as many people travel through Amtrak's Penn Station in New York every day than through JFK, LaGuardia and Newark airports combined.[8]

Economic Development – In 2014, Amtrak and its passengers generated an economic benefit of approximately $10.8 billion, which supported 117,200 jobs and generated $1.7 billion in taxes for Federal, State, and local governments.[9] In addition, station development yields sizable economic benefits including attracting housing and retail development, restored parks and civic and private buildings, an increase in housing and property rental values, and tourism growth. Recent station redevelopment examples include Raleigh, North Carolina and Niagara Falls, New York.

[7] Northeast Corridor Commission, NEC Annual Report FY17, April 2018.
[8] Amtrak, New Passenger Information Displays Improve Customer Experience at Penn Station New York, October 11, 2016.
[9] Amtrak, FY 2016 Budget and Business Plan.

DEPARTMENT OF TRANSPORTATION
FEDERAL RAILROAD ADMINISTRATION

NATIONAL NETWORK TRANSFORMATION GRANTS
APPROPRIATIONS LANGUAGE

NATIONAL NETWORK TRANSFORMATION GRANTS

Contingent upon enactment of multi-year surface transportation authorization language, for necessary expenses related to National Network Transformation Grants, $550,000,000, to remain available until expended: Provided, That the Secretary may withhold up to one percent of the amount provided under this heading for the costs of award and project management oversight of National Network Transformation Grants.

Explanation: The President's Budget is requesting funding for the National Network Transformation Grants program to support operating costs of Long Distance routes of the National Railroad Passenger Corporation (Amtrak) in coordination with a proposal to restructure Amtrak's Long Distance routes.

EXHIBIT III-1
NATIONAL NETWORK TRANSFORMATION GRANTS
Summary by Program Activity
Appropriations, Obligation Limitations, and Exempt Obligations
($000)

	FY 2019 ACTUAL	FY 2020 ENACTED	FY 2021 REQUEST
National Network Transformation Grants	$0	$0	$550,000
TOTAL	$0	$0	$550,000
FTEs			
Direct Funded	0	0	0

Program and Performance Statement

The National Network Transformation Grants program will provide financial assistance to transition Amtrak Long Distance operating support and decision making responsibilities to states. Long Distance operating support has previously been provided by the Federal Government, with costs allocated under Amtrak's National Network grant. FY 2021 will serve as the last year of the Federal Government fully-subsidizing operating costs on these routes as the Department, Amtrak and states begin the process to restructure the Long Distance network. States are encouraged to apply jointly with Amtrak for these funds in FY 2021.

EXHIBIT III-1a

NATIONAL NETWORK TRANSFORMATION GRANTS
SUMMARY ANALYSIS OF CHANGE FROM FY 2020 TO FY 2021
Appropriations, Obligations, Limitations, and Exempt Obligations
($000)

	$000		**FTE**
FY 2020 ENACTED	$0		0
PROGRAM INCREASES	550,000		
SUBTOTAL, PROGRAM INCREASES	**550,000**		**0**
FY 2021 REQUEST	**550,000**		**0**

Detailed Justification for the National Network Transformation Grants

FY 2021 National Network Transformation Grants
Budget Request
($000)

Program Activity	FY 2019 Actual	FY 2020 Enacted	FY 2021 Request
National Network Transformation Grants	0	0	550,000
Total	**$0**	**$0**	**$550,000**

What is this program and what does this funding level support?

The FY 2021 President's Budget proposes to begin restructuring Amtrak's Long Distance network, phasing decision-making and cost responsibilities to states. Amtrak's 15 Long Distance trains serve only 4.5 million of Amtrak's 32.5 million annual passengers, lose nearly $500 million annually, suffer from poor on-time performance, and generally provide inefficient service to the traveling public.

The FY 2021 President's Budget requests $550 million for National Network Transformation Grants for the portion of Amtrak's annual operating losses that are attributable to the operation of Long Distance trains. These funds have historically been provided under Amtrak's annual grants appropriated by Congress. Shifting these funds to the new National Network Transformation Grants program signifies a new approach to be embarked upon by the Department of Transportation, Amtrak, states, and other stakeholders to restructure the Long Distance network to better serve the market demands of the 21st century. The Department and Amtrak are aligned in the belief that the future of intercity passenger rail service should focus on high-performing, regional corridor services connecting markets between 100 and 500 miles apart.

Amtrak Long Distance Routes

Over the next four years, Long Distance operating costs and decision-making responsibilities will be transitioned to states. To allow Amtrak and states to begin preparing for this transition, the Federal Government will continue to cover 100 percent of the net operating costs for Long Distance routes in FY 2021 through the National Network Transformation Grants program. The program will then cover 80 percent of net operating costs in FY 2022, 60 percent of net operating costs in FY 2023, and 40 percent of net operating costs in FY 2024. By FY 2025, states will assume full responsibility for all operating costs associated with their new services. States are encouraged to apply jointly with Amtrak for this funding in FY 2021 so they can begin to make informed decisions about their routes and the elements they value to continue operating in the future. During this period of transition, the Department proposes that Congress create an independent National Network Improvement Commission to issue a report with recommendations to both improve and create more efficient intercity passenger rail service on the National Network.

What benefits will be provided to the American public through this request and why is this program necessary?

As described in detail in the Amtrak section of the FY 2021 President's Budget, Amtrak's existing Long Distance network presents a significant barrier for growth and future success for the company and intercity passenger rail in general. Intercity passenger rail is most effective

when connecting communities that are within 100 to 500 miles from one another, and when individual corridors connect to form integrated regional networks that enhance ridership and financial performance.

DEPARTMENT OF TRANSPORTATION
FEDERAL RAILROAD ADMINISTRATION

CONSOLIDATED RAIL INFRASTRUCTURE AND SAFETY IMPROVEMENTS
APPROPRIATIONS LANGUAGE

CONSOLIDATED RAIL INFRASTRUCTURE AND SAFETY IMPROVEMENTS

Contigent upon enactment of multi-year surface transportation authorization legislation, [For] for necessary expenses related to Consolidated Rail Infrastructure and Safety Improvements Grants, as authorized by section 22907 of title 49, United States Code, [$325,000,000]*$330,000,000*, to remain available until expended: *Provided*, [That section 22905(f) of title 49, United States Code, shall not apply to projects for the implementation of positive train control systems otherwise eligible under section 22907(c)(1) of title 49, United States Code: *Provided further*, That amounts available under this heading for projects selected for commuter rail passenger transportation may be transferred by the Secretary, after selection, to the appropriate agencies to be administered in accordance with chapter 53 of title 49, United States Code: *Provided further*, That the Secretary shall not limit eligible projects from consideration for funding for planning, engineering, environmental, construction, and design elements of the same project in the same application: *Provided further*, That unobligated balances remaining after 4 years from the date of enactment may be used for any eligible project under section 22907(c) of title 49, United States Code: *Provided further*,] That the Secretary may withhold up to one percent of the amount provided under this heading for the costs of award and project management oversight of grants carried out under section 22907 of title 49, United States Code: [*Provided further*, That of the sums appropriated under this heading, $45,000,000 shall be available for projects eligible under section 22907(c)(2) of title 49, United States Code, that require the acquisition of rights-of-way, track, or track structure to support the development of new intercity passenger rail service routes:]*Provided further*, That for amounts available under this heading eligible recipients under section 22907(b) of title 49, United States Code, shall include any holding company of a Class II railroad or Class III railroad (as those terms are defined in section 20102 of title 49, United States [Code): *Provided further*, That the Secretary shall issue the Notice of Funding Opportunity that encompasses funds provided under this heading in this Act no later than 120 days after enactment of this Act and announce the selection of projects to receive awards for such funds no later than 300 days after the enactment of this Act: Provided further, That the Notice of Funding Opportunity under the previous proviso shall require application submissions 60 days after the publishing of such Notice].

Explanation: The President's Budget is requesting funding for this grant program that is authorized by the FAST Act.

EXHIBIT III-1
CONSOLIDATED RAIL INFRASTRUCTURE AND SAFETY IMPROVEMENTS
Summary by Program Activity
Appropriations, Obligation Limitations, and Exempt Obligations
($000)

	FY 2019 ACTUAL	FY 2020 ENACTED	FY 2021 REQUEST
Consolidated Rail Infrastructure and Safety Improvements	$255,000	$325,000	$330,000
TOTAL	$255,000	$325,000	$330,000
FTEs			
Direct Funded	0	0	0

Program and Performance Statement

The Consolidated Rail Infrastructure and Safety Improvements (CRISI) program was authorized by Congress to improve the safety, efficiency, and reliability of passenger and freight rail systems. Eligible activities include a wide range of freight and passenger rail capital, safety technology deployment, planning, environmental analyses, research, workforce development, and training projects. Eligible recipients include states, local governments, Class II and Class III railroads, Amtrak and other intercity passenger rail operators, rail carriers and equipment manufacturers that partner with an eligible public-sector applicant, the Transportation Research Board, University Transportation Centers, and non-profit rail labor organizations. The 2021 Budget proposes to reauthorize the CRISI program as part of a 10 year reauthorization proposal.

EXHIBIT III-1a

CONSOLIDATED RAIL INFRASTRUCTURE AND SAFETY IMPROVEMENTS
SUMMARY ANALYSIS OF CHANGE FROM FY 2020 TO FY 2021
Appropriations, Obligations, Limitations, and Exempt Obligations
($000)

	$000		**FTE**
FY 2020 ENACTED	$325,000		0
ADJUSTMENTS TO BASE:			
Travel	75		
Other Contracts	-25		
SUBTOTAL, ADJUSTMENTS TO BASE	**50**		**0**
PROGRAM INCREASES	4,950		
SUBTOTAL, PROGRAM INCREASES	**4,950**		**0**
FY 2021 REQUEST	**330,000**		**0**

Detailed Justification for the Consolidated Rail Infrastructure and Safety Improvements

FY 2021 Consolidated Rail Infrastructure and Safety Improvements Budget Request ($000)

Program Activity	FY 2019 Actual	FY 2020 Enacted	FY 2021 Request
Consolidated Rail Infrastructure and Safety Improvements	255,000	325,000	330,000
Total	**$255,000**	**$325,000**	**$330,000**

What is this program and what does this funding level support?

The Consolidated Rail Infrastructure and Safety Improvements (CRISI) program provides a comprehensive solution to leverage private, state and local investments to support safety enhancements and general improvements to infrastructure for both intercity passenger and freight railroads. As part of a 10 year reauthorization proposal, the President's Budget requests $330 million in FY 2021 for the Department of Transportation to invest in projects within the United States to improve railroad safety, efficiency, and reliability; mitigate congestion at both intercity passenger and freight rail chokepoints; enhance multi-modal connections; and lead to new or substantially improved intercity passenger rail corridors.

The requested funding will also support critical rail safety projects – such as grade crossing enhancements, trespasser prevention strategies, rail line relocation, and the continued implementation and improvement of positive train control systems – and assist resource-constrained short line railroads. Other eligible activities include rail planning and environmental analyses, rail research and technology initiatives, and workforce development and training activities intended to advance America's rail industry.

The CRISI program also aligns with the Department of Transportation's commitment to address the unmet transportation infrastructure needs of rural areas. Rural transportation networks play a vital role in supporting our national economic vitality. Addressing the deteriorating conditions and disproportionately high fatality rates on our rural transportation infrastructure is of critical interest to the Department, as rural transportation networks face unique challenges in safety, infrastructure condition, and passenger and freight usage. Investment is necessary to grow rural

economies, facilitate freight movement, improve access to reliable and affordable transportation options and enhance health access and safety for residents.

U.S. Rail System

The majority of both freight and intercity passenger rail services operate over privately-owned infrastructure, which enables private investment that generates significant public benefits. Given the variety of private and public sector stakeholders and benefits associated with rail projects, the CRISI program is well-positioned to attract funding from multiple project partners.

FY 2020 Accomplishments

Anticipated FY 2020 accomplishments for CRISI include:

- Announce selections for FY 2019 and FY 2020 CRISI funding.
- Continue obligating grants selected under prior CRISI funding solicitations.
- Conduct stakeholder outreach and technical assistance to provide feedback to applicants to strengthen future applications.
- Issued the Notice of Funding Opportunity for FY 2019 CRISI funds in August 2019, soliciting applications for $244 million.

What benefits will be provided to the American public through this request and why is this program necessary?

Our nation's rail network is a critical component of the U.S. transportation system and economy and has been for over 185 years, carrying over 32.5 million passengers on Amtrak services[1] and more than 1.6 billion tons of freight valued at nearly $600 billion each year.[2] The Consolidated Rail Infrastructure and Safety Improvements program will enhance rail safety, relieve congestion, renew infrastructure, and increase our nation's mobility as the U.S. freight and passenger rail system are called upon to meet the demands of a growing population. In addition, high capacity mobility improvements can be made within a relatively small, and in many cases an existing, geographic footprint.

Increased Safety - According to a recent report by the OneRail Coalition, riding intercity passenger rail or commuter rail is on average 10 times safer than riding in a passenger car. Looking at freight accidents, fatal accidents involving freight rail take place at less than one-third the rate of truck accidents. Accidents involving injuries are one-fifth as frequent, and property damage accidents are 62 times less frequent.[3] However, opportunities exist to further improve the safety of the rail network.

Reduced Congestion and Increased Mobility - Each American requires the movement of approximately 40 tons of freight per year across the freight network and approximately 85,000 passengers per day ride intercity trains. In addition to its intercity riders, the Northeast Corridor supports more than 700,000 commuter rail passengers per day. By 2045, the U.S. freight system is projected to experience a nearly 40 percent increase in the total amount of tonnage it moves, with the rail share expected to increase by 24 percent.[4] Over this same timeframe, U.S. population is anticipated to grow by over 20 percent. Passenger and freight rail transportation must play a critical role in accommodating this projected growth and provide an alternative to the nation's increasingly congested airports and highways.

Energy Efficient – The United States uses more than 14 million barrels of petroleum products every day for transportation, representing nearly 70 percent of the nation's petroleum usage.[5] On average, rail transportation is four times more fuel efficient than trucks. In 2017, U.S. railroads moved a ton of freight an average of 473 miles per gallon of fuel.[6]

Leverages Private Sector Investment – Rail is uniquely suited to leverage private sector investment since private freight rail infrastructure serves as the backbone for much of the nation's passenger rail system.

[1] Amtrak, Monthly Performance Report, September FY 2019.
[2] Federal Highway Administration, 2016 Freight Quick Facts Report, September 2016.
[3] OneRail, Rail Safety in the United States, 2016.
[4] U.S. DOT, Beyond Traffic 2045, January 2017.
[5] U.S. Energy Information Administration, Monthly Energy Review, December 2019.
[6] Association of American Railroads, Overview of America's Freight Railroads, June 2019.

ADMINISTRATIVE PROVISIONS
APPROPRIATIONS LANGUAGE

ADMINISTRATIVE PROVISIONS

SEC. 150. None of the funds provided to the National Railroad Passenger Corporation may be used to fund any overtime costs in excess of $35,000 for any individual employee: *Provided*, That the President of Amtrak may waive the cap set in the previous proviso for specific employees when the President of Amtrak determines such a cap poses a risk to the safety and operational efficiency of the system: *Provided further*, That the President of Amtrak shall report to the House and Senate Committees on Appropriations within 60 days of enactment of this Act, a summary of all overtime payments incurred by the Corporation for 2020 and the three prior calendar years: *Provided further*, That such summary shall include the total number of employees that received waivers and the total overtime payments the Corporation paid to those employees receiving waivers for each month for 2020 and for the three prior calendar years.

Explanation: The above language has been updated for FY 2021 and specifies Amtrak reporting is due within 60 days of enactment of an appropriations act.

SEC. 151. Railroad Safety User Fees. Section 20155 of title 49, United States Code, is amended—(1) in subsection (a) by inserting "rail safety" before "fees for railroad carriers"; and by striking "The fees—" and all that follows through the period at the end and inserting "The fees shall be imposed fairly on railroad carriers, in reasonable relationship to appropriate criteria to be developed by the Secretary."; and (2) by striking subsections (c), (d), and (e) and inserting the following new subsection: "(c) Collection, Deposit, and use.—(1) Fees collected under this section shall be deposited in the Federal Railroad Administrations Safety and Operations account as offsetting collections. (2) Such fees shall be collected and available to the extent provided in appropriations acts.".

Explanation: The President's Budget proposes to impose a user fee that would reimburse the Federal Railroad Administration for the operational costs of rail safety inspectors and activities. Like other regulated industries, railroads benefit directly and indirectly from the government's efforts to ensure high safety standards, and it is therefore appropriate for railroads to bear some of the cost. FRA will begin collecting an estimated $50 million in 2021.

SEC. 152. Of the unobligated balances of funds remaining from—

(a) *"Capital and Debt Service Grants to the National Railroad Passenger Corporation" accounts totaling $10,414,449.82 appropriated by the following Public Laws are hereby permanently cancelled:*

(1) *Public Law 112–10 a total of $289,234.48,*

(2) *Public Law 112–55 a total of $4,760,000.00,*

(3) *Public Law 113–76 a total of $792,502.52,*

(4) *Public Law 113–235 a total of $1,698,806.61,*

(5) *Public Law 114–113 a total of $2,873,906.21;*

(b) *"Railroad Safety Technology Program" account totaling $613,252 appropriated by Public Law 111–117 is hereby permanently cancelled;*

(c) *"Capital Assistance to States - Intercity Passenger Rail Service" account totaling $9,867,630 appropriated by Public Law 111–8 is hereby permanently cancelled;*

(d) *"Rail Line Relocation and Improvement Program" accounts totaling $12,650,365.14 appropriated by the following Public Laws are hereby permanently cancelled:*

(1) *Public Law 110–161 a total of $923,214.63,*

(2) *Public Law 111–8 a total of $5,558,233.95,*

(3) *Public Law 111–117 a total of $3,763,767.95,*

(4) *Public Law 112–10 a total of $2,405,148.61;*

(e) *"Capital Assistance for High Speed Rail Corridors and Intercity Passenger Rail Service" account totaling $55,363,710 appropriated by Public Law 111–117 is hereby permanently cancelled; and*

(f) *"Next Generation High-Speed Rail" accounts totaling $3,019,483.21 appropriated by the following Public Laws are hereby permanently cancelled:*

(1) *Public Law 104–50 a total of $610,807.00,*

(2) *Public Law 104–205 a total of $5,963.71,*

(3) *Public Law 105–66 a total of $1,218,742.47,*

(4) *Public Law 105–277 a total of $17,097.00,*

(5) *Public Law 106–69 a total of $1,005,969.00,*

(6) *Public Law 108–7 a total of $43,951.57,*

(7) *Public Law 108–199 a total of $24,263.48,*

(8) *Public Law 108–447 a total of $92,688.98.*

Explanation: The President’s Budget proposes to impose a one-time rescission in the amount of $91,928,890.15 obtained from unobligated carry-over grant funding.

RESEARCH, DEVELOPMENT & TECHNOLOGY
DEPARTMENT OF TRANSPORTATION
FEDERAL RAILROAD ADMINISTRATION
BUDGET AUTHORITY
(In thousands of dollars)

Account	Program	Classification (A, B, D, F or T)	FY 2019 Actual	FY 2020 Enacted	FY 2021 Request
Railroad Research & Development					
	Track		**11,279**	**11,279**	**10,179**
	Applied Research	A	7,479	7,479	6,379
	Development	D	2,038	2,038	2,038
	Research and Development Facilities (TTC)	F	1,762	1,762	1,762
	Technology Transfer/Deployment	T	-	-	-
	Rolling Stock		**10,322**	**10,322**	**10,322**
	Applied Research	A	8,050	8,050	8,050
	Development	D	2,272	2,272	2,272
	Technology Transfer/Deployment	T	-	-	-
	Train Control and Communication		**8,086**	**8,086**	**8,086**
	Applied Research	A	8,086	8,086	8,086
	Technology Transfer/Deployment	T	-	-	-
	Human Factors		**6,042**	**6,042**	**6,042**
	Applied Research	A	4,822	4,822	4,822
	Development	D	1,220	1,220	1,220
	Technology Transfer/Deployment	T	-	-	-
	Railroad Systems Issues		**4,871**	**4,871**	**6,371**
	Applied Research	A	4,031	4,031	5,531
	Development	D	581	581	581
	Technology Transfer/Deployment	T	109	109	109
	Administrative Expenses (GOE)		150	150	150
	Total Administrative Expenses (GOE)		**4,047**	**4,093**	**4,093**
			4,047	4,093	4,093
	Subtotal, Applied Research (A)		32,468	32,468	32,868
	Subtotal, Basic Research (B)		-	-	-
	Subtotal, Development Research (D)		6,111	6,111	6,111
	Total Technology Transfer/Deployment (T)		109	109	109
	Subtotal, Research and Development Facilities (F)		1,762	1,762	1,762
	Subtotal, Administrative Expenses		4,197	4,243	4,243
	Total FEDERAL RAILROAD ADMINISTRATION		**44,647**	**44,693**	**45,093**

Section 4: Research, Development, and Technology Exhibits and Narrative Justification

	FY 2019 ACTUAL	FY 2020 ENACTED	FY 2021 REQUEST
Track	11,279	11,279	10,179
Rolling Stock	10,322	10,322	10,322
Train Control and Communication	8,086	8,086	8,086
Human Factors	6,042	6,042	6,042
Railroad Systems Issues	4,871	4,871	6,371
TOTAL	$40,600	$40,600	$41,000
FTEs			
Direct Funded	0	0	0

Program and Performance Statement

FRA's Research and Development Program is focused on improving railroad safety. It provides scientific and engineering support for the agency's safety enforcement and regulatory rulemaking efforts. It also identifies and develops emerging technologies for the rail industry to adopt voluntarily. The outcomes of the research and development are reduced railroad accidents and incidents. The program also supports intercity passenger rail development by providing technical assistance, equipment specifications, proposal evaluations, and Buy America compliance research. The focus of FRA's program is to fill the gaps in research not taken on by industry itself, and to partner with industry to leverage private R&D investment in a manner that ensures broader public safety benefits are achieved.

In addition to improving safety, the program contributes significantly towards activities to achieve and maintain a state of good repair and promote job creation and economic growth.

The program has the following areas of research:

- **Track Program** – Reducing derailments due to track related causes.
- **Rolling Stock Program** – Reducing derailments due to equipment failures, minimizing the consequences of derailments, and minimizing hazardous material releases.
- **Train Control and Communication Program** – Reducing train-to-train collisions and train collisions with objects on the line and at grade crossings.

- **Human Factors Program** – Reducing accidents caused by human error.

- **Railroad System Issues Program** – Prioritizing R&D projects on the basis of relevance to safety risk reduction and other DOT goals.

What is this program and what does this funding level support?

The mission of FRA's Research and Development (R&D) program is to ensure the safe, reliable, and efficient movement of people and goods by rail through applied research. FRA's R&D program aligns closely with the Department's key priorities for FY 2021:

- **Safety:** FRA's R&D efforts provide the scientific and engineering basis for safety enforcement, regulatory reform, and non-regulatory safety initiatives.
- **Infrastructure:** FRA's R&D program advances safety and performance of three types of railroad infrastructure – track, rolling stock, and train control and communications systems – while mitigating human factors risks to optimize the use of infrastructure through safe and efficient operations.
- **Innovation:** Historically, FRA's R&D program has invented new technologies that transformed railroad safety inspection, passenger rail crashworthiness, railroad automation. The FY 2021 proposal continues investment in the next generation of transformative technologies.
- **Accountability:** Project evaluations support the R&D program's goals of accountability and help gain insight on how to mature its performance measurement and evaluation efforts.

Work undertaken in the past 5 to 10 years contributes to today's safety performance. R&D projects typically follow one of these paths to implementation:

1. **Voluntary Industry Adoption:** R&D by FRA is necessary for conducting higher-risk and longer-term projects, which private industry would not otherwise undertake, to develop advanced technologies and practices. In many cases, industry voluntarily adopts these safety practices and technology without the need for regulation.
2. **Enforcement:** R&D by FRA creates new technology for efficient and effective oversight of railroad compliance with safety regulations.
3. **Regulation:** R&D by FRA is necessary to develop the scientific and engineering foundation for valid, data-driven and performance based regulations and deregulatory actions.
4. **Incorporation into Industry Standards and Recommended Practices:** The results of research performed by FRA are often used to develop (or modify/update) relevant industry standards. These include those created by the American Public Transportation Association (APTA) and the Association of American Railroads (AAR). Industry standards can leverage the output of FRA R&D without the need for additional regulations and achieve equivalent safety benefits.

FRA's R&D program is organized around the following five rail safety disciplines:

- **Track Program**
  - Track and structures performance, inspection technology and processes, substructure assessment.
  - Rail Integrity assessment and defect detection technologies
  - System Performance and Analysis including predictive analytics.
  - Track and train interaction including wheel-rail interface, vehicle track modeling, simulation and validation.

- **Rolling Stock Program**
  - Rolling stock and components, onboard and wayside monitoring systems, material and design improvements.
  - Hazardous materials transportation risk reduction, tank car damage assessment, inspection, and integrity.
  - Safety research on energy efficiency technologies.
  - Liquefied Natural Gas (LNG) - Natural Gas Safety Research.
  - Train occupant protection, locomotive and passenger car safety and performance.

- **Train Control and Communication**
  - Development and testing of Positive Train Control (PTC) technologies and communication systems.
  - Interoperability standards.
  - Communication cybersecurity.
  - Automation and automated vehicle research.
  - Drone-based technology research.
  - Train control and grade crossing risk simulation and modeling.
  - Grade crossing safety technologies and pilot studies, including intelligent rail systems, blocked crossings, and trespass prevention.
  - Development and testing of train control and communication systems.

- **Human Factors Program**
  - Railroad trespass and suicide prevention.
  - Automation, operating personnel information management and control.
  - Human fatigue.
  - Project evaluation.
  - Motorist behavior at highway grade crossing.
  - Vigilance, attention and distraction.
  - Office of Railroad Safety Support.
  - Support for the Short Line Safety Institute.

- **Railroad System Issues Program**
  - Research, Development & Technology (RD&T) research strategy.
  - Safety risk analysis and performance-based regulations.
  - Research prioritization.

- Strategic collaborations and partnerships.
- Performance-based regulations.
- Railroad environmental issues and locomotive efficiency research
- Locomotive safety.
- Rail Safety IDEA (Innovations Deserving Exploratory Analysis) program grants with the Transportation Research Board.
- Program or Project evaluation, including the Transportation Research Board's independent review of FRA's R&D programs.
- Railroad industry workforce development research.
- Technology Transfer.
- R&D facilities at the Transportation Technology Center (TTC) managed through a public-private partnership. Partnership RD&T related support services.

The FY 2021 Request includes $41 million for FRA's R&D program, in line with the $40.6 million in FY20 enacted funding. Funding requested in FY 2021 is dedicated towards transformative, next-generation safety technology initiatives, with a focus on projects that advance the safe automation of railroad operating and inspection functions.

All research products (including Technical Reports and Research Results) and data produced from FRA's R&D program are published to multiple sites according to RD&T's Research Portfolio Information Action Plan (documented in the FY 2019 – FY 2020 Annual Modal Research Plan).

Technology Transfer (T2) and deployment resources for all projects include:
- Stakeholder Engagement
  - Industry Conferences, Meetings, Presentations/Demonstrations
  - Workshops, Committees and Summits
  - Community Meetings
- Communications
  - Support for publications and reports

FRA will measure performance for T2 as part of the DOT Strategic Goal Innovation.
Development of Innovation:
- Increase Dissemination of DOT-Funded Research Reports (Office of the Assistant Secretary (OST))
- Increase Production of Tangible DOT-Funded Research Outputs (OST)
- Increase DOT Technology Transfer Activity (OST)

Deployment of Innovation:
- Increase Tangible Production of DOT-Funded Research (OST)

TRACK RESEARCH PROGRAM

The FY 2021 Request includes $10.174.9 million for FRA's Track Research Program. The amount reflects FRA's transfer of $1.1 million from Track Research to Railroad Systems Issues to consolidate funds for R&D facilities at TTC.

The number of accidents due to track-related causes decreased by 20 percent from 2009 to 2018. This reduction is due, in part, to the industry's adoption of technologies developed by FRA, such as:

- Gage restraint measurement system, a technology to assess the integrity of ties and fasteners.
- Vehicle-track interaction monitoring system developed for Amtrak and Class I freight railroads.
- Joint bar inspection system, an image-based technology that detects defects.
- Autonomous inspection technology used in Amtrak and freight assessment surveys.

The Track Research Program prepares for the future of rail transportation through applied research, development, and demonstration in the areas of rail performance, predictive analytics, track stability, track inspection, and vehicle track performance. FRA conducts applied research to test concepts and further understanding of safety problems causing accidents and incidents. Research topics that provide deeper understanding of technology, systems, practices or standards may lead to the development and testing of a prototype and demonstration with industry. Projects like Robotics for Bridge Inspection or Autonomous Internal Rail Flaw Inspection Device begin as applied research and are developed utilizing existing and new technologies.

As new technologies continue to emerge, and train axle loads and speeds increase, the timely development of technical information, data, and expertise is crucial to provide a basis on which to make decisions about issues affecting the safe operation of rail vehicles on U.S. track. The Track Research Program supports the goals and objectives of the DOT/FRA administration; conducts safety related research for new and in-service railroad system investments; develops and demonstrates new track condition assessment technologies; and coordinates research teams between railroads, universities, technology leaders, and the government.

The Track Research Program is trying to prevent high-consequence derailments that result in the loss of human life and cause significant damage to property and communities by:

- Identifying, understanding, and mitigating track-related failure modes that pose significant risk to safe Heavy Axle Load (HAL) operations and changes in track designs and/or materials.
- Ensuring the safe and effective implementation of new and innovative technologies and maintenance strategies intended to mitigate adverse effects of HAL operations on track infrastructure.
- Developing procedures for vehicle and track simulation building and validation.
- Providing guidelines for FRA Office of Railroad Safety, railroad industry, and consultants on how to build, model, and simulate different vehicle or track components to better understand the fundamentals of vehicle/track interaction and reduce derailment risk.
- Predicting, detecting, and preventing internal rail defects that lead to train derailments.
- Ensuring the safe and effective implementation of engineered-polymer composite ties and their fastening systems through the development of data-driven recommended practices.

- Preventing track buckles.
- Predicting adverse conditions and safety-related issues in the track infrastructure long before they become problematic.
- Understanding how changes in track infrastructure condition, operations, and/or regulations can affect the potential risk for track-related derailments.
- Increasing safety by reducing track support caused derailments.
- Supporting research partners in derailment investigations.
- Supporting research partners and the railroad manufacturing community in vehicle qualification and evaluation testing.
- Understanding the root cause of rolling contact fatigue in wheels and rails and developing methodologies, techniques, and inspection tools to identify problematic conditions before they become a safety threat.

Strategic collaboration partners for the Track Research Program include FRA's Office of Railroad Safety, American Short Line Regional Railroad Association (ASLRRA), Association of American Railroads (AAR), multiple railroads and universities.

Anticipated FY 2020 accomplishments for the Track Research Program include:

- Develop a device that 3D image internal rail flaws for better sizing and identification and develop remaining rail life calculation through experimental testing and theory.
- Develop a non-contact rail integrity inspection system utilizing acoustic sensors, doppler laser vibrometers, and signal processing.
- Quantify and evaluate Rail Flaw Inspection Practices and Modern Rail Steel Defect Growth Analysis.
- Support data and analysis requests from the FRA Office of Railroad Safety for rail performance issues.
- Finish the design and start building a test bed that can be used to validate the accuracy of track geometry measurement systems being used by FRA and the industry.
- Complete automated procedures for the alignment, processing, and reporting of Automated Track Geometry Measurement Systems (ATGMS) data for predicting areas approaching maintenance and safety limits.
- Support the development of procedures to include advanced friction models that examine the effects of falling friction, speed, and third body layer on wheel-rail contact forces, and 3D contact geometry.
- Successfully research into automated, solid-state frog repair technology with completion of field testing.
- Complete data collection to assess track fouling and the initiate development of safety criteria through understanding of subgrade failures.

Track and Structures……..$8.10 M

Track and Structures - Rail Performance

This research builds upon the FY 2019 first generation prototype with the second-generation prototype of flash thermography technology for detection of base defects.

Activities:

- Broken Rail Detection System on End of Train
  - Develop a cost-effective end of train device that can detect rail breaks utilizing a unique line laser approach.
- Non-contact rail integrity inspection prototype
  - Either laser or acoustic based or both.
- Continue to gather rail defect donations from at least three Class I railroads, characterize these defects, and add them to the FRA rail defect library at TTC for the entire research community to utilize in developing better detection systems.
- Refine towards commercialization a unique automation of detection protocol for ultrasonic rail inspection.
- Refine towards commercialization a unique 3D rail flaw imaging technology.
- Build a prototype to utilize flash IRT (infrared thermography) to detect anomalies in the rail base area.
- Automated, Solid-State Rail Joining Technology.
  - Research and development of friction welding technologies to join rail sections. Cooperative research at TTC with industry to reduce or eliminate performance issues associated with flash butt and thermite welding techniques.
- Innovative treatments for Rail Steel.
  - Research on heat treatment, coatings, and other technologies to improve the service life of running rails and special track work.
  - Continue research and development of automated methods to repair worn frogs, wings and other track appliances.

Expected Outcomes:

- Complete third-generation of broken rail detection system for the end of trains.
- Develop third-generation non-contact rail integrity inspection system prototype and complete a probability of detection study.
- Expanded FRA rail defect library at TTC for the entire research community.
- Complete field tests and assessment of automation of detection protocol for ultrasonic rail inspection. Generate list of needed improvements and research.
- Complete compact 3D rail flaw imaging prototype and rail life estimator software. Both are ripe for the commercial sector to develop the rest of the way and get out into industry where they can make a difference.
- Complete first field tests of flash IRT (Infrared Thermography) to detect anomalies in the rail base area.
- Restart research to develop a solid-state process to join full section rails in cooperative partnership with industry and other research organizations.
- Procure support for rail treatment and coatings research. Complete early development testing in the laboratory.
- Successfully close out research into automated, solid-state frog repair technology with completion of field testing and technology transfer to industry for commercialization.
- Re-start research and development of friction welding technologies to join rail sections. Cooperative research with industry, TTCI, and FRA to reduce or eliminate performance issues associated with flash butt and thermite welding techniques.

- Research on heat treatment, coatings and other technologies to improve the service life of running rails and special track work.
- Complete research and development of automated methods to repair worn frogs, wings and other track appliances. Transition technology to industry for commercialization.

Track and Structures – Track Inspection Technology and Processes
This research improves the track inspection process to automate the detection of conditions that causes track failure and report the conditions and location to the railroad for remediation.

Activities:
- Continue Research and development of change detection technology suitable for deployment on autonomous inspection platforms. In addition, developing automated data analysis of track inspections to determine safety related changes to the track structure, and reports this information to stakeholders with limited human intervention.
- Continue developing innovative approaches to imbed sensors and detection and communications technologies within the track structure to allow for a type of self-enunciation when conditions warrant remedial maintenance or pose a threat to safe rail operations.

Expected Outcomes:
- The long-range objective is to develop technology that permits railroad track to communicate its "state-of -repair" directly to the railroads, in a manner that is somewhat analogous to the way modern devices communicate via the internet of things (IoT).

R&D Facilities and Equipment – On-Track Research and Testing (FRA Research Assets)
This research seeks to conduct track research and testing to prevent derailments caused by track and structures.

Activities:
- Continue revenue service testing focused on the effects of cold weather on the integrity of the track system.
- Continue to investigate root causes of potential issues that may arise during FY20 affecting safe Heavy Axle Load (HAL) operations.

Expected Outcomes:
- Report results of expanded testing using the "rainy section" at TTC to investigate weld strains and failures associated with progressively deteriorated track support.
- Test results on the effects of cold weather on the integrity of the track system (e.g., effects of frozen ballast on Rail Neutral Temperature (RNT) loss and remediation).

Track and Structures – Track Support & Substructure
This research seeks to prevent derailments caused by track support and subgrade issues.

Activities:
- Develop reliable and automated method to assess track fouling and the development of safety criteria through understanding of subgrade failures.

- Develop characterization and further understanding of ballast mechanistic behavior and properties.
- Further develop vertical track deflection measurements to provide a structural indication of the track support structure with large deflection indicating weakness in the track support layers.
- Further refine Gage Restraint Measurement Systems (GRMS) technology to identify potential track strength weakness at the rail tie interface.

Expected Outcomes:
- Automated method to assess track fouling and the development of safety criteria through understanding of subgrade failures.
- Improved understanding of ballast mechanistic behavior and properties.
- Vertical track deflection measurements to provide a structural indication of the track support structure with large deflection indicating weakness in the track support layers.
- Refinement of GRMS technology to identify potential track strength weakness at the rail tie interface.

Track and Structures – Track Stability

This research builds upon the FY2020 first and second-generation prototypes for measuring rail stress without a zero reference.

Activities:
- Develop third generation prototypes to measure rail stress without a zero reference.
- Upgrade of Continuous Welded Rail (CWR)-Safe Software.
- Upgrade Rail Temperature and Buckling Prediction website.
- Initiate build of a rail stress and rail neutral temperature test bed at TTC.
- Finish the design and start building a test bed that can be used to validate the accuracy of track geometry measurement systems Research lateral stability and track buckling practices.

Expected Outcomes*:*
- Prototypes to measure rail stress without a zero reference that are robust and repeatable.
- Completion of CWR-Safe software upgrade. An asset to industry and track researchers trying to understand and prevent track buckles.
- Completion of upgrade of Rail Temperature and Buckling Prediction Website. An asset that will be valuable to field and management personnel, both in government and in industry, for preventing track buckle derailments.
- In-progress build of a rail stress and rail neutral temperature test bed at TTC.
- Quantified ways to build, monitor and maintain track to prevent track buckles.

Track-Train Interaction – Wheel-Rail Interface

The goal of this project is to continue research to understand the root cause of RCF and develop methodology, techniques and inspection tools, to identify problematic conditions before they become a safety threat.

Activities:
- Development of recommendations on third body layer influence and parameters, and operating conditions that can cause Rolling Contact Fatigue (RCF).

Expected Outcomes:
- Recommendations on third body layer influence and parameters, and operating conditions that can cause RCF.

Track-Train Interaction – Vehicle-Track Modeling, Simulation and Validation
Under the vehicle-track modeling research area of this program, TR will continue the work on all the areas related to vehicle-track modeling.

Activities:
- Continue support the development of procedures for both model building and model validation.
- Continue to support the development of procedures to include advanced friction models that examine the effects of falling friction, speed, and third body layer on wheel-rail contact forces, and 3D contact geometry.
- Support testing and modeling of vehicle suspension components.
- Support building of vehicle and track models for various equipment and operating practices to be used for derailment investigations or developing safety.
- Completion of the model perform simulation to see the response of the vehicle to multiple track input.

Expected Outcomes:
- Developed procedures for both model building and model validation.
- Developed procedures to include advanced friction models that examine the effects of falling friction, speed, and third body layer on wheel-rail contact forces, and 3D contact geometry.
- Test results and modeling of vehicle suspension components.
- Progress toward building of vehicle and track models for various equipment and operating practices to be used for derailment investigations or developing safety.
- Completion of the model perform simulation to see the response of the vehicle to multiple track input.

System Performance and Analysis ……..……$2.07 M

System Performance & Analysis – Predictive Analytics
This research focuses on the utilization of "Big Data" sources as well as the automation of track-related data processing and analyses to improve track safety and decrease derailments.

Activities:
- Complete methodologies for the evaluation of track inspection technology effectiveness and initiate process to incorporate as recommend practice.
- Continue research efforts focused on the application of artificial intelligence (AI) into track-related safety inspection techniques.

- Complete automated procedures for the alignment, processing, and reporting of Automated Track Geometry Measurement Systems (ATGMS) data for predicting areas approaching maintenance and safety limits.
- Conduct field investigation into the root causes of track geometry degradation associated with observed/predicted accelerated deterioration trends.

Expected Outcomes*:*
- Continue to improve automated processing capabilities in order to move from near real-time to real-time analysis of track-related data.
- Establish a standardized procedure for evaluating the effectiveness of existing and emerging track inspection technologies prior to use in industry.
- Recommend remedial methods associated with observed/predicted deterioration trends that most improve track geometry stability and safety.

Deployment of Expected Outputs/Products:
Partnerships and stakeholder engagement form the foundation of RD&T's technology transfer (RDT2) methodology leading to the adoption of research products. Autonomous Track Geometry Monitoring System (ATGMS) is an example of Track's collaboration with industry and universities that is leading to the deployment of ATGMS systems throughout the industry.

ROLLING STOCK PROGRAM

The FY 2021 Request includes $10.32 million for FRA's Rolling Stock Research Program.

The number of accidents due to equipment-related causes has decreased by 2 percent from 2009 to 2018. This has been due, in part, to previous research resulting in new operating practices and equipment standards for conventional rail, high-speed rail, and hazardous material transportation.

The Rolling Stock Research Program performs research activities relating to critical transportation topics that promote rail safety, improve rail infrastructure and mobility of goods and passengers, as well as topics that focus on preserving the environment. The Rolling Stock Research program conducts research to reduce railroad accidents and incidents due to rolling stock related causes as well as research to reduce fatalities and injury severity to passengers and crew members involved passenger train accidents and incidents. The Rolling Stock Research program produces solutions contributing to all DOT strategic goals: safety, infrastructure, innovation, and accountability.

This Program's research helps determine criticality and methods for identifying, analyzing, and evaluating potential failure modes. Rolling Stock conducts applied research to test the concepts and further understanding of safety problems causing accidents and incidents. Research topics that provide deeper understanding of technology, systems, practices or standards may lead to the development and testing of a prototype and demonstration with industry.

The Rolling Stock Research Program helps mitigate potential risks of unexpected failures occurring in rolling stock that can cause delays and disruptions to transport services or even result in derailment or collision accidents by:

- Conducting research and testing pertaining to bulk packaging traveling by rail, such as: tank cars, rail cars and intermodal tanks.
- Testing and understanding the different types of hazardous materials to be considered for transportation over the rail network.
- Providing engineering support in the research, design, fabrication, and test planning of ISO tanks, tank car fire testing and the structural performance of this equipment when used as fuel tenders and energy products as commodity transport.
- Improving defect detection, monitoring, inspection and control of rolling stock equipment and components to help reduce risks through the prevention of above-track equipment and component failures to improve safety.
- Developing and demonstrating the effectiveness of designs, strategies, and technology solutions that address structural integrity of locomotives to decrease the risk of fatalities and injuries in the event of accidents.

Strategic collaboration partners for the Rolling Stock Research Program include FRA's Office of Railroad Safety, Pipeline and Hazardous Materials Safety Administration (PHMSA), Maritime Administration (MARAD), American Short Line Regional Railroad Association (ASLRRA), Association of American Railroads (AAR), multiple railroads and universities.

Anticipated FY 2020 accomplishments for the Rolling Stock Research Program include:

- Provide FRA with information on the survivability of tank cars under fire condition in case of train derailment accident.
- Determine cars' behavior and failure modes under normal transportation of tank cars.
- Provide a foundation for modifying, eliminating or creating standards by leading research and capturing the results.
- Disseminate information to the rail and tank car industry so it can be used for tank car designs.
- Provide a realistic fire exposure to the test assembly (tank on flatcar) and make several key measurements, including interior and external temperatures, tank pressure, blast pressure a (if applicable), and heat flux.
- Identify possible studies to address defects that affect the structural integrity of safety equipment and packages.
- Identify projects that can be proactive for existing and future safety equipment and packages.
- Provide RD&T and FRA Office of Railroad Safety (RRS) with information on the performance and durability of safety equipment for tank cars and portable tanks so DOT has the required information to justify, modify, eliminate and create safety standards.
- Better understanding of how failures occur and how to best prevent or manage the consequences of such failures through improved equipment design and protection.
- Assist FRA to evaluate and document damage to railroad tank cars, study and capture the results of the liquid/vapor release flow on pressure relief.

- Design and fabricate LNG tender with the cabinet that protects the enclosed valves and fittings in the event of a collision with a tractor-trailer.
- Evaluate the current computer models and improve the fire computer models
- Develop an online hazardous material (HazMat) release probabilistic risk assessment platform for real-time, local track risk analysis.
- Develop an alternate mechanism for rapid brake signal propagation, to be used on unit trains transporting energy products (High Hazard Flammable Trains).
- Evaluate and test equipment and components for increased integrity to withstand damage and failure that could increase risks and lead to accidents and incidents.
- Research methods to measure the predictability of equipment health and component wear life.
    - Conduct evaluations and demonstrations of advanced devices.
    - Research damage resistance models of freight components. (Tonnage carried per wheel has progressively increased thus increasing stress to railway equipment leading to increased risks).
    - Collaborate with the industry to evaluate failure modes and characteristics.
    - Evaluate and demonstrate advanced equipment and inspection and maintenance procedures.
    - Demonstrate the ability to develop, monitor, control, and evaluate integrated advanced components.
    - Develop a system to power advanced devices and systems.
    - Develop a reliable framework for a wheel life model.
    - Develop technologies to detect defects on rolling stock equipment and predict failures.
    - Collaborate and support the development, demonstration and implementation of advanced wayside and onboard monitoring and inspection of equipment and components to help reduce risks and ensure safe train operations.
    - Develop methods to identify and track defective equipment and component systems.
    - Assess and increase knowledge of advanced technology and its effectiveness in improving the safety of train operations and detection of defects.
    - Conduct data analysis to support the evaluation of the performance of equipment and component systems.
    - Improve the process for demonstrating and implementing new technology. Establish a standard process for wayside technology pilot demonstrations and implementation.
- Develop strategies to identify and quantify safety risks in train operations.
- Evaluate and encourage safe practices for train makeup and handling to reduce accidents and derailments. Develop train handling and operational strategies to help reduce adverse effects on train operations.
- Defining the network topology of the freight transportation system. Also, defining the nodal and linkage bottlenecks, and the investment strategies to be examined.
- Investigate the current passenger truck designs and diagnose the main issues that need improvement.
- Literature review is needed to analyze/investigate the current and previous state-of-the-art methods in Crash Energy Management (CEM) Technology and Implementations (world-wide).
- Conducting accurate and reliable feasibility analysis to improve the CEM capabilities of existing (in-service) passenger and critical HazMat equipment.

- Continued participation in the restarted APTA Passenger Rail Equipment Safety Standards committees to revise existing and/or develop new safety standards which are complementary to existing federal regulations.
- Conduct of train-to-train test to affirm the behavior of the prototype deformable anti-climber and pushback coupler system as an effective means for inhibiting vehicle-to-vehicle override in collisions.
- Complete the engineering analyses related to passenger car side structure requirements which are being performed to address the outstanding National Transportation Safety Board (NTSB) recommendation to FRA.
- Completion of testing to assess the efficacy of retrofit collision posts on older "legacy" locomotives which are not compliant with modern industry crashworthiness standards.
- Evaluating the results of the glazing retention test program to derive appropriate metrics for consideration in possible rulemaking and/or development of industry standards for enhanced glazing retention capacity.
- Leverage results from test program to make recommendations to the industry on most effective mechanisms from improving glazing retention capacity.
- Conduct room corner tests to validate scaling laws developed through simulations.
- Evaluate modern methods for measuring toxicity of burning materials.
- Simulation of other scenarios of fuel tank puncture using validated models
- Evaluate railExodus and other modern available emergency evacuation simulation tools for effectively predicting evacuation of passengers under various scenarios.
- Investigate integration of emergency evacuation tools such as railExodus with fire dynamics models for safety and emergency preparedness research.
- Educating the public and emergency responders on how to locate and use the Emergency Notification System (ENS) sign information.
- Development of standards for natural gas fuel tender.
- Review railroads natural gas fuel usage programs.

Hazardous Material (HazMat) Transportation……...$2.18 M

This research program focuses on improving the safety of rail transport of hazardous materials and is conducted in cooperation with the railroad industry, PHMSA and Transport Canada. This program seeks to develop new standards and methodologies to evaluate the safety and performance of current and new tank car designs used to transport hazardous material. Having a safe means of transportation is vital to growing domestic energy production, both for domestic use and export.

<u>HazMat – Tank Car Research</u>
This research develops and improves the packages that carry hazardous materials, helping to reduce the release of material during rail accidents and incidents.

Activities:
- Fire test on a LPG tank car.
- Side and head impact test on a DOT 113 tank car.

Expected Outcomes:
- Improve the computer model and update current regulation on thermos protection.
- Update computer model to include cryogenic tank cars.

HazMat – Structural Integrity
The goal of this project is to understand the performance and durability of safety equipment, and protective systems for tank cars and portable tanks. This research area focuses the current fleet, identifying problems with current equipment and packages.

Activities:
- Testing of different pressure relief valves used on tank cars.
- Perform a rollover protection test on a current DOT 117.

Expected Outcomes:
- Improve the performance of pressure relief devices.
- Improve the rollover protection for new tank cars.

HazMat – Accident Consequence Reduction
This research will study the loading and unloading practices of hazardous material to improve the operating practices and securement of packages for safe transportation and reducing non-accident releases.

Activities:
- Investigate accidents involving hazardous materials packages.
- Conduct forensic analysis on equipment.
- Procure and store equipment for further investigation.

Expected Outcomes:
- Better understanding of how failures occur and how to best prevent or manage the consequences of such failures through improved equipment design and protection.
- Help FRA evaluate and document damage to railroad tank cars, study and capture the results of the liquid/vapor release flow on pressure relief.

Rolling Stock Equipment and Component (RSEC)……$3.76 M

Research efforts in the Rolling Stock Equipment and Components (RSEC) program area focus on development and improvement of equipment defect detection and control. Both wayside and on-board detection and control systems offer diverse platforms for such research and demonstration.

RSEC - Rolling Stock Component Safety
The research comprised in this project proactively prevent above-track equipment and component failures (e.g., situational hazard prevention), and provide the analytical and

technical basis to develop equipment safety standards while also improving safety, reliability, and respectability of rail equipment, technologies, and material.

Activities:

- Continue to evaluate and test equipment and components for increased integrity to withstand damage and failure that could increase risks and lead to accidents and incidents.
- Continue to research methods to measure the predictability of equipment health and component wear life.
  - Conduct evaluations and demonstrations of advanced devices.
  - Research damage resistance models of freight components. (Tonnage carried per wheel has progressively increased thus increasing stress to railway equipment leading to increased risks).
  - Collaborate with the industry to evaluate failure modes and characteristics.

Expected Outcomes:

- Research, development, and technology transfer of components and systems that reduce the risk of rail incidents and accidents and increase the safety of the nation's rail transportation network.
- Reduce the likelihood of derailments from equipment failures and mitigate the consequences should derailments occur through these or other causes. Strategic priorities include investigation of the effectiveness of wayside and onboard monitoring systems to detect equipment defects and analysis of component failure modes to identify necessary improvements in materials and construction methods.
- Design, develop, and demonstrate prototypes of effective wayside and onboard technologies that can provide component health monitoring.
- Increased understanding of equipment failure mechanisms and facilitate mitigation to reduce public safety risks.

<u>RSEC - Rolling Stock Maintenance & Inspection</u>

The focus of this research is to evaluate and demonstrate the effectiveness and efficiency of automated inspection and maintenance procedures and equipment. This project will demonstrate the ability to develop, monitor, control, and evaluate integrated advanced components to detect defects in real-time, predict and prevent future failures, improve rolling stock capabilities and performance, and improve overall rail operational safety. Developing a system for powering many advanced detection devices on freight trains will increase safety and security, and improve the efficiency of freight railroad operations. Technologies developed to detect defects on rolling stock equipment, and predict future failures that may be prevented, will substantially improve railroad safety. These investments keep the U.S. rail sector growing and improving to keep up with the latest efficiency and safety standards.

Benefits of this research include improved safety requirements, lower operating costs for railroads, reduced railroad accidents and fatalities, improved equipment service life for equipment, and increased safety, security and efficiency of freight railroad operations.

Activities:

- Analysis of broken axles trends and causes.

Expected Outcomes:
- Detailed analysis of broken axles trends and causes, and recommendation to eliminate or mitigate their hazards.

RSEC - Train Handling & Operating Practices

This research will develop simulation scenarios to evaluate different network and capacity related parameters with Electronically Controlled Pneumatic (ECP) brakes and PTC technologies, and compare these to the conventional signaling and braking applications. Simulation scenarios include network topology, traffic type, ECP scenarios, and PTC scenarios (with and without ECP scenarios).

This research will also focus on developing effective methodologies/models for evaluating the economic benefits of improving railroad network velocity and capacity. These tools will be critical in demonstrating the benefits of technologies such as ECP brakes, PTC, higher speed operations, and shared corridors.

This research will also address Topology-based Resilience of Freight Transportation Networks, mainly to enhance the national freight system to address key challenges corresponding to several major trends affecting freight transportation including: (1) expected growth in freight tonnage, (2) underinvestment in the freight system, (3) difficulty in planning and implementing freight projects, (4) continued need to address safety, security, and resilience, and (5) increased global economic competition.

This research will also improve passenger truck designs that can provide superior equalization and curving performance to better handle rough track geometry.
This research is in line with FRA's mission to improve safety and performance, and prevent derailments that cause injury and loss of life. Derailment prevention is a major safety issue. It is in the FRA's best interest to enhance the economic benefits of improving railroad network velocity and capacity. The rail industry will benefit from this research through improved safety requirements, lower operating costs, reduced railroad accidents and fatalities, and overall improved railroad performance.

Activities:
- Continue to define the network topology of the freight transportation system. Also, defining the nodal and linkage bottlenecks, and the investment strategies to be examined.
- Continue to investigate current passenger truck designs and diagnose the main issues that need improvement.

Expected Outcomes:
- Continue to improve the network topology to have the topological structure to offer robustness, resiliency, efficiency and effectiveness. Enhancing the network to meet the current increasing challenges.
- Continue to improve passenger truck designs that can provide superior equalization and curving performance to better handle rough track geometry.

- Evaluate advanced bearing technology and testing that prevents water related failures due to various environmental exposure.

Train Occupant Protection .....$4.38 M

Research in this area will develop improved strategies and designs for rail rolling stock to reduce injuries and fatalities resulting from rail accidents (i.e., collisions and derailments). FRA needs to invest in this research to support its missions of improved safety, performance, and mitigation of the consequences of collisions and derailments that cause injury and loss of life. Crashworthiness and occupant protection continue to be major safety issues as evidenced by several recent, high-profile collisions and derailments.

TOP - Locomotive Crashworthiness and Occupant Protection

Research in this area will develop improved strategies and designs for rail rolling stock to reduce injuries and fatalities resulting from rail accidents (i.e., collisions and derailments). FRA needs to invest in this research to support its missions of improved safety, performance, and mitigation of the consequences of collisions and derailments that cause injury and loss of life. Crashworthiness and occupant protection continue to be major safety issues as evidenced by several recent, high-profile collisions and derailments.

Activities:

- Continue the literature review and analyzation/investigation of the current and previous state-of-the-art methods in crash energy management (CEM) technology and implementations (world-wide).
- Continue conducting accurate and reliable feasibility analysis to improve the CEM capabilities of existing (in-service) passenger and critical hazmat equipment.
- Continue to evaluate geometric compatibility between coach cars and locomotives in collisions. Translate these into additional potential load cases with appropriate evaluation criteria to ensure stable performance under moderate collision conditions
- Re-evaluation of traditional anti-climbing requirements if push-back couplers and CEM are present (may not need same load requirements to be sustained while achieving the same or better performance when compared to conventionally designed equipment).
- Re-evaluation of end frame elastic requirements for passenger vehicles with CEM. Some designs may prematurely activate crush zones but still have significant residual strength to function as intended.

Expected Outcomes:

- Improving the crash energy management (CEM) capabilities of existing (in-service) passenger and critical hazmat equipment, through cost-effective adaptations and retrofit technology.
- The re-evaluation activities described above will take advantage of more sophisticated modelling capabilities which exist and apply them to the structural analyses of alternative passenger equipment designs. Outcomes will be technical data which can be leveraged to inform potential improvements to existing safety standards.

TOP - Glazing Standards

In the last 44 years, at least 25 fatalities have been attributed to ejection through rail car window openings during passenger train accidents. The research in this area will comprehensively describe all the engineering requirements placed on glazing systems, survey existing glazing systems design strategies used throughout the world, and assess the effectiveness of these designs in meeting all of the engineering requirements. In addition to functioning as a window, glazing systems are also expected to be impact resistant, provide emergency egress, provide emergency access, be fire resistant, and provide occupant containment.

FRA needs to invest in this research as it has the responsibility for conceptualizing and demonstrating the effectiveness of technology solutions that improve safety and where safety regulations may or may not already exist. The private sector is not motivated to invest in research in areas where it is already compliant with existing federal regulations and industry standards, even when those regulations and standards do not yield the maximum possible safety.

Activities:

- Activities to be performed would concentrate on what may not have been completed and/or revising the scope to respond to NTSB's assessment of FRA's response to this safety recommendation.

Expected Outcomes:

- Final draft of proposed APTA safety standard for improved glazing retention capacity.

TOP - Fire Safety Research

The Fire Safety Research program will focus on improving current Federal regulations and industry standards for crashworthiness of passenger locomotive fuel tanks, fire performance of materials and components used in passenger rail equipment through research activities. Modern, innovative, alternative methods for evaluating fire performance of materials and components will improve safety, yield cost-savings opportunities, and advancement of modern tools for the passenger rail sector. The FRA requirements for materials fire safety performance and fuel tank crashworthiness were developed over 20 years ago. Passenger locomotive fuel tank structural requirements are based on static loading. Research into the performance of passenger locomotive fuel tanks under dynamic loads such as those seen in derailments and collisions is needed. Smaller profile diesel multiple unit (DMU), which is not a traditional passenger locomotive, fuel tanks are being assessed for their ability to perform under these loads as well. The research allows the FRA to not only evaluate conventional and DMU fuel tanks under dynamics loads, it also validate test methods that can be for evaluation of these types of equipment. This research allows FRA to review the current requirements for equivalency with newer standards, possibly allowing for the application of newer industry standards, promoting innovation and safety. This research allows FRA to review the current requirements for equivalency with newer standards, possibly allowing for the application of newer industry standards, promoting innovation and safety

Activities:
- Conduct room corner tests to validate scaling laws developed through simulations
- Evaluate modern methods for measuring toxicity of burning materials
- Simulation of other scenarios of fuel tank puncture using validated models

Expected Outcomes:
- Validated scaling laws for modeling and simulation of rail car fire growth predictions
- List of toxicity measurement methods
- Final recommendations and reporting on performance of DMU under dynamic loads

TOP - Emergency Preparedness Research

Emergency Preparedness standards set forth the basic minimum requirement for communication and safe evacuation of passengers and crew in emergency situations. Understanding the dynamics of passenger interaction as evacuation ensues on a passenger train will provide FRA with quantitation data to make decisions for improving the current standards. This project will investigate and develop innovative safety technologies that improve emergency preparedness and egress features of passenger rail equipment. The Emergency Preparedness Research program supports initiatives that ensure passenger rail equipment and onboard crewmembers' training is modern, progressive, and effective. It also supports providing vital safety information in a central location for all interested parties; this includes producing training videos and distributing it among related stakeholders and on the FRA website.

Activities:
- Continue to evaluate railExodus and other modern available emergency evacuation simulation tools for effectively predicting evacuation of passengers under various scenarios.
- Investigate integration of emergency evacuation tools such as railExodus with fire dynamics model for safety and emergency preparedness research.
- Educating the public and emergency responders on how to locate and use the Emergency Notification System (ENS) sign information.

Expected Outcomes:
- Identification of modern effective evacuation modeling tool for rail applications.
- Develop plan for integration of evacuation simulation tool and fire dynamics models.
- A training video to be distributed to the public and emergency responders on how to locate and use ENS sign information. The format of the video should follow the same method as used for the rail safety videos. The video shall contain an overall safety message and details of the ENS signs.

TOP - Cab Displays, Controls, & Environment

This project will improve cab/locomotive visibility at night, provide extra alerting for track workers and attempting trespassers, provide extra visibility/alerting when approaching grade crossings, unify an optimized cab display across all railroad providers, increase freight and passenger rail safety, and reduce operating and maintenance costs for locomotives.

Activities:
- Continue to test and validate the candidate LED headlights for railroad application.

Expected Outcomes:
- Validate the new LED headlights and assist in adopting new standards and regulations for LED lights on locomotives.

Liquefied Natural Gas (LNG) - Natural Gas Safety Research
This research will investigate innovative safety technologies that will improve the transportation and use of natural gas, both liquefied and compressed (CNG), in the rail sector. The research provides the FRA RRS with the scientific basis for decision- making and development of standards and requirements.

Activities:
- Development of standards for natural gas fuel tender.
- Review of railroads' natural gas fuel usage programs.

Expected Outcomes:
- Guidance documents to RRS on natural gas fuel usage by nation's railroads.
- Grade-crossing impact test of LNG fuel tender.

Partnerships and stakeholder engagement form the foundation of RD&T's technology transfer (RDT2) methodology leading to the adoption of research products. The Rolling Stock Research Program is subject to continuous input and review from industry stakeholders. PMs are active contributors to industry committees and meetings overseen by the AAR, APTA, American Society of Mechanical Engineers (ASME), and others. Input from industry stakeholders at these meetings is solicited and appropriately addressed in on-going research efforts.

TRAIN CONTROL AND COMMUNICATION PROGRAM

The FY 2021 Request includes $8.08 million for FRA's Train Control and Communication (TC&C) Research Program.

The number of signal-related train accidents has decreased by 4 percent from FY 2009 to FY 2018 with steady incremental improvements each year. Further reduction is expected from the installation of Positive Train Control (PTC) on certain routes, as PTC is one of the most transformative technological changes in the history of railroad signal technologies.

The TC&C Research Program focuses on improving railroad operation safety through the development and testing of train control and communication systems and grade crossing safety technologies. TC&C conducts applied research to test concepts and further understanding of safety problems causing accidents and incidents. Research topics that provide deeper understanding of technology, systems, practices or standards may lead to the development and testing of a prototype and demonstration with industry. The program conducts pilot studies,

creates prototypes, and demonstrates safety and security systems, including intelligent rail systems, blocked crossings, and trespass prevention.

FRA's TC&C Research Program is aimed at reducing train-to-train collisions and train collisions with objects on the line and at grade crossings by:

- Assisting railroads in meeting the Congressional mandate for PTC while maintaining safe and efficient rail operations. As a critical safety system, PTC must be highly reliable, interoperable, and secure.
- Working with railroads to define standards and the initial infrastructure for interoperability between the North American railroads.
- Developing and testing next generation PTC technology to maintain a high level of availability, improve capacity, maintain safe operations and evolve technological advances.
- Facilitating stakeholder coordination and investing in technology development to keep rail on pace with highway vehicle connectivity and automation.
- Developing, testing, and validating methods and means to reduce the number of casualties due to trespass activities.
- Developing technologies and tools to decrease accidents involving injuries and deaths at grade crossings.
- Developing and testing solutions that help prevent pedestrians from crossing the tracks in the presence of a moving train, leading to less incidents and accidents.
- Simulating and modeling non-invasive and non-destructive methods to predict traffic trends and accident reduction in a controlled environment.
- Creating education and awareness tools to increase public understanding and awareness of the risks involved when near railroad property to help decrease incidents and accidents.

Strategic collaboration partners for the TC&C include FRA's Office of Railroad Safety, Intelligent Transportation Systems Joint Program Office (ITS-JPO), Federal Highway Administration (FHWA), Association of American Railroads (AAR), multiple railroads, local DOTs and police departments.

The Train Control and Communication research activity has innovated PTC-related technologies for several years. Notable successes include:

- Freight and Passenger Braking Algorithm development and refinement to improve braking enforcement performance for passenger railroads;
- Cybersecurity protection and PTC communications messaging verification and validation;
- Rail Crossing Violation Warning Application Development, a cooperative vehicle and infrastructure system that assists drivers in avoiding crash-imminent situations at railroad crossings; and,
- Automated and autonomous vehicle research to develop interoperability standards and improve grade crossing safety.

Anticipated FY 2020 accomplishments include:

- Investigation and enhancement of Track Circuit technologies to increase the safety and throughput.

- Development of technologies to safely increase the capacity of freight and passenger railroad trains through densely populated areas.
- Development of improved PTC Adaptive Braking Algorithms.
- Positive Train Control Interoperability Testing Support.
- Monitoring and Analysis of Integrated Network (MAIN).
- Development of Interoperable Lifecycle Management (ILM) network.
- Early stage Automated Train Operation research and development.
- Development of advanced train location and positioning system.
- Investigation of innovative Rail Communication Security approaches.
- Research cooperative automation technologies to improve grade crossing safety.
- Evaluate effectiveness of connected vehicle technologies in a field environment.
- Develop rail industry driven standards for communicating grade crossing status to connected or automated vehicles.
- Continue the research on how artificial intelligence (AI) algorithms and related technologies can be used in reducing trespass occurrences along the railroad's ROW.
- Initiate the research on the effectiveness of mobile systems in monitoring unauthorized access to the railroad right of way. Mobile systems include but are not limited to unmanned aircraft vehicles or portable cameras.
- Explore the design and implementation of novel or improved warning devices.
- Investigate and test the integration of grade crossing locations into mapping providers.
- Investigate the use of enforcement tools to mitigate the risk of accidents by pedestrians at grade crossings.
- Develop a new grade crossing accident prediction and severity model for use by the states and local communities.
- Collaborate with organizations such as Operation Lifesaver.
- Assist the FRA Office of Railroad Safety in events such as the listening sessions ongoing this year for grade crossings, and listening sessions at the top 10 counties with the highest trespass problems, as outlined in the Trespass Strategic Report recently submitted to Congress.
- Conclude the pilot law enforcement grant and develop a final report for internal use as well as the public.

Train Control and Communication……..…….$6.24 M

PTC Technology

This research addresses problems associated with finalizing PTC development, deployment, and continued long-term evolution and maintenance. It supports the design and development of innovative systems to ensure PTC interoperability and reliability continue to evolve with the pace of technology development.

Activities:

- Testing of enhanced track circuit technologies to increase the safety and throughput.
- Continue development of technologies to safely increase the capacity of freight and passenger trains through densely populated areas.

- Testing of improved PTC adaptive braking algorithms.

Expected Outcomes:
- Validate increased efficiency of PTC without reducing safety.
- Increased rail capacity and throughput.
- Increased braking accuracy for freight and passenger trains.

PTC Interoperability

Interoperability is the requirement that all railroads have the ability to work anywhere on the North American railroad network. If railroads are not interoperable, all rail traffic must stop and transition between carriers at each individual railroad boundary. This would be extremely inefficient, costly and create extreme burden on the FRA, railroads, passengers and freight railroad customers.

Interoperability is a requirement of the Rail Safety Improvement Act of 2008 (RSIA '08), as all railroads must have the ability to use the national network and transport goods and people on all lines. Multiple efforts are reviewed for viability, including radiofrequency spectrum allocation, infrastructure enhancements and modifications, and monitoring and analysis of the network. Interoperability will alleviate the regulatory burden requiring the FRA to check the interoperability between different railroads and will lead to development of an automated system that will ensure interoperability.

Activities:
- PTC interoperability testing support.
- Next phase development of Monitoring and Analysis of Integrated Network (MAIN).
- Development of Interoperable Lifecycle Management (ILM) network.

Expected Outcomes:
- Efficient and reliable interoperability controls between railroads.
- Automated interoperability verification between railroads.
- Automated file transfers between railroads to determine problem areas and corrections.
- Centralized test facilities that serve small freight and commuter railroads to streamline testing and validation of their PTC systems.

PTC Next Generation

This research will identify and develop the methods, facilities, equipment and capabilities required for providing future industry PTC development. Research will focus on providing additional functionality, improving reliability, and supporting integration with other technologies, all of which will support the objectives of improving safety and throughput. Multiple areas of consideration are under review for potential development, including signaling, communications, and infrastructure enhancements to reduce PTC burden and improve safety.

Activities:
- Applied automated train operation research and development.
- Testing of advanced train location and positioning system.

- Standardization of new rail communication security techniques.

Expected Outcomes:
- Improved rail network capacity and decreased delays caused by PTC.
- Rail network safety and efficiency improvements through interoperable automation.
- Increased cyber security of PTC systems.

Intelligent Transportation Systems (ITS)
Facilitate collaboration between railroads and automotive industry stakeholders to develop coordinated solutions for automated transportation systems. Accelerated development of connected and autonomous road vehicles must be mirrored by railroad investment in rail automation and connected highway-rail grade crossing technologies.

RD&T's research of ITS improves CFR 49 Part 234 Grade Crossing Safety and Part 924 Highway Safety Improvement Program. Most of the highway-grade crossing regulations, especially those pertaining to the interactions of highway users, fall under FHWA or the Federal Motor Carriers Safety Administration (FMCSA). The regulations that FRA puts forth on highway-grade crossing, in general, pertain to the requirements that the railroads must maintain regarding the safety devices and general upkeep of the highway-rail grade crossing. However, as the auto industry is pursuing autonomous vehicles, those vehicles will need to interact with highway-rail grade crossings and research needs to be conducted. Odds are that the current highway-rail grade crossing safety system will need to be altered to better communicate with autonomous vehicles so that the vehicles are "informed" of the position of the gates as well as informed about oncoming trains. A potential benefit that could come from the inclusion of autonomous vehicles at highway-rail grade crossings is the reduction of accidents caused by highway drivers moving around safety devices or by highway drivers misjudging the distance of an oncoming train and continuing to move through the crossing.

Activities:
- Develop automation technologies to improve grade crossing safety.
- Evaluate effectiveness of connected vehicle technologies in a field environment.
- Develop rail industry-driven standards for communicating grade crossing status to connected or automated vehicles.

Expected Outcomes:
- Advancement of connected and automated vehicle technologies with a focus on grade crossing safety.
- Communication standards tightly coordinated between rail and automotive industry groups.

Grade Crossing Safety and Trespass Prevention……$1.84 M

Grade Crossing Safety Research plays a vital role in reducing accidents and incidents around grade crossings, which has for decades been the rail industry's largest public safety concern. It continues the collaboration with State DOTs, local authorities, and communities to study and implement innovative solutions to improve safety around grade crossings. This research takes advantage of advancement in drones and UAV technologies to detect and prevent trespassers.

In an effort to enhance and verify the accuracy of FRA grade crossing inventory database, this research uses LiDAR technology to map grade crossing profiles including elevation to identify hump crossings and prevent accidents resulting from low ground clearance vehicles being stuck at crossings.

Trespass Countermeasures

Continue to work with stakeholders in developing new tools and technologies to address trespassing on railroad Right-of-ways (ROW).

Activities:

- Continue and/or develop new work on AI applied to railroad trespassing.
- Continue working on the effectiveness of mobile systems used for detection of trespassing activities within any given railroad.
- Develop new research ideas based on the input of the several stakeholders involved in trespassing issues.

Expected Outcomes:

- The outcome of the research described at a high level above is then expected to be transferred to other stakeholders, such as railroads or local communities for further development and implementation, thus increasing public safety.

Grade Crossing Technology

Continue to work with universities, the industry, railroads and public sector in exploring new technologies geared toward innovative devices to increase safety at grade crossings.

Activities:

- Explore new areas where PTC can play a role in increasing safety at grade crossings.

Expected Outcomes:

- With the wide introduction and implementation of PTC, its inclusion of a grade crossing warning system will increase overall public safety and at the same time reduce accountability and liability.

Grade Crossing Pedestrian Safety

Continue to explore measures to address accidents at grade crossings and along railroad ROWs that involve pedestrians.

Activities:

- Explore new methods and techniques to improve pedestrian safety at rail grade crossings.
- Continue to explore enforcement and educational tools to reduce accidents at grade crossings involving pedestrians.

Expected Outcomes:

- TC&C expects to increase safety for pedestrians at crossings thanks to this research described at a high level above.

Grade Crossing Modeling and Simulation
Continue working on the new accident prediction and severity model for grade crossings, as well as developing models for studying behavior in general at grade crossings.

Activities:
- Explore new modelling and simulation to reproduce real scenarios of human behavior at crossings. This can create new testing solutions without intervening on the actual railroad property or grade crossing itself.

Expected Outcomes:
- Simulation and modeling can provide good insight into how safety can be improved before the solution is implemented.

Grade Crossing and Trespass Outreach and Education
Continue developing and disseminating educational tools to the public, including local and state governments, law enforcement agencies, and schools, among others.

Activities:
- Develop new research ideas based on the outcome of the listening sessions planned during FY20.
- Continue collaboration with organizations such as Operation Life Saver and others.
- Formation of an international working group on railroad trespass prevention.

Expected Outcomes:
- Increased safety overall in the railroad environment when interacting with grade crossing and trespass prevention.

Partnerships and stakeholder engagement form the foundation of RD&T's technology transfer (RDT2) methodology leading to the adoption of research products. Stakeholder input is a critical driver of TC&C's research planning. All the research and development activities conducted by the TC&C Research Program are done in partnership with government and non-government groups to target the research to solve rail transportation safety issues and needs. These partnerships benefit from technical and financial collaboration for a more efficient and effective research program. Multiple railroads are contributing in-kind support of the development of requirements, testing and providing technical guidance and intellectual resources.

HUMAN FACTORS PROGRAM

The FY 2021 Request includes $6.04 million for FRA's Human Factors (HF) Research Program.

There was a 4 percent increase in human factors-caused accidents from 2009 to 2018. Human error continues to be one of the primary causes of railroad accidents and incidents. FRA's

Human Factors R&D program's priorities are automation and operating personnel information management and control, suicide prevention and motorist behavior at grade crossing.

Across the rail industry there is a distinct lack of attention to human requirements in the design and development of systems for safety and efficiency. Failure to include human factors requirements in the systems development of new technology, for example, will result in more error -prone systems acquired and used by railroads. The HF research program attempts to fill the gap in attention to human factors by providing the rail industry with knowledge about human behavior in operational settings, and research yielding human requirements for better design of technology and processes., Human factors concepts, behavioral models, and research derived tools are applied in research settings to define and understand human behavior related to safety issues that cause or contribute to accidents and incidents.

The FRA's Cab Technology Integration Laboratory (CTIL), developed under the Human Factors research program, provides the FRA and the rail industry the capability to examine the effect of man-machine collaborative automation, train controls, new and more meaningful displays and different operating procedures, on human and system performance. The CTIL research results are more easily visualized by labor and the operating railroads through the use of the same simulation and track environments provided for training to crews at their home railroads. The CTIL also provides a system development test and prototyping capability in a virtual environment more suitable for new system concepts, where there is less risk, before moving on to an operational testing environment.

The Human Factors Research Program is focused on improving railroad safety and reducing rail accidents caused by human error by:

- Developing interventions and solutions to mitigate fatigue and the effect of irregular work hours, the unpredictability of on-duty times associated with the U.S. rail industry.
- Understanding ways to improve the situational awareness of operating personnel that could improves vigilance and sustained attention.
- The application of research derived simulation and modeling tools to address crew attentiveness and situational awareness issues as well as the design of system safety technology, like Positive Train Control
- Guiding and supporting the development of the Short Line Safety Institute to improve safety and safety culture Class II and Class III railroads.
- Conducting project evaluations to ensure program success and holds contractors conducting government-funded research accountable for efficient and effective use of resources to serve the public good.
- Developing, testing, and validating methods and means to reduce the number of casualties due to trespass activities.
- Developing technologies and tools to decrease accidents involving injuries and deaths at grade crossings.
- Developing and testing solutions that help prevent pedestrians from crossing the tracks in the presence of a moving train, leading to less incidents and accidents.
- Simulating and modeling non-invasive and non-destructive methods to predict traffic trends and accident reduction in a controlled environment.

- Creating education and awareness tools to increase public understanding and awareness of the risks involved when near railroad property to help decrease incidents and accidents.
- Identifying and studying the causal factors that lead to trespassing and suicides incidents on railroad property.

Strategic collaboration partners for the Human Factors Program include FRA's Office of Railroad Safety, American Short Line Regional Railroad Association (ASLRRA), Association of American Railroads (AAR), and other rail safety organizations.

Anticipated FY 2020 accomplishments for the FRA's Human Factors R&D program include:

- Assistance to FRA RRS in executing the Implementation Milestones listed in its report to Congress, *National Strategy to Prevent Trespassing on Railroad Property* (https://www.fra.dot.gov/eLib/Details/L19817).
- Development of technology to identify suicide risks and behaviors, including detection and intervention.
- Training railway staff on trespasser strikes using a high-fidelity simulator.
- Development of a system for emergency service vehicles that predicts when grade crossings will be blocked, and develop an in-vehicle notification system to help emergency service vehicle drivers avoid blocked crossings. This technology may be used to re-route while traveling to/from an emergency and help reduce response time.
- Assessment of in-vehicle auditory alerts (IVAAs) and their effects on driver behaviors at grade crossings. Pilot test IVAA designs in the real-world environment to investigate feasibility and driver acceptance.
- Analysis of technologies such as HUDs, to help crews acquire and maintain situational awareness and maintain focus on the driving task.
- Determination of the extent to which commutes to and from work contribute to locomotive engineer fatigue.
- Assessment of the Information and Communications Technology (ICT) knowledge, attitudes, and skills of the railroad industry. The ICT survey results will provide information about the technologies that should be used for railroad audiences, when developing communication and outreach programs.
- Development and ongoing evaluation of a pilot study to explore a voluntary information sharing and reporting environment for the railroad industry.
- Human reliability studies following full implementation of PTC technology in the CTIL to understand the challenges of human computer interaction and integration of multiple interfaces.
- Development of a communication strategy to expand the use of "Railroaders' Guide to Healthy Sleep" website.
- Evaluation planning, administrative, technical, and other evaluation support services to the DOT Safety Council Evaluation Planning and Action Team.

Human Factors (HF)……...……$6.04 M

Rail Trespass and Suicide Prevention

Human Factors research on rail trespass and suicide addresses the two leading categories of rail fatalities in the U.S. Hundreds of people lose their lives every year on train tracks due to trespassing or suicide. HF will continue to examine the human behaviors associated with rail trespass and suicide.

Activities:

- Partner with non-profit organizations to help improve education and outreach related to rail suicide and trespassing.
- HF will continue its suicide prevention research program, with activities in the following areas:
    - Pilot projects to examine suicide countermeasures
    - Provide best practices to media outlets with regards to reporting on rail suicide incidents
    - Lead the Global Railway Alliance for Suicide Prevention, an international working group
    - Create GIS map of suicide hotspots
    - Examine and categorize the demographic and environmental characteristics of rail suicides.
- HF will lead trespasser prevention research that is identified after completing the milestones listed in *National Strategy to Prevent Trespassing on Railroad Property*.

Expected Outcomes:

The outcome goals of the trespasser and suicide prevention research topic area are to:

- Produce Technical Reports, Research Results reports, and presentations related to the program activities.

Automation, Operating Personnel Information Management and Control

HF addresses the integration of people with automation technology by conducting research particularly on automation and manpower, personnel, human factors engineering, safety, and training. These are the primary aspects where automation intersects with human behavior and human operational requirements. Application of research results in this area by the industry will yield better performing man-machine collaborative systems.

Activities:

- Research head-up display for passenger locomotives and operations.
- Research to develop new approach (human-automation teaming to accommodate the best characteristics of both) for operating displays.

Expected Outcomes:

- Enhanced locomotive crew vehicle and operating environment situational awareness precursor for accident prevention.
- Developed human-machine interface (HMI) producing reduced workload, ease of use, and improved operational performance as impacts safety.

Human Fatigue

Employees in the railroad industry are susceptible to the risk of injury and property damage caused by human fatigue and loss of attentiveness, due to around-the-clock operations. HF seeks to develop interventions or solutions to mitigate the effect of irregular work hours, long shifts, and the unpredictability of on-duty times associated with the U.S. rail industry. Railroad workers need knowledge, training, tools and alertness to do their jobs properly and to ensure the safety of the public, their coworkers, and themselves.

Activities:

- Gather and summarize research on physiological basis of human fatigue.
- Studies related to the measurement and assessment of human fatigue in railroad operations.

Expected Outcomes:

- Informed industry on physiological basis of fatigue and how human fatigue is measured or assessed
- Understanding of human fatigue and how to better manage it in railroad operations

Project Evaluation

HF will continue program evaluation activities related to the SLSI, a non-profit organization funded with Federal grants. Project evaluation activities for the SLSI promote accountability, as evaluation provides unbiased evidence about the extent to which the SLSI's programs are (or are not) working as intended. The SLSI receives a directed grant from FRA to fund its safety culture assessment programs. Built-in project evaluation provides evidence that these funds are being spent on programs that improve the safety of small railroads. Project evaluation of the SLSI will continue as long as it receives FRA funding.

Activities:

- Provide feedback on the follow-up safety culture assessment process, which measures safety culture change over time.
- Conduct follow-up interviews to understand the level of influence, impact, and outcomes of the assessment process on participating railroads.

Expected Outcomes:

- Technical Reports, Research Results reports, and presentations to SLSI stakeholders.

Highway-Rail Grade Crossing

Human Factors research addresses human behavior at grade crossings, and the extent to which individuals understand new technologies to notify them of an approaching train. HF will continue to pursue solutions to highway-rail grade crossing because investment in research on new technologies at grade crossings does not completely address grade crossing safety; one must understand how drivers will react to new technologies at crossings.

Activities:

- Continue to address human behavior issues related to the integration of new technologies aimed at improving grade crossing safety.

Expected Outcomes:
- Technical Reports, Research Results reports, and presentations to stakeholders.

Vigilance, Sustained Attention, and Distraction

The goal of this research project is to understand ways to improve factors that affect vigilance and sustained attention. Research in this area includes conducting studies on cognitive and behavioral elements that affect human sustained attention and vigilance. Railroad operation requires operators to manage and understand information provided by multiple systems, including track and signal status. The problems this research is solving include:
- Loss of operator focus and distraction.
- Accidents caused by human error.

Activities:
- Summary research to examine the role of distraction in accident causation.
- Cross-modal comparative study of policy to manage distraction behaviors in transportation operations.

Expected Outcomes:
- Improved, more effective operating policy to mitigate distraction and its effects.
- Knowledge of cross modal prevalence of distraction behavior.
- Knowledge of the contribution of distraction to diminished operator performance to better inform policy to diminish this behavior.

Short Line Safety Institute
- Human Factors provides program monitoring and support of the Short Line Safety Institute. SLSI addresses the safety of Class II and Class III railroads, small railroads in rural locations with limited resources for safety training and education.
- Funding for this project should continue because small railroads do not have the budget or personnel to conduct safety culture assessments and training and education.
- The SLSI receives annual funding from the FRA.
- HF has learned that Class II and Class III railroads are committed to a strong safety culture, but could use assistance with leadership development training.

Activities:
The SLSI will continue its core program areas:
- The SLSI will conduct safety culture assessments on Class II and Class III freight railroads.
- The SLSI will use findings from the safety culture assessments to identify training and education needs for the Class II and Class III freight industry.

Expected Outcomes:
- Improved safety and safety culture in Class II and Class III freight railroads.
- Possible expansion of safety culture assessment to passenger railroads.
- Technical Reports, Research Results reports, and presentations related to safety culture.

Partnerships and stakeholder engagement form the foundation of RD&T's technology transfer (RDT2) methodology leading to the adoption of research products. The Human Factors Program provided funding to Michigan Technological University to perform a quantitative evaluation of driver behavior at highway rail grade crossings (HRGCs). The research resulted in several publications and presentations at conferences.

RAILROAD SYSTEMS ISSUES PROGRAM

The FY 2021 Request includes $6.37 million for FRA's Railroad System Issues Program, including $1.10 million transferred from the Track Program to consolidate funds for R&D facilities at TTC. A small portion of this funding is for staff to oversee contractors' and grantees' performance and to witness testing, including travel.

FRA's Railroad System Issues Program improves railroad safety by evaluating risks and prioritizing RD&T projects to reduce safety risk and achieve DOT, Office of the Assistant Secretary for Research and Technology (OST-R), and FRA goals. Railroad System Issues objective is to determine strategic research needs and priorities through collaboration with internal and external partners and stakeholders, considering real time safety issues requiring subject matter expertise or long-term research solutions.

Strategic collaboration partners for the Track Research Program include FRA's Office of Railroad Safety, American Short Line Regional Railroad Association (ASLRRA), Association of American Railroads (AAR), multiple railroads and universities.

Anticipated FY 2020 accomplishments for the Railroad Systems Issues program include:

- Updating the safety risk model for guiding future R&D.
- Evaluating projects conducted by the four RD&T divisions.
- Supporting the Workforce Development Program covering: Council on Women and Girls, Transportation Career Pathway Model Development, Minority Serving Institutions Task Force, and the YES Mentoring Program.
- Conducting a railroad industry workforce assessment to gather data on trends, skill demands, training opportunities, industry best practices, cross-modal efforts, etc.

Funding requested in FY 2021 will advance a number of initiatives under the Railroad Systems Issues Research Program, including Rail Safety IDEA (Innovations Deserving Exploratory Analysis) program grants with the Transportation Research Board and Project Selection and Evaluation.

Railroad Systems Issues (RSI)……..……..$4.97 M

Rail Safety Innovations Deserving Exploratory Analysis (IDEA)
The Transportation Research Board (TRB) initiated this effort in conjunction with FRA to address safety needs within the railroad industry. The focus of this project is to solicit

innovation, ideas and advanced technology in railroad safety. Each research effort selected has a unique timeframe, generally lasting one to two years.

Activities*:*
With multiple activities each year, the outcomes vary based on the selected projects and duration of research. In 2021, the focus is on:

- Announcement - An IDEA Program Announcement will be issued annually to solicit proposals for Rail Safety IDEA program exploratory research projects. The announcement describes the program and criteria and provides guidelines for eligibility and preparing and submitting proposals.
- Evaluation of Proposals - Proposals will be evaluated on a competitive basis. The Rail Safety IDEA program committee will evaluate those proposals meeting the technical eligibility criteria.
- Widespread announcement of contract opportunities for rail inventors.
- Management of projects to completion.
- Tracking of successful implementation of completed projects.

Expected Outcomes:

- Detailed Project Work Plan, Budget, and Schedule.
- Project Agreement between TRB and Sub-awardees (Consultants/Contractors).
- Quarterly Progress Reports (using the FRA QPR template).
- Final Performance Report that should describe the cumulative activities of the Project, including a complete description of the Grantee's achievements with respect to the Project objectives and milestones.
- Final Report for each selected project will be posted on TRB's website/publication.

Project Selection

RD&T utilizes a software package (DecisionLens Software) and the Safety Risk Model as part of the prioritization process. This project includes the activities and costs associated to maintaining the license for the prioritization software, optimizing the Safety Risk Model and executing the prioritization process. RD&T conducts prioritization activities to effectively manage its budget and ensure that stakeholder and industry needs are inputs to the investment planning process.

Activities:

- Renew Decision Lens software license for an additional option year.
- Apply improved rating process to candidate research project for FY2022.
- Use results to support the FY2022 Annual Modal Research Plan.

Expected Outcomes:

- Robust FY2022 research portfolio.
- Quantifiable project prioritization plan.

Project Evaluation

The focus of this project is to educate and train program managers (PMs) about project evaluation techniques, develop performance measures, improve project progress, and reduce

cost. PMs and external parties will evaluate projects conducted by the five RD&T divisions to measure success, improve project performance and railroad safety. Project evaluation processes will help RD&T better manage funding and meets the U.S. DOT Strategic Goal of Accountability.

Activities:
- Continue project evaluation training.
- Create project evaluation tools.
- Continue implementation of RD&T's project evaluation methodology.
- Conduct project evaluations.
- Optimize RD&T's performance management metrics.

Expected Outcomes:
- Increase maturity of project evaluation practices.
- Standardize performance measurement.
- Standardize project evaluation.
- Establish performance measurement baseline.

Program Support

This project provides technical editing, analyst and management support to RSI. FRA research produces various deliverables as part of RD&T technology transfer process and FRA works with technical editors to publish this content. Program management/analyst/subject matter experts provide project, program and portfolio management support.

Activities:
- Edited and published RD&T papers, reports, results and other material.
- Strategic planning, tracking, and management of RD&T's portfolio, information and data.

Transportation Technology Center.....$1.40 M

The primary objective of this funding is to utilize FRA's existing authorities that allow the development of unique R&D infrastructure to accommodate the testing and evaluation of intelligent railroad systems technologies and provide the FRA with the type and quality of facilities and equipment needed to meet its R&D mission. Focused on enhancing railroad safety, TTC drives national RR&D and application of new technology for railways, suppliers, governments, and others involved in rail transportation. This funding supports RD&T Facilities and Equipment Programs, which enhance rail transportation technology development, testing, and standards development.

Activities:
- FRA will fund selected site improvements and equipment at TTC that directly support RR&D projects.
- Initiate build of a rail stress and rail neutral temperature test bed.
- Finish the design and start building a test bed that can be used to validate the accuracy of track geometry measurement systems.
- Initiate construction of the curved test track.

Expected Outcome:
- These activities support conducting rail transportation technology development, testing, and standards development.
- Rail stress and rail neutral temperature test bed at TTC.
- Test bed to validate the accuracy of track geometry measurement systems.
- Constructed curved test track.

Railroad Systems Issues

This project conducts research focused on safety with secondary strategic alignment to innovation, infrastructure and accountability in the railroad industry. The problem addressed by this project will be selected based on industry need.

Activities:
Activities are dependent upon Broad Agency Announcements (BAA) selections.

Expected Outcomes:
Outcomes are dependent upon BAA selections.

Workforce Development (WFD)

This research provides support and domain expertise in the areas of railroad WFD to adequately identify suitable approaches for both the management and capture of rail workforce-related trends, and respond to DOT data calls. This research increases the awareness of railroad industry WFD issues by establishing and/or participating in forums and research efforts to foster and support industry collaboration.

Activities:
- Participate in the DOT Education and Workforce Development Community of Practice on behalf of FRA.
- Conduct and publish a railroad industry workforce assessment (known as the Modal Profile).
- Capture and analyze data on trends, skill gaps, skill demands, training opportunities, industry best practices, and cross-modal efforts.

Expected Outcomes:
- Updated Modal Profile published.
- Research results of workforce development published.
- Continued stakeholder engagement.

Energy and Emissions Safety Research

In support of DOT strategic goals of safety and innovation and its research target of environmental stewardship, FRA undertakes research that will investigate efficacy of alternative fuels to improve energy efficiency and reduce emissions of rail transportation. This research area focuses on supporting activities related to real-world demonstration of alternative fuels, technologies and improvements in standards for noise emissions to ensure their implementation on rail systems across the nation.

Research provides data in support of the safe operation and use of alternative fuels and engine improvement technologies. Newer innovative solution for switching and passenger operations such as hydrogen and fuel cell technologies hold great potential for the US rail market. Research on the structural requirements for liquid and gaseous hydrogen containers and their structural design is needed. The efficacy of current CFR standards to address and ensure the safe use of such fuels will be analyzed and decisions made to adjust accordingly. The research provides FRA RRS with the scientific basis for decision-making and development of standards and requirements. FRA will collaborate with other federal agencies to ensure safe use of the energy products.

Activities:
- Continued impact and applicability study of hydrogen for rail applications.
- Identification of standards and best practices for hydrogen fuel usage for rail applications.
- Additional safety assessment of hydrogen and fuel cell technology for rail applications.

Expected Outcomes:
- Identification of safety research needed to progress hydrogen and fuel cell technologies in US.

Accessibility

Investigate universal and inclusive designs for accessibility on-board passenger trains. FRA is in a unique position to collaborate with stakeholders (other Federal agencies, disability advocacy groups, passenger rail operators, and equipment manufacturer and industry groups) to ensure that new standards for accessibility are feasible and safe; balancing the requirements of the law with the capability of the equipment.

Activities:
- Continued testing of rear and forward-facing wheeled mobility devices (WMDs) and its occupant in low-speed train-to-train collision.
- Assessment of current state of art securement systems for WMDs on board trains.

Expected Outcomes
- Data on relative motion of wheeled mobility device and its occupant in non-contained spaces.

Locomotive Safety

The goal of this research is to investigate innovative locomotive engine technologies to ensure the safe and efficient transportation of goods and people. Areas of focus for this research program include; reduction in fuel consumption, improvement in engine component life, and improvement in the efficiency of older, less efficient locomotives. Research is conducted in collaboration with Class I railroads to demonstrate and develop prototype systems. This research area addresses the DOT Strategic Goal of safety and innovation and the DOT RD&T Critical Transportation Topics of promoting safety, and preserving the environment.

Activities:
- Complete assessment of technological innovation using high-pressure heat exchangers in a real-world environment.
- Complete development and prototype demonstration of hybrid systems.

Expected Outcomes:
- Knowledge of the performance of locomotive engine systems to improve efficiency while maintaining safety.
- Ensure that emerging, innovative locomotive engine efficiency improvement technologies are safe.

Partnerships and stakeholder engagement form the foundation of RD&T's technology transfer (RDT2) methodology leading to the adoption of research products. As part of technology transfer efforts, RD&T staff engages with both internal and external stakeholders throughout the research and development life cycle. An integral part of engagement includes collaborating with stakeholders to understand research needs and safety issues. RD&T conducts prioritization activities to effectively manage its budget and ensure that stakeholder and industry needs are included in the RD&T investment planning process. DOT priorities and safety priorities, especially those provided by the FRA Office of Railroad Safety, are a major input into the process.

Research with Universities on Intelligent Railroad Systems

This project will utilize funding from FY17 – FY19 provided to RD&T to support university research on intelligent railroad systems. FRA will use a broad agency announcement (BAA) to solicit basic and applied technology research projects that will support DOT and FRA goals to advance automation and connected vehicle technology adoption in the rail industry. The BAA was produced in collaboration with the Intelligent Transportation Systems – Joint Program Office (ITS-JPO). FRA will review proposals with a preference for projects that advance these technologies for rural applications. Program objectives within this project include:
- Enabling safer vehicles and roadways
- Enhancing mobility
- Limiting environmental impacts
- Promoting innovation
- Supporting transportation connectivity

Activities:
- Publish the request for proposals.
- Review university proposals.
- Select prospective research projects.
- Fund and begin selected projects.

Expected Outcomes:
- Focus on advanced technology, automation, and connected vehicle technologies.
- Projects that advance these technologies for rural application.
- Intelligent transportation systems.

- Workforce development.

Office of Railroad Safety Support

All RD&T divisions support the Office of Railroad Safety (RRS) by providing subject matter expertise (SME) consultation, research, data, and tools to improve railroad safety and reduce accidents and incidents. RRS works closely with RD&T to provide insight into research needs throughout the fiscal year. RD&T needs the ability to support requests for research and expertise for time sensitive safety issues. RD&T plans to support the following RRS requested initiatives:

- RISE Developmental Evaluation Support.
- Periodic requests from RRS.

Activities:

- Partner with RRS and industry on RISE.
- Conduct research of urgent safety issues.
- Provide SME support to RRS.

Expected Outcomes:

- Analysis of safety risks and identifying mitigations to those risks.
- Growth and maturity of RISE including industry involvement.

Note: This funding will come from multiple divisions to support their research.

Public, Private, and University Cooperative Research Agreement

The Public, Private and University Cooperative Research Agreement is a collaboration of the Association of American Railroads (AAR) to provide research opportunities to American academic institutions and it attracts and funds proposals that have the potential of improving safety and performance in railroad systems in the following areas: track, rolling stock, train control & communication, and human factors.

Annually, the Public, Private and University Cooperative Research Agreement committee members will review and determine research themes that the railroad industry needs to address through this Agreement. These research themes will drive research topics. Through this Agreement, research topics will be announced and reviewed and the most promising proposals will be selected for funding.

All selected proposals have the ultimate goals of improving railroad safety and performance, enhancing the infrastructure conditions and services by stimulating economic growth, productivity and workforce development, and serving the nation with reduced regulatory burden and greater efficiency, effectiveness and accountability.

This effort includes a cost-share arrangement with AAR contributing approximately $800K annually and the railroad industry's significant in-kind support.

Activities:

- Publish the request for proposals.

- Review university proposals.
- Select prospective research projects.
- Fund and begin selected projects.

Expected Outcomes:
The expected outcomes align with the DOT Strategic Goals of Safety, Innovation, Infrastructure, and Accountability. Expected outcomes include:
- Projects that focus on advanced technology, automation, and connected vehicle technologies.
- Projects that advance these technologies for rural application.
- Workforce development.

What benefits will be provided to the American public through this request and why is this program necessary?

As described above, FRA's research, development, and technology projects provide tangible safety and operational benefits to the railroad industry. FRA's applied research efforts help to develop innovative solutions to challenges facing the rail industry and ensures that the best available science and technology are the basis for FRA's safety rulemaking, enforcement, and programs. FRA also develops technology that the rail industry can adopt voluntarily to improve safety. FRA conducts research, development, and technology initiatives independently and collaboratively to:

- Ensure safety is the paramount consideration in exploring new technologies and practices;
- Leverage public resources, disperse costs, and reduce or eliminate redundant efforts;
- Assess new concepts and technologies that the railroad industry is using; and
- Promote industry adoption of promising research results.

Research into tank cars will benefit the American public by reducing the spillage of hazardous material. FRA's R&D program will help protect people who live in neighborhoods through which trains operate and reduce the likelihood of environmental damage due to hazardous material releases. Two areas of research that help achieve this are (1) reducing failures such as broken wheels and rails that cause derailments and (2) improving the strength of tank cars to better survive derailments that do occur.

Safe rail transportation directly benefits the public traveling by train. FRA's R&D program will reduce train collisions by facilitating the implementation of new technologies such as PTC. It will reduce collision risks when passenger trains share the same corridors as freight trains. The program will lay the foundation for regulatory reform and performance based approaches that will reduce the likelihood of derailments. FRA's R&D program will also improve occupant protection in collisions and derailments.

By addressing the root causes of grade crossing accidents, FRA's R&D program improves the safety of the American public that needs to cross railroad rights-of-way. Human factors research into driver behavior at highway-rail grade crossing and the effectiveness of alternative

warning systems helps identify optimum solutions. Developing new technologies for crossing protection and train to vehicle communications leads to reduced incidents of grade crossings being blocked, which can delay emergency responders.

FRA's R&D program helps to reduce fatalities and injuries to trespassers on railroad property. Members of the public are known to take shortcuts across railroad property. Innovative solutions for warning people of the danger they face need to be researched and implemented.

By funding universities to conduct R&D, FRA supports a pipeline of future rail expertise by providing opportunity for students to prepare for rewarding jobs in the railroad industry. The age profile for railroad industry employees shows a growing demand for new entrants. University programs that offer railroad classes help provide the next generation of railroad professionals.

INFORMATION TECHNOLOGY
DEPARTMENT OF TRANSPORTATION
FEDERAL RAILROAD ADMINISTRATION
BUDGET AUTHORITY

$(000) Budget Account	FY 2019 Actual	FY 2020 Enacted	FY 2021 Request
Safety and Operations			
Commodity IT SS WCF	*$14.674*	*$14.695*	*$13.735*
Programmatic IT SS WCF	*$0.00*	*$0.000*	*$0.000*
Modal IT	*$12.768*	*$11.998*	*$14.735*
Total	**$27.442**	**$26.693**	**$28.470**

The Federal Railroad Administration (FRA) is requesting **$28.470 million** in FY 2021 for information technologies that support the full spectrum of FRA programs as well as the Department's initiative to transform and consolidate the management of certain IT solutions centrally by the Office of the Chief Information Officer (OCIO).

Commodity IT Shared Services (SS) through the Working Capital Fund

OCIO will continue to provide all modes Commodity IT Shared Services in FY 2021 to achieve economies of scale and increase consistency of cybersecurity protections across the Department. Commodity IT Shared Services include IT functions and activities dedicated to basic support services, including network operations, end-user computing, telecommunications services, and server operations.

FRA requests **$13.735 million** from the Safety and Operations account for Commodity IT Shared Services. FRA's share was based on actual commodity IT consumption in prior years as well as planned future consumption. OCIO, in collaboration with FRA, assumed a one-to-one cost estimate to transition all commodity IT to OCIO. FRA will only be charged for services rendered.

Programmatic IT Shared Services through the Working Capital Fund

OCIO will continue to not transfer modal Programmatic IT investments in FY 2021.

Full Time Equivalents

FRA plans to transfer 5 FTE in FY 2020.

Modal IT

The following major mission-critical IT systems will be maintained by FRA in FY 2021. This list is only a subset of all IT systems that support FRA and are reported in OMB's Corporate Investment Management System.

Railroad Safety Information System (RSIS) - FRA requests **$4.8 million** from Safety and Operations for development, modernization, and enhancement (DME) and operation and maintenance (O&M) of FRA's RSIS. RSIS is a data management program comprised of the people, processes, and tools required to support the collection, processing, delivery, reporting, and analyzing of railroad safety and safety-related data. It supports fundamental FRA safety mission through data and data-driven decision-making processes, enables analysis of safety data for identification of safety issues and trends, prioritization of programs, rulemaking, and resource planning, enables risk analysis for rulemaking, quiet zone establishment, etc., supports Policies and research (R&D) throughout the rail industry, RSIS directly supports RES mission, and provides the authoritative data source and preserves historical data.

Automated Track Inspection Program (ATIP) - FRA requests **$2.2 million** from Safety and Operations for development, modernization, and enhancement (DME) and operation and maintenance (O&M) of FRA's ATIP to ensure track safety, support FRA's vision of ensuring the safe, reliable, and efficient movement of people and goods for a strong America, now and in the future by developing and advancing inspection technologies and also using these technologies in compliance programs for identification of deteriorating and substandard track conditions.

Business Intelligence Services - FRA requests **$1 million** from Safety and Operations for development, modernization, and enhancement (DME) and operation and maintenance (O&M) of FRA's Business Intelligence Services (BIS). BIS is envisioned to be an integrated, platform of business intelligence, data and predictive analytics tools and capabilities in a cloud-based environment that will ingest, integrate and standardize current and future, structured and unstructured, enterprise data using business rules established by the agency.

FRA requests **$6.735 million** from Safety and Operations for DME and O&M for the remaining IT support and systems staying within the mode.

FY 2021
Federal Railroad Administration
$(000)

	FY 2019	FY 2020	FY 2021
Safety and Operations			
Working Capital Fund Base and SSC			
Office of the Chief Financial Officer (RCFO)			
Compute [IT Tower]	$3,277	$4,409	$4,201
Network [IT Tower]	$4,688	$4,945	$5,225
End User [IT Tower]	$6,076	$4,680	$3,535
Application [IT Tower]	$492	$494	$471
Security & Compliance [IT Tower]	$142	$167	$303
Office of the Chief Financial Officer (RCFO) Subtotal	$14,674	$14,695	$13,735
Working Capital Fund Programmatic			
Office of the Chief Financial Officer (RCFO)			
Compute [IT Tower]	$0	$0	$0
Network [IT Tower]	$0	$0	$0
End User [IT Tower]	$0	$0	$0
Application [IT Tower]	$0	$0	$0
Security & Compliance [IT Tower]	$0	$0	$0
Office of the Chief Financial Officer (RCFO) Subtotal	$0	$0	$0
Non-Working Capital Fund (Franchise Fund/ESC)			
Office of the Chief Financial Officer (RCFO)			
Application [IT Tower]	$1,399	$1,240	$1,241
Office of the Chief Financial Officer (RCFO) Subtotal	$1,399	$1,240	$1,241
Programmatic IT Spend			
Office of the Chief Financial Officer (RCFO)			
Application [IT Tower]	$810	$756	$945
IT Management [IT Tower]	$230	$354	$101
Office of the Chief Financial Officer (RCFO) Subtotal	$1,040	$1,110	$1,110
Office of Chief Counsel (RCC)			
Application [IT Tower]	$155	$262	$328
IT Management [IT Tower]	$50	$46	$81
Office of Chief Counsel (RCC) Subtotal	$205	$308	$409
Office of Railroad Safety (RRS)			
Compute [IT Tower]	$352	$472	$591
Application [IT Tower]	$675	$2,573	$3,217
IT Management [IT Tower]	$591	$1,007	$1,259
Office of Railroad Safety (RRS) Subtotal	$1,618	$4,053	$5,066

	FY 2019	FY 2020	FY 2021
Office of Railroad Policy & Development (RPD)			
Application [IT Tower]	$966	$363	$454
IT Management [IT Tower]	$168	$242	$301
Office of Railroad Policy & Development (RPD) Subtotal	$1,134	$605	$755
Office of Administration (RAD)			
Data Center [IT Tower]	$445	$274	$342
Compute [IT Tower]	$173	$135	$168
Storage [IT Tower]	$89	$125	$156
Network [IT Tower]	$159	$219	$274
End User [IT Tower]	$800	$698	$872
Application [IT Tower]	$1,780	$971	$1,314
Delivery [IT Tower]	$1,579	$734	$919
Security & Compliance [IT Tower]	$1,029	$694	$967
IT Management [IT Tower]	$1,318	$833	$1,142
Office of Administration (RAD) Subtotal	$7,372	$4,682	$6,154
Programmatic IT Spend Subtotal	$12,768	$11,998	$14,735
Safety and Operations Subtotal	$27,442	$26,693	$28,470
Total IT Spend	**$27,442**	**$26,693**	**$28,470**