

National Transportation Safety Board

Annual Report to Congress



BEST PLACES TO WORK IN THE FEDERAL GOVERNMENT





Contents

Abbreviations, Acronyms, and Initialisms	4
Table of Tables	4
Table of Figures	5
Chairman's Message	7
Who We Are and What We Do	8
History	8
Role in Transportation Safety	8
Our Mission	9
Our Core Values	9
Legislative Mandate	9
Strategic Goals and Objectives	10
Organization and Program Structure	10
2019–2020 Most Wanted List of Transportation Safety Improvements .	. 14
Eliminate Distractions	14
End Alcohol and Other Drug Impairment	15
Ensure the Safe Shipment of Hazardous Materials	15
Fully Implement Positive Train Control	15
Implement a Comprehensive Strategy to Reduce Speeding-Related Crashes	16
Improve the Safety of Part 135 Aircraft Flight Operations	16
Increase Implementation of Collision Avoidance Systems in All New	16
Highway Vehicles Reduce Fatigue-Related Accidents	16 17
Require Medical Fitness—Screen for and Treat Obstructive Sleep Apnea	17
Strengthen Occupant Protection	17
Office of Aviation Safety	
Completed Investigations Ongoing Investigations ¹	19 20
Ongoing Investigations Ongoing International Investigations	21
Completed Safety Recommendation Reports	22
Other Significant Achievements	23
Safety Alerts	23
Office of Highway Safety	. 24
Completed Investigations	25
Ongoing Investigations	28
Completed Safety Report	29
Other Significant Achievements	29

Office of Marine Safety Completed Investigations Ongoing Investigations Completed International Investigations Other Significant Achievements	30 31 33 34 35
Office of Railroad, Pipeline, and Hazardous Materials Investigations Completed Investigations Ongoing Investigations Completed International Investigations Other Significant Achievements	36 37 40 40 41
Office of Research and Engineering Safety Research Division Materials Laboratory Division Vehicle Recorder Division Vehicle Performance Division Medical Investigations Chief Data Scientist Completed Safety Research Reports Ongoing Safety Research Reports Other Significant Achievements Annual Statistical Reviews Publications	42 43 43 44 44 44 45 45 45 45
Office of Safety Recommendations and Communications Safety Recommendations Division Media Relations Division Government and Industry Affairs Division Safety Advocacy Division Digital Services Division	46 47 48 48 49 49
Transportation Disaster Assistance Division	50
Office of Administrative Law Judges	51
Training Center NTSB Training Center Offerings Transportation Community and Partnerships	52 53 53

¹ Ongoing investigations are those that, as of December 31, 2020, were not yet completed. Any completed as of June 30, 2021, are noted in this report. Additional updates will be provided in the 2021 Annual Report.

Abbreviations, Acronyms, and Initialisms

AS	NTSB Office of Aviation Safety
Atlas	Atlas Air Inc.
AV TEST	Automated Vehicle Transparency and Engagement for Safe Testing
CFR	Code of Federal Regulations
Coast Guard	US Coast Guard
COVID-19	the coronavirus disease that was first identified in 2019 and became a worldwide pandemic in early 2020
CSX	CSX Transportation Inc.
dba	doing businness as
DOT	Department of Transportation
FAA	Federal Aviation Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
HS	NTSB Office of Highway Safety
ICAO	International Civil Aviation Organization
IMO	International Maritime Organization
JTSB	Japanese Transportation Safety Board
LIRR	Long Island Rail Road

MBI	Marine Board of Investigation
MS	NTSB Office of Marine Safety
MWL	Most Wanted List of Transportation Safety Improvements
NHTSA	National Highway Traffic Safety Administration
NPRM	notice of proposed rulemaking
NTSB	National Transportation Safety Board
PHMSA	Pipeline and Hazardous Materials Safety Administration
PTC	positive train control
RE	NTSB Office of Research and Engineering
RPH	NTSB Office of Railroad, Pipeline, and Hazardous Materials Investigations
SA	safety alert
SRC	NTSB Office of Safety Recommendations and Communications
sUAS	small unmanned aircraft systems
SUV	sport utility vehicle
TC	NTSB Training Center
TDA	NTSB Transportation Disaster Assistance Division
U.S.C	United States Code

Table of Tables

١.	2020 Safety Statistics at a Glance
2.	Office of Aviation Safety Statistics
3.	Office of Highway Safety Statistics
4.	Office of Marine Safety Statistics
5.	Office of Railroad, Pipeline, and Hazardous Materials Investigations Statistics
6.	Office of Research and Engineering Statistics 42
7.	Office of Safety Recommendations and Communications Statistics
8.	Closed Safety Recommendations Issued to US DOT Modal Agencies and the Coast Guard in 2020
9.	Safety Recommendations Addressed in Federal Register Notices from Federal Agencies in 2020
10.	Media Presence
11.	Safety Advocacy Division Social Media Followers, Connections, and Subscribers
12.	Safety Advocacy Division Products and Events 49
13.	Transportation Disaster Assistance Statistics 50
14.	Office of Administrative Law Judges Statistics 51
15.	Training Center Statistics

NTSB on Social Media



- www.instagram.com/ntsbgov
- www.facebook.com/ntsbgov
- www.youtube.com/user/ntsbgov
- www.flickr.com/ntsb

NTSB2020







Table of Figures

1.	NTSB Chairman Robert L. Sumwalt, III.	. 7
2.	President Lyndon Johnson signing legislation creating the NTSB	. 8
3.	NTSB Board Members.	11
4.	NTSB organization chart	11
5.	NTSB regions	12
6.	The flightpath of N191SF as the helicopter approached Zaleski, Ohio	19
7.	Wreckage scattered in a marshy area of Trinity Bay, Texas	19
8.	Tesla postcrash fire in Mountain View, California	25
9.	Diagrams of limousine damage from the Schoharie, New York, crash	26
10.	On-scene view of school bus in Rochester, Indiana	27
11.	Pickup truck, motorcycles, and trailer postcrash in Randolph, New Hampshire	28
12.	The Stretch Duck 7 during recovery at Table Rock Lake in Branson, Missouri	31
13.	The <i>Kristin Alexis</i> and crane barge <i>Mr Ervin</i> on the Lower Mississippi River near Baton Rouge, Louisiana	31
14.	The <i>Gibson</i> and barge <i>ART 36109</i> after the accident on the Ohio River, near Warsaw, Kentucky	32
15.	Small passenger vessel Conception, pre-accident	32
16.	Small passenger vessel Conception, postaccident	33
17.	Postaccident damage to the ACX Crystal	34
18.	Postaccident damage to the Fitzgerald	34
19.	NTSB investigator examines the ballast regulator involved in the Wartrace, Tennessee, accident	37
20.	Overhead view of the Alexandria, Virginia, accident scene showing bridge and track damage	38
21.	Overhead view of the Carey, Ohio, accident scene	38
22.	Excavation of the pipe involved in the release of anhydrous ammonia in Tekamah, Nebraska	39
23.	End view of the tank car involved in the ethanol release in Fredericksburg, Virginia	39
24.	FedEx delivery truck involved in the Brampton, Ontario, Canada, fire $\dots \dots \dots$	40

25.	Materials Laboratory Division staff examine a portion of the pipe involved in the Waymon L. Boyd accident in Corpus Christi, Texas	2
26.	Materials Laboratory Division staff reassembles fragments of a helicopter's main rotor blades for analysis	.3
27.	Animation still illustrating the sequence of events leading to the crash of Atlas Air flight 3591 into Trinity Bay, Texas	4
28.	Board Member Thomas Chapman and Media Relations Division staff on scene of Calabasas, California, helicopter crash	8
29.	Virtual Board meeting	9
30.	Reassembled section of the center fuselage of TWA flight 800 5	3
31.	Dedication plaque at the entrance to the NTSB Training Center in Ashburn, Virginia	3



NTSB2020







Chairman's Message



Figure 1. The Honorable Robert L. Sumwalt, III, has served on the National Transportation Safety Board since August 21, 2006, and as the NTSB Chairman since August 10, 2017.

I am pleased to present the 2020 Annual Report to Congress for the National Transportation Safety Board (NTSB). Since our inception in 1967, the agency has been at the forefront of transportation safety and has long been recognized internationally for our accident investigation expertise. We have investigated nearly 151,000 aviation accidents and thousands of highway crashes and other accidents in surface transportation, and we have issued more than 15,000 safety recommendations.

In 2020, NTSB staff turned challenges of the COVID-19 pandemic into opportunities to accomplish our strategic goals of improving products; processes; and employee engagement, diversity, and inclusion. Even during this period of maximum telework, from locations across the nation, we have continued to collaborate, advocate, and investigate. I never cease to be amazed by all that our workforce has achieved during this unusual year.

As we responded to both longstanding and significant challenges, we continued to advance our transportation safety mission. Although we did not deploy teams to several accident sites, we continued to fulfill our mission by remotely gathering such data as air traffic control data and by virtually conducting interviews. In addition, we completed 1,314 domestic investigations, including the Tesla SUV accident in Mountain View, California; the Fire Aboard Small Passenger Vessel Conception near Santa Barbara, California; the Helicopter Air Ambulance Collision with Terrain near Zaleski, Ohio: the Long Island Rail Road Roadway Worker Fatality in Queens Village, New York; and the Magellan Pipeline Anhydrous Ammonia Release in Tekamah, Nebraska. We also completed a hazardous materials investigation of the CSX Tank Car Release of UN1987 Denatured Ethanol in Fredericksburg, Virginia, as well as a safety research

report on Safety Risks to Emergency Responders from Lithium-lon Battery Fires in Electric Vehicles. In addition, we participated in 252 international investigations.

After more than 50 years of investigating train collisions and derailments, issuing safety recommendations, and conducting countless advocacy activities, we were pleased to see all required railroads implement positive train control by the December 31, 2020, deadline outlined in the Rail Safety Improvement Act of 2008.

We also continued to promote the exchange of safety information via a virtual safety panel, a webinar, and a two-part workshop:

Panel: Improving the Safety of Part 135

Operations (Aviation Safety)

Webinar: Vehicle Collision with Student

Pedestrians Crossing High Speed Roadway to Board School Bus

(Highway Safety)

Workshop: Seafloor Investigations Workshops:

(Parts 1 and II) (Marine Safety)

We hope you find the 2020 Annual Report to Congress to be an informative presentation of the agency's accomplishments.

Sincerely,

Robert L. Sumwalt, III

Chairman

SOURCE: US DOT

Figure 2. In 1966, President Lyndon Johnson signed the Department of Transportation Act that created the NTSB.

Who We Are and What We Do

The National Transportation Safety Board (NTSB) is an independent federal agency charged by Congress with investigating every civil aviation accident in the United States and significant accidents in other modes of transportation—railroad, highway, marine, and pipeline. We determine the probable cause of the accidents we investigate and issue safety recommendations aimed at preventing future accidents. In addition, we conduct transportation safety studies and coordinate the resources of the federal government and other organizations to assist victims and their family members who have been impacted by major transportation disasters.

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History

The NTSB's origins can be traced to the Air Commerce Act of 1926, in which the US Congress charged the US Department of Commerce with investigating the causes of aircraft accidents. That responsibility was transferred to the Civil Aeronautics Board's Bureau of Aviation Safety when it was created in 1940. In 1967, Congress consolidated all US transportation agencies into a new US Department of Transportation (DOT) and established the NTSB as an independent agency within the US DOT. In creating the NTSB, Congress envisioned that a single organization with a clearly defined mission could more effectively promote a higher level of safety in the transportation system than the individual modal agencies could working separately. Since 1967, the NTSB has investigated accidents in the aviation, highway, marine, pipeline, and railroad transportation modes, as well as accidents related to the transportation of hazardous materials.

In 1974, Congress reestablished the NTSB as a separate entity outside the US DOT, reasoning that "no federal agency can properly perform such [investigatory] functions unless it is totally separate and independent from any other . . . agency of the United States."

Because the US DOT has broad operational and regulatory responsibilities that affect the safety and efficiency of the transportation system, and transportation accidents may suggest deficiencies in that system, the NTSB's independence was deemed necessary to provide objectivity in its investigations and recommendations.

Role in Transportation Safety

Since its inception in 1967, the NTSB has investigated more than 151,000 aviation accidents and thousands of surface transportation accidents. On call 24 hours a day, 365 days a year, our investigators travel throughout the country and to every corner of the world in response to transportation disasters.

The NTSB investigates accidents to determine their probable cause, examine safety issues, and devise recommendations to prevent the occurrence of similar accidents in the future. We have issued more than 15,000 safety recommendations to more than 2,400 recipients in all transportation modes. The recommended action has been implemented for 82 percent of the over 12,600 recommendations that have been closed.

Since 1990, we have compiled and published an annual or biennial Most Wanted List (MWL) of transportation safety improvements, which increases awareness of—and support for—the most critical changes needed to reduce transportation accidents and save lives.

The agency also develops safety studies focused on broader safety questions and topic areas, enabling us to better perform our mission. Additionally, we serve as the appellate authority for enforcement actions involving aviation and mariner certificates issued by the Federal Aviation Administration (FAA) and the US Coast Guard (Coast Guard), and we adjudicate appeals of civil penalty actions taken by the FAA.



OUR MISSION

Making transportation safer by conducting independent accident investigations, advocating safety improvements, and deciding pilots' and mariners' certification appeals

OUR CORE VALUES

Integrity Transparency Independence **Excellence** Diversity and Inclusion

Legislative Mandate

Maintaining our congressionally mandated independence and objectivity

Conducting objective, precise accident investigations and safety studies

Performing fair and objective pilot and mariner certification appeals

Advocating and promoting safety recommendations

Assisting victims of transportation accidents and their families



Strategic Goals and Objectives

IMPROVING processes:

• Evaluating and identifying ways to enhance the effectiveness and efficiency of our investigative and business processes

Objectives:

- Improve the timeliness of investigations through data analysis
- Improve the timeliness of agency operations through data analysis

1 IMPROVING products:

• Evaluating and identifying ways to enhance the effectiveness and efficiency of our products

Objective:

Improve the effectiveness of agency products

3 IMPROVING employee engagement, diversity, and inclusion: Implementing actions to ensure we sustain a culture that is fair, diverse, and

provides opportunities for all employees to excel

Objectives:

- Improve the engagement of agency staff
- Attract, develop, and retain a high-performing, diverse, and inclusive workforce

Organization and Program Structure

The NTSB's organizational structure is designed around sound business and management principles. The Board comprises five members, each nominated by the president and confirmed by the US Senate to serve a 5-year term. One of these is nominated by the president to serve a 3-year term as chairman, which requires separate Senate confirmation. Another, designated by the president to be vice chairman, serves in that position for 3 years and as acting chairman when the Board has no designated chairman. Our current Board members are pictured on the next page (Figure 3). Figure 4 shows our organizational structure. For more information about our offices and their functions, please visit the Organization page of our website.

NTSB2020

Figure 3. NTSB Board Members.



Honorable

Robert L. Sumwalt, III

Chairman



Honorable **Bruce Landsberg**Vice Chairman



Honorable

Jennifer Homendy

Board Member

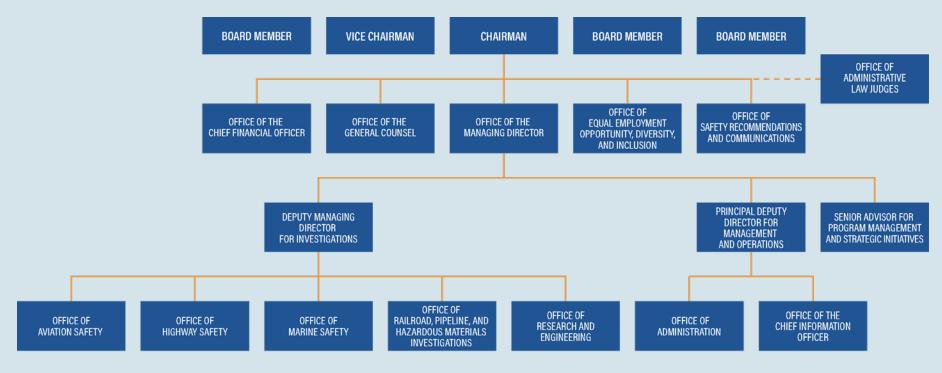


Honorable **Michael Graham**Board Member



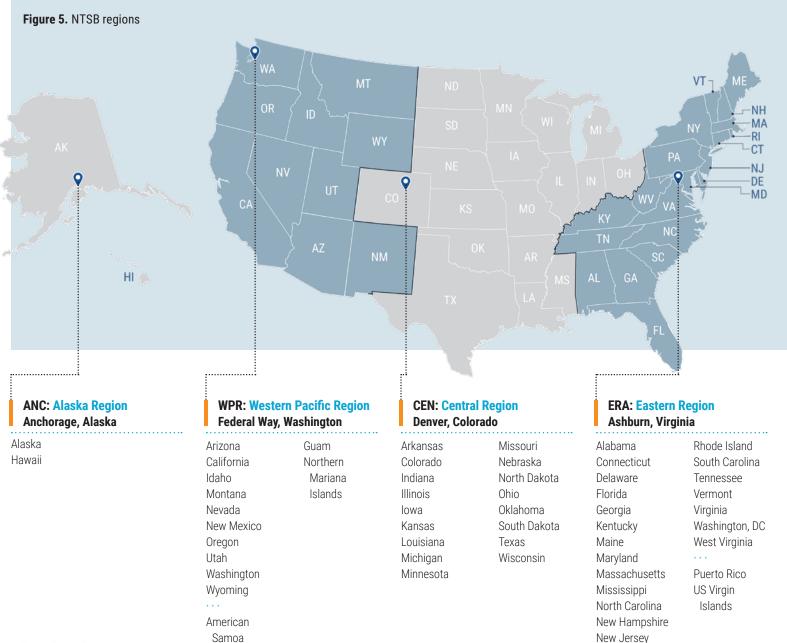
Honorable **Thomas Chapman**Board Member

Figure 4. NTSB organization chart



We are headquartered in Washington, DC, where most of our staff work. Others work remotely throughout the country or are assigned to regional offices in Ashburn, Virginia; Denver, Colorado; Anchorage, Alaska; or Federal Way, Washington.

The map in Figure 5 depicts the four NTSB regions.



NTSB2020

New York Pennsylvania Table 1, below, provides a "snapshot" of the agency's activities over the past year,² and highlights key accomplishments of offices and divisions across the NTSB.

Safety Recommendations		Research and Engineering/Laboratory		
Issued	140	Safety Research Published	4	
Closed Acceptable ³	127	Safety Data Analyses Completed	310	
Closed Unacceptable	30	Readouts of Vehicle Recorders and Other Electronic		
Urgent Closed Acceptable	1	Devices Completed	451	
Reports and Products		Material Laboratory Exam Reports Completed	129	
		Vehicle Performance Reports and Animations Completed	47	
Board-adopted Investigative Reports	24	Advocacy and Outreach		
Delegated Investigative Reports	1,354			
Public Forums, Hearings, Panels, Seminars, Roundtables,	_	Publications	5	
Symposiums, Webinars, and Workshops	5	Advocacy and Outreach Presentations and Events	275	
Safety Alerts and Video	3	Testimony to State Legislative Committees	6	
Safety Actions⁴	213	Family Members and Victims Assisted	2,519	
Accident Launches ⁵		Aviation Certificate Appeals		
Major Investigation Launches	2	Total Cases Received	236	
Field Investigation Launches	68	Total Cases Closed	155	
International Accident Launches	4	Emergency Cases Received	128	
		Emergency Cases Closed	79	
		Hearings Held	11	
		NTSB Training Center		
		Courses, Programs, and Seminars Offered	223	
		Total Attendance	6,083	

² This annual report reflects NTSB activities from January 1 through December 31, 2020.

³ Closed Acceptable classifications include Closed—Acceptable Action, Closed—Acceptable Alternate Action, and Closed—Exceeds Recommended Action.

⁴ A safety action is a positive change within the transportation environment brought about by an NTSB investigation or study without the NTSB's issuing a formal safety recommendation. Safety actions may be initiated either as a result of an NTSB investigation or independent of one.

⁵ Although the COVID-19 pandemic limited the number of accidents to which we launched in 2020, we continued to investigate newly occurring accidents and also continued investigations that were in progress at the start of the pandemic.

2019–2020 NTSB Most Wanted List of Transportation Safety Improvements⁶

Critical changes needed to reduce accidents, injuries, and fatalities in transportation

Tens of thousands of people die in preventable transportation accidents and crashes every year—our neighbors, our coworkers, our schoolmates, our family members. With each accident, we learn lessons about safety gaps and make recommendations that, if acted upon, could close those gaps.

The NTSB's MWL is just that—a list of those transportation safety improvements we would most like to see implemented to help save lives and improve transportation safety. These issue areas are ripe for action now; if addressed, they will significantly impact transportation safety. The MWL groups together safety recommendations under broad topic areas that we refer to as issue areas. These issue areas are developed based on their magnitude of risk, potential safety benefits, timeliness, and probability of advocacy efforts to bring about change. Simply put, MWL issue areas are those that we believe need the most attention to close existing safety gaps. The MWL is our road map from lessons learned to lives saved.

After more than 50 years of investigating train collisions and derailments, issuing safety recommendations, and conducting countless advocacy activities, we were pleased to see that all railroads required to do so had implemented positive train control (PTC) by the December 31, 2020, deadline mandated by Congress. As a result, we were able to close three PTC-related safety recommendations *Acceptable*: R-05-13, R-07-7, and R-97-26.

During the creation of the 2019–2020 MWL, we identified 250 open safety recommendations addressing these 10 key safety issues. Of those recommendations, 41 were closed *Acceptable* by December 31, 2020.⁷



Eliminate Distractions

Distraction is a growing and life-threatening problem in all modes of transportation.

All drivers, pilots, and operators need to eliminate distractions and stay focused on safely operating their vehicle, aircraft, vessel, or train. Pedestrians are equally susceptible to distraction and need to remain aware of their surroundings.

We believe distraction should be addressed through a three-pronged approach of education, legislation, and enforcement as well as technology.

The list printed here is the 2019–2020 MWL. The 2020–2021 MWL was adopted on April 6, 2021, and can be found at https://www.ntsb.gov/safety/mwl/Pages/default.aspx.

⁷ In addition, 7 of the 250 open safety recommendations were closed *Unacceptable*.



End Alcohol and Other Drug Impairment

Impairment is a contributing factor in far too many transportation accidents across all modes, with alcohol impairment a leading cause of highway crashes. We want to continue to see states adopt per se blood alcohol concentration limits of 0.05 percent or below, as well as broaden their use of other effective countermeasures, such as ignition interlock devices and high-visibility enforcement. Impairment in transportation is not limited to alcohol; it also includes impairment by other drugs—both legal and illicit.

We want a national drug testing standard for drivers of passenger vehicles and stronger screening and toxicology testing in commercial transportation.



Ensure the Safe Shipment of Hazardous Materials

More than 2 million miles of pipeline deliver 24 percent of the natural gas and 39 percent of the total oil consumed in the United States, and as infrastructure ages, the risk to the public from pipeline ruptures grows. In addition, older, more dangerous tank cars continue to carry flammable liquids; less than half of US rail tank cars carrying these liquids meet the improved safety specifications for DOT 117/DOT 117R cars.

We are calling on the railroad industry to meet existing federal deadlines for replacing or retrofitting rail tank cars, and on the pipeline industry to conduct adequate risk assessments. Failure to meet safety standards by—or ahead of—deadlines places communities near railroads or above pipelines at an unacceptable risk.



Fully Implement Positive Train Control

PTC systems have great potential to prevent or reduce the number of serious train collisions and overspeed derailments by providing safety redundancy to protect against human performance failures. Although Congress mandated that PTC be installed and operating by December 31, 2018, no railroads were in full compliance with the mandate. A 2-year extension was granted to railroads that were not fully compliant.

As stated earlier, all railroads required to do so by the Rail Safety Improvement Act of 2008 implemented PTC by the extended December 31, 2020, deadline.



Implement a Comprehensive Strategy to Reduce Speeding-Related Crashes

Speeding increases the likelihood of being involved in a crash and intensifies the severity of injuries sustained in a crash. Speeding-related crashes killed 9,378 people in 2018 and cost society more than \$52 billion annually.

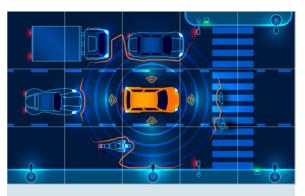
Proven countermeasures—including automated speed enforcement, vehicle technology, infrastructure design, and education campaigns—must be used more broadly to reduce speeding-related crashes.



Improve the Safety of Part 135 Aircraft Flight Operations

Air medical service, air taxi, charter, and on-demand operators are not required to adopt the same safety program criteria as Part 121 operators and could benefit from risk mitigation strategies that are subject to FAA oversight.

All Part 135 operators should implement safety management systems and flight data monitoring programs that address the unique risks associated with their operations, and the FAA should ensure compliance with standard operating procedures.



Increase Implementation of Collision Avoidance Systems in All New Highway Vehicles

Motor vehicle crashes are a leading cause of death and injury in the United States, and many of them could be prevented with collision avoidance systems that are already available.

Vehicle manufacturers should make this technology standard equipment on all vehicles. And consumers, informed about the technology's capabilities and limitations, should buy vehicles equipped with it.



Reduce Fatigue-Related Accidents

Fatigue is a pervasive problem in transportation that degrades a person's ability to stay awake, alert, and attentive to the demands of safely controlling a vehicle, vessel, aircraft, or train.

We are calling for a comprehensive approach to combating fatigue in transportation, focusing on research, education, and training; technology; sleep disorder treatment; hours-of-service regulations; and on- and off-duty scheduling policies and practices.



Require Medical Fitness— Screen for and Treat Obstructive Sleep Apnea

Undiagnosed and untreated obstructive sleep apnea continues to be deadly on our roads and railways, causing too many preventable accidents.

We want to see mandatory screening and treatment for obstructive sleep apnea for rail and highway personnel in safety-sensitive positions.



Strengthen Occupant Protection

Seat belts, child car seats, and child safety restraint systems in highway vehicles and on airplanes reduce the risk of injury and death. Restraints in motor vehicles saved 14,668 lives in 2016 alone.

We want all states to enact laws and regulations requiring all motor vehicle occupants to use seat belts and allowing primary enforcement of seat belt laws for all vehicle occupants.

We also want to see requirements for enhanced vehicle and rail car design to provide better occupant protection, and for general aviation aircraft owners to install shoulder harness systems.

Office of Aviation Safety

Table 2. Office of Aviation Safety Statistics

Safety Recommendations Issued	55
Safety Recommendations Closed Acceptable	39
Safety Recommendations Closed Unacceptable	10
Board-Adopted Investigative Reports	9
Delegated Investigative Reports	1,315
Major Investigation Launches	1
Field Investigation Launches	45
International Accident Launches	1
Safety Actions	212
Safety Alerts and Video	3
Advocacy and Outreach	90



The Office of Aviation Safety (AS) investigates all air carrier, commuter, and air taxi accidents and certain serious incidents; fatal and nonfatal general aviation accidents and serious incidents; unmanned aircraft systems and public aircraft accidents and serious incidents; and commercial space launch/reentry accidents. In addition, to fulfill US obligations under International Civil Aviation Organization (ICAO) agreements, AS participates in the investigations of aircraft accidents that occur in foreign countries and involve US carriers, US-designed or -manufactured equipment, or US-registered aircraft. The office also investigates safety issues that extend beyond a single accident to examine specific aviation safety problems from a broader perspective.

On average, AS investigates over 1,300 domestic aviation accidents and incidents annually and proposes probable causes for approval either by the Board or under delegated authority. Working with other offices within the NTSB, AS develops recommendations to prevent the occurrence of similar accidents and incidents and to improve aviation safety.

AS conducts investigative activities through five specialty divisions based in Washington, DC, and a regional investigation structure consisting of four regional office sites. Investigators are located throughout the country. Major international aviation activities are coordinated from the Washington, DC, office.

In 2020, 1,132 domestic aviation accidents and incidents occurred, a decline that could have been the result of numerous factors, including the COVID-19 pandemic. We initiated investigations of all of them.

Completed Investigations

Helicopter Air Ambulance Collision with Terrain, Survival Flight Inc. Bell 407 Helicopter

Zaleski, Ohio (3 fatalities)

On January 29, 2019, about 6:50 a.m. local time, a single engine, turbine-powered Bell 407 helicopter, N191SF, being operated as a helicopter air ambulance flight, collided with forested terrain about 4 miles northeast of Zaleski, Ohio. The certificated commercial pilot, flight nurse, and flight paramedic died. The helicopter was registered to and operated by Viking Aviation, LLC, doing business as (dba) Survival Flight Inc., under Title 14 Code of Federal Regulations (CFR) Part 135.

We determined that the probable cause of the accident was Survival Flight's inadequate management of safety, which normalized pilots' and operations control specialists' noncompliance with risk analysis procedures and resulted in the initiation of the flight without a comprehensive preflight weather evaluation, leading to the pilot's inadvertent encounter with instrument meteorological conditions, failure to maintain altitude, and subsequent collision with terrain. Contributing to the accident was the FAA's inadequate oversight of the operator's risk management program and failure to require 14 *CFR* Part 135 operators to establish safety management system programs.

Safety issues identified in this investigation included Survival Flight's lack of comprehensive and effective flight risk assessment and risk management procedures, the lack of a positive safety culture endorsed by Survival Flight management, safety management systems, flight data monitoring programs, helicopter air ambulance experience for principal operations inspectors, the radar data available on the HEMS (helicopter emergency medical services) Weather Tool, and onboard flight recorders.

As a result of this investigation, we issued 14 safety recommendations to address these issues. Recipients included the FAA, the National Weather Service, and Survival Flight. We also reiterated four safety recommendations to the FAA.

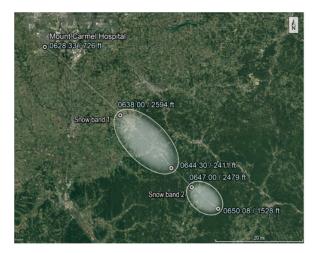


Figure 6. The flightpath of N191SF (white line) and the portions of snow bands (circled) that surrounded it as the helicopter approached Zaleski, Ohio.

SOURCE: GOOGLE EARTH; ANNOTATED BY NTSB

Rapid Descent and Crash into Water, Atlas Air Inc.

Trinity Bay, Texas (3 fatalities)

On February 23, 2019, at 12:39 p.m. local time, Atlas Air Inc. (Atlas) flight 3591, a Boeing 767 375BCF, N1217A, was destroyed after it rapidly descended from an altitude of about 6,000 ft mean sea level and crashed into a shallow, muddy marsh area of Trinity Bay, Texas, about 41 miles east southeast of George Bush Intercontinental/ Houston Airport, Houston, Texas. The captain, first officer, and a nonrevenue pilot riding in the jumpseat died. Atlas operated the airplane as a 14 *CFR* Part 121 domestic cargo flight for Amazon.com Services LLC, and an instrument flight rules flight plan was filed.

We determined that the probable cause of the accident was the inappropriate response by the first officer as the pilot flying to an inadvertent activation of the go-around mode, which led to his spatial disorientation and nose-down control inputs that placed the airplane in a steep descent from which the crew did not recover. Contributing to the accident was the captain's failure to adequately monitor

the airplane's flightpath and assume positive control of the airplane to effectively intervene. Also contributing were systemic deficiencies in the aviation industry's selection and performance measurement practices, which failed to address the first officer's aptitude-related deficiencies and maladaptive stress response. Also contributing to the accident was the FAA's failure to implement the pilot records database in a sufficiently robust and timely manner.

Safety issues identified in this investigation include inadvertent activation of the go-around mode, flight crew performance, Atlas's evaluation of the first officer, industry pilot hiring process deficiencies, awareness of information for Boeing 767 and 757 pilots, adaptations of automatic ground collision avoidance technology, and cockpit image recorders.

As a result of this investigation, we issued six safety recommendations to the FAA to address these issues. We also reiterated six safety recommendations to the FAA.

Figure 7. Wreckage scattered in a marshy area of Trinity Bay, Texas.



Fuel Exhaustion and Loss of Control Kerrville, Texas (6 fatalities)

On April 22, 2019, at 8:51 a.m. local time, a Beechcraft Baron G58 airplane, N501CE, was substantially damaged when it was involved in an accident near Kerrville, Texas. The pilot and five passengers died. The airplane was operated as a 14 *CFR* Part 91 business flight.

The investigation found that the pilot made multiple errors before the flight's departure, which led to fuel exhaustion and the dual engine power loss. He was not present for the airplane's fueling 8 days (and five flights) before the accident flight, did not crosscheck the fuel receipt with his fuel-planning logs, and did not accurately record the amount of fuel added. Review of the accident airplane's fueling records, the pilot's flight-planning logs, and engine data monitoring fuel consumption data revealed that the airplane had about 12 gallons less fuel than the pilot had indicated in his fuel log for the accident flight. We also found that the airplane's fuel quantity transmitters incorrectly indicated that more fuel was onboard than was present.

We determined that the probable cause of this accident was the pilot's inadequate preflight fuel planning and fuel management, which resulted in a loss of engine power due to fuel exhaustion. Also causal was the pilot's failure to follow the one-engine inoperative checklist and maintain the airplane's minimum controllable airspeed by properly configuring the airplane, which resulted in a loss of airplane controllability.

Runway Excursion

Elizabethton, Tennessee (no fatalities or injuries)

On August 15, 2019, about 12:37 p.m. local time, a Textron Aviation Inc. 680A, N8JR, was destroyed when it was involved in an accident near Elizabethton, Tennessee. The pilot and copilot were not injured, but the three passengers sustained minor injuries. The airplane was operated as a 14 *CFR* Part 91 business flight.

The investigation found that the airplane's approach was unstabilized; its airspeed during the approach and landing exceeded the reference speed for the approach, and its descent rate exceeded the maximum allowed for landing just seconds before touchdown. According to the airplane manufacturer's calculations, the airplane could have stopped within the length of runway available if the airplane had not bounced on the first touchdown and if the speedbrakes and wheel brakes had been used. However, the pilot first deployed the thrust reversers during the first touchdown, which prevented the later go-around attempt, and did not use the speedbrakes first as specified in the airplane's flight manual, which led to the runway excursion. The pilot attempted to go around after the third touchdown after deploying the thrust reversers. Although the airplane's flight manual prohibited touch-and-go landings after the thrust reversers had already been deployed, it was not clear to the director of operations that the deployment of thrust reversers was a committed-to-stop point, meaning it was too late in the sequence to go around.

We determined that the probable cause of this accident was the pilot's continuation of an unstabilized approach despite recognizing associated cues and the flight crew's decision not to initiate a go-around before touchdown, which resulted in a bounced landing, a loss of airplane control, a landing gear collapse, and a runway excursion. Contributing to the accident was the pilot's failure to deploy the speedbrakes during the initial touchdown, which might have prevented the runway excursion, and the pilot's attempt to go around after deployment of the thrust reversers.

Ongoing Investigations

As of December 31, 2020, AS had 1,977 open domestic investigations. The following investigations involved significant safety issues:

- A DeHaviland DHC-2 airplane and a DeHaviland DHC-3 airplane collided midair during air tour flights on May 13, 2019, in **Ketchikan, Alaska**; there were 6 fatalities. (Adopted April 20, 2021)
- A Beech 65-A90 parachute flight crashed after takeoff on June 21, 2019, in **Mokuleia, Hawaii**; there were 11 fatalities. (Adopted March 16, 2021)
- A Boeing B-17 living history flight experience flight crashed after a loss of engine power and return to the airport on October 2, 2019, in Windsor Locks, Connecticut; there were 7 fatalities. (Adopted April 7, 2021)
- A Saab 2000 commercial passenger flight crashed during landing on October 17, 2019, in **Dutch Harbor, Unalaska, Alaska**; there was 1 fatality.
- A Sikorsky S-76B helicopter on-demand flight crashed in instrument meteorological conditions on January 26, 2020, in Calabasas, California; there were 9 fatalities. (Adopted February 9, 2021)

Ongoing International Investigations

The NTSB participates in investigations of aviation accidents and serious incidents outside the United States, in accordance with the Chicago Convention of the ICAO and the Standards and Recommended



Practices provided in Annex 13 to the convention.

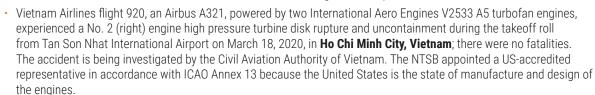
If an accident or serious incident occurs in a foreign state involving a civil aircraft of US registry, a US operator, or an aircraft of US design or manufacture, and the foreign state is a signatory to the ICAO Convention, that state is responsible for the investigation. In accordance with Annex 13, upon receiving ICAO notification of the accident or serious incident, the NTSB designates a US-accredited representative and appoints technical advisors to carry out the obligations, receive the entitlements, provide consultation, and receive safety recommendations from the state of occurrence.

If an accident or serious incident occurs in a foreign state not bound by the provisions of Annex 13, if a foreign state delegates all or part of an investigation by mutual consent to the NTSB, or if the accident or serious incident involves a public aircraft, the investigation will be conducted in consonance with any agreement entered into between the United States and the foreign state.

As of December 31, 2020, AS was participating in the investigations of a number of ongoing international accidents. The following, all of which occurred in 2020, involved significant safety issues:

- Ukraine International Airlines flight 752, a
 Boeing 737-800, crashed shortly after takeoff
 from Tehran Imam Khomeini International Airport
 on January 8, 2020, in **Tehran, Iran**; there were
 176 fatalities. The accident is being investigated by the
 Iranian Aircraft Accident Investigation Board. The NTSB
 appointed a US-accredited representative in accordance
 with ICAO Annex 13 because the United States is the
 state of manufacture and design of the airplane.
- Pegasus flight PC2193, a Boeing 737-800, overran
 the end of runway 6 after landing at Istanbul Sabiha
 Gökçen International Airport on February 5, 2020, in
 Istanbul, Turkey; there were 3 fatalities. The accident
 is being investigated by the Turkish Directorate General
 for Civil Aviation. The NTSB appointed a US-accredited
 representative in accordance with ICAO Annex 13

because the United States is the state of manufacture and design of the airplane.



- Pakistan International Airlines flight 8303, an Airbus A320, crashed into a residential area during a go-around attempt
 at Karachi-Jinnah International Airport on May 22, 2020, in **Karachi, Pakistan**; there were 97 fatalities. The accident is
 being investigated by the Civil Aviation Authority of Pakistan. The NTSB appointed a US-accredited representative in
 accordance with ICAO Annex 13 because the United States is the state of manufacture and design of the engines.
- Air India Express flight 1344, a Boeing 737-800, crashed after overrunning the runway during landing at
 Kozhikode-Calicut International Airport on August 7, 2020, in **Karipur, India**; there were 21 fatalities. The accident is
 being investigated by the Air Accident Investigation Bureau of India. The NTSB appointed a US-accredited representative
 in accordance with ICAO Annex 13 because the United States is the state of manufacture and design of the airplane.



Completed Safety Recommendation Reports

Provide Inspectors with Automatic Notifications of Flight Instructors with Substandard Student Pass Rates

Mokuleia, Hawaii (11 fatalities)

We issued three safety recommendations to the FAA urging them to identify flight instructors whose student pass rates were substandard so that additional surveillance of the flight instructors could be performed. These recommendations were derived from the Mokuleia, Hawaii, parachute accident investigation, during which it was noted that the accident pilot had failed three different checkrides on his initial attempts.

Stratus Oil Filter Adapter Assembly Oil Leaks Mill Creek, California (1 fatality and 2 injured); Ramona, California (no fatalities or injuries); and others

We issued one safety recommendation to the FAA urging them to address unsafe conditions associated with F&M Enterprises Inc. or Stratus Tool Technologies oil filter adapters that were installed via supplemental type certificate. The recommendation was derived from several NTSB investigations in which the airplane experienced a total loss of engine power due to oil leaking from the oil filter adapter. We also issued a safety advisory to inform pilots of this potential, unsafe condition.

Install Flight Data, Audio, and Image Recorder Systems on all Turbine-Powered Helicopters Perryville, Missouri (5 injured); Palm Bay, Florida (3 fatalities); and others

We issued nine safety recommendations altogether to Airbus Helicopters, Bell, Leonardo Helicopter Division, MD Helicopters, Robinson Helicopter Company, and Sikorsky to address the need for crash-resistant flight recorder systems and crash-protected image recorder systems on existing and newly manufactured turbine-powered helicopters. These recommendations were derived from several NTSB investigations of turbine-powered helicopter accidents in which the lack of a crash-resistant or crash-protected flight recording system that records parametric data, cockpit audio, and images hindered our understanding of the accident circumstances and, thus, allowed potential safety issues to go unaddressed.

Revise Processes to Implement Safety Enhancements for Alaska Aviation Operations

Alaska (multiple fatalities and injuries)

We issued one safety recommendation to the FAA to work with Alaska aviation industry stakeholders to review, prioritize, and integrate Alaska's aviation safety needs into the FAA's safety enhancement process. The recommendation was derived from discussions that occurred during our September 2019 Most Wanted List Roundtable: Alaska Part 135 Flight Operations—Charting a Safer Course.⁹

Reported Flight Control System Difficulty on Embraer EMB-175

Atlanta, Georgia (no fatalities or injuries)

We issued 10 safety recommendations altogether to the National Civil Aviation Agency of Brazil and the FAA to address the inspection, design, and maintenance of certain Embraer control column wiring, and to review the pitch trim runaway checklists on these airplanes. These safety recommendations were derived from preliminary findings of an ongoing investigation of an incident in which the flight crew of a Republic Airways Embraer EMB-175 reported a flight control difficulty involving pitch in the airplane nose-up direction shortly after takeoff from Hartsfield-Jackson Atlanta International Airport, Atlanta, Georgia.



⁹ The roundtable was led by the chairman of the NTSB, and the proceedings were transcribed. The transcript is available in the public docket for this event (NTSB number DCA19RT001) at https://dms.ntsb.gov/pubdms/.

Other Significant Achievements

- Supported the Board's Public Safety Panel: Improving the Safety of Part 135 Operations.
 - On March 2, 2020, Chairman Robert L. Sumwalt, III, and Board Member Michael Graham hosted a public safety panel including various-sized aircraft operators operating under 14 CFR Part 135. The panel



discussed current safety issues facing the industry and potential safety solutions.

- Provided NTSB response to the US DOT on the FAA's notice of proposed rulemaking (NPRM) "14 CFR Parts 1, 47, 48, 89, 91, and 107 Remote Identification of Unmanned Aircraft Systems."
- Provided NTSB response to the US DOT on the FAA's final rule "Airworthiness Directives; Airbus Helicopters."
- Provided NTSB response to the US DOT on the FAA's "Clearance of a Renewed Approval of Information Collection: Small Unmanned Aircraft Systems (sUAS) Accident Reporting."
- Provided NTSB response to the US DOT on the FAA's NPRM "Airworthiness Directives; Honeywell International Inc. Turbofan Engines."
- Provided NTSB response to the US DOT on the FAA's final rule "Airworthiness Directives; General Electric Company Turbofan Engines."
- Provided NTSB response to the US DOT on the FAA's NPRM "14 CFR Parts 91, 111, 121, 125, and 135, Pilot Records Database."
- Provided NTSB response to the US DOT on the FAA's supplemental NPRM "Airworthiness Directive; Piper Aircraft Inc. Airplanes."
- Provided NTSB response to the US DOT on the FAA's NPRM "Airworthiness Directives: The Boeing Company Model 737–8 and 737–9 (737 MAX) Airplanes."
- Provided NTSB response to the US DOT on the FAA's NPRM "Airworthiness Directives: Yabora Industria Aeronautica S.A. (Type Certificate Previously Held by Embraer S.A.) Airplanes."
- Provided NTSB response to the Senate Legislative Counsel on draft legislation addressing commercial air tour safety.
- Provided NTSB response to the Senate Legislative Counsel on proposed amendments to draft of the Aircraft Safety and Certification Reform Act of 2020.
- Developed a risk assessment protocol for continuing investigative activity during the COVID-19 pandemic.

Safety Alerts

Stay in the Groove: Check Ignition Switch/Key Integrity (SA-080) and companion Safety Alert Video

This safety alert and video provide information about worn surfaces on keys and internal switch components that can result in switch positioning errors and unintended engine startup.

Stay in the Groove: Check Ignition Switch/Key Integrity What a vision as the part of the

Maintain Airplane Control with One Engine Inoperative (SA-081)

This safety alert provides information on how to recover when one engine becomes inoperative during critical phases of flight.



Flight in Snow: Assess the Risk of Flight in Wet Snow Conditions, Especially at Low Altitudes (SA 082)

This safety alert provides information on defining wet snow conditions and how they can pose a significant hazard to safety through structural, engine, and windshield ice accumulation.



Office of Highway Safety

Table 3.	Office of Highway Safety Statistics			
	Safety Recommendations Issued	35		
	Safety Recommendations Closed Acceptable	23		
	Safety Recommendations Closed Unacceptable	7		
	Board-Adopted Investigative Reports	6		
	Delegated Investigative Reports	3		
	Major Investigation Launches	1		
	Field Investigation Launches	5		
	Public Webinar	1		
	Advocacy and Outreach	38		



The Office of Highway Safety (HS) investigates accidents that have a significant impact on highway safety, highlight national safety issues, or involve emerging technologies. Such accidents may include the collapse of highway bridge or tunnel structures, mass casualties and injuries from crashes involving large vehicles (such as motorcoaches and school buses), collisions at highway-rail grade crossings, and crashes involving automated or alternatively fueled vehicles.

In addition, HS publishes reports based on trends emerging from NTSB accident investigations and from other research and accident data to identify common risks or underlying causes of accidents.

To accomplish these tasks, HS is organized into two divisions: Investigations and Report Development.

Completed Investigations

Collision Between a Sport Utility Vehicle Operating With Partial Driving Automation and a Crash Attenuator Mountain View, California (1 fatality)

On March 23, 2018, about 9:27 a.m. local time, a 2017 Tesla Model X P100D electric-powered sport utility vehicle (SUV) was traveling south on US Highway 101 in Mountain View, California, in the high-occupancy vehicle exit lane to State Route 85 about 71 mph when it traveled through a paved gore area, struck a damaged and nonoperational crash attenuator, rotated counterclockwise, and separated in two. The Tesla was involved in subsequent collisions with two other vehicles, a 2010 Mazda 3 and a 2017 Audi A4. The driver of the Tesla was transported to a local hospital, where he died. The driver of the Mazda sustained minor injuries, and the driver of the Audi was uninjured.

We determined that the probable cause of this crash was the Tesla Autopilot system's steering the SUV into a highway gore area because of system limitations, and the driver's lack of response because of distraction, likely from a cell phone game application, and overreliance on the Autopilot partial driving automation system. Contributing to the crash was the Tesla vehicle's ineffective monitoring of driver engagement, which facilitated the driver's complacency and inattentiveness. Contributing to the severity of the driver's injuries was the vehicle's impact with a crash attenuator barrier that was damaged and nonoperational at the time of the collision because of the California Highway Patrol's failure to report the damage following a previous crash, and systemic problems with the California DOT's maintenance division in repairing traffic safety hardware in a timely manner.

Safety issues identified in this investigation were driver distraction, risk mitigation pertaining to monitoring driver engagement, risk assessment pertaining to operational design domain, the limitations of collision avoidance systems, insufficient federal oversight of partial driving automation systems, the need for event data recording requirements for driving automation systems, and highway infrastructure issues.

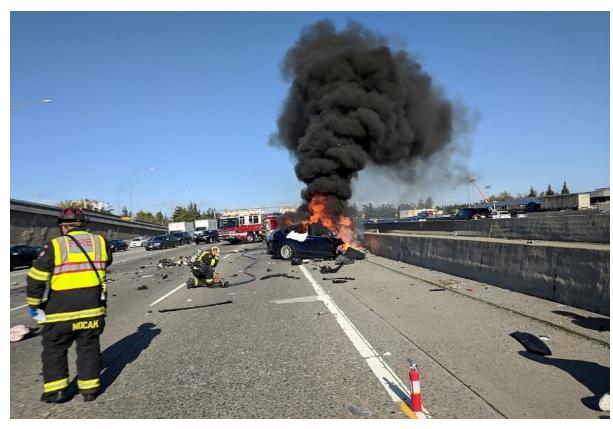


Figure 8. Northbound view of US-101 depicting Tesla postcrash fire in Mountain View, California. SOURCE: S. ENGLEMAN

As a result of this investigation, we issued nine safety recommendations to address these issues. Recipients included the National Highway Traffic Safety Administration (NHTSA), Occupational Safety and Health Administration, SAE International, manufacturers of portable electronic devices (Apple, Google, HTC, Lenovo, LG, Motorola, Nokia, Samsung, and Sony), and Apple Inc. We also reiterated two safety recommendations to NHTSA, and we reiterated and classified five safety recommendations to the US DOT,

NHTSA, and Tesla Inc. In addition, we classified two safety recommendations to the Consumer Electronics Association (now the Consumer Technology Association) and the California State Transportation Agency.

Stretch Limousine Run-Off-Road Crash Schoharie, New York (20 fatalities)

On October 6, 2018, about 1:55 p.m. local time, a 2001 Ford Excursion XLT stretch limousine operated by Prestige Limousine and Chauffeur Service was traveling south on New York State Route 30 near Schoharie, New York. The limousine, occupied by the driver and 17 passengers, was descending a downhill grade when the brake system failed and the vehicle's speed increased to over 100 mph (the posted speed limit was 55 mph). The driver crossed an intersection and entered the driveway of a restaurant parking lot, striking an unoccupied 2015 Toyota Highlander SUV that, in turn, struck two pedestrians. The limousine continued into a ravine, striking an earthen embankment and several trees. As a result of the crash, 20 people died, including all 18 limousine occupants and the 2 pedestrians.

We determined that the probable cause of this crash was Prestige Limousine and Chauffeur Service's egregious disregard for safety in dispatching a stretch limousine with an out-of-service order for a passenger charter trip, resulting in the failure of its brake system while descending the steep grade of Route 30. Contributing to the crash was the New York State DOT's ineffective oversight of Prestige Limousine, despite its knowledge of the carrier's multiple out-of-service violations and lack of operating authority, as well as the department's inadequate repair verification process. Further contributing to the crash was the New York State Department of Motor Vehicles' inadequate oversight of state-licensed inspection stations and its failure to properly register the limousine, which enabled Prestige Limousine to circumvent the state's safety regulations and more rigorous inspection requirements.

Safety issues identified in this investigation were inadequate brake system maintenance, vehicle alteration affecting compliance with applicable Federal Motor Vehicle Safety Standards, drivers falsifying medical histories in medical certification examinations for commercial driver's licenses, ineffective state oversight of intrastate motor carrier operations, and insufficient occupant protection for limousine passengers.

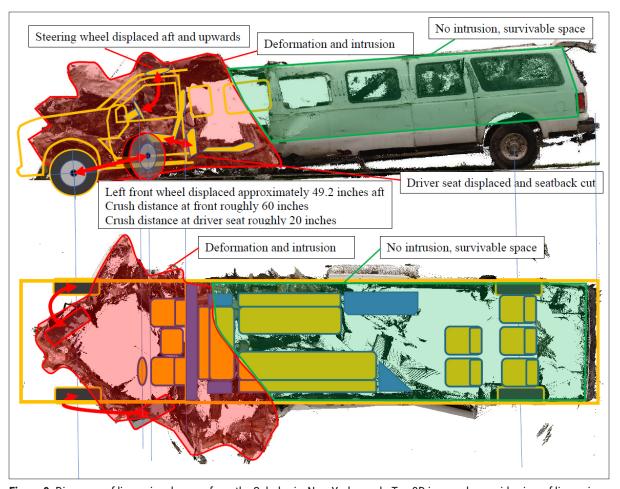


Figure 9. Diagrams of limousine damage from the Schoharie, New York, crash. Top 3D image shows side view of limousine postcrash, with overlaid reconstruction of the vehicle's precrash structure. Bottom 3D image shows overhead view of limousine postcrash, with overlaid reconstruction of the vehicle's precrash structure.

As a result of this investigation, we issued six safety recommendations to address these issues. Recipients included the Federal Motor Carrier Safety Administration (FMCSA), the state of New York, the New York State Department of Motor Vehicles, and the National Limousine Association. We also reiterated five safety recommendations to NHTSA, the New York State DOT, the National Limousine Association, and the state of New York.

Vehicle Collision With Student Pedestrians Crossing High-Speed Roadway to Board School Bus

Rochester, Indiana (3 fatalities, 1 injured)

On October 30, 2018, about 7:12 a.m. local time, a 2015 Thomas Built school bus operated by Tippecanoe Valley School Corporation was traveling north on State Route 25 in Rochester, Indiana, on its morning route. Conditions were dark when the school bus stopped to pick up a group of students waiting on the other side of the road; the driver activated the bus's red warning lights and stop arm and waved to the students to cross. A 2017 Toyota Tacoma pickup truck traveling south failed to stop for the school bus and struck four children at 41 mph. As a result of the crash, a 9-year-old female and two 6-year-old males were fatally injured. An 11-year-old male sustained serious injuries. None of the others waiting for the bus nor any occupants of the truck or bus were injured.

We determined that the probable cause of this accident was the pickup truck driver's failure to stop for the school bus for unknown reasons, despite its clearly visible warning lights and stop arm, as well as a roadway warning sign indicating an upcoming school bus stop. Contributing to the cause of the crash was the Tippecanoe Valley School Corporation's (1) inadequate safety assessment of school bus routes, resulting in the prevalence of bus stops that required student pedestrians to cross a 55-mph roadway to board a bus, increasing the risk of injury during a collision and (2) failure to establish a clear policy regarding surrounding traffic for school bus drivers to follow in determining when it was safe to signal students to cross a roadway to board a school bus.

Safety issues identified in this investigation were deficiencies in establishing safe school bus routes and stop locations, the failure of other drivers to stop or otherwise respond safely when approaching a school bus that is stopped with its warning lights on and stop arm extended, and the need for greater use of technologies to prevent collisions with, and mitigate injuries of, student pedestrians.



Figure 10. On-scene view of the school bus, with lights in operation, in Rochester, Indiana.

SOURCE: INDIANA STATE POLICE

As a result of this investigation, we issued 12 safety recommendations to address these issues. Recipients included NHTSA; the states of Alaska, Arizona, California, Colorado, Delaware, Florida, Hawaii, Iowa, Kansas, Louisiana, Michigan, Minnesota, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, North Dakota, Ohio, Oregon, South Dakota, Texas, Vermont, and Wisconsin: the commonwealths of Kentucky and Massachusetts; the District of Columbia; the Indiana Department of Education; the National Association of State Directors of Pupil Transportation Services; the National Association for Pupil Transportation; the National School Transportation Association; the International Association of Chiefs of Police: the National Sheriffs' Association: the National Association of School Resource Officers; and the Tippecanoe Valley School Corporation. We also reiterated three safety recommendations to NHTSA.

Collision Between Car Operating with Partial Driving Automation and Truck-Tractor Semitrailer

Delray Beach, Florida, (1 fatality)

On March 1, 2019, about 6:17 a.m. local time, a 2018 Tesla Model 3 electric-powered passenger car was southbound in the right lane of US Highway 441 in Delray Beach, Florida, when it struck a 2019 International truck-tractor in combination with a semitrailer, operated by FirstFleet Inc. that was attempting to cross the southbound lanes and turn left into the northbound lanes of the highway. The truck had failed to come to a full stop at a stop sign before beginning to cross the southbound lanes, and the driver of the car, traveling at 69 mph, took no action to avoid the truck, which sheared off the roof of the car. The driver of the car died in the crash. The truck driver was not injured.

We determined the probable cause of this crash was the truck driver's failure to yield the right of way to the car, combined with the car driver's inattention due to overreliance on automation, which resulted in his failure to react to the presence of the truck. Contributing to the crash was the operational design of Tesla's partial automation system, which permitted disengagement by the driver, and the company's failure to limit the use of the system to the conditions for which it was designed. Further contributing to the crash was the failure of NHTSA to develop a method of verifying manufacturers' incorporation of acceptable system safeguards for vehicles with Level 2 automation capabilities that limit the use of automated vehicle control systems to the conditions for which they were designed.

Crash Between a Pick-up Truck and Motorcyclists

Randolph, New Hampshire (7 fatalities, 7 injured)

On June 21, 2019, about 6:26 p.m. local time, a 2016 Ram pickup truck operated by Westfield Transport Inc. was towing an unladen vehicle-hauling trailer west on US Route 2 in Randolph, New Hampshire, when it collided with a group of 15 motorcycles carrying 15 riders and 7 passengers that was traveling east in staggered formation. A postcrash fire ensued, enveloping the pickup truck and two of the motorcycles. Five motorcycle riders and two passengers died in the crash, and an additional five riders and two passengers were injured. The pickup truck driver was not injured.

We determined the probable cause of this crash was the pickup truck driver's crossing the center line and encroaching into the oncoming lane of travel because of his impairment from the use of multiple drugs. Contributing to the crash was Westfield Transport's substantial disregard for, and egregious noncompliance with, safety regulations. Also contributing to the crash was the failure of the Massachusetts Registry of Motor Vehicles to revoke the pickup truck driver's Massachusetts driver's license when notified of his loss of driving privileges in another state.

Safety issues identified in this investigation were deficiencies in out-of-state driver's license notification processing, insufficient federal oversight of motor carriers, and shortcomings in motorcycle rider safety.





Figure 11. At-rest positions of the pickup truck and two of the motorcycles (left); the trailer (right), following the crash in Randolph, New Hampshire. Source: NEW HAMPSHIRE STATE POLICE

As a result of this investigation, we issued six safety recommendations to address these issues. Recipients included the FMCSA; the Massachusetts DOT; the DOTs in 49 states or commonwealths (Massachusetts excepted), the District of Columbia, and the Commonwealth of Puerto Rico; the National Association of State Motorcycle Safety Administrators; and the Motorcycle Safety Foundation. We also reiterated five safety recommendations to NHTSA, three states with no motorcycle helmet laws (Illinois, Iowa, and New Hampshire), 27 states or commonwealths (the states of Alaska, Arizona, Arkansas, Colorado, Connecticut, Delaware, Florida, Hawaii, Idaho, Indiana, Kansas, Maine, Minnesota, Montana, New Mexico, North Dakota, Ohio, Oklahoma, Rhode Island, South Carolina, South Dakota,

Texas, Utah, Wisconsin, and Wyoming; the commonwealths of Kentucky and Pennsylvania), and the territory of Guam, with partial motorcycle helmet laws; and seven states or commonwealths (the states of Alabama, Maryland, Michigan, Mississippi, Nevada, and West Virginia; the commonwealth of Virginia), the District of Columbia, and two territories (Northern Mariana Islands and the US Virgin Islands) with universal motorcycle helmet laws or regulations not specifically requiring Federal Motor Vehicle Safety Standard 218–compliant helmets; and the FMCSA.

Ongoing Investigations

As of December 31, 2020, HS had 10 open domestic investigations. The following investigations involve significant safety issues:

- A multi-vehicle crash involving commercial vehicles occurred on January 2, 2020, on the Pennsylvania Turnpike in **Mount Pleasant Township**, **Pennsylvania**; there were 5 fatalities.
- A medium-size bus crash and rollover occurred on February 22, 2020, in **Pala Mesa, California**; there were 3 fatalities.
- A multi-vehicle crash involving a commercial vehicle occurred on June 12, 2020, in **Arlington Township, Wisconsin**; there were 4 fatalities.
- A service boom truck crossed over the center line and impacted an oncoming school bus on October 27, 2020, in **Decatur, Tennessee**; there were 2 fatalities.
- A box truck collided with a group of 18 bicyclists on US Highway 95 on December 10, 2020, in **Searchlight, Nevada**; there were 5 fatalities.

Completed Safety Report

Safety Risks to Emergency Responders from Lithium-Ion Battery Fires in Electric Vehicles

We investigated three electric vehicle crashes resulting in postcrash fires and one noncrash fire involving an electric vehicle, all of which illustrate the risks to emergency responders posed by the vehicles' high-voltage lithium-ion batteries. We also examined national and international standards established to maximize the safety of electric vehicles. Particular attention was given to the emergency guidance documents supplied by vehicle manufacturers to mitigate the safety risks to first and second responders who deal with electric vehicle crashes and high voltage lithium-ion battery fires. Fires in electric vehicles powered by high-voltage lithium-ion batteries pose the risk of electric shock to emergency responders from exposure to the high-voltage components of a damaged lithium-ion battery. Further, damaged cells in the battery can experience uncontrolled increases in temperature and pressure (thermal runaway), which can lead to battery reignition/fire. The risks of electric shock and battery reignition/fire arise from the "stranded" energy that remains in a damaged battery.

Safety issues identified in this report were the inadequacy of vehicle manufacturers' emergency response guides for minimizing the risks to first and second responders posed by high-voltage lithium-ion battery fires in electric vehicles and gaps in safety standards and research related to high-voltage lithium-ion batteries involved in high-speed, high-severity crashes.

As a result of the report, we issued four safety recommendations to address these issues. Recipients included NHTSA; the manufacturers of electric vehicles equipped with high-voltage lithium-ion batteries (BMW Group, BYD Motors, Fiat Chrysler Automobiles, General Motors Company, Ford Motor Company, Gillig, Honda Motor Company, Hyundai Motor Company, Karma Automotive, Kia Motor Corporation, Mercedes-Benz AG, Mitsubishi Motors, Nissan Motor Company, Nova Bus Inc., Porsche Cars North America, Proterra Inc., North American Subaru, Tesla Inc., Toyota Motor North America, Van Hool NV, Volkswagen Group of America, and Volvo Car Corporation); the National Fire Protection Association; the International Association of Fire Chiefs; the International Association of Fire Fighters; the National Alternative Fuels Training Consortium; the National Volunteer Fire Council; and the Towing and Recovery Association of America.

Other Significant Achievements

- Hosted public webinar: Vehicle Collision with Student Pedestrians Crossing High-speed Roadway to Board School Bus
 - On May 13, 2020, we hosted a webinar on our investigation of the fatal vehicle collision with student pedestrians crossing a high-speed roadway to board a school bus that occurred in Rochester, Indiana, on October 30, 2018. Staff delivered a series of technical presentations regarding the investigation and the resultant safety recommendations.
- Provided NTSB response to the US DOT on NHTSA's "Advanced Driver Assistance Systems Draft Research Test Procedures."
- Provided NTSB response to the Federal Communications Commission on its NPRM "Use of the 5.850-5.925 GHz Band."
- Provided NTSB response to the US DOT on NHTSA's "Agency Information Collection Activities; Notice and Request for Comment; Government 5-Star Safety Ratings Label Consumer Research."
- Provided NTSB response to the US DOT on the FMCSA's "Proposed Pilot Program to Allow Drivers Under 21 to Operate Commercial Motor Vehicles in Interstate Commerce."
- Provided NTSB response to the US DOT on NHTSA's "Reducing the Illegal Passing of School Buses."
- Provided NTSB response to the US DOT on NHTSA's "Automated Vehicle Transparency and Engagement for Safe Testing (AV TEST) Initiative."

Office of Marine Safety

Table 4. Office of Marine Safety Statisti	ble 4.	Office of	f Marine	Safety	Statisti	C
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Safety Recommendations Issued	23
Safety Recommendations Closed Acceptable	19
Safety Recommendations Closed <i>Unacceptable</i>	9
Board-Adopted Investigative Reports	6
Delegated Investigative Reports	36
Field Investigation Launches	3
International Accident Launches	2
Public Hearings and Webinar	2
Advocacy and Outreach	8



The Office of Marine Safety (MS) investigates major marine casualties on or under the territorial waters of the United States, including accidents involving US-flagged merchant vessels worldwide or a casualty involving both a US public vessel and a nonpublic vessel. In addition, the office investigates selected catastrophic marine accidents and those of a recurring nature.

The Coast Guard conducts preliminary investigations of all marine accidents and notifies the NTSB for major marine casualties. To accomplish its work, MS is organized into two divisions: Investigations and Product Development.

Completed Investigations

Sinking of Amphibious Passenger Vessel Stretch Duck 7

Branson, Missouri (17 fatalities, 7 injured)

On July 19, 2018, about 7:08 p.m. local time, the *Stretch Duck* 7, a 33-ft-long, modified World War II-era DUKW amphibious passenger vessel operated by Ripley Entertainment Inc., dba Ride The Ducks Branson, sank during a derecho—a severe thunderstorm with extremely heavy, straight-line winds that can rival those of a tornado or a hurricane in strength—that moved rapidly across Table Rock Lake near Branson, Missouri. Seventeen of the 31 persons aboard died. Loss of the vessel was estimated at \$184,000.

We determined that the probable cause of this accident was Ripley Entertainment Inc., dba Ride The Ducks Branson's, continued operation of waterborne tours after a severe thunderstorm warning was issued for Table Rock Lake, exposing the vessel to a derecho, which resulted in waves flooding through a non-weathertight air intake hatch on the bow. Contributing to the sinking was the Coast Guard's failure to require sufficient reserve buoyancy in amphibious vessels. Contributing to the loss of life was the Coast Guard's ineffective action to address emergency egress on amphibious passenger vessels with fixed canopies, such as the *Stretch Duck 7*, which impeded passenger escape.

Safety issues identified in this investigation were company oversight, engine compartment ventilation closures, reserve buoyancy, survivability, and Coast Guard oversight.

As a result of this investigation, we issued six safety recommendations to address these issues. Recipients included the Coast Guard and Ripley Entertainment Inc., dba Ride The Ducks Branson. We previously issued two safety recommendations to the Coast Guard.



Figure 12. Torn canopy on the *Stretch Duck 7* during recovery at Table Rock Lake after a derecho took the lives of 17 people.

Contact of Crane Barge *Mr Ervin*, Pushed by Towing Vessel *Kristin Alexis*, with Sunshine Bridge Baton Rouge, Louisiana (no fatalities or injuries)

On October 12, 2018, about 1:41 a.m. local time, the towing vessel *Kristin Alexis* was transiting upbound on the Lower Mississippi River near St. James, Louisiana, with the crane barge *Mr Ervin* when the crane struck the deck of the Sunshine Bridge while passing under the west channel span. No pollution or injuries to the six crewmembers on board the *Kristin Alexis* were reported. The bridge was completely closed to vehicular traffic for 49 days while repairs were made, resulting in significant traffic impacts. Damage to the bridge was \$6.7 million, and crane damage was estimated at \$8,500.

We determined that the probable cause of the accident was the inadequate voyage planning and watch turnover between the captain and pilot, resulting in the pilot's transiting beneath the bridge's west span instead of its channel span. Contributing to the accident was the lack of company oversight. Also contributing to the accident was the charted information for the bridge used by the pilot, which did not reflect the actual vertical clearance of the west span.

As a result of this investigation, we issued three safety recommendations. Recipients included the Marquette Transportation Company and the National Oceanic and Atmospheric Administration.



Figure 13. The Kristin Alexis and crane barge Mr Ervin configuration on the Lower Mississippi River near Baton Rouge, Louisiana.

Contact of Mary Lucy Lane Tow with Markland Locks and Workhoat Gibson

Warsaw, Kentucky (no fatalities or injuries)

On December 18, 2018, about 3:55 p.m. local time, the towing vessel Mary Lucy Lane, with eight crewmembers on board and pushing a tow of 12 barges, was locking southbound at the Markland Locks & Dam at mile 531.5 on the Ohio River, when the tow struck first the lock's wall, then its guard wall. Several barges broke loose and continued forward, one of which collided with the moored US Army Corps of Engineers workboat Gibson. No injuries or pollution resulted from the accident. Damage to the Mary Lucy Lane, the barges, and the dam was estimated at \$321,943, and the Corps of Engineers estimated the cost to replace the Gibson at \$1.8 million.

We determined that the probable cause of the contact of the Mary Lucy Lane tow with the Markland Locks and workboat Gibson was a strong outdraft above the dam, caused by the extreme highflow conditions, which overwhelmed the pilot's ability to control the Mary Lucy Lane tow before locking.

Capsizing and Sinking of Workboat MSRC 8-1 **Boothville. Louisiana (2 fatalities)**

On January 16, 2019, about 10:38 a.m. local time, the workboat MSRC 8-1, which operated from the oil spill response vessel Louisiana Responder, capsized and sank during an oil spill boom deployment exercise in the Lower Mississippi River near Boothville, Louisiana, trapping the two MSRC 8-1 crewmembers inside. Although the oil spill response vessel's crew and the Coast Guard attempted to rescue the trapped crewmembers, one crewmember died, and the other was not found and is presumed dead. The MSRC 8-1 sank and was declared a constructive total loss. with damages estimated at \$250,000. A sheen of oil was sighted on the water after the sinking; no other pollution was reported.

We determined that the probable cause of the capsizing of the workboat MSRC 8-1 was the boat's becoming perpendicular to a strong river current, for an undetermined reason, while tethered to the oil spill response vessel Louisiana Responder. Contributing to the accident was the unforeseen risk associated with conducting the exercise in a strong current, which also contributed to the severity of the outcome by hampering rescue efforts.

Figure 14. The Gibson and barge ART 36109 three days after the accident on the Ohio River, near Warsaw, Kentucky.





Figure 15. Small passenger vessel Conception, pre-accident. SOURCE: WWW.SEAWAYBOATS.NET

Fire Aboard Small Passenger Vessel Conception Santa Barbara, California (34 fatalities, 2 injured)

On September 2, 2019, about 3:14 a.m. local time, the Coast Guard received a distress call from the captain of the Conception, a 75-ft-long, small passenger vessel operated by Truth Aquatics Inc. The vessel was anchored in Platts Harbor on the north side of Santa Cruz Island. off Santa Barbara, California, when it caught fire. Despite firefighting and search-and-rescue efforts, the vessel burned to the waterline and sank just after daybreak. Five crewmembers who had been asleep in their bunks on the upper deck survived; the sole crewmember and all 33 passengers who had been asleep in the bunkroom below died. Loss of the vessel was estimated at \$1.4 million

We determined that the probable cause of this accident was the failure of Truth Aquatics Inc. to provide effective oversight of its vessel and crewmember operations, including requirements to ensure that a roving patrol was maintained, allowing a fire of unknown cause to grow, undetected, in the vicinity of the aft salon on the main deck. Contributing to the undetected growth of the fire was the lack of a Coast Guard regulation requiring smoke detection devices in all accommodation spaces. Contributing to the

high loss of life were the inadequate emergency escape arrangements from the vessel's bunkroom, as both exited into a compartment that was engulfed in fire, thereby preventing escape.

Safety issues identified in this investigation were the lack of small passenger vessel regulations requiring smoke detection in all accommodation spaces, the lack of a roving patrol, small passenger vessel construction regulations for means of escape, and ineffective company oversight.

As a result of this investigation, we issued 10 safety recommendations to address these issues. Recipients included the Coast Guard, the Passenger Vessel Association, the Sportfishing Association of California, the National Association of Charterboat Operators, and Truth Aquatics Inc. We also reiterated one safety recommendation to the Coast Guard.

Figure 16. Small passenger vessel *Conception*, **postaccident.** SOURCE: VCFD



Ongoing Investigations

As of December 31, 2020, MS had 35 open domestic investigations. The following investigations involved significant safety issues:

- The gas carrier *Genesis River* collided with a tank barge being pushed by the towing vessel *Voyager*, spilling petrochemical into the water and capsizing a second barge in tow on May 10, 2019, in the Bayport Flare area of the **Houston Ship Channel**; there were no fatalities. (*Adopted March 10, 2021*)
- The vehicle carrier Golden Ray sank on September 8, 2019, in the Brunswick River channel in Saint Simons Sound, Georgia; there were no fatalities.
- The fishing vessel Scandies Rose capsized and sank on December 31, 2019, south of Sutwik Island, Alaska, en route to the Bering Sea; there were 5 fatalities.
- The vehicle carrier *Höegh Xiamen* caught fire on June 4, 2020, while moored to Pier 21 in **Jacksonville, Florida**, and was completely destroyed; there were no fatalities.
- The dredge Waymon L. Boyd struck a submerged propane pipeline on August 21, 2020, in **Corpus Christi, Texas**, and caught fire; there were 5 fatalities.
- The *Cheramie Bo-Truck 33* collided with the Coast Guard cutter *Harry Claiborne*, a buoy tender, on October 11, 2020, in **Sabine Pass, Texas**; there were no fatalities.
- The fishing vessel *Emmy Rose* sank and was lost in high winds and 6-ft seas on November 23, 2020, after fishing in the **Gulf of Maine**; there were 4 fatalities.

Completed International Investigations

MS is responsible for the overall management of the NTSB's international marine safety program, under which the office investigates major marine casualties involving foreign-flagged vessels in US territorial waters and those involving US-flagged vessels anywhere in the world; in fact, accidents involving foreign-flagged vessels accounted for 27 percent of NTSB marine accident investigations over the past 5 years. Under the International Maritime Organization (IMO) Code of International Standards and Recommended Practices for a Safety Investigation into a Marine Casualty or Marine Incident (Casualty Investigation Code), MS also participates with the Coast Guard as a substantially interested State in investigations of serious marine casualties involving foreign-flagged vessels in international waters. The international program also involves reviewing US administration position papers related to marine accident investigations and participating in select IMO sub-committee meetings.

Collision Between US Navy Destroyer *Fitzgerald* and Philippine-Flag Container Ship *ACX Crystal* **Japan Sagami Nada Bay off Izu Peninsula, Honshu Island (7 fatalities, 3 injured)**

On June 17, 2017, about 1:30 a.m. local time, the US Navy Destroyer *Fitzgerald* with 315 persons on board was southbound in the bay of Sagami Nada off Japan's Honshu Island, bound for the Philippines, when it collided with the Philippine-flagged container ship *ACX Crystal*, operated by Sea Quest Ship Management Inc., with 20 crewmembers on board. Seconds before the collision, the watch officers attempted to maneuver the vessels to avoid impact, but they acted too late. Seven *Fitzgerald* crewmembers died in the accident, and three crewmembers suffered serious injuries. The destroyer sustained extensive damage to its forward starboard side. The *ACX Crystal* sustained damage to its bow, but no injuries to its crewmembers were reported.

We determined that the probable cause of the accident was the *Fitzgerald* bridge team's failure to take early and substantial action to avoid collision as the give-way vessel in a crossing situation. Contributing to the accident were ineffective communication and cooperation among the *Fitzgerald* crew on the bridge and in the combat information center, and the *Fitzgerald* commanding officer's insufficient planning for the hazards of the vessel's intended transit. Also contributing was the Navy's ineffective oversight of the *Fitzgerald* in the areas of operations scheduling, crew training, and fatigue mitigation. Further contributing was the *ACX Crystal* watch officer's lack of early detection of the Navy vessel and insufficient actions to avoid collision once in doubt as to the destroyer's intentions.¹⁰

Safety issues identified in this investigation were the *Fitzgerald* crew's fatigue, the practice of US naval vessels not to broadcast automatic identification system information, failure of both vessels to follow required actions in accordance with the International Regulations for the Prevention of Collisions at Sea, the *Fitzgerald* commanding officer's failure to adequately assess the hazard presented by the vessel's intended transit, and insufficient oversight by the US Navy. As a result of the investigation, we issued four safety recommendations to address these issues. Recipients included the US Navy and Sea Quest Ship Management Inc.

Figure 17. Below: Postaccident damage to the *ACX Crystal*'s bow. SOURCE: JAPAN TRANSPORT SAFETY BOARD





Figure 18. Postaccident damage to the *Fitzgerald*'s starboard side. Seven crewmembers of the *Fitzgerald* died as a result of the collision.

SOURCE: US NAVY



¹⁰ The NTSB served as the lead federal agency in this accident investigation and developed our analysis and probable cause based on the evidence gathered by the Coast Guard, as well as additional documentation provided by the US Navy.

Collision Between Containerships Antigua- and Barbuda-flag *Marcliff* and US-flag *APL Guam*

Japan YL-4 Anchorage, Port of Yokohama, Tokyo Bay (No fatalities, no injuries)

On March 21, 2019, about 11:27 p.m. local time, the 468-ft Antigua- and Barbuda-flagged containership *Marcliff*, operating without a pilot, was outbound from the Port of Yokohama, Japan, when it collided first with the 505-ft US-flagged containership *APL Guam*, inbound to an anchorage at the port, and then with the 574-ft Liberian-flagged containership *Hansa Steinburg*, anchored nearby. The master stated to investigators that the *Marcliff* had been specifically designed and built to be able to operate in Japanese ports without pilots or tugboats. The *APL Guam* was under the navigational control of a local Japanese pilot for Tokyo Bay. No pollution or injuries were reported. Damages were estimated at \$1,178,200.

We determined that the probable cause of the collision was the *Marcliff* master's attempt to pass between the *APL Guam* and the anchored *Hansa Steinburg* with insufficient safe maneuvering room. Contributing to the accident was a lack of communication between the *Marcliff* bridge team and the *APL Guam* pilot and bridge team to establish their maneuvering intentions.¹¹

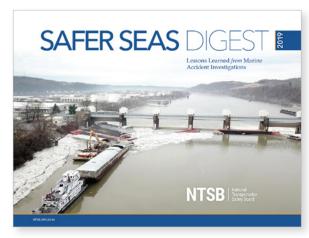
Other Significant Achievements

■ Safer Seas Digest 2019

Our Safer Seas Digest comprises concise summaries of the previous year's accident investigations and represents the NTSB's continuing commitment to sharing the lessons that we learn through our marine investigations.

Marine Board of Investigation Hearing

The Coast Guard held a virtual Marine Board of Investigation (MBI) hearing September 14–22, 2020, into the events leading to the capsizing of the vehicle carrier *Golden Ray*, a 2-year-old Marshall Islands–flagged vessel, classified by Korean registry, that occurred in Brunswick,



Georgia. A representative of MS participated in the hearing along with representatives from the Marshall Islands, Korean Maritime Safety Tribunal, Brunswick Bar Pilots' Association, and the vessel owner. Thirteen witnesses were called to testify as to the events that occurred before, during, and after the vessel capsized. The Coast Guard's Marine Safety Center presented the MBI a report that determined the vessel had not been in compliance with IMO requirements for stability when it departed the dock prior to the casualty.

Seafloor Workshop

The two-part NTSB Seafloor Workshop was developed to help retain expertise learned from NTSB investigations at the seafloor, such as the 2015–2016 search for the *El Faro*. The project shared lessons from current aviation and marine investigations with interested stakeholders who may need to plan future operations. The first part, on September 29, 2020, included nearly 50 participants who represented investigative agencies, seafloor technology companies, and science organizations from all over the world.

The second part, on December 16, 2020, featured seven virtual presentations covering both aviation and marine investigations. Over 70 participants from more than two dozen countries discussed technologies, trends, and issues related to seafloor operations.

¹¹ The Japanese Transportation Safety Board (JTSB) served as the lead Port State investigation agency; the NTSB developed our analysis and probable cause based on evidence gathered by the US Coast Guard and additional documentation provided by the JTSB.

¹² When the Coast Guard, as part of the investigation of a major marine casualty, holds an MBI hearing, NTSB investigators join in as an equal partner. Consistent with Coast Guard responsibility to direct the course of the investigation, those NTSB investigators designated by the MBI may make recommendations about the scope of the investigation, may call and examine witnesses, and may submit or request additional evidence.

Office of Railroad, Pipeline, and Hazardous Materials Investigations

Table 5.	Office of Railroad, Pipeline, and Hazardous Materials Investigations Statistics	
	Safety Recommendations Issued	27
	Safety Recommendations Closed Acceptable	46
	Safety Recommendations Closed <i>Unacceptable</i>	2
	Urgent Safety Recommendations Closed Acceptable	1
	Board-Adopted Investigative Reports	3
	Field Investigation Launches	18
	International Accident Launches	1
	Safety Actions	1
	Advocacy and Outreach	12



The Office of Railroad, Pipeline, and Hazardous Materials Investigations (RPH) investigates accidents in two modes of transportation—railroad and pipeline—as well as accidents involving the release of hazardous materials in all modes of transportation, particularly those that result in fatalities or that cause major disruptions to a community.

Most railroad investigations involve freight train accidents, such as collisions and derailments, but the office also places special emphasis on train accidents that involve the traveling public, such as passenger train and rail transit accidents.

RPH also investigates pipeline accidents involving a release of natural gas, hydrocarbon liquid, ammonia, or carbon dioxide that result in fatalities or substantial property damage. These investigations focus on the cause of the release, the emergency response, and actions taken to mitigate the spill.

The office's hazardous materials investigations focus on the effects of the materials released, the emergency response, and the adequacy of federal standards. When an accident involves the bulk transportation of hazardous materials, the investigation focuses on the performance of the containers; the preparation of the material for, and handling of the material during, transport; the health and safety hazards of the material; the labeling and hazard communications for the shipments; and the effectiveness of the emergency response.

To accomplish its tasks, RPH is organized into four divisions: Railroad, Pipeline and Hazardous Materials, System Safety, and Report Development.

Completed Investigations

Railroad

Long Island Rail Road Roadway Worker Fatality Queens Village, New York (1 fatality)

On June 10, 2017, at 10:12 a.m. local time, Long Island Rail Road (LIRR) train 7623 approached a five-member crew of roadway workers on track 3 who were inspecting and making minor repairs to track 1 at the interlocking in Queens Village, New York. A fifth roadway worker was clear of the tracks, keeping pace with the work group. Upon seeing train 7623, the watchman/lookout sounded a handheld horn, yelled at the other workmen, and raised a disc that told the locomotive engineer to sound the train's horn, which the locomotive engineer did. Three of the roadway workers remained in track 1, but the foreman stepped into the path of the train on track 3 and was killed. The train was traveling about 78 mph when the locomotive engineer applied the emergency brakes just before impact.

We determined that the probable cause of the accident was LIRR's decision to use train approach warning to protect the roadway workers on active tracks. Contributing to the accident was LIRR's and the International Association of Sheet Metal, Air, Rail and Transportation Workers' allowance of overtime work schedules without properly considering and mitigating workers' risk of fatigue.

The safety issues identified in this investigation were roadway worker protection, roadway ontrack safety briefings, management oversight, Federal Railroad Administration (FRA) oversight, and worker fatigue.

As a result of this investigation, we issued six safety recommendations to address these issues. Recipients included the FRA; the Metropolitan Transportation Authority; and the International Association of Sheet Metal, Air, Rail and Transportation Workers. Before the adoption of this report, we issued two urgent safety recommendations to the Metropolitan Transportation Authority.

CSX Transportation Railway Maintenance Machine Operator Fatality

Wartrace, Tennessee (1 fatality)

On March 12, 2018, about 2:15 p.m. local time, a CSX Transportation Inc. (CSX) equipment operator was fatally injured while working with a CSX ballast regulator (roadway maintenance machine) on the main track near Wartrace, Tennessee. The CSX manager of work equipment was traveling on the highway nearby when from his car he saw the operator climb into the regulator cab. Shortly thereafter, he heard a radio transmission from the operator reporting a problem with a proximity switch on the ballast regulator. The manager drove to the accident scene to assist the operator and found the operator under the ballast regulator wing. The operator died at the scene.

We determined that the probable cause of the accident was the operator's attempt to repair the machine without powering it off and using lockout/tagout procedures, which re-established the electrical connection to the proximity sensor, allowing the machine to move and strike the operator while he was out of the cab, resulting in his death.

The safety issues identified in this investigation were rules compliance and operator presence control.

As a result of this investigation, we issued four safety recommendations to address these issues. Recipients included the FRA, CSX, and the American Railway Engineering and Maintenance-of-Way Association.

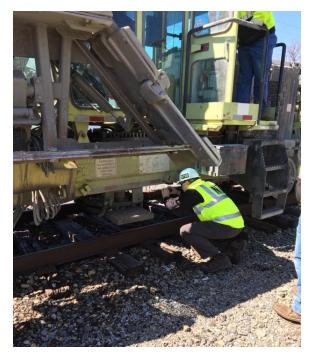


Figure 19. NTSB rail investigator-in-charge Robert "Joe" Gordon examines the ballast regulator involved in the Wartrace, Tennessee, accident.

CSX Transportation Train Derailment and Bridge Collapse

Alexandria, Virginia (No fatalities or injuries)

On May 19, 2018, at 7:02 a.m. local time, a southbound CSX freight train derailed as it approached a bridge overpass in Alexandria, Virginia. The CSX bridge supporting main track one was extensively damaged, and it collapsed at the approaching abutment wall. The bridge structure and 8 of the 31 derailed railcars fell onto the tracks below, owned by Norfolk Southern Railway. The CSX bridge for main tracks two and three was not involved.

We determined that the probable cause of the derailment and subsequent bridge collapse was a subgrade fill failure of the track structure that displaced a large area of ballast under the low rail of the track near milepost 102.9, resulting in a cross-level deviation of the track significant enough to allow a wheel climb derailment.

Figure 20. Below: Overhead view of the Alexandria, Virginia, accident scene showing bridge and track damage.





Figure 21. Overhead view of the Carey, Ohio, accident scene. SOURCE: CSX

Collision of Two CSX Transportation Freight Trains Carey, Ohio (2 injured)

On August 12, 2019, about 5:09 a.m. local time, a westbound CSX freight train collided with an eastbound CSX freight train at a switch near Carey, Ohio. Each train's crew consisted of a conductor and a train engineer. The collision caused the lead locomotive of the westbound train, four of its railcars, and 21 railcars of the eastbound train to derail. In addition, the engineers of both trains suffered minor injuries.

We determined that the probable cause of the collision was the failure of the westbound train engineer to respond to the signal indications requiring him to slow and stop the train prior to Control Point Springs because of his impairment from the effects of alcohol. Contributing to the collision was the design of the PTC system, which allowed

continued operation in restricted mode on the main track.

The safety issues identified in this investigation were train handling and performance, CSX's random drug and alcohol-testing program, inward- and outward-facing image recorders, and railroad switching operations in territory with PTC.

As a result of this investigation, we issued six safety recommendations to address these issues. Recipients included the US DOT, the FRA, the Association of American Railroads, the American Short Line and Regional Railroad Association, the National Railroad Passenger Corporation, Alaska Railroad, the American Public Transportation Association, and CSX. We also reiterated and classified two previously issued safety recommendations to the FRA.

Pipeline

Magellan Pipeline Anhydrous Ammonia Release Tekamah, Nebraska (1 fatality, 2 injured)

On October 17, 2016, about 9:00 p.m. local time, an 8-inch-diameter underground transmission pipeline ruptured and released 2,587 barrels (108,654 gallons) of liquid anhydrous ammonia on private property in Burt County, near Tekamah, Nebraska. The pipeline was owned and operated by Magellan Midstream Partners LP. Upon release and exposure to the atmosphere, the ammonia vaporized and produced a toxic plume. A local resident who had left his home to investigate the accident scene died of respiratory failure from exposure to the ammonia vapor; two other people sustained minor injuries. A total of 49 people from 29 households were evacuated. US Highway 75, a main roadway in the area, was closed for several days.

We determined that the probable cause of the rupture was corrosion fatigue cracks that grew and coalesced under disbonded polyethylene tape coating. Contributing to the location of the cracking was external loading that caused bending stress in the pipe in addition to the cyclic stresses in the pipe from the internal pressure of the ammonia transported.

Figure 22. Below: Excavation of the pipe involved in the release of anhydrous ammonia in Tekamah, Nebraska.

SOURCE: MAGELLAN MIDSTREAM PARTNERS, L.P.



Hazardous Materials

CSX Transportation Inc. Tank Car Release of UN1987 Denatured Ethanol Fredericksburg, Virginia (No fatalities or injuries)

On November 2, 2016, at 3:11 p.m. local time, CSX reported a 68-gallon release of UN1987 denatured ethanol, a flammable Class 3 hazardous material, from cracks in the bottom of the shell of an Archer Daniels Midland Company tank car located in the CSX rail yard in Fredericksburg, Virginia. The leak occurred in the sixth tank car in a train consisting of a buffer car loaded with steel, and seven tank cars fully loaded with denatured ethanol. Because of the release and the resulting emergency, other rail traffic on adjacent main tracks was significantly slowed, causing passenger train delays during peak traffic hours.

We determined that the probable cause of the release of denatured ethanol was undetected cracks that resulted from over-speed, high-energy coupling events, which caused tank shell deformation that led to the initiation of two fatigue cracks at the terminations of the cradle pad fillet welds.

Safety issues identified in this investigation were excessive coupling impact loads and the need for maximum coupling speed and impact force thresholds; the structural integrity of stub sill underframes and the need for qualified inspection and repair following high-energy coupler impact events; and methods used to detect and report excessive coupling speed impact events.

As a result of this investigation, we issued four safety recommendations to address these issues. Recipients included the FRA and the Pipeline and Hazardous Materials Safety Administration (PHMSA).



Figure 23. End view of the tank car involved in the ethanol release in Fredericksburg, Virginia.

Ongoing Investigations

As of December 31, 2020, RPH had 11 ongoing rail investigations and 10 ongoing pipeline and hazardous material investigations. The following investigations involved significant safety issues:

- A light rail vehicle experienced braking issues on August 22, 2017, in **Upper Darby, Pennsylvania**; there were no fatalities, but 33 were injured.
- An Amtrak passenger train struck a track worker on April 24, 2018, in **Bowie, Maryland**; there was one fatality.
- A 30-inch gas pipeline failed on August 1, 2019, in Danville, Kentucky; there was 1 fatality.
- A CSX freight train with hazardous materials tank cars derailed, leading to a fire, on February 13, 2020, in **Draffin, Kentucky**; there were no fatalities.
- A Union Pacific Railroad freight train derailed, causing a bridge to collapse onto a public highway on July 28, 2020, in **Tempe, Arizona**; there were no fatalities.

Completed International Investigations

Although RPH does not have an international mandate to assist with international accident investigations, the office has partnered with international agencies in accident investigations that have relevance to RPH investigations in the United States.

Lithium-Ion Battery Truck Fire Following Aerial Transport

Brampton, Ontario, Canada (No injuries, no fatalities)

On June 3, 2016, about 4:05 p.m. local time, a FedEx W900 local delivery truck and all its cargo were destroyed by a fire while the driver was delivering packages to a business in Brampton, Ontario, Canada; no injuries were reported. The fire began among a shipment of four large-format lithium-ion batteries that had initially been transported by FedEx on two US-registered cargo airplanes before being transferred to the delivery truck about 10 hours after the batteries were offloaded at the airport in Toronto. The FAA notified the NTSB of the accident over concerns that a similar fire could also occur during air transport. Although this event occurred in Canada, the NTSB conducted a limited investigation because the shipment had originated in the United States on a US air carrier, and the incident involved lithium-ion batteries shipped in a configuration that had been presumed to be compliant with US regulations.

We determined that the probable cause of the fire was an electrical short circuit between the battery terminal bolt and the upper cells of the lithium-ion battery module, causing a thermal runaway within the battery, igniting the battery and its packaging. Contributing to the electrical short circuit was Braille's battery design, which did not protect against short circuiting, and Braille's use of combustible packing materials.

As a result of this investigation, we issued two safety recommendations to PHMSA to address these issues.

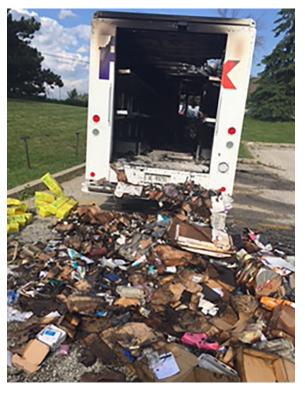


Figure 24. View of the rear of the FedEx delivery truck involved in the Brampton, Ontario, Canada, fire, and the truck's contents. SOURCE: FEDERAL EXPRESS

Other Significant Achievements

- Achieved full implementation of the federally mandated PTC regulation on passenger and hazardous materials rail routes in the United States.
- Provided NTSB response to the US DOT on PHMSA's "Pipeline Safety: Class Location Change Requirements."
- Provided NTSB response to the US DOT on PHMSA's NPRM "49 *CFR* Parts 190, 194, and 195, Pipeline Safety: Regulatory Reform for Hazardous Liquid Pipelines."
- Provided NTSB response to the US DOT on PHMSA's NPRM "49 CFR Parts 192 and 195 Pipeline Safety: Valve Installation and Minimum Rupture Detection Standards."
- Provided NTSB response to the US DOT on the FRA's NPRM "49 CFR Parts 218, 221, and 232, Miscellaneous Amendments
 to Brake System Safety Standards and Codification of Waivers."
- Provided NTSB response to the US DOT on the FRA's NPRM "49 CFR Part 213 Rail Integrity Amendments and Track Safety Standards."

Office of Research and Engineering

Table 6. Office of Research and Engineering Statistics

Safety Data Analyses Completed	310
Materials Laboratory Exam Reports Completed	129
Readouts of Vehicle Recorders and Other Electronic Devices Completed	451
Vehicle Performance Reports and Animations Completed	47
Medical Investigation Reports Completed	180
Safety Research Reports and Statistical Reviews Published	4
Journal and Other Publications	4
Advocacy and Outreach	40



The Office of Research and Engineering (RE) provides technical expertise to NTSB accident investigations in all modes of transportation. The office also conducts safety research, generates periodic statistical reviews of aviation accidents, and provides medical and toxicology expertise for investigations in all modes of transportation.

RE includes four divisions: Safety Research, Materials Laboratory, Vehicle Recorder, and Vehicle Performance, and two program areas: Medical Investigations and Chief Data Scientist.



Figure 25. Frank Zakar and Edward Komarnicki of the Materials Laboratory Division examine a portion of the pipe involved in the *Waymon L. Boyd* marine accident that occurred in Corpus Christi, Texas.

Safety Research Division

The Safety Research Division examines transportation accidents, accident trends, and technological changes to identify problems and associated remedial actions that will reduce risk and improve the safety of the transportation system. Division staff includes transportation safety research and data analysts who systematically examine (1) risks or hazards in the transportation environment that may influence accidents or injury; (2) accident investigation techniques and methods; and (3) the effectiveness of various safety countermeasures, such as policies, programs, and technologies. The division also provides data science, data visualization, and statistical expertise to support accident launches and investigations; assist with safety recommendation development; and publish annual statistical reviews for the NTSB, Congress, and the public.

In 2020, the Safety Research Division completed 310 data and statistical analysis requests, reports, and geospatial products in support of major and field accident investigations and published a response to one notice of proposed rulemaking focused on hours of service and fatigue risk among commercial drivers. The division also published two annual reviews of aviation accident statistics and an update on the survivability of accidents involving air carrier operations in the United States. In addition, we received approval and began a major research study on drug and polydrug use among drivers and started drafting a safety research report on turbulence-related accidents and injuries in air carrier operations, which will complete a 2-year study in collaboration with AS from 2019-2021.

Materials Laboratory Division

The Materials Laboratory Division performs expert multidisciplinary engineering and scientific analyses to determine whether material and structural performance are related to the cause or severity of an accident. Engineers also analyze wreckage to determine the causes of fires and explosions. The division provides chemical and forensic science expertise, as well as technical advice and resources for experimental testing and research in the physical sciences.

In 2020, the Materials Laboratory Division completed 129 reports for 89 accident investigations and supported the development of numerous NTSB reports and recommendations. Most notably, we investigated the materials, metallurgical, and fire-related aspects for these investigations: Union Pacific railroad freight train derailment, hazardous material release and fire, Tempe, Arizona; the striking of a submerged liquid propane pipeline by the dredge vessel *Waymon L. Boyd*, Corpus Christi, Texas; and Atmos Energy Corporation natural gas-fueled explosion, Dallas, Texas.

Figure 26. Michael Meadows of the Materials Laboratory Division reassembles fragments of a helicopter's main rotor blades for analysis following a crash in Afghanistan.



Vehicle Recorder Division

The Vehicle Recorder Division extracts, formats, and analyzes data from aircraft flight data recorders and cockpit voice recorders, and from recorders installed in locomotives, large ships, and some highway vehicles. Engineers also examine recorded electronic audio and video information captured by aircraft, ship, train, and support communication systems; provide electronic engineering expertise for all accident investigation modes in examining communication and control systems; provide time synchronization to correlate voice, data, and video recorder outputs; use advanced digital and analog filtering and signal representation techniques to extract critical recorder information; and perform forensic examinations of personal electronic devices and other computer hardware.

In 2020, the Vehicle Recorder Division received 263 devices; completed 451 readouts, transcripts, and studies in support of aviation, railroad, marine, and highway investigations; and launched in support of four accidents. Of the recorders received, 15 were from foreign accidents and 9 were in support of US military investigations. Most notably, we supported the analysis of flight data from Boeing 737 and Airbus A320 accidents in Kozhikode, India, and Karachi, Pakistan, respectively. Engineers also supported the development of numerous NTSB reports and safety recommendations, including Safety Recommendations A-20-27, -28, -29, and -30 issued as a result of five helicopter accidents; these recommendations address crash-protected and crash-resistant helicopter cockpit image recorders.

The Vehicle Recorder Division also participates in and contributes to multiple national and international bodies to foster interagency cooperation, encourage technical exchange, and improve recorder standards. We participate in the International Recorder Investigator Group; ICAO; SAE Industry Technologies Consortia, ARINC Standards Group; RTCA; the Scientific Working Group on Digital Evidence, and INTERPOL's Digital Forensics Expert Group. Our participation increases the technical ability of our engineers and raises the agency's standing in the international community.

Vehicle Performance Division

The Vehicle Performance Division provides specialized aeronautical, mechanical, structural, and biomechanical engineering expertise; three-dimensional laser scanning and accident reconstruction; photogrammetry and video analysis; and animation and graphics development for all modes. Our engineers use computational and visualization technology to provide accurate time-motion histories of the sequence of events and to evaluate data from multiple sources to determine vehicle and occupant motion and the underlying causes of that motion. They also develop video animations of accident scenarios, evaluate occupant injury mechanisms, and participate in and direct research into special projects, as required.

In 2020, the Vehicle Performance Division completed 46 studies and reports in support of accident investigations (aircraft and surface vehicle performance studies, laser scanning reports, and video/photograph studies). Among the products completed were an evaluation of the airplane flight path and calculation of the effects of airplane acceleration on the pilots during the crash of Atlas Air flight 3591 into Trinity Bay, Texas; the division also developed an animation depicting the sequence of events in that accident for the virtual Board meeting in July 2020. In addition, for the investigation into the collision between the US Navy destroyer *Fitzgerald* and the container ship *ACX Crystal* off Japan's Honshu Island, we assisted in determining the paths of the ships involved and evaluated the results of possible alternative actions by the crew of each ship.

Figure 27. Vehicle Performance Division staff created an **animation** to illustrate the sequence of events leading to the crash of Atlas Air flight 3591 into Trinity Bay, Texas.



Medical Investigations

RE medical staff evaluates the medical aspects of investigations, including medical fitness, pathology, toxicology, injury causation, and biomechanics. Some examples of medical issues that we address are operator incapacitation, injury prevention, night vision, hypoxia, substance impairment, obstructive sleep apnea, and impairing effects from the use of prescription and over-the-counter medications and illicit substances.

During 2020, the program's three physicians participated in more than 123 NTSB accident investigations and completed 180 reports across all transportation modes. We evaluated and addressed medical issues through formal factual and analytical reports, safety recommendations, coordination with other agencies, and formal presentations to the NTSB and external audiences.

Chief Data Scientist

The chief data scientist supports the agency-wide effort to improve the use of data in strategic decision-making, and is designated as the agency's chief data officer, as required by the Foundations for Evidence-Based Policymaking Act of 2018. He is also responsible for applying machine learning and advanced data science methods and techniques to agency investigations and research, analysis, and emerging transportation safety trend reporting.

During 2020, the chief data scientist, along with representatives from the Offices of the Chief Information Officer and AS, led the development of a multimodal database for our investigations, as directed by Congress in the NTSB's 2018 budget reauthorization. He also led the NTSB's initial implementation of requirements detailed in the Foundations for Evidence-Based Policymaking Act of 2018 and Federal Data Strategy and chaired the agency's data-governance body.

Completed Safety Research Reports

2013–2017 Update to Drug Use Trends in Aviation

This safety research report provided the most recent 5 years of data from the ongoing toxicology evaluations among fatally injured flying pilots. Sedating antihistamines continued to be the most common category of potentially impairing drugs found in pilots who died during the report period, with 11.9 percent testing positive for at least one drug in this category, an increase from 9.9 percent during the preceding 5 years. Sedating pain relievers, a category that includes opioids, was the second most common category of potentially impairing drugs, at 5.3 percent.

Safety issues identified during this research update include the ongoing need for the FAA to (1) publicize—for pilots' use—information about marijuana, given its decriminalization in several states and its unchanged classification as an illicit drug per federal law and (2) conduct research to assess the relationship between drug use and accident risk. As a result of this study, we issued one new recommendation and reiterated two more.

2020 Data Update, Survivability of Accidents Involving Part 121 US Air Carrier Operations

This report updated the NTSB's 2001 safety report Survivability of Accidents Involving Part 121 US Air Carrier Operations, 1983 through 2000. Using accident, injury, and flight activity data from 2001 through 2017, we examined and compared the overall proportion of occupants who survive if they are in an accident involving an aircraft operated under 14 CFR Part 121. During the 18-year period from 1983 through 2000 described in the 2001 NTSB report, 569 accidents involving Part 121 operations occurred; 12.5 percent of those accidents resulted in at least one occupant fatality. By contrast, during the 17-year period from 2001 through 2017, 4.1 percent of the 565 Part 121 accidents resulted in at least one fatality. Both the overall accident rate and the fatal accident rate per 100.000 flight hours decreased substantially between the two periods. The fatal accident rate during the period 2001 through 2017 (0.006 per 100,000 flight hours) is equivalent to about one fatal Part 121 accident for every 16.3 million flight hours. Even among serious accidents involving fire or serious or fatal injury, and substantial damage or complete destruction of the aircraft, 59.0 percent of Part 121 aircraft occupants survived. Among occupants who were fatally injured, impact forces from the accident were the most common cause of death. Among serious accidents that were determined to be survivable, 80.8 percent of occupants survived.

Ongoing Safety Research Reports

Preventing Turbulence-Related Injuries in Part 121 Air Carrier Operations

Turbulence-related accidents are the most common type of accident involving air carrier aircraft operating under 14 *CFR* Part 121. From 2008 through 2017, the NTSB found turbulence to be a causal or contributory factor, or designated it as the defining event, in 36 percent of Part 121 accidents. This study will examine the details of the turbulence problem and develop safety recommendations to reduce the risk of turbulence on Part 121 operations. Specifically, the study will attempt to summarize the types and causes of turbulence, detail the safety impacts of turbulence on Part 121 operations, and examine methods to reduce the likelihood of Part 121 turbulence encounters and their consequences.

Drug and Polydrug Use Among Drivers

Impairment from alcohol and other drugs is a major transportation safety issue. The topic "End Alcohol and Other Drug Impairment" is on the NTSB's 2019-2020 MWL; the issue of impairment has also been included on many previous MWLs. The NTSB's concern about this issue has increased over the past decade, particularly in the highway mode, as the NTSB has documented substance impairment in 11 highway crash investigations, 8 of which involved a driver's use of more than one drug (polydrug use). To further examine this development, the NTSB is conducting a study to assess what is known about the risks and prevalence of drug and polydrug use among drivers, as well as what can be done to improve safety in this area. The specific goals of the study are (1) to review and describe what is known about the association between the use of various drugs and highway crash risk, (2) to document drugged driving prevalence and trends in the United States using the best currently available data, and (3) to identify and promote the use of best practices for documenting drugged driving prevalence and understanding the associated crash risk.

Other Significant Achievements

 Provided comments to the US DOT on the FMCSA's NPRM "Hours of Service of Drivers; Pilot Program to Allow Commercial Drivers to Pause Their 14-Hour Driving Window."

Annual Statistical Reviews

- 2000–2019 Preliminary Aviation Statistics
- Summary of US Civil Aviation Accidents for Calendar Year 2018

Publications

- Mueller, Eric M., Nancy McAtee, and David Flaherty. "An Investigation of an Oil Barge Explosion in Corpus Christi, Texas." Journal of Failure Analysis and Prevention 21 (2021): 193–203 (Published in 2020).
- Mueller, Eric M., and Xiaohu Liu. "Failure Analysis and Finite Element Modeling of a Rail Axle Fatigue Fracture." International Journal of Railway Technology 7, no.1 (2018): 45–63 (Published in 2020).
- Mueller, Eric M., Rachel Eckert, Adam Boesenberg, Nicole Hudak, Krish Gupta, Zachary Dickinson, Miabella Doerr, Tao Dodeja, and Eric Echanove. "Failure Analysis of a Fractured Stick End Casting: An ASM Materials Camp Investigation." Journal of Failure Analysis and Prevention 20 (2020): 1825–1831.
- Zakar, Frank. "Installation Errors in Polyethylene Pipe for Natural Gas Service—Recent Case Histories." Proceedings of ASME 13th International Pipeline Conference (IPC 2020) September 28—October 2, 2020, Calgary, Canada, Published as IPC2020-9653.

Office of Safety Recommendations and Communications

Table 7. Office of Safety Recommendations and Communications Statistics

Testimony to State Legislative Committees
Print, Broadcast, Online Mentions
Advocacy and Outreach



The Office of Safety Recommendations and Communications (SRC) publicly releases information on NTSB investigations, activities, and safety recommendations across multiple communication channels. SRC engages a range of stakeholders, including safety recommendation recipients; members of the transportation industry; transportation workers; federal, state, and local government officials; transportation safety advocates; and the public.

SRC's work spans an investigation's lifecycle, providing the transparency that supports the NTSB's independence while building public trust and support for our mission.

Following an investigation, SRC focuses on advocating for and monitoring safety recommendation implementation. The office includes five divisions: Safety Recommendations, Media Relations, Government and Industry Affairs, Safety Advocacy, and Digital Services.

6

46

159,030

Safety Recommendations Division

NTSB safety recommendations address specific issues uncovered during investigations and specify actions to help prevent similar accidents from occurring in the future. These safety recommendations are the agency's most important products because they alert government, industry, and the public to the critical changes that are needed to prevent transportation accidents and crashes, reduce injuries, and save lives.

The NTSB issues its recommendations to the organizations best able to take corrective action, such as the US DOT and its modal administrations, the Coast Guard, other federal and state agencies, manufacturers, operators, labor unions, and industry and trade organizations. The Safety Recommendations Division helps investigative offices craft recommendations that will encourage recipients to take the corrective action needed to prevent the identified safety issue from occurring in the future.

Once the Board issues a recommendation, the Safety Recommendations Division handles the ongoing correspondence between the agency and each recipient, tracking and analyzing a recipient's responses and determining a classification—Acceptable or Unacceptable—for the Board members to consider. The division monitors the progress of action to implement each recommendation until it is closed (which usually takes several years), maintains a database of all recommendations, compiles monthly statistics, and responds to data queries from other offices.

In 2020, 127 open recommendations were closed *Acceptable*; 52 of these had been issued to DOT modal agencies or the Coast Guard (see Table 8).¹³ The number of open recommendations that are closed fluctuates from year to year for various reasons; over the last 5 years (2016 through 2020), the number of recommendations closed *Acceptable* has averaged 100 per year.

During 2020, the division contacted numerous recommendation recipients who had not updated the NTSB on their actions for some time. In many cases, the recipient had completed the recommended action but had not informed us

Also, in 2020, in response to NTSB safety recommendations, the US DOT and other federal agencies issued several notices of proposed rulemaking, notices of request for comments, and final rules in the *Federal Register*. Table 9 provides a summary of these actions.

Table 8. Closed NTSB Safety Recommendations Issued to US DOT Modal Agencies and the Coast Guard in 2020

	Safety Recommendations Closed <i>Acceptable</i>	Safety Recommendations Closed <i>Unacceptable</i>
Federal Aviation Administration		10
Federal Highway Administration		0
Federal Motor Carrier Safety Administration .		3
Federal Railroad Administration		
Federal Transit Administration		0
National Highway Traffic Safety Administratio	n	2
Pipeline and Hazardous Materials Safety Adm	inistration	0
Coast Guard		0
Total		16

Table 9. NTSB Safety Recommendations Addressed in *Federal Register* Notices from Federal Agencies in 2020

F	ederal Register Notices	Open Safety Recommendations Addressed
Federal Communications Commission		
Federal Aviation Administration		
Federal Highway Administration		3
National Highway Traffic Safety Administration		29
Pipeline and Hazardous Materials Safety Adminis	tration	3

¹³ In addition, 30 safety recommendations were closed Unacceptable in 2020; of these, 14 were to recipients other than US DOT modal agencies.

Media Relations Division

The Media Relations Division is responsible for developing and maintaining relationships with the media to communicate with the public about accident and incident investigations and to publicize the release of reports, safety studies, safety recommendations, safety alerts, and other agency activities. Staff members respond to media inquiries, arrange media interviews of agency personnel, and serve as the on-scene public affairs officers supporting Board members during major accident investigations. The division also supports deployed regional investigators and investigators-in-charge, and trains NTSB and transportation industry personnel in successful media engagement.

Media Relations staff launched on every 2020 major investigation, including a Pennsylvania Turnpike bus crash; a helicopter crash in Calabasas, California; and a midair collision at Lake Coeur D'Alene in Idaho. During the COVID-19 pandemic, staff provided remote media relations support for every investigation opened by the NTSB. In addition, the division provided virtual media relations training for the transportation industry and a media relations refresher training webinar for NTSB staff.

As shown below in Table 10, the division helped the NTSB garner more than 159,030 print, broadcast, and online news mentions in 2020. The table also provides data on other aspects of our media presence during the year.

Table 10. NTSB Media Presence

Print, broadcast, online mentions 159,030 $$
MWL article mentions 1,744
Media advisories issued
News releases
Tweets
Training events conducted



Figure 28. During the first phase of an accident investigation, members of the investigative team begin their day early and often continue working late into the night. A quiet, pre-dawn moment during the on-scene phase of the Calabasas, California, helicopter accident investigation allowed Board Member Thomas Chapman and Keith Holloway of the Media Relations Division an opportunity to catch up on e-mail.

Government and Industry Affairs Division

The Government and Industry Affairs Division is the NTSB's primary liaison with Congress, the White House, the Government Accountability Office, other federal agencies, and state and local governments. The division informs Congress, governors, and state legislatures about NTSB activities, including accident launches, investigations, Board meetings, and the issuance and current implementation status of safety recommendations. It also manages inquiries from federal, state, and local governments.

The Government and Industry Affairs Division communicates with the transportation industry about agency initiatives and works with the Safety Advocacy Division to support programs and legislation consistent with our safety recommendations and to monitor relevant state legislative activity. In 2020, we supported Board members and investigators on scene for two accident launches and responded to hundreds of requests for information in each mode of transportation. We also initiated agency outreach to congressional, state, and local officials who expressed an interest in improving transportation safety. In addition, the division supported Board member and senior official testimonies and legislative advocacy efforts before state legislatures.

Safety Advocacy Division

The Safety Advocacy Division leads the agency's advocacy efforts and promotes implementation of safety recommendations on the NTSB's MWL. The division relays NTSB safety messages and lessons learned from our accident investigations through print, digital, and social media channels. The MWL is our primary advocacy focus, and we lead the list's biennial development, working with Board members, representatives from RE, and modal office directors to identify issues for inclusion.

In 2020, the division continued advocating for issues included on the 2019–2020 MWL and coordinated the agency's response to a US DOT report to Congress describing the progress federal agencies have made to address these issues. We also facilitated meetings with modal offices to respond to the Government Accountability Office's MWL audit, which recommended improved transparency about how items are selected for the list and how that rationale is explained to the public. In September 2020, the Board approved the new MWL methodology, which staff then used to develop the 2021–2022 MWL.

The division also increased its use of social and digital media in 2020, hosting virtual meetings to relay information to stakeholders and posting hundreds of social media messages on the NTSB blog, Twitter, Facebook, LinkedIn, Instagram, and YouTube pages. We hosted a Twitter chat on May 21, 2020, to call attention to ways that drivers, pilots, and boat and rail operators could mitigate safety risks as the nation returned to normal operations after the pandemic shutdown. We also expanded our use of the agency's LinkedIn page, developing and posting key takeaways and lessons learned from MWL-related accident findings, highlighting the work of agency staff, and promoting job announcements and training events (see Tables 11 and 12, below).

Table 11. Safety Advocacy Division Social Media Followers, Connections, and Subscribers

	2019	2020
Twitter followers	.149,400 .	. 164,200
Instagram followers	3,683 .	6,500
LinkedIn connections	13,762 .	20,118
E-mail subscribers	5,921 .	7,342

Table 12. Safety Advocacy Division Products and Events

Behind the Scene @NTSB podcasts 9
YouTube videos6
Advocacy Spotlight newsletters
Safety Compass blogs
Subscriber e-mails
Events (conference exhibits, advocacy events, presentations, roundtables, and workshops) 49

Digital Services Division

The Digital Services Division supports the NTSB's internal and external strategic communications goals. The division manages agency communications on www.ntsb.gov and designs and develops graphics and audiovisual products that optimize the NTSB's ability to communicate investigation findings and safety messages and to facilitate employee engagement. We also establish visual style and branding standards for the agency and advise internal stakeholders on how to best use visual information to enhance their products.

In 2020, we promoted employee engagement on the agency's new intranet site, keeping NTSB staff members informed and connected, and adapted workflow and operations to improve collaboration and efficiency during the period of maximum telework. We also provided information in response to 1,701 requests and supported a total of 8 Board meetings and 4 public forums, symposiums, or other events.

Figure 29. The Digital Services Division worked with other divisions and offices to support the seven Board meetings held virtually in 2020.



Transportation Disaster Assistance Division

Table 13. Transportation Disaster Assistance Statistics

Family Members and Victims Assisted	2,519
Advocacy and Outreach Events	41
Agencies/Organizations Supported	264



The Transportation Disaster Assistance (TDA)

Division coordinates federal government resources
to support local and state governments, disaster
relief organizations, and transportation carriers to
meet the needs of family members and survivors
following major aviation and rail accidents. Division
staff also serve as the primary source of investigative
information for family members and survivors for any
accident investigated by the NTSB.¹⁴

To support both our investigative and family assistance efforts at major accidents, we maintain formal agreements with the American Red Cross; the US Departments of Homeland Security, Defense, Health and Human Services, and State; and the Federal Bureau of Investigation.

During 2020, TDA staff participated in three accident launches and provided nonlaunch family assistance support for an additional 700 accident investigations in all modes of transportation. We also supported eight Board meetings, interacting with 2,519 accident victims and family members.

On average, each week staff engaged with family members associated with 75 different accidents, encounters that ranged from a single phone call or e-mail to several hours of work over multiple days with numerous family members from a single accident. We also supported a total of 41 advocacy and outreach events.

In addition, TDA staff interfaced with 264 federal, state, and local agencies; transportation industry organizations; and other nongovernmental organizations that have a role in family assistance operations, with an average of 18 engagements per week requiring either travel or remote interaction.

In 2020, TDA was reassigned from the office of Safety Recommendations and Communications to the Office of the Managing Director.





In 1996, Congress enacted the Aviation Disaster Family Assistance Act (Title 49 United States Code [U.S.C.] sections 1136 and 41113), charging the NTSB with assisting victims of aviation disasters and their families, and coordinating with federal agencies, domestic air carriers, and state and local authorities to ensure that the fundamental concerns of families are met. In 1997, the Foreign Air Carrier Family Support Act (Title 49 U.S.C. section 41313) required foreign air carriers operating flights to and from the United States to meet similar victim assistance standards as their US counterparts. The Rail Safety Improvement Act of 2008 (Title 49 U.S.C. sections 1139 and 24316) gave similar responsibilities to the NTSB, Amtrak, and other interestate and intercity high-speed passenger rail operators following rail passenger accidents. Finally, in 2018, Congress further expanded the Board's responsibilities to provide information regarding NTSB investigative processes and products to the families of individuals involved in any accident investigated by the NTSB to the maximum extent practicable in advance of the media (Title 49 U.S.C. section 1140).

Office of Administrative Law Judges

Table 14. Office of Administrative Law Judges Statistics

Total Cases Received	236
Total Cases Closed	155
Emergency Cases Received	128
Emergency Cases Closed	79
Challenges to Emergency Determinations	14
Hearings Held	11
Board Opinions and Orders	22



Since 1967, the NTSB has served as the court of appeals for holders of pilot, mechanic, air carrier, and mariner certificates when the FAA or the Coast Guard suspends or revokes a certificate and when a certificate application is denied.

The judges within the agency's Office of Administrative Law Judges hear and consider the cases of, and issue initial decisions on, administrative appeals of FAA aviation enforcement actions. Under the Equal Access to Justice Act, the judges also adjudicate claims from certificate holders for legal fees and expenses incurred in defending against FAA certificate actions and adjudicate appeals from civil penalty actions assessed against any individual by the FAA. The certificate holder, the person being assessed, or the FAA may appeal an administrative law judge's decision. The Board's review of such an appeal is based on the record of the proceeding, which includes the transcript of the hearing testimony, exhibits, the judge's decision, and appeal briefs submitted by the parties.

Marine certificate actions are heard first by Coast Guard administrative law judges and may be appealed to the Vice Commandant of the Coast Guard. The Vice Commandant's ruling may then be appealed to the NTSB. The same appellate process is followed for marine certificate actions.

We currently have two judges assigned to headquarters in Washington, DC. Our judge stationed in Denver, Colorado, retired in September 2020, and our judge stationed in Dallas-Fort Worth, Texas, retired in December 2020. In the past, our judges held hearings in their circuits, but the pandemic required a transition to virtual hearings. At first, most hearings held were those identified as emergency hearings; as time went on, non-emergency hearings were added to the schedule, enabling the judges ultimately to dispose of 66 percent of the 2020 caseload by year's end.

Training Center

Table 15. **Training Center Statistics**

Courses, Programs, Seminars Offered (Total)	223
Workforce Development Courses	211
Total Attendance	6,083
NTSB Participants	5,485
External Participants	598
International Participants (Representing 32 Countries)	90
Participants from Other Federal Agencies	261



The NTSB Training Center (TC) located in Ashburn, Virginia, provides training opportunities for NTSB employees and others from the transportation community to improve attendees' knowledge of accident investigation techniques and their ability to respond to transportation disasters.

The program includes courses that focus on key competencies to enhance safety through objective investigations in all modes of transportation, as well as specialized topics in cognitive interviewing techniques, human fatigue factors, communications following a transportation disaster, and coordinating family assistance.

The TC promotes safe transportation by ensuring and improving the quality of accident investigation through critical thought, instruction, and research. In every course, instructors communicate lessons learned, foster the exchange of new ideas and new experiences, advocate for operational excellence, and provide a modern platform for accident reconstruction and evaluation.

The TC's high-quality training resources are also used to facilitate family assistance programs, to ensure that NTSB investigators and party representatives can work effectively to investigate accidents, and to support other federal agencies and transportation entities in conducting incident investigations and safety analyses.

The TC's laboratory area contains the reconstruction of TWA Flight 800, as well as other wreckage and materials, enabling participants to gain experience with real-world examples during investigative courses. During 2020, the NTSB initiated plans to create a digital virtualization of the TWA 800 reconstructed wreckage as a way to highlight the transformative developments in investigative techniques and technologies that have occurred over the past quarter-century since our investigation of the inflight breakup of that aircraft.

The TC's Workforce Development curriculum offers NTSB employees access to courses focused on career development and management, leadership, and other mission-critical and support skills. Vacant seats are offered to other small federal agencies on a reciprocal basis to maximize training opportunities and knowledge management for the federal workforce and to provide the best stewardship of taxpayers' training dollars.

Training Center Offerings

In 2020, the TC continued to evaluate its courses, further refine offerings, and improve instruction in all areas of investigative and mission-support training as well as workforce development. TC staff members regularly conduct needs analyses and assessments to ensure that course offerings are responsive to the NTSB's changing needs and priorities. During 2020, all NTSB investigators and on-scene support personnel were trained in the National Incident Management and Incident Command Systems and Emergency Management protocols, to maximize our ability to work effectively with other agencies during the on-scene phase of investigations.

As telework became the norm in 2020, the TC adapted, moving over 90 percent of courses to a virtual platform without negatively affecting course content. Ultimately, this adaptation to include virtual learning will benefit the 25 percent of NTSB employees living outside the Washington, DC, metropolitan area who, in the past, have occasionally been unable to attend in-person training due to limits on travel funds or the time needed for travel.

A new series of instructor-led courses in supervisory competencies emphasizing performance management (particularly in a telework environment) and novel issues related to the pandemic received high marks from supervisors. We also continued to offer a course in refresher training for experienced supervisors as well as executive coaching.

Transportation Community and Partnerships

Furthering the TC's commitment to meeting the training needs of those in other areas of government, the transportation safety community, and transportation safety investigators worldwide, we continue to build upon our alliances with private organizations and federal agencies. For example we partnered with the Coast Guard to conduct two courses in 2020 exclusively to train its aviation and marine safety operations personnel to investigate mishaps involving Coast Guard assets and personnel. Other NTSB accident investigation courses were attended by 261 employees from other federal agencies and 90 investigators from 32 other countries.



Figure 30. Weighing about 60,000 pounds and consisting of almost 1,600 pieces, the 93-foot section of the center fuselage of TWA flight 800 was transported to and reassembled at the NTSB Training Center in 2003. Since then, it has been used to train thousands of investigators from around the world.

Figure 31. Below: The dedication plague mounted at the entrance to the Training Center in Ashburn, Virginia.





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2020 ANNUAL REPORT TO CONGRESS