Abbreviations, Acronyms, and Initialisms

ADAS  advanced driver assistance systems  
ALJ  Office of Administrative Law Judges  
AS  Office of Aviation Safety  
BH  The Bahamas  
CFR  Code of Federal Regulations  
CMA  Columbia Gas of Massachusetts  
DOT  Department of Transportation  
DS  Digital Services Division  
FAA  Federal Aviation Administration  
FIU  Florida International University  
FRA  Federal Railroad Administration  
FV  fishing vessel  
GA  Government and Industry Affairs Division  
HS  Office of Highway Safety  
HOV  high-occupancy vehicle  
IIC  investigator-in-charge  
IMO  International Maritime Organization  
ICAO  International Civil Aviation Organization  
MAIIF  Marine Accident Investigators’ International Forum  
MCAS  Maneuvering Characteristics Augmentation System  
MI  Marshall Islands  
mph  miles per hour  
MR  Media Relations Division  
MS  Office of Marine Safety  
MV  motor vessel  
MWL  Most Wanted List of Transportation Safety Improvements  
NHTSA  National Highway Traffic Safety Administration  
NO  Norway  
nm  nautical miles  
NTSB  National Transportation Safety Board  
NYCT  New York City Transit  
PIC  pilot-in-command  
PN  Panama  
PHMSA  Pipeline and Hazardous Materials Safety Administration  
PT  Portugal  
PV  passenger vessel  
RE  Office of Research and Engineering  
RPH  Office of Railroad, Pipeline, and Hazardous Materials Investigations  
SA  Safety Advocacy Division  
SEPTA  Southeastern Pennsylvania Transportation Authority  
SIC  second-in-command  
SIS  substantially interested State  
SR  Safety Recommendations Division  
SRC  Office of Safety Recommendations and Communications  
sUAS  small unmanned aircraft system (drone)  
SUV  sport utility vehicle  
TDA  Transportation Disaster Assistance Division  
TC  Training Center  
TV  towing vessel  
Uber ATG  Uber Advanced Technologies Group  
UP  Union Pacific Railroad  

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NTSB on Social Media

www.twitter.com/ntsb  
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Figure 1. The photo collage above shows some of the people of the NTSB and various aspects of our work. Since our inception in 1967, the agency has been at the forefront of transportation safety and is recognized internationally for our accident investigation expertise.
Chairman’s Message

I am pleased to present the 2019 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 is recognized internationally for our accident investigation expertise. We have investigated nearly 150,000 aviation accidents and thousands of surface transportation accidents and have issued more than 15,000 safety recommendations as a result.

In 2019, we were again recognized as one of the Best Places to Work in the federal government for small agencies. This report showcases our outstanding work over the last year and provides details about our completed and ongoing investigations, safety recommendations, safety accomplishments, transportation disaster assistance activities, and emerging safety-related issues.

We continued to respond to both longstanding and leading-edge challenges in 2019 as we advanced our transportation safety mission. We completed a total of 1,169 investigations, including the Amtrak passenger train derailment in DuPont, Washington; the collision between US Navy Destroyer John S McCain and Tanker Alnic MC; the Southwest Airlines engine failure in Philadelphia, Pennsylvania; and the pedestrian bridge collapse in Miami, Florida. We also completed a safety research report on bicycle safety and participated in 319 international investigations.

Our 2019 activities included providing our technical expertise regarding the Boeing 737 MAX aircraft and its systems to the Ethiopian Airlines accident investigation. As a result of our participation in that investigation and in the 2018 737 MAX investigation in Indonesia, we developed safety recommendations to address the design certification process.

In addition to deploying teams to accident and crash sites, we promoted the exchange of safety information by holding these safety forums, roundtables, webinars, and workshops:

- **Forum:** Raise the Bar of Your Safety Culture—NTSB at Experimental Aircraft Association Airventure (Aviation Safety)
- **Roundtables:** Alaska Part 135 Flight Operations—Charting a Safer Course (Aviation Safety) Distracted Driving: Perspectives from the Trucking Industry; and Act to End Deadly Distractions (Highway Safety)
- **Webinar:** Collision Avoidance Systems—Why You Need Them in Your Trucks Today! (Highway Safety)
- **Workshop:** Seafloor Investigations Workshop (Marine Safety)

We hope you find this 2019 Annual Report to Congress to be an informative presentation of the agency’s accomplishments.

Sincerely,

Robert L. Sumwalt, III
Chairman

Figure 2. The Honorable Robert L. Sumwalt, III, above, has served as the NTSB Chairman since August 10, 2017.
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.

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 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, railroad, and public transportation modes, as well as accidents related to the transportation of hazardous materials.

In 1974, Congress reestablished the NTSB as a separate entity outside of the 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 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 nearly 150,000 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 12,400 recommendations that have been closed.

Since 1990, we have compiled and published an annual or biennial Most Wanted List 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, and we adjudicate appeals of civil penalty actions taken by the FAA.

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

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
Strategic Goals and Objectives

<table>
<thead>
<tr>
<th>NTSB Strategic Goals</th>
<th>Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Improving Processes:</strong></td>
<td>Improve the timeliness of investigations through data analysis</td>
</tr>
<tr>
<td>Evaluating and identifying ways to enhance the effectiveness and efficiency of our investigative and business processes</td>
<td>Improve the timeliness of agency operations through data analysis</td>
</tr>
<tr>
<td><strong>Improving Products:</strong></td>
<td>Improve the effectiveness of agency products</td>
</tr>
<tr>
<td>Evaluating and identifying ways to enhance the effectiveness and efficiency of our products</td>
<td></td>
</tr>
<tr>
<td><strong>Improving Employee Engagement, Diversity, and Inclusion:</strong></td>
<td>Improve the engagement of agency staff</td>
</tr>
<tr>
<td>Implementing actions to ensure we sustain a culture that is fair and diverse, and that provides opportunities for all employees to excel.</td>
<td>Attract, develop, and retain a high-performing, diverse, and inclusive workforce</td>
</tr>
</tbody>
</table>

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 below (Figure 5). Figure 6 shows our organizational structure. For more information about our offices and their functions, visit the organization page of our website.

Figure 5. For the first time in several years, the NTSB has a full complement of Board Members.

Honorable Robert L. Sumwalt
Chairman

Honorable Bruce Landsberg
Vice Chairman

Honorable Jennifer Homendy
Board Member

Honorable Michael Graham
Board Member

Honorable Thomas Chapman
Board Member
Figure 6. The chart below shows the organization of the NTSB.

Figure 7. From left, Member Graham, Member Chapman, Member Homendy, and Vice Chairman Landsberg listen to Chairman Sumwalt during a Most Wanted List presentation.
NTSB Regions
Headquartered in Washington, DC, our agency has staff working remotely throughout the country and in regional offices in Anchorage, Virginia; Denver, Colorado; Anchorage, Alaska; and Federal Way, Washington.

Figure 8. The United States is divided into four NTSB regions, as illustrated below.
Table 1. 2019\textsuperscript{2} NTSB Safety Statistics At a Glance

<table>
<thead>
<tr>
<th><strong>Safety Recommendations</strong></th>
<th></th>
</tr>
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<tbody>
<tr>
<td>Issued</td>
<td>154</td>
</tr>
<tr>
<td>Closed “Acceptable”</td>
<td>68</td>
</tr>
<tr>
<td>Closed “Unacceptable”</td>
<td>22</td>
</tr>
<tr>
<td>Urgent Closed “Acceptable”</td>
<td>7</td>
</tr>
<tr>
<td>Urgent Closed “Unacceptable”</td>
<td>1</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Reports and Products</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Reports</td>
<td>22</td>
</tr>
<tr>
<td>Accident Briefs</td>
<td>1,148</td>
</tr>
<tr>
<td>Public Safety Forums, Hearings, Roundtables, Seminars, Webinars, and Workshops</td>
<td>6</td>
</tr>
<tr>
<td>Safety Alerts and Videos</td>
<td>3</td>
</tr>
<tr>
<td>Safety Accomplishments\textsuperscript{3}</td>
<td>107</td>
</tr>
<tr>
<td>Safety Results\textsuperscript{4}</td>
<td>142</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Accident Launches</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Accident\textsuperscript{5} Launches</td>
<td>29</td>
</tr>
<tr>
<td>Regional/Field Accident Launches</td>
<td>256</td>
</tr>
<tr>
<td>International Accident Launches</td>
<td>5</td>
</tr>
<tr>
<td>International Accident Travel</td>
<td>7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Research and Engineering/Laboratory</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety Research Published</td>
<td>5</td>
</tr>
<tr>
<td>Safety Data Analyses Completed</td>
<td>275</td>
</tr>
<tr>
<td>Readouts of Vehicle Recorders and Other Electronic Devices Completed</td>
<td>447</td>
</tr>
<tr>
<td>Material Laboratory Exam Reports Completed</td>
<td>174</td>
</tr>
<tr>
<td>Vehicle Performance Reports and Animations Completed</td>
<td>41</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Advocacy and Outreach</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Journal Publications</td>
<td>4</td>
</tr>
<tr>
<td>Advocacy and Outreach Presentations and Events</td>
<td>434</td>
</tr>
<tr>
<td>Testimony to Congressional Committees</td>
<td>11</td>
</tr>
<tr>
<td>Testimony or Legislative Support to State Legislative Committees</td>
<td>3</td>
</tr>
<tr>
<td>Earned Media Mentions (print, broadcast, online)</td>
<td>230,595</td>
</tr>
<tr>
<td>Family Members and Victims Assisted</td>
<td>2,249</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Aviation Certificate Appeals</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Cases Received</td>
<td>257</td>
</tr>
<tr>
<td>Total Cases Closed</td>
<td>225</td>
</tr>
<tr>
<td>Emergency Cases Received</td>
<td>137</td>
</tr>
<tr>
<td>Emergency Cases Closed</td>
<td>137</td>
</tr>
<tr>
<td>Hearings Held</td>
<td>29</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>NTSB Training Center</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Courses, Programs, and Seminars Offered</td>
<td>128</td>
</tr>
<tr>
<td>Total Attendance</td>
<td>6,111</td>
</tr>
<tr>
<td>External Participants</td>
<td>1,269</td>
</tr>
<tr>
<td>International Participants</td>
<td>187</td>
</tr>
</tbody>
</table>

\textsuperscript{2} This annual report reflects NTSB activities from January 1 through December 31, 2019.

\textsuperscript{3} A safety accomplishment is defined as a positive measurable change within the transportation environment that is brought about through some direct action of an NTSB employee. Such changes are considered safety accomplishments only if the action is taken without the NTSB’s issuing a formal safety recommendation.

\textsuperscript{4} Safety results are defined as positive changes within the transportation environment that are effected because of an NTSB accident or incident investigation. Such changes are considered safety results if they occur as a result of the NTSB investigator’s interacting with elements of the transportation environment and by virtue of the investigator’s direct investigation of the facts, conditions, and circumstances of the occurrence.

\textsuperscript{5} The criteria for determining whether an accident is considered “major” varies among the modes, as does the makeup of the investigative team launched to the accident site.
2019–2020 Most Wanted List of Transportation Safety Improvements

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 these gaps.

The Most Wanted List (MWL), the NTSB's premier advocacy tool, was created in 1990 to identify the top safety improvements that can be made across all modes to prevent accidents, minimize injuries, and save lives. 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 from selected safety recommendations and safety issues, and are based on the 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.

The NTSB issued its 2019–2020 MWL on February 4, 2019. The list highlights 10 issues (shown in table 2, below) that contribute to the preventable loss of life across the nation's transportation system. We identified 268 open safety recommendations addressing these key safety issues.

Table 2. Summary Table of NTSB 2019–2020 MWL-Associated Open Safety Recommendations

<table>
<thead>
<tr>
<th>Topic Area</th>
<th>Open Safety Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eliminate Distractions</td>
<td>12</td>
</tr>
<tr>
<td>End Alcohol and Other Drug Impairment</td>
<td>41</td>
</tr>
<tr>
<td>Ensure the Safe Shipment of Hazardous Materials</td>
<td>46</td>
</tr>
<tr>
<td>Fully Implement Positive Train Control</td>
<td>16</td>
</tr>
<tr>
<td>Implement a Comprehensive Strategy to Reduce Speeding-Related Crashes</td>
<td>21</td>
</tr>
<tr>
<td>Improve the Safety of Part 135 Aircraft Flight Operations</td>
<td>21</td>
</tr>
<tr>
<td>Increase Implementation of Collision Avoidance Systems in All New Highway Vehicles</td>
<td>11</td>
</tr>
<tr>
<td>Reduce Fatigue-Related Accidents</td>
<td>42</td>
</tr>
<tr>
<td>Require Medical Fitness—Screen for and Treat Obstructive Sleep Apnea</td>
<td>15</td>
</tr>
<tr>
<td>Strengthen Occupant Protection</td>
<td>43</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>268</strong></td>
</tr>
</tbody>
</table>

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 content included on pages 14–17 is taken from the 2019–2020 MWL. Statistics are those that were available as of February 2019, when the list was issued.
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.

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.

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. Every day that full implementation is delayed puts the public at risk. PTC must be fully implemented before the extended deadline to ensure the safety of railroad passengers and the people who live and work near railroads.
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


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 Safety Recommendations and Communications

Table 3. Office of Safety Recommendations and Communications Safety Statistics

<table>
<thead>
<tr>
<th>Category</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommendations Issued</td>
<td>154</td>
</tr>
<tr>
<td>Recommendations Closed “Acceptable”</td>
<td>68</td>
</tr>
<tr>
<td>Recommendations Closed “Unacceptable”</td>
<td>22</td>
</tr>
<tr>
<td>Urgent Recommendations Closed “Acceptable”</td>
<td>7</td>
</tr>
<tr>
<td>Urgent Recommendations Closed “Unacceptable”</td>
<td>1</td>
</tr>
<tr>
<td>Testimony to Congressional Committees</td>
<td>11</td>
</tr>
<tr>
<td>Testimony or Legislative Support to State Legislative Committees</td>
<td>3</td>
</tr>
<tr>
<td>Earned Media Mentions (print, broadcast, online)</td>
<td>230,595</td>
</tr>
<tr>
<td>Family Members and Victims Assisted</td>
<td>2,249</td>
</tr>
<tr>
<td>Advocacy and Outreach Events</td>
<td>78</td>
</tr>
</tbody>
</table>

The Office of Safety Recommendations and Communications (SRC) publicly releases information across multiple communication channels to engage a range of stakeholders regarding NTSB investigations, activities, and safety recommendations. These stakeholders include victims of transportation accidents and their families; recipients of NTSB recommendations; the transportation industry; transportation workers; federal, state, and local government officials and agencies; transportation safety advocacy organizations; and the public our agency serves. SRC’s mission spans an investigation’s lifecycle, providing the transparency that supports our independence while building public trust and support.

After an investigation concludes, SRC efforts focus on advocating for and monitoring the implementation of safety recommendations. Through many avenues of communication, SRC tells the NTSB story to gain support for the agency and understanding of its mission.

SRC includes the following six divisions:

- Safety Recommendations (SR)
- Transportation Disaster Assistance (TDA)
- Media Relations (MR)
- Government and Industry Affairs (GA)
- Safety Advocacy (SA)
- Digital Services (DS)
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. They are the agency’s most important products, because they are the means of alerting government, industry, and the public of critical changes that are needed to save lives and property.

The Board issues its safety recommendations to the organizations best able to take corrective action. Typical recipients include the DOT and its modal administrations, the Coast Guard, other federal and state agencies, manufacturers, operators, and industry and trade organizations, among others. Once the Board has issued a recommendation, the SR Division helps develop and coordinate strategies to encourage its implementation.

SR 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 journey from issuance to implementation for a specific safety recommendation is sometimes long and can be challenging. SR staff monitors the progress of each recommendation until it is closed. The division also maintains the NTSB safety recommendations database, compiles monthly statistics, and responds to data queries from other offices.

This division's unique experience prepares staff to assist investigative offices in crafting new recommendations. SR staff members research the history of similar recommendations and advise the modes in choosing language shown to be most effective in addressing the safety issue that prompted the recommendation.

In 2019, in response to NTSB safety recommendations, DOT agencies issued several notices of proposed rulemaking, advance notices of proposed rulemaking, draft manuals, notices of proposed information collection, notices of application for exemption, notices of request for comments, and notices of proposed data collection in the Federal Register. Table 4 provides a summary of these actions.

When a major final rule is issued by a DOT agency, it can lead to the closure of numerous NTSB safety recommendations. The fluctuation in the number of recommendations closed in any given year is often the result of such major rulemaking activity—or the lack of it—by DOT agencies that year. Over the last 5 years, the number of recommendations closed “acceptable” to all recipients has ranged from 102 in 2015 to 68 in 2019. (See figure 9.)

Figure 9. The chart below shows safety recommendations that have been closed “acceptable” (by year).

Of the 68 safety recommendations closed “acceptable” in 2019, 30 were to the DOT, its modal agencies, or the Coast Guard. Table 5, below, shows all the safety recommendations closed to these recipients in 2019.

Table 4. NTSB Safety Recommendations Addressed in Federal Register Notices From Federal Agencies in 2019

<table>
<thead>
<tr>
<th>Agency</th>
<th>Number of Federal Register Notices</th>
<th>Number of Safety Recommendations Addressed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Center for Disease Control and Prevention</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>US Department of Transportation</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Federal Aviation Administration</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Federal Motor Carrier Safety Administration</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>Federal Railroad Administration</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>National Highway Traffic Safety Administration</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Pipeline and Hazardous Materials Safety Administration</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>US Coast Guard</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 5. NTSB Safety Recommendations Issued to the DOT, DOT Modal Agencies, and the Coast Guard Closed in 2019

<table>
<thead>
<tr>
<th>Agency</th>
<th>Number of Safety Recommendations Closed</th>
</tr>
</thead>
<tbody>
<tr>
<td>US Department of Transportation</td>
<td>1</td>
</tr>
<tr>
<td>Federal Railroad Administration</td>
<td>20</td>
</tr>
<tr>
<td>Federal Aviation Administration</td>
<td>18</td>
</tr>
<tr>
<td>Federal Motor Carrier Safety Administration</td>
<td>6</td>
</tr>
<tr>
<td>Pipeline and Hazardous Materials Safety Administration</td>
<td>5</td>
</tr>
<tr>
<td>National Highway Traffic Safety Administration</td>
<td>2</td>
</tr>
<tr>
<td>Federal Transit Administration</td>
<td>2</td>
</tr>
<tr>
<td>Federal Highway Administration</td>
<td>1</td>
</tr>
<tr>
<td>US Coast Guard</td>
<td>3</td>
</tr>
</tbody>
</table>

7 In addition, 22 safety recommendations were closed “unacceptable” in 2019.
8 Closed “acceptable” classifications include “Closed—Acceptable Action,” “Closed—Acceptable Alternate Action,” and “Closed—Exceeds Recommended Action.”
Transportation Disaster Assistance Division

TDA 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, as defined in Title 49 United States Code (U.S.C.) sections 1136 and 1139. TDA staff also serve as the primary source of investigative information for family members and survivors for any accident investigated by the NTSB (49 U.S.C. 1140).

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 2019, TDA staff participated in 16 accident launches. Staff also provided non-launch family assistance support for an additional 538 accident investigations in all modes of transportation and supported 10 Board meetings and investigative hearings, interacting with 2,249 accident victims and family members.

On average, each week staff engaged with family members associated with 56 different accidents, encounters that ranged from a single phone call or email to several hours of work over multiple days with numerous family members from a single accident. The division also supported a total of 65 domestic and 4 international outreach events, and coordinated 2 training courses at the NTSB Training Center, resulting in direct contact with approximately 3,993 participants.

Staff interfaced with 347 federal, state, and local agencies; transportation industry organizations; and other nongovernmental organizations that have a role in family assistance operations, with an average of 26 engagements per week requiring either travel or remote interaction.

TDA OPERATING AUTHORITY

- In 1996, Congress enacted the Aviation Disaster Family Assistance Act (Title 49 U.S.C. sections 1136 and 41113), which charged the NTSB with assisting victims of aviation disasters and their families, and coordinating among federal agencies, domestic air carriers, and state and local authorities to ensure that the fundamental concerns of families are met.
- In 1997, Congress enacted the Foreign Air Carrier Family Support Act (Title 49 U.S.C. section 41313) to require 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 gave similar responsibilities to the NTSB, Amtrak, and other interstate and intercity high-speed passenger rail operators following rail passenger accidents (Title 49 U.S.C. sections 1139 and 24316).
- In 2018, Congress 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).
Media Relations Division

MR is responsible for developing and maintaining mutually beneficial relationships with the media to tell the NTSB story and to communicate information to external audiences that promotes transparency and accountability. The division is the primary conduit through which the agency releases information to the media about accident and incident investigations, as well as other newsworthy agency activities, including the release of reports, safety alerts, safety studies, and safety recommendations. The staff responds to media inquiries, arranges and supports media interviews of agency personnel, and are the on-scene public affairs officers supporting Board Members during major accident investigations. The division also supports deployed regional investigators and investigators-in-charge (IIC) and provides training to both NTSB and transportation industry personnel to prepare them for successful media engagement. The staff supports agency events that are open to the media, such as Board meetings, media briefings, and safety advocacy events of media interest.

The division helped the NTSB garner more than 230,595 print, broadcast, and online news mentions in 2019. Special projects included media relations support for nine multimedia projects, including six episodes of the Cineflex production Mayday, documentaries for the Smithsonian Channel (US) and the Discovery Channel (Canada) about the sinking of the SS El Faro; a PBS News Hour story on railroad safety in America; a press conference in Darien, Connecticut, on PTC; Hearst Television's in-depth news package on PTC; and the satellite media tour commemorating the 10th anniversary of the Colgan Air crash.

MR continued to robustly support the 2019–2020 MWL, resulting in more than 2,200 articles mentioning the MWL and the NTSB. Staff supported the agency’s Alaska Part 135 Roundtable, Distracted Driving Roundtable, and a series of advocacy events focused on impairment and occupant safety to help tell the NTSB story and advance transportation safety.

NTSB media advisories and news releases enjoyed a 24 percent open rate—3 points above the accepted 21 percent average for government communications. The 465 unique URLs used in MR products yielded more than 201,624 link clicks, driving online traffic to agency products on the ntsb.gov website, our YouTube channel, and our Flickr account. The resultant earned-media coverage and online engagement speak to the power of the NTSB story and that story’s relevance to our audiences.

Building on past success, MR continued to emphasize the use of imagery in its news releases and tweets. Staff issued 22 media advisories and 56 news releases; more than 60 percent of the news releases contained imagery. Staff also issued 767 tweets via @NTSB_Newsroom, generating more than 66,763 clicks; 9,145 retweets; and 15,189 likes.

MR launched staff on every 2019 major investigation or “Go Team” launch, and supported regional investigators remotely and, in some cases, with on-scene support. The division provided training to more than 1,246 people in 2019 in 24 training events.

Figure 12. MR staff member Keith Holloway photographs Southwest Airlines Flight 1380, a Boeing 737-7H4, during the on-scene phase of the investigation. IIC Bill English is pictured in the background, left.

Figure 11. Peter Knudson from the MR Division provides support for an NTSB Board meeting.
Government and Industry Affairs Division

GA 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 staff informs Congress, governors, and state legislatures about NTSB activities, including accident launches, investigations, Board meetings, and recommendations, and manage inquiries from these groups. The division supports interaction with the transportation industry regarding agency initiatives, and works with the Safety Advocacy (SA) Division to support programs and legislation consistent with safety recommendations and to monitor relevant state legislative activity.

In 2019, staff provided on-scene support to Board Members and investigators for seven accident launches and responded to hundreds of requests for information in each mode of transportation. The division also initiated agency outreach to congressional, state, and local officials who expressed an interest in improving transportation safety. Staff prepared Board Members and senior officials to testify before Congress at 11 hearings to provide information regarding the investigation of 2 crashes involving 737 MAX aircraft (2 hearings), aviation safety (2 hearings), pipeline safety (2 hearings), highway safety, Amtrak, school bus safety, maritime vessel safety, and automated vehicles. The division also filed 10 statutorily required reports to Congress and coordinated responses to 10 engagements from the Government Accountability Office. In addition, GA supported the Senate confirmation process for two new Board Members, and the reconfirmation of two Board Members.

At the state level, GA supported Board Member and senior official testimonies and legislative advocacy efforts before state legislatures, including those regarding highway safety in Massachusetts and Connecticut.

Safety Advocacy Division

SA leads the agency’s advocacy efforts and promotes the implementation of safety recommendations on the NTSB’s MWL. The division relays NTSB safety messages and lessons learned through print, digital media, and social media communications, including the NTSB blog on www.ntsb.gov, Instagram, LinkedIn, Facebook, YouTube, and Twitter. The division distributes agency products and information to stakeholders and advocacy groups.

SA’s primary advocacy focus is the MWL. The division leads the list’s biennial development, working with Board Members, the Office of Research and Engineering (RE), and modal office directors to identify issues for the list. SA also works with MR to create an overall campaign strategy for the MWL, then develops the strategic communications plan that will be employed for each issue area.

The division identifies and coordinates speaking opportunities for Board Members and staff to promote MWL topics and NTSB recommendations, and tracks agency-wide advocacy efforts related to the list. SA produces all MWL-related materials (such as fact sheets, briefing memos, and legislative testimony) directed toward the range of stakeholders interested in the list.

To develop the 2019–2020 MWL, the division executed a new process that included facilitated meetings with modal offices and RE, and revamped its methodology for identifying topics to be included on the list. Staff developed and coordinated the Board Member review and approval process and developed MWL products—fact sheets, key messages, and related brochures. Additionally, SA worked with MR to plan a press conference and public meeting to announce the new list, and the division helped coordinate a response to Congress regarding new appropriations language related to the MWL. Following the public meeting, staff engaged in several activities and events to move the needle on the issues and safety recommendations identified in the new list, raising awareness about the causes and countermeasures of accidents, injuries, and fatalities in all modes of transportation.

Figure 13. Office of Aviation Safety Director Dana Schulze, left, testifies to the House Committee on Transportation and Infrastructure, Aviation Subcommittee, during the subcommittee’s hearing on the State of Aviation, July 2019. Chief Christopher Wallace and specialist Joseph Schmoll, seated behind her, provided GA support.

Figure 14. SA staff prepared numerous graphics like this one for MWL presentations.
In 2019, SA also accomplished the following:

- **Increased social media use and presence.** The division continued to expand the agency’s use of social media and digital media platforms to highlight significant investigative findings, share MWL safety messages and lessons learned, and promote NTSB recommendations. Staff posted hundreds of social media messages via the NTSB blog, Twitter, Facebook, LinkedIn, Instagram, YouTube, and Flickr. Followers increased in all social media. For example, from 2018 to 2019, Twitter followers increased from 138,000 to 149,400; Instagram followers increased from 4,000 to 5,900. In 2019, NTSB blog posts received more than 35,844 views. In addition, SA posted numerous items on Facebook, reaching more than 191,000 people, and connections on the NTSB LinkedIn account increased by 4,000. The division also became more fully engaged with the agency’s official LinkedIn page, including developing and posting a biweekly safety message from the Chairman, highlighting the work of agency staff and job announcements, and promoting key advocacy events.

- **Developed and released new products.** The division introduced a new podcast host, developed a motorcycle safety and truck fleet safety tip card, produced a webinar, and created safety event videos. SA also taped and released 14 episodes of the “Behind the Scene @ NTSB” podcast and developed 8 YouTube videos, which received more than 15,000 total views.

- **Increased information dissemination capabilities to stakeholders via email messaging platforms.** The number of stakeholder subscribers receiving our products increased by 22 percent in 2019 compared to 2018. SA also increased the number of notifications staff sent out related to events, reports, investigative findings, and MWL-associated information.

- **Increased awareness about the MWL and promoted adoption of MWL-related recommendations.** The division supported 78 advocacy and outreach events, which included 15 exhibits, reaching more than 20,000 stakeholders and interested parties. Of the 78 advocacy and outreach events, staff also supported 26 Board-Member trips and presentations, reaching thousands more people. The division hosted four roundtables to discuss topics such as eliminating distractions and improving Part 135 safety. These roundtables drew more than 1,000 attendees, and involvement participation with survivor advocates and aviation association groups. In 2019, advocacy funds supported 66 agency staff member trips focused on promoting the recommendations associated with the MWL issue areas. For the first time, SA worked with MR to publicly highlight, via news releases and other announcements, specific recommendations related to the MWL as they were closed.

- **Developed a regular Chairman’s Message.** The division developed and released new advocacy and agency promotion products via social and digital media, such as the Chairman’s Message.

- **Developed and released three Advocacy Spotlight newsletters.** SA emailed a digital newsletter to thousands of advocacy groups and other interested stakeholders, sharing news of agency activities and other MWL developments.

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![Figure 15. The SA Division employed a wide variety of graphics such as these in social media messaging.](image-url)
Digital Services Division

DS supports the NTSB’s internal and external strategic communications goals. The division designs and develops a range of audiovisual products that optimize the NTSB’s ability to communicate investigation findings and safety messages, and to facilitate employee engagement internally. The division also establishes standards for the agency for visual style and branding and advises internal stakeholders on how to optimize visual information to enhance their products.

In 2019, DS completed more than 2,000 requests for information release via the web, social media, and visual media (graphics, publications, video). Staff supported 22 accident investigation launches; 11 Board meetings; and 7 public forums, symposia, and other events. The division also provided graphics and video support for the 2019–2020 MWL.

DS managed outgoing agency communications on the NTSB’s public website and supported the agency’s social media messaging, increasing engagement with the public and other stakeholders. In addition, staff developed an editorial calendar to ensure consistent informational content for the agency’s digital platforms.

The division also developed a new internal internet site to support employee engagement, using internal resources and technologies, which saved the agency approximately $200,000 in outside contracting fees.

Figure 16. InsideNTSB was developed to help employees find work resources faster, get to know each other better, and keep up with the latest NTSB news and information.

The six divisions described above are charged with providing information to Congress, industry, the general public, and the families of victims of transportation disasters. From the day of an accident through the day recommended safety measures are implemented, SRC plays a crucial role in the NTSB’s mission.
<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Accident Information</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RAIL, PIPELINE &amp; HAZARDOUS MATERIALS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>February 6</td>
<td>San Francisco, California</td>
<td>An excavator damaged a Pacific Gas &amp; Electric natural gas main. A release of gas and the subsequent ignition led to a fire.</td>
</tr>
<tr>
<td>August 1</td>
<td>Danville, Kentucky</td>
<td>A 30-inch natural gas transmission pipeline failed, releasing a fireball.</td>
</tr>
<tr>
<td><strong>HIGHWAY</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>June 21</td>
<td>Randolph, New Hampshire</td>
<td>A pickup truck towing a trailer collided with a group of motorcyclists on a two-lane highway, causing the death of seven motorcyclists.</td>
</tr>
<tr>
<td>September 9</td>
<td>Bryce Canyon, Utah</td>
<td>A 29-passenger medium-size bus departed the roadway and, as the driver attempted to regain control, the vehicle rolled over. The crash caused the death of four people.</td>
</tr>
<tr>
<td><strong>MARINE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>September 2</td>
<td>Ventura, California</td>
<td>A fire broke out aboard the commercial diving vessel Conception (US Flag, 75-foot) offshore of Ventura. The Coast Guard classified this accident a major marine casualty. The NTSB is leading the investigation.</td>
</tr>
<tr>
<td><strong>AVIATION</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>February 3</td>
<td>Yorba Linda, California</td>
<td>A Cessna 414 impacted terrain east of Fullerton airport. An in-flight breakup was reported just before the wreckage impacted a residential neighborhood.</td>
</tr>
<tr>
<td>February 22</td>
<td>Baytown, Texas</td>
<td>A Boeing 767-300 crashed into Trinity Bay during approach to George Bush Intercontinental Airport, causing the deaths of three people.</td>
</tr>
<tr>
<td>April 22</td>
<td>Kerrville, Texas</td>
<td>A Beechcraft BE-58 crashed on approach to Kerrville Municipal Airport.</td>
</tr>
<tr>
<td>May 3</td>
<td>Jacksonville, Florida</td>
<td>A B737-800 departed the end of the runway and entered St. John's River.</td>
</tr>
<tr>
<td>May 13</td>
<td>Ketchikan, Alaska</td>
<td>A de Havilland DHC-2 collided midair with a de Havilland DHC-3. Both flights were operating as Part 135 sightseeing tours.</td>
</tr>
<tr>
<td>June 10</td>
<td>New York, New York</td>
<td>An Augusta A109E helicopter crash-landed on a roof in midtown Manhattan. The helicopter was destroyed.</td>
</tr>
<tr>
<td>June 21</td>
<td>Mokuleia, Hawaii</td>
<td>A Beech 65-A90 airplane crashed north of the runway at Dillingham Airfield during a parachute operation.</td>
</tr>
<tr>
<td>June 30</td>
<td>Addison, Texas</td>
<td>A Beech BE-350 collided with a hangar and terrain after takeoff from Addison Airport. The airplane was destroyed and a postimpact fire ensued.</td>
</tr>
<tr>
<td>August 17</td>
<td>Lagrangeville, New York</td>
<td>A Cessna 303 crashed into a residence under unknown circumstances.</td>
</tr>
<tr>
<td>October 2</td>
<td>Windsor Locks, Connecticut</td>
<td>A Boeing B-17G operating as a sightseeing flight under Part 91 was destroyed when it collided with an airport building following a runway excursion while landing at Bradley International Airport.</td>
</tr>
</tbody>
</table>
The Office of Aviation Safety's (AS) mission is to—

- investigate all air carrier, commuter, and air taxi accidents; fatal and nonfatal general aviation accidents; certain public aircraft accidents; and select serious incidents.
- participate in the investigations of major airline and significant general aviation crashes in foreign countries that involve US carriers, US-manufactured or designed equipment, or US-registered aircraft to fulfill US obligations under International Civil Aviation Organization (ICAO) agreements.
- conduct investigations concerning safety issues that extend beyond a single accident to examine specific aviation safety problems from a broader perspective.

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 four specialty divisions based in Washington, DC, and a regional investigation management structure consisting of four regional office sites. Investigators are located throughout the country. International aviation activities are coordinated from the Washington, DC, office.

### Table 7. Office of Aviation Safety Statistics

<table>
<thead>
<tr>
<th>Category</th>
<th>Number</th>
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</thead>
<tbody>
<tr>
<td>Recommendations Issued</td>
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</tr>
<tr>
<td>Recommendations Closed &quot;Acceptable&quot;</td>
<td>16</td>
</tr>
<tr>
<td>Recommendations Closed &quot;Unacceptable&quot;</td>
<td>5</td>
</tr>
<tr>
<td>Major Reports</td>
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</tr>
<tr>
<td>Accident Briefs</td>
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</tr>
<tr>
<td>Major Investigation Launches</td>
<td>10</td>
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<td>Regional Investigation Launches</td>
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<td>International Accident Travel</td>
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<td>International Accident Notifications</td>
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<td>Safety Accomplishments</td>
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<td>Safety Alerts</td>
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<tr>
<td>Public Forums and Seminars</td>
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</tr>
<tr>
<td>Journal Publication</td>
<td>1</td>
</tr>
<tr>
<td>Advocacy and Outreach Events</td>
<td>196</td>
</tr>
</tbody>
</table>
Completed Major Investigations

Runway Overrun During Rejected Takeoff
Ameristar Air Cargo Inc.
Ypsilanti, Michigan (1 injured)

On March 8, 2017, Ameristar Air Cargo Inc., dba Ameristar Charters, flight 9363, a Boeing MD-83 airplane, N786TW, overran the departure end of runway 23L at Willow Run Airport in Ypsilanti, Michigan, after the captain executed a rejected takeoff. All 110 passengers and 6 crewmembers evacuated the airplane via emergency escape slides; however, one slide failed to inflate and could not be used. One passenger received a minor injury, and the airplane sustained substantial damage. The airplane was operated under the provisions of Title 14 CFR Part 121 as an on-demand charter flight and was destined for Washington Dulles International Airport in Virginia.

We determined that the probable cause of this accident was the airplane's jammed right elevator, which resulted from exposure to localized dynamic wind while the airplane was parked and rendered the airplane unable to rotate during takeoff. Contributing to the accident was the effect of a large structure on the gusting surface wind at the airplane's parked location, which led to turbulent gust loads on the right elevator sufficient to jam it, even though the horizontal surface wind speed was below the certification design limit and maintenance inspection criteria for the airplane. Also contributing to the accident was the lack of a means to enable the flight crew to detect a jammed elevator during preflight checks for the Boeing MD-83 airplane. Contributing to the survivability of the accident was the captain's timely and appropriate decision to reject the takeoff, the check airman's disciplined adherence to standard operating procedures after the captain called for the rejected takeoff, and the dimensionally compliant runway safety area where the overrun occurred.

Departure From Controlled Flight
Trans-Pacific Air Charter LLC
Teterboro, New Jersey (2 fatalities)

On May 15, 2017, a Learjet 35A, N452DA, departed controlled flight while on a circling approach to runway 1 at Teterboro Airport in New Jersey and impacted a commercial building and parking lot. The pilot-in-command (PIC) and the second-in-command (SIC) died; no one on the ground was injured. The airplane was destroyed by impact forces and postcrash fire. The airplane was registered to A&C Big Sky Aviation LLC and was operated by Trans-Pacific Air Charter LLC under the provisions of 14 CFR Part 91 as a positioning flight. Visual meteorological conditions prevailed, and an instrument flight rules flight plan was filed. The flight departed from Philadelphia International Airport in Pennsylvania and was destined for Teterboro Airport.

As a result of this investigation, we issued six safety recommendations and classified two previously issued safety recommendations. The FAA and The Boeing Company received recommendations.
the accident were Trans-Pacific’s lack of safety programs that would have enabled the company to identify and correct patterns of poor performance and procedural noncompliance and the FAA’s ineffective safety assurance system procedures, which failed to identify these company oversight deficiencies.

As a result of this investigation, we issued three safety recommendations and reiterated six previously issued safety recommendations to the FAA.

### Fatal, Doors-Off Helicopter Crash
**East River, New York (5 fatalities, 1 injured)**

On March 11, 2018, an American Eurocopter Corp (Airbus Helicopters) AS350B2, N350LH, was substantially damaged when it impacted the East River and subsequently rolled inverted after the pilot reported a loss of engine power near New York City. The pilot egressed from the helicopter and sustained minor injuries. The five passengers died on board. The scheduled 30-minute, doors-off aerial photography flight was operated by Liberty Helicopters Inc, on behalf of FlyNYON under the provisions of 14 CFR Part 91. Visual meteorological conditions prevailed, and no flight plan was filed for the flight, which originated from Helo Kearny Heliport in Kearny, New Jersey.

We determined that the probable cause of this accident was Liberty Helicopters Inc’s use of a NYONair-provided passenger harness/tether system, which caught on and activated the floor mounted engine fuel shutoff lever and resulted in the in-flight loss of engine power and the subsequent ditching. Contributing to this accident were Liberty’s and NYONair’s deficient safety management, which did not adequately mitigate foreseeable risks associated with the harness/tether system interfering with the floor-mounted controls and hindering passenger egress. Also contributing was Liberty allowing NYONair to influence the operational control of Liberty’s FlyNYON flights, and the FAA’s inadequate oversight of Title 14 CFR Part 91 revenue-passenger-carrying operations. Contributing to the severity of the accident was the rapid capsizing of the helicopter caused by partial inflation of the emergency flotation system and Liberty’s and NYONair’s use of the harness/tether system that hindered passenger egress.

As a result of this investigation, we issued one urgent recommendation (in March 2018) and 16 additional safety recommendations upon adoption of our final report. The FAA, Airbus Helicopters, the European Union Aviation Safety Agency, Liberty Helicopters, and NYONair received recommendations.

### CFM International Engine Failure
**Southwest Airlines**

**Philadelphia, Pennsylvania (1 fatality, 8 injured)**

On April 17, 2018, Southwest Airlines flight 1380, a Boeing 737-700, N772SW, experienced a failure of the left CFM International CFM-56-7B engine and loss of engine inlet and cowling while climbing at an altitude of 32,000 feet. Fragments from the engine inlet and cowling struck the wing and fuselage, which damaged a passenger window and resulted in a rapid depressurization. The flight crew conducted an emergency descent and diverted into Philadelphia International Airport in Pennsylvania. Of the 144 passengers and 5 crewmembers onboard, 1 passenger received fatal injuries and 8 passengers received minor injuries. The airplane sustained substantial damage.

The regularly scheduled domestic passenger flight was operating under Title 14 CFR Part 121 from LaGuardia Airport in Queens, New York, to Dallas Love Field in Texas.

*Figure 20. This photo shows the front passenger’s tether with top locking carabiner inserted through the third webbing loop (from floor) with three excess loops hanging as a tail. Note: The tether tail’s terminating loop (yellow) is partially obscured.*

*Figure 21. The engine inlet of the Boeing 737-700 was substantially damaged when the inner barrel forward of the containment shield separated circumferentially from the rest of the inlet. Only a portion of the inner barrel back skin remained.*
We determined that the probable cause of this accident was a low-cycle fatigue crack in the dovetail of fan blade No. 13, which resulted in the fan blade’s separating in flight and impacting the engine fan case at a location that was critical to the structural integrity and performance of the fan cowl structure. This impact led to the in-flight separation of fan cowl components, including the inboard fan cowl aft latch keeper, which struck the fuselage near a cabin window and caused the window to depart from the airplane, the cabin to rapidly depressurize, and the passenger to be fatally injured.

As a result of this investigation, we issued seven safety recommendations to the FAA, Southwest Airlines, and the European Union Aviation Safety Agency.

Completed Accident or Incident Briefs

In 2019, 1,095 investigations were completed. The accident and incident briefs below highlight some of the investigations that resulted in critical safety changes and addressed new technology (unmanned aircraft systems).

- **Loss of Engine Power**
  Gypsum, Kansas (no fatalities or injuries)
  On May 5, 2017, a Thrush Aircraft Inc. 52R-H80 airplane, N3045R, lost engine power and impacted terrain and a fence during a forced landing near Gypsum, Kansas. The commercial pilot was uninjured; the airplane sustained substantial fuselage damage during the forced landing. The airplane was registered to and operated by Central Ag Air LLC as a 14 CFR Part 137 aerial application flight. The local flight originated from the Marion Municipal Airport, near Marion, Kansas.
  We determined that the probable cause of this accident was a total loss of engine power during a low-altitude agricultural application flight for reasons that could not be determined during detailed examinations. Contributing to the accident was the pilot’s failure to follow the airplane manufacturer’s emergency procedures to recover engine power, which resulted in a forced landing.
  As a result of this investigation, Thrush Aircraft issued a service bulletin that provides instructions and parts for an improved fuel pump system including new hardware, fuel lines, and location of pumps to ease replacement in the field.

- **Loss of Engine Power During Cruise Flight**
  Adrian, Michigan (2 injured)
  On August 11, 2017, a Navion G airplane, N249KC, lost engine power and impacted trees near Adrian, Michigan. The flight instructor and private pilot were seriously injured, and the airplane sustained substantial damage. The airplane was registered to Kalea Co. LLC and operated by Sky Walker Flying under the provisions of 14 CFR Part 91 as an instructional flight. The local flight departed Lenawee County Airport in Adrian.
  We determined that the probable cause of this accident was a leak in the gascolator, which allowed air to enter the fuel system and resulted in a partial loss of engine power.
  As a result of this investigation, the FAA issued an aviation maintenance alert recommending that all Navion model airplanes complete the gascolator test found in manufacturer service bulletins and take the proper corrective action if the gascolator fails the test.

- **Engine Fire After Touchdown**
  Glendale, Arizona (no fatalities or injuries)
  On August 22, 2017, an Enstrom F-28F helicopter, N52PD, experienced smoke coming from the engine cowling area after touchdown at the Glendale Municipal Airport, Glendale, Arizona. The certified flight instructor and student pilot were not injured, and the helicopter was not damaged. The helicopter was registered to and operated by Airwest Aviation Academy LLC under the provisions of 14 CFR Part 91 as an instructional flight.
  We determined that the probable cause of this incident was an internal failure of the turbocompressor, which resulted in oil leaking into the turbocompressor’s exhaust.
  As a result of this investigation, the FAA issued a safety airworthiness information bulletin alerting owners, operators, maintenance technicians, and inspectors of the potential failure of v-band couplings used in exhaust systems on turbocharged aircraft.
Engine Fire During Takeoff
Las Vegas, Nevada (no fatalities or injuries)

On September 6, 2017, a Delta Air Lines Boeing 757-232, N686DA, equipped with two Pratt & Whitney PW2037 turbofan engines, experienced a No. 1 (left) engine undercowl fire during takeoff from McCarran International Airport in Las Vegas, Nevada. The flight crew reported a left engine fire indication and associated aural fire alert at rotation/initial climb. The crew completed the quick reference handbook procedures, declared an emergency, shut down the left engine, and discharged one of the fire bottles; the fire warning was cleared momentarily. The crew then initiated engine-out procedures to return to the airport. During the downwind leg of the airplane’s flight pattern, the fire warning indication re-illuminated and the second fire bottle was discharged, which cleared the fire warning a second time. The airplane made an uneventful overweight landing at McCarran International Airport and was met by aircraft rescue and firefighting personnel on the runway, who sprayed fire retardant into the engine and confirmed that the fire was extinguished. The airplane was cleared to taxi to the gate under its own power. There were no passenger or crew injuries reported. The flight was being operated in accordance with 14 CFR Part 121 and was a regularly scheduled flight from Las Vegas to John F. Kennedy International Airport in Queens, New York.

We determined that the probable cause of this accident was a No. 1 (left) engine undercowl fire caused by a fuel nozzle installation error during engine overhaul at Delta TechOps. A fuel nozzle b-nut was cross threaded, which allowed fuel to leak on hot engine case surfaces and subsequently ignite.

As a result of this investigation, Delta Airlines updated the diffuser and combustor assembly work instruction card to add an inspector sign-off requirement during the pneumatic leak check step of the fuel system assembly to avoid future installation errors.

Impact with Terrain After Takeoff
San Diego, California (1 fatality)

On February 21, 2018, a Cirrus SR22T airplane, N707DF, impacted terrain shortly after takeoff from Montgomery-Gibbs Executive Airport in San Diego, California. The private pilot was fatally injured and the airplane sustained substantial damage. The airplane was registered to the pilot, who was operating it as a 14 CFR Part 91 personal flight.

We determined that the probable cause of this accident was the pilot’s exceedance of the airplane’s critical angle of attack during an attempted return to the runway following a total loss of engine power after takeoff, which resulted in an aerodynamic stall. Contributing to the accident was the excessive amount of fuel being delivered to the engine for reasons that could not be determined based on the available information.

As a result of this investigation, Cirrus issued a service advisory reminding pilots of the proper use of the fuel pump and of the proper fuel flow parameters.

Runway Excursion During Takeoff
Parkin, Arkansas (no fatalities or injuries)

On May 31, 2018, a Thrush Aircraft S2R-H80, N6215P, received substantial damage during a runway excursion during takeoff on runway 18 from a private airstrip near Parkin, Arkansas. The pilot was not injured. The aircraft was registered to Mid Continent Aircraft Corporation and operated by Air Aids Inc. under the provisions of 14 CFR Part 137 as an aerial application flight.

We determined that the probable cause of this accident was the improper operation of the rudder pedal adjustment mechanism for an undetermined period of time, which led to the failure of the rudder pedal adjustment track, the detachment of the rudder pedal, and the pilot’s subsequent inability to maintain directional control.

As a result of this investigation, Thrush Aircraft issued a service letter to operators detailing proper use, rigging, and maintenance of the rudder system, including the rudder pedal adjustment mechanism.

Inflight Wing Separation on Piper PA-28R Airplane
Daytona Beach, Florida (2 fatalities)

On April 4, 2018, a Piper PA-28R-201, N106ER, collided with terrain following an in-flight separation of the left-wing near the wing root during climb after a touch-and-go maneuver at Daytona Beach International Airport in Florida. The airplane was destroyed. The airplane was registered to and operated by Embry-Riddle Aeronautical University under the provisions of 14 CFR Part 91 as a local instructional flight.

We determined that the probable cause of this accident was extensive fatigue cracking in the left-wing main spar lower cap and doublers, which resulted in the in-flight separation of the left wing. The fatigue cracks initiated and grew to a critical size because of flight and ground loads associated with flight-training: flight-training maneuvers, significant operation at low altitudes, and frequent landing cycles. Previously established inspection criteria were insufficient to detect the fatigue crack before it grew to a critical size.

As a result of this investigation, Piper developed new inspection techniques, procedures, and tools to improve inspection accuracy, and the FAA issued an airworthiness directive for inspections and for owners to report findings.
Unmanned Aircraft System Crash
Blacksburg, Virginia (no fatalities or injuries)

On August 14, 2018, at the Mountain Lake Biological Station, Blacksburg, Virginia, a Dà-Jiang Innovations Phantom 4 small unmanned aircraft system (sUAS, or drone), registration FA3HCWCR4X, operated by the Virginia Tech Conservation Management Institute, collided with a bystander, who sustained minor injuries. The drone was not damaged. The flight was an educational demonstration flight conducted in Class G airspace under the provisions of 14 CFR Part 107. Visual flight rules conditions prevailed at the time of the incident.

We determined that the probable cause of this incident was the drone pilot's incorrect control inputs caused by insufficient knowledge of the aircraft flight manual procedures. Contributing to the incident was the close proximity of the observers and the decision to conduct a demonstration near the observers in a confined area with no assistance.

Completed Safety Recommendation Report
Assumptions Used in the Safety Assessment Process and the Effects of Multiple Alerts and Indications on Pilot Performance

We issued seven safety recommendations to the FAA as a result of our participation under the provisions of ICAO Annex 13 in the investigations of two fatal accidents involving the Boeing 737 MAX. As the accident investigation authority for the state of design and manufacture of the airplane in these accidents, we examined the US design certification process that was used to approve the Maneuvering Characteristics Augmentation System (MCAS) on the Boeing 737 MAX. Following the PT Lion Mentari Airlines accident on October 29, 2018, Boeing developed an MCAS software update to provide additional layers of protection and was working on updated procedures and training when the Ethiopian Airlines accident occurred on March 10, 2019. We are concerned that the process used to evaluate the original design needs improvement because that process is still used to certify current and future aircraft and system designs. The Ethiopian accident investigation is ongoing, and we continue to participate in that investigation.

Ongoing Investigations

As of December 31, 2019, AS had 2,062 open domestic investigations. The following highlights the major investigations involving significant safety issues that which we launched on in 2019:

- A Bell 400 helicopter air ambulance crash in instrument meteorological conditions; Zaleski, Ohio; January 29, 2019; 3 fatalities.
- A Boeing 767-375BCF cargo airplane rapid descent and crash; Trinity Bay, Texas; February 23, 2019; 3 fatalities.
- A de Havilland DHC-2 and a de Havilland DHC-3 midair collision; Ketchikan, Alaska; May 13, 2019; 6 fatalities.
- A Beech 65-A90 airplane crash on takeoff during a parachute operation; Mokuleia, Hawaii; June 21, 2019; 11 fatalities.
- Safety of Part 91 commercial passenger-carrying operations; multiple investigations.
- A Saab 2000 airplane runway overrun; Dutch Harbor, Alaska; October 17, 2019; 1 fatality.
- An Airbus AS 350B2 air tour crash; Lihue, Hawaii; December 26, 2019; 7 fatalities.

Figure 22. NTSB investigator Clint Crookshanks and Board Member Jennifer Homendy observe the site of the midair collision near Ketchikan, Alaska.
INTERNATIONAL PROGRAM

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 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.

International Investigations

The AS international program accomplishes its overall mission of improving aviation safety most directly through participation in foreign investigations involving US aviation operations and products in accordance with ICAO protocols. NTSB participation in foreign investigations is crucial to identifying and driving aviation safety improvements in the US and abroad.

The international program also includes an array of collaborative and outreach initiatives to ensure support for US interests and to enhance the overall effectiveness of the international investigation process. AS staff represent the US on the ICAO Accident Investigation Panel and are actively involved in working groups addressing international investigation matters. AS serves as the focal point for NTSB participation in the US Interagency Group on International Aviation, a multi-agency initiative responsible for coordinating US positions for the Department of State on high-level international aviation issues.

The AS international program also includes extensive outreach to international accident investigation authorities, the FAA, and other US agencies and stakeholders to promote harmonized improvements to the aviation safety system.

The following are ongoing international investigations on which staff launched in 2019:

- On March 10, 2019, Ethiopian Airlines flight 302, a Boeing 737 MAX, crashed shortly after takeoff from Addis Ababa Bole International Airport in Ethiopia. All 157 passengers and flight crew onboard were fatally injured and the airplane was destroyed. The accident is being investigated by the Ethiopian Civil Aviation Authority. 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.

- On October 20, 2019, a Thai Airways International Boeing 777-300ER powered by two General Electric GE90-115B turbofan engines aborted takeoff after experiencing a high pressure turbine uncontainment in the No. 1 engine. The incident is being investigated by Thailand’s Aircraft Accident and Incident Investigation Commission. 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 and engines.
Forum and Roundtable

Forum Presentation Series:
Raise the Bar of Your Safety Culture
Experimental Aircraft Association AirVenture, Oshkosh, Wisconsin

From July 22 to 28, 2019, a contingent of NTSB aviation investigators, researchers, recorder specialists, and safety advocates presented and exhibited at one of the general aviation industry’s largest aviation air shows in the world. As part of the NTSB Forum Presentation Series, we discussed all the ways general aviation pilots can raise the bar of their safety cultures. We also teamed up with aviation industry’s largest aviation air shows in the world.

Most Wanted List Roundtable:
Alaska Part 135 Flight Operations—Charting a Safer Course

On September 6, 2019, at the University of Alaska in Anchorage, we held an MWL Roundtable on Part 135 flight operations (“Improve the Safety of Part 135 Flight Operations”), an issue on the NTSB’s 2019–2020 MWL. Since 2008, we have investigated 182 accidents involving fixed-wing scheduled and nonscheduled Part 135 operations in Alaska that resulted in 74 fatalities, and we continue to investigate multiple accidents involving Part 135 flight operations in Alaska each year. Unique terrain conditions, challenging weather, and congested airspace are factors, but we believe many of the accidents that have occurred to date could have been avoided if operators had implemented safety management systems, installed flight data monitoring devices, and ensured that pilots received comprehensive controlled-flight-into-terrain avoidance training—all the subjects of recommendations we have issued in the last few decades.

Safety Alerts

Stabilized Approaches Lead to Safe Landings (SA-077)

This safety alert provides information on best practices and procedures for stabilized approaches, which lead to safe landings.

Fuel Providers: Prevent DEF Jet Fuel Contamination (SA-079) and Safety Alert Supplemental Flyer

This safety alert provides information on preventing aviation fuel contamination.
Office of Highway Safety

The Office of Highway Safety (HS) investigates accidents that have a significant impact on public confidence in highway transportation safety, highlight national safety issues, or generate high public interest and media attention. Such accidents may include collapses of highway bridge or tunnel structures, mass casualties and injuries on public transportation vehicles (such as motorcoaches and school buses), collisions at highway–rail grade crossings, and accidents that involve new safety issues or technologies. In addition, HS publishes safety 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 primary units: the Investigations Division and the Report Development Division.

Accidents may include collapses of highway bridge or tunnel structures, mass casualties and injuries on public transportation vehicles (such as motorcoaches and school buses), collisions at highway–rail grade crossings, and accidents that involve new safety issues or technologies.

### Table 8. Office of Highway Safety Statistics

<table>
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<td>Recommendations Closed &quot;Unacceptable&quot;</td>
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<td>Major Reports</td>
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<td>Accident Briefs</td>
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<td>Safety Accomplishments</td>
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<td>Public Roundtables and Webinars</td>
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<td>Advocacy and Outreach Events</td>
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Completed Major Investigation Reports

School Bus Run-Off-Road and Fire
Oakland, Iowa (2 fatalities)

On December 12, 2017, a 2004 International 65-passenger school bus, operated by the Riverside Community School District, was traveling south on rural 480th Street outside Oakland, Iowa. The bus driver turned onto a residential driveway to pick up the first student on his route. After the 16-year-old student boarded, the driver reversed out of the driveway, his normal practice, then backed across 480th Street and continued driving in reverse until the bus’s rear wheels ran off the road and dropped into a 3-foot-deep ditch. As the driver tried to drive the bus out of the ditch, a fire began in the engine compartment and spread throughout the bus. Both the driver and passenger died in the fire.

Figure 23. This school bus burned when the driver backed into a ditch, the exhaust pipe was blocked, and the fuel was ignited. Both the driver and the only passenger died in the fire.

We determined that the probable cause of the investigation was the driver’s failure to control the bus, backing it into a roadside ditch for reasons that could not be established, and the failure of the Riverside Community School District to provide adequate oversight by allowing a driver with a known physical impairment that limited his ability to perform emergency duties to operate a school bus. The probable cause of the fire was ignition of a fuel source on the exterior of the engine’s turbocharger because of turbocharger overload and heat production, resulting from the blockage of the exhaust pipe by the bus’s position in the ditch and the driver’s attempts to accelerate out of the ditch. Contributing to the severity of the fire was the spread of flames, heat, and toxic gases from the engine into the passenger compartment through an incomplete firewall.

As a result of this investigation, we issued 10 safety recommendations. The DOT; the National Highway Traffic Safety Administration (NHTSA); 44 states (including Iowa), the District of Columbia, and the Commonwealth of Puerto Rico; the Riverside Community School District; 3 school transportation associations; and 7 school bus manufacturers received safety recommendations. We also reiterated one recommendation to NHTSA and classified a previously issued recommendation to the three school transportation associations.

Pedestrian Bridge Collapse
Miami, Florida (6 fatalities, 8 injured)

On March 15, 2018, a partially constructed pedestrian bridge crossing an eight-lane roadway in Miami, Florida, experienced a catastrophic structural failure in the nodal connection between truss members 11 and 12 and the bridge deck. The 174-foot-long bridge span fell about 18.5 feet onto SW 8th Street, which consists of four through travel lanes and one left-turn lane in the eastbound direction, and three through travel lanes in the westbound direction. Two of the westbound lanes below the north end of the bridge were closed to traffic at the time of the collapse; however, one westbound lane and all five eastbound lanes were open.

The pedestrian bridge was under construction as part of the Florida International University (FIU) City Prosperity Project. Eight vehicles that were stopped below the bridge at the time of the collapse were fully or partially crushed; seven of those were occupied. As a result of the bridge collapse, one bridge worker and five vehicle occupants died. Four bridge workers and four other people were injured.

We determined that the probable cause of the bridge collapse was the load and capacity calculation errors made by FIGG Bridge Engineers Inc. in its design of the main span truss member 11/12 nodal region and connection to the bridge deck. Contributing to the collapse was the inadequate peer review performed by Louis Berger, which failed to detect the calculation errors in the bridge design. Further contributing to the collapse was the failure of the FIGG engineer of record to identify the significance of the structural cracking observed in this node before the collapse and to obtain an independent peer review of the remedial plan to address the cracking. Contributing to the severity of the collapse outcome was the failure of MCM (the design builder); FIGG; Bolton, Perez and Associates Consulting Engineers; FIU; and the Florida Department of Transportation to cease bridge work when the structure cracking reached unacceptable levels and to take appropriate action to close SW 8th Street as necessary to protect public safety.

As a result of this investigation, we issued 11 safety recommendations. The Federal Highway Administration, Florida Department of Transportation, American Association of State Highway and Transportation Officials, and FIGG received recommendations.

Figure 24. These still images from an FIU parking garage camera show an east view of the pedestrian bridge on March 15, 2018, pre-collapse (top) and postcollapse (bottom).
Collision Between Vehicle Controlled by Developmental Automated Driving System and Pedestrian
Tempe, Arizona (1 fatality)

On March 18, 2018, a 49-year-old woman died when a test vehicle struck her as she was walking a bicycle mid-block across Mill Avenue in Tempe, Arizona. The test vehicle, a 2017 Volvo XC90 sport utility vehicle modified with an Uber Advanced Technologies Group (ATG) developmental automated driving system, was occupied by one operator, who was not injured in the crash. The vehicle was controlled by the Uber ATG developmental automated driving system as it encountered the pedestrian.

We determined that the probable cause of the collision was the failure of the vehicle operator to monitor the driving environment and the operation of the automated driving system because she was visually distracted throughout the trip by her personal cell phone. Contributing to the crash were Uber ATG's inadequate safety risk assessment procedures, ineffective oversight of vehicle operators, and inadequate mechanisms for addressing operators' automation complacency—all a consequence of Uber ATG's inadequate safety culture. Further factors contributing to the crash were the impaired pedestrian's crossing the street outside a crosswalk, and the Arizona Department of Transportation's insufficient oversight of automated vehicle testing.

As a result of this collision, we issued six safety recommendations. Recipients included NHTSA, the state of Arizona, the American Association of Motor Vehicle Administrators, and Uber ATG.

Completed Accident Briefs

Investigations resulting in accident briefs are more limited in scope than those leading to major accident reports and primarily determine probable cause. These briefs may be issued by the office director under delegated authority or may be adopted by the Board.

Low-Speed Collision Between Truck-Tractor and Autonomous Shuttle
Las Vegas, Nevada (no fatalities or injuries)

On November 8, 2017, a minor collision occurred on south 6th Street in downtown Las Vegas, Nevada, between a truck-tractor combination vehicle, operated by a 48-year-old driver, and a 2017 Navya Arma autonomous shuttle carrying 7 passengers and a 38-year-old attendant. The shuttle, manufactured by Navya and operated by Keolis North America, was on a 0.6-mile designated loop beginning and ending at a downtown shopping center known as Container Park. The combination vehicle, a 2006 International truck-tractor pulling a 2010 Utility refrigerated trailer, was backing into an alley west of South 6th Street while on a delivery route for US Foods when it struck the shuttle.

The shuttle was a test vehicle, part of a pilot program in Las Vegas, and was on its first day of passenger-carrying operations (shuttle rides were free) when the collision occurred. The pilot program ran from October 2017 to October 2018.

We determined that the probable cause of this collision was the truck driver's backing into the alley and expecting that the shuttle would stop at a sufficient distance from his vehicle to allow him to complete his backup maneuver. Contributing to the cause of the collision was the attendant's inability to take manual control of the vehicle in an emergency.
Rear-End Collision Between a Car Operating with Advanced Driver Assistance Systems and a Stationary Fire Truck
Culver City, California (no fatalities or injuries)

On January 22, 2018, a 2014 Tesla Model S P85 car was traveling behind another vehicle in the high-occupancy vehicle (HOV) lane of southbound Interstate 405 (I-405) in Culver City, California. Because of a collision in the northbound freeway lanes that had happened about 25 minutes earlier, a California Highway Patrol vehicle was parked on the left shoulder of southbound I-405, and a Culver City Fire Department truck was parked diagonally across the southbound HOV lane. The emergency lights were active on both the California Highway Patrol vehicle and the fire truck. When the vehicle ahead of the Tesla changed lanes to the right to go around the fire truck, the Tesla remained in the HOV lane, accelerated, and struck the rear of the fire truck at a recorded speed of about 31 miles per hour (mph).

At the time of the crash, the fire truck was unoccupied. The Tesla driver did not report any injuries. The car was equipped with advanced driver assistance systems (ADAS), including Autopilot. Based on the driver’s statements and on performance data downloaded from the car after the crash, Autopilot was engaged at the time of the collision.

We determined that the probable cause of the rear-end crash was the Tesla driver’s lack of response to the stationary fire truck in his travel lane, caused by inattention and overreliance on the vehicle’s ADAS; the Tesla’s Autopilot design, which permitted the driver to disengage from the driving task; and the driver’s use of the system in ways inconsistent with guidance and warnings from the manufacturer.

Single-Vehicle Run-Off-Road Crash and Fire
Fort Lauderdale, Florida (2 fatalities, 1 injured)

On Tuesday, May 8, 2018, a 2014 Tesla Model S electric-powered car occupied by an 18-year-old driver and two 18-year-old passengers was traveling south in the 1300 block of Seabreeze Boulevard in Fort Lauderdale, Florida, at a recorded speed of 116 mph. The driver and his passengers were on their way to the driver’s residence from a nearby shopping mall, a trip of about 4 miles. The posted speed limit at the crash location is 30 mph, and the roadway curves to the left for southbound traffic. The approach to the curve has a turn-warning sign indicating that the roadway turns left, augmented by a flashing beacon and a posted advisory speed of 25 mph.

According to witnesses, the driver maneuvered the car into the left lane and was passing another vehicle. The driver lost control while moving back into the right lane as he attempted to negotiate the curve. As the car exited the curve, it struck and mounted the curb on the west side of the road, crossed the sidewalk, and continued south, striking a wall on the north side of a residential driveway. The car continued forward and struck the wall on the south side of the driveway. Witnesses reported that flames came from the car after the second collision. Both the driver and the front passenger died in the crash. The rear passenger was ejected during the crash and was transported to a local hospital with serious injuries.

We determined the probable cause of the crash was the driver’s loss of control as a result of excessive speed. Contributing to the severity of the injuries was the postcrash fire originating in the crash-damaged lithium-ion traction battery.

Figure 28. The right side of the car involved in the Fort Lauderdale, Florida, accident, shows the severe crash and fire damage.
Completed Safety Recommendation Reports

Providing Occupant Protection for Limousine Passengers
Schoharie, New York (20 fatalities)

We issued four safety recommendations as a result of our investigation of a collision involving a 2001 Ford Excursion stretch limousine, a 2015 Toyota Highlander sport utility vehicle (SUV), and two pedestrians that occurred in Schoharie, New York, on October 6, 2018. Our investigation identified safety issues related to occupant protection, including the integrity of limousine seat and seat belt systems and the accessibility and use of seat belts by limousine passengers.

As a result of this ongoing investigation, NHTSA, the New York State Department of Transportation, and the National Limousine Association received recommendations. We also reiterated one safety recommendation to the state of New York.

Addressing Systemic Problems Related to the Timely Repair of Traffic Safety Hardware in California
Mountain View, California (1 fatality, 1 injured)

As of December 2019, we were investigating a fatal collision between an SUV and a previously damaged and nonoperational crash attenuator in Mountain View, California, that occurred on March 23, 2018. Our investigation identified systemic problems within the California Department of Transportation that negatively affect the timely repair of traffic safety hardware. Consequently, we issued a safety recommendation to the California State Transportation Agency.

Ongoing Investigations

- Electric vehicle battery fire safety report; multiple cases; 3 fatalities, 3 injured.
- Electrical conduit impacted commercial vehicle after breaking away from tunnel; East Penn Township, Pennsylvania; February 21, 2018; 1 fatality.
- Multi-vehicle crash; Elmhurst, Illinois; March 1, 2018; 1 fatality, 6 injured.
- Tesla SUV crash and postcrash fire on reignition; Mountain View, California; March 23, 2018; 1 fatality, 1 injured.
- Truck-tractor collision with multiple vehicles at end of work zone traffic queue; Boise, Idaho; June 16, 2018; 4 fatalities, 1 injured.
- Truck-tractor tire failure and collision with oncoming motorcoach; Thoreau, New Mexico; August 30, 2018; 8 fatalities, 40 injured.
- Limousine collision with parked car after failing to stop at intersection; Schoharie, New York; October 6, 2018; 20 fatalities, 1 injured.
- Four children in school bus loading zone hit by passing car; Rochester, Indiana; October 25, 2018; 3 fatalities, 1 injured.
- Truck-tractor in combination with van semitrailer impacted passenger car, crashed through median, and struck van, causing rollover and additional vehicle collisions; Alachua, Florida; January 3, 2019; 7 fatalities, 8 injured.
- Truck-tractor in combination with semitrailer crossed in front of 2018 Tesla Model 3 operating with autopilot engaged, shearing off the vehicle’s roof; Delray Beach, Florida; March 1, 2019; 1 fatality.
- Box truck collision with 15-passenger van; Scooba, Mississippi; June 3, 2019; 8 fatalities, 2 injured.
- Pickup truck collision with group of motorcyclists after crossing center line; postcrash fire ensued; Randolph, New Hampshire; June 21, 2019; 7 fatalities, 3 injured.
- Passenger car collision with medium-size bus after crossing center median; SeaTac, Washington; July 25, 2019; 1 fatality, 6 injured.
- Medium-size bus rollover after departing roadway; Bryce Canyon City, Utah; September 30, 2019; 4 fatalities, 26 injured.
- Medium-size bus impacted by passenger vehicle that crossed centerline; Belton, South Carolina; December 17, 2019; 1 fatality, 6 injured.

Figure 29. A local state police investigator discusses details of the June 21, 2019, collision in Randolph, New Hampshire, involving a pickup truck and numerous motorcycles, with HS investigators Kenny Bragg and Dennis Collins.
Safety Roundtables and Webinar

Safety Roundtable: Distracted Driving: Perspectives from the Trucking Industry

On April 11, 2019, we held the third roundtable on distracted driving in partnership with Jetco and StopDistractions.org in Houston, Texas. The roundtable included members of the trucking community, victim advocacy groups, the business community, and legislators, who discussed the problem of distracted driving and potential countermeasures. Although the roundtable discussions were focused on Texas, the topics are applicable nationwide.

Safety Roundtable: Act to End Deadly Distractions

On October 29, 2019, we held a roundtable on distracted driving in Columbia, Missouri, in cooperation with Missouri Coalition for Roadway Safety, StopDistractions.org and the University of Missouri. Participants included state and federal government officials, victims’ families, and other safety advocates, who discussed strategies to prevent distracted driving.


On April 18, 2019, we held a safety webinar to discuss the benefits of collision avoidance system technology and why we put this issue on our MWL (Increase Implementation of Collision Avoidance Systems in All New Highway Vehicles). Representatives from the heavy duty truck industry discussed the rate of implementation and current industry perspectives, and carriers discussed why they installed collision avoidance systems in their fleets and the benefits that resulted.
Office of Marine Safety

Table 9. Office of Marine Safety Statistics

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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 and those involving both US public and nonpublic vessels in the same casualty. 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 if an accident qualifies as a major marine casualty, which is defined as resulting in at least one of the following:

- The loss of six or more lives.
- The loss of a mechanically propelled vessel of 100 or more gross tons.
- Property damage initially estimated at $500,000 or more.
- Serious threat (as determined by the Coast Guard Commandant and concurred with by the NTSB Chairman) to life, property, or the environment from hazardous materials.

MS investigates and determines the probable cause of all major marine casualties. For select major marine casualties, the office launches a full investigative team and presents the investigative product to the Board. In all other major marine casualties, MS launches marine investigators to the scene to gather sufficient factual information to develop a marine accident brief report. Most of these brief investigation reports are adopted by the MS director through delegated authority, the remainder, including reports on accidents involving public and nonpublic marine casualties, are adopted by the Board.
International Investigations

Given the international nature of the marine transportation system and the number of foreign-registered cruise and cargo ships operating from US ports, accident investigations involving both domestic and foreign-registered vessels promote marine safety worldwide. MS is responsible for the overall management of the NTSB international marine safety program and investigates major marine casualties involving foreign-flagged vessels operating in US waters and US-flagged vessels involved in major marine casualties all over the world. MS has investigated accidents involving US-flagged ships as far away as the North Sea, American Samoa, Japan, and Singapore. Accidents involving foreign-flagged vessels have accounted for 28 percent of NTSB marine accident investigations over the past 5 years.

Every year, more than 11 million Americans travel on board foreign-flagged cruise ships. MS cooperates, along with the Coast Guard, with foreign marine casualty investigation authorities under standards established by the IMO Code for the Investigation of Marine Casualties and Incidents as a substantially interested state (SIS) when a casualty involves a foreign-flagged cruise ship with US citizens on board outside US waters. In 2019, MS and the Coast Guard joined Norway in the SIS investigation of the Norwegian flag MV Viking Sky, an investigation which remained ongoing at year’s end (see page 49).

Collision Between US Navy Destroyer John S McCain and Tanker Alnic MC

On August 21, 2017, the US Navy destroyer John S McCain was overtaking the Liberian-flagged tanker Alnic MC as both vessels were transiting the westbound lane in the Middle Channel passage of the Singapore Strait Traffic Separation Scheme. The destroyer’s crew perceived a loss of steering; as the crew attempted to regain control of the vessel, the John S McCain unintentionally turned to port into the path of the Alnic MC, and the two vessels collided. As a result of the collision, 10 John S McCain sailors died, 48 were injured, and the vessel sustained over $100 million in damage. No one was injured on the Alnic MC, but the vessel sustained about $225,000 in damage. We determined that the probable cause of the collision between the John S McCain and the Alnic MC was a lack of effective operational oversight of the destroyer by the US Navy, which resulted in insufficient training and inadequate bridge operating procedures. Contributing to the accident were the John S McCain bridge team’s loss of situation awareness and failure to follow loss-of-steering emergency procedures, which included the requirement to inform nearby traffic of their perceived loss of steering. Also contributing to the accident was the operation of the steering system in backup manual mode, which allowed for an unintentional, unilateral transfer of steering control.

As a result of this investigation, we issued seven safety recommendations to the US Navy.

Figure 30. After the accident, the Alnic MC was anchored in Singapore.

Figure 31. The John S McCain sustained significant port-side damage from the bow of the Alnic MC.
Explosion and Fire Aboard Articulated Tug and Barge Buster Bouchard/B. No. 255
Port Aransas, Aransas Pass Fairway, Anchorage, Texas (2 fatalities)

On October 20, 2017, the crews of the articulated tug and barge Buster Bouchard/B. No. 255 (US) were preparing to get under way from anchorage to proceed into the Port of Corpus Christi, Texas, when an explosion and subsequent fire occurred on the bow of the barge. Two barge crewmembers who were on the bow were killed in the explosion. The fire was extinguished later that day. Approximately 2,000 barrels (84,000 gallons) of crude oil were released from the barge into the water or were consumed in the fire. Damages exceeded $5 million. The barge was scrapped after the accident; there was no damage to the tugboat.

We determined that the probable cause of the explosion was the lack of effective maintenance and safety management of the barge by Bouchard Transportation, which resulted in crude oil cargo leaking through a corroded bulkhead into the forepeak void space, forming vapor, and igniting. Contributing to the accident were the ineffective inspections and surveys by the Coast Guard and the American Bureau of Shipping.

Figure 33. Looking aft from barge B. No. 255, the damage to the chain locker, center forepeak and port forepeak ballast tanks is visible.

As a result of this investigation, we issued three safety recommendations to the Bouchard Transportation Company Inc., the Coast Guard, and the American Bureau of Shipping.

Barge Breakaway and Contact with the Emsworth Locks and Dams
Emsworth, Pennsylvania, (no fatalities or injuries)

On January 13, 2018, 27 dry cargo barges (US) broke free from the Jacks Run barge fleeting area on the Ohio River near Pittsburgh, Pennsylvania. The barges drifted, uncontrolled, downriver and struck the dams at the US Army Corps of Engineers Emsworth Locks and Dams complex. Two Corps of Engineers workboats moored at the foot of the dam were also struck and driven into one of the dam’s concrete piers, causing significant damage to both vessels. Nine barges and the workboats were declared constructive total losses in the accident. Total damages exceeded $12.5 million.

We determined that the probable cause of the accident was the failure of the fleeting area owner, Allegheny County Sanitary Authority, and the operator, Industry Terminal and Salvage Company, to maintain the area’s mooring cells and prevent shoaling, which resulted in inadequate mooring arrangements during high water and ice conditions. Contributing to the accident was the Corps of Engineers’ and the Coast Guard’s lack of resources and authority to inspect fleeting areas effectively and ensure that they are maintained.

As a result of this investigation, we issued four safety recommendations to the Coast Guard and the Corps of Engineers.

Figure 34. The US Army Corps of Engineers vessel (covered in snow, above) was damaged when dry cargo barges drifted downriver and struck the dams. Damages exceeded $12.5 million.

Figure 32. The B. No. 255 sustained significant bow damage from the explosion.
Completed Accident Briefs

Investigations resulting in accident briefs are more limited in scope than those leading to major accident reports and primarily determine probable cause. These briefs may be issued by the office director under delegated authority or may be adopted by the Board.

The briefs described below are 6 of the 35 completed in 2019.

**Diesel Generator Failure Aboard Offshore Supply Vessel Red Dawn**
Amchitka Island, Alaska (no fatalities or injuries)

On December 13, 2017, the offshore supply vessel Red Dawn (US) was transiting through the North Pacific Ocean en route to resupply the radar station Sea-Based X-Band Radar. When the vessel was about 375 miles south-southwest of Amchitka Island, Alaska, its no. 2 main diesel engine suffered a mechanical failure that led to the ejection of components from the cylinder block, which destroyed the engine. No pollution or injuries to the 12 crewmembers or 33 passengers on board were reported. Estimated damages were $957,000.

*Figure 35. The HOS Red Dawn suffered a mechanical failure in December 2017 that destroyed the engine.*

We determined that the probable cause of the mechanical failure was a connecting rod assembly on the no. 2 diesel engine that came loose and separated from the crankshaft caused by improper tightening (torquing) of the connecting rod bolts during the previous engine overhaul.

**Engine Room Fire on Board Towing Vessel Leland Speakes**
Greenville, Mississippi (no fatalities or injuries)

On February 21, 2018, the towing vessel (TV) Leland Speakes (US) was pushing 21 barges up the lower Mississippi River when a fire broke out in the engine room south of Greenville, Mississippi. The nine crewmembers on board tried to fight the fire but, unable to control it, they abandoned the vessel to a skiff dispatched from a Good Samaritan towboat. The abandoned tow drifted 11 miles downriver until another towing vessel pushed it into a sandbar. The fire burned until later that evening before being extinguished by fire response teams and vessels. No crewmembers were injured, and no environmental damage was reported. Estimated damages were $4.5–5 million.

*Figure 36. Fire consumed the upper engine room spaces of the MV Leland Speaks.*

We determined that the probable cause of the fire was a catastrophic failure and crankcase breach of the port main engine resulting from failure of the caps that secured two piston connecting rods to the crankshaft. Contributing to the severity of the fire was the vessel’s lack of a fixed fire-extinguishing system for the engine room and lack of redundant fire pumps.

**Anchor Contact of Articulated Tug and Barge Clyde S VanEnkevort/Erie Trader with Underwater Cables and Pipelines**
Mackinac Bridge, Michigan (no fatalities or injuries)

On April 1, 2018, the articulated tug and barge Clyde S VanEnkevort/Erie Trader (US) was westbound with a crew of 14 in the Straits of Mackinac, Michigan, when the barge’s starboard anchor, which had released and was dragging on the bottom, struck and damaged three underwater electrical transmission cables and two oil pipelines. About 800 gallons of dielectric mineral oil leaked into the water from the cables; the oil pipelines sustained only superficial damage. Repair and replacement of the cables was estimated at more than $100 million. No injuries were reported.

We determined that the probable cause of this accident was the failure of the anchor detail to secure the barge’s starboard anchor and the improper adjustment of the anchor brake band after the engineering crew replaced the brake liner, the combination of which allowed the anchor and chain to play out under way.
Collision of Bulk Carrier Yochow with Articulated Tug and Barge OSG Independence/OSG 243
Houston Ship Channel, Houston, Texas (no fatalities or injuries)

On June 13, 2018, the inbound Hong Kong flag bulk carrier Yochow collided with the articulated tug and barge OSG Independence/OSG 243, which was moored on the Houston Ship Channel in Houston, Texas. The OSG 243’s tanks were empty and awaiting a cargo of methyl tert-butyl ether. As a result of the collision, two of the barge’s tanks and Yochow’s bulbous bow were punctured, and the facility bore extensive structural damage. There were no injuries among the crew of 18 on the Yochow or the 8 aboard the tug OSG Independence, nor was any pollution reported. Damage to the facility ($20 million), the barge ($1 million), and the bulk carrier ($338,000) amounted to an estimated $21,338,000.

We determined that the probable cause of the collision was the Yochow mate’s failure to monitor the helmsman effectively, contrary to the principles of good bridge resource management. Contributing to the accident was the lack of company and shipboard oversight to ensure that crewmembers adhered to work-rest guidelines, resulting in the helmsman’s fatigue.

Capsizing and Sinking of Barge Dredge200 and Loss of Workboat R.E. Pierson 2 Pushed by Tugboat Big Jake
5 miles east of Minots Ledge Light, Massachusetts Bay, Massachusetts (2 injured)

On December 2, 2018, the TV Big Jake (US) was under way in Massachusetts Bay towing five barges and two workboats when the tow broke apart. As a result of the breakaway, the barge Dredge200 (US) and the workboat R.E. Pierson 2 (US) both sank. Two crewmembers sustained minor injuries. Although both sunken vessels had fuel and lube oil on board, no visible oil sheen or pollution was reported. Estimated value of the Dredge200 and the R.E. Pierson 2 totaled $1.98 million.

We determined that the probable cause of the capsizing and sinking of the Dredge200 and the R.E. Pierson 2 was the decision by the tow captain and owner to attempt a transit in forecasted wind and waves that exceeded their original plan for the voyage.

Contact of the Cruise Ship Nippon Maru with Mooring Dolphins
Apra Harbor, Guam, USA (no fatalities or injuries)

On December 30, 2018, the stern of the passenger vessel Nippon Maru (JP) struck mooring dolphins at a US Navy fueling wharf in Apra Harbor, Guam, while the vessel was maneuvering in a turning basin after getting under way from the harbor’s commercial port. No pollution or injuries were reported. Damage to the vessel was estimated at $456,080; damage to the mooring dolphins was in excess of $500,000.

We determined that the probable cause of this accident was the master’s alcohol impairment, which resulted in an errant astern engine input.
Safety Recommendation Report

During accident and incident investigations, safety issues are sometimes identified that warrant Board adoption of safety recommendations outside of a final report or brief. Safety recommendation reports are used to make recommendations on such issues; these reports may be issued at any time during an accident investigation, as happened in the investigation described below.

Safety Recommendation Report: Improving Vessel Survivability and Passenger Emergency Egress of DUKW Amphibious Passenger Vessels Tabletop Lake, Branson, Missouri
(17 fatalities, 6 injured)

On July 19, 2018, 17 of the 31 people aboard the Stretch Duck 7 (US) died when the amphibious passenger vessel sank during a high-wind storm that developed rapidly on Table Rock Lake near Branson, Missouri. As of December 2019, we were investigating the sinking of the Stretch Duck 7, which was built in 1944 as a DUKW landing craft to carry military personnel and cargo during World War II and then modified for commercial purposes to carry passengers on excursion tours.

Our investigation found that, having been constructed with a low freeboard and without compartmentalization or subdivision, the Stretch Duck 7 lacked adequate reserve buoyancy and therefore quickly sank after it encountered severe weather and water entered the vessel. We also found that both the fixed canopy and a closed side curtain spanning the starboard side of the passenger compartment on the Stretch Duck 7 impeded passenger escape, which likely increased the number of fatalities.

As a result of our ongoing investigation, we issued two safety recommendations to the Coast Guard.

Figure 39. Seventeen of the 31 people aboard the Stretch Duck 7 died when the vessel sank in high winds during a storm on Table Rock Lake near Branson, Missouri.
Marine Board of Investigation Hearings Held in Conjunction with the NTSB

NTSB investigators participate in Coast Guard Marine Board of Investigation hearings, which are public hearings related to investigations in which the agency is authorized to obtain testimony under oath.

When the Coast Guard holds a Marine Board of Investigation Hearing with respect to a major marine casualty, the NTSB joins as an equal partner. Consistent with Coast Guard responsibility to direct the course of the investigation, the person or persons designated by the Board may make recommendations about the scope of the investigation, call and examine witnesses, and submit or request additional evidence.

Collision Between the Liquid Propane Gas Carrier *Genesis River* and barges being pushed by the Towing Vessel *Voyager*

September 16–20, 2019, we participated in the Coast Guard’s formal investigation public hearing regarding the May 10, 2019, collision between the liquid propane gas carrier *Genesis River* (PN) and barges being pushed by the TV *Voyager* (US) in Galveston, Texas. Cargo tanks in one of the barges were breached, spilling about 10,000 barrels of reformat, a gasoline blending stock, into the waterway. The second barge capsized. The Houston Ship Channel was shut down for 2 days after the accident during salvage operations. There were no injuries. Damage to the *Genesis River* and the two barges was estimated at over $600,000.

Allision of the Towing Vessel *Kristin Alexis* and Crane Barge *Mr Ervin* with the Sunshine Bridge

May 6–11, 2019, we participated in the Coast Guard formal investigation–Marine Board of Investigation public hearing regarding the allision of the TV *Kristin Alexis* (US) and crane barge *Mr Ervin* (US) with the Sunshine Bridge in St. James Parish, Louisiana. On October 11, 2018, the tug *Kristin Alexis* left a mooring facility, pushing the crane barge *Mr Ervin* ahead, heading for a dock located about 8 miles upriver. The next day, the crane barge struck and became lodged under the Sunshine Bridge that crossed the Mississippi River about 30 miles south-southeast of Baton Rouge, Louisiana. Damage to the crane was minimal. Damage to the bridge is estimated at $3.5 million.

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11 Title 49 CFR 850.30, Procedures for Coast Guard investigation. The Board may designate a person or persons to participate in every phase of an investigation, including on-scene investigation, that is conducted under the provisions of 49 CFR 850.25.
Ongoing Investigations

- **USS Fitzgerald (USN) & ACX Crystal (PH), collision;** 56 nautical miles (nm) southwest of Yokosuka, Japan; June 17, 2017; 7 fatalities, 3 injured.
- Amphibious passenger vessel *Stretch Duck 7* (US) sinking; Table Lake near Branson, Missouri; July 19, 2018; 17 fatalities, 6 injured.

**Figure 40.** Senior investigator Luke Wisniewski departs the *Fairchem Filly* after completing crew interviews and document collection.

- **TV Kristin Alexis/barge Mr. Ervin (US), crane strike with Sunshine Bridge;** St. James, Louisiana; October 12, 2018; no fatalities or injuries.
- **TV Mary Lucy Lane (US) collision with US Army Corps of Engineers workboat Gibson;** Warsaw, Kentucky; December 18, 2018; public/nonpublic; no fatalities or injuries.
- **TV Tom Bussler (US) flooding;** Calvert City, Kentucky; January 7, 2019; no fatalities or injuries.
- **MV Louisiana Responder (US), MSRC 8-1, Coast Guard Small Vessel;** New Orleans, Louisiana; January 16, 2019; public/nonpublic; no fatalities or injuries.
- **TV Lindberg Crosby (US) machinery/equipment damage;** Channelview, Texas; February 11, 2019; no fatalities or injuries.
- **PV Norwegian Epic (BH) contact with San Juan Passenger Terminal Pier 3;** San Juan, Puerto Rico; February 12, 2019; no fatalities or injuries.
- **TV Miss Dixie (US) collision with TV D&B Boney;** St Rose, Louisiana; February 13, 2019; no fatalities or injuries.
- **TV Bettye M Jenkins (US) contact;** Vidalia, Louisiana; February 15, 2019; no fatalities or injuries.
- **F V Pacific I (US) flooding;** Unalaska Island, Alaska; February 15, 2019; no fatalities or injuries.
- **MV St. Clair (US) fire;** Oregon, Ohio; February 17, 2019; no fatalities or injuries.
- **TV Chad Pregracke (US) contact with highway bridge;** Vicksburg, Mississippi; February 27, 2019; no fatalities or injuries.
- **TV Saint Rita (US) flooding;** Baton Rouge, Louisiana; March 7, 2019; no fatalities or injuries.
- **TV Leviticus (US) contact with pier;** Sunshine, Louisiana; March 8, 2019; no fatalities or injuries.
- **FV Freyja (US) grounding;** Tebenkof Point, Unalaska, Alaska; March 9, 2018; no fatalities or injuries.
- **TV Rivers Wilson (US) barges struck NS Railway bridge;** Tombigbee River/Mile Marker 89.9, Alabama; March 10, 2019; no fatalities or injuries.
- **TVs (US) Dixie Vandal and Trinity;** collision; Pasadena, Texas; March 15, 2019; no fatalities or injuries.
- **MV APL Guam (US), collision;** Tokyo Bay, Japan; March 21, 2019; no fatalities or injuries.
- **PV Viking Sky (NO), machinery/equipment damage, IMO SIS investigation;** Molde, Norway; March 23, 2019; no fatalities or injuries.
- **MV Hawk (NO), collision;** Pascagoula, Mississippi; March 29, 2019; no fatalities or injuries.
- **TV Dewey R (US) contact with B&O Railroad bridge;** Chicago, Illinois; April 13, 2019; no fatalities or injuries.
- **TV Dejeanne Maria (US) contact with flooding;** Venice, Louisiana; April 15, 2019; no fatalities or injuries.
- **TV Edna T Gattle (US) contact with Krotz Springs Railroad bridge;** Atchafalaya River, Baton Rouge, Louisiana (Krotz Springs); April 25, 2019; no fatalities or injuries.
- **MV Genesis River (PN)/TV Voyager (US) collision;** Houston Ship Channel, Texas; May 10, 2019; no fatalities or injuries.
- **American Liberty (US), Don D (US), African Griffon (BH), Ever Grace (BH) contact;** La Place, Louisiana; May 16, 2019; no fatalities or injuries.
- **Barges (US) MTC7256 & LTD11140 contact and breakup;** Webbers Fall, Oklahoma; May 23, 2019; no fatalities or injuries.
- **MV Fairchem Filly (MI) hull/machinery, equipment, damage and tank over pressurization and rupture;** Deer Park, Texas; May 30, 2019; no fatalities or injuries.
- **Bulk vessel Century Queen (PN) and TV Kaytin Marie (US) collision;** Norco, Louisiana; June 8, 2019; no fatalities or injuries.
- **MV Dank Silver (MI) contact with Sunshine Bridge;** Lemannahville, Louisiana; June 16, 2019; no fatalities or injuries.
- **Commercial fishing vessels (US) American Eagle and Koorale, collision;** about 1,475 nm northeast of Pago Pago, American Samoa; June 16, 2019; no fatalities or injuries.
- **TV Goose Creek (US) crane barge contact with overhead high-voltage transmission lines;** Elizabeth River, Chesapeake, Virginia; June 20, 2020; no fatalities or injuries.
- **TVs (US) Chattie Sue Smith, Mary R; Mary Fern, Dock Barge flooding;** Hardin, Illinois; July 5, 2019; no fatalities or injuries.
• **FV Alaganik** (US) fire/explosion; Whittier, Alaska; July 8, 2019; no fatalities or injuries.
• Recreational vessel **Silver Lining** (US) flooding; Hood Canal, Washington; July 23, 2019; no fatalities or injuries.
• **TV Mangilao** (US) flooding, capsizing, sinking; 800 nm northwest of Guam; August 4, 2019; no fatalities or injuries.
• **FV Anel** (US) fire/explosion and sinking; Port Gravina, Alaska; August 27, 2019; no fatalities or injuries.
• **TV Kristin Faye** (US) flooding; SW Pass (Mississippi River), Louisiana; no fatalities or injuries.
• Small passenger vessel **Conception** (US) fire and sinking; off Channel Islands, Ventura, California; September 2, 2019; 34 fatalities, 1 injured.
• **TV Savage Voyager** (US) contact with lock; Jamie Whitten Lock, Tenn-Tom Waterway near Denis, Mississippi; September 8, 2019; no fatalities or injuries.
• **MV Golden Ray** (MI) car carrier, capsizing/listing; Brunswick, Georgia; September 8, 2019; no fatalities or injuries.
• Barges (US) strike I-10 bridge; San Jacinto River, Channel View (Houston), Texas; September 19, 2019; no fatalities or injuries.
• **TV G. M. McAllister** (US), assist tug for MV **Ijssel Confidence** (PT), contact with NGL Energy Partners LNG pier; Elizabeth River, Chesapeake, Virginia; September 23, 2019; no fatalities or injuries.
• **TV Susan Lynn** (US) shipyard fire/explosion; Lafitte, Louisiana; October 8, 2019; no fatalities or injuries.
• **Barge IB1940** (US) fire/explosion; Lemont, Illinois; November 4, 2019; no fatalities or injuries.
• Offshore supply vessel **Cheramie Bo Truc No 22** (US) and articulated tug barge **Mariya Moran-Texas** (US) collision; Sabine Pass, Port Arthur, Texas; November 14, 2019; no fatalities or injuries.
• **Deck barge YD71** (US) contact; Hampton, Virginia; November 17, 2019; no fatalities or injuries.
• **FVs Iris Marie and Triton** (US) fire/explosion; Mayport, Florida; December 3, 2019; no fatalities or injuries.
• **MV Levant** (MI) contact with pier; Ferndale, Washington; December 15, 2019; no fatalities or injuries.
• **Yacht Andiamo** (MI) fire/explosion; Island Garden Marina, Miami, Florida; December 19, 2019; no fatalities or injuries.

• **FV Miss Annie** (US) contact; Calicoes Sound, Hilton Head, South Carolina; December 19, 2019; no fatalities or injuries.
• Commercial fishing vessel **Scandies Rose** (US) icing/capsizing; 170 nm southwest of Kodiak Island, Alaska; December 31, 2019; 5 fatalities.

Figure 41. MS investigator Barton Barnum oversees the recovery of the **Conception** wreckage.
**Ongoing International Investigation**

*PV Viking Sky*
*Molde, Norway (18 injured)*

On March 23, 2019, the *PV Viking Sky* (NO) experienced machinery/equipment damage with loss of power off the coast of Molde, Norway. After a mayday call advising that the vessel was drifting close to shore off Norway’s western coast, Norwegian national rescue services began evacuating the *Viking Sky*’s 1,300 passengers and crew amid stormy seas and heavy winds in a high-risk helicopter rescue operation. There were no fatalities; however, 18 people were injured. Once the vessel reached port, NTSB and Coast Guard investigators joined Norway’s Accident Investigation Board to interview crew and examine the machinery failures. The investigation is ongoing; once Norway completes its report, we will submit our comments on it.

**Other Significant Product**

*Safer Seas Digest 2018: Lessons Learned from Marine Accident Investigations*

Our *Safer Seas Digest* is a review of concise summaries from the previous year’s accident investigations and represents our continuing commitment to sharing the lessons that we learn through our investigations.

**Safety Workshop**

On July 11, 2019, we hosted the second session of the “Seafloor Investigations Workshop” at the NTSB Training Center in Ashburn, Virginia. The workshop brought together representatives of US government agencies, international ship registries, and industry to discuss developments in marine and aviation accident investigations at the ocean floor. After four presentations from commercial deep-salvage providers, panels covered various aspects of operations and planning to address the unique challenges posed by such cases as the *El Faro*. Future workshops will share best practices and assist organizations responsible for these investigations.

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**Figure 42.** The *Safer Seas Digest 2018* pictured above highlighted lessons learned from marine accidents including the *Caribbean Fantasy* fire that occurred off the coast or Puerto Rico in August 2016.

**Figure 43.** The Seafloor Investigations Workshop brought attendees from around the world to the NTSB Training Center in July 2019.

**Figure 44.** The promotional poster for the Seafloor Investigations Workshop pictured equipment used for the deep sea recovery of submerged vessels.
Office of Railroad, Pipeline, and Hazardous Materials Investigations

Table 10. Office of Railroad, Pipeline, and Hazardous Materials Investigations Statistics

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<td>Advocacy and Outreach Events</td>
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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. The criteria used to prioritize the investigation of a railroad accident includes whether it resulted in fatalities or substantial damages.

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

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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 for and handling of the material during transport, the health and safety hazards of the material, the labelings and hazard communications for the shipments, and the effectiveness of the emergency response.

Based on the findings of our investigations, the NTSB issues safety recommendations to federal and state regulatory agencies, industry and safety standards organizations, railroads, rail transit agencies, rail labor organizations, pipeline operators, equipment and container manufacturers, hazardous materials producers and shippers, and emergency response organizations.
Completed Major Investigations

**RAILROAD**

**Amtrak Passenger Train 501 Derailment**

**DuPont, Washington** (3 fatalities, 65 injured)

On December 18, 2017, southbound Amtrak passenger train 501, consisting of 10 passenger railcars, a power railcar, a baggage railcar, and a locomotive at either end, derailed from a bridge near DuPont, Washington.

When the train derailed, it was on its first revenue service run on a new single main track (Lakewood Subdivision) at milepost 19.86; one run for special guests had already taken place the week before the accident.

Several passenger railcars fell onto Interstate 5 and hit multiple highway vehicles. At the time of the accident, 77 passengers, 5 Amtrak employees, and a Talgo Inc. technician were on the train. Of these, 3 passengers were killed and 57 passengers and crewmembers were injured. Additionally, 8 people in highway vehicles were injured.

Figure 45. This aerial photograph shows the derailed locomotives and rail cars.

We determined that the probable cause of the accident was Central Puget Sound Regional Transit Authority’s failure to provide an effective mitigation for the hazardous curve without PTC in place, which allowed the Amtrak engineer to enter the 30 mph curve at too high of a speed, as a result of his inadequate training on the territory and inadequate training on the newer equipment. Contributing to the accident was the Washington State Department of Transportation’s decision to start revenue service without ensuring that safety certification and verification had been completed to the level determined in the preliminary hazard assessment. Contributing to the severity of the accident was the FRA’s decision to permit railcars that did not meet regulatory strength requirements to be used in revenue passenger service, resulting in the loss of survivable space and the failed articulated railcar-to-railcar connections. This failure enabled secondary collisions with the surrounding environment, which caused severe damage to railcar-body structures; the structures then failed to provide occupant protection, resulting in passenger ejections, injuries, and fatalities.

As a result of this investigation, we issued 26 safety recommendations. The recipients included the Secretary of Transportation; the FRA; the US Department of Defense Fire and Emergency Services Working Group; the Washington State Department of Transportation; Amtrak; the Oregon Department of Transportation; and the Central Puget Sound Regional Transit Authority. We also reiterated four safety recommendations to the FRA.

**Amtrak Passenger Train Head-on Collision With Stationary CSX Freight Train**

**Cayce, South Carolina** (2 fatalities, 91 injured)

On February 4, 2018, southbound Amtrak train P91, operating on a track warrant, was diverted from the main track through a reversed hand-thrown switch into a siding, where it collided head-on with stationary CSX Transportation Corporation local freight train F777. The accident occurred on CSX’s Florence Division, Columbia Subdivision in Cayce, South Carolina. The engineer and conductor of the Amtrak train were fatally injured, and 91 passengers and crewmembers on the Amtrak train were transported to medical facilities.

The normal method of operation on this segment of track was by wayside signal indications of a traffic control system. On the day prior to the accident, CSX signal personnel began upgrading signal system components to implement PTC on the subdivision. Signal personnel ceased work for the day prior to completing the planned work. The signal suspension remained in place, resulting in the continued use of track warrants to move trains through the affected area of signal suspension.

Figure 46. The Cayce, South Carolina, train collision resulted in 2 fatalities and injuries to 91 people.

We determined the probable cause of this collision was the failure of CSX to assess and mitigate the risk associated with operating through a signal suspension, which eliminated system redundancy for detecting a switch in the wrong position. The CSX conductor failed to properly reposition the switch for the main track, which allowed the Amtrak train to be routed onto the Silica Storage track where the standing CSX train was located. Contributing to the accident was the FRA’s failure to implement effective regulation to mitigate the risk of misaligned switch accidents. Also contributing to the accident was Amtrak’s failure to conduct a risk assessment prior to operating during a signal suspension.

As a result of this investigation, we issued one urgent safety recommendation and three additional safety recommendations. Recommendation recipients included the FRA, CSX, and all host railroads. We also reiterated four safety recommendations to the FRA and one to Amtrak. In addition, we classified two safety recommendations to the FRA.
Building Explosion and Fire
Silver Spring, Maryland (7 fatalities, 68 injured)

On August 10, 2016, a 14-unit apartment building in Silver Spring, Maryland, partially collapsed following a natural gas-fueled explosion and fire. The explosion and fire also heavily damaged an adjacent apartment building with which it shared a common wall. As a result of this accident, 7 residents died, 65 residents were transported to the hospital, and 3 firefighters were treated and released from the hospital.

We determined that the probable cause of the explosion was the failure of an indoor mercury service regulator with an unconnected vent line that allowed natural gas into the meter room, where it accumulated and ignited from an unknown ignition source. Contributing to the accident was the location of the mercury service regulators, which rendered the leak's odor undetectable.

Overpressurization of Natural Gas Distribution System, Explosions, and Fires
Merrimack Valley, Massachusetts (1 fatality, 29 injured)

On September 13, 2018, a series of structure fires and explosions occurred after high-pressure natural gas was released into a low-pressure natural gas distribution system in the northeast region of the Merrimack Valley in Massachusetts. The natural gas distribution system was owned and operated by Columbia Gas of Massachusetts (CMA), a subsidiary of NiSource Inc, which delivers natural gas to about 325,000 customers in Massachusetts. One person was killed and 22 people, including 3 firefighters, were transported to local hospitals with injuries; 7 other firefighters incurred minor injuries. The fires and explosions damaged 131 structures, including at least 5 homes that were destroyed in the city of Lawrence and the towns of Andover and North Andover. Most of the damage occurred from fires ignited by natural gas–fueled appliances; several of the homes were destroyed by natural gas–fueled explosions. Fire departments from the three municipalities were dispatched to the fires and explosions. First responders initiated the Massachusetts fire-mobilization plan and received mutual aid from neighboring districts in Massachusetts, New Hampshire, and Maine. Emergency management officials ordered the electric utility to shut down power in the area, the state police closed local roads, and freight and passenger railroad operations in the area were suspended. CMA shut down the low-pressure natural gas distribution system, affecting 10,894 customers, including some outside the area whose service was halted as a precaution.

We determined that the probable cause of the overpressurization of the natural gas distribution system and the resulting fires and explosions was CMA's weak engineering management, which did not adequately plan, review, sequence, or oversee the construction project that led to the abandonment of a cast iron main without first relocating regulator-sensing lines to the new polyethylene main. Contributing to the accident was a low-pressure natural gas distribution system designed and operated without adequate overpressure protection.

We issued one urgent safety recommendation to the Commonwealth of Massachusetts and four to NiSource Inc. in November 2018. As a result of our investigation, we issued five additional safety recommendations upon adoption of our final report. Recommendation recipients included PHMSA; the states of Alabama, Alaska, Arizona, Arkansas, California, Colorado, Connecticut, Florida, Georgia, Idaho, Illinois, Iowa, Kentucky, Louisiana, Maine, Maryland, Minnesota, Mississippi, Missouri, Montana, Nebraska, Nevada, New York, North Carolina, Pennsylvania, South Carolina, South Dakota, Texas, Utah, Virginia, and Wyoming; the Commonwealth of Massachusetts Executive Office of Public Safety and Security; and NiSource Inc.

Figure 48. Only remnants of this house remained after the explosion and fire in Merrimack Valley, Massachusetts, in which 1 person was killed and 22 people were severely injured.
HAZARDOUS MATERIALS

Rupture of a DOT-105 Rail Tank Car and Subsequent Chlorine Release at Axiall Corporation
New Martinsville, West Virginia (8 injured)

On August 27, 2016, a 42-inch-long crack manifested in a 17,388-gallon DOT 105 tank car’s tank shell shortly after the tank car was loaded with 178,400 pounds of liquefied compressed chlorine at the Axiall Corporation Natrium plant in New Martinsville, West Virginia. Over the next 2.5 hours, the entire load of chlorine was released and formed a large vapor cloud that migrated south along the Ohio River Valley.

We determined that the probable cause of the chlorine release was an undetected preexisting crack near the inboard end of the stub sill cradle pad that propagated to failure with the changing tank shell stresses during the thermal equalization of the car after loading with low temperature chlorine. Contributing to the failure was Axiall’s insufficiently frequent stub sill inspection interval that did not detect the crack, the low fracture resistance of the nonnormalized steel used in the tank car construction, and the presence of residual stresses associated with Rescar Companies’ tank wall corrosion repairs and uncontrolled local postweld heat treatment.

As a result of this investigation, we issued five safety recommendations. Recommendation recipients included PHMSA, the Association of American Railroads, and American Railcar Industries Inc. We also classified one safety recommendation to the FRA.

Air Products and Chemicals, Inc. Tube Trailer Module Hydrogen Release and Subsequent Fire
Diamond Bar, California (no fatalities or injuries)

On February 11, 2018, compressed hydrogen was released and a subsequent fire occurred during the transportation of an Air Products and Chemicals Inc. Mack truck-tractor with a mounted CT-250 tube trailer module. The tube trailer module contained 25 non-DOT-specification, fully wrapped, carbon-fiber reinforced, aluminum-lined cylinders, 24 of which were fully loaded with compressed hydrogen. Pressure relief devices, which actuated on 12 of the cylinders, released about 120 kilograms of hydrogen that was likely consumed in the fire. The Los Angeles County Fire Department estimated that between 1,400 and 2,000 people were evacuated from the adjacent business district and a nearby residential area. Equipment damages were estimated at $175,000.

We determined that the probable cause of the tube trailer module fire was the requalification technician’s installation of an incorrectly rated pressure-relief device in cylinder No. 14, which actuated during normal transportation and released high-pressure hydrogen, and the tube trailer module assembly contractor’s failure to sufficiently tighten compression fittings on the pressure relief device vent lines that disassembled under the pressure of escaping gas, allowing a fire to develop inside the module and impinge on adjacent cylinders. Contributing to the incident was the lack of a requirement for requalification inspectors to verify the pressure-relief device pressure rating and to inspect for vent line assembly securement.

As a result of this investigation, we issued six safety recommendations. Recipients included PHMSA, the US Department of Energy, Pacific Northwest National Laboratory, and the Compressed Gas Association.

Figure 49. These images show a section of rail in New Martinsville, West Virginia, before and after the development of the chlorine vapor cloud.

Figure 50. The circled area above shows the sections of the tube trailer module that suffered the greatest thermal damage in the Air Products and Chemicals Inc. truck-tractor fire.
Completed Accident Briefs

Investigations resulting in accident briefs are more limited in scope than those leading to major accident reports and primarily determine probable cause. These briefs may be issued by the office director under delegated authority or may be adopted by the Board.

RAILROAD

New York City Transit Train Strikes Two Flagmen
Brooklyn, New York (1 fatality, 1 injured)

On November 3, 2016, New York City Transit (NYCT) subway train 2328G, operating underground in a tunnel between the Fort Hamilton Parkway and Church Avenue stations, struck two NYCT employees on the F Line in Brooklyn, New York. The employees were setting up flagging protection for a contractor who needed to cross the track to access an instrument control room in the tunnel. One employee was killed, and the other was seriously injured. After the accident, 23 passengers were evacuated while the crew remained with the train. The transit equipment and the track structure did not sustain any damage.

We determined that the probable cause of the accident was the failure of the Rail Control Center to communicate to the train dispatcher and tower operator that flaggers were on the track.

Also contributing to the accident was NYCT’s absence of a risk assessment when planning its flagging operations and permitting train movements into unprotected work zones.

As a result of this investigation, we issued three safety recommendations to the Metropolitan Transportation Authority, the parent company of the NYCT.

Derailment of Metro-North Railroad Commuter Train
Rye, New York (16 injured)

On May 18, 2017, westbound Metro-North Railroad commuter train 1373 derailed at milepost 24.55 near catenary bridge 215 on main track 3 of the Metro-North New Haven Line in Rye, New York. Train 1373 originated from Stamford, Connecticut, and was destined for Grand Central Terminal in Manhattan, New York, when 5 of the 12 cars in the consist derailed. Train 1373 had 185 passengers, of which 12 suffered minor injuries. Four crewmembers (one conductor and three assistant conductors) also reported minor injuries.

We determined that the probable cause of this derailment was the engineer of Metro-North commuter train 1373 failing to remember the 10 mph temporary speed restriction and operating his train at 55.9 mph into a 10 mph speed-restricted area. Contributing to the accident was the engineer’s failure to communicate the temporary speed restriction to the conductor, who could have reminded the train engineer of the upcoming speed restriction. Also contributing to the accident was the lack of a fully operational PTC system, which would have stopped the train in advance of the speed-restricted area.

As a result of this investigation, we issued two safety recommendations to Metro-North Railroad.

Figure 51. This diagram shows the planned flagging protection and the location of the two employees who were struck by the train.

Figure 52. The diagram at left depicts the area of the Metro-North train derailment.
PIPELINE

Natural Gas Explosion at Family Residence
Firestone, Colorado (2 fatalities, 2 injured)

On April 17, 2017, a single-family home in Firestone, Colorado, was destroyed by an explosion. A resident and a plumber who was working at the house died in the explosion, and two other residents were injured. At the time of the explosion, the fatally injured resident and plumber were replacing a water heater in the basement. The explosion also damaged the adjacent house, which later was demolished.

We determined that the probable cause of the explosion and fire was the ignition of fugitive natural gas that had migrated from the Coors V6-14.Ji well through a pipeline that was not abandoned by Patina Oil and Gas Corporation but had most likely been severed in 2015 during the construction of the house. Contributing to the accident was the approval by local authorities to allow occupied structures to be built on land adjacent to, or previously part of, oil and gas production fields without complete documentation from the operator, Anadarko Petroleum Corporation, on the location and status of its gathering system pipelines.

Completed Safety Recommendation Report

RAILROAD

Train Emergency Brake Communication
Granite Canyon, Wyoming (2 fatalities)

On October 4, 2018, an eastbound Union Pacific (UP) freight train collided with the rear of a stationary UP freight train. The striking train consisted of 3 leading locomotives and 105 railcars. The engineer and conductor of the striking train were killed, 3 locomotives and 57 railcars of the striking train derailed. Nine railcars of the stationary train also derailed. Prior to the accident, the crew of the striking UP freight train reported problems with the train’s air brake system and radioed the UP Harriman Dispatch Center to advise that they had accelerated to 50 mph and were unable to stop.

As a result of this investigation, we issued three safety recommendations to all Class I Railroads and the American Short Line and Regional Railroad Association.

Figure 53. Two people died and two others were injured when an explosion destroyed a family’s residence, pictured above, in Firestone, Colorado, in April 2017. A second home was so damaged that it had to be demolished.

Figure 54. The November 2018 train collision in Granite Canyon, Wyoming, killed 2 crewmembers and derailed 3 locomotives and 66 railcars. This picture shows damage to the brake rigging of one of the railcars.
### Ongoing Investigations

#### RAILROAD

- Long Island Railroad train struck track worker; Queens Village, New York; June 10, 2017; 1 fatality.
- CSX tank cars derailed and a propane car cracked, breached, and caught fire; Hyndman, Pennsylvania; August 2, 2017; no fatalities or injuries.
- SEPTA light rail train collided with another SEPTA train; Upper Darby, Pennsylvania; August 22, 2017; 39 injured.
- UP remote-control locomotive in UP railroad yard killed UP employee; Arlington, Texas; September 22, 2017; 1 fatality.
- CSX truck struck and killed maintenance-of-way worker; Wartrace, Tennessee; March 12, 2018; 1 fatality.
- Amtrak passenger train struck and killed an Amtrak maintenance-of-way worker; Bowie, Maryland; April 4, 2018; 1 fatality.
- CSX freight train derailed on bridge; Alexandria, Virginia; May 19, 2018; no fatalities or injuries.
- BNSF train struck a work train; Kingman, Arizona; June 5, 2018; 1 fatality, 1 injured.
- UP train collided with a stationary UP freight train, which then derailed, killing two crewmembers; Granite Canyon, Wyoming; October 4, 2018; 2 fatalities.
- CSX train struck and killed CSX track welder; Estill, South Carolina; November 30, 2018; 1 fatality.
- NYCT train passenger fell while standing between cars; Bronx, New York; December 5, 2018; 1 fatality.
- Norfolk Southern Railroad conductor died while performing switching operations; Baltimore, Maryland; February 7, 2019; 1 fatality.
- CSX remote-control locomotive struck a mechanical employee; Chattanooga, Tennessee; April 13, 2019; 1 fatality.
- UP train carrying denatured alcohol derailed; Fort Worth, Texas; April 24, 2019; no fatalities or injuries.
- SEPTA train struck two track workers; Philadelphia, Pennsylvania; July 8, 2019; 1 fatality.
- CSX freight train struck another CSX freight train from the side; Carey, Ohio; August 12, 2019; 2 injured.
- Sacramento Regional Transit District Light Rail train struck another Sacramento Regional Transit District Light Rail train; Sacramento, California; August 22, 2019; 27 injured.

#### PIPELINE

- Single-family residence exploded as a result of Atmos Energy gas leak and two previous explosions 48 hours before, causing 300 residence evacuations; Dallas, Texas; February 23, 2018; 1 fatality, 4 injured.
- Pacific Gas & Electric natural gas main damaged during excavation, causing a fire in a busy thoroughfare; San Francisco, California; February 6, 2019; no fatalities or injuries.
- Enbridge Inc. natural gas pipeline rupture and fire; Danville, Kentucky; August 1, 2019; 1 fatality, 6 injured.

#### HAZARDOUS MATERIALS

- Lithium-ion battery caught fire in a delivery truck; Brampton, Ontario, Canada; June 3, 2016; no fatalities or injuries.
- Anhydrous ammonia release from a nurse tank trailer; Beach Park, Illinois; April 25, 2019; 41 injured.
International Assistance

- Lithium-ion battery fire; Ontario, Canada; June 3, 2016; no fatalities or injuries (see above).
- Train carrying crude oil derailed 37 tank cars; St. Lazare, Manitoba, Canada; February 16, 2019; no fatalities or injuries.
- Canadian National Railroad train carrying hazardous materials derailed in a tunnel; Sarnia, Ontario, Canada; June 28, 2019; no fatalities or injuries.

Safety Alert

Fouling Other Railroad Tracks (SA-078)

This safety alert provides information for working safely on rails at locations with multiple tracks.

Figure 55. This Safety Alert was issued as a result of a railroad accident in June 2017 in which two rail workers were struck and killed by an Amtrak train.

12 Fouling means being close enough to a track to be struck by a moving train or, in any case, within 4 feet of the nearest rail.
Office of Research and Engineering

Table 11. Office of Research and Engineering Statistics

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<td>Advocacy and Outreach Events</td>
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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: Physician Consult Section and Chief Data Scientist.

RE conducts safety research, generates periodic statistical reviews of aviation accidents, and provides medical and toxicology expertise for investigations in all modes.
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 risks or hazards in the transportation environment that may influence accidents or injury, accident investigation techniques and methods, and 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 2019, the division published one safety research study report on bicycle crash risk factors that resulted in 10 safety recommendations; two notice-of-proposed-rulemaking responses focused on fatigue risk management programs in commercial trucking; and two annual reviews of aviation accident statistics. In addition, division staff generated 9 rapid reports and 14 data reports and geospatial products to support major accident investigations in aviation, highway, marine, and rail, and completed 261 aviation data report and statistical analysis requests. Division staff also led and participated in multiple presentations and training sessions for internal and external organizations. Staff completed numerous data-collection trips and interviews with national and regional air carriers, meteorological and air traffic control facilities, and other government and industry stakeholders in support of an ongoing research study on turbulence-related injury in air carrier operations.

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 2019, the division completed 174 reports for 138 accident cases, launched to two accident sites, and supported numerous NTSB reports and recommendations. The division supported the investigation of a fire on the 75-foot commercial diving vessel Conception off the coast of Ventura, California, studying the origin, cause, and tenability of the fire. The Conception investigation is ongoing, and the division continues to support the development of a Board report and Board meeting. The division also supported the investigation of a natural gas pipeline rupture in Danville, Kentucky, conducting the root cause failure analysis of the pipeline fracture. The investigation is ongoing, and the division continues to support the development of a Board report and Board meeting.

Figure 56. Frank Zakar of the Materials Laboratory Division examines the pipeline fracture in Danville, Kentucky.

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 2019, the division received 352 devices; completed 447 readouts, transcripts, and studies in support of aviation, railroad, marine, and highway investigations; and launched in support of five accidents. Of the recorders received, 28 were from foreign accidents and 4 were in support of US military investigations. Most notably, the division supported the read-out of the recorders from Ethiopian Airlines Flight 302, sending a recorder specialist to Ethiopia and France for nearly a month to download and analyze the flight data recorders and cockpit voice recorders. Engineers supported the development of numerous NTSB reports and safety recommendations, including Safety Recommendation R-19-7 from the DuPont, Washington Amtrak accident, which addresses inward-facing image and audio recorders. The division hired four new engineers in 2019, bolstering the NTSB’s capacity to download and analyze digital evidence.

Figure 57. Charles Cates of the Vehicle Recorder Division disassembles and inspects the recorder recovered from the Atlas Air crash into Trinity Bay that occurred in February 2019.
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. Engineers use computational and visualization technology to provide accurate time-motion histories of the sequence of events, and evaluate data from multiple sources to determine vehicle and occupant motion and the underlying causes of that motion. Engineers also develop video animations of accident scenarios, evaluate occupant injury mechanisms, and participate in and direct research into special projects, as required.

In 2019, the division staff completed 38 products in support of accident investigations (aircraft and surface vehicle performance studies, laser scanning reports, biomechanics studies, and video/photograph studies). Among the products completed were an evaluation of the airplane flight path and aerodynamic stall of a crash of a Learjet 35A on approach to Teterboro, New Jersey; the division also developed an animation depicting the sequence of events in that accident, which was shown at the Board meeting in March 2019. In addition, the division assisted in contracting for brake testing to develop data that can be used in a simulation to analyze the crash of a limousine in Schoharie, New York. Finally, division staff produced three accident reconstruction animations and video compilations for NTSB events.

Program Areas

Physician Consult Section

RE medical staff evaluates the medical aspects of investigations, including medical fitness, pathology, toxicology, injury causation, and biomechanics. Examples of medical issues addressed include 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 2019, the Physician Consult Section’s three physicians participated in more than 113 NTSB accident investigations and completed 170 reports in all transportation modes. This included evaluating and addressing 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 better utilize data for 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 2019, the chief data scientist, along with representatives from the NTSB Offices of the Chief Information Officer and Aviation Safety, led the development of a multimodal database for NTSB 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, including forming an agency data-governance body.
Completed Safety Research Report

Bicyclist Safety on US Roadways: Crash Risks and Countermeasures

This safety research report examined the prevalence of, and risk factors for, bicycle crashes involving motor vehicles on US roadways and assessed the most applicable countermeasures. Using a combination of quantitative and qualitative methods (countermeasure and research literature review; crash and injury data analysis; and interviews of national, state, and local traffic safety stakeholders), we identified three bicyclist safety issue areas: (1) improving roadway infrastructure for bicyclists, (2) enhancing conspicuity, and (3) mitigating head injury. The report also discusses other safety issues that repeatedly emerged during stakeholder interview sessions.

As a result of this safety research report, we issued 10 recommendations to the DOT’s Intelligent Transportation Systems Joint Program Office; NHTSA; the Federal Highway Administration; the US Consumer Product Safety Commission; the 50 states, the District of Columbia, and the Commonwealth of Puerto Rico; and American Association of State Highway and Transportation Officials. We also reiterated 10 recommendations to NHTSA.13

Figure 59. Dr. Ivan Cheung from the Office of Research and Engineering presents findings of the safety research report “Bicyclist Safety on US Roadways: Crash Risks and Countermeasures” to the Board Members during a public meeting.

Ongoing Safety Research Report

Safety Research Report: 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 Title 14 CFR Part 121. From 2008 through 2016, 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.

13 Additional information about this safety research can be found in the NTSB Docket Management System, using the NTSB ID DCA18SS002. For more information about NTSB safety recommendations, see the Safety Recommendation Database at www.ntsb.gov.
Office of Administrative Law Judges

Table 12. Office of Administrative Law Judges Statistics

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<tr>
<td>Challenges to Emergency Determinations</td>
<td>16</td>
</tr>
<tr>
<td>Hearings Held</td>
<td>29</td>
</tr>
<tr>
<td>Board Opinions and Orders</td>
<td>11</td>
</tr>
<tr>
<td>Advocacy and Outreach Events</td>
<td>4</td>
</tr>
</tbody>
</table>

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 (ALJ) 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 ALJ 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.

The Board's review of appeal of an administrative law judge's decision 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.
We currently have four judges, all assigned to headquarters in Washington, DC. One judge is stationed in Dallas-Fort Worth, Texas, and one judge is stationed in Denver, Colorado. Which hearings a judge holds is determined by his or her circuit assignment.

- In 2019, ALJ disposed of 88 percent of its caseload.
- 281 appeals were filed with the NTSB’s administrative law judges.
- The judges held 29 hearings and closed 225 cases.
- The office received 137 emergency cases14 (see figure 60); statute requires that such cases receive expedited handling and hearing.
- Twenty-one of the judges’ decisions were appealed to the Board, which decided 11 appeals on the merits, affirming the judge in 10 cases, and reversing the judge in 1 case.

14 Emergency cases are those in which the certificate, because of a serious concern for aviation safety, is immediately taken from the certificate holder by the FAA during the pendency of the case.
NTSB Training Center

Table 13. NTSB Training Center Statistics

<table>
<thead>
<tr>
<th>Category</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Courses, Programs, Seminars Offered (Total)</td>
<td>128</td>
</tr>
<tr>
<td>Workforce Development Courses</td>
<td>101</td>
</tr>
<tr>
<td>Total Attendance</td>
<td>6,111</td>
</tr>
<tr>
<td>NTSB Participants</td>
<td>4,842</td>
</tr>
<tr>
<td>External Participants</td>
<td>1,269</td>
</tr>
<tr>
<td>International Participants (representing 40 countries)</td>
<td>187</td>
</tr>
<tr>
<td>Participants from Other Federal Agencies</td>
<td>409</td>
</tr>
</tbody>
</table>

The NTSB Training Center (TC), located in Ashburn, Virginia, provides opportunities for NTSB employees and others from the transportation community through a variety of course offerings 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 the safety in all modes of transportation.

The mission of the TC is to promote safe transportation by—

- **ENSURING** and **IMPROVING** the quality of accident investigation through critical thought, instruction, and research.
- **COMMUNICATING** lessons learned, fostering the exchange of new ideas and new experience, and advocating operational excellence.
- **PROVIDING** a modern platform for accident reconstruction and evaluation.
- **USING** its high-quality training resources to facilitate family assistance and first-responder programs, sister-agency instruction, and other compatible federal activity.

The TC’s laboratory area contains the reconstruction of TWA Flight 800, as well as other wreckage and materials that are used in investigative courses, enabling participants to gain hands-on experience with real-world examples. The Workforce Development curriculum offers NTSB employees access to additional courses focused on career development and management, leadership, and other mission-critical 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. Investigators from the NTSB and other organizations in the domestic and international transportation communities use the TC to improve their accident investigation competencies.
Training Center Offerings

In 2019, the TC continued to upgrade and refine a comprehensive array of training courses focusing on mission-related skills for NTSB staff as well as other domestic and international participants. Staff concentrated on improving investigative programs and courses, which ranged in length from 1 day to 2 weeks and offered wide applicability to the investigative field, including Cognitive Interviewing Techniques for Accident Investigators, Investigating Human Fatigue Factors, Managing Communications Following a Transportation Disaster, and Coordinating Family Assistance.

Most course attendees are from the transportation and emergency response communities. To meet their needs, TC staff ensured that courses relied heavily on case studies, demonstrations, and when appropriate, hands-on training. For example, NTSB Helicopter Accident Investigation classes were able to examine a fully intact UH 1 Iroquois ("Huey") helicopter that we had obtained from the US Army.

The TC added new courses to its standard curriculum, including Refresher Training for Experienced Supervisors and Executive Coaching, which increased learning opportunities for managers. Improved access to on-demand webinars and other online classes expanded opportunities for staff learning, as well. This increased availability of online technical and soft-skills training provided flexibility for all NTSB staff—both those launched on "Go Teams" and others located outside the metropolitan Washington, DC, area—to train at their convenience without increasing agency travel costs.

By continually assessing the needs of external and internal customers, TC staff ensure that course offerings not only address skills and abilities needed today, but also anticipate those that will be needed in the future. Some examples of courses that focus on key current and future needs include these:

- Accident Site Photography
- Accident Site Documentation Using Unmanned Aerial Vehicles
- Advanced Interviewing Techniques
- Mobile Device Forensics
- Civil Treatment
- Comprehensive Project Management
- Critical Incident Stress Management
- Media Relations

Transportation Community and Partnerships

Furthering its commitment to meeting the training needs of those in other areas of government, the transportation safety community, and the security and emergency response communities, we continue to build upon our alliances with private organizations and federal agencies. One example of these alliances is the partnership between the TC and the Coast Guard. We have held 4 courses each year to train Coast Guard aviation and marine safety operations personnel to investigate mishaps involving Coast Guard assets and personnel. Additionally, the TC continues to attract attendees from many foreign governmental agencies and transportation entities. For example, we worked with the Army National Guard Safety Center at Fort Rucker to develop and present a 2-week aircraft accident investigation course, exclusively tailored for the National Guard. The course was so well received that the National Guard requested an additional 1-week helicopter accident investigation course. Whenever possible, we work with our investigative partners to offer classes to larger groups at other locations, eliminating travel costs as a barrier to training. For example, our course on Managing Communications During a Transportation Disaster was presented to Air Methods Corporation, Cathay Pacific Airlines, Dallas–Fort Worth International Airport, Delta Airlines, and Air New Zealand, and received outstanding reviews.

The TC also presents several general aviation safety seminars each year, partnering with the FAA and other interested groups to develop seminars that focus on the safety, regulatory, and training aspects of general aviation. These safety seminars are designed for pilots, flight instructors, and other members of the general aviation community, and pilots participating in the FAA’s WINGS Program receive credit for attendance. In 2019, we delivered our second annual Inspection Authorization Renewal Safety Seminar for airplane mechanics to receive 8 hours of training to fulfill their annual certification requirements. We also delivered a seminar on night flying safety.
INTEGRITY
TRANSPARENCY
INDEPENDENCE
EXCELLENCE
DIVERSITY &
INCLUSION