Testimony of

The Honorable Earl F. Weener, Ph.D.
Member
National Transportation Safety Board

Before the

Subcommittee on Coast Guard and Maritime Transportation
Transportation & Infrastructure Committee
United States House of Representatives

— On —

Examination of Reports on the *El Faro* Marine Casualty and Coast Guard's Electronic Health Records System

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NTSB | National Transportation Safety Board

An Independent Federal Agency

Good morning Chairman Hunter, Ranking Member Garamendi, and the Members of the Subcommittee. Thank you for inviting the National Transportation Safety Board (NTSB) to testify before you today. I am accompanied today by Brian Curtis, the Director of our Office of Marine Safety.

The 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—highway, rail, marine, and pipeline. We determine the probable cause of the accidents we investigate and we issue safety recommendations aimed at preventing future accidents. In addition, we conduct special 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.

This testimony will discuss our investigation into the October 1, 2015, sinking of the US-flagged cargo ship *El Faro*, a 40-year-old vessel owned by TOTE Maritime Puerto Rico and operated by TOTE Services, Inc. The ship sank in the Atlantic Ocean about 40 nautical miles northeast of Acklins and Crooked Island, Bahamas, during Hurricane Joaquin, claiming the lives of all 33 crew members (**Figure 1**). On December 12, 2017, following a 26-month investigation, we determined the probable cause of the sinking and made 53 safety recommendations.

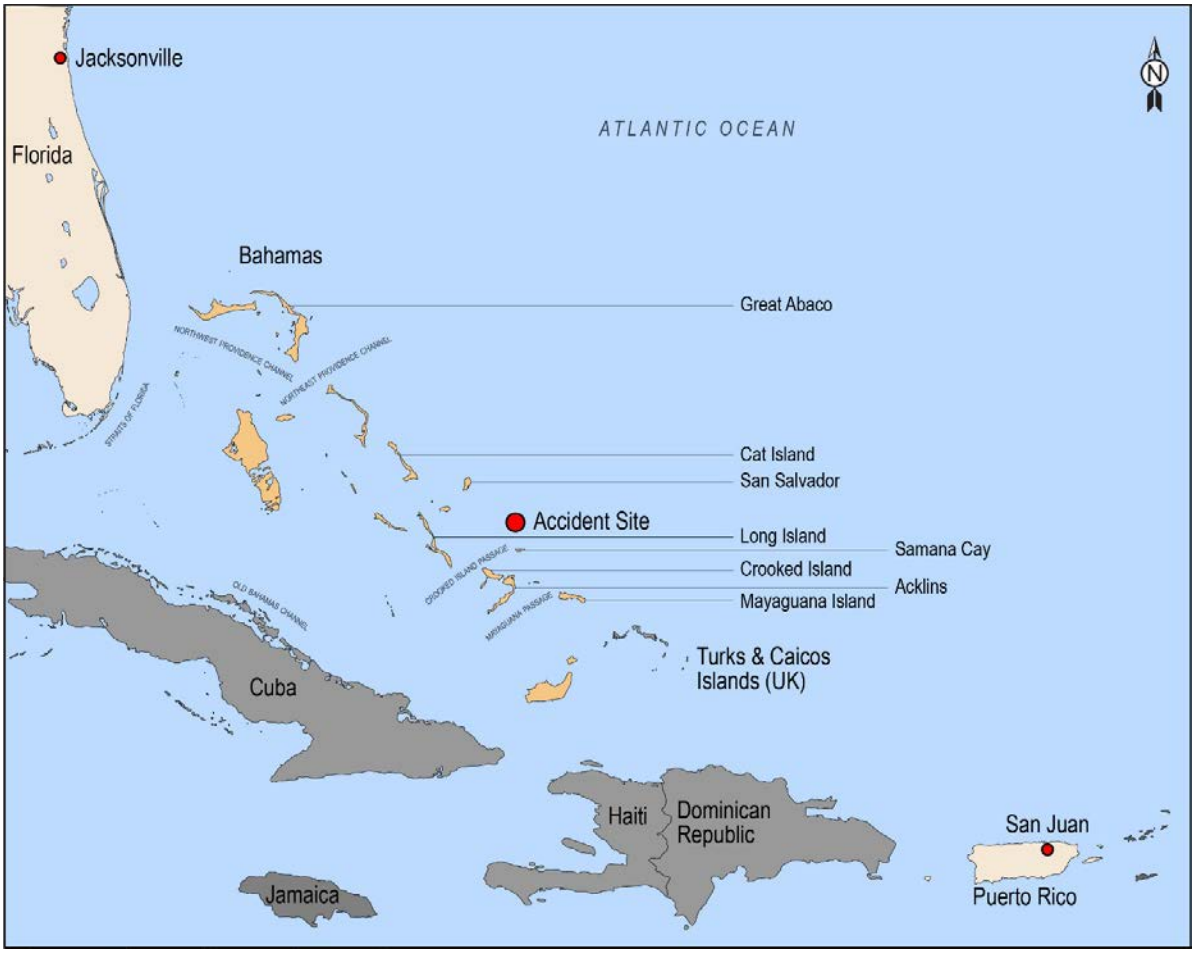

Figure 1. Accident location in the Atlantic Ocean near Acklins and Crooked Island, Bahamas.

The Investigation of the Sinking of *El Faro*

The sinking was investigated jointly by the US Coast Guard and the NTSB, with the NTSB as the lead investigative agency. The Coast Guard convened a Marine Board of Investigation, holding three public hearings, in which we fully participated. In addition, because the sunken *El Faro* could not be physically investigated (although many thousands of images were gathered during the underwater searches), our investigators visited *El Faro*'s sister ship, *El Yunque*, to observe and document its structure and equipment. Our investigators also gathered information by interviewing former and off-duty crewmembers, the crew's family members and friends, TOTE officials, industry representatives, Coast Guard officers, and others. Additional firsthand information about *El Faro* came from photographs and written records collected by Maine Maritime Academy cadets who had sailed on the vessel during the summer of 2015 as part of the school's cadet shipping program. Finally, recovering *El Faro*'s voyage data recorder (VDR) was critical to determining the probable cause of its sinking.[1]

Four days after the sinking, the NTSB, working with the US Navy, began planning an effort to locate the *El Faro* wreckage and retrieve the VDR capsule. On October 31, 2015, the Navy ship *Apache* found *El Faro*'s hull on the seabed 15,400 feet below the surface of the ocean, but the VDR was not located. On April 26, 2016, the research vessel *Atlantis*, which was sent to the wreckage area by the National Science Foundation and the Woods Hole Oceanographic Institution, located the VDR capsule, but investigators determined that it could not be recovered at that time. Ten months after the accident, in August 2016, the Navy ship *Apache* returned to the site with a remotely operated vehicle, CURV-21, and retrieved the capsule from a depth of 15,250 feet. After the *Apache* returned to port on August 12, investigators transported the capsule to NTSB headquarters, where over 26 hours of parametric data and audio files were accessed.

We recovered audio of conversations and ambient sounds from the ship's bridge that began at 5:36 a.m. on September 30 and continued until the *El Faro* sank. This data, as well as parametric data from the VDR such as the ship's heading and speed over ground, provided information regarding the captain's and crew's conversations and actions throughout the voyage, the weather information available to them, and the ship's performance as it sailed into the storm.

We determined that the probable cause of *El Faro*'s sinking and the subsequent loss all 33 aboard was the captain's insufficient action to avoid Hurricane Joaquin, his failure to use the most current weather information, and his late decision to muster the crew. Contributing to the sinking was ineffective bridge resource management (BRM) on board *El Faro*, which included the captain's failure to adequately consider officers' suggestions. Also contributing to the sinking was the inadequacy of both TOTE's oversight and its safety management system. Further contributing factors were flooding in a cargo hold from an undetected open watertight scuttle and damaged seawater piping; loss of propulsion due to low lube oil pressure to the main engine resulting from a sustained list; and subsequent downflooding through unsecured ventilation closures to the cargo holds. Also contributing to the vessel's loss was the lack of an approved damage control plan that

[1] Organizations assisting in the VDR recovery included Department of the Navy, Supervisor of Salvage and Diving and Military Sealift Command; US Coast Guard; American Bureau of Shipping; National Oceanic and Atmospheric Administration; National Science Foundation; Woods Hole Oceanographic Institution; TOTE Services, Inc.; and University of Rhode Island, Inner Space Center.

would have helped the crew recognize the severity of the vessel's condition and guided their response to the emergency. Contributing to the loss of life was the lack of appropriate survival craft for the conditions.

The Accident Voyage

On September 29, 2015, at 9:48 p.m., *El Faro* and its 33 crewmembers departed its homeport in Jacksonville, Florida, on a 1,100-nautical-mile planned voyage to San Juan, Puerto Rico. Carrying 11,046 long tons of cargo, the ship was slated to arrive in the early morning hours of October 2. However, the ship sailed directly into the path of Hurricane Joaquin, a Category 3 storm that reached Category 4 strength shortly after the sinking at approximately 8:00 a.m. on October 1.

Approximately 3 hours before *El Faro* set sail on September 29, the National Hurricane Center (NHC) issued the first marine hurricane warning for Joaquin for a large area of the Atlantic east of the Bahamas; however, we determined that the captain's decision to depart Jacksonville was reasonable, considering the number of options he could employ to avoid the storm. As they tracked the storm the next day, the captain and chief mate diverted course to the south to try to distance themselves from the storm. However, as it continued to intensify, Joaquin also tracked further south than predicted.

The crew onboard *El Faro* relied on two primary sources of weather information to remain aware of Joaquin's changing position, forecast intensity, and forecast track: Inmarsat-C SafetyNET (SAT-C) and the Bon Voyage System (BVS). These sources used different methods and formats to deliver weather guidance. SAT-C provided text broadcasts of NHC weather products, which were delivered to the vessel's bridge. The most current information on Joaquin's position and forecast track and intensity SAT-C delivered (with limited delay) was the NHC's tropical cyclone forecast/advisory, which is issued four times a day for active tropical cyclones. Based on the VDR audio, there were five instances in which the SAT-C terminal on *El Faro*'s bridge likely received a tropical cyclone forecast/advisory between 6:38 a.m. on September 30 and 4:47 am on October 1.

BVS is a software program that provides graphic depictions of weather information via e-mail or broadband. BVS weather files were e-mailed to *El Faro*'s captain, who primarily relied on this information for storm location and forecast track. Seven BVS files were e-mailed to *El Faro* during the accident voyage. At the times the BVS weather files were e-mailed, the storm location and forecast track were not current with the information then available through SAT-C; rather, BVS provided a storm position and forecast track 6 hours behind SAT-C. BVS also sends updates with current forecasts if a user specifically requests them, but during the accident voyage, *El Faro* did not request any such updates.

Figure 2 shows *El Faro*'s position at 2:30 p.m. on September 30, in relation to the storm's location and forecast tracks from SAT-C and BVS received that morning, as well as the NHC's poststorm best-track analysis of actual storm location. At 4:54 p.m., a SAT-C advisory received on the bridge indicated that the storm was moving further southwest. An updated BVS update was available for download at about 5:00 p.m., but it was consistent with the forecast that had been sent through SAT-C at 11:00 a.m.

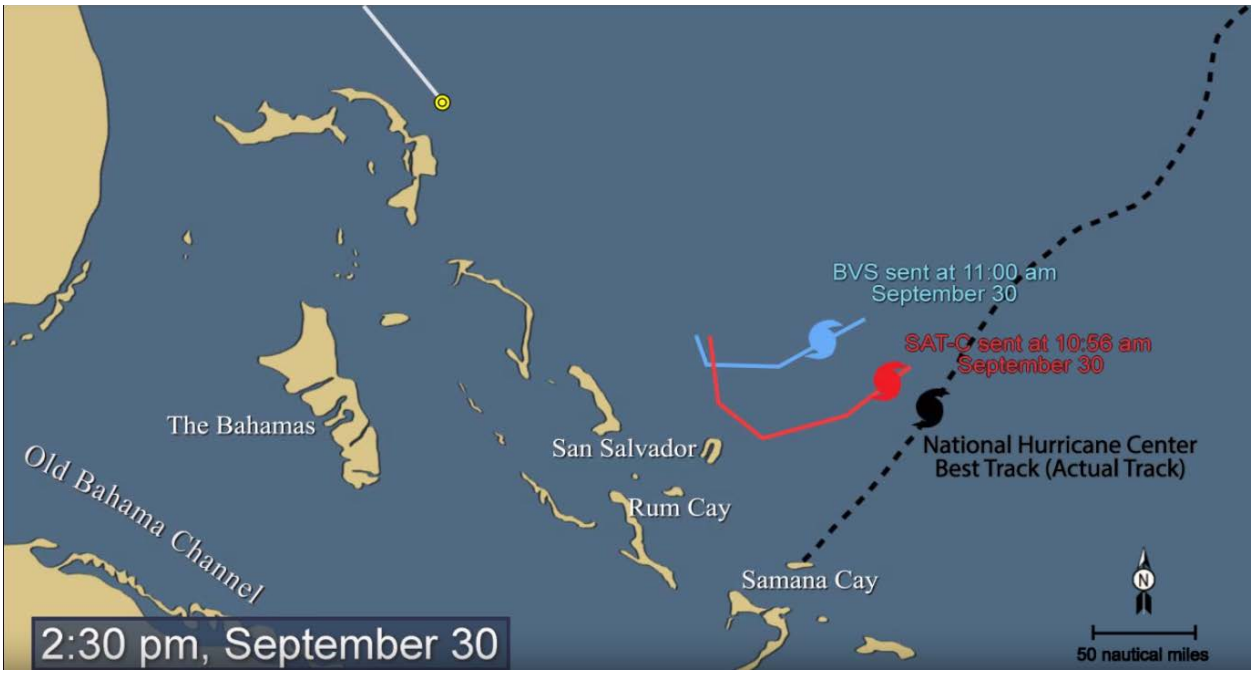

Figure 2. Location of *El Faro* in relation to available weather forecasts and poststorm analysis at 2:30 p.m. on September 30.

At around 7:00 p.m., the captain adjusted the course slightly south (**Figure 3**). At this point, the ship was about 180 nautical miles (nm) northwest of the center of Joaquin. The captain left the bridge at approximately 8:20 p.m. and was not detected on the bridge by the VDR until 4:09 a.m. on October 1.

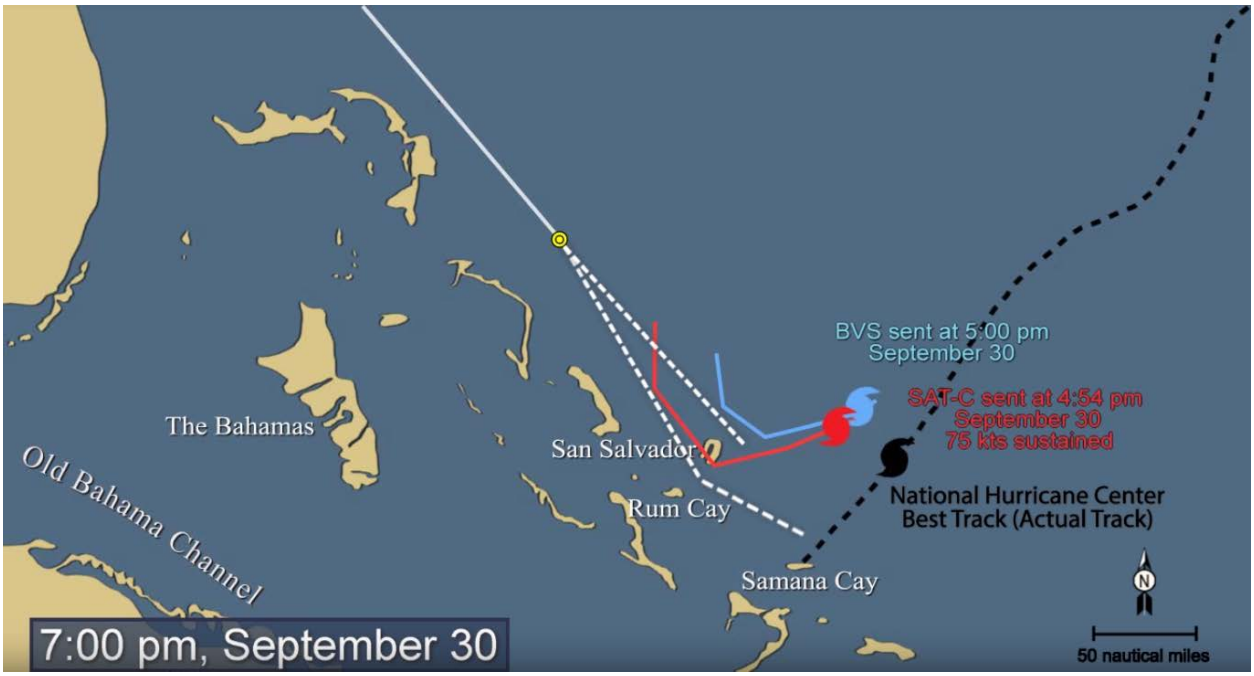

Figure 3. *El Faro*'s location, depicting the course change to the south, in relation to its prior course, available weather forecasts, and poststorm analysis at 7:00 p.m. on September 30.

At 10:53 p.m., a SAT-C advisory received on the bridge indicated that the storm was centered about 120 nm southeast of *El Faro*'s position and was moving southwest at 5 knots. Maximum sustained winds were 100 knots, with gusts to 120 knots. At 11:05 p.m., the third mate called the captain from the bridge telephone to notify him of the SAT-C advisory. At 11:13 p.m., the third mate called the captain again and suggested diverting to the south, noting that at 4:00 a.m. on October 1, they would be 22 miles from the center of the storm (**Figure 4**). This information did not cause the captain to authorize a course change. Later, the third mate told the able seaman on watch that the captain thought they would be south of the storm.

Figure 4. *El Faro*'s location, depicting the current course and expected position, available weather forecasts, and poststorm analysis at 11:13 p.m. on September 30.

At 1:20 a.m., the second mate, who had taken over watch duties, called the captain in his quarters to suggest they alter the course south at 2:00 a.m. According to the VDR, the second mate indicated that the captain told her to maintain the current course. At 1:31 a.m., the NHC issued an intermediate advisory that indicated that Joaquin had moved southwest over the past 3 hours. Intermediate advisories were not transmitted via SAT-C, and *El Faro* did not receive them. Intermediate advisories could have been obtained from the National Weather Service via an FTPmail service, but there is no evidence that the crew attempted to do so.

At 4:09 a.m., the captain arrived back on the bridge, and at 4:45 a.m., he downloaded a BVS weather file that had been sent at 11:04 p.m. the night before. Joaquin's position, forecast track, and intensity given in the file were consistent with the data in the advisory that had been delivered to the bridge via SAT-C almost 12 hours before, at 4:54 p.m. the previous afternoon. At 4:46 a.m., *El Faro*'s SAT-C terminal received an advisory indicating that *El Faro* was 11 nm northwest of the storm center (**Figure 5)**.

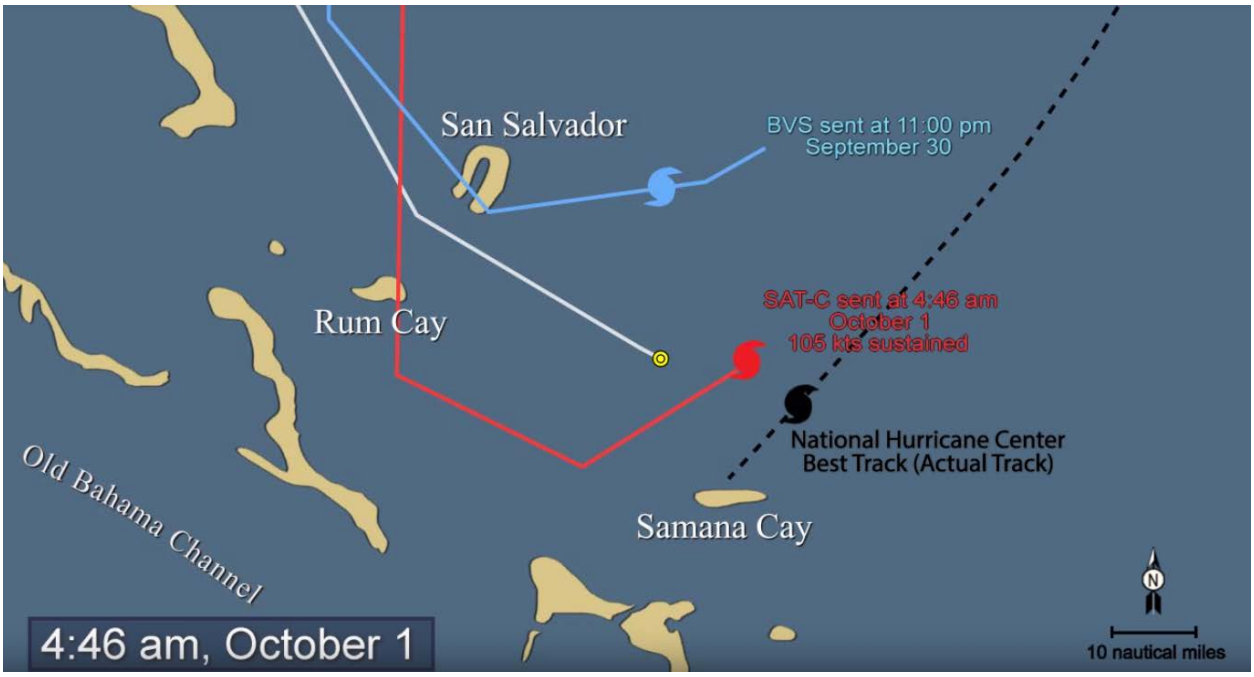

Figure 5. *El Faro*'s location in relation to available weather forecasts and poststorm analysis at 4:46 a.m. on October 1.

For the next hour, the captain ordered actions to address the ship's starboard list, which was caused by increasing wind on the vessel. At 5:43 a.m., the captain received a report of water in cargo hold 3, thought to be coming from an open deck hatch (scuttle) on the second deck, which allowed downflooding through the ship's watertight envelope. The crew did not know when or how the scuttle opened, as there was no open/close indicator at the bridge or other staffed location.

Around the time that he was informed of the flooding in hold 3, the captain was heard on the VDR indicating that cars were loose. He was likely referring to automobiles that had broken free from their lashings, as the automobile-lashing arrangement did not meet the requirements of the vessel's approved cargo-securing manual, making automobiles more likely to shift from vessel motion in heavy weather. The introduction of water to cargo hold 3, combined with the vessel's motion, led to some of the lashings failing and automobiles becoming unsecured.

The ship's list prevented the chief mate from accessing the scuttle, and the chief engineer also reported the list was adversely affecting machinery oil levels in the engine room. The captain ordered a turn to port to correct the list so as to re-establish machinery oil levels and allow the chief mate to access the scuttle area in the flooding cargo hold. The chief mate was able to access and close the scuttle; however, hold 3 continued to take on water, despite the bilge pumps continuously running. The ship continued to lose speed, and at 6:16 a.m., the engine room reported the vessel had lost propulsion. The port list, coupled with the vessel's motion, most likely caused air to enter the bellmouth of the suction pipe to the lube oil service pump, which resulted in a loss of oil pressure that caused the main engine to shut down. The level of lube oil in the main engine sump was not maintained in accordance with the vessel's operations manual, which increased the propulsion system's susceptibility to loss of oil pressure if the ship was listing. Once propulsion was lost, *El Faro* was pushed sideways by the wind and waves.

We found that all the watertight and weathertight ventilation closures to the cargo holds most likely remained open throughout the sinking sequence. As a condition of carriage, *El Faro*'s certificate of inspection required that for each cargo hold, at least one air supply fan was to be operated, and natural exhaust ventilation openings were to remain open under way at sea when transporting vehicles with fuel tanks. Because *El Faro* transported vehicles on the accident voyage that had fuel tanks, the ventilation ducts were required to remain open. The loss of propulsion combined with the heavy flooding and heel would have resulted in downflooding through the cargo hold ventilation openings. Analysis found that the ventilation openings for cargo hold 2A would have intermittently submerged due to flooding in hold 3 plus windheel, waves, and roll motion.

The captain called TOTE's designated person on shore at 7:06 a.m. to advise of the ship's situation, and at 7:12 a.m., he ordered the second mate to send a distress message. The Coast Guard's rescue coordination center in Norfolk, Virginia, received an alert at about 7:15 a.m. At 7:14 a.m., the chief mate informed the captain that the water levels were rising in the cargo hold and that the chief engineer had reported that the fire main, which was fed by seawater piping below the waterline, was ruptured, allowing seawater to rush into the number 3 cargo hold. It is likely that the seawater piping to the vessel's emergency fire pump in cargo hold 3 was inadequately protected from impact and was struck by one or more automobiles that had broken free of their lashings. Impact damage to this seawater piping in cargo hold 3 most likely led to flooding in the hold, which significantly compromised the vessel's stability. The rate of flooding in cargo hold 3 exceeded the bilge pumps' capacity to lower the water level in the hold. At 7:16 a.m., the bilge alarm sounded for hold 2A, indicating that floodwater had entered the hold.

At 7:27 a.m., the captain rang the ship's general alarm, and 1 minute later, the chief mate gave a radio command for the crew to muster on the starboard side of the ship. At 7:29 a.m., the captain ordered abandon ship, and 2 minutes later, he ordered the liferafts thrown overboard and the crew to enter them. The VDR ceased recording at 7:39 a.m., with the captain and able seaman still on the bridge.

A transmission from *El Faro*'s emergency position indicating radio beacon (EPIRB), which had been detected by geostationary satellite at 7:36 a.m., was e-mailed to the Coast Guard. The transmission was forwarded as an "unlocated first alert" because *El Faro*'s EPIRB was not equipped with a GPS beacon. No further communications were received by either the Coast Guard or TOTE. *El Faro*'s last known position, according to VDR data, was 20 nm north of Samana Cay, about 17 nm north of Joaquin's center.

Safety Issues

Our investigation into the sinking identified several major safety issues, including the captain's actions, currency of weather information, bridge team management, company oversight, damage control plans, and survival craft suitability.

The probable cause of sinking reflects the captain's decision-making and actions that put *El Faro* and its crew in peril. The captain did not divert to safer routes to avoid Joaquin, failing to heed the suggestions of the ship's junior officers to alter the course after they determined that

El Faro was headed into the storm. We determined that *El Faro* was receiving sufficient weather information for the captain to make appropriate decisions regarding the vessel's route; however, although up-to-date weather information was available, the captain did not use the most current weather information for decision-making.[2] The captain should have returned to the bridge after the second and third mates called him to gain a better awareness of the changing weather situation. In addition, had the deck officers more assertively stated their concerns, the captain's situational awareness might have been improved. Both the captain's inadequate regard for the crew's suggestions and the crew's inadequate assertiveness in stating their concerns to the captain demonstrate that the concepts of BRM were not implemented onboard *El Faro*.

BRM is a process by which bridge crews use all available resources and act efficiently and as a team to safely operate a ship. Training in BRM encourages junior officers to put forth their opinions and, when safety is a concern, to challenge their superior officers. Senior officers are, in turn, trained to be open to gathering feedback from the bridge team. All members of *El Faro*'s bridge team except the captain completed BRM training in 2013. The company was not required to send crewmembers to BRM training, and the Coast Guard does not require recurrent BRM training. TOTE's failure to ensure that BRM was implemented contributed to *El Faro*'s sinking. As a result, we made several recommendations to promote more effective BRM, including recommending that the Coast Guard require recurring BRM training for all deck officers when renewing their credentials.

The captain's actions led the ship into the middle of the storm, but the *El Faro* was also imperiled by a failure to maintain the ship's watertight integrity. Seawater entered cargo hold 3 through an undetected open scuttle, contributing to automobiles becoming unsecured and striking an inadequately protected emergency fire pump. The high rate of flooding contributed to further flooding susceptibility from water entering cargo ventilation openings. As a result, we recommended that the Coast Guard and the International Association of Classification Societies take action to provide that all watertight access doors and access hatch covers normally closed at sea be equipped with open/close indicators both on the bridge and locally; provide that seawater supply piping below the waterline in all cargo holds be protected from impact; and improve damage-control plans with better information and greater consideration of openings that lead to downflooding.

TOTE's safety management system was also inadequate and did not provide the officers and crew with the necessary procedures to ensure safe passage, watertight integrity, heavy-weather preparations, and emergency response during heavy-weather conditions. The company did not have an effective training program for the use of damage stability assessments, heavy-weather operations, or the use of the ship's weather information software. The company did not ensure that *El Faro* had a properly functioning anemometer, which deprived the captain of a vital tool for understanding his ship's position relative to the storm. The company did not monitor *El Faro*'s

[2] In the course of this investigation, we found that improvements need to be made to the tropical cyclone information that is available to mariners, and that a new emphasis on improving hurricane forecasts is warranted. On June 20, 2017, we adopted 10 recommendations to the National Oceanic and Atmospheric Administration, the National Weather Service, and the Coast Guard (National Transportation Safety Board, *Tropical Cyclone Information for Mariners*, Rpt. No. MSR-17/02 [Washington, DC: NTSB, 2017]).

position relative to the storm and did not provide the captain with support for storm avoidance and heavy-weather preparations during the accident voyage. The company's lack of oversight in critical aspects of safety management, including gaps in training for shipboard operations in severe weather, denoted a weak safety culture in the company and contributed to *El Faro* sinking. As a result, we recommended that TOTE conduct an external, independent audit of its entire safety management system to ensure compliance with the International Safety Management code and to correct noted deficiencies.

Finally, the captain's decision to muster the crew and abandon ship was late and may have reduced the crew's chances of survival. The severe weather, combined with *El Faro*'s list, made it unlikely that the liferafts or lifeboats could be launched manually or boarded by crewmembers once in the water, and they would not have provided adequate protection even if they had been launched. Open lifeboats, such as those *El Faro* carried, are not allowed on newly built vessels. *El Faro* was inspected and surveyed in accordance with the regulations applicable to its delivery date of January 1975. A vessel is surveyed under the same regulations as long as it is in service or until it undergoes a major modification; in the latter case, the vessel must comply with the requirements current at the time of modification as far as is reasonable and practicable. In 1993, *El Faro,* then named *Northern Lights,* began a major modification, but the lifeboats were not required to be upgraded at that time. The vessel was again substantially modified in 2005–2006 to carry load-on/load-off containers, but the Coast Guard did not classify this change as a major modification. We concluded that the 2005–2006 conversion should have been designated a major modification, which may have required the vessel to meet newer safety standards for lifeboats.

Survivability would increase if open lifeboats on all vessels remaining in service were replaced with enclosed lifeboats that adhered to the latest safety standards, and if new cargo vessels were equipped with stern-launched freefall lifeboats, where practical. We are recommending that the Coast Guard require that open lifeboats on all US-inspected vessels be replaced with enclosed lifeboats that meet current regulatory standards.

Conclusion

As with all of our investigations, our aim is to learn from this tragedy to improve safety for current and future generations of mariners. There were many factors that contributed to *El Faro* sinking, and there are many lessons to learn.

We wish to thank the US Coast Guard, the Department of the Navy, the National Science Foundation, Woods Hole Oceanographic Institution, and other organizations for their tremendous support in recovering *El Faro*'s recorder.

Thank you again for the opportunity to testify, and I am happy to take your questions.