NATIONAL TRANSPORTATION SAFETY BOARD
Office of Research and Engineering
Washington, DC

Wind Component Study

El Faro

DCA16MM001

October 2, 2017

Crider Dennis

Contents

Figures

1. ACCIDENT INFORMATION

Vessel:	*El Faro*
Accident Number:	DCA16MM001
Date:	10/1/2015
Time:	0739 eastern daylight time (EDT)
Location:	North Atlantic Ocean, 40 nautical miles northeast of Acklins and Crooked Islands, Bahamas 23.3925˚ N, 73.9029˚ W
Accident type:	Sinking
Complement:	27 crew, 6 supernumeraries

2. GROUP

No group was formed for this activity.

3. SUMMARY

On Thursday, October 1, 2015, about 0715 EDT, the US Coast Guard received distress alerts from the 790-foot roll-on/roll-off container (Ro/Con) ship *El Faro*. The US-flagged ship, owned by TOTE Maritime Puerto Rico (formerly Sea Star Line, LLC[1]) and operated by TOTE Services, Inc. (TOTE), was 40 nautical miles northeast of Acklins and Crooked Islands, Bahamas, and close to the eye of Hurricane Joaquin. The ship was en route from Jacksonville, Florida, to San Juan, Puerto Rico, with a cargo of containers and vehicles. Just minutes before the distress alerts were received, the *El Faro* master had called TOTE's designated person ashore and reported that a scuttle had popped open on deck two and that there was free communication of water into the No. 3 hold. He said the crew had controlled the ingress of water but that the ship was listing 15° and had lost propulsion. The Coast Guard and TOTE were unable to reestablish communication with the ship. Twenty-eight US crewmembers, including an off-duty engineering officer sailing as a supernumerary, and five Polish workers were on board. The vessel sank in 15,400 feet of water.

The Coast Guard, US Navy, and US Air Force dispatched multiple assets to the ship's last known position, but the search was hampered by hurricane-force conditions on scene. On Sunday, October 4, a damaged lifeboat and two damaged life rafts were located. The same day, the Coast Guard found a deceased crewmember wearing an immersion suit. A Coast Guard rescue swimmer tagged the body in

[1] On September 17, 2015, the parent company, TOTE, Inc., announced that Sea Star Line had been renamed TOTE Maritime Puerto Rico.

the immersion suit and left to investigate reported signs of life elsewhere but then could not relocate the tagged suit. No signs of life were found, and on Monday, October 5, a debris field and oil slick were discovered. The Coast Guard determined that *El Faro* was lost and declared the event a major marine casualty. The Coast Guard suspended the unsuccessful search for survivors at sundown on Wednesday, October 7.

4. DETAILS OF INVESTIGATION

4.1. Purpose of Study.

Wind instrumentation on the El Faro had an inaccurate directional component and potentially inaccurate speed component as recorded by voyage data recorder (VDR). The VDR indicated that the crew on the accident voyage did not trust the anemometer data they were receiving. The NTSB contracted with CSRA to do a dynamic analysis of *El Faro* sinking. This analysis included an estimate of wind conditions along the El Faro's route on the morning of October 1st in Table 1-1 of the CSRA report. These winds reflected hindcast data produced by numerical models run by NOAA's Environmental Modeling Center at times and locations corresponding to those of *El Faro* on October 1, in 15-minute intervals, and consideration of the VDR recorded wind speed data. In addition, Tote Inc. provided a submission, which included wind data along the El Faro's route in Appendix B and C (which also reflected hindcast data produced by numerical models run by NOAA's Environmental Modeling Center and considered the VDR recorded wind speed data but combined and weighed the data differently). To help understand the effects of these winds on the El Faro, these winds were converted into longitudinal and lateral components.

4.2. Source Data

The wind speed and direction from the CSRA report are given in figure 1 while the wind speed and direction from the Tote submission is given in figure 2. Note that wind direction in figure 1 from the CSRA report is relative to the stern where wind direction in figure 2 from the Tote submission is relative to true North. Ship's speed and heading needed for the study were available on the VDR and are presented in figure 3.

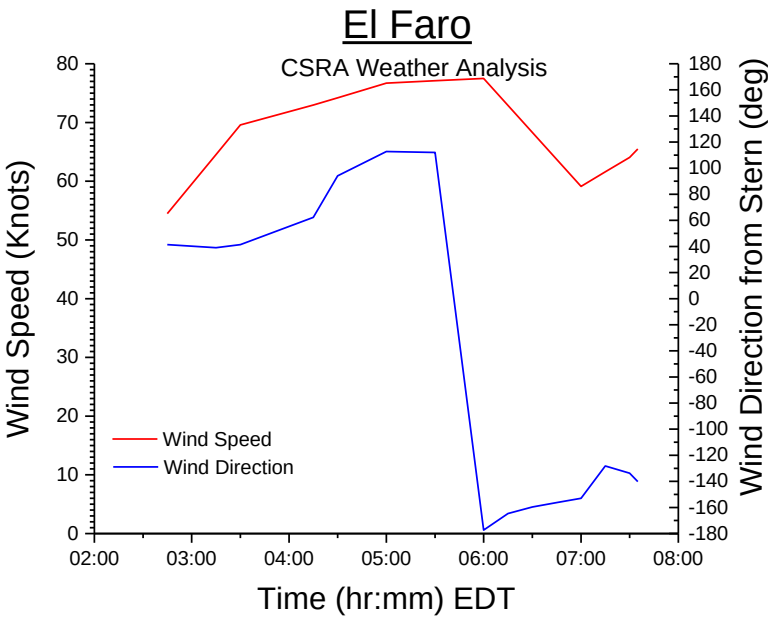

Figure 1 CSRA wind estimate

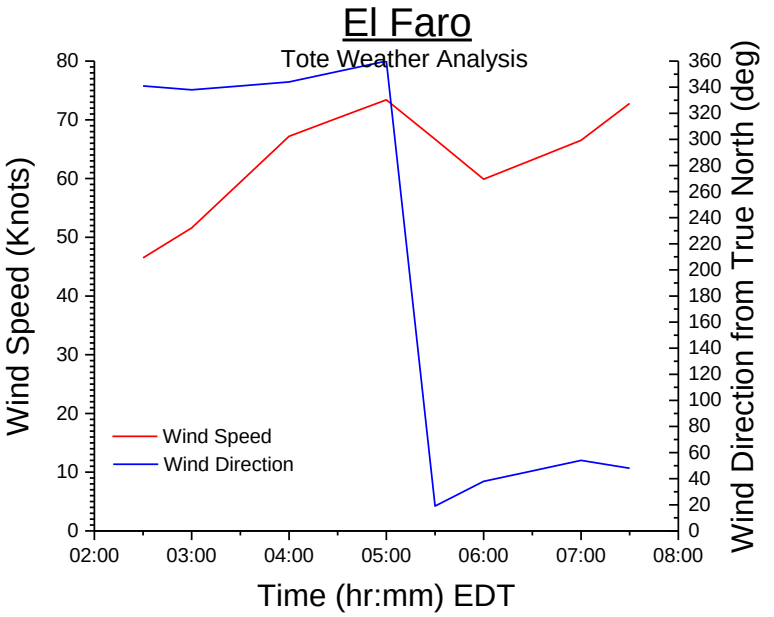

Figure 2 Tote submission wind estimate

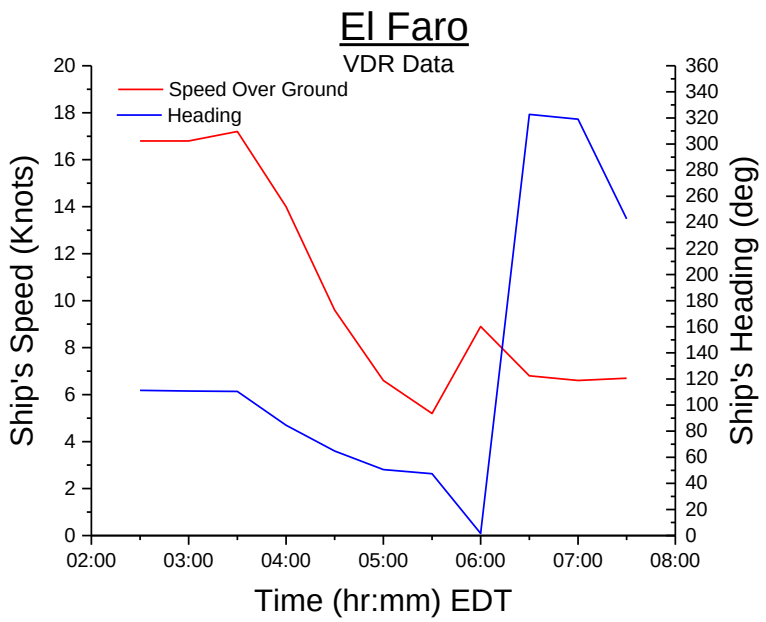

Figure 3 VDR speed and heading

4.3. Wind Components

Since the CSRA wind direction estimate was relative to the ship's stern, the stern wind component was simply:

Stern-wind = wind speed * cos(relative wind direction)

And the side-wind component was:

Side-wind = wind speed * sin(relative wind direction)

Since the Tote submission wind direction was relative to North, relative wind was first obtained by combining the heading with Tote's wind direction. The resulting relative wind direction was then used in the equations above to obtain the stern and side wind components. The stern wind components using Tote and CSRA wind estimates are compared with ship's speed in figure 4 while the side wind components compared with ship speed are presented in figure 5. Both components are presented together in figure 6 with VDR comments added in figure 7.

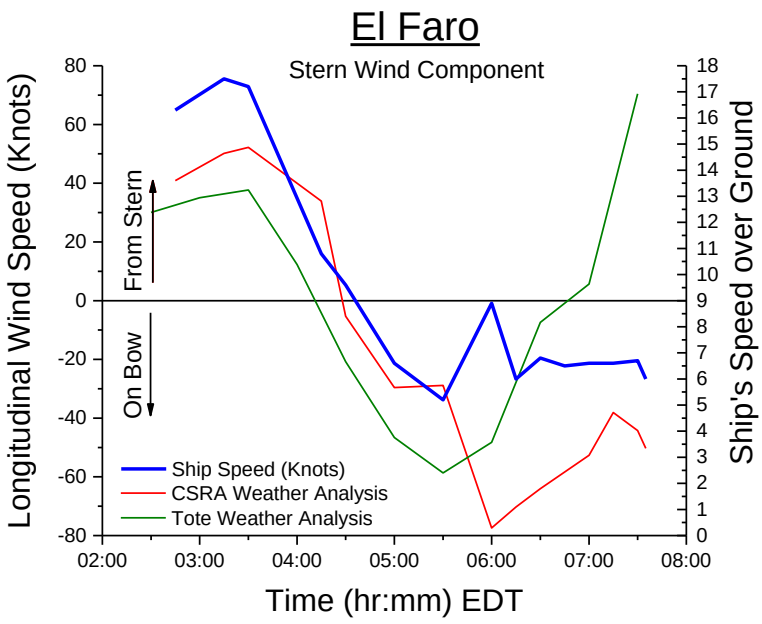

Figure 4 Stern wind component

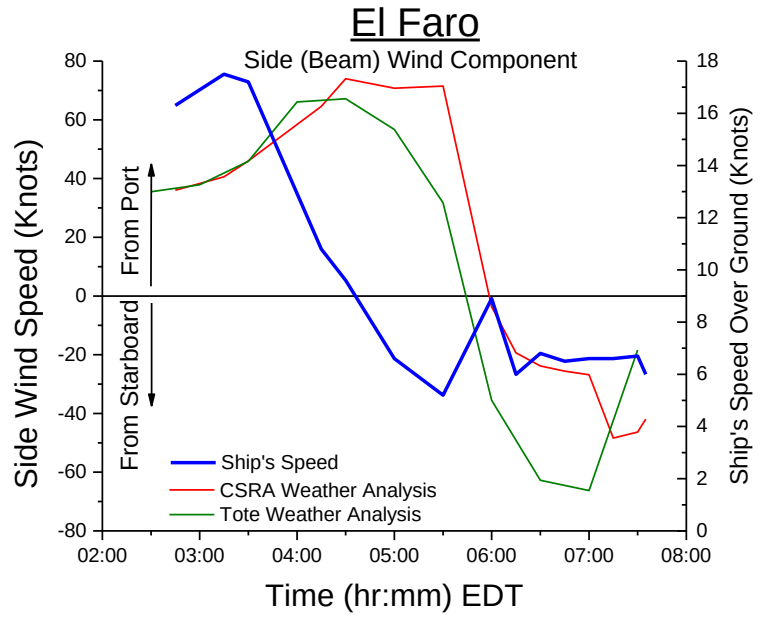

Figure 5 Side wind component

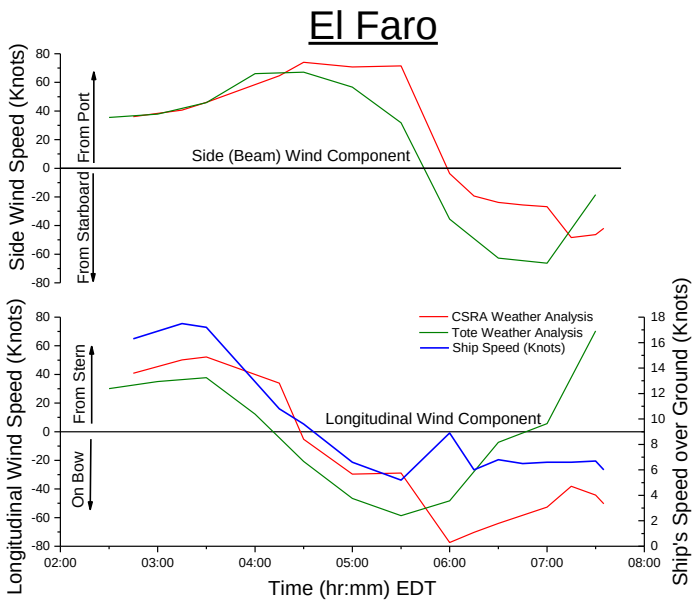

Figure 6 wind components

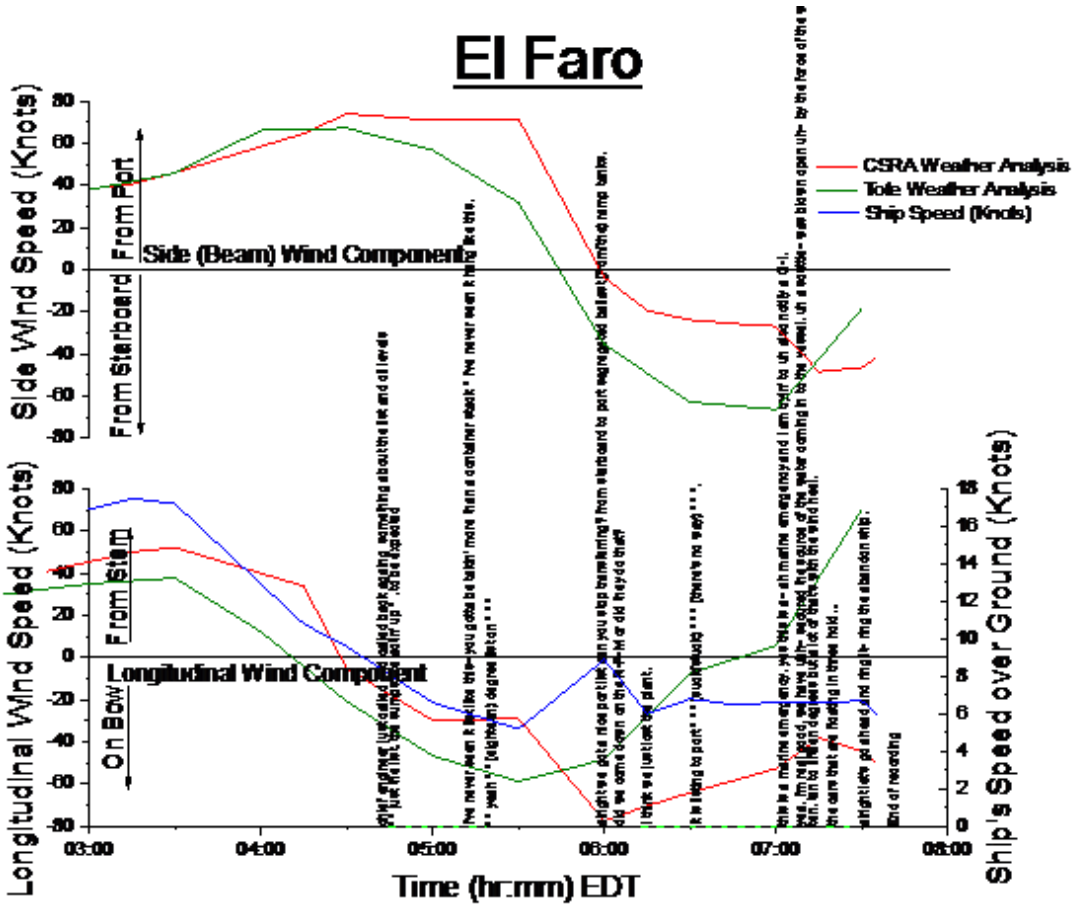

Figure 7 Wind components with VDR comments

4.4. Summary

The ship experienced a strong growing side wind component from the port side as the component from the ship's stern decreased until the ship turned to Port shortly before losing the plant. This wind would contribute to the starboard heal during this period. As the ship reversed course the wind shifted from the bow and from the starboard side. Using the CSRA wind estimate the port side wind peaked at 74 knots. Using the Tote Submission wind estimate the port side wind peaked 67 knots.