National Transportation Safety Board

Office of Marine Safety Washington, D.C. 20594

Addendum 1 to the Engineering Group Chairman Factual Report

El Faro DCA16MM001

Engineering Issues Mentioned in VDR Transcripts and Third Marine Board of Investigation (MBI 3)

The purpose of this addendum is to supplement the Engineering Group Chairman's Factual Report with evidence and information obtained after the release of the report. Reviews of *El Faro*'s VDR audio transcripts for September 30, 2015, and October 1, 2015, and transcripts from the Coast Guard MBI 3 for engineering issues aboard the vessel were conducted by the engineering group chairman. The sections below highlight discussions pertaining to several issues.

References to Propulsion and Lube Oil System

At 07:32:03:2 on September 30, 2015, the second engineer called the bridge and advised that the average RPM (revolutions per minute) for the watch was 113.2. According to parametric data, ship's speed was 19.7 knots, speed over ground (SOG) was 19.7 knots at a heading of 140.9˚, and course over ground (COG) was140.0°.

At 11:53:00.3 on September 30, the captain stated to the second mate: "# we're getting killed with this speed." According to parametric data, ship's speed was 18.9 knots, SOG was 18.9 knots at a heading of 138.0˚, and COG was 138.0°.

At 15:46:18, the second mate advised that the second assistant engineer was "blowin soot." According to parametric data, ship's speed was 19.8 knots, SOG was 19.8 knots at a heading of 138.5˚, and COG was 140.0°.

At 15:46:21.4 on September 30, the second mate stated that they were steering 138˚ and were at maximum RPM. According to parametric data, ship's speed was 19.8 knots, SOG was 19.8 knots at a heading of 138.5˚, and COG was 138.5°.

At 19:31:56.1 on September 30, the chief mate received a phone call and repeated "112.1," a reference to average RPM for the watch. According to parametric data, ship's speed was 19.8 knots, SOG was 19.8 knots at a heading of 150.5°, and COG was 151.0°.

At 23:45:28.2 on September 30, the third mate stated that they were at maximum RPM. According to parametric data, ship's speed was 19.5 knots, SOG was 19.5 knots at a heading of 149.9°, and COG was 151.0°.

At 01:32:56.2 on October 1, after changing course from 150˚ to 133˚, the second mate indicated that they lost RPM. According to parametric data, ship's speed was 18.2 knots, SOG was 18.2 knots at a heading of 112.9°, and COG was 113.0°.

At 01:56:06.4 on October 1, the second mate stated that they "definitely lost some speed," and at 01:56:10.6 stated: "although we're not doin' the max RPMs." According to

parametric data, ship's speed was 18.0 knots, SOG was 18.0 knots at a heading of 114.4°, and COG was 118.0°.

At 02:15:31.9 on October 1, the AB-2 stated that the ship was "down to sixteen knots." According to parametric data, ship's speed was 16.3 knots, SOG was 16.3 knots at a heading of 110.9°, and COG was 117.0°.

At 03:33:11.9 on October 1, the second mate confirmed "eighty turns" on the phone. According to parametric data, ship's speed was 15.8 knots, SOG was 16.1 knots at a heading of 109.7°, and COG was 121.0°.

At 03:46:00.5 on October 1, the second mate received a phone call from the engine room advising that the second assistant engineer was preparing to "blow tubes." According to parametric data, ship's speed was 16.1 knots, SOG was 16.2 knots at a heading of 112.2°, and COG was 120.0°.

At 04:16:10.5 on October 1, the captain called the engine room and asked, "everything good as far as RPM goes?" Then the captain replied, "perfect." The captain then told the bridge that they are "blowin' tubes." According to parametric data, ship's speed was 8.7 knots, SOG was 10.1 knots at a heading of 77.4°, and COG was 108.0°.

At 04:27:13.3 on October 1, the chief mate said to the captain, "we're at a hundred now." According to parametric data, ship's speed was 7.5 knots, SOG was 9.1 knots at a heading of 68.2°, and COG was 103.0°.

At 05:12:51.0 on October 1, the supernumerary chief engineer asked the captain, "maintaining speed?" The captain replied, "eleven." According to parametric data, ship's speed was 9.6 knots, SOG was 10.9 knots at a heading of 86.2˚, and COG was 114.0°.

At 05:15:05.2 on October 1, the supernumerary chief engineer asked the captain if the chief engineer was having a problem in the engine room. The captain replied, "you know he's got a problem like you said a low level." According to parametric data, ship's speed was 9.1 knots, SOG was 10.9 knots at a heading of 86.2°, and COG was 120.0°.

At 06:03:41.0 on October 1, the second mate asked the captain, "did we come down on the RPM or did they do that?", The captain replied, "they did (that/fast)." According to parametric data, ship's speed was 2.0 knots, SOG was 5.4 knots at a heading of 2.0°, and COG was 294.0°.

At 06:16:14.4 on October 1, the captain received a call on the electronic telephone from the engine room, and asked, "so…is there any chance of getting' it back online?" According to parametric data, ship's speed was -0.2 knots, SOG was 6.1 knots at a heading of 343.9°, and COG was 252.0°.

At 06:18:42.8 on October 1, the captain explained the details of a phone call from the engine room to the second mate and said, "yeah (they said/there's) water sloshing (and) it's coming in through the ventilation (in) the engine room." According to parametric data, ship's speed was 0.0 knots, SOG was 6.7 knots at a heading of 329.7°, and COG was 240.0°.

At 06:33:31.0 on October 1, the captain explained the details of a phone call from the chief engineer to the second mate, stating, "yeah we'll see—they're gunna get that boiler back

online any (mi-) any second." According to parametric data, ship's speed was -0.1 knots, SOG was 6.8 knots at a heading of 324.0°, and COG was 233.0°.

At 06:44:34.1 on October 1, the captain stated to the helmsman, "alright @AB-1 you got some turns right now."[1] According to parametric data, ship's speed was -0.7 knots, SOG was 6.6 knots at a heading of 323.7°, and COG was 228.0°.

At 06:48:48.1 on October 1, the captain stated, "they don't have any RPM on it right now so you can just stand by, you don't have to be (there)." According to parametric data, ship's speed was -0.7 knots, SOG was 6.6 knots at a heading of 324.9°, and COG was 229.0°.

At 06:54:33.3 on October 1, the captain stated, "…the engineers are tryin' to get the plant back." According to parametric data, ship's speed was -0.9 knots, SOG was 6.6 knots at a heading of 322.9°, and COG was 225.0°.

At 06:57:32.2 on October 1, the second mate asked the captain, "they havin' trouble getting' it back online?" The captain responded, "yeah because of the list." According to parametric data, ship's speed was -0.4 knots, SOG was 6.6 knots at a heading of 319.5°, and COG was 226.0°.

At 07:05:59.6 on October 1, the captain explained to the emergency call center that, "we've lost the main propulsion unit—the engineers cannot get it goin'." According to parametric data, ship's speed was -0.9 knots, SOG was 6.6 knots at a heading of 323.0°, and COG was 225.0°.

[1] The VDR transcript indicates when personal names are used by abbreviations such as @AB-1. The transcript contains no actual names.

At 07:07:15.4 on October 1, the captain stated to the DP on the satellite phone that, “uh we have a very—very—healthy port list. the engineers cannot get lube oil pressure on the plant therefore we’ve got no main engine.” According to parametric data, ship’s speed was -0.4 knots, SOG was 6.8 knots at a heading of 320.0°, and COG was 227.0°.

At 07:14:22.3 on October 1, the second mate told the captain about a phone call received from the engine room, “he’s just tellin’ us the same thing. he can't do anything with this list.” According to parametric data, ship’s speed was -0.6 knots, SOG was 6.6 knots at a heading of 318.2°, and COG was 223.0°.

At 07:17:52.9 on October 1, an unidentified crewmember stated, “* no RPM * * we can’t do anything” According to parametric data, ship’s speed was 0.1 knots, SOG was 6.8 knots at a heading of 315.0°, and COG was 226.0°.

Graph of Vessel’s Speed

Parametric data from the VDR were tabulated and graphed in 5-minute intervals from 0200 on September 30 until 0730 on October 1. Ship’s speed over ground (SOG) considers the effects of weather conditions such as wind and current, and is shown in green on the graph. SOG starts at about 17 knots and decreases to 6 knots at about 0730.

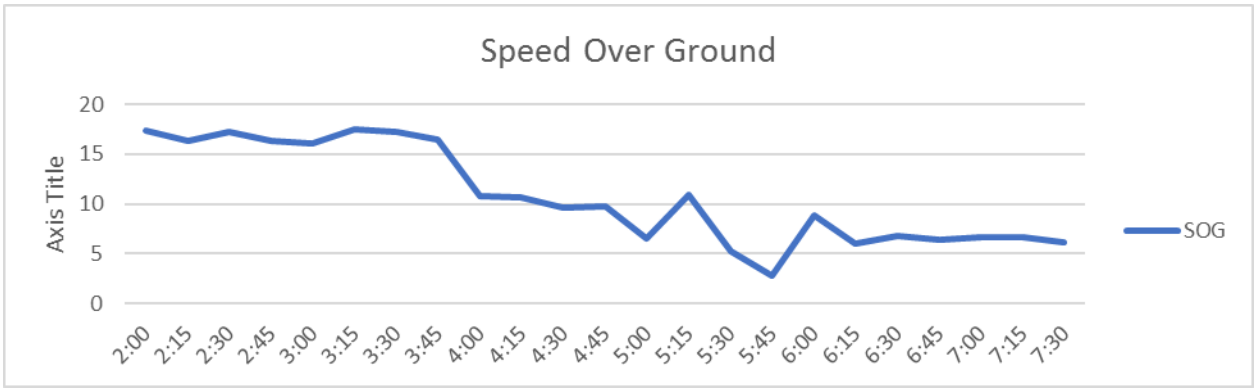

Figure 1. Ship's speed over ground

An engineer who had sailed aboard *El Morro*, *El Yunque*, and *El Faro* was interviewed at MBI 3 on February 8, 2017. He had last served aboard the *Ponce*-class vessels in 2012. He answered questions about the design and operation of the lube oil system aboard the *Ponce*-class vessels to the best of his recollection. He stated that he had never experienced a failure of the lube oil service pumps because of issues with the mechanical seals. He explained that there was a line from the discharge side of the lube oil service pumps that led back to the suction sides of both pumps to keep positive oil pressure on the suction side of the offline pump, which would keep that pump primed and ready for service. In the event of a loss of the lube oil service pumps, head pressure of the storage tank could be used to prime the off-line pump using a line that was piped directly from the storage tank to the suction side of the pumps. If air became entrapped in the suction side of the pump, he stated that the cooling line for the mechanical seal could be cracked open to bleed out the air. When asked about the flow of oil in the "bull's-eye" or sight glass, he stated that at times in rough weather, the flow could possibly be interrupted by the sloshing oil in the gravity tank.

He recalled that when he was sailing on those vessels, standard operating procedures required the level in the main engine oil sump to be kept at between 28 and 32 inches, and he

would operate with the oil level at the "upper level just for safety factor to make sure there was plenty of lube oil in the system." At times, depending on the weather and conditions, the sump level was increased to about 30 or 32 inches. Tote provided a copy of the "Machine Operating Manual" from *El Yunque*, and the manual stated, "When necessary, add lube oil from the storage/settling tank to the sump via purifier to maintain the normal level at 27 inches. Record the amount added in the logbook." The manual also provided information about the levels and capacities of the main engine sump and alarms. The sump design capacity was listed as 2,870 gallons, high level capacity was 2,020 gallons, operating level capacity was 1,426 gallons, and low-level capacity was 724 gallons. High and low-level alarms were installed to warn the operator of either a high or low level in the sump. These levels were also identified on the vessel's original drawings. The low-level alarm was set at 18 inches (or 724 gallons), and the high-level alarm was set at 33 inches (or 2,020 gallons).

An off-duty chief engineer with more recent experience aboard *El Faro* testified at the first MBI hearing that the main engine lube oil system was normally run at a level of about 27 inches in the sump. The available engine logs, for the year preceding the accident voyage, revealed that the lube oil levels for the main engine predominantly ranged from 23 inches to 28 inches. No soundings more than 29 inches were observed in the any of the records available for the year preceding the accident voyage. The last known lube oil tank sounding level, from the engine log for September 1, 2015, was recorded as 26 inches, which was less than the 27-inch nominal fill-level.

The engineer believed that it took about 30 minutes to raise the level in the sump 1 inch using the purifier, but during heavy weather, the lube oil purifier would be shut down. When the purifier was secured, the engineer stated that the sump could be filled instantly, that it would be

directly fed from the tank down to the sump, and it would take "30 seconds to a minute" to raise the level in the sump one inch. The pipe used to fill the main lube oil sump directly from the lube oil storage tank, which can be used to bypass the lube oil purifier, was approximately 1 inch in diameter. The engineer stated that he never had any issues with the lube oil system during heavy weather, other than slight variances of pressure due to rolling.

The director of safety and services for TOTE was interviewed. He had also served in the capacity of port engineer and technical representative for main engine maintenance and repairs. Regarding the design of lube oil sump, he stated that there were numerous baffled sections inside the main engine sump. He explained different situations that could affect the ability of the lube oil pumps to pump oil if air was introduced into the suction side of the pumps. He explained that once air got into the bell-mouth of the suction pipe due to a roll of the vessel, suction would be lost, unless the ship rolled back again and oil was replenished in that pump. He further explained that the positive displacement screw pumps would pump a little bit of air, but they would not pump if the suction side contained a lot of air.

If the mechanical seal failed, the director believed that air entering the pump casing through the failed seal could cause the pump to completely lose its prime. According to the director, a 3-psi reduction in pressure, as identified in a shipyard work list, would not really affect the pump's performance. He thought that having a higher level of lube oil in the sump would have helped the system in maintaining pressure during the accident. He stated that the lube oil pumps could run for about 30 minutes without lubrication before being destroyed internally.

References to Vessel's List

At 04:12:51.9 on October 1, the captain said, "the only way to do a counter on this is to fill up the port side ramp tank up." According to parametric data, ship's speed was 9.6 knots, SOG was 10.8 knots at a heading of 84.2°, and COG was 112.0°.

At 04:37:27.7 on October 1, after receiving a phone call about a trailer leaning over, the chief mate said "yeah, we're heelin' over." According to parametric data, ship's speed was 8.9 knots, SOG was 10.1 knots at a heading of 72.0°, and COG was 100.0°.

At 04:40:33.7 on October 1, the chief mate relayed a phone message to the captain and said, "the chief engineer just called and (then/they) called back again (yeah) something about the list and oil levels ***." According to parametric data, ship's speed was 8.4 knots, SOG was 10.2 knots at a heading of 69.7°, and COG was 104.0°.

At 04:41:28.3 on October 1, after hearing that the chief engineer had called about a list and oil levels, the chief mate stated, "can't even see the (level/bubble)." According to parametric data, ship's speed was 8.4 knots, SOG was 10.1 knots at a heading of 71.5˚, and COG was105.0°.

At 04:43:25.8 on October 1, the captain said, "wants to take the list off, so let's put it in hand steering." According to parametric data, ship's speed was 8.2 knots, SOG was 10.0 knots at a heading of 71.4°, and COG was 106.0°.

At 04:43:45.6 on October 1, the captain said on the phone, "you want us to take the list off a little bit?" According to parametric data, ship's speed was 8.2 knots, SOG was 10.0 knots at

a heading of 71.0°, and COG was 106.0°. According to parametric data, ship's speed was 8.2 knots, SOG was 10.0 knots at a heading of 71.0°, and COG was 106.0°.

At 04:44:56.5 on October 1, the captain said to the chief mate, "** just the list. The sumps are actin' up *. to be expected." According to parametric data, ship's speed was 7.4 knots, SOG was 9.9 knots at a heading of 64.4°, and COG was 106.0°.

At 05:11:33.2 on October 1, the supernumerary chief engineer said to the captain, "I've never seen it list like this—you gotta be takin' more than a container stack * I've never seen it hang like this." The captain replied, "we certainly have the sail area**."** According to parametric data, ship's speed was 9.4 knots, SOG was 11.0 knots at a heading of 83.4°, and COG was 114.0°.

At 05:11:50.3 on October 1, after the captain asked the supernumerary chief engineer, "how does that affect below your operations as far as lube oil(s) and *?" The supernumerary chief engineer replied, "(you hit) the low pressure alarm on the lube oil * * * (stuck) * * * level of the engine * * *, and then repeated, "never seen it hang like that before." The captain replied, "you got a lot of sail area." According to parametric data, ship's speed was 9.3 knots, SOG was 11.0 knots at a heading of 82.2°, and COG was 114.0°.

At 05:13:33.5 on October 1, the captain spoke on the phone and explained to the caller, "(now) we got a lot of sail area." According to parametric data, ship's speed was 9.2 knots, SOG was 10.8 knots at a heading of 84.5°, and COG was 116.0°.

At 05:18:55.6 on October 1, the chief mate referred to the list: "* * yeah * * (eighteen) degree list on * * *." According to parametric data, ship's speed was 4.6 knots, SOG was 6.4 knots at a heading of 47.5°, and COG was 91.0°.

At 05:52:38.6 on October 1, 2015, while on the electronic phone, the captain stated, "okay what I'm gunna do—I'm gunna turn the ship and get the wind (on the north side) right there and get (it goes) more (in that) direction get everything on the starboard side give us a port list and (um see) if we'll have a better look at it." According to parametric data, ship's speed was 5.1 knots, SOG was 5.2 knots at a heading of 47.5°, and COG was 57.0°.

At 05:54:19.9 on October 1, the captain stated on the electronic phone, "alright (gunna) start the turn to port. alright thank you." According to parametric data, ship's speed was 5.3 knots, SOG was 5.3 knots at a heading of 52.5°, and COG was 49.0°.

At 05:54:28.6 on October 1, the captain ordered, "left twenty." According to parametric data, ship's speed was 5.3 knots, SOG was 5.3 knots at a heading of 52.5°, and COG was 49.0°.

At 05:54:44.1 on October 1, after hearing the chief mate's report about the water level on the starboard side of three hold, the captain told the chief mate on the UHF radio, "let me uhh—just got off the house phone with the chief. I want to turn the uhh—ship to port—get the list on the port side there. can you access it right now? how much water is there?" and "okay. (now) let me do that (I'm) comin' left right now. (you need) anybody else down there (with ya)?" According to parametric data, ship's speed was 5.1 knots, SOG was 5.1 knots at a heading of 52.5°, and COG was 48.0°.

At 05:56:43.3 on October 1, the captain said to the chief mate over the UHF radio, "alright mate chief mate we got it listing over to port now can you (see/just) can you see it down there? the water level?" According to parametric data, ship's speed was 2.7 knots, SOG was 3.7 knots at a heading of 349.7°, and COG was 32.0°.

At 05:57:33.2 on October 1, the captain called the engine room and stated, "alright we got a nice port list can you stop transferring? from starboard to port segregated ballast (from/the) ramp tanks." According to parametric data, ship's speed was 4.5 knots, SOG was 4.6 knots at a heading of 349.4°, and COG was 335.0°.

At 06:00:50.7 on October 1, the captain asked on the electronic telephone, "want me to bring it back over to starboard?" and then confirmed, "bring it back roll back over to starboard." According to parametric data, ship's speed was 5.3 knots, SOG was 7.6 knots at a heading of 001.7°, and COG was 316.0°.

At 06:10:55.4 on October 1, the captain had a discussion with the chief mate on the UHF radio and directed him to "transfer over to the starboard ramp tank * * starboard." The chief mate replied, "* * port to starboard ramp tank." According to parametric data, ship's speed was 0.4 knots, SOG was 6.0 knots at a heading of 001.5°, and COG was 275.0°.

At 06:19:21.8 on October 1, the captain spoke with a third engineer on the electronic telephone and stated, "third–[3AE, unclear which 3AE.] need you to pump from port to starboard on the ramp tanks, yeah call me back when you're pumping. I need to pump port to starboard." According to parametric data, ship's speed was 0.0 knots, SOG was 6.7 knots at a heading of 327.7°, and COG was 238.0°.

At 06:20:23.7 on October 1, the captain answered the electronic phone and advised the caller that, “now. (I'm) having them transfer from port to starboard.” According to parametric data, ship’s speed was 0.0 knots, SOG was 6.8 knots at a heading of 326.2°, and COG was 236.0°.

At 06:21:15.3 on October 1, the captain answered the electronic phone and asked the caller, “okay you're transferring from port to starboard?” and also, “yeah and you’re still pumpin’?” During the same phone call, the captain established that he was speaking to a third assistant engineer, and then asked, “is there anyway to tell (then) if you (actually) have suction and it is pumping?” According to parametric data, ship’s speed was 0.1 knots, SOG was 6.8 knots at a heading of 323.0°, and COG was 234.0°.

At 06:24:23.7 on October 1, the captain used the electronic telephone and spoke with a third assistant engineer. The captain asked, “so you’re pumping over segregated ballast (port to) starboard?” and then stated, “I think that’s the plan that’s what we’re doing right now. and then umm. not only are we transferring ballast but I just talked with @3AE1 * he’s back pumping (that/on) hold (too/two).” According to parametric data, ship’s speed was -0.7 knots, SOG was 7.0 knots at a heading of 329.0°, and COG was 233.0°.

At 06:30:44.4 on October 1, a crewmember stated to the captain, “It is listing to port * * * (suck/stuck) * * * (there’s no way) * * *.” The captain replied, “It was from the scuttle that was open * * * (on three) deck?” According to parametric data, ship’s speed was -0.5 knots, SOG was 6.8 knots at a heading of 325.0°, and COG was 231.0°.

At 06:43:59.5 on October 1, the captain spoke on the electronic telephone and advised, “yup. I—I just want to know that we’re pumping from port to starboard on the ramp tanks.”

According to parametric data, ship's speed was -0.7 knots, SOG was 6.7 knots at a heading of 324.4°, and COG was 228.0°.

At 06:45:06.0 on October 1, the second mate told the captain, "once we uh—start coming back over * wind...(on) off of our uh starboard side * * * (/?)" to which the captain replied, "* * (level it up) and get * over to starboard." According to parametric data, ship's speed was -0.4 knots, SOG was 6.5 knots at a heading of 322.4°, and COG was 229.0°.

At 06:54:33.3 on October 1, the captain stated, "(it's) miserable right now. We got all the uhh——all the wind on the starboard side here…" According to parametric data, ship's speed was -0.9 knots, SOG was 6.6 knots at a heading of 322.9°, and COG was 225.0°.

At 6:57:32.2, the second mate and the captain are discussing the fact that the engineers are having trouble getting the engine back online due to the list. According to parametric data, ship's speed was -0.4 knots, SOG was 6.6 knots at a heading of 319.5°, and COG was 226.0°.

At 06:59:43.1 on October 1, the captain left a voicemail message to the DP, stating, "* * * scuttle * * * got a pretty good list * * *." According to parametric data, ship's speed was -0.2 knots, SOG was 6.6 knots at a heading of 318.4°, and COG was 227.0°.

At 7:04:56.1, the chief mate states as follows on the UHF radio: "we're leanin' over pretty good to port". According to parametric data, ship's speed was – 0.8 knots, SOG was 6.8 knots at a heading of 322.7°, and COG was 226.0°.

At 07:05:59.6 on October 1, the captain explained to the emergency call center, "we had a hull breach—a scuttle blew open during a storm—we have water down in three hold—we have

a heavy list." According to parametric data, ship's speed was -0.9 knots, SOG was 6.6 knots at a heading of 323.0°, and COG was 225.0°.

At 07:07:15.4 on October 1, the captain stated to the DP on the satellite phone, "we have uhh—secured the source of the water coming in to the vessel. uh a scuttle—was blown open uh—by the force of the water perhaps—no one knows. can't tell. Uh it's since been closed. However—uh—three hold's got considerable amount of water in it. uh we have a very—very—healthy port list." Later in the same phone call, the captain said, "we are taking every measure to take the list off. By that I mean pump out that pump out that hold the best we can but we are not gaining ground at this time." Also, "right now it's a little hard to tell because all the wind is that on that side too so we got a good wind heel goin'." The captain replied to a question from the DP, "betcha' it's all of fifteen—fifteen degrees." And then the captain stated, "ten. ten to fifteen degrees but a lot of that's with the wind heel." According to parametric data, ship's speed was -0.4 knots, SOG was 6.8 knots at a heading of 320.0°, and COG was 227.0°.

During MBI 3, the director of safety and services was asked about the effectiveness of the ramp tanks to adjust the list of the vessel. He believed that the ramp tanks could adjust the ship about 3 degrees, and there were no other ballast tanks available for list correction.

Bilge/Ballast Systems, Water in Three Hold

At 05:43:36.4 on October 1, the bridge received a phone call advising that there was water in three hold. The captain directed the chief mate to investigate and start pumping bilges. According to parametric data, ship's speed was 3.3 knots, SOG was 3.4 knots at a heading of 49.9°, and COG was 60.0°.

At 05:45:46.6 on October 1, the bridge received a phone call providing more information about the water in three hold. The chief mate was on the phone first: “so that’s where the water’s from?” then, “okay. Are we able to pump the bilges?” and “that’s a lot of water. Okay got the bilge pumps running right? okay.” The captain then spoke on the phone: “bilge pump running water rising. Okay. Can we pump from the starboard ramp tanks to port?” According to parametric data, ship’s speed was 2.6 knots, SOG was 2.6 knots at a heading of 50.4°, and COG was 58.0°.

At 05:48:28.2 on October 1, on the electronic telephone, the captain ordered, “now go ahead transfer * starboard ramp tank to port.” According to parametric data, ship’s speed was 3.8 knots, SOG was 4.1 knots at a heading of 48.2°, and COG was 71.0°.

At 05:52:58.3 on October 1, on the electronic telephone, the captain discussed the source of the water entering three hold and asked, “yeah—so it is the scuttle?” According to parametric data, ship’s speed was 5.1 knots, SOG was 5.2 knots at a heading of 47.5°, and COG was 57.0°.

At 05:54:33.5 on October 1, on the UHF radio, the chief mate reported, “there’s a hold that’s flooded on the starboard side * * (we'll have to go into) three hold * * bosun (to wait/awake).” And, “(ya got) water against the side just enough to (go/throw/pour) over the edge of scuttle about knee deep (in here) water (rolls) right over.” According to parametric data, ship’s speed was 5.1 knots, SOG was 5.1 knots at a heading of 52.5°, and COG was 48.0°.

At 05:59:37.4 on October 1, the captain updated a crewmember on the bridge: “a scuttle popped open and there’s a little bit of water on in three hold.” At 05:59:54.2 he said, “they’re pumping it out right now. the mate’s down there with @SUP-1 he’s down (in the/he’s closing / *

*) the scuttle." According to parametric data, ship's speed was 5.8 knots, SOG was 9.3 knots at a heading of 003.7°, and COG was 312.0°.

At 06:01:09.7 on October 1, on the UHF radio, the chief mate reported, "(yeah) the scuttle is (closed) we're off the (deck/second/deckie)." According to parametric data, ship's speed was 4.9 knots, SOG was 7.2 knots at a heading of 002.0°, and COG was 315.0°.

At 06:02:42.3 on October 1, the captain directed the second mate: "give them a shout down below. one-nine (let 'em know/tell them) the scuttle has been shut—the scuttle is shut." According to parametric data, ship's speed was 2.7 knots, SOG was 5.8 knots at a heading of 004.7°, and COG was 303.0°.

At 06:02:59.2 on October 1, the second mate called the engine room on the electronic telephone and said that the scuttle had been shut. After the call, the second mate told the captain, "hear an alarm going off (he/they) couldn't hear me," According to parametric data, ship's speed was 2.6 knots, SOG was 5.7 knots at a heading of 004.4°, and COG was 301.0°.

At 06:04:30.2 on October 1, the chief mate reported the status of the scuttle, "ya know it's—the scuttle('s) half way open. Clogged. (the way it's/go ahead) (start those) fire hoses * * pretty clear * the guys closed it." According to parametric data, ship's speed was 1.6 knots, SOG was 5.3 knots at a heading of 000.0˚, and COG was 288.0°.

At 06:05:35.3 on October 1, after the chief mate returned to the bridge, the captain asked, "see any cars that broke free or anything like that?" The chief mate replied, "not that I can see just lookin' from third deck. (okay). I saw the water pouring down through the scuttle from third deck—I couldn't (get/climb) the ladder so I went up to the second deck." According to

parametric data, ship's speed was 0.4 knots, SOG was 5.7 knots at a heading of 005.0°, and COG was 279.0°.

At 06:45:22.1 on October 1, the captain told the second mate, "* * (a lot of) water in the cargo hold area." The second mate replied, "(well then) suck out the water." According to parametric data, ship's speed was -0.5 knots, SOG was 6.4 knots at a heading of 323.2°, and COG was 229.0°.

At 06:54:33.3 on October 1, the captain stated, "now a scuttle was left open or popped open or whatever so we got some flooding down in three hold—a significant amount." According to parametric data, ship's speed was -0.9 knots, SOG was 6.6 knots at a heading of 322.4°, and COG was 225.0°.

At 06:56:44.5 on October 1, the captain asked the chief engineer on the electronic telephone, "are ya still pumpin' three hold?" According to parametric data, ship's speed was -0.6 knots, SOG was 6.7 knots at a heading of 321.4°, and COG was 226.0°.

At 07:04:47.6 on October 1, the captain asked the chief mate over the UHF radio, "yea. can you tell what the level is in that hold?" The chief mate responded, "we're leanin' over pretty good to port." The captain then asked, "yea—I'm—I'm sure it is. can you tell if it's decreasing or increasing?" The chief mate replied, "I can't tell (captain) * * seems as if it's goin' down * *." According to parametric data, ship's speed was -1.0 knots, SOG was 6.8 knots at a heading of 324.2°, and COG was 226.0°.

At 07:05:59.6 on October 1, the captain told the emergency call center, "we had a hull breach—a scuttle blew open during a storm—we have water down in three hold—we have a

heavy list." According to parametric data, ship's speed was -0.9 knots, SOG was 6.6 knots at a heading of 323.0°, and COG was 225.0°.

At 07:11:24.9 on October 1, the captain spoke to the DP on the satellite phone and stated, "that that is correct. the engine room has informed me that they are pumping that hold. there's a significant amount of water in there." According to parametric data, ship's speed was -0.7 knots, SOG was 6.6 knots at a heading of 321.0°, and COG was 225.0°.

At 07:14:40.9 on October 1, on the electronic telephone, the captain told the chief engineer, "yeah we're pumpin' you're pumpin'." According to parametric data, ship's speed was -0.8 knots, SOG was 6.6 knots at a heading of 319.9°, and COG was 223.0°.

At 07:14:54.1 on October 1, the chief mate told the captain, "I think that water level's rising captain." According to parametric data, ship's speed was -0.6 knots, SOG was 6.6 knots at a heading of 318.4°, and COG was 223.0°.

At 07:16:11.7 on October 1, the chief mate stated, "bilge alarm in two alpha. Goin' to check (it)." According to parametric data, ship's speed was -0.4 knots, SOG was 6.7 knots at a heading of 316.2°, and COG was 223.0°.

At 07:16:45.4 on October 1, on the electronic telephone, the captain asked the chief engineer, "hey chief [CE] @CAPT here. can you suck on all of all of the uh all of the cargo holds?" Afterwards, the captain asked, "you think the list is getting worse?" Immediately after that, the captain said, "ya me too." According to parametric data, ship's speed was -0.3 knots, SOG was 6.8 knots at a heading of 316.2°, and COG was 224.0°.

At 07:17:31.1 on October 1, the chief mate stated that the supernumerary chief engineer "was suggesting (uh) like rig a Wilden pump[2]...I'm like... where? Through the scuttle?" According to parametric data, ship's speed was 0.1 knots, SOG was 6.9 knots at a heading of 314.4°, and COG was 225.0°.

At 07:17:59.5 on October 1, the captain stated, "the cars that are floating in three hold…" The chief mate responded, "they're subs." According to parametric data, ship's speed was 0.1 knots, SOG was 6.8 knots at a heading of 315.0°, and COG was 226.0°.

At 07:20:40.2 on October 1, the chief mate said, "yeah um—my concerns are (of course) stability (I have no/and no) concept of how much water (may be) sittin' down there * * (can't/very) difficult determine *." According to parametric data, ship's speed was 0.3 knots, SOG was 6.4 knots at a heading of 307.4°, and COG was 220.0°.

At 07:21:00.3 on October 1, the chief mate asked the captain, "what did he say when he said about pumpin' 'em all?" The captain replied, "yeah but if you pump and uh you catch air then the whole thing is—." According to parametric data, ship's speed was 0.2 knots, SOG was 6.4 knots at a heading of 307.9°, and COG was 220.0°.

At 07:24:16.8 on October 1, the captain stated on the phone, "yeah. just tryin' to control that list see where the water's comin' from." According to parametric data, ship's speed was -1.0 knots, SOG was 6.7 knots at a heading of 311.4°, and COG was 213.0°.

[2] A Wilden pump is an air-operated diaphragm pump.

Emergency Fire Pump

At 07:14:56.2 on October 1, after hearing that the water level was rising, the captain asked the chief mate, "(okay). do you know where it's comin' from?" The chief mate responded, "(at) first the chief said something hit the fire main. Got it ruptured. Hard." The captain said, "um there's no way to secure that?" The chief mate responded, "we don't know if they've (seen/still have) any pressure on the fire main or not. don't know where s'sea below—between the sea suction and the hull or what uh but anything I say is a guess." According to parametric data, ship's speed was -0.6 knots, SOG was 6.6 knots at a heading of 318.4°, and COG was 223.0°.

At 07:18:05.0 on October 1, the captain asked the chief mate, "um when you went down there before the—fire main—was there anything near the fire * *?" The chief mate responded, "(when/I mean) I saw the water level's too high (the) fire main's right below the water dark black water." A crewmember, possibly the chief mate, stated, "and I saw cars bobbing around." The captain asked, "(think) they coulda come through there?" The chief mate responded, "yea there's fire main in the aft end * water could have…" According to parametric data, ship's speed was 0.1 knots, SOG was 6.8 knots at a heading of 314.5°, and COG was 225.0°.

At 07:18:35.1 on October 1, the captain asked the chief mate, "so what's the only wha—what option do we have to close that valve so we don't a free communication with the sea? * *." The chief mate replied, "…isolate the fire main...in the engine room." According to parametric data, ship's speed was 0.1 knots, SOG was 6.7 knots at a heading of 313.5°, and COG was 224.0°.

At 07:18:56.6 on October 1, the captain called the engine room and asked the first engineer, “yea can you... isolate the fire main from down in the uh engine room? the fire pump? isolate it? ‘cause that may be the root cause of the water comin’ in.” The captain said to the chief mate, “that’s our last * *.” The chief mate told the captain, “* * (cutout) on the engine room side fire main goin’ forward.” The captain spoke again to the first assistant engineer on the phone, “say first. On the on the engine room side the isolation valve suction fire pump (kindly/highly) secure it isolate it on your side so there’s no free communication from the sea. alright. Thank you.” According to parametric data, ship’s speed was 0.3 knots, SOG was 6.6 knots at a heading of 311.5°, and COG was 224.0°.

At 07:24:24.4 on October 1, while on the electric telephone, the captain asked, “now the—can you isolate the fire pump from down there on the engine room side?” According to parametric data, ship’s speed was -0.8 knots, SOG was 6.7 knots at a heading of 310.0°, and COG was 213.0°.

At 07:25:32.2 on October 1, the chief mate said, “* * chest deep * (water/washin’)* *.” According to parametric data, ship’s speed was -0.5 knots, SOG was 6.8 knots at a heading of 311.0°, and COG was 217.0°.

Loss of Electrical Power

The statements below make reference to equipment operating with electrical power provided by the vessel:

At 05:45:46.6 on October 1, the bridge received a phone call providing more information about the water in three hold. The chief mate was on the phone first, and repeated, “so that’s where the water’s from?” then, “okay. Are we able to pump the bilges?” and “that’s a lot of

water. Okay got the bilge pumps running right? okay." The captain then spoke on the phone and stated, "bilge pump running water rising. Okay. Can we pump from the starboard ramp tanks to port?" According to parametric data, ship's speed was 2.6 knots, SOG was 2.6 knots at a heading of 50.4°, and COG was 58.0°.

At 06:48:34.1 on October 1, the second mate said that coffee has been made. According to parametric data, ship's speed was -0.6 knots, SOG was 6.6 knots at a heading of 324.4°, and COG was 229.0°.

At 06:56:44.5 on October 1, the captain asked the chief engineer on the electronic telephone, "are ya still pumpin' three hold?" According to parametric data, ship's speed was -0.6 knots, SOG was 6.7 knots at a heading of 321.4°, and COG was 226.0°.

At 07:34:07.6 on October 1, the VDR recorded the sound of a loud electronic pulsing alarm, sounding about two pulses per second. The pulsing alarm continued through the end of the recording. The associated parameter "VDR power AC' changed status from OK to "Not present." There were no further parametric data at that time