National Transportation Safety Board

Washington, D.C. 20594

January 31, 2020

Frank English
Manager of Fleet Operations
Ride The Ducks Branson
Branson, Missouri

Re: Tech review of the Engineering/IIC Group Factual Report

Frank:

The NTSB investigative team has reviewed all factual comments submitted by the parties as part of the technical review and has decided on a disposition for each one, as reflected below. All editorial suggestions have been considered and will be incorporated as appropriate.

The deadline for providing party submissions pursuant to 49 CFR 831.14 is February 14, 2020.

Thank you and best regards,

Brian Young
Investigator in Charge
National Transportation Safety Board
490 L'Enfant Plaza, S.W.
Washington, DC 20594

NATIONAL TRANSPORTATION SAFETY BOARD
OFFICE OF MARINE SAFETY
WASHINGTON, D.C. 20594

ERRATA

Group Chairman's Factual Report

Engineering

Stretch Duck 7
DCA18MM028

Page/Line	Original	Correction	NTSB Disposition of Comments
4/6-9	Before departing the shoreside boarding facility the captain and driver were instructed to conduct the water portion of the tour before the land-based portion of the tour (which normally occurred first) and head directly to the lake due to the approaching weather.	This language leaves out certain facts and needs clarification. The transcript of Captain McKee makes clear that the captain had reviewed the weather just prior to the tour, and just prior to the issuance of the severe thunderstorm warning. The description of these events, as written, omits that fact, suggesting that Captain McKee was simply following the suggestions of the MOD. In this regard, we believe the word "instructed" is not accurate. In the NTSB's recent Safety Recommendation Report issued in connection with this matter on November 5, 2019, the report more accurately states the interaction between the Manager on Duty (MOD) and the captain and driver:	Update paragraph to read: "Prior to the accident, the National Weather Service had issued a severe thunderstorm warning for the area advising of wind gusts of 60 mph. The manager-on-duty advised the captain and driver before departing the shoreside boarding facility to complete the lake portion of the tour before the land tour (which normally occurred first) due to the approaching weather.

		"The manager-on-duty advised the captain and driver before departing the shoreside boarding facility to complete the lake portion of the tour before the land tour (which normally occurred first) due to the approaching weather." *See* NTSB Safety Recommendation Report at p. 2. To be more accurate and complete, we request this language be revised to read as follows: "Just prior to the issuance of the severe thunderstorm warning issued at 6:32 PM, the Captain of the Stretch Duck 7 reviewed the weather on a weather monitor at the company's Branson headquarters. Before departing the shoreside boarding facility the captain and driver were advised to conduct the water portion of the tour before the land-based portion of the tour (which normally occurred first) and head directly to the lake due to the approaching weather."	Additional details about the sequence of events to be included in the accident narrative.
4/24	DVR	It is unclear what this acronym stands for. We recommend this be changed to "onboard video and audio recording system"	"Digital video recorder" acronym spelled out.
5/4	In 1999, Ride The Ducks subsidiary…	This year is incorrect. This should read 1996.	Corrected.
5/7	In 2006, Amphibious Vehicle…	This year is incorrect. This should read 2005.	Corrected.

5/7	…for patented “Truck Duck”.	For clarity, we recommend changing “for patented” to “for the patented”	Corrected, added “the”.
5/8	Hersch end	“Hersch end” should be “Herschend”.	Corrected, removed extra space.
5/11-13	The Branson operation was sold to Ripley Entertainment in December 2017. As of the date if this report, Ride The Ducks’ fleet consisted of 95 vehicles, carrying over 1,500,000 guests each year in 6 locations in the United States.	This description of the various corporate entities is unclear, and may imply incorrectly that all of the entities which comprise what the report refers to as “Ride the Ducks” were somehow related. For greater clarity, we request language on page 5 at lines 11-13 be replaced with the following: “As of the date of this report, Ride The Ducks’ fleet, operated by various companies around the United States, consisted of 95 vehicles, which carried over 1,500,000 guests each year in 6 locations. The Branson operation, which was acquired by Ripley Entertainment, Inc. in December 2017, consisted of approximately 22 amphibious vessels that operated solely in the Branson, Missouri area.”	Updated report with following text: (also replaced “guests” with “passengers.”) As of the date of this report, Ride The Ducks’ fleet, operated by various companies around the United States, consisted of 95 vehicles, which carried over 1,500,000 passengers each year in 6 locations. The Branson operation, which was acquired by Ripley Entertainment, Inc. in December 2017, consisted of approximately 22 amphibious vessels that operated solely in the Branson, Missouri area.
5/26	Ride the Ducks International, LLC (RTDI) started converting and operating former military amphibious vessels for the tourism industry in 1971.	Ride The Ducks International did not exist until 2005. In 1971, duck boat operations were started in Branson by a company that was unaffiliated with any companies mentioned in this report. We recommend this language be replaced with the following: “The conversion and operation of these former military amphibious vessels for use in the tourism industry began in 1971, in Branson Missouri.”	Updated report with following text: The conversion and operation of these former military amphibious vessels for use in the tourism industry began in 1971, in Branson Missouri.

6/2	The vessel was inspected by the Coast Guard as a small passenger vessel and shoreside operation was regulated by the Federal Motor Carrier Safety Administration.	For greater accuracy, we request that the language "inspected by the Coast Guard" be changed to "inspected by the Coast Guard and issued a Certificate of Inspection..." For greater clarity, we request that "shoreside operation" be changed to "the land-based operation of the ducks" to make clear that the Federal Motor Carrier Safety Administration does not regulate any aspect of "shoreside operations" for vessels.	Added text "and issued a certificate of inspection." Replaced "shoreside" to "Land-based operation of the duck boats".
6/4	Footnote 2.	There is no footnote 2 at the bottom of the page. Therefore, we suspect this footnote was either inserted in error or the footnote text is somehow missing in the draft report.	Corrected, deleted the number 2 after the sentence.
6/13	Amphibious Vessel Manufacturers (AVM).	This should read "Amphibious Vehicle Manufacturers (AVM)."	Corrected.
6/13	"About 2005, AVM…"	For greater accuracy, we request that this language be changed to "In approximately 2005, AVM…"	Corrected, updated text in report to read: "In approximately 2005, AVM"
8/1-16	Request additional language.	The existing language regarding the engine ventilation system is incomplete in two respects. First, the reference to dampers on the port and starboard side, noting that they "could be individually closed from the captain's station," seems to leave the implication that closing these dampers may have been a realistic option to prevent or mitigate flooding. We believe it is necessary to point out that the dampers are intended to assist in fire suppression in the event of an engine fire, and if the fire dampers were closed, doing so would deprive the engine of air and would lead to eventual shutdown of the engine.	Updated language: The dampers on both sides of the vessel, the engine compartment hood, and the damper on the bow were approved by the U.S. Coast Guard and satisfied applicable regulatory requirements and were designed to be manually closed in the event of an engine fire from individual levers in the captain's station, as a means to assist in fire suppression.

		Second, we believe it is more accurate and complete to note that the design of the fire dampers, as well as the engine hood and forward hatch, were approved by the U.S. Coast Guard, and satisfied applicable regulatory requirements as evidenced by the vessel's U.S. Coast Guard Certificate of Inspection. *See* U.S. Coast Guard MSC Letter E1-0001075, dated May 10, 2000; *see also* USCG Approval Letter dated October 23, 2000, REI1-00004859. To make this section of the report complete and accurate, we request the following language be added after line 16: "The dampers on the port and starboard side of the vessel were required by regulation and were designed to be closed by the captain in the event of an engine fire, as a means to assist in fire suppression. Closing the dampers would deprive the engine of air and would lead to eventual shutdown of the engine. The design of the engine ventilation system, fire dampers, engine hood, and forward hatch, were approved by the U.S. Coast Guard and satisfied applicable regulatory requirements."	Closing the side dampers and engine compartment hood could also limit water ingress. When asked if the engine would continue to run after dampers were closed, the fleet operations manager stated that it wasn't a "great idea to continue under normal operation like that." And that "it would run for a while, but eventually you're going to start to experience some overheat, probably."

9/8-10	Each of these four spaces as well as the sea chest were equipped with high level bilge alarms that provided audible and visual signals on the starboard side of the captain's station under the dashboard.	This language does not state the precise number of bilge alarms, but the diagram on page 10 is missing one of the alarms. Specifically, the report describes a "midship section" which refers to compartments on both sides of the vessel in the vicinity of the sea chest. In this area of the vessel, on the port side, there is one bilge pump, a bilge float switch to activate the bilge pump, and a bilge alarm float switch which actuated the bilge alarm. On the starboard side of the vessel there was an additional bilge alarm float switch, which is not shown on the diagram on page 10. We have attached a photograph of this area of the bilge which shows this additional bilge alarm float switch as Attachment A. The longitudinal bulkheads (that are not connected to the sea chest) had weep holes in them, to allow for water in the bilges to transversely flow to either side of the vessel. Thus, flooding on either side of the vessel in the "midship section" would activate either/both bilge alarms, as well as the bilge pump. Accordingly, we request that this language be modified as follows: "The vessel was equipped with a total of six bilge alarms located near the bottom of the various bilge compartments. The following four spaces contained one bilge alarm: the engine compartment forward of the axle; the sea chest; and the two aft compartments on either of the shaft tunnel. In the midship section there were two alarms located near the bottom of those compartments, one on each side of the vessel. The structural configuration of the midship section of the vessel allowed for water to freely communicate between the port and starboard side of the vessel, while the sea chest remained watertight. Thus, flooding of either the port or starboard side in the midship section would result in both bilge alarms and the bilge pump being activated."	Partially concur and updated text: The vessel was equipped with a total of six bilge alarms located near the bottom of the various bilge compartments. The following four spaces contained one bilge alarm: the engine compartment forward of the axle; the sea chest; and the two aft compartments on either of the shaft tunnel. In the midship section there were two alarms located near the bottom of those compartments, one on each side of the vessel. The structural configuration of the midship section of the vessel allowed for water to freely communicate between the port and starboard side of the vessel, while the sea chest remained watertight. Further description regarding auto -start bilge pumps is introduced below.

9/14-10/1	Each pump had a separate yellow indicating light on the dashboard at the captain's station that illuminated if the pump was in operation.	The description of the bilge pumps and bilge alarms in the draft report is incomplete. Each bilge pump had (i) a separate float switch installed adjacent to the pump that activated the bilge pump; (ii) an indicator light at the captain's station showing the bilge pump was running; and (iii) at least one high level bilge alarm float switch which activated the visual and audible bilge alarm near the captain's station. The language, as written, fails to include a description of the float switch that automatically activated the bilge pump when water levels reached a certain level. In addition, while we recognize the drawing on the top of page 10 is not intended to be to scale, it gives the false impression that the bilge alarms were located higher than they actually were, particularly those on the aft part of the vessel. The diagram should be updated to reflect the existence of all six of the bilge alarms. It should also be noted, in the diagram or elsewhere, that the bilge alarm float switches and bilge pump float switches were both near the bottom of the bilge/vessel. We request the following language at page 9 line 14 be revised as follows: "Each bilge pump was activated automatically by a float switch when the water levels in the bilge reached approximately 1/2 inch. Each pump also had a separate yellow indicating light on the dashboard at the captain's station that illuminated if the pump was in operation."	Updated language: Each bilge pump was activated automatically by a float switch when the water levels in the bilge reached approximately 1/2 inch. Each pump also had a separate yellow indicating light on the dashboard at the captain's station that illuminated if the pump was in operation.

10/1-2	A single switch labeled 'bilge switch' was located on the dashboard as well. This switch provided power to the bilge pumps.	The language "provided power to the bilge pumps" is an unclear description of what occurs when this manual bilge switch is activated. For purposes of redundancy in safety and operational flexibility, there are two separate circuits available for activating the bilge pumps: automatic and manual. This bilge switch allowed the captain to manually turn on the two bilge pumps located in the aft compartments on either side of the shaft tunnel. We believe this language should be made clear that if this bilge switch is activated, both bilge pumps in the aft compartments will begin running simultaneously, regardless of the water level at that pump or whether there is a high level bilge alarm that has been activated for those spaces. Accordingly, we request that this language be revised as follows: "In addition to bilge pumps being activated automatically, two of the aft bilge pumps could be activated manually. A single switch labeled 'bilge switch' was located on the dashboard. This switch would allow the captain to manually operate both aft bilge pumps simultaneously for any reason. This capability was in addition to, and independent of, the automatic activation of the bilge pumps described above."	
10/12	Additional language requested.	For clarity regarding the Higgins Pump, we request the following language be added at the end of line 12: "The Higgins Pump only functioned if the engine was running and the propeller shaft was rotating; its pumping rate increased or decreased with propeller shaft rotation speed."	Updated text: The Higgins Pump only functioned if the engine was running and the propeller shaft was rotating; its pumping rate increased or decreased with propeller shaft rotation speed."

11/11-17	"The Rule 2000, manufactured by Xylem Inc, was a submersible-style, 12-volt electric pump that automatically float-activated when water accumulated in the hull. According to the manufacturer, "this model of pump eliminates the need for a separate float switch to activate the pump. Once power is supplied, starting and stopping is completely automatic. The pump checks for water every 2 ½ minutes by turning on for a second and measuring load against the impeller. If water is present, the pump remains on until the water is removed. Thereafter the pump resumes its 2 ½ minute check cycle."	The description of the bilge pumps outfitted on the SD7, and the manner in which the bilge pumps are automatically activated, is not accurate. As noted above, each of the bilge pumps had a separate float switch installed near the bilge pump itself, which activated the pump automatically when the water level in the bilge reached approximately 1/2 inch. We believe the draft factual report is mixing up the standard model and the fully automatic model of the Rule 2000 pump series. The Rule 2000 fully automatic model does in fact check for water every 2 ½ minutes. *See* https://www.xylem.com/siteassets/brand/jabsco/fully-automatic-bilge-pump---technical-data- sheet---multilingual.pdf By contrast, the Rule 2000 standard model does not have this feature. Instead, to activate this model automatically a float switch must be installed (as was done on the SD7). *See* https://www.xylem.com/siteassets/brand/jabsco/standard-bilge-pump---technical-data-sheet--- _ multilingual.pdf The SD7 was equipped with the Rule 2000 standard model. The float switches which were installed near each bilge pump were "Rule-A-Matic Plus" automatic float switches. See Attachment B (Photograph of bilge pump and float switch on SD7).	Concur and updated text: The *Stretch Duck 7* was equipped with three, Coast Guard-approved Rule 2000 standard model bilge pumps. The submersible-style, 12-volt electric pumps were manufactured by Xylem Inc. Installed adjacent to each bilge pump was a "Rule-a-Matic Plus" automatic float switch, which would activate the bilge pump when the water level in the bilge reached approximately ½ inch. The Rule 2000 pumps were also equipped with 1 1/8-inch diameter plastic discharge hoses which discharged at the gunwale, two on the port side of the passenger area, and one on the starboard side.

		We also believe it is fair and accurate to note that the Coast Guard and a Registered Professional Engineer (P.E.) approved the bilge pumping and alarm arrangement, thereby finding these systems installed on the SD7 to be compliant with applicable regulations. *See* J.D. Ray, P.E. Bilge Pump Flooding Analysis To Support Removal of the Higgins Pump, dated April 30, 2005; *see also* USCG Approval letter dated June 14, 2005; see also U.S. Coast Guard approval letter dated August 13, 2002, and J.D. Ray, P.E. Electrical System Plan submitted to U.S. Coast Guard, dated July 25, 2002. In addition, Coast Guard inspections were conducted at least annually, to verify the system's condition and continued compliance with applicable regulatory requirements. Accordingly, we request that the language at page 11, lines 11-17 be replaced with the following language: "The Rule 2000 standard model, manufactured by Xylem Inc., was a submersible-style, 12-volt electric pump. Installed adjacent to each bilge pump was a "Rule-a-Matic Plus" automatic float switch, which would activate the bilge pump when the water level in the bilge reached approximately ½ inch. The Rule 2000 pumps were also equipped with 1 1/8-inch diameter plastic discharge hoses which discharged at the gunwale, two on the port side of the passenger area, and one on the starboard side. The *Stretch Duck 7*'s bilge pumping system design and alarm arrangement was approved by the Coast Guard, with the current design approved in 2005, and was inspected and tested during routine annual Coast Guard inspections."	

12/13 to 13/3	Request removal of language regarding the bilge capacity test for the reasons described.	The language at page 12 line 13 through page 13 line 3 describes post-accident operational tests performed on the bilge pumps and alarms for the SD7, purportedly to determine the bilge pump "operation" and "capacity". We strongly object to the use of any results of the so-called bilge pump "capacity test." In short, and as discussed further below, use of the results from this test, in any quantitative way, is not consistent with the scientific and investigative rigors expected in the NTSB's investigative process. We strongly request that the bilge capacity test results, as stated on page 12 and 13, be removed from the draft report because the purported "results" are simply unreliable to be used for their intended purpose. The bilge pump "capacity test" was performed using the existing bilge pumping arrangement on the SD7, in conjunction with a stand-alone 12 volt battery, a series of buckets (small buckets and one 5 gallon bucket), a hose, and an unspecified type of timer. The 12 volt battery was used to power the bilge pumps (rather than running the engines), and a hose was attached to the output of the of the bilge system at the gunwale. Our understanding at the time of the test was that the hose was used because the outflow of water from the bilge system, at the gunwale, would have been dispersed and unable to be fully collected in the various buckets. The "capacity test" was conducted as follows: The hose was connected to the bilge outflow fitting, which was located above the vessel's normal waterline at the gunwale (i.e. top of the vessel's side shell). When the bilge pump was energized, the small buckets were partly filled with the water being discharged through the hose, and then the water in the small buckets' was then transferred to the larger 5 gallon bucket, until the 5 gallon bucket was filled.	Updated text: Updated section to be titled: Bilge system operation: Updated text to read. Each bilge pump was operationally tested using an external 12-volt battery, supplied by Ride The Ducks, connected to the electrical wires locally at each pump. The pumps were tested in the field using existing bilge water that had accumulated during the sinking. Each of the pumps operated as expected, near capacity of their ratings. An owner-supplied battery was provided due to the assumption that the engine would not operate after being submerged.

		Once the five gallon bucket was filled, the 5 gallon bucket was emptied, and the contents of the smaller buckets were once again emptied into the 5 gallon bucket. This process was done repeatedly, apparently for just one minute. The five gallon bucket, full of water, was weighed, and calculations were performed to determine the actual volume of output by the bilge pumps. It was determined that the "5 gallon bucket" actually had a capacity of more the 5-1/2 gallons. Then the volume of water was calculated to produce a "calculated pumping rate" in "gallons per minute," as set forth on page 12.[1] As an initial matter, during the performance of this test, we raised concerns about the methodology and investigative efficacy of attempting to assess pumping capacities of the bilge pumps in the manner in which this test was conducted. At the time we raised these concerns, it was represented to us that the tests were not being performed to determine any specific quantitative assessment or measurement of the bilge pumping capacity, but rather the test was being performed to more generally to assess whether the bilge pumps were operating during the voyage. For this reason, we were very surprised to see the precise quantitative assessment of the purported bilge pump "capacity" of the SD7's bilge pumps. At the time this "test" was conducted, the results were not transmitted to us as implied in the draft report. This test was also not performed in accordance with any ASTM Standard, or any other accepted methodology that were are aware of, and the draft report does not cite one. Beyond those concerns, there are many other serious,	

		fundamental questions about the scientific methodology employed and validity of using the "capacity test" results in any quantitative way. For example, we are not aware of anyone having measured the actual inside diameter of the hose to ensure it was the same diameter of the bilge piping (1-1/8 inch), to ensure flow was not restricted. Even if the hose was the correct diameter, we are not aware of anyone having taken into account the added resistance of pumping the water through the hose, and accounting for the resulting reduction in outflow. We are not aware of anyone who was dedicated to ensuring the hose was not kinked or otherwise restricted in any way. We also note that the 12 volt battery was taken from our inventory of batteries that had been stored at our facility for an unknown period of time, and we are not aware of anyone having tested the battery to ensure it was fully charged and providing full power to the pumps. The draft report also states that the five gallon bucket full of water was weighed using a calibrated scale. We do not recall a calibrated scale being used to weigh the water, but we note that we do not have such a calibrated scale on site. Any scale we would have provided for the test is not calibrated. Many other questions persist. How much water was lost in splashing or similar spillage, when transferring and pouring the water among the various buckets used to collect and account for the water?	

[1] Beyond the substantive objections to the use of these "capacity test" results, the results as stated on page 12 list two different amounts for the test of the "port midships pump" and does not list any results for the starboard aft pump.

		Beyond the above, there is an even more fundamental reason why the "calculated pumping rate" cannot be relied on. This is because those test results are not reflective of the conditions under which the SD7's bilge pumps were operating on the accident voyage. Specifically, the evidence is clear that the SD7's engine was running until the very last moments of the voyage. Therefore, in order to determine the approximate pumping capacity of the bilge pumps during the accident voyage, the test should have been performed with the SD7's engine running. In this regard, we note for the record that the NTSB and U.S. Coast Guard conducted a similar bilge pumping capacity test on a near sister vessel to the SD7 (*Stretch Duck 9*) with the same model bilge pumps, but this test is surprisingly not mentioned in the draft report. This test, by contrast, was conducted with the engine running, allowing the alternator to serve as a continuous charging source for the battery, similar to the conditions under which the bilge pumps would have been operating on the accident voyage. The results of this test showed that the actual bilge pumping capacity for the bilge system was consistent with the rated pumping capacity. For this reason alone, the quantitative results of the bilge pumping "capacity test" performed on the SD7 must be disregarded. We respectfully submit that the scientific methodology employed in the bilge pumping "capacity test," as set forth in the draft report, does not meet the rigorous, exacting investigative standards to be expected given the serious nature of this investigation. In our opinion, use of the "results" from this capacity test in any quantitative manner would detract from the overall integrity of the work of the NTSB, which has been faithfully supported by the parties.	

13/5-7	“When the water level was raised to activate the bilge switch, the pump automatically started in each case.”	We believe it should be made clear that the test performed here was on the bilge float activation switch. Therefore, for clarity, we request the language “bilge switch” be amended to “bilge float switch” or “bilge pump activation float switch”.	Updated text in report to read: “bilge pump activation float switch”
13/27	End		