

**NATIONAL TRANSPORTATION SAFETY BOARD
Office of Research and Engineering
Vehicle Recorder Division
Washington, D.C. 20594**



GROUP CHAIRMAN'S FACTUAL REPORT OF INVESTIGATION

DCA18MM028

**By
Sean Payne**

WARNING

The reader of this report is cautioned that the transcript of an image and audio recording is not a precise science but is the best product possible from a Safety Board group investigative effort. The transcript or parts thereof, if taken out of context, could be misleading. The transcript should be viewed as an accident investigation tool to be used in conjunction with other evidence gathered during the investigation. Conclusions or interpretations should not be made using the transcript as the sole source of information.

NATIONAL TRANSPORTATION SAFETY BOARD
Vehicle Recorder Division

April 14, 2020

Onboard Image & Audio Recorders

Group Chairman's Factual Report By Sean Payne

1. EVENT SUMMARY

Location: Branson, Missouri
Date: July 19, 2018
Vessels: SD7, SD54, SD17, SD27
Operator: Ride the Ducks, Branson
NTSB Number: DCA18MM028

On Thursday, July 19, 2018, about 7:05 P.M. central daylight time (CDT), the amphibious passenger vessel Stretch Duck (SD) 7 owned and operated by Ride the Ducks Branson sank in Table Rock Lake, near Branson, Missouri. Local area forecasts for the time of the accident included thunderstorm warnings and data indicated winds of over 70 mph were encountered by a nearby vessel. The Stretch Duck 7 was carrying 31 persons: 29 passengers and two crewmembers. The vessel sank in approximately 15 feet of water and came to rest on the lake floor at a depth of 70 feet. Seventeen persons died, including one crewmember.

2. GROUP

A group was convened on Sept 11, 2018, at the headquarters of the National Transportation Safety Board in Washington, D.C. The group consisted of the following members:

Chairman:	Sean Payne Mechanical Engineer/Recorder Specialist National Transportation Safety Board (NTSB)
Member:	Marcel Muise Marine Safety Investigator NTSB
Member:	Capt. Wayne Arguin Jr. Chairman, SD7 Marine Board of Investigation United States Coast Guard (USCG)
Member:	Lora Wilson Meteorologist NOAA NWS

Member: George Knowles
Lieutenant
Missouri State Highway Patrol (MSHP)

Member: Frank English
Fleet Operations Manager
Ride the Ducks

3. DETAILS OF INVESTIGATION

The NTSB Vehicle Recorder Division received the following Image and Audio Recording Devices:

Recorder Manufacturer/Model: **Brigade MDR-408-1000-MCU**
Vessel: **Stretch Duck 7 (SD7)**
Recorder Serial Number: **1603MCU80040**

Recorder Manufacturer/Model: **Brigade MDR-408-1000-MCU**
Vessel: **Stretch Duck 54 (SD54)**
Recorder Serial Number: **1508MCU80013**

Recorder Manufacturer/Model: **Brigade MDR-408-1000-MCU**
Vessel: **Stretch Duck 17 (SD17)**
Recorder Serial Number: **1508MCU80034**

Recorder Manufacturer/Model: **Brigade MDR-408-1000-MCU**
Vessel: **Stretch Duck 27 (SD27)**
Recorder Serial Number: **1508MCU80050**

3.1 Audio/Image Recorder Carriage Requirements

Chapter V of the International Convention for the Safety of Life at Sea (SOLAS), regulation 20, specifies Voyage Data Recorder (VDR) carriage requirements. Cargo ships larger than 3,000 gross tons, and all passenger ships regardless of tonnage, must be equipped with a VDR. The VDR for a cargo ship larger than 3,000 gross tons, constructed before July 2002, may be a simplified VDR (S-VDR).

The USCG classified the SD boat under 47 *Code of Federal Regulations*, Chapter I, subchapter T, a "Small Passenger Vessel," which are vessels under 100 gross tons and carry less than 149 passengers. A subchapter T vessel, if on an international voyage, would require a VDR. The stretch duck boats in this accident were not used on an international voyage, and as such, were not required to carry a VDR.

3.2 Brigade MDR-408-1000-MCU Description

The Brigade Mobile Digital Recorder (MDR) is a digital video recorder (DVR) with audio recording capabilities for vehicle mounted applications. The DVR is capable of receiving and recording footage from up to eight cameras simultaneously as well as recording parametric data such as GPS position, wheel speed and G force data. The device uses

both a hard disk drive (HDD) as well as an SD¹ card for video and audio record keeping. When configured with the largest available HDD, the MDR is capable of recording up to 1,862 hours of video, audio and parametric data. Data is mirrored between the HDD and the removable SD card, however, data stored on the SD card is limited by the SD card's size. The device's HDD will store the complete dataset from the MDR (video, audio and parametric data). The device's SD card will only store video and audio data. No parametric data is stored on the SD card.

The device can be configured to flag areas of data that exceed limits in wheel speed, G force, or other parameters.

Video and audio data are stored in a proprietary format, and through the use of the manufacturer's software, can be exported to a variety of other formats. Parametric data can be displayed on the manufacturer's software, however, the parametric data can not be exported.

For details of how the MDR was configured on the accident DUKW boat, and on the other DUKW's investigated in this accident, refer to section 3.4 of this report.

3.3 Recorder Damage

Stretch Duck 7 (SD7) – Accident Vessel

The HDD associated with the MDR from SD7 was recovered from Table Rock Lake by MSHP divers on July 20, 2018. The SD card associated with the MDR from SD7 was recovered by MSHP divers on July 23, 2018.

The HDD was transferred to NTSB custody and was hand carried in fresh water by an NTSB investigator to the Vehicle Recorder Laboratory at NTSB headquarters in Washington, D.C. The SD card remained on scene until July 28, 2018, when it was later transported by the NTSB recorder specialist on scene to the NTSB laboratory in Washington, D.C. The HDD and SD card associated with DUKW-7 are shown in figure 1.



Figure 1. The HDD and SD card associated with the MDR (SN: 1603MCU80040) from SD7. The HDD has been removed from the MDR enclosure in this photograph (left).

¹ SD – Secure Digital – A format for removable memory in consumer electronic devices.

The HDD from SD7 showed signs of water exposure and slight corrosion damage. The HDD was rinsed in filtered water in the Vehicle Recorder Laboratory and evaluated. The damage to the HDD required repair within a clean room facility. The HDD was later provided to an assisting federal agency with a clean room facility. The assisting federal agency attempted to repair the HDD, but was unsuccessful. No data was recovered from the HDD associated with SD7.

The SD card associated with the MDR on SD7 was rinsed and dried in the Vehicle Recorder Laboratory using a vacuum drying oven. The SD card was read out using the manufacturer's software and suggested procedures, normally and without difficulty. The results of the recovery are described later in this report.

Stretch Duck 54 (SD54)

The HDD and SD card associated had already been handled on scene by parties other than the NTSB prior to the team's arrival in Branson on July 21, 2018. The HDD and SD were transferred to the custody of the NTSB's General Council on-scene representative on July 23, 2018. The devices were read on-scene via a PC using the manufacturer's software, normally and without difficulty by an NTSB recorder specialist. The HDD and SD card were hand carried to the NTSB Vehicle Recorder Laboratory and logged into evidence on July 28, 2018. The devices are shown below in figure 2.



Figure 2. The HDD and SD card associated with the MDR (SN: 1508MCU80013) from the SD54.

Stretch Duck 17 (SD17)

The HDD and SD card associated with SD17 was transferred to the custody of the NTSB's General Counsel on-scene representative on July 23, 2018. The devices were read on-scene via a PC using the manufacturer's software, normally and without difficulty by an NTSB recorder specialist. The HDD and SD card were hand carried to the NTSB Vehicle Recorder Laboratory and logged into evidence on July 28, 2018. The devices are shown below in figure 3.



Figure 3. The HDD and SD card associated with the MDR (SN: 1508MCU80034) from the SD17.

Stretch Duck 27 (SD27)

The HDD and SD card associated with SD27 was transferred to the custody of the NTSB's General Counsel on-scene representative on July 23, 2018. The device's were read on-scene via a PC using the manufacturer's software, normally and without difficulty by an NTSB recorder specialist. The HDD and SD card were hand carried to the NTSB Vehicle Recorder Laboratory and logged into evidence on July 28, 2018. The devices are shown below in figure 4.



Figure 4. The HDD and SD card associated with the MDR (SN: 1508MCU80050) from the SD27.

3.4 Image and Audio Recording Descriptions

Each SD boat was configured with a five camera MDR system. The camera locations and approximate field of views are illustrated in figure 5 below. This camera layout was common between SD7, SD54, SD17 and SD27. The term “VC” refers to video camera, and the subsequent number is the camera number assigned in the MDR configuration. The driver’s seat and the narrator’s seat are indicated as shown.

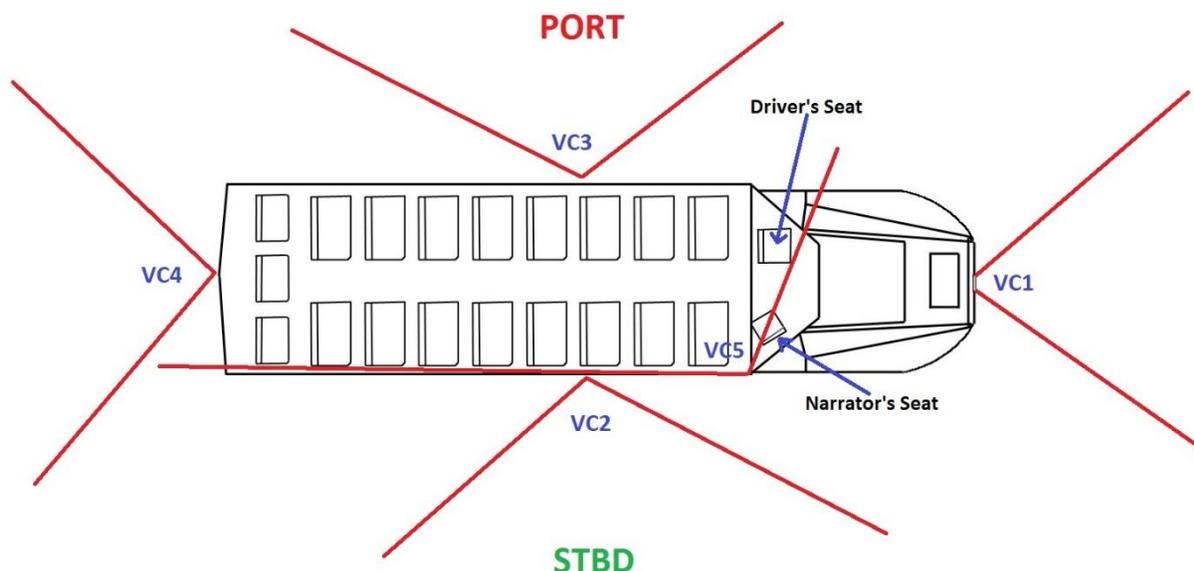


Figure 5. A top down view of a DUKW showing the layout of the camera locations and their approximate field of view for SD7, SD54, SD27 and SD17.

On each SD boat’s MDR configuration, VC5 was configured to record audio. The audio recorded was from an area microphone in the vicinity of the SD boat’s cockpit. Engine noise, as well as passenger, captain and driver comments were captured on the audio recording. At times, music associated with the tour operation and other noises obscured comments by either the passengers, the captain or the driver. For the majority of the tour, the captain of each SD boat used a public address style microphone system, which fed audio across each SD boat’s internal speakers. Other times, comments not directed toward the public address system were generally audible.

Each MDR’s audio quality from each SD boat discussed in this report is indicated in Table 1.² Attachment 1 is the NTSB’s audio quality rating scale, found at the end of this report.

Table 1: Audio Quality.

Vessel #	Content/Source	Quality
DUKW-7	VC-5 (cockpit area)	Fair
DUKW-54	VC-5 (cockpit area)	Fair
DUKW-17	VC-5 (cockpit area)	Fair
DUKW-27	VC-5 (cockpit area)	Fair

² See attached Audio Quality Rating Scale.

3.5 Parametric Data

As discussed above in section 3.2, parametric data is only recorded on the HDD and parametric data cannot be exported using the manufacturer's software. The parametric data can only be displayed inside the manufacturer's software.

The following three figures below are screen captures from the manufacturer's software for vessels SD54, SD17 and SD27. The blue lines show each vessel's track in the time frame nearest to the sinking of SD7. The magenta lines show the route taken one trip prior to the nearest time of SD7's sinking. The green arrow marker shows the vessel's present position at the time the screen capture was taken (just prior to entry at the boat ramp for each vessel). There is no timing information associated with the screen captures

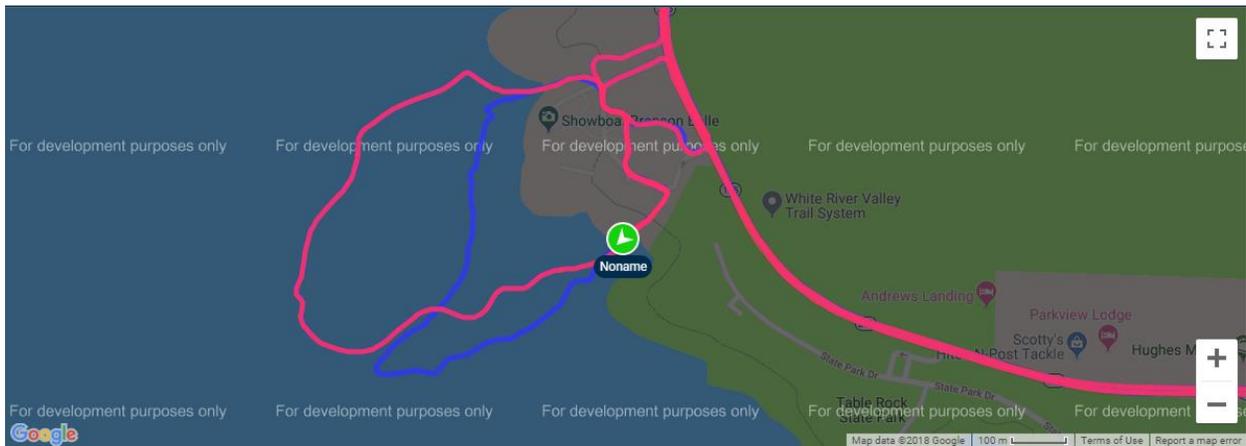


Figure 6. Parametric data showing the vessel's path from SD54.

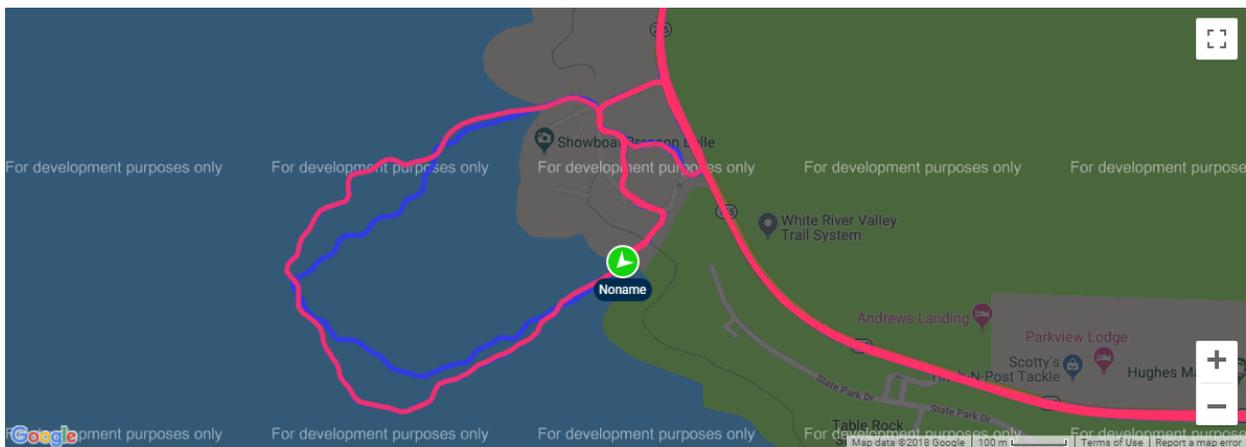


Figure 7. Parametric data showing the vessel's path from SD17.

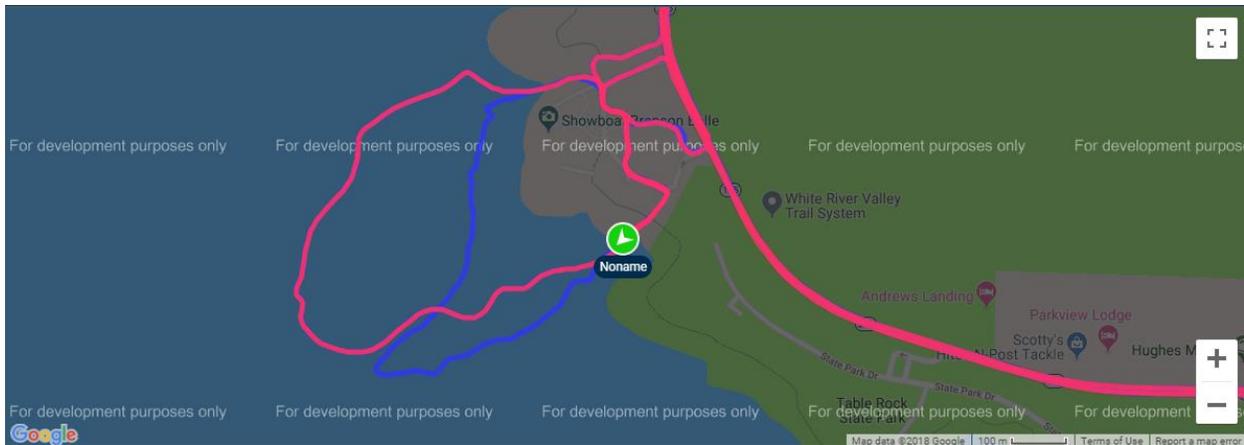


Figure 8. Parametric data showing the vessel's path from SD27.

3.6 Timing and Correlation

Timing for the Brigade MDR DVRs can either use the unit's internal GPS time or can be set by the user. Due to slight inconsistencies in the timing of each device, the devices were assumed to be set by the user. All times appeared to be set close to CDT.

Timing correlation for the transcript was established by correlating the VHF radio traffic between SD7, SD54, SD17 and SD27. Specifically, VHF transmissions were made by the captains of SD54 and SD7 as they entered the water. These transmissions shared commonality on three of the four SD boat recordings, but no single transmission was common across all four recordings.

Table 2 is a graphic illustrating how timing was correlated across all four recordings. Each vertical column represents a recording from each DUKW boat (SD7, SD54, SD17 and SD27). The first horizontal row shows the native timing of the VHF transmission from SD54, as detected on each recording. The second horizontal row shows the native timing of the VHF transmission from SD7, as detected on each recording. The times in black show times of VHF transmissions that were audible on each recording. The times in red show times of VHF transmissions that were not audible on each recording, but calculated based on the time difference between the transmissions from SD54 and SD7 (88 seconds). The blue arrows under each column show the amount of seconds that need to be added or subtracted to bring each recording in alignment with the recording from SD7.

The following formulas were calculated for each recording:

For SD7: Authoritative Time, no offset applied

For SD54: $SD54 + 0.3 \text{ seconds} = CDT$

For SD17: $SD17 - 6.5 \text{ seconds} = CDT$

For SD27: $SD27 + 2.6 \text{ seconds} = CDT$

Table 2: Time Correlation.

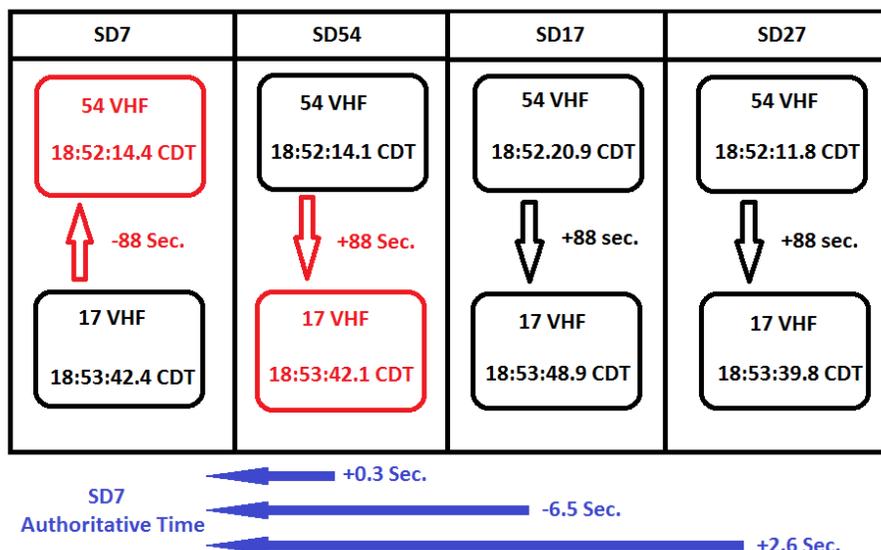


Table 2. A graphic illustration of the time correlation process.

3.7 Description of Audio and Video Events

In agreement with the Investigator-In-Charge, an image and audio transcription group was convened and the following four image and audio transcripts were produced.

Each image and audio transcript is provided as an attachment to this report. Each attachment includes a legend for the respective vessel and subsequent transcript. All times are given in CDT.

Attachment 1 is the audio quality rating scale.

Attachment 2 is the image and audio transcript for the accident vessel, SD7. Any audible comment deemed pertinent to the accident investigation has been transcribed by the investigation group verbatim. Audible commentary related to normal tour narration has been summarized to give a general perspective. Every video action deemed relevant to the accident voyage has been summarized.

Attachment 3 is the image and audio transcript for the SD54. Any audible comment deemed pertinent to the accident investigation has been summarized by the investigation group. Audible commentary related to normal tour narration was not included. Every video action relevant to the investigation has been summarized.

Attachment 4 is the image and audio transcript for SD17. Any audible comment deemed pertinent to the accident investigation has been summarized by the investigation group. Audible commentary related to normal tour narration was not included. Every video action relevant to the investigation has been summarized.

Attachment 5 is the image and audio transcript for SD27. Any audible comment deemed pertinent to the accident investigation has been summarized by the investigation group.

Audible commentary related to normal tour narration was not included. Every video action relevant to the investigation has been summarized.

3.8 Surviving Crew Commentary

As part of the Safety Board's accident investigation process, the surviving crew member(s), in this case, the captain, are invited to review the image/audio transcript and suggest corrections or additions. At the time of publishing, the captain and his representatives have not responded to the invitation.

Attachment I

Audio Quality Rating Scale

The levels of recording quality are characterized by the following traits of the MDR audio information:

Excellent Quality	Virtually all of the crew conversations could be accurately and easily understood. The transcript that was developed may indicate only one or two words that were not intelligible. Any loss in the transcript is usually attributed to simultaneous cockpit/radio transmissions that obscure each other.
Good Quality	Most of the crew conversations could be accurately and easily understood. The transcript that was developed may indicate several words or phrases that were not intelligible. Any loss in the transcript can be attributed to minor technical deficiencies or momentary dropouts in the recording system or to a large number of simultaneous cockpit/radio transmissions that obscure each other.
Fair Quality	The majority of the crew conversations were intelligible. The transcript that was developed may indicate passages where conversations were unintelligible or fragmented. This type of recording is usually caused by cockpit noise that obscures portions of the voice signals or by a minor electrical or mechanical failure of the CVR system that distorts or obscures the audio information.
Poor Quality	Extraordinary means had to be used to make some of the crew conversations intelligible. The transcript that was developed may indicate fragmented phrases and conversations and may indicate extensive passages where conversations were missing or unintelligible. This type of recording is usually caused by a combination of a high cockpit noise level with a low voice signal (poor signal-to-noise ratio) or by a mechanical or electrical failure of the CVR system that severely distorts or obscures the audio information.
Unusable	Crew conversations may be discerned, but neither ordinary nor extraordinary means made it possible to develop a meaningful transcript of the conversations. This type of recording is usually caused by an almost total mechanical or electrical failure of the CVR system.