



**NATIONAL TRANSPORTATION SAFETY BOARD  
OFFICE OF HIGHWAY SAFETY  
WASHINGTON, D.C.**

**HUMAN PERFORMANCE FACTORS GROUP CHAIRMAN'S  
FACTUAL REPORT**

---

**A. CRASH INFORMATION**

Location: State Route 12 (SR-12) mile marker 10.4 near Bryce Canyon City,  
Garfield County, Utah

Vehicle 1: 2017 Freightliner, Embassy body 37-passenger medium-size bus

Operator 1: America Shengjia Inc.

Date: September 20, 2019

Time: Approximately 11:30 a.m. MDT

NTSB #: **HWY19MH012**

**B. HUMAN PERFORMANCE FACTORS GROUP**

Dennis Collins, Senior Human Performance Factors Investigator, Group Chairman  
NTSB Office of Highway Safety  
490 L'Enfant Plaza East, S.W., Washington, DC 20594

**C. CRASH SUMMARY**

For a summary of the crash, refer to the *Crash Summary Report* in the docket for this investigation.

**D. DETAILS OF THE HUMAN PERFORMANCE FACTORS INVESTIGATION**

The human performance factors factual investigation focused on the behavioral, medical, operational, and environmental factors associated with the driver of the 2017 Freightliner, Embassy body 37-passenger mid-size bus (hereafter the bus).

## 1. Driver of the Bus

### 1.1. Background

The driver of the bus was a 60-year-old male. At the time of the crash he held a class “B” California commercial driver’s license<sup>1</sup> with a “P” (passenger) endorsement, a “46” restriction, and an “E” restriction.<sup>2</sup> His license was issued in August of 2018 and expires in December of 2021.<sup>3</sup> He held a medical examiner’s certificate for commercial driver medical certification issued in October of 2017 which was valid for two years.<sup>4</sup>

The National Driver Register (NDR) is a division within the National Highway Traffic Safety Administration (NHTSA) that maintains a computerized database of information from 51 U.S. jurisdictions on individuals whose privilege to operate a motor vehicle has been revoked, suspended, canceled, or denied or who have been convicted of serious traffic-related offenses. If information is found in the NDR, it will “point” to the State of Record where the driver’s status and history is maintained. A check for this driver found no pointers.

According to the motor carrier, the driver began his employment with the company (America Shengjia, Inc.) on September 11, 2019, nine days before the crash.

### 1.2. Driver Activities Prior to the Crash

Using information from an interview with the driver,<sup>5</sup> his cell phone records,<sup>6</sup> the tour itinerary<sup>7</sup> and his electronic logs,<sup>8</sup> investigators generated the following table of the driver’s activities in the days prior to the crash. All times in the table are in Mountain Daylight Time (MDT).<sup>9</sup>

---

<sup>1</sup> Allows the operation of: (1) a single vehicle with a gross combination weight rating (GCWR) of 26,001 or more pounds; (2) a 3-axle vehicle weighing over 6,000 pounds; (3) a bus, except a trailer bus, with endorsement; (4) any farm labor vehicle, with endorsement; and (5) all vehicles under Class C).

<sup>2</sup> The California 46 restriction indicates the license holder must wear corrective lenses when driving commercially and the E restriction limits the driver to commercial motor vehicles with automatic transmissions.

<sup>3</sup> Available as an attachment to the Motor Carrier Group Chairman’s Factual Report.

<sup>4</sup> Human Performance Attachment: Driver Medical Card.

<sup>5</sup> Human Performance Attachment: Narratives and Transcripts of Investigative Interviews.

<sup>6</sup> Human Performance Attachment: Driver Cellular Telephone Records.

<sup>7</sup> Human Performance Attachment: Tour Itinerary.

<sup>8</sup> Available as an attachment to the Motor Carrier Group Chairman’s Factual Report.

<sup>9</sup> The driver’s E-logs are maintained in Pacific time and were adjusted by adding one hour. The times reported by the driver in his interview were adjusted to match known times; i.e. if the driver stated he began driving at 8:30 and the e-logs show 9:30, the driver’s times for other events that day were increased by one hour.

Table 1. Driver Activities Prior to the Crash

Monday, September 16, 2019			
<i>Time</i>	<i>Description</i>	<i>Location</i>	<i>Source</i>
8:18 a.m.	Driver goes on-duty	El Monte, CA	E-logs
8:30 a.m.	Driver begins driving	El Monte, CA	E-logs
8:47 a.m.	Driver goes on-duty	El Monte, CA	E-logs
9:06 a.m.	Driver begins driving	El Monte, CA	E-logs
11:33 a.m.	Driver goes on-duty	San Diego, CA	E-logs
11:35 a.m.	Driver begins driving	San Diego, CA	E-logs
11:45 a.m.	Driver goes off duty	Tijuana, Mexico	E-logs
4:19 p.m.	Driver begins driving	Tijuana, Mexico	E-logs
4:58 p.m.	Driver goes off-duty	San Diego, CA	E-logs
5:37 p.m.	Driver begins driving	San Diego, CA	E-logs
6:01 p.m.	Driver goes off-duty	San Diego, CA	E-logs
6:32 p.m.	Driver begins driving	San Diego, CA	E-logs
6:46 p.m.	Driver goes off-duty	San Diego, CA	E-logs
7:34 p.m.	Driver begins driving	San Diego, CA	E-logs
7:45 p.m.	Driver goes off-duty	Chula Vista, CA	E-logs
8:34 p.m.	Driver begins driving	Chula Vista, CA	E-logs
10:40 p.m.	Driver goes on-duty	El Monte, CA	E-logs
10:51 p.m.	Driver begins driving	El Monte, CA	E-logs
10:59 p.m.	Driver goes off-duty	El Monte, CA	E-logs
Tuesday, September 17, 2019			
<i>Time</i>	<i>Description</i>	<i>Location</i>	<i>Source</i>
7:00 a.m.	Driver awakes	-	Interview
9:29 a.m.	Driver goes on-duty	El Monte, CA	E-logs
9:41 a.m.	Driver begins driving	El Monte, CA	E-logs
10:34 a.m.	Driver goes off-duty	San Dimas, CA	E-logs
11:16 a.m.	Driver begins driving	San Dimas, CA	E-logs
11:33 a.m.	Driver gets incoming call, first of day	-	Cell Records
12:39 p.m.	Driver goes off-duty	Barstow, CA	E-logs
1:10 p.m.	Driver begins driving	Barstow, CA	E-logs
1:21 p.m.	Driver goes on-duty	Barstow, CA	E-logs
1:31 p.m.	Driver begins driving	Barstow, CA	E-logs
1:45 p.m.	Driver goes off-duty	Barstow, CA	E-logs
3:21 p.m.	Driver begins driving	Barstow, CA	E-logs
3:23 p.m.	Driver goes off-duty	Barstow, CA	E-logs
3:46 p.m.	Driver begins driving	Barstow, CA	E-logs
4:44 p.m.	Driver goes on-duty	Baker, CA	E-logs
4:58 p.m.	Driver begins driving	Baker, CA	E-logs
6:37 p.m.	Driver goes off-duty	Las Vegas, NV	E-logs
7:29 p.m.	Driver begins driving	Las Vegas, NV	E-logs
7:49 p.m.	Driver goes off-duty	Las Vegas, NV	E-logs
8:59 p.m.	Driver begins driving	Las Vegas, NV	E-logs

**Tuesday, September 17, 2019 (continued)**

<u>Time</u>	<u>Description</u>	<u>Location</u>	<u>Source</u>
9:25 p.m.	Driver goes off-duty	Las Vegas, NV	E-logs
10:00 p.m.	Driver gets incoming call, last of day	-	Cell Records
10:03 p.m.	Driver begins driving	Las Vegas, NV	E-logs
10:17 p.m.	Driver goes off-duty	Las Vegas, NV	E-logs
10:55 p.m.	Driver begins driving	Las Vegas, NV	E-logs
11:05 p.m.	Driver goes off-duty	Las Vegas, NV	E-logs

**Wednesday, September 18, 2019**

<u>Time</u>	<u>Description</u>	<u>Location</u>	<u>Source</u>
8:00 a.m.	Driver awakes	-	Interview
9:12 a.m.	Driver gets incoming call, first of day	-	Cell Records
9:19 a.m.	Driver goes on-duty	Las Vegas, NV	E-logs
9:36 a.m.	Driver begins driving	Las Vegas, NV	E-logs
11:24 a.m.	Driver goes on-duty	Kingman, AZ	E-logs
11:33 a.m.	Driver goes off-duty	Kingman, AZ	E-logs
11:45 a.m.	Driver begins driving	Seligman, AZ	E-logs
12:52 p.m.	Driver goes on-duty	Seligman, AZ	E-logs
1:10 p.m.	Driver begins driving	Seligman, AZ	E-logs
1:55 p.m.	Driver goes off-duty	Williams, AZ	E-logs
2:45 p.m.	Driver begins driving	Grand Canyon Vil. AZ	E-logs
3:50 p.m.	Driver goes off-duty	Grand Canyon Vil. AZ	E-logs
5:31 p.m.	Driver begins driving	Grand Canyon Vil. AZ	E-logs

**Thursday, September 19, 2019**

<u>Time</u>	<u>Description</u>	<u>Location</u>	<u>Source</u>
7:04 p.m.	Driver goes off-duty	Flagstaff, AZ	E-logs
7:52 p.m.	Driver begins driving	Flagstaff, AZ	E-logs
7:58 p.m.	Driver goes off-duty	Flagstaff, AZ	E-logs
9:31 p.m.	Driver gets incoming call, last of day	-	Cell Records
11:00 p.m.	Driver goes to sleep	-	Interview
8:00 a.m.	Driver awakes	-	Interview
8:40 a.m.	Driver goes on-duty	Flagstaff, AZ	E-logs
9:04 a.m.	Driver begins driving	Flagstaff, AZ	E-logs
11:25 a.m.	Driver goes off-duty	Page, AZ	E-logs
12:36 p.m.	Driver begins driving	Page, AZ	E-logs
12:42 p.m.	Driver goes off-duty	Page, AZ	E-logs
1:30 p.m.	Driver begins driving	Page, AZ	E-logs
1:36 p.m.	Driver goes off-duty	Page, AZ	E-logs
1:59 p.m.	Driver begins driving	Page, AZ	E-logs
2:21 p.m.	Driver gets incoming call, first of day	-	Cell Records
2:27 p.m.	Driver goes on-duty	Page, AZ	E-logs
2:39 p.m.	Driver begins driving	Page, AZ	E-logs
2:41 p.m.	Driver goes off-duty	Page, AZ	E-logs
3:07 p.m.	Driver begins driving	Page, AZ	E-logs
3:30 p.m.	Driver goes off-duty	Page, AZ	E-logs

Thursday, September 19, 2019 (continued)			
<u>Time</u>	<u>Description</u>	<u>Location</u>	<u>Source</u>
4:02 p.m.	Driver begins driving	Page, AZ	E-logs
4:13 p.m.	Driver goes off-duty	LeChee, AZ	E-logs
5:13 p.m.	Driver begins driving	LeChee, AZ	E-logs
7:38 p.m.	Driver goes off-duty	Hurricane, UT	E-logs
8:16 p.m.	Driver begins driving	Hurricane, UT	E-logs
8:22 p.m.	Driver goes off-duty	Hurricane, UT	E-logs
11:00 p.m.	Driver goes to bed	-	Interview
11:22 p.m.	Driver makes call; last of day	-	Cell Records
Friday, September 20, 2019			
<u>Time</u>	<u>Description</u>	<u>Location</u>	<u>Source</u>
7:00 a.m.	Driver awakes	-	Interview
7:39 a.m.	Driver goes on-duty	Hurricane, UT	E-logs
8:02 a.m.	Driver begins driving	Hurricane, UT	E-logs
8:59 a.m.	Driver goes on-duty	Hurricane, UT	E-logs
9:10 a.m.	Driver begins driving	Hurricane, UT	E-logs
9:35 a.m.	Driver goes on-duty	Orderville, UT	E-logs
9:43 a.m.	Driver goes on-duty	Orderville, UT	E-logs
9:49 a.m.	Driver begins driving	Orderville, UT	E-logs
10:07 a.m.	Driver goes off-duty	Orderville, UT	E-logs
10:15 a.m.	Last cell activity before crash	-	Cell Records
10:23 a.m.	Driver spends 1 minute on FaceTime	-	Employer
10:30 a.m.	Driver begins driving	Orderville, UT	E-logs
<b>11:26 a.m. CRASH OCCURS in Bryce Canyon City, UT</b>			

### 1.3. General Health<sup>10</sup>

When interviewed, the driver described his health as good. He sustained minor injuries in the crash but declined medical treatment.

### 1.4. Vision and Hearing

When interviewed by NTSB investigators, the driver described his vision as good when wearing his glasses, which he said he always does. He denied having any problems with his vision on the day of the crash. He described his hearing as normal and denied having any hearing issues on the day of the crash.

According to the driver's most recent commercial driver medical exam, his corrected visual acuity was 20/30 with the right eye, 20/30 with the left eye, and 20/20 with both eyes. His horizontal field of vision was recorded as 85 degrees with both the right eye and the left eye. He was able to distinguish a forced whisper at 7.5 feet with both the left and right ear.

<sup>10</sup> Per NTSB policy, medical records are not placed in the docket. The medical exam form was reviewed by the Human Performance Group Chairman for relevant information to be used in this report.

### **1.5. Medical Examination Report for Commercial Motor Vehicle Driver Fitness Determination (CDL Medical Exam)**

Commercial drivers in the United States are required be medically certified as being physically qualified to drive a commercial vehicle.<sup>11</sup> Drivers in interstate commerce, which includes this driver, must meet the requirements specified in the *Federal Motor Carrier Safety Regulations* (FMCSRs). These examinations result in one of four outcomes with respect to medical qualification:

- The driver is found to meet the standards in 49 *Code of Federal Regulations* (CFR) §391.41 and is given a 2-year certificate;<sup>12</sup>
- The driver is found to meet the standards, but requires periodic evaluation for one or more conditions and is qualified for 3 months, 6 months, or 1 year;
- The driver is temporarily disqualified due to a condition or medication; or;
- The driver is found not to meet the standards.

Investigators located the driver's October 2017 CDL medical exam. In that exam, the driver indicated no health history or other health conditions. He indicated he had not undergone any surgeries. He stated he was not taking any prescription, over the counter, or herbal medications. The examiner made no notations in the driver health history review section. The driver's blood pressure and pulse rate were typical. His urinalysis was within normal limits. His height was listed as five feet five inches and his weight was listed as 170 pounds. The physical examination of the driver was unremarkable.

The driver stated that he had never been denied a USDOT/FMCSA medical certificate or had been issued one for less than two years. As a result of the October 2017 exam, the driver was qualified for two years. The performing examiner was a chiropractor who was listed on the national registry of certified medical examiners.<sup>13</sup> The examiner was added to the registry on October 30, 2015.

### **1.6. Medical Providers**

When interviewed, the driver identified his primary care provider. He stated he only went to this doctor once, for stomach issues.

---

<sup>11</sup> 49 Code of Federal Regulations §391.41.

<sup>12</sup> For more information on who must be examined and the examination process, please see 49 CFR §391.43 and 49 CFR §391.45.

<sup>13</sup> Investigators verified the examiner was on the registry using <https://www.fmcsa.dot.gov/national-registry-certified-medical-examiners-search>.

## **1.7. Medications (Prescription, Over the Counter, Other)**

### **1.7.1. Pharmacy Records**

When interviewed by NTSB investigators, the driver stated he fills his prescriptions at the pharmacy next door to his doctor. NTSB investigators also conducted a canvas of additional pharmacies in the area around the driver's residence. One of those pharmacies was found to have a record of prescriptions in the driver's name; the driver last filled a prescription there approximately one year ago. A subpoena was issued for records from both pharmacies. The pharmacy identified in the canvas provided records which indicated the prescription was an antibiotic and would not be expected to affect driving.

## **1.8. Drug and Alcohol Information**

When interviewed, the driver stated he has never taken illicit drugs and only occasionally drinks alcohol. He stated he did not drink any alcohol the week prior to the crash.<sup>14</sup>

## **1.9. Previous Toxicological Testing**

A pre-employment DOT drug test, taken on September 10, 2019 for his current employer, resulted in a negative result.<sup>15</sup>

## **1.10. Post-Crash Toxicology**

Following the crash, the driver voluntarily provided a blood sample to the Utah Highway Patrol (UHP). The sample taken was too small to allow a portion to be sent to the Federal Aviation Administration (FAA) laboratory for an independent analysis. Testing performed by the Utah Public Health Laboratory was negative<sup>16</sup> for cocaine, methamphetamine, morphine, THC metabolites, and alcohol.<sup>17</sup>

## **1.11. Psychological Factors**

When interviewed, the driver denied experiencing any significant life events<sup>18</sup> in the past month.

---

<sup>14</sup> See *Narratives and Transcripts of Investigative Interviews*.

<sup>15</sup> Available as an attachment to the Motor Carrier Group Chairman's Factual Report.

<sup>16</sup> Human Performance Attachment: Driver Toxicology Report.

<sup>17</sup> The testing looked for ethanol, acetone, isopropanol, methanol, amphetamine, methamphetamine, MDA, MDMA, cocaine, benzoylecgonine, morphine, alprazolam,  $\alpha$ -OH alprazolam, amitriptyline, butalbital, carbamazepine, carisoprodol, chlorpheniramine, chlordiazepoxide, clonazepam, 7-aminoclonazepam, codeine, cyclobenzaprine, dextromethorphan, diazepam, diphenhydramine, doxylamine, fentanyl, norfentanyl, hydrocodone, lorazepam, meperidine, meprobamate, methadone, midazolam, nordiazepam, nortriptyline, oxazepam, oxycodone, phenobarbital, phenytoin, propoxyphene, temazepam, tramadol, trazodone, zaleplon, and zolpidem.

<sup>18</sup> In this context, significant life events are things such as marriage, divorce, a birth, a death, significant illness, significant monetary expense, loss of a job, getting a new job, and so on.

### 1.12. Sleep Habits

When interviewed, the driver stated he sleeps well and has never been told he has any sleep-related medical conditions. He occasionally wakes during the night. Based on the interview with the driver and additional sources of information, investigators were able to estimate the time the driver had available for sleep and/or rest in the days preceding the crash. This information is presented in Figure 1 and Table 2 below.

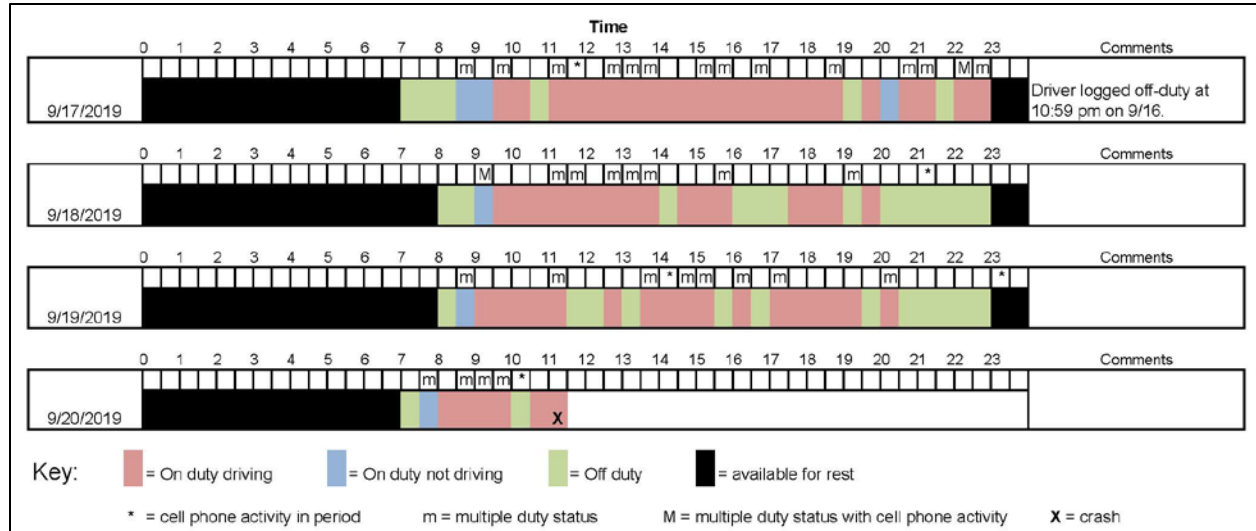


Figure 1. Driver Time Available for Rest

Table 1. Driver Time Available for Rest

From		To		Available for Rest
Date	Time	Date	Time	
Monday 9/16	10:59 p.m.	Tuesday 9/17	7:00 a.m.	8 hours 1 minute
Tuesday 9/17	11:05 p.m.	Wednesday 9/18	8:00 a.m.	8 hours 55 minutes
Wednesday 9/18	11:00 p.m.	Thursday 9/19	8:00 a.m.	9 hours
Thursday 9/19	11:22 p.m.	Friday 9/20	7:00 a.m.	7 hours 38 minutes

### 1.13. Training/Experience

When interviewed,<sup>19</sup> the driver stated he had approximately two and a half years of experience driving buses. All that experience was with prior employers. The driver also worked as a tour guide prior to becoming a driver.<sup>20</sup> The driver told investigators that prior to the crash trip, he had made similar trips six times in 2019 when employed by Dragon Coach, a company he had previously driven for. This was his first trip for America Shengjia, Inc. He stated that when employed by Dragon Coach, he drove buses like the one he was driving at the time of the crash; they were the same manufacturer but slightly larger at Dragon.

<sup>19</sup> See *Narratives and Transcripts of Investigative Interviews*.

<sup>20</sup> See the Motor Carrier Group Chairman’s Factual Report for more information on the driver’s employment history.



For additional information on the driver's experience and employment history, please see the *Motor Carrier Group Chairman's Factual Report*.

#### **1.14. License History**

A Commercial Driver's License Information System (CDLIS) report<sup>21</sup> for the driver showed no convictions, accidents, or withdrawals.<sup>22</sup>

#### **1.15. Distractions Inside the Vehicle**

According to the driver, he was not using his phone at or near the time of the crash. Records from the driver's cellular service provider indicate the last activity was over an hour before the crash.<sup>23</sup> The driver specifically denied using a GPS device and did not know if there were any other communication devices, such as a CB radio, on the bus. The bus was not equipped with any camera systems that would have recorded his actions during the trip.

#### **1.16. Distractions Outside the Vehicle**

Investigators conducted a visual examination of the crash scene under conditions like those at the time of the crash and did not observe any unusual or distracting environmental features. When asked, the driver stated he did not make note of the illumination at the time of the crash.

Video of the eastbound approach to the crash scene was taken by investigators.<sup>24</sup>

#### **1.17. Crash Trip**

At the time of the crash, the driver was engaged in driving a tour group. According to the tour itinerary,<sup>25</sup> he picked up the tour group at the Los Angeles airport, Los Angeles, California on Saturday, September 14th. The group visited Hollywood Boulevard, the Chinese Theater, and the Dolby Theater. The group stayed the night at a hotel in Rosemead, California. On Sunday, September 15<sup>th</sup>, the group went to Universal Studios Hollywood and returned to their hotel. On Monday, September 16<sup>th</sup>, the group went to Tijuana, Mexico before visiting the harbor, Balboa Park, the "Victory Kiss" statue, and Old Town in San Diego. On September 17<sup>th</sup>, the group went to the Mellish Island Sea Cucumber Plant, Barstow Outlets in Barstow, California, and on to Las Vegas, Nevada. The group stayed in a hotel in Las Vegas. On September 18<sup>th</sup>, the group went to the Grand Canyon (South) in Arizona and on to Flagstaff, Arizona for the night. On September 19<sup>th</sup>, the group went to Antelope Canyon and Horseshoe Bend in Paige, Arizona. They then went to Lake Powell and Zion National Park in Utah. They spent the night in a hotel in Hurricane, Utah. On September 20<sup>th</sup>, the first scheduled destination of the day was Bryce Canyon; this is where the bus was heading when the crash occurred.

---

<sup>21</sup> Available as an attachment to the *Motor Carrier Factors Group Chairman's Factual Report*.

<sup>22</sup> A withdrawal usually results from unpaid fees, bad checks, pending applications, or medical examination. The person's permission to drive is withdrawn; the license is not surrendered and remains active but invalid until the issue is resolved.

<sup>23</sup> See *Driver Cellular Telephone Records*.

<sup>24</sup> Human Performance Attachment: Video of Approach to Crash Scene.

<sup>25</sup> See *Tour Itinerary*.

The driver told NTSB investigators the trip was normal before the crash. There had been one problem with the bus; during the stop in Orderville, Utah; the bus would not start. The driver used FaceTime to talk to his boss, who told him to crawl under the bus and give the starter two good hits. The driver did this, and the bus started. This stop was the last event prior to the crash.

When asked about the conditions at the time of the crash, the driver stated the road had been recently paved. When asked why he thought that, he stated it was different than during his last trip to Bryce Canyon, in July. He went on to describe the road surface as slippery.

He stated that as he was driving, the bus tilted to the left, then tilted to the right, then tilted back to the left. He was asked to confirm the order of tilting as left-right-left; he reversed the order to right-left-right, then returned to left-right-left. The driver insisted several times that he did not apply any steering input. He described the bus as being not under his control. When asked if his wheels went off the edge of the road, the driver stated he did not remember. He also did not remember the bus going onto its side, striking the guardrail, or rotating back onto its wheels. After the crash, he exited the bus to check on the passengers. He placed a bag under the head of one as a pillow and pushed a second passenger who was half out of a window back inside the bus. He was not sure how many passengers were outside the bus when he exited the bus. Emergency responders were on the scene quickly. When asked what the passengers were doing at the time of the crash, he said he did not know as he was concentrating on driving. He was wearing his seatbelt at the time of the crash.

## **2. Other Factors**

### **2.1. Global Positioning System (GPS) Location**

NTSB investigators used a Cannon camera GPS unit to determine the coordinates of the crash scene:

Latitude:	37° 42' 28.15" N	(37.7078194)
Longitude:	112° 12' 22.54" W	(-112.2062611)
Elevation:	7,698 feet	

### **2.2. Weather**

The closest official weather reporting location to the crash site was from Bryce Canyon Airport (KBCE), Bryce Canyon, Utah, about 3 miles east of the crash site at an elevation of 7,590 ft above mean sea level (msl). The airport had a federally installed and maintained Automated Surface Observation System (ASOS) and reported the following conditions at 1053 MDT. Wind from the northwest at 7 mph, visibility unrestricted at 10 statute miles or more, clear skies, a temperature of 53° Fahrenheit (F), and a dew point temperature of 24° F, with a relative humidity of 32%.<sup>26</sup>

A review of the 24-hour period indicated that a cold front had moved across the region during the evening and was located over extreme southwest Utah at the time of the crash. No

---

<sup>26</sup> Human Performance Attachment: Weather Data.

precipitation was recorded during the 24-hour period. A low temperature of 29° F occurred near 0600 MDT on the morning of the crash.

### 2.3. Illumination

According to the NOAA Solar Calculator,<sup>27</sup> for the crash location on September 20, 2019, apparent sunrise was at 7:15 a.m., solar noon was at 1:22 p.m., and apparent sunset was at 7:29 p.m. At 11:30 a.m., the sun was at an azimuth of 138.17 degrees from true north and an elevation of 45.15 degrees. Figure 2 shows direction of travel (red arrow), the crash location (red balloon), and the relative position of the sun at the time of the crash (purple line).

Figure 2. Graphic Representation of the Sun's Position (image modified from the NOAA Solar Calculator).



### 2.4. Technology

#### 2.4.1. Lane Departure Warning (LDWS)

Lane departure warning systems (LDWS) are forward-looking video systems that warn the driver if the vehicle drifts from the lane. Most such systems only activate if the vehicle is travelling over a specific speed and are deactivated if the driver indicates they intend to change lanes by using the turn signal.<sup>28</sup> These systems can provide warnings visually, auditorily, via haptics, or through a combination of modalities.

In a field operation test sponsored by NHTSA, an LDWS—when compared with baseline driving without this technology—was found to increase turn signal usage per mile driven by 9 percent,

<sup>27</sup> Available at <https://www.esrl.noaa.gov/gmd/grad/solcalc/>. The latitude and longitude listed above, a time zone offset of -6, a date of 20 September 2019, and a local time of 11:26:00 were used to calculate values and generate the graphic.

<sup>28</sup> P. Rau, "Drowsy Driver Detection and Warning System for Commercial Vehicle Drivers: Field Operational Test Design, Data Analyses, and Progress," *Proceedings, 19th International Technical Conference on the Enhanced Safety of Vehicles*, DOT HS 809 825 (Washington, DC: National Highway Traffic Safety Administration, June 2005).

to decrease lane position deviation, and to cause drivers to more quickly return to their travel lane after being issued an imminent alert.<sup>29</sup> Researchers predict that LDWSs could reduce heavy truck road departure crashes by 17–24 percent, though the effectiveness of these systems has varied along with such factors as field testing environment, driving population, and test design.<sup>30</sup>

In its investigative report on a 2005 motorcoach collision with an overturned truck in Osseo, Wisconsin, the NTSB described LDWSs as a tool to warn drivers about unintended lane shifts, regardless of whether they are impaired by fatigue, distraction, poor driving, or other conditions.<sup>31</sup> Following its investigation of a loss of control and rollover crash near Dolan Springs, Arizona, on January 30, 2009, the NTSB recommended that the National Highway Traffic Safety Administration (NHTSA) require new commercial vehicles with a gross vehicle weight rating above 10,000 pounds<sup>32</sup> be equipped with lane departure warning systems.<sup>33</sup> As of February 13, 2020, that recommendation is classified “Open – Unacceptable Response”.<sup>34</sup>

#### **2.4.2. Lane Keeping Support System (LKS)**

Lane Keeping Support (LKS), also known as Lane Keeping Assist (LKA), is a safety system that builds on the warning provided by a LDWS by taking action to keep drivers from unintentionally drifting out of their lane. LKS uses the information provided by the sensors in a LDWS to determine if a vehicle is about to move out of its lane; if so, the LKS activates and either corrects the steering, brakes or accelerates one or more of the wheels, or a combination of both to keep the vehicle within its lane of travel. NHTSA has not set performance specifications for this technology.<sup>35</sup>

#### **2.4.3. Stability Control**

Stability control systems use automatic braking to help prevent directional and roll instabilities. The systems monitor lateral acceleration, driver steering input, and yaw rate and apply braking, including differential braking, to prevent rollover and address understeer or oversteer during an emergency maneuver.

Several studies have shown stability control systems to be highly effective in preventing single-vehicle accidents involving automobiles and SUVs.<sup>85</sup> Beginning with the 2012 model year, NHTSA required all vehicles with GVWRs of 10,000 pounds or less be equipped with stability control systems.<sup>86</sup>

---

<sup>29</sup> D. LeBlanc and others, *Road Departure Crash Warning System Field Operational Test: Methodology and Results*, UMTRI 2006-9-1 (Ann Arbor, Michigan: University of Michigan Transportation Research Institute, June 2006).

<sup>30</sup> S. Johnson, *Human Factors Study of Driver Assistance Systems to Reduce Lane Departures and Side Collision Accidents* (Fayetteville, Arkansas: Mack–Blackwell National Rural Transportation Study Center, 2008).

<sup>31</sup> *Truck-Tractor Semitrailer Rollover and Motorcoach Collision With Overturned Truck, Interstate Highway 94 Near Osseo, Wisconsin, October 16, 2005*, Highway Accident Report NTSB/HAR-08/02 (Washington, DC: National Transportation Safety Board, 2008).

<sup>32</sup> The vehicle in this crash had a GVWR of 26,000 pounds.

<sup>33</sup> *Bus Loss of Control and Rollover, Dolan Springs, Arizona, January 30, 2009*, Highway Accident Report NTSB/HAR-10/01 (Washington, DC: National Transportation Safety Board, 2010).

<sup>34</sup> See [https://www.nts.gov/safety/safety-recs/layouts/ntsb\\_recsearch/Recommendation.aspx?Rec=H-10-001](https://www.nts.gov/safety/safety-recs/layouts/ntsb_recsearch/Recommendation.aspx?Rec=H-10-001).

<sup>35</sup> See <https://www.safercar.gov/Vehicle+Shoppers/Safety+Technology/lks/>, accessed February 13, 2020.

The NTSB has advocated the study and implementation of technology to aid commercial vehicle drivers in maintaining control of their vehicles since the multiple-fatality incident that occurred near Slinger, Wisconsin, in 1997.<sup>36</sup> In that crash, a doubles truck traveling northbound on U.S. Route 41 in hazardous weather conditions crossed over the median into the southbound lanes. This incursion initiated a series of collisions that resulted in eight fatalities. As a result of this crash, the NTSB issued a recommendation to NHTSA to assess the safety benefits of adding traction control devices to antilock brake systems. That recommendation is classified “Closed – Acceptable Action”.<sup>37</sup>

The NTSB revisited the potential benefits of vehicle control technology in its investigation of a 2005 multiple-fatality crash near Osseo, Wisconsin,<sup>38</sup> recommending that NHTSA determine whether equipping commercial vehicles with collision warning systems with active braking and electronic stability control systems will reduce commercial vehicle crashes and, if these technologies are determined to be effective in reducing crashes, require their use on commercial vehicles. This recommendation is classified “Closed - Unacceptable Action”.<sup>39</sup>

A crash in Dolan Springs, Arizona<sup>40</sup> involved a medium-sized bus leaving its lane to the left and the driver steering sharply to the right, causing the bus to enter the right shoulder. The driver then steered back to the left, causing the bus to yaw, enter the median, and overturn. Seven passengers were killed and 15 of the 17 occupants were fully or partially ejected. After its investigation, the NTSB recommended NHTSA develop stability control system performance standards applicable to newly manufactured buses with a GVWR above 10,000 pounds and, once the performance standards have been developed, require the installation of stability control systems in all newly manufactured buses in which this technology could have a safety benefit. Both these recommendations are classified “Closed – Superseded”; as of February 13, 2020, the recommendations that superseded them are classified “Open – Unacceptable Response”.<sup>41</sup>

---

<sup>36</sup> *Multiple Vehicle Crossover Accident, Slinger, Wisconsin, February 12, 1997*, Highway Accident Report NTSB/HAR-98/01 (Washington, DC: National Transportation Safety Board, 1998).

<sup>37</sup> See <https://www.nts.gov/safety/safety-recs/ layouts/ntsb.recsearch/Recommendation.aspx?Rec=H-98-015>.

<sup>38</sup> NTSB/HAR-08/02.

<sup>39</sup> See <https://www.nts.gov/safety/safety-recs/ layouts/ntsb.recsearch/Recommendation.aspx?Rec=H-08-015>.

<sup>40</sup> NTSB/HAR-10/01.

<sup>41</sup> See <https://www.nts.gov/safety/safety-recs/ layouts/ntsb.recsearch/Recommendation.aspx?Rec=H-11-007> and <https://www.nts.gov/safety/safety-recs/ layouts/ntsb.recsearch/Recommendation.aspx?Rec=H-11-008>.

**E. DOCKET MATERIAL**

The following attachments and photographs are included in the docket for this investigation:

LIST OF ATTACHMENTS

- Human Performance Attachment: National Driver Register Problem Driver Pointer System Check.
- Human Performance Attachment: Narratives and Transcripts of Investigative Interviews.
- Human Performance Attachment: Driver Cellular Telephone Records.
- Human Performance Attachment: Tour Itinerary.
- Human Performance Attachment: Driver Toxicology Report.
- Human Performance Attachment: Video of Approach to Crash Scene.
- Human Performance Attachment: Weather Data.

LIST OF PHOTOGRAPHS

NONE

END OF REPORT

---

Dennis J. Collins  
Senior Highway Investigator (Human Performance)