SURVIVAL FACTORS GROUP
FACTUAL REPORT

Miami, OK

HWY-09-MH-015
(17 Pages)

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

SURVIVAL FACTORS GROUP
FACTUAL REPORT

A. ACCIDENT

LOCATION:	Interstate 44 (I-44) East, Will Rogers Turnpike, at Milepost 321.5, in Ottawa County, Oklahoma, approximately 8 miles northeast of Miami, Oklahoma
VEHICLE 1:	2008 Volvo Truck Tractor and 2009 Great Dane Refrigerated Semi-Trailer Combination Unit
OPERATOR:	Associated Wholesale Grocers Inc. of Springfield, Missouri
VEHICLE 2:	2003 Land Rover SUV
VEHICLE 3:	2003 Hyundai Sonata Passenger Car
VEHICLE 4:	2004 Kia Spectra Passenger Car
VEHICLE 5:	2000 Ford Windstar Minivan
VEHICLE 6:	2004 Ford F350 Pickup Truck and 16-foot Livestock Trailer
VEHICLE 7:	2008 Chevrolet Tahoe SUV
DATE:	June 26, 2009
TIME:	Approximately 1:16 p.m. CDT

NTSB #: **HWY-09-MH-015**

B. SURVIVAL FACTORS GROUP

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C. ACCIDENT SYNOPSIS

About 1:13 p.m. CDT on Friday June 26, 2009 an 18-year-old driver operating a 2001 Ford Focus passenger car eastbound on I-44 Will Rogers Turnpike near milepost 321.76 drifted into a parked truck tractor semi-trailer on the right-hand shoulder. After the Ford side-swiped the semi-trailer wheels the driver overcorrected, lost control and struck the concrete median barrier twice, before coming to rest in the roadway and blocking the dual eastbound lanes. Traffic began stopping and a queue developed before passing motorists could push the disabled vehicle to the right-hand shoulder. The queue of stopped and slowing vehicles extended back approximately 1500 feet to milepost 321.5.

Meanwhile, a 76-year-old truck driver operating a 2008 Volvo truck tractor and a 2009 Great Dane refrigerated semi-trailer was traveling eastbound in the outside lane. The combination unit had crested a vertical curve down a 2.75 percent grade toward the stopped traffic, approximately 1,735 feet away. Witnesses stated the combination unit was traveling about 70 mph in the posted 75 mph zone, did not brake to slow down and collided into the rear of the stopped and slow moving traffic. This accident occurred at 1:16 p.m. CDT or about three minutes after the first accident.

At initial impact, the combination unit struck a 2003 Land Rover SUV, pushing it forward into a 2003 Hyundai Sonata passenger car; the Land Rover continued off to the right where it came to rest on the right-hand grassy right-of-way. The combination unit continued forward approximately 42 feet and collided into the Hyundai, overriding it and pushing it forward about 29 feet to where the combination unit then struck and overrode a 2004 Kia Spectra passenger car. The combination unit and the two passenger vehicle continued forward into the rear of a 2000 Ford Windstar minivan, which was also partially overridden by the combination unit. The Ford minivan was pushed forward into the rear of a 16-foot livestock trailer (loaded with 10 head of sheep) being towed by a 2004 F350 pickup truck. The F350 pickup truck was then pushed forward into a 2008 Chevrolet Tahoe. The combination unit came to final rest on top of the Hyundai, Kia, and a portion of the Ford minivan. From the initial impact to final rest, the combination unit traveled approximately 270 feet, leaving gouges and friction tire marks on the pavement.

At the time of the accident the weather was clear and the pavement was dry.

As a result of the collision, 10 occupants in the passenger vehicles were fatally injured; nine passengers were fatally injured at the crash site and one passenger died at an area hospital and five passengers received minor to serious injuries. The driver of the combination unit received serious injuries. Four of the passenger cars were destroyed from impact. The Ford F350, livestock trailer, and Chevy Tahoe had moderate damage. The Volvo truck tractor sustained extensive damage, and the Great Dane trailer was undamaged.

D. SURVIVAL FACTORS GROUP FACTUAL DETAILS

1. Injuries

Unit	Vehicle	Occupant	Position	Restraint/Usage	Trapped	Injury Severity
1	Combination Unit	76-year-old male	Driver	3-point belt Not Used	No	Serious
2	2003 Land Rover	49-year-old male	Driver	3-point belt Not Used	Yes	Fatal
		51-year-old female	Right Front	3-point belt Not Used	Yes	Fatal
		12-year-old female	Right Rear	3-point belt Used	Yes	Serious
3	2003 Hyundai Sonata	38-year-old male	Driver	3-point belt Used	Yes	Fatal
		34-year-old female	Right Front	3-point belt Used	Yes d	Fatal[1]
		6-year-old male	Left Rear	3-point belt w/booster seat Used	Yes	Fatal
		55-year-old female	Right Rear	3-point belt Used	Yes	Fatal
4	2004 KIA Spectra	52-year-old female	Driver	3-point belt Not Used	Yes	Serious
		5-year-old female	Left Rear	3-point belt w/booster seat Used	No	Minor
		6-year-old male	Right Rear	3-point belt w/booster seat Used	No	Minor
5	2004 Ford Minivan	79-yrear-old male	Driver	3-point belt Used	Yes	Fatal
		73-year-old female	Right Front	3-point belt Used	Yes	Fatal
		71-year-old female	Left Rear	3-point belt Used	Yes	Fatal
		52-year-old male	Right Rear	3-point belt Used	Yes	Fatal
6	2004 Ford F-350 Pick-up Truck Towing Livestock Trailer	41-year-old male	Driver	3-point belt Used	No	None
		12-year-old female	Right Front	3-point belt Used	No	None
7	2008 Chevrolet Tahoe	69- year-old male	Driver	3-point belt Used	No	None
		61- year-old female	Right Front	3-point belt Used	No	Serious
		12- year-old female	Left Rear	3-point belt Used	No	None
		12- year-old female	Right Rear	3-point belt Used	No	None

Table 1 – Occupant Information Chart

[1] Fatal two days post accident.

Injury Type	Drivers	Passengers	Total
Fatal	3	7	10
Serious	2	2	4
Minor		2	2
None	2	3	5
Total	7	14	21

Title 49 Code of Federal Regulations 830.2 defines fatal injury as "any injury which results in death within 30 days of the accident" and serious injury as "an injury which: (1) requires hospitalization for more than 48 hours, commencing within 7 days from the date the injury was received; (2) results in a fracture of any bone (except simple fractures of fingers, toes, or nose); (3) causes severe hemorrhages, nerve, or tendon damage; (4) involves any internal organ; or (5) involves second- or third-degree burns, or any burn affecting more than 5 percent of the body surface."

Table 2 – Injuries

2. VEHICLE INFORMATION

The accident involved seven vehicles. A 2008 Volvo truck tractor and 2009 Great Dane refrigerated semi-trailer combination unit, a 2003 Land Rover Discovery SE (VIN: SALTY1646XXXXXXXX), a 2003 Hyundai Sonata four-door passenger car (VIN: KMHWF25S0XXXXXXXX), a 2004 Kia Spectra four-door passenger car (VIN: KNAFE1217XXXXXXXX), a 2000 Ford Windstar minivan (VIN: 2FMDA5348XXXXXXXX), a 2004 Ford F350 Crew Cab Pickup Truck (VIN: 1FTSW30P6XXXXXXXX) with 16-foot Livestock Trailer, and a 2008 Chevrolet Tahoe SUV (VIN: 1GNFC13J1XXXXXXXX).

The approximate weights of the Volvo truck tractor semi-trailer combination unit and accident vehicles run over by the Volvo is as follows;

- 40,000 lb. 2008 Volvo truck tractor semi-trailer combination unit traveling 70 mph[2]
- 4,500 lb. 2003 Land Rover
- 3,500 lb. 2003 Hyundai Sonata
- 2,600 lb. 2004 Kia Spectra
- 3,700 lb. 2000 Ford Windstar minivan

[2] The 70 mph is according to the Event Data Recorder (Cadec and Cummins engine) discussed in the Event Data Recorder Group Chairman's Factual Report.

3. VOLVO TRUCK-TRACTOR EXTERIOR AND INTERIOR INSPECTION

In this accident the Volvo truck tractor's front bumper struck the rear bumper of the Land Rover then overrode it. This resulted with the front of the tractor intruding into the cargo portion of the Land Rover and then into the occupant compartment prior to knocking it off the roadway. The Volvo truck tractor then proceeded to overrun the Hyundai, Kia, and Ford minivan due to their mismatched bumper heights[3]. The Volvo truck tractor came to rest completely on top of the Hyundai and Kia with the back two thirds of the Ford minivan also under the power unit of the Volvo truck tractor.

The truck tractor sustained significant damage to the front end and undercarriage from impacting and riding over the top of four vehicles. The trucks fiberglass front fenders and hood were partially broken away from the body revealing the engine compartment. The front right tire and 2nd axle outside tire were flattened and the axle was pushed rearward approximately 8 inches.

The windshield glazing was cracked but still in place. There was a spider web crack towards the right side of the windshield. The tempered windows on both doors and rear backlight remained intact.

The interior of the truck-tractor was equipped with two seating positions. The vehicle was equipped with driver air bag that did not deploy. For further information on the air bag non-deployment see the Event Data Recorder Group Chairman's Factual Report. Both seats had a three-point lap and shoulder restraint belt system. The driver's seat belt showed evidence of prior usage but based on witness interviews he was not restrained at the time of the accident. An inspection of the D-ring, webbing and buckle showed no evidence of friction rub or cupping/stretching. The interior sustained no significant damage. There was a scuff to the steering wheel column and to the top of the air bag cover on the steering wheel.

4. 2003 LAND ROVER SUV EXTERIOR AND INTERIOR INSPECTION

The rear impact from the Volvo truck tractor resulted in significant override damage that resulted in 2/3rds of the Land Rover's body being crushed forward and upward off the frame. The rear left bumper corner was crushed 19 inches forward of the rear axle and 36 inches off the ground. The frame of the vehicle was bent upward lifting the right rear tire off the ground approximately 7 inches with the wheel well 31 inches above the wheel. All the windows were broken out and both the sunroof windows either broke out or popped out. The Volvo truck tractor pushed the Land Rover off the south side of the roadway where it came to rest.

[3] Bumper standards are defined in Part 581.215 of the Federal Motor Vehicle Safety Standards. This bumper standard specifies the performance requirements for passenger car bumpers in low speed front and rear impact collisions. According to the standard, protection must be provided by any means in the region 16 to 20 inches above the road surface. Sport utility vehicles, minivans, and light trucks are not included in the bumper standard, nor are buses or heavy trucks. http://www.nhtsa.dot.gov/cars/problems/studies/Bumper/Index.html

The front end of the vehicle also sustained damage to the front right bumper corner and down the left side front fender from impacting the back of the Hyundai. The interior of the vehicle was almost totally collapsed. There was a small area in the back seat of the passenger compartment on the right side that remained with some survivable space. According to first responders, that is the area where the surviving 12-year-old female was entrapped.

The vehicle was equipped with driver and passenger air bags that did not deploy. It was also equipped with lap and shoulder belts in all the seat positions but due to the extent of damage, none could be inspected. According to first responders and witnesses, only the entrapped rear right passenger was restrained by her lap and shoulder restraints. The steering wheel column was pushed forward into the dash with the rim also bent forward.

5. 2003 HYUNDAI SONNATA EXTERIOR AND INTERIOR INSPECTION

Due to the mismatched bumper height, the rear impact from the Volvo truck tractor resulted in complete override damage to the Hyundai. The Hyundai came to final rest underneath the Volvo truck tractor. The entire back end of the Hyundai was crushed inward with the roof being crushed downward. The right rear bumper corner was crushed forward approximately 36 inches. This resulted in the frame of the vehicle being bent upward lifting the left rear tire off the ground approximately 5 inches. The roof was completely cut off during the extrication process. All the windows were broken out.

The interior of the vehicle was almost totally collapsed downward. There were black tire marks on the top of the rear center seat and to the driver's headrest. On-scene photos show that there was a minimal amount of survivable occupant space[4] within the passenger compartment.

The vehicle was equipped with driver and passenger air bags which were not deployed. The side airbag attached to the outside of the driver's seat back was deployed. The vehicle was also equipped with lap and shoulder belts at all seat positions. The inspection revealed that three of the four seatbelts were cut with the seatbelt in the left rear seat position still attached to the "Ambassador" Cosco child booster seat. According to the Police report and first responders, the deceased 6-year-old male was found seated in his booster seat and restrained by the lap and shoulder belt. According to the sticker attached to the booster seat, it was manufactured September 10, 2007 and had a model number of 22-293-BVL. Inspection of the backless booster seat showed no visible damage. A review of NHTSA's Office of Defect website for recalls for this model booster seat showed there had been none. The steering wheel was crushed downward and the rim was bent.

[4] Survivable Occupant Space- The occupant compartment space of any vehicle is considered non-survivable whenever one or more of the following conditions occurs: The occupant compartment is reduced in volume by 15% or more, the impact forces exceed human tolerance levels, or the environment is altered (smoke, fire, water toxic fumes. The United States Army, Biodynamics Research Laboratory, Crashworthiness Handbook, Fort Rutger, Alabama.

6. 2004 KIA SPECTRA EXTERIOR AND INTERIOR INSPECTION

Due to the mismatched bumper height, the rear impact from the Volvo truck tractor resulted in complete override damage to the Kia. The Kia came to final rest underneath the Volvo truck tractor. The entire back end of the vehicle was crushed inward and the roof crushed downward. The left rear bumper corner was crushed forward approximately 18 inches. The bumper and frame of the vehicle was bent upward approximately 15 inches. The front half of the roof was cut and peeled back during the extrication process. The back half of the roof was crushed downward and all of the windows were broken out.

The seat backs were partially collapsed downward. Some of the air brake lines from the striking tractor were embedded in the Kia's left A-pillar. On-scene photos show that there was very little amount of survivable occupant space within the passenger compartment.

The vehicle was equipped with driver and passenger air bags, that did not deploy, and side air bags in the outside of the seat backs,. The side airbag attached to the outside of the driver's seat back was deployed. The vehicle was equipped with lap and shoulder belts in all seat positions. The inspection of the driver's seat belt revealed no evidence of usage during the accident and the driver later confirmed that she was not using it at the time of the accident. A passerby released the two seat belts restraining the 5 and 6 year old children in the back seat in order to extricate them. Both children were restrained in Cosco child booster seats. According to the sticker attached to the booster seat on the left side behind the driver, it was manufactured February 23, 2005 and had a model number of 22-296-WAL. The sticker on the Cosco booster seat on the right side showed it was manufactured November 10, 2005 and had a model number of 22-296-WAL. Neither booster seat showed any visible signs of damage. A review of NHTSA's Office of Defect website for recalls for this model booster seat showed there had been none. The steering wheel had very little deformation.

7. 2000 FORD WINDSTAR MINIVAN EXTERIOR AND INTERIOR INSPECTION

Due to the mismatched bumper height, the rear impact from the Volvo truck tractor resulted in complete override damage to the Windstar minivan. The rear two-thirds of the minivan came to final rest underneath the Volvo truck tractor. The rear override impact from the Volvo truck tractor resulted in the body of the Windstar minivan being crushed forward and upward off the frame. The roof was bent accordion style forward and upwards at a 90 degree angle. The roof was torn away from the D-pillars in the very rear, while the B and C-pillars were cut during the extrication. Only the front A-pillars remained attached at the time of the inspection. The rear left bumper corner was crushed forward to the rear axle and lifted upwards 45 inches off the ground. The vehicle's entire front end sustained a moderate amount of damage from impacting the livestock trailer attached to the Ford F-350.

The interior of the vehicle was almost totally collapsed forward except for the front right passenger seat back. On-scene photos show hardly any amounts of survivable occupant space in the rear seat area and very little survivable occupant space in the front seat area.

The vehicle was equipped with driver and passenger air bags that were deployed. The vehicle was also equipped with side air bags located in the outside of the front seat backs that did not deploy. It was equipped with lap and shoulder belts in all the seat positions but due to the extent of damage, none could be inspected. According to first responders, the driver and the other three occupants were restrained and their lap and shoulder restraints were cut during their extrication. The steering wheel column was pushed into the dash and the rim was bent forward.

8. 2004 FORD F-350 CREWCAB PICK-UP TRUCK EXTERIOR AND INTERIOR INSPECTION

The vehicle exterior sustained moderate damage to the front and back end. The rear impact from the Windstar van into the vehicle's towed livestock trailer resulted in the livestock trailer being pushed forward into the bed of the pick-up truck. This resulted in the bed of the truck being pushed forward into the back of the cab cracking the rear window. In addition, the bed was bowed outward on the right side approximately 20 inches.

The front left bumper corner sustained 17 inches of direct contact damage and was crushed rearward approximately 15 inches from impacting the rear bumper of the Tahoe. The pick-up truck came to rest between the inside and outside westbound lanes. The interior of the vehicle sustained no damage. The vehicle was equipped with driver and passenger air bags that did not deploy. It was also equipped with lap and shoulder belts in all the seating positions.

8.1 Featherlite Livestock Trailer

The rear right sidewall of the livestock semi-trailer sustained approximately 30 inches of crush from being struck by the Windstar van. The rear impact from the Windstar van resulted in override type damage pushing the loading gates further inward, buckling the roof up forward and bowing the trailers left side wall outward approximately 20 inches. Subsequently, the front of the semi-trailer was deformed from being pushed into the back of the rear bumper and bed of the Ford pick-up.

9. 2008 CHEVROLET TAHOE EXTERIOR AND INTERIOR INSPECTION

The vehicle exterior sustained moderate damage to the rear bumper corner and right side fender from the impact with the Ford pick-up truck. The Tahoe came to rest in the left westbound lane. The rear impact resulted in approximately 12 inches of direct damage to the right rear bumper corner. The impact continued down the right rear fender breaking out the right rear window. The interior of the vehicle sustained no damage.

The vehicle was equipped with driver and passenger air bags that did not deploy. It was also equipped with lap and shoulder belts in all the seating positions.

10. VEHICLE COMBATIBILITY

The Safety Board has looked at vehicle compatibility in the past[5] and made recommendations regarding compatibility[6]. Collisions between small vehicles and large vehicles may be incompatible because of the geometry (i.e., mismatch in bumpers), the differences in stiffness, and the weight differences between vehicles. Issues such as self-protection and partner protection[7] are critical when discussing vehicles that may not be compatible structurally.

As previously mentioned, vehicle compatibility typically incorporates three aspects: weight, stiffness, and geometry. If any of these elements differ radically between two impacting vehicles, then the vehicles will not be compatible in a crash[8]. As a result, the smaller vehicle will likely absorb more of the impact energy either through crush or large accelerations. For example, in this accident the bumpers of the Volvo and three of the four vehicles it impacted from the rear did not overlap, consequently the Volvo overrode the rear of the other vehicles (and the other vehicles under rode the front of the Volvo).

Presently, the National Highway Traffic Safety Administration has no front under ride protection requirements for heavy trucks. However, there are Federal requirements for heavy truck rear under ride protection[9].

Europe has regulations for both front under ride protection[10] and rear under ride protection[11]. In 2003, the European Commission (EU) and Department of Transport UK (DfT), sponsored a three year project called the Improvement of Vehicle Crash Compatibility through the development of Crash Test Procedures (VC-COMPAT)[12]. The primary objectives of the VC-COMPACT project were the following;

- Conduct analysis of truck and trailers.
- Create a database of Heavy Goods Vehicles (HGV's).
- Provide a report on current under ride devices.
- Consider the use of numerical modeling as an alternative to car-truck front under ride testing.

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[5] HWY-04-MH-001 Hampshire, IL collision between a 1999 Goshen shuttle bus and the 1995 Freightliner tractor trailer.

[6] H-06-016 the National Transportation Safety Board recommends that the U.S. Department of Transportation: Include heavy vehicles in your research, testing, and eventual rulemaking on highway vehicle incompatibility, especially as that incompatibility affects the severity of accidents. OPEN AWAITING RESPONSE

[7] Partner protection refers to design strategies to maximize occupant protection in the struck vehicle.

[8] S. Acierno and others, "Vehicle Mismatch: Injury Patterns and Severity," *Accident Analysis and Prevention*, Vol. 36 (2004): 761

[9] FMVSS 571.223 and 571.224 These standards set minimum requirements for the geometry, configuration, strength and energy absorption capability of rear impact guards on full trailers and semi-trailers over 10,000 pounds Gross Vehicle Weight manufactured on or after January 26, 1998.

[10] Economic Commission for Europe (ECE) Regulation 93 Technical definitions and demands on a rigid front underride protection. www.unece.org/trans/main/wp29/wp29regs.html?expandable=0&subexpandable=0

[11] ECE R58 Technical definitions and demands on a rear underride protection. www.unece.org/trans/main/wp29/wp29regs.html?expandable=0&subexpandable=0

[12] DfT Support for VC-COMPACT Final Report (Cranfield Impact Centre Ltd. Report 572) pgs 3-5

One of the issues the project looked at was an analysis of how their approved rigid Front Under ride Protection Systems (FUPS)[13] compared to other devices available which included an energy absorbing FUPS. Results from the 2006 VC-COMPAT revealed that about 11% of the fatally and 30% of the seriously injured car occupants could be saved if trucks were equipped with energy absorbing front under ride protection systems (EAFUPS) instead of rigid FUPS[14].

According to a Volvo representative, because of the difference in design and weight between European heavy trucks and heavy trucks sold and on the road in North America, Volvo does not produce any type of FUPS's in their heavy trucks. In addition, he added that there are no standards or guidelines for equipping heavy trucks with these FUPS's. However, they do sell their heavy trucks with an optional Vehicle On-Board Radar (VORAD) [15] systems and adaptive cruise control systems[16].

Presently under a cooperative agreement with the U. S. Department of Transportation the University of Michigan Transportation Research Institute (UMTRI)[17] and partners Visteon Corp., Eaton Corp., Honda R&D Americas Inc., International Truck and Engine, TK Holdings, Battelle, Con-way Freight, and the Michigan Department of Transportation are developing and testing a new, integrated crash warning system in a fleet of 16 passenger cars and 10 heavy-duty trucks. The Integrated Vehicle-Based Safety Systems (IVBSS)[18] is an ongoing program involved in developing integrated, advanced technologies that can help drivers avoid crashes. The integrated system warns drivers when they are about to run off the roadway, are in danger of colliding with another vehicle while attempting a lane change, or are at risk of impacting the vehicle in front of them. IVBSS is using information gathered by inertial, video, and radar sensors, plus a global positioning system module to prevent or lessen the severity of crashes. The research team has developed these systems in the first phase of the program, and is now starting the second phase on evaluating system performance and driver acceptance when the systems are used under everyday conditions[19].

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[13] As required in ECE R93

[14] DfT Support for VC-COMPACT Final Report (Cranfield Impact Centre Ltd. Report 572) pg. 6

[15] The VORAD system is a radar-based collision warning system. The system is equipped with forward and side radar sensors that detect the presence and movements of vehicles around the truck to alert the driver of other vehicles' proximity. When the sensors detect that the host vehicle is closing on a vehicle ahead at a rate beyond a determined threshold, or that a nearby vehicle is located in a position that may be hazardous, the system warns the driver visually and audibly. www.sae.org/technical/papers/2009-01-2911

[16] Adaptive cruise control is similar to conventional cruise control in that it maintains the vehicle's pre-set speed. However, unlike conventional cruise control, this new system can automatically adjust speed in order to maintain a proper distance between vehicles in the same lane. This is achieved through a radar headway sensor, digital signal processor and longitudinal controller. If the lead vehicle slows down, or if another object is detected, the system sends a signal to the engine or braking system to decelerate. Then, when the road is clear, the system will re-accelerate the vehicle back to the set speed. http://auto.howstuffworks.com/cruise-control4.htm

[17] UMTRI is serving as the prime contractor on the program.

[18] U.S. DOT funding is provided by the ITS Joint Program Office of the Research and Innovative Technology Administration (RITA). The program is administered by National Highway Traffic Safety Administration (NHTSA). Federal Motor Carrier Safety Administration (FMCSA) provides additional oversight, and the Volpe Center serves as the independent evaluator.

[19] UMTRI; Integrated Vehicle-Based Safety Systems (IVBSS).mht

11. EMERGENCY RESPONSE

The Miami, OK Police Department dispatcher was notified of the accident through the 911 system at 1:20 p.m. An Oklahoma Highway Patrol (OHP) Trooper, who was working an accident a short distance west of the accident, was notified by a passerby of the accident and was enroute at 1:22 p.m. and arrived on-scene at 1:23 p.m. At 1:24 p.m. the Trooper assumed Incident Command for law enforcement and immediately requested OHP dispatch to send all available ambulances, 3 medical helicopters, and a larger wrecker stating that there were injuries and people pinned in their vehicles. The trooper also requested that the Turnpike Authority close the eastbound tollgate in Miami and start re-routing traffic.

The first call from dispatch went out to the Downstream Fire Department at 1:22 p.m. and their first unit arrived on-scene at 1:31 p.m. The Miami Fire Department was notified of the accident at 1:23 p.m. and their first unit arrived on-scene at 1:33 p.m. The arriving shift captain for the Downstream Fire Department assumed Incident Command for the rescue, recovery, extrication, and transport of injured involved.

At 1:33 Guardian Air was put on standby and at 1:36 p.m. they were dispatched to the scene to pick-up the 12-year-old female who was extricated from the Land Rover. Guardian Air arrived at 1:50 p.m. and transported the young female at 2:01 p.m. to St. John's hospital in Joplin, Missouri. At 1:35 p.m. Eagle Med-Flight 14 was dispatched to the scene and arrived on-scene at 1:51 p.m. After being extricated from her vehicle, the right front passenger of the Hyundai was transported at 3:25 p.m. by Eagle Med-Flight 14 to Freeman hospital in Joplin, Missouri. A second Eagle Med-Flight was put on standby at 1:38 p.m. and was dispatched to the scene at 1:39 p.m. Eagle Med-Flight 12 arrived on-scene at 2:18 p.m. At 4:21 p.m., after being extricated from her vehicle, Eagle Med-Flight 12 transported the Kia driver to Freeman hospital in Joplin, Missouri

At 1:33 p.m. eastbound traffic on I-44 turnpike (Oklahoma Turnpike) was closed and traffic was redirected off at the Miami tollbooth. Westbound traffic was reduced to one lane.

Due to the truck tractors position on top of the three vehicles, extrication was a prolonged process. In addition, traffic and distance to the limited entry points on the turnpike resulted in the heavy-duty wreckers[20] not arriving for approximately 40 minutes after the first call from dispatch. According to the wrecker owner/driver, he took the most direct route to the accident scene, a distance of approximately 15 miles. Due to the traffic being backed-up, he had to drive his heavy-duty wrecker along the shoulder and at times, into the drainage ditch around vehicles in order to get to the scene, which prolonged his response.

[20] Dispatched called the closest heavy-duty wrecker service, that was also considered the most experienced.

According to first responders, initial patient evaluation showed that there were ten survivors and seven fatally injured. According to the fire department IC, the driver and front passenger in the Land Rover were already deceased while the 12-year-old female back seat passenger was alive but trapped. The 30 minute extrication of the surviving 12-year-old female in the Land Rover involved cutting her seat belt, popping open the door and maneuvering her body so she could be removed through the front moon roof. She sustained serious injuries and was transported to St. John's hospital in Joplin, Missouri then transferred to Children's Mercy hospital in Kansas City, Missouri.

According to the IC, the driver of the Windstar van was crushed between his seat back and steering wheel and had serious injuries that included a visible skull fracture with agonal[21] breathing. The IC stated that the van driver passed away minutes later while still seated in the vehicle.

The driver of the Kia was also trapped in her car that was located directly under the truck tractors 2nd axle. The approximately 3-hour extrication of this driver was prolonged due to the fact that every time a part of the Kia's roof, A-pillar, or door was cut, pressure from another area caused her more discomfort. She was finally released and removed through the windshield when the wrecker was able to lift the truck tractor off her vehicle. The driver of the Kia was then flown by Eagle Med-flight #12 to Freeman hospital where she was treated for a ruptured spleen, several fractured ribs on her left side, and a collapsed left lung.

The right front passenger in the Hyundai also experienced prolonged 2-hour extrication. Although the Hyundai was located directly under the truck tractor just behind the dual wheels, the right front passenger was removed prior to the wrecker lifting the truck tractor off her vehicle. She was then flown by Eagle Med-flight #14 to the Freeman hospital where she subsequently passed away on Sunday June 28, 2009 at 7:00 a.m.

According to the IC, the first responder did not rush the extrication due to the instability of the truck tractor and semi-trailer on the vehicles and because both victims were stable, conscious, and conversing with rescuers. In addition, the vital signs for both victims were being monitored. After rescuers sufficiently stabilized the truck tractor semi-trailer they removed the Hyundai passenger and it wasn't until the wrecker lifted the truck tractor semi-trailer off the Kia before that driver could be removed.

In order to relieve traffic in the eastbound travel lanes, the Hyundai and Ford Windstar were covered in tarps and put on flatbed trailers then taken to the nearby state of Oklahoma's Department of Transportation facilities. The seven already deceased persons in these two vehicles were extricated at this location. First responders didn't locate the eighth deceased victim until they took the roof off the Windstar and found the passenger crushed in the back left seat on the floorboard.

[21] **Agonal respiration** is an abnormal pattern of breathing characterized by shallow, slow (3-4 per minute), irregular inspirations followed by irregular pauses. They may also be characterized as gasping, labored breathing, accompanied by strange vocalizations and involuntary muscle jerks. Agonal breathing is an extremely serious medical sign requiring immediate medical attention, as the condition generally progresses to complete apnea and death.

A total of 7 fire departments with 7 rescue and engine units and 12 ambulances responded to the scene. In addition, 3 med helicopters responded transporting 3 persons from the scene. The truck driver was transported by ambulance to Freeman hospital.

A stress debriefing was held by the responding agencies. No notes or documents were transcribed due to the personal and psychological nature of the debriefing of the first responders. A post-operational critique of the accident was not done.

Responding agencies:
Miami Police Department
Miami Fire Department
Downstream Fire Department and EMS
Quapaw FD and EMS
Picher FD and EMS
Miami Integris/Baptist EMS
Joplin Fire Department
Redings Mill Fire Department
Baxter Springs Fire Department
Newton County EMS

Copies of the fire departments Brief Field Incident Reports have been compiled and this information is included in this report.

While numerous agencies responded with ambulances and EMT's only three ambulance units transported injured persons. Agencies that responded to the scene and transported injured persons were:

- Downstream Fire Department and EMS (includes Quapaw FD and EMS, and Picher FD and EMS)
- Miami Integris/Baptist EMS
- Eagle Med Flight – 2 helicopter responded, 2 people transported to Freeman Hospital
- Guardian Air – 1 helicopter responded, 1 person transported to Saint Johns Hospital then to Children's Hospital in Kansas City

10.1 Ottawa County Emergency Management

The County's Standard Operating Procedures (SOP) for handling disasters was obtained. According to the Ottawa County Emergency Management Director, the county does not have a specific Mass Casualty Incident (MCI) plan but the disaster plan does follow the National Incident Management System (NIMS) program and does have a plan for what responsibilities each responding agency has. The plan states under the Fire and Rescue Annex K, that;

All on-scene management of an incident will be in accordance with the Incident Management System (ICS). The first responder on-scene will assume the Incident Commander's responsibilities, contain the incident and establish the Incident Command Post.

The "Oklahoma Intrastate Mutual Aid Compact" (**63 O.S. 2006, Section 695.1)** created a system of intrastate mutual aid between participating jurisdictions, including Sovereign Tribal Nations, in the State of Oklahoma. This Compact includes the local jurisdictions from surrounding states.

This Compact was for all resources that may be available in a jurisdiction during an emergency or disaster including Law Enforcement, Fire Service, Emergency Medical Service, Public Works, Emergency Management and others.

Based on interviews with first responders, the incident was handled as a unified command with the OHP doing the investigation of the accident and traffic control with the fire department handling the rescue, extrication, and recovery efforts. All interviewed first responders commented that the rescue and recovery aspects went smooth and all the responding agencies worked well together.

12. HOSPITAL INFORMATION

Three drivers and six occupants were pronounced dead at the scene of the accident and were transported to the Paul Thomas Funeral home in Miami, OK. The Tulsa County Medical Examiner from Tulsa, Oklahoma picked up the nine deceased victims and transported them back to Tulsa. Another passenger died two days later at Freeman hospital. No invasive autopsies were conducted on any of the ten fatalities. The other three injured persons were treated at three hospitals and hospitalized. The NTSB has received the autopsy reports and medical records for all persons involved in the accident. The facilities are as follows:

Freeman Hospital
2040 W. Charleston Blvd
Joplin, Missouri 64804
(417)-347-1111
Received 2 drivers and 2 passengers (1 passenger died two days post-crash)

St. Johns Medical Center
2727 McClelland Blvd.
Joplin, Missouri 64804
(417) 781-2727
Received 1 passenger and transferred her to Children's Hospital in Kansas City

Children's Mercy Hospital
2401Gillham Road
Kansas City, MO. 64108
(816)-234-3000
Received 1 passenger

Tulsa County Medical Examiner
1115W.17th St
Tulsa, Oklahoma 74107
(918) 582-0985
Conducted 10 non-invasive Autopsies

13. MEDICAL EXAMINERS REPORT OF INJURIES

According to medical records and non-invasive autopsy records, six of the ten fatally injured sustained pulmonary contusions with resulting hemo-thorax[22]. Five of the ten fatally injured sustained skull fractures with one of them being an open fracture. The medical examiner (ME) noted that six of the ten fatally injured had blood in their ears, nose, and mouth. All the fatally injured had severe abrasion and lacerations. The ME also noted that two occupants in the minivan and one occupant in the Hyundai had gasoline burns[23].

Medical records for the four seriously injured persons showed that;

- The driver of Volvo heavy truck sustained a mandible fracture;
- The driver of the Kia had multiple right rib fractures and a ruptured spleen.
- The rear right passenger in the Land Rover sustained bilateral humerus, rib, and pelvic fractures, bilateral renal contusions, and bilateral pulmonary contusions,
- The front right passenger in the Tahoe sustained a concussion and unknown type of brain injury.

All four seriously injured persons were hospitalized.

14. INTERVIEWS

The NTSB conducted interviews with the following first responders;

- Quapaw Fire Department Incident Commander (IC) that was,
- the Chief of the Quapaw Fire Department,
- Chief of the Joplin Fire Department,
- Two Miami Fire Department EMT/Paramedic/Engineers that were the second fire department to arrive on-scene, and
- The first Oklahoma Highway Patrol Trooper to arrive on scene and also the initial first responder on-scene.

[22] Accumulation of blood in the pleural cavity (the space between the lungs and the walls of the chest) wordnetweb.princeton.edu/perl/webwn
[23] The ME wrote "*gasoline burns*" but the Volvo truck tractor used diesel, these injuries were chemical burns.

In addition, interviews were conducted with three of the surviving four drivers and five witnesses. The remaining survivor was the truck driver and he declined to be interviewed on advice from his attorney. Refer to Attachment 1 for complete interviews.

14.1 SYNOPSIS OF FIRST RESPONDER INTERVIEWS

The following is a synopsis of the First Responder interviews collected while on-scene;

- Heavy extrication tools, heavy wrecker service, and medical helicopters were requested immediately upon arrival.
- Closing eastbound traffic on I-44 turnpike (Oklahoma Turnpike) helped alleviate traffic back-up.
- Medical assessment of surviving victims' vital signs was being continuously monitored.
- Initially there were concerns about the instability of truck tractor semi-trailer on top of vehicles during extrication.
- Initial concerns over leaking diesel fuel from truck tractor semi-trailer on victims inside vehicles.
- Prolonged extrication of victims was due to instability of truck tractor semi-trailer on top of vehicles
- Traffic and distance to the limited entry points on the turnpike resulted in the prolonged arrival of heavy-duty wreckers.

14.2 WITNESS AND HELPER INTERVIEWS

The following is a synopsis of the witness and helper interviews collected while on-scene;

- All witnesses interviewed reported that they saw traffic backed up upon coming over hill
- Several witnesses described approach of truck tractor semi-trailer was like a freight train.
- Several interviewees stated they never saw the tractor semi-trailer brake lights prior to impact.
- The truck tractor driver was seen climbing up off passenger floor after impact.
- At final rest several interviewees saw trailer tires still spinning.
- Witnesses reported that two kids removed from back seat of Kia were restrained in child booster seats.

14.3 DRIVER INTERVIEWS

The following is a synopsis of the three driver interviews collected while on-scene;

- Two of the three drivers mentioned seeing traffic stopped as they came over the hill.
- Eight of the nine occupants in the three vehicles were restrained. Only the driver of the Kia admitted to not wearing her lap and shoulder belt restraint.
- Two of the three drivers say they heard the initial impact between the tractor semi-trailer and SUV. The driver of the Kia did not recall anything about the accident.

END OF REPORT