CRASH DATA RESEARCH CENTER

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CALSPAN ON-SITE OFFICE OF DEFECTS INVESTIGATION

ROLLOVER CRASH INVESTIGATION

SCI CASE NO. - CA09001

VEHICLE – 2007 FORD F150 CREW CAB PICKUP TRUCK

LOCATION – FLORIDA

CRASH DATE – APRIL 2008

Contract No. DTNH22-07-C-00043

Prepared for:

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The crash investigation process is an inexact science which requires that physical evidence such as skid marks, vehicular damage measurements, and occupant contact points are coupled with the investigator's expert knowledge and experience of vehicle dynamics and occupant kinematics in order to determine the pre-crash, crash, and post-crash movements of involved vehicles and occupants.

Because each crash is a unique sequence of events, generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicle(s) or their safety systems.

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CALSPAN ON-SITE OFFICE OF DEFECTS INVESTIGATION
ROLLOVER CRASH INVESTIGATION
SCI CASE NO. - CA09001
VEHICLE – 2007 FORD F150 CREW CAB PICKUP TRUCK
LOCATION – FLORIDA
CRASH DATE – APRIL 2008

BACKGROUND

This on-site investigation focused on the contributing factors to a rollover crash of a rental 2007 Ford F150 4x2 Crew Cab pickup truck **(Figure 1)**. The driver of the vehicle lost directional control on a wet asphalt surfaced roadway as he was traveling at an estimated speed of 89 km/h (55 mph). The F150 yawed in a counterclockwise direction and departed the left side of the road onto the grassy roadside. The vehicle initiated a tripped rollover to its right, completing a minimum of five-quarter turns before coming to rest on its right side. The unrestrained driver sustained moderate level injuries of his extremities and the unrestrained female front right passenger sustained incapacitating head and thoracic injuries. Both occupants were transported to a local hospital for treatment of their injuries.

Figure 1. 2007 Ford F150 Crew Cab pickup truck.

Notification of this April 2008 crash was provided to NHTSA's Vehicle Safety Hotline by an attorney representing the occupants of the vehicle. He alleged that a faulty tire valve stem in the right front wheel rim resulted in a loss of tire pressure that caused the vehicle to hydroplane on the wet road surface. The indicator light for the vehicle's indirect Tire Pressure Monitoring System (TPMS) was illuminated at the time of the rental agreement. The driver brought this to the attention of the rental agency prior to departing the rental facility. The tires were reportedly inflated and the driver was instructed that the tires were in good condition. He was further told that the TPMS indicator light would reset after traveling approximately 20 minutes; however, the TPMS light never reset during the six-day rental period prior to the crash.

The notification was forwarded to the Calspan Special Crash Investigations (SCI) team on January 9, 2009 and assigned for an on-site investigation. The SCI team contacted the notifying attorney and established cooperation for the on-site inspection of the vehicle and the crash site. Furthermore, the attorney consented to allow an in-person interview with the driver and the front right passenger of the Ford F150. The Ford was stored in a secure lot at a service facility for the rental agency. The SCI inspection of the vehicle, tires, wheels and tire valve stems occurred on January 27, 2009. Legal and consulting representatives of the driver and the rental company were present and observed the SCI inspection.

SUMMARY

Crash Site

The crash occurred off-road of a two-lane State route during daylight hours in April 2008. In the vicinity of the crash site, the roadway was oriented in a north/south direction with a slight left curve with a positive grade of less than two-percent for northbound traffic **(Figure 2)**. The asphalt road surface was in good condition with paved shoulders bordering both travel lanes. The off-road area to the west of the roadway consisted of a graded road edge that transitioned to a shallow drainage ditch that was centered approximately 4.6 m (15') outboard of the shoulder edge **(Figure 3)**. The slopes that formed the ditch were less than 10 percent. Tall cut grass was present over the sandy soil. Utility poles were positioned beyond the ditch. It should be noted that guy wires were installed on the poles after the crash and were present in the images obtained during this SCI investigation. These guy wires were positioned in the path of the Ford F150. Several images of the counterclockwise yaw marks of the F150 across the grassy area were provided by the driver to the SCI investigator; however, these tire marks were no longer present at the time of the scene inspection that occurred nearly 10 months after the crash.

The asphalt road surface was wet from an isolated rain shower with a light drizzle of rain present at the time of the crash. The driver further noted that on his approach to the crash site, the road was dry and that the rain began in the immediate vicinity of the crash. The posted speed limit was 89 km/h (55 mph). The crash schematic is attached as **Figure 24**.

Figure 2. Pre-crash trajectory of the Ford F150.

Figure 3. Off-road terrain adjacent to the west road edge.

Vehicle Data

The involved vehicle in this crash was a 2007 Ford F150 XLT Crew Cab four-door pickup truck. The Ford was manufactured in February 2007 and was identified by Vehicle Identification Number (VIN) 1FTRW12W47F (production number deleted). The truck was configured on a 353 cm (139") wheelbase and was powered by a 4.6 liter V-8 engine with rear-wheel drive and a four-speed automatic transmission with a column mounted shifter. The service brakes were power-assisted four wheel disc with anti-lock (ABS) and Electronic Brake Force Distribution. The Gross Vehicle Weight Rating (GVWR) was 3,084 kg (6,800 lb) with a distribution of 1,497 kg (3,300 lb) for the front axle and 1,724 kg (3,800 lb) at the rear axle. The vehicle manufacturer recommended tire

size was P255/65R17 on 43x19 cm (17x7.5) wheel rims at a pressure of 240 kPa (35 PSI). The pickup truck was equipped with OEM five-spoke aluminum wheels. The F150 was equipped with an indirect Tire Pressure Monitoring System (TPMS). This system consisted of a remote sensor that was band-mounted to the outboard aspect of each aluminum wheel. The sensors were mounted 180 degrees opposite of the valve stems. If low tire pressure was detected by any of the TPMS sensors, the system would illuminate a low tire pressure warning light on the instrument panel. Electronic Stability Control (ESC) was not an available option on this pickup truck platform.

The interior of the F150 was configured with six-passenger seating. The front seat positions consisted of outboard bucket seats with reclining seat backs and adjustable head restraints. The center seat consisted of a fixed seat cushion with a forward folding seat back that doubled as a center armrest. At the time of the crash, both front seat head restraints were adjusted approximately 4 cm (1.5") above the seat backs.

The rear seat was a split, forward folding bench seat (70/30 left side wide) with adjustable head restraints for the outboard positions. Both rear head restraints were adjusted 10 cm (3.75") above the seat back at the time of the SCI inspection. The outboard positions of the rear seat were equipped with Lower Anchors and Tethers for CHildren (LATCH).

The front outboard and the three rear seat positions were equipped with manual three-point lap and shoulder safety belt systems. The center front was equipped with an adjustable lap belt.

The Ford F150 was equipped with a Certified Advanced 208-Complaint frontal air bag system for the driver and front right passenger positions. The vehicle manufacturer has certified that this F150 is compliant with the advanced air bag requirements of Federal Motor Vehicle Safety Standard (FMVSS) No. 208. The frontal air bag system did not deploy in this rollover crash. Side impact air bags and inflatable curtain air bags were not available on this model.

Vehicle History

The involved 2007 Ford F150 Crew Cab pickup truck was a short-term rental vehicle. The driver required the use of a rental pickup truck for his employment as his personal pickup truck was at a dealership for warranty repair. The rental company located this F150 within its fleet in another Florida city and had the F150 transferred to a facility that was closer to the driver's residential location. The vehicle's odometer reading at the time of the rental agreement was 44,201 km (27,466 miles).

Prior to departing the rental facility, the driver and his wife noted that the TPMS warning light was illuminated on the instrument panel. They reported this to the rental agent. The agent called the service department and the vehicle was driven to the service facility and returned to the driver. He stated during the SCI in-person interview that the service department checked the tire pressures and inflated the tires. They assured the driver that the tires were in good condition and that the TPMS light would automatically reset within

20 minutes of driving. The driver stated that during the six days of the rental, the TPMS light never reset or turned off.

Following the crash, the F150 was towed from the scene to a local tow yard. The vehicle was subsequently deemed a total loss and was transferred to an insurance salvage yard for auction. The F150 was reportedly purchased from the auction facility by a body shop where repairs of the damage were initiated. These repairs included the removal the damaged windshield and backlight glazing and the associated bonding, removal of the taillight assemblies, straightening of the dents at the C-pillars, right front door, roof, and extensive straightening of the left roof and roof side rail area **(Figure 4)**. In an effort to accomplish this task, the right upper A-pillar was cut full thickness and the interior aspect of the upper left B-pillar was cut away. The side rail was pulled back and the A-pillar was welded. The hood, both front fenders and the top aspect of the bumper fascia was sanded and prepared for repaint. The upper area of the front doors and the quarter panels were straightened, filled, and repainted. All direct contact evidence (body deformation and paint abrasions) associated with the rollover crash was masked by the partial repair process.

Figure 4. Partially repaired damage of the left roof side rail and C-pillar area.

Figure 5. Condition of the F150 at the time of the SCI inspection.

During the partial repair process, the interior A-, B-pillar, and side rail trim was removed in addition to the headliner, the front outboard safety belt systems and the front right seat. Replacement windshield and door glazing were purchased by the repair facility and were found in the vehicle at the time of the SCI inspection. In this condition **(Figure 5)**, the F150 was located by the driver's attorney and the vehicle was repurchased by the rental company and transferred to a body shop that was affiliated with the rental company. The vehicle had been stored at this location since June 2008.

The SCI team obtained permission to inspect the vehicle and the inspection was conducted on January 27, 2007. The vehicle was in the above condition at the time of the inspection and was exposed to the elements. Based on the condition of the vehicle, it was apparent that the F150 was uncovered for an extended period of time prior to the inspection.

The driver's attorney assured the SCI investigator that the OEM tires and wheels were on the same axle locations as at the time of the crash. Due to the duration of time between

the transfer of the vehicle to this storage facility and the SCI inspection date, the tires settled 8-10 cm approximately (3-4") into the sandy soil. The dirt debris noted in the images of the vehicle immediately following the crash had been removed from the aluminum wheel rims prior to the time of the inspection. The condition and status of the tires, wheel rims, and the tire valve stems at the time of the SCI inspection are detailed in the section entitled *Tires/Wheel Rims and Valve Stems* of this report.

Crash Sequence

Pre-Crash

On the sixth day of the rental of the 2007 Ford F150, the driver and his front right passenger were traveling in a northerly direction on the two lane State route at a driver estimated speed of 89 km/h (55 mph). As he traveled on the asphalt surfaced road, he noted the transition from dry to wet pavement due to an isolated rain shower. He further stated that all side windows were closed and the windshield wipers were set to an intermittent mode. While traveling northbound, the driver stated that he had his right hand on the steering wheel rim at the 12 o'clock position. As an avid driver of a pickup truck, he wanted to check the spray from the tires as this was the first wet road surface he encountered during the course of this rental period. He stated that he checked his left outside mirror and as he returned his attention forward, he felt a shimmy in the steering wheel. He commented to his front right passenger "what's this" and stated that the F150 began to yaw in a clockwise direction. He stated to the SCI investigator that the vehicle continued to yaw CW (contrary to the physical evidence) and depart the left side of the roadway onto the grassy area.

The driver photographed the crash site on the day following the crash and provided two 35mm prints of the tire marks from his vehicle across the grass. Based on a review of these tire marks, the evidence indicated the Ford F150 yawed in a counterclockwise (CCW) direction across the southbound travel lane and exited the west roadside **(Figure 6)**.

Figure 6. F150 CCW yaw marks across the grass roadside (Image courtesy of the driver).

Based on a review of these CCW yaw marks, the vehicle rotated approximately 90 degrees CCW as it traversed the shallow drainage ditch. The front of the F150 narrowly missed a wooden utility pole and an underground utility marker. The vehicle continued to yaw CCW across the wet grass surface before the right side tires either de-beaded or furrowed into the sandy soil that tripped the F150 into a lateral right side leading rollover event. It was estimated that the F150 rotated approximately 110 degrees CCW prior to the trip point. The length of the CCW yaw marks was not documented during the police investigation. These yaw marks eroded prior to this SCI investigation due to the extended period of time between the crash date and the investigation date.

Crash

The Ford F150 rolled to its right across the grassy area. The left roof side rail area sustained the greatest extent of roof damage, estimated at several inches of vertical crush with a matching extent of lateral crush at the left B-pillar area. The vehicle overturned an estimated five-quarter turns before coming to rest on its right side an unknown distance from the trip point. In addition to the sheet metal crush, the windshield was cracked and holed at the left header area. The left side door glazing and the right front door glazing disintegrated during the rollover. The right rear door glazing remained closed and intact. The fixed backlight glazing was not damaged.

Post-Crash

The driver stated that as the vehicle came to rest, he kicked out the right side of the windshield and exited the vehicle unassisted. Once outside the vehicle, he called to locate the front right passenger only to hear her respond from within the Ford F150. The passenger stated that she came to rest in the rear seat area of the vehicle, lying against the right rear door panel. He assisted her from the vehicle through the windshield opening and they waited at the scene for medical assistance. Both were transported by ambulance to a local hospital for treatment of their injuries.

Vehicle Damage

Exterior

The following damage description was derived from several photographs of the vehicle that were taken on the days following the crash and provided to the SCI investigator by the driver's attorney **(Figures 7 and 8)**. The Ford F150 sustained moderate severity damage that was attributed to the rollover event. The left roof side rail area was crushed downward and laterally right with both values estimated at 5-8 cm (2-3") at the left B-pillar area. The left upper A-pillar was displaced laterally right resulting in vertical buckling of the windshield header over the driver's position. The windshield cracked with a split of the laminate at this location. Isolated dents were present at the midline and along the right side rail area of the roof.

Figure 7. Right side rollover damage to the F150 (Image provided by the driver's attorney).

Figure 8. Left side rollover damage prior to the noted repairs (Image provided by the driver's attorney.

The upper aspect of the right front door was dented from the separation of the outside mirror. The left door mounted mirror was fractured from its mount. At the time of the

crash, all side glazing was closed. The left front, left rear and right front door glazing disintegrated during the rollover event. The backlight was fixed and remained intact. Dirt and grass were embedded into the ride side aluminum wheel rims. The Collision Deformation Classification for this rollover event was 00-TDDO-3.

Interior

The interior of the 2007 Ford F150 was partially disassembled prior to the time of the SCI inspection. There were no available images of the interior of the vehicle prior to the repair process.

As previously noted, at the time of the SCI inspection, the interior trim above the beltline had been removed from the vehicle. The headliner had been removed and was lying loose in the vehicle. The door panels were intact and undamaged with mold present on all four armrests. The right front seat was unbolted from the floor and was lying loose in its position. The front outboard safety belt systems had been removed and found lying on the front floor of the F150. There was no discernable occupant contact damage present within the vehicle or on the removed and available components. A blood-like stain was noted to the headliner. **Figures 9 and 10** are views of the interior at the time of the SCI inspection.

Figure 9. Left interior view of the Ford F150 at the time of the SCI inspection.

Figure 10. Right side interior view.

Tire / Wheel / Valve Stem Data

The 2007 Ford F150 was equipped with Michelin LTX A/S Radial tires mounted on OEM five-spoke aluminum wheels. The tires were sized at P255/65R17 with a load range of 108, a speed rating of S, and were mud and snow rated. The Michelins had a Treadwear Rating of 420, a Traction Rating of A and a Temperature Rating of B. The maximum load rating for these tires was labeled at 1,000 kg (2,205 lb) with a maximum inflation pressure of 240 kPa (35 PSI). The rental car agency confirmed that these tires and valve stems were the original components installed on the vehicle at the time of purchase as a new vehicle for its rental fleet.

The SCI investigator used a hydraulic floor jack to raise the vehicle to remove the tires and wheels for a thorough visual inspection. The tires and wheels were placed on a flat surface (pickup truck tailgate) adjacent to the F150 for inspection and photographic

purposes. The tires were not re-inflated and leak tests were not performed during this inspection. The condition of the tires, aluminum wheel rims, and the valve stems at the time of the SCI inspection were as follows:

Left Front

Tire - The left front tire was found inflated and the bead was fully engaged against the aluminum wheel. This tire was the only tire on the vehicle that remained inflated during and after the rollover crash. The Tire Identification Number (TIN) for this tire was DOT M3LT H7WX 5306. The tire pressure was measured at 10 kPa (1.5 PSI) using an Accutire digital tire pressure gauge. The tread depth averaged 8 mm (10/32") with a minimum depth of 7 mm (9/32") located in the outboard groove in the vicinity of the tire vale stem and a maximum depth of 9 mm (11/32") measured at the third groove from the outboard side 180 degrees from the referenced stem. There was no damage to the sidewalls or to the tread area of the tire **(Figure 11)**.

Figure 11. Left front tire and wheel.

Aluminum Wheel Rim – There was no damage to the OEM five-spoke aluminum wheel rim. Balancing weights of 35 grams (1.25 oz) were affixed to the outboard and inboard aspects of the wheel rim.

Valve Stem – The left front rubber snap-in tire valve stem was intact with no visible damage or cracking **(Figure 12)**. The manufacturer identification on the bottom of the stem is unknown as the tire remained inflated and the bead was fully seated, thus preventing a visual inspection of the stem.


Figure 12. Left front tire valve stem.

Left Rear

Tire – The left rear tire **(Figure 13)** was flat and de-beaded from the aluminum wheel rim at the time of the SCI inspection. Images of the vehicle on the day or days following the crash were provided to the SCI investigator and depicted the left rear tire in the same flat and de-beaded condition. The TIN for this tire was DOT M3LT H7WX 0507. The measured tread depth was 6 mm (7/32") uniformly across all four groves at various regions of the tread. The outer

Figure 13. Left rear tire and wheel.

sidewall of the tire had superficial gouges and abrasions that possibly resulted from the rollover event, or from previous contact with an unknown object. These gouges and abrasions were superficial to the sidewall.

A rusty metal object resembling a nail was present in the tread and was located in the second row tread rib from the outboard aspect of the tire **(Figure 14)**. Viewing the outboard aspect of the tire, this object was located approximately 140 degrees clockwise from the valve stem. It is unknown if this metal object resulted in air loss.

Figure 14. Steel object in the tread of the left rear tire.

Aluminum Wheel Rim – The outboard aspect of the aluminum wheel rim was clean and undamaged. It appeared that the face of the wheel was lightly sanded as subtle orbital marks were present in the finish of the wheel.

Valve Stem – The rubber snap-in valve stem was in place in the wheel rim and exhibited a laterally oriented crack at the base of the stem, immediately above the wheel on the inboard aspect of the stem (with respect to the wheel). A second laterally oriented crack of approximately 4 mm in length was located on the flare of the stem above the previously mentioned crack **(Figure 15)**. A mirror was positioned on the inside aspect of the wheel rim to obtain the identification numbers from the stem. The identification appeared to be 08TR4 with the remainder of the characters abraded from probable interaction of the tire bead **(Figure 16)**.

Figure 15. Lateral cracking of the left rear valve stem.

Figure 16. Identification numbers on the inside aspect of the left rear valve stem.

Right Front

Tire – The right front tire **(Figure 17)** was flat and de-beaded from the OEM wheel rim. The TIN was DOT M3LT H7WK 0507. The tire tread depth was 6 mm (7/32”) and was uniform across the tread. There were no defects or visible punctures of the tire tread. The outboard sidewall of the Michelin tire was gouged at both midpoints

of the raised white letters MICHELIN. These gouges did not penetrate the sidewall of the tire.

Aluminum Wheel Rim – The OEM right front aluminum wheel was not damaged. Dirt was embedded into the spokes of the wheel following the crash, but was removed prior to this SCI inspection. A 71 gm (2.5 oz) wheel balancing weight was attached to the outboard aspect of the wheel rim and a 64 gm (2.25 oz) weight was affixed to the inboard edge of the wheel. **Figure 18** is the TPMS band sensor in the right front wheel.

Figure 17. Right front tire and wheel rim prior to removal from vehicle.

Figure 18. Right front TPMS band sensor.

Valve Stem – The right front valve stem was intact within the aluminum wheel rim. The outboard base of the stem at the bell-shape was cracked with minimal loss of rubber material **(Figure 19)**. The stem appeared to be gouged; however, there was no damage to the surrounding aluminum wheel rim to support contact with a hard surface. Without flexing the rubber stem, no linear cracks to the stem were visible.

The outboard bead of the tire was compressed and an inspection mirror was placed under the inner base of the stem. The stem was identified by the following alpha numeric characters: 07 TR414 064 **(Figure 20)**.

Figure 19. Crack/gouge to the base of the right front valve stem.

Figure 20. Right front valve stem identification numbers.

Right Rear

Tire – The right rear tire was flat with the inner and outer beads engaged against the wheel rim. The tire was identified by the following TIN: DOT M3LT H7WX 0407. The tire tread depth averaged 6 mm (7/32") with the third rib yielding a depth of 6 mm (8/32"). There was no visible damage to the tread or sidewall surfaces of the tire **(Figure 21)**.

Figure 21. Right rear tire and wheel.

Aluminum Wheel Rim – The five-spoke wheel rim was not damaged. Wheel balancing weights were present on both bead edges of the wheel.

Valve Stem – The rubber valve stem was intact and fully engaged in the bore of the aluminum wheel rim. The shaft of the stem was cracked at the flare. The top of the stem was moved approximately 6-13 mm (0.25-0.5") by the SCI investigator to open the linear crack for photographic purposes. The stem was also cracked at the base on the outboard aspect of the wheel rim. **Figures 22 and 23** are of the cracks to the right rear valve stem. Due to the engagement of the tire bead against the alloy wheel, the identification numbers of the stem could not be obtained.

Figure 22. Cracks of the right rear valve stem.

Figure 23. Close-up view of the right rear tire valve stem cracks.

Manual Safety Belt Systems

The 2007 Ford F150 was equipped with manual three-point lap and shoulder belt systems for the front outboard and the three rear seated positions. The center front position utilized an adjustable length lap belt. All systems utilized continuous loop webbing and sliding latch plates. The front outboard systems had adjustable D-rings and buckle pretensioners. The driver's belt system retracted onto an Emergency Locking Retractor (ELR) while the front right belt system utilized a switchable ELR/Automatic Locking Retractor (ALR). Both front belt systems were removed from the B-pillar mounts during the partial repair process of the vehicle. The driver stated that he did not use the manual belt system at the time of the crash. The front right passenger stated that she was initially

restrained; however, she unbuckled the safety belt system to reposition herself within the vehicle immediately prior to the rollover. The front outboard retractor pretensioners did not actuate in this rollover crash.

The three rear belt systems utilized ELR/ALR retractors with fixed D-rings.

Frontal Air Bag System

The 2007 Ford F150 was equipped with a Certified Advanced 208-Compliant (CAC) frontal air bag system for the driver and right passenger positions. The manufacturer of this vehicle has certified that the F150 is compliant with the advanced air bag requirements of Federal Motor Vehicle Safety Standard (FMVSS) No. 208. The CAC system included dual stage frontal air bags, seat track positioning sensors, safety belt buckle pretensioners, and a front right occupant presence sensor. A remote satellite sensor was mounted to a bracket affixed between the mid line of the upper and lower radiator supports. This sensor aids in the detection of center front pole and narrow object impacts to trigger air bag deployment.

The driver's air bag module was conventionally mounted within the four-spoke steering wheel rim. The front right passenger air bag was top mounted in the right upper instrument panel. The CAC frontal air bag system did not deploy during this rollover event. The Ford was not equipped with side impact air bags or inflatable curtain air bags as these safety features were not available for this platform.

Event Data Recording

Crash sensing and diagnostic functions were performed by a passenger compartment mounted Restraints Control Module (RCM) that had data recording capabilities. The Ford system does not record non-deployment events and since the frontal air bag system did not deploy, the RCM did not capture data related to this crash.

The Ford F150 was equipped with a Power train Control Module (PCM) that had limited data recording capabilities. The PCM utilized a 25 second circular buffer for data recording and the module stored specific parameters related to the operation of the engine, brakes, and the transmission. The data parameters in the PCM were continuously updated over that 25 second window whenever the PCM was energized (i.e. ignition switch "On"). The PCM <u>did not</u> record TPMS data.

In a crash event with air bag and/or pretensioner deployment, the recording buffer in the PCM may lock preserving the crash event data. At the time of deployment, the Restraint Control Module (RCM) sends a Restraint Deployment Signal (RDS) to the PCM. If that RDS is received, the PCM will then lock the stored PCM data. In this rollover crash, a deployment command was not issued by the RCM. Therefore, a RDS was not initiated and the data within the PCM remained in a volatile state. At any point in time post crash, 12 volt electrical power supplied to the PCM via the vehicle's communication bus would initiate recording within the module.

During the SCI inspection of the Ford F150, the data stored in the PCM was imaged using the Bosch Crash Data Retrieval hardware and software version 3.1. The PCM module was disconnected from the vehicle's communication bus and the Bosch umbilical cable was connected directly to the PCM module. Under this procedure, the stored data within the PCM could not be altered. An analysis of the imaged data indicated that the stored data was not related to this rollover crash event. The vehicle speed recorded over the entire 25 second buffer was 0 km/h (0 mph). Additionally, the position of the transmission was recorded as Neutral. This parameter would have been recorded as Not Neutral had the transmission selector been in the Drive position. The imaged data was probably related to an activation of the PCM during towing activities or movement of the vehicle during its repair process. Also, it should be noted that a private consulting firm attempted to image the PCM several months prior to SCI notification of this crash. The imaging procedures and the results of that attempt could not be ascertained.

Occupant Data/Demographics

Driver

Age/Sex:	51 year old/Male
Height:	180 cm (71")
Weight:	126 kg (278 lb)
Manual Safety Belt Use:	None
Usage Source:	Driver interview
Seat Track Position:	Rear track
Ejection/Entrapment:	None
Egress from Vehicle:	Kicked out windshield, exited unassisted
Mode of Transport from Scene:	Ambulance
Type of Medical Treatment:	Transported to a local hospital where he was treated for his injuries and released.

Driver Injuries

Injury	Injury Severity (AIS 90/Update 98	Injury Source
Compression fracture of T12	Moderate (650432.2,7)	Indirect axial loading of the seat cushion
Medial tear of the left meniscus	Moderate (850822.2,2)	Indirect motion related
Medial tear of the right meniscus	Moderate (850822.2,1)	Indirect motion related
Partial thickness intrasubstance tear of the supraspinatus tendon of the left shoulder	Minor (740200.1,2)	Possible contact to the left side rail and/or headliner
Lumbar back strain	Minor (640678.1,8)	Indirect axial loading of the seat cushion

Source – Hospital and follow-up medical records

Driver Kinematics

The driver of the Ford F150 was seated in a rear seat track position. The adjustable head restraint was adjusted 4 cm (1.5") above the seat back at the time of the SCI inspection. The driver stated that he was not wearing the safety belt system. Prior to the crash, he further stated that he was driving with his right hand on the steering wheel rim at the 12 o'clock position.

As the vehicle yawed in a counterclockwise direction, the unrestrained driver would have been minimally displaced to his right. At the on-set of the rollover, the vehicle rolled laterally to the right. Although not supported by contact evidence, the driver contacted the interior and the headliner during the early phase of the rollover event. As the Ford continued to roll, there was possible interaction between the two unrestrained front seat occupants. The driver's upper body motion with respect to the vehicle as the vehicle was overturning resulted in loading of the knees as his lower extremities probably remained in the area of the floor and foot pedals. This loading resulted in an indirect (not contact related) tearing of the meniscus of the knees. His head and or left shoulder probably impacted the headliner and left roof side rail area of the vehicle resulting in a tendon tear of the left shoulder. His pelvic region probably compressed the seat cushion resulting in axial loading of the lumbar and thoracic spine. The driver sustained a compression fracture of thoracic vertebra T12 and lumbar strain.

The F150 came to rest on its right side with the driver resting against the right door panel. He stated that he immediately kick-out the right aspect of the windshield and exited the vehicle. He was subsequently transported by ground ambulance to a local hospital where he was evaluated for injury and released.

Front Right Passenger

Age/Sex:	48-year old/Female
Height:	170 cm (67")
Weight:	64 kg (142 lb)
Manual Safety Belt Use:	None
Usage Source:	Passenger interview
Seat Track Position:	Unknown
Ejection/Entrapment:	None
Egress from Vehicle:	Assisted from vehicle by driver
Mode of Transport from Scene:	Ambulance
Type of Medical Treatment:	Admitted to a local hospital for treatment

Front Right Passenger Injuries

Injury	Injury Severity (AIS 90/Update 98)	Injury Source
Small cerebral contusion, unknown aspect, NFS	Serious (140604.3,9)	Unknown, contact with hard surface within the vehicle or possible partial ejection
Subarachnoid hemorrhage	Serious (140684.3,9)	Unknown, contact with hard surface within the vehicle or possible partial ejection
Multiple skull fractures (not further specified)	Moderate (150400.2,9)	Unknown, contact with hard surface within the vehicle or possible partial ejection
Right rib fractures (not further specified)	Moderate (450210.2,9)	Probable loading against interior door panel/armrest
Sternum fracture	Moderate(450804.2,4)	Probable loading against interior door panel/armrest
Fracture of C5 with fusion of C4-6	Moderate (650216.2,6)	Indirect from head contact to an unknown hard surface within the vehicle or possible partial ejection
Fracture of the vertebral body of T3	Moderate (650430.2,7)	Indirect from probable loading against interior door panel/armrest or possible partial ejection
Semi-circular flap avulsion of the posterior scalp with 250-500 cc of blood loss (26 staples to close wound)	Minor (190802.1,6)	Unknown, contact with hard surface within the vehicle or possible partial ejection

Source – Hospital and follow-up medical records

Front Right Passenger Kinematics

The front right passenger of the Ford F150 stated during the SCI interview that she was seated on the seat cushion with her body turned slightly to the right. She unbuckled the safety belt system to reposition herself immediately prior to the crash. As the driver lost control of the vehicle, the front right passenger was unrestrained.

During the counterclockwise yaw off the left roadside, the unrestrained passenger was slightly displaced to her right. As the vehicle tripped in a right side leading rollover, she probably contacted the headliner of the pickup truck. The right front door glazing shattered as the right side impacted the ground. During the next two-quarter turns, the front right passenger probably engaged the unrestrained driver and other interior components. Her head impacted an unknown hard surface resulting in a semi-circular flap laceration of the posterior scalp. This unknown head impact also resulted in fractures of the skull, a small cerebral contusion, subarachnoid hemorrhage, and a fracture of the C5 vertebrae. It is possible that the front right passenger's head was

partially ejected through the front right window opening (glazing disintegrated) resulting in the head injuries.

During the rollover, the unrestrained passenger probably impacted the right side door panel that resulted in lower right rib fractures, a fracture of the sternum, and an indirect fracture of the vertebral body of T3. Her body also traveled between the front seat backs as she came to rest in the second row seat area against the right rear door panel.

Immediately following the driver's exit from the vehicle, he called for the passenger as he could not locate her at the crash site. She responded from the back seat and was assisted from the vehicle through the windshield opening. The passenger was transported by ambulance to a local hospital where she was admitted for treatment of her injuries.

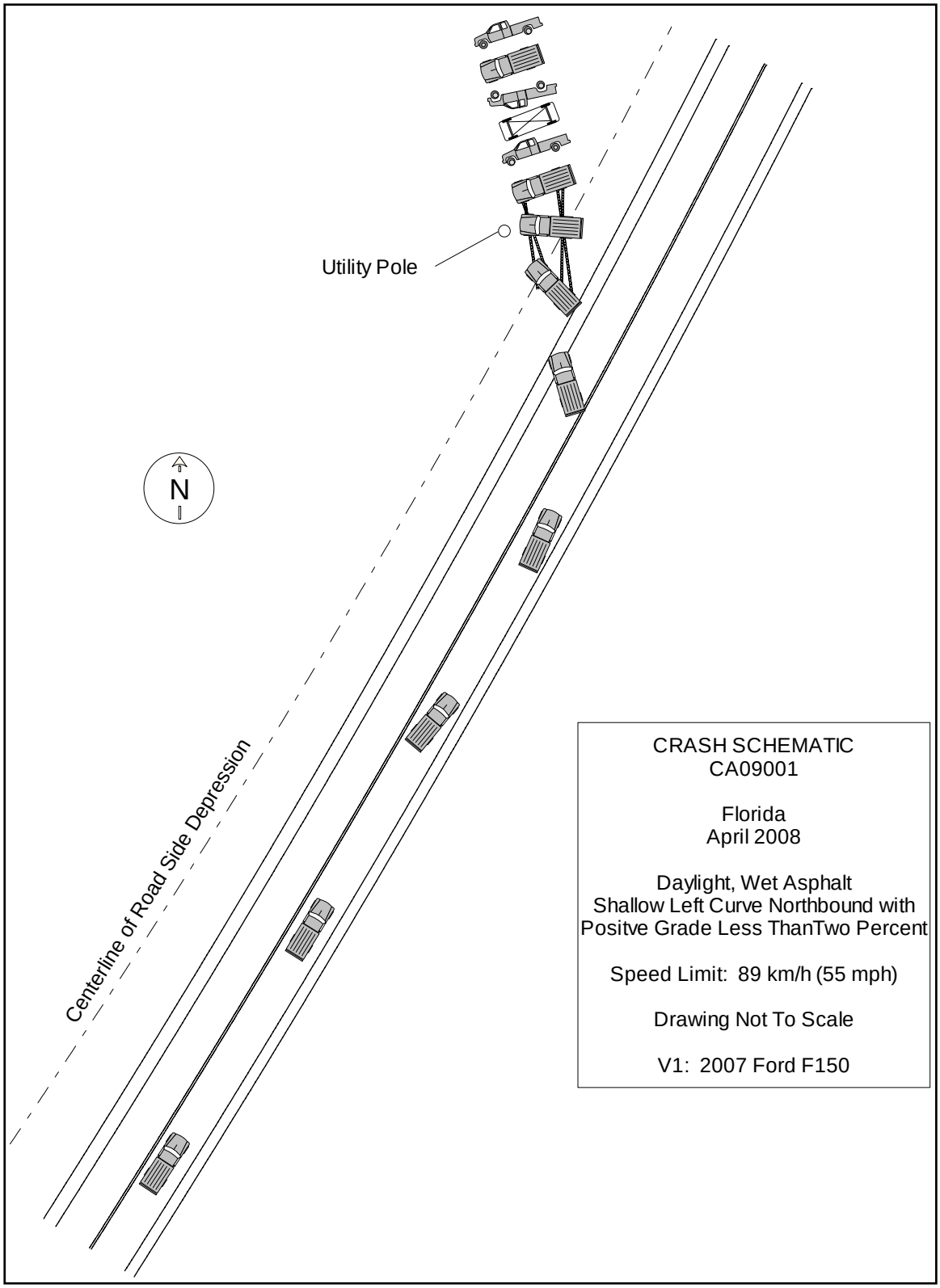

Figure 24. Crash Schematic