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CALSPAN ON-SITE SMALL OVERLAP/OBLIQUE CRASH INVESTIGATION
SCI CASE NO.: CA11002

VEHICLE: 2010 LEXUS ES350

LOCATION: NORTH CAROLINA

CRASH DATE: DECEMBER 2010

Contract No. DTNH22-07-C-00043

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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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16. Abstract This on-site investigation focused on the small overlap/oblique fixed object crash of a 2010 Lexus ES350. The Lexus departed the left side of the road and was involved in frontal and oblique impacts with several trees. The Lexus was equipped with a Certified Advanced 208-Compliant frontal air bag system (CAC), driver and front right passenger knee air bags, side impact air bags located in the front seat backs, and roof side rail-mounted side impact Inflatable Curtain (IC) air bags. The tree impacts to the left, front and right planes of the Lexus resulted in the deployment of the frontal and knee air bags for the driver and front right passenger. The Lexus was occupied by a restrained 73-year-old male driver and a restrained 71-year-old female front right passenger. The driver sustained moderate severity injuries. The front right passenger sustained minor severity injuries. Both occupants were transported by ground ambulance to a regional trauma center where they were treated and released.			
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BACKGROUND

This on-site investigation focused on the small overlap/oblique fixed object crash of a 2010 Lexus ES350 **(Figure 1)**. This crash was identified by the Calspan Special Crash Investigations (SCI) team through a news search and a visit to a regional vehicle salvage facility on February 2, 2011. Based on the location of the impacts and the severity of the damage, this case was assigned by the Crash Investigation Division (CID) of the National Highway Traffic Safety Administration (NHTSA) for an investigation on February 3, 2011. The on-site portion of the investigation was initiated on February 7, 2011 and involved the inspection and documentation of the Lexus and the crash scene. Additionally, the Event Data Recorder (EDR) of the Lexus was imaged during the SCI inspection of the vehicle. The occupants of the Lexus declined to participate in this research and were not interviewed.

Figure 1: Front left oblique view of the 2010 Lexus ES350.

The Lexus ES350 departed the left side of the road and was involved in frontal and oblique impacts with several trees. The Lexus was equipped with a Certified Advanced 208-Compliant frontal air bag system (CAC), driver and front right passenger knee air bags, side impact air bags located in the front seat backs, and roof side-rail mounted side impact Inflatable Curtain (IC) air bags. The tree impacts to the left, front and right planes of the Lexus resulted in the deployment of the frontal and knee air bags for the driver and front right passenger. The Lexus was occupied by a restrained 73-year-old male driver and a restrained 71-year-old female front right passenger. The driver sustained moderate severity injuries. The front right passenger sustained minor severity injuries. Both occupants were transported by ground ambulance to a regional trauma center where they were treated and released.

CRASH SUMMARY

Crash Site

This crash occurred during early morning hours of December 2010. The environmental conditions at the time of the crash were dark, dry and clear. The crash occurred in the wooded median of a divided interstate highway. The roadway consisted of two straight, asphalt-surfaced travel lanes that extended north. The northbound grade of the roadway was negative 1%. The width of the outboard lane measured 3.7 m (12.1 ft). The inboard lane was 3.4 m (11.2 ft) in width. The travel lanes were bordered by asphalt shoulders with rumble strips. The outboard and inboard shoulders measured 3.3 m (10.8 ft) and 1.2 m (3.9 ft) wide, respectively. A wide depressed grass median extended to the west beyond the inboard shoulder. A tree line, oriented parallel to the road, was located within the median 25 m (82 ft) west of the road edge. The median had a negative cross slope to the west. The initial grade measured negative 3% and increased to negative 16% approaching the tree line. The Lexus departed the west (left) side of the road at a shallow angle and traversed the cross slope of the median evidenced by 153 m (502 ft) long tracking and rotating tire impressions. Along the path of travel, the grade transitioned from negative 3% during the first third of its travel, to negative 8% during the center of its travel, and then to negative 2% as it approached the initial point of impact. **Figure 2** depicts the point at which the Lexus departed the west roadside. **Figure 3** is a trajectory view of the Lexus at the central aspect of its off-road travel. Scene Diagrams are included at the end of this report.

Figure 2: Northbound trajectory view of the Lexus at the roadside departure.

Figure 3: Trajectory view of the Lexus at the central aspect of its northerly off-road travel.

Pre-Crash

The driver of the Lexus was operating the vehicle northbound in the left lane of the highway at a police-reported speed of 105 km/h (65 mph). For an unknown reason, the driver lost directional control of the vehicle and the Lexus departed the left side of the roadway at a shallow 5 degree angle. The vehicle traveled 170 m (557 ft) on the grass roadside. The cross slope of the terrain caused the vehicle to increase its departure angle as it traversed the roadside. Based on the tire

evidence at the scene in conjunction with imaged EDR data, there were no attempted steering, braking, or acceleration maneuvers made by the driver in an attempt to avoid the crash. The Lexus maintained its tracking attitude to the tree line (**Figure 4**).

Figure 4: Northbound trajectory view of the Lexus approaching the tree line points of impact.

Crash

The front left corner of the Lexus, outboard of the frame rail, impacted the first tree. Tree #1 was a V-shaped double tree (two trunks sharing a common base) and was 31 cm (12.2 in) in diameter. The tree damage extended from ground level to 96 cm (37.8 in) in height. The tree was not displaced. A branch of this tree impacted and fractured the windshield of the vehicle. A triangular hole was punctured in the windshield. The impact to this tree resulted in deformation of the vehicle's front plane (outboard the frame rail) and the left front fender, fractured and displaced the left front wheel rim, and engaged the left side of the vehicle ending at the aft end of the left rear door. The force of this impact resulted in the actuation of the safety belt pretensioners and the deployment of the frontal and knee air bags in the Lexus. The front of the Lexus was deflected to the right approximately 5 degrees by the front left corner impact.

The Lexus continued 4 m (13 ft) north on its trajectory and impacted trees #2 and #3 with the front plane. Tree 2 measured 9 cm (3.5 in) in diameter. The force of the impact displaced the tree 15 degrees and sheared it off 48 cm (18.9 in) above ground level. Tree #3 measured 13 cm (5.1 in) in diameter and was located 0.6 m (2 ft) north of tree #2. The impact displaced tree #3 65 degrees and sheared it off 61 cm (24 in) above ground level.

The Lexus traveled forward an additional 4.6 m (15.1 ft) and impacted tree #4 with the right corner of the front plane (outboard of the frame rail). This impact detached the right front suspension from the Lexus, deformed and fractured the right front wheel rim, and damaged the right front fender and right front door. Tree #4 measured 21 cm (8.3 in) in diameter and was displaced 20 degrees. The damage on tree #4 started at ground level and extended upward 103 cm (40.5 in). The Lexus came to rest against this tree facing north. Debris found at the scene during the SCI inspection matched the color and model of the Lexus.

Post-Crash

Police, Emergency Medical Services (EMS) and fire personnel responded to the crash site. The driver and front right passenger were assisted from the vehicle and transported by ground ambulance to a regional trauma center for treatment. The Lexus was towed from the scene due

to disabling damage. It was later transferred from a local tow yard to a regional vehicle salvage facility for auction, where it was inspected.

2010 LEXUS ES 350

Description

The 2010 Lexus ES 350 was manufactured in December, 2009 and was identified by the Vehicle Identification Number (VIN) JTHBK1EG8A2xxxxxx. The odometer read 12,601 km (7,832 mi) at the time of the crash. The front-wheel drive Lexus was powered by a 3.5-liter, V6 engine linked to a six-speed automatic transmission. The braking system consisted of power-assisted front and rear disc brakes with four-wheel antilock, electronic brakeforce distribution and brake assist. The Lexus was also equipped with Electronic Stability Control (ESC), traction control and a direct Tire Pressure Monitoring System (TPMS). The Lexus was equipped with four Michelin Energy MXV4 S8 tires in size P215/55R17, which matched the vehicle manufacturer recommendation. The vehicle manufacturer recommended cold tire pressure was 207 kPa (30 PSI) for the front and rear. The specific tire data at the time of the SCI inspection was as follows:

Position	Measured Pressure	Measured Tread Depth	Restricted	Damage
LF	Tire Flat	6 mm (8/32 in)	Yes	Rim fractured and deformed, tire de-beaded
LR	186 kPa (27 PSI)	6 mm (8/32 in)	No	None
RR	179 kPa (26 PSI)	6 mm (8/32 in)	No	None
RF	Tire Flat	6 mm (8/32 in)	No	Rim fractured and deformed, tire de-beaded

The interior of the Lexus was configured with leather-surfaced five passenger seating. The front bucket seats were separated by a center console. All seating positions were equipped with height adjustable head restraints. The driver's head restraint and all three second row head restraints were in the full-down position at the time of the SCI inspection. The front right head restraint was 6 cm (2.4 in) above the full-down position at the time of the SCI inspection. The driver's seat track and adjustable seat back were operational post-crash. The driver's seat track was adjusted 15 cm (5.9 in) forward of the full-rear position. The driver's seat back angle was 20 degrees aft of vertical. This placed the steering wheel rim in close proximity to the driver. The distance between the driver's seat back and the lower aspect of the steering wheel rim was 37 cm (14.6 in). The distance from the center of the steering wheel hub to the driver's seat back was 50 cm (19.7 in). The front right passenger's seat track was 11 cm (4.3 in) forward of the full-rear position and the seat back was at an angle 22 degrees aft of vertical. The second row consisted of a fixed bench with a pass through panel to the trunk located behind the center seat back/armrest.

The occupant safety systems consisted of 3-point manual lap and shoulder safety belts for all five designated seating positions, front seat retractor pretensioners, CAC dual-stage frontal air bags, side impact air bags located in the upper outboard aspects of the front seat backs, and side impact IC air bags located in both roof side rails that provide protection to the four outboard seating positions.

Exterior Damage

The front, left, right and top planes of the Lexus sustained moderate damage in this multiple impact crash sequence **(Figure 5)**. In the initial impact (Event 1), the Lexus impacted tree #1 with its front left corner. This impact was located outboard of the left end of the bumper beam. The initial impact damage began at the left corner and extended rearward down the left side of the vehicle a distance of 338 cm (133 in) and ended at the aft end of the left rear door, 22 cm (8.7 in) forward of the left rear axle. The maximum deformation from the initial impact was located on the left plane of the vehicle 293 cm (115.4 in) forward of the left rear axle and measured 10 cm (3.9 in). The left wheelbase was reduced 20 cm (7.8 in). The corner configuration of this Event 1 damage invalidated a reconstruction with the WinSMASH program. For reference purposes, the imaged EDR data reported a maximum frontal delta-V of 17.2 km/h (10.7 mph). The Collision Deformation Classification (CDC) assigned for this impact was 12FLEE9.

Figure 5: Frontal and oblique damage to the Lexus.

In Events 2 and 3 of this crash sequence, the front of the Lexus impacted two trees. Both trees yielded and sheared off. The front bumper beam was deformed along its full width by these two overlapping impacts. The combined direct damage to the front of the Lexus began 10 cm (3.9 in) right of the centerline, and extended right 20 cm (7.9 in). The maximum crush was located 10 cm (3.9 in) right of the vehicle centerline, and measured 31 cm (12.2 in). A residual crush profile was documented along the full width of the exposed bumper beam and was as follows: C1 = 0 cm, C2 = 7 cm (2.8 in), C3 = 20 cm (7.9 in), C4 = 31 cm (12.2 in), C5 = 15 cm (5.9 in), C6 = 0 cm. Due to the yielding nature of the trees, a full reconstruction with the WinSMASH program was invalidated. For comparative purposes only, a Barrier Equivalent Speed (BES) was calculated by the Barrier Algorithm of the program based on the residual frontal deformation. The resultant BES was 22 km/h (13.6 mph). The CDC assigned to this overlapping impact damage was 12FZEN2.

The Event 4 damage to the Lexus is depicted in **Figure 6**. The right front corner of the Lexus impacted Tree #4 outboard of the right frame rail end. The direct damage to the Lexus began at the front right corner with continuous engagement rearward down the right plane of the vehicle. The length of the damage measured 199 cm (78.3 in), started at the corner of the vehicle and ended 161 cm (63.3 in) forward of the right rear axle. The front right suspension was fractured and the wheel had separated. The corner configuration of the impact with Tree #4 invalidated a WinSMASH reconstruction. The CDC assigned to Event #4 was 12FREE8.

At the point when the Lexus was coming to final rest, one of the trees impacted earlier in the crash sequence fell onto the vehicle (Event 5), impacting the roof with a non-horizontally direction of force **(Figure 7)**. The direct damage was 24 cm (9.4 in) wide and 186 cm (73.2 in) long. It began at the center aspect of the roof, and extended over the backlight header to the aft edge of the trunk lid. The maximum crush was located on the backlight header, 48 cm (18.9 in) inboard of the right, and measured 7 cm (2.8 in). The CDC assigned for this non-horizontal impact was 00TZZN2.

Figure 6: Event 4 sideswipe damage to the Lexus.

Figure 7: Non-horizontal roof damage to the Lexus.

Event Data Recorder

The Event Data Recorder (EDR) of the Lexus was imaged using the proprietary EDR-ROT tool that was provided by Toyota North America and software version 1.4.1.1. The ROT tool imaged the EDR data through a direct connection with the Diagnostic Link Connector (DLC) in the Lexus. The Lexus EDR had the capability of storing two distinct crash events. The distinct crash events were termed the “Latest Event Page 0” and the “Next Most Recent Event Page 1”, respectively. Associated to each respective distinct event was a five second pre-crash buffer that recorded Vehicle Speed, Accelerator Pedal Position, Brake Switch Status, and Engine RPM data. The EDR monitored and measured vehicle acceleration in both the longitudinal and lateral direction and the recording of each distinct crash event could be triggered by a frontal (longitudinal) and/or a side (lateral) crash pulse.

The data imaged from the EDR consisted of one distinct crash event labeled the "Latest Event Page 0". This data was related to the multiple tree impacts of this SCI investigation. Data fields within the "Next Most Recent Event Page 1" indicated that this memory buffer was still in an initial state and that no data had been written to these pages.

The pre-crash data of the recorded event was labeled "Latest Pre-Crash Page 0". This data indicated the Lexus was traveling 92 km/h (57.2 mph) 4.3 seconds prior to Algorithm Enable (AE). The brakes were reported as "Off" throughout the pre-crash period. Without the brakes being applied, the Lexus decelerated to a speed of 82 km/h (51.0 mph) at the time of AE. The accelerator position was reported as "Off" (0.78 volts) 4.3 seconds prior to AE to 0.3 second prior to AE. At AE, the accelerator position was reported as "Off" (0.9 volts). The engine speed was reported at 1200 RPM throughout the pre-crash period. The driver and front right passenger safety belts were reported as buckled. The recorded pre-crash data is listed in the following table:

	Pre-Crash Time					
	-4.3 sec	-3.3 sec	-2.3 sec	-1.3 sec	-0.3 sec	AE
Vehicle Speed	92.1 km/h (57.2 mph)	90.0 km/h (55.9 mph)	88.0 km/h (54.7 mph)	88.0 km/h (54.7 mph)	85.9 km/h (53.4 mph)	82..1 km/h (51.0 mph)
Accelerator Position	Off 0.78 volts	Off 0.78 volts	Off 0.78 volts	Off 0.78 volts	Off 0.78 volts	Off 0.9 volts
Brake Switch Status	Off	Off	Off	Off	Off	Off
Engine RPM	1200	1200	1200	1200	1200	1200

The "Latest Event" was comprised of three data pages derived by three separate triggers. The three data pages were all linked to the "Latest Pre-Crash Page 0" by a field within the data set. The three triggers were consecutive and related in time. The initial event was triggered at time zero (AE) and was reported as a driver's (left) side impact. This data was labeled "Side Crash Page 0". There was no deployment commanded for the left side air bag or IC air bag. The maximum reported lateral speed change ("Gy") was reported by the floor sensor with a magnitude of -1.3 mph at 71 milliseconds. The writing flag for this event was recorded as "Finished Writing".

The second recorded event was a frontal impact that triggered 3 milliseconds after AE. This data set was labeled "Frontal Crash Page 0". This event was a deployment event with a maximum delta-V of 17.2 km/h (10.7 mph) at 200 milliseconds. Actuation of the pretensioners and

deployment of the frontal air bags was commanded 94 milliseconds after the recognition of the frontal impact. The driver's frontal air bag deployment stage was reported as "High" and the front right passenger's deployment stage was reported as "ExLow". The writing flag for this event was recorded as "Finished Writing".

The third recorded event was a passenger (right) side impact that triggered 97 milliseconds after AE. This data seat was labeled "Side Crash Page 1". This impact did not result in the deployment of the right side air bag or IC air bag. The maximum lateral speed change ("Gy") was recorded at the C-pillar with a magnitude of -2.5 mph at 38 milliseconds. The writing flag for this event was recorded as "Finished Writing".

Interior Damage

The Lexus sustained moderate severity interior damage that was attributed to passenger compartment intrusion and air bag deployment. As a result of the non-horizontal impact to the roof (Event 5), the roof and backlight header intruded into the second row seating positions. The intruded values of the roof into the second row were 3 cm (1.2 in), 7 cm (2.8 in) and 6 cm (2.4 in) from left to right. The respective backlight header intrusions were 2 cm (0.8 in), 7 cm (2.8 in) and 3 cm (1.2 in).

The AS1 windshield was 100% fractured with a higher level of damage on the right side, resulting from contact by the front right passenger air bag. There was a small triangular hole in the windshield that was 14 cm (5.5 in) vertically and 7 cm (2.8 in) horizontally, produced by a tree branch near the Event 1 impact. The side windows and backlight were AS2 tempered glass. The left front and backlight were disintegrated by impact forces. The right front, both rear and both rear quarter windows were undamaged. The AS3 deep tint sunroof glazing was closed and undamaged.

All four doors remained closed and operational post-crash. The driver's door was difficult to open and close, and only opened approximately two-thirds of its normal travel due to sheet metal damage near the A-pillar. All other doors operated normally.

Manual Restraint Systems

The Lexus was equipped with 3-point lap and shoulder safety belts for the five designated seating positions. All belt systems utilized continuous loop webbing and sliding latch plates. The upper D-rings for the front seats were height adjustable and both were in the full-up position at the time of the SCI inspection. The driver's belt retracted onto an Emergency Locking Retractor (ELR), all other belts retracted onto switchable ELR/Automatic Locking Retractors (ALR). Both front belts utilized retractor pretensioners which actuated during the crash and locked the belts in the used position. The driver's safety belt had 165 cm (64.9 in) of webbing spooled out from the B-pillar and locked, and the front right passenger's safety belt had 157 cm

(61.8 in) of webbing spooled out and locked at the time of the SCI inspection. There was contact evidence on the front right belt. This evidence consisted of a frictional abrasion located 75-77 cm (29.1-30.3 in) above the lower trim slot on the outboard aspect of the front right seat. The lower safety belt anchor was not visible. There was no loading evidence on the driver's safety belt system. Based on the vehicle interior and safety belt inspection the driver and front right passenger were restrained at the time of the crash. This determination was consistent with the imaged EDR data.

Supplemental Restraint Systems

The Lexus was equipped with a Certified Advanced 208-Compliant (CAC) frontal air bag system that consisted of dual-stage driver and front right passenger air bags, seat track positioning sensors, a front right occupant presence sensor, front seat retractor pretensioners, and safety belt buckle sensors. The manufacturer of the Lexus has certified that this vehicle is compliant with the advanced air bag portion of the Federal Motor Vehicle Safety Standard (FMVSS) Number 208. In addition to the frontal air bags, The Lexus was equipped with knee air bags at both front positions. The CAC frontal and knee air bags deployed during the crash.

The Lexus was equipped with side impact air bags located in the upper outboard aspects of both front seats, and IC air bags mounted in the roof side rails on both sides of the vehicle. None of these side air bags deployed during this crash sequence.

Figure 8: Overall view of the driver's frontal air bag.

The driver's frontal air bag was concealed within the center hub of the three-spoke steering wheel by a tri-flap design. The upper cover flap was 12 cm (4.7 in) in width and 9 cm (3.5 in) in height. The upper flap contained an oval-shaped Lexus logo that extended into the lower cover flaps. The lower flaps were 6 cm (2.4 in) in width and 10 cm (3.9 in) in height. None of the flaps were damaged. The driver's air bag measured 60 cm (23.6 in) in diameter in its deflated state. It was vented by two ports on the upper rear aspect of the air bag located at the 11 and 1 o'clock positions. There were two internal tethers that attached to a 23 cm (9.1 in) dual-circular tear seam at the center of the face of the air bag. The deployed driver's frontal air bag is depicted in **Figure 8**. The steering wheel was rotated approximately 180 degrees post-crash and was locked in place.

There was a scuff mark that included several small holes on the face of the air bag. This contact was located in the lower left quadrant, 1-4 cm (0.4-1.6 in) below the horizontal centerline of the

air bag and 11-26 cm (4.3-10.2 in) left of the vertical centerline of the air bag. This contact was attributed to the driver's chest. There were also multiple droplets of blood on the front and top aspects of the air bag. Blood was present at all four quadrants, but the highest concentration of blood droplets were on the upper right quadrant of the air bag. Due to the rotation of the steering wheel, this would have placed the upper right quadrant at the bottom of the assembly when the vehicle came to final rest.

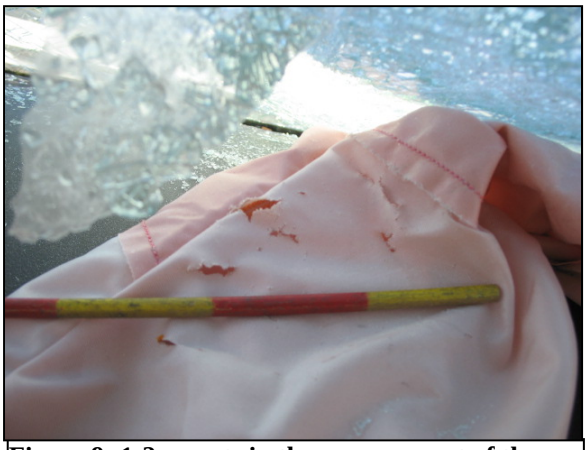


Figure 9: 1-2cm cuts in the upper aspect of the front right air bag, near the windshield.

The front right passenger's frontal air bag was concealed within the upper aspect of the right instrument panel by two cover flaps. The upper cover flap measured 10 cm (3.9 in) in width and 6 cm (2.4 in) in height. The lower flap was 10 cm (3.9 in) in width at the upper tear seam, 20 cm (7.9 in) in width at the lower edge and 8 cm (3.1 in) in height. There was no damage to either cover flap. The air bag consisted of two symmetrical panels. Each panel was 50 cm (19.7 in) in length and 34 cm (13.4 in) in width. Including the slight overlap where the panels were joined by a 12 x 11 cm (4.7 x 4.3 in) oval patch, the air bag was 66 cm (26 in) in width. There was a 15 cm (5.9 in) damaged area at the top center on the left half of the air bag. Within this area there were several 1-2 cm (0.4-0.8 in) cuts from contact with the windshield (**Figure 9)**.

Figure 10: Driver's knee air bag.

The Lexus was equipped with knee air bags for the driver and front right passenger seating positions. Both of these air bags deployed from the lower aspect of the left and right instrument panels as a result of the frontal impact. The driver's knee air bag is depicted in **Figure 10**. The driver's air bag was concealed by two cover flaps. The upper flap was 3 cm (1.2 in) in height and 25 cm (9.8 in) in width. The lower flap was 5 cm (2 in) in height and 25 cm (9.8 in) wide. The driver's knee air bag was 30 cm (11.8 in) tall and 60 cm (23.6 in) wide. There was a dark scuff mark on the top aspect of the air bag 13-24 cm (5.1-9.4 in) below the upper edge of the air bag and 17-29 cm (6.7-11.4 in) left of the right side of the air bag. There were no tethers or vent ports in left knee air bag.

The front right passenger's knee air bag was concealed in the lower aspect of the right instrument panel by two cover flaps. The upper was 20 cm (7.9 in) wide and 3 cm (1.2 in) in height, and the lower was 20 cm (7.9 in) wide and 6 cm (2.4 in) in height. The air bag measured 30 cm (11.8 in) vertically and 60 cm (23.6 in) horizontally. No tethers or vent ports were present in the front right knee air bag. There was no damage or contact evidence to the right knee air bag.

2010 LEXUS ES 350 OCCUPANTS

Driver Demographics

Age/Sex:	73 years/Male
Height:	163 cm (64 in)
Weight:	78 kg (172 lb)
Eyewear:	Eyeglasses
Seat Type:	Bucket
Seat Track Position:	Mid track, 15 cm (5.9 in) forward of full-rear
Manual Restraint Usage:	Lap and shoulder
Usage Source:	Vehicle Inspection, EDR
Air Bags:	Frontal and knee air bags deployed
Alcohol/Drug Involvement:	None
Egress from Vehicle:	Assisted by EMS
Transport from Scene:	Ground ambulance
Medical Treatment:	Transported to a regional trauma center. Treated in ER and left against medical advice (AMA)

Driver Injuries

Inj. No.	Injury	AIS 2005/08	Injury Source	Confidence Level
1	Facial contusion	(210402.1,9)	Eyeglasses and frontal air bag	Certain
2	Left leg contusion	(810402.1,2)	Knee bolster air bag	Probable
3	Nose laceration	(210602.1,4)	Eyeglasses and frontal air bag	Certain
4	Bilateral hand lacerations	(710602.1,3)	Flying glass	Certain
5	Unknown abrasion	(910200.1,9)	Unknown	Unknown

Source: Medical Records

Driver Kinematics

The 73-year-old male driver of the Lexus was seated in a mid-track position with the seat adjusted 15 cm (5.9 in) forward of full-rear. He was restrained by the manual 3-point lap and shoulder belt system. The vehicle departed the left side of the roadway for an unknown reason

and the driver did not initiate any avoidance maneuvers prior to the multiple impacts with the trees.

The Event 1 impact resulted in the actuation of the safety belt pretensioners and the deployment of the frontal air bags. This event was closely followed by the subsequent frontal impacts (Events 2-4). The driver responded to the 12 o'clock direction of impacts by initiating a forward and slightly left trajectory within the front left seating position. The driver contacted and loaded the safety belt with his chest and abdomen. His lower extremities loaded the deployed knee air bag which resulted in a left leg contusion. The driver's chest and face loaded the frontal air bag. The combination of the driver's glasses and his facial contact to the driver air bag resulted in a laceration of his nose and a facial contusion. Blood from the laceration was deposited onto the deployed frontal air bag as the vehicle came to final rest. The driver rebounded back into his seat and came to rest within the front left seating position.

The driver was transported by ground ambulance to a regional trauma center. He was treated for his injuries and discharged himself, leaving against medical advice.

Front Right Occupant Demographics

Age/Sex:	71 years/Female
Height:	152 cm (60 in)
Weight:	61 kg (134 lb)
Eyewear:	Unknown
Seat Type:	Bucket
Seat Track Position:	Mid track, 11 cm (4.3 in) forward of full-rear
Manual Restraint Usage:	Lap and shoulder
Usage Source:	Vehicle Inspection, EDR
Air Bags:	Frontal steering wheel and knee air bags deployed
Alcohol/Drug Involvement:	None
Egress from Vehicle:	Assisted by EMS
Transport from Scene:	Ground ambulance
Medical Treatment:	Transported to a regional trauma center, treated in ER and released

Front Right Occupant Injuries

Inj. No.	Injury	AIS 2005/08	Injury Source	Confidence Level
1	Facial abrasions (multiple)	(210202.1,9)	Frontal air bag	Certain
2	Right shin contusion	(810402.1,1)	Knee air bag	Certain

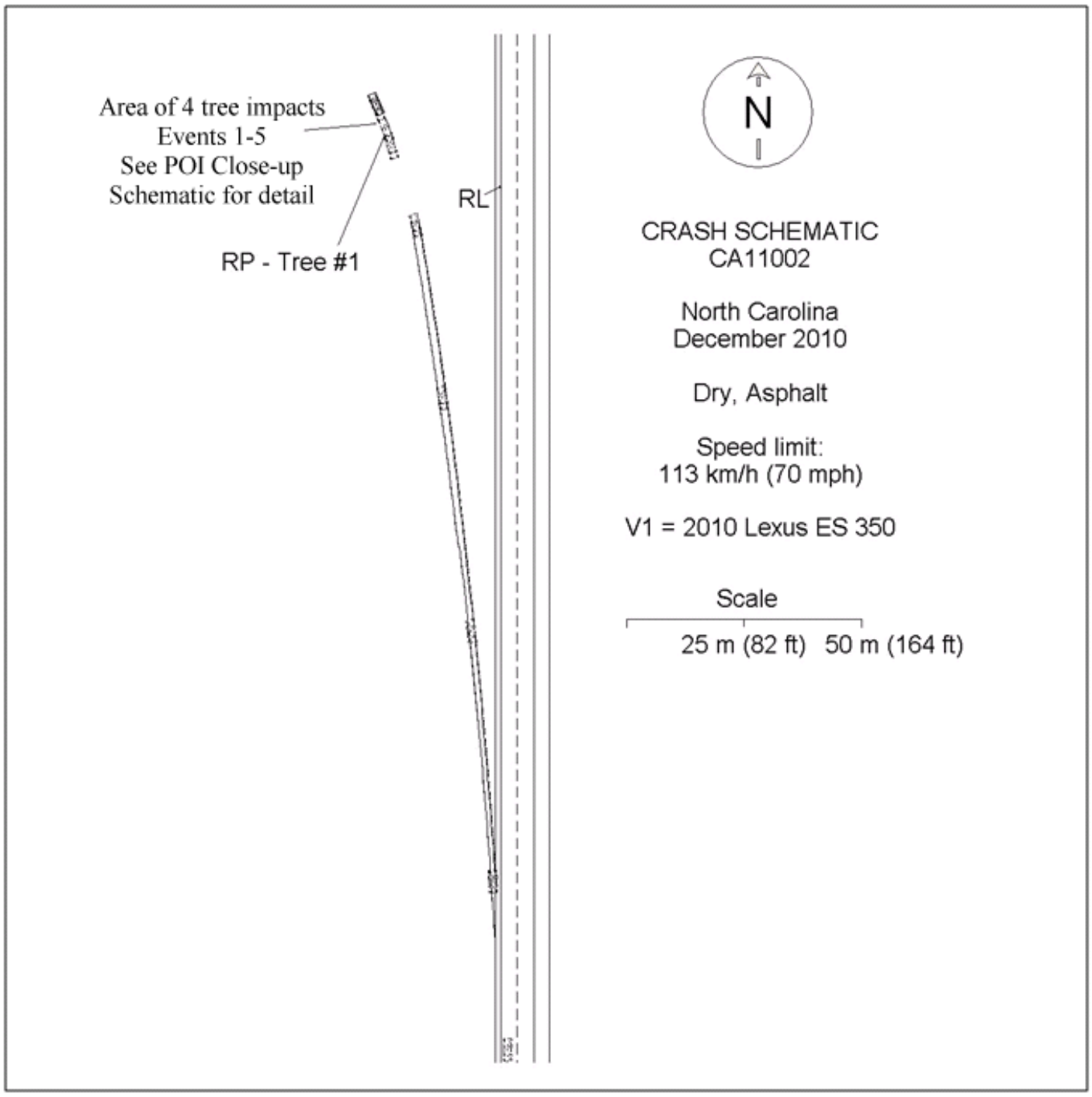
Source: Medical Records

Front Right Occupant Kinematics

The 71-year-old female front right passenger of the Lexus was seated in a mid-track position with the seat adjusted 11 cm (4.3 in) forward of full-rear. She was restrained by the manual 3-point lap and shoulder belt system. At the Event 1 impact, the safety belt pretensioners actuated and the frontal air bags deployed. The passenger initiated a forward and slightly left trajectory within the front right seating position in response to the 12 o'clock direction of the impact. This event was closely followed by the subsequent frontal impacts with the trees (Events 2-4). The front right passenger loaded the safety belt with her chest and abdomen evidenced by a friction abrasion to the webbing located at the latch plate. She also loaded the deployed front right passenger frontal air bag with her face and chest, and the knee bolster air bag with her lower extremities. The passenger sustained soft tissue injuries to the face and right shin as a result of the air bag loading. She then rebounded and came to rest within the front right seat position.

The front right passenger was assisted from the vehicle by EMS and transported by ground ambulance to a regional trauma center where she was treated and released the day of the crash.

SCENE DIAGRAM



SCENE DIAGRAM (Enlarged POI)