TRANSPORTATION SCIENCES
CRASH RESEARCH SECTION

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REDESIGNED AIR BAG SPECIAL STUDY (RABSS)
SCI TECHNICAL SUMMARY REPORT

NASS RABSS CASE NO. 1998-08-805F

RABSS VEHICLE - 1998 BUICK LeSABRE CUSTOM

LOCATION - STATE OF PENNSYLVANIA

CRASH DATE - NOVEMBER, 1998

Contract No. DTNH22-94-D-07058

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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16. *Abstract* This investigation focused on a single vehicle crash involving a 1998 Buick LeSabre Custom 4-door sedan. The Buick LeSabre was equipped with redesigned frontal air bags that deployed as a result of a frontal collision with a utility pole. The driver was operating the vehicle northbound on a two lane rural roadway and negotiating a left curve when he apparently had fallen asleep and allowed the vehicle to depart the right (east) pavement edge. As the vehicle exited the east pavement edge the front right area struck a wooden utility pole resulting in moderate damage. The Buick rotated clockwise and re-entered the roadway where it came to rest in the northbound lane facing northeast. The 79 year old male driver of the Buick LeSabre was unrestrained (3-point manual lap and shoulder belt system available) and presumed to be seated slightly out-of-position to the right. At impact, he initiated a forward trajectory in response to the 12 o'clock impact force as the expanding air bag contacted the anterior aspect of his forearms resulting in bilateral contusions. He subsequently struck the windshield which resulted in a concussion. He also sustained an abrasion and contusion to the right knee from contact to the center instrument panel. The driver of the Buick was transported to a local hospital for treatment and admitted for one day.			
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BACKGROUND

This investigation focused on a single vehicle crash involving a 1998 Buick LeSabre Custom 4-door sedan. The Buick LeSabre was equipped with redesigned frontal air bags that deployed as a result of a frontal collision with a utility pole. The driver was operating the vehicle northbound on a two lane rural roadway and negotiating a left curve when he apparently had fallen asleep and allowed the vehicle to depart the right (east) pavement edge. As the vehicle exited the east pavement edge the front right area struck a wooden utility pole resulting in moderate damage. The Buick rotated clockwise and re-entered the roadway where it came to rest in the northbound lane facing northeast. The 79 year old male driver of the Buick LeSabre was unrestrained (3-point manual lap and shoulder belt system available) and presumed to be seated slightly out-of-position to the right. At impact, he initiated a forward trajectory in response to the 12 o'clock impact force as the expanding air bag contacted the anterior aspect of his forearms resulting in bilateral contusions. He subsequently struck the windshield which resulted in a concussion. He also sustained an abrasion and contusion to the right knee from contact to the center instrument panel. The driver of the Buick was transported to a local hospital for treatment and admitted for one day.

This crash was initially selected for investigation by the National Automotive Sampling System (NASS) as case number 98-08-805F for the Redesigned Air Bag Special Study. The Crash Investigation Division of the National Highway Traffic Safety Administration (NHTSA) assigned the Special Crash Investigation (SCI) team at Veridian/Calspan the task of case review and final report preparation.

SUMMARY

Crash Site

This single vehicle crash occurred during the late evening hours of November, 1998. At the time of the crash, it was dark (street lighted) with no adverse conditions as the roads were dry. The crash occurred off the east pavement edge of a rural two lane north/south asphalt roadway **(see Figure 6 - page 5)** which curved left for northbound traffic. A hillcrest was documented just south of the crash site adjacent to an intersecting residential roadway. No traffic control was present at the scene which had a posted speed limit of 56 km/h (35 mph).

Figure 1. Northbound approach for the 1998 Buick LeSabre (impacted pole in background).

Pre-Crash

The 79 year old male driver of the 1998 Buick LeSabre was operating the vehicle northbound and negotiating a left curve **(Figure 1)** at a driver reported speed of 72 km/h (45 mph). As the Buick crested the hill the driver apparently fell asleep and allowed

as the vehicle to proceed in a straight line trajectory. The Buick subsequently departed the right (east) pavement edge and continued across the residential connector and alongside the shoulder 32.0 meters (105.0 feet) prior to impact. This trajectory was confirmed by 17.0 meters (55.8 feet) of pre-impact soil furrowing documented at the scene.

Crash

As the Buick LeSabre exited the east pavement edge of the two lane rural roadway, the front right area struck a 30.5 cm (12.0 in) wooden utility pole resulting in moderate damage. The impact induced deceleration was sufficient to deploy the Buick's redesigned frontal air bag system. Although the utility pole was classified as a yielding object (out of scope), the damage algorithm of the WinSMASH program computed a (barrier equivalent) velocity change of 27.4 km/h (17.0 mph). The specific longitudinal component was -27.4 km/h (-17.0 mph). The Collision Deformation Classification (CDC) for this impact to the Buick LeSabre was 12-FZEN-2. At this point, the Buick rotated clockwise 50 degrees and re-entered the roadway where it came to rest in the northbound lane facing northeast.

Post-Crash

The driver was removed from the vehicle while disoriented or with perceived serious injury. Treatment was rendered at the scene by paramedics. The driver was transported by ambulance to a local hospital and admitted for one day. The vehicle was towed from the scene.

RABSS VEHICLE

The 1998 Buick LeSabre Custom was identified by the Vehicle Identification Number (VIN): 1G4HP52K5WH (production sequence deleted). The vehicle was a 4-door sedan equipped with front wheel drive and a 3.8 liter, V-6 engine. The vehicle's odometer reading was 26,368 km (16,385 miles) at the time of the crash. The police report listed the driver as the owner of the vehicle. The seating was configured with front (split) and rear benches. The driver reported no previous crashes or maintenance on the air bag system (original equipment). *Next Generation Air Bag* identification labels were affixed to each front window glazing. No cell phone was present or in-use at the time of the collision.

VEHICLE DAMAGE

Exterior Damage

The 1998 Buick LeSabre Custom sustained moderate frontal damage as a result of the impact with the utility pole **(Figure 2)**. The direct contact damage began 20.0 cm (7.9 in) to the left of the front right bumper corner and extended 40.0 cm (15.7 in) inboard. The impact deformed the full frontal width resulting in a combined direct and induced damage length (Field L) of 123.0 cm (48.4 in). Six crush measurements were documented at the level of the bumper: C1= 0 cm, C2= 0 cm, C3= 1.0 cm (0.4 in), C4= 14.0 cm (5.5 in), C5= 42.0 cm (16.5 in), C6= 18.0 cm (7.1 in). The hood was displaced up and rearward from engagement against the utility pole. The right fender was deformed rearward which restricted the right front wheel (not deflated). Reduction in the right side wheelbase measured 10.0 cm (3.9 in). No windshield damage was noted as a result of exterior impact forces, but a spider web fracture pattern was noted from (interior) occupant contact.

Figure 2. Frontal damage to the 1998 Buick LeSabre.

Interior Damage

Figure 3. Interior view.

Interior damage to the Buick LeSabre identified through the NASS vehicle inspection was moderate and was attributed to occupant contact **(Figure 3)**. The upper portion of the steering wheel rim was deformed forward 4.0 cm (1.6 in) with the turn signal column attachment displaced. Scuff marks were documented to the driver knee bolster (padded type) and center instrument panel area. The ashtray was out-of-place. The rear-view mirror was displaced forward (undamaged) with a small spider web fracture pattern noted to the nearby windshield area. The right portion of the front left seat back was deformed slightly rearward. Intrusions into the front right passenger space included 4.0 cm (1.6 in) of longitudinal toepan intrusion and 3.0 cm (1.2 in) of vertical floorpan intrusion.

REDESIGNED AIR BAG SYSTEM

Figure 4. 1998 Buick LeSabre redesigned driver air bag.

The 1998 Buick LeSabre Custom was equipped with redesigned frontal air bags for the driver and front right passenger positions. The air bags had deployed as a result of the crash. Air bag warning labels were affixed to each sun visor. The driver air bag was housed in the center of the steering wheel with a vertically oriented flap tear seam (I-configuration). The flaps were symmetrical in shape and measured 13.0 cm (5.1 in) in width and 9.0 cm (3.5 in) in height. Although no contact evidence was identified on the exterior surface of the module cover flaps, light red horizontal striations were documented on the upper/lower sections of the air bag. The NASS researcher measured the diameter of the driver air bag at 62.0 cm (24.4 in) in its deflated state **(Figure 4)**. No internal tether straps were present. The bag was vented by two ports located at the 3 o'clock and 9 o'clock sectors on the rear aspect of the air bag.

Figure 5. 1998 Buick LeSabre redesigned passenger air bag.

The front right passenger air bag deployed from the right mid-instrument panel area with a single cover flap design hinged at the top aspect. There was no contact evidence identified on the air bag or exterior surface of the module cover flap. The cover flap was rectangular in shape and measured 32.0 cm (12.6 in) in width and 13.0 cm (5.1 in) in height. The NASS researcher measured the passenger air bag at 62.0 cm (24.4 in) square in its deflated state **(Figure 5)**. No internal tether straps were present. The bag was vented by two ports located at the 3 o'clock and 9 o'clock sectors on the side aspect of the air bag. No cutoff switch was reported for the front right redesigned passenger air bag.

DRIVER DEMOGRAPHICS

Age/Sex:	79 year old male
Height:	170 cm (67 in)
Weight:	79 kg (175 lb)
Seat Track Position:	Middle position
Manual Restraint Use:	None
Usage Source:	NASS vehicle inspection, driver interview, medical report
Eyeware:	None
Type of Medical Treatment:	Transported to a local hospital and admitted (one day)

Driver Injuries

Injury	*Severity (AIS 90)*	*Injury Mechanism*
Loss of consciousness (awake on admission)	Moderate (160406.2,0)	Windshield
Contusion bilateral anterior forearms	Minor (790402.1,3)	Front left air bag
Contusion left posterior wrist	Minor (790402.1,2)	Steering column attachment (turn signal arm)
Abrasion right knee	Minor (890202.1,1)	Center instrument panel
Contusion right knee	Minor (890402.1,1)	Center instrument panel

Driver Kinematics

The 79 year old male driver of the 1998 Buick LeSabre had fallen asleep and was presumed to be seated slightly out-of-position to the right with his hands at or in close proximity to the initial 10 o'clock and 2 o'clock positions on the steering wheel rim. The seat back was slightly reclined and the seat track was adjusted to the middle position. There was no evidence on the belt system to support usage, further evidenced by the injuries sustained and contact points within the vehicle.

At impact, the driver initiated a forward trajectory in response to the 12 o'clock impact force as the expanding air bag contacted the anterior aspect of his forearms resulting in bilateral contusions. This mechanism was evidenced by the pre-crash placement of the hands relative to the inflated diameter of the air bag. The left hand subsequently struck the turn signal arm which resulted in a contusion to the posterior aspect of the left wrist, evidenced by the displacement of this component. It was possible that he was out of position to his right pre-crash. At impact he moved forward, and loaded the deployed air bag (with subsequent rim loading following deflation) with his left chest area while his right shoulder moved outboard of the bag. This induced a counterclockwise rotation to his upper body and deflected

his head downward. As a result, his head possibly impacted the glazing which fractured the windshield resulting in the coded loss of consciousness (no associated soft tissue injury reported). This trajectory was evidenced by the steering rim deformation, displacement of the rear-view mirror and spider-web fracture pattern to the windshield. His right knee impacted the center instrument panel resulting in an abrasion and contusion as evidenced by the scuff mark and displaced ashtray. At this point, he rebounded into the front left seat back as evidenced by the deformation identified to the right portion of this component. The driver was transported to a local hospital for treatment and admitted for one day.

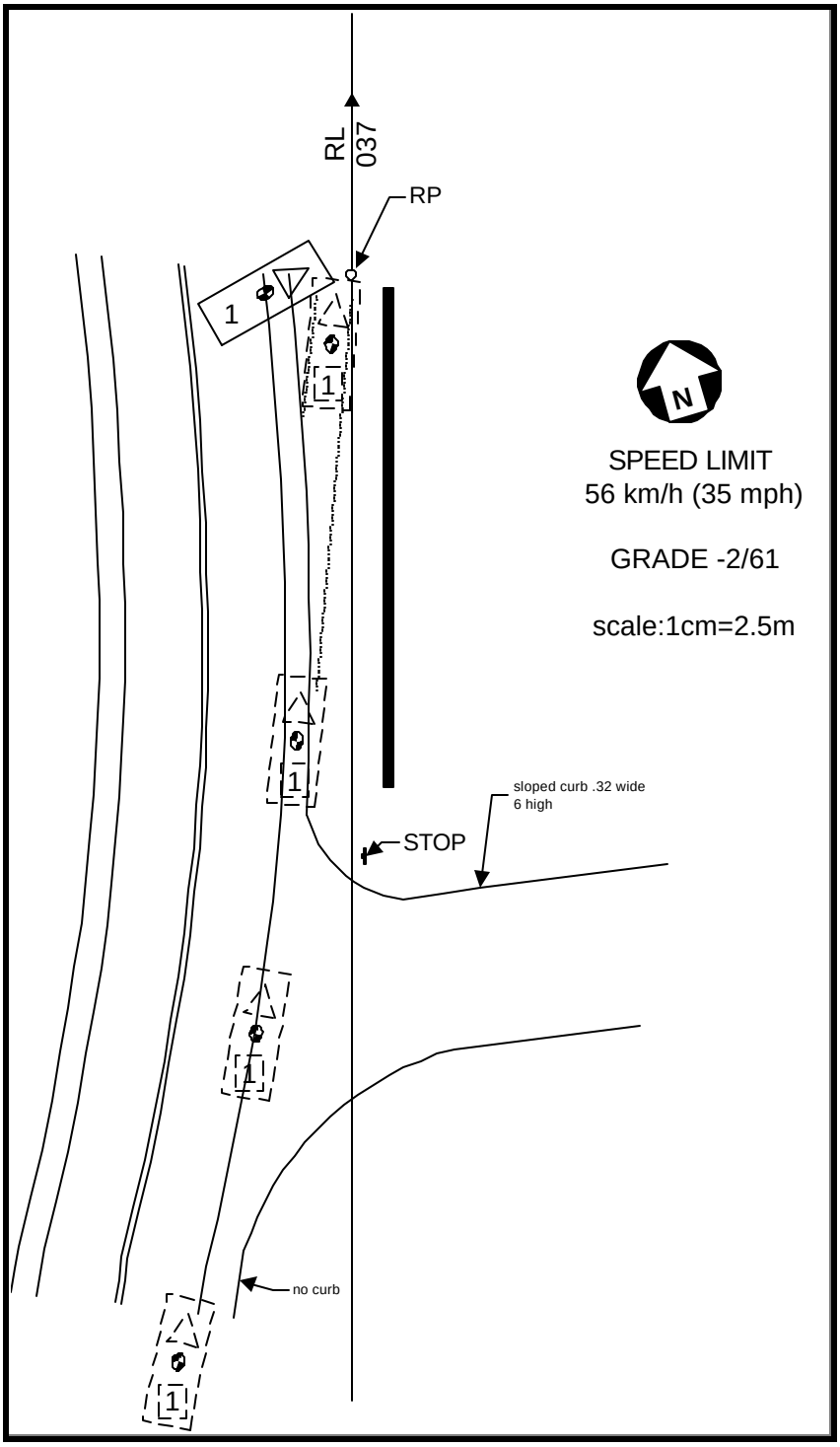

Figure 6. NASS Scene Diagram