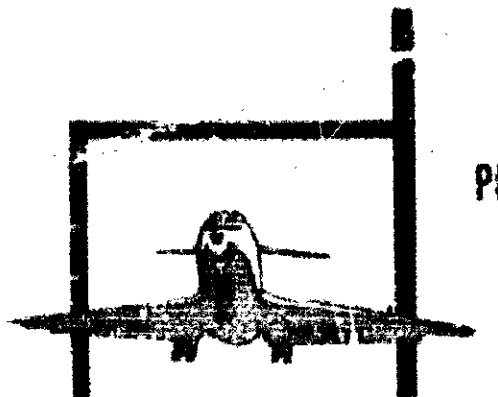

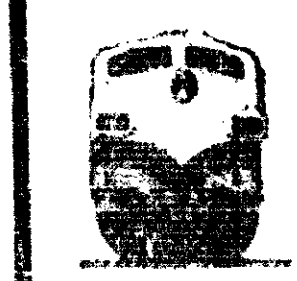

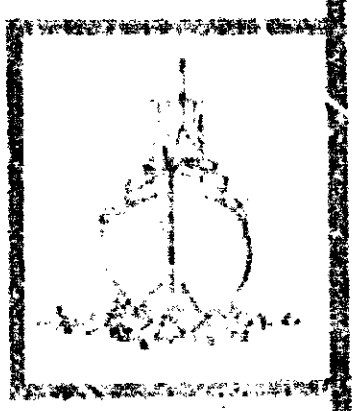

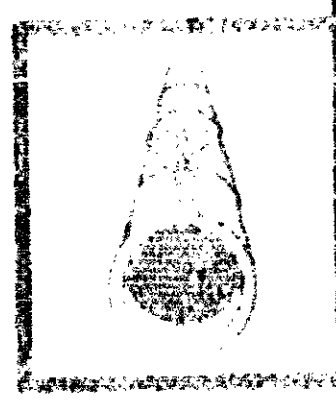

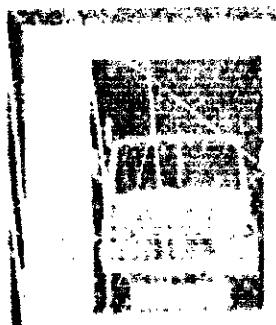

PB84-916207

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

HIGHWAY ACCIDENT REPORT

COLLISION OF
DeQUEEN, ARKANSAS
POLICE DEPARTMENT PATROL CAR
AND TERRELL TRUCKING, INC.
TRACTOR-SEMITRAILER
U.S. ROUTE 71
ASHDOWN, ARKANSAS
JULY 5, 1984

NTSB/HAR 84/07

UNITED STATES GOVERNMENT

TECHNICAL REPORT DOCUMENTATION PAGE

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15. Supplementary Notes

16. Abstract

About 8:40 a.m., central daylight time, on July 5, 1984, a northbound tractor-semitrailer jackknifed and struck a southbound police patrol car on two-lane U. S. Route 71 about 1 mile south of Ashdown, Arkansas. The patrol car was destroyed, and the four police officers inside were killed. The truck was damaged moderately; the truckdriver was injured.

The National Transportation Safety Board determines that the probable cause of this accident was the failure of the driver of the tractor-semitrailer combination to maintain a proper interval from the preceding automobile which required a sudden brake application to avoid a collision with the preceding automobile when it slowed unexpectedly, and resulted in his tractor jackknifing and entering the oncoming traffic lane. Contributing to the accident were the improperly adjusted service brakes on both the tractor and semitrailer.

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NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

HIGHWAY ACCIDENT REPORT

Adopted: October 30, 1984

COLLISION OF DEQUEEN, ARKANSAS, POLICE DEPARTMENT PATROL CAR AND TERRELL TRUCKING, INC., TRACTOR-SEMITRAILER U. S. ROUTE 71 ASHDOWN, ARKANSAS JULY 5, 1984

SYNOPSIS

About 8:40 a.m., central daylight time, on July 5, 1984, a northbound tractor-semitrailer jackknifed and struck a southbound police patrol car on two-lane U. S. Route 71 about 1 mile south of Ashdown, Arkansas. The patrol car was destroyed, and the four police officers inside were killed. The truck was damaged moderately; the truckdriver was injured.

The National Transportation Safety Board determines that the probable cause of this accident was the failure of the driver of the tractor-semitrailer combination to maintain a proper interval from the preceding automobile which required a sudden brake application to avoid a collision with the preceding automobile when it slowed unexpectedly, and resulted in his tractor jackknifing and entering the oncoming traffic lane. Contributing to the accident were the improperly adjusted service brakes on both the tractor and semitrailer.

INVESTIGATION

The Accident

On July 5, 1984, a group of police officers representing city, county, and State police in Arkansas and Oklahoma gathered at the DeQueen, Arkansas, Police Department to travel together 50 miles to Texarkana, Arkansas, to attend a police officer's funeral at 11 a.m. that day. The caravan of 12 marked police cars and 2 civilian cars left DeQueen about 7:55 a.m., led by an Arkansas State Police car, and traveled south on a two-lane section of U. S. Route 71. All of the cars were traveling with their headlights on. All of the police cars were traveling with their overhead blue emergency lights flashing except for one car near the middle of the caravan. It was daylight, the skies were darkened by heavy clouds, rain fell intermittently, and the roadway was wet.

After traveling about 35 miles, the vehicles traveled over a four-lane section of U. S. Route 71 that passes through Ashdown, Arkansas. An Arkansas Highway Police car joined the caravan at Ashdown, and the caravan continued traveling south on the two-lane section of U. S. Route 71 that begins near the south limits of Ashdown. The 15-car caravan reportedly was traveling at the posted speed of 45 mph and extended over a distance of about 1 mile. (See appendix B.)

About 8:40 a.m., an automobile northbound on U. S. Route 71, followed by a Terrell Trucking, Inc., tractor dump-type semitrailer (truck), traveling empty, was approaching the crest of a hill about 1 mile south of Ashdown. The automobile driver said that she was traveling between 40 and 45 mph when she glanced into her rearview mirror and saw the trailing truck so close behind her that she could see the front of the truck but not the driver inside; she then looked forward and saw a flashing light on an approaching police car in the southbound lane as it crossed the hillcrest ahead. She said that she then saw three more cars with flashing lights behind the lead car and "touched" her brake pedal to slow. The truck following the automobile also braked and then jackknifed. The tractor rotated counterclockwise; the front end of the tractor crossed the highway centerline and struck the third car in the southbound caravan, a DeQueen Police Department police patrol car occupied by four police officers. (See figure 1.)

The right front of the tractor near the end of the tractor bumper struck the left front of the patrol car. The portion of the tractor ahead of the front axle overrode the patrol car's passenger space. The patrol car then disengaged from beneath the tractor (rotating counterclockwise) and came to rest upright on the west shoulder of the road facing northwest about 44 feet south of the impact area. The semitrailer remained coupled to the tractor and continued moving northward in the northbound lane after the front of the tractor rotated into the opposing traffic lane. The coupled unit traveled for about 60 feet and stopped upright astride the northbound traffic lane and the shoulder of the road; the front of the tractor was facing southwest in the northbound traffic lane with its left side jackknifed toward the left side of the semitrailer. (See figure 2.) The tractor-semitrailer and the single patrol car were the only vehicles involved in the accident. There was no fire.

The patrol car was destroyed by the crushing forces of the tractor override (see figure 3); the four police officers inside the car were killed instantly. None of the police officers was using available seatbelts. The tractor and semitrailer were moderately damaged. The truckdriver remained at his seat position and suffered moderate injuries. The truckdriver was not using the available seatbelt. The truckdriver was semiconscious after the accident and was assisted from the tractor cab by three Oklahoma Highway Patrol officers who were traveling with the caravan. The officers found two unopened cans of beer on the tractor floorboard; one of the officers picked up the cans and stated that they were warm and dusty.

The drivers and occupants of the second and fourth cars in the caravan said that their vehicles were separated from the accident patrol car by at least five car lengths or more at the time of the accident. The driver of the fourth police car said that when he saw the truck crossing the centerline, he braked and veered off the roadway to the right through a grassy area. A passenger in the fourth police car said that the jackknife angle of the truck was about 90 degrees when the vehicles collided.

The truckdriver said that he had left Sibley, Louisiana, about 6 a.m., en route to Wilton, Arkansas, and had traveled nonstop about 108 miles; he was about 15 miles from his destination when the accident occurred. He said that he traveled through intermittent rain from Sibley, and that it was raining heavily at the accident site; other witnesses said that at the time of the accident it was raining slightly or had recently stopped raining. The truck came onto U. S. Route 71 at Hosston, Louisiana, and had continued on that route through Texarkana to the accident site. From Texarkana, the truck traveled over a four-lane section of U. S. Route 71 for about 5 miles and then over a two-lane section for about 7 miles to the accident site.

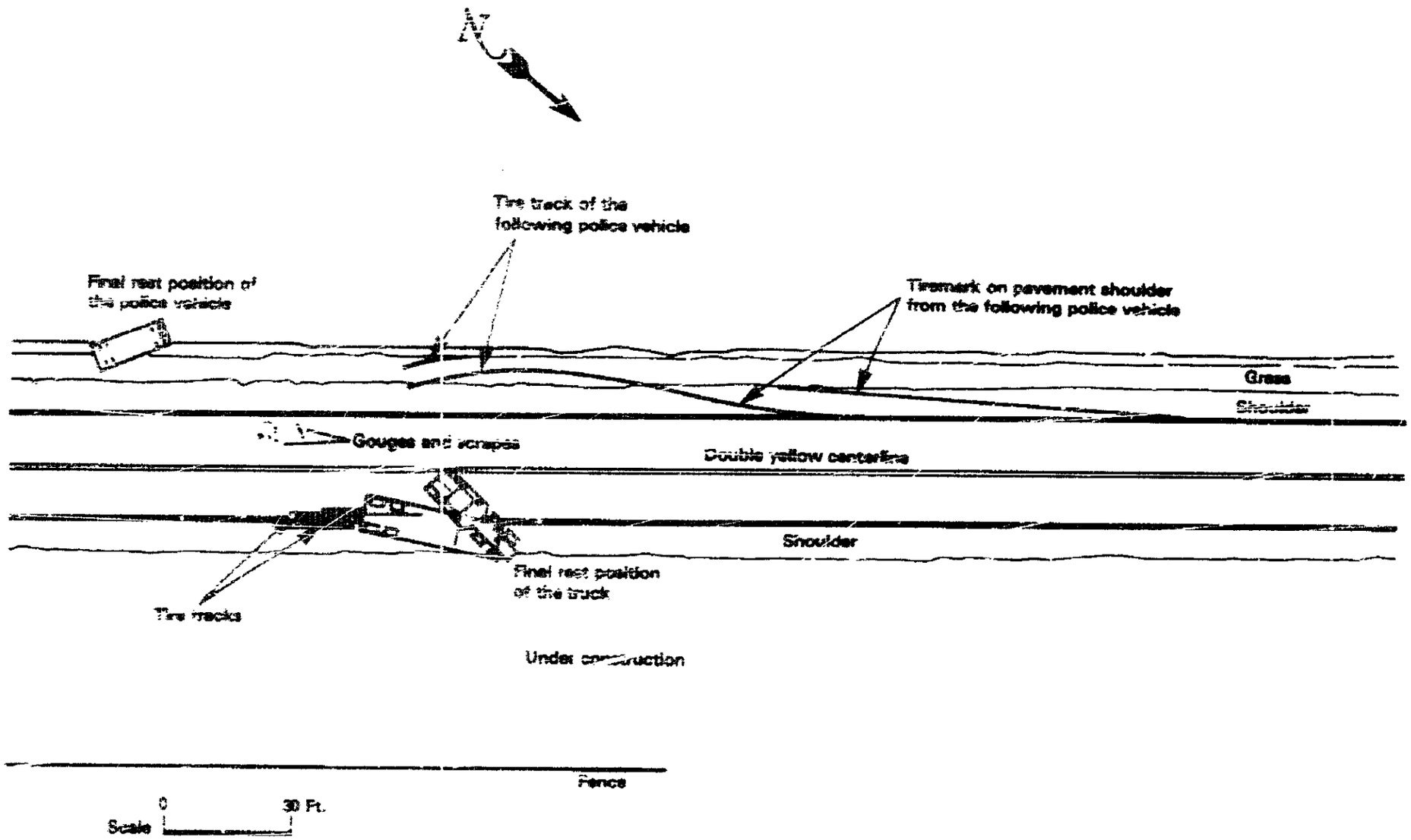

Figure 1.—Plan view of accident site.

Figure 2.—Tractor-semitrailer stopped in the northbound lane of U.S. Route 71.

The truck came up on the automobile it was following at the time of the accident as the two vehicles left Texarkana on the four-lane section of U. S. Route 71. The driver of another truck said that he followed the automobile and the accident truck from Texarkana at speeds of between 50 and 60 mph. This driver said that the accident truck passed the automobile two or three times in the 5 miles he was following the two vehicles. According to this driver, the driver of the accident truck would move into the inside lane and pull up along the left side of the automobile; after traveling alongside the automobile for a short distance, the truck would overtake it and move back to the outside lane in front of the automobile. When fully ahead of the automobile, the accident truck would slow and the automobile would pass the truck. It appeared to the witness that the truckdriver was "playing games" with the woman driver in the automobile. Near the end of the four-lane section, the following truckdriver passed both vehicles, crossed the Red River Bridge, traveled about 2 miles on the two-lane section, and then stopped on the shoulder of the road because of a flat tire on his truck. The automobile was ahead of the accident truck when the two vehicles passed his truck about 5 miles from the accident site.

The driver of the accident truck acknowledged that he and the automobile had been traveling together from Texarkana to the accident site on U. S. Route 71 and that he had passed the car two or three times on the four-lane section in the manner described by the other truckdriver. When questioned if he was "playing around" with the automobile driven by the woman, he replied, "Well, you know how it is." The automobile driver said that she did not recall the truck passing her vehicle. She said that she first became aware of the

Figure 3.—Wreckage of police patrol car.

truck when it came up close behind her car near the end of the four-lane section. The truck followed her over the Red River Bridge and over the 7-mile-long, two-lane section to the accident site. She said that she was frightened by the truck because it tailgated her consistently while trailing her on the two-lane section. The truckdriver said that his vehicle was about three car lengths behind the car and traveling about 40 to 45 mph before the accident.

The investigating Arkansas State Police officer initially charged the truckdriver with traveling too fast for conditions. It was later determined that the truckdriver had a 0.09 percent blood alcohol concentration, and he was charged with four counts of manslaughter.

Injuries to Persons

Injuries	Drivers	Passengers	Others	Total
Fatal	1	3	0	4
Nonfatal	1	0	0	1
None	0	0	0	0
Total	2	3	0	5

Vehicle Information and Damage

Police patrol car.—The police patrol car was a 1981 Chevrolet Impala four-door sedan owned by the city of DeQueen and assigned to the DeQueen Police Department. It was equipped with a roof-mounted emergency blue flashing light bar; the flashing lights were operating at the time of the accident. Both the front and rear seats were equipped with seatbelts, but none was in use. Its black and white color and "DeQueen Police Dept." insignias affixed on each front door prominently identified the vehicle as a police patrol car. The odometer was destroyed in the accident.

Tractor-semitrailer.--The tractor and semitrailer were owned by G. W. Lary Trucking Company, Inc., and leased to Terrell Trucking, Inc. Both corporations are located at Sibley, Louisiana, and are owned by G. W. Lary. The tare weight of the combination unit was 28,860 pounds.

The 1980 Kenworth tractor, VIN No. 181421, had three axles and a conventional cab. It was equipped with a 270 Cummins diesel engine, a Fuller 10-speed Model KT0958LL transmission, Eaton rear axles with a 5.29 ratio, and 11R-24.5 radial tubeless tires. The tire pressures ranged between 70 and 96 pounds; the manufacturers recommend that these tires be inflated between 55 and 120 psi. The tread depth groove measurements ranged between 6/32 and 16/32 inch and averaged 9/32 inch; the Federal Motor Carrier Safety Regulations (FMCSR) (49 CFR Parts 390-397) require that the steering axle tires have a tread depth groove of no less than 4/32 inch and that all other tires have at least 2/32 inch. The tractor was capable of making brake applications of up to 120 psi. The maximum speed of the tractor was approximately 67 mph. The speedometer was inoperative; the odometer read 103,420 miles. The tare weight of the tractor was 17,860 pounds.

The semitrailer was a 1984 Model LW3224 Clement 32-foot-long, tandem-axle, dump-type semitrailer. The two left rear axle tires were 11R-24.5, radial, tubeless; the remaining tires were 11-24.5, bias-ply, tubeless. Except for the two tires mounted at the right rear axle, the tire pressures ranged between 72 and 96 pounds; one of the right rear tires was inflated to 25 pounds and the other to 28 pounds. The tread depth groove measurements of the trailer tires ranged between 2/32 and 12/32 inch, and averaged 9/32 inch. The tare weight of the semitrailer was 11,000 pounds.

All of the wheels on the combination unit were equipped with air mechanical "S" cam-type brakes, manual slack adjusters, and "C" clamp-type brake chambers. The front (steering) axle wheels on the tractor had 15- by 4-inch brakes with type-20 chambers and 5 1/2-inch slack adjusters. The tandem axle wheels on the tractor and trailer had 16 1/2- by 7-inch brakes with type-30 chambers. The tractor tandem axles had 5 1/2-inch slack adjusters, and the trailer had 6-inch slack adjusters. The brake chambers on the rear tandem axle of the tractor and on both axles of the trailer had a spring-actuated, dual split system brake (piggyback spring brake).

The brake drum at the right rear tandem axle of the tractor was deeply grooved by projecting rivets in the upper brake shoe on which the lining was only 4/32 inch thick; there was no drum contact when the brakes were applied in postaccident testing. The remaining brake shoe lining thicknesses on the brakes of the tandem axle of the tractor measured 9/32 inch to 15/32 inch; the FMCSR requires that brake linings be adequate in thickness to provide for safe and reliable stopping of the motor vehicles. The brake shoe lining thicknesses on the brakes of the tandem axle of the semitrailer measured 15/32 inch to 18/32 inch. New lining thickness is 24/32 inch; rivet heads are 8/32 inch above the brake shoe. The visual inspection of the brake drums and the brake shoe linings of the tandem axles of the tractor and semitrailer revealed no other deficiences that would adversely affect braking capability.

The air braking system of the tractor and semitrailer in combination was checked by an inlet air test, and no air loss was detected. The push rods from the brake chambers on all wheels were operating normally; the cam bushings, anchor pins, hoses, and slack adjusters were in good mechanical condition.

The brake adjustments on three of the six tractor wheels and on all four semitrailer wheels were close to the maximum stroke limits. The strokes of the brake slack adjuster of the tractor's front (steering) axle brakes measured 2 1/8 and 2 1/4 inches; the maximum stroke limit was about 2 1/3 inches. The stroke of the tractor's left rear tandem axle brake measured 2 1/2 inches, and the strokes of the four semitrailer brakes measured 2, 2 1/4, 2 1/8, and 2 1/4 inches; the maximum stroke limit was 2 1/2 inches. The tractor manufacturer recommends that the tractor brakes be adjusted to as short a stroke as possible without the brakes dragging and recommends a maximum 1 7/8-inch stroke on the front (steering) axle brakes and a maximum 2 1/4-inch stroke on the tandem axle brakes. The semitrailer manufacturer recommends that the semitrailer brakes be adjusted to as short a stroke as possible without the brakes dragging; the manufacturer does not specify a recommended maximum stroke. (See table 1.)

The motor carrier did not maintain records of adjustments or repairs performed on the tractor or semitrailer. Both vehicles were placed in service by the motor carrier on March 12, 1984; the tractor was used and the trailer was new. The carrier's shop foreman said that he installed new brake shoes on the two wheels of the forward tandem axle of the tractor on March 24, 1984; he adjusted the brakes on the four tandem axle wheels at that time. His normal practice was not to check or adjust the brakes on the front (steering) axle wheels of tractors, and he did not adjust the steering axle brakes on the accident tractor. The shop foreman stated that he preferred that steering axle wheels not be equipped with brakes; therefore, he never adjusts brakes on steering axle wheels so they will be rendered inoperative. 1/ He reportedly adjusts all the brakes except the brakes on the front (steering) axle wheels on all company equipment every 2 or 3 weeks. He said that he believed that the brakes (except those on the tractor's steering axle) on the tractor-semitrailer involved in the accident had been adjusted within the 3 weeks before the accident.

The driver of the accident truck had driven the tractor and semitrailer as a unit since they had been placed in service. The truckdriver said that he had not adjusted the tractor brakes, but that he had adjusted the semitrailer brakes about 2 weeks before the accident. He said that he adjusted the semitrailer brakes by turning the adjustment screw clockwise until the brake shoe linings were in tight contact with the brake drums, and he then turned the same screw counterclockwise "a round and a half" to release the linings from the drum. When readjusted to the manufacturer's recommended measurements after the accident, it was necessary to turn the adjustment screw less than 1/4 turn counterclockwise to release the brake shoe linings from contact with the brake drum. The motor carrier's owner stated that he permitted his drivers to adjust brakes on their trucks but had not provided any training on the techniques to be used.

Safety Board investigators examined the wreckage of the combination unit 2 days after the accident at a salvage yard where it was taken after the accident. The tractor transmission was in neutral; the driver of the wrecker that removed the vehicles from the accident site said that the transmission was placed in neutral at the accident scene so that the truck could be towed, and that he did not know its setting at the accident scene. A Louisiana safety inspection sticker indicated that the tractor was inspected on May 5, 1984. The windshield wipers were on; when air was supplied to the vehicle, the wipers began operating. The right end of the bumper was deformed rearward and upward alongside the right longitudinal frame member. The front headlight assembly was torn

1/ Some truckdrivers believe that if brakes do not operate on the steering axle wheels they have a better opportunity to steer to avoid accidents and to prevent jackknifing. In reality, lack of brakes on the front wheel may enhance the occurrence of jackknifing especially on wet pavement and the combination vehicle can not stop as quickly.

Table 1.--Brake adjustment information.

	Brake push rod (slack adjuster) stroke measurement (inches)			Maximum brake chamber push rod stroke capability (inches)
	After crash 1/	Adjusted to manufacturer's recommendation 2/	Excessive adjustment	
Tractor--				
Front axle				
Left	2 1/8	1 1/2	5/8	2.334
Right	2 1/4	1 1/2	3/4	2.334
2nd axle				
Left	1 9/16	1 3/8	3/16	2 1/2
Right	1 3/4	1 5/16	7/16	2 1/2
3rd axle				
Left	2 1/2	1 1/8	1 3/8	2 1/2
Right	1 3/4	1 3/16	9/16	2 1/2
Semitrailer--				
Front axle				
Left	2	1 3/8	5/8	2 1/2
Right	2 1/4	15/16	1 5/16	2 1/2
Rear axle				
Left	2 1/8	1	1 1/8	2 1/2
Right	2 1/4	1	1 1/4	2 1/2

1/ All stroke measurements were made with at least 60 pounds air pressure.

2/ Manufacturers' recommended stroke measurements:

Tractor--- Short as possible without brakes dragging. Maximum stroke front-axle brakes, 1 7/8 inches; rear-axle brakes, 2 1/4 inches.

Semitrailer-- Short as possible without brakes dragging. Maximum stroke not specified.

away, the lower half of the front bumper was bent rearward, and the lower grill was deformed inward. Undercarriage components ahead of the front axle, the lower grill, and the entire front bumper showed markings from contact with the patrol car; the spring hanger spacer on the left front (steering) axle was broken. The left rear of the cab and left saddle tank were crushed inward; the transmission bell housing and the engine oil pan were breached. All components associated with the steering system appeared to be normal; there was no damage to the tires.

The left side of the semitrailer body was deformed inward, matching the location where the left rear of the tractor cab struck the trailer when the unit jackknifed; the semitrailer's left support leg was similarly deformed by the tractor's left saddle tank. No other damage to the semitrailer was evident. There were no markings on the semitrailer to indicate that it was struck by the patrol car.

Terrell Trucking, Inc., and the DeQueen Police Department estimated the property damage to be:

Tractor-semitrailer	$17,425
Police patrol car (including equipment)	7,000
Total	$24,425

Driver Information

The 33-year-old driver of the patrol car was employed as a captain on the DeQueen Police Department's seven-person police force. He had been employed in his current position since May 1981. He held a valid, nonrestricted, Arkansas operator/motorcycle license. His driver license record revealed no past traffic violations or accidents.

The 46-year-old truckdriver had driven tractor-semitrailer units for approximately 21 years; he had been driving for Terrell Trucking, Inc., since January 1981. He had received no formal training in the driving or maintenance and repair of truck tractors or semitrailers. He held a valid Louisiana Chauffeur (Class D) driver license restricted to require wearing corrective lenses; he reportedly was wearing his prescription glasses at the time of the accident. His driver license record showed that since November 1979 he had been convicted of seven moving and one nonmoving traffic violations; four of the violations were for speeding. The truckdriver said that he was involved in one previous accident about 9 years ago, for which he was not cited. (See appendix C.)

The truckdriver stated that he began drinking when he was 21 and was a light drinker for several years. He said he progressively became a heavy drinker, and his alcohol problem caused his first marriage to end in divorce. He said he continued to drink heavily until 1978, when he stopped drinking at his second wife's insistence. Both the truckdriver and his wife said that that he had drunk beer or whiskey only once since 1978; in May 1984, the truckdriver drank one can of beer, and it made him "so drunk and sick," he said, that he had taken no alcoholic drink since. The truckdriver said that he had never received any medical treatment or rehabilitation for his alcohol problem.

A brother-in-law and his family spent the night of July 3, 1984, and all day on July 4, 1984, at the truckdriver's house. The brother-in-law brought along 36 cans of beer that were consumed in the truckdriver's presence. The brother-in-law said that he encouraged the truckdriver to drink some of the beer but the truckdriver refused. The brother-in-law said that he and his wife drank all of the beer. The smell of beer reportedly gave the truckdriver a violent headache, and he took two Tylenol

(acetaminophen) capsules about 2 p.m. on July 4, 1984, two more between 5:30 and 6:30 p.m., and two more when he went to bed at 11:30 p.m. The truckdriver and his wife said that he drank none of his brother-in-law's beer.

The truckdriver said that he got up on July 5 about 3:30 a.m. after 4 hours sleep. He ate no breakfast but drank about seven cups of black caffeinated coffee while preparing to leave for work. He reported for work at the Sibley terminal of Terrell Trucking, Inc., at 5:05 a.m., and departed about 6 a.m. The truckdriver said that he did not stop between Sibley and the accident site. He said that he had not consumed any alcoholic beverage on the day before or the morning of the accident. The carrier owner, who dispatches his trucks each morning, and at least three other drivers saw the truckdriver at the terminal before he departed. The owner and one of the drivers said they talked to the truckdriver and noted no smell of alcohol; the owner and all three of the witnessing drivers stated that his behavior did not indicate to them that he had been drinking. He had been on duty about 61 1/2 hours during the preceding 8-day-period and had been driving about 2 3/4 hours when the accident occurred. (See appendix D.)

At the time of the accident, the truckdriver did not have a medical examiner's certificate that he was physically qualified to drive a motor vehicle, as required by the FMCSR. The truckdriver said that the carrier owner never had required him to be medically examined to determine if he was physically qualified as an interstate driver under the FMCSR requirements.

Highway Information

For 7 miles, in the vicinity of the accident site, U. S. Route 71 is a two-lane, two-way roadway. This two-lane section connects a four-lane section that ends 6.2 miles north of Interstate 30 to a five-lane section that begins 0.8 mile south of Ashdown. The accident occurred 0.9 mile south of the north end of the two-lane, two-way section. The asphalt-surfaced road has two 12-foot-wide lanes with a 7.25-foot-wide asphalt shoulder adjacent to the northbound lane and an 8-foot-wide asphalt shoulder adjacent to the southbound lane.

The roadway was built in 1950, and there have been no changes since its initial construction. The roadway in the area of the accident site is divided by a double yellow-painted centerline. The shoulder was constructed of an asphalt material that provided a contrast with the roadway. The painted edgeline on the road had been worn away. Adjacent to the southbound shoulder was a grassy 6-foot slope down to a drainage ditch. The area adjacent to the northbound shoulder was disrupted by road-widening construction. The overall profile in the area of the accident site is straight with a vertical sag. About 250 feet before the point of impact, the truck began to climb a 1.8-percent upgrade, which continued to the crest of the hill about 525 feet north of the point of impact. (See figure 4.)

The cross section of the road had a normal crown of 2 to 3 percent. Rutting was measured in the northbound wheelpath; it was about 0.06 to 0.125 inch deep in most locations. The northbound roadway had a rut 0.375 inch deep in the right wheel track about 50 feet south of where gouge marks, indicating an area of impact, were found in the southbound lane.

Beginning about 1 mile south of the accident site, the two-lane highway is being widened into a five-lane section, which will extend northward to and join a five-lane section south of Ashdown. The existing roadway in the vicinity of the accident site was scheduled to be resurfaced. No construction work was performed between July 4 and

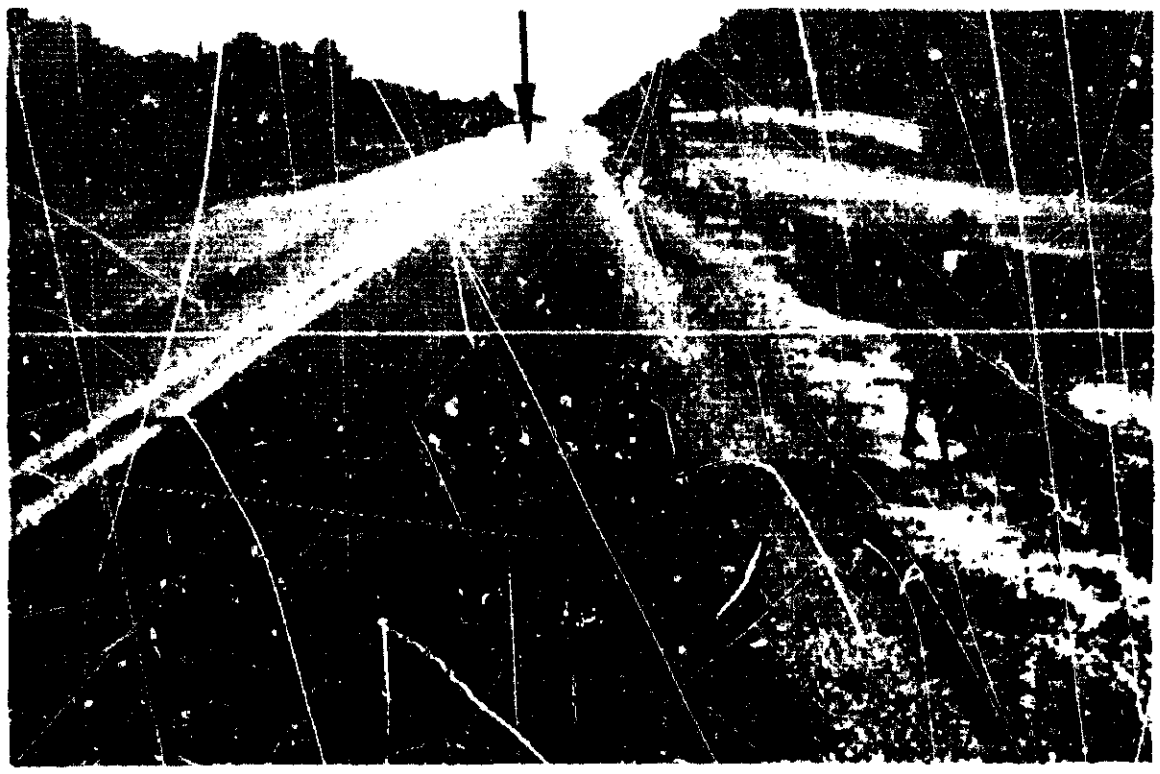

Figure 4.—View northward at accident site on July 6, 1984, showing the construction conditions at the time of the accident. Point of impact is noted by "X."

July 7 because of wet conditions. When observed on July 6, the soil adjacent to the northbound asphalt shoulder dropped 15 inches in 3 feet, and at the bottom of the vertical sag there was a deep dropoff where a box culvert was being constructed. There were construction signs covered with burlap in the accident vicinity. These signs were to be used for a detour that was not yet completed. The speed limit in the area of the accident site was 45 mph according to posted regulatory signs; the speed limit was not related to the construction area.

Physical evidence at the accident site included gouge marks and scrapes in the southbound lane at the point of impact. In addition, there was a tire mark on the southbound pavement shoulder, similar to that made by a vehicle braking on wet pavement, and a path through the grass; this mark and path were identified as having been made by the police car that was following the patrol car involved in the accident.

According to a survey conducted by the Arkansas State Highway Transportation Department (ASHTD), the average daily traffic on U.S. Route 71 at the accident site was 8,877 vehicles on July 17-18, 1984. The ASHTD survey found that 17.8 percent of the vehicles were trucks, many of which were transporting logs locally. The ASHTD analyzed the accident data for the 7-mile, two-lane, two-way section for July 1980 through June 1983 (log mile 1.20 to 8.30). The data revealed 5 other fatal accidents, 21 injury accidents, and 60 property damage accidents in the 3-year period. The data indicate:

- o 16.3 percent of the accidents on this section of U. S. Route 71 are on wet surfaces, as compared to 21.3 percent statewide.
- o The accident rate on this section of U. S. Route 71 is 1.37 accidents/million vehicle miles, compared to the statewide accident rate for a two-lane, rural highway of 1.41 accidents/million vehicle miles.
- o There were three other reported head-on accidents.

- 26 accidents were rear-end accidents, and 21 accidents were sideswipe accidents.
- 23 accidents involved left turns.
- 15.4 percent of the vehicles involved in accidents were semi-trucks.

Carrier Mode of Operation

Terrell Trucking, Inc., is a for-hire interstate motor carrier authorized by the Interstate Commerce Commission to transport gravel, rock, sand, and lignite coal in bulk between points in Arkansas, Louisiana, and a designated area of eastern Texas. The carrier is subject to the requirements of the FMCSR administered by the Bureau of Motor Carrier Safety (BMCS), Federal Highway Administration (FHWA), U. S. Department of Transportation. The carrier's owner also owns G. W. Lary Trucking Co., an intrastate motor carrier that transports gravel and sand in northwest Louisiana. The corporate headquarters for both motor carriers are in Sibley, Louisiana, where the owner maintains office and garage facilities.

Repairs to carrier-owned equipment were made in the motor carrier's garage. The motor carrier had no systematic inspection and maintenance program and did not maintain records of adjustments or repairs performed on vehicles in its garage. These records are required by the FMCSR. The carrier operates one outlying terminal at Ashdown. At the time of this accident, the carrier was operating 46 tractor-semitrailer units and employed 46 truckdrivers. Seven of the combination units were owned by the carrier, 9 were owned by G. W. Lary Trucking and were under lease to the carrier, and 30 were leased from owner-operators. The owner-operators were responsible for repairs to their equipment.

Carrier Oversight

The motor carrier is under the jurisdiction of the Baton Rouge, Louisiana, field office of the Office of Motor Carrier Safety (OMCS), 2/ which administers BMCS regulations in Louisiana. The field office is staffed by two investigators responsible for monitoring the operations of approximately 4,550 interstate motor carriers based in Louisiana to insure their compliance with the FMCSR. The investigators are also responsible for compliance with Federal Hazardous Materials Regulations (49 CFR Parts 171 through 179) by motor carriers and shippers in Louisiana.

The FHWA has an automated Management Information System (MIS) designed to give the OMCS, through its regional and division offices, access to multiple data on known motor carriers operating in interstate commerce. Some of the FHWA regional offices have provided terminal access to the MIS at some of the FHWA division offices where an OMCS officer-in-charge is located. The Louisiana division office has access to the MIS.

The MIS data include the total number of known interstate motor carriers nationally. This total is further subdivided by the total number domiciled in each State. The record for each carrier indicates whether the carrier has ever received a safety audit from BMCS inspectors. Based on data for known active interstate motor carriers supplied to the Safety Board by the BMCS in September 1984, safety audits have been performed on 11.1 percent of the motor carriers domiciled in Louisiana (505 of 4,551); 21.9 percent (45,648 of 208,422) of all carriers nationwide had received safety audits. Of interstate

2/ The FHWA has designated the former BMCS field operation in its regional and division offices as the Office of Motor Carrier Safety. The only FHWA employees designated as BMCS personnel are at the Washington D.C. headquarters.

motor carriers based in Louisiana with fleets of 100 to 999 vehicles, 60 percent have been audited; 73.7 percent of the interstate fleet operators nationwide have been audited. Of interstate motor carriers with fleets of 24 to 100 vehicles, 55.6 percent based in Louisiana have been audited, compared to 83.6 percent nationwide. Of interstate motor carriers with fleets of 7 to 23 vehicles, 26 percent based in Louisiana have been audited; nationwide, 63.5 percent of such carriers have been audited. Of interstate motor carriers with fleets of six or less vehicles, 8.2 percent based in Louisiana have been audited, 16.8 percent of such carriers have been audited nationwide. (The BMCS criteria for scheduling audits are listed in appendix B.)

Although the OMCS had mailed Terrell Trucking, Inc., a copy of the FMCSR in 1980, accompanied by a letter outlining the motor carrier's responsibility to comply, and although the MIS selected the carrier for a safety audit in Fiscal Year (FY) 1984, no audit was made prior to the date of this accident. The audit was on a priority list on which 465 other carriers were listed ahead of Terrell Trucking, Inc. On February 1, 1984, the OMCS sent a letter to the carrier advising the carrier that one of its drivers (not the driver involved in the Ashdown accident) was disqualified from driving in interstate commerce because of a recent conviction for driving while under the influence of alcohol; the driver received a similar letter. The driver reportedly advised the carrier owner that he had retained an attorney to resolve the disqualification matter with the OMCS. The disqualified driver was permitted by the carrier to continue driving, and he was still driving for the carrier at the time of this accident.

In FY 1983, the Louisiana office of the OMCS conducted 72 carrier safety audits, 114 hazardous materials surveys, and 54 roadside checks, and initiated 9 documented enforcement cases. Through 11 months of FY 1984, the office conducted 75 carrier safety audits, 85 hazardous materials surveys, and 204 roadside checks. The office initiated 33 documented enforcement cases, and expended 165 hours training State motor carrier inspectors.

On July 10, 1984, an OMCS investigator visited the Sibley office of Terrell Trucking, Inc., and conducted a compliance audit of the motor carrier's operation. That audit revealed the following FMCSR violations:

FMCSR Section		Violation
391.11(b)(9)	-	Using a disqualified driver [one driver].
391.51(a)	-	Failing to maintain a driver qualification file on each driver employed [all drivers].
394.7	-	Failing to give immediate notice to FHWA of a fatal accident.
394.9	-	Failing to report an accident.
395.8(1)	-	Failing to maintain accurate and true records showing the time a driver reports for duty, the total number of hours a driver is on duty each day, and the time a driver is released from duty [violation extended to the carrier's 30 leased drivers that should have been preparing daily logs in lieu of the time record].

FMCSR Section		Violation
396.3(b)(1)	-	Failing to keep minimum records of inspection and maintenance [all vehicles the carrier operated].
392.5(a)(2)	-	Driver consuming or under the influence of an intoxicating liquor while operating a motor vehicle [citing the driver in the Ashdown accident].

The OMCS audit showed an overall evaluation of the motor carrier's safety compliance with the FMCSR to be "Unsatisfactory." Following the audit, the OMCS investigator prepared an enforcement case citing the motor carrier for using a disqualified driver and charged the driver with driving after having been disqualified. The case was forwarded to the General Counsel of the FHWA on September 13, 1984; the case is pending at this time.

On July 19, 1984, 2 weeks after this accident, an Arkansas Transportation Commission investigator cited the motor carrier after one of its vehicles was involved in an accident on U. S. Route 71 about 4 miles from where the July 5 accident occurred. One person was injured, and the truckdriver was charged by the Arkansas State Police with driving too fast for conditions. According to the accident report, the truckdriver tried to brake when a van in front of his truck was turning from the highway. The tractor-trailer hit the van, jackknifed, and struck an oncoming pickup truck. The driver of the pickup truck was injured. The investigator cited the motor carrier for the truckdriver not having a log book or medical certificate, for the vehicle not having emergency equipment, and for unsafe vehicle operation. The investigator discovered 10 violations under the unsafe vehicle operation category, including no brakes on the trailer, working brakes on only one set of wheels on the tractor tandem axle, and a cracked frame on the tractor.

Meteorological Information

At the accident site, there were thunderstorms and rain showers throughout the early morning hours of July 5, lasting until shortly after the time of the accident. Based on an interpretation of the available weather radar information, the intensity of the rain showers was light to moderate, up to 1.1 inches per hour, from 8 a.m. to about 8:24 a.m. From 8:24 a.m. until the time of the accident, the intensity of the rain showers was light, less than 0.2 inch per hour. All of the witnesses said that the pavement was wet; however, some of the witnesses did not recall that it was raining at the time of the accident.

Medical and Pathological Information

The four fatally injured officers in the patrol car died at the scene. The Little River County, Arkansas, coroner determined that each of the officers died from massive injuries received in the accident.

The truckdriver's injuries included a broken rib plus some contusions and superficial abrasions on the left cheek and face. He was taken from the scene by ambulance to an Ashdown hospital where he was hospitalized for 1 day.

Postcrash toxicology was performed on both drivers. The blood sample taken from the patrol car driver was negative for drugs and alcohol. The blood sample taken from the truckdriver was negative for drugs but revealed a 0.09 percent blood alcohol concentration (BAC).

The officers who assisted the truckdriver from the truck after the accident said that they did not detect the odor of alcohol either in the tractor or about the truckdriver. The nurse that accompanied the truckdriver in the ambulance from the accident site to the Ashdown hospital stated that she did not smell an odor of alcohol. The head nurse in the hospital emergency room said that she thought she detected the odor of alcohol on the truckdriver when he was treated there. The attending physician detected the odor of alcohol on the truckdriver's breath and specifically mentioned it in his emergency room notes. However, the physician did not observe any behavioral characteristics that would have indicated the truckdriver had consumed alcohol.

The blood sample was taken from the truckdriver at 9:50 a.m. The 3 ml of blood was taken according to good medical practice without the use of alcohol for a disinfectant and was placed in a gray-top tube. The tube contained an anticoagulant and sodium fluoride to prevent bacterial growth. The blood sample was given immediately to an Ashdown police officer to be delivered to the Arkansas State Police investigating officer. This transfer did not take place until 10:30 a.m. The investigating officer also received, at approximately 11:30 a.m., a blood sample taken from the deceased officer who operated the patrol car involved in the accident. The investigating officer had the samples in his possession until 8:30 p.m. while he was investigating the accident. The samples were either in his pocket or on the front seat of his police vehicle during the day. Sometimes the samples were in an air-conditioned environment and sometimes they were exposed to the outside temperature, which reached about 80° during the day. Both samples apparently were handled and maintained under the same conditions.

At 8:30 p.m., both samples were placed in a refrigerator at the Hope, Arkansas, State Patrol Troop Headquarters. At about 10:30 a.m. on July 6, 1984, another officer of the Arkansas State Police removed the blood samples from the refrigerator and delivered them to the State crime laboratory in Little Rock. The laboratory records show that the samples were received at 12:54 p.m. on July 6.

In summary, the blood sample taken from the truckdriver was in the possession of the investigating officer for about 10.5 hours. The sample was not received by the laboratory until approximately 27 hours after it was removed from the truckdriver.

The toxicologist at the laboratory reported that he received approximately 3 ml of blood, which, based only on visual inspection, appeared to be adequately preserved. A gas chromatographic (GC) procedure was used to analyze the sample for ethyl alcohol. Other products that are indicative of putrefaction, such as acetaldehyde and n-propanol, were not found.

A State regulation for blood testing, issued by the Arkansas Department of Health, sets forth the following criteria under which blood samples are to be collected, identified, and stored until analysis:

1. Collect 5 ml (smaller samples may be analyzed if necessary) under sterile conditions without the use of alcohol as a disinfectant;

2. Place blood in a sterile container with sodium fluoride preservative and sodium citrate or potassium oxalate anticoagulant;

3. Sample is to be sealed, identified, labeled, and initialed by individual collecting sample;

4. Place in a tamperproof container;

5. Refrigerate sample except in transit; and

6. Officer requesting blood sample should observe the collection so that he may attest to the authenticity. He should mark it for future identification.

Although not in the regulation, it is the Arkansas Department of Health policy to preserve any remaining sample after the analysis.

Survival Aspects

Two ambulances from the Little River County Memorial Hospital Service in Ashdown responded to the scene shortly after the accident; the personnel on the ambulances included two emergency medical technicians and two licensed practical nurses. The truckdriver was transported to the Little River County Memorial Hospital in Ashdown. The patrol car was towed to a location about 1 mile from the scene where the bodies of the police officers were removed and taken to the local hospital.

The patrol car was equipped with three-point shoulder harnesses at the front seating positions and lapbelts at the rear seating positions. None was in use at the time of the accident. It is not probable that the severity of the police officers' injuries would have been reduced if they had been wearing the seat restraints because of the extensive damage to the patrol car's occupant compartment. In 1981, the International Association of Chiefs of Police (IACP) passed a resolution (A-34) to support the National Highway Traffic Safety Administration (NHSTA) program promoting the use of seatbelts by police and other public employees. The 1981 resolution reinforces the 1976 IACP Model Procedure (PR-76-084) which states, "All department personnel as either drivers or passengers in a moving departmental vehicle shall wear seatbelts if they are available for use in the seated position which they are occupying."

The truckdriver was not wearing the available seatbelt. His injuries were typical of the type of injuries that drivers generally receive when they are thrown forward from their seat during a crash. Inasmuch as the driver compartment of the tractor was not damaged, the severity of the truckdriver's injuries probably would have been reduced if he had been wearing the available seatbelt.

Tests and Research

Semitrailer brakes.--On July 9, 1984, Safety Board investigators performed several braking tests using the accident semitrailer and a tractor similar to the one involved in the accident. The semitrailer was empty, as it was at the time of the accident. The precrash adjustments of the semitrailer's service brakes were not changed. Two tests were performed on a dry pavement surface at 37 and 45 mph with a service braking application pressure of 60 psi. The application of 60 psi was used because it was the pressure estimated by the truckdriver at which he made the sudden stop. In addition, another truckdriver, employed by Terrell Trucking, Inc., was asked to simulate a sudden stop in a similar tractor and semitrailer by using a service braking application, and an application of 60 psi was observed. None of the semitrailer wheels stopped rolling before the tractor brakes brought the entire combination unit to a stop. A third test using a similar tractor and the accident semitrailer was made at 33 mph on dry pavement by applying the semitrailer brakes only with full line pressure (about 120 psi). The unit stopped after about 1/4 mile; only the left forward wheel stopped rolling before the unit came to rest. In each of the three tests, the semitrailer tracked behind the tractor and the combination unit did not jackknife.

Highway pavement.--Since the pavement was wet at the time of the accident, the surface was tested to determine certain characteristics of the pavement. The tests included sand patch tests to measure texture, wet pavement skid tests with an ASHTD skid trailer, and flooding of the surface. Texture depth measurements were made on July 8, 1984, using the sand patch method. The average texture depth ranged from 0.017 inch to 0.036 inch.

There are no Federal regulations or guidelines regarding minimum pavement texture depths for minimizing hydroplaning by vehicles on wet pavement. One study has recommended a minimum average texture depth of 0.040 inch. 3/ Research conducted in France developed five categories of asphalt and concrete pavements based on the sand patch test. 4/ For pavements with texture depths of 0.007 inch or less, this research noted: "Very fine-textured pavements; these pavements are to be prohibited." For pavements with texture depths of 0.007 inch to 0.015 inch, this research noted: "Fine-textured pavements; vehicle speeds are only occasionally capable of exceeding 80 Km/h hour (50 mph), e.g., in urban areas." For pavements with texture depths of 0.015 inch to 0.031 inch, this research noted: "Medium-textured pavements; these are normal pavements for sections on which moderate speeds are encountered between 80 and 120 Km/h (50 and 75 mph)." Texture depths between 0.031 inch and 0.047 inch were termed "coarse-textured pavements; these pavements are to be used for sections on which speeds are normally higher than 120 Km/h (75 mph)."

Skid testing in compliance with American Society for Testing and Materials (ASTM) standard test method E274-79 was conducted at the accident site on July 9, 1984. All wheelpaths were tested when wet at 40 mph. The pavement temperature was 33° C (91° F). The results of the tests indicated that the skid numbers ranged between 32 and 39 with an average of 35 in the left wheelpath and between 30 and 36 with an average of 33 in the right wheelpath in both directions. At the accident site the skid numbers in the northbound left wheelpath averaged 38.5 while the right wheelpath averaged 34.3. 5/

On July 9, 1984, the surface was flooded in the northbound lane 50 feet before the point of impact and at the point of impact, using a hose and the water from the skid trailer. The water drained diagonally across the pavement, and the length of flow was measured as 14.75 feet at the point of impact and as 13.33 feet at a point 50 feet before impact. There was no noticeable flow of water in the wheelpaths.

New Investigative Techniques

It is well known that tractor-semitrailers are subject to sudden or unpredictable jackknifing during use of brakes on wet or icy surfaces, but jackknifing usually will not occur on dry roads that have a higher skid resistance due to the higher lateral resistance. Through computer simulation, it was possible to study the Ashdown accident by making a model of a similar truck operating on a similar road and to observe the jackknifing action in response to braking. Because the parts of the model could be easily changed, it was possible to separate the factors that influenced jackknifing in the accident and to assess

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3/ "Tentative Pavement and Geometric Design Criteria for Minimizing Hydroplaning," Gallaway, et. al., February 1975, FHWA-RD-75-11.
4/ "Pavement Characteristics and Skid Resistance," Eisenaar, Reichert, and Sauterey, Transportation Research Record No. 622, 1976.
5/ A skid number is the coefficient of friction times 100 of a standard tire sliding on wet pavement when tested at 40 mph with a two-wheel skid trailer or equivalent device following the procedures outlined in ASTM E274-79. Skid numbers on the order of 10 to 15 are typical of ice-covered surfaces, while numbers of 80 and above are typical of clear, dry, rough-textured surfaces, and indicate optimal operating conditions.

their causative effect. Safety Board investigators used the T3DRS:V1 computer program developed by the Motor Vehicle Manufacturers Association, the University of Michigan Transportation Research Institute, and the NHTSA.

The T3DRS:V1 simulation functions by creating a mathematical model of the tractor-semitrailer and the highway and then operating the truck model over the highway model under conditions which approximate those at the time of the accident. An initial speed and the timing of braking and steering applications are entered into the computer, and the computer simulates the run of the vehicle, calculating the resultant path of the vehicle. The computer also calculates the speed of the vehicle, the headings of the vehicle elements, and about 60 other measurable factors relating to the vehicle, and continues to make calculations as the vehicle moves along its mathematical path until it either comes to a stop or the pre-set time limit of the run is reached. The computation describes the run of the vehicle in terms of tables of numbers, each of which describes a facet of the progress of the vehicle or some condition of the vehicle, such as the forces on the tires or springs. As many as 7 pages of tables, describing more than 60 parameters, can be computed in each simulation.

To assess the relative severity of the jackknifing, the behavior of the tractor when the heading was changed 15 degrees was selected as an indicator. When a tractor has rotated 15 degrees by braking without any steering input having been made, the rotation is likely to continue. Given time and space, drivers can release the brakes and steer back to center if the rotation does not exceed 15 degrees. A heading change of 15 degrees has been the upper limit of rotation selected by truck designers who have attempted to prevent jackknifing by placing mechanical limits on the rotation of the tractor.

The two indicators of severity of jackknifing are the time required after braking takes effect to reach a heading change of the tractor of 15 degrees and the rotational velocity in degrees per second when the tractor reaches the 15-degree heading change. The shorter the time and the higher the velocity, the less time available for the driver and the truck's braking and steering system to react and "steer out" of the jackknife.

In this accident, the following factors could have affected the rapidity of the jackknife, and these factors were assessed for their effect, using the computer simulation:

- The intensity of the driver's brake application, shown as air brake pressure in psi.

- Excessive slack adjustment of the brakes on the tractor and semitrailer and the ineffectiveness of one brake shoe, which unbalanced the braking forces between the left and right sides of the axles.

- Differences of skid resistance of the pavement in the left and right wheelpaths of the northbound lane.

- The skid resistance of the wet pavement, indicated by the average skid number of 34, was below the skid resistance of the wet pavement, usually a skid number of 62, on which truck tires are tested.

Table 2.—Jackknifing tendencies of simulated tractor-semitrailer in accident condition, with maladjusted brakes.

Brake application pressure (psi)	Time to rotate tractor heading 15° (seconds)	Rotational velocity of tractor passing 15° (degrees per second)
85	4.60	02.35
75	2.75	12.7
65	2.48	14.3
50	2.65	19.2
40	3.20	14.0
30	3.30	13.5
20	4.35	07.8
15	(Reached only 11° at end of 5.3 seconds)	02.7

All of the data entered into the simulation were obtained from accident evidence or were estimated from vehicle information. Table 2 shows the results of the simulation in regard to brake pressure application. The simulation determined that the jackknifing of the truck could have occurred with any brake application pressure between 20 to 84 psi. The simulation determined that the truck would not have jackknifed following a brake application at a pressure of 20 psi or less or following a brake application at a pressure of 85 psi or more. However, for applications of 85 psi and above, all wheels would have been locked up, resulting in increased stopping distance and complete lack of steering during the stop.

At a brake application pressure of 30 to 80 psi, the wheels of the tractor and semitrailer would not have locked up and skidded even though some of the brakes were not adjusted properly. The nonskidding wheels, particularly those on the front (steering) axle of the tractor, would have retained their steering capability initially. As the truck jackknifed past 15 degrees, the rolling wheels would have compounded the vehicle rotation because the braked wheels of the tractor would have been trying to move ahead of the rolling wheels. An automobile experiences similar movement when its rear emergency brakes are activated; if the driver does not initiate any steering, the rear end of the automobile will rotate in an attempt to exchange places with the front end.

The results of simulations made with data representing properly adjusted brakes and with equal pavement skid resistance in both wheelpaths revealed that the vehicle would still jackknife at brake application pressures of 20 to 50 psi on a similar wet pavement. The simulations revealed that, under the conditions present at the time of the accident, the truckdriver could have avoided jackknifing only by keeping the brake application at 20 psi or below, an application of only one-sixth (16 percent) of the 120 psi pressure available. However, with a brake application of 20 psi, he might have overridden the automobile he was following. The simulations also revealed that, under the conditions present at the time of the accident, the vehicle would not have jackknifed if the pavement at the accident site had had a skid number of 62, which is typical of brushed concrete pavement before it becomes worn.

Other Information

Emergency lights.--The Arkansas State Police car leading the 15-vehicle caravan was appropriately marked and equipped with a roof-mounted emergency blue flashing light bar; the second and third vehicles were DeQueen Police Department cars appropriately marked and equipped with similar overhead light bars. The third police car was the accident vehicle. The next four vehicles were police cars, each of which had some type of overhead revolving blue light. Of the remaining eight vehicles, two were civilian automobiles, one was a marked police car without an overhead light, and five were marked police cars with overhead revolving blue lights of some type. The overhead emergency lights on the 12 police cars so equipped were operating at the time of the accident. The investigation did not determine when the lights were turned on or who made the decision to turn them on.

The Arkansas Motor Vehicle and Traffic Laws and State Highway Commission regulations regarding use of emergency lights on police vehicles follow the Uniform Vehicle Code, which is prepared by the National Committee on Uniform Traffic Laws and Ordinances. (See appendix F.) The State Police have a written policy that requires the use of emergency flashing lights on police vehicles in funeral processions. There is an unwritten policy that emergency flashing lights can be used in other escorting assignments. The policy does not appear to extend to nonemergency use in caravans, even though the activity may be one of ceremonial respect or tribute. The police cars involved in this accident were traveling en route to a funeral and were not in a funeral procession.

The Highway Safety Committee of the IACP recently approved a Model Police Traffic Service Policy on "Use of Authorized Emergency Equipment." A specific section of the policy states,

> Officers shall utilize emergency equipment only when authorized directly to do so by a supervisor, or by the nature of a dispatched assignment, or when situations confront him that, in his best judgment, indicate the need for the use of the emergency equipment.

ANALYSIS

The Accident

The truckdriver said that he was about three car lengths--about 60 feet--behind the automoble he was following just before the accident. When the automobile driver applied brakes in response to the approaching police cars with the flashing lights, the truckdriver had no alternative to making a sudden brake application to try to avoid striking the automobile. The truckdriver probably could not have turned the truck to the right to avoid the braking automobile because it would have taken the truck 100 feet or more to turn 6.5 feet to clear the rear of the automobile. With a 60-foot headway, the truck was 40 feet too close to avoid impact.

A severe brake application on a wet pavement often results in a jackknife. The Truckdriver's Handbook published by the American Trucking Associations, Inc., states:

> Tailgating
>
> 1. Never follow another vehicle so closely that you annoy or bother its driver, or so close that you will not be able to make a safe stop under any conditions. Observe a 2-second following

> distance at speeds up to 40 mph. 6/ At higher speeds, your safe following time should be doubled to 4 seconds. Under adverse conditions such as rain, fog, or snow, increase your following distance still more to insure being able to avoid an accident. 7/

Based on this guideline, the truckdriver should have allowed at least a 240-foot interval (about 12 car lengths) between his truck and the automobile ahead since the truck was traveling about 40 mph (59 feet per second) and the pavement was wet.

The lateral stability of an articulated vehicle (such as a tractor-semitrailer) during braking operations is dependent on balanced braking on both units. Partial braking at single wheel positions or imbalanced braking from opposite wheels on the same axle can influence the lateral movement of one or both of the units in combination. The coefficient of friction on the roadway, the condition and proper operation of the service brake components, and the proper adjustment of the brake actuators at each wheel position are critical factors that affect vehicle stability when braking.

Jackknifing is primarily attributed to a relative change in the speed and/or direction of the tractor and semitrailer while both units are in motion. Effective semitrailer braking is absolutely essential in the avoidance of jackknife accidents. The semitrailer brakes exert a retarding force on the combination to maintain it in straight alignment and to prevent the semitrailer from overrunning the tractor and causing the tractor to rotate laterally about its fifth wheel attachment. Jackknifing can occur without vehicle braking; however, it usually occurs during moderate to heavy braking applications. Studies indicate that the probability of occurrence of a jackknife before an accident, compared to the probability of its nonoccurrence, are about 10 times greater on a wet road than on a dry road. 8/

In this accident, a brake imbalance existed between the tractor and semitrailer because of the improper brake adjustments. When the service brakes were applied during the sudden stop maneuver, it caused the tractor to decelerate more rapidly than the semitrailer. This circumstance caused the semitrailer to overrun the tractor, applying a force at the fifth wheel connection between the tractor and semitrailer, and the tractor rotated laterally. The rotation caused the front of the tractor to deviate left from its forward path. The continued forward movement of the semitrailer forced the front of the rotating tractor across the highway centerline, where it struck the patrol car, and then to fully jackknife to the left side of the semitrailer.

The physical evidence indicates that the patrol car was near the center of the northbound lane and was about 3 feet from the centerline when it was struck by the tractor, and that the patrol car may have just started to steer right to attempt to avoid the impact. The physical evidence, which included vehicle damage and scrapes on the hood of the patrol car, indicated that the tractor had jackknifed about 60 to 120 degrees, with the right front of the tractor extending 4 to 6 feet into the southbound lane when it struck the patrol car. The tractor continued to jackknife after it struck the patrol car and came to rest at a rotation of 144 degrees. Calculations and some of the computer simulations indicated that the truck would have jackknifed to about 96 degrees at the time of impact.

6/ Two-Second Rule—A defensive driving rule of thumb used to determine a safe following distance. If one car stays 2 seconds behind the car ahead, a safe distance will be insured under ideal conditions.
7/ Truckdriver's Handbook, American Trucking Associations, Inc., July 1980, p. 10.
8/ Fleischer, G. A., Phillipson, L. L., "Statistical Analyses of Commercial Vehicle Accident Factors," Vol. 2 - Summary Report, Final Report, 1973.

In order to determine why the truck jackknifed and caused this accident, the Safety Board examined the physical evidence, made calculations based on this evidence, and then used the calculations in computer simulations.

Based on the weather analysis of rain intensity, the average road surface texture depth, the drainage path length, and the cross slope of the highway, the water depth on the roadway was calculated to be 0.012 inch, which was well less than the average texture depth of 0.017 to 0.034 inch. Since the pavement had sufficient depth to prevent flooding and the tires had adequate tread depth (9/32 inch) to channel water away from the tread surface, the truck did not hydroplane. However, the surface was wet, which markedly reduces available friction for stopping and for preventing jackknifing on this surface.

In avoiding involvement in the accident, the police car immediately behind the patrol car struck by the truck turned abruptly, leaving a tire mark on the shoulder similar to that made by a vehicle braking on wet pavement and left a path through the grass beside the highway. Projecting the path of the following police car back to the center of the lane at the point its driver made an initial brake application, it was calculated that the following police car was traveling about 45 mph when its driver first realized that a hazard was ahead and began taking evasive action. The calculations indicate that there was a 200- to 250-foot headway between the patrol car struck by the truck and the following police car. The speed of the patrol car struck by the truck was established as about 45 mph since the police cars had been traveling together for an extended time. (See figure 5.)

The initial inspection and road testing of the tractor-semitrailer combination determined that the semitrailer brakes probably would not have provided braking on a surface that was wet and had a relatively low coefficient of friction compared to the dry surface on which the testing was conducted. Once the tractor was jackknifed past about 15 degrees, all the tractor's tires were rolling; however, in the longitudinal direction, the tires were effectively providing sliding resistance. As an example of this concept, a MuMeter trailer measures friction generated between two rolling tires towed with a 15-degree yaw angle between the tires. Based on the distance the truck and the patrol car traveled after impact, the friction between the vehicle tires and the surface, the 45-mph speed of the patrol car before impact, and the conservation of momentum equation, calculations showed that the truck was traveling about 23 to 25 mph when it struck the patrol car.

Because of the absence of any marks on the highway before the point of impact, the speed and path of the truck while jackknifing could not be determined independently. The truckdriver stated that his vehicle was traveling about 40 to 45 mph before the accident, and that he made no evasive steering maneuver. However, the truck speedometer was inoperative. Calculations and computer simulations, which included time-distance relationships, were made to determine the speed and path of the truck. The calculations indicated that, unless there was at least one more wheel braking or a combination of wheels with partial braking, and significantly more effective braking on the left side than on the right side, the tractor probably would not have rotated as fast as was necessary at a speed of 40 to 45 mph for it to enter the southbound lane and strike a vehicle that was 3 feet from the centerline. The computer simulation showed that this truck had a tendency to jackknife on a wet road with a skid number lower than 60, and with a brake pressure between 20 and 55 psi when the brakes were balanced, and between 20 and 80 psi with the brakes in the unbalanced condition in which they were at the time of the accident. The computer simulation indicated that, with a heavy brake application between 60 and 80 psi of an available 120 psi, the truck's uneven braking would have caused the necessary rotation rate of the tractor. Based on these calculations, the Safety

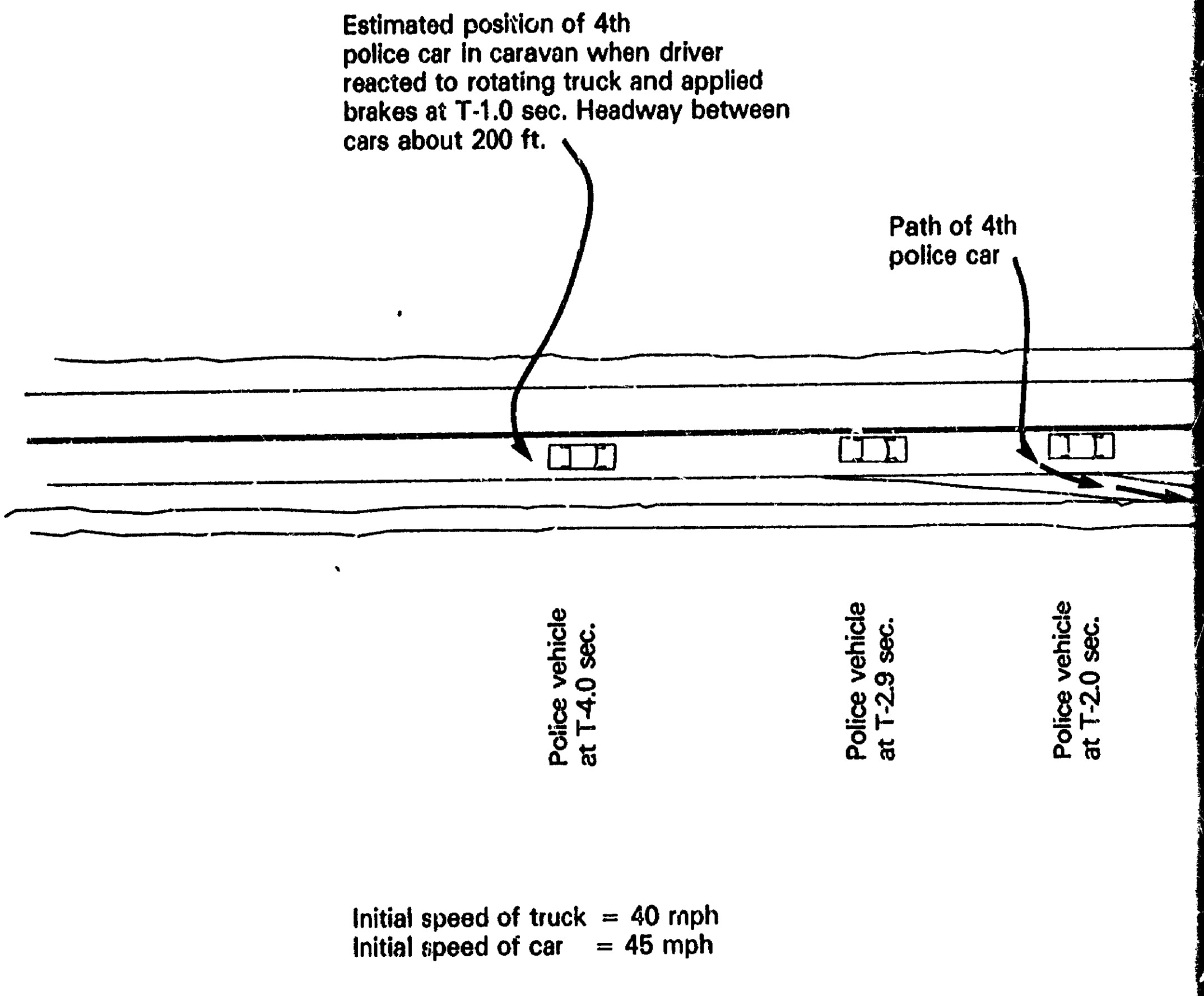
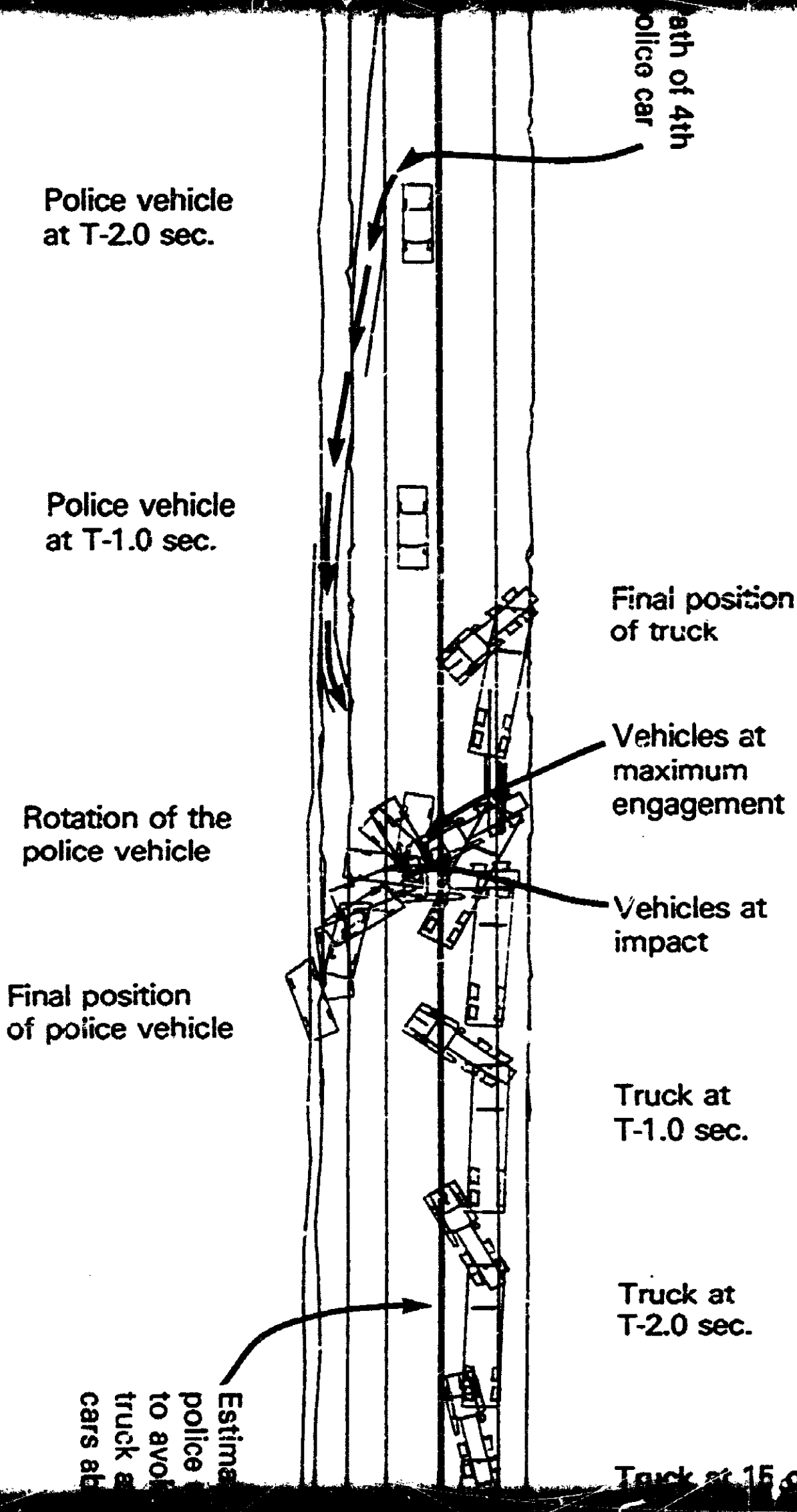
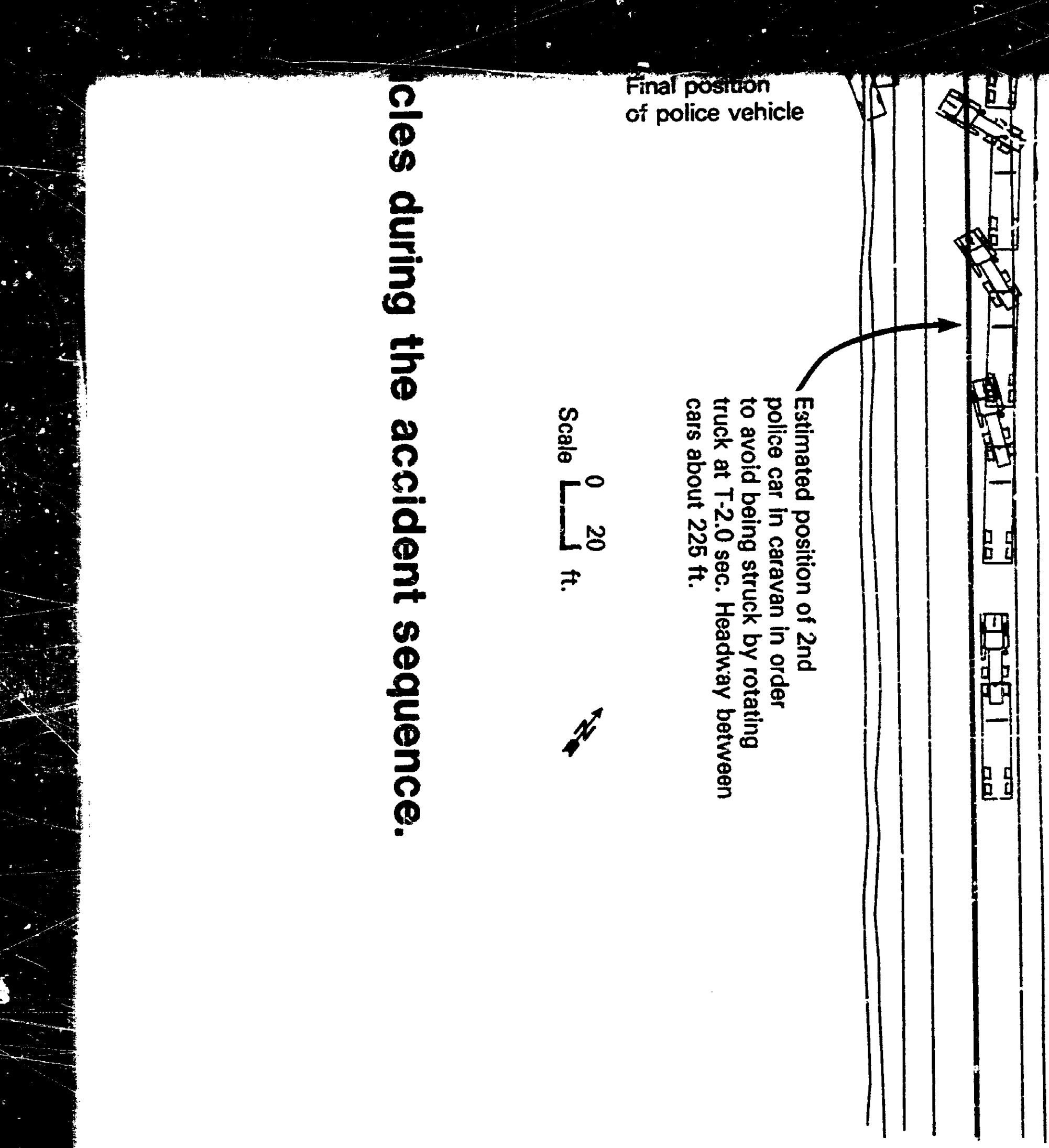


Figure 5. - Relativ

5. – Relative positions of the vehicles during the ac





cles during the accident sequence.

Board concludes that the truck was traveling at 40 to 45 mph when the truckdriver made the brake application. The trailer brakes tend to lock when loaded lightly and the trailer tends to hop. A loaded trailer without brakes would tend to rotate the tractor even faster.

In an attempt to make a more precise estimate of speed, the Safety Board analyzed the following factors for time-distance and relative locations: (1) the drivers and occupants of the police cars immediately in front of and behind the patrol car involved in the accident said that at least five car lengths or more separated each vehicle in the area where the four-lane section changed into two lanes; (2) the driver of the police car behind the patrol car involved in the accident reacted to the truck crossing the centerline rather than the ensuing collision, and braked off the road to the right; (3) a passenger in the following police car thought the truck was at a jackknife angle of about 90 degrees when the collision occurred; and (4) the police car in front of the patrol car involved in the accident was not struck by the truck. The analysis of these factors indicated that the speed of the truck was about 40 mph when the truckdriver applied full braking.

The skid testing revealed that the coefficient of friction of the left wheelpath in the northbound lane was higher than that of the right wheelpath. A comparison was made of the tractor rotation at 40 mph at the time of full brake application between a roadway surface with the split coefficient of friction that existed at the accident scene and a roadway with a uniform coefficient of friction. The calculations indicated that the tractor would have rotated a maximum of about 20 percent slower if the coefficient of friction of the surfaces had been uniform. Instead of being jackknifed as calculated at about 96 degrees at impact, the tractor would have been jackknifed about 78 degrees at impact. However, this lesser degree of jackknifing would have decreased the penetration of the tractor into the southbound lane only about 0.4 foot, and the patrol car would have underridden the center of the truck's bumper rather than the right corner of the bumper. The accident probably would have been just as severe.

Based on calculations and computer simulations, if all of the truck's brakes had been operating properly, the tractor would have rotated slower due to the split coefficient of friction. Under that condition, the truckdriver might have been able to regain control by reducing his foot pressure on the brake pedal; or if the brakes were fully applied, the tractor might not have rotated far enough into the southbound lane to strike the patrol car.

Roadway Surface

The normal procedure for skid testing of a wet roadway surface in most States calls for testing of the left wheelpath in a traffic lane. At this accident site, skid numbers in the left wheelpath ranged between 32 and 39, with an average of 35. The Safety Board has encouraged State agencies to adopt minimum criteria (skid numbers) below which corrective action would be initiated in the form of signing or resurfacing. Highway engineers familiar with skid testing generally agree that when the skid number for a surface is below 30, the pavement is becoming slippery and corrective action should be initiated. Arkansas does not have specific criteria for relating skid numbers to a category of slipperiness. Kentucky, one of the leaders in developing skid resistance criteria, has developed the following criteria, based on a 1979 survey of its roads:

Skid number	Criteria
Above 39	Skid resistant
33 to 39	Marginal
28 to 32	Slippery
Below 28	Very slippery

Under these criteria, the skid numbers at the accident site in the left wheelpath of the northbound lane would be considered marginal. However, even if Arkansas had used these criteria in evaluating the roadway surface, more detailed testing that included the right wheelpath probably would not have been conducted, since the incidence of accidents on wet pavement is lower on this section of U. S. Route 71 than statewide (16.3 percent vs. 21.3 percent). There may be a number of reasons for this apparent discrepancy; however, the road is now scheduled to be resurfaced as part of the construction project. Testing of the right wheelpath in the northbound lane after the accident revealed skid numbers between 30 and 36 with an average of 33. Under the Kentucky criteria, the roadway surface would be considered a marginal pavement. Therefore, while neither wheelpath by itself presented a clear skid resistance hazard, the wheelpaths in combination presented a hazard because of the split coefficient of friction, which was about 4.2 skid numbers different at the accident site in the northbound lane.

There has been little research and testing on the effect of split coefficients of friction on articulated vehicles. Research and testing on passenger vehicles have shown that on a split coefficient of friction, a passenger vehicle will tend to rotate toward the wheelpath with the higher coefficient of friction. 9/ At the accident scene, a passenger vehicle would have tended to rotate to the left as the tractor did before striking the patrol car. Based on this research and testing, it can be predicted that on the surface where the accident occurred with a skid number difference of 4, a passenger vehicle traveling at 40 mph and braking would rotate between 21 and 35 degrees before coming to a stop. During its investigation of an accident in Luling, Texas, in November 1980, 10/the Safety Board conducted a passenger vehicle brake test on a wet road with a split coefficient of friction, and the vehicle rotated as expected. The Safety Board has reported on its investigation of another accident where a split coefficient of friction existed. 11/ As a result of the split coefficient of friction problem, the Safety Board has encouraged the use of skid trailers that have the capability to lock both wheels to allow for complete testing of roadway surfaces.

Research has developed a list of the most commonly found conditions that cause differences in the skid resistance in the wheelpaths of a roadway surface. 12/ At the accident location, the most likely reason for the split coefficient of friction was unequal wear. Field observations of traffic revealed that a large number of trucks were carrying large loads of timber on the section of U. S. Route 71 where the accident occurred. Since there was no apparent flushing or bleeding of the asphalt in the wheelpaths, the crown of the roadway may have caused an additional load on the right side of these timber trucks, thereby causing the right wheelpath to become more worn and polished than the left wheelpath. In addition, the pavement may be a little less stable near the shoulder, and

9/ Zuk, William, "The Dynamics of Vehicle Skid Deviation as Caused by Road Conditions," Paper presented to the First International Skid Prevention Conference, September 1958; Burns, John C., "Differential Friction--A Potential Skid Hazard," Arizona Department of Transportation, January 1976; Hayhoe, Gordon F., and John J. Henry, "Effects of Differential Pavement Friction on the Response of Cars in Skidding Maneuvers," Transportation Research Record 836, 1981.

10/ Highway Accident Report--"East Side Church of Christ Bus Skid and Overturn, U. S. Route 183, near Luling, Texas, November 16, 1980" (NTSB-HAR-81-4) (skid number difference between wheelpaths was 2 to 16 numbers).

11/ Highway Accident Report—"Osterkamp Trucking, Inc., Truck/Full Trailer and Dodge Van Collision, U. S. 91, Near Scipio, Utah, August 26, 1977" (NTSB-HAR-79-1) (skid number difference between wheelpaths was 7 numbers).

12/ Burns, John C., "Differential Friction--A Potential Skid Hazard," Arizona Department of Transportation, January 1976.

the loads may have realigned longitudinal particles slightly. This particle realignment would result in less sharp protrusions of the aggregates. The ASHTD has issued a contract for resurfacing this section of highway, which should eliminate the split coefficients of friction.

At the time of the accident, the east shoulder of the roadway was under construction. However, there is no evidence from which to conclude that the roadway construction was a causal factor in the accident. Since the truck was tailgating the automobile, the truckdriver had little time to react. If the truck had been following the automobile at distances recommended for safe travel, the truckdriver would have had the option to swerve to the right onto the shoulder. When the truck brakes were applied fully, the rear of the truck was about 225 feet from the impact location. The bottom of the vertical sag was 250 feet from the point of impact. In this area there was a steep dropoff where a box channel for drainage was being constructed. Taking into consideration inherent reaction time (1 to 2.5 seconds), had the truckdriver chosen this alternative he would have encountered the dropoff at the box channel. North of this area was an area with a 15-inch drop over the 3 feet of ground adjacent to the shoulder. If the truck traversed this area, it probably would have overturned once it left the 7.25-foot-wide shoulder.

Tractor-Semitrailer Brakes

Current clamp-type chamber air brakes lose effectiveness with increasing brake chamber stroke. The brake adjustments on three of the six tractor wheels and on all four semitrailer wheels were close to the maximum stroke limit. The stroke adjustment on the two wheels of the front (steering) axle were beyond the maximum stroke recommended by the manufacturer; the excessive stroke resulted in a significant reduction in, or possibly the total elimination of, braking at those wheels. The four semitrailer brakes failed to stop the rolling wheels when the service brakes were applied during a road test after the accident. Also, a brake shoe that could not make drum contact at the right rear tandem axle wheel of the tractor caused imbalanced braking on the rear tandem axle of the tractor.

The motor carrier operated a garage that made repairs to the carrier-owned equipment. The carrier did not meet the requirements of the FMCSR since it did not have a systematic inspection and maintenance program and did not maintain records of adjustments or repairs made to the vehicles. The last brake repair to the tractor was on March 24, 1934, when new brake shoes were installed on the two wheels of the forward tandem axle. Adjustments were made to the tandem axle brakes at that time but not to the front (steering) axle brakes. The shop foreman for the carrier stated that he adjusted the brakes on all company equipment every 2 or 3 weeks, except for the brakes on the front (steering) axles. He believed that the brakes on the accident tractor-semitrailer combination were adjusted within the 3 weeks before the accident. Because of the absence of records to substantiate this fact, it was not possible to establish that the tractor brakes had been adjusted since the last brake repair in March. The truckdriver stated that he adjusted the semitrailer brakes about 2 weeks before the accident. The truckdriver was not trained to make brake adjustments. The method that he described using would have resulted in excessive stroke at each brake and seriously reduced the semitrailer's braking capability.

A study by the NHTSA in 1982 (based on data taken from 1981 California Highway Patrol Vehicle Inspection Reports) compared brake stroke adjustments on vehicles equipped with manual slack adjusters to those on vehicles equipped with automatic slack

adjusters. 13/ The inspection criteria established maximum stroke travel (similar to those set by manufacturers for the various brake chamber types) and placed out of service those vehicles on which 40 percent or more of the brake strokes exceeded those limits. The inspections included 84 combination units equipped with manual slack adjusters and 96 with automatic slack adjusters. Forty-seven percent of the units with manual slack adjusters were found to have one or more brakes that exceeded the maximum stroke, as opposed to 42 percent of the units with automatic slack adjusters. Fifteen percent of the units with manual slack adjusters were placed out of service, as opposed to 9 percent of the units with automatic slack adjusters. This study revealed that the brakes on only a few of those vehicles equipped with automatic slack adjusters were in better adjustment than on those vehicles equipped with manual slack adjusters, but this difference was not statistically significant. The data substantiate the fact that neither the manual slack adjuster nor the automatic slack adjuster will maintain proper brake adjustment on a vehicle unless the adjuster is inspected regularly and maintained to insure its proper operation. Adequate vehicle inspection and maintenance programs can prevent accidents. Proper brake adjustment should be an essential part of any maintenance program.

As a result of its investigations of earlier accidents involving runaway combination vehicles, the Safety Board issued Safety Recommendation H-78-48 on June 23, 1978, which recommended that the NHTSA:

> Develop a Federal Motor Vehicle Safety Standard [FMVSS] stating a performance requirement for all newly manufactured commercial vehicles to have equipment that would insure brakes being in proper adjustment at all times.

As a result of its investigation of an accident in Pittsburgh, Pennsylvania, on April 28, 1980, the Safety Board reiterated Safety Recommendation H-78-48 and issued Safety Recommendation H-81-1 on February 11, 1981, asking the NHTSA to:

> Require manufacturers of air brake actuation devices to incorporate indicators which will warn users when brakes must be adjusted.

Safety Recommendation H-78-48 recommended a performance standard for automatic brake adjustment devices for newly manufactured commercial vehicles while Safety Recommendation H-81-1 recommended a simple visual brake adjustment indicator (such as a mark, groove, or knurl) on the brake chamber push rod to enhance the inspection of both automatic and manually adjusted brakes. The visual brake adjustment indicator would disclose whether the push rod stroke had reached the point where brake readjustment was essential, could be installed with minimum delay on new vehicles, and could be an after-market installation during routine maintenance of existing vehicles. While acknowledging that the indication of improper brake adjustment does not in itself insure that corrective maintenance action will be taken, the Safety Board believes that a visual brake adjustment indicator would encourage maintenance and reduce accidents.

Currently, the NHTSA is reviewing a proposal being studied by the Economic Commission for Europe, a United Nations group, to require self-adjusting brakes for trucks. In addition, the NHTSA started an automatic slack adjuster in-use evaluation program in 1983 that is to be completed in 1986. The results of this program will be used

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13/ Society of Automotive Engineers, Technical Paper Series, 821263, "The Importance of Maintenance Air Brake Adjustment," National Highway Traffic Safety Administration, Washington, D. C.

to determine if rulemaking action is appropriate. Safety Recommendations H-78-48 and H-81-1 remain in an "Open" status while the NHTSA program is underway. 14/

The Safety Board supports and encourages the use of automatic slack adjusters on commercial vehicles with air-mechanical service brakes. However, the use of such devices, by themselves, does not relieve the motor carrier of the responsibility to inspect and properly maintain all brake components, nor does it guarantee that the service brakes will remain properly adjusted for all types of operation. It is still imperative for motor carriers to inspect all service brake components periodically, including the automatic slack adjuster units, to insure that the vehicle service brakes are functioning properly.

FHWA-BMCS Administration of the FMCSR

A number of deficiencies in carrier oversight identified in this report reflect on the BMCS's administration of the FMCSR for interstate motor carriers. These deficiencies are the result of problems with the BMCS organizational structure within the FHWA, its management practices, and its manpower resources.

As part of the FHWA, the BMCS carries out its activities through its Washington, D. C., headquarters office and FHWA field personnel. When the FHWA and the BMCS were consolidated into the U.S. Department of Transportation in 1966, it was on the basis of a common safety mission. However, in fact, their safety missions, although complementary, differ significantly. The FHWA's safety functions are centered around the construction and improvement of roadways to eliminate hazardous conditions for motorists, while the efforts of the BMCS are directed at safe operation and maintenance of commercial, mainly interstate, vehicles on the roadway. The functions of the BMCS are only distantly related to other safety missions of the FHWA, as discussed in a congressional report made in 1983. 15/

The BMCS headquarters in Washington, D. C., does not have direct line authority to field personnel carrying out its programs, a circumstance that results in inefficient supervision and inconsistent operating practices by field personnel. The largest group of personnel in the BMCS program are the safety inspectors in the field offices; each State has at least one. However, the chief inspector in each State (the officer-in-charge (OIC)) responds to the FHWA Division Administrator (DA), not the Director of the BMCS. As a matter of fact, according to the cited congressional report,

> One of the curious bureaucratic alignments of the BMCS is that OICs do not answer directly to the head of the Bureau of Motor Carrier Safety. The BMCS Director controls the Washington, D. C. headquarters, but must communicate with his agents through the Federal Highway chain of command: FHWA Central, FHWA Region, FHWA Division (Each state is a FHWA Division). The Division Administrator oversees the Bureau's OIC. This total integration has been completed only in the last couple of years. 16/

14/ The NHTSA rulemaking activity with respect to heavy truck brakes has been limited over the last 3 years to amending FMVSS 121 in response to petitions from the trucking industry. The NHSTA had planned some time ago to replace the existing standard 121 with a proposed brake standard 130. NHTSA personnel indicated that this is not a high priority item, and they do not foresee any rulemaking activity in this area for the next 5 years.

15/ "Improving The Effectiveness of the Bureau of Motor Carrier Safety and Its Enforcement of Hazardous Materials Regulations," Twenty-First Report by the Committee On Government Operations, U.S. House of Representatives, Nov. 17, 1983.

16/ Ibid., p. 6.

Since the early 1970s, various governmental investigative groups including the Safety Board have been critical of the BMCS program for monitoring the safety of interstate motor carriers. 17/ Because of the small size of the agency's field inspection resources, the wisdom of using these personnel for on-the-road inspections of individual interstate trucks has been questioned repeatedly; the BMCS has been urged to use its limited inspection personnel to perform "safety audits" of the motor carriers' main terminals, to review company records, to inspect trucks at the terminals, and to interview company officials and drivers. Furthermore, the BMCS has been urged repeatedly over the years to develop selection criteria for deciding which carriers to audit, since the total number to be inspected is far beyond the capability of the BMCS to handle, even in a 2-to 3-year cycle. As the Safety Board noted in its 1981 study of the BMCS:

> The most striking fact about the DOT's program for enforcing general truck safety and bulk truck hazardous materials regulations is the tiny size of its enforcement staff in comparison to the industry it is regulating and monitoring. There are about 168,000 known interstate carriers, about 12,000 known hazardous materials shippers, 4 million interstate trucks (estimated as of 1975), and 413,000 tank trucks regularly hauling hazardous materials. With only 187 field personnel [18/] it is crucial that the BMCS find ways to focus its available resources on activities that are the most productive in increasing good safety practices by carriers and shippers. 19/

The Safety Board went on to state that it "could find little evidence that BMCS is making a systematic effort to decide how best to focus its activities," a lack of focus the Board found to be "evident throughout the field enforcement program." The BMCS has "not developed explicit criteria for deciding which carriers . . . to audit to ensure that the BMCS's small resources are focused on the companies most in need of attention," the Board said. 20/ The Safety Board's 1981 study resulted in several recommendations to the BMCS, including Safety Recommendation H-81-6:

> Develop explicit criteria for deciding which carriers and hazardous materials shippers to audit to ensure that the small resources of the Bureau of Motor Carrier Safety are focused on the companies most in need of attention. The criteria should take into account such factors as accident experience, type of cargo, compliance history, measures of exposure, and other factors related to the degree of hazard presented by the candidate companies.

17/ See U.S. General Accounting Office, "Need for Improved Inspection and Enforcement in Regulating Transportation of Hazardous Materials" (B-164497, May 1, 1973); "The Federal Motor Carrier Safety Program: Not Yet Achieving What the Congress Wanted" (CED-77-62, May 16, 1977); "Programs for Ensuring the Safe Transportation of Hazardous Materials Need Improving" (CED-81-5, November 4, 1980); U.S. Department of Transportation, Office of Inspector General, "Special Study of Bureau of Motor Carrier Safety, Federal Highway Administration" (September 28, 1979); National Highway Safety Advisory Committee, "Task Force Report on Commercial Vehicle Maintenance and Safety Inspection Programs" (June 15, 1979); Colin, S. Diver, "A Study of the Effectiveness and Fairness of DOT Hazardous Materials Enforcement Penalties" (June 1980); Congressional Research Service, Library of Congress, "Hazardous Materials Transportation: A Review and Analysis of the Department of Transportation's Regulatory Program" (April 1979).

18/ In 1984 there were 191 field personnel; however, only 94 were available for safety regulations enforcement activities, such as terminal safety audits.

19/ "Federal and State Enforcement Efforts in Hazardous Materials Transportation by Truck," February 19, 1981 (NTSB-SEE-81-2), p. 37.

20/ Ibid., p. 92.

In response, the BMCS has made progress in developing criteria for selecting motor carriers for safety audits. The criteria include a series of items that are assigned point values (from 1 to 5 points each) dependent upon the critical nature of each; by comparing each item to each motor carrier's record, a total point value is compiled that ranks the carriers on order of need-for-audit. The resulting motor carrier listing is distributed annually to the BMCS field offices from the Washington, D. C., headquarters to set priorities for scheduling safety audit by BMCS field inspectors. 21/

Using the criteria, the interstate motor carriers based in Louisiana were ranked in FY 1984 in order of need-for-audit. That listing included a total of 712 motor carriers (15.6 percent of the 4,551 interstate motor carriers of record in that State). Of that total, 59 carriers had a total point value of "1," 188 carriers (including Terrell Trucking, Inc.) had a total point value of "2," and 465 carriers had a total point value in excess of "2" points; that is, there were 465 carriers ahead of Terrell Trucking, Inc., to be safety audited by the two inspectors in the local office. Therefore, it is not surprising that the motor carrier had not been audited.

Of all the problems confronting the BMCS, the greatest problem is sufficient manpower to insure that the growing national interstate motor carrier population complies with the FMCSR. A General Accounting Office report to a House Subcommittee of the Government Activities and Transportation Committee on Government Operations in July 1984 stated that the FY 1984 BMCS field staff numbered 191, of which 94 were investigators who were responsible for performing safety audits of the over 200,000 interstate motor carriers. Accordingly, the ratio of BMCS investigators to carriers is 1 to 1,047; as to those investigators who conduct safety audits, the ratio is 1 to 2,128.

The Safety Board has recognized the BMCS manpower shortage for many years and has continuously supported BMCS efforts to increase its staff of field investigators; those efforts have failed. In its 1981 study of the BMCS, the Safety Board also reviewed in some detail State programs for truck safety, including a federally financed four-State "Demonstration Program" authorized by Congress in 1978. 22/ Based on the perceived success of this program, the Surface Transportation Assistance Act (STAA) of 1982 authorized the Secretary of Transportation to make grants to States for enhanced enforcement of Federal and State motor carrier safety regulations. The Secretary of Transportation assigned the FHWA the responsibility to implement the portion of this act that pertains to motor carrier safety. To fulfill this responsibility, the FHWA developed the Motor Carrier Safety Assistance Program (MCSAP); the program goal is to protect the public from risks arising from commercial truck and bus transportation by highway. The major thrust of the safety effort is to reduce the risk of commercial vehicle accidents and hazardous materials incidents by providing economic incentives to the States to institute or increase motor carrier safety inspection and enforcement activities. The MCSAP is intended to promote a cooperative effort between the FHWA and the States. It is not intended to replace or duplicate existing programs, but rather to enhance ongoing efforts and/or develop programs in States where none exists. The Safety Board believes that State-conducted enforcement and investigation activities, particularly roadside driver/vehicle inspections, have the potential to achieve positive safety benefits and will simultaneously permit more productive use of the limited BMCS resources available for inspection efforts.

21/ However, it should be noted that in recent hearings held by the Government Activities and Transportation Subcommittee of the House Government Operations Committee, the General Accounting Office testified that BMCS safety investigators are still "inconsistent" in selecting trucking companies for safety audits, in handling responses to third-party complaints, and in rating and penalizing firms for safety violations.

22/ "Federal and State Enforcement Efforts in Hazardous Materials Transportation by Truck," February 19, 1981 (NTSB-SEE-81-2), pp. 49-91 and appendix B.

The Safety Board believes also that the uniformity of State-conducted motor carrier safety inspection and enforcement activities among the States is essential to the success of the MCSAP. Although it is the responsibility of the FHWA to ensure the implementation of a uniform commercial motor carrier safety program, and to provide technical assistance and program guidance, the Safety Board encourages the States to participate in joint discussions among jurisdictions such as those sponsored by the member States of the Commercial Vehicle Safety Alliance, 23/ to promote uniformity and reciprocity in State motor carrier safety inspection and enforcement activities.

The Driver

Sleep/Nutrition.—The investigation revealed that the driver had received limited sleep (4 hours) during the night preceding the accident and that he had consumed seven cups of coffee with no solid food since arising at 3:30 a.m. Additionally, he had taken six Tylenol (acetaminophen) capsules during the day before the accident. The events leading to the accident are not indicative of behavior which would result from fatigue or lack of nutrition.

Alcohol.—The truckdriver had a 0.09 percent BAC approximately 1 hour after the accident. The human body eliminates alcohol at a rate of approximately 0.015 to 0.018 percent per hour. Therefore, since the blood sample was taken 1 hour after the accident, the truckdriver's BAC at the time of the accident would have been above 0.10 percent. Research has determined that BAC's in the 0.10 percent range create substantial impairment of muscular coordination, visual perception, response time, judgment, and other physiological and psychological functions critical to the safe operation of a vehicle. Such a concentration of alcohol could have affected the truckdriver's judgment before the accident as he passed the automobile several times and was tailgating. Such a concentration of alcohol could have affected the truckdriver's judgment as to how fast the automobile was slowing, delayed his reaction to the automobile's initial braking, and slowed his response in braking the truck.

To try to resolve the discrepancy between the analytical results and the observations of the emergency response personnel and the truckdriver's family and coworkers, the Safety Board consulted a physician at an alcohol treatment program at a leading university. The physician said that it is not unusual for close friends and relatives to be unaware of an individual's use of alcohol. Furthermore, it may not be unusual for an individual with an alcohol problem to control the amount of alcohol he or she consumes for a short period of time. Another common phenomenon is to deny the use of alcohol, especially in the face of a tragic accident.

Of all modes of transportation, the highway mode involves the greatest loss of life. Of all causes/factors involved in highway deaths, alcohol/drunk driving ranks as the single leading factor. The tragic consequences of alcohol abuse have long been of concern to the Safety Board, which has issued Safety Recommendations to Federal, State, and local governments and to private organizations, focusing on both the specific causes of individual accidents, as well as on the general factors which lead to alcohol-involved accidents on our highways.

Data from the Fatal Accident Reporting System (FARS) of the NHTSA show that about 19 percent of the drivers of heavy trucks (10,000 pounds or greater) killed in 1982 and 1983 had been drinking, and 14.7 percent had a BAC at or above 0.10 percent. The data are from a small sample--57 of 300 drivers--in accidents in 15 States which the NHTSA believes have a good reporting system for the presence of alcohol in FARS data.

23/ Commercial Vehicle Safety Alliance, P. O. Box 6638, Phoenix, Arizona 85005.

A FARS computer analysis of FARS data on drivers of heavy trucks involved in fatal accidents (a fatality occurred in the truck or another vehicle involved in the collision) in the 15 States indicated that only 5.8 percent of the truckdrivers had consumed alcohol. However, 76.1 percent of the truckdrivers involved in these fatal accidents were not tested to determine their BAC. More emphasis should be given to testing for the presence of alcohol in truckdrivers involved in accidents, especially serious accidents, so that the magnitude of the safety problem of alcohol use among drivers of heavy trucks can be determined accurately and action taken to reduce the problem.

In the accident under consideration, only 3 ml of blood was collected and the sample was carried around by a police officer for 10.5 hours while he investigated this accident. While the sample was not analyzed for 27 hours after the drawing of the blood, the sample was preserved with sodium fluoride to prevent microbial growth. The delay in the analysis of the sample was not critical since the sample was adequately preserved. The fact that the sample was not refrigerated for the entire time until measurement does not appear to have had an effect on the results in this case. The analytical results confirmed the integrity of the sample. However, since the sample was perishable and was in a breakable container, it was poor practice to carry the blood sample around during an investigation. The practice of carrying around a blood sample during the day's routine apparently is not an unusual practice by police officers in other jurisdictions.

Emergency Signalling Equipment

Seeing the flashing blue lights as they approached from the opposite direction, the driver of the northbound automobile slowed her vehicle in anticipation of meeting emergency vehicles. Her reaction to slow her automobile and yield the right-of-way was not uncommon. Law enforcement agencies throughout the country have found that the behavior of motorists reacting to flashing lights ranges from orderly reduction of speed to erratic maneuvers. Because the California Highway Patrol (CHP) found that its patrol cars often were struck by vehicles and substantially damaged while the patrol cars were parked with flashing lights illuminated on roadway shoulders, the CHP now by policy restricts the use of emergency lights under such conditions. The proper use of emergency signalling equipment is essential to the safety of police officers and other motorists. Such signalling is disruptive to orderly traffic movement, and it should be used only under unusual conditions that, in a police officer's best judgment, require an emergency response.

Most State statutes that authorize the use of emergency signalling equipment (flashing lights and/or sirens) by police officers follow the general recommendations of the Uniform Vehicle Code that recommends its use when the individual officer determines that an emergency condition exists. Additionally, police department policies generally require that officers operate flashing lights when escorting funeral processions and dignitaries. However, neither the State statutes nor general police policies specifically prohibit police officers from operating their emergency flashing lights or sirens when traveling under nonemergency conditions.

The Safety Board believes that police officers must have broad discretionary authority to decide when emergency conditions exist warranting the use of emergency signalling equipment. However, the Board believes that the use of emergency lights on vehicles not involved in emergency service or escort activities is improper. While a slow-moving funeral procession involves little opportunity for confusion, a caravan of vehicles traveling at highway speeds with emergency signalling equipment in operation can confuse drivers.

The Safety Board understands that the IACP is developing a "Model Police Traffic Services--Policies and Procedures," which will cover many aspects of police service including the use of emergency flashing lights and sirens. However, the draft policy reportedly does not address specifically when emergency signalling equipment should not be used. The Safety Board believes that the IACP should review the proposed policy to insure that guidelines to cover the circumstances similar to those in this accident are covered by the proposed policy.

CONCLUSIONS

Findings

1. When the driver of the northbound automobile observed flashing blue lights on the approaching police cars, she perceived them to be emergency vehicles and slowed her automobile as a normal reaction to yield the right-of-way.

2. The northbound truck was following the automobile too closely when the automobile braked, and the truckdriver made a sudden rather than a normal brake application to avoid striking the rear of the automobile.

3. The truck probably was traveling about 40 mph when the truckdriver braked heavily; the tractor rotated about 96 degrees and slowed to about 25 mph and then collided with the police patrol car in the southbound lane.

4. The patrol car probably was traveling about 45 mph at the time of impact.

5. With a heavy brake application, the tractor rotated rapidly because of the wet pavement and uneven brake balance between the left and right side of the truck.

6. There was a split coefficient of friction in the wheelpaths on the wet road surface in the northbound lane which may have increased the rate of rotation of the tractor, but the accident would have occurred and its severity probably would have been the same if the pavement surface had had a uniform coefficient of friction.

7. The wet pavement with a split coefficient of friction and the road construction were not factors in the accident.

8. The technique that the truckdriver said he used to adjust the semitrailer brakes about 2 weeks before the accident would have resulted in improper adjustment and the partial or complete loss of braking capability at all wheels.

9. Brake adjustments were not performed on the two wheels of the front (steering) axle of the tractor; at the time of the accident, there was no effective braking on these wheels.

10. Terrell Trucking, Inc., procedures did not meet the requirements of the Federal Motor Carrier Safety Regulations regarding an inspection and maintenance program for vehicles and records of inspection, repair, and maintenance.

11. With its limited resources, the Bureau of Motor Carrier Safety cannot discharge its current responsibilites with a substantial degree of effectiveness.

12. The lack of direct line authority from the Bureau of Motor Carrier Safety headquarters in Washington, D. C., to its field forces results in ineffective supervision and inconsistent operating practices.

13. The Surface Transportation Assistance Act of 1982 provided funds through the Motor Carrier Safety Assistance Program to enhance and develop State motor carrier enforcement and inspection programs.

14. Analysis of a blood sample taken from the truckdriver yielded a blood alcohol concentration of 0.09 percent.

15. The blood sample was not given optimal handling before delivery to the laboratory. However, there is no evidence, such as the formation of acetaldehyde or other volatile components which would be a byproduct of putrefaction, to indicate that the results or the analysis of the blood sample are invalid.

16. Persons who were around the truckdriver in the 24 hours before the accident, at the accident scene, and in the ambulance on the way to the hospital did not see the truckdriver imbibe alcohol, did not smell the odor of alcohol on the truckdriver's breath, and did not see any of the behavioral characteristics that a person who has consumed alcohol might be expected to exhibit.

17. The attending physician at the hospital detected the presence of alcohol on the truckdriver's breath, but he noted no behavioral characteristics that would have indicated the truckdriver had consumed alcohol.

18. The results of the blood test of the truckdriver are believed to be more reliable than witness statements and indicate that the truckdriver was driving under the influence of alcohol, which may have affected his response time and his decisionmaking.

19. Emergency flashing blue lights were operating on 12 of the 13 police cars in the caravan. No emergency condition existed that required the use of the flashing lights.

20. Current State statutes and general police policies authorize the use of emergency flashing lights when emergency conditions exist, but they do not specifically prohibit their use at other times.

21. Existing policies regarding use of emergency flashing lights in nonemergency conditions should be clarified.

Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the failure of the driver of the tractor-semitrailer combination to maintain a proper interval from the preceding automobile which required a sudden brake application to avoid a collision with the preceding automobile when it slowed unexpectedly, and resulted in his tractor jackknifing and entering the oncoming traffic lane. Contributing to the accident were the improperly adjusted service brakes on both the tractor and semitrailer.

RECOMMENDATIONS

As a result of its investigation of this accident, the National Transportation Safety Board made the following recommendations:

--to the International Association of Chiefs of Police, Inc.:

Develop a recommended policy to clarify the use of emergency signalling equipment by police in nonemergency conditions. (Class II, Priority Action) (H-84-91)

Develop a recommended policy to the States which will prompt law enforcement personnel to request medical testing for the presence of alcohol in the blood of all truckdrivers involved in serious accidents. (Class II, Priority Action) (H-84-92)

--to the Bureau of Motor Carrier Safety:

Issue an "On-Guard" Bulletin which discusses the circumstances of the accident in Ashdown, Arkansas, on July 5, 1984, with particular reference to tailgating by trucks, improper adjustment of truck brakes, and the tendency of trucks to jackknife on wet pavement. (Class II, Priority Action) (H-84-93)

--to the Arkansas State Police and the Arkansas State Crime Laboratory:

Instruct State Police officers to request that two separate vials of blood containing 5 ml each be collected for alcohol and drug analysis in serious and fatal accident investigations and that the samples be refrigerated until they can be transported to a laboratory for analysis and not be held in an officer's possession except for direct transportation to the laboratory. (Class II, Priority Action) (H-84-94)

Provide State Police officers with commercially available blood collection kits which contain the necessary materials for drawing blood under sterile conditions, two sterile containers for the blood samples that are precharged with an appropriate preservative and anticoagulant, and labels for identifying the samples. (Class II, Priority Action) (H-84-95)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JIM BURNETT
Chairman

/s/ PATRICIA A. GOLDMAN
Vice Chairman

/s/ G.H. PATRICK BURSLEY
Member

JIM BURNETT, Chairman, filed the following statement, dissenting in part:

I would add the following sentence to the probable cause: "Also contributing to the cause of the accident was the intoxication of the driver of the tractor-semitrailer."

October 30, 1984

APPENDIXES

APPENDIX A

INVESTIGATION

Investigation

The National Transportation Safety Board was notified of the accident on July 5, 1984. An investigator from the Safety Board's Fort Worth field office arrived at the accident scene at 11:30 p.m., on July 5, 1984. The investigator-in-charge, from the Safety Board's Atlanta field office, arrived at the scene at 1 a.m. on July 6, 1984, and an investigator from the Safety Board's Headquarters in Washington, D. C., arrived at noon the same day. Representatives from the Arkansas State Police and the Arkansas State Highway and Transportation Department participated in the investigation. Additional information was provided by the Bureau of Motor Carrier Safety, the National Highway Traffic Safety Administration, the International Association of Chiefs of Police, Inc., Kenworth Truck Company, Clement Industries, Inc., Indian Head Industries, Inc., (MGM Brake Division), and Midland Brake, Inc.

Deposition/Hearing

There were no depositions or hearings held in connection with this investigation.

APPENDIX B

POLICE CAR CARAVAN INFORMATION

	DRIVER	POLICE AGENCY	EMERGENCY LIGHT EQUIPMENT
1.	John Sanderlin	Arkansas State Police	Roof Mounted Blue Light Bar
2.	William T. Jones	DeQueen, AR Police Department	Roof Mounted Revolving Blue Light
3.	William T. Hills	DeQueen, AR Police Department	Roof Mounted Blue Light Bar
4.	Frank McKeller	Arkansas Highway Police	Roof Mounted Blue Light Bar
5.	Kerry Hockersmith	DeQueen, AR Police Department	Roof Mounted Blue Light Bar
6.	Roy Hill	Broken Bow, OK Police Department	Roof Mounted Blue Light Bar
7.	Wesley Sossaman	McCurtain Co., OK Sheriff Department	Roof Mounted Revolving Blue Light
8.	John Gilbreath	Oklahoma Highway Patrol	Right Side Mounted Red Spot and Two Amber in Ledge of Rear Window
9.	Scott Watkins	Oklahoma Highway Patrol	Roof Mounted Revolving Blue Light
10.	James Dean	Horatio, AR Police Department	Roof Mounted Blue Light Bar
11.	Jim Smith	Sevier Co., AR Sheriff Department	Roof Mounted Blue Light Bar
12.	Brenda Gilham	Civilian Automobile - Mrs. Herman Jones, Sr., passenger. Each occupant was wife of Officer killed in car No. 3.	None
13.	Hut Greenwood	Civilian Automobile - DeQueen, AR City Manager	None
14.	Keith Tucker	DeQueen, AR Police Department	Roof Mounted Blue Light Bar
15.	Doyle Crouch	Arkansas Highway Police	Roof Mounted Blue Light Bar

Notes: (1) All of the cars left DeQueen, Arkansas, together except for car number 15; that car joined the group when it was passing through Ashdown, Arkansas.

(2) The emergency light was operating on each of the police cars equipped with blue lights; only the right side red spot light was flashing on car number 8.

APPENDIX C

TRUCKDRIVER DRIVER LICENSE RECORD

Traffic Violations - Louisiana Drivers License Record

DATE	VIOLATION	LOCATION	TYPE VEHICLE	OWNER
11-08-79	Failure To Stop/Stop Sign	Caddo Parish, LA	Tractor-Trailer	Unknown
09-25-81	Following Too Closely	Bossier Parish, LA	Tractor-Trailer	Terrell Trucking
05-25-82	Speeding 66/55	Desoto Parish, LA	Tractor-Trailer	Terrell Trucking
08-05-82	Backing Without Safety	Carthage, TX	Tractor-Trailer	O. W. Lary
08-07-83	Speeding 69/55	Caddo Parish, LA	Tractor-Trailer	O. W. Lary
04-11-83	Speeding 63/55	Bossier Parish, LA	Tractor-Trailer	O. W. Lary
09-06-83	Speeding 67/55	Shreveport, LA	Tractor-Trailer	Terrell Trucking
*04-10-84	Writ Proms	Caddo Parish, LA	Tractor-Trailer	Terrell Trucking

* Charge was "Expired Motor Vehicle Inspection Sticker". Writ Proms ("Promise to appear in court to answer charge on 04-24-84) was extended by the District Attorney to permit the defendant to pay a fine rather than appear. McCoy paid a $56.50 fine on May 23, 1984.

APPENDIX D

TRUCKDRIVER INFORMATION

TRUCKDRIVER ACTIVITY (8 days) - FOOD AND MEDICINE INTAKE (3 days)

DATE	ACTIVITY	FOOD & MEDICINE INTAKE	DUTY IN MOTOR CARRIER'S SERV		
			On duty	Off duty	Hours
Thursday June 28, 1984	Drove truck two round trips from Wilton, AR to Longview, TX. Spent night at home in Dubberly, LA.		4:03 AM	5:58 PM	13.5
Friday June 29, 1984	" " "		3:59 AM	6:38 PM	14.0
Saturday June 30, 1984	Off duty at home in Dubberly, LA				0.0
Sunday July 1, 1984	Changed oil and filter in tractor at Terrell's Sibley, LA terminal; otherwise spent day at home.		10:47 AM	11:59 AM	1.25
Monday July 2, 1984	At home - got out of bed at 3 AM, showered, then drove about 5 miles to Terrell's terminal and reported for work. Drove truck two round trips from Wilton, AR to Longview, TX then returned to Sibley. In bed at home about 10 PM.	Ate no breakfast, drank several cups of black coffee before leaving for work. Ate "snacks" on road during day then full meal at home that night.	4:49 AM	7:54 PM	14.5
Tuesday July 3, 1984	At home - got out of bed about 3 AM. Drove same trips as previous day then returned to Sibley. In bed about 10 PM.	Same food intake as previous day.	4:23 AM	7:47 PM	14.5
Wednesday July 4, 1984	Holiday - at home all day. Persued activities with family activities; baseball & swimming. In bed at home at 11:30 PM.	Ate no breakfast, drank several cups of black coffee during day, then ate full meal about 6 PM. Took 6 tylenol (extra strength) capsules between 2 - 11:30 PM			0.0
Thursday July 5, 1984	At home - got out of bed about 3:30 AM. Drove to Sibley terminal.	Ate no breakfast, drank about 7 cups of black coffee (caffeine)	5:05 AM	8:40 AM	3.75
				Total duty hours - - -	61.5

APPENDIX B

BUREAU OF MOTOR CARRIER SAFETY
CRITERIA FOR SAFETY AUDIT SELECTON

Bureau of Motor Carrier Safety personnel used the following criteria during Fiscal Year 1984 to rate motor carriers with point values to prioritize the order in which they should be safety audited. The first 7 items were developed by the BMCS Washington Headquarters and the last 12 items were developed by the 9 BMCS Regional Offices to fulfill special emphasis needs in their region. Each BMCS region used a minimum of 7 of the listed criteria as a guide. Items 01 thorugh 07 were mandated to each region. Each region had an option of selecting up to 3 additional items from the listing resulting in every region using a minimum of 7 and a maximum of 10 criteria to prioritize their motor carriers for safety auditing.*

84-01 - Carriers with an accident ratio above the national average (4)
84-02 - Carriers with a safety rating of unsatisfactory (5)
84-03 - Carriers with a safety rating of conditional (1)
84-04 - Motor carriers of bulk hazardous materials not audited since 10/1/81 (4)
84-05 - Motor carriers of hazardous wastes and/or substances not audited since 10/1/80 (5)
84-06 - Motor carriers with an out-of-service defects per inspection ratio greater than 0.54 for calendar 1982 (3)
84-07 - Carriers operating 7 or more power units with no reported accidents since 1979 or later (2)
84-08 - New passenger carriers with no audit (4)
84-09 - Carriers of explosives and/or blasting agents not audited since 9/30/82 (4)
84-10 - New ICC [Interstate Commerce Commission] authorized carriers wih no audit (2)
84-11** - Passenger carriers not audited since 10/1/82 (2)
84-12 - Carriers with two or more drivers declared out-of-service (4)
84-13 - Carriers of hazardous materials not audited after 10/1/81 (5)
84-14 - Carriers with drivers placed out-of-service - calender year 1982 (4)
84-15 - Exempt carriers with no audit since 10/1/81 (2)
84-16** - Passenger carriers not audited since 10/1/82 (4)
84-17 - Carriers experiencing accidents and incidents of noncompliance (5)
84-18 - Carriers of oilfield equipment not audited since 1/1/80 (3)
84-19 - Large carriers not audited since 1/1/80 (4)

Note: * The criteria used by BMCS Region 6, which includes Louisiana, included items 01 through 07 plus items 10, 18, and 19.

** Items 11 and 16 are the same except for the point value assigned. The difference in point values to these items resulted from some region's desire to place a greater emphasis on passenger carrier audits than did other regions.

APPENDIX F

INFORMATION ON ARKANSAS MOTOR VEHICLE AND TRAFFIC LAWS REGARDING USE OF EMERGENCY LIGHTS ON POLICE VEHICLES

AUTHORIZED EMERGENCY VEHICLE EQUIPMENT	STATUTE	AUTHORIZED TO EQUIP VEHICLES	STATUTE	DUTY IMPOSED UPON MOTORIST WHEN IN USE	STATUTE	SPECIFIC AUTHORIZATION TO USE	STATUTE
AMBER LIGHTS	75-402(d)(2) 75-737 75-738	State, County, City or Municipal where use (determined by state agency) to be required for dangerous or hazardous services; Public service corporations or private individuals whose use thereof is determined by the Commissioner of Motor Vehicles	75-402(d)(2) 75-737	Use caution upon approach (not same as an emergency vehicle)	75-402(d)(2)	During dangerous and hazardous services	75-402(d)(2
RED LIGHTS	75-402(d)(2)	State, County, City or Municipal fire departments, volunteer firemen solely while engaged in performance of duty. Privately owned fire departments; Ambulances solely for ambulance purposes.	75-402(d)(2)	NONE	NONE	Vol. Firemen in performance of duty as vol. fireman	75-402(d)(2
BLUE LIGHTS	75-402(d)(1) 75-735	State, County, City or Municipal police agencies.	75-402(d)(2) 75-735	NONE	NONE	Not stated	
SIREN, EXHAUST WHISTLE, BELL	75-725 75-625	Every authorized emergency vehicle	75-725	Yield right of way; Drive to right as far as possible and stop	75-625	In response to emergency call; in the immediate pursuit of violator or suspect etc; when necessary to warn ped. and other drivers.	75-725

TRAFFIC LAWS AUTHORIZED EMERGENCY VEHICLES ALLOWED TO VIOLATE

AUTHORIZED TO	STATUTE
Authorized emergency vehicles may exceed speed limits if audible signal (bell, siren, whistle) is sounding and is responding to emergency.	75-606
When responding to an emergency call upon approaching red or stop signal or stop sign shall slow down as necessary for safety but may proceed cautiously past.	75-423(b)
Not required to stop at hazardous railroad crossings when responding to an emergency call.	75-640
May hold right-of-way over military forces of organized militia in necessary performance of duties.	11-100%

RESPONSIBILITY	STATUTE
Duty to drive with due regard for safety of all persons using street. No protection for consequence of reckless disregard of safety to others	75-606
No driver of any authorized emergency vehicle shall assume any special privilege except when such vehicle is operated in response to an emergency call or in the immediate pursuit of an actual or suspected violator.	75-423 (c)