

PB 247 837

365062



**NATIONAL  
TRANSPORTATION  
SAFETY  
BOARD**

WASHINGTON, D.C. 20594

**HIGHWAY ACCIDENT REPORT**

**MULTIPLE -VEHICLE COLLISIONS**

**IN FOG,**

**NEAR CORONA, CALIFORNIA**

**FEBRUARY 28, 1975**

**REPORT NUMBER: NTSB-HAR-75-7**

Reproduced by  
NATIONAL TECHNICAL  
INFORMATION SERVICE  
U.S. Department of Commerce  
Springfield, VA 22151

**UNITED STATES GOVERNMENT**



TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No. NTSB-HAR-75-7	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle Highway Accident Report-- Multiple-Vehicle Collisions in Fog, Near Corona, California, February 28, 1975		5. Report Date November 5, 1975	6. Performing Organization Code
7. Author(s)		8. Performing Organization Report No.	
9. Performing Organization Name and Address National Transportation Safety Board Bureau of Surface Transportation Safety Washington, D. C. 20594		10. Work Unit No. 1692	11. Contract or Grant No.
12. Sponsoring Agency Name and Address  NATIONAL TRANSPORTATION SAFETY BOARD Washington, D. C. 20594		13. Type of Report and Period Covered Highway Accident Report February 28, 1975	
		14. Sponsoring Agency Code	
15. Supplementary Notes			
16. Abstract On February 28, 1975, at 7:40 a.m., P.d.t., the first of several multiple vehicle collisions occurred on State Route 91 near Corona, California. The collisions occurred in fog. Personnel of the California Highway Patrol had started to escort some vehicles through the fog in convoys when the collisions occurred. The vehicles in the convoys were not involved in the serious collisions.  The highway was closed for about 4 hours. There were no fatalities. Twenty-three persons were injured, 6 of whom were hospitalized. About 60 automobiles and 24 commercial trucks were involved. Fire began when a truck struck an automobile.  The National Transportation Safety Board determines that the probable cause of the collisions was the penetration of vehicles into fog at speeds which were too high for the visibility conditions. The drivers had no advance information to warn them of the fog's severity and a reduced speed limit had not been posted.			
17. Key Words Reduced visibility driving tactics; driver education; police fog convoy procedures; automatic hazard warning system; vehicle rear lighting systems; multiple-vehicle collisions; dense fog.		18. Distribution Statement This document is available to the public through the National Technical Information Service, Springfield, Virginia 22151.	
19. Security Classification (of this report) UNCLASSIFIED	20. Security Classification (of this page) UNCLASSIFIED	21. No. of Pages 29	22. Price 4.00

## FOREWORD

The accident described in this report has been designated a major accident by the National Transportation Safety Board under the criteria established in the Safety Board's regulations.

The report is based on facts obtained from an investigation by the Safety Board. Information used in the report was received from the California Department of Transportation, the California Highway Patrol, and the Federal Highway Administration.

The conclusions, the determination of probable cause, and the recommendations are those of the Safety Board.

## TABLE OF CONTENTS

	Page
SYNOPSIS . . . . .	1
FACTS . . . . .	1
The Accidents . . . . .	1
Accident Site . . . . .	2
Environmental Factors . . . . .	2
Fog Accident History . . . . .	7
Driver Reactions to the Fog . . . . .	7
Rescue and Emergency Services . . . . .	9
Postcrash Inspection of Vehicles . . . . .	9
ANALYSIS . . . . .	9
The Need for Improved Hazard Warning Systems . . . . .	9
Driver Information Needs Associated with Reduced- Visibility Driving . . . . .	10
Vehicle Rear Lighting Systems . . . . .	12
CHP Operating Procedures in Fog . . . . .	12
CONCLUSIONS . . . . .	14
PROBABLE CAUSE . . . . .	15
RECOMMENDATIONS . . . . .	15
APPENDIXES	
Appendix A: Adverse Weather and Road Conditions Procedures, Riverside Area CHP . . . . .	17
Appendix B: Letter of Recommendation to the National Highway Traffic Safety Administration . . . . .	22
Appendix C: Letter of Recommendation to the State of California . . . . .	25

SS-H-39

NATIONAL TRANSPORTATION SAFETY BOARD  
WASHINGTON, D. C. 20594

HIGHWAY ACCIDENT REPORT

Adopted: November 5, 1975

---

MULTIPLE-VEHICLE COLLISIONS IN FOG,  
NEAR CORONA, CALIFORNIA,  
FEBRUARY 28, 1975

SYNOPSIS

On February 28, 1975, at 7:40 a.m., P.d.t., the first of a series of multiple-vehicle collisions occurred on State Route 91 near Corona, California. The collisions occurred in fog. Personnel of the California Highway Patrol had started to escort some vehicles through the fog in convoys when the collisions occurred. The vehicles in the convoys were not involved in the serious collisions.

The highway was closed for about 4 hours. There were no fatalities. Twenty-three persons were injured, 6 of whom were hospitalized. About 60 automobiles and 24 commercial trucks were involved. Fire began when a truck struck an automobile.

The National Transportation Safety Board determines that the probable cause of the collisions was the penetration of vehicles into fog at speeds which were too high for the visibility conditions. The drivers had no advance information to warn them of the fog's severity and a reduced speed limit had not been posted.

FACTS

The Accidents

At 7:30 a.m. on February 28, 1975, a California Highway Patrol (CHP) officer patrolling on State Route 91 in Corona, California, advised CHP headquarters that visibility was dropping to between 35 and 50 feet, and that about 4 miles of freeway, from the Orange County line to Maple Street in Corona, were affected by a dense fog. Two CHP units in the area began to escort vehicles through the fog. A third CHP unit joined in the operation, and convoys were conducted both eastbound and westbound between the Orange County line and Main Street, Corona--a distance of 6.34 miles.

At 7:40 a.m., a multiple-vehicle collision occurred on the westbound lanes of State Route 91 near Corona. About 10 minutes later, a second multiple-vehicle collision occurred on the eastbound lanes. These accidents occurred in the vicinity of milepost 3.5, Serfas Club Drive. (See Figure 1.) Another collision occurred on the eastbound lanes between mileposts 4 and 5 and another on the westbound lanes at milepost 1.7. One of the series of collisions occurred on the westbound lanes and involved 30 vehicles; most of the collisions involved 3 to 5 vehicles. (See Figures 2, 3, and 4.) These collisions involved vehicles which were not in convoys. Most of the drivers involved in the collisions were not aware of the convoys.

The collisions involved 60 automobiles and 24 commercial trucks. Many vehicles were destroyed, and the remainder were damaged. A fire erupted when a truck struck an automobile. There were no fatalities resulting from the collisions. Twenty-three persons were injured, 6 of whom were hospitalized.

A CHP unit leading a westbound convoy was involved in a collision at 8 a.m., but there were no reports of personal injury or vehicle damage to the individuals and vehicles in that convoy. The convoy was traveling at 20 mph, and the CHP officer in the lead car was looking to his left to signal an automobile attempting to pass him when he ran into a vehicle ahead of him.

#### Accident Site

In the area of the collisions, State Route 91 consists of eight 12-foot lanes (four eastbound and four westbound) separated by a 24-foot grass median. Adjacent to the median in each direction of travel is an 11-foot paved emergency stopping lane. On the outer edges of the highway are 10-foot paved shoulders. Westbound, the highway follows a 4,000-foot-radius curve to the right with a 0.39 percent downgrade. From the eastern edge of the city limits of Corona to a point 10 miles west (Riverside-Orange County line), there are seven on-ramps westbound and seven eastbound. (See Figure 1.)

Inspection of the highway in the area of the accidents revealed no defects with respect to design, construction, or maintenance.

At 3:30 a.m. on the day of the accidents, 4-foot by 4-foot "FOG" signs were placed on each side of the westbound lanes in advance of fog-affected areas. No signs were placed in advance of the fog area on the eastbound lanes.

#### Environmental Factors

Information from surrounding airports revealed that fog and, in some places, haze and smoke were restricting visibility in the early morning hours of February 28, 1975. Chino Airport, 6 1/2 miles from the accident site, reported 0 visibility between 6:18 a.m. and 8:55 a.m. because of fog.

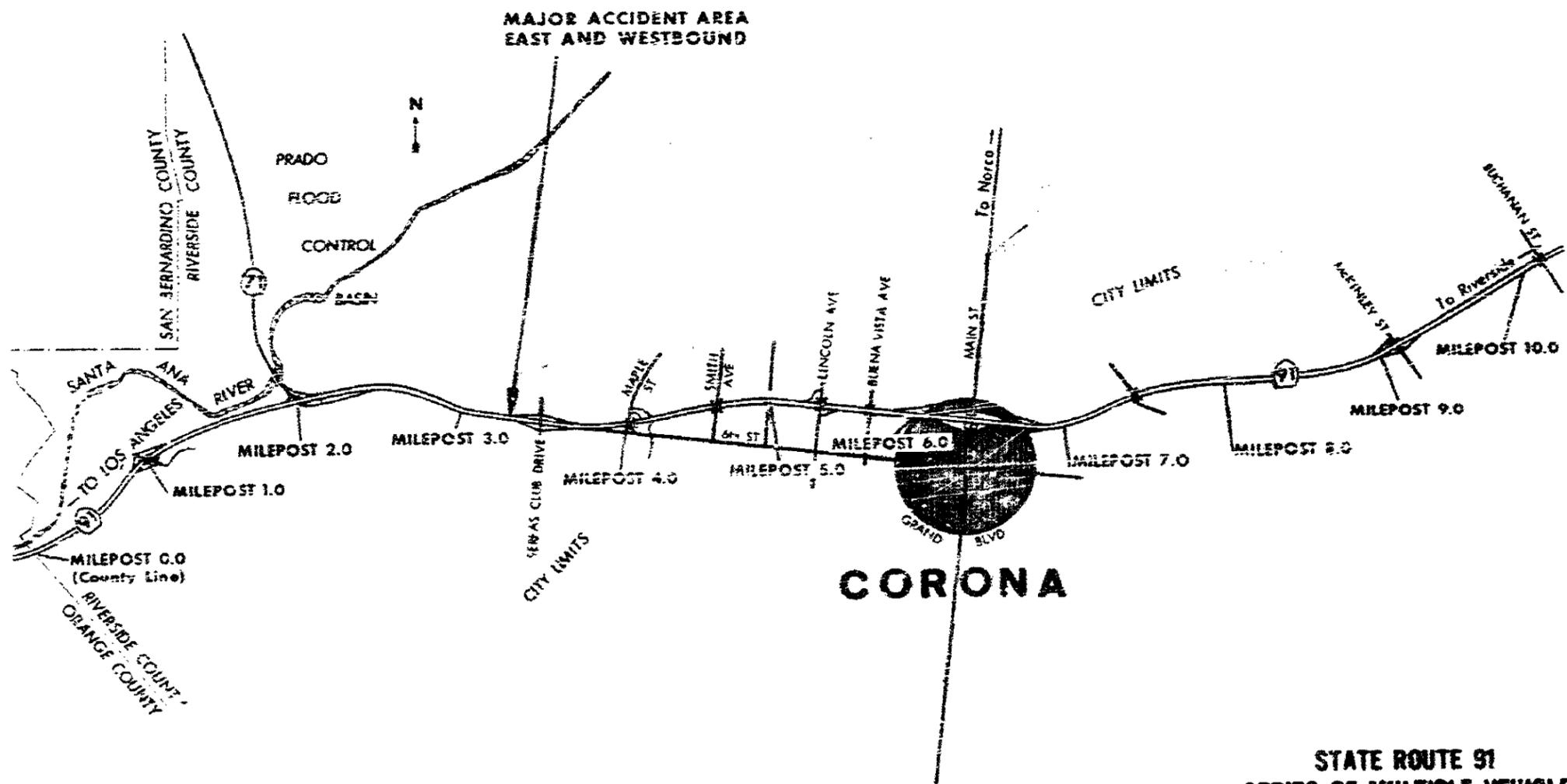


Figure 1. ACCIDENT SITES

STATE ROUTE 91  
 SERIES OF MULTIPLE VEHICLE  
 COLLISIONS AND FIRE  
 FEBRUARY 28, 1975

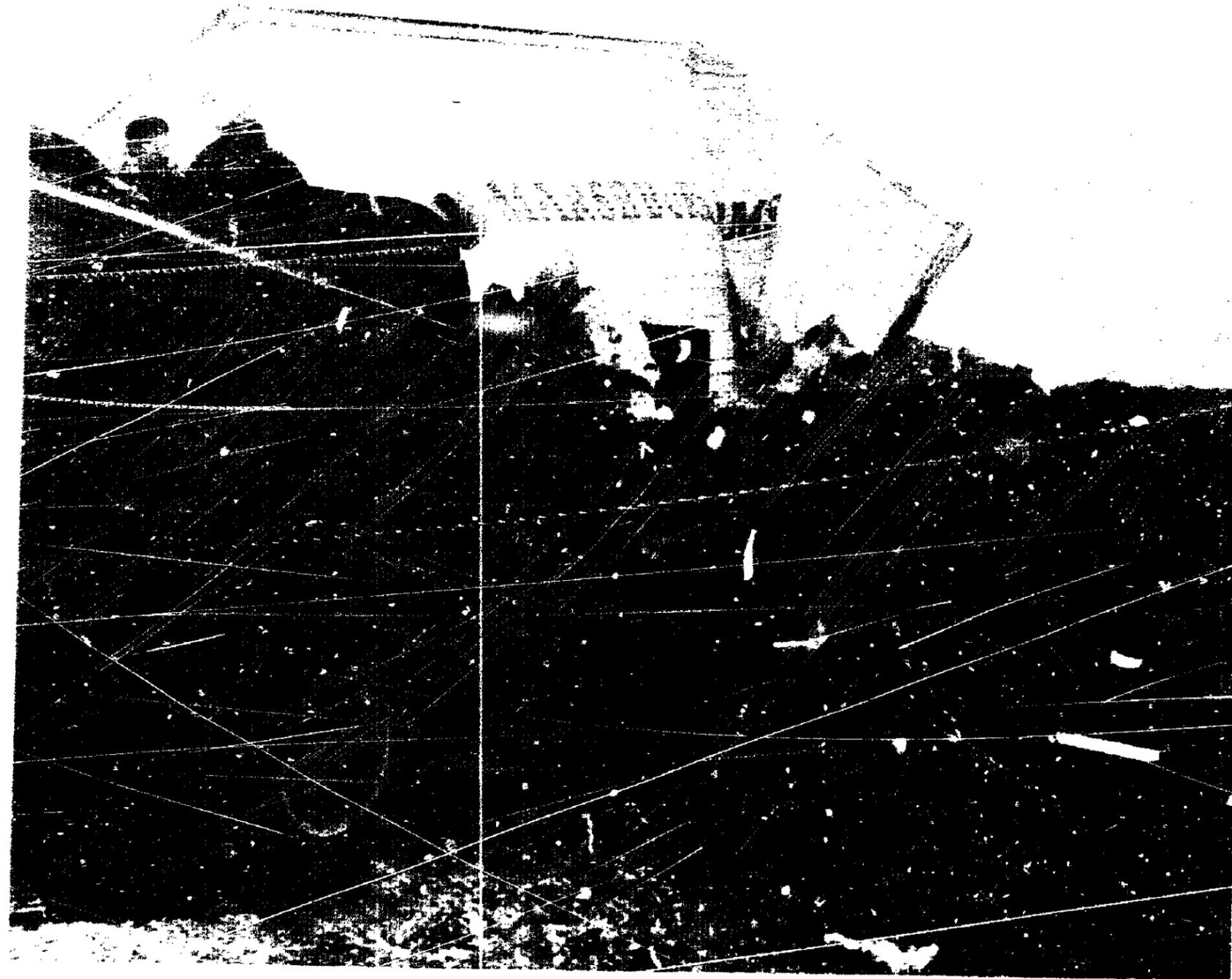
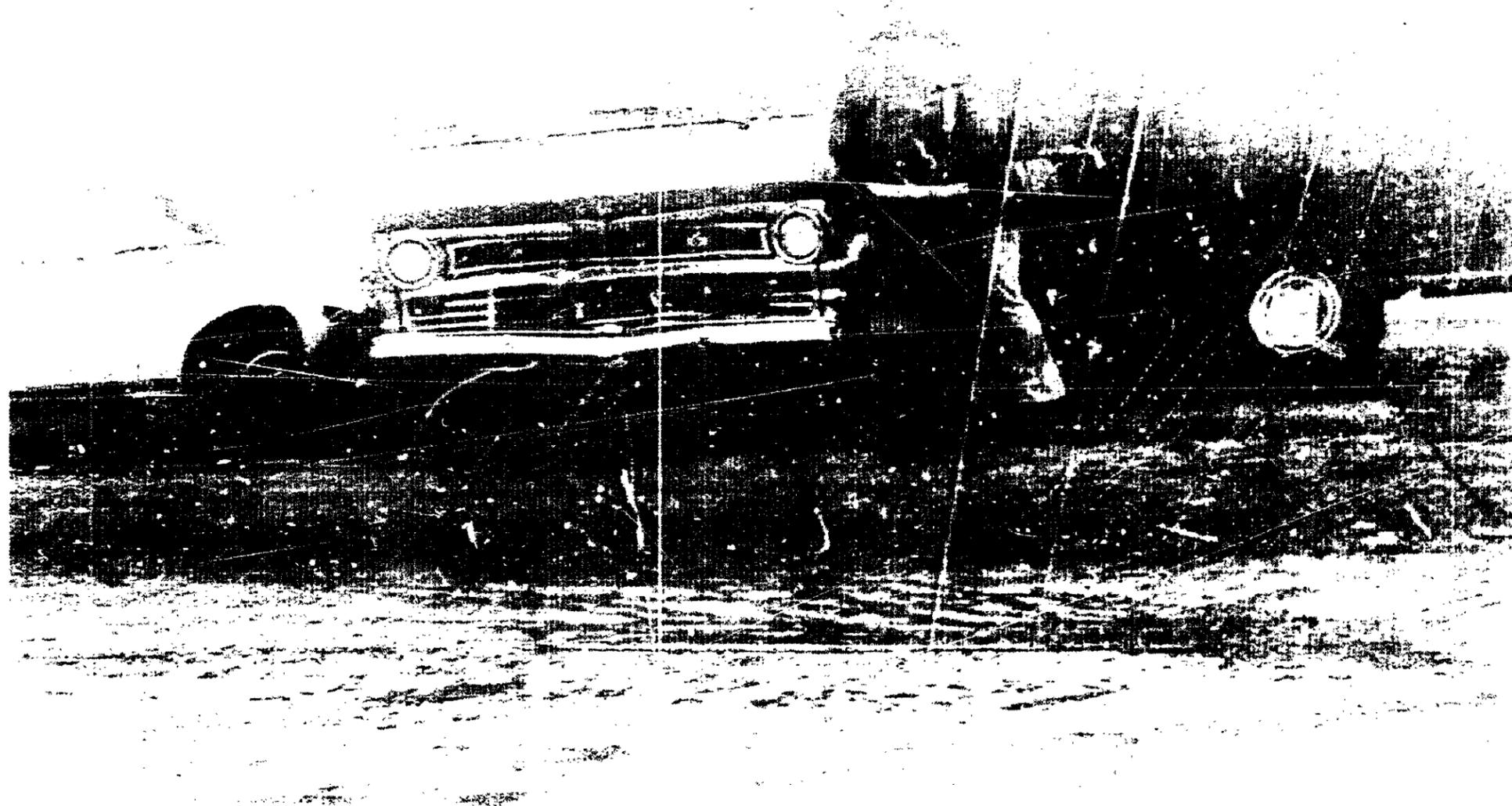


Figure 2. Damaged trucks.



- 5 -

Reproduced from  
best available copy.

Figure 3. Damaged vehicles. Note different final stopping directions.

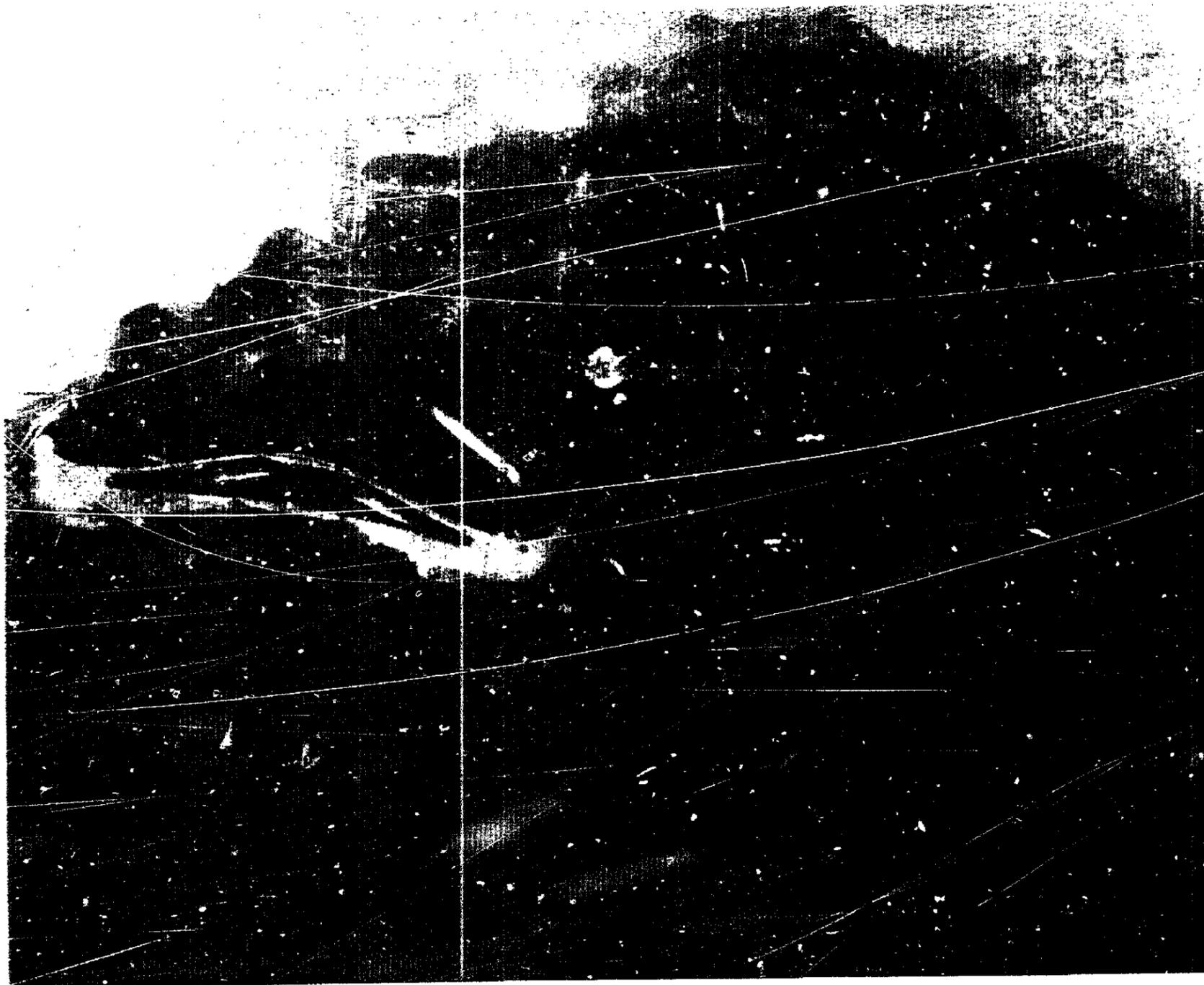


Figure 4. Damaged truck and automobiles.

Acting in compliance with their "Adverse Weather and Road Conditions" procedures (See Appendix A.), the CHP attempted to warn motorists of local weather hazards.

Starting at 6:00 a.m. and continuing through the commuter hours (6 a.m. - 10 a.m.), the CHP local dispatch centers issued traffic advisories ("Sig Alerts") through the four local radio stations, cautioning motorists in the Corona-Riverside area about the heavy fog and poor visibility conditions. Drivers using Route 91 were urged either to use other routes, if possible, or to exercise extreme care.

Between 6 and 7 a.m., patrol officers reported that visibility in the Corona-Riverside area was between 300 and 1,500 feet.

A westbound truckdriver who was involved in one of the accidents stated that when he had passed through the accident area eastbound at 6:15 a.m., visibility was 1/4 to 3/4 of a mile.

A westbound automobile driver who was involved in a crash at 8:05 a.m. stated that he talked with friends who were 5 minutes ahead of him and they said the visibility in the accident area was unlimited.

Many of the drivers involved in the collisions were commuters from the Corona area. When questioned about the density of the fog in the accident area, they stated that they had encountered fog many times, but it had never been so dense.

#### Fog Accident History<sup>1/</sup>

Accident statistics for the 4-year period of 1971-1974 show that 38 fog-related accidents occurred on State Route 91 between the Orange-Riverside County line (milepost 0) and Riverside, California (milepost 21.66). Three accidents occurred at mileposts 3.12, 3.36, and 3.72, and involved 13 vehicles. Two persons were killed and 45 were injured, and 111 vehicles were involved. The CHP advised that there is a fog season between September and March. Thirty-three of the 38 accidents, or 87 percent, occurred during this season.

#### Driver Reactions to the Fog

Most of the drivers stated that as they were traveling toward the accident area, visibility ranged from 200 feet to unlimited visibility, and presented no problem to them. They maintained vehicle speeds at or close to the posted speed limit (55 mph) because visibility was adequate. Several drivers stated that they had observed the "FOG" signs on the westbound lanes of the freeway before they entered the area of reduced visibility, but that they did not reduce their speeds appreciably. One driver stated that he continued at turnpike speeds because the signs were located in a clear area and were "deceptive."

<sup>1/</sup> Fog statistics were collected from the California Department of Public Works, Division of Highways, District 8. District 8 is responsible for San Bernardino County and part of Riverside County.

Near the accident area, visibility suddenly dropped to between 0 and 20 feet. Drivers described this drastic change as "running into a cloud," ".....a blanket of solid fog with 0 visibility," and "all of a sudden it got dark....." Drivers reported that their vehicle speeds were between 20 and 50 mph as their vehicles entered and proceeded through the dense fog. One driver stated, "I was going around 40 mph in this 20 to 30 feet visibility," and another stated, "As the fog got heavier, I slowed to 50 mph."

Once in the dense fog, drivers reacted to reduced visibility in various ways. Some drivers used the taillights of the vehicle in front of them as a guide through the fog. When they lost sight of the taillights, they slowed or stopped their vehicles. In many instances, those drivers who stopped their vehicles were struck in the rear. Others stated that they could not tell by the lighted taillights whether the vehicle ahead was stopped or not and, as a result, struck the vehicle when it was stopped. For example, one driver stated, "I couldn't tell if the vehicle rear lights were stoplights or just taillights."

To reduce the reaction time necessary for braking, one driver kept his foot poised over the brake pedal as he proceeded through the fog, but he still struck a stopped vehicle.

Another driver reported that he had difficulty seeing, so he decided to follow 30 feet behind a truck (at 20 mph) because the truck was blowing the fog away and clearing a path for him. He brought his vehicle to a safe stop, but it was struck in the rear by a truck.

Several drivers who could not see at all in the fog stopped their vehicles in reaction to the sounds they heard. One stated he heard tire braking noises, so he stopped, while another reported he heard vehicles crashing, so he stopped.

Some drivers steered to the right and successfully stopped on the shoulder without becoming involved in accidents. Others drove slowly through the accident area (on the shoulder and open portions of the travel lanes) and got off the road before they could be hit by other vehicles.

Several drivers tried to proceed through the fog at the 55-mph speed limit. One driver admitted to "pushing his luck" and another said that he had to get to work. Both drivers became involved in accidents. Many of the drivers had trouble judging distance in the fog and stopping in time to avoid hitting stopped vehicles.

The drivers did not know what action they should take after they were in a collision. Some drivers stayed in their vehicles while others got out. One driver was about to leave his vehicle when another vehicle slid past his door and crashed into the vehicle ahead. This convinced the driver to remain inside his vehicle until all the crashes stopped. Another driver, who had to remain in his vehicle because of a broken leg, lit a cigarette even though the fuel tank on his automobile was ruptured and leaking gasoline.

Several drivers left their cars and were inspecting the damage to their vehicles when they heard tire noises and vehicles crashing. They ran off the highway and up an embankment to avoid injury. In general, those drivers who got out of their vehicles milled about on the highway. They appeared to be more concerned about the damage to their vehicles than about their own safety; they did not appreciate the hazard of remaining on the highway.

#### Rescue and Emergency Services

After the collisions, California Highway Patrol units from Riverside, Santa Ana, San Bernardino, and Banning; the Corona Police Department; the Corona Fire Department; the California Division of Forestry; and the California Department of Transportation (CAL-DOT) assisted in the rescue and emergency efforts.

At 8:10 a.m., traffic on State Route 91 was routed off the highway and through the city of Corona. The California Division of Highways brought out barricades to block the on-ramps. The Corona and Riverside Police Departments directed traffic through the city of Corona. The freeway in the affected area was closed to traffic for about 4 hours.

The Corona Fire Department was notified at 8:11 a.m. of a vehicle fire on State Route 91 and responded with two engines, one truck, and one rescue unit. They arrived at 8:20 a.m. and quickly extinguished the vehicle fire. Visibility was reduced to such an extent that a fireman had to walk in front of the fire equipment and guide it to the scene.

The California Division of Forestry received a call about the collisions at 8:30 a.m. They responded with four fire engines and four rescue units. Also, eight ambulances and five local rescue units responded to carry the injured to the local hospital.

#### Postcrash Inspection of Vehicles

Twenty-eight vehicles were inspected after the accident; they included 15 passenger cars, 3 light trucks, 5 heavy truck tractors, and 5 heavy truck trailers. No mechanical failures (brakes, steering, etc.) were found that could have contributed to the collisions. Most of the vehicles showed evidence of moderate-to-heavy front and rear end damage. There was considerable evidence that at least one-half of the impacts occurred when the vehicles were in a braking attitude (i.e., nose down--rear end up configuration).

### ANALYSIS

#### The Need for Improved Hazard Warning Systems

The advisory signs bearing the single word "FOG" placed along the westbound lanes in advance of the fog area did not provide the motorists with enough information to deal with the hazardous situation ahead. It did warn

of a hazard, but it did not advise them to slow down. Since a reduced speed limit was not displayed, drivers made individual and varied decisions as to a safe speed for their vehicles. Some drove too fast and some too slow. As a result, stopped or slow-moving vehicles were struck in the rear by faster-moving vehicles.

The signs also did not inform motorists how far ahead the hazard was. Some drivers, who saw the signs, did not encounter the fog immediately, and had resumed speeds, were caught by surprise when they were suddenly enveloped by the fog.

Over the years, CAL-DOT has tested various devices (reflective lane line markings, variable speed limit signs, etc.) and techniques (increased highway patrolling, etc.) to guide drivers through fog. Results to date show that: (a) The posting of speed limits has a measurable effect on traffic, and (b) because of their cost, variable speed limit signs should be used only at locations with repetitive problems.

Research conducted by CAL-DOT suggests that an automatic hazard warning system is needed and would be accepted by motorists.

At present, the CAL-DOT is not working to develop an automatic hazard warning system even though it recognizes the necessity of such a system

#### Driver Information Needs Associated with Reduced-Visibility Driving

The driver reactions demonstrated in these collisions and in other limited visibility accidents investigated by the Board show that drivers lack the knowledge to deal with reduced visibility situations and do not understand the dangers of such situations. In previous reports, the Safety Board has observed that drivers tend to go too fast when visibility is limited.<sup>2/</sup>

This was illustrated by the high rates of speed at which many of the vehicles entered the fog area. For example, one driver stated he was proceeding at 40 mph through an area of 20 to 30 feet of visibility. Assuming a normal reaction time of .75 seconds, it would have taken that driver 126 feet to stop his vehicle. Thus, the 20 to 30 feet of visibility was inadequate for the speed of the vehicle. However, since there was no reduced speed limit displayed or adequate information about the hazard ahead, drivers cannot be held entirely responsible for having chosen unsafe speeds.

Many drivers involved in these collisions were traveling at what they considered were safe speeds. They realized that their speeds were excessive only when they found they were unable to stop their vehicles in time to avoid

<sup>2/</sup> National Transportation Safety Board, Motor Carrier Highway Accident, Near Joliet, Illinois, August 12, 1967; Interstate Bus-Automobile Collision and Rollover on Indiana Route 57, South of Petersburg, Indiana, November 24, 1969.

a collision. Some drivers knowingly chose speeds that were too fast.

Some drivers maintained speeds that were too fast because of their past experience with "patchy fog" on this section of highway. When there is patchy fog, visibility is reduced for only short periods of time, after which visibility increases again, and drivers can continue at the same speed. Many drivers probably maintained their speeds because they were local residents and had operated their vehicles in this manner many times. However, many of the drivers stated after the collisions that this fog was much thicker than any they had encountered before.

Not only did the drivers demonstrate a lack of knowledge as to the safest manner of proceeding through the fog, they also demonstrated a lack of knowledge as to whether they should leave or stay in their stopped vehicles.

Vehicle occupants are protected by the vehicle structure if they remain inside. But if a vehicle's fuel tank is ruptured, the occupants should evacuate immediately.

The drivers who left their vehicles and climbed a dirt embankment on the roadside appeared to have taken the safest action. However, the question of whether vehicle occupants should leave or stay in their vehicles has not been studied adequately.

The Safety Board has investigated a number of multiple-vehicle chain accidents, has conducted a fog symposium, and has published a special study in which these problems were analyzed. In its special study, the Board concluded:

There is no national agreement among educators and experts as to specific steps to be taken when drivers enter and operate in a dense fog zone. A need exists to resolve the present controversy over the conflicting advice currently being disseminated concerning driving procedures in fog.

At present, there are no criteria in driver education or research literature that will aid drivers in determining safe driving speeds under various conditions of fog.<sup>3/</sup>

Consequently, the Safety Board made recommendations to NHTSA to resolve these problems. NHTSA has not done so. Those same recommendations apply to this accident.

<sup>3/</sup> National Transportation Safety Board, "Special Study: Reduced Visibility (Fog) Accidents on Limited Access Highways," p. 14. NTSB-HSS-72-4

### Vehicle Rear Lighting Systems

Driver interviews and inspections of damaged vehicles indicate that rear lighting devices on vehicles were not visible enough in the fog to aid motorists in avoiding collisions. The lights might have been more visible if they had been yellow instead of red. Photometric criteria indicate that visibility would be improved by 250 to 300 percent if the lights were yellow.<sup>4/</sup>

When drivers have difficulty seeing the lights of the vehicles ahead of them, they need more time to react to stopped vehicles. Human factors data <sup>5/</sup>show that the decision to stop can take 1 to 2 seconds or longer before human motor response is initiated. At 25 mph, a vehicle would cover 37 to 74 feet of roadway in this time period. If lights are clearly visible, a reflex reaction time of only 0.1 second would be necessary for human motor response. At 25 mph, only 3 to 4 feet would be covered before the driver begins braking.

The visibility of brake and turn signals would also be improved if the signals were located higher up on vehicles. Brake lights on automobiles are normally mounted at bumper level. In moving traffic, it is often impossible, even in clear weather, to see the brake lights of any vehicle except the one immediately ahead, regardless of separation distance. If a brake light were located higher, it could be visible not only to the driver directly behind, but also to drivers of other vehicles farther behind. Those drivers would be alerted to the sudden stop of vehicles in the traffic ahead, and would have more time to stop their vehicles.

At least one automobile model has a set of brake and turn lights at the top of the trunk lid. Also, many law enforcement patrol vehicles have brake and turn lights installed inside their rear windows. Although there are no formal studies of the effectiveness of such lighting, observations indicate that advance warning is enhanced because these lights can be seen more easily than lights at bumper level.

### CHP Operating Procedures in Fog

These collisions occurred while the CHP was conducting convoys intended to prevent such accidents in fog. There are two reasons that, despite the convoy procedure, the collisions occurred. First, the CHP did not activate enough units when the fog became hazardous. Second, most of the collisions involved vehicles that were not in convoys. The westbound convoy vehicles that were in collisions at 8:00 a.m. were not damaged as severely, and their occupants were not injured as severely, as were the vehicles and occupants not in the convoys.

<sup>4/</sup> 1974 Society of Automotive Engineers Handbook, J588e, Twin Signal Lamps.

<sup>5/</sup> Damon, Albert; Stoudt, Howard W.; and McFarland, Ross A.; "The Human Body in Equipment Design," 1966, p. 238.

Therefore, since the convoy procedure was not fully implemented at the first collisions, the effectiveness of the convoys cannot be fully evaluated.

The collisions indicate that the CHP "Adverse Weather and Road Conditions" procedures (See Appendix A.) were not being completely complied with. These procedures require that when visibility is reduced to 200 feet, two officers should be deployed to the beginning of the fog area; they should park their patrol units one on the shoulder and one on the median; they should place a fog warning sign 500 feet in advance of the first patrol unit; and they should then use hand signals to slow traffic. The instruction states that "Round Robin 6/units will be utilized to slow traffic prior to entering foggy area."

If the officers had caused motorists to slow down before they entered the fog area, they might not have entered at excessive speeds.

State Route 91 in the area of the accident is composed of four lanes of traffic in each direction. Visibility was reduced to from 0 to 30 feet. It is most difficult for one patrol car to control four lanes of traffic safely when other motorists are not anticipating the presence of a slow-moving convoy. At 20 mph and with visibility of 0 to 30 feet, the driver of the patrol unit must direct his attention ahead so he will not collide with an unanticipated, stopped vehicle. The fact that one convoy escort unit did strike a vehicle ahead when his attention was diverted by a passing vehicle demonstrates the difficulty under which the officer was operating. With such limited visibility, it would be more practical either to use two patrol units per convoy or to close the road.

The "Round Robin" procedure would be improved if personnel were increased in critical areas before a fog occurs. This does not mean that patrols would have to be increased throughout the patrol system, but they could be increased in areas that the CHP considers essential. The "Adverse Weather and Road Conditions" procedures specify those areas, those days of the week, and those times of day that are "critical." It would seem logical to increase the number of patrols during these time periods in those areas for several reasons.

First, the increased number of patrols will mean that fog conditions might be discovered sooner, so convoys can be started sooner. Second, the increased number of patrols will reduce the time between each patrol unit on the "Round Robin" route. In that way, more "Round Robin" cycles can be completed, and more vehicles can be escorted. If more vehicles are escorted, there is less chance of multiple-vehicle collisions, because there will be fewer vehicles traveling between the convoys.

6/ In the "Round Robin" procedure, a CHP unit weaves slowly back and forth across all lanes of the freeway while it decreases its speed to slow down the traffic behind it. The unit escorts vehicles behind it through the fog area and then turns around to begin a convoy in the opposite direction through the fog area. Other units in the area may join in the convoy procedure as necessary.

More patrols would require additional manpower. However, this would not necessarily be a problem. In this instance, seven special duty patrolmen could have been activated on short notice, but they were not. Also, many patrolmen responded to the scene after the collisions occurred. They did so because the collisions were considered emergencies. If the fog itself had been considered an emergency, these patrolmen would have reported before the collisions, and they could have helped in the convoy procedure.

The present convoy procedure cannot prevent all fog accidents, but it can reduce the severity of those that do occur. One way to prevent fog accidents is to stop vehicles on the highway and to escort all vehicles through the fog. However, it is dangerous to stop vehicles traveling at high speed under fog conditions. Stopping the vehicles could cause rather than prevent collisions.

It might be more practical to warn motorists entering fog that police vehicles are conducting reduced-speed convoys through the fog. This would enable them to avoid running up onto a slow-moving convoy from the rear.

The Safety Board recognized in its special study <sup>7/</sup> the importance of the convoy procedures as an effective way to deal with fog accidents. The CHP should be commended for the development of this system. They should work toward refining this technique. The Safety Board recommends adoption of the convoy concept by other police agencies. However, before the concept is implemented, the convoy procedures used by the CHP and other police agencies should be studied and guidelines developed that could be adopted by any police agency for use in limited visibility highway conditions. Such guidelines should be incorporated into a manual and their implementation advocated by the National Highway Traffic Safety Administration through its Highway Safety Program Standard No. 15, "Police Traffic Services."

#### CONCLUSIONS

1. The design, construction, and maintenance of State Route 91 were not factors in these collisions.
2. No mechanical failures were found in the vehicles that could have contributed to the collisions.
3. Some drivers ignored the advanced warning "FOG" signs and were traveling too fast when they entered the area of reduced visibility.
4. No reduced speed limit signs were displayed and the drivers were traveling at different speeds.
5. Because of the reduced visibility, the drivers could not judge vehicle separation, vehicle speeds, and vehicle deceleration. As a result they did not have sufficient time to react to stopped or slowing vehicles ahead.

<sup>7/</sup> (See Footnote No. 3), p. 14.

6. A need exists for an automatic hazard warning system in fog-susceptible areas to provide more information to drivers about the hazard to be encountered.
7. Rear lighting systems of the vehicles involved in the accidents did not give enough warning to some of the overtaking motorists.
8. There is a need for rear lighting systems that are more visible to overtaking motorists.
9. After the collisions, many drivers did not know what they should do to protect themselves and their passengers from injury.
10. The actions of drivers involved in these collisions demonstrate the need for improved criteria in driver education to aid drivers in determining safe driving speeds, safe driving methods, and safe postaccident actions under fog conditions.
11. The CHP "Round Robin" procedure was not fully effective because it was not fully implemented at the time the accidents occurred.
12. To reduce the number and severity of multiple-vehicle fog collisions, dense fog should be treated as an emergency situation so that adequate manpower and vehicles can be available.
13. If traffic had been slowed by CHP units before they entered the foggy area, the accidents might have been prevented or reduced in severity.

#### PROBABLE CAUSE

The National Transportation Safety Board determines that the probable cause of the collisions was the penetration of vehicles into fog at speeds which were too high for the visibility conditions. The drivers had no advance information to warn them of the fog's severity and a reduced speed limit had not been posted.

#### RECOMMENDATIONS

As a result of the investigation of this accident, the National Transportation Safety Board submitted recommendations to the National Highway Traffic Safety Administration (See Appendix B.) and to the State of California. (See Appendix C.)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JOHN H. REED  
Chairman

/s/ FRANCIS H. McADAMS  
Member

/s/ LOUIS M. THAYER  
Member

/s/ ISABEL A. BURGESS  
Member

/s/ WILLIAM R. HALEY  
Member

November 5, 1975

APPENDIX A

CALIFORNIA HIGHWAY PATROL

RIVERSIDE AREA

ADVERSE WEATHER AND ROAD CONDITIONS

PHASE I: PROBLEM IDENTIFICATION AND EVALUATION

Fog Collision Analysis

Most critical time of day--0600-1000 hours, early morning commute traffic.

Most Critical Days of the Week

Monday through Friday are the most critical days, because of commute traffic. Saturday and Sunday cannot be completely discounted, especially if the fog should settle on a three day holiday.

Most Critical Beats

201, 301 Rte 91 Tyler St. to Orange County line 13 mi. 205, 411, 412, 611 IS 15 Watkins Drive to San Diego County line 39 mi. 101 Rte 60 Valley Way to San Bernardino County line 7 mi. 116, 311 Rte 31 San Bernardino County line to Norco 6 mi.

FOG FORECAST ALERTING PROCEDURE

If there is a probability of fog, the on-duty supervisor or a designated officer should call one or all of the following for weather conditions:

MAFB recorded weather (up dated every 6 hrs) 655-4613  
MAFB Forecaster 655-2463 or 655-1110  
NORTON AFB continuing weather 382-4380  
RIVERSIDE continual temperature and weather 684-1242

The on-duty supervisor or a designated officer will notify Central Dispatch and advise them of predictions or current fog conditions when necessary and keep same updated every 30 minutes or as necessary. When weather or road conditions warrant a sig alert (fog) Central Dispatch will notify surrounding dispatch centers of road and weather conditions and request that they notify their local radio stations when possible. Central Dispatch will notify the following scale facilities during limited visibility to warn commercial traffic. Santa Ana Canyon, Cajon, and Hanning.

Several radio stations now call Central Dispatch for the current weather and road conditions tape. Central Dispatch will notify the stations when they call that the road information (weather, etc) is updated as changes in conditions occur and request that they broadcast the tape every thirty (30) minutes during commute hours (0600-1000). The on duty supervisor or designated officer will contact Central Dispatch when necessary to coordinate with the Division

APPENDIX A

- 18 -

of Highways and local Police Departments during the re-routing of traffic and road closures. Preparations have been made by the Division of Highways for on-ramp closures through the Corona Area when requested by this Department. (Barricades have been placed at on-ramps through the Corona Area for immediate use when notified by dispatch.)

When necessary to re-route traffic on Rte 91, IS 15, and Rte 60 the following alternate routes will be used:

Rte 91

E/B Rte 91--Beginning on the west end at the Sixth Street off-ramp. East on Sixth Street-Magnolia Ave to the Magnolia E/B on ramp to Rte 91.

W/B Rte 91--Beginning on the East end at the Magnolia Ave off ramp west on Magnolia Ave-Sixth Street to W/B on ramp at Maple Street to Rte 91.

IS 15

Perris Blvd via Ramona Expressway to Nuevo Road.

Rte 60

Mission Blvd via Valley Way to Bain Street.

On re-routing of traffic, coordinate with the Division of Highways and local Police Departments as necessary.

ALERTING MEDICAL FACILITIES

When there are several injuries as a result of traffic collisions the officer or the supervisor on the scene will immediately notify Central Dispatch and advise them of the approximate number of injuries that will be transported to the hospitals. Central Dispatch will then notify the local medical facilities and relay the information to them in order that they may begin their preparations to receive the injured.

RADIO COMMUNICATIONS

If a situation warrants a round robin or road closure for a prolonged period of time the on duty supervisor or designated officer shall determine if necessary to switch to the blue frequency.

If the situation warrants, all units involved shall use the blue frequency tone 5. This will enable Central Dispatch to copy transmissions. If at any time there is no response to Central Dispatch on the blue frequency, use green frequency channel 1.

When there is a predicted or existing critical fog situation the on duty supervisor shall pick up four (4) or more portable radios located at Central Dispatch. They should be distributed as follows:

- (1) On duty supervisor or designated officer
- (2) Assisting police department

#### PHASE II: PUBLIC EDUCATION

Information and Education Officer will contact the local radio stations in the month of September to solicit their cooperation in limited visibility operation.

The graveyard Sergeant and the early morning Sergeant have grave responsibilities because the fog very often comes in after midnight and the early morning commute traffic should be informed by radio broadcasts prior to leaving for work.

The local newspapers should be requested to print the attached list of do's and don'ts for driving in the fog. Newspapers to be contacted by the I&E Officer in September. The I&E Officer will give the fog conditions on the news release to the several stations using the direct phone call release.

Sig Alert: The local Traffic Advisory or Sig Alert shall be used by the supervisors and the I&E Officer to keep the local citizens alerted to the adverse weather and road conditions. A careful choice of words when using the sig alert will hopefully prevent unnecessary phone calls to the office.

The practice of notifying Los Angeles and surrounding dispatch points is very important during the holidays, or if the fog sets in and does not clear the area for long periods of time. This will be handled by Central Dispatch.

#### PHASE III: ENGINEERING

Beat Officers will be directed to bring immediately to the attention of the supervisors any road condition that can be improved by signing or striping. If the hazard is great enough, the dispatcher shall be used to notify the proper road department involved, i.e., uncontrolled "T" intersections, curb striping as required or indicated, signs reflecting ice on overcrossings during fog, and low temperatures, portable flashing amber lights at school crossings.

Officers will immediately report and direct traffic as indicated at any defective traffic control signal. Traffic signals should be put on flashing if at all possible. The Officer will place flares to direct traffic away from him for his safety.

## APPENDIX A

### PHASE IV: TRAINING

See training outline attached from Riverside Area, "Limited Visibility Operation."

### PHASE V: DEPLOYMENT

Supervisors should take into consideration extraordinary days off on weekends during fog conditions to accommodate the commute traffic on the weekdays.

PVI teams and special duty personnel will be utilized to augment patrol personnel during limited visibility when deemed necessary by the on duty supervisor. They should be used during the early morning commute traffic to assist in regulating traffic, and the more experienced beat officer should be used for accident investigation.

The I&E officer and other special duty officers may be assigned as needed to handle phone calls at the office to relieve Central Dispatch. Central Dispatch will handle all calls etc., during the initial alerting period. Central Dispatch must be kept informed of any changes that would affect the overall operation.

Single-man units should be used on the "Round Robin" patrol to escort vehicles late at night and the early morning hours when the Departmental policy requires two-man units. Use of overtime shall be held to a minimum and confined to accident investigation and in-custody arrests.

During "Round Robin" operation short beats will be assigned to Rt 91 and IS 15. Assignments will be made by the duty sergeant, based on the need and consideration of past accident experience and availability of manpower.

Short beats will be developed on Rt 91 and Rt 395 as the accident experience develops and the availability of manpower is determined or established. The length of the short beats will be greatly influenced by the available crossovers along the route. Officers will be directed not to turn through the divider strip during limited visibility conditions.

Should a major accident occur, especially an accident with many injuries, a local beat officer should be assigned to the hospitals receiving the most patients to gather the information to properly complete the Form 555. The office investigating the accident scene until it is clear, or the officer is properly relieved. The above could also hold true on any other roadway. When traffic collisions do occur during limited visibility, officers shall indicate in the Special Conditions Box of the Form 555 Fog or Dust.

### PHASE VI: TRAFFIC CONTROL

Visibility in excess of 400 feet will not require traffic control by the beat officers.

When the visibility has been reduced to 200' or less the sergeant should deploy 2 officers to the area of the beginning of limited visibility with warning signs.

Officers are to park on the right shoulder and the center divider if safe to do so. Utilizing the rear warning amber light and 4-way flashers. The low visibility warning sign should be placed approximately 500 feet to the front of the patrol unit. The officer should stand in a safe location between the patrol unit and warning signs using hand signals to slow traffic. Observing moving traffic at all times, in order to take evasive action if needed. If two units are used, they should be staggered. Unit in the center divider area should be ahead of the unit on the shoulder by approximately 500 feet beyond the sign on the shoulder.

Officers will be deployed on the beat so that their area of responsibility will not overlap. It is better that the public see the officers evenly spaced up and down the highway rather than seeing several officers in about three miles.

Officers should remain in view and on patrol at all times during fog conditions. Rest periods will be coordinated by the duty sergeant.

"Round Robin" may be instituted by the sergeant where and when he deems it necessary. If the visibility is 100 feet or less, the fog condition will be considered extreme or heavy and the "Round Robin" should be placed into effect. Round Robin units should escort through the fog unless roadway is blocked. Round Robin units will be utilized to slow traffic prior to entering foggy area.

A senior officer should be in charge of the "Round Robin" team and act as coordinator, and make decisions as possible regarding rest stops, shortening or extending beats, etc.

Officers on traffic control, "Round Robin," should not abandon the convoy in dense fog to issue a citation in most cases. The integrity of the caravan should be maintained at all times once it is established.

Adjustments in technique and procedures will be made as the fog season progresses and there is an indication that adjustments are required.

The same limited visibility operation applies when visibility is limited by dust.

A written critique of each period of operation is to be submitted by the Duty Sergeant, and any recommended changes in the operation if needed.

**NATIONAL TRANSPORTATION SAFETY BOARD  
WASHINGTON, D.C.**

APPENDIX B

ISSUED: December 2, 1975

Forwarded to:

Honorable James B. Gregory  
Administrator  
National Highway Traffic Safety  
Administration  
Washington, D. C. 20590

SAFETY RECOMMENDATION(S)

H-75-32 through H-75-36

On February 28, 1975, at 7:40 a.m., P.d.t., the first of a series of multiple-vehicle collisions occurred on State Route 91 near Corona, California. The collisions occurred in fog. Eighty-four vehicles were involved and 23 persons were injured.

The Safety Board's investigation revealed that many drivers did not know what they should do to avoid becoming involved in a collision. The investigation also revealed that the drivers did not know what they should do when they became involved in a collision, i.e., if they should leave their vehicles or remain in them.

At the time of the accidents, the California Highway Patrol had started to escort some of the vehicles through the fog. The speeds in the convoy vehicles were lower and more constant than the speeds of those vehicles not in the convoy. Because of the higher and more varied speeds of the vehicles not in the convoy, they became involved in more severe accidents.

The convoy procedure was implemented by the California Highway Patrol in November 1970. It consists of an escort service to motorists who encounter fog on selected highways.

There may be other state police agencies that also use a convoy or similar procedure that could prevent or reduce the severity of collisions in fog. All such procedures should be studied and the most effective should be compiled into a manual for use by police agencies in areas that have problems with fog.

The findings of this accident pertain to three areas of interest to the National Highway Traffic Safety Administration (NHTSA): driver education, highway-police department procedures, and vehicle lighting. The Safety Board has made previous recommendations to the NHTSA in the first two areas.

In the area of driver education, the National Transportation Safety Board has recommended that the National Highway Traffic Safety Administration:

1. Assume a leadership role with driver educators to resolve the conflicting information which is being taught relative to driving tactics in fog. (Recommendation H-72-51)
2. Modify the Driver Education Standard (Standard No. 4) to include more definitive information relative to reduced-visibility driving. (Recommendation H-72-52)
3. Recommend to driver education instructors the need to stress in the teaching of drivers that there is no single solution to the highway fog problem and point out the need to avoid or discontinue highway use until conditions warrant safe travel. (Recommendation H-72-53)

These recommendations were made to the NHTSA in a Special Study <sup>1/</sup>; recommendation No. 2 was repeated in a recent Board report. <sup>2/</sup>

The NHTSA appears to have had difficulty in implementing the recommendations for several reasons: (a) The lack of a study of accident statistics revealing the magnitude of the reduced visibility problem; (b) there is no consensus among driver educators as to what should be taught about driving in fog; (c) research which has already been done has produced conflicting results; and (d) evaluations of what is being taught now relative to driving in fog have not been successful.

The Safety Board recognizes that before the NHTSA can implement recommendation H-72-52, the conflicting information being taught relative to driving in fog (recommendation H-72-51) must be resolved and additional data must be gathered.

Therefore, the National Transportation Safety Board recommends that the National Highway Traffic Safety Administration:

1. Sample motor vehicle accident reports from States to determine the percentage of fatal and injury-producing accidents which have occurred under reduced visibility conditions. (Recommendation H-75-32) (Class II, Priority Followup)
2. Review its multidisciplinary accident investigation files to identify the factors involved in reduced visibility conditions. (Recommendation H-75-33) (Class II, Priority Followup)

---

<sup>1/</sup> National Transportation Safety Board, "Special Study: Reduced Visibility (Fog) Accidents on Limited Access Highways, 1972."

<sup>2/</sup> National Transportation Safety Board, "Series of Multivehicle Collisions and Fires Under Limited Visibility Conditions, New Jersey Turnpike, Gate 15, and U.S. Route 46, October 23 and 24, 1973."

APPENDIX B

3. Conduct a formal survey of driver educators to determine what is and what should be taught about driving under reduced visibility conditions and issue such guidelines for driver education courses. (Recommendation H-75-34) (Class II, Priority Followup)

In addition, the National Transportation Safety Board also recommends that the National Highway Traffic Safety Administration:

4. Revise FMVSS 108 to require that all new vehicles be equipped with a set of brake and turn lights mounted high enough above the pavement so a driver could see the lights of at least the two vehicles directly ahead. (Recommendation H-75-35) (Class II, Priority Followup)
5. (a) Survey those police agencies that employ convoy or escort procedures; (b) select from the procedures those that have proven to be most effective; (c) analyze the procedures and develop recommendations to assure maximum effectiveness of patrol procedures; and (d) compile and issue an operations manual that can be implemented by the States through Highway Safety Program Standard No. 15, "Police Traffic Services." (Recommendation H-75-36) (Class II, Priority Followup)

REED, Chairman, McADAMS, THAYER, BURGESS, and HALEY, Members, concurred in the above recommendations.

  
By: John H. Reed  
Chairman

**NATIONAL TRANSPORTATION SAFETY BOARD  
WASHINGTON, D.C.**

**APPENDIX C**

ISSUED: December 2, 1975

Forwarded to:

Mr. Howard C. Ulrich  
Director of Transportation  
Business and Transportation Agency  
State of California  
1120 N Street  
Sacramento, California 95814

**SAFETY RECOMMENDATION(S)**  
**H-75-37 through H-75-38**

On February 28, 1975, at 7:40 a.m., P.d.t., the first of a series of multiple-vehicle collisions occurred on State Route 91 near Corona, California. The collisions occurred in fog. Eighty-four vehicles were involved, and 23 persons were injured.

Portable traffic controls employed at the time of the collisions by the California Highway Patrol (CHP) consisted of two 4-foot by 4-foot signs that displayed the word, "FOG."

Although these signs warned drivers of a hazard, they did not provide the drivers with enough information to deal with the hazardous situation ahead. Since there was no speed limit drivers made individual and varied decisions as to the safe speed for their vehicles.

Research <sup>1/</sup> conducted by the California Department of Transportation (CAL-DOT) showed that advisory posting of speeds in fog conditions had some effect on traffic. Further study <sup>2/</sup> revealed that drivers approved of advisory signs. In more recent work <sup>3/</sup> on an automatic fog warning system, the CAL-DOT recognized the need for such a system.

At present, the CAL-DOT is not engaged in continuing research to develop an automatic fog warning system even though it recognizes the need for such a system.

- 
- <sup>1/</sup> California State Transportation Agency, Reduced Visibility (Fog) Study (1967).
- <sup>2/</sup> Hulbert S., and Beers, J., Research Development of Changeable Messages for Freeway Traffic Control. Institute of Transportation and Traffic Engineering, School of Engineering and Applied Sciences, University of California, Los Angeles, August 1971.
- <sup>3/</sup> California Department of Transportation. Automatic Detection for Fog Warning Signs, 1973.

APPENDIX C

A relatively inexpensive fog warning system (inexpensive fog detectors, timers, changeable message signs, etc.) that can be applied to long sections (5 miles with extensions of 2 1/2 miles) of highway is available. The system was developed by the FHWA in 1972. <sup>4/</sup>

Therefore, the National Transportation Safety Board recommends that the California Department of Transportation:

1. Continue to work on a fog warning system to inform motorists of fog ahead and to provide an appropriate speed limit. (Recommendation H-75-37) (Class II, Priority Followup)
2. Conduct an engineering study in conjunction with the California Highway Patrol to determine the most feasible locations for the installation of such systems. (Recommendation H-75-38) (Class II, Priority Followup)

REED, Chairman, McADAMS, THAYER, BURGESS, and HALEY, Members, concurred in the above recommendations.

  
By John H. Reed  
Chairman

---

<sup>4/</sup> Adverse Weather and Visibility Hazard Warning Systems, Office of Traffic Operations, FHWA, September 1972.