October 27, 1987

Hon. Thomas H. Kean
Governor
State of New Jersey
State House
Trenton, New Jersey 08625

Dear Governor:

We are pleased to respectfully submit to you a Truck Safety Report, prepared by the New Jersey Interagency Coordinating Committee.

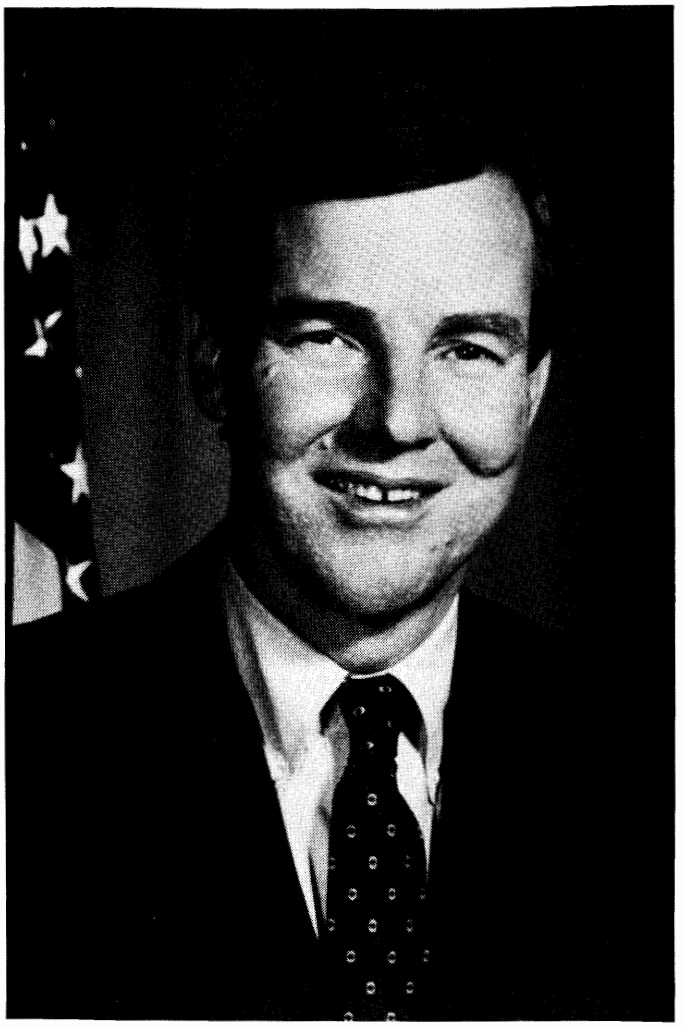
As you are aware, the New Jersey Interagency Coordinating Committee members have been concerned with the increasing number of truck accidents, particularly on our facilities. As a result, the committee conducted a survey of its members to evaluate programs and determine areas of improvement.

We hope the recommendations developed will help in dealing with the important issue of truck safety.

Thank you for your support.

Sincerely,

Jon F. Hanson
Chairman



The Honorable Thomas H. Kean
Governor of New Jersey

NEW JERSEY INTERAGENCY COORDINATING COMMITTEE

JON F. HANSON
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New Jersey Sports &
Exposition Authority

LEONARD S. COLEMAN, JR.
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New Jersey Highway Authority

JOSEPH "BO" SULLIVAN
Chairman
New Jersey Turnpike Authority

EXECUTIVE SUMMARY

There has been a growing concern on the part of government, the public, and the motor carrier industry concerning truck safety. The absolute number of truck accidents and more importantly, of truck accidents involving fatalities, has risen recently due to a significant increase in truck travel. The purposes of this report are to analyze what the various New Jersey Interagency Coordinating Committee (NJICC) members are doing with regard to truck safety, to determine the need for strengthening some of the agencies' programs, and to develop recommendations for agency cooperation in a regional truck safety program.

The NJICC compiled data on truck accident causes, reporting procedures, and safety programs. A comparative analysis of similarities and differences was performed in order to identify the program strengths of member agencies. The strengths of each agency, as well as "other" data, served as the basis for suggestions to improve enforcement and inspection programs and to promote regional cooperation in increasing truck safety. It was necessary to expand the scope of the original project to obtain comparative experiences of other states and agencies to add depth to this report. As a result, a wealth of material has been collected and synthesized.

The focus of the survey was on three Interagency Coordinating Committee members -- the New Jersey Turnpike Authority, The Port Authority of New York & New Jersey, and the New Jersey Highway Authority (which operates the Garden State Parkway). Other Interagency members are The New Jersey Sports & Exposition Authority and the Hackensack Meadowlands Development Commission.

The Interagency Coordinating Committee Administrator gratefully expresses his appreciation for the cooperation and help extended by federal, state and private organizations, the New Jersey Division of State Police, the Turnpike Authority, the Port Authority, and the Highway Authority, all of whom provided invaluable assistance in carrying out the survey. The independent authorities should be commended for their overall contribution to safety by allocating resources for engineering and enforcement improvements. Special thanks to the New Jersey Department of Transportation and other agencies, which forwarded statistical material. Information was also provided by the New Jersey Motor Truck Association.

New Jersey is heavily dependent on truck transportation for the movement of goods in and out of the State. The State's geographic location makes it a key corridor connection among the rapidly developing regions in the southeast, southwest and the established markets of the northeast. Trucking is important to the State's economy. It is even more important to have trucks move cargo safely.

This report is organized along three major topics: Accident Reporting, describing various facets of the truck safety problem; Procedures, explaining what NJICC members as well as others are doing about truck accidents; and Technology, examining several approaches to the problem from a broader perspective.

Accident information is crucial to discerning trends in factors contributing to truck accidents such as location, time of day, pavement condition, and unsafe speed. The more detailed the information collected, the better the opportunity for analyzing accident trends, causes, and contributing factors. Once this information is analyzed, mitigating measures may be taken where appropriate.

The primary source of accident data is the accident reporting form. While the Turnpike Authority, the Port Authority, and the Highway Authority each utilize a different accident form, each agency uses the accident data to develop recommendations to improve conditions on their facilities. NJICC members may wish to adopt the Turnpike's accident reporting form, which helps in accident reconstruction and insurance matters. The police and agency operating personnel should consider getting together more frequently on a more formal basis to exchange information and ideas about truck accidents and related enforcement programs.

NJDOT and the NJICC authorities have compiled a comprehensive set of truck accident statistics. In addition to highlighting the extent of the problem, these statistics have been employed by the agencies to identify critical locations requiring corrective actions. For example, the Turnpike Authority identified and made improvements to five locations where the condition of the road surfaces was a contributing factor in several accidents involving trucks. The Port Authority found that over 60% of the accidents occurring on the George Washington Bridge were sideswipes, angle, or rear end accidents at or around its toll plazas. The Port Authority is investigating better signing and improved lane delineators to reduce these accidents.

Truck related accidents are occurring at a higher rate than their composition in the traffic stream. In New Jersey, trucks were involved in 28,024 accidents in 1984 or 75 per day. About 20 percent of all multiple vehicle accidents involved trucks, yet trucks accounted for only 7 percent of the total volume. Trucks were involved in 21.4 percent of the fatal accidents in 1985.

Separate accident statistics are available for the toll facilities. The accident rate on the Turnpike has been increasing steadily as has the truck accident rate. Accidents on the Turnpike from 1980 to 1985 show a heavy involvement of trucks, a trend which continued for the first six months of 1986. The percentage of truck accidents has been averaging 37 percent, while trucks generally average about 12 percent of the total volume since 1980. The percentage of fatalities involving trucks has been on the high side, too. The lowest it reached was 37.9 percent in 1985.

Similarly, the Port Authority has been experiencing an increase in accidents involving trucks at its Trans Hudson crossings. The overall 1984-1985 accident picture for the Port Authority crossings showed that trucks represented 7.2 percent of the volume, but accidents involving trucks represented 41 percent. A particular concern is the George Washington Bridge, where trucks make up 7.9 percent of the volume and are involved in 52 percent of the accidents. The Port Authority notes that most of these accidents are minor fender benders occurring at merge points around the toll plaza and at heavy weave points.

Truck accidents on the Garden State Parkway, on the other hand, have been minimal. This is mainly due to the fact that trucks are prohibited in the most densely traveled sections of the Parkway, north of Eatontown.

This accident data has been used by the agencies to develop programs to eliminate other types of contributing factors. For example, each agency has conducted at least some skid testing to identify roadway sections for pavement resurfacing or other surface treatment. Consideration should be given to implement a regularly scheduled skid testing program.

The accident data has also shown that a significant number of accidents occur at interchange ramps and toll plazas. The New Jersey Turnpike Authority has already designed improvements to several interchanges as part of its ongoing construction program. The Turnpike will reconstruct a number of other interchanges as part of its $2 billion widening program. The authorities should consider implementing experimental exact change lanes at Hudson River crossings or at certain Turnpike interchanges to expedite traffic flow.

The NJICC agencies recognize the need for more uniform truck safety enforcement procedures. The US Department of Transportation has encouraged these twin objectives through the Motor Carrier Safety Assistance Program (MCSAP) which provides funding for truck safety enforcement activities to states which agree to adopt and enforce federal safety regulations. New Jersey is a full participant in MCSAP, which has enabled the State Police to hire additional inspectors to conduct more inspections. The State Police are focusing on driver out of service criteria to ensure that drivers do not exceed hours of service limits. The troopers are also enforcing new vehicle out of service rules particularly with respect to the braking systems.

The Port Authority has an inspection program, although it is not as comprehensive as that of the State Police. One constraint is competing priorities for limited manpower and another is the lack of adequate facilities and the space to conduct in depth vehicle inspections. The New Jersey Turnpike Authority has expanded its truck inspection program recently, but there are other priorities competing for limited resources. Staffing levels have not kept pace with the multitude

of enforcement demands. The Turnpike and the Parkway may need more safety inspection and weigh teams in addition to regular patrols.

There appears to be a need on the part of the NJICC members for a cooperative, comprehensive truck safety program, including a mechanism to share data on driver records, repeat violators, accident trends, and innovative enforcement practices. This program should include an expansion of the federal-state partnership which has been evolving recently.

SafetyNet, a national database system designed to collect and disseminate truck inspection driver records and accident statistics, is one means to accomplish this objective. The State Police plans to tie into this system. The State Police should consider coordinating its SafetyNet activities with the database systems utilized by NJICC agencies.

There also appears to be a need for a permanent truck inspection station within the urban core of the metropolitan region. Such a facility would increase the chances of finding and removing unsafe vehicles from the region's roadways.

Most transportation experts agree that in addition to roadway improvements and more rigorous vehicle inspections, the key to reducing preventable accidents rests with the truck driver. Truck drivers are expected to be professionals who can compensate for unexpected complications resulting from vehicle failures, erratic behavior by other drivers, roadway problems, or bad weather. Unfortunately, this is not always the case. Government and the trucking industry must cooperate to ensure that truck drivers are properly trained, that they obey the law, and that only properly trained, well qualified drivers are allowed to operate trucks on our roadways.

One problem has been the fact that many truck drivers have multiple driver licenses. This enables a driver to spread his violations among states, thus avoiding losing his right to drive. This practice has been outlawed as a result of federal legislation which became effective on July 1, 1987.

Another problem has to do with the lack of minimum standards for driver training and testing. Effective July 15, 1988, the Secretary of USDOT will issue regulations establishing minimum federal standards for testing and licensing, as well as ensuring fitness of persons who operate commercial vehicles. By January 1, 1989, the Secretary must establish a clearinghouse for driver license information including violations. New Jersey will have to comply with these federal requirements. In the interim, New Jersey should enact a commercial license requirement for intrastate drivers of vehicles over 10,000 pounds, with uniform standards for buses or trucks, plus training and testing to determine driver qualifications.

The federal govenment is studying the appropriateness of lowering the blood alcohol content for truck drivers from the current limit of 0.10 to 0.04. New Jersey may want to consider enacting legislation to prohibit a truck driver from operating a truck with any alcohol content in his blood.

Several studies have indicated that driver fatigue is a significant factor in truck accidents. These studies estimate that many drivers routinely violate federal hours of service limits. Several experts claim that computerized on-board recording devices would eliminate or reduce hours of service violations and, consequently,

fatigue induced accidents. It is suggested that NJICC members go on record supporting the use of on-board recording equipment by passing such a resolution and forwarding it to Washington.

There is a need to educate the motoring public about the differences in operating capabilities of trucks as compared to cards. This is a necessary step which could be a significant factor in the reduction of car-truck accidents. A campaign of public awareness of truck safety could be initiated as a joint effort by members of the Interagency Coordinating Committee. The campaign would be directed at reducing accidents and "hostile attitudes" among all drivers. This campaign could be a joint effort of the governors of both states. Both could issue proclamations featuring the need and desire of working together for truck safety. The campaign theme could be developed with emphasis on media releases, posters and handouts to patrons using the facilities. Posters could be placed at primary locations in terminals, restaurants, shops, etc.

Safety experts have also focused much of their attention on trying to make trucks more compatible with passenger cars. The typical truck requires two to three times the stopping distance compared to a car. All too frequently a truck's brakes are out of adjustment, adding to the distance needed to stop. Some drivers have disconnected their front brakes under the impression that this will improve their ability to maintain control during a sudden stop under slippery road conditions.

Engineers are now testing various brake technologies like automatic slack adjusters and anti-lock systems. New Jersey should consider a statute which requires that brakes be kept in good order. NJICC could play a useful role in developing greater awareness, and

alerting officials in Washington of the need for action to upgrade truck braking systems. Engineers and manufacturers are also looking at other truck components, such as the tires, trailer lighting, and special mirrors to eliminate blind spots.

Based on analysis, the following legislative issues have been identified:

- Adoption of national truck driver standards;
- Establishment of a commercial license for all truck drivers;
- Banning radar detectors;
- Endorsement of a federal requirement for speed limiting devices on all trucks;
- Amending state laws to require truck tractors to have front wheel brakes in conformance with federal standards, without any grandfather clause;
- Prohibiting any drinking and driving at all for truck drivers under a penalty of loss of license;
- Requiring a fine of $1,000 for owners of tractor trailers whose vehicles' brakes are found to be more than 40 percent out of adjustment (which is the Commercial Vehicle Safety Alliance standard);
- Requiring that intrastate trucks meet the same standards that currently apply to interstate trucks.

In conclusion, the truck safety problem is a complex issue. Each NJICC agency is addressing the problem through a diverse set of strategies. More work needs to be done. There is a clear need for a cooperative approach by NJICC members to exchange data, to share information on innovative practices, to coordinate enforcement activities to maximize the effectiveness of limited budgets, and to speak with one voice in lobbying for truck safety reforms.

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A TRUCK SAFETY REPORT

PREPARED FOR:

NEW JERSEY INTERAGENCY COORDINATING COMMITTEE

PREPARED BY:
F. JOSEPH CARRAGHER
ADMINISTRATOR

ACCIDENT REPORTING

OVERVIEW OF TRUCK SAFETY

There has been a growing concern on the part of government, the public, and the motor carrier industry concerning truck safety. The number of truck accidents and, more importantly, of truck accidents involving fatalities have risen recently due to a significant increase in truck travel (see Table 1A). The purposes of this report are to analyze what the various New Jersey Interagency Coodinating Committee (NJICC) members are doing with regard to truck safety, to determine the need for strengthening some of the agencies' programs, and to develop recommendations for agency cooperation in a regional truck safety program.

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Interagency members are The New Jersey Sports & Exposition Authority and the Hackensack Meadowlands Development Commission. The Interagency Coordinating Committee Administrator gratefully expresses his appreciation for the cooperation and help extended by federal, state and private organizations, the New Jersey Division of State Police, the Turnpike Authority, the Port Authority, and the Highway Authority, all of whom provided invaluable assistance in carrying out the survey. The independent authorities should be commended for their overall contribution to safety by allocating resources for engineering and enforcement improvements. Special thanks to the New Jersey Department of Transportation and other agencies, which forwarded statistical material. Information was also provided by the New Jersey Motor Truck Association.

The task was accomplished through numerous interviews with transportation leaders and enforcement officials, as well as trucking representatives. The interviews with the three member agencies covered reporting procedures, investigative requirements, record keeping, data processing, follow up with accident participants, causes of accidents, contributory factors, location, time of day, vehicle defects, severity of accidents, drivers' accident records, and company owners' experience. Also it included safety programs, current and proposed, information exchanges, signing enforcement and who pays for damage and other costs. A bibliography was developed for a survey of interest.

New Jersey is heavily dependent on truck transportation for the movement of goods in and out of the State. The State's

geographic location makes it a key corridor connection among the rapidly developing regions in the southeast, southwest and the established markets of the northeast. An indication of the volume that passes through New Jersey yearly can be gleaned from the New Jersey Turnpike records which show it handled more than 20,877,718 trucks in 1985 compared with 22,288,979 in 1986. An estimated total of 479,000 trucks were registered in New Jersey in 1984. About 173,000 were considered heavy trucks or 36 percent of the total trucks registered. An estimated 68.8 million tons of freight moved in and out of New Jersey in 1982. Truck vehicle miles travelled (VMT) was 3,635 million in 1984, compared to a total VMT of 52,170 million. Truck VMT has been growing faster than total VMT in New Jersey. (54)

Trucking is essential to the State's economy and, therefore, it is of utmost importance to have trucks move cargo in a safe and efficient manner. The truck safety debate has become intertwined with the debate over the economic deregulation of the motor carrier industry in 1980. There are many theories about the impact on truck safety as a result of deregulation. In a 1986 report prepared for the Eno Foundation for Transportation, Inc. of Westport, CT., on the "Effects of Deregulation on Motor Carriers," Nicholas A. Glaskowsky writes that "...economic deregulation may have a (negative) link with safety." He based his findings on three trends: 1) the equipment fleet of the motor carrier industry is aging 2) a lot of maintenance (expense) is being deferred and 3) the motor carrier accident rate is increasing. (24)

This contention, however, is challenged by the U.S. Department of Transportation report of February, 1986 on deregulation which says, "the trucking industrys' safety record has been carefully monitored since implementation of the Motor Carrier Act of 1980. As expected, prior to deregulation, no valid statistical evidence was found linking the presence or absence of economic regulation with safety performance of motor carrier operations."[96] There is much debate about whether deregulation impacts truck safety. The simple fact is that truck accidents, whether they are increasing or not, are a problem and action by industry and by government is needed now to reverse that trend.

Other factors contributing to truck accidents are the low level of enforcement and a delay in introducing new technological advances in truck brake systems. Compounding the problem is the density of traffic and the simple fact that truck sizes are on the increase and cars are getting smaller. In some cases, traffic congestion can contribute to higher accident rates, although the seriousness of these accidents are reduced due to lower speeds. It is only now that the public is beginning to voice concern over the alarming rise in truck accidents in recent years. Traffic volumes continue to increase at a record breaking rate each year, even though it appears that the saturation point was reached the previous year.

Already overcrowded and overtaxed facilities have managed to squeeze in "just a few more" each year, for another record. Rush hours have been stretched and extended. Congestion and grid lock

alerts are every day events, compounded by accidents. Perhaps, it is the congestion-caused frustration and impatience which lead to inattentive driving and are indeed, important contributory factors for truck-related accidents. A focus on volume reflects on the growth of some facilities. In 1952 the New Jersey Turnpike recorded a total of 18,239,197 vehicles and 34 years later, in 1985, it registered total vehicles of 167,857,961 -- an increase of 820 percent since its first full year of operation. The Highway Authority and Port Authority crossings have registered significant growth as well. (*per. comm.*)

Efforts have been finalized to improve truck enforcement in New Jersey. The State Department of Transportation as well as the State Police have developed and put into place an updated enforcement program for truck safety. (*54*)

ACCIDENT REPORTING

Accident information is crucial to discerning trends in factors contributing to accidents such as locations, time of day, pavement conditions, and unsafe speed. The more detailed information collected, the better opportunity for analyzing accident trends, causes and contributing factors.

The Turnpike accident form (see Exhibit 1, page 5A) is probably the most detailed document of its kind in the State. The Port Authority has its own accident form (see Exhibit 2, page 5B) and the Highway Authority uses an accident reporting system employed by all other State Police troops (see Exhibit 3, page 5C). The

EXHIBIT 1

NEW JERSEY STATE POLICE
TROOP D – NEW JERSEY TURNPIKE

1. Case Number | 2. Station | 3. REPORTABLE ☐ NON-REPORTABLE ☐

4. Date of Collision: MONTH | DAY | YEAR
5. Day of Collision: S | M | T | W | TH | F | S
6. Time (Use 2400)
7. No. of Vehicles
8. Number Killed
9. Number Injured
Daylight ☐ Dark ☐

10. County
11. Municipality
12. Milepost
Delineator
13. Roadway

VEHICLE 1
14. Policy No.
15. Ins. Code

VEHICLE 2
16. Policy No.
17. Ins. Code

VEHICLE NUMBER ONE

18. Driver's First Name Initial Last Name
19. Street Address
20. City
21. State
22. Driver's License Number
23. State
24. D.O.B.
25. Eyes
26. Sex
27. Driver Exp.
28 Age
29. Exp. Date
30. Res. Code
31. Bus D.L. Number
32. VIN
33. Legal Speed
34. Vehicle Defect
35. Owner's First Name Initial Last Name ☐ SAME AS DRIVER
36. Street Address
37. City
38. State
39. Make of Vehicle
40. Year
41. Body
42. License Plate No.
43. State
44. Date Inspected
45. Re-insp. Req. ☐ Yes ☐ No
46. Trailer Plate Number
47. Seat Belts Used ☐ LF ☐ CF ☐ RF ☐ LR ☐ CR ☐ RR
48. Describe Damage to Vehicle
49. Vehicle Removed To BY
50. Vehicle Was ☐ Moving-direction: ☐ Parked ☐ Stopped

VEHICLE NUMBER TWO

51. Driver's First Name Initial Last Name
52. Street Address
53. City
54. State
55. Driver's License Number
56. State
57. D.O.B.
58. Eyes
59. Sex
60. Driver Exp.
61. Age
62. Exp. Date
63. Res. Code
64. Bus D.L. Number
65. VIN
66. Legal Speed
67. Vehicle Defect
68. Owner's First Name Initial Last Name ☐ SAME AS DRIVER
69. Street Address
70. City
71. State
72. Make of Vehicle
73. Year
74. Body
75. License Plate No.
76. State
77. Date Inspected
78. Re-insp. Req. ☐ Yes ☐ No
79. Trailer Plate No.
80. Seat Belts Used ☐ LF ☐ CF ☐ RF ☐ LR ☐ CR ☐ RR
81. Describe Damage to Vehicle
82. Vehicle Removed To BY
83. Vehicle Was ☐ Moving-direction: ☐ Parked ☐ Stopped

WITNESS

84. Name and Address
85. Age
86. Location at Time of Accident

87. Traffic Control
1 ☐ Police Off. 2 ☐ Const. Sign 3 ☐ Lane Markings 4 ☐ No Controls Present 5 ☐ Speed Warning Sign – Message: 6 ☐ Other

88. Level of Service
1 ☐ Light 2 ☐ Medium 3 ☐ Moderate 4 ☐ Heavy 5 ☐ Very Heavy 6 ☐ Stop-go 7 ☐ Not Known

89. Weather
1 ☐ Clear 2 ☐ Rain 3 ☐ Snow 4 ☐ Fog

90. Road Condition
1 ☐ Dry 2 ☐ Wet 3 ☐ Snowy 4 ☐ Icy

91. Lighting Condition
1 ☐ On 2 ☐ Off 3 ☐ None

92. Road Surface
1 ☐ Concrete 2 ☐ Blacktop 3 ☐ Other

93. Type of Vehicle
1 ☐ Passenger Car 2 ☐ Tractor-trailer 3 ☐ Bus 4 ☐ Truck 5 ☐ Motorcycle 6 ☐ Other

94. Accident Type
1 ☐ Same Direction 2 ☐ Non-collision 3 ☐ Head-on 4 ☐ Side-swipe 5 ☐ Right Angle 6 ☐ Object 7 ☐ Other

95. Damage to Property Other Than Vehicle (Give Owner's Name and Address)

96. Contributing Circumstances
No. 1
No. 2

ALL INVOLVED

	14	15	16	17	18	19	20	21	22	23	24	Names of Injured If Deceased Also Include Date of Death
A												
B												
C												
D												
E												
F												

PINK COPY (Division of Motor Vehicles)

CANARY COPY (State Police Station)

WHITE COPY (Traffic Eng.- NJ Tpk)

97. Road character	98. Road width	99. No. of lanes	100. Divided by	101. Accident Involved
102. Under construction	103. Kind of shoulder	104. Shoulder width	105. Kind of locality	106. Road defects

107. Drinking involved Tests Given	No. 1	No. 2

108. What was pedestrian doing

109. Diagram ☐ Rural ☐ Urban

Indicate North

110. Narrative (Refer to vehicle by number)

#1 Today's Trip Began At _____ Time _____ Last Stop _____ Time _____

Entered Turnpike At _____ Date _____ Time _____ Collector _____ Class _____

#2 Today's Trip Began At _____ Time _____ Last Stop _____ Time _____

Entered Turnpike At _____ Date _____ Time _____ Collector _____ Class _____

	VEHICLE NUMBER ONE		VEHICLE NUMBER TWO	
111. Initial contact				
112. Skid marks	Before _____ Feet	After _____ Feet	Before _____ Feet	After _____ Feet
113. Vehicle traveled after impact				
114. What was driver doing				
115. Driver's vision obscured by				
116. Physical condition of driver				

KILLED OR INJURED

117. List name of injured or killed, where taken, by whom

NAME	WHERE	BY WHOM	Seat belts used: Yes	No	None	Age	Sex	Veh.	Loc.	Injury code

118. Recommend drivers for re-examination ☐ Yes ☐ No

119. Summons to _____ Summons number _____ Charge _____ Name of Court _____

120. Officer's signature	121. Badge No.	122. Reviewed by (Badge No.)	123. Status

EXHIBIT 2

PA 621/9-86 A85807

THE PORT AUTHORITY OF NY & NJ

MOTOR VEHICLE ACCIDENT REPORT

(SEE INSTRUCTIONS ON REVERSE SIDE)

DETAILED LOCATION (1) (2) (3) (4)

☐ N.Y. ☐ N.J. FACILITY

DAY OF WEEK (19)	WEATHER (20)	ROAD (21)	LIGHT (22)	(23)	NO. OF VEHICLES INVOLVED (24)
☐ 1. Mon.	☐ 1. Clear	☐ 1. Dry	☐ 1. Daylight		
☐ 2. Tues.	☐ 2. Foggy	☐ 2. Wet-Rain or Snow	☐ 2. Dawn		
☐ 3. Wed.	☐ 3. Overcast	☐ 3. Wet-Tunnel Wash	☐ 3. Dusk		
☐ 4. Thurs.	☐ 4. Raining	☐ 4. Wet-Other	☐ 4. Dark, Roadway Lighted	(25)	(26)
☐ 5. Fri.	☐ 5. Dew or Misty Rain	☐ 5. Oily, Greasy	☐ 5. Dark, Roadway Not Lighted		
☐ 6. Sat.	☐ 6. Snowing or Sleeting	☐ 6. Snowy	☐ 6. In Tunnel		
☐ 7. Sun.	☐ 9.	☐ 7. Muddy	☐ 9.		
☐ 9.		☐ 8. Icy			
		☐ 9.			

NOTE: CODE OR CHECK UNSHADED BOXES

LOCATION (5) (6) (7) (8) (9)	ACCIDENT DATE MO. (10) (11) DAY (12) (13) YR. (14) (15)	HOUR
SEE FACILITY MAP FOR APPROPRIATE CODING	16 17 18	____ A.M. ____ P.M.

TYPE OF ACCIDENT (27-28)
- ☐ 01. Head On (Two Vehicles)
- ☐ 02. Rear End
- ☐ 03. Sideswipe
- ☐ 04. Angle Collision
- ☐ 05. Backing
- ☐ 06. Fixed Object
- ☐ 07. Object Lying in Road
- ☐ 08. Falling or Flying Object
- ☐ 09. Pedestrian (Not Police Officer)
- ☐ 10. P.A. Police Officer (Pedestrian)
- ☐ 11. Damaged While Parked
- ☐ 12. Improper Loading or Load Cover
- ☐ 13. Turned Over in Road
- ☐ 14. Ran Off Road
- ☐ 80. Other
- ☐ 99. Unknown

FIXED OBJECT (29-30) (31) (32) (33) (34)
- ☐ 00. None
- ☐ 01. Toll Booth Structure, Gate
- ☐ 02. Light Pole or Utility Pole
- ☐ 03. Tunnel Wall or Ceiling
- ☐ 04. Divider Beginning or Prow
- ☐ 05. Medial Divider
- ☐ 06. Channelizing Island or Stanchion
- ☐ 07. Bridge Pier, Pillar Abutment
- ☐ 08. Building
- ☐ 09. Fire Hydrant
- ☐ 10. Construction Barrier
- ☐ 11. Garage Door
- ☐ 12. Fence or Railing
- ☐ 30. Other

TYPE OF VEHICLE (35-36)

VEH 1 2
- ☐☐ 01. Passenger Car
- ☐☐ 02. Taxicab
- ☐☐ 03. P.A. Police Car
- ☐☐ 04. Truck, Single Unit
- ☐☐ 05. Tractor and/or Trailer
- ☐☐ 06. P.A. Emergency Vehicle
- ☐☐ 07. Small Bus or Limousine
- ☐☐ 08. Regular Bus
- ☐☐ 09. Fork Lift, Sweeper, Snow Plow
- ☐☐ 10. Motorcycle, Motorscooter Bicycle
- ☐☐ 11. Carts, Stairs, Power Units & Other Apron Vehicles
- ☐☐ 12. Aircraft
- ☐☐ 90. Other
- ☐☐ 99. Unknown

POSSIBLE VIOLATION (37-38)

VEH 1 2
- ☐☐ 01. Improper Turn
- ☐☐ 02. Disregarded Traffic Signal or Sign
- ☐☐ 03. Disregarded Officers
- ☐☐ 04. Crossed Centerline
- ☐☐ 05. Speeding
- ☐☐ 06. Failed to Yield
- ☐☐ 07. Following too Close
- ☐☐ 08. Vehicle Lights Not Working
- ☐☐ 09. Other Vehicle Defect Including Load
- ☐☐ 10. Wrong Way Against Traffic
- ☐☐ 90. Other

DRIVER ACTION (39-40)

VEH 1 2
- ☐☐ 01. Going Straight Ahead
- ☐☐ 02. Turning
- ☐☐ 03. Slowing or Stopping
- ☐☐ 04. Parking or Unparking
- ☐☐ 05. Stopped by Traffic Congestion
- ☐☐ 06. Stopped by Traffic Sign or Signal
- ☐☐ 07. Stopped by Traffic Officer
- ☐☐ 08. Merging
- ☐☐ 09. Diverging
- ☐☐ 10. Passing
- ☐☐ 11. Lost Control
- ☐☐ 12. Avoiding Vehicle, Object, Pedestrian
- ☐☐ 13. Changing Lanes
- ☐☐ 14. Opening Door Roadside
- ☐☐ 90. Other
- ☐☐ 99. Unknown

	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61
VEHICLE NO. 1											P.A. VEHICLE NO.				Driver's Unit No.						
VEHICLE NO. 2											P.A. VEHICLE NO.				Driver's Unit No.						

P.A. VEHICLE DAMAGE JOB NO. ____

P.A. PROPERTY DAMAGE OTHER THAN VEHICULAR MAINT. W.O. JOB NO.

NAME & ADDRESS OF WITNESS

VEHICLE NO. 1

IF OTHER THAN DRIVER, OWNER'S FULL NAME & ADDRESS | VEHICLE, YEAR, MAKE & TYPE | PLATE NO. & STATE

DRIVER'S FULL NAME & ADDRESS (IF P.A. EMPLOYEE, TITLE & UNIT NO.) | DRIVER'S LICENSE NO. & STATE | AGE | ☐ MALE ☐ FEMALE

DESCRIBE APPARENT DAMAGE TO VEHICLE | ☐ DAMAGE OVER $500 (N.J.) ☐ DAMAGE OVER $600 (N.Y.) ☐ STOPPED ☐ PARKED EST. SPEED ____ ☐ SUMMONSED ☐ ARRESTED

POLICY NUMBER | NAME - INSURANCE COMPANY | EFFECTIVE DATE / / | EXPIRATION DATE / /

VEHICLE NO. 2

IF OTHER THAN DRIVER, OWNER'S FULL NAME & ADDRESS | VEHICLE, YEAR, MAKE & TYPE | PLATE NO. & STATE

DRIVER'S FULL NAME & ADDRESS (IF P.A. EMPLOYEE, TITLE & UNIT NO.) | DRIVER'S LICENSE NO. & STATE | AGE | ☐ MALE ☐ FEMALE

DESCRIBE APPARENT DAMAGE TO VEHICLE | ☐ DAMAGE OVER $500 (N.J.) ☐ DAMAGE OVER $600 (N.Y.) ☐ STOPPED ☐ PARKED EST. SPEED ____ ☐ SUMMONSED ☐ ARRESTED

POLICY NUMBER | NAME - INSURANCE COMPANY | EFFECTIVE DATE / / | EXPIRATION DATE / /

INJURY

FULL NAME & ADDRESS OF INJURED | WEARING SEAT BELTS ☐ YES ☐ NO | AGE | ☐ MALE ☐ FEMALE | IN VEH. NO. | ☐ PEDESTRIAN ☐ DRIVER ☐ PASSENGER ☐ FATALITY

NATURE OF INJURIES

MEDICAL ATTENTION ☐ REFUSED MEDICAL ATTENTION ☐ WILL SEE OWN DOCTOR
TREATED BY ____ AT ____
FIRST AID BY ____ TAKEN TO ____ HOSPITAL BY ____

REPORTED BY (SIGNATURE)

DATE REPORTED / / DID YOU WITNESS ACCIDENT ☐ YES ☐ NO

DESCRIBE ACCIDENT, INCLUDING ANY PROPERTY DAMAGE OTHER THAN TO VEHICLES

INDICATE
DRAW DIAGRAM (SEE INSTRUCTIONS ON REVERSE SIDE)
NORTH

General Instructions

1. Print heavily in **Black** Ink. Make check marks thick and dark.

2. Code or check all unshaded boxes. Refer to P.A. Guide Book for detailed instructions.

3. If facility property (other than vehicles) is damaged, prepare Maintenance Work Order—Non-Routine, form PA 2302 and enter Maintenance Work Order number in appropriate box on front of this form. Under "3. Description of Job" on form PA 2302 enter "Accident Damage" followed by a description of the damage. Desk Officer immediately forwards form PA 2302 to Maintenance Scheduler.

4. If 3 or more vehicles are involved fill out separate form PA 621 and number cars "3," "4," etc. Staple second card to first and code in detail; Accident Location, Type of Vehicle, etc.

5. If there is more than one injury per two vehicles, the additional injuries are to be recorded under Accident Description if space is available or on an attached sheet of paper.

If P.A. Vehicle is involved, P.A. driver must:

1. Notify P.A. Manager, Claims Administration at once whenever a P.A. vehicle is involved in an accident in which:

   a. Non P.A. personal injuries are sustained or

   b. Non P.A. property damage is involved over $500 in New Jersey or over $600 in New York.

2. P.A. driver must complete state form, if required, and forward with this card to P.A. Manager, Claims Administration, Law Department.

Diagram Instructions

Show position of vehicles, using vehicle numbers from reverse side, at point of impact and if significant, of vehicles and objects after stopping.

Use solid lines for path of vehicles before collision; dotted lines for path to stopped position.

Locate the occurrence accurately in diagram by showing curb lines, traffic lanes, engineering marks or signal stations, etc.

Use facility spot map references when applicable.

EXHIBIT 3

PAGE_____OF_____

NEW JERSEY POLICE ACCIDENT REPORT

REPORTABLE ☐ NON-REPORTABLE ☐

44 ROAD SYSTEM
1 Interstate 4 State Park or Inst. 7 Municipal
2 State Highway 5 County 8 Priv. Prop.
3 State Interstate 6 Co. Auth. Park or Institution 9 U.S. Gov. Prop. ☐

41 CASE NUMBER | 42 POLICE DEPARTMENT OF | CODE | 43 STATION-PRECINCT

45 DATE OF COLLISION: MONTH | DAY | YEAR
46 DAY OF COLLISION: S | M | T | W | TH | F | S
47 TIME (USE 2400 HRS.) | 48 NO. OF VEHICLES | 49 NUMBER KILLED | 50 NUMBER INJURED | 51 COUNTY

52 MUNICIPALITY | 53 ROUTE NUMBER OR NAME OF STREET | 54 MILE POST | 55 INTERSECTING STREET, ROAD OR RAILROAD

56 IF NOT AT INTERSECTION & NOT MILE POSTED (IDENTIFY NEAREST INTERSECTING ROADS BETWEEN WHICH THE ACCIDENT OCCURED) 1. 2. | 57 DISTANCE FROM 1 OR 2 (DESIGNATE)

VEHICLE 1

58 POLICY NO. | 59 INS. CODE

☐ PARKED VEH. ☐ PEDESTRIAN ☐ PEDALCYCLIST

60 DRIVER'S FIRST NAME | INITIAL | LAST NAME

61 NUMBER AND STREET

62 CITY | STATE | EXPIRES

63 DRIVER'S LICENSE NUMBER | 64 STATE | 65 DOB MO. | DAY | YR. | 66 EYES | 67 SEX

68 OWNER'S FIRST NAME ☐ SAME AS DRIVER | INITIAL | LAST NAME

69 NUMBER AND STREET

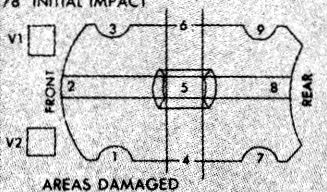
70 CITY | STATE | EXPIRES

71 MAKE AND MODEL | 72 YEAR | 73 LICENSE PLATE NO. | 74 STATE

75 VEHICLE REMOVED TO | 76 AUTHORITY 1 OWNER 2 DRIVER 3 POLICE

77 VIN NUMBER

78 INITIAL IMPACT



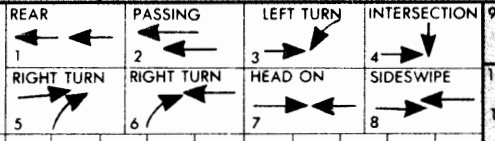
AREAS DAMAGED

	V1	V2
10 UNDERCARR. DAMAGE	☐	☐
11 OVERTURNED	☐	☐
12 TOTALLED	☐	☐
13 NONE OR UNKNOWN	☐	☐
14 OTHER	☐	☐

SPD. ZONED | V1 SPD. | V2 SPD.

79 DIAGRAM

CHECK ONE OF THE 8 DIAGRAMS IF IT ADEQUATELY DESCRIBES THE ACCIDENT, OR DRAW YOUR OWN DIAGRAM IN SPACE BELOW



9

VEHICLE 2

80 POLICY NO. | 81 INS. CODE

☐ PARKED VEH. ☐ PEDESTRIAN ☐ PEDALCYCLIST

82 DRIVER'S FIRST NAME | INITIAL | LAST NAME

83 NUMBER AND STREET

84 CITY | STATE | EXPIRES

85 DRIVER'S LICENSE NUMBER | 86 STATE | 87 DOB MO | DAY | YR. | 88 EYES | 89 SEX

90 OWNER'S FIRST NAME ☐ SAME AS DRIVER | INITIAL | LAST NAME

91 NUMBER AND STREET

92 CITY | STATE | EXPIRES

93 MAKE AND MODEL | 94 YEAR | 95 LICENSE PLATE NO. | 96 STATE

97 VEHICLE REMOVED TO | 98 AUTHORITY 1 OWNER 2 DRIVER 3 POLICE

99 VIN NUMBER

100 ALCOHOL DATA

DRIVER NO. 1

TEST GIVEN	TEST TYPE	TEST RESULTS
YES	BLOOD	
NO	URINE	
REFUSED	BREATH	

DRIVER NO. 2

TEST GIVEN	TEST TYPE	TEST RESULTS
YES	BLOOD	
NO	URINE	
REFUSED	BREATH	

PEDESTRIAN

TEST GIVEN	TEST TYPE	TEST RESULTS
YES	BLOOD	
NO	URINE	
REFUSED	BREATH	

101 ACCIDENT DESCRIPTION

102 DAMAGE TO PROPERTY OTHER THAN VEHICLE (GIVE OWNER'S NAME AND ADDRESS)

103 SUMMONS TO | SUMMONS NUMBER | CHARGE | NAME OF COURT

104 OFFICER'S SIGNATURE | 105 BADGE NUMBER | 106 REVIEWED BY (BADGE NUMBER) | 107 STATUS

ALL INVOLVED

	14	15	16	17	18	19	20	21	22	23	24 NAMES - ADDRESSES OF INJURED - IF DECEASED ALSO INCLUDE DATE & TIME OF DEATH
A											
B											
C											
D											
E											

NJTR-1 (R8/83)

RECORD BUREAU COPY

S.P. 123 (Rev. 3-84)

STATE OF NEW JERSEY

POLICE ACCIDENT REPORT

*EXPLAIN IN ACCIDENT DESCRIPTION

IF A QUESTION DOES NOT APPLY, ENTER A DASH (–).

IF AN ANSWER IS UNKNOWN, ENTER A "U"

1 PEDESTRIAN MANEUVER
1 Crossing/Entering Roadway at Intersection
2 Crossing/Entering Roadway Not at Intersection
3 Walking on Road w/Traffic
4 Walking on Road Against Traff.
5 Playing in Road
6 Standing in Road
7 Getting On or Off Vehicle
8 Pushing or Working on Veh.
9 Other Working in Roadway
10 Hitch-Hiking
11 Approaching or Leaving School Bus
12 Coming From Behind Parked Veh.
13 Other*

2 Veh. 1 / 3 Veh. 2 TRAFFIC CONTROLS
1 Police Officer
2 R.R. Watchman, Gates, Etc.
3 Traffic Signal
4 Flashing Signal
5 Lane Markings
6 Channelization – Painted
7 Channelization – Physical
8 Special Construction
9 Warning Signal
10 Stop Sign
11 Yield Sign
12 No Control Present
13 Other*

4 KIND OF LOCALITY
1 Mfg. or Industry
2 Shopping or Business
3 Residential
4 School
5 Open Country

5 TRAFFIC
1 Light
2 Medium
3 Heavy

6 ROAD CHARACTER
1 Straight and Level
2 Straight and Grade
3 Straight at Hillcrest
4 Curve and Level
5 Curve and Grade
6 Curve at Hillcrest

7 ROAD SURFACE TYPE
1 Concrete
2 Blacktop
3 Other*

8 SURFACE CONDITION
1 Dry
2 Wet
3 Snowy
4 Icy
5 Other*

9 ROAD CONDITION
1 No Defects
2 Defective Shoulder
3 Holes, Ruts, Etc.
4 Foreign Material
5 Loose Surface Mat'l.
6 Obstruction Not Lighted
7 Obstruction Not Signaled
8 Flood, Landslide, Etc.
9 Road Under Construction*
10 Other*

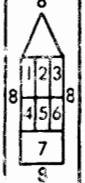
10 Veh. 1 / 11 Veh. 2 VEHICLE TYPE
1 Pass. Car-Sta. Wag.
2 Pass. Car w/Trailer
3 Truck
4
5 Recreation Veh.
6 Taxicab/Lim.
7 Bus
8 School Bus
9 Emergency Veh.
10 Motorcycle
11 Other*
12 Pickup/Panel
13 Moped
14 Trk. Combo 8' x 55'
15 Trk. Combo 8½' x 55'
16 Trk. Combo 8' over 55'*
17 Trk. Combo 8½' over 55'*
18 Trk. Combo Dbl. Bottom*

12 ROAD DIVIDED BY
1 Metal Barrier
2 Concrete Barrier
3 Concrete Island
4 Grass Median
5 None
6 Wood Barrier
7 Other*

13 WEATHER
1 Clear
2 Rain
3 Snow
4 Fog
5 Other*

WHICH VEHICLE OCCUPIED
1 Veh. 1 B Pedalcycle O Other*
2 Veh. 2 P Pedestrian

14 POSITION IN/ON VEHICLE
1 Driver 2 thru 7 Passengers
8 Riding/Hanging On Outside



15 SAFETY EQUIP. USED
1 No restraint used
2 Lap Belt
3 Harness
4 Lap Belt & Harness
5 Child Restraint
6 Helmet
7 Other*

16 17 EJECTION FROM VEHICLE
1 Not Ejected
2 Partial Ejection
3 Ejected

18 AGE / 19 SEX (M F)

20 LOCATION OF MOST SEVERE PHYSICAL INJURY
1 Head
2 Face
3 Eye
4 Neck
5 Chest
6 Back
7 Shoulder – Upper Arm
8 Elbow/Lower Arm/Hand
9 Abdomen/Pelvis
10 Hip – Upper Leg
11 Knee/Lower Leg/Foot
12 Entire Body

21 TYPE OF MOST SEVERE PHYSICAL INJURY
1 Amputation
2 Concussion
3 Internal
4 Bleeding
5 Contusion/Bruise/Abrasion
6 Burn
7 Fracture–Dislocation
8 Complaint of Pain
9 None Visible

22 VICTIM'S PHYSICAL CONDITION
1 Killed
2 Incapacitated
3 Moderate Injury
4 Complaint of Pain

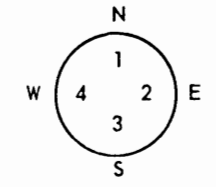
23 INJURED TAKEN BY / 24 TO

APPARENT CONTRIBUTING CIRCUMSTANCES
1 Unsafe Speed
2 Failing to Keep Right
3 Failing to Yield Right of Way to Vehicle/Pedestrian
4 Following Too Closely
5 Backing Unsafely
6 Driving Under Influence
7 Improper lane change
8 Improper Passing
9 Improper Turning
10 Failing to Signal
11 Improper Signal
12 Driver Inattention
13 Improper Crossing of Center Isle
14 Failing to Obey Signal
15 Disregarded Stop Sign
16 Dazzling, Improper or No Lights
17 Wrong Way, One-Way Road
18 Improper Parking
19 Animal on Highway
20 Pedestrian's Actions
21 Vehicle Defects*
22 Environment
23 Roadway Defects
24 None
25 Other*
26 Right turn on red

Veh. 1 25 / Veh. 2 26

27 LIGHT CONDITION
1 Daylight
2 Dawn or Dusk
3 Dark (St. Light On)
4 Dark (St. Lights Off)
5 Dark (No St. Lights)

DIRECTION OF TRAVEL



Veh. 1 28 / Veh. 2 29

PRE-ACCIDENT VEHICLE ACTION
1 Going Straight Ahead
2 Making Right Turn
3 Making Left Turn
4 Making U Turn
5 Starting from Parking
6 Starting in Traffic
7 Slowing or Stopping
8 Stopped in Traffic
9 Parking
10 Parked
11 Changing Lanes
12 Racing
13 Backing
14 Driverless/Moving
15 Other*

Veh. 1 30 / Veh. 2 31

LOCATION OF FIRST EVENT
1 On Roadway
2 Off Roadway

32

COLLISION INVOLVED
1 Pedestrian
2 Other Motor Vehicle
3 Overturned
4 Other Non-Collision
5 Pedalcycle
6 Animal
7 Fixed Object
8 Other Object*
9 R. R. Train

33

COLLISION TYPE (With Other MV)
1 Same Direction
2 Angle
3 Head-On
4 Left Turn
5 Struck Parked Veh.
6 Other*

34

FIXED OBJECT
1 Utility Pole
2 Trees
3 Ctr. Barrier/Median/Ctr. Island
4 Curb, Catch Basin, Culvert
5 Guide Rail
6 Sign Post
7 Signal Standard
8 Abutment, Embankment Wall
9 Building, Telephone Booth
10 Other*

35

VIEW OBSTRUCTION
1 Trees, Crops, Etc.
2 Building
3 Embankment
4 Sign Board
5 Hillcrest
6 Parked Vehicle
7 Moving Vehicle
8 No Obstruction
9 Other*

Veh. 1 36 / Veh. 2 37

PHYSICAL STATUS
1 Apparently Normal
2 Had Been Drinking
3 Physical Handicaps
4 Ill
5 Fatigued
6 Apparently Asleep
7 Using Drugs
8 Other*

Dr. 1 38 / Dr. 2 39

Ped. 40

State Police form has a check-off system rather than requiring written details. The Turnpike's generally requires that the detailed information be written rather than be checked off. The investigating trooper has to draw an accurate diagram of the location and position of each vehicle in an accident. This is extremely important for accidents involving fatalities and major injuries. Additionally, the trooper has to describe the accident and the narrative in a format which could be easily followed.

The Port Authority uses what it calls a 621 form as its accident report. The 621, like the Turnpike's form, requires detailed explanation and part of its function is to serve for accident analysis by the Authority's traffic division. The traffic division currently is conducting analysis to determine whether improved signing will decrease truck accidents at the George Washington Bridge. (*pers. comm.*)

The Turnpike accident report is a document developed by a trained trooper. Accident details have to be presented in a manner where corrective measures are justified. It also serves as a legal document whereby the Authority is able to defend itself from suits, based on the information presented in the report.

Essential information is on the accident form. There is no need for coding sheets to interrupt the information shown in the boxes appearing in the margin as in the State report. The information is then fed into a computerized accident data bank. This data is used by the Authority and State Police Troop D to develop strategies to improve safety on the Turnpike. No overlay is

needed to evaluate the accident as required by the State Police form.

The boxes on the side of the form seek specific information, which results in pin-pointing the exact location of the accident. The boxes include the types of roadways within the Turnpike system. Still other boxes require information about seat belts used by the driver and occupant. Additionally, another box requires the witness' name and address.

The Turnpike form has seven categories describing the level of service compared with only three such categories on the State form. Contributing circumstances must be spelled out and properly identified rather than simply checking the appropriate box. The form also contains origin and destination information as well as date and time of entry, the entry interchange, and the name of the entry collector. The Trooper must spell out, in detail, the movements of the vehicle after the accident as well as the state of the driver.

Information on the accident form is used to determine trends and to take action to alleviate probable causes of accidents on roadways. For example, Turnpike officials credited information obtained in its reporting system for a major capital expenditure to improve road surfaces at Interchanges 11, 13, 14, 15E and 15W, which had been the scene of several truck accidents. (*per. comm.*)

Information and statistics from the accident forms were used in the design of a portion of the Turnpike's $2 billion

widening project. One safety improvement in the widening will be the realignment of the "mixing bowl" on the Turnpike main line between Interchanges 14 and 15. The new design calls for a separation of roadway which will eliminate the excess weaving that now exists, and will also eliminate a combination of grades on the roadway. Heavy weaving sections may contribute to the significant number of sideswipe accidents being experienced.

Another analysis of data supports the Turnpike concept of improved safety in the widening by building a dual-dual roadway as opposed to a non-dual roadway. An analysis was made between Interchanges 7A and 9 on the main line as compared to a comparable section of dual roadway of Interchanges 9 and 12 in 1983, 1984, and 1985. The results showed that the non-dual section had an accident rate of 60.8 per 100 million miles travelled while the dual-dual portion had an accident rate of 51.5 per 100 million miles travelled or a difference of 15.3 percent. The dual-dual roadway concept allows for the separation of cars and trucks while the standard-dual section mixes all kinds of traffic./ (per. comm.) Other authorities may want to adopt the Turnpike accident reporting form, which helps in accident reconstruction and insurance matters.

The Authorities investigate and reconstruct accidents, particularly serious ones. The Highway Authority has a Fatal Accident Committee, which is composed of the operations manager, the State Police, the legal department, and the traffic engineer. The Committee reviews all pertinent data in fatal accidents and make recommendations to improve conditions for the roadway. At the

Turnpike a similar function is carried out by the Operations Department's Traffic Engineering Division in conjunction with the State Police, the Legal Department, and the Risk Management Department under the supervision of the Director of Operations. The Port Authority, also, evaluates and reconstructs serious accidents. The matter is mainly handled by police who conduct an investigation. They rely on assistance from engineering and traffic engineer departments on certain problems. The police and agency operating personnel should consider getting together more frequently on a more formal basis to exchange information and ideas about truck accidents and related enforcement programs. (*per. comm.*)

TRUCK ACCIDENT STATISTICS

Truck related accidents are occurring at a higher rate than their composition in the traffic stream. In New Jersey, trucks were involved in 28,024 accidents in 1984 or 75 per day. About 20 percent of all multiple vehicle accidents involved trucks, yet trucks accounted for only 7 percent of the total volume. Trucks were involved in 21.4 percent of the fatal accidents in 1985 (see Table 1B). Table 1A shows what between 10.1 percent and 13.1 percent of the vehicles involved in fatal accidents between 1981-1984 were either commercial, single tractors or commercial tractor trailer combinations. The percent of their estimated vehicle miles travelled varied from only 6.3 percent to a high of 7 percent.

Table 1B shows that truck involvement in fatal accidents has been slowly but steadily rising from 1980 through 1985 and the

21.4 percent figure for 1985 appears much higher than their percent of the traffic mix.

Tables 1C and 1D compare the numbers of fatalities involving trucks. Table 1C shows that even though the larger trucks accounted for a low involvement in fatal accidents (Table 1B) they had a much more significant involvement in fatalities (Table 1C). Trucks historically have had a higher fatal involvement rate than cars due in large part to the great difference in mass between the two classes of vehicles. The truck combination total in 1984 was 80 fatals; Table 1C shows the involvement by size. These figures appear to simply represent the relative numbers of each size combination using New Jersey roads.

Table 1D shows what type of roadways truck related fatals occurred on in 1983. Truck combinations had an involvement rate of 8.3 percent on Interstate, State and toll authority roadways while pick-up - panel trucks had an involvement rate of 8 percent. Both of these percentages are higher than their percent of the mix.

Separate accident statistics are available for the toll facilities. The accident rate on the Turnpike has been increasing steadily as has the truck accident rate. Accidents on the Turnpike from 1980 to 1985 show a heavy involvement of trucks, a trend which continued for the first six months of 1986. The percentage of truck accidents has been averaging 37 percent while trucks, generally, average about 12 percent of the total volume since 1980. The percentage of fatalities involving trucks has been on the high side, too. The lowest it reached was 37.9 percent in 1985 (see attached

New Jersey Turnpike Table II, page 11A). No pattern was discerned on the Turnpike. Some of the fatal accidents involved "breakdown or disabled vehicles on the shoulder." This indicates a need to speed up aid to disabled vehicles.

Similarly, the Port Authority has been experiencing an increase in accidents involving trucks at its Trans Hudson crossings. The overall 1984-1985 accident picture for the Port Authority crossings showed that trucks represented 7.2 percent of the volume, but accidents involving truck represented 41 percent. A particular concern is the George Washington Bridge, where trucks make up 7.9 percent of the volume and are involved in 52 percent of the accidents (see attached Port Authority Table III, page 11B and Chart I, page 11C). The Port Authority notes that most of these accidents are minor fender benders occurring at merge points around the toll plaza and at heavy weave points.

Truck accidents on the Garden State Parkway, on the other hand have been minimal. This is mainly due to the fact that trucks are prohibited in the most densely travelled sections of the Parkway, north of Eatontown.

On the Garden State Parkway most of the accidents are one vehicle off the road type accidents even though the Parkway has many miles of extremely dense traffic. In 1985, the Parkway had a total of 4,110 accidents of which 1,555 involved vehicles hitting fixed objects which represented 37.9 percent of the accidents. Sixteen of the Parkway's 20 fatalities for 1985 or 82 percent represented accidents that involved hitting a fixed object./ (55) The Parkway does

TABLE III

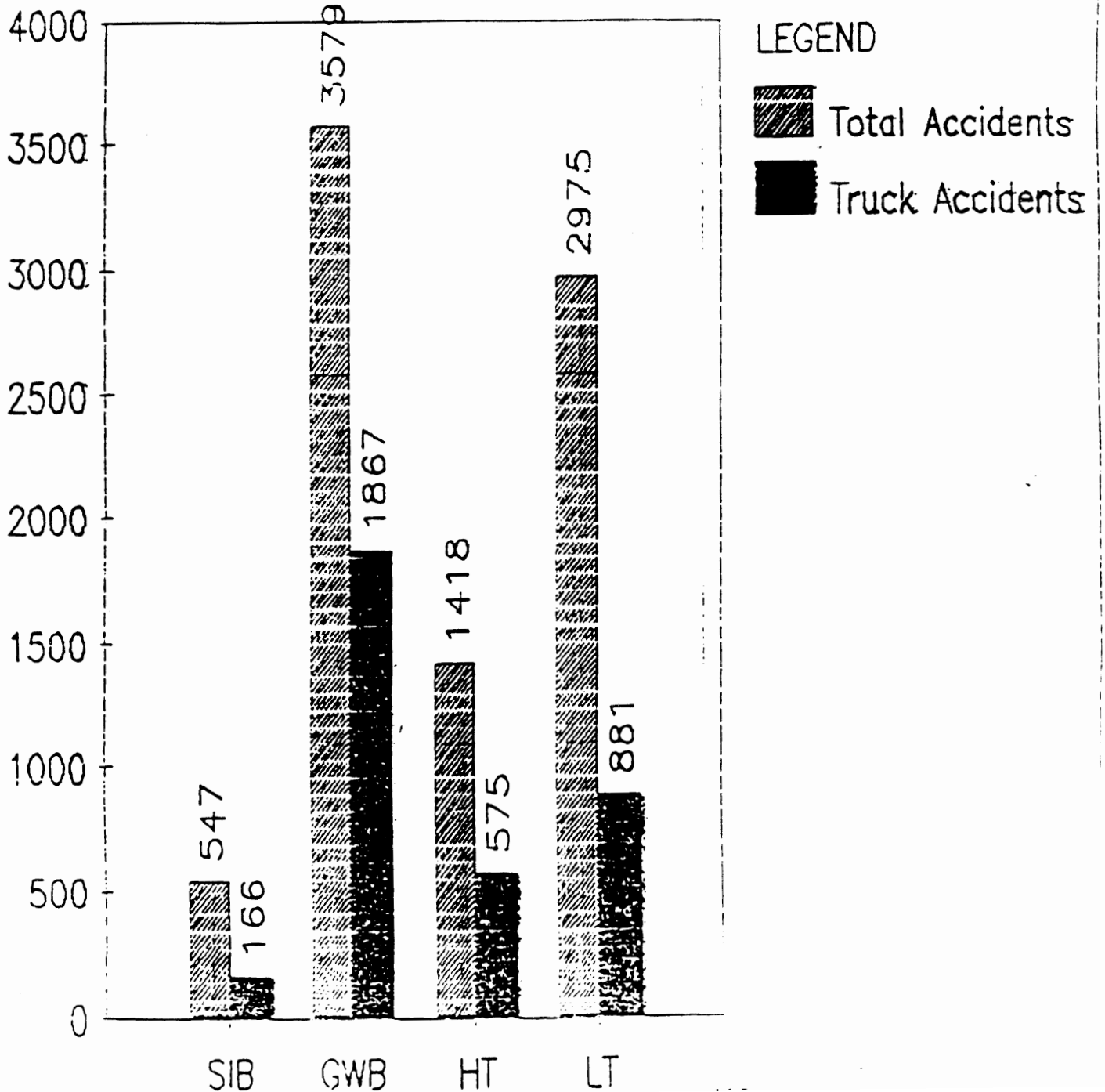
THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

1984 - 85 TRUCK PERCENTAGES

	% TRUCKS IN TRAFFIC	TRUCK ACCIDENTS TO TOTAL ACCIDENTS
TOTAL	7.2%	41%
Staten Island Bridges	6.9%	30%
Lincoln Tunnel	5.4%	30%
George Washington Bridge	7.9%*	52%
Holland Tunnel	7.8%	41%

Information furnished courtesy of the Port Authority of New York & New Jersey (70)

TUNNELS AND BRIDGES
Truck Accidents/Total Accidents
1984–1985
The Port Authority of NY and NJ



allow trucks in the southern end where traffic densities are lighter and they apparently do not have a problem with trucks mixing with cars and buses in these less urban areas.

Port Authority and Turnpike statistics show something different. The Port Authority multiple accidents are much higher as is the New Jersey Turnpike's. The Turnpike's accidents totalled 3,420 in 1984, versus 3,781 for 1985, an increase of 242 or 7.3 percent. Similarly the Port Authority had a high multiple vehicle accident rate as evidenced by the George Washington Bridge. The dominant factors for accidents on the George Washington Bridge were sideswipes, angle and rear end multiple accidents. With only the above statistics available it could not be determined how many of these type accidents involved trucks as the contributing factor. It should be noted that trucks on the Port Authority facilities are involved in 41 percent of all accidents and therefore it would be safe to assume that there were at least this percentage involved in the above categories. Over the last six years, trucks have been involved in about 35 to 40 percent of all accidents on the Turnpike. The above statistics appear to point out that in urban, fast-paced, densely travelled areas trucks and cars are often in conflict for a variety of reasons.

Some of them are:

1. Trucks are cut off by impatient car drivers anxious to keep their pace or change lanes, exit or enter the roadway and who do not realize the inability of the truck driver to stop or swerve the rig to avoid a car;

2. Trucks sometime impair sight distance;

3. Trucks have bigger blind spots than cars when changing lanes;

4. Truck brakes are not as efficient as car brakes;

5. Dense traffic makes for difficulties for trucks exiting the roadway except from the right lane of a roadway;

6. Many trucks exceed the speed limit.

A two-year study of "Driver-Vehicle, Highway Characteristics and Car-Tractor Trailer Collisions at Interchanges and Roadway Construction Maintenance Locations" was completed by Stephen P. Shao, Jr. Ph.D. of the School of Business at the University of Baltimore for the AAA Foundation of Traffic Safety in Falls Church, Virginia. In his study completed in September, 1986, Dr. Shao said "it is readily apparent that both car and tractor trailer drivers must share the responsibility of accident collisions. Generally negligent driving by both drivers, excessive truck driver speed and car driver failure to yield offer sample

evidence to this remark. Also the many frontal truck impacts highlight the need to give special focus on tractor trailer driving behavior." Among the interchange findings were: 1. Interchange collisions are most frequent during morning and afternoon rush hour traffic between 7 and 10 am and 3 and 6 pm. 2. Major reported causes of interchange located collisions were a) failure to drive within a single lane b) failure to reduce speed c) failure to yield the right of way. 3. Over half the interchange collisions involve passenger side sideswipes with next most frequent type being direct rear end collisions. 4. The major vehicle defect contributing to collision was defective brakes for tractor trailers, for the car it was defective tires. 5. More interchange collisions involving in-state trucks were caused by rear ending while out of state trucks were often involved in sideswipe collisions. Also, intra-state trucks were sited for failure to reduce speed and interstate trucks were sited for failure to drive within a single lane. (1)

AGENCY FOLLOW THROUGHOUT ON ACCIDENT STATISTICS

The NJICC member agencies have utilized the data described previously to identify factors contributing to truck accidents and to implement various improvements to reduce the potential for future accidents. The Turnpike Authority, the Highway Authority, and the Port Authority each have accident investigation teams which reconstruct serious accidents, investigate the contributing factors, and recommend mitigating measures, where appropriate.

Based on the results of its accident report system, the New Jersey Turnpike Authority identified 5 locations where the condition of the road surfaces was a contributing factor in several truck accidents. As a result, the Authority took action to improve the roadway surfaces at these locations. The Turnpike also utilized its accident data to identify a number of accidents occurring over the "mixing bowl" on the Turnpike main line between Interchanges 14 and 15. This section is scheduled to be improved as part of the Turnpike $2 billion widening project. This project will also extend the Turnpike's dual-dual roadway which will further extend the separation of trucks from auto traffic. The Turnpike found that nearly 30 percent of the accidents on its entire roadway occurred at interchanges. Based on its accident analysis as well as other factors, the Turnpike hired a consultant to design improvements for three interchanges - 13,14, and 14B. (*per. comm.*)

The Port Authority reported that 62 percent of all the accidents on the George Washington Bridge were sideswipes, angle, or

rear end accidents occurring at or around its toll plazas. An analysis of these accidents determined that most were minor property damage only accidents. Many resulted from last minute lane changes. Frequently a car would make an unanticipated maneuver into a truck's blind spot resulting in a sideswipe. The Port Authority is investigating improved signing to avoid the necessity for a motorist to make a last minute lane change across several lanes to reach an exit ramp or to enter a toll lane. The Port Authority is also investigating various lane delineators such as the "Superduck (noted on page 68) or reflective pavement markers which are especially effective at night or in rainy weather.(*per. comm.*)

OVERWEIGHT TRUCKS

Overweight trucks cause roadway damage and can be a contributing factor in truck accidents. The New Jersey State Police consolidated monthly truck overweight report (see Table 4) from January 1 through December 31, 1985 showed that the total number of vehicles weighed at stationary and portable scales amounted to 436,861, and overweight violations at these locations came to 17,333, about 4 percent. Adequate deterrence is essential to help end the abuse of overweight trucks. Other states put overweight trucks out-of-service. This action would be enough of a deterrent, because of the inconvenience it would cause, and may have a greater effect than a fine. New Jersey State law requires that the operator of an overweight vehicle adjust, redistribute, or reduce the load to legal limits before proceeding.

TABLE 4

NEW JERSEY STATE POLICE
CONSOLIDATED MONTHLY TRUCK
OVERWEIGHT REPORT
JAN. 1 - DEC. 31, 1985

	VEHICLES WEIGHED STATIONARY AND PORTABLE		OVERWEIGHT VIOLATIONS STATIONARY AND PORTABLE	
	TOTAL	PERCENT	TOTAL	PERCENT
A	120,781	28%	2,486	14%
B	147,216	34%	7,543	44%
C	160,847	37%	4,841	28%
D	3,157	1%	1,363	8%
E	457	0%	12	0%
PA	4,403	1%	1,094	6%
TOTALS	436,861	100%	17,339	100%

Information furnished courtesy NJ State Police

The Port Authority purchased and put on line four electronic scales in late 1986. The Port Authority anticipates increased weigh activity at the George Washington Bridge and on Staten Island. Similarly, the Turnpike is planning to purchase additional portable scales. The Port Authority's new electronic scales are of extremely rugged construction and are accurate, even with harsh and abusive use. They are fully electronic with no mechanical components to wear out and this means no expensive maintenance schedule. They are light weight and designed for easy handling and can be set up by one man. They have large, bright, easy to read digital indicators. The high quality tilt bed trailers make it easy to transport scales, by a single person, to remote locations. / (per. comm.) Independent authorities must place greater priority on enforcing weight limits.

PAVEMENT SURFACE

A cause of accidents on any roadway may be the pavement surface. That is why the federal government started a skid accident program many years ago. It mandates that every state shall have a program of skid testing for improved safety. The program shall provide standards with specific provisions for skid resistant qualities. It also requires that each state have a program for resurfacing or other surface treatment with emphasis on correction of sections of highway with low skid resistance and high or potentially high accident rates.

In accordance with the Federal Highway Administration's instructional memorandum of 1968, the Port Authority Traffic

Engineering Division has conducted skid resistant surveys on all Port Authority roadways since 1969./ (68) The Port Authority Roadway Skid Testing monitors pavement skid resistance for safety. Skid resistance data is evaluated in conjunction with wet-road accident experience and pavement condition inspections. This coordinated approach reduces wet-roadway accidents, while establishing priorities for efficient use of pavement maintenance funds.

The Port Authority continues to utilize the New Jersey DOT skid testing vehicle. NJDOT provided the vehicle, driver, test equipment, gasoline, maintenance, and data reduction. Testing in the field, however, was directed by the Port Authority Engineering Staff. About 800 locations were tested with an average of 3 readings each. (68)

The Turnpike has been using, for the past 30 years, the best aggregate for all of its paving work. These aggregates, which have a coefficient of friction of .35 or higher, basically maintain the good condition for the life of the pavement. However, if the pavement is found to be too smooth, the Engineering Department will conduct a skid test using the ATSM skid trailer. If the coefficient of friction is found to be below standard, then corrective measures are implemented. As stated above, due to the high quality aggregate, the Authority does not have a need to conduct skid tests on a continuous basis. (per. comm.)

The NJHA, on the other hand, has from time to time done the skid testing but has no overall plan.

Skid testing determines the condition of the pavement which particularly can be effected by vehicle "drippings" or "oil leaks" and from normal wear and tear. These conditions lead to a slippery road surface which is compounded during wet weather. This condition can be an added adverse effect with the braking capability of cars and trucks.

Skid testing can also be used to assure that new overlays meet specifications. The use of skid testing could reduce accidents by determining and correcting roadway conditions. Skid testing should be done at least every year where there is heavy and dense truck use. It is suggested that anyone not doing skid testing should do so.

SPEED, WEAVING AND BACKUPS

A significant amount of accidents occurred on Interchange ramps and toll plazas. In these areas there seems to be plenty of weaving, backups, and even speeding. People usually are impatient while paying their toll, and after the toll they seem to be looking to get out of the box as quickly as possible. A number of accidents happened at the upper and lower level toll plazas on the George Washington Bridge. Trucks accounted for 82 percent of the accidents on the upper toll plaza, and 79 percent for the lower. The accident picture was quite different for the Holland and Lincoln Tunnels (admittedly different facilities) where truck accidents amounted to 1,456 in a total picture of 3,848 vehicles, or 71.8 percent of the total accidents. Trucks made up only 11.9 percent of the traffic. Similar conditions were noted at other plaza locations of the GWB.(70) Safety people contend that quick lane changes or last minute lane changes may be responsible for the accidents, even though some could be ascribed to impatience and frustration, jack rabbit starts and speeding to another booth because the line is shorter. There also could be some who are weaving across the plaza in hopes of making an entrance or exit connection. These are accidents resulting from high volumes and heavy weaving at toll plazas.

The New Jersey Turnpike Authority had a similar accident experience in that a number of accidents took place at its interchanges. The Turnpike interchanges had 1,082 accidents in 1985 compared to a total of 3,781 for the entire roadway. 28.06 percent of accidents occurred at interchanges. The leading interchange for

accidents was #14 in Newark which had 197 accidents. This same interchange (#14) had 162 accidents in 1984 in which one person died and 61 were injured. It is a complicated interchange where several lanes of traffic converge among exit and entrance ramps and onto the toll plaza. The Turnpike plans improvements to Interchange 14 during its widening program in an effort to reduce the number of accidents. Interchange 16 in Secaucus had 85 accidents and Interchange 13 in Elizabeth had 97 accidents and 104 accidents were reported at Interchange 11 in Woodbridge. The Turnpike recognizes the problems being caused at its interchanges and at present is studying the possibility of expanding or improving the interchange 16W with the widening and they are evaluating 16E, 17E, and 18E in the Northern terminus. The Turnpike must find ways of diffusing the high volumes of traffic now using its interchanges. In fact, the Turnpike may expand or redesign other interchanges to reduce congestion and potential for accidents. Among the possibilities being considered by the Turnpike is the split plaza concept where entry and exit toll lanes are separated by the toll plaza building. Presently, only Intergange 13A has this configuration. The Turnpike could look at the possibility of separate plazas for trucks.(*per. comm.*)

At its January, 1987 meeting, members of the Turnpike Authority took action on three interchange improvements based on a study conducted two years ago by its consultant, Howard Needles, Tammen and Bergendorf. The consultant is nearly finished with an upgrading of Interchange 14B and recently received approval for more design improvements at Interchange 14. A different consultant has completed the final design of improvements to the ramp from the

Goethals Bridge to Interchange 13's toll plaza. This ramp will be widened to two lanes and among other features will result in a better superelevation. (60)

Initially, the Turnpike plans a split plaza for the 30 million dollar relocation of Interchange 7 in Burlington County. However, the Authority decided to construct a conventional 12 lane plaza because the ramps and the approaches for a split plaza required a "more substantial width" than a standard plaza. The design of a conventional plaza enables the Turnpike to minimize the impact on wetlands. With the current mix and congestion at Interchange 7, many cars and trucks interfere with each other in a relatively small area. It takes longer to process a truck payment. Normally, when a person enters or leaves an Interchange or plaza area, he is trying to do too many things: rolling up a window, accelerating the car, and vying for position, and if in an unfamiliar area, looking for a sign to point the right direction. Sometimes doing too many things can cause accidents. Some safety experts believe that a police presence in a plaza area just before or just after the toll could reduce accidents. While a police presence is recognized as a benefit to safety, it is not feasible to continuously station state troopers at toll plaza areas. (*per. comm.*)

Example: At 16W during professional football games at Giants Stadium, State Police have been positioned at tolls with flashing lights. This has a slowing effect on traffic, and keeps people in lines, and appears to be successful. The police presence at 16W serves a specific purpose.

SIGNING

Drivers may encounter great difficulty in using unfamiliar toll facilities. Once a travel ticket has been obtained on entering the toll system or after paying the toll upon exiting, an instant decision has to be made which may require a weave across several lanes to go North or South, depending on the destination. Signing and advance signing could improve the condition. The Turnpike signing has been generally good but there is always room for improvement. It may be necessary for the Turnpike Traffic Consultant to review Turnpike signing from the viewpoint that the motorist is in unfamiliar territory and is using the Turnpike for the first time. As a suggestion it may be beneficial to use directional signs above the plaza, mounted on the roof of the toll lanes. Most people look at the plaza as they approach it. Signs informing people to keep right for North and New York or keep left for a Southern point, would be an appropriate way of helping motorists.

The Port Authority is also considering new signs for the George Washington Bridge as a result of accidents. When designing signs, engineers should consider them from the perspective of a motorist travelling through the area for the first time. Sign

difficulties can be equally frustrating for truckers making an initial trip in the area. (*per. comm.*)

Signs are also needed to keep trucks off prohibited roadways such as the Garden State Parkway. More and more incidents of trucks illegally using areas of the Parkway are occurring. This is being caused to some degree by the present signing, or lack of it. Some truck drivers, particularly those unfamiliar with the area, see the signs too late. The signs are usually posted on the entrance ramps of the Parkway and by then it is too late for a driver to turn around. An abrupt stop or last minute maneuver may cause an accident. Instead the driver continues on the roadway and finally finds himself alone with passenger cars in a prohibited area on the Parkway. An effort should be made to have more advanced signing in the Northern section of Parkway, with the international symbol, warning that trucks are prohibited on the Parkway. Also after each interchange from Eatontown north, there could be signs before or after the toll plaza, warning that trucks are prohibited from this section of roadway.

As was stated earlier, people get frustrated and aggravated with delays and toll processing. An experiment may be conducted to determine if special exact change lanes could be established on the Hudson River crossings or at the Turnpike to expedite the flow of traffic. This requires that anyone using the lane have the exact change in hand or a commutation ticket. The exact change would stop the collector from routing around and counting out money which delays processing.

Ramp signing for trucks at reduced speeds may be appropriate. The Federal Highway Administration has been unable to come up with a hard and fast rule to determine safe truck speeds on ramps. According to the American Trucking Association, however, a good general rule of thumb would be to teach truck drivers that they should take ramps at 10 m.p.h. less than the posted safe ramp speed. (3) The Authorities may want to consider truck signing in the future to be 10 m.p.h. less than the posted safe ramp speed for cars. In other words, if the posted ramp speed is 25 m.p.h., the posted sign for trucks would be 15 m.p.h. The proposed change in signing should be researched by the Federal Highway Administration before an authority or anyone else takes such action unilaterally.

UNIFORM ENFORCEMENT PROCEDURES

The NJICC agencies recognize the need for more uniformity in truck safety enforcement procedures. They also recognize the desirability of a cooperative, comprehensive truck safety program including a mechanism to share information on driver records, repeat violators, accident trends, and innovative enforcement activities. This cooperative approach includes a high end federal-state partnership which has been evolving recently.

In recent years, the federal government has placed higher priority and emphasis on enforcement of safety among trucks. The federal government has "put its money where its mouth is" so to speak. Congress has given the Department of Transportation the responsibility for maintaining a high level of truck safety. As the volume of truck traffic grows, these responsibilities require an increasing effort to maintain highway safety. In its charge to the Department of Transportation, Congress has set the following goals:

1. The US Department of Transportation, the Federal Highway Administration, and National Highway Traffic Safety Administration establish and enforce truck safety standards including regulations governing design, manufacturing, maintenance and operation of trucks, and driver qualification and training.

2. The Surface Transporation Act of 1982 established a federal-state partnership for truck safety which is carried out through the Motor Carrier Safety

Assistance Program (MCSAP). This five-year program authorized USDOT to provide $270 million to assist states in improving motor carrier safety enforcement. Under MCSAP, states that adopt and enforce the Federal Motor Carrier Hazardous Materials Transportation Regulations are reimbursed for part of the cost. Additionally, the programs promote the adoption of the National Uniform Safety Regulations, allowing the industry to avoid the expense of complying with multiple, diverse and sometimes inconsistent, standards.

3. Since MCSAP began over 2000 state inspectors have been trained including 650 inspectors who have completed the courses in safe transportation of hazardous materials. In 1983 and 1984 combined there were only 450,000 roadside inspections. By the end of fiscal 1987, USDOR estimates that 4,000 inspectors will have been trained and that there will have been about 2 million roadside inspections.

4. The Secretary of Transportation has established a safety task force to review the Department's program to ensure that DOT is dealing effectively with its safety responsibilities. As part of that review the task force is examining truck safety and DOT is meeting with district groups to hear their views on

truck safety issues.

5. The DOT Secretary plans to add 150 safety specialists to the Office of Motor Carrier Safety field staff by the end of 1987. This increase is part of a major shift in the Federal program emphasis to focus on its resources on high risk and problem motor carriers. An integrated computer system that incorporates the information from the MCSAP funded state road inspections and other data sources will target unsafe carriers for close monitoring, technical assistance and strong enforcemenet actions when necessary.(118)

NEW JERSEY'S EXPERIENCE WITH MCSAP

After two years of developing a MCSAP plan, New Jersey last July was accepted in the MCSAP program. What does this mean? Most importantly it means that MCSAP enforcement related activities could and should reduce the probability of a major incident occurring by truck transportation of hazardous material. This reduction will occur as a result of increased enforcement, increased awareness of potential dangers, education to the potential danger, and a forced emphasis on safety. Agencies involved in the MCSAP program are the offices of Freight Services and Regulatory Affairs in the New Jersey Department of Transportation, and the New Jersey Division of State Police. A cooperating agency is the New Jersey Department of Environmental Protection, Division of Waste Management which will have the role of registering hazardous waste (54)

transporters. This unit will be responsible for enforcement of hazardous materials and hazardous waste regulations and off highway storage locations. This agency also issues permits for transportation of radioactive materials and approves routing as part of the permit application. Another cooperating agency will be the Port Authority, which has been conducting safety checks on commercial motor carriers at the entrances to its bridges and tunnels. The Division of Motor Vehicles will license drivers of articulated vehicles and register commercial motor vehicles.

The total budget for the MCSAP program will be $2.834 million, of which $1.242 million will be requested in federal funds. The remaining $1.591 million will be paid for by the State of New Jersey. State Police received one-shot funding of $1 million for enforcement of hazardous material laws. By way of contrast, enforcement expenditures amounted to $240,000 in 1980 and 1981.

California places greater emphasis and priority on truck enforcement. Its commercial vehicle enforcement section has a budget of $24 million with 435 uniformed personnel and 139 civilian inspectors. In 1985, California conducted 280,000 inspections and placed 67,000 trucks out of service. The California Highway Patrol utilizes 114 officers in mobile equipped scale trucks for random inspection on highways as well as 13 large permanent sites for inspection. Additionally, the patrol has 39 platform scale locations throughout the state. MCSAP funding is being used for random inspections on California roads not normally covered by the highway patrol. At these locations, about 50 percent of the trucks

are being put out of service. Out of service rates are running 22 percent at facilities and 42 percent at mobile locations.(*per. comm.*)

California's experience is instructive. When a comprehensive inspection program is first initated, out of service numbers will be high. Once the program is established and the industry is aware of the consequences, that number will drop. Maintaining lower out of service numbers still requires continued vigilance.

The New Jersey MCSAP program, which was underway in 1987, will mean 15 more state troopers to bring its strength to 58 in commercial vehicle enforcement and HAZMAT inspections. Prior to this, 24 people plus some sergeants were responsible for this commercial vehicle inspection program. The commercial vehicle inspection and the HAZMAT staff performed similar functions but are in fact two separate units. The HAZMAT troopers are basically going to be long term troopers assigned to the program indefinitely while CVI troopers are assigned for 3-year staggered terms. (*54*)

MCSAP SHORT TERM GOALS FOR THE STATE

The short term objectives of the New Jersey MCSAP program are:

1. Complete adoption of the Federal Motor Carriers Safety Regulations applied to interstate travel.

2. Increase the staffing for commercial vehicle inspection teams within the State Police.

3. Train new enforcement personnel assigned to commercial inspections in hazardous materials in Federal Motor Carriers Safety Regulations and Inspections.

4. Conduct 40,000 roadside inspections of commercial vehicles per year.

5. Conduct 100 terminal equipment checks per year.

6. Train appropriate enforcement personnel on safety management audits with a new course of procedure when it becomes available from the federal government.

7. Set up the SafetyNet database in New Jersey in cooperation with federal agencies.

8. Recommend legislation or adoption of regulation needed to insure maximum effectiveness of the Motor Carrier Safety and Hazardous Material enforcement efforts.

9. Participate in commercial vehicle safety alliance programs and activities.

10. Update regulations to correspond with the latest published federal documents.

11. Analyze commercial vehicle accidents and inspection data for purposes of directing enforcement regulatory efforts.

MCSAP MEDIUM TERM GOALS

The medium term objectives are:

A. Examine existing reporting procedures and modify as necessary to comply with the OMCS reporting requirements.

B. Recommend legislation or adopt regulations needed to insure maximum effectiveness of motor carrier safety and hazardous material enforcement efforts.

C. Create a coordinated management information system for all record keeping procedures of relevant agencies in the State of New Jersey to create a common database.

D. Maintain and update SafetyNet systems.

E. Monitor effectiveness of enforcement efforts and identify additional legislative or regulatory needs if any, also determine whether and how enforcement efforts are most needed and can be most effective.

MCSAP LONG TERM GOALS

The long term objectives are:

1. Improvement of the existing permanent inspection sites and waste stations, provide facilities for enforcement personnel and holding areas for vehicles placed out of service.

2. Develop new sites and facilities as necessary.

3. Legislative changes to regulations and promulgate new regulations as deemed necessary.

4. Analyze data collected during enforcement efforts and make necessary adjustments in manpower procedures to ensure maximum effectiveness of the enforcement program. (54)

EFFECTIVE ENFORCEMENT

Highway safety experts working to reduce truck accidents know that they must focus on the vehicle, the driver, and the trucking company itself. Accordingly, the State plans to conduct 40,000 truck inspections this year, 25 percent of which will be during evening or early morning hours. As of January 13, 1987, the State will be enforcing new driver out of service criteria (for inter-state as well as intrastate operations) to ensure that drivers do not exceed hours of service limits.

For example:

1. Driving more than ten hours following eight consecutive hours off duty: "a driver could be placed out of service for eight consecutive hours until such time as eligibility to drive is re-established."

2. Driving for any period after having been on duty 15 hours following eight consecutive hours off duty: "to be placed out of service for eight consecutive hours or until such time as eligibility to drive is re-established."

3. Driving after having been on duty more than 60 or 70 hours (combined driving and on duty time) in 7 or 8 consecutive days: "to be placed out of service until on duty time over eight consecutive days totals less than 70 hours (time to release from out of service starts 12:01 am of the following day of each succeeding 24-hour period until hours are available).

4. No record of duty status in possession when one is required: "to be placed out of service for eight consecutive hours".

5. A record of duty status not in conformance with Title 49 Part 395-13(Db): "to be placed out of service for eight consecutive hours."

The troopers also will be enforcing a new vehicle out of service criterion for braking systems. These will include readjustment of brake limits adjustment balance, brake hose, brake tubing, low pressure warning devices, air loss rate, air check valves and air compressors. All these have never been enforced before on interstate trucks. Moreover under the new regulations troopers will be checking coupling devices as well as steering mechanism, suspension and wheels and rims. The Federal criteria should also cover intra-state trucks to accomplish uniformity of standards. This will require state legislation or regulation to cover intra-state trucks.

THE NEED FOR MORE INSPECTIONS

The Port Authority, in 1985, conducted 9,000 safety inspections at the Lincoln Tunnel, 8,500 at the Holland, 407 at the George Washington Bridge, and 1,861 on the Staten Island Crossings. The Port Authority has six men assigned to truck weigh teams. No CVI checks as prescribed by MCSAP, are made on the trans-Hudson crossings. The Port Authority concentrates its inspections on documents and glaring equipment defects. (*per. comm.*)

Lack of adequate facilities is a difficulty facing the Port Authority in carrying out truck inspections. Most of the entrances to the tunnels and bridges are cramped wihtout available space for inspections. The inspections site should be a safe area for the officers to work. The Port Authority could find adequate sites in the vicinity of its trans-Hudson Crossings.

Troop D, State Police on the New Jersey Turnpike conducted 725 vehicle inspections in 1985, resulting in 352 of these vehicles being placed out of service. As of August 31, 1986 a total of 338 commercial vehicles were inspected, resulting in 157 of these vehicles being placed out of service. Two troopers are assigned to commercial vehicle inspections on the Turnpike, which handles about 26 million trucks a year.

A safety expert contended that accidents will decrease when enforcement reaches a level in proportion to the volume of trucks on the roadway. The term random inspection is misleading because inspections are selective rather than random. In other words, a trooper picks a truck for inspection based on obvious and glaring defects, resulting in a disproportionately high number of trucks being ticketed.

Table 5 is attached showing the number of truck inspections performed by the State Police during the last four years. After declining to a low of 16,360 in 1982, the number of inspections had nearly doubled to 31,516 by 1985. It appears that the independent agencies could broaden the number of inspections and examinations.

There appears to be a serious need for a permanent truck inspection station within the urban, densely populated metropolitan area. It is entirely conceivable that once a truck enters New Jersey on the Turnpike, it can travel the entire length or take the Bayonne extension to New York City with the high probability of not being inspected. Most of the Turnpike inspections are done at

STATISTICAL SUMMARY

ROADSIDE TRUCK SAFETY INSPECTIONS

State of New Jersey

	1981	1982	1983	1984	1985
Commercial Vehicles Stopped	22,550	16,360	18,294	28,104	31,516
Commercial Vehicles Checked	19,506	12,648	15,617	22,730	26,425
No. of Out-of-Service Violations	5,940	3,978	5,690	10,439	9,294
Other Violations	74,572	50,923	72,475	129,930	138,971
Vehicles Placed Out-of-Service	4,089	2,767	3,642	6,290	6,884
TERMINAL INSPECTIONS					
Terminal Safety Inspections	0	0	0	13	3
Records Checked	0	0	0	326	36
Violations Out-of-Service	0	0	0	108	16
Other Violations	0	0	0	522	47

ROADSIDE BUS SAFETY INSPECTIONS

	1981	1982	1983	1984	1985
No. of Road Checks	124	275	285	146	365
No. of Vehicles Checked	1,797	2,486	3,100	1,518	4,380
No. of Rejections	1,396	2,448	2,980	1,497	4,183
Accident Investigations Conducted	370	361	387	352	478

Courtesy NJ State Police

interchanges. Inspections could be performed at service locations or other designated areas along the Turnpike. Perhaps, the independent authorities could explore the possibilities of using MCSAP funding for truck enforcement even though the autonomous authorities are reluctant to accept federal funds. However, these funds may be used by the police agencies.

The State, in cooperation with the authorities, could seek a permanent inspection facility for trucks in the vicinity of the George Washington Bridge. Possible locations could include Route 80 in the Hackensack Meadowlands or the vacant snack bar on the Bayonne extension of the New Jersey Turnpike. Other suitable sites could be identified on the Turnpike as well as at trans-Hudson crossings. Inspections are of increasing importance in finding and eliminating unsafe vehicles from the roadway.

Once word goes forth that the State is ridding its roads of unsafe vehicles, the drivers and the owner operators, as well as some fleets, will take a more positive approach of increasing the maintainance of their equipment. Unsafe vehicles travelling our roads is not a new happening but the public is starting to clamor about truck accidents. Inspections at night and on weekends are needed. Most of the outlaws know when the troopers and other law enforcement people are out inspecting trucks. Word goes forth the minute a scale or an inspection team sets up work. Nevertheless, it is important to put out the checks to assure that everybody is complying with the law. Excessive speed and other moving violations, such as tailgating, are factors in truck accidents.

Based on observations, trucks tailgate too frequently and try to intimidate car drivers. Cars and trucks travelling at the same speed cause panic stopping problems for trucks, due to the truck's longer stopping distance. Steady and concentrated enforcement eliminates speeding, tailgating and other moving violations. Lower speeds for trucks on bridges and in tunnels may be required. Car-truck segregation is ideal but it is not pragmatic in urban areas.

LIMITED MAN POWER AND CVSA

Man power and resources are limited. A way to maximize efforts is for the states to join the Commercial Vehicle Safety Alliance (CVSA). This is an organization that was started by a handful of western states a few years ago to achieve uniform standards and maximum resources. In a short period of time this organization has mushroomed from 5 or 6 western states to 36 states and 6 provinces in Canada. New Jersey joined the national organization last October. CVSA is recognized by the government as an important organization to bring about national uniformity in standards and help achieve a minimum national uniform policy for truck safety. In its memorandum of understanding, the CVSA states its purpose is "to maximize the utilization of commercial vehicle, driver and cargo inspection resources; to avoid duplication of effort; to expand the number of inspections performed on a regional basis; to encourage more uniform inspection criteria; and to minimize delays in schedules incurred by industry inherent to this type of enforcement activity; to advance uniformity in inspections of commercial vehicles and their operators, the CVSA potential

members agree to adopt the minimum CVSA inspection criteria and to consider as violation and require corrections of condition as disclosed by CVSA inspection items.

The success of the CVSA program depends on the acceptance of its inspection decal program. Inspections are made under the terms as outlined by CVSA. Decals when affixed shall remain valid for a period not to exceed three consecutive months. In general, trucks displaying a valid decal will not be subject to reinspection. However, the CVSA agreement does not prevent reinspection of vehicles with valid inspection decals. Each vehicle, whether used singly or in combination, must pass inspection to qualify for a decal. The term "pass inspection" means that no violations of CVSA policies and procedures have been disclosed in the inspection and a CVSA decal is affixed.

CVSA maintains and updates federal regulations and other changes among the states and also recommends and suggests programs to the federal government. It is suggested that the independent authorities join the CVSA. CVSA development should be encouraged as it is the basis of a national inspection program with uniform minimum standards. (16)

TURNPIKE ENFORCEMENT

Last September, the Turnpike in cooperation with the State Police began an enforcement program designed to improve driving habits of commercial vehicle operators on the Turnpike. The Turnpike analysis of motor vehicle accidents in the past seven months identified a trend showing "an alarming rate" of involvement by commercial vehicles. Specifically, the rate of accident involvement is not commensurate with the rate at which commercial vehicles are integrated in the traffic flow. This gap represents the area that give rise to concern among those interested in the safety of Turnpike patrons. Truck accidents have increased 23.5 percent from January - July of 1986 over the same period in 1985. (*per. comm*)

The State Police have initiated a program of selective assignment of patrols in those areas identified as high accident locations. Other criteria that are being considered for assignment include: time of day, day of week, when the highest percentage of accidents are occurring and those causes of factors identified through accident report analysis that occur with the greatest frequency. Specific violations include excessive speed, following too closely, unsafe lane changes, and inattentive driving. In addition to the normal operational patrols on the highway on a rotating shift basis, Commercial Accident Reduction Teams (CART) are being utilized to the fullest extent possible under the new program. The CART patrols operate in marked and unmarked vehicles and employ selective enforcement techniques to pinpoint violators among the commercial vehicle operators and take appropriate enforcement

action. All vehicles are equipped with mobile radar units and troopers will strictly enforce the 55 m.p.h. speed limit. Another facet of the program is the use of State Police weigh teams. These troopers will be on the alert for those trucks exceeding the legal weight limits and thereby causing hazardous conditions to exist in relation to other vehicles with which they share the road. As an adjunct to the selective enforcement task force, troopers supplemented by regular station personnel are conducting frequent commercial vehicle equipment checks in service areas and toll plazas to increase voluntary compliance with self inspection programs and also to apprehend and remove from the roadway those vehicles deemded hazardous by the inspecting trooper. (59)

A review of the CART program on the Turnpike shows an increase in the number of summonses without any decrease in the accident rate. The number of summonses for trucks in a five-month comparable period of pre-CART and CART show an increase from 11,138 to 12,944, or a 16.2 percent. Truck accidents for the same period went from 608 to 749, or a 23.1 percent increase. The review also showed that the increase of summonses in specially targeted areas caused a decrease in accidents in the areas covered by the extra patrol. However, the program was terminated due to staffing problems which resulted in an overall increase in truck accidents. Truck enforcement efforts on the Turnpike need more staff to be effective. The Turnpike recognizes it and has tried to do something about it. CART, which is carried out on State Police "power days" when more troopers are scheduled, is something that happens three days in a trooper work week. Other priorities take precedence over

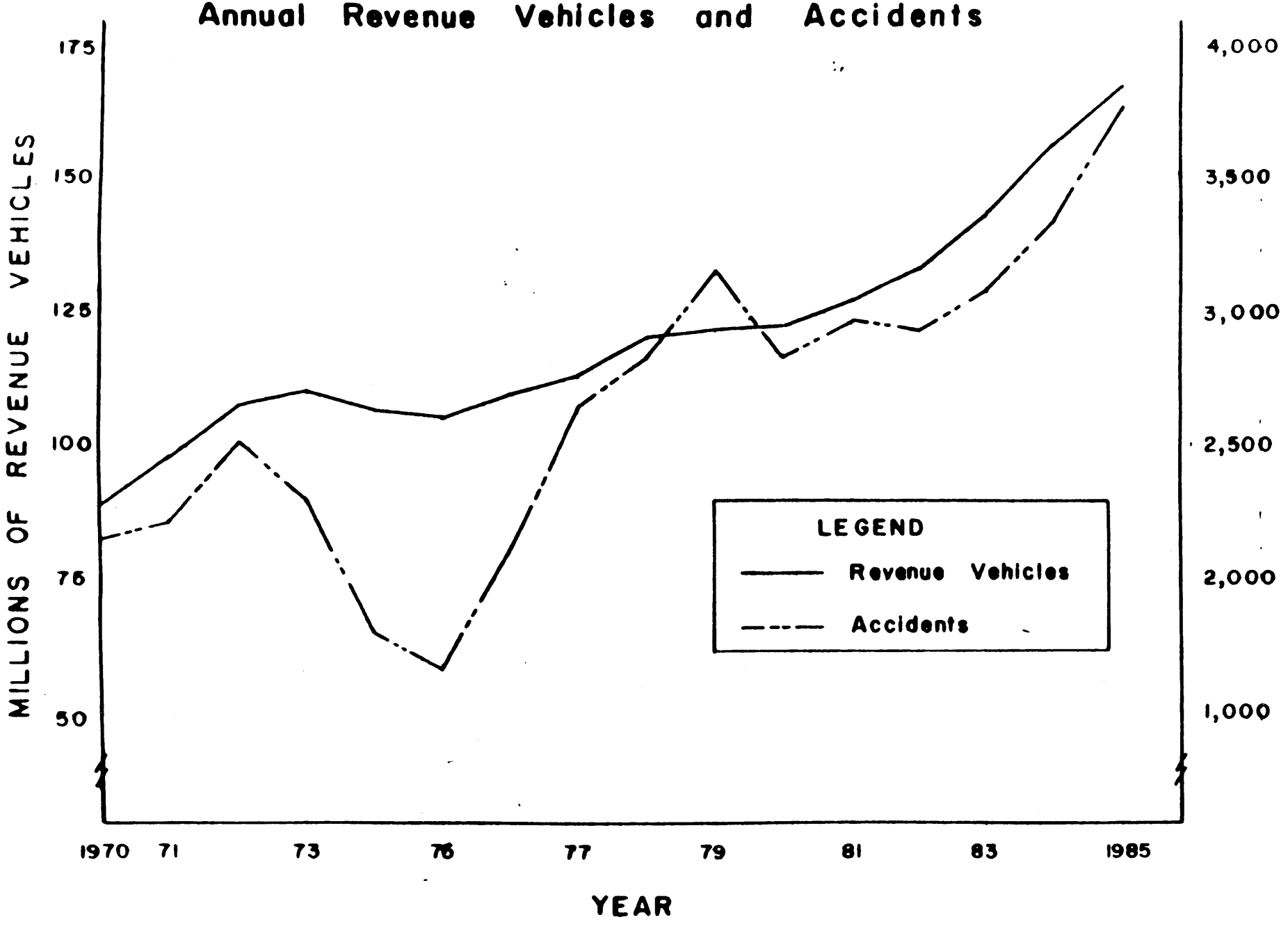
truck enforcement. State police have been averaging about two days a week on truck enforcement. Prior to the CART, the State Police's CVI activities on the Turnpike amounted to two checks a month at each of its three stations. (*per. comm.*)

INCREASED ENFORCEMENT STAFF

Staffing levels have basically stayed the same for the last 15 years even though demands have increased dramatically. In 1970, Turnpike State Police had a total complement of 170 men, including 130 troopers. Traffic volume in 1970 was 89.5 million vehicle miles (see Turnpike Chart II). In 1985, the Troop D complement was the same but the traffic volume rose 86 percent and now is 177 million vehicle miles. The troopers are required to take more seminars, pistol practice and other job related programs, than ever before. The Turnpike has requested 40 more troopers to improve the enforcement level, but it is doubtful that State Police can provide that many at once. The Turnpike as well as the Highway Authority are negotiating with State Police to increase troop levels. Increased manpower is the first step, but it is still going to take time for a new trooper to develop his skills and knowledge, particularly on the toll roads. The Turnpike and Parkway may need more CVI and weigh teams as well as regular patrols.

Staffing problems are also in evidence at the Port Authority crossings. The Port Authority has a total of 34 officers qualified and trained to do hazardous material inspections. There are ten inspectors at the Lincoln Tunnel, eight at the George Washington Bridge, eleven at the Holland Tunnel, and five at the

CHART II



Courtesy of the New Jersey Turnpike Authority

Staten Island Crossings. HAZMAT inspections in 1985 amounted to 37,000 at the Lincoln Tunnel; 26,429 at the Holland Tunnel; 20,288 at the George Washington Bridge; and 15,026 at the Staten Island Crossings. (per. comm.) Qualified and trained weight details amounted to 18 for all trans-Hudson crossings. There are six at the Lincoln, five at the George Washington Bridge, four at the Holland, and three at the Staten Island. Truck weighing is done five days a week at the Holland Tunnel and two days a week at the Lincoln. It is done in a "piece meal" fashion without any consistency at the George Washington Bridge and Staten Island Crossings. In fact, the George Washington Bridge accounted for .02 percent of the total truck weighs at all trans-Hudson crossings even though it has the heaviest truck volume. Truck weighing and enforcement could be improved at the George Washington Bridge and Staten Island Crossings. To improve enforcement, the Port Authority could add additional staff to handle inspections and weighing or it could utilize the task force concept and rotate it at the various crossings.

ASSESSMENT OF DAMAGES

A routine practice on toll road facilities is to charge the driver in an accident or his insurance company for damages. This usually includes cost for clean-up, maintenance personnel, and material plus the time and effort to replace guard rail, light poles, etc. The principle has been in effect for many years at the New Jersey Highway Authority and New Jersey Turnpike Authority. Then a new procedure was established by the Highway Authority as a result of a Conrail derailment on October 13, 1980. The Conrail

work train loaded with stone and gravel derailed and jack-knifed from a bridge onto the Parkway in East Orange. The accident effectively shut the parkway for 17 hours in the northern area. The Highway Authority filed suit against Conrail and it marked the first time that the Authority ever charged for toll loss, wages, and salaries for administration, collectors and police. There were also charges for meal allowances and equipment for personnel. The Turnpike has been using a similar policy since 1982 in suing for damages that include loss of toll revenue and extraordinary labor and police costs. At present the Turnpike has two suits pending where they are seeking "substantial amounts" in salaries and lost revenue. One is a two-day closure in Carteret and the other is a one-day closure of portions of the northern roadway at the start of the Labor Day weekend as a result of an accident. The Turnpike charges salaries of union personnel but not that of management. Its operations department usually estimates the total losses. It may be reasonable for other authorities to adopt similar policies. California has used similar policies to recoup revenue and extraordinary expenses in accidents in that state.

DEVELOPING A REGIONAL APPROACH

Communications and record keeping are paramount in enforcement activities for trucks, drivers, companies and independent owner-operators. The electronic age has provided the capabilities of collecting and storing and analyzing data, while at the same time providing rapid access to it. New Jersey State Police are expected to be on line shortly with "SafetyNet", a national

database designed to gather truck inspection and accident statistics. State Police hope to be hooked into the Federal system by June, 1987. SafetyNet is a database managment system designed to support the Federal Highway Administration's motor carrier safety assistance program (MCSAP). The SafetyNet inspection system -- the first of several automated components -- will allow state and federal participants in MCSAP to manage data collected during safety inspections of interstate and intrastate commercial vehicles. It will function as the premier communication system among agencies. This system will allow the State Police and NJICC members to share information, to monitor trends, to identify problem drivers and repeat violators, and to coordinate their inspection and enforcement programs.

SafetyNet's modular construction using micro computers allows the system to be configured in any of several modes: as a stand alone unit, in a micro network, or linked to a State mainframe. The collection of driver inspection data in a standardized format supports the creation of a national inspection database. The information gathered from SafetyNet will enable states to establish program priorities and to analyze motor carrier trends.

There are still things to be done before SafetyNet reaches its full potential. The top priority will be for the State to tap the federal database, and the next piece to go on line will give the states retrieval capabilities. Future SafetyNet enhancements include capturing data from accidents and safety

management audits. This will enable police to better direct their resources in the enforcement area. It is imperative that the State Police coordinate their activities using the SafetyNet software database with the Port Authority and Turnpike Authority and other independent agencies. This coordination should be done so that all information about truck inspection statistics and accidents are being gathered in one place. In fact, the independent agencies' police should have direct access to SafetyNet. The components of a standard SafetyNet inspection system include the IBM PC-18 micro computer, a printer, Modem, phone set, and Iomega cartridge disc sub-system. The Iomega sub-system allows three months of inspection data to be stored on a single cartridge. The federal government's attempt at SafetyNet culminates a 3-year project to develop an automated inspection system which addresses federal and state informational needs. (*per. comm.*)

The Port Authority has been experimenting with its own computer system at the Holland Tunnel. The computer program is a modem type and it enables the operator to look up trucks by telephone line. It gives ready access to the field of violations or past violations. The Port Authority is planning to use its computer program at other trans-Hudson crossings. The agency has been gathering and collecting information on trucks for some time. Again, this information should be shared with the New Jersey State Police. The State Police should explore with the Port Authority a means of providing access to its computer in Trenton. The Port Authority should consider providing access to its truck enforcement computer and its database. The pooling of information will be vital

to the overall success of truck information databases. The New Jersey State Police should take the lead in establishing on-going communications among all agencies including specific terminal hook-ups for police at independent agencies.

NEW DRIVER REGISTRY

Other efforts are being done by the federal government too. The new improved electronic National Drivers Registry (NDR) moved closer to reality last summer when Transportation Secretary Dole named four states to participate in a pilot program to test the new system. The program, which is scheduled to begin in August 1987, will involve the states of North Dakota, Ohio, Virginia, and Washington. The upgraded NDR, which was mandated by Congress, will reduce the time required for states to exchange information on problem drivers. The NDR has received broad based support from safety advocates. However, the program has come under increasing criticism due to the extensive start-up delays. The electronic system eventually is intended to provide states with instant information on drivers records. The actual records would remain with the participating state agencies under the new system while NDR would expedite inquiries among the states. (*per. comm.*)

THE NEVADA SYSTEM

In place since 1960, the current NDR contains information provided voluntarily by state agencies on drivers whose licenses have been suspended or revoked. However, most states communicate with the register by mail, leading to delays of a week or more

before information on a problem driver is received. The electronic version would enable states to request driver record information from another state in less than ten seconds. If there is a record, the telecommunications system would deliver it in a matter of minutes. Congress will await a report from the federal group before extending it to other states. Nevada already has a multiple drivers license inquiry capability in place. This system was developed to address driver problems when dealing with commercial vehicle safety. The objective was to get immediate and continuous information concerning the drivers license status (that is, is the drivers license valid, suspended, revoked, expired or does the driver have multiple licenses from different states?). The new system was designed for drivers licenses verification within Nevada.

From July 16, 1985 to June 26, 1986 the mobile dispatch center had the following results: 1,581 total driver checks, and 161 had status problems. Of the 161, 98 or 60 percent were suspended or revoked; 57 or 35 percent held multiple license and 5 percent were expired. The federal government also is using as its database the Inlet system. (*State of Nevada pilot project for Inlet System*)

SECTION II

PROCEDURES

DRIVER RELATED ACCIDENTS

A recent study completed by Mandex Inc. entitled "Identification of Preventable Accidents and Their Causes", concluded that the truck driver is responsible for 90 percent of all preventable truck accidents. The study determined that 68 percent of all truck accidents are preventable. This study makes the assumption that truck drivers are professionals and they should be able to compensate for unexpected complications resulting from vehicle failure, erratic behavior of other drivers, roadway problems, or bad weather. While this assumption is logical, it assumes that drivers are properly trained, properly supervised, and do not make mistakes. However, it is clear that this assumption is not always accurate. Accordingly, government and the trucking industry must cooperate to ensure that drivers are professionals and that unprofessional drivers are kept off the road.

Many drivers have multiple licenses, and when stopped in one state present another state's drivers license so that they do not lose their license in that particular state. The multiple license helps spread violations over many states. According to a National Transportation Safety Board investigation of crashed-involved drivers of large trucks, 44 held 63 licenses, had 98 suspensions, were involved in 104 previous crashes, and had 456 traffic convictions. Additionally, only 15 percent of accident involved truck drivers have had any formal commercial driving education. Driver training comes on the job and it isn't suprprising that drivers of big trucks with less than a year

experience are proportionally more involved in crashes compared to drivers with more experience. Part of the cause of the increasing accident rate is probably due to the use of many more less-experienced drivers. Driver fatigue also compounds the problem of unqualified drivers. Federal regulations restrict interstate truck driving to no more than ten hours following 8 consecutive hours off duty. It doesn't apply to intra-state drivers. Driver log books are supposed to ensure compliance. But in practice, the 10 hour driving limitation is ignored. It is too easy for truckers to falsify their log books or carry multiple ones. Some drivers are paid by the mile instead of by the hour -- another encouragement for them to drive too long and too fast. *(30)*

NATIONAL DRIVERS' LICENSE

The states will be getting a powerful new enforcement tool when the national truck drivers license takes effect on July 1, 1987. At that time only one license will be allowed to a driver; violation results in a $2,500 fine. Also, effective July 1, 1987 anyone convicted of a violation of state law shall notify the appropriate home state official and employer within 30 days. One must notify the employer if his license has been suspended or revoked or cancelled in any state. No employer shall knowingly allow, permit, or authorize an employee to operate a commercial motor vehicle in the U.S. if his license has been suspended, revoked or cancelled. Fines and jail terms are among the penalties for violations.

Effective on July 15, 1988, the DOT Secretary shall issue regulations to establish minimum federal standards for testing and ensuring fitness of persons who operate commercial motor vehicles. The requirements shall include written and driving tests and the vehicle must be representative of one that the operator will use. The DOT Secretary may establish different minimum standards for different classes of commercial vehicles. Also, any person shall be tested as to his/her knowledge of the regulations for safe operation of any safety system on the vehicles. Hazardous materials vehicle drivers will require additional testing on knowledge about regulations and handling of hazardous materials. The drivers will be issued a fitness certificate to operate a commercial motor vehicle and the driver must carry that certificate when operating the commercial vehicle. It must be a tamper proof license that contains the name and address and physical description of the person and the social security number or another number that the Secretary of the DOT determines to be appropriate. Also it would contain the class or type of the vehicle being operated by the driver and the name and the state of license and the date when the license expires. Then no later than January 1, 1989 the DOT Secretary shall have established a clearing house or depository for driver information.

The national drivers license establishes firm penalties for violations. Federal disqualification for the period of not less than one year will be established for drunken driving, leaving the scene of an accident, or commission of a felony with a commercial vehicle on first offense. Second offense would mean disqualification for life. Anyone convicted of a felony in

transporting hazardous materials shall be disqualified for three years. The Secretary has power to issue guidelines and conditions for life disqualification which may be reduced to 10 years. The special section of the law enables the DOT Secretary to disqualify a commercial operator for life in transporting hazardous material in violation of the law. Serious traffic violations are also covered in this act. Disqualification for a period of not less than 60 days for each person in a three year period who commits two serious traffic violations. Once a driver is convicted of a third violation, in a three year period, he shall be disqualified for not less than 120 days. The bill also provides for study by the National Academy of Science to determine the appropriateness of reducing the blood alcohol level from 0.10 to 0.04 percent. The Secretary of DOT will formulate and determine what is a serious traffic violation such as speeding, careless driving, tailgating etc. The Secretary will also determine the speed limit for which a violation will take effect, i.e. whether it will be one mile over or ten miles over.

NEW JERSEY TRUCK LICENSE PROCEDURES

Once National Driving Standards are fully implemeted, it will give the states a way of dealing with the multiple drivers license and hopefully remove bad drivers which should enhance safety. In the meantime, there is still much that can be done in New Jersey.

New Jersey should immediately implement the national drivers standards in the State. At present, New Jersey does not

have any commercial vehicle license. New Jersey presently has four licence categories. They are the basic drivers license, the bus license, the articulated license, and the motorcycle license. The only age difference among the licenses is that a bus driver has to be 18 years of age. In all other cases, the driver has to be 17 years of age. The State conducts a screening test involving vision. Vision has to be 20/50 with or without glasses for basic, articulated and cycle license, and 20/40 with or without glasses for bus drivers. The State also gives a written test and asks questions about health./(53) The articulated drivers license is for a person who has a vehicle over 18,000 lbs. gross weight and is joined by a coupling device with a drawn vehicle (trailer). In order to get an articulated license you must be in possession of a basic drivers license. Your license to operate an articulated vehicle is designated by a code or endorsement on the basic license./(51) If you have any restrictions on your drivers license such as wearing glasses while driving, that is also designated on your basic license by the appropriate codes. The articulated license does not necessarily mean a driver is qualified to handle an 18 wheeler. The driver may arrive with a small vehicle that has a trailer in tow, pass his articulated test and get the license which will enable him to drive any type of articulated vehicle, including the 18 wheeler. Additionally, any licensed driver can operate a solid waste or contractors vehicle without any special test or endorsement on his license. Drivers should be given tests and approved to handle any vehicle over 10,000 pounds. New Jersey should enact a commercial license for intra-state drivers for vehicles over 10,000 lbs, with

uniform standards for buses or trucks plus training and testing to determine qualifications.

ALCOHOL ABUSE

New Jersey may want to enact legislation to prohibit a truck driver from driving with any alcohol content in his blood. Drinking should not be tolerated on the job. Driving a truck is a dangerous occupation as it is. Temporary suspension from driving a truck seems to be a reasonable penalty, even for one drink. The ban is being proposed as the federal government studies the appropriateness of lowering the alcohol percent from 0.10 percent to 0.04 percent for truck drivers. Recently, the New Jersey Senate passed a bill prohibiting a driver from operating a truck if his blood alcohol content exceeds 0.04 percent. This bill is currently awaiting action in the Assembly.

SEAT BELT ENFORCEMENT

Attitude is an important and effective tool for safety, and there appears to be a need to enforce seat belt requirements and restraints for trucks. From observations, it appears that too many truckers are ignoring this requirement. Seat belt enforcement could be the initial step in a campaign to emphasize safety among drivers.

Buckling up should serve to remind drivers to be aware of safety and courtesy on the road. The federal government requires that a truck with a seat belt assembly "shall not be driven unless the driver has properly restrained himself."

KEEPING TRACK OF THE DRIVER

Recently, the Insurance Institute for Highway Safety called for all trucks to be equipped with automatic on-board recording devices, contending that hours of service regulations are widely abused by truck drivers, and these abuses result in crashes.[30] A study prepared for the American Automobile Association (AAA) reported that 41 percent of heavy truck crashes involved fatigued drivers, and an estimated 1 out of every 3 drivers on the road drive beyond the 10-hour per day federal limit.[2] Some experts believe that fatal and serious injury crashes can be reduced on roads with the use of automatic recording devices, such as tachographs or electronic systems. These systems which mechanically or electronically record and monitor driver and equipment performance can reduce the chances of falsified, erroneous and inaccurate records as well as the burden of record keeping. The equipment recording devices obtain the following information:

1) Distance travelled by the vehicle
2) Speed of the vehicle
3) Driving time
4) Other periods of work or tendencies at work by the crew and member or members
5) Break from work and daily rest periods

6) Opening the case containing the record sheet

Tachographs, a recording device, have been required and used with success in Europe. They have been used for over 20 years by some hazardous material fleets, including most of the gasoline carriers in this country.

Major American carriers of hazardous waste materials, such as Shell, Exxon, Texaco, Mobil, and Dupont have been using tachographs for two decades. The fleets have routinely used the device for long haul and local delivery. They have found that the devices increase efficiency, reduce speeding, and are valuable for accident reconstruction. Some of these companies also require that independent operators who haul materials under contract have tachograph equipped vehicles. In addition to their other benefits, companies have found that these records are valuable for billing purposes.

Computerized on-board record keeping devices also have become available in the last few years. The Bureau of Motor Carrier Safety recognized the potential benefits of these systems when they granted an exemption from the log keeping requirements for hours of service to Frito-Lay Corporation that installed use of Cadak 300 on board systems. Frito-Lay expected to have 700 log keeping computers in use by the end of last year. Reportedly most drivers are enthusiastic about their new found freedom from paperwork.(30)

The use of on-board recording systems, referred to as "rat boxes" by some truckers, will reduce and in many cases

eliminate the hours of services abuses that contribute to fatigue-related crashes that are now so prevalent. More over these systems will reduce the paperwork requirement of individual drivers, reduce speeding, and result in an increase in productivity. It is suggested that member agencies go on record supporting tachographs and other on-board recording equipment by passing such a resolution and sending it to Washington.

WEIGH-IN-MOTION

New Jersey State Police has a force of 50 men on its weigh teams. They are assigned to eight permanent and portable locations in the state. State Police are in the process of buying 22 sets of portable scales at an estimated cost of $400,000. These will augment scales already on hand and being used around the State by police. The new scales will be the state-of-the-art devices. Stationary weight teams are at I-287, Piscataway; I-295, Salem County; I-78, Warren County; I-80, Morris County; Route 22, Somerset County; Route 206, Bordentown; and Route 17, Mahwah. Other facilities are planned at a cost of 2.5 million dollars per unit. They are at I-95 in Mercer County, I-78 in Somerset County, and a replacement for I-295 in Salem County. State Police and DOT officials are encountering opposition to construction of new weigh stations. As a result, State Police are considering using weigh-in-motion devices, which are the latest state-of-the-art and can detect speeding and overweight trucks. (*per. comm.*)

Weigh-in-motion has been successfully used by police in other states. It takes about a half hour to place a weighing device

in the highway. Once there, the trucks are slowed to a speed of 35 m.p.h. and are "screened" and "weighed" as they travel over the device. Those trucks that appear overweight are then pulled to the side of the road and weighed on a portable scale. Weigh in motion appears to be a sound approach for use by authorities and their enforcement people. The scales cost about $40,000 per unit.

CHANGES IN TRUCK SIZE

The 1982 Federal Law set "new maximum weight limits of at least 80,000 pounds for trucks and an increase in their width from 96 to 102 inches for use on interstate and primary routes in the United States". Twin trailer combinations, typically about 65 feet long, were permitted to use interstate and designated routes in the states. There have been no fatalities in NJ resulting from an accident involving a twin trailer. Nevertheless, large trucks are a concern in that the large difference in mass between a truck and a car results in a higher level of auto driver/passenger fatalities in car/truck accidents.

USE OF PERSONNEL RESOURCES

Reduction of overtime could be a factor that should be considered by State Police and the Port Authority. The Port Authority like any other management would probably like to have control over overtime, which is still the most inexpensive and appropriate method of handling short term increases in work load. The Port Authority is not alone in its concern for overtime. The State of New Jersey could be paying an estimated $2.5 million per

year in overtime as a result of an arbitrators decision. That decision awarding troopers time and a half for overtime after 40 hours is being appealed by the State. Previously, troopers were paid one and a half times overtime after they accumulated 171 hours in a 28-day schedule, which had build in an 11 hour cushion. A concept that could receive consideration is privatization - the use of private security forces to do truck weighs and inspections on a contract basis. This would require some police supervision over the inspecting force for issuing summonses. All other functions could be handled by the private contracting group. In this way, police could be free to do other law enforcement functions.

The Port Authority might be able to use trained and qualified FOAs to do the inspecting and weighing, providing a suitable agreement could be worked out with the unions. This concept would require police supervision. California uses qualified civilian personnel for truck enforcement. They are trained and qualified inspectors who have mechanical knowledge, background and experience and complete a two-week training course. The civilian personnel are better able to perform the inspections because of their mechanical aptitude. The program also is considered to be cost eficient. A uniformed member of the California patrol makes $34,000 a year, while the civilian inspector is paid $27,000 annually. A uniformed trooper is still needed to work with the civilians for the issuance of summonses. (*per. comm.*)

SPEED ISSUES

New Jersey motorists do not need statistical wizards to tell them many truck drivers are among those who flaunt speed laws. A short drive on any toll facility or interstate highway will give ample evidence. The 55-mile speed limit law is under increasing attack in Congress. The Reagan Administration wants to raise the speed limit beyond 55 mph. However, New Jersey Congressman James Howard (D-3rd District) is fighting to preserve the limit. Howard narrowly won retention of the 55-mile limit last fall in the last House showdown.

In a story involving the speed limit, the Sunday Star-Ledger of November 9, 1986 reported that more than half of all drivers in the State are routinely ignoring the law. Despite aggressive safety programs, and unilateral political and professional endorsements of the 55-mile limit, New Jerseyans are driving faster than they have in years and dying for it.

"There is no question that speeding is on its way back up" said State Police superintendent Clinton Pagano. "It is true for the cars and it is true for the trucks which are larger, carrying bigger loads, and going faster. Clearly, speed is directly related to fatalities and it can be a terror situation for the motorist." Pagano echoed merely a universal belief among traffic experts that allowing speed limits of 65 mph really means drivers will go at least 75 mph. Pagano noted studies by the National Safety Council, which show that the probability of fatal accidents doubles between 55 and 65. When evaluating the roles of the vehicle

roadway and driver in the major accidents, the driver was responsible in 72 percent of all highway fatalities. "We have made the highway safe at 70 miles an hour" said Pagano referring to the new interstates "but the lord made people who are only safe at 55 miles an hour." Governor Thomas Kean favors retention of the 55 mile speed limit for New Jersey.

While efforts to raise the speed limit died in the 99th Congress the issue surfaced again in the 100th Congress. The Surface Transportation and Uniform Relocation and Assistance Act of 1987, enacted on April 2, 1987, permits states to raise the speed limit on Interstate routes outside urbanized areas to 65 m.p.h.

Some fleet owners are already gearing up trucks for 62-65 mph and considering tolerance for the governor that could allow 73 mph under certain conditions. (3)

There is a growing need for speed enforcement and with limited manpower a resouceful way to achieve speed enforcement would be a decoy program involving at least four marked cars and two troopers. This would appear to warrant trial demonstration. The cars could be spaced at two mile intervals on the Turnpike or Parkway. Two Troopers would be used in the program, and they would rotate among the cars so that the public could not determine which car is being used. One trooper could rotate among the vehicles while the other trooper issues summonses. This could be a deterrent.

MORE PUBLIC AWARENESS

The need to educate the public about car-truck relationships is evident. It is a necessary step that could be a significant factor in the reduction of car-truck accidents.

The place to start may be the driver manual in the Division of Motor Vehicles which is issued to all applicants seeking a drivers license. The manual should be updated to reflect relationships of trucks cars and vice-versa. Simple facts should be pointed out, i.e. when a car and truck collide, it is usually the car that suffers the most. New drivers should be made aware that truck braking systems require more distance than a car to stop. Driver courtesy, etiquette and common sense should be emphasized not only with relationships to trucks but other drivers as well. The drivers manual should feature a section on defensive driving near trucks and with suggestions and recommendations for safe coexistence of both. Moreover, driver education classes in school should focus on truck-car relationshps and materials should be developed to bring about greater awareness of safety, particularly in light of the fact that trucks are getting bigger and bigger and cars are getting smaller and smaller.

There is also a need for the general public and truck awareness campaign on a regional, state or national level with suggestions, recommendations and tips about driving with trucks.

A campaign of awareness and truck safety could be initiated as a joint effort by members of the Interagency

Coordinating Committee. The campaign would be directed at reducing accidents and "hostile attitudes" among all drivers. This campaign could be a joint effort of the governors of both states. Both could issue proclamations featuring the need and desire of working together for truck safety. The campaign theme could be developed with emphasis on media releases, posters and handouts to patrons using the facilities. Posters could be placed at primary locations in terminals, restaurants, shops, etc.

LEGISLATIVE ISSUES

The author believes that legislation is required to bring about greater truck safety on the State's highways. The author recommends that the State Legislature consider the following proposals:

- Adoption of national truck driver standards;
- Establishment of a commercial license for all truck drivers;
- Banning radar detectors;
- Endorsement of a federal requirement for speed limiting devices on all trucks;
- Amending state laws to require truck tractors to have front wheel brakes in conformance with federal standards, without any grandfather clause;
- Prohibiting any drinking and driving at all for truck drivers under a penalty of loss of license.
- Requiring a fine of $1,000 for owners of tractor trailers whose vehicles' brakes are found to be more than 40 percent out of adjustment (which is the Commercial Vehicle Safety Alliance standard);
- Requiring that intrastate trucks meet the same standards that currently apply to interstate trucks.

SECTION III

TECHNOLOGY

SAFER TRUCKS

For 1979-1980 (Figure 1), Ian S. Jones of the National Highway Safety Institute states that the U.S. large truck accidents were 5.7 percent of the total accidents and 11.8 percent of the fatal accidents. /(31) These figures cannot be compared directly without knowing how "large" trucks are defined in these statistics. Yet there is a belief that truck involvement in accidents is greatly increasing in urban, fastpaced, densely travelled areas. Trucks have to be made more compatible with the remaining traffic mix.

Attention should be directed and efforts should be expended to make trucks safer. Braking ability is one of the key areas to focus on. In Ian Jones' study of "What States Can Do About Truck Safety", he says "...trucks take much longer to stop than cars. The Federal rule requires passenger cars going 60 miles an hour to stop in 216 feet or less on a dry road. Most cars stop more quickly--in as little as 140-150 feet. But a loaded tractor trailer under similar conditions, typically takes 250-300 feet to stop. An empty rig takes about 300-400 feet. A tractor without trailer (or bob tail) can take as much as 500 feet to stop". /(30) There have been no stopping distance requirements for new trucks since the federal rule was set in 1978.

Member agencies should consider a move to support the following:

1. All brakes should include devices that automatically maintain brake adjustment and ensure compatibility;

2. Trucks should have faster brakes, slack adjusters, and disk brakes;

3. Brakes shuld include load devices that automatically adjust the air pressure reaching the brakes;

4. Anti-lock brakes on all new trucks;

5. A task force to bring pressure in Washington for safety requirements for trucks, similar to that done on cars;

6. Increase inspection of truck brakes.

The issue of front wheels brakes was settled by Congress when it enacted the 1986 Commercial Vehicle Act, which required all trucks manufactured since July, 1980 to be equipped with front brakes on 3-axle tractors as of July, 1987. The Congress also gave the National DOT Secretary an option to make the law mandatory by July, 1988. The law change should increase brake efficiency and improve stopping.

FRONT BRAKES

The Congressional action came after frequent demands by safety experts that the front brakes be connected on three axle truck tractors. Last September 19th, the Federal Highway Administration performed a demonstration in East Libby, Ohio that showed trucks with front wheel brakes stopped quicker than those without them. It will cost an estimated $2300 per tractor to have this type of brakes installed. The California Highway Patrol began

enforcing a similar regulation for all trucks four years ago. This was greeted with concern by many truckers. However, since that time there has been little negative talk. New Jersey should adopt a similar statue to California's. It would be stronger than the Federal requirement which would only go back to 1980. The New Jersey statues should not have any grandfather clause. New Jersey should also revise Title 39:3-67, which requires all vehicles manufactured since 1937 to have front brakes connected "except front wheels of three axle truck tractors."

Quoting another section of the Jones report "...random inspection showed that brakes frequently are out of adjustment, too. This can increase stopping distances by 25 percent at high temperature (e.g. city and mountain driving). Unlike the hydraulic brakes on passenger cars the air brakes on trucks produce significant delay between the time the driver hits the brakes and when they are fully activated -- a delay that increases stopping distance even further. Federal rules require full brake application on tractors in 0.45 seconds and on trailers in 0.30 seconds. When these units are connected, compatibility problems can increase the time between pedal and full brake application to more than a second -- as much as 2-1/2 seconds on a triple trailer rig. Incompatibility between tractors and trailers can also produce unbalanced braking and promote wear and fading (loss of braking due to overheating), because it results in isolated brakes on a rig doing the majority of the work." (31)

Truck brakes need adjustment more often than car brakes. The air brake system does not allow the driver to sense that the brakes are out of adjustment. Badly adjusted brakes increase the stopping distance by another 25 to 75 percent. Truck operators with s-cam brakes should have regular brake inspections and carry certificates for their trucks. This would improve safety in the short run.

DISK BRAKES

Automatic slack adjusters have yet to receive acceptance. They take up the slack created during normal wear and tear of the brake shoes, yielding faster braking and shorter stopping distances. In the interim, stepped up police inspection and news releases could be an effective short run counter measure, until regular inspections and/or slack adjusters are mandatory. Disk brakes should be required on all new trucks. Slack adjusters will achieve shorter stopping distances and longer brake life with less frequent and easier maintenance. They will resist fading and, most importantly they are self-adjusting. Load sensing valves adjust the amount of braking force according to the load on each individual axle. Automatic slack adjusters are required to be properly maintained for the load sensing valves to work effectively. They are most effective in reducing stopping distances for empty or partially loaded trucks.

Anti-lock systems have all the benefits of load sensing systems. Additionally, they automatically adjust for braking on wet or icy surfaces while allowing steering control to be maintained at

all levels of braking. They also minimize the potential for jack-knifing.

NEW BRAKE TECHNOLOGY

The United States is still manufacturing trucks with 1950's technology while the Europeans are already addressing all the issues detailed above in their tractor trailers. Regulations are needed to require new trucks to be manufactured with acceptable stopping distances. Anti-lock brakes have been greatly improved and as a result they have shorter stopping distances on wet or slick surfaces while increasing truck stability. Anti-locks are becoming standard equipment on cars and are being increasingly used on trucks in Europe. They should be installed on all new trucks in this country. The federal government and the American Trucking Associations are concerned about brakes. The ATA research monies will go to the Truck-Trailer Brake Research Committee (TTBRC) in its efforts for regulations to improve brake systems. (3)

To achieve better braking performance, New Jersey should consider a statute which requires that brakes be kept in good working order. Tractor trailers that do not meet the Commercial Vehicle Safety Alliance's 40 percent braking standard should be put out of service and the owner or corporation should be fined in excess of $1,000. To assure safer operation, all brakes should include devices that automatically maintain the brake adjustment. The California survey results indicate that big trucks equipped with such adjusters are much less likely to have serious brake defects than trucks without them. Braking must be improved for trucks.

Appended (see Figure 1) is a report prepared by Ian S. Jones on "Truck Air Brakes" which discusses in detail a complete overview of truck air brakes as well as the need for new braking standards in this country.[31] There appears to be much room for improvement in the quality of truck brakes used on U.S. manufactured trucks. The Interagency Coordinating Committee could play a role in developing greater awareness, and alerting officials in Washington of the need for action on truck braking systems.

TIRES

Safety experts voice concern about steering. Most experts believe that all tractor trailers should be equipped with power steering. The steering linkage play allowed in the wheels should be much less than it is today. Tire failure, particularly in the front wheels, is another contributing factor for loss of control of big trucks. Heavy loads with underinflated tires lead to overheating which makes trucks prone to blowouts or fires.

In another area involving tires, the Turnpike has started an investigation to determine whether overinflated radial tires on tractor trailers are causing deep ruts in its roadways. The ruts cause steering problems for truckers themselves and are a hazard to other traffic, according to the Turnpike officials. They have hired two consultants to study the ruts in the truck lanes, which have become more pronounced in the last 12 months. There are actual depressions of pavement failure in the wheel path. The depressions act as a basin for rainwater accumulation which leads to hydroplaning in bad weather. The puddles, or slick surfaces, mean

longer stopping distances for trucks. Additionally, the problem is an economic one in that the road must be resurfaced more often. The ruts seem to be especially bad between Interchanges 7 in Burlington and 8A in Monroe and between Interchanges 11 and 14 in Newark. Those sections will be milled as a stop gap solution. The Turnpike suspects that some truckers overinflate their radial tires to conserve fuel. The steel in the side walls would normally be rounded but it is straightened by overinflation. More pounds per square inch of pressure are put on the pavement. They believe this contributes to the creation of the ruts. [76] Another possibility is that the pavement failure is being caused by overweight trucks. Overweight trucks in the past have caused similar rutting conditions. The Turnpike studies are expected to be completed within three to four months. The American Association of State Highway Transportation Officials (AASHTO) and the Rubber Manufacturers Association are also studying overinflation.

BLIND SPOTS AS A FACTOR IN ACCIDENTS

Truck blind spots contribute accidents, especially sideswipes. An indication of this condition can be obtained in review of the Port Authority statistics for 1984 and 1985 on truck accidents on the George Washington Bridge. The Port Authority reported that 62 percent of the accidents on the George Washington Bridge were sideswipes, angles, and rear end accidents occurring at plazas or after plazas. The New Jersey Turnpike also had a large number of rear end and sideswipe accidents. There were 619 rear end accidents on the Turnpike in 1985 as well as 735 sideswipe accidents

while vehicles were moving straight ahead. The contributing factor for accidents for these types seem to be last minute lane changes where motorists try to make connections or other motorists are not paying attention and simply cut off a truck or a truck cuts them off. These collisions seem to be growing. This trend indicates that there is a need for some type of assitance for the driver of a big truck in particular. The latest state-of-the-art mirror for eliminating blind spots on right turns has been developed by K-10 Enterprises of Mission, Texas. One company, using the innovative "K-10 eyeball" mirror is Lenartz Truck Line of St. Paul, Minnesota. "They are great, and we have had a big reduction in accidents as a result of installing that mirror", said a company safety director who added the mirrors have been put on its fleet of 200 cab-over trucks. "They open up the blind spots for right hand lane changes", said the Lenartz official. The company's accidents had been reduced from 17 to 8 (a 53 percent decrease) with use of the new mirrors. The results would have been even better if all drivers kept the mirrors clean and used them. The only drawback to the mirror is its frame, which juts out, and occasionally has been knocked off or damaged. The company is satisfied, and the mirror has paid for itself. The 10-inch mirror costs $100 including a frame for installation. Other benefits of the mirror are that the driver can see the blind spots on right hand turns and he has a clear view of the right side while backing up. The Convex mirrors are made of a heavy stress plexiglass. The mirrors come in 6", 8", and 10" diameters to fit properly on all size vehicles. Moreover, the mirror maintains its clear image while travelling or vibrating on

rough roads. The Federal Express fleet is now equipped with a back-up safety mirror developed by K-10 to eliminate blind spots.

RADAR COLLISION AVOIDANCE

Another device to help trucks and bus drivers is a collision avoidance radar system which costs about $1,000 per unit. The Rashid radar safety collision avoidance warning system -- which detects an object directly in the path of a vehicle -- is compact and can be installed easily in any truck or bus. After 36 years of development and over one million miles of road testing, the new model was given Federal Communications Commission approval in 1985. Through a series of signal lights and a buzzer, the radar system alerts the driver if a frontal collision is imminent. A 6-inch diameter microwave radar antenna is mounted on the front of the vehicle. It ignores objects on either side, such as stop lights, parked cars, or road signs. When the beam strikes a slower moving or stationary object as high as or higher than the front bumper, the signal is sent through an electrical signal processsor. The signal processor, usually located in the engine compartment, automatically computes the vehicle speed, the distance to the object in its path, the difference in rate of speed between the vehicle and the object, and whether the vehicle or the object is changing speed.

If the vehicle is travelling faster than the object, a signal is sent to the dash-board monitor which lights up to alert the driver. If the driver needs to decelerate, brake or steer clear, the monitor starts to buzz and lights up. Although the device turns on automatically when the ignition key is turned on, it

does not operate until the vehicle attain a speed of 10 miles per hour to allow the driver to park and to maneuver in tight spaces. It does not bother with continuous signals in bumper-to-bumper traffic. This signal processor, equipped with a microprocessor chip, is sensitive enough to discriminate between those objects that pose a safety threat and those that do not. It can also measure density.

The system is not intended to give the driver a safe following distance but to give him a safe braking distance. The Rashid collision radar system is the first and only one approved by the FCC.

LIGHTING ON TRUCKS

Other difficulties in stopping and lane changes are directional signals and brake lights on big trucks. If a car is in a blind spot on the right side of a truck, the driver of the car may not be able to see the flashing directional signal.

Brake lights on trucks do not appear to be adequate. These braking lights are not as prominent as those recently required in the rear windows of cars. It would be an improvement if similar braking light systems could be developed under the rear door of truck trailers. This height is at about the eye level of car drivers.

The University of Michigan Transportation Research Institute (UMTRI) has found there is a difference in incidents of rear end accidents sustained by vans and flat trailers. /(3) Flat

trailers appear to be hit more often. While the UMTRI work does not show cause, the American Trucking Associations believes lighting is a possibility as the UMTRI project involves nighttime accidents. Furthermore, the ATA also reported a study by Vector on the use of reflective tape on trailers. That study showed that such tape placed in a single line along the trailer side and completely around the back could reduce accident rates from 16 to 21 percent during daytime and nighttime operations, respectively.

OTHER TECHNOLOGY

"Superduck" is a device being considered in an effort to eliminate weaving and lane changing to reduce truck accidents at the George Washington Bridge toll plazas./ (13) The Port Authority plans to experiment with the "Superducks", which are round, 36" long flexible delineators that can be epoxied to the pavement. When a truck hits a "superduck", it springs back to its position. It clearly delineates the lane. A difficulty in using this device may be in snow when a plow might jar the delineator out of the ground.

The State of New Jersey and the Highway Authority have had good results with plowable pavement markers. These markers are cut into the pavement and are then held in place by epoxy. The reflective pavement markers clearly delineate the roadway and help improve roadway visibility during rain and bad weather. Recently, the New Jersey DOT installed three types of Stimonite all weather, year-round, snow plowable guidance systems on Route 1 between New Brunswick and Trenton. DOT intends to undertake a six-month evaluation of the three different types.

The pavement marker is an all weather year-round guidance system specifically designed for roads requiring snow removal. This raised, reflective marker can withstand the shock of heavy plows and provides the same seeing advantage found in warmer climates. An experimental demonstration could be conducted to determine the value of pavement markers in reducing accidents in rain or bad weather on Hudson River crossings or on locations on the New Jersey Turnpike.

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FIGURE I
(see page 15)

Truck Air Brakes - Current Standards and Performance

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TRUCK AIR BRAKES - CURRENT STANDARDS AND PERFORMANCE

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ABSTRACT

This paper provides an overview of the problems associated with heavy truck air brakes. Overall truck accident experience is examined, and an assessment made of the effect that improved braking could have on reducing accident frequency. The controversial Federal Motor Vehicle Safety Standard (FMVSS) 121 brake standard is reviewed together with the maintenance and reliability problems that led to its rescission. Current brake technology is discussed and the stopping distances that can be expected from trucks are theoretically and experimentally evaluated. The effect that out-of-adjustment brakes have on these stopping distances is assessed. Finally, improvements that can be expected from new brake technology are reviewed, and the feasibility and practicality of a new brake safety standard discussed in relation to European brake regulations.

FOR MANY YEARS HIGHWAY SAFETY experts have called attention to the need for all motor vehicles to have similar braking capabilities. Under the National Traffic and Motor Vehicle Safety Act of 1966, the National Highway Traffic Safety Administration (NHTSA) was authorized to issue Federal Motor Vehicle Safety Standards (FMVSS). However, a notice of proposed rulemaking for air brake systems on trucks and buses was not issued until June 1970. After a lengthy rulemaking process, FMVSS 121 became effective in March 1975. The final standard required trucks to stop without wheel lockup from 60 mph on a dry road in 293 feet and from 20 mph on a wet road in 60 feet. Three years later, in April 1978, Paccar, Inc. successfully challenged FMVSS 121 on the grounds that it was not a workable standard. The result of Paccar's suit was that stopping distance requirements were effectively eliminated from the air brake standard so that, at present, the only federal truck braking standard with a stopping distance requirement is the Bureau of Motor Carrier Safety (BMCS) in-service regulation. This regulation requires trucks, depending on their configuration, to stop from 20 mph

in 35-40 feet on a dry road. In contrast, FMVSS 105, which is the applicable braking standard for passenger cars and other vehicles with hydraulic brakes, requires passenger cars to stop from 60 mph in 216 feet on a dry road.

The purpose of this paper is to review current truck brake standards in both the U.S. and Europe in relation to the brake performance of heavy trucks in service today. Current brake technology is discussed together with the problems of vehicle stability and control that are associated with emergency braking. Braking performance and vehicle control improvements that can be expected from applying new technology such as load sensing and anti-lock are discussed, and the feasibility of upgrading FMVSS 121 is assessed.

CONTRIBUTION OF TRUCK BRAKES IN ACCIDENTS

To put the problem into perspective, the role of truck braking performance in accidents must be assessed. In 1978, large trucks (10,000 lbs. or greater) were involved in 432,000 accidents, or about 6 percent of the national total (1). In the same year, large trucks contributed 12 percent of the national total of fatal accidents. An overview of the truck accident problem is given in Figure 1 (1). Trucks have a lower overall accident involvement rate per mile than cars, but their fatal accident rate is significantly higher. The overall involvement rate for large trucks in 1978 was 474 per 100 million vehicle miles compared to 825 per 100 million vehicle miles for cars (1). The fatal accident rate for large trucks was 5.3 per hundred million vehicle miles compared to 2.8 for cars. The lower overall involvement rate for trucks is largely due to the large proportion of mileage that they travel on roads with lower than average involvement rates for all vehicles, i.e., interstate, limited access, and toll road systems. However, a recent NHTSA study (2) of toll road traffic showed that the heavy truck accident involvement rate was actually higher than that of passenger cars on a per vehicle mile basis. In other words, on the roads they travel trucks have higher involvement rates than cars.

Although these figures give the magnitude of the truck accident problem, they do not explain what effect improved braking and/or braking with improved vehicle control would have on reducing accident frequency. The types of accidents most likely to be affected would involve loss of control, including jackknifing and trailer swing, and some vehicle-to-vehicle collisions. An analysis of the National Accident Sampling System (NASS) data for 1979-80 (1) shows that trucks are more susceptible to single vehicle loss of control accidents (termed noncollision events) than passenger cars. Table 1 shows the distribution of accident type by first harmful event for the 1979-80 NASS data: 10 percent of truck accidents were single vehicle noncollision events compared to 1.5 percent for cars. This suggests that if the braking and stability of trucks could be improved, many of the single vehicle truck accidents could be avoided. Corresponding

Table 1
Distribution of Accident Type by First Harmful Event*
(Percent of Accidents)
1979-1980 Annual Average

	Passenger Cars	Single-Unit and Combination Trucks
Multiple-Vehicle:		
Collision with another motor vehicle	78.8	75.9
Single-Vehicle:		
Collision with other object	17.0	12.9
Noncollision**	1.5	10.0
Pedestrian and Nonmotorist	2.5	1.2

* First harmful event is the first property-damage or injury producing event that can be determined to have happened in the accident.
** Noncollision includes rollover, overturned, jackknife, etc.
Source: National Accident Sampling System (1979-1980).

figures for fatal truck accidents using 1981 Fatal Accident Reporting System (FARS) data in Table 2 show similar trends. Single vehicle noncollision accidents are twice as frequent among trucks as cars, and they represent 7 percent of all fatal truck accidents compared to 3 percent for passenger cars.

Regarding multivehicle accidents, it can be argued that improved braking is likely to reduce those accidents in which the truck strikes the side or rear of the other vehicle, i.e., intersection collisions, but is less likely to affect the head-on type collision in which the vehicle is struck on the front. Table 3, using 1981 FARS data, gives the direction of impact for the other vehicle in fatal two-vehicle accidents involving trucks: the corresponding figures are also given for cars. Thirty-seven percent of the impacts in two-vehicle fatal truck accidents were to the side or rear of the other vehicle, whereas the corresponding figure for two-vehicle fatal car accidents was 24 percent. This suggests that improving braking performance could reduce two-vehicle truck

Table 2
Characteristics of Single Vehicle Fatal Accidents (1981)
Large Trucks compared to Cars

Accident Type	Trucks N	Trucks %	Cars N	Cars %
Noncollision	308	28	2,238	14
Fixed object	315	28	8,299	51
Nonmotorist	395	35	4,685	29
Other	100	9	928	6
Total	1,118	100	16,150	100

Source: Fatal Accident Reporting System 1981

accidents by as much as 13 percent, which would be an overall reduction of about 8 percent for all truck accidents. Combining this latter figure with the 4 percent from single vehicle accidents suggests that up to 12 percent of crashes could be avoided or reduced in severity by improved truck braking. By comparison, the NHTSA fleet evaluation of FMVSS 121 concluded that 10-20 percent of all large truck crashes are amenable to brake countermeasures (3).

Table 3
Distribution of Damage to the Other Vehicle
in Fatal Two-Vehicle Accidents (1981)

Impact to Other Vehicle	Accidents Involving Trucks N	Accidents Involving Trucks %	Accidents Involving Cars N	Accidents Involving Cars %
Front	1,801	62	9,422	74
Left side	506	17	1,189	9
Right side	364	12	979	8
Rear	225	8	933	7
Unknown	80	3	197	2
Total	2,394	100	12,720	100

Source: Fatal Accident Reporting System 1981.

In addition to reducing accidents through improved stopping distance requirements, FMVSS 121 attempted to improve the directional control of trucks by requiring that wheels not lock during braking. To assess what effect improved control would have on reducing accident frequency, NHTSA's fleet evaluation of FMVSS 121 compared trucks fitted with anti-lock brake systems to those without. The study showed that jackknifing accidents (3) as reported by BMCS (Table 4) were reduced by some 29 percent for 1977 model year vehicles, which was the first full production year for FMVSS 121 prescribed anti-lock brake systems. Jackknifing as a pre-impact event occurs in 4 to 7 percent of the FARS and BMCS data such that the 29 percent decrease in jackknifing would represent about 1.6 percent of all accidents.

Table 4
Summary of Jackknife Accidents
Intercity Use Only

Tractor Model Year	Fatal Involvements (FARS 1976-1978) Percent of All Fatal Accidents	Fatal Involvements (FARS 1976-1978) Rate per 100 Million Vehicle Miles	BMCS-Reported Involvements (1976-1977) Percent of all Fatal Accidents	BMCS-Reported Involvements (1976-1977) Rate per 100 Million Vehicle Miles
1974	3.7	0.225±0.032*	5.5	3.33±0.92*
1975	4.8	0.371±0.045	6.7	5.6 ±2.54
1976	5.0	0.393±0.153	5.4	3.91±3.98
1977	3.7	0.204±0.007	3.9	2.83±0.22

*95% confidence interval.
Source: Campbell and Carsten (3).

A United Kingdom study (4) evaluated the effectiveness of load-sensing valves under in-service conditions. Load-sensing valves are fitted in the truck braking circuit and adjust the brake force to be commensurate with the load carried by the axle to prevent premature lock up during emergency braking. The study found that in 3 to 15 percent of the truck accidents, the truck was unable to stop in time and that a further 10-15 percent of accidents involved trailer swing or jackknifing. The use of load-sensing valves reduced the number of jackknifing

accidents substantially (10.8 percent to 2.2 percent), but it appeared that they might have increased the occurrence of trailer swing and the number of accidents attributable to the vehicle not stopping in time. These increases occurred from a high incidence of the load-sensing valves not functioning correctly because of poor maintenance.

A later study (5) examined the accident frequency of tractor trailers fitted with anti-lock brakes on the tractor compared to units with load-sensing valves. The incidence of jacknifing was 0.4 percent for anti-lock vehicles compared to 2.0 percent for vehicles with load-sensing valves (the latter figure was similar to that achieved in the preceeding study (4) with load-sensing valves). Trailer swing also appeared to be reduced, but crashes where the vehicle failed to stop in time to prevent a collision increased. Collectively, these studies suggest that anti-lock brakes may be more effective in reducing the frequency of jacknifing than load-sensing valves.

Runaway trucks are responsible for another group of accidents that could be reduced by improved braking. In recent years, the probability of a truck running away on a downgrade has increased because the overall effect of fuel efficiency improvements such as radial tires, aerodynamic shields, and reduced friction engines is roughly equivalent to increasing the slope of downgrades by one percent (6). Escape ramps are an obvious countermeasure to runaway trucks; another alternative is to ensure that brakes are functional and properly adjusted. One study of 35 runaway accidents (7) on a severe grade suggested that the probability of improper brake adjustment given a runaway crash was 0.72. In contrast, surveys of heavy trucks in service at this same location yielded a 40 percent probability for improper adjustment of at least one brake on the vehicle. If in an ideal situation, all truck brakes were correctly adjusted, these probabilities imply that the runaway accident rate could be reduced by 47 percent. However, even when the brakes are correctly adjusted the horsepower rating of truck brakes is often insufficient to handle steeper grades. To provide a margin of safety for traveling downhill many vehicle owners install retarders, which are devices fitted to the engine or drive shaft of trucks to provide added deceleration on long down grades. Data collected from Colorado (7), where about 70 percent of vehicles operating on severe grades have retarders, suggest that heavy vehicles without retarders have a crash rate almost three times greater than trucks so equipped.

FEDERAL TRUCK BRAKE REGULATIONS

Motor Vehicle Safety Standards covering air brakes were first considered in October 1967; however, the first notice of proposed rulemaking was not issued for air brake systems on trucks and buses until June 1970. This notice proposed that trucks be able to stop in distances of: 216 feet from 60 mph on a dry road; 435 feet from 60 mph on a wet road; and 54 feet from 20 mph on a wet road. Also, the vehicle would not be

allowed to deviate from a 12 foot traffic lane and wheels not lock above 10 mph. The proposed effective date was January 1, 1972. The final rule was published in February of 1971, with an effective date of January 1, 1973, with the stopping distance requirements amended to: 245 feet from 60 mph on a dry road and 54 feet from 20 mph on a wet road. Both stops required that wheels not lock, but the stopping distance of 435 feet from 60 mph on a wet road had been deleted. Subsequent manufacturers' petitions for reconsideration of the rulemaking delayed the effective date for trailers until January 1, 1975, and trucks and buses until March 1, 1975, and the dry stopping distance was increased to 258 feet from 60 mph. Further amendments in August 1975 resulted in a relaxation of the dry loaded stopping distance requirement to 277 feet from 60 mph until January 1, 1978. (Buses were exempted from these requirements in January 1976.)

In March of 1976, the rule was further relaxed with a loaded and empty dry stopping distance of 293 feet from 60 mph, and a wet stopping distance of 60 feet from 20 mph. Finally, after lengthy opposition, parts of the air brake standard were invalidated in the Ninth Circuit Court of Appeals decision in Paccar, Inc. v. NHTSA in 1978. The court's decision rescinded those sections of FMVSS 121 referring to anti-lock braking. This effectively eliminated the stopping distance requirements from the standard so that at present the only federal truck braking standard with any stopping distance requirement is the Bureau of Motor Carrier Safety (BMCS) in-service regulation. This regulation requires trucks, depending on configuration, to stop from 20 mph in 35-40 feet, which is an effective braking coefficient of 0.38 g; by contrast, FMVSS 105, the brake standard for cars, requires an effective braking coefficient of 0.56 g. Unfortunately, even this regulation is not enforced so that in practical terms there is no stopping distance requirement for heavy trucks.

MAINTENANCE AND RELIABILITY PROBLEMS WITH FMVSS 121 BRAKE SYSTEMS

Although the estimates for reducing accident frequency from improved braking performance are between 10 and 20 percent, NHTSA's evaluation of FMVSS 121 (3) found no convincing evidence that it reduced fatal or injury accident rates. However, accidents involving jackknifing reported in the FARS or BMCS accident files were reduced by 29 percent for 1977 model year trucks. The major reasons cited for the lack of any effect were maintenance and reliability problems in the early anti-lock systems. Analysis of maintenance experience showed that tractors equipped with FMVSS 121 systems had to be serviced at more frequent intervals than those predating the requirement. Truck operators appear to have tried to accomodate anti-lock systems, but the designs were not rugged enough to survive the low level and lack of sophistication of truck maintenance procedures. NHTSA's study (3) noted that 18 months after FMVSS 121 came into effect only 20 percent of the

fleets equipped with anti-lock brakes had appropriate diagnostic equipment and only 15 percent reported that their mechanics had any special training to maintain the anti-lock systems.

A California Highway Patrol survey (8) of heavy trucks found that 17 percent of vehicles equipped with FMVSS 121 anti-lock brakes were out of adjustment beyond manufacturers' tolerances compared to 9 percent of vehicles manufactured before the requirement. However, FMVSS 121 required that vehicles be equipped with brakes on the front wheels, and in practice these brakes were often "backed off" (i.e., they were adjusted so the shoes did not touch the drums) or disconnected. (This is done to help maintain steering control.) Before FMVSS 121 was issued, many heavy trucks were not equipped with front brakes, which could explain some of the differences that were found between trucks manufactured before and after the FMVSS requirements. The survey also found that 22 percent of intermixed tractors and trailers (i.e., one unit with FMVSS 121 brakes, the other without) had to be placed out of service by the California Highway Patrol because of brakes adjusted beyond manufacturers tolerance.

The higher proportion of brakes that were out of adjustment on FMVSS 121 equipped vehicles was most likely the result of the more aggressive, faster-wearing linings fitted to these brakes. Also on trucks with intermixed brake combinations, the faster air transmission to FMVSS 121 brakes cause them to react more quickly than brakes not subject to the standard; consequently, these brakes are over-used and undergo greater wear. These problems could be overcome by retiming the existing equipment using control valves with different response characteristics.

Of the FMVSS 121 brake equipped vehicles in the California Highway Patrol survey, 34 percent had one or more violations relating to anti-lock equipment deficiencies including anti-lock warning devices on dashboards that were rendered inoperative or were covered to avoid driver distraction, corroded terminals, broken electrical connectors, etc.

Clearly, the main reason FMVSS 121 was not successful was the lack of reliability of anti-lock systems stemming from maintenance problems. It is perhaps surprising that there was no provision for an in-service standard to ensure that FMVSS 121 systems were adequately maintained. In fact, in July 1976, the Teamsters Union petitioned the Bureau of Motor Carrier Safety to amend its regulations to include use and maintenance of FMVSS 121 braking systems.

CURRENT BRAKE TECHNOLOGY

Three basic brake systems are currently fitted to heavy trucks (Figure 2). The most common is the S-cam drum brake, which is operated via a push rod from a diaphragm air chamber. The wedge drum brake, which is a development of the S-cam brake, consists of a wedge actuator coupled directly to the diaphragm air chamber; the wedge brake is designed to overcome the out of adjustment problems that occur with the S-cam

brake. The disc brake offers improved braking performance over the drum brake, including better resistance to fade, self-adjustment, and longer service life.

An analysis of the theoretical limits of braking (3) for tractor trailer combinations (equipped with drum brakes) showed that in the absence of load-sensing devices, the maximum braking efficiency* was 75 percent, with the brake force distributed 17 percent on the front wheels of the tractor, 47 percent on the rear tractor wheels, and 36 percent on the rear trailer wheels. The calculation assumed a gross weight of 77,000 lbs., a wet road friction coefficient of 0.2, and dry road friction coefficient of 0.8. The brake distributions were chosen to accomodate both empty and loaded situations. However, many trucks are operated without front brakes on the basis that the risk of the front wheels locking is eliminated and steering control can be maintained at all times. By removing braking from the front wheels of the tractor, the analysis showed that braking efficiency was automatically reduced from 74 percent to about 64 percent. This is typical of on-road situations where efficiencies rarely achieve 60 percent. Thus, on a road with a friction coefficient of 0.8 the maximum deceleration achievable would be 0.48g. To put this in context, the braking distances required under the original FMVSS 121 and subsequent modifications are given in Table 5 together with the decelerations required to meet these stopping distances and the corresponding braking efficiencies for a tire to road friction coefficient of 0.8.. It can be seen that although the original stopping distance requirement of 216 feet is optimistic given current braking systems, the two modifications that were subsequently made to FMVSS 121 are achievable with properly adjusted brake systems in good condition.

Table 5
Braking Efficiencies Required to Meet
FMVSS 121 Stopping Distances on Dry Pavement
with Friction Coefficient of 0.8

FMVSS 121 Status	Stopping Distance	Deceleration	Braking Efficiency for μ=0.8
June 1970	216 feet	0.56g	70
Feb. 1971	245 feet	0.49g	61
March 1976	293 feet	0.41g	51

*Braking efficiency is defined as $a/32.2/\mu$ where a is the deceleration of the vehicle in ft/sec^2 and μ, the tire/roadway friction coefficient.

Experimental evidence to support these braking efficiency figures is provided by the NHTSA brake performance test program (10). Note that anti-lock systems were not used in these tests (half of the wheels of an axle or tandem axle were permitted to lock up; below 20 mph all wheels were allowed to lock up). Indicators were provided in the cab so that test drivers could detect wheel lockup and manually modulate the brakes to maintain steering control. The results of the test program suggested:

- Trucks had little problem meeting FMVSS 121 stopping distances at 20 mph, whether loaded or not, on both wet and dry pavement. Loaded stopping distances were greater than unloaded stopping distances.
- The majority of the trucks tested could not meet the BMCS in-service stopping distances (35-40 feet from 20 mph) without front brakes.
- At 60 mph, a majority of loaded tractor trailers met the 293 foot braking distance requirement, while most straight trucks did not (Figure 3). Unloaded trucks could not meet the 60 mph standard and usually required distances in excess of 400 feet to stop. Bobtails (tractor units without trailers) were the worst vehicles, taking 500 feet to stop from 60 mph.
- The importance of front brakes was established. In the 60 mph test (Figure 4), braking distances were increased by 50-100 feet in the absence of front brakes.
- Front axle limiting valves, which are commonly used, degrade stopping distance (Figure 5); a single axle tractor took 440 feet to stop from 60 mph with automatic limiting valves compared to 355 feet without. Most vehicles were underbraked on the front axle.

The NHTSA brake performance program also included controllability tests to evaluate the effect of front axle braking on control. The tests consisted of braking while following a curve or changing lanes at 35 mph on wet low friction (μ=0.2) and wet high friction (μ=0.6) surfaces. Increasing front brake torque improved performance on curves and during lane changes. The optimum brake distribution for straight line performance was also the optimum for curve and lane change maneuvers.

The tests clearly established that removing the front brakes degrades controllability. Despite this finding, there is still concern about problems of steering pull on split coefficient surfaces (i.e., surfaces where wheels on one side of the vehicle are on a low coefficient surface and the wheels on the other side on a high coefficient surface). NHTSA tests (10) on a split coefficient surface (μ=0.2/0.6) showed that with power steering the steering pull was low regardless of the front brake torque (161 lbs. without front brakes versus 181 lbs. with them). For trucks without power steering the steering pull was much larger (377 lbs. without front brakes versus 725 lbs. with). Note that anti-lock brake systems can overcome these problems by balancing the brake forces on the steered wheels.

An important conclusion that both the NHTSA test program and the previous theoretical analysis suggest, is that if front

brakes are retained, the 293 foot braking distance requirements at 60 mph issued in the March 1976 amendment to FMVSS 121 can be met without anti-lock systems.

To ensure adequate braking performance from current systems, brake adjustment is also extremely important. Most current brake systems are operated using an S-cam via a push rod from a diaphragm air chamber (see Figure 2). Adjustment is more critical than for hydraulic brake systems because the push rod force drops off rapidly once the push rod travel exceeds two inches. Also, as the air brake stroke increases the volume of air required to actuate the brake increases, which increases the application time. Furthermore, air brakes are actuated by a treadle valve with a relatively short stroke that is not affected by brake chamber displacement. Consequently, it is difficult for drivers to sense that their brakes are out of adjustment. To provide some data on how brake adjustment

Table 6
Effect of Adjustment
on Vehicle Stopping Distance

Vehicle	Average Stopping Distance: Fully Adjusted Brakes	Backed-off Brakes	Percent Increase
Test A			
Straight Truck (Single Axle)	219	283	29%
27,500 pounds (GVWR)			
55 mph			
Brake Temperature: <200°F			
Test B			
Tractor-trailer (Twin Axle)	256	319	25%
80,500 pounds (GVWR)			
60 mph			
Brake Temperature: <200°F			
Test C			
Straight Truck (Twin Axle)			
55,000 pounds (10 % overload)			
60 mph			
Brake Temperature —			
150°F	342	458	34%
200°F	351	519	48%
300°F	366	625	71%
400°F	393	692	76%

Source: Radlinski et al. (11).

affects stopping distance. Table 6 gives the results of tests run with brakes set to minimize slack compared to brakes adjusted to the maximum stroke allowable before the brakes should be readjusted (11). For the first two tests, the increases in stopping distance were 29 percent for the straight truck and 25 percent for the tractor trailer. Both these tests were run with brake temperatures of less than 200°F, whereas the third test was run with brake lining temperatures of up to 400°F (temperatures as high as this are not unusual in service and can go higher in city and mountain driving). In the third test, increases in stopping distance as high as 76 percent were recorded. Thus, it is clear that for optimum performance of current S-cam type brakes, the brake stroke must be minimized.

NEW BRAKE TECHNOLOGY

FMVSS 121 required significant upgrading of truck brake technology including: dual air systems, larger air reservoirs, faster application/release timing, bigger brakes and anti-lock systems. It has been argued that FMVSS 121 was not successful because the technology was not available to allow this upgrade. It is important, therefore, to address the issues of whether anti-lock brake systems have improved to the point of being reliable in service and whether realistic stopping distances are achievable with or without them.

Disc brakes are the most obvious advance since FMVSS 121 was first introduced. These systems have been available for some time, yet disc brakes currently have less than 3 percent of the truck brake market (12). The advantages that disc brakes offer include improved stopping distance, longer service life, less frequent and easier maintenance, and resistance to fade.
Moreover, disc brakes are self-adjusting, which produces balanced braking. Early problems with disc brakes in fleet operations involved premature pad wear and rotor failure due to cracking. These conditions resulted from incompatibilities between disc and drum systems such that the discs were doing virtually all the braking. These problems can also occur if the disc brakes specified are undersized.

Compatibility has remained the key issue, and fleet operators who have overcome compatibility problems across their fleets have stayed with disc brakes (12). Improved timing from modifying brake and air system valving, together with automatic slack adjusters on the drum brake systems, have overcome most compatability problems.

Although disc brakes are the preferred choice for balanced braking, existing cam actuated drum brakes can provide adequate performance providing the slack in the system is kept to a minimum. To overcome the problems of brake slack, a number of manufacturers now market automatic slack adjusters although these devices have yet to receive wide acceptance. Automatic slack adjusters minimize the

amount of slack in the push rod/cam system by taking up the slack created during normal wear of the brake shoes. Early models had problems with over adjusting causing the brake to overheat and wear excessively; however, these problems have been overcome.

The effect of automatic adjusters on the incidence of brakes out of adjustment is shown in Table 7, which is based on the results of a 1981 survey by the California Highway Patrol (11). The number of vehicles that had 40 percent or

Table 7
Frequency of Brakes Out of Adjustment
for In-Use Vehicles

Date	Survey Location	Number of Vehicles	Vehicles with One or More Brakes Out of Adjustment**	Vehicles with 40% or More Brakes Out of Adjustment*
1981	California			
	w/o Auto Slacks	94	47%	15%
	w/Auto Slacks	96	42%	9%
1981	Maryland	80	69%	28%

* California Highway Patrol Out-of-Service Criteria
** Not necessarily on all axles
Source: Radlinski et al. (11).

more of their brakes out of adjustment (the percentage at which the highway patrol places a vehicle out of service) was reduced by over one-third although there were still a large percentage of vehicles with at least one brake out of adjustment. (This survey also looked at brake adjustment status by individual axles and concluded that automatic slack adjusters had their biggest effect on trailer and dolly axles reducing the percent out of adjustment from 21 percent to 13 percent.) Figures are also provided in the table for vehicle inspections carried out in the state of Maryland, which does not have the extensive commercial vehicle inspection program of California. The effect is quite evident: The number of vehicles with at least one brake out of adjustment is over 50 percent higher in Maryland and the number of vehicles that would be placed out of service because their brakes were 40 percent out of adjustment is almost double.

Load-sensing valves that adjust the amount of braking force according to the load on the individual axle have been demonstrated to be beneficial providing the adjusters are

adequately maintained (4). Load sensing valves are of greatest benefit for empty or partially loaded trucks because most truck braking systems are set up to provide the most efficient braking to fully loaded trucks. In its brake performance test program, NHTSA demonstrated the benefit of load sensing for empty and partially loaded trucks, particularly for tractors without semitrailers (known as "bobtails"). For example, bobtails without the sensing valves required 520 feet to stop from 60 mph on a dry surface compared to 290 feet with load sensing valves.

Anti-lock systems offer all the benefits of load sensing systems and in addition automatically adjust for braking on split coefficient surfaces and allow steering control to be maintained at all levels of braking.

Unfortunately, anti-lock systems gained a reputation in the United States of being unreliable in service because FMVSS 121 required the truck industry to accept them before they had been adequately tried and tested. However, anti-lock systems in Europe have been developed cautiously, and, as a result, have not gained the unreliable reputation of their U.S. counterparts. For example, there are now proven anti-lock systems (13) that can be retrofitted with minimal interference to the vehicle's standard braking system. The systems are sufficiently flexible that they can be specified for individual axles. For example, to prevent jackknifing, many operators specify anti-lock for the tractor's drive axle and load proportioning for the trailer. Additionally, specifying anti-lock systems for the trailer axle prevents trailer swing and putting them on the tractor's front axle helps maintain steering control.

EUROPEAN TRUCK BRAKE REGULATIONS

Two sets of regulations govern truck brakes in Europe (14): (1) The European Economic Community (EEC) Directives apply to member countries and to any other country exporting to these Common Market countries; (2) The United Nations Economic Commission for Europe (ECE) regulations, which are agreed upon by a committee of member countries such that if a member nation endorses a particular ECE regulation, manufacturers complying with the regulation can export to that country. Individual countries can also set their own standards; however, these usually coincide with the EEC or ECE standards. In summary EEC Directives are the regulations in Common Market countries and ECE regulations cover export to other European countries not necessarily in the Common Market.

There has been a tendency during the development of EEC and ECE braking legislation for each to overtake the other as revisions are made. Thus, the EEC Directive on braking, 71/320, arose from discussions based on ECE Regulation 13. At present, ECE Regulation 13 is more stringent than the current EEC Directive 79/489. The EEC Directive 79/489 requires a mean deceleration of 0.45g, (compared to the 0.38g required in the U.S.), and under all conditions of loading all axles must

achieve an adhesion utilization within a defined band. Also between specified adhesion and deceleration levels, the rear axle must not lock before the front axle. At present this requirement has to be met by using load-sensing valves. Because load-sensing valves rely on suspension position, they are affected by spring setting and need to have their adjustment checked from time to time. Accordingly, the EEC directive calls for information to be marked on the vehicle to enable the valves to be checked in service. Pressure test connections are required to facilitate maintenance and checking while in service. Required reaction times are considerably more stringent than for U.S. trucks; the time between the brake control first being actuated and the last brake reaching service performance must not exceed 0.6 seconds.

Although load sensing is required under EEC directives, and anti-lock brakes must be additional to the basic load-sensing system, the ECE regulations provide fleet owners a choice of either load-sensing or anti-lock brakes. Also some individual countries, e.g. the United Kingdom, allow either load-sensing or an ECE-approved anti-lock system. Truck operators must therefore decide which system to specify. Load-sensing valves are cheaper but can only compensate for load distribution without taking any account of variations in the surface-friction conditions or any imbalance inherent in the brake system. However, because many EEC countries also endorse ECE regulations, truck fleets operating through a number of countries are likely to opt for compliance with ECE regulations.

A recently proposed update to ECE Regulation 13 would mean that the ECE stopping distance requirements exceed those of the EEC Directive 79/489. Currently the main difference between the two standards is the anti-lock provision. The proposed update to ECE regulation 13 would also increase the required deceleration from 0.45g to 0.51g. Together with the existing anti-lock requirement, this regulation would provide Europe with a truck brake standard equivalent to the U.S. FMVSS 121 as it was originally proposed.

A NEW U.S. BRAKE STANDARD

It is clear that truck brake technology could support a standard that would require vastly improved stopping distances. The original FMVSS 121 proved to be unacceptable, not because the stopping requirements could not be met, but because of problems with in-service maintenance of the anti-lock equipment and incompatibility between tractor and trailer brakes. Had the standard remained in effect, there is no doubt that truck brake technology would have improved to meet it. However, one could argue that FMVSS 121 was too large a step for the truck industry to make at one time. A more logical approach would have been to specify improved stopping distances with braking on the front wheels and automatic slack adjusters, then once the industry had caught up, to specify even more stringent stopping distances without wheel lock. The technology for such an approach is

currently available, and it is precisely this approach that has been adopted in Europe.

Theoretical and experimental results show that a 293 foot stopping distance from 60 mph could be met if brakes were required on the front wheels of tractors. Equipping tractors with disc brakes would improve stopping distances to 250 feet or better. Existing truck combinations with drum brakes and brakes on the front wheels should also be capable of meeting a 250 foot stopping distance if they are equipped with automatic slack adjusters. Although braking coefficients of 0.6g on dry pavement and 0.3g on wet pavement are possible for loaded trucks, load-sensing valves or anti-lock brakes are essential to maintain these braking levels for partially loaded or empty trucks.

Some improvement in braking distances can be achieved without using anti-lock or load-sensing systems; however, vehicle stability and control must be considered. This is particularly important now that twin trailer configurations are permitted in all states under federal law. The work reviewed here suggests that maintenance problems of earlier anti-lock systems can be overcome by using systems similar to those developed in Europe that are reliable.

Compatibility problems between pre- and post-standard tractors and trailers could also be overcome by specifying improved timing. One solution would be to require anti-lock systems on the rear wheels of tractor units to prevent lock-up and subsequent jackknifing problems as well as to produce optimal braking efficiency on the tractor. In combination with this, load-sensing valves with slack adjusters could be required for trailers to optimize their braking efficiency under unloaded and loaded conditions. That such systems can work has already been demonstrated in Europe. However, it is quite clear that unless new federal regulations are established requiring these advances in brake technology, heavy trucks with loads of 80,000 lbs or more will continue to operate with brake systems using 1950's technology.

ACKNOWLEDGEMENTS

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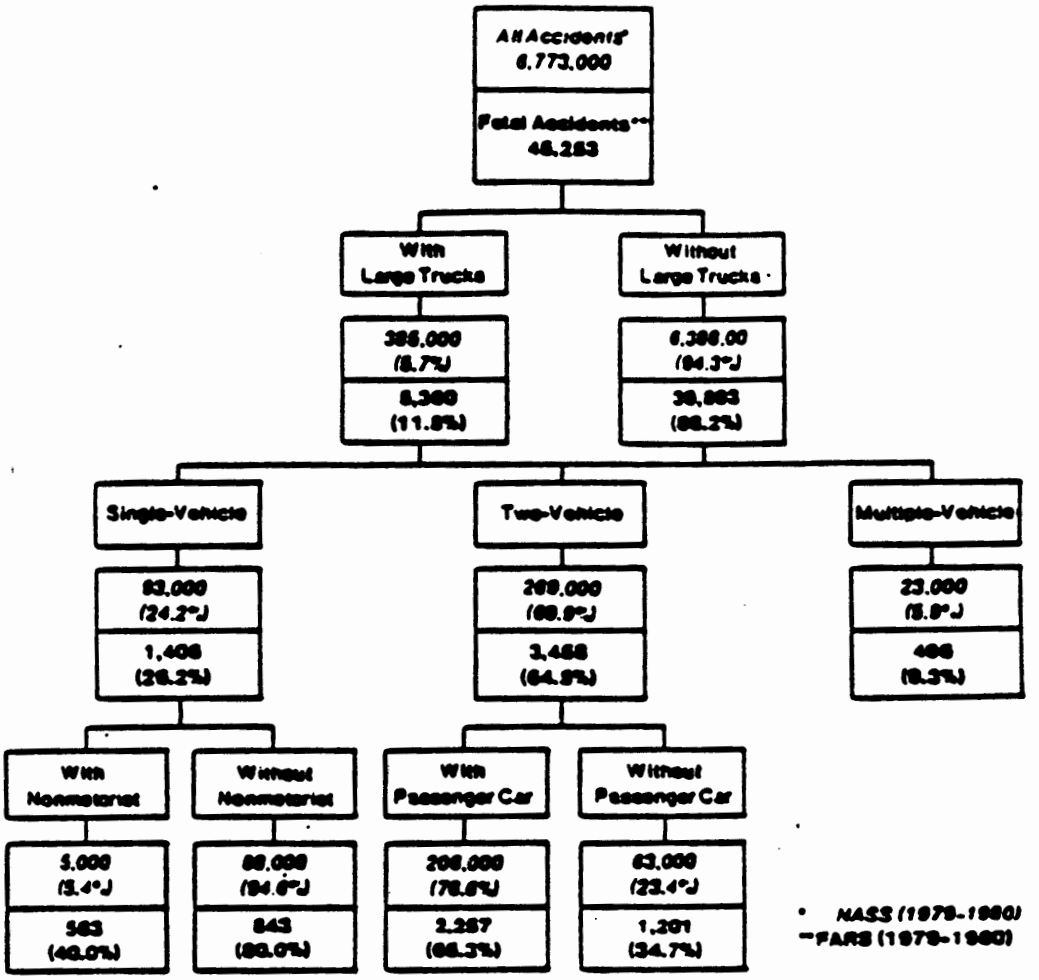
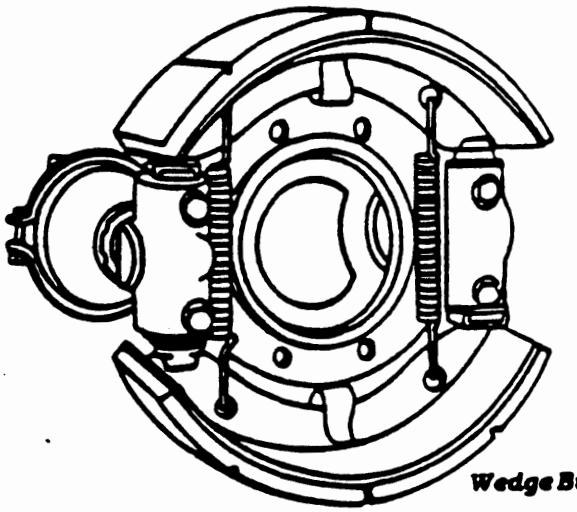
Figure 1 Large-Truck Accident Experience 1979-1980 Annual Average.

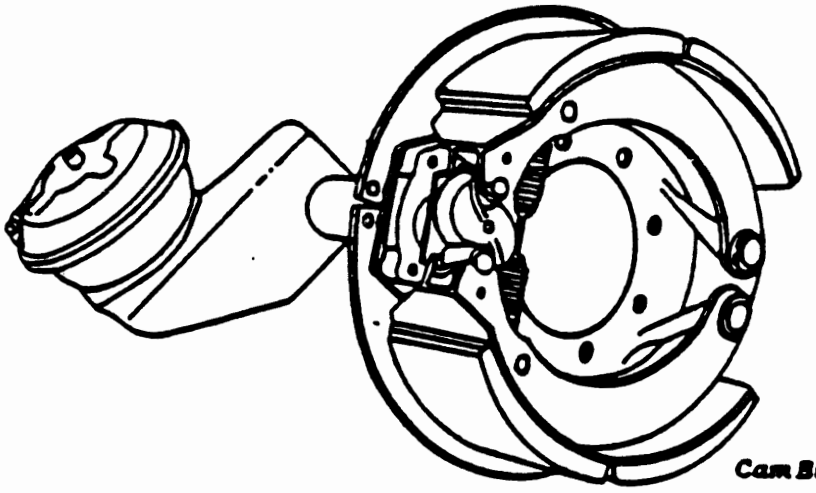


Source: Eicher, J.P et al (1)

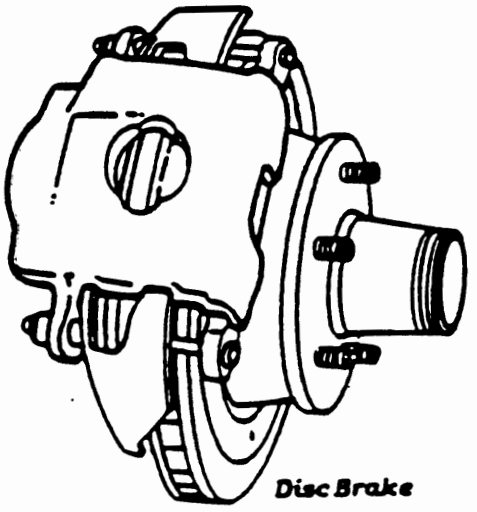
Figure 2 Types of Air Brakes for Heavy Trucks



Wedge Brake

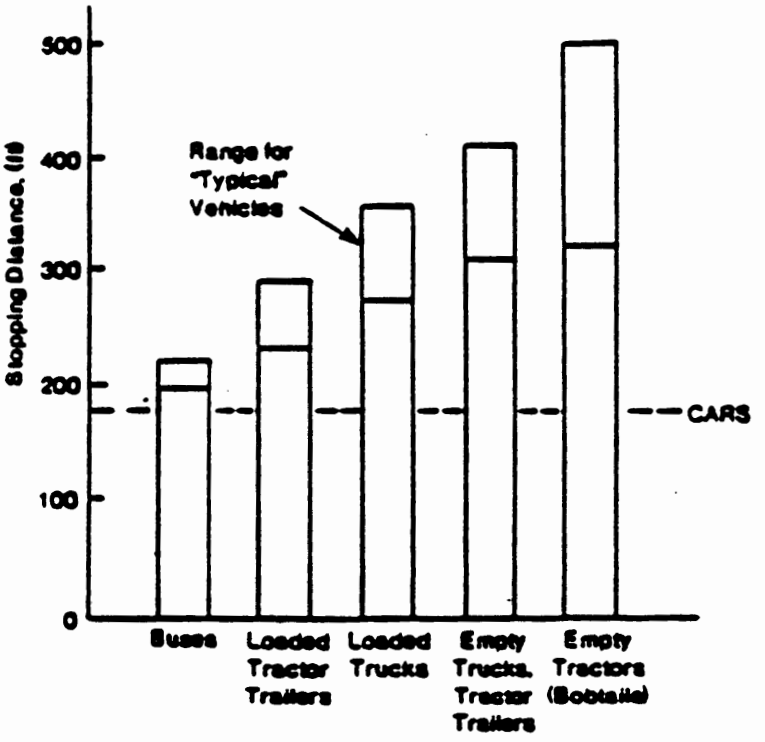


Cam Brake



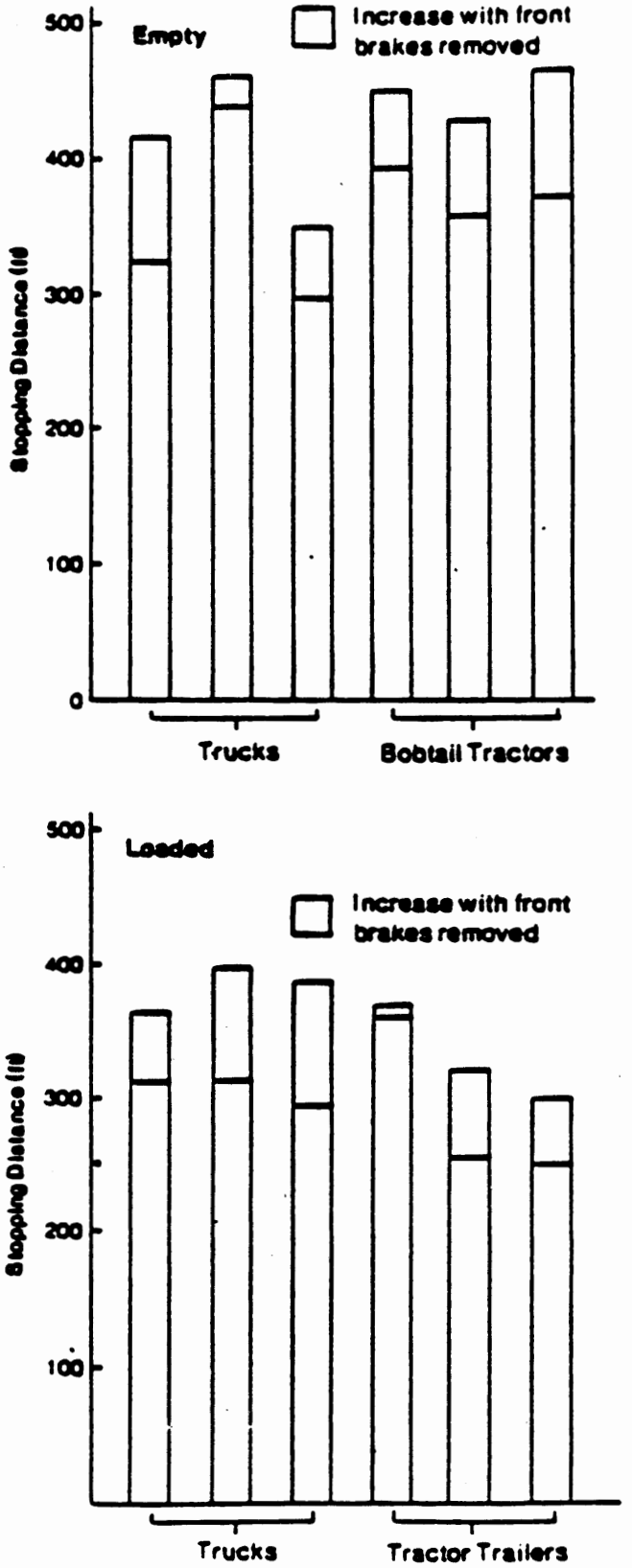
Disc Brake

Figure 3 Stopping Distances by Truck Type and Load: 60 mph on Dry Pavement.



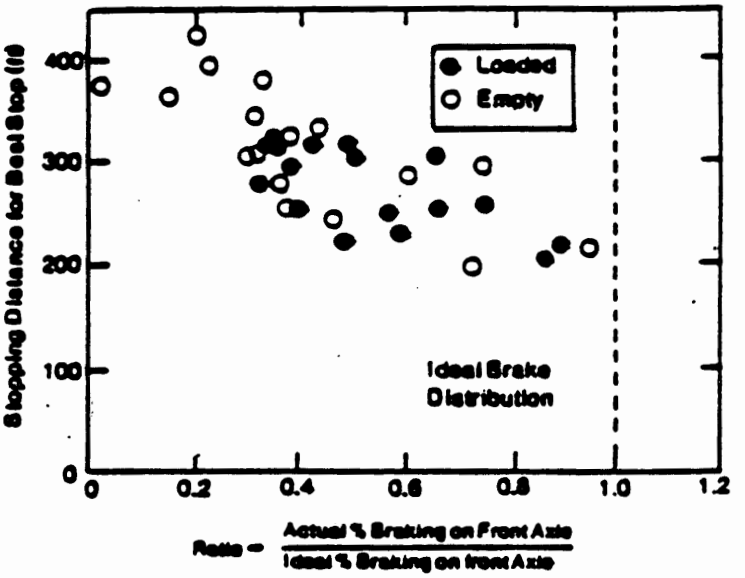
Source: Radlinski, R.W., "A Comparison of United States and European Brake Systems for Heavy Vehicles," Oral only, S.A.E. Government/ Industry Meeting, Washington, D.C. May 1984.

Figure 4 Effect of Front Brakes on Increasing Stopping Distance: 60 mph on Dry Pavement.



Source. NHTSA Docket 83-06 Submission 83-06-N-01-001
Heavy Duty Vehicle Brake Research

Figure 5 Degradation in Stopping Distance As a Function of Percent Braking on the Front Axle; 60 mph on Dry Pavement.



Source: NHTSA Docket 83-06 Submission 83-06-N-01-001 Heavy Duty Vehicle Brake Research