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STATISTICAL DESCRIPTION OF HEAVY TRUCK ACCIDENTS ON REPRESENTATIVE SEGMENTS OF INTERSTATE HIGHWAY

W. F. Hartman, C. A. Davidson, J. T. Foley

Prepared by Sandia Laboratories, Albuquerque, New Mexico 87115
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ON REPRESENTATIVE SEGMENTS OF INTERSTATE HIGHWAY

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ABSTRACT

Any quantitative analysis of the risk of transportation accidents requires the use of many different statistical distributions. Included among these are the types of accidents which occur and the severity of these when they do occur. Several previous studies have derived this type of information for truck traffic over U. S. highways in general; these data are not necessarily applicable for the anticipated LMFBR spent fuel cask routes. This report presents data for highway segments representative of the specific LMFBR cask routes which are anticipated. These data are based upon a detailed record-by-record review of filed reports for accidents which occurred along the specified route segments.

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2

CONTENTS

	<u>Page</u>
Introduction	7
Representative Route Segments	8
I-80 Segments	10
I-70 Segments	10
FAP Mountainous	11
Traffic Volume Data	12
Accident Rates	12
I-80	12
I-70	12
Probabilities of Various Types of Truck Accidents	13
Velocity Distributions of Truck Accidents	22
Miscellaneous Data and Data Comparisons	31
Use of Data	39
Summary	42
References	43
Appendix	45

•

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TABLES

<u>Table</u>	<u>Page</u>
I Number of Truck/Semi-Trailer Accidents and Daily Truck Volume on Selected Colorado Highways	14
II Accident Rates for Vehicles Similar to Those Used for Transport of LMFBR Casks for Different Types of Representative Roadway	15
III-A Accident Statistics for Tractor/Semi-Trailer Accidents Occurring on Flat, Straight Segments of Interstate (Segment 1 - I-70 East of Denver)	17
III-B Accident Statistics for Tractor/Semi-Trailer Accidents Occurring on Hilly Segments of Interstate Highway with Sweeping Curves (Segment 2 - I-80 in Northern Utah)	18
III-C Accident Statistics for Tractor/Semi-Trailer Accidents Occurring on Mountainous Segments of Interstate Highway (Segment 3 - I-70 West of Denver)	19
III-D Accident Statistics for Tractor/Semi-Trailer Accidents Occurring on Urban Segments of Interstate Highway (Segment 4 - Urban Denver)	20
III-E Accident Statistics for Tractor/Semi-Trailer Accident Occurring on Mountainous Segments of Federal Aid Primary (FAP) Highway (Segment 5, Colorado)	21
IV Velocity and Weight Distributions for Collision Accidents with Other Vehicles	23-25
V Velocities for On-Road Collisions with Non-Vehicles	26
VI Listing of Accidents Involving OvertURNS on Road (Accidents in Which Trailer Does Not Leave Roadbed)	27
VII Velocity Distributions, Trailer Damage, and Impacted Objects for Accidents Caused by the Tractor-Trailer Leaving the Road (ran-off-road Accidents)	28-30
VIII Listing of Pertinent Data for Accidents in This Sample Which Involved Fire	32
IX Percent of Accidents Occurring During Inclement Driving Conditions	33
X Probabilities of Having Various Types of Accidents on I-80 in Utah, as Determined from Accident Records, Compared with Those Predicted from Detailed Survey	35
XI Approximate Distribution of Embankment Slopes and Hardnesses Along I-80 Segment in Northern Utah	36

Tables (Continued)

<u>Table</u>	<u>Page</u>
XII Very Approximate Distribution of the Normal Component of the Velocity of Impact of Truck, V_N , upon Roadside Embankments if Truck Leaves Roadbed	36
XIII Comparison of Accident Type Distributions from SLA-74-0001, and Utah and Colorado Data	37
XIV Comparison of Collision Geometry Distributions for the Several Data Sources	38

STATISTICAL DESCRIPTION OF HEAVY TRUCK ACCIDENTS ON REPRESENTATIVE SEGMENTS OF INTERSTATE HIGHWAY

Introduction

This report discusses the frequency, types of occurrences, and severities of highway accidents which involve tractor-trailer combinations or similar heavy transport highway vehicles. The numbers which are presented may be, by themselves, somewhat interesting but their major significance is that they provide one essential component in the calculation of the risk of transporting radioactive material.

With respect to the highway shipment of LMFBR fuel casks, this effort has relevance in two distinctly different aspects.

1. It is required to permit the construction of an environmental impact statement, and
2. It can lead to a better definition of the highway accident environment anticipated for LMFBR spent fuel shipments than that which presently exists. Through this definition, it may be possible to specify a more appropriate set of cask design criteria to insure that a cask is being designed to protect against those environments which are actually experienced in highway accidents.

There are, of course, alternative methods of accomplishing both of these objectives. The recently published report on transportation accident severity, (Ref. 1), describes the general highway accident environments. Reference 1, however, lumps travel over all types of road systems (interstate, primary, secondary, etc.) into one general statistical conglomerate--casks will, generally, be transported via the interstate highway system and the use of these general accident statistics is probably inappropriate. This conclusion is substantiated by a prior analysis of truck accident involvements conducted by the University of Michigan Highway Safety Research Institute² for the National Highway Traffic Safety Administration.

Addressing the second objective, standard tests³ to qualify transport packages are presently in existence. While packages qualified by these tests have been satisfactory for general coverage of accident environments, these same tests, however, may not provide an accurate description of probable accidents for IMFBR or other large casks. It is quite possible that these standard tests are more severe than can be justified for controlled shipments on interstate highways and that cask designs employing these standards may possibly have their design criteria dominated by unrealistic requirements.

This report deals only with the type of environment experienced by the truck and not that which will be seen by the cask itself; the former is a necessary part of but does not, by itself, define the latter. As an example of how the environment experienced by the cask can be predicted from a description of the truck accident, consider the situation in which the truck leaves the road and impacts into a steep embankment alongside the road. Assume that accident rates, distributions of the various types of events and their velocity distributions, and the probabilities of impacting various objects if the truck leaves the road are known. It is then possible to infer how frequently a truck might hit the embankment and the velocity of the impact. The environment experienced by the cask can be predicted as a function of truck impact velocity and the properties of the embankment by analytical (spring-mass) modeling of the impact process. The cask environment can be significantly different from that of the truck itself--in some accidents the cask will stay on the vehicle and see a relatively benign shock loading; in other events, it may break loose and suffer a severe impact. In either eventuality, these techniques offer the possibility of predicting what types of environment the cask will encounter, how frequently they can be expected, and their potential severity.

Representative Route Segments

Studying the potential highway routes for the shipment of IMFBR spent fuel rapidly leads to the conclusion that completely surveying and analyzing each of these routes individually is both economically and technically impractical and that some generalization is required. In keeping with this perspective, five different route segments were selected for detailed study with the anticipation that each

actual route can be subdivided into regions of which these five segments are typical. The type of segments which were defined and which appear to be logical routes for LMFBR shipments were:

1. Flat and straight interstate similar to that over a large portion of the western and mid-western U.S.
2. Wide sweeping curves and hilly interstate highway which is characteristic of much of the U.S. from the Mississippi River eastward and also descriptive of a large part of the mountainous west.
3. Mountainous segments of interstate such as encountered in going over mountain passes; these constitute a very small percentage of the total interstate system.
4. Interstate routes through urban or highly populated areas. The urban descriptions presented here are applicable when the traffic volume over the segment is above about 20,000 vehicles per day.
5. A noncontrolled access FAP (Federal aid primary) segment in heavily mountainous terrain. This segment represents the type of road which might be employed to bypass tunnels on mountainous interstate through which transport of hazardous materials is prohibited.

To pick the actual segments to be subjected to the detailed study, likely LMFBR shipping routes were determined from specified origination and destination points--Hanford, Washington, and Columbia, South Carolina, respectively--which are assumed locations for a breeder reactor and a spent fuel reprocessing plant. The primary route between the two points was established on the advice of trucking companies and state and local highway officials to the effect that future interstate shipments of hazardous materials and shipments that might be overweight and oversize would most likely be restricted to travel on interstate highways. On this basis, a series of interstate highways was selected which resulted in the minimum number of miles traveled between these points (see map, Ref. 4). Alternate routes (also on interstate) were selected to permit routing to avoid inclement weather (primarily snow and ice).

Highway departments of the states lying on the primary route were then contacted concerning the availability of truck accident data, truck traffic volume data, and the availability of detailed road maps. With the primary and alternate route network so identified and by consideration of availability of the requisite accident data and the representativeness of particular candidate sections of highway, route segments of I-80 near Ogden, Utah, and I-70 adjacent to Denver, Colorado, were selected.

Consideration of the use of these data to the many potential LMFBR shipping routes lead to the inevitable question regarding the consistency of accident involvement rates over different, but similar, interstate segments. The data reported in Ref. 2, which considered the Indiana, Ohio, and Pennsylvania Turnpikes, indicated a variation in truck involvement rates of less than 10 percent from the average. This order of possible error is certainly acceptable for the estimates to be considered here.

I-80 Segments

This portion of interstate, running east from Ogden on 80N to Echo Junction and continuing on I-80 to the Wyoming state line is representative of hilly terrain (type 2 above). Accident records for all 1975 heavy truck accidents--including both property damage (\$200 or more) and personal injury events--were secured. During 1975 there were 16 heavy truck accidents over the road segment of interest; the accident rates were based on this figure. As this sample size was insufficient to permit reasonable estimates of the relative occurrence frequencies of the various types of accidents (collisions, ran-off-road, fires, etc.) to be made, the data sample was expanded to consider accidents on similar segments of Utah interstate. In all, 72 individual accidents were considered for the Utah portion of the study.

I-70 Segments

There are three portions of I-70 of interest: I-70 east of Denver to Limon (type 1), I-70 west of Denver to Silverthorne (type 3), and the heavily traveled portion of I-70 in urban Denver (type 4). In addition, the bypass around the Eisenhower tunnel (US-6) was chosen to represent type 5 road.

Unfortunately, it was necessary to utilize an accident definition for the Colorado accidents which considered only those accidents in which injuries occurred--it is only for injury accidents that the desired sorting of the 104,000 accident records could be accomplished. The alternative to the use of machine sorting of the accident records would be a hand search of these records to determine those in which heavy trucks were involved and this was deemed inefficacious. Therefore, the accident rates for Utah and Colorado could be compared only by factoring in the ratio of injury accidents to all accidents. Of even greater concern is the inability to relate severity distribution data; accidents in which injury occurs are generally more severe than those which involve only vehicle damage. While this definition discrepancy is unfortunate and undoubtedly can result in confusion, the resulting answers are proper if consistency is maintained--i.e., if the severities are mated only with the accident rates applicable to those severities. To state this last thought in another manner, a proper definition will result for each of the five highway segment types only if the accident rate for a particular segment is used with the severity data for that segment.

When accident severity and types of accidents for the Colorado interstate segments are considered, the same insufficient data problem arises as was noted for I-80 in Utah. The same solution (complementing these data by accident information from similar highway segments) was employed here as was done for Utah data.

FAP (Mountainous)

This section of highway US-6 around the Eisenhower tunnel presented a special problem as there were no injury accidents reported in either 1974 or 1975*. Here it is necessary to expand the "similarity" argument to deduce an accident rate in addition to the severity and type categorization as was done previously. The highway segments chosen as similar to the US-6 bypass were:

1. Highway 6, Vail to Frisco
2. Highway 6, Glenwood Springs to Eagle
3. Highway 50, Montrose to Canon City
4. Highway 40, Empire to Kremmling
5. Highway 550, Durango to Silverton

*Based upon the distance, the traffic volume, and the accident rate derived here, none would have been anticipated.

Traffic Volume Data

Both Utah and Colorado Departments of Highways publish analyses of traffic volume over all highway segments within the state.^{5,6} In both instances, the traffic volumes are subdivided in a manner to permit actual volumes of heavy truck usage to be determined. Use of these volumes permits the determination of the truck mileage corresponding to the number of accidents which occurred over a particular segment. Colorado publishes their survey results biannually; therefore, the accident rate was based upon the number of accidents in 1975 and a mileage figure resulting from extrapolation of 1972 and 1974 figures. This extrapolation indicated an increase in usage on these interstate segments about 6 percent greater than the 1974 measurements. This 6 percent predicted increase for 1975 traffic volume over the 1974 data was used for the I-70 segment west of Denver, although comparison of the 1972-1974 data showed a much larger increase, probably because of the opening of the Eisenhower tunnel. For the mountainous FAP routes, the route usage data for 1972 and 1974 were essentially similar so the 1974 figures were used without correction.

Accident Rates

I-80

Over this section, there were 16 accidents in 1975 and an average daily heavy truck volume of 69407 truck miles. The accident rate is therefore $16/(365 \times 69407)$ or 6.3×10^{-7} accidents per truck mile. As no truck-truck accidents were present among these 16 accidents, this rate is identical to the involvement rate discussed in Ref. 2.

I-70

For the Colorado data, computer listings were obtained for both 1974 and 1975 truck injury accidents; it was only the 1975 accidents for which the individual records were reviewed to insure that the accidents were properly identified and categorized.* The number of accidents, the volume figures as discussed previously, and the resulting accident rates are shown in Table I.

*For the 1974 data, the individual records were not reviewed so proper categorization on the listing cannot be guaranteed; the 1975 rates were based upon extrapolation of 1974 volume figures.

Table I - To achieve what was felt to be the most representative rate figure, the 1974 and 1975 Colorado rates were averaged. Despite the different definitions, it is possible to compare them with the Utah data by noting that, in the latest available compilations (1973 and 1974)^{7,8}, about 31 percent of the tractor-trailer accidents which occurred statewide in Colorado involved injury*. These data all appear in Table II.

Table II - These data indicate, as would be expected, that the accident rates over the mountainous segments are the highest of the five rates, the urban rate follows, and segments 1 and 2 are lowest. The fact that segment 2 has a rate only one-half that of segment 1 is somewhat disturbing, but it can be attributed at least partially to traffic volume differences. On I-70 in eastern Colorado, the volume is about 5000 vehicles a day compared to the 3500 per day volume on the I-80 segment in Utah.

For the Colorado data (as was also true for the Utah information), the rates based upon the number of accidents involving trucks (the accident rate) or the number of trucks involved in accidents (the 'involvement' rate) are essentially identical. Only one event in the data sample (a segment 5 accident) involved two trucks. In this case, the involvement rate would be 4 percent higher than the presented accident rate, and for all other categories they are identical.

It is worth reiterating that the injury accident rates must be used for calculations relating to type 1, 3, 4 and 5 segments as the severity distributions are based upon the condition that an injury accident has occurred.

Probabilities of Various Types of Truck Accidents

This section relates the frequency of the various types of accidents in the basic categories of--

*For the Ref. 2 data, the average ratio of injury or fatality accidents to all accidents is .38.

TABLE I

Number of Truck/Semi-Trailer Accidents and
Daily Truck Volume on Selected Colorado Highways

Segment Category	Highway	Number of Injury Accidents		Daily Tractor Trailer Volume (truck miles)	
		<u>1974</u>	<u>1975</u>	<u>1974</u>	<u>1975</u>
1	I-70 east of Denver	9	8	68212	72304
3	I-70 west of Denver	16	11	25301	26819
4	I-70 in Denver	13	10	35647	37786
5	FAP moun- tainous sections		27		45779

TABLE II

Accident Rates for Vehicles
Similar to Those Used for Transport of LMFBR Casks
for Different Types of Representative Roadway

<u>Segment Category</u>	<u>Type of Terrain and Highway</u>	<u>Injury Accidents per Truck Mile</u>	<u>Truck Accidents per Truck Mile</u>
1	Flat, straight (interstate)	3.3×10^{-7}	$1.1 \times 10^{-6*}$
2	Gentle hills and curves (inter- state)	$2.1 \times 10^{-7*}$	6.3×10^{-7}
3	Mountainous (interstate)	1.4×10^{-6}	$4.5 \times 10^{-6*}$
4	Urban (interstate)	8.7×10^{-7}	$2.8 \times 10^{-6*}$
5	Mountainous (FAP)	1.6×10^{-6}	$5.2 \times 10^{-6*}$

*Based upon .31 ratio of injury or fatality accidents to total number of truck accidents.

1. Collision with another vehicle,
2. Ran off the road,
3. Collision with non-vehicles,
4. Overturns in road, and
5. Miscellaneous types of events

These five basic accident types are then further subdivided to provide a description of the environments resulting from this type of accident. As mentioned previously, the number of accidents which occurred over the specific segments was insufficient to establish a completely satisfactory data base for these distributions and these data were supplemented by accidents which took place on similar sections of highway in the same general locality. Even with these additions, the data sample is insufficient to be statistically significant so that the results presented here should be considered only as a reasonable estimate of the descriptions of truck accidents.

In accidents which involved the truck leaving the roadbed, a subjective judgment was made of what subsequent occurrence constituted the most serious threat to the trailer. Of the types of accidents described under this heading, those impacts with posts and guardrails are probably the least threatening to a cask while those with "stout" structures are of greatest concern. In this context, a "stout" structure implies a rather massive, hard structure such as a tunnel face, a large concrete bridge pillar or abutment, a snow plow, etc. For those accidents in which the trailer rolled down an embankment, there were no accidents in which the vehicle encountered a sheer drop in excess of five feet.

In collisions with other vehicles, the only truck-truck collisions of consequence are those shown in Table III-A. As an example to clarify the use of Tables III-A through III-E, 63 percent of the accidents in Table III-E involved collisions with another vehicle. Thirty-five percent of these collisions or 22 percent of the total number of accidents were head-on collisions: 17 percent of the head-on collision accidents with other vehicles resulted in overturning of the trailer and an equal group (17 percent of the head-on collisions) involved a head-on collision with a similarly sized heavy truck. This same procedure is employed throughout Table III, the percentages in the right-hand columns are the percentages of the particular type of accident event P_C or P_I (e.g., head-on collision, impact with "stout" structure, etc.) in which the trailer overturned, the tractor-trailer rig left the roadbed, etc.

TABLE III-A

Accident Statistics for Tractor/Semi-Trailer Accidents Occurring on Flat, Straight
Segments of Interstate (Segment 1 - I-70 East of Denver)

Type of Accident	Percent of Accidents of This Type	Supplementary Data			
		Type of Collision	Percentage of Collisions of This Type (P_C)	Percent of P_C in Which Trailer Overturned	Remarks
Collisions With Other Vehicles	55	Head-on	17	50	In 13 percent of rear-end accidents trailer left road.
		Rear-end	58	13	
		Side-on or side-swipe	25	33	
Collisions With Non-Vehicles	9	All of these involved trivial impacts, although the trailer overturned in 50 percent of these accidents.			
Tractor-Trailer Ran Off Roadbed	36	Most Severe Impact Environment Experienced by Trailer		Percentage (P_I)	Other Environments
		Hit ditch, median, soft hillside		61	In 80 percent of these, trailers overturned.
		Hit "stout" structure (bridge railing)		13	100 Percent followed by fires; no overturns.
		Hit posts, guardrail		13	100 Percent overturns.
		Rolled down embankment		13	100 Percent overturns.
Overturns on Road	0				
Fire		Fire occurred in 5 percent of the accidents on Segment 1.			

TABLE III-B

Accident Statistics for Tractor/Semi-Trailer Accidents Occurring on Hilly Segments of
Interstate Highway with Sweeping Curves (Segment 2 - I-80 in Northern Utah)

Type of Accident	Percent of Accidents of This Type	Supplementary Data			
		Type of Collision	Percentage of Collisions of This Type (P_C)	Percent of P_C in Which Trailer Overturned	Percent of P_C in Which Truck Left Road
Collisions with Other Vehicles	47	Head-on	9	33	33
		Rear-end	38	15	15
		Side-on or sideswipe	53	0	0
		Object Struck	Percentage of Collisions of This Type (P_C)	Percent of P_C in Which Trailer Overturned	
Collisions with Non-Vehicles	7	Animals	40		0
		Trivial	60		0
		Most Severe Impact Environment Experienced by Trailer	Percentage of Accidents Which Had Impact of This Type (P_I)	Percentage of P_I in Which Trailer Overturned	Remarks
Truck Ran Off Road	38	Hit ditch, median, soft hillside	37	10	33 Percent of these involved fire.
		Hit "stout" structure (bridge)	7	0	
		Hit posts, guardrails	30	43	
		Rolled down embankment	4	100	
		Inconsequential impacts	22	67	
Overturns on Road	4	In 33 percent of these accidents, the trailer struck guardrails after overturning.			
Jackknifed	3	No overturns.			
Fire* only	1	No overturns.			

*Fire occurred in a total of 4 percent of these accidents.

TABLE III-C

Accident Statistics for Tractor/Semi-Trailer Accidents Occurring on Mountainous Segments
of Interstate Highway (Segment 3 - I-70 West of Denver)

<u>Type of Accident</u>	<u>Percent of Accidents of This Type</u>	<u>Supplementary Data</u>		
		<u>Type of Collision</u>	<u>Percentage of Collisions of This Type (P_c)</u>	<u>Percent of P_c in Which Trailer Overturned</u>
Collisions with Other Vehicles	44	Head-on	0	0
		Rear-end	50	0
		Side-on or sideswipe	50	0
Collisions with Non-Vehicles	0			
Truck Run off Road	44	<u>Most Severe Impact Environment Experienced by Truck</u>	<u>Percentage of Accidents Which Had Impact of This Type (P_I)</u>	<u>Percent of P_I in Which Trailer Overturned</u>
		Hit ditch, median, soft hillside	25	100
		Hit "stout" structure	25	100
		Hit guardrails, posts, etc.	38	67
		Rolled down embankment	12	0
Overturns on Road	12	100 Percent hit median restraining wall.		
Fire only*	0			

*None of these accidents involved fire.

TABLE III-D

Accident Statistics for Tractor/Semi-Trailer Accidents Occurring on Urban Segments of Interstate Highway (Segment 4 - Urban Denver)

Type of Accident	Percentage of Accidents of This Type	Supplementary Data		
		Type of Collision	Percentage of Collisions This Type (P_C)	Percent of P_C in Which Trailer Overturned
Collisions with Other Vehicles	75	Head-on	0	0
		Rear-end	53	0
		Side-on or side-swipe	47	0
Collisions with Non-Vehicles	5	100 Percent trivial with no overturns.		
		Most Severe Impact Environment Experienced by Trailer	Percent of Accidents with Impact of This Type (P_I)	Percent of P_I in Which Trailer Overturned
Truck Ran off Road	10	Hit ditch, median	100	50
Overturns on Road	10	In 50 percent of these accidents the trailer slid into guardrails.		
Fire only*	0			

*None of these accidents included fire.

TABLE III-E

Accident Statistics for Tractor/Semi-Trailer Accident Occurring on Mountainous Segments
of Federal Aid Primary (FAP) Highway (Segment 5, Colorado)

Type of Accident	Percentage of Accidents of This Type	Supplementary Data			
		Type of Collision	Percentage of Collisions of This Type (P _c)	Percent of P _c in Which Trailer Overturned	Remarks
Collisions with Other Vehicles	63	Head-on	35	17	{ 17 Percent with trucks.
		Rear-end	12	0	
		Side-on or side-swipe --			
		a) Opposite direction	41	14	
		b) Same direction	12	0	
Collision with Non-Vehicles	0				
		Most Severe Impact Environment Experienced by Trailer	Percentage of Accidents with Impact of This Type (P _I)	Percent of P _I in Which Trailer Overturned	Remarks
Truck Ran Off Road	33	Hit ditch, median, hillside	45	75	{ 50 Percent had severe fire.*
		Hit "stout" structure	33	67	
		Inconsequential impact	22	50	
Overturns on Road	4				
Fire only*	0				

*Fires occurred in 4 percent of these accidents.

Velocity Distributions of Truck Accidents

Based upon the same accident records, estimates of accident velocity distributions for the various classes of roads can be made. These data, along with other pertinent information, are presented in Tables IV through VII.

Table IV presents the data for collisions with other vehicles. Since the weight of these objects is extremely important in determining the severity of the accident environment,⁹ the distribution of weights of the vehicle with which the truck collides is also included. A review of the data suggests that velocities and traffic on all three segments of Colorado interstate are similar. This permitted them to be combined into one distribution. In many of the particular accident types, sufficient data were not available to achieve a distribution and, in these cases, the individual data are simply listed. In practically every instance, it was necessary to deduce the impact velocity from the reported pre-accident velocity of the colliding vehicles and the narrative description of the behavior of the vehicles prior to impact. The velocities which are listed are relative velocities; that is, for head-on collisions it is the sum of the speeds of the two vehicles and, for rear end collisions, it is the difference in the speeds.

The same sort of judgment application resulted in the listing shown in Table V. In none of the non-vehicle, on-road collision accidents did the trailer experience damage intensive enough to suggest a threat to a cask from the impact alone. The listing shown in Table VI deals with accidents involving overturning of the tractor-trailer rig. As is seen, a large number of these accidents involve a later impact of the overturned trailer with fixed objects on the right-of-way. The number of these accidents was too small to develop a distribution but they are included in Table VI as the type of peripheral information that frequently is required in hazards analysis.

As was shown in Table III, a large percentage of the total number of accidents involve events in which control of the vehicle is lost and the vehicle leaves the driving surface. In these accidents, the major threat to cargo results from the subsequent impacts; the velocity of these impacts, the distribution of surfaces impacted, and estimates of the dollar damage incurred during these accidents are shown in Table VII. While dollar damage is not a particularly good yardstick of

TABLE IV

Velocity and Weight Distributions for Collision
Accidents with Other Vehicles

Head-On Collisions with Other Vehicles

Velocity
(Relative velocity between vehicles at impact in miles per hour)

<u>Utah Interstate</u>		<u>Colorado Interstate</u>		<u>Colorado FAP</u>	
Insufficient Data		Insufficient Data		Sparse Data	
<u>Number of Accidents</u>	<u>ΔV (mph)</u>	<u>Number of Accidents</u>	<u>ΔV (mph)</u>	<u>ΔV (mph)</u>	<u>% Less Than This Value</u>
1	45	1	50	20	14
1	55	1	105	40	43
1	60			60	57
				80	72
				100	86
				120	100

Weight of Other Vehicle
(in pounds)

<u>Utah Interstate</u>		<u>Colorado Interstate</u>		<u>Colorado FAP</u>	
Insufficient Data		Insufficient Data		Sparse Data	
<u>Number of Accidents</u>	<u>Weight (lbs)</u>	<u>Number of Accidents</u>	<u>Weight (lbs)</u>	<u>Weight (lbs)</u>	<u>%</u>
1	$W < 3000$	2	$3000 < W < 4000$	$W < 3000$	30
2	$3000 < W < 4000$			$3000 < W < 5000$	53
				$5000 < W^*$	17

*Collision with another semi- at $\Delta V = 75$ mph.

TABLE IV (cont'd)

Rear-end Collisions with Other Vehicles

Velocity (Relative velocity between vehicles at impact, mph)					
Utah Interstate		Colorado Interstate		Colorado FAP	
13 Percent of these accidents involved the other vehicle running into the truck; 87 percent the truck running into the other vehicle.		22 Percent of these accidents involved the other vehicle running into the truck; 78 percent the truck running into the other vehicle.		Insufficient data.	
Velocity	% Less Than Average	Velocity	% Less Than Average	No. of Accidents	ΔV (mph)
10	28	10	17	1	25
20	50	20	67	1	30
30	71	30	90		
40	93	40	95		
50	100	50	100		
Weight of Other Vehicle (in pounds)					
Utah Interstate		Colorado Interstate		Colorado FAP	
Weight	% Less Than W	Weight	% Less Than W	Number of Accidents	Weight (lbs)
3000	19	3000	11	1	W < 3000
4000	50	4000	44	1	3000 < W < 4000
5000	88	5000	94		
6000	94*	7000	100		

*Remaining collision is with tractor trailer at 10 mph.

TABLE IV (cont'd)

Side-on or Sideswipe Collisions with Other Vehicles

Velocity (Relative velocity between vehicles at impact, mph)					
Utah Interstate			Colorado Interstate		Colorado FAP
<u>Same Direction</u>	<u>Opposite Direction</u>		<u>Same Direction</u>	<u>Opposite Direction</u>	
Vel. % Less Than V	Insuf- ficient data.		Vel. % Less Than V	None.	1 Accident with $\Delta V = 15$.
10 50	1 Accident		10 36		20 14
20 88	with $\Delta V = 80$.		20 79		40 42
30 94			30 86		60 57
40 100			50 93		80 71
			80 100		100 100
Weight of Other Vehicle (in pounds)					
Utah Interstate			Colorado Interstate		Colorado FAP
<u>Same Direction</u>	<u>Opposite Direction</u>		<u>Same Direction</u>	<u>Opposite Direction</u>	
Wt. % Less Than W	Insufficient data.		Wt. % Less Than W	None.	Insufficient data.
3000 31	1 Accident with		3000 14		1 Accident
4000 50	5000 < W < 6000.		4000 50		with 4000 < W
5000 81			5000 86		< 5000
6000 88			6000 93		4000 57
7000 100			7000 93		5000 100
			8000 100		

TABLE V

Velocities for On-Road Collisions with Non-Vehicles

<u>Utah Interstate</u>		<u>Colorado Interstate</u>		<u>Colorado FAP</u>	
<u>Velocity (mph)</u>	<u>Object Struck</u>	<u>Velocity (mph)</u>	<u>Object Struck</u>	<u>Velocity (mph)</u>	<u>Object Struck</u>
35	horse	30	construction barrel	None	
40	deer	55	ice from overpass		
40	rubber boat	80	car wheel		
50	piece of metal				
55	small metal object				
80	trailer wheel				

TABLE VI

Listing of Accidents Involving Overtums on Road
(Accidents in which trailer does not leave roadbed)

Utah Interstate			Colorado Interstate			Colorado FAP		
Accident Velocity (mph)	Object Struck After Overtum	Estimated Velocity of Subsequent Impact	Accident Velocity (mph)	Object Struck After Overtum	Estimated Velocity of Subsequent Impact	Accident Velocity (mph)	Object Struck After Overtum	Estimated Velocity of Subsequent Impact
15	None		30	Guardrail*	20	30	Delineator posts	20
35	None							
55	Guardrails	35	50	Guardrail	30			
			70	Concrete retaining wall	30			
			80	Concrete Retaining wall	50			

*Trailer rolled on top of guardrail.

TABLE VII

Velocity Distributions, Trailer Damage, and Impacted Objects
for Accidents Caused by the
Tractor-Trailer Leaving the Road (ran-off-road Accidents)

Velocity Distributions

Utah Interstate				Colorado Interstate				Colorado FAP			
Estimated Velocity of Subsequent Impacts (all accidents)		Estimated Velocity of Subsequent Impacts (overturn accidents only)		Estimated Velocity of Subsequent Impacts (all accidents)		Estimated Velocity of Subsequent Impacts (overturn accidents only)		Estimated Velocity of Subsequent Impacts (all accidents)		Estimated Velocity of Subsequent Impacts (overturn accidents only)	
Vel. (mph)	% Less Than V	Vel. (mph)	% Less Than V	Vel. (mph)	% Less Than V	Vel. (mph)	% Less Than V	Vel. (mph)	% Less Than V	Vel. (mph)	% Less Than V
10	7	10	0	10	11	10	0	10	0	10	0
20	30	20	7	20	47	20	40	20	11	20	0
30	37	30	7	30	79	30	80	30	33	30	33
40	63	40	7	40	84	40	80	40	67	40	67
50	81	50	67	50	95	50	90	50	78	50	83
60	100	60	100	60	95	60	90	60	89	60	100
				70	100	70	100	70	89		
								80	100		

TABLE VII (cont'd)

Estimated Trailer Damage (in dollars)

<u>Utah Interstate</u>				<u>Colorado Interstate</u>				<u>Colorado FAP</u>			
<u>Estimated Cost (all accidents)</u>		<u>Estimated Cost (overturns only)</u>		<u>Estimated Cost (all accidents)</u>		<u>Estimated Cost (overturns only)</u>		<u>Estimated Cost (all accidents)</u>		<u>Estimated Cost (overturns only)</u>	
<u>Cost</u>	<u>% Less Than \$</u>	<u>Cost</u>	<u>% Less Than \$</u>	<u>Cost</u>	<u>% Less Than \$</u>	<u>Cost</u>	<u>% Less Than \$</u>	<u>Cost</u>	<u>% Less Than \$</u>	<u>Cost</u>	<u>% Less Than \$</u>
500	44	500	0	500	0	500	0	500	11	500	0
1,000	67	1,000	11	1,000	16	1,000	18	1,000	22	1,000	16
2,000	74	2,000	33	2,000	26	2,000	18	2,000	22	2,000	16
5,000	93	5,000	78	5,000	47	5,000	36	5,000	33	5,000	33
10,000	97	10,000	89	10,000	68	10,000	55	10,000	67	10,000	83
20,000	100	20,000	100	20,000	100	20,000	100	20,000	89	20,000	100
								30,000*	100		

*Trailer completely destroyed by fire.

TABLE VII (cont'd)

Objects Struck in Most Significant Impact

<u>Utah Interstate</u>		<u>Colorado Interstate</u>		<u>Colorado FAP</u>	
Type of Impact (in order of subjective im- pact severity)	Percent in Category	Type of Impact (in order of subjective im- pact severity)	Percent in Category	Type of Impact (in order of subjective im- pact severity)	Percent in Category
No damaging impact	15	No damaging impact	5	No damaging impact	11
Guardrails, poles, signs, posts	34	Guardrails, poles, signs, posts	21	Guardrails, poles, signs, posts	0
Ditch, median	30	Ditch, median	37	Ditch, median	11
Went over embank- ment, impacted soil	7	Went over embank- ment, impacted soil	11	Went over embank- ment, impacted soil	34
Hillside	7	Hillside	0	Hillside	0
Overpass supports, bridge railing*	7	Overpass supports, bridge railing*	26	Overpass supports, bridge railing*	22
Steep cliff, large boulders, tunnel faces, bridge abutments	0	Steep cliff, large boulders, tunnel faces, bridge abutments	0	Steep cliff, large boulders, tunnel faces, bridge abutments	22

*These accidents involved skidding into bridge railings and retaining walls rather than head-on impacts.

accident severity, it is useful in a qualitative sense. In particular, the comparison of damage in overturn accidents with the damage resulting in other types of accidents shows that overturns are the most probable source of serious damage to the trailer and, similarly, may be one of the more serious threats to an LMFBR cask.

The other major division of transportation accidents included in Table III are fires. In the entire series of records reviewed for this analysis, only five of the accidents involved fire. This small number of fire accidents permits merely a listing of this data as an illustration of what can occur and this is done in Table VIII. It is possibly worth mentioning that fire did not occur in a single collision accident.

There is other miscellaneous information that can be collated in an analysis of this type although some of it perhaps is more of general interest than of use in hazards analysis. Among these are the percentage of accidents (Table IX) which occurs during inclement driving conditions. For these data to be useful in determining if the risk increases by transporting material during these periods, it is necessary to know the traffic volume during the inclement driving time. This, perhaps, could be done but it has not been attempted here and Table IX is presented primarily as background information.

Miscellaneous Data and Data Comparisons

Coincident with this analysis of accident records, a detailed survey of the same interstate routes was conducted⁴ to determine the types of potential hazards present, the frequency of these hazards, and their physical properties. A legitimate question at this point is how do the predictions that might be made on the basis of the physical survey compare to what has been historically observed in the accident records. The answer is "not particularly well" as is shown in Table V; in addition to the obvious difficulty in performing an adequate survey, another basic reason for this discrepancy exists. Using guardrails as an example, the estimate of the frequency of running off the road and hitting a guardrail requires the assumption that each and every mile along a particular segment has

TABLE VIII

Listing of Pertinent Data for Accidents in
This Sample Which Involved Fire

<u>Location</u>	<u>Dollar Damage to Trailer</u>	<u>Was Trailer Totalled?</u>	<u>Did Trailer Overturn?</u>	<u>Source of Fire</u>	<u>Cause of Accident</u>
Utah I-80	22,000	yes	yes	Not reported.	Ran off road and overturned.
Utah I-80	10,000	no	yes	Not reported.	Ran off road and overturned.
Utah I-80	26,000	yes	no	Not reported.	Fire only acci- dent; fuel leak probable.
Colorado I-80	13,000	yes	no	Not reported.	Ran off road; hit bridge
Colorado FAP	30,000	yes	yes	8500 Gallon fuel (tanker).	Ran off road and rolled.

TABLE IX

Percent of Accidents Occurring During
Inclement Driving Conditions

I-70 East of Denver	32
I-80 Utah	42
I-70 West of Denver	33
I-70 Urban Denver	40
FAP (mountainous)	52

the same accident probability as every other mile. This is probably not the case and a reasonable argument can be advanced that accidents in the vicinity of rails and bridges are more probable than accidents on flat, straight portions of the road. This argument can explain the difference between the observed data and that based upon the survey.

Also of interest and obtainable from the Utah survey data (and from the Colorado data) are predictions of the angles of embankment along the interstate and a qualitative assessment of the hardness of these embankments. The angle considered in Table XI is the angle of the embankment measured from the horizontal and these data should be interpreted to indicate, if an embankment is present, the steepness distribution of the embankment.

If one desires to calculate the severity of an impact against one of these embankments, the most significant velocity parameter is the normal velocity of the vehicle with respect to the impacted surface. This can be calculated using the Utah velocity distribution for accidents in which the vehicle left the roadbed and estimates of the velocity vector of the vehicle when it impacts the embankment. The values of V_N shown in Table XII are intentionally conservative; i.e., based upon these data, the actual distribution would be expected to have each value of V_N cover a higher percentage of accidents. In the values shown in Table XII, it is considered that the plane of the embankment is normal to the road surface and, if impact severities are to be made realistically, the data in Table XII should be combined in the calculation with the angular data in Table XI.

It is both of interest and of importance in establishing the credibility of the data presented here to compare the various segments of highway discussed with the average data for transport by all kinds of trucks over all U. S. highways (Ref. 1). The types of accidents and collision geometries are compared in this manner in Tables XIII and XIV. It is difficult to say much about the comparison. There is a smaller percentage of collision accidents on the interstate except for urban travel; this seems reasonable. The number of fires, perhaps, is somewhat higher than that used in Ref. 1. Part of the problem in attempting to compare these (and the collision geometries as well) is that the accident rates should be factored in to permit visualization of how frequently the various types of accidents on a mileage-traveled basis occur.

TABLE X

Probabilities of Having Various Types of Accidents
on I-80 in Utah, as Determined from Accident Records,
Compared with Those Predicted from Detailed Survey

Occurrence	Probability of This Type of Event	
	Based Upon Accident Records	Based Upon Survey
Of impacting guardrail if truck leaves roadbed.	0.25	0.16
Of hitting bridge or "stout" struc- ture in "ran-off-road" accidents.	0.07	0.04
Of truck entering water if it leaves roadbed.	0.0	<0.015
Of truck hitting embankment whose vertical angle with roadbed is greater than 10 degrees (for "ran-off-road" accidents).	0.1	~0.05
Of truck hitting substantial off-road structure (overpass supports, large trees, etc.) in "ran-off-road" accidents.*	0.0	0.01

*These data are particularly subjective.

TABLE XI

Approximate Distribution of Embankment Slopes and Hardnesses
Along I-80 Segment in Northern Utah
(if embankment present)

Angle of Embankment (α)	Percent in This Range	Material	
		Soft (grass, soil, de- composed rock)	Hard (granite, basalt, other rock formation)
< 30	3	50	50
30 - 60	52	40	60
60 - 90	45	30	70

TABLE XII

Very Approximate Distribution of the Normal Component
of the Velocity, of Impact of Truck, V_N , upon
Roadside Embankments if Truck Leaves Roadbed*

Normal Velocity V_N (mph)	Percentage of Accidents in This Range
< 10	24
$10 < V_N < 15$	21
$15 < V_N < 20$	17
$20 < V_N < 30$	24
$30 < V_N < 40$	7
$40 < V_N < 50$	7

*Does not consider embankment slope distributions shown in Table XI.

TABLE XIII

Comparison of Accident Type Distributions from
SLA-74-0001, and Utah and Colorado Data

Type of Accident	SLA-74-0001	Utah I-80 ²	Colo I-70 West ³	Colo I-70 East ^{2,3}	Colo I-70 Urban ³	Colo FAP (mnts) ^{2,3}
Collision with other vehicle	65	47	44.5	55	75	63
Collision with non-vehicle	17	7		9	5	0
Ran off road ¹		38	44.5	36	10	33
Overturns on road	7	4	11.0	0	10	4
Fires	1	4	0.0	5	0	4
Jackknifed	0	3	0.0	0	0	0
Trivial	10	0	0.0	0	0	0

¹Non-vehicle collisions in SLA-74-0001 include some of the same accidents included here as "ran-off-road" events.

²Total greater than 100 percent as some fire accidents are preceded by other events.

³Colorado data are based upon injury accidents; direct comparison with SLA-74-0001 data and Utah figures require correlation ratio previously discussed.

TABLE XIV

Comparison of Collision Geometry Distributions
for the Several Data Sources

Collision Orientation	Percent of Collisions of This Type					
	SLA-74- 0001	Utah I-80	Colo I-70 West of Denver	Colo I-70 East of Denver	Colo I-70 Urban Denver	Colo FAP (mnts)
Head-on	29	9	0	17	0	35
Rear-end	48	38	50	58	53	12
Side-on or Sideswipe	23	53	50	25	47	53

In Table XIV, the percentage of head-on accidents is seen to be less for interstate travel than for general truck commerce as would be expected. What is somewhat surprising is that the percentage of rear-end collisions remains about the same for these data as in Ref. 1 but that the side-on and sideswipe accidents increase appreciably. It was expected that both rear-end and side-on collisions would increase to compensate for the decreased rate of head-on accidents.

The final comparison which was made was to plot the data regarding trailer damage for all accidents and the same data for accidents in which overturn of the trailer occurred. This appears as Fig. 1. As has been mentioned earlier, overturn accidents involve greater observed economic liability than the average accidents. The large difference between the Utah and Colorado data is, of course, primarily attributable to the differences in accident definition. As would be expected, Fig. 1 implies that injury accidents are the more severe and costly occurrences.

Use of Data

At this point, after the presentation of so much tabulated data, it is not unreasonable for the reader to ask, "Just what do I do with all of this?" The answer to this is that it is just this type of data which is required in a detailed analysis of transportation hazards and this use will be illustrated in this section by two simplistic examples. The two which have been chosen are:

1. What is the comparison of the probability per mile of experiencing a serious impact into either another truck or a relatively "stout" structure between the general commercial routes (Ref. 1) and a segment of Colorado interstate? For purpose of this example, assume that we're interested only in velocities in excess of 30 mph.
2. What is the probability of the trailer overturning at a velocity in excess of 20 mph over a given 2000 miles route? Here again, the prediction from Ref. 1 data can be compared to that based upon the specific route information which has been the subject of this report.

Figure 1. Estimated Trailer Damage Cost in "Ran Off Road" Accidents

These two examples will illustrate not only how the data may be used, but they also point out the number of assumptions that are still required.

For the first example, choose the Colorado I-70 segment east of Denver for consideration. Starting with the calculation based upon the Ref. 1 data, the accident rate for trucks for collision or overturn accidents is about 2.2×10^{-6} accidents per mile. The probability, given a collision or overturn accident, that it be head-on with another truck is .042; the probability that it be with a train bridge, parked truck, concrete wall or other rigid structure is .038. (These data come from Table VI of Vol. 3 of Ref. 1.) For head-on truck collisions, about 87 percent of them have a net velocity in excess of 30 mph; for fixed object collisions about 63 percent are at velocities greater than 30 mph. Therefore, the probability per mile, using Ref. 1, of having a "serious" impact accident at a velocity in excess of 30 mph is

$$2.2 \times 10^{-6} [.042(.87) + .038(.63)] = 1.3 \times 10^{-7}.$$

The same type of calculation can be made for travel on interstate highway segments. From the data presented in this report, the accident rate is 3.3×10^{-7} injury accidents per mile. Along this segment 9 percent of the accidents were head-on collisions and 36 percent of them were "ran-off-road" type of accidents. In the Colorado interstate accidents, however, none of the head-on impacts were with another truck so this component is zero. For the accidents in which the vehicle left the roadbed, 26 percent of these impacted a reasonably stout object and 21 percent of these accidents are predicted to have a velocity in excess of 30 miles per hour. This accident rate then becomes:

$$3.3 \times 10^{-7} [.36(.26)(.21)] = 6 \times 10^{-9} \text{ serious impact accidents per mile.}$$

This is a factor of about 20 less than the calculation based upon the SLA-74-0001 results.

There are two basic reasons for this large difference. The first of these is the rarity of head-on accidents on the interstate system and the second is the lower accident rate on this type of controlled access routes. While this illustration is admittedly superficial and this example was not intended to lead to a concrete comparison of the two methods, it does suggest that a more realistic

assessment of the frequency of the serious types of accidents which might threaten an LMFBR cask can be made by using the route specific data.

The second example proceeds along similar lines. Assume that the 2000 mile route is composed of 800 miles of Segment 1 type road, 800 miles of Segment 2 highway, 200 miles of Segment 3, and 200 miles of Segment 4. Starting again with the general (Ref. 1) approach, the collision or overturn rate is again 2.2×10^{-6} collision or overturn accidents per mile. Of these, about 7.7 percent are overturns and 75 percent* of these are predicted to be in excess of 20 miles per hour. The probability of this accident occurrence is then:

$2.2 \times 10^{-6}(.077)(.75) = 1.3 \times 10^{-7}$ accidents per mile or, over the 2000 mile trip, the probability of having such an event is

$(1.3 \times 10^{-7})(2000) = 2.5 \times 10^{-4}$ per trip, or one such accident would be expected about every 4000 trips.

Again, comparing this calculation with the route specific data which are developed in this report, the accident rates used here for the various interstate segments are 3.3×10^{-7} , 2.1×10^{-7} , 1.4×10^{-6} , and 8.7×10^{-7} injury accidents per mile. The overturn probabilities, given an accident, on the four segments are .45, .21, .39, and .15. Using the estimated velocity of impact as the overturn velocity, the predicted probabilities of overturn at velocities in excess of 20 miles per hour are .53, .7, .53, and .53. The probability of having an overturn accident at a velocity in excess of 20 miles per hour along this 2000 mile route then becomes:

$$\begin{aligned} & 800(3.3 \times 10^{-7})(.45)(.53) + 800(2.1 \times 10^{-7})(.21)(.7) \\ & + 200(1.4 \times 10^{-6})(.39)(.53) + 200(8.7 \times 10^{-7})(.15)(.53) \\ & = 6.3 \times 10^{-5} + 2.5 \times 10^{-5} + 5.8 \times 10^{-5} + 1.4 \times 10^{-5} \\ & = 1.6 \times 10^{-4} \text{ per trip;} \end{aligned}$$

*As in other places in these examples, the comparisons are not completely real. The 75 percent mentioned here is the velocity of the truck when the accident commences, that used in the analysis pertaining to this report is the estimated velocity when the overturn occurs.

or one such occurrence every 6200 trips. In this case, it is noted that there is less than a factor of two differences between the two methods. This smaller difference results from the higher percentage of overturn accidents for interstate travel and the composite route considered makes the average accident rate somewhat closer to the Ref. 1 rate.

Summary

This report is basically a data presentation, reporting compilation of distributions of truck transportation accident data gleaned from the report-by-report review of state accident records and traffic volume information. An attempt has also been made to demonstrate how the data might be used to illustrate its usefulness in the evaluation of transportation hazards and the derivation of truck transport accident severity distributions.

There is one conclusion regarding the continual endeavor to improve the data base for this type of hazard analysis that is in order at this state of the investigation. This conclusion is that the information secured by the detailed physical route surveys, as described in SAND76-0313,⁴ is of lesser value than that derived from the detailed review of accident records and traffic volume data. It is suggested that further detailed physical surveys are not required for use in the type of hazards analysis described in this report.

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APPENDIX

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APPENDIX

Listing of Accident Digests

To permit any person who wishes to consider aspects of accidents which have not been specifically compiled in this analysis, digests of the accidents (based upon the more complete accident reports) are included in this appendix. Pages 49 through 62 report the Utah data and pages 63 through 80 are for the Colorado segments. The two tables are not identical as the interpretation of the type of data which was useful changed somewhat as the study progressed. Much of the information in these tables is possibly comprehensible only to the compiler, but it is included here to permit anyone so inclined to have access to the information for his particular interest.

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UTAH LARGE TRUCK ACCIDENT REPORTS

DIGEST - 1975 FOR ALL ACCIDENTS

Accident Number	Highway	Road Condition	Type of Accident	Vehicles			Speed			Dollar Damage to Vehicles	Object Hit	Injury Standard Code	Damage to other Property	Remarks
				Type #1	Type #2	Type #3	Posted	Travel	Impact					
01281	80 N Ogden-Echo	Snow packed	Ran off road	Van-trailer 2 pieces			55	40	35	7K 5.5 cab 1.5 trailer	--	None		Jackknifed while trying to stop, did not overturn 10°
01867	80 N Ogden-Echo	Ice	Ran off road	Van-trailer 2 pieces			55	40	40	10K to trailer	Bridge	None	Bridge rail \$ 500	Lost control trying to stop, jackknifed
09909	80 N Ogden-Echo	Wet	Hit object	Van truck 1 piece			55	45	35	.7K	Horse	None	Killed horse	Horse entered interstate by exit ramp
11354	80 N Ogden-Echo	Dry	Overturn on road	Reefer van 2 pieces			55	70	55	20K 5K van	Roadway	1-B	Guard rail	Went into curve too fast and got sideways
15146	80 N Ogden-Echo	Dry	Hit guard rail overturned	2 piece tractor trailer			55	60	55	5K	Guard rail	1-B		Driver asleep, guard rails held vehicle in road bed but possible (not mentioned) guardrail puncture
17101	80 N Ogden-Echo	Dry	Ran off road, overturned	2 piece van trailer			55	45	20	22K	Roadway	1-K	4 horses, tools 50K	Fire - destroyed van and contents including 4 show horses, fatal to driver
26626	80 N Ogden-Echo	Snowy	Overturn	Tanker-truck 2 piece			55	40	15	3K	Roadway	None		Fishtail on new snow, on overpass; overturned in roadway, no fire
32987	80 N Ogden-Echo	Dry	Ran off road	Tractor and two trailers	Non-contact		55	55+		8K	None. Did not overturn	None		Veh. #2 made U turn at crossover, truck jackknifed while trying to avoid

UTAH LARGE TRUCK ACCIDENT REPORTS
DIGEST - 1975 FOR ALL ACCIDENTS (Cont'd)

24386	I-15 SLC-Ogden	Wet	Collision sideswipe	Tractor trailer	Chev Nova		55	55 58	55 58	450				Truck changed lanes into car
24974	I-15 SLC-Ogden	Dry	Ran off road overturned	Tractor trailer			55	15	15	1500				Wind blew trailer off of 5th wheel, overturned on shoulder
29491	I-15 SLC-Ogden	Dry	Collision rear end	Tractor trailer	Tractor trailer		55 .	25 20	10 0	250				Traffic slowed in construction zone
31342	I-15	Dry	Ran off road	Tractor flat bed			55	50	40	11K 1K trailer	Down embankment	1-A	69' of rail, 1 post	Truck went across median hitting guard rails, went across two lanes and hit rail on other side, down steep embankment, tractor total loss
31386	I-15 SLC-Ogden	Dry	Collision sideswipe	Tractor Van	Ford Sedan		55	45 55	45 55	2K		2-B 1-C		Sideswipe entering construction area
31544	I-15 SLC-Ogden	Snow, ice	Collision rear end	Tractor trailer			55	25 0	15 0	450	Guard rail			Truck struck parked vehicle from rear - no damage to truck
31855	I-15 SLC-Ogden	Snowy	Ran off road hit fixed object	Tractor Van			55	25	25	300	Bridge			Van not damaged - jackknife, skid into bridge
32558	I-15 SLC-Ogden	Snowy	Collision side	Tractor truck	Chev sedean		55	45 45	45 45	\$1400				Car hit guard rail, then truck @ 30° which went onto shoulder
33574	I-15 SLC-Ogden	Snowy	Collision side	Truck	Lincoln Cont.		55	50 55	50 55	1500				Car spun into truck
33569	I-15 SLC-Ogden	Snowy	Collision side	Tractor Van	Cadillac		55	50 45	45 45	200				Car spun into truck

UTAH LARGE TRUCK ACCIDENT REPORTS
DIGEST - 1975 FOR ALL ACCIDENTS (Cont'd)

24168	I-15 Provo-SLC	Dry	Collision sideswipe	Tractor tanker	Chev Nova		55	45 50	45 15	900				Car moved into truck while passing
24468	I-15 Provo-SLC	Dry	Collision sideswipe	Tractor trailer	Chrysler		55	58 58	58 58	400				Truck moved into lane occuppied by car
28600	I-15 Provo-SLC	Dry	Collision sideswipe	Tractor trailer	Chev Vega		55	50 50	45 unk	1200				At highway con- struction two vehicles converged
29015	I-15 Provo-SLC	Wet	Collision rear end	Tractor trailer	Chev Bel Air	Chev Nova	55	25	15	1250				Truck ran into traffic stopped for road work
31306	I-15 Provo-SLC	Dry	Collision rear end	Tractor trailer	Dodge Pickup		55	40 15	40 15	2K				Truck hit slower moving pickup from rear
32521	I-15 Provo-SLC	Snowy	Ran off road Overturnd	Tractor Van			55	55	45	5.5K	Overturnd in median	1-A		Truck slid into median, overturnd
32515	I-15 Provo-SLC	Snowy	Collision rear end	Truck trailer	Ford sedan		55	45 45	40 10	1100				Car spun, truck hit
32631	I-15 Provo-SLC	Dry	Collision sideswipe	Tractor trailer	Chev Nova					200				Truck moved into cars lane
33557	I-15	Snowy	Ran off road	Tractor Reefer			55	50	40	2.5K				Lost control, jack- knifed, stopped up- right in road
03585	I-15 SLC-Ogden	Snowy, ice	Collision sideswipe	Tractor trailer	Ford sedan		55	50 50	50 50	500				Car passing truck lost control, side- swiped-both upright in median
24364	I-15 SLC-Ogden	Dry	Collision rear end	Tractor trailer	Inter. Van		55	30 30	10 25	400				Van hit truck when it slowed for con- struction

UTAH LARGE TRUCK ACCIDENT REPORTS
DIGEST - 1975 FOR ALL ACCIDENTS (Cont'd)

00601	15 SLC	Dry	Collision sideswipe	Tractor trailer	Chev		55	55 60	50 50	\$800		1-C		Tractor trailer changed lanes into Chev
25460	15 SLC	Dry	Collision sideswiped	Tractor trailer	Ford		55	50 55	50 55	1K		2-C		Truck sideswiped car which spun and was again hit by truck
31711	15 SLC	Snowy	Ran off road, hit fixed object	Tractor trailer			55	40	40	4K	Guard rail, ditch		60' rail	Hit rail, back across road into medium
33024	15 SLC	Dry	Ran off road hit fixed object	Tractor and 1 - tanker			55	50	40	200	Guard rail		50' bent rail	Trailer broke hitch, came loose, hit guard rail
30986	15 SLC	Snowy	Collision head on	Tractor trailer	Ford pickup	Chev pickup	55	50 55 50	40 5 40	24K little damage to trailer	Truck went thru guard rail	1-C 2-B	58' guard	Pickup spun, hit truck which went thru median and hit other pickup head on
01038	I-15 Provo-SLC	Wet	Collision rear end O.T.	Tractor trailer	Dodge Dart	Dodge Coronet Chev Biscayne	55	55 0 55	50 0 10	14K prob. about		4-A 3-B	175' guard rail	Tractor trailer came upon previous acci- dent and could not stop, overturned, thru guard rail
01496	I-15 Provo-SLC	Wet, fog	Collision rear end	Tractor trailer	VW		55	40 0	30 0	2K		1-A		Truck came upon stopped car in fog and over ran truck into ditch @ 50°
23748	I-15	Dry	Collision rear end O.T.	Tractor van	Dodge pickup		55	55 50	50 50	11.5K 2K to van	Embankment	1-A 1-B	40'	Truck over ran pick- up, rolled over into embankment, tore out fence
23886	I-15 Provo-SLC	Dry	Hit object	Tractor van	Plymouth duster		55	55	50	1K	Wheel of trailer	1-C		Wheel from trailer hit Plymouth head on

UTAH LARGE TRUCK ACCIDENT REPORTS
DIGEST - 1975 FOR ALL ACCIDENTS (Cont'd)

30312	80 SLC - Echo	Dry	Ran off road				55	55	55	2K			200' of fence 1K	Ran through median fence (over and back) when driver fell asleep
30337	80 SLC - Echo	Dry	Overtuned in road	Tractor reefer			55	65	35	20K 15K - reefer		1-B		Trailer tipped over on curve, slid down highway
32988	80	Snowy, slippery	Hit object	Tractor trailer			55	50	50	2K	Metal object from sand truck		None	Object in highway
00171	80 SLC	Dry	Collision raking	Tractor trailer	Chev		55	55 50	55 50	350				Converged on same lane
00178	80 SLC	Snowy	Ran off road	Tractor trailer			55	40	30	800	Guard rail		20 ft Guard rail	Skidded, hit rail, bounced off, hit rail on other side, came to rest in road
08439	80 SLC	Snowy	Ran off road into media	Tractor trailer			55	40	14	1K	Embankment			Lost control, jack- knifed into median
08448	80 SLC	Snowy	Collision raking	Tractor trailer	Chev		55	55 20	55 20	1K				Trailer fishtailed, hit car as truck passed it
14725	80 SLC	Dry	Collision rear end	Tractor trailer	Chev		55	50 50	35 30	\$550				Truck following too closely as car slowed
20111	80 SLC	Wet	Ran off road, Hit object	Tractor trailer			55	55	35	5K	Light pole hillside	1-A	\$500 to pole	Lost control on road, hit pole and hillside at about 30°
26164	80 SLC	Dry	Collision raking	Tractor trailer	Chev		55	45 55	45 55	\$800				Sideswipe as both crowding center line

UTAH LARGE TRUCK ACCIDENT REPORTS
DIGEST O 1975 FOR ALL ACCIDENTS (Cont'd)

22195	15 N of Ogden	Dry	Ran off road, rolled over	tractor 2 trailer	Cab Total Box Torn Open, 1st Van R side Damaged, 2nd Van		55	56	50	25K	Down embankment, ditch	1-A	2 wooden posts, 5 steel posts	DWI, came down exit too fast, rolled, trailers torn open
03603	80 E SLC and and Echo	Dry	Ran off road rolled over in median	Tractor 40' trailer			55	80	60	9K	Into median	1-B		Too fast around curve, lost control
04055	80 SCL - Echo	Dry	Collision rear end	Tractor tank	Plymouth		55	12 50	12 50	3K		1-A		Plymouth ran into rear of tanker
12047	80 SLC - Echo	Dry	Ran off road, OT, into rail	Tractor van			55	50	50	30K 18K to van	Guard rail 255' and post	1-C	255' of guard rail	Van on side on top of rail
19126	80 SLC - Echo	Dry	Hit object	Tractor trailer			55	40	40	250'	Deer		Killed deer	Hit deer at night
22748	80 SLC - Echo	Dry	Hit object	Tractor trailer	Ford Van		55	40 55	40 40	750'	Rubber boat		Rubber boat	Rubber boat on Ford van blew off and hit tractor
21349	80 SLC - Echo	Dry	Collision head on, overturn	Tractor trailer	Chev pickup		55	60 55	10 55	7K		3-A		Truck lost control, across median into opposite lane where hit by Chevy
24390	80 SLC - Echo	Dry	Ran off road, rolled	Tractor trailer			55	35	35	11K R side of trailer torn	Unto shoulder		None	Rolled onto side on road shoulder
24400	80 SLC - Echo	Dry	Hit object	Tractor trailer			55	55	55	1K	Hit metal part from another truck			Of little conse- quence
25205	80 SLC - Echo	Wet	Fire	Tractor trailer			55	55 Fire	55	26K				Apparent fuel leak truck burned com- pletely
28606	80 SLC - Echo	Snowy	Jackknifed	Tractor trailer			55	70	10	400				Lost control on snow, remained on road

UTAH LARGE TRUCK ACCIDENT REPORTS
DIGEST - 1975 FOR ALL ACCIDENTS (Cont'd)

01329	80 East of Echo	Snowy	Collision - from rear	Tractor- trailer	Pickup		55	40	40	2K	None - came rest of shoulder	1-C		Pickup spun on snow hit by semi
03900	80 East of Echo	Snow - low visibility	Collision from rear	Tractor trailer	Olds		55	30	30	1K	Stayed upright on road	None		Poor visibility, #2 pulling back on road after stopping
07916	80 East of Echo	Snowing	Collision front glancing blow	Tractor van	Fiat		55	30 35	30 35	10K 5K to Fiat 5K to tractor	Went into ditch, 45° angle	2-A 3-C		2 lane portion of 80, Fiat spun across center line and was hit
09359	80 East of Echo	Dry	Collision w/object	Tractor trailer			55	45	45	None	Guard rail	None	50 ft. guard rail and posts \$500	Mechanical defect, hit guard rail at low angles, broke off posts; did not overturn
10512	80 East of Echo	Dry	Ran off road collision with object	Tractor trailer			55	55	30	200	Hillside	None		Blow out ran off road into hillside
18637	80 East of Echo	Dry	Collision sideswipe	Tractor trailer	Van		55	55 55	50 50	#1 - \$800 #2 totaled (fire)		1-A 1-B		Undivided section, van went across and hit rear of trailer van overturned, burned (truck up- right)
25180	80 East of Echo	Dry	Ran off road hit object	Tractor trailer			55	50	10	\$200	Ditch	None		Trailer came undone
27202	80 East of Echo	Damp	Ran off road overturned, fire	Tractor trailer			55	55+	55+	40K R side of trailer		1-A 1-K	\$1K, fence telephone poles, up RR	Fire destroyed tractor-ran off road, turned 1/4 over
01901	15 N of Ogden	Dry	Collision rear end	Tractor trailer	VW		55	55 40	20 12	1K		None		VW changed lanes in front of truck
21342	15 N of Ogden	Dry	Ran off road, rolled over	Tractor trailer	Most Damage to Cab		55	50	45	10K	Sign guard rail (30 ft)	1-B	\$300	Driver asleep, ran off road and over- turned

COLORADO LARGE TRUCK ACCIDENT REPORTS
DIGEST - 1975 FOR INJURY OR FATALITY ACCIDENTS

Accident Report Number	Highway Segment		Road Cond.	Type of Accident	Vehicle Type	Truck Speed		Fire	Angle of Truck Leaving Road (β) or Hitting Rail	Impact			Trailer			1-neg., 5-total 1-5	Fat., Inj. K, A, B, C, D		Remarks
	Act.	Sim. to				Posted (mph)	Actual Pre-Accident (mph)			α	V(mph)	Sort	Over turn?	Damage	By What	Severity to Cargo	Truck	Other Vehicle	
024935	70W		Snowing	Collision sideswipe same direction	(1) Van trailer (2) Sedan (3) Sedan	55	30	No	--	--	--	--	No	None	--	0	0	3-C	Truck sideswiped stalled vehicles
24940	70W		Ice, snow	Rear end collision	(1) Renault (2) Van trailer (3)(4) Sedans	55	35	No	10°	--	10	Guard rail	No	\$175	Impact	0	0	3-B	Rear end collision into stalled cars on road
59060	70W		Clear	Rear end collision	(1) Tanker (2) Dodge Van	40 40	20 50	No	--	--	--	--	No	\$75	--	0	0	4-B	Dodge ran into rear of tanker
66904	70W		Clear	Ran off road right side	(1) Tractor-trailer	55	50	No	45°	--	70	Solid concrete rail	Yes	20K	Impact roll over	4	1-A		Trailer overturned, hit retaining wall
71803	70W		Clear	Overturn, in road hit wall	(1) Tractor-flat bed	55	80+	No	30°	--	80	Solid wall	Yes	20K	wall, roll over	5	1-A		40,000 lbs lumber scattered over 617'
82102	70W		Clear	Collision rear end	(1) Impala (2) Truck-trailer	55 55	85 35	No	--	--	--	--	No	\$200	Car	11	0		Impala rear ended truck, $\Delta V \approx 50$ mph
88313	70W		Snowy	Ran off road then collision	(1) Tractor-semi (2) Tractor-semi	55 55	35-40 35-40	No	30°	90°	20	Median	Yes	37K 10K	Median, collision	4 2	1-B 1-B		(1) went into median, across and trailer into path of (2)

Note: 70W is segment of I-70 between Denver and Silverthorne
70V is segment of I-70 in urban Denver
70E is segment of I-70 between Denver and Limon

COLORADO LARGE TRUCK ACCIDENT
DIGEST - 1975 FOR INJURY OR FATALITY ACCIDENTS (Cont'd)

96259	70W		Clear	Overturn, hit wall	(1) Tractor-semi	55	68		No	15°	90°	30	Retain wall	Yes	10K	Overturn, wall	3	2B	--	Lumber truck, brake failure, overturned, hit retaining wall
97602	70W		Clear	Collision rear end by (1)	(1) Datsun P. V. (2) Tractor-semi	55 55	40 5		No					No	0	--	0	0	1-B	Truck moving slowly rear ended by pickup
103580	70W		Clear	Ran off road	(1) Truck-semi	55	20		No	20°	30°	5	Ditch	Yes	6K	Impact w/guard rail, O. T.	2	1-C	--	Defective brakes, drivers abandoned, thru rail into ditch
104309	70W		Clear	Ran off road	(1) Truck-semi	55	65		No	10°	-70° -80°	40	Ditch	No	10K	Impact	3	1-A	0	Driver jumped out of truck was hit and killed, truck traveled 1/4 mile along rail, thru & down embankment
910579	70W		Dry	Rolled over	(1) Semi	55	30		No	--	--	30	Guard rail	--	3K	Laid over on guard rails	2	1-B	--	Truck tipped on curve, laid over on rails, possible puncture
904523	70M		Clear	Rear end collision	(1) Nova (2) Tractor-semi	55 55	30 40		No	--	--	--	--	No	25	Impact	0	0	1-D	Car changed lanes, rear ended by truck
905287	70V		Clear	Rear end collision	(1) Tractor-semi (2) Car (3) Van (4) Van	50 50 50 50	55 0 0 0		No	--	--	--	--	No	300	Impact	1	0	1-D 1-B	Vehicle (2), (3) & (4) stopped. Truck didn't, hit (2) with corner of trailer, & (3) with front of cab
906960	70V		Icy	Rear end collision truck hit rail	Tractor-semi plus 6 cars	50	30		No	20°	--	15	Guard rail	No	2000	Impact	1	1-C	5-B 2-C	Truck came upon stop- ped cars on icy road, slid & trailer hit guard rail & rebounded into cars - big mess
908382	70V		Dry	Overturn on- to exit ramp	Tractor-trailer	50	50		No	30°	--	30	Guard rail	Yes	?	Impact roll-over	3	1-B	--	Rolled over exiting I-70. Report is not properly filled out for details
918659	70V		Dry	Rear end collision	(1) Car (2) Tractor-trailer	55 55	50 50		No	--	--	--	--	No	0	--	0	1-D	1-D	Car hit divider and rebounded into path of truck
924310	70V		Dry	Sideswipe	(1) Tractor-trailer (2) Car	55 55	50 50		No	--	--	--	--	No	0	--	0	0	1-D	Truck changed lanes into car, no damage to truck

COLORADO LARGE TRUCK ACCIDENT
DIGEST - 1975 FOR INJURY OR FATALITY ACCIDENTS (Cont'd)

925480	70V		Dry	Sideswipe	(1) Pinto (2) Tractor-semi	55 55	45 30		No	--	--	--	--	No	~0	--	1	0	1-B	Pinto hit brakes, skidded into trailer - truck didn't stop
925717	70V		Dry	Sideswipe	(1) Tractor-semi (2) Pinto	55 55	55 55		No	--	--	--	--	No	~0	--	0	0	1-C	Truck changed lanes, car braked to avoid truck, skid, hit rail then truck, truck didn't stop
928-318	70V		Dry	Sideswipe	(1) Mercury (2) Tractor-semi	55 55	55 50		No	--	--	--	--	No	.01	--	0	0	1-B	Car lost wheel, spun and hit rear duals of trailer
931076	70V		Icy	Rear end collision	(1) Pickup (2) Tractor-semi	55 55	50 20		No	--	--	--	--	No	150	Collision	0	0	0	Car ran into jack-knifing trailer
Accident Report Number	Highway Segment		Road Cond.	Type of Accident	Vehicle Type	Truck Speed			Fire	Angle of Truck Leaving Road or Hitting Rail	Impact			Overturn	Trailer		Severity to Cargo	Injuries		Narrative
	Act.	Sim. to				Posted	Actual				α	V	Sort		Damage	By What		Truck	Other Vehicle	
02782	70E		Dry	Ran off road	Tractor-semi	55	45-50		No	30°	0°	20	Dirt	Yes	5K	Overturn, 20' skid	2	0	--	Truck overturned on exiting, 75' of guard rail wiped out
18738	70E		Icy	Ran off road	Tractor-semi	55	40		No	Broadside (in skid)	-10°	15	Grassy median	No	600	Impact	1	0	--	Truck skidded, went into median, slight damage only
28114	70E		Icy	Collision sideswipe	(1) Tractor-semi (2) Valiant	55 55	40-45 40-45		No	30°	-10°	20	Grassy median	Yes	3K	Overturn	2	1-C	0	Car skid in front of truck, collision ensued, truck turned over in median
30639	70E		Dry	Rear end collision	(1) Mercury (2) Tractor-2 trailers	55 55	55 60		No	30°	None	20	Ditch	No	2K	Trailer broke	2	0	4-B	Truck ran into rear of car, bumpers locked, unlocked, both spun separately into ditch
072095	70E		Dry	Ran off road	Tractor-semi	55	65		No	--	--	50	--	Yes	8K	Overturn, skidding	2	1-C	--	Ran off shoulder, lost control, overturned, skidded 162', 200 of 339 sheep killed

COLORADO LARGE TRUCK ACCIDENT
DIGEST - 1975 FOR INJURY OR FATALITY ACCIDENTS (Cont'd)

084704	70E		Dry	Ran off road- hit rail, bridge	Tractor-semi	55	65		Yes	10°	--	20	Rail, bridge rail	No	13K	Impact	2	1-B	--	Ran off shoulder, hit rail, followed along bridge rail, did not leave road, tractor lost front axle
092607	70E		Dry	Collision with object	Tractor-semi	55	55		No	--	--	--	--	--	0	--	0	1-B	--	Kids dropped chunk of ice thru windshield from overpass
107405	70E		Icy	Ran off road hit rail	Tractor-semi	55	30-35		No	10°	--	25	Rail, grassy median	Yes	1K	Overturn	1	1-B	--	Truck lost control avoiding spinning car, hit rail, rebounded across road into depressed median
107848	70W		Icy	Hit rail - stayed on road	Tractor-semi	55	35		No	10°	--	25	Median barrier	No	2K	Impact w/rail	1	1-D	--	Driver lost control on ice, hit median barrier when truck jackknifed
102184	70W		Icy	Hit rail stayed on road	Tractor - 2 trailers	45	20		No	20°	--	10	Rail	No	3K	Impact w/rail	1	1-C	--	Brakes locked on icy exit ramp, jackknifed, hit rail
093824	70W		Icy	Ran off road non- collision	Tractor-semi	55	45		No	30°	--	20	Rail, Median	Yes	15K	Overturn	2	1-D 1-B		Brakes locked, out of control, into median, across road, thru rail, overturned in ditch
083120	70W		Dry	Collision w/parked vehicle	(1) Tractor-semi (2) Mobile home	55 55	55 0		No	30°	--	25	Rail	No	2K	--	1	--	1-B	Truck hit parked mobile home, left road after collision
065430	70W		Dry	Collision sideswipe	(1) Chev (2) Tractor-flatbed	35 35	80 0		No	--	--	--	--	--	1K	Collision	1	--	1-B	Car sideswiped parked truck (air rest lane) at high rate of speed
053539	70W		Dry	Ran off road	Tractor-semi	55	55		No	20°	--	45	Rail	Yes on top	20K	Overturn	--	1-C	--	Hit unknown object in road, lost control, went over rail, trailer rolled onto top
048434	70W		Dry	Collision sideswipe same dir.	(1) Pickup (2) Tractor-semi	35 35	40 60		No	--	--	--	--	No	--	--	--	1-D 1-D	1-B 1-D	Truck sideswiped car, threw it into retain- ing wall, hit it again and car ended up partially on trailer

COLORADO LARGE TRUCK ACCIDENT
DIGEST - 1975 FOR INJURY OR FATALITY ACCIDENTS (Cont'd)

Number	Highway		Road Cond.	Type of Accident	Vehicle Type	Posted Speed	Vehicle Speed		Fire	Angle of Rail Impact or Leaving	α	V	Surface	Over-turn	Trailer	What Damaged Trailer	Severity to Cargo	Injury Truck	Injury Other Vehicle	Remarks
		Sim.																		
906590	25V	70V	Wet	Collision broadside on road	(1) Tractor-semi (2) Corvette	55 55	45 40		No	10°	--	--	Wall	No	0	--	0	--	1-C	Truck brakes failed, hit wall, deflected back and hit auto broadside
931109	25	70V	Icy	Collision side on road	(1) Subarn (2) Tractor-semi	55 55	35 45		No	--	--	--	--	No	0	--	0	--	1-D	Auto spun, hit wall, rebounded into truck wheels
930003	25	70V	Dry	Collision rear end	(1) Semi (2) Pickup	55 55	50 45		No	None	--	--	--	No	0	--	0	--	1-C 2-D	Pickup stopped for accident ahead, truck unable to stop and struck glancing blow
927116	25	70V	Icy	Collision rear end	(1) Car (2) Semi	55 50	55 50		No	None	--	--	--	No	0	--	0	--	1-B	Auto spun in front of truck
927102	25	70V	Icy	Ran off road	(1) Semi-flatbed	30	30		No	45°	--	30	Sign	Yes	1K	Roll over	2	1-B	--	Truck lost brakes on exit ramp, left ramp, overturned
908090	25	80V	Dry	Collision sideswipe	(1) Semi (2) Gramlin	55 55	45 45		No	--	--	--	--	No	0	--	0	--	2-D	Truck moved into car by changing lanes
090363	25	70V	Icy	Ran off road (retained by media)	Semi, 2 trailers	55	35		No	20°	--	30	Wall	No	3K	Impact	1	1-C	--	Truck out of control, hit media wall bounced back across interstate stayed in
072388	25	70V	Dry	Collision w/object	Semi Chevy	50 50	50 50		No	--	--	--	--	--	0	--	0	--	1-C	Wheel on Chevy in SB lane came off, hit truck in NB lane
10918	25	70V	Icy	Collision rear end by truck	Semi Chevy Ford	55 55 55	25 20 20		No	--	--	--	--	No	0	--	0	--	1-D	Trailer rear ended stopping Chevy, then hit Ford
06720	70	70E	Dry	Collision rear end by truck	(1) Car (2) Semi	55 55	40 70		No	--	--	--	--	No	0	--	0	--	1-A	Truck hit slower car dead center from rear

COLORADO LARGE TRUCK ACCIDENT
DIGEST - 1975 FOR INJURY OR FATALITY ACCIDENTS (Cont'd)

64163	76	70E	Dry	Collision rear end by truck	(1) Car (2) Semi	55 55	45 60		No	40°	--	30	--	Yes	20K	Overturn	2	1-B	--	Truck hit car, lost control, went off road, flipped onto side
060700	76	70E	Dry	Collision head on	(1) Semi (2) Pickup	55 55	55 60		No	20°	--	20	--	No	5K	Jackknifing	1	1-B	1-A	Car down wrong side of interstate - he won't do that again
053702	76	70E	Dry	Ran off road	Semi	35	55		No	20°	30'	20	Rail embankment	Yes 1/4-3/4	Totaled 20K	Rolling impact	3	1-A	--	Lost control on off ramp, hit rail, rolled & turn on road, rolled another 1/2, slid down 30' embankment
04878	76	70E	Dry	Collision head on	(1) Semi (2) Ford	55 55	5 45		No	--	--	--	--	No	0	--	0	--	1-B	Ford coming down wrong side of divided highway truck almost stopped
024882	76	70E	Icy	Collision sideswipe	Ford Semi	55 55	55 45		No	--	--	--	--	No	0	--	0	--	1-C 1-D	Car spun on ice in front of truck, truck continued on road
024879	76	70E	Icy	Collision side	(1) Auto (2) Semi	55 55	20 35		No	--	--	--	--	No	0	--	0	--	2-D	Wind blew empty trailer into car and flicked it into barrow pit
067702	76	70E	Dry	Collision rear end by truck	(1) Auto (2) Semi	55 55	0 55		No	10°	3'	30	Dirt	No	1K	Rough ride	1	1-D	1-C	Truck hit car parked on shoulder
071078	76	70E	Dry	Collision rear end by truck	(1) Semi (2) Pickup	55 55	60 45		No	10°	--	~0	Shoulder	No	200	--	0	--	1-C	Truck rear ended car
21885	76	70E	Icy	Collision rear end by truck	(1) Chev (2) Semi	55 55	30 45		No	90°	--	30	Shallow median	No	1K	Unknown	1	1-D	1-D	Truck rear ended car in snow storm
025407	76	70E	Icy	Collision rear end by truck	(1) Pontiac (2) Blazer (3) Semi	55 55 50	5-10		No	--	--	--	--	No	Slight	Impact	1	--	--	Truck rear ended Pontiac which hit slowly moving Blazer
034792	76	70E	Dry	Ran off road	(1) Semi	55	55		No	10°	--	30	Ditch	Yes	10K	Roll over	2	1-D	--	Wheel dropped off road, overturned in ditch
37344	70	70E	Dry	Collision w/object	(1) Semi	30	30		No	--	--	30	Barrel	Yes	7K	Roll over	2	--	--	Driver ran thru construction barricade, braked & overturned

COLORADO LARGE TRUCK ACCIDENT
DIGEST - 1975 FOR INJURY OR FATALITY ACCIDENTS (Cont'd)

067213	76	70E	Dry	Ran off road overtake	(1) Tanker	30	40		No	20°	~ 5° down	20	Utility pole, sign	Yes 1 1/2 times	15K	Roll over	2	--	--	Lost control on curve, rolled over 1 1/2 times, stopped in ditch, no severe impact
10001	70X	6G	Icy	Overtake on road	Semi	40	30		No	--	--	--	Delineator posts	Yes on side	5K	Roll over	2	1-C	--	Truck hit ice on down grade, jackknifed and rolled
086742	80X	6G	Icy	Collision head on	(1) Semi (22trailer trailers) (2) Ford	40 40	25 35		No	--	--	ΔV ~ 10	--	No	0	--	0	--	1-D	Ford slid into incom- ing lane on ice, hit truck head on
082801	70X	6G	Dry	Ran off road	Semi	55	45		No	30°	Down into creek	45	Boulders rocks	Yes	6K	Ride overtake	3	1-A	--	Driver fell asleep, ran off road (in can- yon), into stream, overtaken
76522	70X	6G	Wet	Collision opposite dir.	(1) Semi (2) Saab	40 40	30 55		No	10°	--	15	Shoulder	No	2K	Impact by car	1	--	1-B	Car failed to negotiate curve, hit trailer of truck coming toward it
024499	70X	6G	Icy	Collision sideswipe opposite dir.	(1) Ford (2) Semi	50 50	45 15		No	--	--	--	--	No	\$375	Impact by car	1	--	1-D	Car spun, hit trailer wheels
21314	6E	6G	Wet	Object in road, ran off road	Semi	50	50		No	25°	--	30	Shoulder	Yes	1K	Roll over	1	1-D	--	Rocks in road blew tire, ran off road, rolled over on shoulder
18784	6E	6G	Wet	Collision side opposite dir.	(1) Semi (2) Van	50 50	0 15		No	--	--	--	--	No	\$200	Impact	0	--	1-B	Rocks in road, truck stopped, van hit rocks spun into trailer wheels
089402	6E	6G	Dry	Collision head on	(1) VW (2) Semi	55 55	55 50		No	40°	--	5	Shoulder	No	3K	Jackknifing	1	1-D	1-A	VW driver asleep, crossed into incoming lane, cars ended up locked on shoulder
055955	50A	6G	Dry	Collision sideswipe same dir.	(1) Blazer (2) Semi	50 50	45 60		No	5°	--	5 when left road	Shoulder	No	None	--	0	--	1-D	Semi trailer side- swiped Blazer, truck stayed on road, Blazer hit embankment
04818	50A	6G	Dry	Ran off road	(1) Semi	50	50		No	10°	~90°	20	Mountain wall	No	20K	Impact	4	1-B	--	Lost control on curve, ran off road into mountain wall, trailer bounced 34', on wheels

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02859	50A	6G	Icy	Collision sideswipe, opposite dir.	(1) Ford (2) Semi	50 50	45 45		No	30°	-20°	25	Down into stream bed	No	6K	Ride, tractor hit tree, fence	2	1-B	1-C	Car spun into truck, truck lost control, off highway into fence, tree, then river
86165	50A	6G	Dry	Ran off road	Semi	55	80		No	10°	-2°	80	2 fences, field	No	500	Ride	1	1-D	--	Truck lost brakes, took off across ditch, thru 2 fences and fields
084992	50A	6G	Dry	Collision rear end by truck	(1) Ford (2) Semi	55 55	20 50		No	--	--	--	Shoulder	No	--	--	0	--	2-C	Car pulled on road in path of truck
077901	50A	6G	Dry	Ran off road	Semi	50	80	Load spilled, badly damaged	No	45°	-60°	60	Rolled down mountain	Yes	10K	Impacts	4	1-A 1-B	--	Lost control on curve, separated trailer rolled, came down mountain
49201	50A	6G	Dry	Collision, sideswipe, opposite dir.	Semi Scout	40 40	65 40		No	--	--	--	--	Yes	10K	Roll over	3	1-C 1-D	2-A 1-B	Truck lost control coming down pass, over turned, steel rod cargo came off and pushed Scout over edge
02802	50A	6G	Snowy	Collision sideswipe opposite dir.	Pickup Semi	50 50	5 25		No	--	--	--	--	Non	None	--	0	--	1-D 1-B	Car spun, hit duals on tractor
102102	50A	6G	Icy	Collision head on	Chev Semi	50 50	50 65		No	--	--	--	Shoulder	Yes.	8K	Impact roll over	2	1-C	3-A	Truck crossed center line, hit car, rolled over in road
077905	50A	6G	Dry	Ran off road	(1) Semi	40	65		No	50°	-10°	40	Embankment	Yes	5K	Impact roll over	2	1-A	--	Lost control on curve, hit embankment, turned over onto top
072231	50A	6G	Dry	Collision rear end by truck	(1) Semi (2) Pinto	45 45	45 0		No	--	--	25	--	No	100	Impact	1	1-B	2-D	Car stopped to turn, truck couldn't stop
14201	50A	6G	Icy	Collision head on	(1) Semi (2) Semi	55 55	35 40		No	--	--	--	--	No	1K 3K	Impact	1	1-A 1-A	--	Both trucks on center line coming around corner in snow storm

COLORADO LARGE TRUCK ACCIDENT
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28564	40A	6G	Snow	Collision side opposite dir.	(1) Datson (2) Semi	35 35	40 40		No	--	--	--	--	No	40	Impact	1	--	1-B	Datson came across center line and hit front of trailer
09973	40A	6G	Snow	Collision head on	(1) Saab (2) Tanker	40 40	40 5		No	--	--	--	--	No	--	--	0	--	1-D	Saab came around curve on wrong side of road and hit front corner of truck
08125	40A	6G	Icy	Collision	(1) Snow plow (2) Semi	55 55	25 40		No	--	--	--	--	No	1K	Impact	1	--	3-C 1-D	Snow plows brakes locked as truck passed, it spun into path of truck
083590	40A	6G	Dry	Ran off road	(1) Semi	50	40	28 cattle killed	No	20°	~90°	35	Dirt	Yes	10K	Roll over	2	1-C	--	Driver fell asleep ran off road, into embank- ment, followed embank- ment 88' & turned over
63235	40A	6G	Dry	Ran off road	Semi and pup trailer	50	50	Fire destroyed vehicles	Yes (8500 gals of gas)	10°	10°	35	Dirt	No	Totaled 30K	Fire	4-5	1-D	--	Ran off road, up em- bankment, came to rest, then caught on fire, completely destroyed
11877	550B	6G	Icy	Collision head on	(1) Chev (2) Semi	40 40	35 25		No	--	--	--	--	No	--	--	0	1-C	--	Car skidded on ice in- to truck
100266	550B	6G	Dry	Ran off road	Semi	40	55		No	60°	-30°	30	Ditch	Yes 2 rev.	20K	Roll over	3	1-C	--	Truck brakes locked, missed curve, rolled over twice going down embankment

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