

LARGE TRUCK CRASH CAUSATION STUDY IN THE UNITED STATES

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ABSTRACT

The United States Department of Transportation has been conducting a major study on the causes of large truck crashes. An unprecedented database containing highly detailed data (over 1,000 data elements) on 1,000 serious large truck crashes is being created. When completed, it will be the most comprehensive database on large truck crashes in existence. The database will be made widely available to researchers around the world.

This paper will describe the many pieces of information in the database and the countless uses of the data. Specific examples will be discussed that illustrate the richness, depth, quality, and the variety of the data.

The paper will also discuss the methods being used to capture and describe the contributing factors and the events that led up to each crash, as well as illustrate the added value of collecting data on-scene, immediately after the crash.

INTRODUCTION

The Large Truck Crash Causation Study (LTCCS) is a three-year data collection project conducted by the National Highway Traffic Safety Administration (NHTSA) and the Federal Motor Carrier Safety Administration (FMCSA) of the United States Department of Transportation (DOT).

The National Highway Traffic Safety Administration is charged with the responsibility of reducing the personal and property losses resulting from motor vehicle crashes. The goal of FMCSA is to reduce the number of commercial truck and bus crashes. Many sources of information are needed to permit researchers to adequately measure the characteristics of the highway safety environment. NHTSA's National Center for Statistics and Analysis (NCSA) operates a system of crash research teams that provide detailed nationally representative statistics on motor vehicle crashes and a database for evaluation of standards and countermeasures design.

BACKGROUND

The Motor Carrier Safety Improvement Act (MCSIA) of 1999 established the Federal Motor Carrier Safety Administration and provided the foundation for NCSA of NHTSA to provide assistance to FMCSA for collection of large truck crash data. The two agencies working together have developed the Large Truck Crash Causation Study (LTCCS), which is being conducted within the infrastructure of the National Automotive Sampling System (NASS). Currently, no national database exists that contains information describing the causes or contributing factors for large truck crashes. The Federal Motor Carrier Safety Administration recognized the importance of having these data and began investigating methods to collect them in the fall of 1998.

LTCCS is the first-ever national study to determine the reasons and associated factors contributing to serious large truck crashes so agencies within DOT can implement effective countermeasures to reduce the occurrence and severity of these crashes. Teams of trained researchers from NHTSA's NASS program and State truck inspectors are collecting nationally representative data on the factors contributing to serious large truck crashes.

NHTSA is authorized by Congress (Volume 49 of the United States Code, Section 30166, 30168 and Volume 23, Section 403) to collect statistical data on motor vehicle traffic crashes to aid in the development, implementation and evaluation of motor vehicle and highway safety countermeasures. NASS is the mechanism through which NHTSA collects nationally representative data on motor vehicle traffic crashes.

Researchers under contract to NHTSA and FMCSA-funded State truck inspectors are collecting information on a sample of large truck crashes. NASS researchers depend on the voluntary participation and cooperation of law enforcement agencies, hospitals, physicians, medical examiners, coroners, tow yard operators, garages, vehicle storage

facilities, and the individuals involved in crashes. Cooperation is established with police agencies and hospitals to provide copies or transcripts of official records. Tow yards, police impound yards, and crash involved parties are contacted to obtain permission to inspect vehicles. Personal or telephone contact is made with interviewees to obtain information about occupant characteristics and crash circumstances.

Regardless of the mode of data collection, the agencies and individuals are assured by the NASS researcher that any information obtained that identifies the individual will be held confidential. The preservation of the privacy of individuals is statutorily mandated. This requirement serves to ensure the public's trust in the program and enhances the researcher's ability to solicit the required information.

NASS Infrastructure

The NASS mission is to provide nationally representative data on fatal and nonfatal motor vehicle traffic crashes for use in developing and evaluating federal motor vehicle safety standards and other safety countermeasures. NASS operates in 60 sites throughout the contiguous United States (Figure 1). At 24 of these sites, in depth crash investigations are conducted in the Crashworthiness Data System (CDS). These same sites, called Primary Sampling Units or PSUs, are being used for the LTCCS.

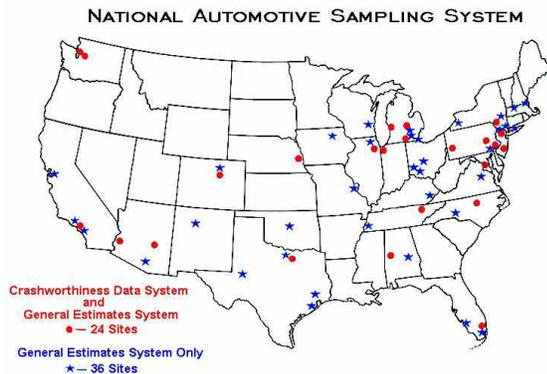


Figure 1. NASS Site Locations.

The field data collection operation of the crash research teams, maintenance of field research quality, and technical guidance for each PSU are the primary responsibilities of two contractors. These contractors are referred to as Zone Centers. Zone Centers serve as resource centers providing the teams with expert technical guidance in crash investigation. The Zone Centers monitor closely the performance and productivity of each PSU under close supervision by

NHTSA. NHTSA has overall policy and administrative management of the project.

NASS was selected for this study because: it has been designed to provide nationally representative data randomly selected from police traffic crash reports; it provides quality assurance at multiple levels to ensure data completeness, accuracy, reliability, consistency, and timeliness; it offers quality assurance to identify trends and problems in field data collection methods; it offers quality assurance to identify, measure, and control errors; it has an established training program to teach the basics of crash investigation, to improve data collection skills, and provide remedial training; the data collected are kept confidential to ensure the public trust and enhance the program's ability to solicit required information from crash victims; and, the data are publicly made available for others to clinically review and analyze.

The NASS infrastructure has the capability to establish operational procedures at multiple locations, promote rapid start-up procedures for special data collection efforts, provide real-time investigations, and release timely reports of crash data. The NASS program has been in existence for over two decades and operationally has developed experience in the establishment and maintenance of close relationships with local agencies. This experience has helped NHTSA to successfully launch and conduct unique studies such as the Large Truck Crash Causation Study.

FIELD DATA COLLECTION METHODOLOGY

There were a number of issues/concerns associated with the proposed large truck crash causation study. It has been documented in preceding crash investigation efforts that large trucks tend to be moved from the immediate vicinity of the crash site in a relatively short time frame. This is particularly evident in circumstances where a national or regional carrier owns the commercial vehicle. These units tend to be moved to regional repair centers either to be repaired and placed back in service or to be stripped for parts. Given this tendency, it was critical to the success of the program to initiate investigation activities relatively quickly following the crash occurrence.

An on-scene investigation response protocol was developed, as opposed to a reactive approach (follow-on investigation), to meet the large truck study requirements of gathering in-depth crash

related data in a timely manner. Since the start of this study, experience has shown that the availability of crash data often diminishes with the passage of time. When the case investigation is initiated one to several days after the crash, vehicles towed from the scene tend to be more difficult to locate, and when located, frequently are undergoing repair, have been repaired, or have been processed through salvage. In the case of interstate trucks, this situation is further complicated by the transient nature of these vehicles, as the potential for them to leave the area before being inspected is understandably high.

On-scene presence by the NASS truck researcher and State truck inspector provides the capability to obtain vehicle and interview data that may not have been available in a reactive post-crash environment. As an example, the overall length of the vehicle (total length of the vehicle including projections beyond the front and rear planes) is more accurately measured in the field than obtained later from other sources. Interviewee responses to questions tend to be less biased at the scene than away from the scene. Another advantage of on-scene presence is the opportunity to establish a rapport with the interviewee at the scene, which makes it possible to conduct a more in-depth follow-up interview.

It is noteworthy that the on-scene investigative approach signifies the first time in NASS history (and perhaps in the history of crash data studies) that police investigators, certified Commercial Vehicle Safety Alliance (CVSA) Level 1 State truck inspectors, and NASS truck researchers have combined their efforts and agreed to simultaneously respond to a crash scene. This unique arrangement, although initially thought to be difficult to achieve, has developed into a first rate network among on-scene responders, yielding several important results. These results include a higher rate of participation by crash victims, a higher quality of interview and vehicle information, and a better understanding of the crash events. Additionally, these results have been achieved without compromising enforcement rules or research protocols. The police and CVSA State truck inspectors have maintained their responsibility for enforcing traffic laws and safety regulations while NASS has maintained its obligation of ensuring research data confidentiality.

Investigation Team Structure

A team of two individuals completes the investigation protocol utilized for each crash in this study. Primary responsibility for each investigation is assigned to the NASS truck researcher at the

designated data collection site. A certified State truck inspector who completes a limited number of investigation activities assists this individual. Since these individuals are not at the same office location, the NASS truck researcher is assigned responsibility for tracking the location of the truck unit(s) and for contacting the appropriate State truck inspector. If the truck inspection cannot be conducted at the crash scene with the state truck inspector, then the NASS truck researcher will make arrangements for completion of the truck inspection sequence at an alternative location.

Team Data Collection Responsibilities

The NASS truck researcher is assigned primary responsibility for case completion (See Table 1). The role of the State truck inspector is to complete the North American Level 1 truck inspection and secure the cooperation of truck drivers and trucking companies in completing required interviews. Information collected by the NASS truck researchers is not shared with the State truck inspectors in order to maintain the separation between a research study and law enforcement responsibilities.

In addition to these specific responsibilities, the NASS truck researcher monitors the post-crash location of the large truck unit(s) and schedules the Level 1 inspection sequence. The NASS truck researcher is also present for the inspection sequence and secures photographic documentation of relevant inspection findings.

On-scene Investigation Sequence

The sequence of data collection activities varies from crash to crash and is dependent upon the number of vehicles and participants involved, and the amount of time available before the crash scene is cleared. The NASS truck researcher is required to obtain a set of digital images of the scene with emphasis on pre-crash vehicle trajectory, impact, and final rest position(s). These images provide crucial data that are used in the assessment of crash events. Additionally, views of the involved vehicles are very important as the vehicles, especially interstate vehicles, may not be available after the scene is cleared. Areas of photographic interest include alleged mechanical defects (e.g., degraded brake hoses, worn reflective tape, defective tires, suspension defects, etc.), location and severity of vehicle damage, vehicle placard information (e.g., Gross Vehicle Weight Rating (GVWR), Vehicle Identification Number (VIN), etc.), and overall vehicle exterior and interior views.

**Table 1.
Team Data Collection Responsibilities**

NASS Truck Researcher	State Truck Inspector
<ul style="list-style-type: none"> • Document physical evidence at scene • Perform all non-commercial vehicle inspections • Document commercial vehicle damage documentation • Conduct all driver and witness interviews • Conduct all trucking company interviews • Acquire medical reports • Acquire police crash report • Complete forms • Submit case materials 	<ul style="list-style-type: none"> • Interact between police and NASS truck researcher • Conduct Level 1 truck inspection • Inspect truck driver log book • Secure permission, if necessary, from police officer at scene to inspect truck • Facilitate communication between truck driver and trucking company with NASS truck researcher • Provide on-scene photographs if taken by inspector/police

The NASS truck researcher works with the State truck inspector and observes the vehicle inspection process, including the review of mechanical components (e.g., brake stroke measurements, suspension, lighting, reflective tape, tires, etc.), observes the types of cargo loads and loading pattern, and reviews the driver logs. Any vehicle defects noted by the State truck inspector are reported to the NASS truck researcher and recorded on data collection forms.

The NASS truck researchers have attended the intensive Commercial Vehicle Post Crash Inspection Training Course (T.E.A.M.- Training Expertise in Accident Management) to gain an appreciation of truck regulations that has helped when interacting with the State truck inspectors. Likewise, many State truck inspectors have attended the NASS truck study training to gain an appreciation of program requirements. The purpose of this cross training was to help understand the responsibilities of each at the crash scene and to build relationships between researchers and inspectors.

Scene evidence documentation is another priority and is best obtained while on-scene. Researchers have noted that physical evidence captured in on-scene photography has degraded or vanished when they returned for follow-up investigation. Researchers are required to document pre-impact tire marks (e.g., skid marks, yaw marks, etc.), the point of impact(s), and final rest positions of vehicles. They also document several key items including roadway design, traffic control devices, environmental conditions, and sightline restrictions. While the scene evidence is easier to obtain when the roadway

is closed to traffic, many of these tasks understandably require considerable time to complete and often require a return visit after the scene is cleared.

Interviewing crash participants is clearly the most important aspect of the LTCCS. During an on-scene investigation, the NASS truck researcher conducts interviews with the truck driver(s), the other driver(s), and any witnesses to ascertain precrash events. Given the fact that agreeing to an interview is a voluntary act by the interviewee, the researchers have noted that the presence of law officials has helped them in gaining acceptance by the interviewee. Police and State truck inspectors have generally taken an active role in supporting this research effort and encourage participants to discuss the crash events with the NASS truck researcher.

Unfortunately, there have been a small number of crash participants who were unwilling to discuss precrash events with the NASS truck researcher while on-scene, especially when criminal charges were pending or where the driver (in the case of a truck driver) has been instructed by the carrier not to discuss aspects of the crash. Even in those circumstances, the NASS truck researcher has been able to glean information from the participants just by being in the vicinity and listening to statements as they are given to other individuals.

The NASS truck researcher has also been trained to observe driver behavioral patterns for indications of fatigue (e.g., speech pattern, the driver's posture, blood shot eyes, etc.). This was exemplified in one crash where the truck driver indicated that he had

sufficient sleep and claimed he had encountered mechanical difficulties resulting in the crash. His initial statement appeared compelling, but it began to unravel as he was observed dozing while waiting in the police car. This and other data in this particular case indicated that the driver had fallen asleep prior to departing the roadway.

In some cases, the crash participants have been removed from the scene and transported to medical treatment facilities. The NASS truck researcher subsequently visits the medical facility and attempts to obtain an interview. In most cases, the interviewee is very cooperative as the person realizes that the NASS truck researcher does not pose a legal threat.

Field data collection forms were designed to record data in an efficient manner and to provide a guideline for the NASS truck researcher. The NASS truck researcher attempts to complete all relevant forms at the scene, however, information that cannot be obtained on-scene is obtained as soon as possible afterward.

Modification of Current Cooperative Agreements

Currently, cooperative agreements with police jurisdictions exist because of the infrastructure established by NHTSA to conduct the NASS program. These agreements had to be modified in order to conduct the study requirements of this large truck crash causation study. Successful completion of the truck study required that the investigation teams receive timely notification of the crash occurrence from the local police jurisdictions. This is necessary to ensure that truck documentation protocols can be completed before the unit is removed from the immediate vicinity of the crash site. New cooperative agreements with participating police agencies have been negotiated to include securing direct notification of a crash occurrence. The team must respond rapidly to the crash site while the vehicles are on scene to obtain critical evidence before it disappears. It is advantageous to begin documentation procedures soon after the crash incident.

In addition to providing crash notification, the cooperative agreements with the local police provide the names of applicable towing agencies and the intended destination of at least the truck unit from the dispatcher or responding officer. Upon receipt of notification, the NASS truck researcher contacts the

intended destination site of the truck unit and schedules vehicle inspection activities.

This study needed well-established cooperative agreements with State truck inspectors and other local police agencies in order to collect the data needed for the project.

Notification Criteria

One important part of the notification process is how to determine eligible crashes. Trucks involved in the crash must be greater than 10,000 pounds and the crash must result in a police-reported injury level of “K”, “A”, or “B”. Threshold vehicle types like the Ford F350 and F450 can be difficult to categorize; however, pickup trucks above the F350 series and similar trucks from other manufacturers are eligible for this study. Injury levels are defined on police reports by the standard KABCOU injury-coding scheme. Police officers or State truck inspectors responding to the scene visually define injuries as “K” for killed, “A” for incapacitating injury, “B” for evident but non-incapacitating, “C” for possible injury or complaint of pain, “O” for no injury, and “U” for injury status unknown. Definitions of injuries are in the glossary. Determining the injury level at an on-scene crash can be difficult for the responding police officer or State truck inspector and becomes a judgmental issue as to whether or not to notify the NASS truck researcher. When injury classification at the scene is difficult, the NASS truck researcher may follow the victim to the hospital to better evaluate the injury level before determining its eligibility for the study.

Notification Process

Figure 2 graphically represents a general description of the notification and communication network developed for the Large Truck Crash Causation Study. A typical scenario is once a crash occurs the police dispatcher is usually notified through “911.” The police dispatcher alerts the police officer on-duty who responds to the scene. The responding police identify the involvement of a large truck and report back to the police dispatcher. The police dispatcher calls a state truck inspector who also responds to the scene of the crash. The eligibility of a crash for LTCCS is determined by the state truck inspector who then calls the NASS truck researcher via a cell phone about the eligible crash. The NASS truck researcher responds to the scene as soon as possible.

Notification - Communications



Figure 2. Notification/Communication Process.

The NASS truck researcher may be notified through other outside sources such as media, personal observation or other team members using police scanners.

NASS truck researchers are available 24 hours a day, 7 days a week except at locations where more than 80 crashes are expected to occur annually. If more than 80 crashes are expected, then an alternative plan will be designed to randomly select eligible crashes. At one study site, because of the high volume of eligible truck crashes, every other crash is selected. State truck inspectors typically work shifts and there may be blackout periods where no State truck inspector is available. Regardless of the State truck inspectors' duty hours, the NASS truck researcher, if notified, will respond as quickly as is feasible.

Sample Design of LTCCS

The crashes investigated for the LTCCS are a probability sample of all large truck crashes in which at least one person was killed or injured in the United States. Using the infrastructure of the National Automotive Sampling System Crashworthiness Data System (NASS CDS), the number of crashes involving at least one large truck and at least one person involved that was killed or injured can be estimated. Standard errors associated with these national estimates will be computed. The selection of crashes for the LTCCS is being accomplished in two stages. The first stage is the selection of geographic areas called Primary Sampling Units (PSUs). The

United States has been divided into 1,195 PSUs where each PSU is comprised of a large city, a county, or a group of counties. The PSUs are grouped into 12 categories described by geographic region (Northeast, Midwest, South, West) and degree of population (central city, large county, and group of counties). Two PSUs were selected from each category with probability proportional to its 1983 population.

Since the majority of the PSUs will investigate all of the qualifying large truck crashes that occur within their area, the national estimate for these crashes is obtained by weighting each crash in the PSU by the inverse of the probability of the selection of the PSU.

For those PSUs that have too many crashes to investigate, a sample of qualifying large truck crashes will be selected. That is, for every n th qualifying crash that the PSU is notified of, one crash will be selected for investigation. The n th crash is called the interval. This is the second stage of the sample design. The national estimate for these crashes is equal to the product of the interval and the inverse of the probability that the PSU was selected. The crashes eligible for the LTCCS are identified at the on-scene investigation. Therefore, it is critical that the NASS truck researcher at the PSU be notified by the police that a qualifying large truck crash occurred. Unfortunately, the NASS truck researcher is not always notified that a large truck crash occurred. Therefore, to adjust for the non-notified LTCCS crashes, the national estimate for each crash

will be multiplied by an adjustment factor. The adjustment factor is equal to the number of qualifying large truck crashes listed by the PSU divided by the number of crashes selected

Data Collection Elements

The sources for the information collected in this study come from the North American Standard Level 1 inspection report completed by State truck inspectors for the truck and truck driver, the police crash report, the NASS researcher's reconstruction data, interviews, medical reports, motor carriers, and any other data source that can contribute to the understanding of the crash events and circumstances.

Field data collection forms were designed to record data in an efficient manner and to provide a guideline for the NASS truck researcher. Forms taken on-scene include: Collision Diagram Measurement Table, General Vehicle Form, Exterior Truck Form, Exterior Vehicle Form, Truck Driver Interview Form (A), Surrogate Truck Interview Form (A), Other Driver Interview Form (B), Surrogate Other Driver Interview Form (B), Motor Carrier Interview Form (C), Witness Interview Form (D), and Nonmotorist Interview Form (E).

A general outline of data elements contained in each data collection form is listed below by category.

- **General Crash Data**
 - Crash Summary Description
- **Collision Diagram Measurement Table**
 - Document physical evidence
 - Document vehicle dynamics
- **Collision Diagram**
- **General Vehicle Data**
 - Vehicle Identification
 - Official Records
 - Pre-crash Environmental Data
- **Exterior Truck Data**
 - Vehicle Identification
 - Cargo Information
 - Truck Conspicuity
 - Exterior Mirror Data
 - Crush Measurements
 - Vehicle Damage Sketch
 - Level 1 Inspection Results
- **Interior Truck Data**
 - Truck Occupant Contact Sketch
 - Points of Truck Occupant Contacts
- **Interview Forms for Truck Drivers and Other Drivers**
 - Driver's Description of Crash Events
 - Occupant's Description of Crash Events
 - Crash Data Driver Related Data
 - Rollover Data
 - Fire Data
 - Jackknife Data
 - Cargo Shift Data
 - Fatigue Issues
 - Driver Physical Condition
 - Inattention/Distracted Issues
 - Perception/Decision Issues
 - Aggressive Driving Issues
 - Trip Related Data
 - Vehicle Related Data
 - Occupant Data Questions
 - Restraint Information
 - Ejection, Entrapment, Mobility Information
 - Injury Information
- **Interview Form for Motor Carriers**
 - Carrier Information Vehicle Information
 - General Driver Information
 - Detailed Crash-Involved Driver Information
 - Crash Trip Information
- **Interview Form for Witness**
 - Description of Crash Events
 - Crash Data Information
- **Interview Form for Nonmotorist**
 - Description of Crash Events
 - Nonmotorist Demographic Data
 - Crash Data Information Physical Condition
 - Fatigue Issues
 - Inattention/Distracted Issues
 - Decision Issues
 - Performance Issues
 - Injury Information
- **Occupant Assessment Data**
 - Occupant Characteristics
 - Seating
 - Ejection/Entrapment
 - Belt System Function
 - Police Reported Restraint Use
 - Air Bag System Function

- Injury Consequences
- Trauma Data
- Belt Use Determination
- **Occupant Injury Data**
 - Source of Injury
 - Body Region
 - Type of and Specific Anatomic Structure
 - Level of Injury
- **Crash Event Assessment Data**
 - Pre-crash Event Related Data
 - Key Pre-crash Event Characteristics
 - Critical Event Associated Factor Support Data
 - Driver Related Physical Factors
 1. Alcohol Use
 2. Illegal Drug Use
 3. Over-the-Counter Medication Use
 4. Prescription Medication Use
 5. Driver Fatigue
 6. Illness
 7. Vision
 - Driver Related Recognition Factors
 1. Inattention
 2. Conversation
 3. Other Non-Driving Activities
 4. Exterior Factors
 5. Inadequate Surveillance
 - Driver Related Decision Factors
 1. Following Too Closely
 2. Misjudgment of Gap Distance to Other Vehicle
 3. False Assumption of Other Road User's Actions
 4. Illegal Maneuver
 5. Inadequate Evasive Action
 6. Aggressive Driving Behavior
 - Driver Related Emotional Factors
 1. Driver Was Upset Prior to Crash
 2. Driver Under Work-Related Pressure
 3. Driver Was in a Hurry
 - Driver Related Experience Factors
 1. Vehicle Familiarity
 2. Roadway Familiarity
 - Relation with Carrier/Employer Factors
 1. Under Pressure To Accept Loads
 2. Under Pressure To Operate
- Traffic Flow Related Factors
 1. Traffic Flow Interruption Factors
- Vehicle Factors
 1. Vehicle Condition Related Factors
- Environmental Related Factors
 1. Roadway Related Factors
 2. Weather Related Factors

Post-crash Activities

After the data have been electronically entered into the LTCCS database, the case information is forwarded to the Zone Center where experienced staff determine the crash event assessment for the crash occurrence, injuries sustained by occupants of all involved motor vehicles, sources for those injuries, and speed reconstructions.

The crash event assessment for a crash occurrence consists of three elements for each vehicle involved in the crash: the “critical precrash event”; the “critical reason for the critical event”; and “associated factors”.

The “critical precrash event” is the action or event that placed the vehicle on a collision course such that the collision was unavoidable given reasonable driving skills and vehicle handling. In other words, the “critical precrash event” makes the crash inevitable. The “critical precrash event” is typically coded in relation to a pedestrian, nonmotorist, object, other motor vehicle, or animal that the subject vehicle was attempting to avoid. It is important to note that culpability/fault is not considered when making the “critical precrash event” determination.

The “critical reason for the critical event” is the immediate reason for this event and is often the last failure in the causal chain (i.e., closest in time to the “critical precrash event”). This variable establishes the critical reason for the occurrence of the critical event. Although the critical reason is an important part of the description of crash events, it is not the cause of the crash nor does it imply the assignment of fault. The primary purpose for the “critical reason for the critical event” is to enhance the description of crash events and allow analysts to better categorize similar events.

NASS truck researchers collect a wide range of data on the presence of “associated factors” in the crash. Associated factors can be related to driver physical factors, driver recognition factors, driver decision factors, driver emotional factors, driver experience

factors, relation with carrier or employer, traffic flow, vehicle condition, or environment. In some cases, the presence of a particular factor may be ambiguous. Therefore, the observation of the driver by the NASS truck researcher at the scene before, during, and after the crash is critical to the identification of many “associated factors”. Identifying factors are important in order to provide additional information about the crash so that it can be described completely and hypotheses created that are related to crash risk.

CURRENT STATUS REPORT

This three-year study consists of three phases: six months for preparation and pilot testing; two years for field data collection; and, six months for completion and analysis. The pilot test began in January 2001 and ended June 30, 2001. Cases from the pilot test continue to be updated as variables are added and improvements to the system are implemented. Since field operations went smoothly at the end of the pilot study, the regular data collection phase of LTCCS began on July 1, 2001.

Through December 2002, 18,695 crashes involving large trucks occurred at all 24 study locations. Of these crashes, 12 percent (2189 crashes) satisfied the study criteria. Active NASS truck researchers received notification on 5 percent (957 crashes) of the large truck crashes and initiated investigations on 69 percent of those notifications (662 crashes).

EARLY CASES – PRELIMINARY TALLIES

Preliminary tallies of the LTCCS data are presented here to give an overview of the types of crashes being investigated, as well as to give an idea of future potential analyses. Out of the many variables being collected, a few were chosen to demonstrate the level of detail of the study. Tables that currently appear rather sparse are expected to become well populated as the case count increases. Note that no tally of “crash cause” exists, since, as mentioned previously, the LTCCS approaches a crash as a series of events with associated factors that may or may not increase the risk of a crash.

Only after data quality control and applications of weighting factors will it be possible to make meaningful national estimates from LTCCS data. As mentioned above, preliminary tallies can provide some insight into the types of cases being collected in the study; the tabulations in this paper are meaningful only for those purposes. **No national estimates of proportions, relationships, or risks should be inferred from them.**

Tallies in this paper include summations of certain variables at the crash level (where the characteristic of interest applies to the *crash* as a whole) and at the vehicle level (where the characteristic of interest applies to each *vehicle* in the crash). At either level, the tabulations are divided into the following subject matter areas:

- Crash Types
- Vehicles
- Drivers
- Injuries
- Crash Event Assessment and Associated Factors

Until the study is complete, the database is constantly being updated as new cases are initiated and as new data are entered on older cases. Each case goes through several levels of quality control during which values of previously coded variables can change. At the time this paper was completed, the LTCCS data file contained over 750 cases in various stages of completion. For the purpose of the preliminary data tallies presented here, only cases closer to completion and in the advanced coding stages were queried.

Cases included in the tallies in this report were from the pilot study and are in advanced coding stages. This means that data collection has been completed and coding of the crash event assessment form has been completed to a certain degree. As with every study, there is, to a certain extent, a learning curve over which techniques and documentation improve. Since the cases presented here represent the early cases, some data values are likely to be missing. In the following tables, when a tally includes data points with values that are missing or yet to be determined, those points are tabulated in the category “Incomplete Coding.”

Each variable has several attributes. The tables show only the variable attributes for which there was a value; categories with counts of zero have been omitted.

Crash Types

As of January 10, 2003, 750 LTCCS cases had been initiated, and 159 had been completed through advanced stages of Zone Center coding. These 159 are the basis of the tallies in the following sections. They have involved 166 large trucks and 153 other vehicles in single or multi-vehicle crashes. Table 2 summarizes the number of cases by the type of crash. Multiple vehicle crashes involve two or more vehicles with at least one of the vehicles being a large truck.

Table 2.
Number of Cases by Type of Crash
LTCCS Coded Crashes Through January 2003

Type of Crash	Cases
Single Vehicle	34
Multiple Vehicle	125
Total	159
Source: Large Truck Crash Causation Study: Preliminary Tallies, January 2003, NCSA, NHTSA No National Estimates or Analysis Should be Inferred from Preliminary Tallies	

The first harmful event is the first damage or injury-producing event in the crash. It is determined and coded for each vehicle in the crash.

Table 3 shows that for both trucks and all other types of vehicles, the most frequent first harmful event was a collision with another vehicle that was in motion. Collisions with non-occupants and with parked vehicles were relatively infrequent. The second most prevalent first harmful event for trucks was rollover (i.e. overturn).

Table 3.
Number of Involved Vehicles by First Harmful Event and Involved Vehicle Type
LTCCS Coded Crashes Through January 2003

First Harmful Event	Involved Vehicle Type	
	Truck	Other Vehicle
Non-Collision Events		
Overturn	18	0
Other Non-collision	1	0
<i>Subtotal</i>	<i>19</i>	<i>0</i>
Collision Events		
Pedestrian	4	0
Pedalcycle	2	0
Railway Train	1	0
Motor Vehicle in Transport	121	123
Parked Motor Vehicle	1	3
Concrete Traffic Barrier	6	4
Guardrail	4	2
Embankment – Earth	3	0
Other Post, Pole, or Support	3	0
Other Object (Not Fixed)	0	1
Tree	1	0
Thrown or Falling Object	0	5
Injured in Vehicle	0	1
Incomplete Coding	1	13
<i>Subtotal</i>	<i>147</i>	<i>153</i>
Total	166	153
Source: Large Truck Crash Causation Study: Preliminary Tallies, January 2003, NCSA, NHTSA No National Estimates or Analysis Should be Inferred from Preliminary Tallies		

Vehicle Types

The LTCCS pays due attention to the types of vehicles involved in large truck crashes. Detailed information is recorded on the vehicle body type and cargo body type of each truck in a sampled crash. “Combination Truck” is used to represent all tractor-trailers, including bobtails (tractors hauling nothing) and tractors hauling one or more trailers. There have been 58 single unit trucks and 108 combination trucks coded in LTCCS cases. Table 4 displays the numbers of involved vehicles by vehicle body type. For display purposes, the different configurations have been combined into main categories. Combination trucks also include single unit trucks pulling a trailer.

Table 4.
Number of Involved Vehicles by Body Type
LTCCS Coded Crashes Through January 2003

Vehicle Body Type	Involved Vehicles
Single Unit Trucks	58
Combination Trucks	108
<i>Trucks Total</i>	<i>166</i>
Passenger Cars and Light Trucks	151
Other Vehicles	2
<i>Non-Truck Vehicles</i>	<i>153</i>
Total	319
Source: Large Truck Crash Causation Study: Preliminary Tallies, January 2003, NCSA, NHTSA No National Estimates or Analysis Should be Inferred from Preliminary Tallies	

Trucks are further classified in the LTCCS according to their cargo body type, a description more specific than the vehicle body type of Table 4. From the cases in the pilot study, many body types have been sampled and investigated. Van-type trucks and dump trucks have been most frequently involved. Table 5 gives the numbers of involved trucks by cargo body type. For vehicles hauling more than one cargo type, the code used in these tallies was determined by the cargo type in the first trailer, or in the case of a single unit truck pulling a trailer, the cargo in the single unit truck.

The cargo body types most frequently seen in the LTCCS so far have been vans and dump trucks.

Table 5.
Number of Involved Trucks by Cargo Body Type
LTCCS Coded Crashes Through January 2003

Cargo Body Type	Involved Trucks
Van	63
Open Top Van	3
Refrigerated Van	14
Livestock Carrier	2
Flatbed	11
Low Boy	3
Flatbed with Equipment	4
Flatbed with Sides	1
Pole/Logging	2
Tank	7
Auto Carrier	2
Dump	30
Garbage/Refuse	3
Cement Mixer	2
Other (Specify)	11
Unknown	8
Total	166
Source: Large Truck Crash Causation Study: Preliminary Tallies, January 2003, NCSA, NHTSA No National Estimates or Analysis Should be Inferred from Preliminary Tallies	

Drivers

Information about involved drivers is important to any crash investigation. In the LTCCS, investigators collect demographic information about truck and non-truck drivers as well as interview them and others for additional information. In the early LTCCS cases, most truck drivers were between the ages of 26 and 55 while the age of drivers in other vehicles was generally more distributed. Table 6 shows the distribution of driver ages seen so far in the LTCCS.

Table 6.
Number of Drivers by Age and Involved Vehicle
LTCCS Coded Crashes Through January 2003

Driver Age (Years)	Involved Vehicle Type	
	Truck	Other Vehicle
16-20	2	20
21-25	9	16
26-30	21	23
31-35	26	15
36-40	25	13
41-45	30	22
46-50	19	8
51-55	13	5
56-60	8	11
61-65	5	6
66-70	4	2
71-75	0	2
76 or Older	0	7
No Driver Present	4	3
Incomplete Coding	0	0
Total	166	153

Source: Large Truck Crash Causation Study: Preliminary Tallies, January 2003, NCSA, NHTSA
No National Estimates or Analysis Should be Inferred from Preliminary Tallies

Injuries

To qualify as an LTCCS case, a large truck crash must involve at least one police-reported injury of level “K” (Killed), “A” (Incapacitating Injury), or “B” (Non-Incapacitating Injury) on the standard “KABCOU” scale (Appendix). Due to the nature of the study, many cases were investigated that had minor or no injury. The investigations are completed prior to the availability of the police report; therefore injury level has not yet been confirmed. In addition, some cases without known injuries were investigated for experience-gaining purposes during the pilot study and in the early months of the study. These

cases will be statistically weighted accordingly in the final data set.

Injuries are recorded as occupant-level variables, but occupants are recorded as being within vehicles, and vehicles are recorded as being within cases. Thus it is simple to determine the maximum injury level within a vehicle or within a case. In the initial 159 cases, 32 crashes have had at least one occupant with a fatal injury. The largest category for maximum injury level has been “A” or incapacitating injury, appearing in 51 cases. Table 7 shows the number of cases by maximum police reported injury level in the early LTCCS cases.

Table 7.
Number of Cases by Maximum Injury Level
LTCCS Coded Crashes Through January 2003

Maximum Injury Level	Cases
K – Killed	32
A – Incapacitating Injury	51
B – Non-incapacitating Injury	48
C – Possible Injury	17
O – No Injury	11
Total	159

Source: Large Truck Crash Causation Study: Preliminary Tallies, January 2003, NCSA, NHTSA
No National Estimates or Analysis Should be Inferred from Preliminary Tallies

Crash Event Assessment and Associated Factors

After the researcher in the field collects all of the data from the scene, through interviews, from the motor carriers, etc., the case is sent to the Zone Center for quality control and coding of the Crash Event Assessment Form. This form is used to summarize the events of the crash and the associated factors to those events, using all of the other data in the case.

According to a method developed by K. Perchonok, each crash has a sequence of events leading up to it. There is no one specific cause of a crash; rather, there exist several contributing factors and related events. The “critical event” is that which is the last in the chain of events after which the crash becomes imminent. The “critical reason” describes why the critical event took place. These two variables are located on the Crash Event Assessment Form.

There are a variety of environmental and other factors such as weather conditions, time of day,

lighting conditions, the driver's physical condition, and attentiveness that can be considered factors possibly associated with the crash. The LTCCS researchers code the levels of many such variables regardless of whether they contributed to the crash. At the end of the study, through statistical analyses, the relative risk approach will help determine whether certain conditions contribute to crashes. However, for reasons discussed earlier, the set of 159 coded LTCCS cases is not weighted for statistical evaluation. To show the kinds of cases being investigated that will eventually be available for analysis, the following section provides preliminary tabulations of the critical reason for the critical event.

The "critical reason for the critical event," tallied in Table 8, is the immediate reason for the event and is often the last failure in the causal chain. Critical reason can be subjective in nature and is determined at the Zone Center by the case reviewer using all available information in the case. There are many attributes for this variable; therefore the driver related factors are categorized into groups for display purposes. The most frequent driver-related critical reason in the preliminary LTCCS data was inadequate surveillance, one of the recognition errors.

It is important to note that where a vehicle's critical event is coded as the action of another vehicle, the critical reason field is usually given the code "Critical Event Not Coded to this Vehicle." Thus the relatively large counts in Table 8 for that category do not signify missing data.

There were seven single vehicle crashes where the critical reason was "critical event not coded to this vehicle." Examples include a crash that resulted from an avoidance maneuver due to a pedestrian in the roadway and a critical event that was coded to a non-contact vehicle.

Other Variables

The preceding tables cover only a fraction of the variables being collected (over 1,000 coded data elements) in the LTCCS. Each LTCCS investigation gathers detailed information on many other crash characteristics, including (but not limited to):

- Pre-crash environmental data
- Roadway surface conditions/defects
- Cargo weight
- Pedestrian/pedal cyclist/skater data
- Federal rating of motor carrier
- Truck conspicuity
- View line obstructions

- Cargo shift
- Driver citation history
- Driver years of experience
- Driver second job
- Driver hours on duty/schedule/over hours
- Driver physical condition/medications
- Driver sleep conditions/patterns preceding crash
- Suspected aggressive driving behavior (noted by researcher)
- Driver attention issues
- Driver perception issues

CONCLUSION

Upon completion of the study, using national estimates, data on such factors can be mined for associations among themselves and with various crash scenarios, outcomes, and relative risks. Some ideas for testing hypotheses of association among factors and outcomes could include the following:

- Override or underide vs. the presence of truck underide guards
- Truck conspicuity vs. lighting conditions
- Vision-related crashes vs. the presence of supplemental mirrors
- Driver fatigue vs. first harmful event
- Record of previous violations vs. crash involvement

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Table 8.
Number of Involved Vehicles by Critical Reason, Crash Type, and Involved Vehicle Type
LTCCS Coded Cases Through January 2003

Critical Reason	Crash Type		
	Single Vehicle	Multi-Vehicle	
	Truck	Truck	Other Veh.
Driver			
Critical Non-performance	5	1	11
Recognition Error	3	16	27
Decision Error	7	18	14
Performance Error	4	4	5
Type of Driver Error Unknown	0	1	8
<i>Subtotal</i>	<i>19</i>	<i>40</i>	<i>65</i>
Vehicle			
Tires/Wheels Failed	1	0	1
Brakes Failed	2	0	0
Other Vehicle Failure	0	3	0
Unknown Vehicle Failure	0	0	1
<i>Subtotal</i>	<i>3</i>	<i>3</i>	<i>2</i>
Environment			
View Obstructed by Other Vehicle	0	0	1
Road Design	1	0	0
Slick Roads (Ice, Loose Debris, etc.)	2	0	5
Wind Gust	1	0	0
Fog	0	0	2
Glare	0	0	1
<i>Subtotal</i>	<i>4</i>	<i>0</i>	<i>9</i>
Others			
Unknown	1	2	3
Critical Event not Coded to this Vehicle	7	87	74
Incomplete Coding	0	0	0
<i>Subtotal</i>	<i>8</i>	<i>89</i>	<i>77</i>
Total	34	132	153
Source: Large Truck Crash Causation Study: Preliminary Tallies, January 2003, NCSA, NHTSA No National Estimates or Analysis Should be Inferred from Preliminary Tallies			

GLOSSARY

Incapacitating injury

An incapacitating injury is any injury, other than a fatal injury, which prevents the injured person from walking, driving or normally continuing the activities the person was capable of performing before the injury occurred.

Inclusions:

- Severe lacerations
- Broken or distorted limbs
- Skull or chest injuries
- Abdominal injuries
- Unconsciousness at or when taken from the accident scene
- Unable to leave the accident scene without assistance
- And others

Exclusions:

- Momentary unconsciousness
- And others

Nonincapacitating evident injury

A nonincapacitating evident injury is any injury, other than a fatal injury or an incapacitating injury, which is evident to observers at the scene of the accident in which the injury occurred.

Inclusions:

- Lump on head, abrasions, bruises, minor lacerations
- And others

Exclusions:

- Limping (the injury cannot be seen)
- And others

Possible injury

A possible injury is any injury reported or claimed which is not a fatal injury, incapacitating injury or nonincapacitating evident injury.

Inclusions:

- Momentary unconsciousness
- Claim of injuries not evident
- Limping, complaint of pain, nausea, hysteria
- And others