CRASH WEIGHTING ANALYSIS

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U.S. Department of Transportation
Federal Motor Carrier Safety Administration

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TABLES

FIGURES

ACRONYMS

AIC	Akaike Information Criterion
ATRI	American Transportation Research Institute
BASIC	Behavior Analysis and Safety Improvement Category
BIC	Bayesian Information Criterion
CIR	Crash Investigation Record
CMV	Commercial Motor Vehicle
CSA	Compliance, Safety, Accountability
CSMS	Carrier Safety Measurement System
FARS	Fatality Analysis Reporting System
FMCSA	Federal Motor Carrier Safety Administration
GES	General Estimates System
HM	Hazardous Materials
HOS	Hours-of-Service
LTCCS	Large Truck Crash Causation Study
MCMIS	Motor Carrier Management Information System
NASS	National Automotive Sampling System
NHTSA	National Highway Traffic Safety Administration
NMVCCS	National Motor Vehicle Crash Causation Survey
NSC	National Safety Code [Canada]
OOS	Out-of-Service
PAR	Police Accident Report
PU	Power Unit
SMS	Safety Measurement System
TIFA	Trucks Involved in Fatal Accidents
UMTRI	University of Michigan Transportation Research Institute
VMT	Vehicle Miles Traveled

EXECUTIVE SUMMARY

EX 1 INTRODUCTION

The Federal Motor Carrier Safety Administration (FMCSA) is dedicated to reducing crashes, injuries, and fatalities involving large trucks and buses. The Compliance, Safety, Accountability (CSA) program is FMCSA's enforcement model that allows the Agency and State Partners to address motor carrier safety problems before crashes occur. The foundation of CSA is the Safety Measurement System (SMS), which quantifies the on-road safety performance of motor carriers to prioritize enforcement resources.

The SMS uses State-reported crash and inspection data to assess motor carriers' crash risk and prioritize them for safety interventions.[1] The Crash Indicator is one of the seven Behavior Analysis and Safety Improvement Categories (BASICs) that the SMS uses to evaluate safety performance. The Crash Indicator uses all crash records involving commercial motor vehicles (CMVs) that are submitted by the States through the Agency's Motor Carrier Management Information System (MCMIS). In submitting these crash records, States may use data from Police Accident Reports (PARs) that were prepared by State or local law enforcement officials; FMCSA does not receive PARs or any other information pertaining to a motor carrier's role in a crash from the States. Crash Indicator measures and percentiles are not available to the public: this information is available only to motor carriers and enforcement personnel with access to the SMS.

A variety of studies have looked at the SMS BASICs and their relationship to future crash risk. Starting with the independent analysis during the test phase of CSA conducted by the University of Michigan Transportation Research Institute (UMTRI) and continuing with studies conducted by the FMCSA, it is clear that there is a strong relationship between several of the BASICs, especially the Crash Indicator, and future crash involvement:

- The 2011 UMTRI evaluation of the effectiveness of the CSA field test found that the SMS is a significant improvement over its predecessor, SafeStat, in identifying unsafe motor carriers. In particular, the evaluation found that five of the seven BASICs employed during the test demonstrated a strong relationship to crash risk.[2]
- The FMCSA analysis shows that nearly 40 percent of recently active motor carriers[3] have sufficient data to be assessed by the SMS; these carriers own or operate 80 percent of vehicles and are involved in over 90 percent of all crashes involving a CMV.[4]

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[1] 49 CFR Part 390.5 defines the types of crashes that States must report (recordable crashes) as occurrences involving a commercial motor vehicle operating on a highway in interstate or intrastate commerce that result in (1) a fatality; (2) bodily injury to a person who, as a result of the injury, immediately receives medical treatment away from the scene of the accident; or (3) one or more motor vehicles incurring disabling damage as a result of the accident, requiring the motor vehicle(s) to be transported away from the scene by a tow truck or other motor vehicle.

[2] University of Michigan Transportation Research Institute (UMTRI), *Evaluation of the CSA 2010 Operational Model Test*, August 2011.

[3] Recently active carriers are those with an inspection, crash, investigation, safety audit, Unified Carrier Registration payment, registration, or insurance update within the last three years.

- The FMCSA's SMS Effectiveness Test (ET) shows that motor carriers prioritized for interventions in six of the BASICs have higher future crash rates than the national average; in particular, those carriers above the threshold in the Crash Indicator have a future crash rate that is 85 percent higher than the national average.[5]

While this research demonstrates the relationship between crashes and future crash risk, some stakeholders have expressed concern that the Crash Indicator may not identify the highest risk motor carriers for intervention because it looks at all crashes without regard to the role of the carrier in the crash. In response to stakeholder interest and as part of the Agency's commitment to continuous improvement, this *Crash Weighting Analysis* informs decision-making about the feasibility of using a motor carrier's role in crashes as an indicator of future crash risk. The analysis focused only on the three broad questions below addressing the procedural issues surrounding a crash weighting program and the feasibility of implementing such a program; it did not focus on any other implications of the program. The Agency will seek comments on this study and the other implications of a crash weighting program through a Federal Register notice. The three analysis questions are not addressed sequentially but each as separate analyses designed to inform Agency decisions.

- Do PARs provide sufficient, consistent, and reliable information to support crash weighting determinations?

- Would a crash weighting determination process offer an even stronger predictor of crash risk than overall crash involvement, and how would crash weighting be implemented in the SMS?

- Depending upon the analysis results for the questions above, how might FMCSA manage the process for making crash weighting determinations, including public input to the process?

EX 2 STUDY APPROACH

To address these questions, FMCSA defined crash weighting as the following two-step process: (1) review a sample of PARs to determine the critical reason for the crash events and the motor carriers' roles; and (2) use the critical reason determinations (defined below) as a basis for weighting the crashes in the SMS using various approaches. Based on this approach, FMCSA identified a process and associated costs for a national crash weighting program.

PARs are used by law enforcement across the United States to document the circumstances surrounding a crash. This study focused on crashes involving a fatality, an injury, or a vehicle towed from the scene. There is no one single standard format for a PAR or for the many pieces of information that a police officer records in a PAR—including all of the vehicles involved in the crash, the names of drivers and companies if CMVs are involved, the weather and road

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[4] "Safety Measurement System (SMS): Carrier Populations and Crash Involvement," January 23, 2014.

[5] *The Carrier Safety Measurement System (CSMS) Effectiveness Test by Behavior Analysis Safety Improvement Categories (BASICs),* January 2014. http://csa.fmcsa.dot.gov/Documents/CSMS_Effectiveness_Test_Final_Report.pdf.

conditions, a written description of the events leading to the crash, and a diagram to illustrate what happened and where. The format and content of PARs vary among the States and often even within a State.

The FMCSA does not receive PARs from the States, but only a partial set of the information recorded on the PAR that may be included in the State-reported crash record.[6] Thus, to create a database for the purposes of this analysis, FMCSA obtained 10,892 PARs from two national data sets: the National Highway Traffic Safety Administration (NHTSA) Fatality Analysis Reporting System (FARS) and the National Motor Vehicle Crash Causation Survey (NMVCCS).[7]

Depending upon State procedures, most PARs do not indicate the reason for a crash; therefore, the FMCSA employed a review process based on the process developed for FMCSA's Large Truck Crash Causation Study (LTCCS), particularly the methodology for assigning the "critical event" and the "critical reason" for the critical event. This methodology focuses on pre-crash events, such as vehicle and driver actions/movements, driver condition, and the environment at the crash scene, to identify the circumstances leading to the crash.[8] The critical event and critical reason are defined as follows:

- **Critical Event:** The event that immediately led to the crash and that put the vehicle or vehicles on a course that made the crash unavoidable. In this study, the PAR reviewers assigned the critical event to the vehicle or other party, such as a pedestrian, responsible for the action or inaction that made the crash inevitable.

- **Critical Reason:** The immediate reason for the critical event or the failure leading to the critical event. The critical reason was identified to describe the role of the driver or vehicle involved in the crash event. For example, if a CMV driver decides to drive too fast for the roadway type, the CMV driver would be assigned the critical reason.

The FMCSA reviewed the PARs and determined the critical event and critical reason to identify a motor carrier's role in a crash and assign a crash weighting for analysis purposes. The sections below present an overview of the results of analyses conducted to provide insight into the three questions guiding the study. In order to derive the most robust analysis of each question, the Agency used several crash data sources, including PARs, the NMVCCS, and the MCMIS. Each section of the report identifies the source of the data used for the particular analysis.

EX 3 DO PARS PROVIDE SUFFICIENT, CONSISTENT, AND RELIABLE INFORMATION TO SUPPORT CRASH WEIGHTING DETERMINATIONS?

One of the key questions for this study is whether FMCSA could make reliable crash weighting determinations based solely on PARs, since the PAR is often perceived as the most common and timely record of a crash. This analysis reviewed PAR sufficiency for determining a motor carrier's role in a crash, compared a sample of PARs with other data sets to assess the reliability

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[6] A State uploads CMV accident reports in accordance with current FMCSA policy guidelines.
[7] The FMCSA obtained 10,505 PARs representing fatal crashes in the FARS from 2008-2010 and 387 PARs for recordable crashes (fatality, injury, or tow-away) from the 2005-2007 NMVCCS.
[8] For details on the LTCCS methodology, go to http://www.ai.fmcsa.dot.gov/ltccs/default.asp?page=method.

of the information on the PARs, and assessed the feasibility of identifying (coding) the motor carrier's role for particular types of crash events without reviewing the PAR.

EX 3.1 Sufficiency of PARs to Support Crash Weighting Determinations

This analysis assessed the sufficiency of PARs for determining a motor carrier's role in a crash. The analysis assumed that the information on PARs was accurate.

EX 3.1.1 Approach

The PAR reviewers first examined the 10,892 PARs to identify those that met the study criteria: at least one vehicle was a CMV; the CMV was regulated by FMCSA; and the crash met the severity criteria for a recordable crash (i.e., fatality, bodily injury, or tow-away). They reviewed those PARs thoroughly, including any narratives, diagrams, or supplemental material, and coded each with one of five critical reason choices: (1) truck/bus driver; (2) truck/bus vehicle; (3) environment; (4) not assigned to this truck/bus driver/vehicle; and (5) unable to assign critical reason.

EX 3.1.2 Analysis Results

Of the 10,892 PARs:

- Ninety-one percent (9,884) met the criteria to be reviewed for a critical reason determination.

- Nine percent (1,008) could not be reviewed because it could not be determined from the PAR that the study criteria were met (a CMV was involved, the CMV was regulated by FMCSA, and the crash was recordable). These PARs were often incomplete or contained illegible or redacted information.

Table EX 1 summarizes the results of the PAR review process. These results show the critical reason outcomes for the CMVs involved in the 9,884 crash events for which the PAR met the criteria to be reviewed for a critical reason determination.

Table EX 1. PAR Coding Results: CMV Critical Reason Outcomes

Critical Reason Outcomes	Attribute to Motor Carrier?	# CMVs Involved in Crash Events	% CMVs Involved in Crash Events
Truck/Bus Driver	Yes	3,622	33.7%
Truck/Bus Vehicle	Yes	234	2.2%
Environment	Unknown	52	0.5%
Not Assigned to This Driver/Vehicle	No	6,537	60.8%
Unable to Assign Critical Reason	Unknown	304	2.8%

The five critical reason outcomes shown in Table EX 1 above formed the basis for assigning crash weighting determinations in the second part of this study. (See Section 4.) The "Truck/Bus Driver" and "Truck/Bus Vehicle" outcomes determined that the reason for the crash could be attributed to the motor carrier. The "Not Assigned to This Driver/Vehicle" outcome determined that the crash could not be attributed to the motor carrier. The “Environment” and “Unable to Assign Critical Reason” outcomes determined that the crash could not be attributed to either the motor carrier or the other vehicle(s). The crashes were “weighted” by assigning a value, for analysis purposes, based on the role of the motor carrier in the crash (attributed or not attributed to the carrier).

EX 3.2 Reliability of PARs

The purpose of this analysis was to assess whether the critical reason determinations based solely on reviewing the PARs could be considered reliable. It was limited to the following:

- Comparing data from specific fields on the PAR with related fields in the matching FARS record. Because the FARS does not identify the critical reason for a crash, the comparison of data fields was thought to provide insight into the overall reliability of the PAR and thus the resulting critical reason determination.

- Comparing the critical reasons assigned by the PAR reviewers with those assigned in matching records from the NMVCCS, which employs the same critical event/critical reason methodology used by the LTCCS.

EX 3.2.1 Comparison of PARs with FARS

Approach

After linking PARs to records in the FARS, FMCSA compared five data fields on each PAR with the same data fields in the matched FARS record to look for the same outcomes:

- Driver contributing factors

- First harmful event

- Traffic-way flow

- Weather condition

- Roadway surface condition

Analysis Results

Results of the PARs-FARS comparison indicated varying levels of agreement on the data for the fields examined, as shown in Table EX 2.

Table EX 2. Results of PARs–FARS Comparison

Data Field	PARs/FARS Match	PARs/FARS Non-Match	Missing PAR Data
Driver Contributing Factors	12.6%	5.3%	82.0%
First Harmful Event	46.9%	5.6%	47.5%
Traffic-Way Flow	52.4%	14.9%	32.8%
Weather Condition	95.7%	3.2%	1.1%
Roadway Surface Condition	96.7%	2.3%	1.0%

EX 3.2.2 Comparison of PARs with NMVCCS

Approach

The FMCSA received 387 PARs used for the 2005-2007 NMVCCS. There were 277 CMVs from these PARs that could be linked to a corresponding NMVCCS vehicle record. The Agency compared the critical reason assignments for these CMVs to identify any discrepancies.

Analysis Results

The comparison of critical reason assignments shows that:

- Ninety percent (249) of CMVs had the same critical reason determinations in the two data sources.
- Ten percent (28) were coded differently.

EX 3.3 Feasibility of Coding Crash Events without a PAR Review

The FMCSA assessed the practicality of coding crashes for two types of crash events using information available in the MCMIS as an approach to crash weighting that would not require reviewing an actual PAR:

- Single-vehicle crashes deemed to be “attributable” to the motor carrier.[9]
- Both single- and multiple-vehicle crashes with associated post-crash inspection records indicating a pre-crash out-of-service (OOS) condition on the CMV involved.[10]

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[9] This study considered a single-vehicle crash to be attributable to the CMV when the event code description did not indicate a collision with a pedestrian, a motor vehicle in transport, an animal, work zone maintenance equipment, other/unknown movable object, or "other."

[10] The study used State, date, vehicle, and carrier information to match PAR crash records to MCMIS crash records. It considered MCMIS inspection records to be associated with a pre-crash OOS condition when the "post-accident indicator" field equaled "yes" and the "OOS total" value was greater than zero.

EX 3.3.1 Approach

For the two categories of crashes listed above, FMCSA identified the crashes from 2008-2010 coded by the PAR reviewers that were linked with records in the MCMIS. This produced a linked set of 671 records for single-vehicle crashes and 767 records for crashes associated with a pre-crash OOS violation.

It was hypothesized that the reviewers would assign a critical reason that would attribute to the motor carrier for any single-vehicle crash or crash with a pre-crash OOS condition. The assumption for pre-crash OOS conditions was that the CMV driver or vehicle should not have been on the road and should thus be assigned the critical reason. To test the feasibility of such an approach, PAR reviewers assigned the critical reason for such crashes independently, without referring to the MCMIS data.

EX 3.3.2 Analysis Results

Results of the analysis are as follows:

- For 94 percent of the 671 single-vehicle crashes identified, the PAR reviewers assigned a critical reason attributed to the motor carrier. Of the remaining 6 percent, 3 percent were coded “unable to assign critical reason” because the PAR lacked sufficient information to make a determination, 2 percent were assigned to another vehicle, and 1 percent were assigned to the environment. For the 2 percent assigned to another vehicle, the PAR indicated that another vehicle was involved, while the MCMIS record did not.

- For the 767 crashes with an accompanying OOS condition, PAR reviewers assigned a critical reason attributed to the motor carrier for fewer than half (43 percent) of the records. This is likely because they used only the PAR and did not have access to post-crash inspection results indicating a pre-crash driver or vehicle OOS condition.

EX 4 WOULD A CRASH WEIGHTING DETERMINATION PROCESS OFFER AN EVEN STRONGER PREDICTOR OF CRASH RISK THAN OVERALL CRASH INVOLVEMENT?

This portion of the crash weighting analysis assumed PAR sufficiency and reliability and looked at whether a crash weighting methodology in the SMS Crash Indicator would provide a sharper view of the highest risk motor carriers.[11] Crash weights were derived based on the critical reason assignments for the 10,892 PARs that were reviewed and single-vehicle attributable crashes identified in the MCMIS. The Agency employed various statistical and analytical approaches to assess crash weighting benefits, in particular the SMS ET Methodology.

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[11] As stated above, the study questions addressing PAR sufficiency, PAR reliability, and crash weighting benefits were not addressed sequentially but as separate analyses designed to inform Agency decisions. Thus, this portion of the analysis did not consider the sufficiency or reliability of the PARs used in the study.

EX 4.1 Overview of Methodology

The FMCSA used the SMS ET to assess the safety benefits of implementing various approaches to crash weighting as part of the Crash Indicator. The Crash Indicator currently relies on crash involvement and does not include any weighting based on a motor carrier's role in a crash. The SMS ET quantifies how effectively FMCSA uses its resources to target high-risk motor carriers for interventions; it compares the crash rate of carriers above the Intervention Threshold to the national average. For this analysis, the test used crash data from 2009-2010 to define Crash Indicator percentiles, then tracked the future (January 2011 to June 2012) crash rate of motor carriers above the Intervention Threshold.

The Agency applied two approaches for modifying crash weights:

- Applying higher severity weights for two types of crashes—crashes for which PAR reviewers assigned a critical reason attributed to the motor carrier and single-vehicle attributable crashes—and applying lower weights for crashes that were reviewed, but not attributed to the motor carrier.

- Removing crashes that were reviewed but not attributed to the motor carrier.

The FMCSA then compared these crash weighting approaches with the current Crash Indicator. The analysis was performed using both all crashes and fatal crashes alone.

EX 4.2 Crash Weighting Using All Crashes

The data set used for this analysis consisted of fatal crashes from the PAR data set obtained from the FARS that were coded for a critical reason using the PAR, single-vehicle attributable crashes identified in the MCMIS, and all other crashes in the MCMIS for the required time period without a crash weighting determination. The first two types of crashes accounted for less than 20 percent of the crashes used in the analysis, or approximately 25,000 crashes over the 2-year period.[12]

EX 4.2.1 Approach

The FMCSA ran the SMS ET for the modified Crash Indicator, applying the crash weighting approaches described above. The Agency then compared the results with those for the current Crash Indicator.

EX 4.2.2 Analysis Results

The analysis results showed that modifying the Crash Indicator by changing the crash weights based on a motor carrier's role in a crash does not appear to improve its ability to predict future crash rates when all crashes are considered. If effectiveness were improved, the average crash rate for carriers above the Intervention Threshold would be higher for the modified Crash

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[12] For the analysis years, 2009-2010, the data available for analysis included 1,995 crashes coded to the truck/bus driver or vehicle; 3,613 coded "not assigned to this driver/vehicle"; and 34,385 single-vehicle attributable crashes.

Indicator than for the current approach; however, the analysis results showed that these average crash rates were nearly identical.[13]

EX 4.3 Crash Weighting Using Fatal Crashes Alone

This data set consisted of fatal crashes from the PAR data set obtained from the FARS that were coded for a critical reason based on the PAR and all other fatal crashes in the MCMIS for the required time period. Fatal crashes that were coded for the critical reason accounted for more than 75 percent of fatal crashes used in the analysis; however, all fatal crashes account for 3 percent of the crashes in the MCMIS.

EX 4.3.1 Approach

The FMCSA modified the Crash Indicator to include only fatal crashes. The Agency then applied crash weighting and compared the SMS ET results with those for the unweighted Crash Indicator.

EX 4.3.2 Analysis Results

When using fatal crashes alone in the Crash Indicator, weighting crashes by removing those not attributed to the motor carrier appears to improve the ability of the SMS to predict future crash rates by 1.8 percent to 5.0 percent. However, this analysis was limited to approximately 4,500 fatal crashes over the 2-year period,[14] or less than 3 percent of total crashes.

EX 5 HOW MIGHT FMCSA MANAGE THE PROCESS FOR MAKING CRASH WEIGHTING DETERMINATIONS?

This analysis examined how a crash weighting process might be structured and the estimated resources required. In particular, such a process requires a method for uniformly acquiring the final PARs for all or a subset of crashes, since the States do not currently provide PARs to FMCSA; a process and system for uniform analysis; and a method for receiving and analyzing public input. To estimate the associated costs and other resources, FMCSA identified a potential process for a national crash weighting program based on that used for this analysis.

EX 5.1 Crash Weighting Determination Process

EX 5.1.1 Approach

The Agency expanded the PAR review process employed for this analysis to include the acceptance of public input.

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[13] Applying the two crash weighting approaches resulted in a change in the average crash rate of -1.3 percent to 0.7 percent compared to the current Crash Indicator.

[14] Fatal crashes used in the SMS are fewer than all fatal crashes over the 2-year period; this is due to motor carrier screens designed to remove carriers from the analysis with potential data anomalies that could skew the results.

EX 5.1.2 Analysis Results

A potential process for crash weighting determinations would include five steps:

- Establish agreements with the States and obtain PARs in either hard copy or electronic format.
- Develop a system to support the collection and storage of crash weighting determinations.
- Implement the PAR review process.
- Publish the results of the PAR reviews in the Federal Register.
- Establish a procedure for accepting public input should the results of a PAR review be appealed.

EX 5.2 Implementation Costs

EX 5.2.1 Approach

The FMCSA estimated the costs associated with the five-step process described above. The estimate was based on information collected throughout the study and included both start-up and annual costs. To determine the costs associated with the acceptance of public input, the Agency considered as a proxy the current process for approval of applications for operating authority.[15]

EX 5.2.2 Analysis Results

Estimated costs for a crash weighting determination process are as follows:

- The start-up costs to establish agreements with each State, obtain the PARs, and develop information technology systems are estimated at $1.1 million.
- Coding a single PAR (including labor and overhead costs for both the initial review and a quality control review) requires on average 19 minutes and costs $26.50, based on the process used for this analysis.
- Annual costs for a PAR review process depend on both the number of crashes reviewed and the number of appeals; estimated annual costs, including PAR reviews and appeals, range from $3.9 million to $11.2 million.[16] FMCSA considered a number of scenarios in developing these estimates, from reviewing only single-vehicle crashes and those for

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[15] Because FMCSA receives relatively few appeals for the granting of operating authority, the cost estimate for crash weighting appeals may be low.

[16] Estimates assume $26.50 per PAR for initial review and quality control and $106 for re-review of a PAR and any additional materials following an appeal. The annual cost to obtain the PARs from the States is assumed to be $500,000 and annual operation and maintenance costs are estimated at $350,000.

which a post-crash inspection identified a pre-crash OOS condition to reviewing all recordable crashes.

EX 5.3 Timeframes

One concern is the timeliness of the review and weighting of any crashes. The above analysis assumes that the reviews are completed on crashes used in the SMS, which uses a 24-month time period. It is possible that the timeframe for the entire process—including the submittal of the PAR by law enforcement, its receipt by FMCSA, analysis to make a crash weighting determination, possible appeal of the analysis results, and final disposition of the appeal—could exceed the 24-month analysis period used by the SMS.

EX 6 CONCLUSIONS

The following are conclusions resulting from the analyses described above. Although these conclusions will inform FMCSA decision-making regarding crash weighting, they are not definitive and additional analysis may be needed to address the study questions.

EX 6.1 Do PARs provide sufficient, consistent, and reliable information to support crash weighting determinations?

- Although 91 percent of PARs met the criteria to be reviewed for a critical reason determination, the information on the PAR may not be reliable. For a large number of PARs, a low match rate between fields on the PAR and similar fields in the FARS was identified. This could be due to the additional information and analysis used in creating FARS records, which was not available for this study. These results suggest that PARs may not provide sufficient information to support crash weighting determinations.

- For 9 percent of PARs, the reviewers could not determine that a CMV was involved, that a CMV was regulated by FMCSA, or that the crash was recordable. These PARs were often incomplete or contained illegible or redacted information.

- Coding crash events based solely on MCMIS data for either single-vehicle attributable crashes or crashes with a post-crash inspection with a pre-crash OOS condition was not always consistent with coding results based on a PAR review.

EX 6.2 Would a crash weighting determination process offer an even stronger predictor of crash risk than overall crash involvement?

- Modifying the SMS Crash Indicator to include crash weighting improves its ability to predict future crash rates when fatal crashes alone are used. However, fatal crashes represent less than 3 percent of all crashes in the MCMIS.

- Analysis using all crashes shows that incorporating crash weighting determinations does not consistently improve the Crash Indicator when the various weighting approaches are applied.

EX 6.3 How might FMCSA manage the process for making crash weighting determinations?

- The FMCSA would need to establish a process with the States to receive and manage PAR data.

- The range of costs for implementing a system for accepting and analyzing public input is conservatively estimated to be four times that of the initial PAR review. Annual costs could range from $3.9 million to $11.2 million, depending on the number of PARs reviewed, the number of appeals, and the process established by the Agency.

- The timeframe for the entire process—including the submittal of the PAR by law enforcement, its receipt by FMCSA, analysis to make a crash weighting determination, possible appeal of the analysis results, and final disposition of the appeal—could exceed the 2-year analysis period used by the SMS.

1 INTRODUCTION

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1.1 BACKGROUND

The SMS uses State-reported crash and inspection data to assess motor carriers' crash risk and prioritize them for safety interventions.[17] The Crash Indicator is one of seven Behavior Analysis and Safety Improvement Categories (BASICs) that the SMS uses to evaluate safety performance:

- **Unsafe Driving**: Operation of commercial motor vehicles (CMVs) in a dangerous or careless manner.

- **Hours-of-Service (HOS) Compliance**: Operation of CMVs by drivers who are ill, fatigued, or in noncompliance with the HOS regulations.

- **Driver Fitness**: Operation of CMVs by drivers who are unfit to operate due to a lack of training, experience, or medical qualifications.

- **Controlled Substances and Alcohol**: Operation of CMVs by drivers who are impaired due to alcohol, illegal drugs, or misuse of prescription or over-the-counter medications.

- **Vehicle Maintenance**: Failure to properly maintain a CMV and/or to properly prevent shifting loads.

- **Hazardous Materials (HM) Compliance**: Unsafe handling of HM on a CMV.

- **Crash Indicator**: Histories or patterns of high crash involvement, including frequency and severity, based on information from State-reported crashes.

The Crash Indicator uses all crash records involving CMVs that are submitted by the States through the Agency's Motor Carrier Management Information System (MCMIS). In submitting these crash records, States may use data from Police Accident Reports (PARs) that were prepared by State or local law enforcement officials; FMCSA does not receive PARs or any other information pertaining to a motor carrier's role in a crash from the States. Crash Indicator

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While this research demonstrates the relationship between crashes and future crash risk, some stakeholders have expressed concern that the Crash Indicator may not identify the highest risk motor carriers for interventions because it looks at all crashes without regard to the role of the carrier in the crash. In response to stakeholder interest and as part of the Agency's commitment to continuous improvement, this *Crash Weighting Analysis* informs decision-making about the feasibility of using a motor carrier's role in crashes as an indicator of future crash risk. The analysis focused only on the three broad questions below addressing the procedural issues surrounding a crash weighting program and the feasibility of implementing such a program; it did not focus on any other implications of the program. The Agency will seek comments on this study and the other implications of a crash weighting program through a Federal Register notice. The three analysis questions are not addressed sequentially but each as separate analyses designed to inform Agency decisions.

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- Do PARs provide sufficient, consistent, and reliable information to support crash weighting determinations?

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- Depending upon the analysis results for the questions above, how might FMCSA manage the process for making crash weighting determinations, including public input to the process?

1.2 STUDY APPROACH

To address these questions, FMCSA defined crash weighting as the following two-step process: (1) review a sample of PARs to determine the critical reason for the crash events and the motor carriers' roles; and (2) use the critical reason determinations (defined below) as a basis for weighting the crashes in the SMS using various approaches. Based on this approach, FMCSA identified a process and associated costs for a national crash weighting program.

PARs are used by law enforcement across the United States to document the circumstances surrounding a crash. This study focused on crashes involving a fatality, an injury, or a vehicle towed from the scene. There is no one single standard format for a PAR or for the many pieces of information that a police officer records in a PAR—including all of the vehicles involved in the crash, the names of drivers and companies if CMVs are involved, the weather and road conditions, a written description of the events leading to the crash, and a diagram to illustrate what happened and where. The format and content of PARs vary among the States and often even within a State.

The FMCSA does not receive PARs from the States, but only a partial set of the information recorded on the PAR that may be included in the State-reported crash record.[22] Thus, to create a database for the purposes of this analysis, FMCSA obtained 10,892 PARs from two national data sets: the National Highway Traffic Safety Administration (NHTSA) Fatality Analysis Reporting System (FARS) and the National Motor Vehicle Crash Causation Survey (NMVCCS).[23]

Depending upon State procedures, most PARs do not indicate the reason for a crash; therefore, the FMCSA employed a review process based on the process developed for FMCSA's Large Truck Crash Causation Study (LTCCS), particularly the methodology for assigning the "critical event" and the "critical reason" for the critical event. This methodology focuses on pre-crash events, such as vehicle and driver actions/movements, driver condition, and the environment at the crash scene, to identify the circumstances leading to the crash.[24] The critical event and critical reason are defined as follows:

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[22] A State uploads CMV accident reports in accordance with current FMCSA policy guidelines.

[23] The FMCSA obtained 10,505 PARs representing fatal crashes in the FARS from 2008-2010 and 387 PARs for recordable crashes (fatality, injury, or tow-away) from the 2005-2007 NMVCCS.

[24] For details on the LTCCS methodology, go to http://www.ai.fmcsa.dot.gov/ltccs/default.asp?page=method.

- **Critical Event:** The event that immediately led to the crash and that put the vehicle or vehicles on a course that made the crash unavoidable. In this study, the PAR reviewers assigned the critical event to the vehicle or other party, such as a pedestrian, responsible for the action or inaction that made the crash inevitable.

- **Critical Reason:** The immediate reason for the critical event or the failure leading to the critical event. The critical reason was identified to describe the role of the driver or vehicle involved in the crash event. For example, if a CMV driver decides to drive too fast for the roadway type, the CMV driver would be assigned the critical reason.

The FMCSA reviewed the PARs and determined the critical event and critical reason to identify a motor carrier's role in a crash and assign a crash weighting for analysis purposes.

1.3 CONTENTS

The sections below present an overview of the results of analyses conducted to provide insight into the three questions guiding the study. In order to derive the most robust analysis of each question, the Agency used several crash data sources, including PARs, the NMVCCS, and the MCMIS. Each section of the report identifies the source of the data used for the particular analysis.

- **Section 2**: Review of previous studies addressing the sufficiency, completeness, and reliability of PARs, the effectiveness of predicting future crashes based on prior crashes, and related efforts to identify high-crash-risk motor carriers and drivers.

- **Section 3**: Analysis approach and results for the assessment of PAR sufficiency and reliability, including a description of the data sets analyzed, the process used to review the PARs, and the results of the review process (Study Question 1).

- **Section 4**: Analysis approach and results for the assessment of crash weighting safety benefits, including alternative approaches for implementing crash weighting in the SMS (Study Question 2).

- **Section 5**: Estimated costs associated with implementing a crash weighting determination process and discussion of other implementation issues (Study Question 3).

- **Section 6**: Conclusions from this *Crash Weighting Analysis*.

- **Appendix A**: Police Accident Report Coding Guidelines.

- **Appendix B**: Examples of PARs used in this analysis.

- **Appendix C**: Additional methodological details and analysis results for the assessment of crash weighting benefits.

- **Appendix D**: Additional details related to the calculation of the Crash Indicator.

- **Appendix E**: Summary of comments from the peer review of this study and FMCSA’s response.

2 BACKGROUND AND LITERATURE REVIEW

As part of this *Crash Weighting Analysis*, the Federal Motor Carrier Safety Administration (FMCSA) identified and reviewed previous studies whose methodologies, results, or conclusions might support the Agency's crash weighting research. In particular, this review focused on three areas:

- Studies assessing the accuracy of information contained in Police Accident Reports (PARs) and the consistency of PARs among States and other reporting agencies.
- Research addressing the benefits of weighting crashes based on the motor carrier's role in the crash, including the effectiveness or validity of predicting future crashes based on prior crashes and of crash prediction models, with or without crash weighting.
- Other efforts to identify high-crash-risk drivers or motor carriers based on factors that include prior crashes and responsibility for those crashes.

2.1 PAR ACCURACY AND CONSISTENCY

Law enforcement officials use PARs to document the circumstances surrounding a crash event. Police officers record many pieces of information in this report, including all of the vehicles involved in the crash; the names of drivers and, if commercial motor vehicles (CMVs) are involved, the names of companies; weather and road conditions; a written description of the events that led to the crash; and a diagram to illustrate what happened and where.

The documents and studies reviewed for this analysis contain important information about the accuracy and consistency of PARs. In particular, a 2009 FMCSA study assessed the feasibility of accurately and consistently determining a motor carrier's role in a crash event using only the PAR.[25] For this study, the test was whether the CMV involved in a crash could be coded with the critical reason for the crash event.[26] The test included PARs for 1,221 fatal, injury, and property-damage-only large truck and bus crashes that were part of either the Large Truck Crash Causation Study (LTCCS) or the National Highway Traffic Safety Administration's General Estimates System (GES). The study employed two different validation processes:

- For crashes from the LTCCS, the study compared the critical reason determination made by reviewers using only the PAR with the critical reason identified in the LTCCS.
- For crashes from the GES, the study compared the critical reason determination of two different reviewers who used only the PAR.

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[25] FMCSA, *Coding Scheme for Motor Carrier Crash Accountability: a Test of Using a Modified Critical Reason Methodology*, 2009. Available at http://csa.fmcsa.dot.gov/Documents/PARCodingTest_7-2012.pdf.

[26] The critical crash event is the action or event that immediately led to the crash and that made the crash inevitable. FMCSA's study uses the critical crash reason coding methodology developed for the LTCCS. The critical crash reason is the immediate reason for the critical crash event or the failure leading to the critical event.

Between the two data sets, the study documented a 93 percent agreement on the critical reason.[27]

Other studies reviewed for this analysis concluded the following:

- Police officers do not always complete a PAR, especially for minor crashes, and are most likely to do so for crashes involving fatalities or injuries.[28]
- When comparing the PAR and other sources of information about a crash (such as the emergency department report or ambulance report) with an in-depth crash investigation record, the PAR is the most accurate data source.[29] However, for all information sources, there is only fair to moderate agreement with the crash investigation record.
- Because CMV crashes are complex, police officers may not be able to document the crash event sufficiently. Thus, when using crash data, analysts should examine carefully the driver statements and the facts that officers collect at the crash scene to identify discrepancies.[30]

The studies discussed above provide insight as to how to analyze information on PARs to determine the critical reason; however, this research is limited due to small and restricted sample sizes; failure to examine whether the PAR accurately depicts the circumstances that led to the crash; inability to identify an outside data source or methodology for validating and coding PARs across all States; and failure to address a process for coding PARs to identify a motor carrier's role, including quality control issues.

2.2 PREDICTING FUTURE CRASHES BASED ON PRIOR CRASHES

The FMCSA reviewed research relevant to identifying the benefits of weighting crashes based on the motor carrier's role. These studies highlighted the many factors that contribute to a crash and found that, for drivers, past crash involvement is a good predictor of future crashes. Specifically:

- A number of CMV driver behaviors are statistically significant predictors of future crashes, especially failure to use or improper use of signals, involvement in a prior crash, and improper passing.[31]

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[27] In a July 2, 2013 letter to the FMCSA Administrator, members of the Motor Carrier Safety Advisory Committee (MCSAC) wrote that, because of the methodology employed, this analysis failed to demonstrate the viability of relying on PARs to determine a motor carrier's role in a crash.

[28] Fife. D. and Cadigan, R., "Regional Variation in Motor Vehicle Accident Reporting: Findings from Massachusetts," *Accident Analysis & Prevention* 21, no. 2 (1989): 193-196.

[29] Grant, R.J., Gregor, M.A., Maio, R.F., and Beck, P.W., "A Comparison of Data Sources for Motor Vehicle Crash Characteristic Accuracy," *Academic Emergency Medicine* 7, no. 8 (2000): 892-897.

[30] Wolkowicz, M.E., *Commercial Vehicle Accidents: the Data Gathering Experience* (Downsview, Ontario: Ontario Ministry of Transportation, 1989).

[31] American Transportation Research Institute, *Predicting Truck Crash Involvement: A 2011 Update*, 2011, http://atri-online.org. (Accessed September 2013).

- Past crashes, driver and vehicle violations, and driver demographics are all significantly related to the likelihood of future crashes. In particular, CMV driver crash involvement significantly increases the chance of a future crash.[32]

- A model developed to predict future "at-fault" crashes for all Kentucky drivers found that prior at-fault crashes, driver's license suspensions, and citations are strongly associated with driver responsibility for a subsequent crash.[33]

- For Ontario truck and car drivers, crash involvement is a strong predictor of future crashes.[34]

- Among older drivers in Québec, prior crashes are a better predictor of crash risk than prior convictions for such violations as speeding, failure to stop at a traffic signal or stop sign, or failure to wear a safety belt.[35]

Among the limitations of these various studies are a short timeframe of analysis, geographic restrictions, focus only on drivers rather than motor carriers, focus on a limited driver population, and focus not on CMV drivers. Most significantly, none of the studies examined the benefits of assessing crash risk based on motor carriers' and drivers' roles in crashes rather than on overall crash involvement.

2.3 IDENTIFYING HIGH-CRASH-RISK MOTOR CARRIERS AND DRIVERS

For this part of the review, FMCSA consulted a number of sources, including insurance companies and Canadian officials, to identify various approaches to classifying "risky" motor carriers and drivers and determining their roles in crashes. Insurance companies were unwilling to share information about how they assign fault and identify high-risk drivers; therefore, the study focused on Canada's approach to evaluating motor carrier crash involvement. In summary:

- Canada regulates the motor carrier industry based on the National Safety Code (NSC), which is similar to the Federal Motor Carrier Safety Regulations; however, there is no national oversight of the NSC, and each province implements the code independently.

- All provinces evaluate motor carrier crash involvement using some form of crash weighting, although the "weighted" crashes remain on the carriers' and drivers' records.

- There is no national policy or standardized metric for determining crash weighting; the specific approach varies among the Canadian provinces.

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[32] Cantor, D.E., Corsi, T.M., Grimm, C.M. and Ozpolat, Koray, "A Driver Focused Truck Crash Prediction Model," *Transportation Research Part E: Logistics and Transportation Review* 46, no. 52 (2010): 683-692.

[33] Chandraratna, S., Stamatiadis, N., and Stromberg, A., "Crash Involvement of Drivers with Multiple Crashes," *Accident Analysis & Prevention* 38 (2006): 532-541.

[34] Persaud, B., Smiley, A., Hauer, E., Duncan, D. and Clifford, L., "Accident Prediction Models for Ontario Truck Drivers," *Truck Safety: Perceptions and Reality* (1996): 413-427.

[35] Daigneault, G., Joly, P., and Frigon, J., "Previous Convictions or Accidents and the Risk of Subsequent Accidents of Older Drivers," *Accident Analysis & Prevention* 34 (2002): 257-261.

- Ontario assigns points for crashes based on severity and “impropriety”; if a crash involves no impropriety on the part of the CMV or driver, zero points are assigned; however, all crashes remain on carrier and driver records for five years.

2.4 OBSERVATIONS

The FMCSA’s review of previous studies provides insight into methodologies and approaches relevant to an assessment of crash weighting. In particular:

- While analysis has shown that critical reason determinations based solely on the PAR are consistent 93 percent of the time, other studies suggest that PARs may have shortcomings in the extent to which they thoroughly depict the circumstances of a crash.

- Research shows that particular driver behaviors, including crash involvement, are highly predictive of future crashes.

- All Canadian provinces use some method of crash weighting; however, the weighted crashes remain on motor carriers’ and drivers’ records for five years.

- Previous analyses do not address the practicability, effectiveness, or safety benefits of weighting crashes based on a motor carrier’s role in the crash.

3 DO PARS PROVIDE SUFFICIENT, CONSISTENT, AND RELIABLE INFORMATION TO SUPPORT CRASH WEIGHTING DETERMINATIONS?

One of the key questions for this study is whether the Federal Motor Carrier Safety Administration (FMCSA) could make crash weighting determinations based solely on Police Accident Reports (PARs), since the PAR is often perceived as the most common and timely record of a crash. FMCSA addressed this question by:

- Reviewing PAR sufficiency for determining a motor carrier's role in a crash.
- Comparing a sample of PARs with other data sets to assess the reliability of the information on the PARs.
- Assessing the feasibility of identifying (coding) the motor carrier's role for particular types of crash events, such as some single-vehicle crashes, without reviewing the PAR.

3.1 SUFFICIENCY OF PARS TO SUPPORT CRASH WEIGHTING DETERMINATIONS

This analysis assessed the sufficiency of PARs for determining a motor carrier's role in a crash. The analysis assumed that the information on the PARs was accurate.

3.1.1 Approach

The analysis of PAR sufficiency included:

- Obtaining a sample of PARs.
- Reviewing and collecting data from the PARs in an online data collection tool and coding the involved motor carriers' roles in the crashes recorded.
- Analyzing the results of the PAR reviews.

3.1.1.1 Obtaining the PARs

As discussed in Section 1.2, FMCSA reviewed and collected data from 10,892 PARs from two national data sets:

- **Fatality Analysis Reporting System (FARS)**: The FARS contains data on fatal crashes within the 50 States, the District of Columbia, and Puerto Rico. Collected by FARS analysts in each of the States, the data is gathered from the original PAR and the State's own source documents and then coded on standard FARS forms. FARS analysts are trained to understand and translate data from their State PAR to FARS data elements using State documents such as vehicle registration files, driver licensing files, highway department data, vital statistics, death certificates, coroner/medical examiner reports, hospital medical reports, and emergency medical service reports. Each crash in the FARS has more than 125 different coded data elements that characterize the crash, the vehicles, and the people involved. The specific data elements may be modified slightly each year to conform to changing user needs, vehicle characteristics, and highway safety emphasis areas.

- **National Motor Vehicle Crash Causation Survey (NMVCCS)**: The NMVCCS uses recordable crashes from NHTSA's National Automotive Sampling System, which is based on a nationally representative sample of police-reported motor vehicle crashes resulting in property damage, injury, or death. Like the FARS analysts, the NMVCCS analysts are well trained to interpret and research crash facts using supplemental data sources beyond the PAR. The NMVCCS database includes more than 600 data elements related to the drivers, vehicles, roadways, and environment. In particular, the NMVCCS includes photographs, schematic diagrams, vehicle information, data from event data recorders, and other information collected during an in-depth study of each PAR. The NMVCCS also assesses the critical reason and critical event related to the crash.

Table 1 shows the number of PARs received from each data set and source.

Table 1. PARs Received for Analysis

Data Set/Source	Received
FARS 2008-2010	10,505
NMVCCS 2005-2007	387
Total	**10,892**

3.1.1.2 Reviewing and Collecting PAR Data

FMCSA employed a PAR review process based on that developed for the Agency's Large Truck Crash Causation Study (LTCCS). Central to this process was the LTCCS critical event/critical reason methodology. (See Section 1.2 for definitions of the critical event and critical reason.)

The PAR reviewers had previous experience with the critical event/critical reason methodology and with interpreting and understanding the nuances of crash reporting. Reviewers also had experience with earlier studies, such as the LTCCS, that involved the processing of large volumes of PARs to identify unique crash variables. As additional guidance for the PAR reviewers, FMCSA developed guidelines addressing the types of information to be reviewed on a PAR; the various crash scenarios covering most single- and multi-vehicle events; and the collection of information from the PAR in an online tool. (See Appendix A.)

3.1.1.2.1 Data Collection Tool

FMCSA developed an online tool to support a uniform method for collecting data from and analyzing the PARs. The PAR reviewers entered information into the online tool from specific sections of the PAR as completed by the police officer. Based on this information, the reviewers coded the critical reason and the justification for the critical reason; all other data elements were entered directly from the PAR without interpretation. The PAR reviewers did not interpret information found elsewhere on the PAR if it differed from the specified field.

Table 2 shows the information that was collected from the PAR and entered into the data collection tool. The PAR reviewers collected information for each data element shown in Table 2, unless it was not available on the PAR. Several of these data elements were used to match the information on the PAR to a corresponding record in the FARS database, the NMVCCS, or the Motor Carrier Management Information System (MCMIS).

Table 2. PAR Data Captured by Collection Tool

Type of Data		**Reason for Including**
System-Generated Information		
1	Record ID #	Database record number
2	Date of review	Identifies when review was conducted
3	Start time of review	Used to calculate time to enter record
4	End time of review	Used to calculate time to enter record
5	User ID	Identifies who conducted review
Crash Information on the PAR		
6	Scanned PAR file name	Used to match database record to a PAR
7	Reporting State	Used to match PAR to records in MCMIS/FARS/NMVCCS
8	PAR number	Identifies State report number
9	Record source	Identifies source of record
10	Report/case # from the source	Used to match PAR to records in FARS
11	Crash date	Used to match PAR to records in MCMIS/FARS/NMVCCS
12	Crash time (as appears on PAR)	Used to match PAR to records in MCMIS/FARS/NMVCCS
13	Crash severity	Used to categorize records by severity
14	Total # of vehicles involved in crash event	Used to identify single- versus multi-vehicle crashes
15	# of CMVs involved in crash event	Used to identify CMV involvement
16	Weather condition	Used to assess reliability of PAR with respect to data in FARS
17	Roadway surface condition	Used to assess reliability of PAR with respect to data in FARS
18	Traffic-way type	Used to assess reliability of PAR with respect to data in FARS
19	First harmful event in the crash event	Used to assess reliability of PAR with respect to data in FARS
Vehicle and Carrier Information & Critical Reason Results		
20	Vehicle # involved in crash	Used to match PAR to records in MCMIS/FARS
21	Vehicle type	Used to verify vehicle type in MCMIS/FARS/NMVCCS
22	Vehicle license plate #	Used to match PAR to records in MCMIS
23	Vehicle license plate State	Used to match PAR to records in MCMIS/FARS
24	Initial impact area on the vehicle*	Used to assess reliability of PAR with respect to data in FARS
25	Driver contributing factors	Used to assess reliability of PAR with respect to data in FARS
26	Carrier U.S. DOT #	Used to match PAR to records in MCMIS/FARS
27	Carrier MC #	Used to match PAR to records in MCMIS
28	Carrier name	Used to match PAR to records in MCMIS
29	Street address	Used to match PAR to records in MCMIS

Type of Data		Reason for Including
30	City	Used to match PAR to records in MCMIS
31	State	Used to match PAR to records in MCMIS
32	Zip code	Used to match PAR to records in MCMIS
33	Critical reason (required)	Used to capture critical reason determination and compare to NMVCCS
34	Critical reason justification (required)	Identifies a justification for critical reason determination
35	Justification description	Captures text explanation for "other" critical reason justifications

* Dropped from study because of difficulties with coding.

3.1.1.2.2 PAR Review

The PAR reviewers examined thoroughly all documentation provided in a PAR to understand the driver, vehicle, and other factors influencing the crash event and assign a critical reason. Reviewers faced a number of challenges, including:

- **PAR Quality**: Because the PARs were provided in hard-copy format, they varied greatly in terms of quality, legibility, and completeness. Many were handwritten and, in some cases, had been edited, marked on, or redacted. This compounded the legibility problems associated with reviewing scanned copies. (See Appendix B for an example.)

- **Lack of Consistency across States:** Each State had a unique format for the PAR. (See Appendix B.)

- **Changes within a State**: Because crashes are reported at the local, county, and State levels, a State could have multiple versions of the same PAR; moreover, States often made changes to the format of their PARs, sometimes annually.

Although States' PARs had unique layouts and somewhat different data elements, the large majority contained the information necessary to determine the critical event and critical reason. Such information included details about the parties involved in the crash, the numbers and types of vehicles, the general weather and roadway characteristics, and a detailed description and diagram of the crash event. In addition, some PARs had supplemental forms, such as witness statements, photographs of the crash scene, driver logbooks, or commercial driver/vehicle inspection reports.

Shown in Figure 1, the process that the PAR reviewers followed comprised four steps:

- **Step 1. Review PAR for Relevancy and Completeness**: The PAR reviewers first checked each PAR to ensure that it met the following study criteria:
    - At least one of the vehicles was a CMV (a large truck or bus or a light vehicle placarded for hazardous materials (HM)).
    - The CMV was regulated by FMCSA.

  - The crash event met the severity criteria for a recordable crash (fatal, bodily injury, or tow-away).[36]

  If a reviewer could not determine from the PAR that these criteria were met, he or she created a record for that crash but did not complete a full review; the number of CMVs was entered as “0” and the review process ended.

- **Step 2. Review Crash and Vehicle Information**: The PAR reviewers examined the remaining PARs to understand the nature of the crash events, including the basic crash information (crash date and time, crash severity, number of vehicles involved, number of CMVs, weather and road surface condition, traffic-way type, first harmful event); vehicle information (configuration, cargo body type, weight, class, HM information, license plate number and State, motor carrier information); driver information (driver condition, driver action immediately prior to the crash, alcohol test results, citations, license class, endorsements, restrictions, or license status); and the crash diagram and narrative description. Reviewers crosschecked the data in the driver and vehicle sections to ensure that the PAR contained sufficient information to determine the critical event/critical reason; if the PAR did not contain enough information, the reviewer assigned the critical reason as “unable to assign critical reason.”

- **Step 3. Determine the Critical Event and Critical Reason**: After thoroughly reviewing the information on the PAR, reviewers determined the vehicle(s) (or other party) that committed the critical event and assigned a critical reason to each CMV involved in the crash. (Reviewers did not assign a critical reason to the non-CMVs.) There were five critical reason choices: (1) truck/bus driver; (2) truck/bus vehicle; (3) environment; (4) not assigned to this truck/bus driver/vehicle; and (5) unable to assign critical reason. Reviewers also selected from among a number of critical reason justifications.

- **Step 4. Enter Crash and Vehicle Information into the Data Collection Tool**: Reviewers entered relevant data from the PAR, as well as the critical reason and critical reason justification, into the data collection tool. (See Figure 2.) Reviewers entered information for each CMV involved in the crash. No information was recorded for the non-CMVs. (In addition, reviewers did not record driver identifying information due to privacy issues.)

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[36] The review process did not involve looking up vehicle identification numbers to decode the vehicle type or tracking down missing pages or other information from the PAR that may have contained the CMV information.

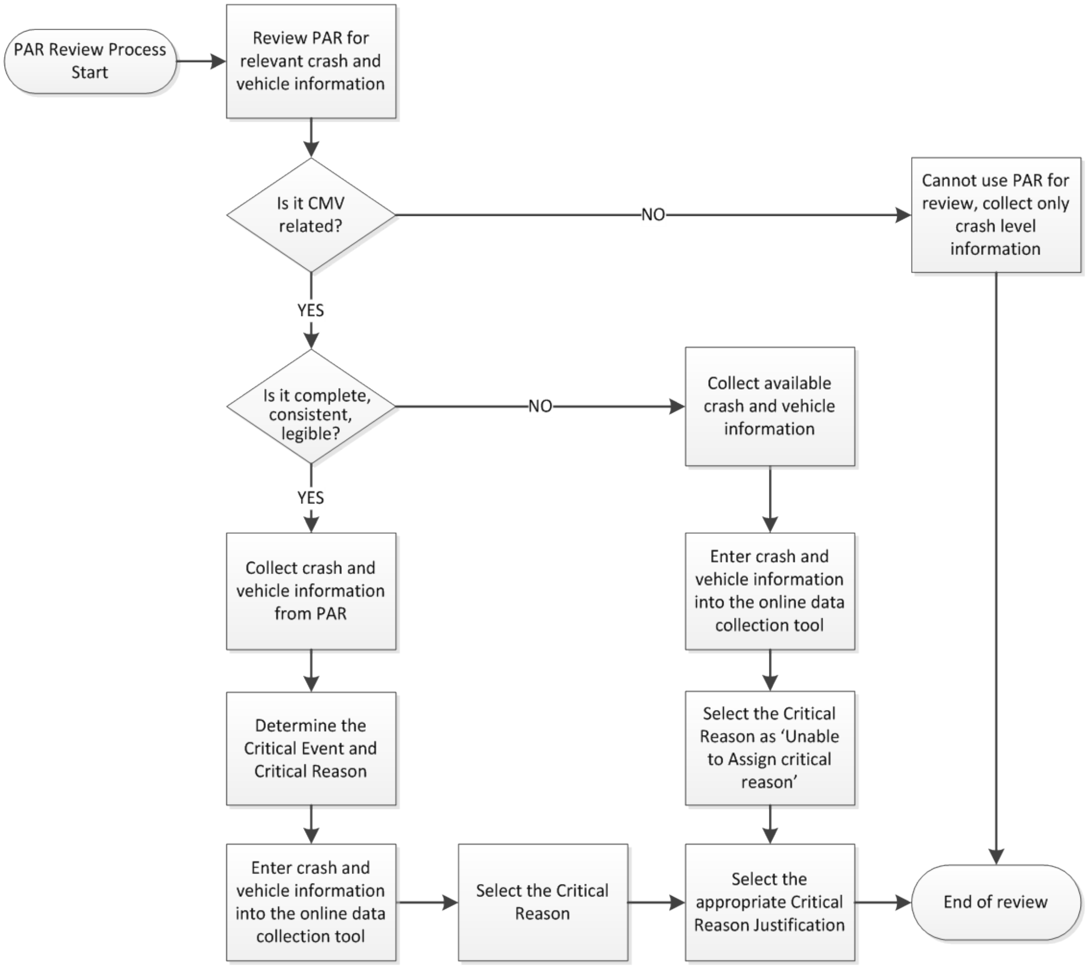
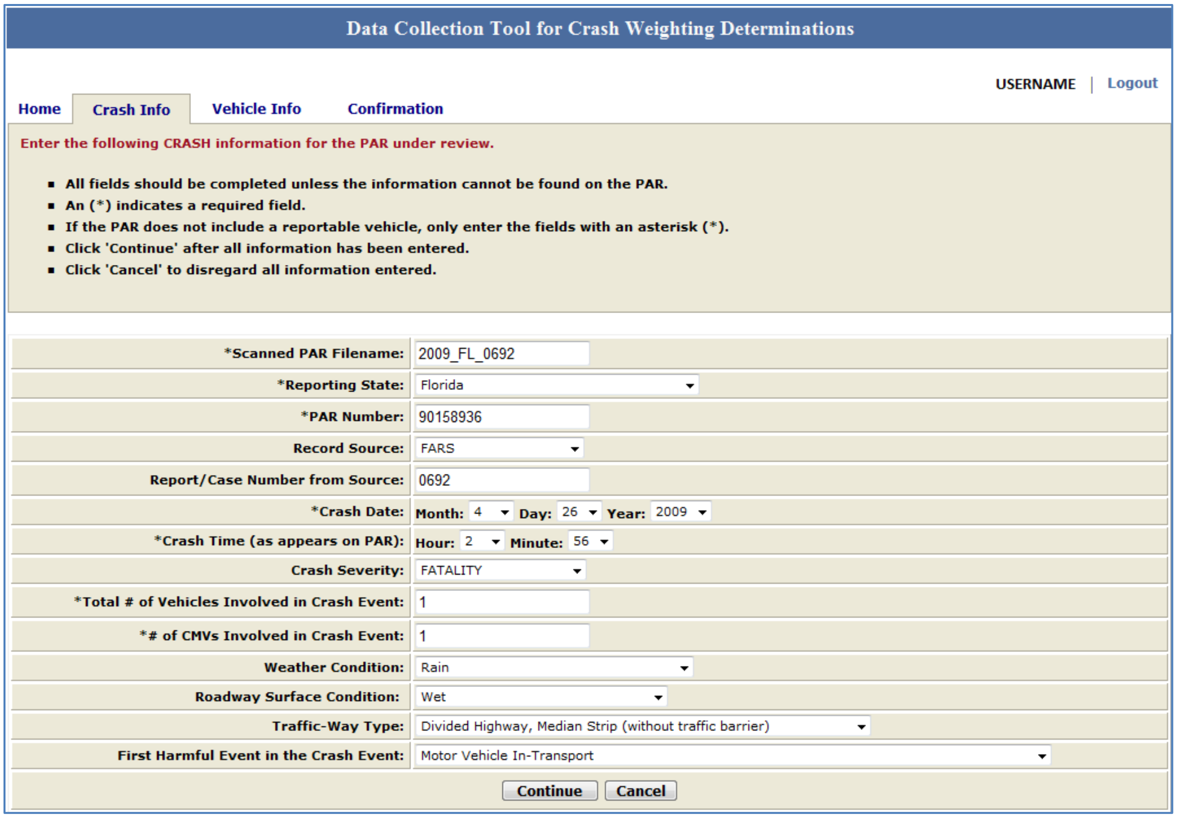


Figure 1. PAR Review Process

.



Enter the following CRASH information for the PAR under review.

- All fields should be completed unless the information cannot be found on the PAR.
- An (*) indicates a required field.
- If the PAR does not include a reportable vehicle, only enter the fields with an asterisk (*).
- Click 'Continue' after all information has been entered.
- Click 'Cancel' to disregard all information entered.

*Scanned PAR Filename: 2009_FL_0692
*Reporting State: Florida
*PAR Number: 90158936
Record Source: FARS
Report/Case Number from Source: 0692
*Crash Date: Month: 4 Day: 26 Year: 2009
*Crash Time (as appears on PAR): Hour: 2 Minute: 56
Crash Severity: FATALITY
*Total # of Vehicles Involved in Crash Event: 1
*# of CMVs Involved in Crash Event: 1
Weather Condition: Rain
Roadway Surface Condition: Wet
Traffic-Way Type: Divided Highway, Median Strip (without traffic barrier)
First Harmful Event in the Crash Event: Motor Vehicle In-Transport

Figure 2. Data Collection Tool Screenshot

3.1.2 Analysis Results

Table 3 shows the number of PARs, the number that met the criteria to be reviewed for a critical reason determination, and the number not reviewed, for the FARS and NMVCCS data sets.

Table 3. Number of PARs Reviewed

Critical Reason Coding	FARS		NMVCCS		Total	
	Number	Percent	Number	Percent	Number	Percent
Reviewed for Critical Reason	9,574	91%	310	80%	**9,884**	**91%**
Not Reviewed for Critical Reason	931	9%	77	20%	**1,008**	**9%**
Total	10,505	100%	387	100%	**10,892**	**100%**

As shown in Table 3, approximately 91 percent (9,884) of PARs met the criteria to be reviewed for a critical reason determination. For the remaining 9 percent (1,008) of PARs, the reviewers could not determine from the PAR that a CMV was involved, the CMV was regulated by FMCSA, and the crash was recordable. These PARs were often incomplete or contained illegible or redacted information.

Table 4 shows the number of CMVs involved in the crashes reported on the PARs.

Table 4. Number of CMVs per PAR

# CMVs per PAR	# PARs
1	9,196
2	587
3	70
4	15
5	5
6	5
7	3
10	2
13	1
Could Not Determine CMV Involvement	1,008
Total CMVs 10,749	**Total PARs 10,892**

The table shows that the number of CMVs involved in the crash events ranged widely, from 1 to 13.[37] The large majority of crashes (85 percent) involved a single CMV. PARs categorized as "Could Not Determine CMV Involvement" lacked sufficient information to determine that a CMV was involved. Although the PARs used in this study were assumed to have had at least one CMV involved in the crash, the information presented on the PAR alone proved insufficient to confirm that a CMV was involved.

3.1.2.1 Critical Reason Determinations

For each CMV involved in a crash, the PAR reviewers evaluated the crash event and assigned one of five critical reasons: (1) truck/bus driver; (2) truck/bus vehicle; (3) environment; (4) not assigned to this truck/bus driver/vehicle; or (5) unable to assign critical reason. (Reviewers considered all non-CMVs involved in a crash, but only to the extent that their role pertained to determining the CMV's responsibility.)

Table 5 summarizes the results of the PAR review process. These results show the critical reason outcomes for the CMVs involved in the 9,884 crash events for which the PAR met the criteria to be reviewed for a critical reason determination.

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[37] Of the 10,749 CMVs, 10,711 were trucks, 36 were buses, and 2 were light vehicles placarded for HM.

Table 5. PAR Coding Results: CMV Critical Reason Outcomes

Critical Reason Outcomes	Attribute to Motor Carrier?	# CMVs Involved in Crash Events	% CMVs Involved in Crash Events
Truck/Bus Driver	Yes	3,622	33.7%
Truck/Bus Vehicle	Yes	234	2.2%
Environment	Unknown	52	0.5%
Not Assigned to This Driver/Vehicle	No	6,537	60.8%
Unable to Assign Critical Reason	Unknown	304	2.8%

The five critical reason outcomes shown in Table 5 formed the basis for assigning crash weighting determinations in the second part of this study. (See Section 4.) The "Truck/Bus Driver" and "Truck/Bus Vehicle" outcomes determined that the reason for the crash could be attributed to the motor carrier. The "Not Assigned to This Driver/Vehicle" outcome determined that the crash could not be attributed to the motor carrier. The "Environment" and "Unable to Assign Critical Reason" outcomes determined that the crash could not be attributed to either the motor carrier or the other vehicle(s). The crashes were "weighted" by assigning a value, for analysis purposes, based on the role of the motor carrier in the crash (attributed or not attributed to the carrier).

In addition to assigning a critical reason, PAR reviewers selected a critical reason justification associated with the driver's or vehicle's actions to explain how the critical reason was determined. Table 6 shows the breakout of critical reasons and their justifications for all CMVs.

Table 6. Critical Reasons Associated with Justification Descriptions

Critical Reason	Critical Reason Justification Description	#CMVs	%CMVs
Critical Reason: Truck/Bus Driver		**3,622**	**33.70%**
Category - Recognition Error/Poor Judgment		**906**	**8.43%**
Truck/Bus Driver	Driver was following too close for conditions.	120	1.12%
Truck/Bus Driver	Driver was going too fast for conditions.	400	3.72%
Truck/Bus Driver	Driver was going too slowly for traffic stream.	11	0.10%
Truck/Bus Driver	Driver exhibited aggressive driving behavior.	11	0.10%
Truck/Bus Driver	Truck/bus struck the rear of a vehicle.	310	2.88%
Truck/Bus Driver	Driver was aware of dangerous atmospheric conditions.	5	0.05%
Truck/Bus Driver	Driver was aware of ongoing highway conditions.	8	0.07%
Truck/Bus Driver	Other.	41	0.38%
Category - Intersection/Crossing Path		**244**	**2.27%**
Truck/Bus Driver	Driver turned across path of another vehicle at a junction without a traffic control device present.	108	1.00%
Truck/Bus Driver	Driver turned across path at a junction in violation of a traffic control device.	60	0.56%
Truck/Bus Driver	Driver performed a wide turn from a portion of wrong lane.	31	0.29%
Truck/Bus Driver	Driver performed a wide turn and struck object on road.	1	0.01%
Truck/Bus Driver	Other.	44	0.41%
Category - Decision Error		**688**	**6.40%**
Truck/Bus Driver	Driver misjudged gap or other's speed.	96	0.89%
Truck/Bus Driver	Driver had false assumption of other's actions.	50	0.47%

Critical Reason	Critical Reason Justification Description	#CMVs	%CMVs
Truck/Bus Driver	Truck/bus was disabled as a result of a driver action that caused the vehicle to stop operating.	9	0.08%
Truck/Bus Driver	Driver did not obey a traffic control device.	194	1.80%
Truck/Bus Driver	Driver executed an inadequate evasive action.	175	1.63%
Truck/Bus Driver	Driver executed an illegal maneuver.	58	0.54%
Truck/Bus Driver	Other.	106	0.99%
Category - Mechanical Failure		**30**	**0.28%**
Truck/Bus Driver	Truck/bus lost control as a result of mechanical failure.	8	0.07%
Truck/Bus Driver	Driver actions caused the cargo shift/loss.	13	0.12%
Truck/Bus Driver	Other.	9	0.08%
Category - Erratic Actions/Unsafe Driving		**1,008**	**9.38%**
Truck/Bus Driver	Driver failed to drive safely due to physical condition.	100	0.93%
Truck/Bus Driver	Driver failed to drive safely due to distraction or inattention.	131	1.22%
Truck/Bus Driver	Driver failed to drive safely due to inadequate surveillance.	285	2.65%
Truck/Bus Driver	Driver failed to drive safely by exercising poor directional control or overcompensating.	467	4.34%
Truck/Bus Driver	Truck/bus swung or jackknifed resulting in a crash (if no extenuating circumstances).	5	0.05%
Truck/Bus Driver	Other.	20	0.19%
Category - Lane Change		**385**	**3.58%**
Truck/Bus Driver	Truck/bus encroached into a lane occupied by another motor vehicle.	110	1.02%
Truck/Bus Driver	Truck/bus traveled over the lane line or off the road.	272	2.53%
Truck/Bus Driver	Other.	3	0.03%
Category – Other		**361**	**3.36%**
Truck/Bus Driver	Truck/bus struck pedestrian— pedestrian's actions were NOT deliberate.	159	1.48%
Truck/Bus Driver	Truck/bus struck animal—driver had time for evasive action.	2	0.02%
Truck/Bus Driver	Driver actions or inactions led to crash.	159	1.48%
Truck/Bus Driver	Other.	41	0.38%
Critical Reason: Truck/Bus Vehicle		**234**	**2.18%**
Category - Vehicle Issue		234	2.18%
Truck/Bus Vehicle	Truck/bus was disabled in travel lane and was struck by other vehicle.	32	0.30%
Truck/Bus Vehicle	Truck/bus failure or degraded vehicle component(s) led to the crash.	128	1.19%
Truck/Bus Vehicle	Truck/bus cargo shift/loss caused loss of control leading to a crash.	15	0.14%
Truck/Bus Vehicle	Truck/bus disabled as a result of a mechanical breakdown.	28	0.26%
Truck/Bus Vehicle	Other.	31	0.29%
Critical Reason: Environment		**52**	**0.48%**
Category – Road		**18**	**0.17%**
Environment	Unanticipated roadway issue.	10	0.09%
Environment	Traffic control signs/signals: missing; erroneous; defective; inadequate.	0	0.00%

Critical Reason	Critical Reason Justification Description	#CMVs	%CMVs
Environment	Road issue/defect (e.g., low bridge without appropriate signage; sudden roadway deterioration; etc.).	1	0.01%
Environment	Truck/bus driver's view was obstructed by roadway design/signage or by other vehicles.	2	0.02%
Environment	Truck/bus cargo shift/loss caused by unanticipated roadway issue.	0	0.00%
Environment	Truck/bus struck animal—driver had no time for evasive action.	4	0.04%
Environment	Other.	1	0.01%
Category – Weather		**34**	**0.32%**
Environment	Unanticipated environmental condition.	31	0.29%
Environment	Truck/bus swung or jackknifed caused by sudden unanticipated environmental condition.	2	0.02%
Environment	Truck/bus cargo shift/loss caused by unanticipated environmental condition.	0	0.00%
Environment	Truck/bus disabled as a result of an unseen or sudden weather event.	1	0.01%
Environment	Other.	0	0.00%
Critical Reason: Not Assigned to This Driver/Vehicle		**6,537**	**60.81%**
Category - Other Vehicle Reason		6,537	60.81%
Not Assigned to This Driver/Vehicle	Truck/bus had the right of way.	385	3.58%
Not Assigned to This Driver/Vehicle	Truck/bus stopped safely before being struck.	17	0.16%
Not Assigned to This Driver/Vehicle	Truck/bus is the lead vehicle and was stopped at traffic light and struck in rear.	6	0.06%
Not Assigned to This Driver/Vehicle	Truck/bus is lead vehicle, stopped in traffic, struck in rear and pushed into another vehicle or object.	3	0.03%
Not Assigned to This Driver/Vehicle	Truck/bus performed a wide turn from correct lane and struck vehicle making an illegal maneuver.	0	0.00%
Not Assigned to This Driver/Vehicle	Truck/bus turned in compliance with a traffic control.	0	0.00%
Not Assigned to This Driver/Vehicle	Truck/bus encroached into another lane/off road to avoid crash.	0	0.00%
Not Assigned to This Driver/Vehicle	Truck/bus struck pedestrian/non-motorist. Pedestrian/non-motorist actions were deliberate.	53	0.49%
Not Assigned to This Driver/Vehicle	Truck/bus mechanical problem found, but is not responsible for crash.	0	0.00%
Not Assigned to This Driver/Vehicle	Truck/bus disabled as a result of previous crash.	6	0.06%
Not Assigned to This Driver/Vehicle	Critical event not coded to truck/bus driver/vehicle.	6,049	56.28%
Not Assigned to This Driver/Vehicle	Other.	18	0.17%
Critical Reason: Unable to Assign Critical Reason		**304**	**2.83%**
Category - PAR Issue		**304**	**2.83%**
Unable to Assign Critical reason	PAR not legible.	0	0.00%

Critical Reason	Critical Reason Justification Description	#CMVs	%CMVs
Unable to Assign Critical Reason	PAR not complete (includes missing pages, supplemental forms).	144	1.34%
Unable to Assign Critical Reason	PAR information not consistent.	1	0.01%
Unable to Assign Critical Reason	Not enough/sufficient information to make a determination.	155	1.44%
Unable to Assign Critical Reason	Other.	4	0.04%
Total		**10,749**	**100.00%**

Approximately 61 percent of the CMVs were not assigned the critical reason for the crash. For about 34 percent of CMVs, the critical reason was an action or inaction on the part of the truck or bus driver, and for 2 percent it was a CMV-related vehicle issue. Other critical reasons included the environment, such as weather or roadway conditions (less than 1 percent), and "unable to assign," due to incomplete, inconsistent, or insufficient information (about 3 percent).

Among the CMVs assigned the critical reason (either to the driver or the vehicle), the leading justification was erratic driver actions or unsafe driving (approximately 26 percent of CMVs), followed by driver recognition error or poor judgment (23 percent), driver decision error (18 percent), lane change (10 percent), other (9 percent), intersection/crossing path errors (6 percent), and vehicle issues (6 percent).

3.1.2.2 Quality Control of Coding Process

Throughout the PAR coding, the results in the data collection tool were checked against the original PAR for (1) proper interpretation of the data; (2) correct data entry; and (3) understanding of the critical reason methodology. Observations and feedback were provided to the PAR reviewers and, if necessary, the record in the online tool was corrected.

In addition, a quality control check was performed for about 6 percent, or 673, of the coded PARs. The PARs were selected by sampling approximately the same percentage of records completed by each PAR reviewer within a specific timeframe. The quality control check supported approximately 92 percent of the critical reason determinations made by the PAR reviewers. Table 7 shows the explanations for the 8 percent that were not upheld by the quality control process.

Table 7. Results of PAR Coding Quality Control

Explanation for Different Critical Reason Determination	Number of Vehicle Records	Percent of Vehicle Records
Reviewer Assigned Critical Reason to Non-CMV; Quality Control Assigned to CMV	8	13%
Reviewer Assigned Critical Reason to CMV; Quality Control Assigned to Non-CMV	16	25%
Quality Control Assigned Critical Reason to Environment; Reviewer Did Not	2	3%
Quality Control Determined There Was Not Enough Information to Identify CMV or That PAR Was Illegible; Reviewer Assigned Critical Reason to CMV or Non-CMV	37	59%
Total	**63**	**100%**

The majority of differences (59 percent) were due to insufficient information on the PAR as to the involvement of a CMV in the crash; typically, these PARs were unclear or unreadable or did not have a clearly defined motor carrier section to distinguish a vehicle as a CMV. The remaining differences were due to assigning the critical reason to a different driver or vehicle or to the environment.

3.2 RELIABILITY OF PARS

The purpose of this analysis was to assess whether the critical reason determinations based solely on reviewing the PARs could be considered reliable. It was limited to the following:

- Comparing data from specific fields on the PAR with related fields in the matching FARS record. Because the FARS does not identify the critical reason for a crash, the comparison of data fields was thought to provide insight into the overall reliability of the PAR and thus the resulting critical reason determination.
- Comparing the critical reasons assigned by the PAR reviewers with those assigned in matching records from the NMVCCS, which employs the same critical event/critical reason methodology used by the LTCCS. (This analysis used the methodology employed for FMCSA’s 2009 crash weighting study, which was based on but differs somewhat from the LTCCS approach.)

3.2.1 Comparison of PARs with FARS

3.2.1.1 Approach

This analysis involved the following:

- Linking the PARs to records in the FARS.
- Comparing data fields on the PARs with related fields in the matched FARS records.

3.2.1.1.1 Linking PARs to Records in FARS

There were two criteria for including a PAR from the initial PAR data set in the analysis: (1) the record source was the FARS; and (2) the crash event involved one or more CMVs. The linking process comprised two-steps:

- **Step 1:** Link the PARs to the FARS at the crash level using the year, case number, and State (resulted in a record match for 8,021 PARs).

- **Step 2:** Link the CMVs from these matched PARs to the CMVs in the corresponding FARS records using the license plate, State, and U.S. DOT Number (yielded 8,813 CMVs matched to FARS records).

3.2.1.1.2 Comparison of Data Fields

After linking PARs to records in the FARS, FMCSA compared five data fields on each PAR with the same data fields in the matched FARS record to look for the same outcomes:

- **Driver Contributing Factors**: The police officer’s assessment of driver factors that contributed to the crash event. Up to four factors may be recorded.

- **First Harmful Event**: The first injury- or damage-producing event of the crash (e.g., rollover, collision with pedestrian).

- **Traffic-Way Flow**: The traffic-way type on which the crash event occurred (e.g., not physically divided, one-way).

- **Weather Condition**: The weather condition at the time of the crash event (e.g., clear, rain, snow).

- **Roadway Surface Condition**: The condition of the roadway surface at the time of the crash (e.g., dry, wet).

The records “matched” if the codes for these fields were completed and were the same. Since up to four driver contributing factors can be found per driver in either the PAR or the FARS record, a match was identified if one out of the four were the same.

3.2.1.2 Analysis Results

Results of the PARs-FARS comparison indicated varying levels of agreement on the data for the fields examined, as shown in Table 8.

Table 8. Results of PARs-FARS Comparison

Data Field	PARs/FARS Match	PARs/FARS Non-Match	Missing PAR Data
Driver Contributing Factors	12.6%	5.3%	82.0%
First Harmful Event	46.9%	5.6%	47.5%
Traffic-Way Flow	52.4%	14.9%	32.8%
Weather Condition	95.7%	3.2%	1.1%
Roadway Surface Condition	96.7%	2.3%	1.0%

*All fields are counted at the crash level except the driver contributing factors field, which is counted at the vehicle level.

**The FARS has up to four driver contributing factors. All were recorded in the data collection tool if shown on the PAR.

Roadway surface condition and weather condition matched for more than 95 percent of records. Traffic-way flow matched for more than 50 percent; the main reason for the lower match rate for this field is that FARS analysts derive this information from other State documents. Driver contributing factors and first harmful event had match rates of less than 50 percent, primarily because this information was either missing from the PAR or was interpreted by the FARS analyst from information found in other places on the PAR. Further explanation for the low matching percentages includes:

- The PAR reviewers had only the PAR to review and did not have additional documentation. Reviewers were trained to copy information from specific fields on the PAR without interpreting information found elsewhere.

- In addition to a specific field on the PAR, the FARS analysts may derive data from different fields on the PAR, from a combination of fields, or from other information, such as the crash narrative; moreover, a FARS analyst may override a coded field on a PAR if there is conflicting information elsewhere. In general, when the FARS data is derived from a source other than the field being matched, the comparison between the PAR and the FARS record is likely to result as a "non-match."

- FARS analysts make use of additional resources pertaining to a crash, such as information on vehicles and drivers (from State vehicle registration and driver license files); traffic-way flow type (from State highway departments); or other information related to the crash (such as photographs, witness statements, or other documentation).

This suggests that the PAR alone may not provide sufficient information to support crash weighting determinations.

3.2.2 Comparison of PARs with NMVCCS

3.2.2.1 Approach

This analysis involved:

- Linking the PARs to records in the NMVCCS.
- Comparing the critical reason determinations.

3.2.2.1.1 Linking PARs to NMVCCS

The FMCSA received 387 PARs from the 2005-2007 NMVCCS. Of these PARs, 310 could be coded for a critical reason. (See Table 4.) These 310 coded crashes involved 321 CMVs (vehicle records).

For this analysis, FMCSA attempted to link the information for the 321 PAR vehicle records with the NMVCCS vehicle records. The records "matched" if the State and crash date for both were the same. The process resulted in a linked data set of 277 CMVs.

3.2.2.1.2 Comparing Critical Reason Determinations

FMCSA compared the critical reason assignments for the 277 CMVs to identify any discrepancies.

3.2.2.2 Analysis Results

Table 9 shows the results of the PAR-NMVCCS critical reason comparisons. Ninety percent (249) of the CMVs had the same critical reason determinations in the two data sources. Ten percent (28) were coded differently.

Table 9. Comparison of Coded PAR and NMVCCS Critical Reasons

NMVCCS Critical Reason	Coded PAR Critical Reason					
	Truck/Bus Driver	**Truck/Bus Vehicle**	**Environment**	**Not Assigned to This Truck/Bus**	**Unable to Assign Critical Reason**	**Total**
Truck/Bus Driver	88	0	0	3	2	93
Truck/Bus Vehicle	4	10	0	0	0	14
Environment	1	0	0	0	0	1
Not Assigned to This Truck/Bus	11	0	0	151	1	163
Unable to Assign Critical Reason	4	1	0	1	0	6
Total	**108**	**11**	**0**	**155**	**3**	**277**

Likely reasons for the 28 non-matches include the following:

- The NMVCCS conducted additional analysis of the crash events that was not part of the PAR review process. For this study, the PAR reviewers relied solely on the information in the PAR to assign the critical reason.
- Differences in the critical reason methodologies may account for a number of the discrepancies. For example, this study assigned the critical reason to the truck/bus driver in 11 cases, while the NMVCCS assigned the critical reason to a different vehicle or entity.[38]

3.3 FEASIBILITY OF CODING OF CRASH EVENTS WITHOUT A PAR REVIEW

The FMCSA assessed the practicality of coding crashes for two types of crash events using information available in the MCMIS as an approach to crash weighting that would not require reviewing an actual PAR:

- Single-vehicle crashes deemed to be “attributable” to the motor carrier.[39]
- Both single- and multiple-vehicle crashes with associated post-crash inspection records indicating a pre-crash out-of-service (OOS) condition on the CMV involved.[40]

3.3.1 Approach

For the two categories of crashes listed above, FMCSA identified the crashes from 2008-2010 coded by the PAR reviewers that were linked with records in the MCMIS. Because there is no direct link between a PAR and the MCMIS crash record, two different linking processes were used to create the data sets used for this analysis:

- Linking to a MCMIS crash record based on the State, crash date, vehicle license plate number, and vehicle license plate State.
- Linking to a FARS record using the FARS case number, State, and date, and then to the MCMIS using the FARS/MCMIS matching tool.[41]

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[38] Specific circumstances in which this study may have assigned the critical reason to the CMV but the NMVCCS would not have include (1) right-of-way (non-CMV was responsible for the critical event but had the right-of-way); (2) disabled CMV (truck or bus became disabled in the travel lane due to a driver error or vehicle problem); (3) cargo spillage (on-road cargo spillage led to the crash); or (4) multiple CMVs (more than one CMV contributed to the crash event).

[39] This study considered a single-vehicle crash to be attributable to the CMV when the event code description did not indicate a collision with a pedestrian, a motor vehicle in transport, an animal, work zone maintenance equipment, other/unknown movable object, or "other."

[40] The study used state, date, vehicle, and carrier information to match PAR crash records to MCMIS crash records. It considered MCMIS inspection records to be associated with a pre-crash OOS condition when the "post-accident indicator" field equaled "yes" and the "OOS total" value was greater than zero.

[41] The FARS/MCMIS matching tool defines a "matched record" between the two databases as a crash that involved at least one fatality, involved a large truck or bus, and contains the same information in several key fields (e.g., State, date, time, county, U.S. DOT Number, etc.). The methodology has more than 40 unique matching

The results of these two processes produced a linked set of 671 records for single-vehicle crashes and 767 records for crashes associated with a pre-crash OOS violation.

It was hypothesized that the reviewers would assign a critical reason that would attribute to the motor carrier for any single-vehicle crash or crash with a pre-crash OOS condition. The assumption for pre-crash OOS conditions was that the CMV driver or vehicle should not have been on the road and should thus be assigned the critical reason. To test the feasibility of such an approach, PAR reviewers assigned the critical reason for such crashes independently, without referring to the MCMIS data.

3.3.2 Analysis Results

3.3.2.1 Single-Vehicle Crash Analysis

Table 10 shows the critical reason determinations for the 671 single-vehicle crashes identified.

Table 10. Critical Reason Determinations for Single-Vehicle Attributable Crashes

Critical Reason Determination	Number Assigned	Percent Assigned
Assigned to CMV	**630**	**93.9%**
Not Assigned to CMV	**41**	**6.1%**
Environment	6	0.9%
Not Assigned to Truck/Bus Driver or Vehicle	14	2.1%
Unable to Assign Critical Reason	21	3.1%
Total	**671**	**100%**

For 94 percent of the 671 single-vehicle crashes identified, the PAR reviewers assigned a critical reason attributed to the motor carrier. Of the remaining 6 percent, 3 percent were coded “unable to assign critical reason” because the PAR lacked sufficient information to make a determination, 2 percent were assigned to another vehicle, and 1 percent were assigned to the environment. For the 2 percent assigned to another vehicle, the PAR indicated that another vehicle was involved, while the MCMIS record did not.

3.3.2.1 Post-Crash Inspection with OOS Violation Analysis

Table 11 shows the critical reason determinations for the 767 crashes associated with a pre-crash OOS condition.[42]

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combinations that can produce a single match between the FARS and MCMIS fatal crash records. For more information, go to: https://ai.fmcsa.dot.gov/DataQuality/DataQuality.asp?redirect=about_datatools_desc.asp

[42] Of these OOS violations, 39 percent were brake violations, 36 percent were other vehicle violations, 19 percent Hours-of-Service were violations, and 6 percent were other driver violations.

Table 11. Critical Reason Determinations for CMVs with Accompanying OOS Conditions

Critical Reason Determination	Number Assigned	Percent Assigned
Assigned to CMV	**327**	**42.6%**
Truck/Bus Driver	293	38.2%
Truck/Bus Vehicle	34	4.4%
Not Assigned to CMV	**440**	**57.4%**
Environment	1	0.1%
Not Assigned to Truck/Bus Driver or Vehicle	426	55.5%
Unable to Assign Critical Reason	13	1.7%
Total	**767**	**100%**

For the 767 crashes with an accompanying OOS condition, PAR reviewers assigned a critical reason attributed to the motor carrier for fewer than half (43 percent) of the records. This is likely because they used only the PAR and did not have access to post-crash inspection results indicating a pre-crash driver or vehicle OOS condition.

3.4 OBSERVATIONS

The following observations are based on FMCSA's analysis of the sufficiency, reliability, and feasibility of using PARs to make crash weighting determinations:

- The results of the quality control process, comparison of data on the PARs with that in the FARS, and comparison of critical reason determinations with the NMVCCS suggest that the PAR alone may not be sufficient for a crash weighting determination.

- PAR reviewers may need to take additional time to derive data for blank, missing, or incomplete fields from other data sources, including the MCMIS, to make the most accurate critical reason determinations. This would increase the length and complexity of the PAR review process.

- Some PARs did not clearly identify CMVs or allocate sufficient space or have fields for motor carrier identification information, such as carrier name, U.S. DOT Number, or MC Number; for this reason, additional information may be necessary to identify the motor carrier involved in a crash.

- Because the majority of PARs used for this analysis were limited to fatal crashes, the results may not be applicable to a broader range of crash events.

4 WOULD A CRASH WEIGHTING DETERMINATION PROCESS OFFER AN EVEN STRONGER PREDICTOR OF CRASH RISK THAN OVERALL CRASH INVOLVEMENT?

This portion of the crash weighting analysis assumed the sufficiency and reliability of Police Accident Reports (PARs) and looked at whether a crash weighting methodology in the Safety Measurement System (SMS) Crash Indicator would provide a sharper view of the highest risk motor carriers.[43] The Federal Motor Carrier Safety Administration (FMCSA) defined crash weighting as a two-step process: (1) review a sample of PARs to determine the critical reason for the crash events and the motor carriers' roles; and (2) use the critical reason determinations as a basis for weighting the crashes in the SMS. Crash weights were derived based on the critical reason assignments for the 10,892 PARs that were reviewed and single-vehicle attributable crashes identified in the Motor Carrier Management Information System (MCMIS). (See Section 3 for details on the critical reason determination process and the identification of single-vehicle attributable crashes.)

The FMCSA employed various statistical and analytical approaches to assess crash weighting benefits, in particular the SMS Effectiveness Test (ET) Methodology.[44] The SMS ET quantifies how effectively FMCSA uses its resources to target high-risk motor carriers for interventions; it compares the crash rate of carriers above the Intervention Threshold to the national average. (A discussion of the methodology and results for the other statistical tests performed is in Appendix C.)

4.1 OVERVIEW OF METHODOLOGY

The FMCSA used the SMS ET to assess the safety benefits of implementing various approaches to crash weighting as part of the Crash Indicator.

4.1.1 Crash Indicator Calculation

As discussed in Section 1, the Crash Indicator currently relies on crash involvement and does not include any weighting based on a motor carrier's role in a crash.

The Crash Indicator is calculated as the sum of severity- and time-weighted crashes, divided by a motor carrier's average Power Units (PUs) multiplied by a Utilization Factor that accounts for some difference in Vehicle Miles Traveled (VMT) between carriers, as follows:

$$Crash\ Indicator\ Measure = \frac{Total\ of\ time\ and\ severity\ weighted\ applicable\ crashes}{Average\ PUs\ x\ Utilization\ Factor}$$

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[43] As stated above, the study questions addressing PAR sufficiency, PAR reliability, and crash weighting benefits were not addressed sequentially but as separate analyses designed to inform Agency decisions. Thus, this portion of the analysis did not consider the sufficiency or reliability of the PARs used in the study.

[44] See the SMS ET Methodology at http://csa.fmcsa.dot.gov/Documents/CSMS_Effectiveness_Test_Final_Report.pdf

In this equation, the terms are defined as follows:

- **Applicable Crash.** A State-reported crash during the past 24 months that meets the recordable crash standard (results in at least one fatality, at least one injury where the injured person is taken to a medical facility for immediate medical attention, or at least one vehicle towed from the scene as a result of disabling damage caused by the crash).

- **Crash Severity Weight.** Places more weight on crashes with more severe consequences. For example, a crash involving an injury or fatality is weighted more heavily than a crash where only a tow-away occurred. A hazardous materials (HM) release also increases the weight of a crash.

- **Time Weight.** Assigned to each applicable crash based on the time elapsed since the crash occurred. This time-weighting places more emphasis on recent crashes relative to older crashes.

- **Time- and Severity-Weighted Crash.** A crash's severity weight multiplied by its time weight.

- **Average PUs.** Calculated using (1) the motor carrier's current total PUs; (2) the total PUs the carrier had six months ago; and (3) the total PUs the carrier had 18 months ago.

- **Utilization Factor.** A multiplier that adjusts the average PU values in terms of VMT per average PU where VMT data in the past 24 months are available from either (1) Form MCS-150 (filled out by the motor carrier); or (2) Form MCS-151 (filled out by law enforcement as part of an investigation).

After a measure is calculated, the SMS places a motor carrier in a safety event group based on the carrier's number of crashes and industry segment. There are two industry segments:

- **Combination Segment**. Combination trucks/motor coach buses constitute 70 percent or more of the total PUs.

- **Straight Segment**. Straight trucks/other vehicles constitute more than 30 percent of the total PUs.

The SMS then determines a percentile from 0 to 100, with 100 indicating the worst performance, by comparing the motor carrier's Crash Indicator measure to those of other carriers in the safety event group and segment.[45] If the carrier's percentile exceeds the threshold, the carrier becomes a candidate for an intervention.[46] (Additional details on the Crash Indicator calculation are presented in Appendix D.)

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[45] See the SMS Methodology at http://csa.fmcsa.dot.gov/Documents/SMSMethodology.pdf.

[46] The Intervention Threshold used in this analysis for the Crash Indicator is the general freight threshold of 65 percent.

4.1.2 SMS ET

The SMS ET compares the crash rate of carriers above the Intervention Threshold to the national average. The SMS is “effective” if the crash rate for above-threshold carriers is higher than the national average crash rate. For this analysis, the test used crash data from 2009-2010 to define Crash Indicator percentiles, then tracked the future (January 2011 to June 2012) crash rate of motor carriers above the Intervention Threshold, as shown in Figure 3. (See Appendix C for additional details on the SMS ET Methodology.)

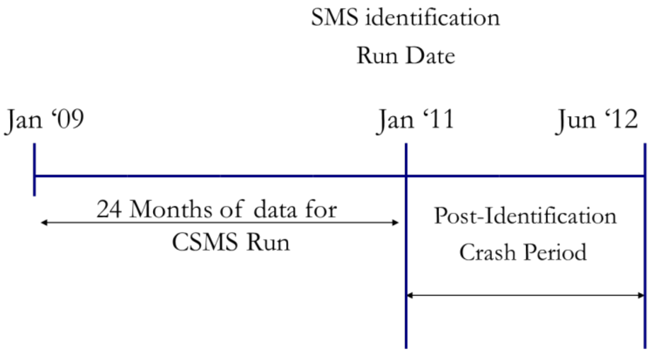

Figure 3. SMS Effectiveness Test Timeline

4.1.3 Crash Weighting Approaches

The FMCSA applied two approaches for modifying crash weights in the Crash Indicator:

- **Removing “Not Assigned Crashes.”** “Not assigned crashes” included 3,613 vehicles involved in fatal crashes from the FARS data set with a critical reason not attributed to the motor carrier (critical reason “not assigned to this driver/vehicle”) as a result of the PAR reviews discussed above in Section 3.

- **Increasing the Weight of “Assigned Crashes” and Reducing the Weight of “Not Assigned Crashes.”** “Assigned crashes” included (1) 1,995 vehicles involved in fatal crashes from the FARS data set with a critical reason attributed to the motor carrier (critical reason of “truck/bus driver” or “truck/bus vehicle”)[47]; and (2) 34,385 single-vehicle crashes from the MCMIS considered to be attributable to the CMV.[48] (See Section 3.)

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[47] All crashes in this analysis with a critical reason assigned were fatal crashes, which means that crash severity may be a confounding factor in analysis conducted on the full set of crashes.

[48] The crashes that were not coded had no PAR available to confirm the attribution to the CMV; this assignment is based solely on the number of vehicles and first harmful event recorded in the MCMIS crash database. The set of single-vehicle attributable crashes was not chosen to be representative of all attributable crashes and may have biases, such as toward particular geographic areas or carrier operation types.

The Agency then compared these crash weighting approaches with the current Crash Indicator, or “baseline” (SMS Version 3.0), using the SMS ET to assess future crash rates of motor carriers above the Intervention Threshold.[49] The analysis was performed using both all crashes and fatal crashes alone.

4.1.4 Motor Carrier Data Set

The FMCSA applied a number of screens to ensure there were no large changes in data relevant to the analysis and that motor carriers continued to operate in the “future crash” period. The following screens were used:

- Carrier must have been under FMCSA jurisdiction in December 2010.[50]
- Carrier must have been domiciled in the United States.
- Carrier must have had a crash in the pre-period (2009 or 2010).
- Carrier must have had a crash or inspection in the post-period (January 2011 to June 2012).
- Carrier must have had positive average PUs in both the pre- and post-periods.[51]
- Carrier’s average number of PUs from the pre-period to the post-period is within three standard deviations of the mean.
- Carrier must have had a reasonable crash-to-PU ratio in the pre-period.[52]

Applying these screens on motor carriers with a Crash Indicator percentile resulted in a data set of 12,640 carriers for the all-crash analysis and 1,912 carriers for the fatal crash analysis. Table 12 shows the resulting size distribution of the motor carriers included in the analysis.

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[49] Additional weighting approaches were tested, but not included in the body of this report, because the results did not differ substantially from those reported below. Appendix B contains descriptions of these other weighting approaches.

[50] Active interstate or intrastate hazardous materials carriers.

[51] Derived by adding the motor carrier's current PUs, PUs 6 months ago, and PUs 18 months ago, and dividing by 3. Positive average PUs imply that the motor carrier had at least one PU during those three time periods.

[52] A “reasonable” crash-to-PU is described in the SMS ET Methodology, Appendix A, http://csa.fmcsa.dot.gov/Documents/CSMS_Effectiveness_Test_Final_Report.pdf.

Table 12. Motor Carrier Size Distribution

Motor Carrier Size Group (Average PUs)	All-Crash Analysis Carriers			Fatal Crash Analysis Carriers		
	# of Carriers	PUs	% of Total Carriers	# of Carriers	PUs	% of Total Carriers
Carriers with 5 or fewer PUs	1,279	3,796	10.1%	86	261	4.5%
Carriers with more than 5 and up to 15 PUs	2,521	25,269	19.9%	207	2,100	10.8%
Carriers with more than 16 and up to 50 PUs	4,324	126,610	34.2%	435	13,277	22.8%
Carriers with more than 51 and up to 500 PUs	4,002	554,848	31.7%	867	150,641	45.3%
Carriers with more than 500 PUs	514	971,940	4.1%	317	792,179	16.6%
Total	12,640	1,682,464	100%	1,912	958,458	100%

4.2 CRASH WEIGHTING USING ALL CRASHES

The data set used for this analysis consisted of (1) fatal crashes from the PAR data set obtained from the FARS that were coded for a critical reason using the PAR; (2) single-vehicle attributable crashes identified in the MCMIS; and (3) all other crashes in the MCMIS for the required time period without a crash weighting determination. The first two types of crashes accounted for less than 20 percent of the crashes used in the analysis, or approximately 25,000 crashes over the 2-year period.[53]

4.2.1 Approach

The approach for this analysis included:

- Modifying the Crash Indicator by applying crash weights.
- Running the SMS ET for the modified and baseline Crash Indicator and comparing the results.

4.2.1.1 Modified Crash Indicator Using All Crashes

The FMCSA modified the Crash Indicator severity weights for “assigned crashes” (those for which the critical reason was attributed to the motor carrier or single-vehicle attributable crashes) and “not assigned crashes” (those that were reviewed but not attributed to the carrier involved). Table 13 compares the current severity weights with the modified approach.

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[53] For the analysis years, 2009-2010, the data available for analysis included 1,995 crashes coded to the truck/bus driver or vehicle; 3,613 coded “not assigned to this driver/vehicle”; and 34,385 single-vehicle attributable crashes.

Table 13. Modified Crash Indicator Weighting Approach

Approach	Crash Type	Crash Severity Weight
Original Weight	Involves Tow-Away but No Injury or Fatality	1
Original Weight	Involves Injury or Fatality	2
Original Weight	Involves an HM Release	Severity Weight + 1
Modified Weight	Assigned Crash	+ Additional Weight
Modified Weight	Not Assigned Crash	- Weight or Do Not Count

The Agency applied the following methods for modifying the Crash Indicator, as described above: (1) removing "not assigned crashes"; and (2) applying higher severity weights for "assigned crashes" and lower weights for "not assigned crashes." Table 14 shows these two crash weighting approaches.

Table 14. Crash Severity Weight Approaches

Approach	Weight for Assigned Crashes	Weight for Not Assigned Crashes
Current Crash Indicator	0	0
Remove Not Assigned Crashes	+ 1	Not Included
Add Weight for Assigned Crashes/Remove Weight for Not Assigned Crashes	+ 3	- 0.5

4.2.1.2 SMS ET Run Using All Crashes

The FMCSA ran the SMS ET for the modified Crash Indicator and compared the results with the current Crash Indicator.

4.2.2 Analysis Results

Table 15 shows the future crash rate and the percent improvement for the two crash weighting methods compared to the current Crash Indicator when using all crashes.[54]

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[54] As explained in the SMS Methodology, the Crash Indicator splits carriers into two segments according to the carrier's fleet mix (based on the ratio of straight and combination vehicles) to ensure that carriers with fundamentally different types of vehicles and operations are not compared with each other.

Table 15. SMS Effectiveness Test Results Using Crash Weighting for All Crashes

Crash Weighting Model	*Straight* # of Carriers Above Threshold	*Straight* Crash Rate per 100 Adjusted PUs[55]	*Straight* % Increase from Baseline	*Combination* # of Carriers Above Threshold	*Combination* Crash Rate per 100 Adjusted PUs	*Combination* % Increase from Baseline
Baseline	1,501	2.99	0%	3,026	7.02	0%
Remove Not Assigned Crashes[53]	1,469	2.95	-1.3%	2,967	7.01	-0.1%
Add Weight for Assigned Crashes/ Reduce Weight for Not Assigned Crashes[56]	1,514	3.01	0.7%	3,022	6.99	-0.4%

Changing the weights of "assigned" and "not assigned crashes" in the Crash Indicator does not appear to improve its ability to predict future crash rates when all crashes are considered.[57] If effectiveness were improved, the average crash rate for carriers above the Intervention Threshold would be higher for the modified Crash Indicator than for the current approach; however, the analysis results show that these average crash rates are nearly identical.

The FMCSA also compared the set of carriers that would be above the Intervention Threshold in a modified Crash Indicator versus the baseline, or the "churn rate." A higher churn rate suggests that the applied weighting approach prioritizes a different set of carriers than the current approach, while a lower churn rate means that fewer carriers would change prioritization status. Whether or not the changes represent an improvement depends on the characteristics (crash and violation rates) of the carriers identified. The Agency found the following:

The approach that adds weight to "assigned crashes" and reduces weight for "not assigned crashes" has a churn rate of 4.2 percent for the straight segment and 4.5 percent for the combination segment. (This means, for example, that 4.2 percent of the straight segment carriers over the threshold in the baseline Crash Indicator are under the threshold in the weighted Crash Indicator.)

- The approach that removes "not assigned crashes" has a churn rate of 1.2 percent for the straight segment and 2.3 percent for the combination segment.

4.3 CRASH WEIGHTING USING FATAL CRASHES ALONE

This data set consisted of (1) fatal crashes from the PAR data set obtained from the FARS that were coded for a critical reason using the PAR; and (2) all other fatal crashes in the MCMIS for

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[55] Adjusted PUs = average PUs × Utilization Factor.

[56] Weight changes from baseline are described in Table 13 and Table 14.

[57] Again, other weighting approaches were tested but results were not included, because they did not differ substantially from the analysis results shown here. See Appendix D.

the required time period. Fatal crashes that were coded for the critical reason accounted for more than 75 percent of fatal crashes used in the analysis; however, all fatal crashes account for 3 percent of the crashes in the MCMIS.

4.3.1 Approach

The analysis approach included:

- Modifying the Crash Indicator to use fatal crashes alone and applying crash weights.
- Running the SMS ET for the modified and baseline Crash Indicator and comparing the results.

4.3.1.1 Modified Crash Indicator Using Fatal Crashes

The FMCSA modified the Crash Indicator to include only fatal crashes since the number of "assigned" and "not assigned crashes" is small relative to the total number of crashes in the SMS. Prior to modifying the Crash Indicator, the Agency adjusted the SMS data sufficiency requirements to account for the smaller number of crashes, from at least two crashes to at least two crashes where one is a fatal crash. FMCSA also adjusted the Crash Indicator safety event groups, as shown in Table 16.

Table 16. Modified Crash Indicator Safety Event Groups

Industry Segment	Safety Event Group	# Fatal Crashes	# Carriers
Combination[58]	1	1*	220
Combination	2	2	63
Combination	3	3	619
Combination	4	4+	125
Straight[59]	1	1*	34
Straight	2	2+	75

*1 fatal crash but 2 or more total crashes

4.3.1.2 SMS ET Run Using Fatal Crashes

The FMCSA ran the SMS ET for the fatal-only Crash Indicator with crash weights and compared the results with the unweighted fatal-only Crash Indicator.

4.3.2 Analysis Results

Table 17 compares the SMS ET results for the two methods of crash weighting with those for the current Crash Indicator using fatal crashes alone.

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[58] Combination trucks/motorcoach buses constitute 70 percent or more of the carrier's total PUs.
[59] Straight trucks/other vehicles constitute more than 30 percent of the carrier's total PUs.

Table 17. SMS Effectiveness Test Results Using Crash Weighting for Fatal Crashes

Crash Weighting Model	***Straight*** **# of Carriers**	***Straight*** **Crash Rate per 100 Adjusted Pus**	***Straight*** **% Increase from Baseline**	***Combination*** **# of Carriers**	***Combination*** **Crash Rate per 100 Adjusted Pus**	***Combination*** **% Increase from Baseline**
Baseline	106	3.41	0%	309	6.66	0%
Remove Not Assigned Crashes	57	3.58	5.0%	164	6.78	1.8%
Add Weight for Assigned Crashes/ Reduce Weight for Not Assigned Crashes	108	3.40	-0.3%	318	6.72	0.9%

When using fatal crashes alone in the Crash Indicator, weighting crashes by removing those not attributed to the motor carrier (“not assigned crashes”) appears to improve the ability of the SMS to predict future crashes by 1.8 percent (for the combination segment) to 5.0 percent (for the straight segment); however, this analysis was limited to approximately 4,500 fatal crashes over the 2-year period, or less than 3 percent of total crashes. Moreover:

- The number of carriers in the fatal-only analysis is about 10 times lower than that for all crashes, as shown in Table 15.[60] Thus, the differences in future crash rates might simply be a result of the greater variability presented by a smaller sample size.[61]

- Removing crashes not attributed to the motor carrier decreased the total number of carriers above the threshold by approximately 50 percent.

Regarding the churn rate for the fatal-only models:

- The model that adds weight to “assigned crashes” and reduces weight for “not assigned crashes” has a churn rate of 6.5 percent for the straight segment and 8.5 percent for the combination segment. (For example, 6.2 percent of the straight segment carriers over the threshold in the baseline fatal Crash Indicator are under the threshold in the weighted fatal Crash Indicator.)

- The model that removes “not assigned crashes” has a higher churn rate, at 8.8 percent for the straight segment and 14.6 percent for the combination segment; thus, more carriers would have changes in their Crash Indicator percentiles with this model.

4.4 OBSERVATIONS

Limitations in the data used restrict the applicability of the results presented above. In particular:

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[60] Only 415 carriers were over the threshold for this analysis, compared to 4,527 for the all-crash analysis and about 40,000 used in the standard SMS ET.

[61] The SMS ET was not designed to provide sensitivity for such comparative analyses.

- Smaller carriers are underrepresented, since they are less likely to be involved in fatal crashes; conversely, larger carriers are overrepresented, because they are more likely to be involved in such crashes due to exposure.

- Given the limited data available, analysis on a different set of future crashes—such as fatal or single-vehicle “assigned crashes” that were coded for a critical reason or another crash data set—was not deemed feasible.

- The SMS ET can be used only to assess the future crash rates of motor carriers, not drivers; moreover, data sufficiency requirements (two or more crashes) restrict the number of carriers and crashes that can be included.

- Because the SMS ET requires a total of 42 months of data, there was not enough coded crash data available to perform analysis for future assigned coded crash rates.

- For the fatal-only SMS ET results to apply more broadly to all crashes, one must assume that fatal crashes are representative of all other types of crashes.

5 HOW MIGHT FMCSA MANAGE THE PROCESS FOR MAKING CRASH WEIGHTING DETERMINATIONS?

This analysis examined how a crash weighting process might be structured and the estimated resources required. In particular, such a process requires a method for uniformly acquiring the final Police Accident Reports (PARs) for all or a subset of crashes, since the States do not currently provide PARs to the Federal Motor Carrier Safety Administration (FMCSA); a process and system for uniform analysis; and a method for receiving and analyzing public input. To estimate the associated costs and other resources, FMCSA identified a potential process for a national crash weighting program based on that used for this analysis.

5.1 CRASH WEIGHTING DETERMINATION PROCESS

5.1.1 Approach

In identifying a process for a national crash weighting program, the Agency:

- Outlined a potential process for reviewing and coding PARs based on the process employed for this analysis.
- Expanded the process to include the acceptance of public input.

5.1.2 Analysis Results

A potential process for crash weighting determinations would include five steps:

- **Step 1.** Establish agreements with the States and obtain PARs in either hard copy or electronic format. As this study shows, obtaining and handling physical PARs can be problematic. The majority of PARs used in this study were hard copies that required scanning prior to the review process; a number of these PARs were illegible or otherwise difficult to interpret. Moreover, because of privacy concerns, all PARs had to be stored in a secure location with access control. Challenges associated with accessing electronic PARs include incompatible security controls and differences among the States’ electronic versions.
- **Step 2.** Develop a system to support the collection and storage of crash weighting determinations. Considerations would include how the PAR would be linked to the Motor Carrier Management Information System (MCMIS) record, since no direct link currently exists, and how the crash weighting determinations would be stored within the MCMIS.
- **Step 3.** Implement the PAR review process.
- **Step 4.** Publish the results of the PAR reviews in the Federal Register.
- **Step 5.** Establish a procedure for accepting public input should the results of a PAR review be appealed. Such a process could involve an appeal committee established to re-review the PAR and any additional materials provided.

5.2 IMPLEMENTATION COSTS

5.2.1 Approach

The FMCSA estimated the costs associated with the five-step process described above. The estimate was based on information collected throughout the study and included both start-up and annual costs. To determine the costs associated with the acceptance of public input, the Agency considered as a proxy the current process for approval of applications for operating authority.[62]

The FMCSA:

- Estimated the start-up costs for establishing agreements with the States and supporting systems (Steps 1 and 2).
- Estimated costs for PAR review and quality control, based on the total number of hours, and associated costs, required to review and code PARs for this study (Step 3).
- Estimated costs for a PAR appeal process (Step 5) considering the current appeals process for the approval of operating authority applications.
- Estimated total annual costs based upon all of the above.

5.2.2 Analysis Results

5.2.2.1 Start-Up Costs

To establish a process for crash weighting determinations, FMCSA must reach agreements with the States to obtain their PARs and establish the necessary systems for PAR collection and storage. Based on efforts to obtain PARs for this study, FMCSA estimated 40 hours to establish an agreement with each State. (States are reluctant to provide PARs because of privacy concerns and the uncertainty of how the crash weighting process may interact with the State judicial process.) The aggregated costs for all “52 States” (the 50 States, District of Columbia, and territories) are shown in Table 18. The table also shows the approximate cost to establish information technology systems to support the process.

Table 18. Start-Up Costs for Crash Weighting Determination Process

Task/Step	Cost*
Obtain and Store PARs	$610,000.00
System/Process Set-Up	$500,000.00
Total	**$1,110,000.00**

*Assumes $200 per hour for legal support and $95 per hour for administrative support.

The $1.1 million start-up cost shown above is a fixed cost and is not included as an annual operating expense.

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[62] Because FMCSA receives relatively few appeals for the granting of operating authority, the cost estimate for crash weighting appeals may be low.

5.2.2.2 Costs of Initial PAR Review

The coding of PARs involves thoroughly reviewing all elements relevant to the crash, determining the critical event and critical reason, and quality control of the coding results. As shown in Table 19, this required approximately 19 minutes and $26.50 per PAR for this analysis.[63]

Table 19. Time and Cost Requirements for PAR Review

Process Element	Time per PAR	Cost per PAR*
Review PAR	15.6 minutes	$21.09
Quality Control (sample of PARs reviewed)	3.0 minutes	$5.37
Total	**18.6 minutes**	**$26.46**

*Includes labor and overhead costs.

The FMCSA assumed that the time and costs shown in Table 19 are representative of those for a nationally implemented crash weighting process.

5.2.2.3 Costs of PAR Review Appeal

Table 20 shows the estimated costs associated with re-review of a PAR and additional materials by an appeal committee. The estimate assumes that the re-review of a PAR would take four times as long as the initial review, or 74.4 minutes.

Table 20. Time and Cost Requirements for PAR Review Appeal

Process Element	Time per PAR	Cost per PAR
Re-review PAR and Additional Materials	74.4 minutes	$105.84

As shown in the table, reviewing additional information provided by the public for a PAR review would require approximately $106 per PAR in addition to the costs of the initial review.

5.2.2.4 Total Annual Costs

Annual costs for obtaining PARs, operating supporting systems, reviewing PARs, and accepting public input (appeals) are shown in Table 21. The table presents costs for four scenarios and considers three rates of public input for each. These scenarios include:

- Reviewing and coding all recordable crashes.
- Reviewing and coding only interstate and intrastate hazardous materials (HM) crashes.

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[63] Estimates are based on actual costs of the PAR coding process during the study.

- Reviewing and coding interstate and intrastate HM crashes after removing crashes for which a post-crash inspection identifies a pre-crash out-of-service (OOS) condition; for the purposes of this study, the proportion of these crashes is estimated at 5 percent.

- Reviewing and coding interstate and intrastate HM crashes after removing two types of crashes: (1) those for which a post-crash inspection identifies a pre-crash OOS condition, and (2) single-vehicle “attributable” crashes.

Table 21. Estimated Annual Costs for a National PAR Review Process

Scenario	Initial Review		Appeal			Operating Costs*	Total Costs
	Number of PARs per Year	Cost	Public Input Rate	Number of PARs per Year	Cost		
All Crashes	130,000	$3,439,800	10%	13,000	$1,375,920	$850,000	$5,665,720
			25%	32,500	$3,439,800	$850,000	$7,729,600
			50%	65,000	$6,879,600	$850,000	$11,169,400
Interstate and Intrastate HM Only	100,000	$2,646,000	10%	10,000	$1,058,400	$850,000	$4,554,400
			25%	25,000	$2,646,000	$850,000	$6,142,000
			50%	50,000	$5,292,000	$850,000	$8,788,000
Remove Pre-Crash OOS (~5 %)	95,000	$2,513,700	10%	9,500	$1,005,480	$850,000	$4,369,180
			25%	23,750	$2,513,700	$850,000	$5,877,400
			50%	47,500	$5,027,400	$850,000	$8,391,100
Remove Single-Vehicle Attributable and Pre-Crash OOS (~13%)	82,650	$2,186,919	10%	8,265	$874,768	$850,000	$3,911,687
			25%	20,663	$2,186,919	$850,000	$5,223,838
			50%	41,325	$4,373,838	$850,000	$7,410,757

*Assumes $500,000 to obtain PARs and $350,000 to operate and maintain systems.

The total annual costs for a PAR review process range from approximately $3.9 million to $11.2 million.

5.3 TIMEFRAMES

One concern is the timeliness of the review and weighting of any crashes. The above analysis assumes that the reviews are completed on crashes used in the Safety Measurement System (SMS), which uses a 24-month time period. It is possible that the timeframe for the entire process—including the submittal of the PAR by law enforcement, its receipt by FMCSA, analysis to make a crash weighting determination, possible appeal of the analysis results, and final disposition of the appeal—could exceed the 24-month analysis period used by the SMS.

5.4 OBSERVATIONS

- The resources required for implementing a crash weighting determination process would depend primarily upon the nature of the process defined by the Agency.

- Annual costs for crash weighting determinations would likely vary, depending on the number of crashes reviewed each year and the number of appeals.

- The time and costs identified above are based on the methods used for this analysis, in particular, the sole use of the PAR for a crash weighting determination; use of additional data sources, such as MCMIS data or supplemental documentation about the crash, would require additional resources.

6 CONCLUSIONS

The Federal Motor Carrier Safety Administration's (FMCSA) assessment of crash weighting focuses on three questions:

- Do Police Accident Reports (PARs) provide sufficient, consistent, and reliable information to support crash weighting determinations?
- Would a crash weighting determination process offer an even stronger predictor of crash risk than overall crash involvement, and how would crash weighting be implemented in the Safety Measurement System (SMS)?
- Depending upon the analysis results for the questions above, how might FMCSA manage the process for making crash weighting determinations, including public input to the process?

The following are conclusions resulting from the analyses described above. Although these conclusions will inform Agency decision-making regarding crash weighting, they are not definitive and additional analysis may be needed to address the study questions.

6.1 DO PARS PROVIDE SUFFICIENT, CONSISTENT, AND RELIABLE INFORMATION TO SUPPORT CRASH WEIGHTING DETERMINATIONS?

- Although 91 percent of PARs met the criteria to be reviewed for a critical reason determination, the information on the PAR may not be reliable. For a large number of PARs, a low match rate was found between fields on the PAR and similar fields in the Fatality Analysis Reporting System (FARS). This could be due to the additional information and analysis used in creating FARS records, which was not available for this study. These results suggest that PARs may not provide sufficient information to support crash weighting determinations.
- For 9 percent of PARs, the reviewers could not determine that a commercial motor vehicle (CMV) was involved, that a CMV was regulated by FMCSA, or that the crash was recordable. These PARs were often incomplete or contained illegible or redacted information.
- Coding crash events based solely on the Motor Carrier Management Information System (MCMIS) data for either single-vehicle attributable crashes or crashes with a post-crash inspection with a pre-crash out-of-service (OOS) condition was not always consistent with coding results based on a PAR review.

6.2 WOULD A CRASH WEIGHTING DETERMINATION PROCESS OFFER AN EVEN STRONGER PREDICTOR OF CRASH RISK THAN OVERALL CRASH INVOLVEMENT?

- Modifying the SMS Crash Indicator to include crash weighting improves its ability to predict future crash rates when fatal crashes alone are used. However, fatal crashes represent less than 3 percent of all crashes in the MCMIS.

- Analysis using all crashes shows that incorporating crash weighting determinations does not consistently improve the Crash Indicator when the various weighting approaches are applied.

6.3 HOW MIGHT FMCSA MANAGE THE PROCESS FOR MAKING CRASH WEIGHTING DETERMINATIONS?

- The FMCSA would need to establish a process with the States to receive and manage PAR data.

- The range of costs for implementing a system for accepting and analyzing public input is conservatively estimated to be four times that of the initial PAR review. Annual costs could range from $3.9 million to $11.2 million, depending on the number of PARs reviewed, the number of appeals, and the process established by the Agency.

- The timeframe for the entire process—including the submittal of the PAR by law enforcement, its receipt by FMCSA, analysis to make a crash weighting determination, possible appeal of the analysis results, and final disposition of the appeal—could exceed the 2-year analysis period used by the SMS.

APPENDIX A POLICE ACCIDENT REPORT CODING GUIDELINES

This appendix to the Federal Motor Carrier Safety Administration (FMCSA) *Crash Weighting Analysis* presents guidelines for coding Police Accident Reports (PARs) used by the PAR reviewers. All of the PAR reviewers had previous experience with the format and content of PARs, with the critical event/critical reason methodology, and with interpreting and understanding the nuances of crash reporting. Reviewers also had experience with studies, such as the Large Truck Crash Causation Study (LTCCS), that involved the processing of large volumes of PARs to identify unique crash variables.

PAR REVIEW PROCESS

FMCSA's "Crash Weighting Analysis" employed a review process based on that developed for the LTCCS, particularly the methodology for assigning the critical event and critical reason.[64] The critical event and critical reason are defined as follows:

- **Critical Event:** The event that immediately led to the crash and that put the vehicle or vehicles on a course that made the crash unavoidable. In this study, the PAR reviewers assigned the critical event to the vehicle or other party, such as a pedestrian, responsible for the action or inaction that made the crash inevitable.

- **Critical Reason:** The immediate reason for the critical event or the failure leading to the critical event. The critical reason was identified to describe the role of the driver or vehicle involved in the crash event. For example, if a commercial motor vehicle (CMV) driver decides to drive too fast for the roadway type, the CMV driver would be assigned the critical reason.

The PAR review process comprised four steps:

- **Step 1. Review PAR for Relevancy and Completeness**: The PAR reviewers first checked each PAR to ensure that at least one of the vehicles listed was a CMV[65]; that the CMV was regulated by FMCSA; and that the crash event met the severity criteria for a recordable crash.[66] If a reviewer could not determine from the PAR that these criteria were met, he or she created a record for that crash but did not complete a full review; the number of CMVs was entered as "0" and the review process ended.

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[64] For details on the LTCCS methodology, go to http://www.ai.fmcsa.dot.gov/ltccs/default.asp?page=method.

[65] Any self-propelled or towed motor vehicle used on a highway in interstate commerce to transport passengers or property when the vehicle (1) has a gross vehicle weight rating or gross combination weight rating, or gross vehicle weight or gross combination weight, of 10,001 pounds or more; (2) is designed or used to transport more than 8 passengers (including the driver) for compensation; (3) is designed or used to transport more than 15 passengers, including the driver, and is not used to transport passengers for compensation; or (4) is used in transporting hazardous materials (HM) as defined under 49 U.S.C. 5103 and transported in a quantity requiring placarding under 49 CFR, subtitle B, chapter I, sub-chapter C.

[66] Fatal, injury, or tow-away.

- **Step 2. Review Crash and Vehicle Information**: The PAR reviewers examined the remaining PARs to understand the nature of the crash events, including the basic crash information (crash date and time, crash severity, number of vehicles involved, number of CMVs, weather and road surface condition, traffic-way type, first harmful event); vehicle information (configuration, cargo body type, weight, class, hazardous materials (HM) information, license plate number and State, motor carrier information); driver information (driver condition, driver action immediately prior to the crash, alcohol test results, citations, license class, endorsements, restrictions or license status); and the crash diagram and narrative description. Reviewers crosschecked the data in the driver and vehicle sections to ensure that the PAR contained sufficient information to determine the critical event/critical reason; if the PAR did not contain enough information, the reviewer assigned the critical reason as "unable to assign critical reason."

- **Step 3. Determine the Critical Event and Critical Reason**: After carefully reviewing the information on the PAR, reviewers determined the vehicle(s) (or other party) that committed the critical event and assigned a critical reason to each CMV involved in the crash. (Reviewers did not assign a critical reason to the non-CMVs.) There were five critical reason choices: truck/bus driver, truck/bus vehicle, environment, not assigned to this truck/bus driver/vehicle, and unable to assign critical reason. Reviewers also selected from among a number of critical reason justifications.

- **Step 4. Enter Crash and Vehicle Information into the Data Collection Tool**: Reviewers entered relevant data from the PAR, as well as the critical reason and critical reason justification, into a data collection tool. (See below.) Reviewers entered information for each CMV involved in the crash. No information was recorded for the non-CMVs. (In addition, reviewers did not record driver identifying information due to privacy issues.)

These steps are shown in Figure A1.

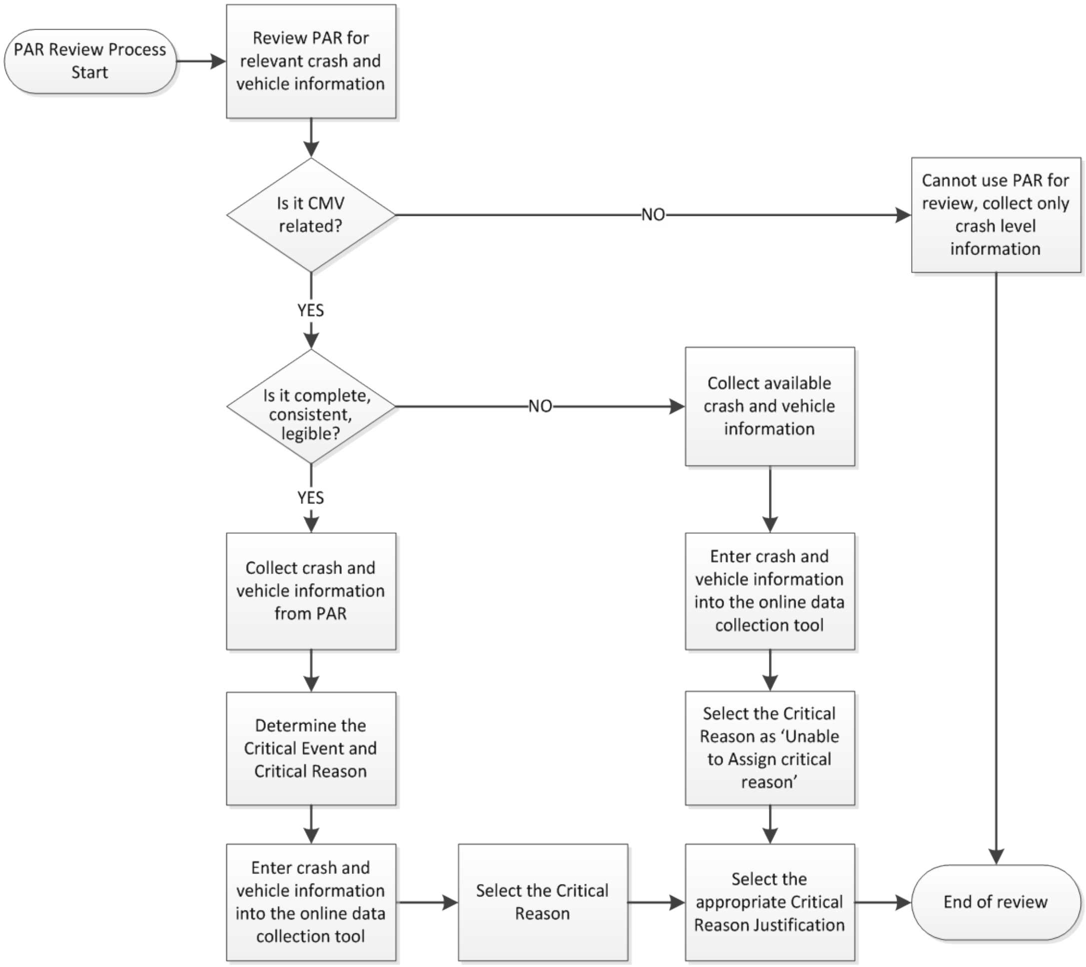


Figure A1. PAR Review Process

DATA ELEMENTS COLLECTED IN THE PAR COLLECTION TOOL

To support a uniform method for collecting data from the PARs, FMCSA developed an online data collection tool. Using this tool, the PAR reviewers entered crash and vehicle information, the critical reason, and the critical reason justification for each PAR reviewed. The PAR reviewers extracted information from specific sections of the PAR as entered by the police officer. Although the reviewers interpreted (coded) the critical reason and the critical reason justification, they entered the remaining elements directly from the PAR without interpretation. The PAR reviewers did not interpret information found elsewhere on the PAR if it differed from the specified field.

Table A1 shows the information collected from the PARs and entered in the data collection tool. The PAR reviewers collected information for each data element shown, unless it was not available on the PAR. Several data elements were used to match the information on the PAR to a corresponding record in the Fatality Analysis Reporting System (FARS) database, the National

Motor Vehicle Crash Causation Survey (NMVCCS), or the Motor Carrier Management Information System (MCMIS).

Table A1. PAR Data Captured by Collection Tool

Type of Data		Reason for Including
System-Generated Information		
1	Record ID #	Database record number
2	Date of review	Identifies when review was conducted
3	Start time of review	Used to calculate time to enter record
4	End time of review	Used to calculate time to enter record
5	User ID	Identifies who conducted review
Crash Information on the PAR		
6	Scanned PAR file name	Used to match database record to a PAR
7	Reporting State	Used to match PAR to records in MCMIS/FARS/NMVCCS
8	PAR number	Identifies State report number
9	Record source	Identifies source of record
10	Report/case # from the source	Used to match PAR to records in FARS
11	Crash date	Used to match PAR to records in MCMIS/FARS/NMVCCS
12	Crash time (as appears on PAR)	Used to match PAR to records in MCMIS/FARS/NMVCCS
13	Crash severity	Used to categorize records by severity
14	Total # of vehicles involved in crash event	Used to identify single- versus multi-vehicle crashes
15	# of CMVs involved in crash event	Used to identify CMV involvement
16	Weather condition	Used to assess reliability of PAR with respect to data in FARS
17	Roadway surface condition	Used to assess reliability of PAR with respect to data in FARS
18	Traffic-way type	Used to assess reliability of PAR with respect to data in FARS
19	First harmful event in the crash event	Used to assess reliability of PAR with respect to data in FARS
Vehicle and Carrier Information & Critical Reason Results		
20	Vehicle # involved in crash	Used to match PAR to records in MCMIS/FARS
21	Vehicle type	Used to verify vehicle type in MCMIS/FARS/NMVCCS
22	Vehicle license plate #	Used to match PAR to records in MCMIS
23	Vehicle license plate State	Used to match PAR to records in MCMIS/FARS
24	Initial impact area on the vehicle*	Used to assess reliability of PAR with respect to data in FARS
25	Driver contributing factors	Used to assess reliability of PAR with respect to data in FARS
26	Carrier U.S. DOT #	Used to match PAR to records in MCMIS/FARS
27	Carrier MC #	Used to match PAR to records in MCMIS
28	Carrier name	Used to match PAR to records in MCMIS
29	Street address	Used to match PAR to records in MCMIS
30	City	Used to match PAR to records in MCMIS
31	State	Used to match PAR to records in MCMIS
32	Zip code	Used to match PAR to records in MCMIS
33	Critical reason (required)	Used to capture critical reason determination and compare to NMVCCS
34	Critical reason justification (required)	Identifies a justification for critical reason determination
35	Justification description	Captures text explanation for “other” critical reason

Type of Data		Reason for Including
		justifications

* Dropped from study because of difficulties with coding.

The following sections describe how the PAR reviewers collected the data elements shown in Table A1.

Crash Information

The following information was entered once for each PAR:

Scanned PAR File Name

The name given to the file when the PAR was scanned and saved electronically as a PDF file. For example, 2008_MA_0123.pdf, where:

- 2008 is the PAR year of the crash event.
- MA is the State abbreviation.
- 0123 is the FARS crash number.

This was a required field.

Reporting State

The State reporting the crash event, usually found as part of the PAR number; for example, the following PAR number is from Massachusetts: MA0123456789. This was a required field.

PAR Number

The number assigned by the State to the PAR, usually following the State abbreviation, for example, MA0123456789.

Record Source

The source of the PAR under review. This was chosen from a drop-down list with the following items:

- FARS – selected if the source of the PAR was the FARS.
- NMVCCS – selected if the source of the PAR was the NMVCCS.

This information was not on the PAR.

Report/Case # from Source

Found on the PAR, the number assigned to the PAR by the FARS or NMVCCS.

Crash Date

The date of the crash event. This was a required field.

Crash Time

The time of the crash event. This was a required field.

Crash Severity

The severity of the crash event. The values were chosen from a drop-down list with the following items:

- Fatality
- Injury
- Tow-away

Reviewers selected the severity with the highest priority for the crash; the priority was the same as the order in the drop-down list.

Total # of Vehicles Involved in Crash Event

The total number of all vehicles involved in the crash event (CMVs and non-CMVs). This was a required field.

# of CMVs Involved in Crash Event

The number of CMVs involved in the crash event. This was a required field.

Weather Conditions

The weather conditions at the time of the crash event. This was chosen from a drop-down list that varied depending on the choices in the FARS for the year of the crash.[67] When the weather condition was obtained from the PAR, the value was matched to one in the list. (For example, if a 2010 PAR had a value of “Snowing,” the reviewer selected “Snow” from the drop-down list.) The lists for the different years are displayed in Table A2.

Table A2. Weather Conditions

Crash Event Year: 2008 and 2009	Crash Event Year:2010
Clear/Cloudy	Clear
-----	Cloudy
Rain	Rain

Crash Event Year: 2008 and 2009	**Crash Event Year:2010**
Sleet, Hail	Sleet, Hail (Freezing Rain or Drizzle)
Snow or blowing snow	Snow
-----	Blowing Snow
Fog, Smog, Smoke	Fog, Smog, Smoke
Severe Crosswinds	Severe Crosswinds
Blowing Sand, Soil, Dirt	Blowing Sand, Soil, Dirt
Other	Other
-----	Not Reported
Unknown	Unknown

Roadway Surface Condition

The condition of the roadway surface at the time of the crash. This was chosen from a drop-down list that varied depending on the choices in the FARS for the year of the crash. When the roadway surface condition was obtained from the PAR, the value was matched to one in the list. (For example, if a 2008 PAR has a value of “Moving Water,” the reviewer selected “Water (Standing, Moving)” from the drop-down list.) The lists for the different years are displayed in Table A3.

Table A3. Roadway Surface Conditions

Crash Event Year: 2008 and 2009	Crash Event Year: 2010
-----	Non-Traffic-Way Area
Dry	Dry
Wet	Wet
Snow or Slush	Snow
-----	Slush
Ice/Frost	Ice/Frost
Water (Standing, Moving)	Water (Standing, Moving)
Sand, Mud, Dirt, Gravel	Sand
-----	Mud, Dirt, Gravel
Oil	Oil
Other	Other
-----	Not Reported
Unknown	Unknown

<u>Traffic-Way Type</u>

The traffic-way type on which the crash event occurred. This was chosen from a drop-down list that varied depending on the choices in the FARS for the year of the crash. When the traffic-way type was obtained from the PAR, an equivalent value was selected from the list. The lists for the different years are displayed in Table A4.

Table A4. Traffic-Way Types

Crash Event Year: 2008 and 2009	Crash Event Year: 2010
-----	Non-Traffic-Way Area
Not Physically Divided (Two-Way Traffic-Way)	Two-Way, Not Divided
Not Physically Divided (With Two-Way Continuous Left-Turn Lane)	Two-Way, Not Divided With a Continuous Left-Turn Lane
Divided Highway, Median Strip (without traffic barrier)	Two-Way, Divided, Unprotected (Painted > 4 Feet) Median
Divided Highway, Median Strip (with traffic barrier)	Two-Way, Divided, Positive Median Barrier
One-Way Traffic-Way	One-Way Traffic-Way
Entrance/Exit Ramp	Entrance/Exit Ramp
-----	Not Reported
Unknown	Unknown

<u>First Harmful Event in the Crash Event</u>

The first injury or damage-producing event of the crash (identified on the PAR). This was chosen from a drop-down list that varied depending on the choices in the FARS for the year of the crash.

When the first harmful event was obtained from the PAR, an equivalent value was selected from the list. The lists for the different years are displayed in Table A5.

Table A5. First Harmful Events

Crash Event Year: 2008 and 2009	Crash Event Year: 2010
Category: Non-Collision Harmful Events	
Rollover/Overturn	Rollover/Overturn
Fire/Explosion	Fire/Explosion
Immersion	Immersion
Gas Inhalation	Gas Inhalation
Jackknife (Harmful to This Vehicle)	Jackknife (Harmful to This Vehicle)
Injured in Vehicle (Non-Collision)	Injured in Vehicle (Non-Collision)
Pavement Surface Irregularity (Ruts, Potholes, Grates, etc.)	Pavement Surface Irregularity (Ruts, Potholes, Grates, etc.)
Other Non-Collision	Other Non-Collision
Thrown or Falling Object	Thrown or Falling Object
Cargo/Equipment Loss or Shift (Harmful to This Vehicle)	-----
-----	Cargo/Equipment Loss or Shift (Harmful to This Vehicle)
Fell/Jumped from Vehicle	Fell/Jumped from Vehicle
Vehicle Occupant Struck or Run over by Own Vehicle	-----
Category: Collision with Motor Vehicle In-Transport:	
Motor Vehicle In-Transport	Motor Vehicle In-Transport
Motor Vehicle In-Transport on Different Roadway	-----
CMV In-Transport Strikes/Is Struck by Objects Set-in-Motion by Another CMV In-Transport	CMV In-Transport Strikes/Is Struck by Objects Set-in-Motion by Another CMV In-Transport
Motor Vehicle In Motion Outside the Traffic-Way	Motor Vehicle In Motion Outside the Traffic-Way
Category: Collision with Object Not Fixed:	
Pedestrian	Pedestrian
Pedalcyclist	Pedalcyclist
Railway Vehicle	Railway Vehicle
Live Animal	Live Animal
Ridden Animal or Animal Drawn Conveyance	Ridden Animal or Animal Drawn Conveyance
Other Object (Not Fixed)	Other Object (Not Fixed)
Non-Motorist on Personal Conveyance	Non-Motorist on Personal Conveyance
Parked Motor Vehicle	Parked Motor Vehicle

Crash Event Year: 2008 and 2009	**Crash Event Year: 2010**
Working Motor Vehicle	Working Motor Vehicle
Category: Collision with Fixed Object:	
Boulder	Boulder
Building	Building
-----	Ground
Impact Attenuator/Crash Cushion	Impact Attenuator/Crash Cushion
Bridge Overhead Structure	Bridge Overhead Structure
Bridge Pier or Support	Bridge Pier or Support
Bridge Parapet End	-----
Bridge Rail	Bridge Rail (Includes Parapet)
Guardrail Face	Guardrail Face
Guardrail End	Guardrail End
Concrete Traffic Barrier	Concrete Traffic Barrier
Cable Barrier	Cable Barrier
Other Traffic Barrier	Other Traffic Barrier
-----	Traffic Sign Support
Traffic Signal Support/Signal	Traffic Signal Support
Utility Pole	Utility Pole/Light Support
Other Post, Other Pole or Other Supports	Other Post, Other Pole or Other Supports
Culvert	Culvert
Highway/Traffic sign Post/Sign	-----
Overhead Sign Support/Sign	-----
Luminarie/Light Support	-----
Curb	Curb
Ditch	Ditch
Embankment-Earth	Embankment
Embankment-Rock, Stone, or Concrete	-----
Embankment-Material type Unknown	-----
Fence	Fence
Wall	Wall
Fire Hydrant	Fire Hydrant
Shrubbery	Shrubbery
Tree (Standing Only)	Tree (Standing Only)
Snow Bank	Snow Bank
Mail Box	Mail Box
Other Fixed Object	Other Fixed Object
Category: Not Reported and Unknown:	
-----	Not Reported
Unknown	Unknown

Vehicle and Carrier Information

The following information was entered for each CMV involved in a crash event:

Vehicle # Involved in the Crash

The number assigned to the vehicle on the PAR. For example, if there were six total vehicles involved in the crash, and the CMV being coded was number four, the value “4” would be entered as the vehicle number. This was a required field.

Vehicle Type

A drop-down list of the vehicle types for the CMV:

- Truck
- Bus
- Light vehicle with HM placard

If the vehicle type was not a field on the PAR, the reviewer selected the appropriate value based on other PAR fields, such as vehicle class, vehicle configuration, etc.

Vehicle License Plate Number

The license plate number for the vehicle as found on the PAR.

Vehicle License Plate State

A drop-down list of States that issued the license plate number for the vehicle.

Driver Contributing Factors

Up to four driver contributing factors as indicated on the PAR. These were chosen from four drop-down lists that varied depending on the choices in the FARS for the year of the crash. When a driver contributing factor was identified on the PAR, the value was matched to one in the list or an equivalent value was selected. The lists for the different years are displayed in Table A7.

Table A7. Driver Contributing Factors

Crash Event Year: 2008	Crash Event Year: 2009	Crash Event Year: 2010
None	None	None
Physical/Mental Condition:		
Drowsy, Sleepy, Asleep Fatigued	Drowsy, Sleepy, Asleep Fatigued	-----
Ill, Passed Out/Blackout	Ill, Passed Out/Blackout	-----
Emotional (e.g. Depression, Angry, Disturbed)	Emotional (e.g. Depression, Angry, Disturbed)	-----
Aggressive Driving / Road Rage	Aggressive Driving / Road Rage	Aggressive Driving / Road Rage
Mentally Challenged	Mentally Challenged	Mentally Challenged
Reaction to or Failure to Take Drugs/Medication	Reaction to or Failure to Take Drugs/Medication	Reaction to or Failure to Take Drugs/Medication
Under the Influence of Alcohol, Drugs or Medication	Under the Influence of Alcohol, Drugs or Medication	-----
Operating the Vehicle in Careless or Inattentive Manner	Operating the Vehicle in Careless or Inattentive Manner	-----
Restricted to Wheelchair	Restricted to Wheelchair	-----
Impaired Due to Previous Injury	Impaired Due to Previous Injury	-----
Other Physical Impairment	Other Physical Impairment	-----
Mother of Dead Fetus	Mother of Dead Fetus	Mother of Dead Fetus
Seat Back Not In Normal Upright Position, Seat Back Reclined	Seat Back Not In Normal Upright Position, Seat Back Reclined	Seat Back Not In Normal Upright Position, Seat Back Reclined
Miscellaneous Factors:		
Traveling on Prohibited Traffic-Ways	Traveling on Prohibited Traffic-Ways	Traveling on Prohibited Traffic-Ways
Legally Driving on Suspended or Revoked License	Legally Driving on Suspended or Revoked License	Legally Driving on Suspended or Revoked License
Leaving Vehicle Unattended in Roadway	Leaving Vehicle Unattended in Roadway	Leaving Vehicle Unattended in Roadway
Improper Loading of Vehicle With Passengers or Cargo	Improper Loading of Vehicle With Passengers or Cargo	Improper Loading of Vehicle With Passengers or Cargo

Crash Event Year: 2008	Crash Event Year: 2009	Crash Event Year: 2010
Towing or Pushing Improperly	Towing or Pushing Improperly	Towing or Pushing Improperly
Failure to Dim Lights or to Have Lights on When Required	Failure to Dim Lights or to Have Lights on When Required	Failure to Dim Lights or to Have Lights on When Required
Operating Without Required Equipment	Operating Without Required Equipment	Operating Without Required Equipment
Following Improperly	Following Improperly	Following Improperly
Improper or Erratic Lane Changing	Improper or Erratic Lane Changing	Improper or Erratic Lane Changing
Failure to Keep in Proper Lane	Failure to Keep in Proper Lane	Failure to Keep in Proper Lane
Illegal Driving on Shoulder, Ditch, Sidewalk or Median	Illegal Driving on Shoulder, Ditch, Sidewalk or Median	Illegal Driving on Shoulder, Ditch, Sidewalk or Median
Making Improper Entry To or Exit From Traffic-Way	Making Improper Entry To or Exit From Traffic-Way	Making Improper Entry To or Exit From Traffic-Way
Starting or Backing Improperly	Starting or Backing Improperly	Starting or Backing Improperly
Opening Closure into Moving Traffic or While Vehicle is in Motion	Opening Closure into Moving Traffic or While Vehicle is in Motion	Opening Closure into Moving Traffic or While Vehicle is in Motion
Passing Where Prohibited or School Bus Displaying Warning Not to Pass	Passing Where Prohibited or School Bus Displaying Warning Not to Pass	Passing Where Prohibited or School Bus Displaying Warning Not to Pass
Passing on Wrong Side	Passing on Wrong Side	Passing on Wrong Side
Passing With Insufficient Distance, Inadequate Visibility	Passing With Insufficient Distance, Inadequate Visibility	Passing With Insufficient Distance, Inadequate Visibility
Operating the Vehicle in an Erratic, Reckless or Negligent Manner	Operating the Vehicle in an Erratic, Reckless or Negligent Manner	Operating the Vehicle in an Erratic, Reckless or Negligent Manner
Police or Law Enforcement Officer	Police or Law Enforcement Officer	Police or Law Enforcement Officer
Police Pursuing This Driver or Police Officer in Pursuit	Police Pursuing This Driver or Police Officer in Pursuit	Police Pursuing This Driver or Police Officer in Pursuit
Failure to Yield Right-of-Way	Failure to Yield Right-of-Way	Failure to Yield Right-of-Way
Failure to Obey Traffic Signs, Control Devices or Traffic Officers	Failure to Obey Traffic Signs, Control Devices or Traffic Officers	Failure to Obey Traffic Signs, Control Devices or Traffic Officers

Crash Event Year: 2008	Crash Event Year: 2009	Crash Event Year: 2010
Passing Through or Around Barrier	Passing Through or Around Barrier	Passing Through or Around Barrier
Failure to Observe Warnings or Instructions on Vehicles Displaying Them	Failure to Observe Warnings or Instructions on Vehicles Displaying Them	Failure to Observe Warnings or Instructions on Vehicles Displaying Them
Failure to Signal Intentions	Failure to Signal Intentions	Failure to Signal Intentions
Driving Too Fast for Conditions	-----	-----
Driving in Excess of Posted Maximum	-----	-----
Driving Less Than Posted Minimum	Driving Less Than Posted Minimum	Driving Less Than Posted Minimum
Racing	-----	-----
Making Right Turn From Left-Turn Lane, Left Turn from Right-Turn Lane	Making Right Turn From Left-Turn Lane, Left Turn from Right-Turn Lane	Making Right Turn From Left-Turn Lane, Left Turn from Right-Turn Lane
Making Other Improper Turn	Making Other Improper Turn	Making Other Improper Turn
Driving Wrong Way on One-Way Traffic	Driving Wrong Way on One-Way Traffic	Driving Wrong Way on One-Way Traffic
Driving on Wrong Side of Road (Intentional or Unintentional)	Driving on Wrong Side of Road (Intentional or Unintentional)	Driving on Wrong Side of Road (Intentional or Unintentional)
Operator Inexperience	Operator Inexperience	Operator Inexperience
Unfamiliar with Roadway	Unfamiliar with Roadway	Unfamiliar with Roadway
Stopped in Roadway (Vehicle Not Abandoned)	Stopped in Roadway (Vehicle Not Abandoned)	Stopped in Roadway (Vehicle Not Abandoned)
Underriding a Parked Vehicle	-----	-----
Locked Wheel	Locked Wheel	Locked Wheel
Overcorrecting	Overcorrecting	Overcorrecting
Getting Off/Out of or On/In to a Vehicle	Getting Off/Out of or On/In to a Vehicle	Getting Off/Out of or On/In to a Vehicle
Vision Obscured By:		
Rain, Snow, Fog, Smoke, Sand, Dust	-----	-----
Reflected Glare, Bright sunlight, Headlights	-----	-----

Crash Event Year: 2008	**Crash Event Year: 2009**	**Crash Event Year: 2010**
Curve, Hill, or Other Design Features (Including Traffic Signs, Embankment)	-----	-----
Building, Billboard, Other Structures	-----	-----
Trees, Crops, Vegetation	-----	-----
Motor Vehicle (Including Load)	-----	-----
Parked Vehicle	-----	-----
Splash or Spray of Passing Vehicle	-----	-----
Inadequate Defrost or Defog System	-----	-----
Inadequate Lighting System	-----	-----
Obstructing Angles on Vehicle	-----	-----
Mirrors	-----	-----
Broken or Improperly Cleaned Windshield	-----	-----
Other Visual Obstruction	-----	-----
Skidding, Swerving, Sliding Due To:		
Severe Crosswind	Severe Crosswind	Severe Crosswind
Wind From Passing Truck	Wind From Passing Truck	Wind From Passing Truck
Slippery or Loose Surface	Slippery or Loose Surface	Slippery or Loose Surface
Tire Blowout or Flat	Tire Blowout or Flat	Tire Blowout or Flat
Debris or Objects in Road	Debris or Objects in Road	Debris or Objects in Road
Ruts, Holes, Bumps in Road	Ruts, Holes, Bumps in Road	Ruts, Holes, Bumps in Road
Live Animals in Road	Live Animals in Road	Live Animals in Road
Vehicle in Road	Vehicle in Road	Vehicle in Road
Phantom Vehicle	Phantom Vehicle	Phantom Vehicle
Pedestrian, Pedal Cyclist, or Other Non-Motorist	Pedestrian, Pedal Cyclist, or Other Non-Motorist	Pedestrian, Pedal Cyclist, or Other Non-Motorist
Ice, Snow, Slush, Water, Sand, Dirt, Oil, Wet Leaves on Road	Ice, Snow, Slush, Water, Sand, Dirt, Oil, Wet Leaves on Road	Ice, Snow, Slush, Water, Sand, Dirt, Oil, Wet Leaves on Road
Trailer Fishtailing or Swaying	Trailer Fishtailing or Swaying	Trailer Fishtailing or Swaying
Special Circumstances:		
Driver Has Not Complied With Learner's Permit or	Driver Has Not Complied With Learner's Permit or	Driver Has Not Complied With Learner's Permit or

Crash Event Year: 2008	**Crash Event Year: 2009**	**Crash Event Year: 2010**
GDL Restrictions	GDL Restrictions	GDL Restrictions
Driver Has Not Complied With Physical or Other Imposed Restrictions	Driver Has Not Complied With Physical or Other Imposed Restrictions	Driver Has Not Complied With Physical or Other Imposed Restrictions
Driver has a Driving Record or License from More Than 1 State	Driver has a Driving Record or License from More Than 1 State	Driver has a Driving Record or License from More Than 1 State
Hit and Run Vehicle Driver	-----	-----
Non-Traffic Violation Charged (Manslaughter, Homicide)	Non-Traffic Violation Charged (Manslaughter, Homicide)	Non-Traffic Violation Charged (Manslaughter, Homicide)
Other Non-Moving Traffic Violations	Other Non-Moving Traffic Violations	Other Non-Moving Traffic Violations
Devices in Vehicle With Potential for Distractions:		
Cellular Telephone Present in Vehicle	Cellular Telephone Present in Vehicle	-----
Cellular Telephone in Use in Vehicle	Cellular Telephone in Use in Vehicle	-----
Computer/Fax Machines/Printers	Computer/Fax Machines/Printers	-----
Onboard Navigation System	Onboard Navigation System	-----
Two-Way Radio	Two-Way Radio	-----
Head-Up Display	Head-Up Display	-----
Unknown	Unknown	Unknown

Carrier U.S.DOT #

A unique FMCSA-issued identifier for the CMV; the value was entered as found on the PAR.

Carrier MC #

Another unique FMCSA-issued identifier for the CMV. This field was entered **ONLY** if the carrier's U.S. DOT number was not provided in the PAR.

Carrier Name and Address

Includes the following fields:

- Carrier name
- Street address
- City

- State
- ZIP code

This information was collected from the PAR **<u>ONLY</u>** if the carrier's U.S. DOT Number or MC Number was not available.

Critical Reason and Critical Reason Justification

The critical reason describes the role of the driver or vehicle involved in the crash. For each PAR, a critical reason was assigned by a PAR coder after a thorough review of the PAR. (The PAR does not identify a critical reason.) In addition to assigning a critical reason, PAR reviewers selected a critical reason justification associated with the driver's or vehicle's actions to explain how the critical reason was determined

<u>Critical Reason</u>

This field was required.

The following were the critical reason choices for the PAR reviewers:

1. Truck/Bus Driver – used as a result of the driver's actions or inactions that lead to the crash, including:
    a. A driver who was incapable of action due to a physical condition just prior to the crash (falling asleep, physical impairment such as a heart attack);
    b. A situation where the driver did not perceive a critical situation due to the level of cognitive awareness (inattentiveness, failure to conduct proper surveillance of his/her surroundings);
    c. A driver decision error that led to risky driving behavior (driving too fast or too slow for conditions or the roadway type, illegal maneuvers, aggressive driving behavior); and
    d. A situation where the driver responded in an inappropriate way that resulted in the crash (panic/freezing response, overcompensation, poor directional control).
2. Truck/Bus Vehicle – used as a result of a vehicle mechanical failure or component degradation that led to the crash, including:
    a. Brake failure or degraded capability;
    b. Tire failure or degradation;
    c. Steering, suspension, transmission, engine failure;
    d. Light failure or vehicle related vision obstruction; and
    e. Cargo shift, trailer attachment failure or jackknife.
3. Environment – used in a situation where the driver suddenly encountered either a highway-related factor or a weather-related factor that led to the crash. Reviewers considered if the driver was aware of the particular factor prior to the crash. If the PAR did not indicate the condition occurred immediately prior to the crash, the presumption was that the condition was ongoing prior to the crash and the driver proceeded in spite of the risk.

   a. Highway conditions include missing, inadequate or erroneous/defective signs/signals; view obstructed by roadway design or other vehicles; sudden encounter with poor roadway conditions; slick roadway conditions.
   b. Weather conditions include sudden, onset rain, snow, fog, wind gusts, sun glare, and blowing debris.
4. Not assigned to this driver/vehicle – driver’s or vehicle’s action or condition <u>did not</u> lead to the crash.
5. Unable to assign critical reason – insufficient information in the PAR to assign the critical reason to this vehicle.

<u>Critical Reason Justification</u>

Relates to the driver’s or vehicle’s actions and explains how the critical reason was determined. This justification was not on the PAR but determined by the PAR coder after a thorough PAR review. Reviewers selected from among a group of standard justification explanations associated with each of the five critical reason choices. If no explanation seemed relevant, the coders chose “Other” from the list. This was a required field.

Table A8 lists the justifications associated with each critical reason.

Table A8. Critical Reason Justifications

1. Critical Reason: Truck/Bus Driver
Category: Recognition Error/Poor Judgment
Driver was following too close for conditions.
Driver was going too fast for conditions.
Driver was going too slow for traffic stream.
Driver exhibited aggressive driving behavior.
Truck/bus struck the rear of a vehicle.
Driver was aware of dangerous atmospheric conditions.
Driver was aware of ongoing highway conditions.
Other.
Category: Intersection/Crossing Path
Driver turned across path of another vehicle at a junction without a traffic control device present.
Driver turned across path at a junction in violation of a traffic control device.
Driver performed a wide turn from a portion of wrong lane.
Driver performed a wide turn and struck object on road.
Other.
Category: Decision Error
Driver misjudged gap or other’s speed.
Driver had false assumption of other’s actions.
Truck/bus was disabled as a result of a driver action that caused the vehicle to stop operating.
Driver did not obey a traffic control device.

Driver executed an inadequate evasive action.
Driver executed an illegal maneuver.
Other.
Category: Mechanical Failure
Truck/bus lost control as a result of mechanical failure.
Driver actions caused the cargo shift/loss.
Other.
Category: Erratic Actions/Unsafe Driving
Driver failed to drive safely due to physical condition.
Driver failed to drive safely due to distraction or inattention.
Driver failed to drive safely due to inadequate surveillance.
Driver failed to drive safely by exercising poor directional control or overcompensating.
Truck/bus swung or jackknifed and resulting in a crash (if no extenuation circumstances).
Other.
Category: Lane Change
Truck/bus encroached into a lane occupied by another motor vehicle.
Truck/bus traveled over the lane line or off the road.
Other.
Category: Other
Truck/bus struck pedestrian - pedestrian's actions were NOT deliberate.
Truck/bus struck animal - driver had time for evasive action.
Driver actions or inactions led to crash.
Other.
2. Critical Reason: Truck/Bus Vehicle
Category: Vehicle issue
Truck/bus was disabled in travel lane and was struck by other vehicle.
Truck/bus failure or degraded vehicle component(s) led to the crash.
Truck/bus cargo shift/loss caused loss of control leading to a crash.
Truck/bus disabled as a result of a mechanical breakdown.
Other.
3. Critical Reason: Environment
Category: Road
Unanticipated roadway issue.
Traffic control signs/signals: missing; erroneous; defective; inadequate.
Road issue/defect (e.g., low bridge without appropriate signage; sudden roadway deterioration; etc.)
Truck/bus driver's view was obstructed by roadway design/signage or by other vehicles.
Truck/bus cargo shift/loss caused by unanticipated roadway issue.
Truck/bus struck animal - driver had NO time for evasive action.

Other.
Category: Weather
Unanticipated environmental condition.
Truck/bus swung or jackknifed caused by sudden unanticipated environmental condition.
Truck/bus cargo shift/loss caused by unanticipated environmental condition.
Truck/bus disabled as a result of an unseen or sudden weather event.
Other.
4. Critical Reason: Not Assigned to This Driver/Vehicle
Category: Other Vehicle Reason
Truck/bus had the right of way.
Truck/bus stopped safely before being struck.
Truck/bus is the lead vehicle and was stopped at traffic light and struck in rear.
Truck/bus is the lead vehicle, stopped in traffic, struck in rear and pushed into another vehicle or object.
Truck/bus performed a wide turn from correct lane and struck vehicle making an illegal maneuver.
Truck/bus turned in compliance with a traffic control.
Truck/bus encroached into another lane/off road to avoid crash.
Truck/bus struck pedestrian/non-motorist. Pedestrian//non-motorist actions were deliberate.
Truck/bus mechanical problem found, but is not responsible for crash.
Truck/bus disabled as a result of previous crash.
Critical event not coded to truck/bus driver/vehicle.
Other.
5. Critical Reason: Unable to Assign Critical Reason
Category: PAR Issue
CMV not involved.
PAR not legible.
PAR not complete (includes missing pages, supplemental forms).
PAR information not consistent.
Not enough information to make a determination.
Other.

Justification Description

Used with a critical reason justification of “Other” or to document additional details to support the critical reason justification. This field was not required.

CRITICAL REASON CODING

PAR reviewers used a modified version of the LTCCS critical event and critical reason methodology to assess the role of the CMV in a crash event. Critical events were assigned to a vehicle or responsible “Other” party involved in the crash. Based on the critical event, a critical reason was coded for each involved CMV to indicate the role of the CMV driver or vehicle.

Differences from LTCCS Methodology

The following five crash situations followed different rules than those specified in the LTCCS:

1. **Right-of-way**: A truck or bus that had the right-of-way to make an on-road maneuver was not assigned the critical event, even when that maneuver made the crash inevitable. When the CMV did not commit the critical event, it was not coded with the “truck/bus driver” or “truck/bus vehicle” critical reasons.
2. **Multiple qualifying vehicles**: In the LTCCS coding methodology, vehicles not involved in the first harmful event could not be coded with the critical event. In this study, if the review of the PAR revealed that more than one CMV contributed to the crash event, each of those CMVs was coded with the critical event. For example, if two CMVs were involved in a crash with a passenger vehicle and it was determined that both CMVs made errors, both CMVs would be coded with the critical event. Each vehicle would also be coded with the appropriate critical reason.
3. **Disabled vehicles**: Any truck or bus that became disabled in the travel lane due to a driver error or vehicle problem could be coded with the critical event and the appropriate critical reason. In the LTCCS coding methodology, the vehicle striking the disabled truck or bus was assigned the critical reason.
4. **Cargo spillage**: For any on-road cargo spillage leading to a crash, the motor carrier responsible for the cargo committed the critical event and was coded with the appropriate critical reason. In the LTCCS coding methodology, the vehicle striking the spilled cargo was coded with the critical event and critical reason.
5. **Pedestrian crashes**: If a pedestrian was assigned the critical event for a crash, the critical reason could not be coded as “truck/bus driver or truck/bus vehicle.”

Examples of Crash Situations

The following are examples of crash events and the resulting critical event and critical reason determinations. These examples do not represent all crash scenarios.

Example 1. Non-contact encroachment by a non-CMV

Discussion: A non-CMV traveling from the opposite direction crosses the centerline into the CMV’s travel lane. The CMV driver attempts to avoid the crash by steering right and by doing so departs the roadway and strikes a tree. The action of the non-CMV made the crash inevitable. If the CMV driver had not taken evasive action, the truck would have collided with the non-CMV. When it did take evasive action, the truck hit the tree.

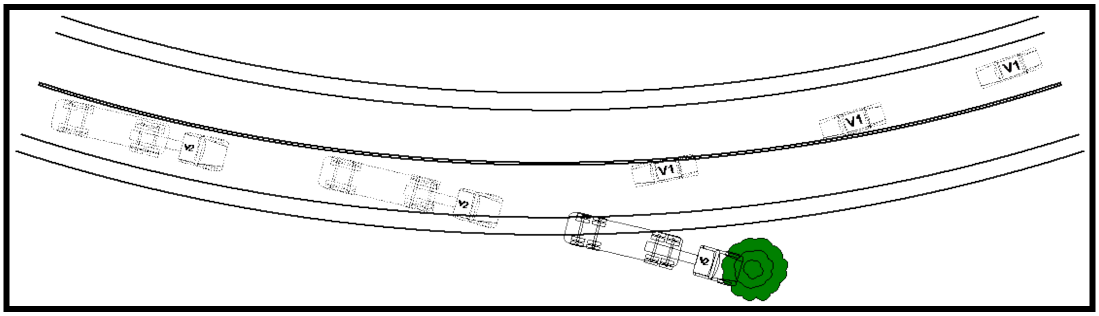


Figure A2. Non-Contact Encroachment By Non-CMV

Critical Event and Reason: The critical event was committed by the non-CMV. The critical reason for the CMV is coded as "not assigned to this vehicle."

Example 2. Lane change maneuver by both vehicles

Discussion: The non-CMV was initially driving the wrong way in the CMV's lane. The CMV driver swerved into the oncoming lane to avoid the non-CMV. The non-CMV returned to its original lane and was struck by the CMV.

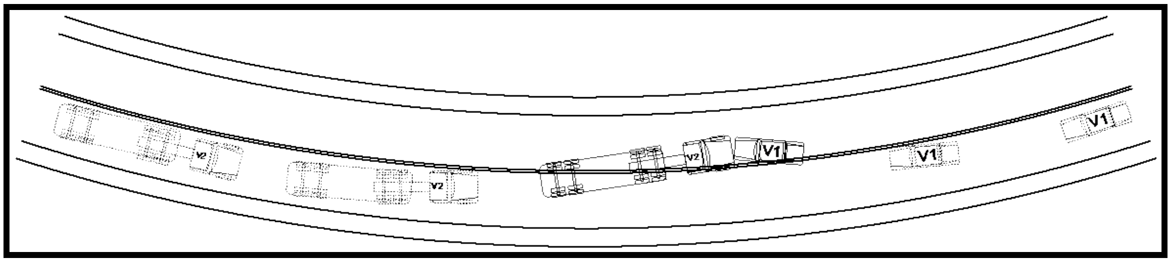


Figure A3. Lane-Change Maneuver By Both Vehicles

Critical Event and Reason: The critical event was committed by the CMV. The critical reason is coded as the CMV "truck/bus driver."

Guideline: The CMV driver should have steered to the right to attempt to avoid the crash. The critical reason is coded to the CMV driver, if there was a driver error, or to the CMV, if there was a mechanical malfunction.

Example 3. CMV strikes a pedestrian

Discussion: Pedestrian enters travel lane and is struck.

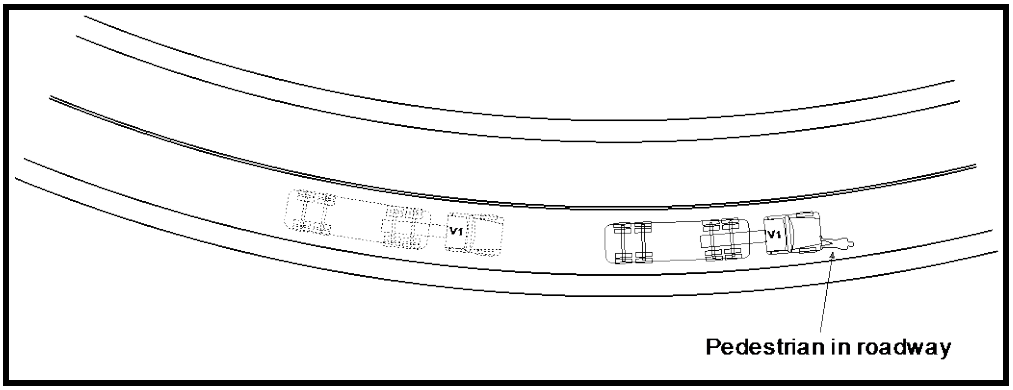


Figure A4. CMV Strikes a Pedestrian

Critical Event and Reason: The critical event was committed by the CMV and the critical reason is assigned to the CMV driver, unless the pedestrian is assigned the critical event for the crash.

Guideline: The critical event is assigned to the CMV and the critical reason coded to the CMV driver in pedestrian-related crashes unless the PAR indicates that the pedestrian's action resulted in the critical event, such as attempting a deliberate act (e.g., suicide, crossing road unsafely outside of pedestrian walkway, etc.). If the PAR does not indicate the pedestrian was responsible for the crash (e.g., walking along the edge of the roadway, etc.), the CMV driver is assigned the critical reason for the crash.

Example 4. CMV strikes an animal

Discussion: Animal enters travel lane and is struck.

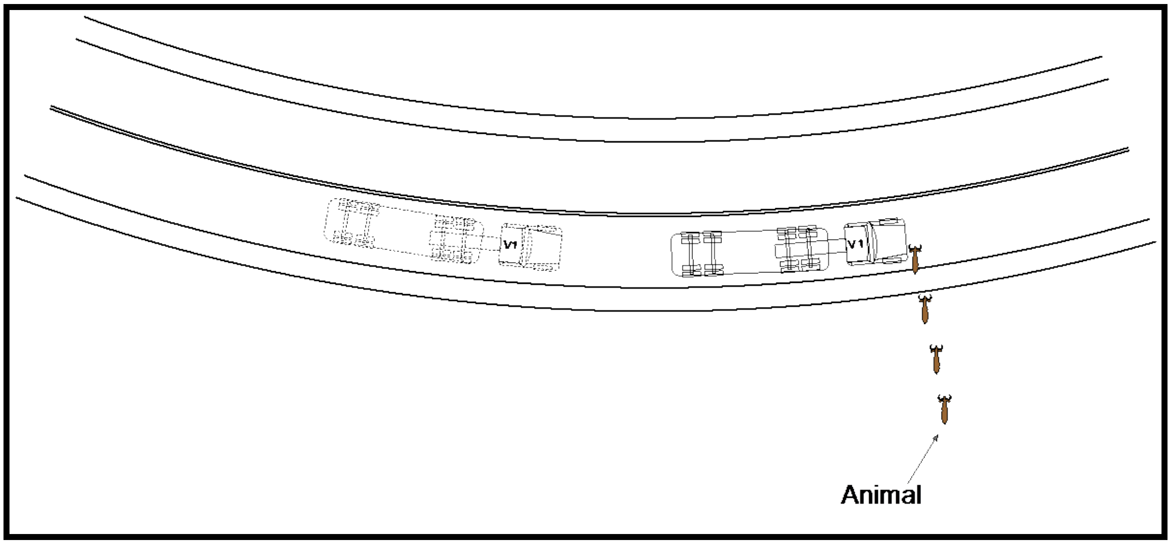


Figure A5. CMV Strikes an Animal

Critical Event and Reason: The critical event was committed by the CMV, but the critical reason is coded to the environment.

Guideline: The critical reason is not assigned to the CMV driver in most animal-related crashes. The assumption is that animals can appear at any time without any notice and enter the path of the CMV or run into the side of a CMV. This situation is considered to be a manifestation of the environment.

However, if the animal had been standing in the road, and the CMV had enough time to observe the animal and to stop or take evasive action, the CMV would be coded with the critical event and the CMV driver would be coded with the critical reason.

Example 5. CMV disabled and stopped in the travel lane at time of impact from a following non-CMV

Discussion: A CMV is disabled and stopped in the travel lane due to a mechanical breakdown.

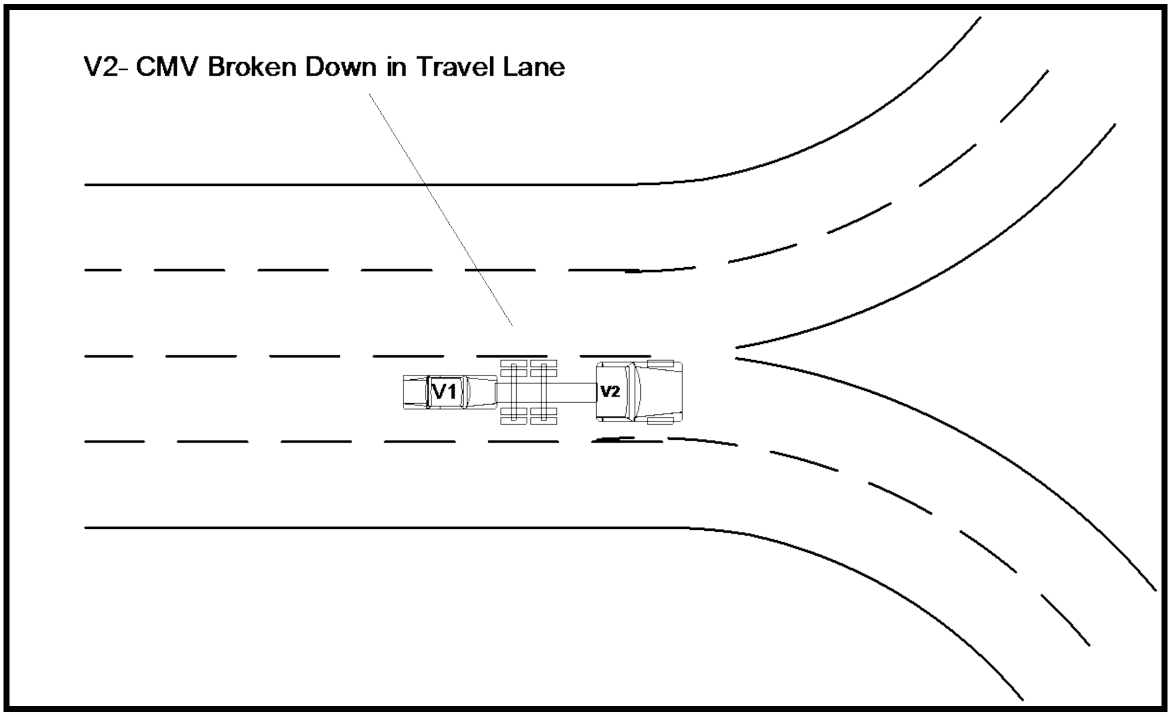


Figure A6. CMV Disabled and Stopped in Travel Lane at Time of Impact

Critical Event and Reason: The critical event was committed by the CMV and the critical reason is coded to the CMV vehicle.

Guideline: A CMV should be in good condition when the trip started and should not be stopped on a travel lane due to mechanical malfunctions. Warning devices are not a consideration for assessing critical reasons.

However, if the CMV has been disabled by a previous crash or disabled by a sudden roadway event (large pothole, debris blown under the CMV, etc.), the CMV is not coded with the critical event for the crash.

Example 6. CMV spins out due to weather-related conditions and is struck by another vehicle

Discussion: A CMV spins out due to weather-related roadway surface conditions and is struck by another vehicle while still in the travel lanes.

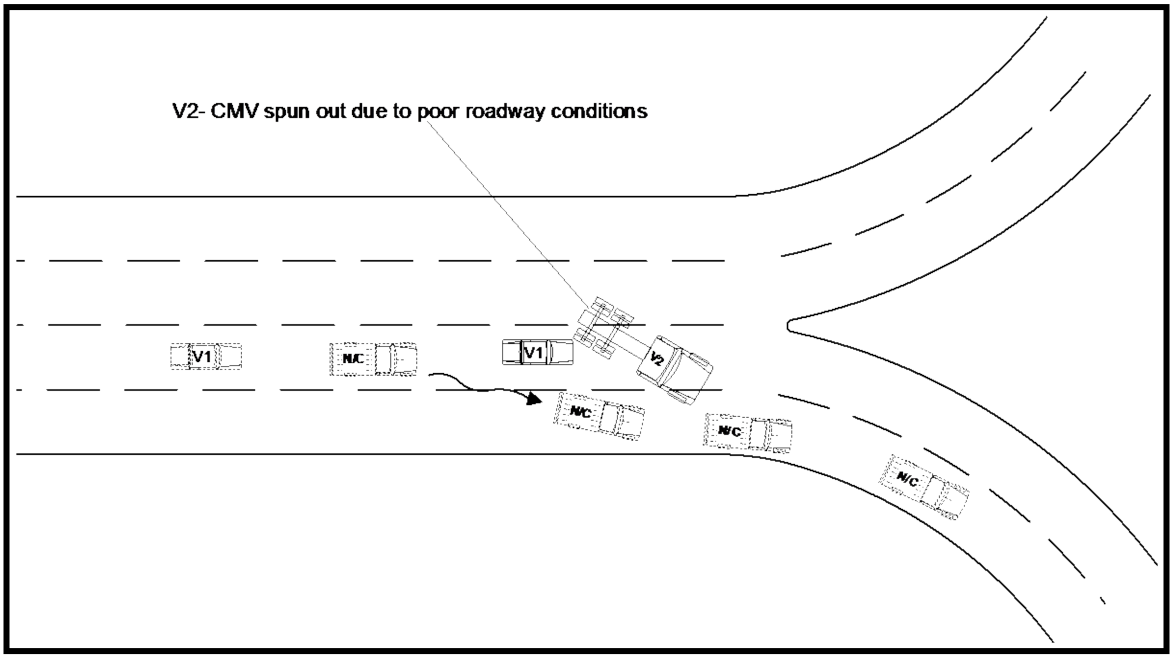


Figure A7. CMV Spins Out Due to Weather Conditions and Is Struck by Another Vehicle

Critical Event and Reason: The critical event was committed by the CMV and the critical reason is coded to the CMV driver.

Guideline: The rationale is that the driver was traveling too fast for conditions and the driver was not in control of the vehicle. The driver should have adjusted his/her speed to the conditions.

However, for unexpected cataclysmic environmental or roadway conditions (e.g., earthquake, washed out roadway, tornado, flood, etc.), the critical event would be coded to the CMV but the critical reason coded to the environment.

Example 7. CMV successfully stopped in travel lane due to a previous collision and is subsequently struck by another vehicle

Discussion: A crash event occurs and the CMV successfully avoids the previous collision and stops. A vehicle trailing behind the CMV is unable to stop and hits the CMV.

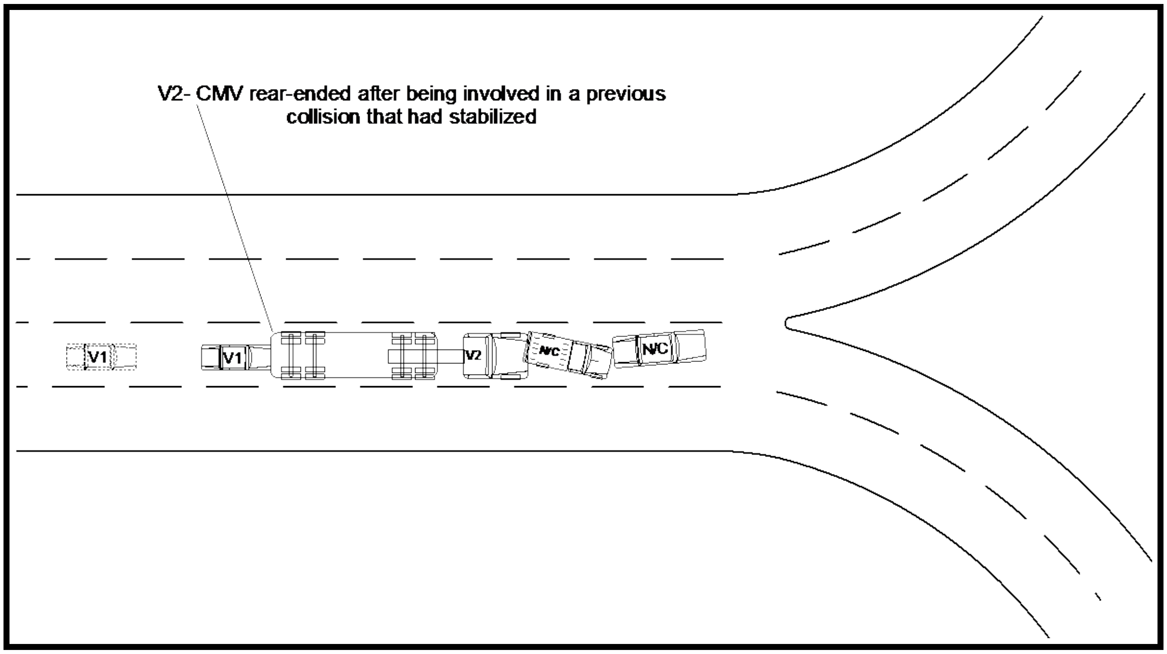


Figure A8. CMV Fully Stopped in Travel Lane Due to Previous Collision Is Hit

Critical Event and Reason: The critical event was committed by the non-CMV and the critical reason is coded to the CMV as "not assigned to this driver/vehicle."

Guideline: Critical events are not assigned to the CMV if the CMV is stopped in traffic due to a previous collision.

Example 8. CMV swings wide into adjacent travel lane to make either a right or left turn at an intersection

Discussion: The wide turning maneuver can occur at an intersection, driveway, or junction and it involves the CMV partially or fully departing its original travel lane to attempt a turning maneuver. Another vehicle attempts to pass the CMV and is either struck by the CMV or it strikes the side of the CMV.

The following image shows a right-turn collision:

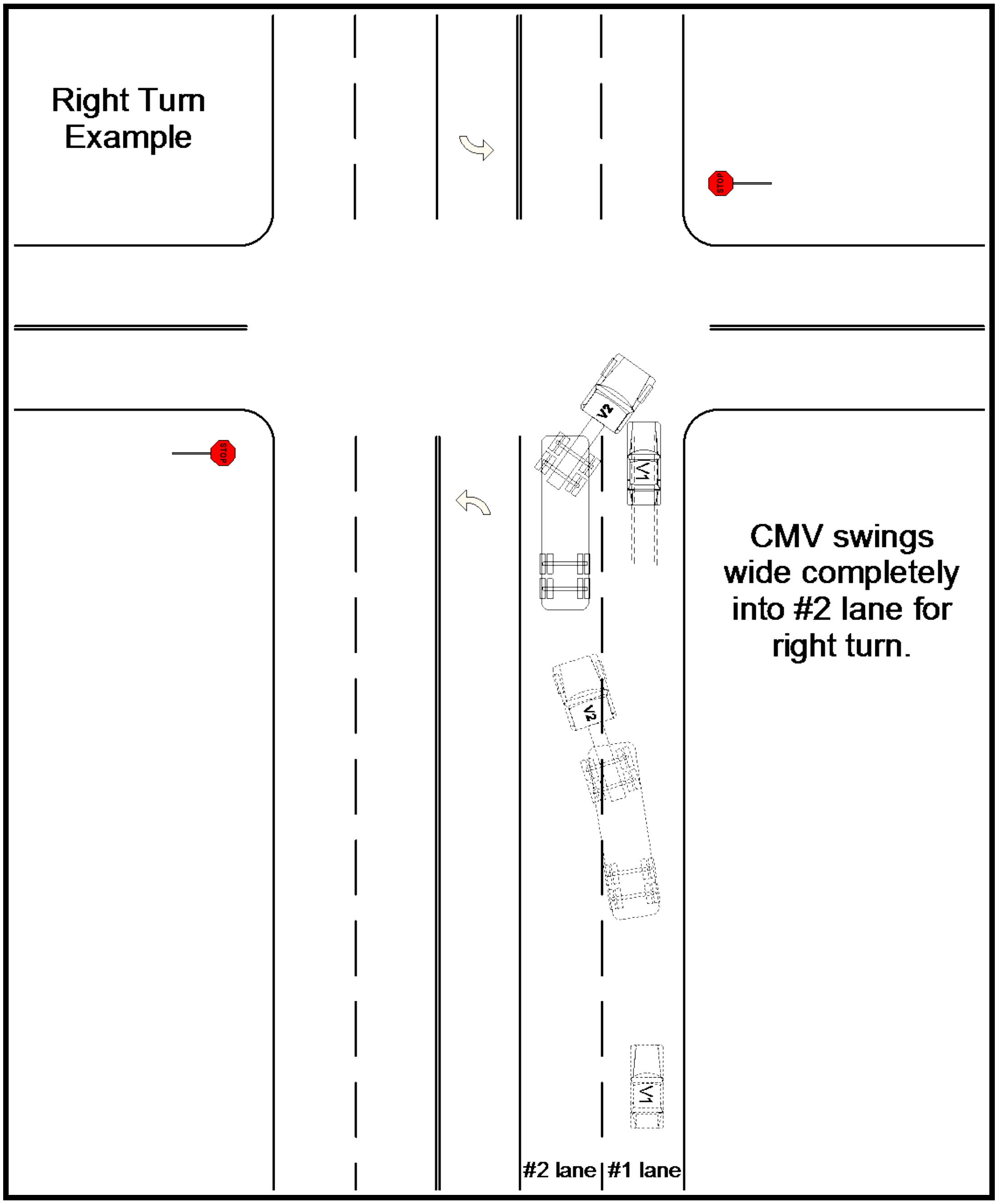


Figure A9. CMV Swings Wide into Adjacent Travel Lane-Right Turn at Intersection

The following image shows a left-turn collision:

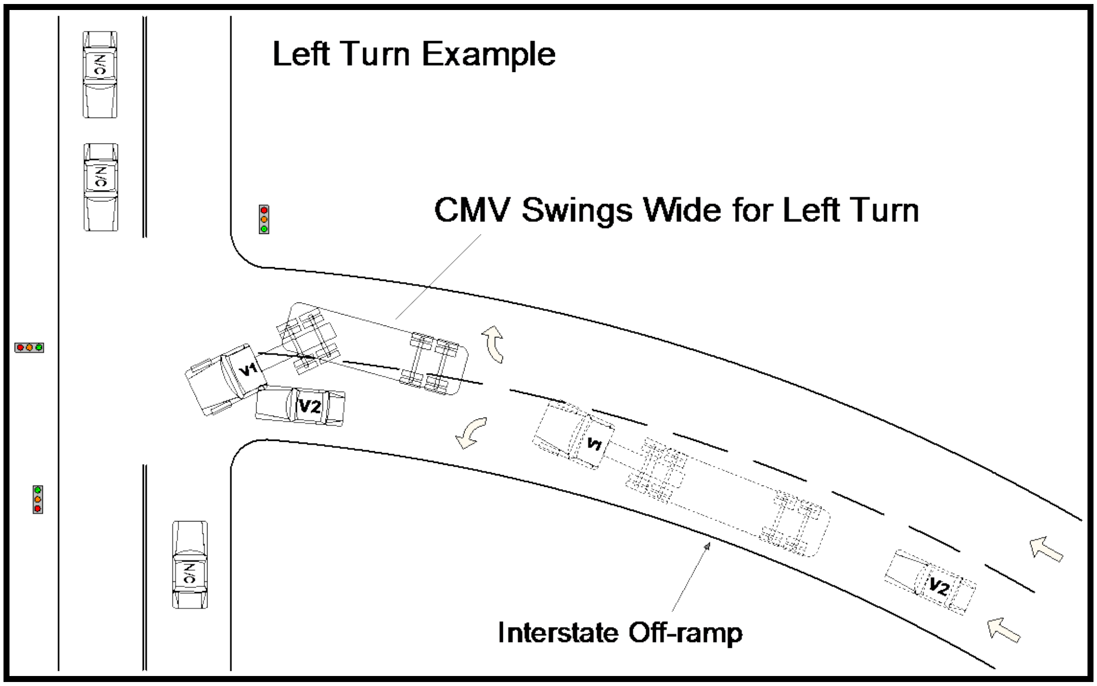


Figure A10. CMV Swings Wide into Adjacent Travel Lane-Left Turn at Intersection

Critical Event and Reason: The critical event was committed by the CMV and the critical reason is coded as “truck/bus driver.”

Guideline: For crashes where both vehicles are in the same direction of travel and the CMV swings wide to make a turn, the CMV committed the critical event and the CMV driver is coded with the critical reason for a driving error (making a turn from a portion of the wrong lane).

If the CMV is located in the correct lane for turning and there is a shoulder area adjacent to that lane, then the CMV is not responsible if another vehicle attempts to pass the CMV using that shoulder area.

If the CMV driver initiates a turn and the CMV strikes an object on the roadside (e.g., utility pole, etc.), the CMV committed the critical event and the CMV driver is coded with the critical reason.

Example 9. **Intersection crash involving one vehicle making a left turn in front of another vehicle traveling in a straight path**

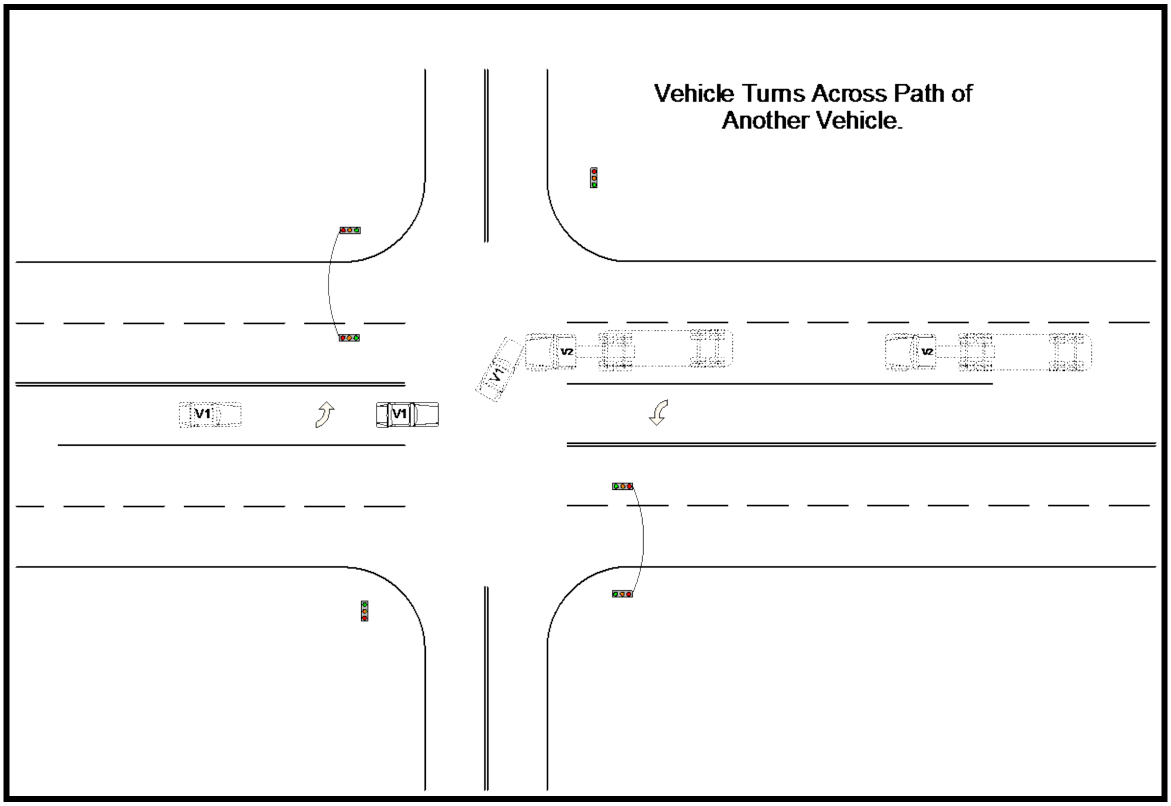


Figure A11. Intersection Crash: Vehicle Making Left Turn in Front of Vehicle Traveling Straight

<u>**Scenario 1:**</u> A non-CMV is in an intersection turning left on a green arrow. A CMV from the opposite direction (going straight) has a red light and does not stop and the crash occurs.

> **Discussion**: When a vehicle does not obey a traffic control device, it does not have the right-of-way, and this fact is considered when assigning critical events and critical reasons.
>
> **Critical Event and Reason:** The critical event was committed by the CMV and the critical reason is assigned to the CMV "truck/bus driver."
>
> **Guideline:** When there is an indication that a CMV driver has violated a traffic control device making a crash inevitable, the CMV is assigned the critical reason.

<u>**Scenario 2:**</u> A non-CMV is in an intersection waiting to turn left on a green light. The traffic light changes from green to yellow and this vehicle starts to turn left. A CMV from the opposite direction (going straight) does not stop with a yellow light and the crash occurs.

> **Discussion:** Consideration is given to the legality of passing through or turning during a yellow light cycle according to local law. In this case the assumption is that it is legal to enter an intersection on a green light and then turn on a yellow light. Thus, the non-CMV has the right of way.

Critical Event and Reason: The critical event was committed by the CMV and the critical reason is assigned to the CMV "truck/bus driver."

Guideline: If the light turns yellow for the non-CMV making the left turn, the light for the CMV coming from the opposite direction (going straight) would also be yellow. The critical reason is therefore coded to the CMV driver because the CMV must yield the right-of-way with a yellow caution light.

Scenario 3: A non-CMV is in an intersection waiting to turn left on a green light. The traffic light changes from yellow to red and this vehicle starts to turn left. A CMV from the opposite direction (going straight) does not stop with a red light and the crash occurs.

Discussion: Violation of a traffic control device is considered when assessing responsibility and assigning critical events and critical reasons.

Critical Event and Reason: The critical event was committed by the CMV and the critical reason is assigned to the CMV "truck/bus driver."

Guideline: If the light turns red for the non-CMV making the left turn, the light for the CMV coming from the opposite direction going straight would also be red. When there is an indication that a CMV has violated a traffic control device, the critical reason is assigned to that CMV driver.

Scenario 4: A non-CMV is in an intersection turning left with unknown traffic controls. A CMV from the opposite direction (going straight) does not stop with unknown traffic controls and the crash occurs. Both drivers are claiming the right of way and the investigating officer cannot determine who had the right of way.

Discussion: When the PAR does not make a determination of which driver violated the traffic controls, the coder does not assign a critical event to either vehicle.

Critical Event and Reason: The critical reason is coded as "unable to assign critical reason."

Guideline: When the evidence does not indicate that the CMV is responsible for the critical event, the CMV cannot be coded with the critical reason.

Example 10. Intersection crash, intersecting straight paths

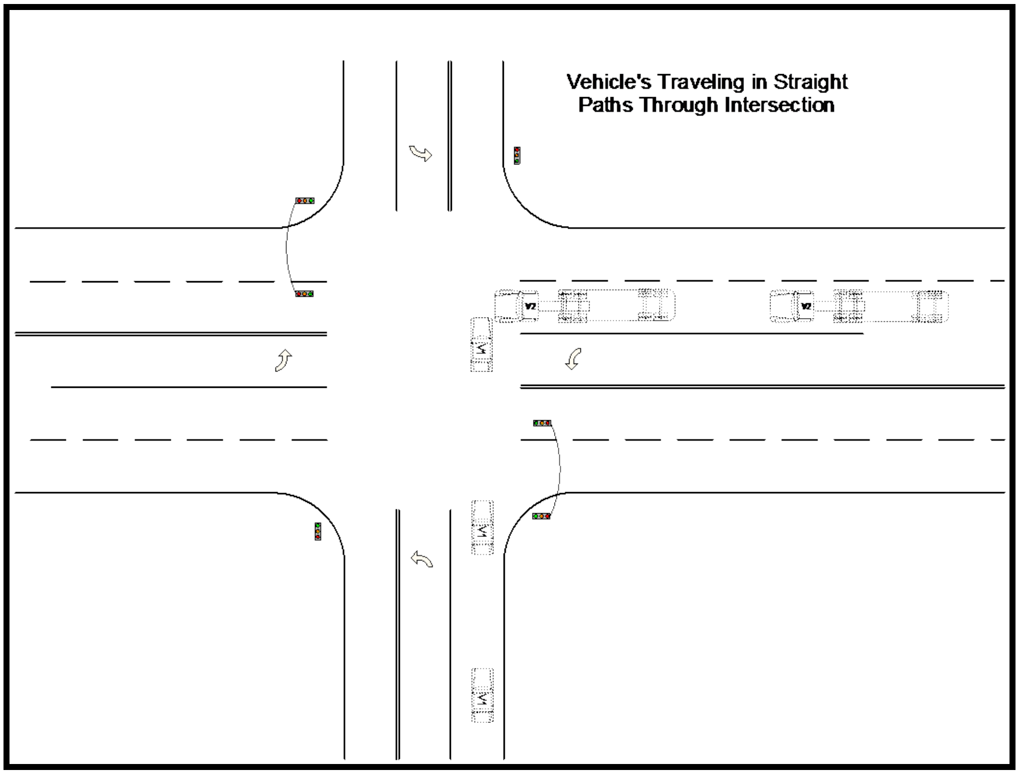


Figure A12. Intersection Crash, Intersecting Straight Paths

Scenario 1: The CMV approaches the intersection when the light changes to red.

Discussion: The CMV driver does not stop in time and strikes the other vehicle.

Critical Event and Reason: The critical event was committed by the CMV and the critical reason is coded to the CMV "truck/bus driver."

Guideline: The vehicle that violates the traffic control device (and thus does not have the right-of-way) makes the crash inevitable and is assigned the critical event.

Scenario 2: The two vehicles collide and both drivers claim they had a green light.

Discussion: If evidence does not indicate that the CMV was responsible for the critical event, the CMV driver cannot be assigned the critical reason.

Critical Event and Reason: The critical reason is coded as "unable to assign critical reason."

Guideline: Since it is not known which vehicle had the right-of-way and no other information is available, the critical reason cannot be assigned.

Example 11. Multiple CMVs involved in a crash

Scenario 1: A CMV bus (V1) is in the number one lane and abruptly changes lanes to the left into the number two lane in front of a tractor-trailer (V2) and then immediately decelerates due to slower moving forward traffic.

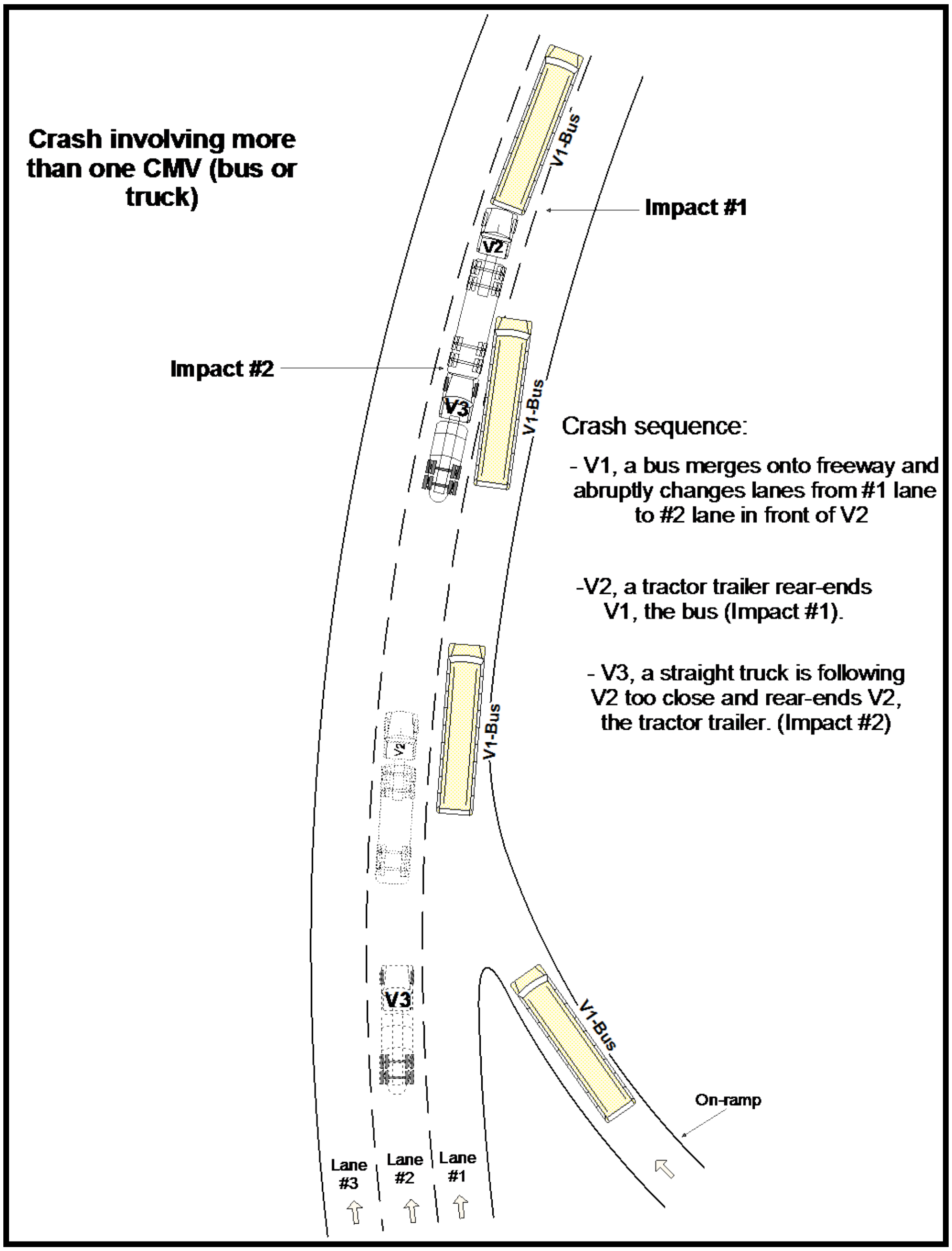


Figure A13. Multiple CMVs Involved in a Crash – Scenario 1

Discussion: The tractor-trailer cannot stop and impacts the rear plane of the bus. A third vehicle, a straight truck (V3), was traveling behind the tractor-trailer in the number two lane and cannot stop in time and impacts the rear plane of the tractor-trailer.

Critical Event and Reason:

- Vehicle 1 – The critical event was committed by the bus and the driver of the bus is assigned the critical reason. The bus driver made an unsafe lane change and encroached into the path of the tractor-trailer making the crash inevitable.
- Vehicle 2 – The tractor semi-trailer is not responsible and is coded with the critical reason “not assigned to this driver/vehicle.” The action of the bus made the crash inevitable.
- Vehicle 3 – The driver of the straight truck is responsible for his/her actions. The driver was following too closely to respond to unexpected actions of the tractor-trailer. This vehicle is assigned a critical event and the critical reason is coded as “truck/bus driver.”

Guideline: Each CMV involved in a crash is assigned a critical event and critical reason. The bus made the first impact of the crash inevitable. The tractor semi-trailer was not responsible for the first impact or for being hit from behind. The straight truck was responsible for the second impact because it was following too close to the tractor-trailer.

Scenario 2: A CMV bus (V1) is stopped in the number two lane due to stopped forward traffic. Trailing behind the bus in the same travel lane and direction is a CMV tractor semi-trailer (V2) that decelerates and avoids striking the bus. Behind the tractor-trailer is a third vehicle, a CMV straight truck (V3), also in the number two lane.

Discussion: The third vehicle, straight truck, cannot stop in time and rear-ends the second vehicle, the tractor semi-trailer (Impact #1). The second vehicle is then pushed forward into the back of the bus (Impact #2). The investigating officer cited the second vehicle for inadequate stop lamp visibility. This information is part of the PAR.

Critical Event and Reason:

- Vehicle 1 – The driver of the bus was not responsible for the crash event. The bus was simply stopped in its travel lane due to congested forward traffic. This vehicle did not commit the critical event and is coded with the critical reason of “not assigned to this driver/vehicle.”
- Vehicle 2 – A critical event was committed by the tractor semi-trailer as a result of the mechanical defect. The critical reason is the faulty stop lamp. When the PAR indicates a CMV has a mechanical defect that made the crash inevitable, the critical event is assigned to the CMV. The critical reason is coded as “truck/bus vehicle.”
- Vehicle 3 – If it is decided that the straight truck hit Vehicle 2 because it was following too closely, a critical event was committed by the straight truck. The straight truck is given a critical event and the driver is coded with the critical reason of “truck/bus driver.” If it is decided that the straight truck failed to stop in time as a result of the faulty stop lamp on Vehicle 2, the straight truck would not be coded with a critical event and the critical reason “not assigned to this vehicle” would be coded to Vehicle 3.

Guideline: Critical events and reasons are assigned based on the driver and vehicle conditions and actions of each truck or bus involved in the crash.

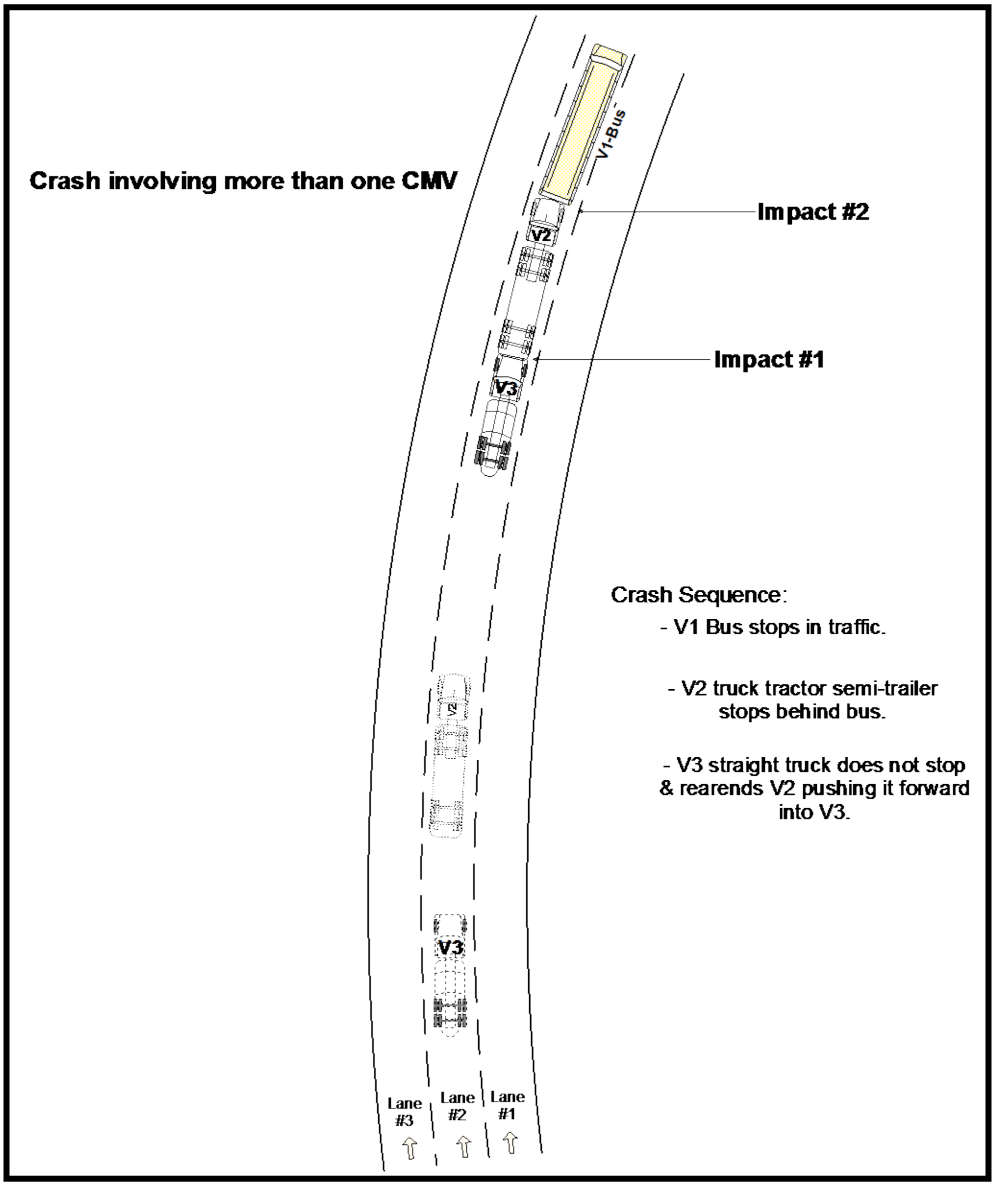


Figure A14. Multiple CMVs Involved in a Crash – Scenario 2

Critical Reason Assignments in Common Crash Scenarios

The following examples demonstrate common crash scenarios found on the PARs and the resulting critical reason determinations.

Example 1. The CMV is the only vehicle involved in the crash.

a. **Critical reason assigned to CMV driver or vehicle**
   - Driver actions or inactions led to crash
   - Failure or degraded vehicle component(s) led to the crash

b. **Critical reason assigned to environment**
   - Sudden environmental condition
   - Sudden roadway issue

Example 2. The CMV changes direction that results in a crash.

a. **Critical reason assigned to CMV driver or vehicle**
   - Turn across path at a junction in violation of a traffic control device
   - Wide right turns
   - Lane change maneuvers without having the right-of-way

b. **Critical reason "Not assigned to this driver/vehicle"**
   - Turn in compliance with a traffic control device (e.g., turning with a green turn arrow, etc.)

Example 3. A lead vehicle is either in the process of stopping or is stopped.

a. **Critical reason assigned to CMV driver or vehicle**
   - Striking the rear of a lead vehicle either in the process of stopping or is stopped
   - Striking the rear of other vehicles stopping for a lead vehicle

b. **Critical reason "Not assigned to this driver/vehicle"**
   - CMV lead vehicle stopped and was struck in rear
   - CMV lead vehicle stopped, struck in rear, and subsequently pushed into another vehicle or object

Example 4. A trailer swing or jackknife occurs to the CMV.

a. **Critical reason assigned to CMV driver or vehicle**
   - Results in a crash

Critical reason assigned to environment
   - Sudden environmental condition

Example 5. Load shift of the CMV.

a. **Critical reason assigned to CMV driver or vehicle**
   - Results in a crash

Example 6. Cargo spillage by the CMV.

a. **Critical reason assigned to CMV driver or vehicle**
   - Results in a crash

Example 7. CMV mechanical problem.

a. **Critical reason assigned to CMV driver or vehicle**
    - Tire failure
    - Steering failure
    - Brake failure
    - Degraded braking capability
    - Drive train failure
    - Trailer attachment failure
    - Other

Example 8. CMV disabled in the travel lane.

a. **Critical reason assigned to CMV driver or vehicle**
    - Regardless of whether the driver turned on warning devices

Critical reason assigned to environment
- When vehicle is disabled due to sudden-onset weather or roadway condition

Example 9. CMV right-of-way violation.

a. **Critical reason assigned to CMV driver or vehicle**
    - CMV violates a traffic control device
        - Runs a stop sign
        - Runs a signal light
    - CMV enters a traffic-way and fails to yield

Example 10. Ongoing environmental conditions.

a. **Critical reason assigned to CMV driver or vehicle**
    - Ongoing rain
    - Ongoing snow
    - Ongoing sleet
    - Ongoing fog
    - Ongoing sun glare
    - Previous rock slide

b. **Critical reason assigned to environment**
    - Sudden onset of rain
    - Sudden onset of snow
    - Sudden onset of sleet
    - Sudden onset of fog
    - Isolated patch of black ice
    - Sudden rock slide
    - Blowing debris
    - Wind gust
    - Sudden sun glare

Example 11. Ongoing highway conditions.

a. **Critical reason assigned to CMV driver or vehicle**
    - Construction

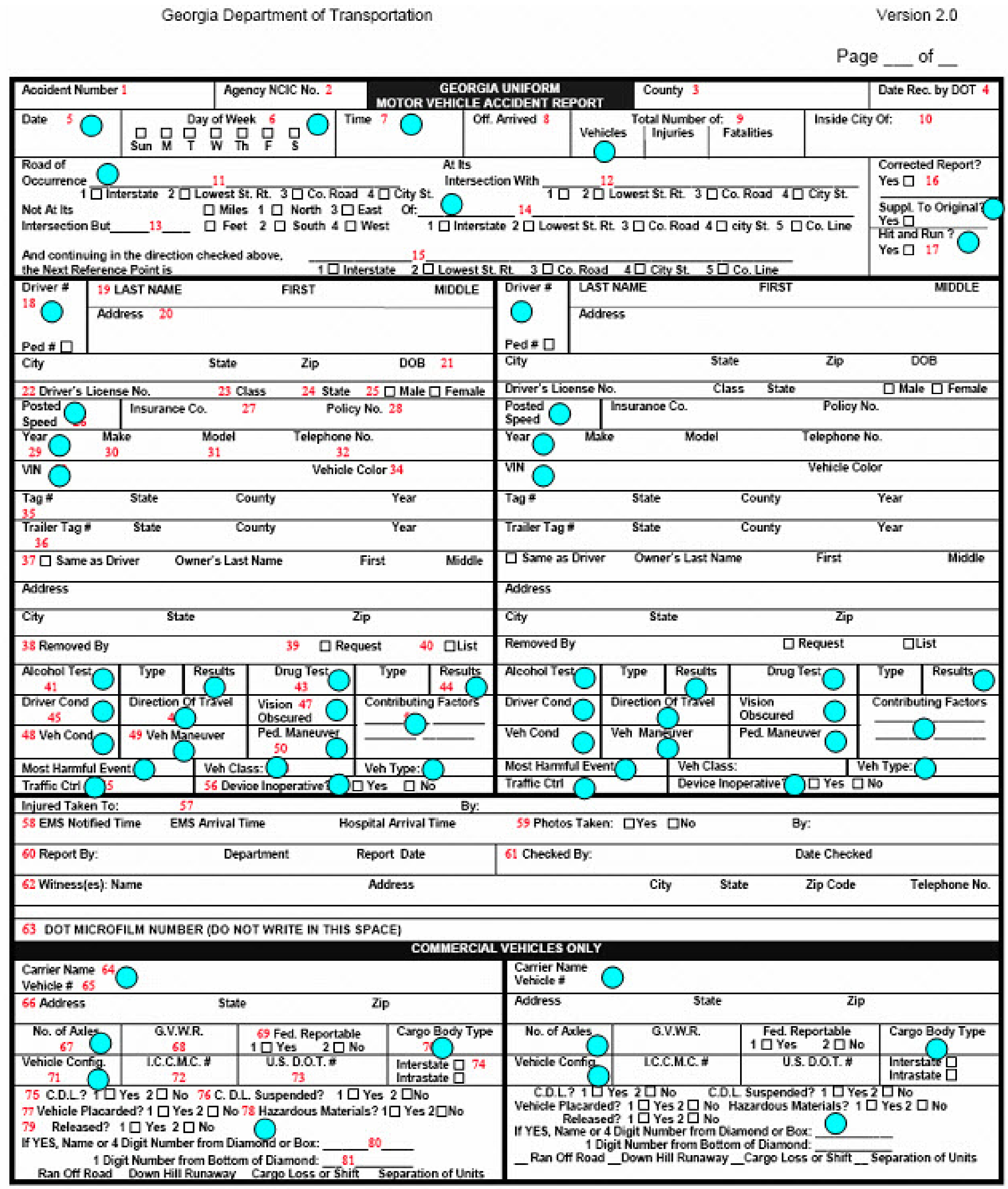
  - Deteriorated surface
  - Low bridge with appropriate signage

b. Critical reason assigned to environment

- Traffic control signs/signals: missing, erroneous, defective, inadequate
- Low bridge without appropriate signage
- Traffic control signs
- Sudden roadway deterioration
  - Sink hole
  - Bridge collapse
  - Washout

EXAMPLE PAR

The blue dots on the following image indicate relevant areas of interest for a PAR review:



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Page ___ of __

Accident Number 1 | Agency NCIC No. 2 | GEORGIA UNIFORM MOTOR VEHICLE ACCIDENT REPORT | County 3 | Date Rec. by DOT 4

Date 5 | Day of Week 6 ☐ Sun ☐ M ☐ T ☐ W ☐ Th ☐ F ☐ S | Time 7 | Off. Arrived 8 | Total Number of: 9 Vehicles | Injuries | Fatalities | Inside City Of: 10

Road of Occurrence ______11______ 1 ☐ Interstate 2 ☐ Lowest St. Rt. 3 ☐ Co. Road 4 ☐ City St.

At Its Intersection With ______12______ 1 ☐ 2 ☐ Lowest St. Rt. 3 ☐ Co. Road 4 ☐ City St.

Not At Its Intersection But______13____ ☐ Miles ☐ Feet 1 ☐ North 2 ☐ South 3 ☐ East 4 ☐ West Of: ______14______ 1 ☐ Interstate 2 ☐ Lowest St. Rt. 3 ☐ Co. Road 4 ☐ city St. 5 ☐ Co. Line

And continuing in the direction checked above, the Next Reference Point is ______15______ 1 ☐ Interstate 2 ☐ Lowest St. Rt. 3 ☐ Co. Road 4 ☐ City St. 5 ☐ Co. Line

Corrected Report? Yes ☐ 16

Suppl. To Original? Yes ☐

Hit and Run ? Yes ☐ 17

Driver # 18 | 19 LAST NAME | FIRST | MIDDLE | Driver # | LAST NAME | FIRST | MIDDLE

Address 20 | Address

Ped # ☐ | Ped # ☐

City | State | Zip | DOB 21 | City | State | Zip | DOB

22 Driver's License No. | 23 Class | 24 State | 25 ☐ Male ☐ Female | Driver's License No. | Class | State | ☐ Male ☐ Female

Posted Speed | Insurance Co. 27 | Policy No. 28 | Posted Speed | Insurance Co. | Policy No.

Year 29 | Make 30 | Model 31 | Telephone No. 32 | Year | Make | Model | Telephone No.

VIN | Vehicle Color 34 | VIN | Vehicle Color

Tag # 35 | State | County | Year | Tag # | State | County | Year

Trailer Tag # 36 | State | County | Year | Trailer Tag # | State | County | Year

37 ☐ Same as Driver | Owner's Last Name | First | Middle | ☐ Same as Driver | Owner's Last Name | First | Middle

Address | Address

City | State | Zip | City | State | Zip

38 Removed By | 39 ☐ Request | 40 ☐List | Removed By | ☐ Request | ☐List

Alcohol Test 41 | Type | Results | Drug Test 43 | Type | Results 44 | Alcohol Test | Type | Results | Drug Test | Type | Results

Driver Cond 45 | Direction Of Travel 4 | Vision 47 Obscured | Contributing Factors | Driver Cond | Direction Of Travel | Vision Obscured | Contributing Factors

48 Veh Cond | 49 Veh Maneuver | Ped. Maneuver 50 | Veh Cond | Veh Maneuver | Ped. Maneuver

Most Harmful Event | Veh Class: | Veh Type: | Most Harmful Event | Veh Class: | Veh Type:

Traffic Ctrl 5 | 56 Device Inoperative? ☐ Yes ☐ No | Traffic Ctrl | Device Inoperative? ☐ Yes ☐ No

Injured Taken To: 57 | By:

58 EMS Notified Time | EMS Arrival Time | Hospital Arrival Time | 59 Photos Taken: ☐Yes ☐No | By:

60 Report By: | Department | Report Date | 61 Checked By: | Date Checked

62 Witness(es): Name | Address | City | State | Zip Code | Telephone No.

63 DOT MICROFILM NUMBER (DO NOT WRITE IN THIS SPACE)

COMMERCIAL VEHICLES ONLY

Carrier Name 64 Vehicle # 65 | Carrier Name Vehicle #

66 Address | State | Zip | Address | State | Zip

No. of Axles 67 | G.V.W.R. 68 | 69 Fed. Reportable 1 ☐ Yes 2 ☐ No | Cargo Body Type 7 | No. of Axles | G.V.W.R. | Fed. Reportable 1 ☐ Yes 2 ☐ No | Cargo Body Type

Vehicle Config. 71 | I.C.C.M.C. # 72 | U.S. D.O.T. # 73 | Interstate ☐ Intrastate ☐ 74 | Vehicle Config. | I.C.C.M.C. # | U.S. D.O.T. # | Interstate ☐ Intrastate ☐

75 C.D.L.? 1 ☐ Yes 2 ☐ No 76 C. D.L. Suspended? 1 ☐ Yes 2 ☐No

77 Vehicle Placarded? 1 ☐ Yes 2 ☐ No 78 Hazardous Materials? 1☐ Yes 2☐No

79 Released? 1 ☐ Yes 2 ☐ No

If YES, Name or 4 Digit Number from Diamond or Box: ______80____

1 Digit Number from Bottom of Diamond: ___81________

Ran Off Road Down Hill Runaway Cargo Loss or Shift Separation of Units

C.D.L.? 1 ☐ Yes 2 ☐ No C.D.L. Suspended? 1 ☐ Yes 2 ☐ No

Vehicle Placarded? 1 ☐ Yes 2 ☐ No Hazardous Materials? 1 ☐ Yes 2 ☐ No

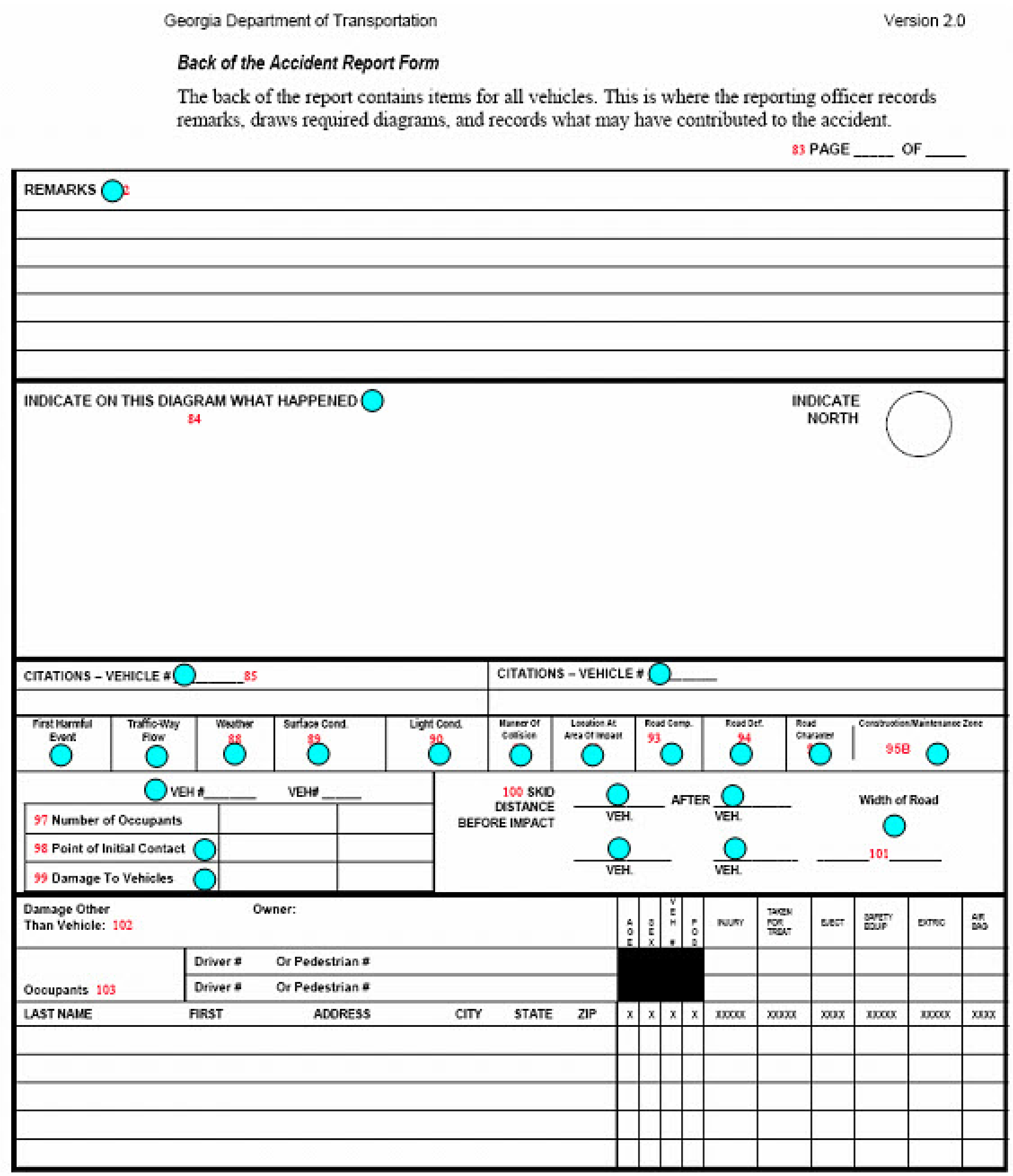
Released? 1 ☐ Yes 2 ☐ No

If YES, Name or 4 Digit Number from Diamond or Box: ________

1 Digit Number from Bottom of Diamond: ________

__ Ran Off Road __Down Hill Runaway __Cargo Loss or Shift __ Separation of Units

Overlay



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Back of the Accident Report Form

The back of the report contains items for all vehicles. This is where the reporting officer records remarks, draws required diagrams, and records what may have contributed to the accident.

83 PAGE _____ OF _____

REMARKS

INDICATE ON THIS DIAGRAM WHAT HAPPENED
84

INDICATE NORTH

CITATIONS – VEHICLE # ______85

CITATIONS – VEHICLE # ______

First Harmful Event	Traffic-Way Flow	Weather 88	Surface Cond. 89	Light Cond. 90	Manner Of Collision	Location At Area Of Impact	Road Comp. 93	Road Def. 94	Road Character	Construction/Maintenance Zone 95B

VEH #______ VEH# _____

97 Number of Occupants		
98 Point of Initial Contact		
99 Damage To Vehicles		

100 SKID DISTANCE BEFORE IMPACT ______ VEH. AFTER ______ VEH.

______ VEH. ______ VEH.

Width of Road ______101______

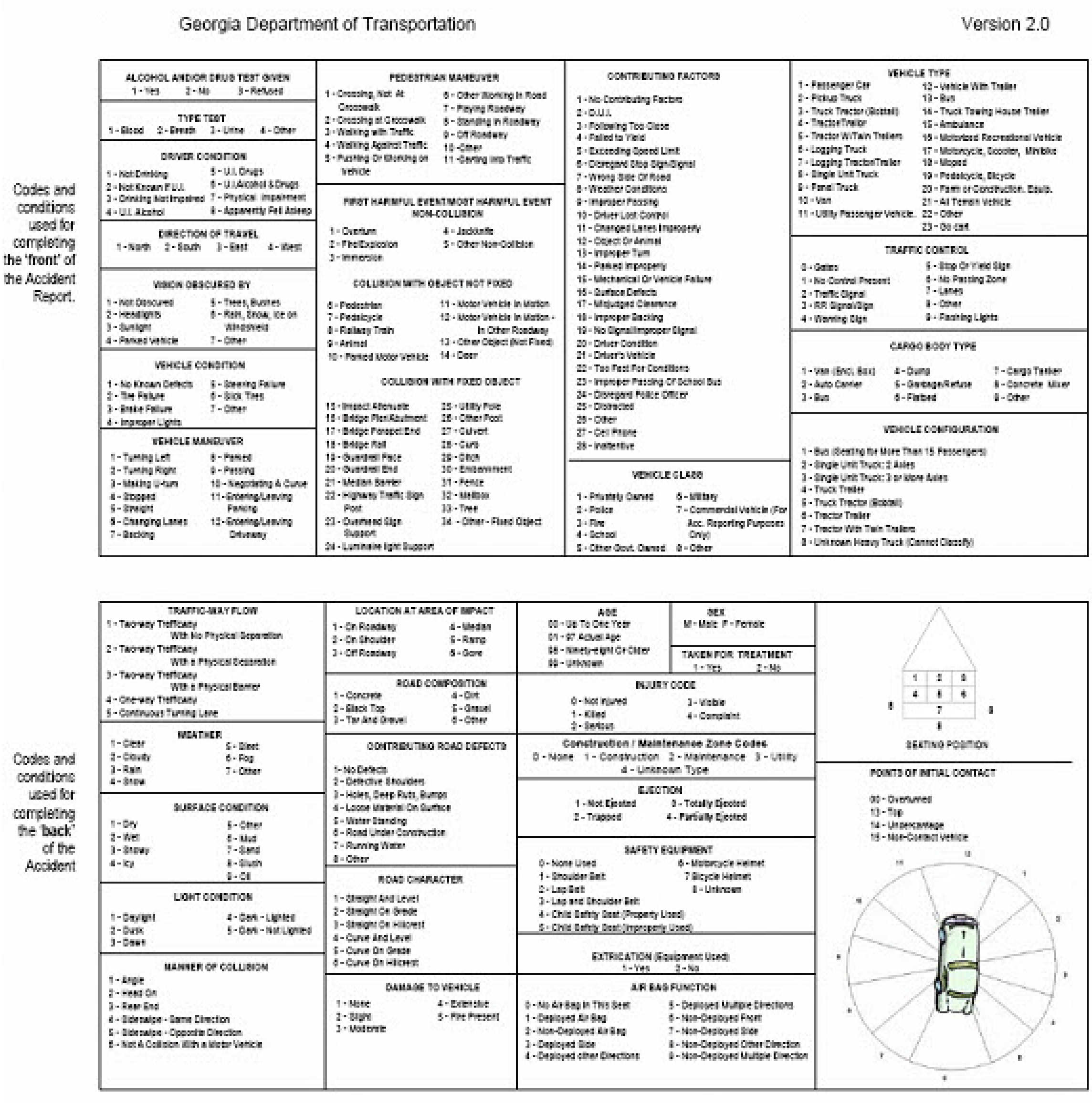
Damage Other Than Vehicle: 102 Owner:

Occupants 103

Driver # Or Pedestrian #

Driver # Or Pedestrian #

LAST NAME	FIRST	ADDRESS	CITY	STATE	ZIP	AGE	SEX	VEH #	POS	INJURY	TAKEN FOR TREAT	EJECT	SAFETY EQUIP	EXTRIC	AIR BAG
						X	X	X	X	XXXXX	XXXXX	XXXX	XXXXX	XXXXX	XXXX



Georgia Department of Transportation

Version 2.0

Codes and conditions used for completing the 'front' of the Accident Report.

ALCOHOL AND/OR DRUG TEST GIVEN
1 - Yes 2 - No 3 - Refused

TYPE TEST
1 - Blood 2 - Breath 3 - Urine 4 - Other

DRIVER CONDITION
1 - Not Drinking
2 - Not Known If U.I.
3 - Drinking Not Impaired
4 - U.I. Alcohol
5 - U.I. Drugs
6 - U.I.Alcohol & Drugs
7 - Physical Impairment
8 - Apparently Fell Asleep

DIRECTION OF TRAVEL
1 - North 2 - South 3 - East 4 - West

VISION OBSCURED BY
1 - Not Obscured
2 - Headlights
3 - Sunlight
4 - Parked Vehicle
5 - Trees, Bushes
6 - Rain, Snow, Ice on Windshield
7 - Other

VEHICLE CONDITION
1 - No Known Defects
2 - Tire Failure
3 - Brake Failure
4 - Improper Lights
5 - Steering Failure
6 - Slick Tires
7 - Other

VEHICLE MANEUVER
1 - Turning Left
2 - Turning Right
3 - Making U-turn
4 - Stopped
5 - Straight
6 - Changing Lanes
7 - Backing
8 - Parked
9 - Passing
10 - Negotiating A Curve
11 -Entering/Leaving Parking
12 -Entering/Leaving Driveway

PEDESTRIAN MANEUVER
1 - Crossing, Not At Crosswalk
2 - Crossing at Crosswalk
3 - Walking with Traffic
4 - Walking Against Traffic
5 - Pushing Or Working on Vehicle
6 - Other Working In Road
7 - Playing Roadway
8 - Standing In Roadway
9 - Off Roadway
10 -Other
11 -Darting Into Traffic

FIRST HARMFUL EVENT/MOST HARMFUL EVENT NON-COLLISION
1 - Overturn
2 - Fire/Explosion
3 - Immersion
4 - Jackknife
5 - Other Non-Collision

COLLISION WITH OBJECT NOT FIXED
6 - Pedestrian
7 - Pedalcycle
8 - Railway Train
9 - Animal
10 - Parked Motor Vehicle
11 - Motor Vehicle In Motion
12 - Motor Vehicle In Motion - In Other Roadway
13 - Other Object (Not Fixed)
14 - Deer

COLLISION WITH FIXED OBJECT
15 - Impact Attenuator
16 - Bridge Pier/Abutment
17 - Bridge Parapet End
18 - Bridge Rail
19 - Guardrail Face
20 - Guardrail End
21 - Median Barrier
22 - Highway Traffic Sign Post
23 - Overhead Sign Support
24 - Luminaire light Support
25 - Utility Pole
26 - Other Post
27 - Culvert
28 - Curb
29 - Ditch
30 - Embankment
31 - Fence
32 - Mailbox
33 - Tree
34 - Other - Fixed Object

CONTRIBUTING FACTORS
1 - No Contributing Factors
2 - D.U.I.
3 - Following Too Close
4 - Failed to Yield
5 - Exceeding Speed Limit
6 - Disregard Stop Sign/Signal
7 - Wrong Side Of Road
8 - Weather Conditions
9 - Improper Passing
10 - Driver Lost Control
11 - Changed Lanes Improperly
12 - Object Or Animal
13 - Improper Turn
14 - Parked Improperly
15 - Mechanical Or Vehicle Failure
16 - Surface Defects
17 - Misjudged Clearance
18 - Improper Backing
19 - No Signal/Improper Signal
20 - Driver Condition
21 - Driver's Vehicle
22 - Too Fast For Conditions
23 - Improper Passing Of School Bus
24 - Disregard Police Officer
25 - Distracted
26 - Other
27 - Cell Phone
28 - Inattentive

VEHICLE CLASS
1 - Privately Owned
2 - Police
3 - Fire
4 - School
5 - Other Govt. Owned
6 - Military
7 - Commercial Vehicle (For Acc. Reporting Purposes Only)
8 - Other

VEHICLE TYPE
1 - Passenger Car
2 - Pickup Truck
3 - Truck Tractor (Bobtail)
4 - Tractor/Trailer
5 - Tractor W/Twin Trailers
6 - Logging Truck
7 - Logging Tractor/Trailer
8 - Single Unit Truck
9 - Panel Truck
10 - Van
11 - Utility Passenger Vehicle.
12 - Vehicle With Trailer
13 - Bus
14 - Truck Towing House Trailer
15 - Ambulance
16 - Motorized Recreational Vehicle
17 - Motorcycle, Scooter, Minibike
18 - Moped
19 - Pedalcycle, Bicycle
20 - Farm or Construction. Equip.
21 - All Terrain Vehicle
22 - Other
23 - Go cart

TRAFFIC CONTROL
0 - Gates
1 - No Control Present
2 - Traffic Signal
3 - RR Signal/Sign
4 - Warning Sign
5 - Stop Or Yield Sign
6 - No Passing Zone
7 - Lanes
8 - Other
9 - Flashing Lights

CARGO BODY TYPE
1 - Van (Encl. Box)
2 - Auto Carrier
3 - Bus
4 - Dump
5 - Garbage/Refuse
6 - Flatbed
7 - Cargo Tanker
8 - Concrete Mixer
9 - Other

VEHICLE CONFIGURATION
1 - Bus (Seating for More Than 15 Passengers)
2 - Single Unit Truck: 2 Axles
3 - Single Unit Truck: 3 or More Axles
4 - Truck Trailer
5 - Truck Tractor (Bobtail)
6 - Tractor Trailer
7 - Tractor With Twin Trailers
8 - Unknown Heavy Truck (Cannot Classify)

Codes and conditions used for completing the 'back' of the Accident

TRAFFIC-WAY FLOW
1 - Two-way Trafficway With No Physical Separation
2 - Two-way Trafficway With a Physical Separation
3 - Two-way Trafficway With a Physical Barrier
4 - One-way Trafficway
5 - Continuous Turning Lane

WEATHER
1 - Clear
2 - Cloudy
3 - Rain
4 - Snow
5 - Sleet
6 - Fog
7 - Other

SURFACE CONDITION
1 - Dry
2 - Wet
3 - Snowy
4 - Icy
5 - Other
6 - Mud
7 - Sand
8 - Slush
9 - Oil

LIGHT CONDITION
1 - Daylight
2 - Dusk
3 - Dawn
4 - Dark - Lighted
5 - Dark - Not Lighted

MANNER OF COLLISION
1 - Angle
2 - Head On
3 - Rear End
4 - Sideswipe - Same Direction
5 - Sideswipe - Opposite Direction
6 - Not A Collision With a Motor Vehicle

LOCATION AT AREA OF IMPACT
1 - On Roadway
2 - On Shoulder
3 - Off Roadway
4 - Median
5 - Ramp
6 - Gore

ROAD COMPOSITION
1 - Concrete
2 - Black Top
3 - Tar And Gravel
4 - Dirt
5 - Gravel
6 - Other

CONTRIBUTING ROAD DEFECTS
1- No Defects
2 - Defective Shoulders
3 - Holes, Deep Ruts, Bumps
4 - Loose Material On Surface
5 - Water Standing
6 - Road Under Construction
7 - Running Water
8 - Other

ROAD CHARACTER
1 - Straight And Level
2 - Straight On Grade
3 - Straight On Hillcrest
4 - Curve And Level
5 - Curve On Grade
6 - Curve On Hillcrest

DAMAGE TO VEHICLE
1 - None
2 - Slight
3 - Moderate
4 - Extensive
5 - Fire Present

AGE
00 - Up To One Year
01 - 97 Actual Age
98 - Ninety-eight Or Older
99 - Unknown

SEX
M - Male F - Female

TAKEN FOR TREATMENT
1 - Yes 2 - No

INJURY CODE
0 - Not Injured
1 - Killed
2 - Serious
3 - Visible
4 - Complaint

Construction / Maintenance Zone Codes
0 - None 1 - Construction 2 - Maintenance 3 - Utility
4 - Unknown Type

EJECTION
1 - Not Ejected
2 - Trapped
3 - Totally Ejected
4 - Partially Ejected

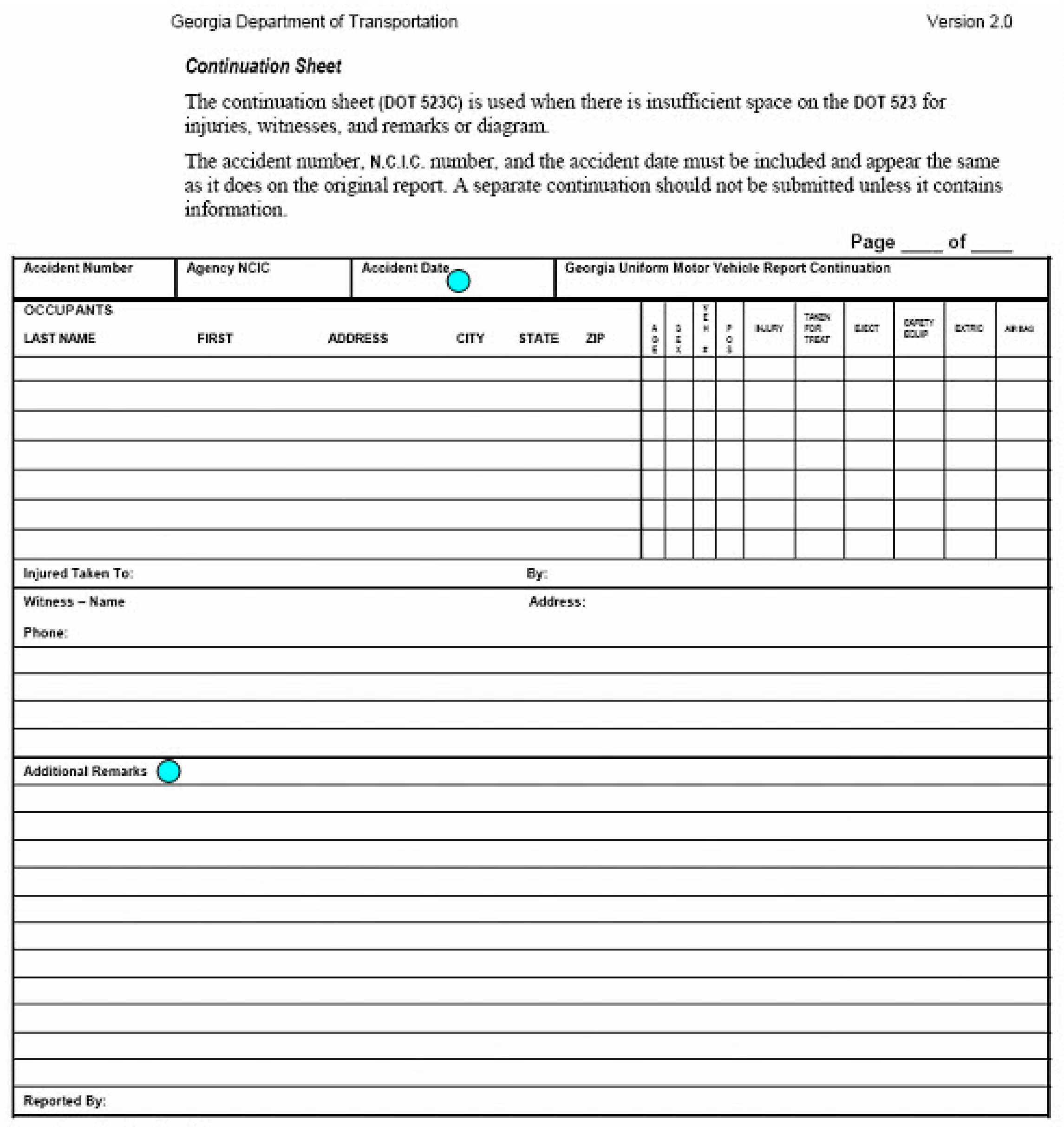
SAFETY EQUIPMENT
0 - None Used
1 - Shoulder Belt
2 - Lap Belt
3 - Lap and Shoulder Belt
4 - Child Safety Seat (Properly Used)
5 - Child Safety Seat (Improperly Used)
6 - Motorcycle Helmet
7 Bicycle Helmet
8 - Unknown

EXTRICATION (Equipment Used)
1 - Yes 2 - No

AIR BAG FUNCTION
0 - No Air Bag In This Seat
1 - Deployed Air Bag
2 - Non-Deployed Air Bag
3 - Deployed Side
4 - Deployed other Directions
5 - Deployed Multiple Directions
6 - Non-Deployed Front
7 - Non-Deployed Side
8 - Non-Deployed Other Direction
9 - Non-Deployed Multiple Direction

SEATING POSITION

POINTS OF INITIAL CONTACT
00 - Overturned
13 - Top
14 - Undercarriage
15 - Non-Contact Vehicle



Continuation Sheet

The continuation sheet (DOT 523C) is used when there is insufficient space on the DOT 523 for injuries, witnesses, and remarks or diagram.

The accident number, N.C.I.C. number, and the accident date must be included and appear the same as it does on the original report. A separate continuation should not be submitted unless it contains information.

Page ____ of ____

Accident Number	Agency NCIC	Accident Date	Georgia Uniform Motor Vehicle Report Continuation

OCCUPANTS

LAST NAME	FIRST	ADDRESS	CITY	STATE	ZIP	AGE	SEX	VEH #	POS	INJURY	TAKEN FOR TREAT	EJECT	SAFETY EQUIP	EXTRIC	AIR BAG

Injured Taken To: By:

Witness – Name Address:

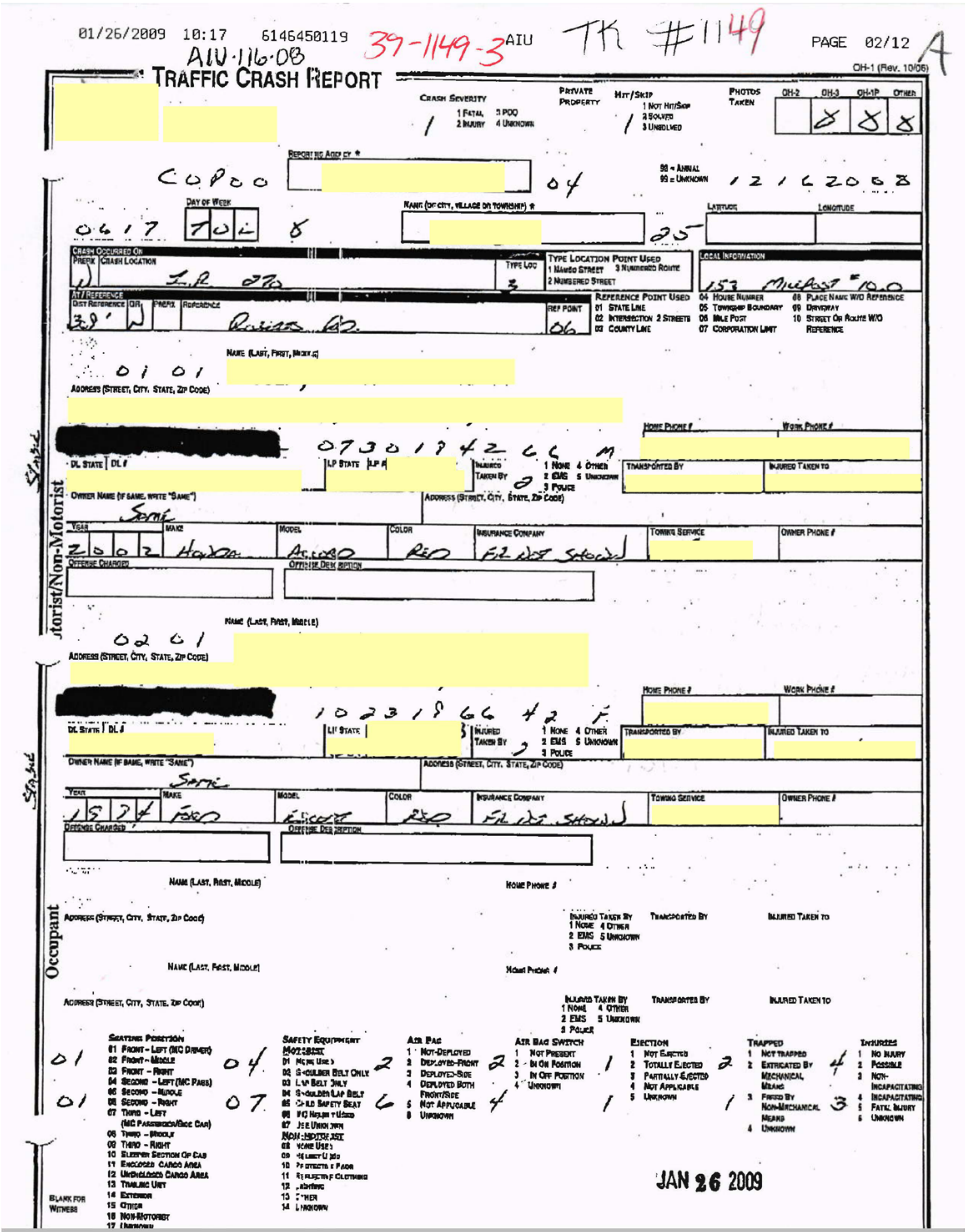
Phone:

Additional Remarks

Reported By:

Sample Continuation page

APPENDIX B EXAMPLE PARS



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AIU·116·08

OH-1 (Rev. 10/06)

TRAFFIC CRASH REPORT

[redacted] [redacted]

Crash Severity: 1 — 1 Fatal, 2 Injury, 3 PDO, 4 Unknown

Private Property

Hit/Skip: 1 — 1 Not Hit/Skip, 2 Solved, 3 Unsolved

Photos Taken: OH-2 ☐ OH-3 ☒ OH-1P ☒ Other ☒

COP00

Reporting Agency *: [redacted]

04

98 = Annual, 99 = Unknown

12/16/2008

0617

Day of Week: 7 0 2 — 8

Name (of city, village or township) *: [redacted]

25

Latitude:

Longitude:

Crash Occurred On — Prefix: N — Crash Location: I.R. 270 — Type Loc: 3

Type Location Point Used: 1 Named Street, 2 Numbered Street, 3 Numbered Route

Local Information: 153 Milepost #10.0

At/Reference — Dist Reference: 38' — Dir: W — Prefix: — Reference: Roberts Rd. — Ref Point: 06

Reference Point Used: 01 State Line, 02 Intersection 2 Streets, 03 County Line, 04 House Number, 05 Township Boundary, 06 Mile Post, 07 Corporation Limit, 08 Place Name W/O Reference, 09 Driveway, 10 Street Or Route W/O Reference

Motorist/Non-Motorist

01 01

Name (Last, First, Middle): [redacted]

Address (Street, City, State, Zip Code): [redacted]

[redacted] 07/30/1942 66 M

Home Phone #: [redacted] Work Phone #:

DL State / DL #: [redacted]

LP State / LP #: [redacted]

Injured Taken By: 2 — 1 None, 2 EMS, 3 Police, 4 Other, 5 Unknown

Transported By: [redacted]

Injured Taken To: [redacted]

Owner Name (If same, write "Same"): Same

Address (Street, City, State, Zip Code):

Year: 2002 — Make: Honda — Model: Accord — Color: Red — Insurance Company: F.I. Not Shown — Towing Service: [redacted] — Owner Phone #:

Offense Charged:

Offense Description:

02 01

Name (Last, First, Middle): [redacted]

Address (Street, City, State, Zip Code): [redacted]

[redacted] 10/23/1966 42 F

Home Phone #: [redacted] Work Phone #:

DL State / DL #: [redacted]

LP State: [redacted]

Injured Taken By: 3 — 1 None, 2 EMS, 3 Police, 4 Other, 5 Unknown

Transported By: [redacted]

Injured Taken To: [redacted]

Owner Name (If same, write "Same"): Same

Address (Street, City, State, Zip Code):

Year: 1974 — Make: Ford — Model: Escort — Color: Red — Insurance Company: F.I. Not Shown — Towing Service: [redacted] — Owner Phone #:

Offense Charged:

Offense Description:

Occupant

Name (Last, First, Middle) — Home Phone #

Address (Street, City, State, Zip Code) — Injured Taken By: 1 None, 2 EMS, 3 Police, 4 Other, 5 Unknown — Transported By — Injured Taken To

Name (Last, First, Middle) — Home Phone #

Address (Street, City, State, Zip Code) — Injured Taken By: 1 None, 2 EMS, 3 Police, 4 Other, 5 Unknown — Transported By — Injured Taken To

	Seating Position	Safety Equipment	Air Bag	Air Bag Switch	Ejection	Trapped	Injuries
01	01	04	2	2	1	2	4
01	01	07	6	4	1	1	3

Seating Position: 01 Front - Left (MC Driver), 02 Front - Middle, 03 Front - Right, 04 Second - Left (MC Pass), 05 Second - Middle, 06 Second - Right, 07 Third - Left (MC Passenger/Side Car), 08 Third - Middle, 09 Third - Right, 10 Sleeper Section Of Cab, 11 Enclosed Cargo Area, 12 Unenclosed Cargo Area, 13 Trailing Unit, 14 Exterior, 15 Other, 16 Non-Motorist, 17 Unknown

Safety Equipment — Motorist: 01 None Used, 02 Shoulder Belt Only, 03 Lap Belt Only, 04 Shoulder/Lap Belt, 05 Child Safety Seat, 06 MC Helmet Used, 07 Use Unknown; Non-Motorist: 08 None Used, 09 Helmet Used, 10 Protective Pads, 11 Reflective Clothing, 12 Lighting, 13 Other, 14 Unknown

Air Bag: 1 Not-Deployed, 2 Deployed-Front, 3 Deployed-Side, 4 Deployed Both Front/Side, 5 Not Applicable, 6 Unknown

Air Bag Switch: 1 Not Present, 2 In On Position, 3 In Off Position, 4 Unknown

Ejection: 1 Not Ejected, 2 Totally Ejected, 3 Partially Ejected, 4 Not Applicable, 5 Unknown

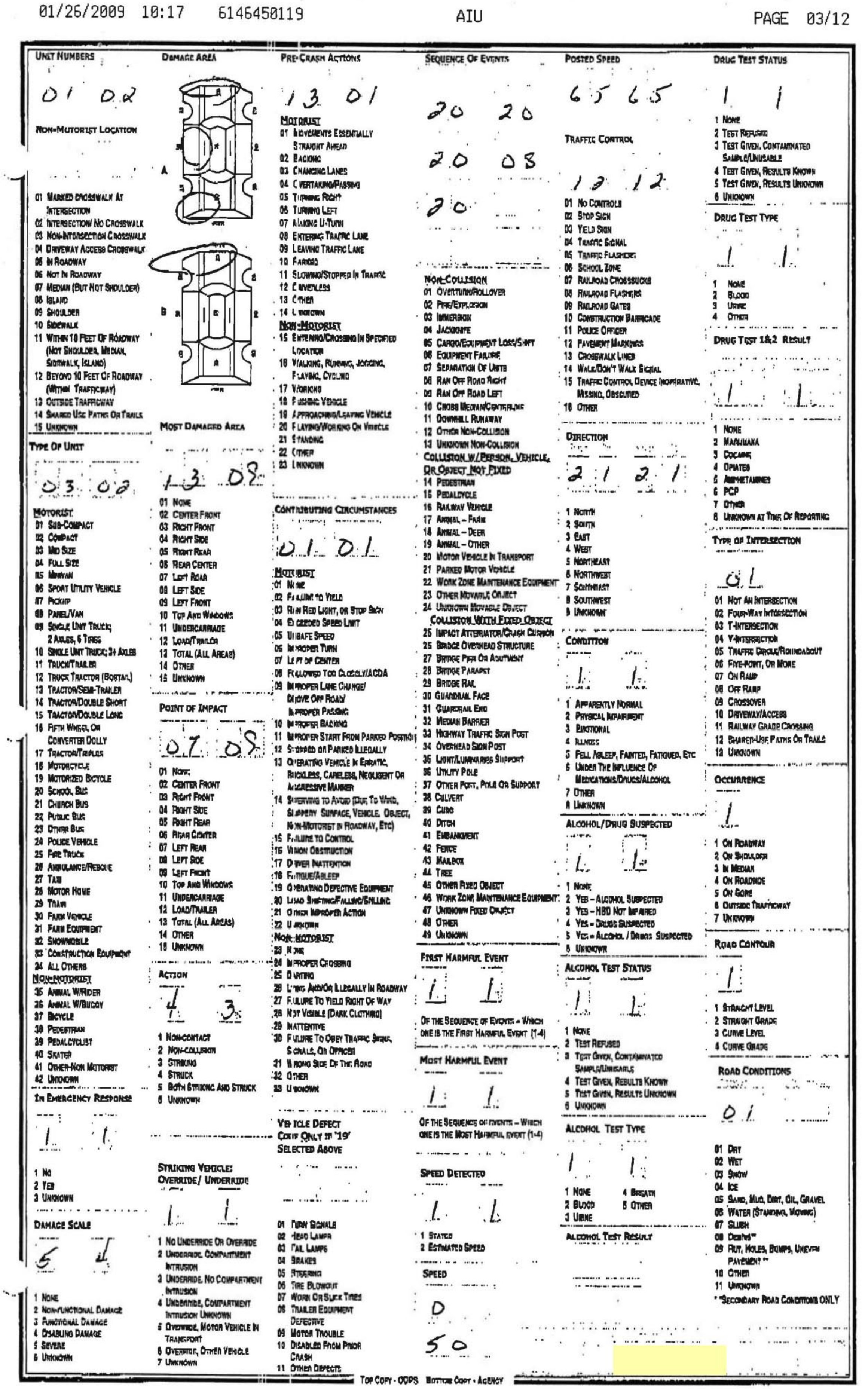
Trapped: 1 Not Trapped, 2 Extricated By Mechanical Means, 3 Freed By Non-Mechanical Means, 4 Unknown

Injuries: 1 No Injury, 2 Possible, 3 Non-Incapacitating, 4 Incapacitating, 5 Fatal Injury, 6 Unknown

Blank For Witness

JAN 26 2009

Figure B-1. Example PAR - Illegible with Missing Diagram



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Unit Numbers

01 02

Non-Motorist Location

01 Marked Crosswalk At Intersection
02 Intersection No Crosswalk
03 Non-Intersection Crosswalk
04 Driveway Access Crosswalk
05 In Roadway
06 Not In Roadway
07 Median (But Not Shoulder)
08 Island
09 Shoulder
10 Sidewalk
11 Within 10 Feet Of Roadway (Not Shoulder, Median, Sidewalk, Island)
12 Beyond 10 Feet Of Roadway (Within Trafficway)
13 Outside Trafficway
14 Shared Use Paths Or Trails
15 Unknown

Type Of Unit

03 02

Motorist
01 Sub-Compact
02 Compact
03 Mid Size
04 Full Size
05 Minivan
06 Sport Utility Vehicle
07 Pickup
08 Panel/Van
09 Single Unit Truck; 2 Axles, 6 Tires
10 Single Unit Truck; 3+ Axles
11 Truck/Trailer
12 Truck Tractor (Bobtail)
13 Tractor/Semi-Trailer
14 Tractor/Double Short
15 Tractor/Double Long
16 Fifth Wheel, Or Converter Dolly
17 Tractor/Triples
18 Motorcycle
19 Motorized Bicycle
20 School Bus
21 Church Bus
22 Public Bus
23 Other Bus
24 Police Vehicle
25 Fire Truck
26 Ambulance/Rescue
27 Taxi
28 Motor Home
29 Train
30 Farm Vehicle
31 Farm Equipment
32 Snowmobile
33 Construction Equipment
34 All Others
Non-Motorist
35 Animal W/Rider
36 Animal W/Buggy
37 Bicycle
38 Pedestrian
39 Pedalcyclist
40 Skater
41 Other-Non Motorist
42 Unknown

In Emergency Response

1 1

1 No
2 Yes
3 Unknown

Damage Scale

5 4

1 None
2 Non-Functional Damage
3 Functional Damage
4 Disabling Damage
5 Severe
6 Unknown

Damage Area

A B

Most Damaged Area

13 08

01 None
02 Center Front
03 Right Front
04 Right Side
05 Right Rear
06 Rear Center
07 Left Rear
08 Left Side
09 Left Front
10 Top And Windows
11 Undercarriage
12 Load/Trailer
13 Total (All Areas)
14 Other
15 Unknown

Point Of Impact

07 08

01 None
02 Center Front
03 Right Front
04 Right Side
05 Right Rear
06 Rear Center
07 Left Rear
08 Left Side
09 Left Front
10 Top And Windows
11 Undercarriage
12 Load/Trailer
13 Total (All Areas)
14 Other
15 Unknown

Action

4 3

1 Non-Contact
2 Non-Collision
3 Striking
4 Struck
5 Both Striking And Struck
6 Unknown

Striking Vehicle: Override/ Underride

1 1

1 No Underride Or Override
2 Underride, Compartment Intrusion
3 Underride, No Compartment Intrusion
4 Underride, Compartment Intrusion Unknown
5 Override, Motor Vehicle In Transport
6 Override, Other Vehicle
7 Unknown

Pre-Crash Actions

13 01

Motorist
01 Movements Essentially Straight Ahead
02 Backing
03 Changing Lanes
04 Overtaking/Passing
05 Turning Right
06 Turning Left
07 Making U-Turn
08 Entering Traffic Lane
09 Leaving Traffic Lane
10 Parked
11 Slowing/Stopped In Traffic
12 Driverless
13 Other
14 Unknown
Non-Motorist
15 Entering/Crossing In Specified Location
16 Walking, Running, Jogging, Playing, Cycling
17 Working
18 Pushing Vehicle
19 Approaching/Leaving Vehicle
20 Playing/Working On Vehicle
21 Standing
22 Other
23 Unknown

Contributing Circumstances

01 01

Motorist
01 None
02 Failure to Yield
03 Ran Red Light, or Stop Sign
04 Exceeded Speed Limit
05 Unsafe Speed
06 Improper Turn
07 Left of Center
08 Followed Too Closely/ACDA
09 Improper Lane Change/ Drove Off Road/ Improper Passing
10 Improper Backing
11 Improper Start From Parked Position
12 Stopped or Parked Illegally
13 Operating Vehicle In Erratic, Reckless, Careless, Negligent Or Aggressive Manner
14 Swerving to Avoid (Due To Wind, Slippery Surface, Vehicle, Object, Non-Motorist in Roadway, Etc)
15 Failure to Control
16 Vision Obstruction
17 Driver Inattention
18 Fatigue/Asleep
19 Operating Defective Equipment
20 Load Shifting/Falling/Spilling
21 Other Improper Action
22 Unknown
Non-Motorist
23 None
24 Improper Crossing
25 Darting
26 Lying And/Or Illegally In Roadway
27 Failure To Yield Right Of Way
28 Not Visible (Dark Clothing)
29 Inattentive
30 Failure To Obey Traffic Signs, Signals, Or Officer
31 Wrong Side Of The Road
32 Other
33 Unknown

Vehicle Defect
Code Only If '19' Selected Above

01 Turn Signals
02 Head Lamps
03 Tail Lamps
04 Brakes
05 Steering
06 Tire Blowout
07 Worn Or Slick Tires
08 Trailer Equipment Defective
09 Motor Trouble
10 Disabled From Prior Crash
11 Other Defects

Sequence Of Events

20 20
20 08
20

Non-Collision
01 Overturn/Rollover
02 Fire/Explosion
03 Immersion
04 Jackknife
05 Cargo/Equipment Loss/Shift
06 Equipment Failure
07 Separation Of Units
08 Ran Off Road Right
09 Ran Off Road Left
10 Cross Median/Centerline
11 Downhill Runaway
12 Other Non-Collision
13 Unknown Non-Collision
Collision W/Person, Vehicle, Or Object Not Fixed
14 Pedestrian
15 Pedalcycle
16 Railway Vehicle
17 Animal – Farm
18 Animal – Deer
19 Animal – Other
20 Motor Vehicle In Transport
21 Parked Motor Vehicle
22 Work Zone Maintenance Equipment
23 Other Movable Object
24 Unknown Movable Object
Collision With Fixed Object
25 Impact Attenuator/Crash Cushion
26 Bridge Overhead Structure
27 Bridge Pier Or Abutment
28 Bridge Parapet
29 Bridge Rail
30 Guardrail Face
31 Guardrail End
32 Median Barrier
33 Highway Traffic Sign Post
34 Overhead Sign Post
35 Light/Luminaries Support
36 Utility Pole
37 Other Post, Pole Or Support
38 Culvert
39 Curb
40 Ditch
41 Embankment
42 Fence
43 Mailbox
44 Tree
45 Other Fixed Object
46 Work Zone Maintenance Equipment
47 Unknown Fixed Object
48 Other
49 Unknown

First Harmful Event

1 1

Of The Sequence Of Events – Which One Is The First Harmful Event (1-4)

Most Harmful Event

1 1

Of The Sequence Of Events – Which One Is The Most Harmful Event (1-4)

Speed Detected

1 1

1 Stated
2 Estimated Speed

Speed

0
50

Posted Speed

65 65

Traffic Control

12 12

01 No Controls
02 Stop Sign
03 Yield Sign
04 Traffic Signal
05 Traffic Flashers
06 School Zone
07 Railroad Crossbucks
08 Railroad Flashers
09 Railroad Gates
10 Construction Barricade
11 Police Officer
12 Pavement Markings
13 Crosswalk Lines
14 Walk/Don't Walk Signal
15 Traffic Control Device Inoperative, Missing, Obscured
16 Other

Direction

2 1 2 1

1 North
2 South
3 East
4 West
5 Northeast
6 Northwest
7 Southeast
8 Southwest
9 Unknown

Condition

1 1

1 Apparently Normal
2 Physical Impairment
3 Emotional
4 Illness
5 Fell Asleep, Fainted, Fatigued, Etc
6 Under The Influence Of Medications/Drugs/Alcohol
7 Other
8 Unknown

Alcohol/Drug Suspected

1 1

1 None
2 Yes – Alcohol Suspected
3 Yes – HBD Not Impaired
4 Yes – Drugs Suspected
5 Yes – Alcohol / Drugs Suspected
6 Unknown

Alcohol Test Status

1 1

1 None
2 Test Refused
3 Test Given, Contaminated Sample/Unusable
4 Test Given, Results Known
5 Test Given, Results Unknown
6 Unknown

Alcohol Test Type

1 1

1 None
2 Blood
3 Urine
4 Breath
5 Other

Alcohol Test Result

Drug Test Status

1 1

1 None
2 Test Refused
3 Test Given, Contaminated Sample/Unusable
4 Test Given, Results Known
5 Test Given, Results Unknown
6 Unknown

Drug Test Type

1 1

1 None
2 Blood
3 Urine
4 Other

Drug Test 1&2 Result

1 1

1 None
2 Marijuana
3 Cocaine
4 Opiates
5 Amphetamines
6 PCP
7 Other
8 Unknown At Time Of Reporting

Type of Intersection

01

01 Not An Intersection
02 Four-Way Intersection
03 T-Intersection
04 Y-Intersection
05 Traffic Circle/Roundabout
06 Five-Point, Or More
07 On Ramp
08 Off Ramp
09 Crossover
10 Driveway/Access
11 Railway Grade Crossing
12 Shared-Use Paths Or Trails
13 Unknown

Occurrence

1

1 On Roadway
2 On Shoulder
3 In Median
4 On Roadside
5 On Gore
6 Outside Trafficway
7 Unknown

Road Contour

1

1 Straight Level
2 Straight Grade
3 Curve Level
4 Curve Grade

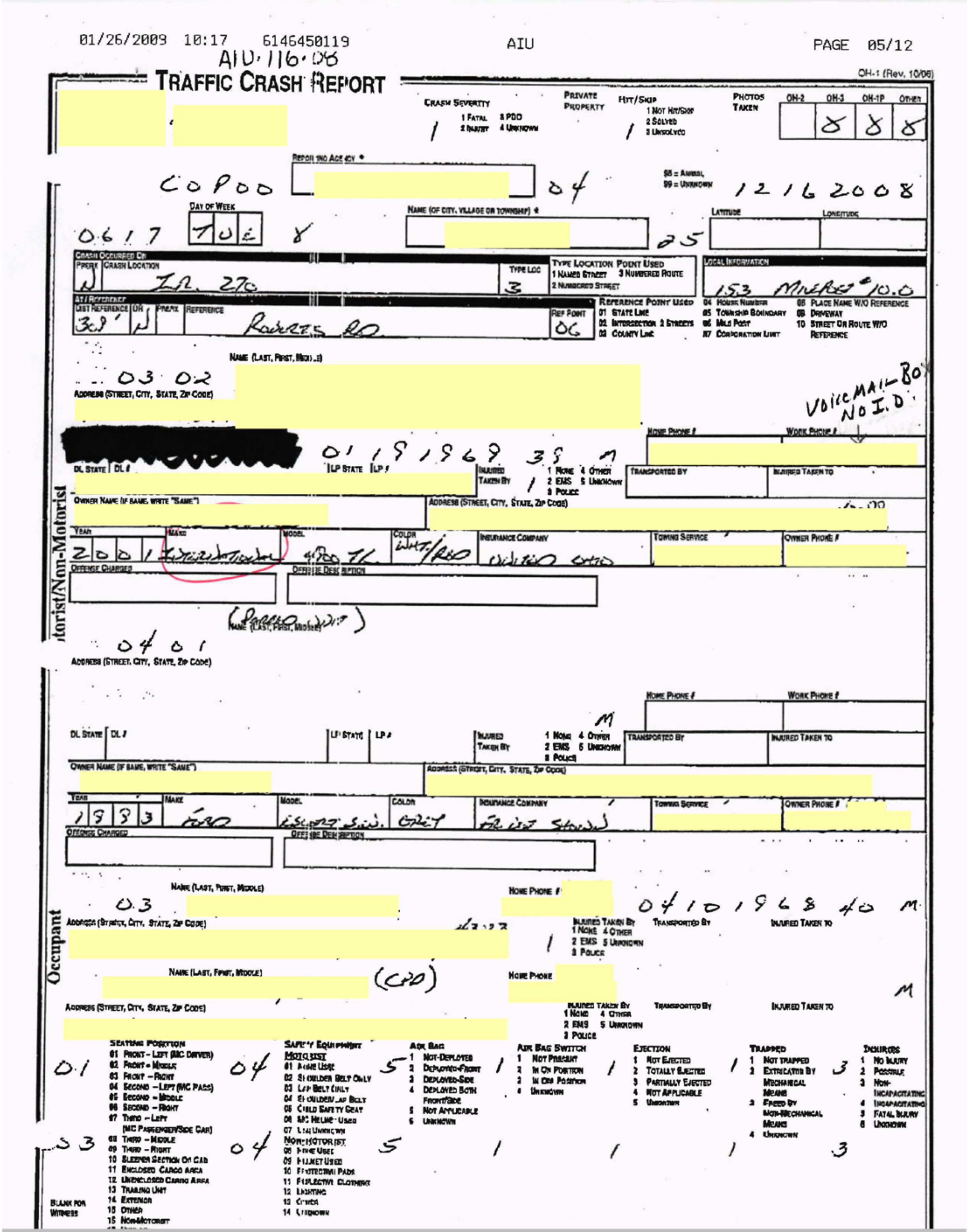
Road Conditions

01

01 Dry
02 Wet
03 Snow
04 Ice
05 Sand, Mud, Dirt, Oil, Gravel
06 Water (Standing, Moving)
07 Slush
08 Debris**
09 Rut, Holes, Bumps, Uneven Pavement **
10 Other
11 Unknown
**Secondary Road Conditions ONLY

Top Copy - ODPS Bottom Copy - Agency

Figure B-1. Example PAR - Illegible with Missing Diagram (continued)



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AIU·116·08

TRAFFIC CRASH REPORT

OH-1 (Rev. 10/06)

[redacted] , [redacted]

Crash Severity 1 Fatal 3 PDO 2 Injury 4 Unknown — 1

Private Property

Hit/Skip 1 Not Hit/Skip 2 Solved 3 Unsolved — 1

Photos Taken: OH-2 ☐ OH-3 8 OH-1P 8 Other 8

Reporting Agency: CoPoo [redacted] 04

98 = Animal, 99 = Unknown — 12 16 2008

Day of Week: 0617 TUE 8

Name (of City, Village or Township): [redacted] 25

Latitude

Longitude

Crash Occurred On — Prefix: W Crash Location: IR. 270 Type Loc: 3

Type Location Point Used: 1 Named Street 2 Numbered Street 3 Numbered Route

Local Information: 153 Milepost #10.0

At / Reference — Dist Reference: 30' Dir: W Prefix Reference: Roberts Rd Ref Point: 06

Reference Point Used: 01 State Line 02 Intersection 2 Streets 03 County Line 04 House Number 05 Township Boundary 06 Mile Post 07 Corporation Limit 08 Place Name W/O Reference 09 Driveway 10 Street or Route W/O Reference

03 02 Name (Last, First, Middle): [redacted]

Address (Street, City, State, Zip Code): [redacted]

Voicemail-Box No I.D.

Home Phone #

Work Phone #

[redacted] 01/19/1969 39 M [redacted]

DL State DL # [redacted] LP State LP #

Injured Taken By 1 None 2 EMS 3 Police 4 Other 5 Unknown — 1

Transported By

Injured Taken To

Owner Name (if same, write "SAME") [redacted]

Address (Street, City, State, Zip Code) [redacted]

Year: 2001 Make: Freightliner Model: 4200 7L Color: WHT/RED Insurance Company: United Ohio Towing Service: [redacted] Owner Phone #: [redacted]

Offense Charged

Offense Description

(Parked unit)

04 01 Name (Last, First, Middle)

Address (Street, City, State, Zip Code)

Home Phone #

Work Phone #

M

DL State DL #

LP State LP #

Injured Taken By 1 None 2 EMS 3 Police 4 Other 5 Unknown

Transported By

Injured Taken To

Owner Name (if same, write "SAME") [redacted]

Address (Street, City, State, Zip Code) [redacted]

Year: 1993 Make: Ford Model: Escort S.W. Color: GREY Insurance Company: Erie Ins Towing Service: [redacted] Owner Phone #: [redacted]

Offense Charged

Offense Description

Name (Last, First, Middle): 03 [redacted] Home Phone #: [redacted] 04/10/1968 40 M

Address (Street, City, State, Zip Code): [redacted]

Injured Taken By 1 None 2 EMS 3 Police 4 Other 5 Unknown — 1

Transported By

Injured Taken To

Name (Last, First, Middle): [redacted] (CPD) Home Phone: [redacted] M

Address (Street, City, State, Zip Code): [redacted]

Injured Taken By 1 None 2 EMS 3 Police 4 Other 5 Unknown

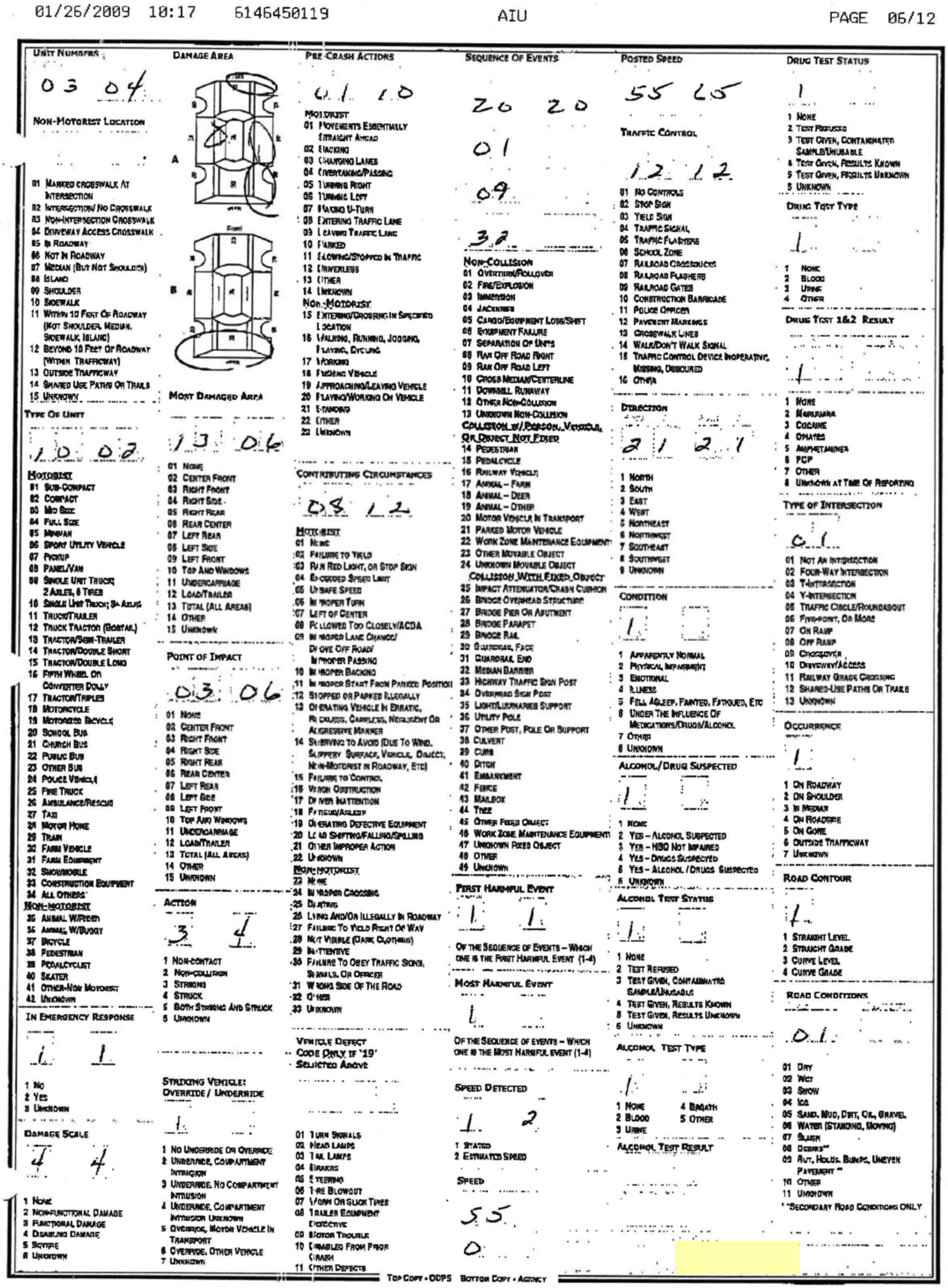
Transported By

Injured Taken To

Seating Position		Safety Equipment		Air Bag		Air Bag Switch		Ejection		Trapped		Injuries
01	01 Front – Left (MC Driver) 02 Front – Middle 03 Front – Right 04 Second – Left (MC Pass) 05 Second – Middle 06 Second – Right 07 Third – Left (MC Passenger/Side Car) 08 Third – Middle 09 Third – Right 10 Sleeper Section On Cab 11 Enclosed Cargo Area 12 Unenclosed Cargo Area 13 Trailing Unit 14 Exterior 15 Other 16 Non-Motorist	04	Motorist 01 None Used 02 Shoulder Belt Only 03 Lap Belt Only 04 Shoulder & Lap Belt 05 Child Safety Seat 06 MC Helmet Used 07 Use Unknown Non-Motorist 08 None Used 09 Helmet Used 10 Protective Pads 11 Reflective Clothing 12 Lighting 13 Other 14 Unknown	5	1 Not-Deployed 2 Deployed-Front 3 Deployed-Side 4 Deployed Both Front/Side 5 Not Applicable 6 Unknown	1	1 Not Present 2 In On Position 3 In Off Position 4 Unknown	1	1 Not Ejected 2 Totally Ejected 3 Partially Ejected 4 Not Applicable 5 Unknown	1	1 Not Trapped 2 Extricated By Mechanical Means 3 Freed By Non-Mechanical Means 4 Unknown	3	1 No Injury 2 Possible 3 Non-Incapacitating 4 Incapacitating 5 Fatal Injury 6 Unknown
03		04		5		1		1		1		3

Blank for Witness

Figure B-1. Example PAR - Illegible with Missing Diagram (continued)



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UNIT NUMBERS

03 04

NON-MOTORIST LOCATION

01 Marked Crosswalk At Intersection
02 Intersection/ No Crosswalk
03 Non-Intersection Crosswalk
04 Driveway Access Crosswalk
05 In Roadway
06 Not In Roadway
07 Median (But Not Shoulder)
08 Island
09 Shoulder
10 Sidewalk
11 Within 10 Feet Of Roadway (Not Shoulder, Median, Sidewalk, Island)
12 Beyond 10 Feet Of Roadway (Within Trafficway)
13 Outside Trafficway
14 Shared Use Paths Or Trails
15 Unknown

TYPE OF UNIT

10 02

MOTORIST

01 Sub-Compact
02 Compact
03 Mid Size
04 Full Size
05 Minivan
06 Sport Utility Vehicle
07 Pickup
08 Panel/Van
09 Single Unit Truck; 2 Axles, 6 Tires
10 Single Unit Truck; 3+ Axles
11 Truck/Trailer
12 Truck Tractor (Bobtail)
13 Tractor/Semi-Trailer
14 Tractor/Double Short
15 Tractor/Double Long
16 Fifth Wheel Or Converter Dolly
17 Tractor/Triples
18 Motorcycle
19 Motorized Bicycle
20 School Bus
21 Church Bus
22 Public Bus
23 Other Bus
24 Police Vehicle
25 Fire Truck
26 Ambulance/Rescue
27 Taxi
28 Motor Home
29 Train
30 Farm Vehicle
31 Farm Equipment
32 Snowmobile
33 Construction Equipment
34 All Others

NON-MOTORIST

35 Animal W/Rider
36 Animal W/Buggy
37 Bicycle
38 Pedestrian
39 Pedalcyclist
40 Skater
41 Other-Non Motorist
42 Unknown

IN EMERGENCY RESPONSE

1 1

1 No
2 Yes
3 Unknown

DAMAGE SCALE

4 4

1 None
2 Non-Functional Damage
3 Functional Damage
4 Disabling Damage
5 Severe
6 Unknown

DAMAGE AREA

A

Front

B

MOST DAMAGED AREA

13 06

01 None
02 Center Front
03 Right Front
04 Right Side
05 Right Rear
06 Rear Center
07 Left Rear
08 Left Side
09 Left Front
10 Top And Windows
11 Undercarriage
12 Load/Trailer
13 Total (All Areas)
14 Other
15 Unknown

POINT OF IMPACT

03 06

01 None
02 Center Front
03 Right Front
04 Right Side
05 Right Rear
06 Rear Center
07 Left Rear
08 Left Side
09 Left Front
10 Top And Windows
11 Undercarriage
12 Load/Trailer
13 Total (All Areas)
14 Other
15 Unknown

ACTION

3 4

1 Non-Contact
2 Non-Collision
3 Striking
4 Struck
5 Both Striking And Struck
6 Unknown

STRIKING VEHICLE: OVERRIDE / UNDERRIDE

1

1 No Underride Or Override
2 Underride, Compartment Intrusion
3 Underride, No Compartment Intrusion
4 Underride, Compartment Intrusion Unknown
5 Override, Motor Vehicle In Transport
6 Override, Other Vehicle
7 Unknown

PRE-CRASH ACTIONS

01 10

MOTORIST

01 Movements Essentially Straight Ahead
02 Backing
03 Changing Lanes
04 Overtaking/Passing
05 Turning Right
06 Turning Left
07 Making U-Turn
08 Entering Traffic Lane
09 Leaving Traffic Lane
10 Parked
11 Slowing/Stopped In Traffic
12 Driverless
13 Other
14 Unknown

NON-MOTORIST

15 Entering/Crossing In Specified Location
16 Walking, Running, Jogging, Playing, Cycling
17 Working
18 Pushing Vehicle
19 Approaching/Leaving Vehicle
20 Playing/Working On Vehicle
21 Standing
22 Other
23 Unknown

CONTRIBUTING CIRCUMSTANCES

08 12

MOTORIST

01 None
02 Failure To Yield
03 Ran Red Light, Or Stop Sign
04 Exceeded Speed Limit
05 Unsafe Speed
06 Improper Turn
07 Left Of Center
08 Followed Too Closely/ACDA
09 Improper Lane Change/ Drove Off Road/ Improper Passing
10 Improper Backing
11 Improper Start From Parked Position
12 Stopped Or Parked Illegally
13 Operating Vehicle In Erratic, Reckless, Careless, Negligent Or Aggressive Manner
14 Swerving To Avoid (Due To Wind, Slippery Surface, Vehicle, Object, Non-Motorist In Roadway, Etc)
15 Failure To Control
16 Vision Obstruction
17 Driver Inattention
18 Fatigued/Asleep
19 Operating Defective Equipment
20 Load Shifting/Falling/Spilling
21 Other Improper Action
22 Unknown

NON-MOTORIST

23 None
24 Improper Crossing
25 Darting
26 Lying And/Or Illegally In Roadway
27 Failure To Yield Right Of Way
28 Not Visible (Dark Clothing)
29 Inattentive
30 Failure To Obey Traffic Signs, Signals, Or Officer
31 Wrong Side Of The Road
32 Other
33 Unknown

VEHICLE DEFECT

Code Only If '19' Selected Above

01 Turn Signals
02 Head Lamps
03 Tail Lamps
04 Brakes
05 Steering
06 Tire Blowout
07 Worn Or Slick Tires
08 Trailer Equipment Defective
09 Motor Trouble
10 Disabled From Prior Crash
11 Other Defects

SEQUENCE OF EVENTS

20 20

01

09

32

NON-COLLISION

01 Overturn/Rollover
02 Fire/Explosion
03 Immersion
04 Jackknife
05 Cargo/Equipment Loss/Shift
06 Equipment Failure
07 Separation Of Units
08 Ran Off Road Right
09 Ran Off Road Left
10 Cross Median/Centerline
11 Downhill Runaway
12 Other Non-Collision
13 Unknown Non-Collision

COLLISION W/ PERSON, VEHICLE, OR OBJECT NOT FIXED

14 Pedestrian
15 Pedalcycle
16 Railway Vehicle
17 Animal – Farm
18 Animal – Deer
19 Animal – Other
20 Motor Vehicle In Transport
21 Parked Motor Vehicle
22 Work Zone Maintenance Equipment
23 Other Movable Object
24 Unknown Movable Object

COLLISION WITH FIXED OBJECT

25 Impact Attenuator/Crash Cushion
26 Bridge Overhead Structure
27 Bridge Pier Or Abutment
28 Bridge Parapet
29 Bridge Rail
30 Guardrail Face
31 Guardrail End
32 Median Barrier
33 Highway Traffic Sign Post
34 Overhead Sign Post
35 Light/Luminaries Support
36 Utility Pole
37 Other Post, Pole Or Support
38 Culvert
39 Curb
40 Ditch
41 Embankment
42 Fence
43 Mailbox
44 Tree
45 Other Fixed Object
46 Work Zone Maintenance Equipment
47 Unknown Fixed Object
48 Other
49 Unknown

FIRST HARMFUL EVENT

1 1

Of The Sequence Of Events – Which One Is The First Harmful Event (1-4)

MOST HARMFUL EVENT

1

Of The Sequence Of Events – Which One Is The Most Harmful Event (1-4)

SPEED DETECTED

1 2

1 Stated
2 Estimated Speed

SPEED

55

0

POSTED SPEED

55 25

TRAFFIC CONTROL

12 12

01 No Controls
02 Stop Sign
03 Yield Sign
04 Traffic Signal
05 Traffic Flashers
06 School Zone
07 Railroad Crossbucks
08 Railroad Flashers
09 Railroad Gates
10 Construction Barricade
11 Police Officer
12 Pavement Markings
13 Crosswalk Lines
14 Walk/Don't Walk Signal
15 Traffic Control Device Inoperative, Missing, Obscured
16 Other

DIRECTION

2 1 2 1

1 North
2 South
3 East
4 West
5 Northeast
6 Northwest
7 Southeast
8 Southwest
9 Unknown

CONDITION

1

1 Apparently Normal
2 Physical Impairment
3 Emotional
4 Illness
5 Fell Asleep, Fainted, Fatigued, Etc
6 Under The Influence Of Medications/Drugs/Alcohol
7 Other
8 Unknown

ALCOHOL/DRUG SUSPECTED

1

1 None
2 Yes – Alcohol Suspected
3 Yes – HBD Not Impaired
4 Yes – Drugs Suspected
5 Yes – Alcohol / Drugs Suspected
6 Unknown

ALCOHOL TEST STATUS

1

1 None
2 Test Refused
3 Test Given, Contaminated Sample/Unusable
4 Test Given, Results Known
5 Test Given, Results Unknown
6 Unknown

ALCOHOL TEST TYPE

1

1 None
2 Blood
3 Urine
4 Breath
5 Other

ALCOHOL TEST RESULT

DRUG TEST STATUS

1

1 None
2 Test Refused
3 Test Given, Contaminated Sample/Unusable
4 Test Given, Results Known
5 Test Given, Results Unknown
6 Unknown

DRUG TEST TYPE

1

1 None
2 Blood
3 Urine
4 Other

DRUG TEST 1&2 RESULT

1

1 None
2 Marijuana
3 Cocaine
4 Opiates
5 Amphetamines
6 PCP
7 Other
8 Unknown At Time Of Reporting

TYPE OF INTERSECTION

01

01 Not An Intersection
02 Four-Way Intersection
03 T-Intersection
04 Y-Intersection
05 Traffic Circle/Roundabout
06 Five-point, Or More
07 On Ramp
08 Off Ramp
09 Crossover
10 Driveway/Access
11 Railway Grade Crossing
12 Shared-Use Paths Or Trails
13 Unknown

OCCURRENCE

1

1 On Roadway
2 On Shoulder
3 In Median
4 On Roadside
5 On Gore
6 Outside Trafficway
7 Unknown

ROAD CONTOUR

1

1 Straight Level
2 Straight Grade
3 Curve Level
4 Curve Grade

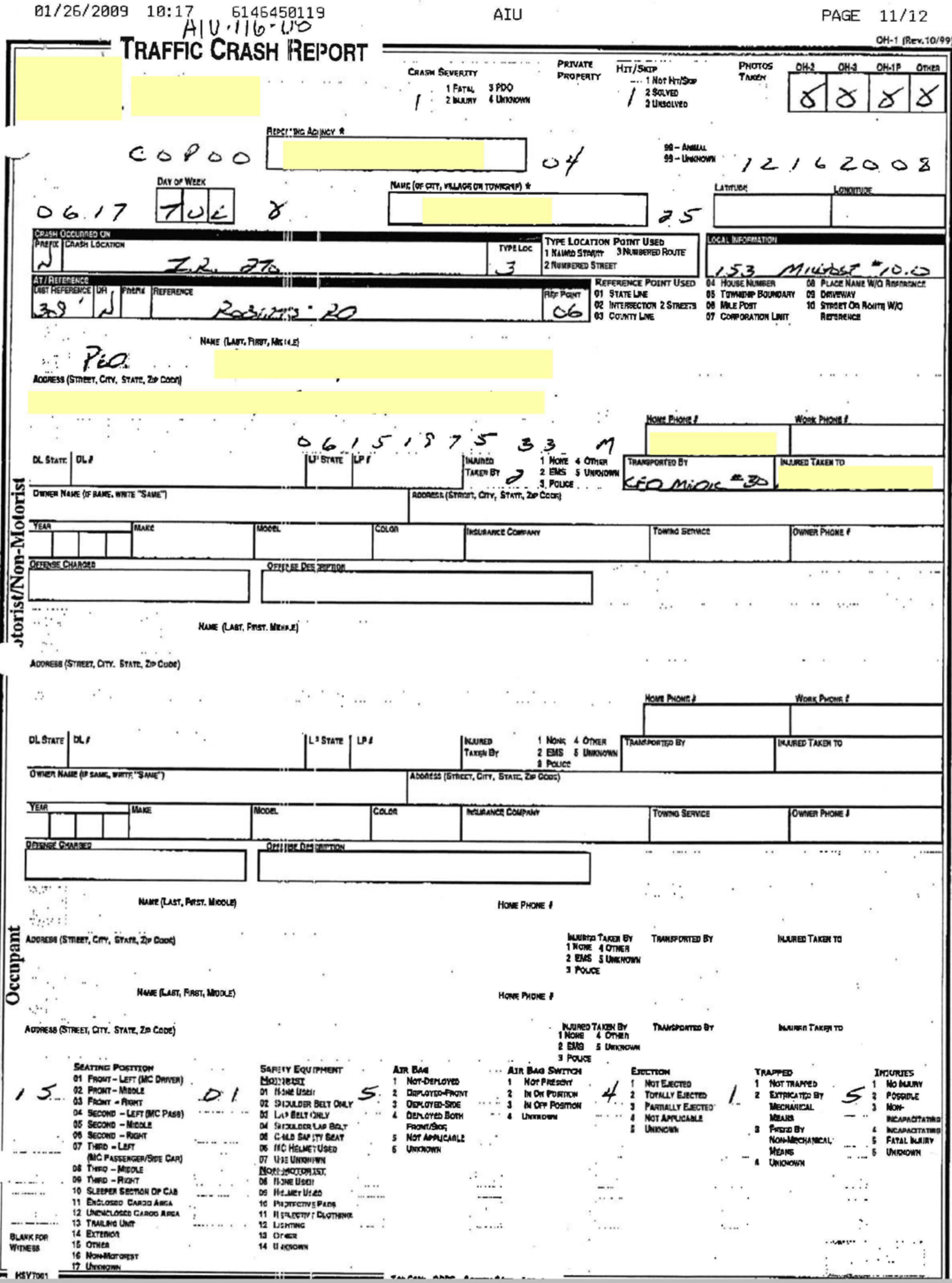
ROAD CONDITIONS

01

01 Dry
02 Wet
03 Snow
04 Ice
05 Sand, Mud, Dirt, Oil, Gravel
06 Water (Standing, Moving)
07 Slush
08 Debris**
09 Rut, Holes, Bumps, Uneven Pavement **
10 Other
11 Unknown
**Secondary Road Conditions ONLY

Top Copy - ODPS Bottom Copy - Agency

Figure B-1. Example PAR - Illegible with Missing Diagram (continued)



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AIU-116-US

OH-1 (Rev.10/99)

TRAFFIC CRASH REPORT

[redacted] [redacted]

Crash Severity: 1 Fatal, 2 Injury, 3 PDO, 4 Unknown — 1

Private Property

Hit/Skip: 1 Not Hit/Skip, 2 Solved, 3 Unsolved — 1

Photos Taken: OH-2 8 | OH-3 8 | OH-1P 8 | Other 8

COPOO

Reporting Agency *: [redacted]

04

98 – Animal
99 – Unknown

12162008

0617

Day of Week: TUE

8

Name (of City, Village or Township) *: [redacted]

25

Latitude:

Longitude:

Crash Occurred On

Prefix: N

Crash Location: I.R. 270

Type Loc: 3

Type Location Point Used: 1 Named Street, 2 Numbered Street, 3 Numbered Route

Local Information: 153 Milepost #10.0

At / Reference

Dist Reference: 39

Dir: N

Prefix:

Reference: Roberts · RD

Ref Point: 06

Reference Point Used:
01 State Line
02 Intersection 2 Streets
03 County Line
04 House Number
05 Township Boundary
06 Mile Post
07 Corporation Limit
08 Place Name W/O Reference
09 Driveway
10 Street Or Route W/O Reference

Motorist/Non-Motorist

PED

Name (Last, First, Middle): [redacted]

Address (Street, City, State, Zip Code): [redacted]

Home Phone #: [redacted]

Work Phone #:

06/15/1975 33 M

DL State:

DL #:

LP State:

LP #:

Injured Taken By: 2 (1 None, 2 EMS, 3 Police, 4 Other, 5 Unknown)

Transported By: CFD Medic #30

Injured Taken To: [redacted]

Owner Name (if same, write "Same"):

Address (Street, City, State, Zip Code):

Year:

Make:

Model:

Color:

Insurance Company:

Towing Service:

Owner Phone #:

Offense Charged:

Offense Description:

Name (Last, First, Middle):

Address (Street, City, State, Zip Code):

Home Phone #:

Work Phone #:

DL State:

DL #:

LP State:

LP #:

Injured Taken By: 1 None, 2 EMS, 3 Police, 4 Other, 5 Unknown

Transported By:

Injured Taken To:

Owner Name (if same, write "Same"):

Address (Street, City, State, Zip Code):

Year:

Make:

Model:

Color:

Insurance Company:

Towing Service:

Owner Phone #:

Offense Charged:

Offense Description:

Occupant

Name (Last, First, Middle):

Home Phone #:

Address (Street, City, State, Zip Code):

Injured Taken By: 1 None, 2 EMS, 3 Police, 4 Other, 5 Unknown

Transported By:

Injured Taken To:

Name (Last, First, Middle):

Home Phone #:

Address (Street, City, State, Zip Code):

Injured Taken By: 1 None, 2 EMS, 3 Police, 4 Other, 5 Unknown

Transported By:

Injured Taken To:

15

Seating Position:
01 Front – Left (MC Driver)
02 Front – Middle
03 Front – Right
04 Second – Left (MC Pass)
05 Second – Middle
06 Second – Right
07 Third – Left (MC Passenger/Side Car)
08 Third – Middle
09 Third – Right
10 Sleeper Section Of Cab
11 Enclosed Cargo Area
12 Unenclosed Cargo Area
13 Trailing Unit
14 Exterior
15 Other
16 Non-Motorist
17 Unknown

Blank for Witness

01

Safety Equipment:
Motorist
01 None Used
02 Shoulder Belt Only
03 Lap Belt Only
04 Shoulder/Lap Belt
05 Child Safety Seat
06 MC Helmet Used
07 Use Unknown
Non-Motorist
08 None Used
09 Helmet Used
10 Protective Pads
11 Reflective Clothing
12 Lighting
13 Other
14 Unknown

5

Air Bag:
1 Not-Deployed
2 Deployed-Front
3 Deployed-Side
4 Deployed Both Front/Side
5 Not Applicable
6 Unknown

Air Bag Switch:
1 Not Present
2 In On Position
3 In Off Position
4 Unknown

4

Ejection:
1 Not Ejected
2 Totally Ejected
3 Partially Ejected
4 Not Applicable
5 Unknown

1

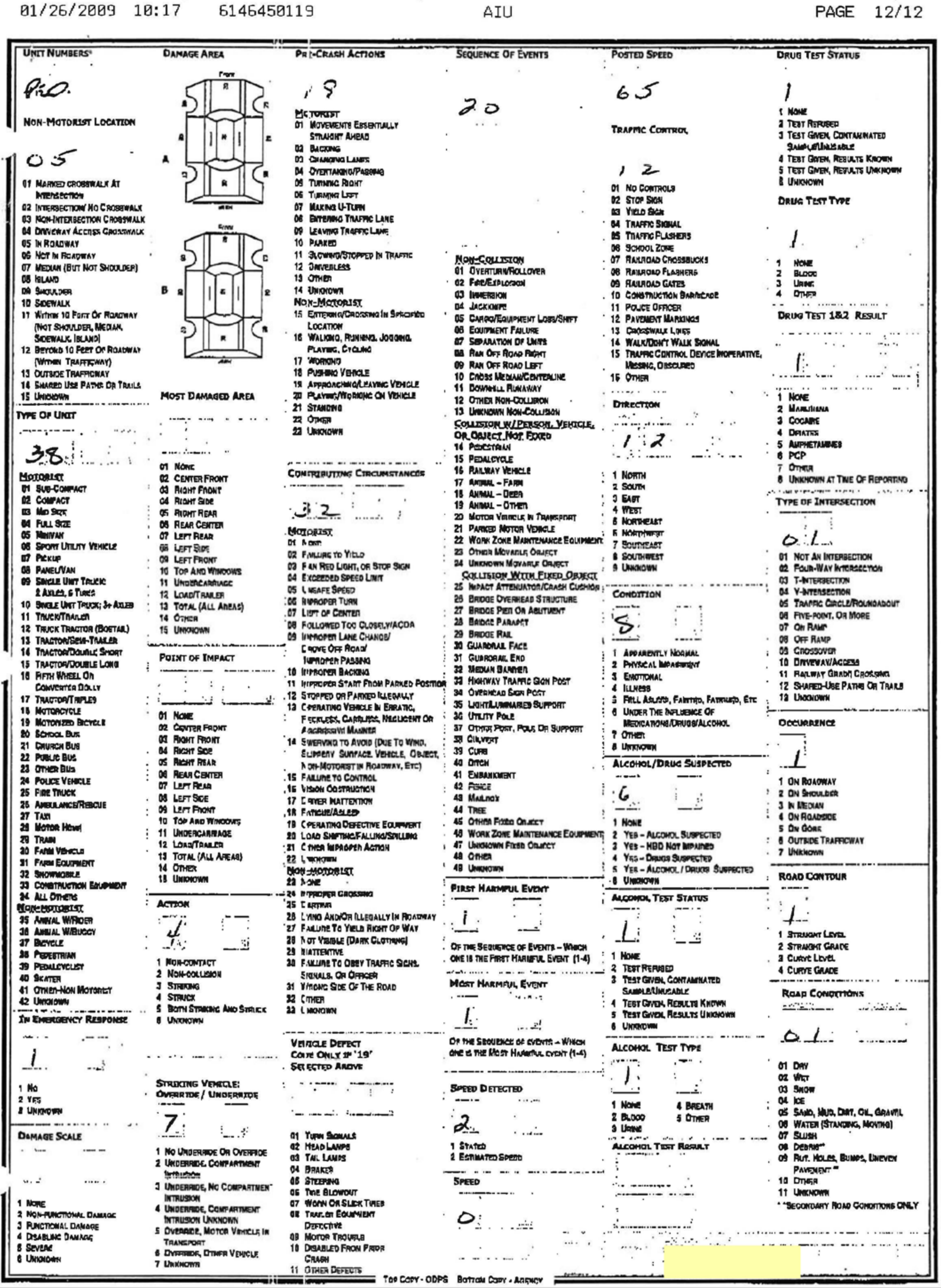
Trapped:
1 Not Trapped
2 Extricated By Mechanical Means
3 Freed By Non-Mechanical Means
4 Unknown

5

Injuries:
1 No Injury
2 Possible
3 Non-Incapacitating
4 Incapacitating
5 Fatal Injury
6 Unknown

HSY7061

Figure B-1. Example PAR - Illegible with Missing Diagram (continued)



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Unit Numbers

P.O.

Non-Motorist Location

05

01 Marked Crosswalk At Intersection
02 Intersection/ No Crosswalk
03 Non-Intersection Crosswalk
04 Driveway Access Crosswalk
05 In Roadway
06 Not In Roadway
07 Median (But Not Shoulder)
08 Island
09 Shoulder
10 Sidewalk
11 Within 10 Feet Of Roadway (Not Shoulder, Median, Sidewalk, Island)
12 Beyond 10 Feet Of Roadway (Within Trafficway)
13 Outside Trafficway
14 Shared Use Paths Or Trails
15 Unknown

Type Of Unit

38

Motorist
01 Sub-Compact
02 Compact
03 Mid Size
04 Full Size
05 Minivan
06 Sport Utility Vehicle
07 Pickup
08 Panel/Van
09 Single Unit Truck 2 Axles, 6 Tires
10 Single Unit Truck; 3+ Axles
11 Truck/Trailer
12 Truck Tractor (Bobtail)
13 Tractor/Semi-Trailer
14 Tractor/Double Short
15 Tractor/Double Long
16 Fifth Wheel On Converter Dolly
17 Tractor/Triples
18 Motorcycle
19 Motorized Bicycle
20 School Bus
21 Church Bus
22 Public Bus
23 Other Bus
24 Police Vehicle
25 Fire Truck
26 Ambulance/Rescue
27 Taxi
28 Motor Home
29 Train
30 Farm Vehicle
31 Farm Equipment
32 Snowmobile
33 Construction Equipment
34 All Others
Non-Motorist
35 Animal W/Rider
36 Animal W/Buggy
37 Bicycle
38 Pedestrian
39 Pedalcyclist
40 Skater
41 Other-Non Motorist
42 Unknown

In Emergency Response

1

1 No
2 Yes
3 Unknown

Damage Scale

1 None
2 Non-Functional Damage
3 Functional Damage
4 Disabling Damage
5 Severe
6 Unknown

Damage Area

Most Damaged Area

01 None
02 Center Front
03 Right Front
04 Right Side
05 Right Rear
06 Rear Center
07 Left Rear
08 Left Side
09 Left Front
10 Top And Windows
11 Undercarriage
12 Load/Trailer
13 Total (All Areas)
14 Other
15 Unknown

Point Of Impact

01 None
02 Center Front
03 Right Front
04 Right Side
05 Right Rear
06 Rear Center
07 Left Rear
08 Left Side
09 Left Front
10 Top And Windows
11 Undercarriage
12 Load/Trailer
13 Total (All Areas)
14 Other
15 Unknown

Action

4

1 Non-Contact
2 Non-Collision
3 Striking
4 Struck
5 Both Striking And Struck
6 Unknown

Striking Vehicle: Override / Underride

7

1 No Underride Or Override
2 Underride, Compartment Intrusion
3 Underride, No Compartment Intrusion
4 Underride, Compartment Intrusion Unknown
5 Override, Motor Vehicle In Transport
6 Override, Other Vehicle
7 Unknown

Pre-Crash Actions

19

Motorist
01 Movements Essentially Straight Ahead
02 Backing
03 Changing Lanes
04 Overtaking/Passing
05 Turning Right
06 Turning Left
07 Making U-Turn
08 Entering Traffic Lane
09 Leaving Traffic Lane
10 Parked
11 Slowing/Stopped In Traffic
12 Driverless
13 Other
14 Unknown
Non-Motorist
15 Entering/Crossing In Specified Location
16 Walking, Running, Jogging, Playing, Cycling
17 Working
18 Pushing Vehicle
19 Approaching/Leaving Vehicle
20 Playing/Working On Vehicle
21 Standing
22 Other
23 Unknown

Contributing Circumstances

32

Motorist
01 None
02 Failure to Yield
03 Ran Red Light, or Stop Sign
04 Exceeded Speed Limit
05 Unsafe Speed
06 Improper Turn
07 Left of Center
08 Followed Too Closely/ACDA
09 Improper Lane Change/ Drove Off Road/ Improper Passing
10 Improper Backing
11 Improper Start From Parked Position
12 Stopped or Parked Illegally
13 Operating Vehicle In Erratic, Reckless, Careless, Negligent Or Aggressive Manner
14 Swerving to Avoid (Due To Wind, Slippery Surface, Vehicle, Object, Non-Motorist In Roadway, Etc)
15 Failure to Control
16 Vision Obstruction
17 Driver Inattention
18 Fatigue/Asleep
19 Operating Defective Equipment
20 Load Shifting/Falling/Spilling
21 Other Improper Action
22 Unknown
Non-Motorist
23 None
24 Improper Crossing
25 Darting
26 Lying And/Or Illegally In Roadway
27 Failure To Yield Right Of Way
28 Not Visible (Dark Clothing)
29 Inattentive
30 Failure To Obey Traffic Signs, Signals, Or Officer
31 Wrong Side Of The Road
32 Other
33 Unknown

Vehicle Defect

Code Only If '19' Selected Above

01 Turn Signals
02 Head Lamps
03 Tail Lamps
04 Brakes
05 Steering
06 Tire Blowout
07 Worn Or Slick Tires
08 Trailer Equipment Defective
09 Motor Trouble
10 Disabled From Prior Crash
11 Other Defects

Sequence Of Events

20

Non-Collision
01 Overturn/Rollover
02 Fire/Explosion
03 Immersion
04 Jackknife
05 Cargo/Equipment Loss/Shift
06 Equipment Failure
07 Separation Of Units
08 Ran Off Road Right
09 Ran Off Road Left
10 Cross Median/Centerline
11 Downhill Runaway
12 Other Non-Collision
13 Unknown Non-Collision
Collision W/ Person, Vehicle, Or Object Not Fixed
14 Pedestrian
15 Pedalcycle
16 Railway Vehicle
17 Animal – Farm
18 Animal – Deer
19 Animal – Other
20 Motor Vehicle In Transport
21 Parked Motor Vehicle
22 Work Zone Maintenance Equipment
23 Other Movable Object
24 Unknown Movable Object
Collision With Fixed Object
25 Impact Attenuator/Crash Cushion
26 Bridge Overhead Structure
27 Bridge Pier Or Abutment
28 Bridge Parapet
29 Bridge Rail
30 Guardrail Face
31 Guardrail End
32 Median Barrier
33 Highway Traffic Sign Post
34 Overhead Sign Post
35 Light/Luminaries Support
36 Utility Pole
37 Other Post, Pole Or Support
38 Culvert
39 Curb
40 Ditch
41 Embankment
42 Fence
43 Mailbox
44 Tree
45 Other Fixed Object
46 Work Zone Maintenance Equipment
47 Unknown Fixed Object
48 Other
49 Unknown

First Harmful Event

1

Of The Sequence Of Events – Which One Is The First Harmful Event (1-4)

Most Harmful Event

1

Of The Sequence of Events – Which One Is The Most Harmful Event (1-4)

Speed Detected

2

1 Stated
2 Estimated Speed

Speed

0

Posted Speed

65

Traffic Control

12

01 No Controls
02 Stop Sign
03 Yield Sign
04 Traffic Signal
05 Traffic Flashers
06 School Zone
07 Railroad Crossbucks
08 Railroad Flashers
09 Railroad Gates
10 Construction Barricade
11 Police Officer
12 Pavement Markings
13 Crosswalk Lines
14 Walk/Don't Walk Signal
15 Traffic Control Device Inoperative, Missing, Obscured
16 Other

Direction

1 2

1 North
2 South
3 East
4 West
5 Northeast
6 Northwest
7 Southeast
8 Southwest
9 Unknown

Condition

8

1 Apparently Normal
2 Physical Impairment
3 Emotional
4 Illness
5 Fell Asleep, Fainted, Fatigued, Etc
6 Under The Influence Of Medications/Drugs/Alcohol
7 Other
8 Unknown

Alcohol/Drug Suspected

6

1 None
2 Yes – Alcohol Suspected
3 Yes – HBD Not Impaired
4 Yes – Drugs Suspected
5 Yes – Alcohol / Drugs Suspected
6 Unknown

Alcohol Test Status

1

1 None
2 Test Refused
3 Test Given, Contaminated Sample/Unusable
4 Test Given, Results Known
5 Test Given, Results Unknown
6 Unknown

Alcohol Test Type

1

1 None
2 Blood
3 Urine
4 Breath
5 Other

Alcohol Test Result

Drug Test Status

1

1 None
2 Test Refused
3 Test Given, Contaminated Sample/Unusable
4 Test Given, Results Known
5 Test Given, Results Unknown
6 Unknown

Drug Test Type

1

1 None
2 Blood
3 Urine
4 Other

Drug Test 1&2 Result

1

1 None
2 Marijuana
3 Cocaine
4 Opiates
5 Amphetamines
6 PCP
7 Other
8 Unknown At Time Of Reporting

Type Of Intersection

01

01 Not An Intersection
02 Four-Way Intersection
03 T-Intersection
04 Y-Intersection
05 Traffic Circle/Roundabout
06 Five-point, Or More
07 On Ramp
08 Off Ramp
09 Crossover
10 Driveway/Access
11 Railway Grade Crossing
12 Shared-Use Paths Or Trails
13 Unknown

Occurrence

1

1 On Roadway
2 On Shoulder
3 In Median
4 On Roadside
5 On Gore
6 Outside Trafficway
7 Unknown

Road Contour

1

1 Straight Level
2 Straight Grade
3 Curve Level
4 Curve Grade

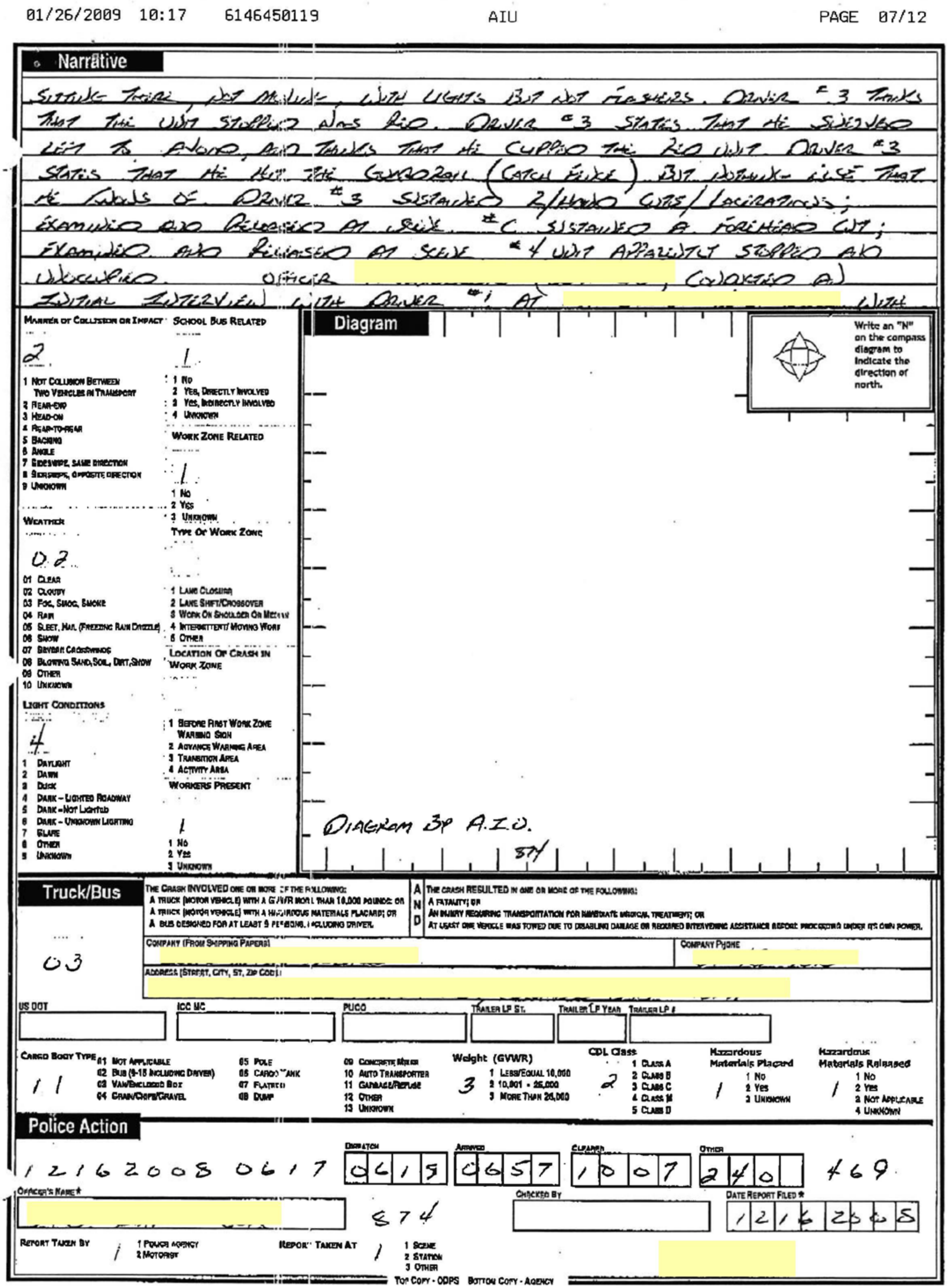
Road Conditions

01

01 Dry
02 Wet
03 Snow
04 Ice
05 Sand, Mud, Dirt, Oil, Gravel
06 Water (Standing, Moving)
07 Slush
08 Debris**
09 Rut, Holes, Bumps, Uneven Pavement **
10 Other
11 Unknown
**Secondary Road Conditions Only

Top Copy - ODPS Bottom Copy - Agency

Figure B-1. Example PAR - Illegible with Missing Diagram (continued)



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Narrative

SITTING THERE, NOT MOVING, WITH LIGHTS BUT NOT FLASHERS. DRIVER #3 THINKS THAT THE UNIT STOPPED WAS RED. DRIVER #3 STATES THAT HE SWERVED LEFT TO AVOID, AND THINKS THAT HE CLIPPED THE RED UNIT. DRIVER #3 STATES THAT HE HIT THE GUARDRAIL (CATCH FENCE) BUT NOTHING ELSE THAT HE KNOWS OF. DRIVER #3 SUSTAINED 2/HAND CUTS/LACERATIONS; EXAMINED AND RELEASED AT SCENE. #C SUSTAINED A FOREHEAD CUT; EXAMINED AND RELEASED AT SCENE #4 UNIT APPARENTLY STOPPED AND UNOCCUPIED. OFFICER [redacted], CONDUCTED AN INITIAL INTERVIEW WITH DRIVER #1 AT [redacted] WITH

Manner of Collision or Impact: 2
1 Not Collision Between Two Vehicles in Transport
2 Rear-End
3 Head-On
4 Rear-to-Rear
5 Backing
6 Angle
7 Sideswipe, Same Direction
8 Sideswipe, Opposite Direction
9 Unknown

Weather: 02
01 Clear
02 Cloudy
03 Fog, Smog, Smoke
04 Rain
05 Sleet, Hail (Freezing Rain Drizzle)
06 Snow
07 Severe Crosswinds
08 Blowing Sand, Soil, Dirt, Snow
09 Other
10 Unknown

Light Conditions: 4
1 Daylight
2 Dawn
3 Dusk
4 Dark – Lighted Roadway
5 Dark – Not Lighted
6 Dark – Unknown Lighting
7 Glare
8 Other
9 Unknown

School Bus Related: 1
1 No
2 Yes, Directly Involved
3 Yes, Indirectly Involved
4 Unknown

Work Zone Related: 1
1 No
2 Yes
3 Unknown

Type of Work Zone
1 Lane Closure
2 Lane Shift/Crossover
3 Work On Shoulder Or Median
4 Intermittent/ Moving Work
5 Other

Location of Crash in Work Zone
1 Before First Work Zone Warning Sign
2 Advance Warning Area
3 Transition Area
4 Activity Area

Workers Present: 1
1 No
2 Yes
3 Unknown

Diagram

Write an "N" on the compass diagram to indicate the direction of north.

DIAGRAM BY A.I.O.
574

Truck/Bus 03

The crash INVOLVED one or more of the following:
A truck (motor vehicle) with a GVWR more than 10,000 pounds; or
A truck (motor vehicle) with a hazardous materials placard; or
A bus designed for at least 9 persons, including driver.

AND

The crash RESULTED in one or more of the following:
A fatality; or
An injury requiring transportation for immediate medical treatment; or
At least one vehicle was towed due to disabling damage or required intervening assistance before proceeding under its own power.

Company (From Shipping Papers): [redacted]
Company Phone: [redacted]
Address (Street, City, St, Zip Code): [redacted]
US DOT:
ICC MC:
PUCO:
Trailer LP St.:
Trailer LP Year:
Trailer LP #:

Cargo Body Type: 11
01 Not Applicable
02 Bus (9-15 Including Driver)
03 Van/Enclosed Box
04 Grain/Chips/Gravel
05 Pole
06 Cargo Tank
07 Flatbed
08 Dump
09 Concrete Mixer
10 Auto Transporter
11 Garbage/Refuse
12 Other
13 Unknown

Weight (GVWR): 3
1 Less/Equal 10,000
2 10,001 - 26,000
3 More Than 26,000

CDL Class: 2
1 Class A
2 Class B
3 Class C
4 Class M
5 Class D

Hazardous Materials Placard: 1
1 No
2 Yes
3 Unknown

Hazardous Materials Released: 1
1 No
2 Yes
3 Not Applicable
4 Unknown

Police Action

12162008 0617
Dispatch: 0615
Arrived: 0657
Cleared: 1007
Other: 240
469

Officer's Name*: [redacted]
574
Checked By:
Date Report Filed*: 12162008

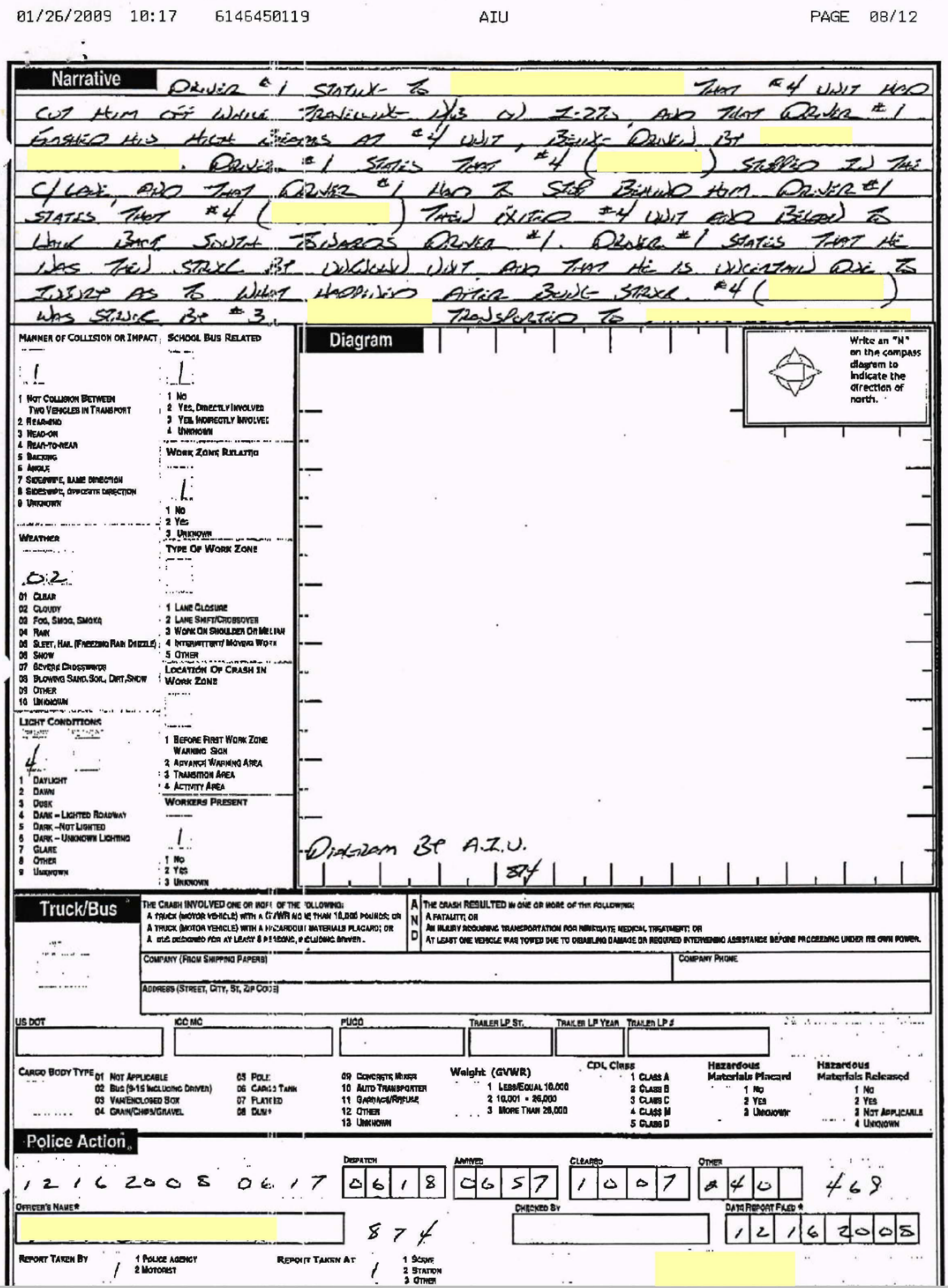
Report Taken By: 1
1 Police Agency
2 Motorist

Report Taken At: 1
1 Scene
2 Station
3 Other

[redacted]

Top Copy - ODPS Bottom Copy - Agency

Figure B-1. Example PAR - Illegible with Missing Diagram (continued)



01/26/2009 10:17 6146450119 AIU PAGE 08/12

Narrative DRIVER #1 STATED TO [redacted] THAT #4 UNIT HAD CUT HIM OFF WHILE TRAVELING N/B ON I-270, AND THAT DRIVER #1 FLASHED HIS HIGH BEAMS AT #4 UNIT, BEING DRIVEN BY [redacted] [redacted]. DRIVER #1 STATES THAT #4 ([redacted]) STOPPED IN THE C/LANE, AND THAT DRIVER #1 HAD TO STOP BEHIND HIM. DRIVER #1 STATES THAT #4 ([redacted]) THEN EXITED #4 UNIT AND BEGAN TO WALK BACK SOUTH TOWARDS DRIVER #1. DRIVER #1 STATES THAT HE WAS THEN STRUCK BY UNKNOWN UNIT AND THAT HE IS UNCERTAIN DUE TO INJURY AS TO WHAT HAPPENED AFTER BEING STRUCK. #4 ([redacted]) WAS STRUCK BY #3. [redacted] TRANSPORTED TO [redacted]

MANNER OF COLLISION OR IMPACT 1

1 NOT COLLISION BETWEEN TWO VEHICLES IN TRANSPORT
2 REAR-END
3 HEAD-ON
4 REAR-TO-REAR
5 BACKING
6 ANGLE
7 SIDESWIPE, SAME DIRECTION
8 SIDESWIPE, OPPOSITE DIRECTION
9 UNKNOWN

WEATHER 02

01 CLEAR
02 CLOUDY
03 FOG, SMOG, SMOKE
04 RAIN
05 SLEET, HAIL (FREEZING RAIN DRIZZLE)
06 SNOW
07 SEVERE CROSSWINDS
08 BLOWING SAND, SOIL, DIRT, SNOW
09 OTHER
10 UNKNOWN

LIGHT CONDITIONS 4

1 DAYLIGHT
2 DAWN
3 DUSK
4 DARK – LIGHTED ROADWAY
5 DARK – NOT LIGHTED
6 DARK – UNKNOWN LIGHTING
7 GLARE
8 OTHER
9 UNKNOWN

SCHOOL BUS RELATED 1

1 NO
2 YES, DIRECTLY INVOLVED
3 YES, INDIRECTLY INVOLVED
4 UNKNOWN

WORK ZONE RELATED 1

1 NO
2 YES
3 UNKNOWN

TYPE OF WORK ZONE

1 LANE CLOSURE
2 LANE SHIFT/CROSSOVER
3 WORK ON SHOULDER OR MEDIAN
4 INTERMITTENT/MOVING WORK
5 OTHER

LOCATION OF CRASH IN WORK ZONE

1 BEFORE FIRST WORK ZONE WARNING SIGN
2 ADVANCE WARNING AREA
3 TRANSITION AREA
4 ACTIVITY AREA

WORKERS PRESENT 1

1 NO
2 YES
3 UNKNOWN

Diagram

Write an "N" on the compass diagram to indicate the direction of north.

Diagram BY A.I.U. 874

Truck/Bus

THE CRASH INVOLVED ONE OR MORE OF THE FOLLOWING:
A TRUCK (MOTOR VEHICLE) WITH A GVWR MORE THAN 10,000 POUNDS; OR
A TRUCK (MOTOR VEHICLE) WITH A HAZARDOUS MATERIALS PLACARD; OR
A BUS DESIGNED FOR AT LEAST 8 PERSONS, INCLUDING DRIVER.

AND

THE CRASH RESULTED IN ONE OR MORE OF THE FOLLOWING:
A FATALITY; OR
AN INJURY REQUIRING TRANSPORTATION FOR IMMEDIATE MEDICAL TREATMENT; OR
AT LEAST ONE VEHICLE WAS TOWED DUE TO DISABLING DAMAGE OR REQUIRED INTERVENING ASSISTANCE BEFORE PROCEEDING UNDER ITS OWN POWER.

COMPANY (FROM SHIPPING PAPERS)
COMPANY PHONE
ADDRESS (STREET, CITY, ST, ZIP CODE)
US DOT
ICC MC
PUCO
TRAILER LP ST.
TRAILER LP YEAR
TRAILER LP #

CARGO BODY TYPE
01 NOT APPLICABLE
02 BUS (9-15 INCLUDING DRIVER)
03 VAN/ENCLOSED BOX
04 GRAIN/CHIPS/GRAVEL
05 POLE
06 CARGO TANK
07 FLATBED
08 DUMP
09 CONCRETE MIXER
10 AUTO TRANSPORTER
11 GARBAGE/REFUSE
12 OTHER
13 UNKNOWN

Weight (GVWR)
1 LESS/EQUAL 10,000
2 10,001 - 26,000
3 MORE THAN 26,000

CDL Class
1 CLASS A
2 CLASS B
3 CLASS C
4 CLASS M
5 CLASS D

Hazardous Materials Placard
1 NO
2 YES
3 UNKNOWN

Hazardous Materials Released
1 NO
2 YES
3 NOT APPLICABLE
4 UNKNOWN

Police Action

	DISPATCH	ARRIVED	CLEARED	OTHER	
12 16 2008 06 17	0618	0657	1007	840	469

OFFICER'S NAME* [redacted] 874

CHECKED BY

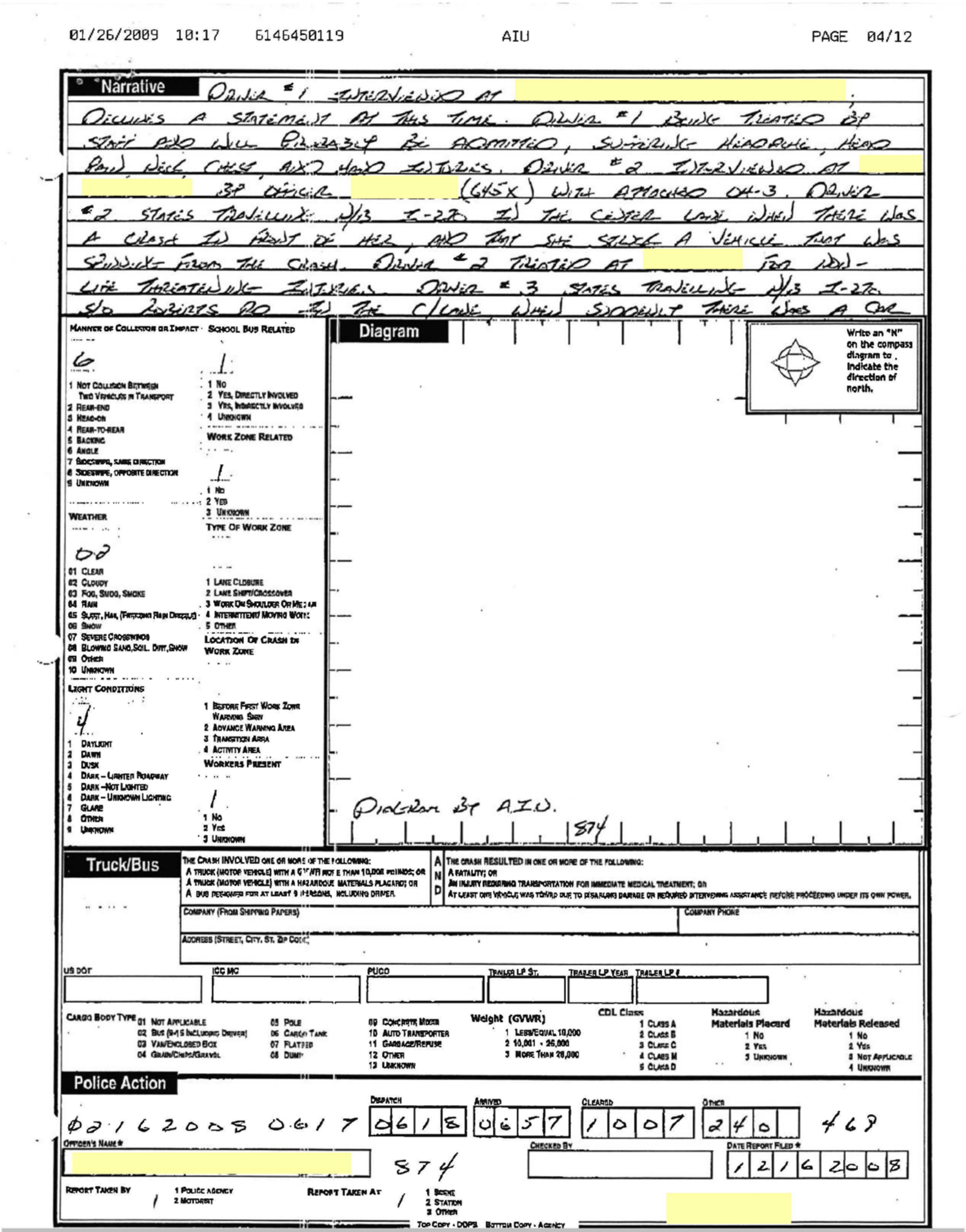
DATE REPORT FILED* 12 16 2008

REPORT TAKEN BY 1 — 1 POLICE AGENCY, 2 MOTORIST

REPORT TAKEN AT 1 — 1 SCENE, 2 STATION, 3 OTHER

[redacted]

Figure B-1. Example PAR - Illegible with Missing Diagram (continued)



01/26/2009 10:17 6146450119 AIU PAGE 04/12

Narrative

DRIVER #1 INTERVIEWED AT [redacted];
DECLINES A STATEMENT AT THIS TIME. DRIVER #1 BEING TREATED BY
STAFF AND WILL PROBABLY BE ADMITTED, SUFFERING HEADACHE, HEAD
PAIN, NECK, CHEST, AND HAND INJURIES. DRIVER #2 INTERVIEWED AT [redacted]
[redacted] BY OFFICER [redacted] (645X) WITH ATTACHED OH-3. DRIVER
#2 STATES TRAVELLING N/B I-270 IN THE CENTER LANE WHEN THERE WAS
A CRASH IN FRONT OF HER, AND THAT SHE STRUCK A VEHICLE THAT WAS
SPINNING FROM THE CRASH. DRIVER #2 TREATED AT [redacted] FOR NON-
LIFE THREATENING INJURIES. DRIVER #3 STATES TRAVELLING N/B I-270
S/O ROBERTS RD IN THE C/LANE WHEN SUDDENLY THERE WAS A CAR

MANNER OF COLLISION OR IMPACT

6

- 1 NOT COLLISION BETWEEN TWO VEHICLES IN TRANSPORT
- 2 REAR-END
- 3 HEAD-ON
- 4 REAR-TO-REAR
- 5 BACKING
- 6 ANGLE
- 7 SIDESWIPE, SAME DIRECTION
- 8 SIDESWIPE, OPPOSITE DIRECTION
- 9 UNKNOWN

WEATHER

02

- 01 CLEAR
- 02 CLOUDY
- 03 FOG, SMOG, SMOKE
- 04 RAIN
- 05 SLEET, HAIL, (FREEZING RAIN DRIZZLE)
- 06 SNOW
- 07 SEVERE CROSSWINDS
- 08 BLOWING SAND, SOIL, DIRT, SNOW
- 09 OTHER
- 10 UNKNOWN

LIGHT CONDITIONS

4

- 1 DAYLIGHT
- 2 DAWN
- 3 DUSK
- 4 DARK – LIGHTED ROADWAY
- 5 DARK – NOT LIGHTED
- 6 DARK – UNKNOWN LIGHTING
- 7 GLARE
- 8 OTHER
- 9 UNKNOWN

SCHOOL BUS RELATED

1

- 1 NO
- 2 YES, DIRECTLY INVOLVED
- 3 YES, INDIRECTLY INVOLVED
- 4 UNKNOWN

WORK ZONE RELATED

1

- 1 NO
- 2 YES
- 3 UNKNOWN

TYPE OF WORK ZONE

- 1 LANE CLOSURE
- 2 LANE SHIFT/CROSSOVER
- 3 WORK ON SHOULDER OR MEDIAN
- 4 INTERMITTENT/ MOVING WORK
- 5 OTHER

LOCATION OF CRASH IN WORK ZONE

- 1 BEFORE FIRST WORK ZONE WARNING SIGN
- 2 ADVANCE WARNING AREA
- 3 TRANSITION AREA
- 4 ACTIVITY AREA

WORKERS PRESENT

1

- 1 NO
- 2 YES
- 3 UNKNOWN

Diagram

Write an "N" on the compass diagram to indicate the direction of north.

DIAGRAM BY A.I.U.

874

Truck/Bus

THE CRASH INVOLVED ONE OR MORE OF THE FOLLOWING:
A TRUCK (MOTOR VEHICLE) WITH A GVWR MORE THAN 10,000 POUNDS; OR
A TRUCK (MOTOR VEHICLE) WITH A HAZARDOUS MATERIALS PLACARD; OR
A BUS DESIGNED FOR AT LEAST 9 PERSONS, INCLUDING DRIVER.

AND

THE CRASH RESULTED IN ONE OR MORE OF THE FOLLOWING:
A FATALITY; OR
AN INJURY REQUIRING TRANSPORTATION FOR IMMEDIATE MEDICAL TREATMENT; OR
AT LEAST ONE VEHICLE WAS TOWED DUE TO DISABLING DAMAGE OR REQUIRED INTERVENING ASSISTANCE BEFORE PROCEEDING UNDER ITS OWN POWER.

COMPANY (FROM SHIPPING PAPERS)

COMPANY PHONE

ADDRESS (STREET, CITY, ST, ZIP CODE)

US DOT

ICC MC

PUCO

TRAILER LP ST.

TRAILER LP YEAR

TRAILER LP #

CARGO BODY TYPE

- 01 NOT APPLICABLE
- 02 BUS (9-15 INCLUDING DRIVER)
- 03 VAN/ENCLOSED BOX
- 04 GRAIN/CHIPS/GRAVEL
- 05 POLE
- 06 CARGO TANK
- 07 FLATBED
- 08 DUMP
- 09 CONCRETE MIXER
- 10 AUTO TRANSPORTER
- 11 GARBAGE/REFUSE
- 12 OTHER
- 13 UNKNOWN

Weight (GVWR)

- 1 LESS/EQUAL 10,000
- 2 10,001 - 26,000
- 3 MORE THAN 26,000

CDL Class

- 1 CLASS A
- 2 CLASS B
- 3 CLASS C
- 4 CLASS M
- 5 CLASS D

Hazardous Materials Placard

- 1 NO
- 2 YES
- 3 UNKNOWN

Hazardous Materials Released

- 1 NO
- 2 YES
- 3 NOT APPLICABLE
- 4 UNKNOWN

Police Action

Ø2162008 0617

DISPATCH	ARRIVED	CLEARED	OTHER
0618	0657	1007	240

468

OFFICER'S NAME * [redacted]

874

CHECKED BY

DATE REPORT FILED * 12/16/2008

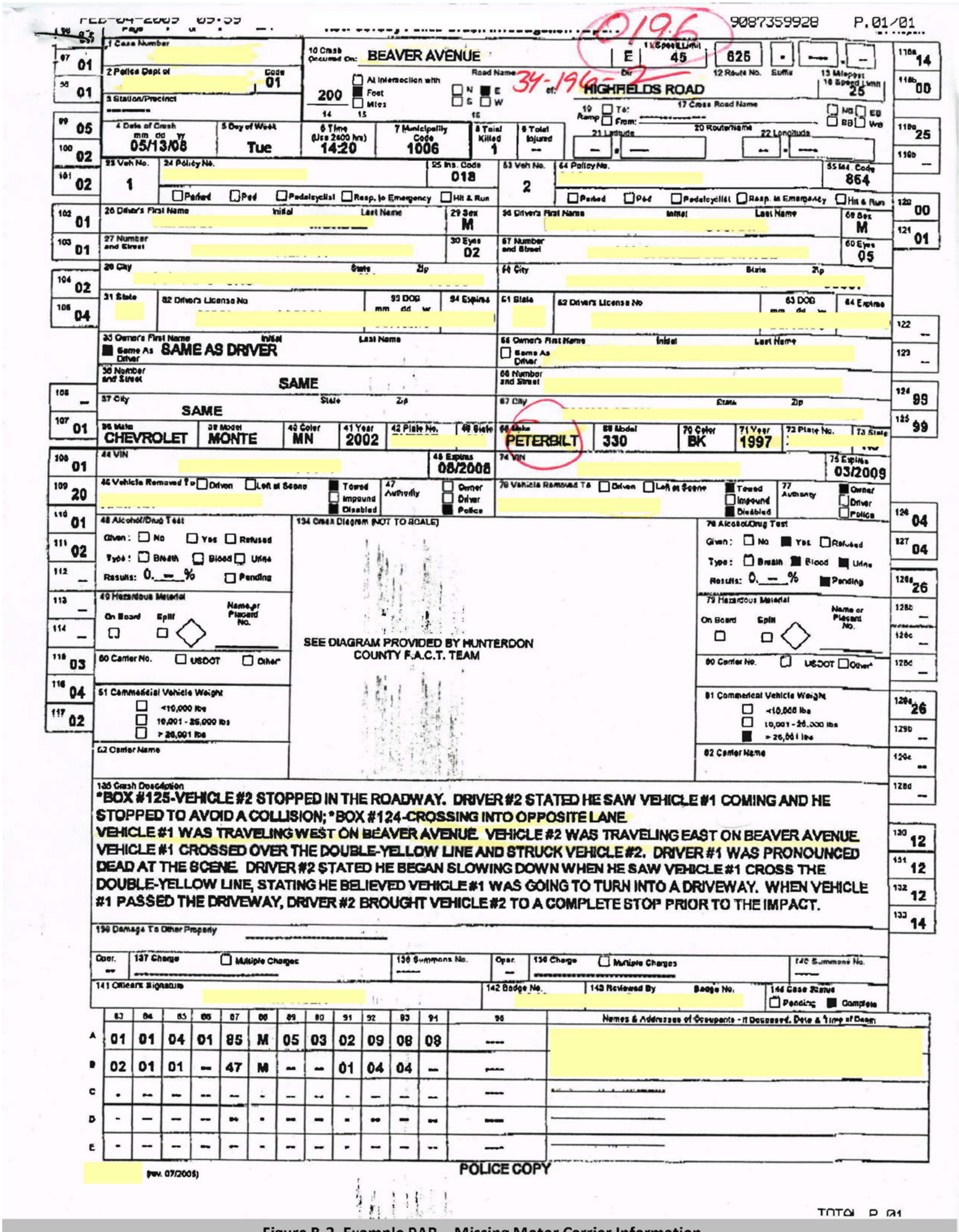
REPORT TAKEN BY 1
- 1 POLICE AGENCY
- 2 MOTORIST

REPORT TAKEN AT 1
- 1 SCENE
- 2 STATION
- 3 OTHER

[redacted]

TOP COPY - DOPS BOTTOM COPY - AGENCY

Figure B-1. Example PAR - Illegible with Missing Diagram (continued)



FEB-04-2009 09:59 9087359928 P.01/01

0196

34-1962-2

97	01
98	01
99	05
100	02
101	02
102	01
103	01
104	02
105	04
106	—
107	01
108	01
109	20
110	01
111	02
112	—
113	—
114	—
115	03
116	04
117	02

1 Case Number [redacted]

2 Police Dept of [redacted] Code 01

3 Station/Precinct ——

4 Date of Crash mm dd yy 05/13/08

5 Day of Week Tue

6 Time (Use 2400 hrs) 14:20

7 Municipality Code 1006

8 Total Killed 1

9 Total Injured —

10 Crash Occurred On: BEAVER AVENUE E 11 Speed Limit 45

12 Route No. 625 Suffix . — . —

13 Milepost

14 200 15 ☐ At intersection with ☒ Feet ☐ Miles 16 ☐ N ☒ E ☐ S ☐ W of: HIGHFIELDS ROAD 18 Speed Limit 25

17 Cross Road Name

19 Ramp ☐ To: ☐ From: ———— ☐ NB ☐ EB ☐ SB ☐ WB

20 Route/Name

21 Latitude — . ——

22 Longitude — . ——

23 Veh No. 1

24 Policy No. [redacted]

25 Ins. Code 018

☐ Parked ☐ Ped ☐ Pedalcyclist ☐ Resp. to Emergency ☐ Hit & Run

26 Driver's First Name Initial Last Name [redacted]

29 Sex M

27 Number and Street [redacted]

30 Eyes 02

28 City State Zip [redacted]

31 State [redacted]

32 Driver's License No [redacted]

33 DOB mm dd yy

34 Expires

35 Owner's First Name Initial Last Name ☒ Same As Driver SAME AS DRIVER

36 Number and Street SAME

37 City State Zip SAME

38 Make CHEVROLET

39 Model MONTE

40 Color MN

41 Year 2002

42 Plate No. [redacted]

43 State

44 VIN [redacted]

45 Expires 08/2008

46 Vehicle Removed To ☐ Driven ☐ Left at Scene ☒ Towed ☐ Impound ☒ Disabled [redacted]

47 Authority ☐ Owner ☐ Driver ☐ Police

48 Alcohol/Drug Test

Given: ☐ No ☐ Yes ☐ Refused

Type: ☐ Breath ☐ Blood ☐ Urine

Results: 0. — % ☐ Pending

49 Hazardous Material

On Board ☐ Spill ☐ Name or Placard No.

50 Carrier No. ☐ USDOT ☐ Other

51 Commercial Vehicle Weight

☐ <10,000 lbs

☐ 10,001 - 26,000 lbs

☐ > 26,001 lbs

52 Carrier Name

53 Veh No. 2

54 Policy No. [redacted]

55 Ins. Code 864

☐ Parked ☐ Ped ☐ Pedalcyclist ☐ Resp. to Emergency ☐ Hit & Run

56 Driver's First Name Initial Last Name [redacted]

59 Sex M

57 Number and Street [redacted]

60 Eyes 05

58 City State Zip [redacted]

61 State [redacted]

62 Driver's License No [redacted]

63 DOB mm dd yy

64 Expires

65 Owner's First Name Initial Last Name [redacted] ☐ Same As Driver

66 Number and Street [redacted]

67 City State Zip [redacted]

68 Make PETERBILT

69 Model 330

70 Color BK

71 Year 1997

72 Plate No. [redacted]

73 State

74 VIN [redacted]

75 Expires 03/2009

76 Vehicle Removed To ☐ Driven ☐ Left at Scene ☒ Towed ☐ Impound ☒ Disabled [redacted]

77 Authority ☒ Owner ☐ Driver ☐ Police

78 Alcohol/Drug Test

Given: ☐ No ☒ Yes ☐ Refused

Type: ☐ Breath ☒ Blood ☒ Urine

Results: 0. — % ☒ Pending

79 Hazardous Material

On Board ☐ Spill ☐ Name or Placard No.

80 Carrier No. ☐ USDOT ☐ Other

81 Commercial Vehicle Weight

☐ <10,000 lbs

☐ 10,001 - 26,000 lbs

☒ > 26,001 lbs

82 Carrier Name

134 Crash Diagram (NOT TO SCALE)

SEE DIAGRAM PROVIDED BY HUNTERDON COUNTY F.A.C.T. TEAM

118a	14
118b	00
119a	25
119b	—
120	00
121	01
122	—
123	—
124	99
125	99
126	04
127	04
128a	26
128b	—
128c	—
128d	—
129a	26
129b	—
129c	—
129d	—
130	12
131	12
132	12
133	14

135 Crash Description

*BOX #125-VEHICLE #2 STOPPED IN THE ROADWAY. DRIVER #2 STATED HE SAW VEHICLE #1 COMING AND HE STOPPED TO AVOID A COLLISION; *BOX #124-CROSSING INTO OPPOSITE LANE

VEHICLE #1 WAS TRAVELING WEST ON BEAVER AVENUE. VEHICLE #2 WAS TRAVELING EAST ON BEAVER AVENUE. VEHICLE #1 CROSSED OVER THE DOUBLE-YELLOW LINE AND STRUCK VEHICLE #2. DRIVER #1 WAS PRONOUNCED DEAD AT THE SCENE. DRIVER #2 STATED HE BEGAN SLOWING DOWN WHEN HE SAW VEHICLE #1 CROSS THE DOUBLE-YELLOW LINE, STATING HE BELIEVED VEHICLE #1 WAS GOING TO TURN INTO A DRIVEWAY. WHEN VEHICLE #1 PASSED THE DRIVEWAY, DRIVER #2 BROUGHT VEHICLE #2 TO A COMPLETE STOP PRIOR TO THE IMPACT.

136 Damage To Other Property

Oper. — 137 Charge ☐ Multiple Charges 138 Summons No. ——

Oper. — 139 Charge ☐ Multiple Charges 140 Summons No. ——

141 Officer's Signature [redacted]

142 Badge No. [redacted]

143 Reviewed By Badge No. [redacted]

144 Case Status ☐ Pending ☒ Complete

	83	84	85	86	87	88	89	90	91	92	93	94	95	Names & Addresses of Occupants - If Deceased, Date & Time of Death
A	01	01	04	01	85	M	05	03	02	09	08	08	----	[redacted]
B	02	01	01	—	47	M	—	—	01	04	04	—	----	
C	-	—	—	—	—	-	—	—	-	—	—	—	----	
D	-	—	—	—	—	-	—	—	-	—	—	—	----	
E	-	—	—	—	—	-	—	—	-	—	—	—	----	

[redacted] (rev. 07/2005)

POLICE COPY

TOTAL P.01

Figure B-2. Example PAR - Missing Motor Carrier Information

APPENDIX C CRASH WEIGHTING BENEFITS: ANALYSIS APPROACH AND RESULTS

This appendix provides additional analysis results and describes the technical details of the analysis approaches used to address the following questions: (1) Would crash weighting offer an even stronger predictor of crash risk than overall crash involvement; and (2) How might crash weighting be implemented in the Federal Motor Carrier Safety Administration's (FMCSA) Safety Measurement System (SMS). These approaches are described below:

- The Wilcoxon-Mann-Whitney statistical test, which compares projected future crashes of carriers and drivers based on how their previous crashes have been weighted.
- A negative binomial regression model, which predicts future crashes of carriers and drivers based on weighting the previous crashes.
- Assessment of the safety benefits of various crash weighting approaches using the SMS Effectiveness Test (ET). (See Section 4 for a summary of this analysis and results.)

AVAILABLE DATA

For all analyses, FMCSA used motor carrier and driver crashes from the calendar year 2009 and 2010 "pre-period" to compare or predict future crashes in 2011 and 2012. The subset of crashes with crash weighting determinations from 2009-2010 included:

- Fatal crashes from 2009 to2010 that Police Accident Report (PAR) reviewers assigned a critical reason. These crashes represented approximately 2 percent of the total crashes in the Motor Carrier Management Information System (MCMIS) and 75 percent of the fatal crashes in the MCMIS.
- Single-vehicle crashes from the MCMIS considered "attributable" to the motor carrier.[68] These crashes represented about 13 percent of the crashes in the MCMIS.

Together, these two groups of crashes accounted for 15 percent of the crashes in the MCMIS. Given the small percentage of total crashes with crash weighting determinations, the Agency performed all analyses both with all crashes and with just those carriers that had fatal crashes in the 2009-2010 pre-period. The fatal crash models were calculated to determine what happens when there are larger percentages of crashes with crash weighting determinations.

The study applied a number of screens to both carriers and drivers to ensure that there were no large changes in data relevant to the analysis and that the carrier or driver continued to operate in the "future crash" period:

---

[68] Single-vehicle crashes are defined when the field "number of vehicles involved in the crash" equaled one in the MCMIS database. This study considered a single-vehicle crash to be attributable to the CMV when the event code description did not indicate a collision with a pedestrian, a motor vehicle in transport, a train or pedalcycle, an animal, work zone maintenance equipment, other/unknown movable object, or "other."

- **Screens for Carrier Data Set:** (1) Must have been under FMCSA jurisdiction in December 2010;[69] (2) must have been domiciled in the United States; (3) must have had a crash in the pre-period (2009 or 2010); (4) must have had a crash or inspection in the post-period (2011 or 2012); (5) must have had positive average Power Units (PUs) in both the pre-and post-periods;[70] (6) average PUs in the pre-period must have been less than twice as much and more than one-half as much as the post-period; and (7) the carrier had a reasonable crash-to-PU ratio in the pre-period.[71]

- **Screens for Driver Data Set:** (1) Must have had a crash in the pre-period (2009 or 2010); (2) must have had five or more inspections in the post-period to ensure that drivers were actively on the road for a significant portion of the post-period (2011 or 2012); (3) must have had a valid driver's license number; and (4) must have had a license from the United States or Canada.

All analysis in this study used crash rates for motor carriers and crash counts for drivers. These rates and counts are defined as follows:

- **Carrier Crash Rate:** Number of crashes the motor carrier has been involved in divided by the carrier's average PUs multiplied by 100 (crashes per 100 PUs).

- **Carrier Adjusted Crash Rate:** A crash rate adjusted for high utilization (high Vehicle Miles Traveled (VMT) per PU). In each carrier segment,[72] the crash rate denominator is increased for carriers with high utilization by multiplying the carriers' average PUs by their Utilization Factor.[73]

- **Driver Crash Count:** Number of crashes the driver has been involved in.

COMPARING FUTURE CRASHES USING CRASH WEIGHTING

Model Selection

The Wilcoxon-Mann-Whitney test is a widely used non-parametric test to determine if there are statistically significant differences between two independent groups. The test was selected because it is a simple, robust test that is very resilient to differences in data, including the characteristics of entities in a group, number of entities within a group, distribution (does not require normal distribution), and data type (only requires ordinal data). These traits are

---

[69] Active interstate or intrastate hazardous materials carriers.

[70] Derived by adding the motor carrier's current PUs, PUs 6 months ago, and PUs 18 months ago, and dividing by 3. Positive average PUs imply that the motor carrier had at least one PU during those three time periods.

[71] "Reasonable" in this case means that either the carrier's average PUs was higher than its crash count for the pre-period, or that the carrier had no more than 50 inspections for the pre-period (indicating that the carrier is small/inactive enough that it's reasonable for them to have more crashes than PUs).

[72] Carrier segment is defined in the SMS Methodology according to the carrier's fleet mix (based on the ratio of straight and combination vehicles). Breaking out these two segments ensures that carriers with fundamentally different types of vehicles and operations are not compared with each other. See the SMS Methodology for more details http://csa.fmcsa.dot.gov/Documents/SMSMethodology.pdf.

[73] See the SMS Methodology for more explanation of the Utilization Factor at http://csa.fmcsa.dot.gov/Documents/SMSMethodology.pdf.

particularly useful for the data set at hand, because crash counts and rates are not normally distributed and the groups of carriers and drivers analyzed are of varying size.

Wilcoxon-Mann-Whitney Technical Details

The Wilcoxon-Mann-Whitney test is conducted by taking two groups of numbers and ranking them all from smallest to largest. The sums of the ranks for each group are compared and a statistical test is performed to see whether the difference is significant[74] or could reasonably be attributed to random variation. The test is calculated as:

Calculate the test statistic U as:

$$U_1 = R_1 - \frac{n_1(n_1 - 1)}{2}$$

Where:

n_1 = the sample size for sample 1

R_1 = the sum of the ranks in sample 1

For large[75] samples, U is approximately normally distributed and the Z-statistic is calculated to determine the p-value.

$$\text{z} = \frac{U - m_U}{\sigma_U}$$

Where:

$$m_U = \frac{n_1 n_2}{2}$$

And:

$$\sigma_U = \sqrt{\frac{n_1 n_2 (n_1 + n_2 + 1)}{12}}$$

For small samples, the U statistic is compared directly against a table of known critical values to get the significant level. All tests were calculated in the statistical software R, which applies corrections for continuity and ties that slightly alter the formula for standard deviation and resulting significance level.

---

[74] "Significance" in this analysis is defined where the p-value is less than or equal to 0.05.

[75] "Large" is generally considered to mean "greater than or equal to 20."

Analysis Approach and Results

Approach

The FMCSA used the Wilcoxon-Mann-Whitney test to compare future crashes of carriers and drivers (crashes per PU for carriers and crash counts for drivers) for four mutually exclusive groups based on how and whether their previous crashes were weighted:

- **Assigned Crashes**: Carriers or drivers with at least one crash in the pre-period assigned to the commercial motor vehicle (CMV) and no “not assigned” crashes. (See below.) “Assigned crashes” include both fatal crashes for which the critical reason was assigned to the CMV and single-vehicle crashes considered to be attributable.

- **Not Assigned Crashes**: Carriers or drivers with at least one crash in the pre-period that was not assigned to the CMV and no “assigned crashes.” “Not assigned crashes” include fatal crashes for which the PAR reviewers did not assign the critical reason to the CMV.

- **Both Assigned and Not Assigned Crashes**: Carriers or drivers with both “assigned crashes” and “not assigned crashes” in the pre-period.

- **Neither Assigned nor Not Assigned Crashes**: Carriers or drivers with no weighted crashes in the pre-period.

Carriers or drivers in these groups may have had any number of crashes without an assignment.

The Agency ran the Wilcoxon-Mann-Whitney test several times to see if the results changed based on driver activity level (as measured by the driver’s number of inspections in 2011-2012), carrier size[76], or carrier segment. This appendix shows the results and significance levels for these analyses.

Analysis Results

Carrier Results – All Crashes (43,465 Carriers)

Table C1 shows the characteristics of the four groups of carriers used in this analysis.

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[76] Size groups are defined by the average number of PUs the carrier has: (1) more than 0 to 5, (2) more than 5 to 15, (3) more than 15 to 50, (4) more than 50 to 500, (5) more than 500.

Table C1. Characteristics of Grouped Carriers Using All Crashes

Carrier Group	**Number of Carriers**	**Number of Future Crashes**	**PUs**	**Average PUs of Group**
Assigned	10,606	37,449	712,627	67.19
Not Assigned	1,033	1,951	37,481	36.28
Both	783	38,693	755,895	965.38
Neither	31,043	30,731	649,744	20.93
Total	**43,465**	**108,824**	**2,155,746**	**49.60**

As shown in this summary table, the “both” group has the fewest carriers (783), and includes much larger carriers. The “neither” group has the most carriers, followed by the “assigned” and “not assigned” groups. These differences are to be expected, since any carrier in the “both” group must have had at least two crash involvements in the pre-period, while carriers in the “assigned,” “not assigned,” and “neither” groups may have had as little as one crash. The Wilcoxon-Mann-Whitney test is designed to accommodate variation in the size (number of carriers in the group) and shape of the distributions under consideration, so all carrier groups were included in the analysis. Although crash and PU totals are provided for each group in the table, the Wilcoxon-Mann-Whitney test does not use these totals, but the individual crash rates of the carriers within the groups.

The Wilcoxon-Mann-Whitney test was run to compare the future crash rates of two of the groups; the group with higher future crash rates was determined by comparing the U statistics. The significance level of the statistic is also provided by the test; differences between groups were deemed significant for p-values less than or equal to 0.05. In the results tables below, the p-value is bolded in cases where the p-value is small enough to indicate significance.

Table C2 describes the Wilcoxon-Mann-Whitney results when the four groups of carriers defined above are compared to one another without breaking out the carrier groups by segment or size.

Table C2. Carrier Model, All Crashes Included (43,465 Carriers)

Carrier Group with Higher Crash Rates	Carrier Group with Lower Crash Rates	Significance Level of the Difference Between the Groups
Both	Assigned	**< 2.2E-16**
Both	Not Assigned	**< 2.2E-16**
Both	Neither	**< 2.2E-16**
Assigned	Not Assigned	**1.65E-06**
Assigned	Neither	**< 2.2E-16**
Not Assigned	Neither	**7.60E-06**

When carriers were stratified by size, again there were fewer significant differences for some groups (described below), but the ordering of groups was generally the same as in the non-stratified analysis:

- **Carriers with more than 0 and up to 5 Average PUs**: The "assigned" group had higher future crash rates than the "not assigned" and "neither" groups.

- **Carriers with more than 5 and up to 15 Average PUs**: The "assigned" group had higher future crash rates than the "neither" group.

- **Carriers with more than 15 and up to 50 Average PUs**: All results were significant and the order of carrier groups remained the same.

- **Carriers with more than 50 and up to 500 Average PUs**: All results were significant and the order of carrier groups remained the same.

- **Carriers with more than 500 Average PUs**: Carriers in the "both" group had higher future crash rates than carriers in the "not assigned" group and the "neither" group, and carriers in the "assigned" group had higher future crash rates than carriers in the "both" and "neither" groups.

When carriers were stratified by segment—straight and combination—the results were very similar to the non-stratified analysis, but there were fewer significant differences for the straight segment:

- **Combination Carriers:** All results were significant and the ordering of carrier groups by future crash rate remained the same.

- **Straight Carriers:** The “both” group had higher future adjusted crash rates than all three other groups, and the “assigned” group had higher adjusted crash rates than the “neither” group, but there were no other significant differences.

Note that when carriers are stratified by segment, crash rates are calculated using adjusted PUs.[77]

When carriers were stratified by both size and segment, there were fewer significant results, likely due to the number of carriers in each group. However, one statistically significant result differed from the non-stratified results: For straight carriers with more than 500 adjusted PUs, the “neither” group had higher future crash rates than the “not assigned” group, with a p-value of 4.87E-8.

Carrier Results – Fatal Crashes (3,071 Carriers)

Table C3 shows the characteristics of the four groups of carriers involved in at least one fatal crash in the pre-period.

Table C3. Characteristics of Grouped Carriers Using Fatal Crashes

Carrier Group	Number of Carriers	Number of Future Crashes	PUs	Average PUs of Group
Assigned*	824	6,433	114,651	139.14
Not Assigned	1,619	14,430	257,548	159.08
Both	187	26,009	533,445	2,852.65
Neither	441	3,997	107,364	243.46
Total	**3,071**	**50,869**	**1,013,008**	**329.86**

*Does not include single-vehicle attributable crashes, because this analysis was restricted to grouping carriers using only the PAR coding method of assignment.

The table shows that, similar to the all-crash model, the “both” group in the fatal crash model has the fewest carriers (187) and includes much larger carriers. The “not assigned” group has the most carriers, followed by the “assigned” and “neither” groups. Because this analysis uses only fatal crashes to determine the carrier groups, the number in the “not assigned” group increases, since carriers in the “both” group moved to this group if their “assigned” crash was an attributable single-vehicle crash (not included in this analysis).

Table C4 describes the Wilcoxon-Mann-Whitney results for the four groups of carriers based on fatal crashes.

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[77] Adjusted PUs = average PUs × Utilization Factor.

Table C4. Carrier Model, Fatal Crashes Only (3,071 Carriers)

Carrier Group with Higher Crash Rates	Carrier Group with Lower Crash Rates	Significance Level of the Difference Between the Groups
Both	Not Assigned	**1.24E-07**
Both	Assigned	**2.03E-07**
Both	Neither	**2.81E-09**
Not Assigned	Assigned	0.79490
Not Assigned	Neither	0.10990
Assigned	Neither	0.20930

For the carrier fatal crash analysis, the carrier groups were restricted to those carriers that had a fatal crash in 2009-2010. The goal was to approximate what the analysis and crash rate results might look like if all PARs were coded. Thus, crashes where PARs were not available were not used for grouping the carriers. When the same stratifications by carrier size and segment, as described above, were applied, the only significant result was that carriers with both assigned and not assigned crashes had higher future crash rates than carriers in the "assigned," "not assigned," and "neither" groups. The lack of any other significant differences likely reflects the small size of the carrier groups resulting from the fatal crash data set.

Driver Results – All Crashes (24,781 Drivers)

The FMCSA performed similar analyses for drivers, by comparing across driver groups the number of crashes in the post-period. Table C5 shows the characteristics of these driver groups.

Table C5. Characteristics of Grouped Drivers Using All Crashes

Driver Group	Number of Drivers	Number of Future Crashes
Assigned	4,158	658
Not Assigned	412	39
Both	7	0
Neither	20,204	2,685
Total	**24,781**	**3,382**

As shown, the “neither” group has the largest number of drivers, followed by the “assigned” and “not assigned” groups. The “both” group has very few drivers.

Table C6 displays results for drivers who had five or more inspections in the post-period. The results were functionally identical[78] when the test was conducted on drivers with varying levels of inspections in the post-period.

Table C6. Driver Model, All Crashes Included (24,781 Drivers)

Driver Group with Higher Crash Counts	Driver Group with Lower Crash Counts	Significance Level of the Difference Between the Groups
Assigned	Both	0.997100
Assigned	Neither	**0.009022**
Assigned	Not Assigned	**0.000001**
Both	Neither	0.933500
Both	Not Assigned	0.605400
Neither	Not Assigned	**0.000029**

The significant results are that the “assigned” group had a higher future crash count than the “not assigned” group or the “neither” group, and that the “not assigned” group had a higher future crash count than the “neither” group. There were no significant differences between the “both” group and any other group of drivers, probably because there were only seven drivers who had both an “assigned” and a “not assigned” crash in the pre-period.

Driver Results – Fatal Crashes (609 Drivers)

Table C7 displays the results for drivers who had a fatal crash and had five or more inspections in the post-period. The “both” group contained no drivers, so it was not used.

Table C7. Driver Model, Fatal Crashes Only (609 Drivers)

Driver Group with Higher Crash Counts	Driver Group with Lower Crash Counts	Significance Level of the Difference Between the Groups
Not Assigned	Neither	0.886400
Not Assigned	Assigned	0.833900
Neither	Assigned	0.959500

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[78] For tests where the result was significant, the ordering of groups was the same as in the analysis shown.

The test derived no statistically significant results for the comparison of future crash count distributions among any driver groups. This is likely due to the small numbers of drivers and future crashes used.

PREDICTING FUTURE CRASHES USING CRASH WEIGHTING

Model Selection

The negative binomial model is a predictive regression model that is commonly used in crash analysis because it has an additional parameter to correct for over-dispersed data.[79] The data for both carriers and drivers for the all crash analysis is over-dispersed, as is the data for the carrier fatal crash analysis; the driver fatal crash data is not over-dispersed, and may have been better examined with a simple Poisson Regression Model. It is unlikely that this would have produced significant results, given the small size of the data set available. The regression model allows the user to predict future crashes or crash rates for an entity based on prior characteristics. In this case, different characteristics of prior crash involvement are used to predict future crash rates for carriers (using average PUs as the exposure factor) and crash counts for drivers.

Negative Binomial Technical Details

The negative binomial model is a specific sub-case of a Poisson Regression Model, with an additional over-dispersion parameter. The counts model assigns the dependent variable a Poisson distribution. In this context, the model calculates the probability of a given number of "successes" as a function of the dependent variables. Successes are defined as future crash rates for this analysis.

The negative binomial distribution is presented below.[80]

$$P(X = r) = {}_{n-1}C_{r-1}\, p^{r} (1-p)^{n-r}$$

Where:

n = Number of events.

r = Number of successful events.

p = Probability of success on a single trial.

$${}_{n-1}C_{r-1} = \{ (n-1)! / [(n-1)-(r-1)]! \} / (r-1)!$$

The negative binomial model results indicate which models are statistically significant with a p-value below .05. Then the models can be compared to each other using the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC). The closer each statistic is to zero, the stronger the model. The AIC and BIC are each calculated via the formula:

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[79] Data is over-dispersed when the variance is larger than the mean, which is a common occurrence with crash data.

[80] Formula source: http://easycalculation.com/statistics/learn-negative-binomial.php.

$-2 * \log(L) + k*p$

Where:

L = Likelihood function.

p = Number of parameters in the model.

k = Penalty coefficient ($k = 2$ under AIC, and $k = \log(n)$ under BIC).

The penalty coefficient prevents the inclusion of weakly predictive variables by providing a net increase in the criterion. The formula $\exp((AIC_i – AIC_j)/2)$ provides the relative likelihood that probability that model j is a better fit than model i. Thus, to achieve a standard significance of .05, a difference in AIC values of at least 6 is desirable to say that one model is better than another: $\exp((-6)/2) = .0498$. This assessment should still be weighed against the possibility of over-fitting, which is why this analysis required the BIC to also show an improved model. A variable that reduces both the AIC and BIC when included is considered a net improvement to the model.

Analysis Approach and Results

Approach

This study used the negative binomial regression model to determine which of four categories of pre-period (calendar years 2009 and 2010) crashes was the best predictor of future crashes. These categories were tested as individual predictors and combinations of predictors for future crash rates.

- **All Crashes**: All reportable crashes.
- **Single-Vehicle Attributable Crashes**: Single-vehicle crashes considered to be attributable to the CMV.
- **Coded Assigned Crashes**: Crashes for which the PAR reviewers assigned a critical reason to the CMV.
- **Not Assigned Crashes**: Crashes reviewed but not assigned to the CMV.

The analysis was performed by taking individual carrier records or driver records and analyzing their future crash rate or crash count, respectively, based on their prior crash rate or count for the above combinations. All analysis was calculated via the STATA 10 statistical package.

Analysis Results

Carrier Results – All Crashes (43,465 Carriers)

Table C8 shows each combination of variables used to predict the carrier’s future crash rate. Each row represents one model, where if a variable is named in a column that variable is included in that model. The next two columns present the AIC and BIC, where the smaller numbers indicate a stronger model. The last column indicates if the model was statistically significant.

Table C8. Carrier Model, All Crashes Included (43,465 Carriers)

Pre Period Crash Rate Variables				Criteria		
All Crash Rate	**Single-Vehicle (SV) Attributable Rate**	**Coded Assigned Crash Rate**	**Not Assigned Crash Rate**	**AIC**	**BIC**	**Statistically Significant**
All Crashes				118,753	118,779	Yes
All Crashes	SV Attributable			118,738	118,773	Yes
All Crashes	SV Attributable	Assigned		118,740	118,783	Yes
All Crashes	SV Attributable	Assigned	Not Assigned	118,733	118,785	Yes
	SV Attributable			120,963	120,989	Yes
		Assigned		121,510	121,536	No
			Not Assigned	121,578	121,604	No

In this carrier model, neither “assigned” nor “not assigned” crash rates were statistically significant predictors of future crash rates. The “single-vehicle attributable” crash rate was a statistically significant predictor, but had moderately higher AIC and BIC values than other significant models, indicating that it was not as strong as other predictors. The combination of all crash data with “single-vehicle attributable” crash data produced a stronger model than only using all crash data. All of the remaining models were comparable predictors of future crash rates, as evidenced by their similar AIC and BIC values.

These analyses were also performed on the combination and straight carrier segments individually. Note that when carriers are stratified by segment, crash rates are calculated using adjusted PUs. The results from each of these tests were comparable to the all-crash model, and are available upon request.

Carrier Results – Fatal Crashes (3,071 Carriers)

Table C9 shows the combination of pre-period fatal crash rates that are used to predict future crash involvement. The study did not include single-vehicle attributable crashes in this analysis.[81]

Table C9. Carrier Model, Fatal Crashes Only (3,071 Carriers)

Pre-Period Crash Rate Variables			Criteria		
Fatal Crash Rate	**Coded Assigned Crash Rate**	**Not Assigned Crash Rate**	**AIC**	**BIC**	**Statistically Significant**
Fatal Crashes			14,716	14,734	Yes
Fatal Crashes	Assigned		14,718	14,742	Yes
Fatal Crashes	Assigned	Not Assigned	14,719	14,749	Yes
	Assigned		14,819	14,837	Yes
		Not Assigned	14,860	14,878	No

The “not assigned” crash rate was the only non-statistically significant variable. This suggests that “not assigned” crashes are not as strong a predictor of future crashes as the other variables. The other combinations of variables are statistically significant, with the “assigned” crashes having the highest AIC/BIC, indicating that it is not as strong as the other models.

Driver Results – All Crashes (40,720 Drivers)

Table C10 presents the types of crashes included as variables in each model, the assessment criteria (AIC/BIC), and statistical significance used to predict drivers’ future crash involvement.

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[81] There are very few cases in which a fatal single-vehicle attributable crash would not have a critical reason coded.

Table C10. Driver Model, All Crashes Included (40,720 Drivers)

Pre-Period Crash Data Variables				Criteria		
All Crash Count	**Single-Vehicle (SV) Attributable Count**	**Coded Assigned Count**	**Not Assigned Count**	**AIC**	**BIC**	**Statistically Significant**
Crashes				31,933	31,958	Yes
Crashes	SV Attributable			31,911	31,946	Yes
Crashes	SV Attributable	Coded Assigned		31,913	31,956	Yes
Crashes			Not Assigned	31,930	31,964	Yes
Crashes	SV Attributable		Not Assigned	31,909	31,953	Yes
	SV Attributable			31,942	31,967	Yes
		Coded Assigned		31,973	31,999	No
			Not Assigned	31,969	31,995	No

Neither “coded assigned” crashes nor “not assigned” crashes were statistically significant predictors of future crashes. The remaining models have similar AIC and BIC values, suggesting that they are comparable predictors of future crashes, though the models that include both “single-vehicle attributable” crashes and total crashes appear to be stronger than models that do not include one of those variables.

Driver Results – Fatal Crashes (977 Drivers)

Table C11 shows the combination of pre-period fatal crashes used to predict a driver’s future crash involvement. The study did not include single-vehicle attributable crashes in this analysis.[82]

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[82] There are very few cases in which a fatal single-vehicle attributable crash would not have a critical reason coded in the FARS.

Table C11. Driver Model, Fatal Crashes Only (977 Drivers)

Pre-Period Crash Data Variables			Criteria		
Fatal Crash Count	**Coded Assigned Count**	**Not Assigned Count**	**AIC**	**BIC**	**Statistically Significant?**
Fatal Crashes			1,171	1,186	No
Fatal Crashes	Coded Assigned		1,149	1,168	No
Fatal Crashes		Not Assigned	1,093	1,112	No
Fatal Crashes	Coded Assigned	Not Assigned	1,030	1,055	No
	Coded Assigned		1,147	1,162	No
		Not Assigned	1,091	1,105	No

No variables from this test were statistically significant predictors, likely due to the small sample of drivers with fatal crashes that met the data screens.

IMPLEMENTING CRASH WEIGHTING IN THE SMS

Model Selection

The SMS ET was developed to evaluate the effectiveness of the SMS, especially with respect to the motor carriers that are being identified as exceeding the Intervention Threshold. Motor carriers that exceed the Intervention Threshold are prioritized by FMCSA to receive interventions. The SMS ET can be applied to all of the Behavior Analysis and Safety Improvement Categories (BASICs), but this analysis focuses on modifying the weights in the Crash Indicator to see if applying different weights for assigned and not assigned crashes produces a more effective SMS. (A summary of the analysis and results are in Section 4.)

SMS ET Technical Details

The SMS ET uses historical data to examine the future adjusted crash rate of the population of motor carriers with a Crash Indicator BASIC above the Intervention Threshold. The test was accomplished by:

1. Defining the ET carrier population. To be included in the ET, carriers must (a) demonstrate some level of activity in both the 24-month SMS time period and the 18-month "post-

identification crash period," as many of the carriers in the MCMIS no longer operate; and (b) provide reasonable exposure data, as carriers often self-report PUs and VMT, which are therefore subject to error. Approximately 278,000 motor carriers pass these screening criteria, and are included in the ET.

Performing a simulated SMS identification run that calculates carrier percentile ranks for each BASIC as of January 2011 using historical data from calendar years 2009 and 2010. This time period was used to allow sufficient time (18 months) for the "post-identification crash period" to calculate future adjusted crash rates, as well as extra time to allow for the time lag in crash reporting.

Observing each carrier's crash involvement over the 18-month period immediately following the simulated SMS timeframe (i.e., the post-identification crash period, January 2011 to June 2012).

Depicting the relationship between the percentile ranks (from 0 to 100) in the Crash Indicator and subsequent post-SMS carrier crash involvement. A timeline of the ET is presented in Figure C1.

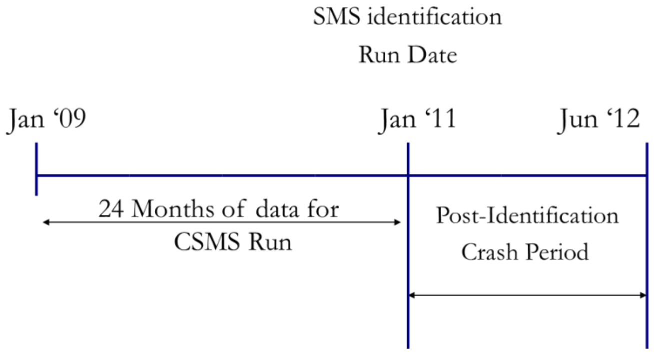

Figure C1. SMS ET Timeline

The SMS ET compares the future adjusted crash rate of those carriers exceeding the Intervention Threshold in the Crash Indicator[83] under various weighting schemes. All weighting schemes are compared to the baseline, which is the current SMS Crash Indicator.[84] (A weighting scheme that would improve the model would identify carriers with higher future adjusted crash rates.)

Analysis Approach and Results

The analysis results presented in this section include those described in Section 4 as well as five additional models.

Table C12 describes the severity weight changes to the current SMS Crash Indicator. The SMS ET results presented in Section 4 of this report are marked with an asterisk (*). Each model or set

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[83] The Intervention Threshold for the Crash Indicator is 65 for general freight carriers, 60 for placardable hazardous materials carriers, and 50 for passenger carriers.

[84] At the time of this study, SMS Methodology Version 3.0. CSMS Methodology Version 3.0: http://csa.fmcsa.dot.gov/Documents/SMSMethodology.pdf.

of models is intended to investigate a question about the predictive strength of “assigned” and “not assigned” crashes. “Assigned crashes” here include single-vehicle attributable crashes as well as coded fatal crashes assigned to the CMV, as in the Wilcoxon-Mann-Whitney comparative analysis.

Table C12. SMS ET Runs with Variety of Severity Weights

Model	**Assigned Crash Weight**	**Not Assigned Crash Weight**	**Model Description**
0*	-	-	Baseline
1*	+3	-0.5	Medium weight for “assigned crashes,” decreased weight for “not assigned crashes”
2	+6	-0.5	High weight for “assigned crashes,” decreased weight for “not assigned crashes”
3	+4	+2	Increased weight for “assigned” and “not assigned crashes”
4	-0.5	-0.5	Decreased weight for “assigned” and “not assigned crashes”
5	+1	Not Included	Remove “not assigned crashes,” do not include severity weight for *fatal/injury and HM spill* crashes
6*	+1	Not Included	Remove “not assigned crashes,” add additional weight for “assigned crashes”
7	+5	Not Included	Remove “not assigned crashes,” add high additional weight for “assigned crashes”

* Included in Section 4 of this report.

Models 1 and 2 were selected to determine the change in adjusted crash rate if “assigned crashes” receive a higher weight, undetermined crashes are weighted in the middle, and “not assigned crashes” have the lowest weight.

Models 3 and 4 test the assumptions that “assigned crashes” should be weighted more heavily than “not assigned crashes.”

Models 5, 6, and 7 explore scenarios where “not assigned crashes” are removed altogether, and then various weights for “assigned crashes” are explored.

Table C13 presents the future adjusted crash rates of carriers (by segment) that are above the Intervention Threshold under each of the tested models. Adjusted crash rates were calculated under two scenarios: An all-crash model that replicates the SMS as currently constructed, and a fatal crash model that only includes fatal crashes. The shaded boxes indicate where the future adjusted crash rate is larger than the baseline.

Table C13. SMS ET Run Results

		Future Crash Rate of Carriers per 100 Adjusted PU above Intervention Threshold			
		All Crash Model		**Fatal Crash Model**	
Model	**Description**	**Straight**	**Combination**	**Straight**	**Combination**
0* (Baseline)	Baseline	2.99	7.02	3.41	6.66
1*	Medium weight for “assigned crashes,” decreased weight for “not assigned crashes”	3.01	6.99	3.40	6.72
2	High weight for “assigned crashes,” decreased weight for “not assigned crashes”	2.99	6.91	3.41	6.64
3	Increased weight for “assigned” and “not assigned crashes”	2.73	7.01	2.71	6.66
4	Decreased weight for “assigned” and “not assigned crashes”	3.04	7.02	3.41	6.66
5	Remove “not assigned crashes,” do not include severity weight for fatal/injury and HM spill crashes	2.83	7.08	3.77	6.74
6*	Remove “not assigned crashes,” add additional weight for “assigned crashes”	2.95	7.01	3.58	6.78
7	Remove “not assigned crashes,” add high additional weight for “assigned crashes”	2.89	6.99	3.64	6.8

*Included in Section 4 of this report.

The all-crash model included approximately 1,500 carriers in the straight segment and 3,000 carriers in the combination segment above the threshold. The fatal crash model included approximately 150 carriers in the straight segment and 300 carriers in the combination segment above the Intervention Threshold.

The all-crash model showed that no combination of crash weights provides a strictly higher adjusted crash rate (for both the straight and combination carrier segments). The small sample size of coded and single-vehicle crashes likely plays a role in these results.

Under the fatal crash model, models 5, 6, and 7 all provide higher future adjusted crash rates than the baseline. This suggests that models incorporating crash weighting may have the potential to increase the effectiveness of the Crash Indicator; however, given the small numbers of carriers and the concentration on fatal crashes, this result is inconclusive.

APPENDIX D CRASH INDICATOR

(From the CSMS Methodology Version 3.0, Revised 2013)

This appendix describes the calculation of carrier measures and percentile ranks for the Crash Indicator, one of the seven Behavior Analysis and Safety Improvement Categories (BASICs) of the Federal Motor Carrier Safety Administration's (FMCSA) Safety Measurement System.[85] The Crash Indicator is defined as:

> Histories or patterns of high crash involvement, including frequency and severity, based on information from State-reported crash reports.

The crash history used by the Crash Indicator is not specifically a behavior; rather, it is the consequence of behavior and may indicate a problem that warrants attention.

The Carrier Safety Measurement System (CSMS) assesses the Crash Indicator using relevant State-reported crash data reported in the Motor Carrier Management Information System (MCMIS). Individual carriers' Crash Indicator measures also incorporate carrier size in terms of Power Units (PU) and annual Vehicle Miles Traveled (VMT). These measures are used to generate percentile ranks that reflect each carrier's safety posture relative to carriers in the same segment with similar numbers of crashes.

CALCULATION OF CRASH INDICATOR MEASURE

The Crash Indicator measure is calculated as the sum of severity and time-weighted crashes divided by carrier average PUs multiplied by a Utilization Factor, as follows:

$$Crash\ Indicator\ Measure = \frac{Total\ of\ time\ and\ severity\ weighted\ applicable\ crashes}{Average\ PUs\ x\ Utilization\ Factor}$$

In this equation, the terms are defined as follows:

Applicable Crash. An applicable crash is a State-reported crash that meets the reportable crash standard during the past 24 months. A reportable crash is one that results in at least one fatality, at least one injury where the injured person is taken to a medical facility for immediate medical attention, or at least one vehicle towed from the scene as a result of disabling damage caused by the crash (i.e., tow-away).

Crash Severity Weight. A crash severity weight places more weight on crashes with more severe consequences. For example, a crash involving an injury or fatality is weighted more heavily than a crash where only a tow-away occurred. A hazardous materials (HM) release also increases the weight of a crash, as shown in Table D1.

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[85] The content of this appendix is taken from the CSMS Methodology Version 3.0: http://csa.fmcsa.dot.gov/Documents/SMSMethodology.pdf.

Table D1. Crash Severity Weights for Crash Indicator

Crash Type	Crash Severity Weight
Involves tow-away but no injury or fatality	1
Involves injury or fatality	2
Involves an HM release	Crash Severity Weight (from above) + 1

Time Weight. A time weight of 1, 2, or 3 is assigned to each applicable crash based on the time elapsed since the crash occurred. This time-weighting places more emphasis on recent crashes relative to older crashes. Crashes that occurred within six months of the measurement date receive a time weight of 3. Crashes that occurred more than six months after and up to 12 months before the measurement date receive a time weight of 2. All crashes that happened later (more than 12 months but within the past 24 months of the measurement date) receive a time weight of 1.

Time- and Severity-Weighted Crash. A time and severity-weighted crash is a crash's severity weight multiplied by its time weight.

Average PUs. PUs are used in part to account for each carrier's level of exposure when calculating the BASIC measure. A carrier's total number of PUs is calculated using the numbers of owned, term-leased, and trip-leased PUs (trucks, tractors, hazardous material tank trucks, motor coaches, and school buses) contained in the MCMIS Census data. The average PUs for each carrier is calculated using (1) the carrier's current total PUs, (2) the total PUs the carrier had six months ago, and (3) the total PUs the carrier had 18 months ago. The average PU calculation is shown below:

$$AveragePU = \frac{PU_{Current} + PU_{6Months} + PU_{18Months}}{3}$$

Utilization Factor. The Utilization Factor is a multiplier that adjusts the average PU values based on the utilization in terms of VMT per average PU where VMT data in the past 24 months are available. The primary sources of VMT information in the Census are: (1) Form MCS-150, filled out by the carrier, and (2) Form MCS-151, filled out by law enforcement as part of an investigation. Carriers are required to update their MCS-150 information biennially. In cases where the VMT data has been obtained multiple times over the past 24 months for the same carrier, the most current positive VMT figure is used. The Utilization Factor is calculated from the following three steps:

1. Carrier Segment. Each motor carrier is placed into one of two segments:

   Combination Segment: Combination trucks/motor coach buses constitute 70 percent or more of the total PU.

   Straight Segment: Straight trucks/other vehicles constitute more than 30 percent of the total PU.

2. VMT per Average PU. The VMT per average PU is derived by taking the most recent positive VMT data and dividing it by the average PUs (defined above).

3. Utilization Factor. Given the information from steps 1 and 2 above, the Utilization Factor is determined from Table D2 and Table D3.

Table D2. Utilization Factors for Combination Segment

VMT per Average PU	**Utilization Factor**
< 80,000	1
80,000 - 160,000	1+0.6[(VMT per PU-80,000) / 80,000]
160,000 - 200,000	1.6
> 200,000	1
No Recent VMT Information	1

Table D3. Utilization Factors for Straight Segment

VMT per Average PU	**Utilization Factor**
< 20,000	1
20,000 - 60,000	VMT per PU / 20,000
60,000 - 200,000	3
> 200,000	1
No Recent VMT Information	1

CALCULATION OF CRASH INDICATOR PERCENTILE RANK

Based on the Crash Indicator measures, the CSMS applies data sufficiency standards and safety event groupings to assign a percentile rank to carriers. A carrier's percentile rank may prompt an intervention. The calculation is as follows:

1. Carrier Segment. Determine the carrier's segment:

   - Combination Segment: Combination trucks/motor coach buses constitute 70 percent or more of the total PU.
   - Straight Segment: Straight trucks/other vehicles constitute more than 30 percent of the total PU.

2. Safety Event Group. For carriers with two or more applicable crashes, place each carrier into one of ten groups based on carrier segment and number of crashes, as shown in Table C4 and Table C5.

Table D4. Safety Event Groups for Crash Indicator: Combination Segment

Safety Event Group	Number of Crashes
Combination 1	2-3
Combination 2	4-6
Combination 3	7-16
Combination 4	17-45
Combination 5	46+

Table D5. Safety Event Groups for Crash Indicator: Straight Segment

Safety Event Group	Number of Crashes
Straight 1	2
Straight 2	3-4
Straight 3	5-8
Straight 4	9-26
Straight 5	27+

3. Percentile Rank. Within each group, rank all the carriers' Crash Indicator measures in ascending order. Transform the ranked values into percentiles from 0 (representing the lowest indicator measure) to 100 (representing the highest indicator measure). Remove carriers that did not have a crash recorded in the previous 12 months. The remaining carriers retain the aforementioned percentiles.

APPENDIX E PEER REVIEW FINDINGS AND RECOMMENDATIONS

PEER REVIEWERS

- Sam Faucette, Safety Director, Old Dominion Freight: http://www.linkedin.com/pub/sam-faucette/50/611/b49
- H. Scott Mathews: http://www.ce.cmu.edu/people/faculty/matthews.html
- Peter Savolainen: http://engineering.wayne.edu/profile/peter.savolainen/
- Bob Scopatz: http://www.linkedin.com/pub/bob-scopatz/24/a97/519
- Eric Teoh, Insurance Institute for Highway Safety

REVIEW CRITERIA

The reviewers were asked to evaluate the report based on eight criteria:

1. Clarity of Hypothesis

All reviewers found the hypothesis clear, with one suggestion to clearly define crash weighting. The FMCSA addressed this recommendation in the final version of the report.

2. Validity of Research Design

The reviewers generally found that the research design was valid. There were many recommendations to provide further details and explanation on the research design. The FMCSA addressed several of these recommendations in the final version of the report.

The reviewers also suggested that the design be extended beyond fatal crashes. The Agency did not address this recommendation as the decision to use fatal crashes alone was based on data constraints.

3. Quality of Data Collection Activities

The reviewers generally supported the quality of data collection activities but asked for additional details in the report about the data collection process. The final version of the report provided details on the data collection tool; the Police Accident Report (PAR) reviewers' level of expertise, background, and training; and the quality assurance process.

One reviewer questioned why the data collection process did not include a review of the narrative to identify some of the crash elements (first harmful event and driver contributing factors) instead of limiting the review to the information from the data field on the PAR. This comment was addressed by including a detailed explanation of how this approach supported the study objectives.

4. Robustness and Depth of Analysis Methods

In general the reviewers accepted the analysis methods. Some offered specific suggestions for further justification of the approach. The final version of the report provided additional details on the analysis approach and results.

One reviewer did suggest that the analysis would be stronger if it focused on predicting future "weighted" crashes rather than all crashes. This analysis was not conducted due to the limitations of the available data.

5. Appropriateness of Methods for Hypotheses Being Tested

Reviewers raised some questions, offered some suggestions, and asked for further in-depth justification of the methods employed. The final version of the report explained in greater detail the analysis approach and why specific methods were selected.

6. Extent to Which Conclusions Follow Analysis

Reviewers generally found that the conclusions followed the analysis.

One reviewer suggested that further conclusions be drawn—for example, that there be a uniform reporting standard for PARs. This is beyond the scope of this study and was not addressed in the final version of the report.

7. Strengths and Limitations of the Overall Product

Overall, the reviewers found the study valuable and the analysis and results sound. The reviewers did point out potential limitations of the report, which were explained in the final version.

8. Specific Recommendations for Improvement of the Product

Reviewers had a number of recommendations for improvement. The final version of the report addressed most of these concerns by providing additional explanation on the study approach. Examples of areas in the report that were expanded to provide more description include:

(1) The data collection tool.

(2) The coders' expertise in terms of experience and training.

(3) The quality assurance process.

(4) The available data sets used in the analysis.

(5) The process and approach for linking the PAR to other available data sources.

(6) The statistical analysis approach and results.

(7) The Safety Measurement System and the effectiveness test.

(8) Summary of process cost estimates.

(9) Why a sample of crashes cannot support national implementation of crash weighting determinations.

The final report did not address the following suggestions related to study design:

(1) Employ a larger sample of PARs with varying severity.

(2) Design the analysis to predict future “weighted” crashes.

(3) Draw more concrete conclusions.

CONCLUSION

Overall, the peer review did not result in any strong criticism of the study approach or results. Among the suggestions included were:

- Provide additional detail and explanation on tools and methods used for the study. The majority of these comments were addressed in the final report.
- Include a larger sample of PARs and coded crashes of varying severity. This was not addressed in the final report due to limitations of the available data.
- Shift the focus of the report to predicting future “weighted” crashes rather than all future crashes. This was not addressed in the final report due to limitations of the available data.