Analysis of the Railroad-Highway Grade Crossing Rules

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

June 2020

FOREWORD

Several Federal Motor Carrier Safety Regulations address commercial motor vehicle (CMV) driver requirements at railroad highway-grade (RRHG) crossings. This report focuses on two of these regulations:

- **49 CFR 392.10:** This regulation requires drivers of buses and hazardous materials vehicles (HMVs) to stop at all RRHG crossings. An exception to this rule, under 49 CFR 392.10(b)(3), allows these drivers to proceed without stopping if the crossing has an active traffic control device that transmits a green indication when safe to cross. However, most active traffic control devices do not use green indications.
- **49 CFR 392.11:** This regulation requires drivers of all other CMVs to slow down almost to a stop at RRHG crossings. Specifically, the regulation states that CMVs should "be driven at a rate of speed which will permit said commercial motor vehicle to be stopped before reaching the nearest rail of such crossing." There is no exception to this rule.

This study examined crash data to estimate the costs and benefits of modifying 49 CFR 392.10 to allow drivers of buses and HMVs to obey active traffic control devices and supporting highway signage at actively controlled RRHG crossings, rather than stopping in every instance. This report summarizes the history of the RRHG crossing rules and presents findings from the cost-benefit analysis. Interested audiences may include Federal and State transportation agencies, motor carriers and CMV drivers, and others interested in railroad or CMV safety.

NOTICE

QUALITY ASSURANCE STATEMENT

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
FMCSA-RRR-18-015		

4. Title and Subtitle	5. Report Date
Analysis of the Railroad-Highway Grade Crossing Rules	**June 2020**
	6. Performing Organization Code
7. Author(s) **Britton, Daniel; Stowe, Kelly A.**	8. Performing Organization Report No.
9. Performing Organization Name and Address **Pathfinder Consultants, LLC** **1616 H St., NW, Washington, DC 20006** ***and*** **Econometrica, Inc.** **7475 Wisconsin Ave. #1000, Bethesda, MD 20814**	10. Work Unit No. (TRAIS) 11. Contract or Grant No.
12. Sponsoring Agency Name and Address **U.S. Department of Transportation** **Federal Motor Carrier Safety Administration** **Office of Analysis, Research, and Technology** **1200 New Jersey Ave. SE** **Washington, DC 20590**	13. Type of Report and Period Covered **Final Report (March–December 2018)** 14. Sponsoring Agency Code **FMCSA**

15. Supplementary Notes
Contracting Officer's Representative: Nicole Michel

16. Abstract

This study examined crash data to estimate the costs and benefits that would be associated with modifying 49 CFR 392.10 to allow drivers of buses and hazardous materials vehicles (HMVs) to obey active traffic control devices and supporting highway signage at actively controlled railroad highway-grade (RRHG) crossings, rather than stopping in every instance.

Potential benefits of t 49 CFR 392.10 include decreased fatalities, injuries, and property damage resulting from rear-end crashes involving HMVs and buses at RRHG crossings. Potential costs include increased train-bus or train-HMV crashes attributable to malfunctioning active traffic control devices. Predicted benefits significantly exceed predicted costs, indicating the proposed amendment would be a net safety improvement.

17. Key Words	18. Distribution Statement
49 CFR 392.10, 49 CFR 392.11, commercial motor vehicle, crash avoidance, hazardous materials vehicle, bus, railroad-highway grade crossing, active traffic control device	**No restrictions**

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	**Unclassified**	**48**	

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized.

SI* (MODERN METRIC) CONVERSION FACTORS

Approximate Conversions to SI Units

Symbol	When You Know	Multiply By	To Find	Symbol
		Length		
In	inches	25.4	millimeters	mm
Ft	feet	0.305	meters	m
Yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		Area		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yards	0.836	square meters	m^2
ac	Acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		Volume (volumes greater than 1,000L shall be shown in m^3)		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		Mass		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2,000 lb)	0.907	megagrams (or “metric ton”)	Mg (or “t”)
		Temperature (exact degrees)		
°F	Fahrenheit	5(F-32)/9 or (F-32)/1.8	Celsius	°C
		Illumination		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		Force and Pressure or Stress		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

Approximate Conversions from SI Units

Symbol	When You Know	Multiply By	To Find	Symbol
		Length		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		Area		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
Ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		Volume		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		Mass		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or “t”)	megagrams (or “metric ton”)	1.103	short tons (2,000 lb)	T
		Temperature (exact degrees)		
°C	Celsius	1.8c+32	Fahrenheit	°F
		Illumination		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		Force and Pressure or Stress		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

* SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380. (Revised March 2003, Section 508-accessible version September 2009.)

TABLE OF CONTENTS

LIST OF FIGURES (AND FORMULAS)

LIST OF TABLES

LIST OF ACRONYMS, ABBREVIATIONS, AND SYMBOLS

Acronym	Definition
CFR	Code of Federal Regulations
CRSS	Crash Report Sampling System
FARS	Fatality Analysis Reporting System
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FMCSR	Federal Motor Carrier Safety Regulation
FR	Federal Register
FRA	Federal Railroad Administration
GES	General Estimates System
HM	hazardous materials
HMV	hazardous materials vehicle
MCMIS	Motor Carrier Management Information System
NAS	National Academy of Sciences
NHTSA	National Highway Traffic Safety Administration
PDO	property damage only
Primary highway	A highway that is designated as part of the Federal Aid primary highway system. These are separate from interstates and secondary highways.
RRHG	railroad highway-grade
USDOT	U.S. Department of Transportation

[This page intentionally left blank.]

EXECUTIVE SUMMARY

BACKGROUND

The primary mission of the Federal Motor Carrier Safety Administration (FMCSA) is to reduce crashes, injuries, and fatalities involving large trucks and buses. In carrying out this safety mission, FMCSA develops and enforces data-driven Federal Motor Carrier Safety Regulations (FMCSRs) that balance motor carrier safety with efficiency.

Several FMCSRs address commercial motor vehicle (CMV) driver requirements at railroad highway-grade (RRHG) crossings. This report focuses on two of these regulations:

- **49 CFR 392.10, "Railroad grade crossings; stopping required."** This regulation requires drivers of buses and hazardous materials vehicles (HMVs) to stop at all RRHG crossings. An exception to this rule, under 49 CFR 392.10(b)(3), allows these drivers to proceed without slowing or stopping if the crossing has an active traffic control device that transmits a green indication when safe to cross. However, the vast majority of railroad-highway active traffic control devices do not use green indications.
- **49 CFR 392.11, "Railroad grade crossings; slowing down required."** This regulation requires drivers of all other CMVs to slow down almost to a stop at RRHG crossings. Specifically, the regulation states that CMVs should "be driven at a rate of speed which will permit said commercial motor vehicle to be stopped before reaching the nearest rail of such crossing." There is no exception to this rule.

Stopping at RRHG crossings, especially on high-speed divided highways, has been identified as a potential crash hazard, since CMVs can be rear-ended while stopped. The two regulations cited above were formulated in the mid-twentieth century at a time when most RRHG crossings were un-gated. Since then, strides have been made to identify and control RRHG crossings with sophisticated arm and light systems. The goal of this study was to estimate the costs and benefits associated with modifying 49 CFR 392.10, to allow drivers of buses and HMVs to obey active traffic control devices (not just those that transmit a green indication) and supporting highway signage at actively controlled RRHG crossings, rather than stopping in every instance.

STUDY APPROACH

The study employed the following approach:

- Examine the history and development of 49 CFR 392.10 and 49 CFR 392.11.
- Analyze data on crashes at RRHG crossings to estimate the potential costs and benefits of amending 49 CFR 392.10. Data sources for the analyses include:

– Fatal crash data from the National Highway Traffic Safety Administration's (NHTSA's) Fatality Analysis Reporting System (FARS).

– Non-fatal crash data from NHTSA's General Estimates System (GES) and Crash Report Sampling System (CRSS).

– State crash publications.
– Published data from the Federal Railroad Administration (FRA).
– Ad hoc State studies of crashes at actively controlled RRHG crossings.

- Examine supporting documentation, such as RRHG crossing violation rates and State RRHG crossing regulations.

A detailed history of the RRHG crossing rules is presented in Section 1.2. Results from the cost-benefit analysis are summarized below, followed by a description of the study's limitations and a discussion of anecdotal evidence related to States' enforcement of 49 CFR 392.11.

KEY FINDINGS

Costs and Benefits of Amending 49 CFR 392.10

The potential costs of amending 49 CFR 392.10 as proposed include increased train-bus or train-HMV crashes (attributable to malfunctioning active traffic control devices) [i] that would have been prevented if buses and HMVs were still required to stop at RRHG crossings. Potential benefits include decreased fatalities, injuries, and property damage resulting from rear-end crashes involving HMVs and buses at RRHG crossings.

Three different statistical approaches, described in detail in Section 3, were used to estimate the increase in costs from new crashes that could result if 49 CFR 392.10 were modified as proposed. The most conservative (highest) predicted number of increased crashes was then used to make the cost-benefit comparison.

Section 2 describes the methods used to estimate the benefits of modifying 49 CFR 392.10 as proposed. Findings, shown in Table 1, indicate that the potential benefits significantly outweigh the potential new costs.

Table 1. Estimated annual impact of amending 49 CFR 392.10 as proposed.

Crash Type	Estimate of Crashes Prevented	Estimate of New Crashes	Estimated Net Change in Crashes	Estimated Cost per Crash	Value of Net Change in Crashes
Fatal bus crashes	0.57	0.60	0.04	$11,496,000	$ -433,434
Injury bus crashes	119.77	5.18	-114.59	$472,000	$ 54,088,360
Property damage only bus crashes	386.99	39.98	-347.01	$75,000	$ 26,025,913
Fatal HMV crashes	0.75	0.25	-0.50	$11,496,000	$ 5,798,866
Injury HMV crashes	44.70	0.49	-44.22	$472,000	$ 20,870,092
Property-damage-only HMV crashes	66.54	2.03	-64.51	$75,000	$ 4,838,314
Total	**619.32**	**48.52**	**-570.80**	**n/a**	**$111,188,110**

[i] Traffic controls (active and passive) at RRHG crossings are installed and maintained by the railroads and State highway/local street agencies. They are thus outside FMCSA's and FHWA's jurisdictions.

LIMITATIONS

This study examines data on some very specific crash types which often cannot be accurately determined using the existing national crash databases. For example, rear-ended buses and HMVs at RRHG crossings can only be reliably identified in one annual national dataset (FARS), which only includes fatal crashes. This report utilizes complex methods, incorporating data from many sources, to estimate injury and towaway crashes of this type. The results of this analysis depend heavily on some specific statistics, and it is possible that a different method would produce significantly different rates.

There are many different types of RRHG crossings; some have only passive signage, while others have various types of active signage. State regulations sometimes make distinctions between how non-commercial and commercial drivers should proceed across the different types of RRHG crossings, in addition to the Federal Regulations examined in this report. Most of the crash data does not distinguish between the different types of RRHG crossings or different rules applying to drivers in different States.

To estimate many of the costs and benefits of 49 CFR 392.10, it is necessary to assume a hypothetical state of the world in which buses and HMVs do not have to stop before proceeding across RRHG crossings. There are many ways this analysis could be performed; this report provided four methods (described in Section 2), which had significantly different results.

To account for these limitations, the final analysis used the most conservative results from the different methods used (i.e., the least predicted benefits and the highest predicted costs), resulting in a predicted net reduction of 570.8 crashes per year.

DISCUSSION

Anecdotal evidence suggests that some States are not enforcing 49 CFR 392.11. That is, some States may be allowing drivers of CMVs to proceed at speed through actively controlled RRHG crossings (when a train's presence is not indicated) without issuing violations for this behavior. This is consistent with the majority of State railroad crossing regulations, which do not specifically state that commercial vehicles should always slow down (enough to be able to stop) at actively controlled RRHG crossings.[1] Separately, industry safety guidance suggests that truck drivers should "know the regulations in the States where [they] operate," when dealing with active signal devices at RRHG crossings.[2] Finally, RRHG crossing violation rates are extremely low nationwide, which suggests that some States may not be strictly enforcing 49 CFR 392.11. It was outside the scope of this study to explore modification of 49 CFR 392.11, but given this evidence and the findings from this study, it may be worth conducting additional research specific to this regulation.

CONCLUSION

Study findings suggest that the safety benefits of modifying 49 CFR 392.10 as proposed would significantly outweigh the costs, resulting in approximately 571 fewer crashes per year. This translates to a net reduction of approximately $110 million in crash costs, annually.

[This page intentionally left blank.]

1. BACKGROUND

1.1 INTRODUCTION

The primary mission of the Federal Motor Carrier Safety Administration (FMCSA) is to reduce crashes, injuries, and fatalities involving large trucks and buses. In carrying out this safety mission, FMCSA develops and enforces data-driven Federal Motor Carrier Safety Regulations (FMCSRs) that balance motor carrier safety with efficiency.

Several FMCSRs address commercial motor vehicle (CMV) driver requirements at railroad highway-grade (RRHG) crossings. This report focuses on two of these regulations:

- **49 CFR 392.10, "Railroad grade crossings; stopping required."** This regulation requires drivers of buses and hazardous materials vehicles (HMVs) to stop at all RRHG crossings. An exception to this rule, under 49 CFR 392.10(b)(3), allows drivers of HMVs and buses to proceed without slowing or stopping if the crossing has an active traffic control device that transmits a green indication when safe to cross. However, the vast majority of railroad-highway active traffic control devices do not use green indications.
- **49 CFR 392.11, "Railroad grade crossings; slowing down required."** This regulation requires drivers of all other CMVs to slow down almost to a stop at RRHG crossings. Specifically, the regulation states that CMVs should "be driven at a rate of speed which will permit said commercial motor vehicle to be stopped before reaching the nearest rail of such crossing." There is no exception to this rule.

Stopping at RRHG crossings, especially on high-speed divided highways, has been identified as a potential crash hazard, with concerns that CMVs can be involved in rear-end crashes while stopped. The two regulations cited above were formulated in the mid-twentieth century at a time when most RRHG crossings were un-gated. Since then, progress has been made in identifying and controlling RRHG crossings with sophisticated arm and light systems.

The goal of this study was to estimate the costs and benefits associated with modifying 49 CFR 392.10, to allow drivers of buses and HMVs to obey active traffic control devices (not just those that transmit a green indication) and supporting highway signage at actively controlled RRHG crossings, rather than stopping in every instance. The study employed the following approach:

- Examine the history and development of 49 CFR 392.10 and 49 CFR 392.11.
- Analyze data on crashes at RRHG crossings to estimate the potential costs and benefits of amending 49 CFR 392.10. Data sources for the analyses include:
  - Fatal crash data from the National Highway Traffic Safety Administration's (NHTSA's) Fatality Analysis Reporting System (FARS).
  - Non-fatal crash data from NHTSA's General Estimates System (GES) and Crash Report Sampling System (CRSS).
  - State crash publications.
  - Published data from the Federal Railroad Administration (FRA).

– Ad hoc State studies of crashes at actively controlled RRHG crossings.

- Examine supporting documentation, such as RRHG crossing violation rates and State RRHG crossing regulations.

A detailed history of the RRHG crossing rules is presented in Section 1.2. Findings from the analyses and from a cursory review of State practices and RRHG violation rates are presented in Sections 2, 3, and 0.

1.2 HISTORY OF THE REQUIREMENTS

Before the U.S. Department of Transportation (USDOT) was established in 1967, the Interstate Commerce Commission (ICC) was responsible for regulation of certain transportation modes.(3) The Federal Motor Carrier Act of 1935 gave the ICC the authority to regulate interstate motor carriers and required the ICC to establish a general motor carrier safety program.(4) In response to this requirement, the ICC developed a series of safety regulations for motor carriers. The original multi-point RRHG crossing rule was included in these safety regulations.(5)

The notice of proposed rulemaking (NPRM) for the ICC's motor carrier safety regulations was published in the Federal Register in 1936.(6) The proposed language appeared as Rule 13 in Part III of the NPRM, as follows:

> Every motor vehicle transporting passengers, and every motor vehicle transporting explosives, inflammable or corrosive liquids, compressed or poisonous gases, or other dangerous articles, shall, upon approaching any railroad grade crossing, be brought to a full stop within fifty feet, but not less than ten feet, from the nearest rail of such railroad, and shall not proceed until the course is known to be clear. All other motor vehicles shall, upon approaching a railroad grade crossing, reduce speed to a rate not exceeding ten miles per hour and shall proceed to cross only if the course is known to be clear. In all cases, crossing shall be made only in such gear that there will be no necessity for changing gears before crossing is completed. The regulations contained in this paragraph need not apply at a street car crossing within a business or residence district, nor at a railroad crossing where trains are required to stop and give right of way to vehicular traffic, nor at a railroad crossing protected by a watchman or traffic officer on duty or by a traffic control "stop and go" signal giving positive indication to approaching vehicles to proceed; provided, however, that nothing herein contained shall be construed so as to relieve the driver of the responsibility of determining that the course is clear before proceeding over such crossing.

The 1936 NPRM explained that the logic for most of the proposed motor carrier safety regulations was largely based on existing practices, which were based on expert opinion:

> …the ultimate objective of the safety regulations of the Interstate Commerce Commission, Bureau of Motor Carriers (in so far as concerns operations subject to the Motor Carrier Act, 1935) is to decrease accidents, save human lives, and reduce property losses…

> To accomplish these purposes, a long-term program, involving various regulations and means for their enforcement will be necessary. This complete program, based on the best existing State motor vehicle laws and regulations and the proven safety practices of leading motor carriers, requires consideration of the following elements…

The text of the final rule establishing the RRHG crossing requirements was published in 1937, with several minor changes.(7) The language in the final rule (which became Rule 14, under Part II) stated:

> Every motor vehicle transporting passengers, high explosives, or poisonous or compressed inflammable gases, and every motor vehicle used for the transportation of inflammable or corrosive liquids in bulk, whether loaded or empty, shall, upon approaching any railroad grade crossing, be brought to a full stop within 50 feet, but not less than 10 feet, from the nearest rail of such railroad grade crossing, and shall not proceed *until due caution has been taken to ascertain that the course is clear*; provided, however, that such full stop shall not be required at a street-car crossing within a business or residence district, nor at a railroad grade crossing protected by a watchman or traffic officer on duty or by a traffic-control "stop and go" signal *(not railroad flashing signal)* giving positive indication to approaching vehicles to proceed. *Any other motor vehicle shall, upon approaching a railroad grade crossing, reduce speed to a rate that shall enable a stop to be made before reaching the nearest rail of such crossing and shall proceed to cross only after due caution has been taken to ascertain that the course is clear.*

1.2.1 Codification of the RRHG Crossing Requirements

The ICC issued its final rule in 1937 as a standalone publication. In 1938, the Office of the Federal Register completed its first codification of all Federal Government regulations, codifying the RRHG crossing rule as 49 CFR 193.14.(8) In May of 1952, the ICC issued a final rule that re-codified 49 CFR 193.14 as two distinct rules: 49 CFR 192.10 and 49 CFR 192.11.(9) Between codifications, the ICC dropped the words "stop and go" from the exception, rephrasing it to say that drivers of buses and HMVs could proceed at speed across RRHG crossings "where a traffic-control signal (not a railroad flashing signal) directs traffic to proceed."

In 1967, an ICC final rule transferred the motor carrier safety regulations from 49 CFR parts 190–197 to the newly created USDOT, re-designating them as 49 CFR parts 290–297.(10)

In 1968, the Secretary of Transportation, in conjunction with each of the modal administrations, published a Federal Register Notice addressing the rules transferred from the ICC.(11, ii) In that

---

[ii] FHWA was established as a separate administration within the U.S. Department of Transportation (USDOT) on April 1, 1967. FHWA is the successor to the Bureau of Public Roads, which was transferred from the Commerce Department when USDOT was established in 1967. FHWA is now the national authority for highway standards of many types, including approved active traffic control devices (such as those installed at RRHG crossings).

notice, the portion relating to the Federal Highway Administration (or FHWA, the USDOT agency that absorbed motor carrier regulation responsibilities) states:

> The regulations of the Federal Highway Administration in Title 49 and in Chapter II of Title 23 are redesignated and transferred as set forth…. Since this amendment merely reorganizes existing regulatory material and makes minor nonsubstantive corrections therein, notice and public procedure thereon are unnecessary.

That re-designation codified the RRHG crossing rules as 49 CFR 392.10 and 49 CFR 392.11.[(12)] While the two rules have undergone several amendments since 1968, the substance has remained largely unchanged. As of 2019, 49 CFR 392.10 reads as follows:

> **§ 392.10 Railroad grade crossings; stopping required.**
>
> **(a)** Except as provided in paragraph (b) of this section, the driver of a commercial motor vehicle specified in paragraphs (a) (1) through (6) of this section shall not cross a railroad track or tracks at grade unless he/she first: Stops the commercial motor vehicle within 50 feet of, and not closer than 15 feet to, the tracks; thereafter listens and looks in each direction along the tracks for an approaching train; and ascertains that no train is approaching. When it is safe to do so, the driver may drive the commercial motor vehicle across the tracks in a gear that permits the commercial motor vehicle to complete the crossing without a change of gears. The driver must not shift gears while crossing the tracks.
>
> **(1)** Every bus transporting passengers,
> **(2)** Every commercial motor vehicle transporting any quantity of a Division 2.3 chlorine.
> **(3)** Every commercial motor vehicle which, in accordance with the regulations of the Department of Transportation, is required to be marked or placarded with one of the following classifications:
> **(i)** Division 1.1
> **(ii)** Division 1.2, or Division 1.3
> **(iii)** Division 2.3 Poison gas
> **(iv)** Division 4.3
> **(v)** Class 7
> **(vi)** Class 3 Flammable
> **(vii)** Division 5.1
> **(viii)** Division 2.2
> **(ix)** Division 2.3 Chlorine
> **(x)** Division 6.1 Poison
> **(xi)** Division 2.2 Oxygen
> **(xii)** Division 2.1
> **(xiii)** Class 3 Combustible liquid
> **(xiv)** Division 4.1
> **(xv)** Division 5.1
> **(xvi)** Division 5.2

(xvii) Class 8
(xviii) Division 1.4

(4) Every cargo tank motor vehicle, whether loaded or empty, used for the transportation of any hazardous material as defined in the Hazardous Materials Regulations of the Department of Transportation, parts 107 through 180 of this title.

(5) Every cargo tank motor vehicle transporting a commodity which at the time of loading has a temperature above its flashpoint as determined by § 173.120 of this title.

(6) Every cargo tank motor vehicle, whether loaded or empty, transporting any commodity under exemption in accordance with the provisions of subpart B of part 107 of this title.

(b) A stop need not be made at:

(1) A streetcar crossing, or railroad tracks used exclusively for industrial switching purposes, within a business district, as defined in § 390.5 of this chapter.

(2) A railroad grade crossing when a police officer or crossing flagman directs traffic to proceed.

(3) A railroad grade crossing controlled by a functioning highway traffic signal transmitting a green indication which, under local law, permits the commercial motor vehicle to proceed across the railroad tracks without slowing or stopping.

(4) An abandoned railroad grade crossing which is marked with a sign indicating that the rail line is abandoned,

(5) An industrial or spur line railroad grade crossing marked with a sign reading "Exempt." Such "Exempt" signs shall be erected only by or with the consent of the appropriate State or local authority.

The current exception under 49 CFR 392.10(b)(3) states that drivers of buses and HMVs can proceed through actively controlled RRHG crossings when the active traffic control device is transmitting a green indication. This differs from the 1952 version of the rule, which stated that drivers of buses and HMVs could proceed through railroad grade crossings "where a traffic-control signal (not a railroad flashing signal) directs traffic to proceed."

The second rule, 49 CFR 392.11, requires all other CMVs to slow down sufficiently to be able to stop at all RRHG crossings. There are no exceptions to this rule. As of 2019, 49 CFR 392.11 reads as follows:

§ 392.11 Railroad grade crossings; slowing down required.

Every commercial motor vehicle other than those listed in § 392.10 shall, upon approaching a railroad grade crossing, be driven at a rate of speed which will permit said commercial motor vehicle to be stopped before reaching the nearest rail of such crossing and shall not be driven upon or over such crossing until due caution has been taken to ascertain that the course is clear.

2. POTENTIAL BENEFITS OF MODIFYING 49 CFR 392.10

This section estimates the potential benefits of modifying 49 CFR 392.10, to allow drivers of buses and HMVs to obey active traffic control devices (not just those that transmit a green indication) and supporting highway signage at actively controlled RRHG crossings, rather than stopping in every instance. The anticipated safety benefit is a decrease in rear-end crashes involving buses and HMVs.

Crashes involving all types of motor vehicles at or near RRHG crossings have declined in recent years. It should be noted that only some of these crashes actually involve trains, and only some of them involve buses or HMVs. The total number of fatal and non-fatal crashes at RRHG crossings in 2016 was less than half of what it was in 2000, as shown in Figure 1. This suggests that the safety of such crossings has still been improving over the past several years.

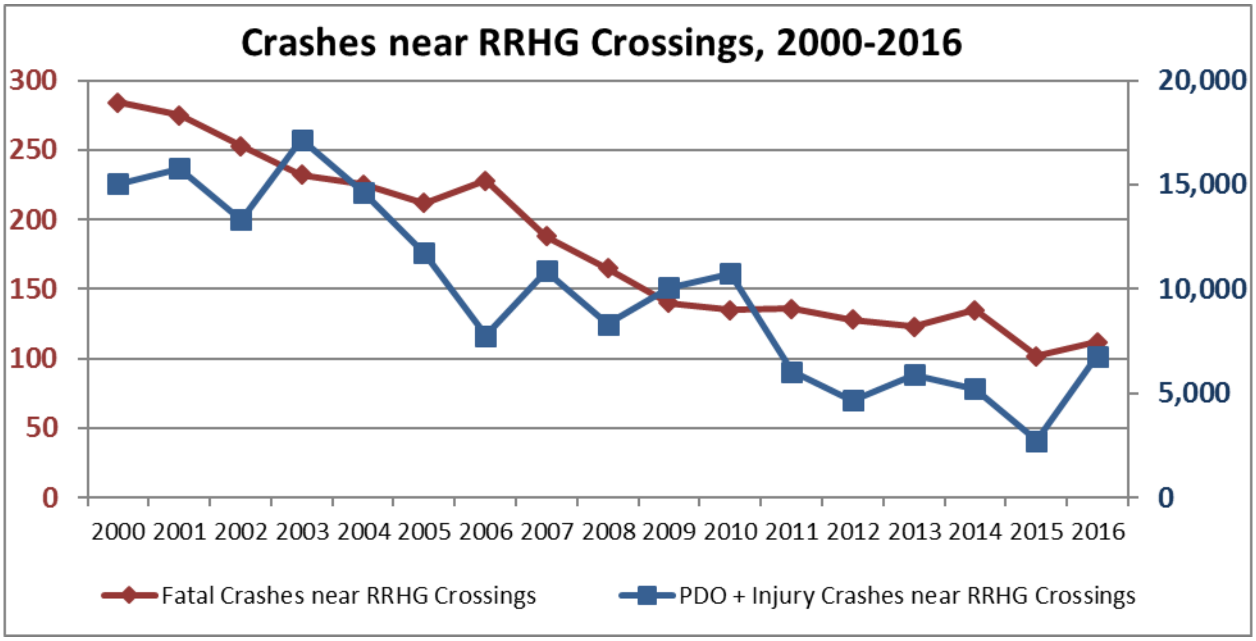

Figure 1. Line graph. Annual counts of fatal and non-fatal crashes near RRHG crossings, 2000–16.

2.1 FATAL CRASH DATA

The most thorough, reliable, and longest-running public database on crashes involving motor vehicles is the National Highway Traffic Safety Administration's (NHTSA's) Fatality Analysis Reporting System (FARS), an annual census of all fatal crashes involving at least one motor vehicle on public roadways. Although there are many different types of RRHG crossings, FARS has not distinguished between them since 2010, so we will not attempt to distinguish between them in our analysis. FARS data indicate that there were 9 buses and 13 HMVs involved in fatal crashes at RRHG crossings from 2007 to 2016. [iii]

Six of those buses (67 percent) and eight of those HMVs (62 percent) were rear-ended. In contrast, only 16 percent of buses and 13 percent of HMVs in fatal crashes during these years at locations other than RRHG crossings were rear-ended. There were 1,401 other motor vehicles in fatal crashes at RRHG crossings during this period, only 74 of which (5 percent) were rear-ended. These statistics indicate that buses and HMVs are rear-ended at disproportionate rates near RRHG crossings, and 49 CFR 392.10 is likely the main reason for this.

2.2 NON-FATAL CRASH DATA

NHTSA's General Estimates System (GES), which was replaced with the new Crash Report Sampling System (CRSS) beginning with 2016 data, is one of the best sources for nationwide data on non-fatal—or injury and property-damage-only (PDO)—crashes. Unlike FARS, GES and CRSS are based on samples of crashes from data collection sites scattered around the country. Weights are applied to this sample data to produce nationally representative results for broad categories of crashes, such as "injury crashes involving large trucks" or "PDO crashes on each day of the week." But statistics on less common crash types such as crashes at RRHG crossings are less reliable because of the very small sample sizes.

The weighted GES/CRSS data for 2007–16 indicate there was a yearly average of 485 non-fatal crashes at RRHG crossings involving rear-ended buses or HMVs, but these numbers fluctuated widely, from 6 to 1,603, with a significant downward trend, as shown in Figure 2. However, it is difficult to be confident about these estimates, since data at specific locations like RRHG crossings may be consistently biased if the percentage of RRHG crossings in the data collection sites is higher or lower than the national average.

For these reasons, GES/CRSS data on buses and HMVs rear-ended in injury and PDO crashes at RRHG crossings is not as reliable as the analogous FARS data on fatal crashes.

[iii] To simplify the analysis in this report, we sometimes use the terms "crashes at RRHG crossings involving rear-ended buses or HMVs" and "buses or HMVs rear-ended in crashes at RRHG crossings" interchangeably, though technically it is possible (but extremely unlikely) for two of these vehicles to be rear-ended in the same crash. Crash data from 2007 to 2016 is generally used in this report from this point forward. Because crashes in which buses or HMVs were rear-ended near RRHG crossings are so uncommon, any single year of data is subject to yearly fluctuations. Although there seem to have been significant reductions in crashes at RRHG crossings since 2007, we feel that using 10 years of data makes the results more robust.

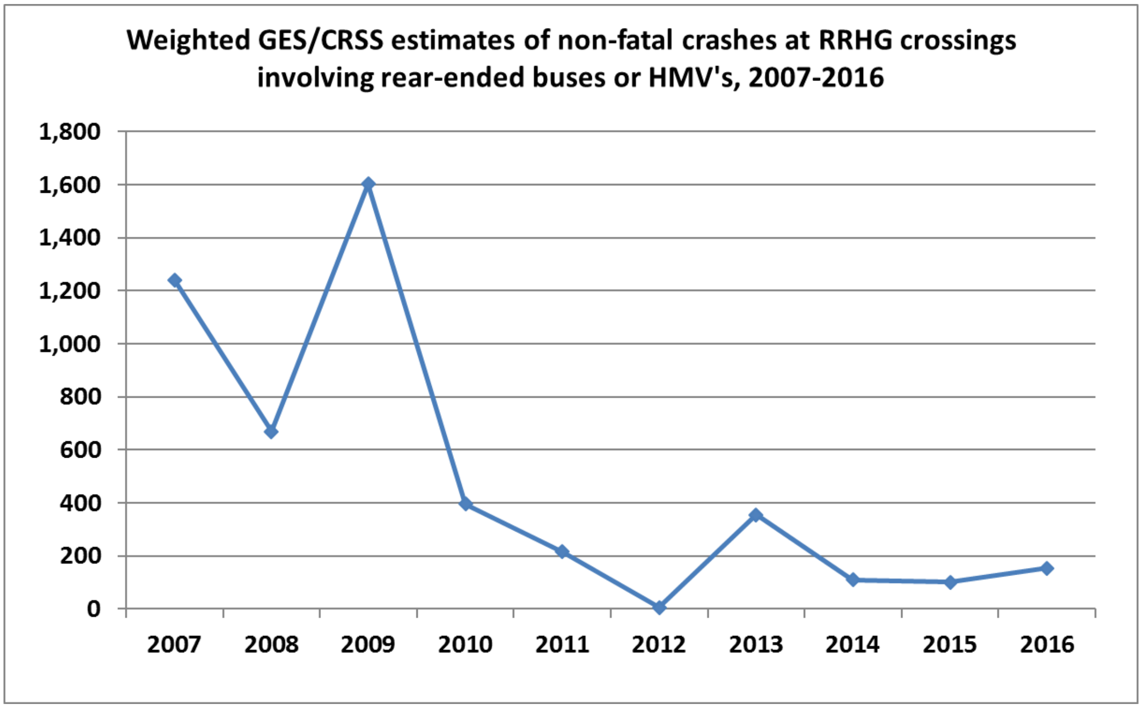

Figure 2. Line graph. Weighted GES/CRSS estimates of non-fatal crashes at RRHG crossings involving rear-ended buses or HMVs, 2007–16.

2.2.1 Percent of Injury and Property-Damage-Only Crashes involving Rear-Ended Buses and HMVs

Although GES/CRSS data on the number of nonfatal crashes involving rear-ended buses and HMVs at RRHG crossings might not be reliable, GES/CRSS does provide a useful statistic not found anywhere else: the percentage of injury and PDO crashes at RRHG crossings that involved rear-ended buses or HMVs. There may be uncertainty as to whether the GES/CRSS weights produce accurate estimates of the total number of injury and PDO crashes involving rear-ended buses or HMVs at RRHG crossings, but we can be more confident in the reliability of GES/CRSS data for determining the percentage of crashes that involved rear-ended buses or HMVs at RRHG crossings, since that rate probably does not vary by much between the GES/CRSS sampling sites and the Nation as a whole. These rates can be combined with data from other sources on nonfatal crashes to estimate the number of buses and HMVs rear-ended in injury and PDO crashes at RRHG crossings in each State, and then summed to produce a national estimate.

The four rates we need are:

1. The percentage of injury crashes at RRHG crossings that involved rear-ended buses.
2. The percentage of PDO crashes at RRHG crossings that involved rear-ended buses.
3. The percentage of injury crashes at RRHG crossings that involved rear-ended HMVs.
4. The percentage of PDO crashes at RRHG crossings that involved rear-ended HMVs.

Unfortunately, the weighted GES/CRSS data produce an implausibly low result of 0.08 percent for the fourth rate, compared with an analogous rate of 0.6 percent for fatal crashes from FARS.

As mentioned earlier, the weights in the GES/CRSS data are designed to generate nationally representative totals for broad categories of crashes, but they are less reliable for very specific crash types such as those being analyzed here. Because the weights assigned to non-fatal crashes in GES/CRSS at RRHG crossings involving rear-ended buses or HMVs vary from 1.0 to 322.9, using the weighted data can provide a misleading estimate.

The four rates of interest are presented in Table 2, based on weighted and unweighted GES/CRSS data.

Table 2. Percentages of injury and PDO crashes at RRHG crossings involving rear-ended buses and HMVs, based on weighted and unweighted GES/CRSS data, 2007–16.

Rate	Percentage (based on weighted data)	Percentage (based on unweighted data)	Number of Crashes Rates Are Based On
1. Percentage of injury crashes at RRHG crossings that involved rear-ended buses	3.25%	4.93%	Out of 302 injury crashes at RRHG crossings in the unweighted GES/CRSS data from 2007 to 2016, 15 involved rear-ended buses.
2. Percentage of PDO crashes at RRHG crossings that involved rear-ended buses	5.79%	5.86%	Out of 301 PDO crashes at RRHG crossings in the unweighted GES/CRSS data from 2007 to 2016, 18 involved rear-ended buses.
3. Percentage of injury crashes at RRHG crossings that involved rear-ended HMVs	1.72%	1.84%	Out of 302 injury crashes at RRHG crossings in the unweighted GES/CRSS data from 2007 to 2016, 7 involved rear-ended HMVs.
4. Percentage of PDO crashes at RRHG crossings that involved rear-ended HMVs	0.08%	1.28%	Out of 301 PDO crashes at RRHG crossings in the unweighted GES/CRSS data from 2007 to 2016, 5 involved rear-ended HMVs.

As shown in Table 2, the weights in the GES/CRSS data had a significant impact on Rate 4, but not much impact on the other three rates. The five PDO crashes in the GES/CRSS data that involved rear-ended HMVs at RRHG crossings happened to be assigned small weights, which resulted in an implausibly low rate of 0.08 percent, compared with the more reasonable 1.28-percent rate based on the unweighted data. This analysis uses the results from the unweighted GES/CRSS data to avoid this problem.

As mentioned earlier, these rates can be combined with data on the number of injury and PDO crashes at RRHG crossings in each State to determine the total number of injury and PDO crashes likely attributable to the stopping requirements under 49 CFR 392.10.

2.2.2 Estimating Injury and PDO Crashes in each State using Statistics from State Crash Publications

GES/CRSS does not allow data to be broken out by States. However, 30 States release statistics on fatal, injury, and PDO crashes within their borders, often in annual publications. Five of those States also publish tables with counts of injury and PDO crashes at or near RRHG crossings, and the other 25 States provide counts of injury[iv] and PDO crashes in each State with no specific breakout of crashes at RRHG crossings. The remaining 20 States and the District of Columbia do not seem to provide any official counts of injury and PDO crashes. All 50 States and the District of Columbia are categorized into three groups, based on the crash data they provide, in Table 3. Table 3 also mentions the steps taken to estimate the number of injury and PDO crashes involving rear-ended buses and HMVs at RRHG crossings for each group.

Table 3. States grouped by the crash data they release and the steps taken to estimate the number of injury and PDO crashes involving rear-ended buses and HMVs at RRHG crossings for each group.

State Group	Number of States	How to determine the number of injury and PDO crashes in each State	How to determine the number of injury and PDO crashes at RRHG crossings	How to determine the number of injury and PDO crashes involving rear-ended buses and HMVs at RRHG crossings
Group One: States that publish counts of injury and PDO crashes at RRHG crossings	5 States (Arkansas, Indiana, Kansas, Ohio, and South Carolina)	Not necessary, though there are two possibilities: (I) use published injury and PDO crash counts or (II) calculate estimates based on FARS/CRSS ratios.[v]	These States publish precise counts of this type of crash.	Multiply the numbers reported in the State's crash publications by the rates in Table 2.
Group Two: States that publish injury and PDO crash statistics (but not for crashes at RRHG crossings)	25 States	(I) Use published injury and PDO crash counts or (II) calculate estimates based on FARS/CRSS ratios.	(A) Use the results of the regression in Section 2.2.3 or (B) multiply the injury and PDO crash counts or estimates by the RRHG crossing crash rates of the five Group One States.	Multiply the numbers determined in the previous column by the rates in Table 2.

[iv] Five of these 25 States report "persons injured" instead of "injury crashes," but the number of persons injured can be divided by the national average of 1.44 persons injured per injury crash (based on GES/CRSS data from 2007 to 2016) to estimate the number of injury crashes.

[v] For these five States, it is not necessary to obtain the total injury and PDO crash counts since we already have precise counts of injury and PDO crashes at RRHG crossings.

State Group	Number of States	How to determine the number of injury and PDO crashes in each State	How to determine the number of injury and PDO crashes at RRHG crossings	How to determine the number of injury and PDO crashes involving rear-ended buses and HMVs at RRHG crossings
Group Three: States that do not publish any injury and PDO crash statistics	20 States and the District of Columbia	(II) Calculate estimates based on FARS/CRSS ratios.	(A) Use the results of the regression in Section 2.2.3 or (B) multiply the injury and PDO crash counts or estimates by the RRHG crossing crash rates of the five Group One States.	Multiply the numbers determined in the previous column by the rates in Table 2.

As shown in the third column of Table 3, we consider two ways to obtain counts of the injury and PDO crashes in a State (though for some States, one method is not possible):

(I) Using published injury and PDO crash counts (if they exist), or

(II) Assuming that each State's share of injury and PDO crash estimates nationwide in CRSS is to the same as its share of fatal crashes nationwide found in FARS data; for example, if 2.6 percent of nationwide fatal crashes in FARS from 2007 to 2016 were in Alabama, we could assume they would also have 2.6 percent of the nationwide injury and PDO crashes in CRSS in 2016. (We use 2007–2016 FARS data to accommodate for smaller States, in which the number of fatal crashes can fluctuate significantly from year to year.)

2.2.3 Estimating Injury and PDO Crashes at RRHG Crossings in Each State

To determine the number of injury and PDO crashes that occurred at RRHG crossings in each of the 45 States (and the District of Columbia) that do not publish that information, we considered two options:

(A) Developing two regressions using the number of fatal crashes, the number of RRHG crossings, and population estimates for each State. The regression for injury crashes is shown in Figure 3. A similar regression was developed for PDO crashes.

$$ICRRC_n = \beta_0 + \beta_1 IC_n + \beta_2 RRC_n + \beta_3 POP_n + \beta_4 FC_n$$

Figure 3. Equation. Regression for calculating injury crashes at RRHG crossings in a State.

where,

$ICRRC_n$ = estimated injury crashes at RRHG crossings in a State, n in 2016;

IC_n = injury crashes in a State, n in 2016 for the most recent year available (source: 25 of the States for which we need this information publish injury and PDO crash totals; data for the remaining States can be estimated using FARS and CRSS ratios);

RRC_n = RRHG crossings in a State, n in 2012[vi] (source: FRA *Railroad Safety Statistics*);[(13)]

POP_n = population in a State, n[14] (source: 2016 update to 2010 census); and

FC_n = annual average number of fatal crashes from 2007 to 2016 in a State, n[vii] (source: FARS)

(B) Using the rates found in the five States that publish data on crashes at RRHG crossings (0.15 percent of the injury crashes and 0.16 percent of the PDO crashes in those States were at RRHG crossings).[viii]

2.2.4 Selection of the Most Appropriate Method

The previous analyses provide two options for determining how many injury and PDO crashes occur in each State each year ("I" and "II" above) and two options for determining the percentage of those crashes that were at RRHG crossings ("A" and "B" above). Therefore, a total of four methods for determining how many injury and PDO crashes occurred at RRHG crossings in each State are available for analysis:

- Method IA: (I) Use published counts of injury and PDO crashes in each State when available and estimates based on FARS/CRSS ratios when published data is unavailable; (A) use the results of the regressions for calculating the number of injury and PDO crashes that were at RRHG crossings in each State.

- Method IB: (I) Use published counts of injury and PDO crashes in each State when available and estimates based on FARS/CRSS ratios when published data is unavailable; (B) multiply those injury and PDO crash counts or estimates by the average RRHG crossing crash rates of the five States who publish data on crashes at RRHG crossings.

- Method IIA: (II) Use estimates of injury and PDO crashes in each State based on FARS/CRSS ratios (even for States that publish counts of injury and PDO crashes); (A) use the results of the regressions for calculating the number of injury and PDO crashes that were at RRHG crossings in each State.

[vi] 2012 is the most recent year for which FRA seems to have published these statistics. Although it is unfortunate that we could not find more recent data, these numbers are unlikely to have changed much.

[vii] We used 2007–2016 data here to more accommodate for smaller States, in which the number of fatal crashes can fluctuate significantly from year to year.

[viii] Statistics from the annual crash publications of Arkansas (covering crashes in 2010–2014), Indiana (covering crashes at RRHG crossings in 2012, 2014, and 2016 and all crashes in 2012–2016), Kansas (covering crashes in 2012–2016), Ohio (covering crashes in 2012–2016), and South Carolina (covering crashes in 2012–2016) were gathered. These five States publish counts of injury and PDO crashes at RRHG crossings and total injury and PDO crashes. From this information, the rates of injury and PDO crashes that occur at RRHG crossings were estimated to be 0.15 percent and 0.16 percent, respectively.

- Method IIB: (II) Use estimates of injury and PDO crashes in each State based on FARS/CRSS ratios (even for States that publish counts of Injury and PDO crashes); (B) multiply those injury and PDO crash counts or estimates by the average RRHG crossing crash rates of the five States who publish data on crashes at RRHG crossings.

The results from these four methods are shown in Table 4.

Table 4. Results of the four methods for estimating the number of injury and PDO crashes at RRHG crossings in each State.

Method	Estimated Annual Injury Crashes at RRHG Crossings	Estimated Annual PDO Crashes at RRHG Crossings
Method IA	2,429.44	6,785.26
Method IB	3,036.62	7,981.14
Method IIA	2,512.29	6,896.02
Method IIB	3,275.81	8,128.03

As shown in Table 4, the differences between the results of the four methods are not very large. From this point forward, we will use the results of Method IA because (a) it is the smallest of the four estimates (and therefore represents the most conservative estimate) and (b) it utilizes the most information of the four methods.

The percentages of injury and PDO crashes involving rear-ended buses and HMVs at RRHG crossings are shown in Table 5, which contains numbers from Table 2. As mentioned earlier, these rates were calculated from GES/CRSS data.

Table 5. Percentages of injury and PDO crashes involving rear-ended buses and HMVs at RRHG crossings, 2007-2016.

Percentage of injury Crashes Involving Rear-Ended Buses at RRHG Crossings	Percentage of PDO Crashes Involving Rear-Ended Buses at RRHG Crossings	Percentage of Injury Crashes Involving Rear-Ended HMVs at RRHG Crossings	Percentage of PDO Crashes Involving Rear-Ended HMVs at RRHG Crossings
4.93%	5.86%	1.84%	1.28%

Multiplying the Method IA results in Table 4 by the rates in Table 5 produces the estimates in Table 6.

Table 6. Estimated annual nationwide injury and PDO crashes involving rear-ended buses and HMVs at RRHG crossings.

Crash Type	Estimated Result
Annual injury crashes involving rear-ended buses at RRHG crossings	119.77
Annual PDO crashes involving rear-ended buses at RRHG crossings	397.62
Annual injury crashes involving rear-ended HMVs at RRHG crossings	44.70
Annual PDO crashes at involving rear-ended HMVs at RRHG crossings	86.85
Total nonfatal crashes involving rear-ended buses or HMVs at RRHG crossings	648.94

2.3 DETERMINING HOW MANY CRASHES AT RRHG CROSSINGS ARE DUE TO 49 CFR 392.10

2.3.1 Total Crashes at RRHG Crossings

The preceding analysis provides annual estimates for each State's fatal, injury, and PDO crashes involving rear-ended buses or HMVs at RRHG crossings. The total number of nonfatal crashes determined in the preceding section is 648.94 (164.47 injury crashes and 484.47 PDO crashes), which is higher than the GES/CRSS data mentioned in Section 2.2 and depicted in Figure 2 (the 2016 total was 154.0 crashes, and the 2007–2016 average was 485.0 crashes). This suggests that merely relying on GES/CRSS data would underestimate the true number of crashes involving rear-ended buses and HMVs at RRHG crossings.

Table 7. Estimated annual crashes involving rear-ended buses and HMVs at RRHG crossings.

Crash Type	Fatal Crashes	Injury Crashes	PDO Crashes	Total Crashes
Crashes involving rear-ended buses at RRHG crossings	0.60	119.77	397.62	518.99
Crashes involving rear-ended HMVs at RRHG crossings	0.80	44.70	86.85	132.35
Total	1.40	164.47	484.47	650.34

2.3.2 Crashes at RRHG Crossings Not Caused by Stopping in Traffic

There are many reasons for crashes, and not all crashes involving rear-ended buses and HMVs at RRHG crossings are completely attributable to the current regulation requiring buses and HMVs to stop at these crossings. Some of these rear-end crashes would likely still occur without this regulation. Vehicles not subject to the rule are also occasionally rear-ended at RRHG crossings, indicating that the rule is not the sole cause of all 650.34 crashes displayed in Table 7.

The following analysis estimates how many fatal crashes involving buses at RRHG crossings would likely be prevented if 49 CFR 392.10 were modified as proposed. An analogous analysis was performed for the other five types of crashes involving rear-ended buses or HMVs at RRHG crossings (fatal crashes involving HMVs, injury crashes involving buses, injury crashes involving HMVs, PDO crashes involving buses, and PDO crashes involving HMVs).

FARS data show that there were an average of 0.9 annual buses in fatal crashes at RRHG crossings from 2007 to 2016, but that 0.3 of those buses were not actually rear-ended.

To estimate how many buses would still be rear-ended in fatal crashes after the proposed amendment to 49 CFR 392.10, we can average the percent of *buses* in fatal crashes at *all locations* that were rear-ended with the percentage of *all vehicles* in fatal crashes at *RRHG crossings* that were rear-ended. Only 15.6 percent of the buses in fatal crashes at all locations were rear-ended, and only 5.3 percent of all vehicles in fatal crashes at RRHG crossings were rear-ended. The average of these rates (10.4 percent) is a reasonable estimate for the percentage of buses in fatal crashes at RRHG crossings that would be rear-ended even if 49 CFR 392.10 were amended as proposed in this report. This leaves us with a pair of related equations:

$$0.30 + x = y$$

$$0.104 * y = x$$

Figure 4. Equations. Equations to determine the annual number of buses and rear-ended buses that would still be in fatal crashes at RRHG crossings if 49 CFR 392.10 were amended.

Where *x* is the annual number of rear-ended buses in fatal crashes at RRHG crossings and *y* is the total annual number of buses in fatal crashes at RRHG crossings predicted to occur if 49 CFR 392.10 were amended.

Solving these equations, we find that *x* = 0.03496 (rounded to 0.03 in row number 9 of Table 8) and *y* = 0.33 (rounded to 0.33 in row number 8 of Table 8).

Results from the above analysis and analogous analyses of the five other crash types are shown in Table 8. The predicted reduction in each of the six types of crashes is in the bottom row.

Table 8. Annual buses and HMVs in crashes at RRHG crossings.

Statistic	Buses in Fatal Crashes	Buses in Injury Crashes	Buses in PDO Crashes	HMVs in Fatal Crashes	HMVs in Injury Crashes	HMVs in PDO Crashes
1. Estimated annual rear-ended buses or HMVs in crashes of this severity at RRHG crossings[a]	0.60	119.77	397.62	0.80	44.70	86.85
2. Percent of buses or HMVs in crashes of this severity at RRHG crossings that were rear-ended[b]	66.7%	100.0%	94.7%	61.5%	100.0%	62.5%
3. Total estimated annual buses or HMVs in crashes of this severity at RRHG crossings (including rear-ended and non-rear-ended vehicles)[c]	0.90	119.77	419.71	1.30	44.70	138.96
4. Non-rear-ended annual buses or HMVs in crashes of this severity at RRHG crossings[d]	0.30	0.00	22.09	0.50	0.00	52.11
5. Percent of buses or HMVs that were rear-ended in crashes of this severity at all locations[e]	15.6%	24.5%	30.7%	13.0%	21.1%	21.8%
6. Percent of all vehicles in crashes of this severity at RRHG crossings that were rear-ended[e]	5.3%	33.7%	34.2%	5.3%	33.7%	34.2%
7. Average of above two rates (a prediction of the percentage of buses or HMVs in crashes of this severity at RRHG crossings that would be rear-ended if they were not required to stop before crossing)	10.4%	29.1%	32.5%	9.1%	27.4%	28.0%
8. Predicted total annual buses or HMVs in crashes of this severity at RRHG crossings if 49 CFR 392.10(b)(3) were amended ("*y*" from Figure 5)[f]	0.33	0.00	32.71	0.55	0.00	72.42

Statistic	Buses in Fatal Crashes	Buses in Injury Crashes	Buses in PDO Crashes	HMVs in Fatal Crashes	HMVs in Injury Crashes	HMVs in PDO Crashes
9. Predicted annual rear-ended buses or HMVs in crashes of this severity at RRHG crossings if 49 CFR 392.10 were amended ("*x*" from Figure 5)[g]	0.03	0.00	10.62	0.05	0.00	20.31
10. Predicted annual non-rear-ended buses or HMVs in crashes of this severity at RRHG crossings if 49 CFR 392.10 were amended[h]	0.30	0.00	22.09	0.50	0.00	52.11
11. Predicted annual reduction in crashes of this severity at RRHG crossings if 49 CFR 392.10 were amended ("Benefits")[i]	0.57	119.77	386.99	0.75	44.70	66.54

[a] The numbers in row 1 are from Table 7.

[b] The numbers in row 2 are from 2007–2016 FARS data for fatal crashes and 2007–2016 unweighted GES/CRSS data for injury and PDO crashes.

[c] The numbers in row 3 are calculated by dividing the numbers in the row 1 by the numbers in row 2.

[d] The numbers in row 4 are calculated by subtracting the numbers in the row 1 from the numbers in row 3.

[e] The numbers in rows 5 and 6 are from 2007–2016 FARS data for fatal crashes and 2007-16 unweighted GES/CRSS data for injury and PDO crashes.

[f] The numbers in row 8 are calculated by solving the two equations mentioned in Section 2.3.2 for y, or, in other words, dividing the numbers in row 4 by (1 minus the numbers in row 7).

[g] The numbers in row 9 are calculated by subtracting the numbers in row 4 from the numbers in row 8.

[h] The numbers in row 10 are calculated by subtracting the numbers in row 9 from the numbers in row 8.

[i] The numbers in row 11 are calculated by subtracting the numbers in row 8 from the numbers in row 3.

[This page intentionally left blank.]

3. POTENTIAL COSTS OF MODIFYING THE RULE: MORE CRASHES INVOLVING TRAINS AND BUSES OR HMV'S

This section estimates the potential costs of modifying the 49 CFR 392.10, to allow drivers of buses and HMVs to obey active traffic control devices and supporting highway signage at actively controlled RRHG crossings, rather than stopping in every instance. These costs would be train-HMV and train-bus crashes in which an active traffic control device malfunctioned, causing a train to collide with a bus or HMV. Three methods were considered.

3.1 METHOD 1: FARS AND GES/CRSS

Every vehicle in FARS and GES/CRSS is coded with a "most harmful event." FARS defines this as "the event during a crash for a particular vehicle that is judged to have produced the greatest personal injury or property damage." One of the options for this variable is a collision with a train. Table 9 provides the numbers of all vehicles, large trucks, buses, and HMVs in fatal, injury, and PDO crashes from 2007 to 2016, along with the corresponding percentages of those crashes in which the most harmful event was a collision with a train. As can be seen in this table, for some crash types (i.e., injury and PDO crashes), zero (0) percent of buses and HMVs had "collision with a train" coded as the most harmful event.

Table 9. Percent of vehicles in crashes with train collision as most harmful event, by vehicle category and crash severity, 2007–16.

Vehicle Type	Vehicles in Fatal Crashes	Percent of Vehicles in Fatal Crashes with Train Collision as Most Harmful Event	Vehicles in Injury Crashes	Percent of Vehicles in Injury Crashes with Train Collision as Most Harmful Event	Vehicles in PDO Crashes	Percent of Vehicles in PDO Crashes with Train Collision as Most Harmful Event
All Vehicles	481,396	0.264%	30,357,544	0.011%	73,672,528	0.011%
Large Trucks	38,880	0.319%	751,316	0.040%	2,909,886	0.082%
Buses	2,517	0.079%	128,459	0.000%	485,422	0.000%
HMVs	1,396	0.143%	12,044	0.000%	24,620	0.000%

The rates for train collisions involving HMVs and buses are considerably lower than the rates for other large trucks and vehicles, which might be due in part to the current regulations.

If buses and HMVs did not have to stop before crossing railroads, the percentage of their crashes with a train collision as the most harmful event would likely increase, perhaps reaching the rates for large trucks or all vehicles shown in Table 9. Although it might seem counterintuitive that a higher percentage of large truck crashes than all vehicle crashes have a train collision as the most harmful event, this is likely a result of safer driving by large truck drivers.[ix] Crashes involving

[ix] For example, compare the rates of large trucks in fatal, injury, and PDO Crashes per 100 Million VMT in 2016

all vehicles involve high rates of unsafe behaviors such as alcohol or drug use, distractions, and speeding more often than crashes involving large trucks. As a result, a higher percentage of large truck crashes involve factors that are not necessarily indicative of unsafe driving, such as train collisions.

Two possibilities (Method 1A and Method 1B) for estimating annual train-bus and train-HMV crashes that would occur if 49 CFR 392.10 were amended as proposed are explored in this section: the percentages of crashes involving buses and HMVs with a train collision as the most harmful event becoming equal to that of (A) all vehicles or (B) all large trucks, using the numbers in Table 9. For example, the 0.08 percent of buses in fatal crashes with a train collision as the most harmful event might increase to the 0.27 percent associated with all vehicles, an increase of 0.19 percentage points. **Error! Reference source not found.**10 shows these calculations for buses and HMVs in fatal, injury, and PDO crashes.

Table 10. Method 1A: Predicted annual percent of buses and HMVs in crashes with train collision as the most harmful event if the 49 CFR 392.10 were modified as proposed and bus and HMV train collision rates became equal to those of all vehicles.

Vehicle Type	Annual Number of Vehicles in Fatal Crashes	Difference Between Train-Collision-as-Most-Harmful-Event Share for All Vehicles and Vehicles of This Type in Fatal Crashes	Annual Number of Vehicles in Injury Crashes	Difference Between Train-Collision-as-Most-Harmful-Event Share for All Vehicles and Vehicles of This Type in Injury Crashes	Annual Number of Vehicles in PDO Crashes	Difference Between Train-Collision-as-Most-Harmful-Event Share for All Vehicles and Vehicles of This Type in PDO Crashes
Buses	251.7	0.18%	12,845.9	0.01%	48,542.2	0.01%
HMVs	139.6	0.12%	1,204.4	0.01%	2,462.0	0.01%

Multiplying the numbers and percentages for each vehicle type and crash severity in Table 10 produces the numbers in Table 11, which represent a prediction of the increase in bus-train and HMV-train crashes that could occur if the percentages of bus and HMV crashes with a train collision as the most harmful event becomes equal to that of all vehicles.

Table 11. Method 1A: Predicted annual increase in bus-train and HMV-train crashes if 49 CFR 392.10 were amended as proposed and bus and HMV train collision rates became equal to those of all vehicles.

Vehicle Type	Vehicles in Fatal Crashes	Vehicles in Injury Crashes	Vehicles in PDO Crashes
Buses	0.46	1.45	5.17
HMVs	0.17	0.14	0.26
Total	**0.63**	**1.59**	**5.43**

---

of 1.46, 38.1, and 134.7, respectively, to the corresponding rates for passenger vehicles of 1.45, 132.5, and 294.5 (*Large Truck and Bus Crash Facts 2016*, Trends Tables 4, 5, 7, 8, 10 and 11). The rates for fatal crash involvement are similar, but large trucks have much lower rates for the other two crash severities, of which there are far more crashes.

As shown inTable 11, for Method 1A, the total predicted annual increase in train-HMV and train-bus crashes if 49 CFR 392.10 were amended as proposed is 7.66 crashes:

- 0.63 fatal crashes (0.46 involving buses and 0.17 involving HMVs).
- 1.59 injury crashes (1.45 involving buses and 0.14 involving HMVs).
- 5.43 PDO crashes (5.17 involving buses and 0.26 involving HMVs).

Table 12 and Table 13 are analogous to Table 10 and Table 11, assuming the percentages of crashes involving buses and HMVs with a train collision as the most harmful event become equal to that of large trucks (rather than all vehicles).

Table 12. Method 1B: Predicted annual percent of buses and HMVs in crashes with train collision as the most harmful event if 49 CFR 392.10 were modified as proposed and bus and HMV train collision rates became equal to those of large trucks.

Vehicle Type	Annual Number of Vehicles in Fatal Crashes	Difference Between Train-Collision-as-Most-Harmful-Event Share for Large Trucks and Vehicles of This Type in Fatal Crashes	Annual Number of Vehicles in Injury Crashes	Difference Between Train-Collision-as-Most-Harmful-Event Share for Large Trucks and Vehicles of This Type in Injury Crashes	Annual Number of Vehicles in PDO Crashes	Difference Between Train-Collision-as-Most-Harmful-Event Share for Large Trucks and Vehicles of This Type in PDO Crashes
Buses	251.7	0.24%	12,845.9	0.04%	48,542.2	0.08%
HMVs	139.6	0.18%	1,204.4	0.04%	2,462.0	0.08%

Table 13. Method 1B: Predicted annual increase in bus-train and HMV-train crashes if 49 CFR 392.10 were amended as proposed and bus and HMV train collision rates became equal to those of large trucks.

Vehicle Type	Vehicles in Fatal Crashes	Vehicles in Injury Crashes	Vehicles in PDO Crashes
Buses	0.60	5.18	39.98
HMVs	0.25	0.49	2.03
Total	**0.85**	**5.66**	**42.01**

Since large truck drivers are currently supposed to slow down before crossing railroads, while most other vehicles are not, an argument could be made for Method 1A over Method 1B. However, since (a) many factors other than suggested slowdown speeds contribute to crash causation, (b) bus and HMV drivers have much more in common with large truck drivers regarding training, experience, and behavior, (c) buses and HMVs likely drive on routes more similar to those of large trucks than all vehicles, and (d) the larger results of Method 1B represent a more conservative option, this report will use the results from Method 1B. As shown in Table 13, for Method 1B, the total predicted annual increase in train-HMV and train-bus crashes is 48.52 crashes:

- 0.85 fatal crashes (0.60 involving buses and 0.25 involving HMVs).
- 5.66 injury crashes (5.18 involving buses and 0.49 involving HMVs).

- 42.01 PDO crashes (39.98 involving buses and 2.03 involving HMVs).

3.2 METHOD 2: UTILIZATION OF FRA DATA ON "CONFIRM NO WARNING" CRASHES AT RRHG CROSSINGS

Information on crashes associated with active traffic control device malfunctions is available through the FRA. FRA has reported data on collisions between trains and motor vehicles, including data on crashes with a "confirm no warning" (suggesting that the warning devices at the crossing were not functioning properly), in an annual report series titled *Railroad Safety Statistics*, the most recent edition of which contains data for 2012.(15) Table 14, below, uses data from *Railroad Safety Statistics* dating back to 1998.(16)

Table 14. FRA data on collisions involving trains and motor vehicles at RRHG crossings, 1998–2012.

Year	Total Crashes Involving Trains and Motor Vehicles at RRHG Crossings	Total Crashes Involving Trains and Motor Vehicles at RRHG Crossings With a "Confirm No Warning"	Percent
1998	1,451	17	1.17%
1999	1,484	19	1.28%
2000	1,494	22	1.47%
2001	1,431	13	0.91%
2002	1,382	17	1.23%
2003	1,332	17	1.28%
2004	1,428	22	1.54%
2005	1,412	21	1.49%
2006	1,382	34	2.46%
2007	1,353	26	1.92%
2008	1,143	46	4.02%
2009	917	27	2.94%
2010	984	34	3.46%
2011	968	21	2.17%
2012	925	23	2.49%
1998-2012 avg.	1,272.40	23.93	1.99%

Notes: The numbers for each year in this table are from the corresponding editions of *Railroad Safety Statistics*, in tables titled "Motor Vehicle HRC Incidents At Public Crossings" (Table 8-15 for the 1998 and 1999 editions, Table 8-16 for the 2000–12 editions). The final edition of this publication seems to be the edition covering 2012. There was an average of 3.07 crashes each year over this period for which it was unknown whether the warning device functioned properly. The 1.99 percent average percent is calculated by averaging the percentages for each year, rather than dividing 23.93 by 1,272.40.

Table 14 shows an annual average of 23.93 crashes involving trains and all motor vehicles (not just buses and HMVs) at RRHG crossings with a "confirm no warning." (Notice that the 10-year total of 12,555 vehicles in crashes of all severities with a train collision as the most harmful indicates a yearly average of 1,255, which is very close to the yearly average of 1,272.40 in Table 14, even though these two numbers come from different sources.) The bottom row in Table 15 allows us to estimate the likely severity of the 23.93 average annual crashes with a "confirm no warning."

Table 15, based on the numbers in the first row of Table 9 (from FARS and GES/CRSS), shows how many vehicles were in crashes with a train collision as the most harmful event. (Notice that the 10-year total of 12,555 vehicles in crashes of all severities with a train collision as the most harmful indicates a yearly average of 1,255, which is very close to the yearly average of 1,272.40 in Table 14, even though these two numbers come from different sources.) The bottom row in Table 15 allows us to estimate the likely severity of the 23.93 average annual crashes with a "confirm no warning."

Table 15. Percent of vehicles in crashes with train collision as most harmful event by injury severity, 2007–16.

Vehicle Type	Vehicles in Fatal Crashes	Vehicles in Injury Crashes	Vehicles in PDO Crashes	Total Vehicles in All Crashes
All vehicles in crashes	481,396	30,354,106	73,664,681	104,500,183
Percent of all vehicles in crashes with train collision as most harmful event	0.26%	0.01%	0.01%	0.01%
All vehicles in crashes with train collision as most harmful event	1,271	3,438	7,847	12,556
Percent of total vehicles in all crashes with train collision as most harmful event	10.12%	27.38%	62.50%	100.00%

Multiplying the 23.93 crashes by the percentage shares in the bottom row of Table 15 produces the following estimates for the total annual number of "confirm no warning" crashes involving a train and any type of motor vehicle by severity:

- 2.42 fatal crashes (23.93 * 10.12 percent).
- 6.55 injury crashes (23.93 * 27.38 percent).
- 14.96 PDO crashes (23.93 * 62.50 percent).

Table 16**Error! Reference source not found.**, also based on Table 9, allows us to estimate the number of buses and HMVs in these crashes.

Table 16. Vehicles in crashes by injury severity, 2007–16.

Vehicle Type	Vehicles in Fatal Crashes	Percent of All Vehicles in Fatal Crashes	Vehicles in Injury Crashes	Percent of All Vehicles in Injury Crashes	Vehicles in PDO Crashes	Percent of All Vehicles in PDO Crashes
Buses	2,517	0.52%	128,459	0.42%	485,422	0.66%
HMVs	1,396	0.29%	12,044	0.04%	24,620	0.03%
Sum of Buses and HMVs	3,913	0.81%	140,503	0.46%	510,042	0.69%
All Vehicles	481,396	100.00%	30,357,544	100.00%	73,672,528	100.00%

As shown in in Table 16, buses and HMVs combined accounted for 0.81 percent of the vehicles in fatal crashes, 0.46 percent of the vehicles in injury crashes, and 0.69 percent of the vehicles in PDO crashes from 2007 to 2016. If those rates also apply to the 23.93 crashes involving malfunctioning RRHG crossing signals, these are the estimated annual numbers of crashes involving HMVs or buses struck by a train at a RRHG crossing with malfunctioning warning devices:

- 0.02 fatal crashes (2.42 * 0.81 percent).
- 0.03 injury crashes (6.55 * 0.46 percent).
- 0.10 PDO crashes (14.96 * 0.69 percent).

These results (0.15 total crashes) are significantly lower than the estimates derived using Method 1A, Method 1B, or Method 3, below.

3.3 METHOD 3: FRA DATA ON TRAIN CRASHES AT RRHG CROSSINGS AND INJURIES AND DEATHS

FRA publishes a "Ten Year Accident / Incident Overview" on its website, which includes counts of "highway-rail incidents," "highway-rail incidents deaths," and "highway-rail incidents injuries."(17) FRA defines an incident as "any impact between a rail and highway user (both motor vehicles and other users of the crossing as [sic] a designated crossing site, including walkways, sidewalks, etc., associated with the crossing)."(18)

From 2009 to 2017, the average annual number of "incidents" at RRHG crossings was 2,076.4, with 1,780 of these occurring at public crossings. The average annual number of highway-rail deaths was 249.2, and the average annual number of highway-rail injuries was 915.4. However, it is unclear from these statistics how many of these incidents actually involved collisions with motor vehicles at RRHG crossings; many probably only involved collisions with pedestrians. *Railroad Safety Statistics* provides annual counts of collisions between trains (or "rail equipment") and motor vehicles through 2012, which can be divided by the total number of incidents at RRHG crossings to estimate the percentage of incidents that actually involved motor vehicles. After performing this analysis for 2009 through 2012, we estimate that about 76.2 percent of the incidents involve collisions between motor vehicles and trains, with most of the rest likely involving collisions between trains and pedestrians, animals, trees, or other rail equipment.

If that rate applies to the 2017 highway-rail crashes, fatalities, and injuries, it suggests there were about 1,617.5 collisions between trains and motor vehicles in 2017, which would have resulted in 206.6 fatalities and 642.6 non-fatal injuries. We equate these numbers to 206.6 fatal crashes, 642.6 injury crashes, and 768.3 (1,617.5 – 206.6 – 642.6) PDO crashes involving collisions between trains and motor vehicles at RRHG crossings in 2017. Multiple fatalities and injuries can occur in a single crash, but we use a conservative estimate (the largest possible estimate) for the numbers of crashes with trains by assuming only one fatality per fatal crash and one injury per injury crash.

For the sake of simplicity, we assume that train-motor vehicle crashes involve only one motor vehicle and that the percentage of these crashes that involved buses or HMVs would therefore be approximately equal to the percentage of vehicles in crashes that were buses or HMVs. We can then apply the rates in Table 16**Error! Reference source not found.** to determine the following counts of train-bus and train-HMV crashes that are prevented by the current regulations:

- 1.67 fatal crashes (206.6 * 0.81 percent).
- 2.96 injury crashes (642.6 * 0.46 percent).
- 5.30 PDO crashes (768.3 * 0.69 percent).

The total is 9.93 crashes prevented.

3.4 CHOOSING BETWEEN THE RESULTS OF METHODS 1, 2, AND 3

The methods detailed above yielded the following estimates of annual bus and HMV crashes with trains due to malfunctioning signals that are currently prevented by the stopping requirements of 49 CFR 392.10 but would begin to occur if the amendment were adopted:

- Method 1A: 7.66 annual bus and HMV crashes.
- Method 1B: 48.52 annual bus and HMV crashes.
- Method 2: 0.15 annual bus and HMV crashes.
- Method 3: 9.93 annual bus and HMV crashes.

Method 2, which only counted crashes in which the signals were determined to have malfunctioned, stands out for producing results much lower than the other methods. Motor vehicles can certainly be involved in crashes with trains for reasons other than malfunctioning signals, and crashes can have multiple contributing factors. Crashes caused by factors other than malfunctioning signals would be more likely to be counted by the other methods.

One could argue that bus and HMV drivers are better drivers and therefore less likely to take risks than a typical passenger vehicle driver (see, for example, the footnote in Section 3.1), but to be conservative, Method 1B's results, which are the largest overall (though Method 3's results for fatal crashes were about twice as large as Method 1B's), will be used in the final analysis of this report. As shown in Table 17, they are still significantly lower than the prevented crashes estimated in Section 2.

Table 17. Estimated annual impact of amending 49 CFR 392.10 as proposed.

Crash Type	Crashes Prevented (results from Table 8, which had the smallest numbers of the four methods analyzed)	New Crashes (results from Table 13, which had the largest numbers of the four methods analyzed)	Net Change in Crashes
Fatal bus crashes	0.57	0.60	0.04
Injury bus crashes	119.77	5.18	-114.59

Crash Type	Crashes Prevented (results from Table 8, which had the smallest numbers of the four methods analyzed)	New Crashes (results from Table 13, which had the largest numbers of the four methods analyzed)	Net Change in Crashes
PDO bus crashes	386.99	39.98	-347.01
Fatal HMV crashes	0.75	0.25	-0.50
Injury HMV crashes	44.70	0.49	-44.22
PDO HMV crashes	66.54	2.03	-64.51
Total	**619.32**	**48.52**	**-570.80**

[This page intentionally left blank.]

4. OTHER INFORMATION

4.1 ANECDOTAL EVIDENCE OF POTENTIAL BENEFITS

At least 1 bus and 12 HMVs were rear-ended while stopping at a particularly dangerous RRHG crossing on US-90 in Iberia Parish, Louisiana from 2011 to 2015 (an annual average of 2.6 crashes), causing the Louisiana Department of Transportation and Development to undertake a study of how to remedy the situation.[19] The analysis performed in Section 2.2 produced an estimated annual average of 16.4 of these crashes in all of Louisiana.

This particular Iberia Parish RRHG crossing is especially problematic because of a 65 mi/h speed limit on that stretch of highway, but many other RRHG crossings nationwide also have high speed limits: FARS data indicate that 19.8 percent of the vehicles in fatal crashes at RRHG crossings from 2007 to 2016 were on roads with a speed limit of 55 mi/h, and 4.2 percent were on roads with higher speed limits.

4.2 EVIDENCE THAT SOME STATES ARE NOT ENFORCING 49 CFR 392.11

Anecdotal evidence (i.e., unofficial reports) suggests that some States are not enforcing 49 CFR 392.11. That is, some States may be tacitly allowing drivers of all other CMVs (but not necessarily HMVs and buses) to proceed at speed over actively controlled RRHG crossings when the active traffic control device does not indicate the presence or approach of a train.

According to the American Automobile Association's *Digest of Motor Laws*, the majority of State-specific railroad crossing regulations do not specify that drivers of CMVs must slow down at RRHG crossings.[(20)] A few exceptions include Colorado, Maine, and Massachusetts, which require drivers of all motor vehicles to slow down to a "reasonable" speed at RRHG crossings, and Florida, which requires drivers of commercial vehicles to slow down at RRHG crossings. Industry safety guidance for professional truck drivers recommends that drivers should slow down at tracks with a crossbuck only (with no flashing lights or gate), but to "know the regulations in the states where you operate" when dealing with active signal devices at RRHG crossings.[(21)]

Finally, a cursory review of the Motor Carrier Management Information System (MCMIS) data for 2011–17 shows that there have been fewer than 100 RRHG crossing violations (i.e., 392.2RR violations) for drivers of non-HM large trucks and buses each year since 2011. When compared with the roughly 114,000 violations received by non-HM large truck and bus drivers for speeding each year,[(22)] this suggests that whatever laws that apply to large truck speeds near RRHG crossings may not be strictly enforced.

The evidence above suggests that many State enforcement agencies expect CMV drivers to rely on active traffic control devices and supporting highway signage at actively controlled RRHG crossings, rather than slowing down sufficiently to be able to stop in every instance. It was outside the scope of this study to explore modification of 49 CFR 392.11, but given this evidence and the findings from this study, it may be worth conducting additional research specific to this regulation.

5. CONCLUSIONS

As described in Section 1 of this report, 49 CFR 392.10 requires drivers of buses and HMVs to stop at all RRHG crossings. An exception to this requirement, under 49 CFR 392.10(b)(3), allows these drivers to proceed without slowing or stopping if the crossing has an active traffic control device that transmits a green indication when safe to cross. However, the vast majority of railroad-highway active traffic control devices do not use green indications. This effectively means that drivers of buses and HMVs must stop at virtually all actively controlled RRHG crossings.

Stopping at RRHG crossings, especially on high-speed divided highways, has been identified as a potential crash hazard, with concerns that vehicles can be involved in rear-end crashes while stopped. The regulation cited above was formulated in the mid-twentieth century at a time when most RRHG crossings were un-gated. Since then, strides have been made to identify and control RRHG crossings with sophisticated arm and light systems. The goal of this study was to estimate the costs and benefits associated with modifying 49 CFR 392.10, to allow drivers of buses and HMVs to obey active traffic control devices (not just those that transmit a green indication) and supporting highway signage at actively controlled RRHG crossings, rather than stopping in every instance.

5.1 COSTS AND BENEFITS OF AMENDING 49 CFR 392.10

Findings indicate that the potential benefits of modifying 49 CFR 392.10 as proposed in this report significantly outweigh the potential new costs. As shown in Table 18, potential benefits include decreased fatalities, injuries, and property damage resulting from rear-end crashes involving HMVs and buses at RRHG crossings. Potential costs would result from increased train-HMV or train-bus crashes attributable to malfunctioning railroad-highway active traffic control devices.[x]

Table 18. Estimated annual impact of amending 49 CFR 392.10 as proposed.

Crash Type	Estimate of Crashes Prevented	Estimate of New Crashes	Estimated Net Change in Crashes	Estimated Cost per Crash	Value of Net Change in Crashes
Fatal bus crashes	0.57	0.60	0.04	$11,496,000	$-433,434
Injury bus crashes	119.77	5.18	-114.59	$472,000	$54,088,360
Property damage only bus crashes	386.99	39.98	-347.01	$75,000	$26,025,913
Fatal HMV crashes	0.75	0.25	-0.50	$11,496,000	$5,798,866
Injury HMV crashes	44.70	0.49	-44.22	$472,000	$20,870,092
Property-damage-only HMV crashes	66.54	2.03	-64.51	$75,000	$4,838,314
Total	**619.32**	**48.52**	**-570.80**	**n/a**	**$111,188,110**

[x] Traffic controls (active and passive) at RRHG crossings are installed and maintained by the railroads and State highway/local street agencies. They are thus outside FMCSA's and FHWA's jurisdictions.

5.2 LIMITATIONS

This study examines data on some very specific crash types which often cannot be accurately determined using the existing national crash databases. For example, rear-ended buses and HMVs at RRHG crossings can only be reliably identified in one annual national dataset (FARS), which only includes fatal crashes. This report uses some complex methods, incorporating data from many sources, to estimate injury and towaway crashes of this type. The results of this analysis depend heavily on the four rates presented in Table 5, each of which are ratios of roughly 5 to 20 crashes out of about 300 in the GES and CRSS data from 2007 to 2016. Those rates depend, to some extent, on the locations sampled in GES and CRSS, and it is possible that a different sampling of RRHG crossings would produce significantly different rates.

There are many different types of RRHG crossings; some have only passive signage, while others have various types of active signage. State regulations sometimes make distinctions between how non-commercial and commercial drivers should proceed across the different types of RRHG crossings, in addition to the requirements of bus and HMV drivers examined in this report. But most of the crash data does not distinguish between the different types of RRHG crossings or different rules applying to drivers in different States.

To estimate many of the costs and benefits of 49 CFR 392.10, it is necessary to assume a hypothetical state of the world in which buses and HMVs do not have to stop before proceeding across RRHG crossings. There are many ways this analysis could be performed; this report provided four methods, which had significantly different results.

To account for these limitations, the final analysis of this report used (a) the benefit estimation method with the smallest results of the four methods presented in Table 4 and (b) the cost estimation method with the largest results of the four methods presented in Section 3.4, and the predicted change in crashes was still a reduction of 570.8 crashes per year.

5.3 DISCUSSION

Anecdotal evidence suggests that some States are not enforcing 49 CFR 392.11. That is, some States may be allowing drivers of CMVs to proceed at speed through actively controlled RRHG crossings (when a train's presence is not indicated) without issuing violations for this behavior. This is consistent with the majority of State RRHG regulations, which do not specifically state that commercial vehicles should always slow down (enough to be able to stop) at actively controlled RRHG crossings.[23] Separately, industry safety guidance suggests that truck drivers should "know the regulations in the States where [they] operate," when dealing with active signal devices at RRHG crossings.[24] Finally, RRHG crossing violation rates are extremely low nationwide, which suggests that some States may not be strictly enforcing 49 CFR 392.11. It was outside the scope of this study to explore modification of 49 CFR 392.11, but given this evidence and the findings from this study, it may be worth conducting additional research specific to this regulation.

5.4 CONCLUSION

Study findings suggest that the safety benefits of modifying 49 CFR 392.10 as proposed would significantly outweigh the costs, resulting in approximately 570 fewer crashes per year. This translates to an annual net reduction of approximately $110 million in crash costs.

[This page intentionally left blank.]

REFERENCES

[1] Digest of Motor Laws: Railroad Crossing, United States. (n.d.) American Automobile Association (AAA). Retrieved from: https://drivinglaws.aaa.com/tag/railroad-crossing/

[2] Operation Lifesaver (n.d.). Stay Alive When You Drive: Highway-Rail Grade Crossing Training for Professional Truck Drivers. Retrieved from: https://oli.org/images/page/OLTDGuide15stayalive(1).pdf

[3] "Motor Carrier Act (1935)." Major Acts of Congress. Retrieved December 12, 2018, from Encyclopedia.com: https://www.encyclopedia.com/history/encyclopedias-almanacs-transcripts-and-maps/motor-carrier-act-1935

[4] George, John J. (1936). Federal Motor Carrier Act of 1935. *Cornell Law Review*, *21*(2). Retrieved from: http://scholarship.law.cornell.edu/clr/vol21/iss2/2

[5] Safety Regulations: Rules and Regulations Governing Qualifications of Employees and Safety of Operation and Equipment of Common Carriers and Contract Carriers by Motor Vehicle, 2 Fed. Reg. 113 (January 22, 1937). Retrieved from: https://www.loc.gov/item/fr002014/

[6] Proposed Safety Regulations of the Interstate Commerce Commission, Applicable to Motor Carriers Subject to the Motor Carrier Act, 1935, 1 Fed. Reg. 738 (proposed July 8, 1936). Retrieved from: https://www.loc.gov/item/fr001083/

[7] Safety Regulations: Rules and Regulations Governing Qualifications of Employees and Safety of Operation and Equipment of Common Carriers and Contract Carriers by Motor Vehicle, 2 Fed. Reg. 113 (January 22, 1937). Retrieved from: https://www.loc.gov/item/fr002014/

[8] Railroad crossings. 49 C.F.R. § 193.14 (1938). Retrieved from: https://heinonline.org/HOL/P?h=hein.cfr/cfr1938216&i=873

[9] Subchapter B—Carriers by Motor Vehicle: Parts 190-197—Safety Regulations. 17 Fed. Reg. 4423 (May 15, 1952). Retrieved from: https://www.govinfo.gov/content/pkg/FR-1952-05-15/pdf/FR-1952-05-15.pdf

[10] Title 49—Transportation, Chapter X—Interstate Commerce Commission: Republication and Redesignation of Regulations. 32 Fed. Reg. 20003 (December 20, 1967). Retrieved from: https://www.govinfo.gov/content/pkg/FR-1967-12-20/pdf/FR-1967-12-20.pdf

[11] Chapter III—Federal Highway Administration, Department of Transportation: Establishment of Chapter. 33 Fed. Reg. 19700 (December 25, 1968). Retrieved from: https://www.loc.gov/item/fr033250/

[12] Part 392: Driving of Motor Vehicles, 33 Fed. Reg. 19732 (December 25, 1968). Retrieved from: https://www.loc.gov/item/fr033250/

[13] Federal Railroad Administration (2012). Railroad Safety Statistics: 2010 Annual Report, Table 9-2. Washington, DC: Federal Railroad Administration. Retrieved from: https://safetydata.fra.dot.gov/officeofsafety/publicsite/publications.aspx

[14] U.S. Census Bureau (2010). Census Resident Population Data; 2016 Annual Estimates of the Resident Population: April 1, 2010, to July 1, 2016.

[15] Federal Railroad Administration (2012).

[16] FRA Publications. (n.d.) Federal Railroad Administration, Office of Safety Analysis. Retrieved from: https://safetydata.fra.dot.gov/officeofsafety/publicsite/publications.aspx

[17] 1.12 – Ten Year Accident/Incident Overview (2018, September 30). Federal Railroad Administration, Office of Safety Analysis. Retrieved from: https://safetydata.fra.dot.gov/OfficeofSafety/publicsite/Query/TenYearAccidentIncidentOverview.aspx

[18] 9.12 – Definitions. (n.d.) Federal Railroad Administration, Office of Safety Analysis. Retrieved from: https://safetydata.fra.dot.gov/officeofsafety/publicsite/definitions.aspx

[19] Louisiana Department of Transportation and Development (October 2016) Study & Feasibility Report for US Hwy 90 and LDRR At-Grade Crossing, Iberia Parish.

[20] Digest of Motor Laws: Railroad Crossing, United States. (n.d.) American Automobile Association (AAA). Retrieved from: https://drivinglaws.aaa.com/tag/railroad-crossing/

[21] Operation Lifesaver (n.d.). Stay Alive When You Drive: Highway-Rail Grade Crossing Training for Professional Truck Drivers. Retrieved from: https://oli.org/images/page/OLTDGuide15stayalive(1).pdf

[22] Federal Motor Carrier Safety Administration. (2018). Pocket Guide to Large Truck and Bus Statistics, 2018, Table 2-10: Most Frequent Driver Violations in Inspections, 2017. Retrieved from: https://www.fmcsa.dot.gov/sites/fmcsa.dot.gov/files/docs/safety/data-and-statistics/413361/fmcsa-pocket-guide-2018-final-508-compliant-1.pdf

[23] Digest of Motor Laws: Railroad Crossing, United States. (n.d.) American Automobile Association (AAA). Retrieved from: https://drivinglaws.aaa.com/tag/railroad-crossing/

[24] Operation Lifesaver (n.d.). Stay Alive When You Drive: Highway-Rail Grade Crossing Training for Professional Truck Drivers. Retrieved from: https://oli.org/sites/default/files/2019-09/OLI-DriverGuide-stayalive.pdf