REGULATORY IMPACT ANALYSIS OF ELECTRONIC ON-BOARD RECORDERS

Federal Motor Carrier Safety Administration

October 5, 2009

Exhibits

Abbreviations

CMV	Commercial Motor Vehicle
EOBR	Electronic On-Board Recorder
FMCSA	Federal Motor Carrier Safety Administration
FMS	Fleet Management System
HOS	Hours of Service
LH	Long Haul
MCMIS	Motor Carrier Management Information System
NPRM	Notice of Proposed Rule-Making
PIN	Personal Identification Number
RIA	Regulatory Impact Analysis
RODS	Record Of Duty Status
SH	Short Haul
VIUS	Vehicle Inventory and Use Survey

Executive Summary

This Regulatory Impact Analysis (RIA) provides an assessment of the costs and benefits of requiring motor carriers to use electronic on-board recorders (EOBRs) to track driving and duty time. The FMCSA is setting this requirement to improve compliance with the hours of service (HOS) limits on commercial motor vehicle (CMV) drivers. EOBRs track driving time and other activities electronically, providing largely the same information currently collected on paper record of duty status (RODS).

A notice of proposed rulemaking (NPRM) for EOBRs for HOS compliance was published on January 18, 2007 [72 FR 2374]. The RIA prepared in support of that proposal examined three options that differed based solely on the number and type of regulated entities that would be subject to mandatory EOBR use. Under the first option, the entire interstate trucking population would be required to use EOBRs, including those vehicles and drivers involved in short-haul (SH) and long-haul (LH) operations subject to HOS regulation (Universal Mandate). The second option would mandate EOBR use for all LH trucks and drivers operating in interstate commerce (LH Only). The third option would mandate EOBR use for a relatively small population of companies and drivers with a recurrent HOS compliance problem, consisting of those carriers determined – based on HOS records reviewed during each of two compliance reviews conducted within a 2-year period – to have had a 10 percent or greater violation rate ("pattern violation") for any regulation in proposed Appendix C to Part 385 of Title 49, CFR (“2x10 Remedial Directive Carriers”).

In the NPRM, FMCSA proposed mandating EOBR installation, maintenance, and use for the third option, the 2x10 Remedial Directive Carriers. The FMCSA determined that an approach designed to target only HOS violators would (1) be most likely to improve the safety of the motoring public on the highways in the near term, and (2) effectively utilize motor carrier and Federal and State enforcement resources. The NPRM therefore focused on which of several options, limited to mandatory-installation triggers designed to single out motor carriers that have a demonstrated history of poor HOS compliance, would be most appropriate. Based on a variety of considerations, FMCSA proposed a 2x10 trigger.

The FMCSA estimated at the time that approximately 465 remedial directives would be issued annually. The Agency stated that this relatively small carrier population, with its severe and recurring HOS compliance deficiencies, poses a disproportionate risk to public safety. Therefore, mandatory EOBR installation and use by this narrow subset of carriers would be considered to be an appropriate and resource-effective means of promoting motor carrier safety.

However, numerous commenters to the NPRM stated that the proposal would not mandate EOBR use by a sufficiently large number of motor carriers relative to the total population to make a meaningful difference in highway safety outcomes. After reconsidering the discussion in the NPRM, and based on comments received, FMCSA examined two regulatory options for the final rule – the 2x10 remedial directive proposed in the NPRM, and a considerably broader and more stringent 1x10 remedial directive. Under a 1x10 remedial directive, motor carriers with a 10 percent violation rate of any HOS Appendix C regulations in any single compliance review would be subject to a remedial directive. It is estimated that over 2,800 motor carriers would be subject to the 1x10 remedial directive annually. This RIA examines the costs and benefits of the two regulatory options described above.

The FMCSA cannot extend the EOBR mandate beyond those covered by the final rule because the scope of the current rulemaking is limited to compliance-based regulatory approaches, implemented through a remedial directive. However, FMCSA will examine the issue of a broader mandate under a new rulemaking proceeding in the near future.

Cost information was gathered from publicly available marketing materials and contact with EOBR vendors. This analysis focuses on the least expensive device determined to be compliant with the rule.[1] We do not expect all carriers will use this specific device, only that it represents a device at the low end of the cost range of an EOBR that the Agency believes would be compliant with the provisions of the final rule. Benefit estimates include safety benefits from improved HOS compliance and the reduction of certain paperwork costs brought about with EOBR use.

For many carriers, this rule would not require new equipment. Some carriers already use onboard systems with EOBR functionality or Automatic On-Board Recording Devices (AOBRDs) and AOBRDs with enhanced functionality, which the rule will allow them to continue using provided certain conditions are met. These carriers are excluded from cost and benefit calculations when appropriate, but are still included in the affected population for calculating per power unit numbers. Cost estimates are lower for carriers that employ Fleet Management Systems (FMS) capable of fulfilling this rule’s requirements with the activation of available hardware or software functions.

Costs were estimated on an annualized basis over a ten-year horizon. Costs and benefits that accrue throughout the year are presented at their present value at the beginning of the year. Training time costs for drivers, office staff, and state enforcement personnel were estimated. The analysis estimates the cost to carriers of coming into compliance with HOS and corresponding safety benefits as induced through EOBR use. Cost savings on paper log purchase, use, and processing are also assessed.

Safety benefits of EOBR use are assessed by estimating reductions in HOS violations and resulting reductions in fatigue-related crashes. Other non-safety health effects (positive and negative) for drivers, as a result of the potential decreased driving time based on increased pressure on drivers to comply with the HOS regulations, are considered but not quantified in this analysis.

Finally, we analyze the sensitivity of the estimates to assumptions of the discount rate used to calculate present values and other key assumptions.

The estimates of the total annualized net benefits discounted at a 7 percent rate are presented in Exhibit ES-1 and ES-2.

Of the two regulatory options, Regulatory Option 1 (1x10 Remedial Directive) yields higher total net benefits. Although Regulatory Option 2 (2x10 Remedial Directive) performs better on a per power unit basis, the small number of carriers affected results in small total net benefits.

[1] The least expensive device that satisfies the requirements of the rule was found to be the RouteTracker sold by Turnpike Global. Cost data are based on the use of this device with the Sprint network.

Exhibit ES-1. Total Annual Net Benefits (millions)

	Regulatory Option 1: 1X10 Remedial Directive	Regulatory Option 2: 2X10 Remedial Directive
Total Costs	($138)	($14)
Total Benefits	$182	$22
Net Benefits	$44	$8

Exhibit ES-2. Annual Net Benefits per Power Unit

	Regulatory Option 1: 1X10 Remedial Directive	Regulatory Option 2: 2X10 Remedial Directive
Total Costs	($993)	($1,054)
Total Benefits	$1,311	$1,662
Net Benefits	$318	$608

Additionally, the overall crash rates of Option 1 and Option 2 motor carriers are considerably higher than the crash rates of the general motor carrier population. Using data from the FMCSA Motor Carrier Management Information System (MCMIS) and compliance review databases, crash rates were computed by dividing total crashes by each carrier's number of power units. Crash rates were compared between the Option 1 and 2 motor carrier populations and motor carriers in the general population. Option 1 motor carriers were found to have a 40 percent higher crash rate than the general motor carrier population, and Option 2 motor carriers a 90 percent higher crash rate than the general motor carrier population. The final rule's application of a remedial directive to the Option 1 motor carriers is an appropriate and resource-effective means of promoting motor carrier safety, and provides considerably higher net benefits to society when compared to the Option 2 motor carriers as proposed in the NPRM.

1 Background

This Regulatory Impact Analysis (RIA) provides an assessment of the costs and benefits of requiring motor carriers to use electronic on-board recorders (EOBRs) to track driving, on-duty, off-duty, and sleeper berth time. This requirement would be set primarily to improve compliance with the hours of service (HOS) limits on commercial motor vehicle (CMV) drivers. EOBRs track driving time and other activities electronically, providing similar information to the currently used paper record of duty status (RODS). However, use of EOBR technology would significantly reduce or eliminate false or erroneous driving time records, and could reduce false or erroneous on-duty, off-duty, and sleeper-berth entries. Motor carriers, including regulated buses, are currently permitted to use automatic on-board recording technology to record hours of service, but the costs and benefits of this use for all motor carriers had not been estimated.

Short Haul (SH) operations for vehicles are defined as those that occur within 150 air-miles of their base, and Long Haul (LH) operations for vehicles are defined as those that occur outside of the 150 air-mile radius. The SH and LH group together is the entire regulated freight and passenger transporting population subject to HOS regulations. Carriers in this group are subject to HOS provisions, but drivers are generally not required to keep RODS if they work less than 12 hours a day, start and stop at the same location, and operate within a 100-air mile radius (under the provisions of § 395.1(e)(1)) or operate certain vehicles within a 150-air mile radius (under the provisions of § 395.1(e)(2)).[2] The LH group excludes drivers operating within 150 air-miles of their base. The carrier groups are defined in greater detail in Section 2.

A notice of proposed rulemaking (NPRM) for EOBRs for HOS compliance was published on January 18, 2007, and the RIA prepared in support of that proposal examined three options that differed based solely on the number and type of regulated entities that would be subject to mandatory EOBR use. Under the first option, the entire interstate trucking population would be required to use EOBRs, including those vehicles and drivers involved in SH and LH operations subject to HOS regulation (Universal Mandate). The second option would mandate EOBR use for all LH trucks and drivers operating in interstate commerce (LH Only). The third option would mandate EOBR use for a relatively small population of companies and drivers with a recurrent HOS compliance problem, consisting of those carriers determined – based on HOS records reviewed during each of two compliance reviews conducted within a 2-year period – to have had a 10 percent or greater violation rate ("pattern violation") for any regulation in proposed Appendix C to Part 385 of Title 49, CFR (“2x10 Remedial Directive Carriers”).

In the NPRM, FMCSA proposed mandating EOBR installation, maintenance, and use for the 2x10 Remedial Directive Carriers. If adopted, FMCSA estimated at that time that approximately 465 remedial directives would be issued annually. The Agency stated that this relatively small carrier population, with its severe and recurring HOS compliance deficiencies, poses a disproportionate risk to public safety. Therefore, mandatory EOBR installation and use by this narrow subset of carriers would be considered to be an appropriate and resource-effective means of promoting motor carrier safety.

[2] These SH drivers are allowed to substitute time-cards for RODS.

There are notable differences between this RIA and the RIA prepared for the NPRM. This RIA adds estimates of costs and benefits of a second remedial directive option that was considered at the NPRM stage, but that was not evaluated in the RIA accompanying the NPRM. This additional regulatory option includes a considerably larger number of potentially-regulated motor carriers due to more stringent selection criteria. Due to uncertainties regarding the final technical requirements, the previous analysis considered three estimates for EOBR device costs. Now that the technical requirements are finalized, only one cost estimate is provided, based on the least expensive device found on the market. This device is less expensive than the previous "low cost" estimate. Also, per new DOT guidance issued in February 2008, safety benefits are adjusted for a higher Value of a Statistical Life (VSL).[3]

This RIA develops estimates of the net quantifiable benefits through a series of steps, each of which is in explained in some detail in the remaining chapters. Following the presentation of the net benefit estimates, several sensitivity analyses show how the results would be affected by the consideration of alternative assumptions. The last section of the RIA assesses the impacts of an EOBR requirement on small entities. Two appendices are attached, covering additional details for some of the calculations used in the analysis.

1.1 Purpose and Need for Proposed Action

The goal of the HOS regulations (49 CFR Part 395) is to promote safe driving of commercial vehicles by limiting on-duty and driving time and ensuring that drivers have adequate time to rest. The FMCSA conducts regular checks, at the roadside and during compliance reviews, to ensure that drivers are operating within the HOS limits. Surveys have shown, however, that many commercial vehicle drivers violate HOS limits, and that many also falsify their paper RODS to give the appearance of legal operation. The National Transportation Safety Board and safety advocacy groups have recommended mandatory use of on-board HOS recording devices as a way to increase compliance with HOS regulations.

Since 1988, motor carriers have had the option of using automatic on-board recording devices (AOBRDs), which perform functions similar to EOBRs. One carrier has been using an EOBR-like system under a pilot program. Some carriers in the U.S. already use fleet management systems (FMS) that have the capability to generate electronic HOS logs, although most carriers do not yet use this functionality.

1.2 New Standards for EOBRs

The technical requirements for EOBR devices are key to understanding the total purchase, installation, and operating cost of each unit. Standards for EOBR equipment will require devices to have the following capabilities:

- Record driver identification
- Show vehicle location, updated at least one time per hour
- Produce records for audit
- Produce information on HOS compliance for roadside inspections

[3] Office of the Secretary of Transportation, Treatment of the Economic Value of a Statistical Life in Departmental Analyses. Available at: http://ostpxweb.dot.gov/policy/reports/080205.htm (Accessed 5/27/2008).

- Give a signal as a driver approaches HOS limits
- Be integrally synchronized with the vehicle, that is, record the engine use status from sources internal to the vehicle.

1.3 Regulatory Options

For this RIA, we have examined two regulatory options that use violation-based triggers. The number of regulated entities that would be subject to mandatory EOBR installation, maintenance, and use in these options differ based on the criteria used to select them for the remedial directive. This RIA examines the costs and benefits of the regulatory options described as follows:

- Option 1: Mandate EOBR use for companies and drivers with a 10 percent or greater violation rate ("pattern violation") for any regulation in proposed Appendix C to Part 385 of Title 49, CFR in any single compliance review ("1x10 Remedial Directive Carriers"). It is estimated that over 2,800 motor carriers would be subject to the 1x10 remedial directive annually.
- Option 2: Mandate EOBR use for companies and drivers with a recurrent HOS compliance problem, consisting of those carriers determined – based on HOS records reviewed during each of two compliance reviews conducted within a 2-year period – to have had a 10 percent or greater violation rate ("pattern violation") for any regulation in proposed Appendix C to Part 385 of Title 49, CFR ("2x10 Remedial Directive Carriers"). It is currently estimated that approximately 475 remedial directives would be issued annually.

The NPRM proposal focused on violation-based triggers. The final rule adopts a violation-based trigger for mandatory EOBR installation, maintenance, and use. As noted above, this approach best utilizes motor carrier, Federal, and State enforcement resources within the scope of the NPRM.

The FMCSA cannot extend the EOBR mandate beyond that covered by the final rule because the scope of the current rulemaking is limited to compliance-based regulatory approaches, implemented through a remedial directive. However, FMCSA will examine the issue of a broader mandate under a new rulemaking proceeding in the near future.

1.4 Baseline for the Analysis

This analysis was conducted under the assumption that the motor carrier industry is operating under the HOS regulations that were promulgated in April 2003. A new rule was published in August 2005. Differences between the 2003 and 2005 rules include a relaxation of RODS requirements for SH motor carriers, an allowance for a 16-hour duty window for certain SH carriers twice per week, and a revision to the split sleeper berth provision. The baseline of 2003 and not 2005 is used because the 2003 RIA includes a partial compliance baseline not analyzed for the 2005 rule.

Although it is assumed that the industry operates under the 2003 rules, full compliance is not assumed. Complete compliance was assumed for analytical purposes when the RIAs for the 2003 and 2005 HOS rules were conducted, though it was recognized that this assumption was not completely realistic. Rather, full compliance was assumed to ensure that the estimated costs of the 2003 HOS rule changes were not understated and because this type of assumption is standard for regulatory cost analyses. An assumption of full compliance is, however, self-defeating in analyzing a rule whose sole purpose is to increase compliance. Instead, it is necessary to assume a realistic degree of non-compliance, and then assess the degree to which the rule will move the affected population toward full compliance.

Determining the true degree of non-compliance is difficult, largely because operators who violate the regulations have a strong incentive to disguise that fact. Roadside surveys conducted by the Insurance Institute for Highway Safety (IIHS)[4] and by the Commercial Vehicle Safety Alliance (CVSA)[5] have indicated that compliance has not improved since the 2003 rule, but it is still not possible to determine the level of non-compliance. As an approximation to the degree of non-compliance, we use a scenario developed for the RIA of the 2003 HOS rule. That scenario, called the "status quo baseline," was intended to represent realistic levels of compliance with rules in effect before 2003. Its characteristics were based on survey data collected anonymously at truck stops. The 2003 HOS RIA presented estimates of both the costs and safety benefits of shifting carriers from the status quo baseline to a situation of full compliance with the 2003 rules. Under the assumption that the violators of the 2003 rules operate similarly to the violators of the pre-2003 rules, we can use the status quo baseline to represent the current baseline for this rule. Similarly, we can use the estimated costs and benefits of moving from the status quo to full compliance with the 2003 rule as a measure of the effects of enforcing full compliance for this EOBR rule.

Another issue with the use of these data is that they assume that the status quo has not changed since the introduction of the 2003 HOS rule. While it seems reasonable that carriers that are willing to operate out of compliance have not changed their behavior from that assumed in the 2003 status quo baseline, any carriers that adhere closely to the HOS rules and operate close to the limits likely have changed their behavior to comply with the more stringent changes (e.g., the shorter on-duty time) in the 2003 rule. Similarly, compliant carriers likely changed their behavior to take advantage of the relaxation of some requirements (e.g., allowing driving in the 11th hour). Since the RIA found negative costs for changing from full compliance with the pre-2003 rule to the 2003 rule, using the pre-2003 status quo as the baseline is likely to understate the costs of the operational changes needed to come into compliance. Conversely, since changing from full compliance with the pre-2003 rule to the 2003 rule results in positive safety benefits, using the 2003 status quo could overstate the potential safety benefits to the extent that large numbers of carriers are fully compliant.

One key difference between the populations affected by this rule and the HOS changes is the inclusion of buses. Since buses make up a small portion of the carrier population, we generally develop cost and benefit estimates with trucks in mind and assume that buses

---

[4] McCartt, A. T., L. A. Hellinga, and M. G. Solomon. Work Schedules Before and After 2004 Hours-of-Service Rule Change and Predictors of Reported Rule Violations in 2004: Survey of Long-Distance Truck Drivers. Proc., 2005 International Truck and Bus Safety and Security Symposium, Alexandria, Va., 2005.

[5] CVSA, "Roadcheck 2007 Results Show Safety Improvements Are Needed" June 29, 2007, www.cvsa.org.

will be identical on a per unit basis. The potential effects of this assumption on the net benefits are minimal.

A final important part of the baseline for the analysis is that some power units already use EOBRs, AOBRDs, or Fleet Management Systems (FMS) that can be easily upgraded to comply with the rule. Vehicles using devices that already comply with the rule are generally excluded from cost and benefit calculations when appropriate, but are still included in the affect population for calculating per power unit numbers. Costs and benefits for vehicles using FMS that are capable of fulfilling the requirements with some additional hardware or software are calculated differently as well.

In the analyses presented below, dollar figures are in 2005 dollars, unless otherwise indicated. Values from other years are brought to 2005 dollars using a GDP deflator.[6] The analysis considers a 10-year timeframe; costs and benefits are generally presented as annualized amounts, using a 7 percent discount rate, except where noted. Per Office of Management and Budget (OMB) guidelines and for comparison purposes, the sensitivity analysis of a 3 percent discount rate is displayed.

[6] U.S. Department of Commerce, Bureau of Economic Analysis, National Income and Product Accounts Table, Table 1.1.9. Implicit Price Deflators for Gross Domestic Product, accessed April 2008. http://www.bea.gov/bea/dn/nipaweb/TableView.asp?SelectedTable=13&FirstYear=1999&LastYear=2007&Freq=Ann.

2 Description of the Carrier Groups Evaluated for EOBR Requirement

This RIA evaluated two regulatory options for identifying motor carriers that would be subject to a remedial directive requiring mandatory installation, maintenance, and use of EOBRs for HOS compliance. The NPRM proposal focused on violation-based triggers. The final rule adopts a violation-based trigger for mandatory EOBR installation, maintenance, and use. As noted above, this approach effectively utilizes motor carrier, Federal, and State enforcement resources.

The regulatory options evaluated include motor carriers of all sizes. Owner-operators who are leased to other motor carriers are covered under the leasing motor carrier. The rule can apply both to straight trucks (i.e., a single integrated vehicle with both a cab and a cargo compartment), tractors (i.e., the cab/engine combination used to pull trailers), and buses. In the remainder of this document, all are referred to as power units. Motor carriers refer to companies that operate trucks, buses, or both.

2.1 Regulatory Option 1: 1X10 Remedial Directive

Under Option 1, a subset of interstate motor carriers would be required to install and use EOBRs. Motor carriers would trigger the requirement for EOBR installation when a "threshold rate" violation of HOS regulations listed in new Appendix C to Part 385 is discovered during a compliance review (CR).[7] A "threshold rate" violation is defined here as a violation rate equal to or greater than 10 percent of the records reviewed. For example, 25 violations of the 11-hour rule (395.3(a)(1)) out of 100 driver records reviewed would represent a 25 percent violation rate and constitute a "threshold rate" violation. Carriers who meet the 10 percent criterion are required to install and use an EOBR for two years to track their HOS.

Based on past compliance review data, FMCSA staff estimated that, on average, 2,834 motor carriers per year would meet the 10 percent criterion and be required to install and use EOBRs. These motor carriers operate an estimated 69,484 power units and employ 64,288 drivers.[8] In the first year of the program, then, these 2,834 carriers and their power units and drivers would be the only ones affected by Option 1. In the second year, an additional 2,834 carriers would be identified as meeting the 10 percent criterion, and

[7] The NPRM used the term "pattern violation" to describe the "trigger that would require installation of EOBRs. The new term, "threshold rate" violation, appearing in revised 49 CFR 385.503, is being used to avoid possible confusion with other patterns of violations in the Federal Motor Carrier Safety Regulations.

[8] Section 4114 of the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), P.L. 109-59, (119 Stat. 1725) (Aug. 10, 2005) was codified in the FMCSRs on July 5, 2007 (72 FR 36759), about six months after the EOBR NPRM was published. Prior to SAFETEA-LU § 4114, although motor carriers had been required under 49 CFR 390.15 to record intrastate accidents on their accident registers, FMCSA did not take intrastate accidents or safety violations into account when determining the motor carriers' safety ratings. Under § 4114, FMCSA must now utilize interstate motor carriers' accident and safety inspection data from intrastate operations (and from operations in Mexico or Canada if the carrier also has U.S. operations) in determining carriers' safety fitness under 49 USC 31144. This includes safety inspection data on HOS violations while operating in intrastate commerce. As a result of this larger universe of violations under consideration in the safety fitness determination process, the number of carriers subject to the remedial directive is now slightly higher than it would have been prior to the enactment of § 4114.

would be required to install and use EOBRs. This change would bring the total in the program to 5,668 carriers, with 138,968 power units and 128,576 drivers. In the third year, yet another cohort of 2,834 carriers would be added. The first year's cohort, however, would reach the end of its required two years of EOBR use. Though they could well decide to continue to use the EOBRs, the costs and impacts at that point would be voluntary and have therefore been excluded from this analysis. Their exit leaves 5,668 carriers, 138,968 power units, and 128,576 drivers in the program for the third year, and for all of the subsequent years – each year 2,834 carriers are assumed to enter the program, and another 2,834 leave. The assumption that the entire cohort would be replaced is somewhat conservative, but a review of compliance review data from 2003 to 2007 indicated that relatively few Option 1 carriers in a given year showed up in the Option 1 group in the subsequent year.

2.2 Regulatory Option 2: 2X10 Remedial Directive

Under Option 2, carriers with a 10 percent or greater violation rate of HOS in a second compliance review in a two-year period would be required to install and use EOBRs. These carriers would be required to install and use an EOBR for two years to track their HOS. Based on past compliance review data, FMCSA staff estimated that, on average, 475 motor carriers per year would meet the 10 percent criterion and be required to install and use EOBRs. The estimation of the annual average numbers of carriers, power units, and drivers required to use EOBRs is derived is an analogous manner to those figures for Option 1. In years two through ten, this group will consist of 950 carriers with 13,198 power units and 13,162 drivers.

2.3 Estimation of EOBR-Using and EOBR-Ready Units

This evaluation requires an estimate of how many power units would use AOBRDs, EOBRs, and FMS in the absence of the rule.

Recently collected data indicate that up to 10 percent of power units currently use EOBRs or AOBRDs. In a survey of 415 of the largest carriers in the U.S., 8 percent of units had electronic or automated logs.[9] A 2007 field survey conducted by FMCSA provided an analogous estimate of 5 percent of units. However, based on their poor compliance records, we assume that no Regulatory Option 1 or 2 carriers are using devices that would comply with the rule.

A recent Volpe study[10] estimated that the number of power units with systems capable of complying with the rule after minor hardware or software upgrades ("EOBR-ready units") in LH grew from 20 percent in 2003 to 25 percent in 2005. Similarly, EOBR-ready units in SH grew from 5 percent in 2003 to 8 percent in 2005. The Volpe study estimates that some of the growth is attributable to increased use of GPS phones, which

[9] ICF Analysis of data from "Do Electronic Logbooks Contribute to Motor Carrier Safety Performance?" Cantor, David E., Corsi, Thomas M., and Grimm, Curtis M. 2006.
[10] Recommendations Regarding the Use of Electronic On-Board Recorders (EOBRs) for Reporting Hours of Service. FMCSA, 2005

we do not classify as EOBR-Ready,[11] but one of the main sources of their data[12] indicates that GPS phones accounted for a small portion of the market in 2005. Other sources indicate that the number of EOBR-ready units may be higher[13] and growing faster.[14]

We estimate that the penetration of EOBR-ready units in the LH sector was 25 percent in 2005, and an additional 2 percent will be added each year throughout the time window.[15] This increase is slightly slower than the rate seen in the Volpe study (i.e., from 20 to 25 percent over two years, or 2.5 percent per year), in recognition of the likelihood that a small part of the growth was attributable to GPS phones. For SH, we assume that 8 percent were EOBR ready, and an additional 1 percent will be added each year. Again, this rate of increase is slightly slower than the rate reported in the Volpe study. As demonstrated in Exhibit 1, these assumptions, combined with the number of SH and LH units, result in an average of 26 percent EOBR-Ready SH and LH units over the 10 year time horizon. The corresponding estimate for LH only is 42 percent. We assume that the Regulatory Option 1 and 2 populations will be similar to the total carrier population in this respect and that 26 percent will be EOBR-ready.

Exhibit 1. Estimation of Market Penetration of EOBR-Ready Devices

	SH	LH	All (SH and LH, Regulatory Option1, and Regulatory Option 2)
Assumed Growth	1%	2%	
2005 Estimate	8%	25%	14.4%
2009 Estimate	12%	33%	19.9%
2018 Estimate	21%	51%	32.2%
Average Over Time Horizon	16.5%	42.0%	26.0%

Due to the uncertainty of these estimates and their substantial effects on the results, the sensitivity analysis section contains net benefits calculations for various levels of market penetration.

Exhibit 2 summarizes the sizes and market penetration assumptions.

---

[11] The classification of GPS phones as EOBR-ready is not correct for the final rule because of the requirement for integral synchronization. Carriers and drivers using GPS phones could save money by using a cheaper cell phone service and using the EOBR for GPS tracking, but these savings would be much less than those realized what we classify as carriers that can use their current system with a small upgrade.

[12] 2005-06 Mobile Resource Management Systems Market Study, C.J Driscoll and Associates. See: http://www.cjdriscoll.com/images/C%20J%20%20Driscoll%20MRM%20Market%20Study%20Press%20Release%209-20-05.pdf

[13] ICF Analysis of the Cantor, Corsi, and Grimm survey indicate an estimate of about 40 percent of LH units.

[14] A presentation by Merlin Mobile created in 2006 estimated that 40 percent of LH trucks use satellite-based tracking systems, and that number would grow to 60 percent by 2010.

[15] The growth rate during this period may be increasing or decreasing, so we assume a linear trend as a simplification. The study by C J Driscoll projects stable annual revenues for EOBR-ready systems, which supports our use of a linear trend.

Exhibit 2. Summary of Affected Populations and Market Penetration

	Regulatory Option 1: 1X10 Remedial Directive	Regulatory Option 2: 2X10 Remedial Directive
Carriers	5,668	950
Drivers	128,576	13,162
Power Units	138,968	13,198
Using AOBRD/EOBR	0%	0%
EOBR-Ready	26%	26%

3 Analysis of Direct Cost Impacts of EOBR Requirement

3.1 Costs of EOBRs

The first step in the cost/benefit analysis is to calculate the costs of equipping affected power units with EOBR technology. The system that serves as the basis for this analysis[16] costs less than the low-cost device considered in the RIA for the proposed EOBR rule; FMCSA confirms that it will comply with the proposed regulation. When appropriate, costs are calculated separately for units that are "EOBR-ready" as discussed in Section 2.

Costs are calculated for the entire 10 year time period and then annualized using a discount rate of 7 percent to come up with the total annual cost. Total annual costs per power unit are presented as well by dividing by the number of affected power units in each option.[17]

EOBR purchase and installation costs were gathered from publicly available information about the device. Vendors also commented in the public docket that if EOBRs were mandated, manufacturing costs would decrease in the long-run. The amount of cost decline yet to be realized, however, is quite uncertain. EOBRs are comprised of existing off-the-shelf components and technology, and furthermore, a market for EOBRs already exists, both as independent devices and "add-ons" to fleet management systems. Current and would-be EOBR manufacturers should already experience considerable economies of scope because they (1) currently produce similar products, (2) already possess the necessary technical expertise, organizational infrastructure, distribution networks, and some of the necessary manufacturing equipment, and (3) have access to variable inputs (materials and labor). Manufacturers might achieve further manufacturing cost savings through "learning by doing" (that is, finding more efficient manufacturing methods as cumulative output increases), but learning effects may also have already been exhausted in the course of manufacturing similar devices. Finally, uncertainty about the number of new manufacturers entering the expanded market makes it impossible to estimate the number of units per manufacturer, a key variable in determining both scale and learning effects. For this analysis, we made the simplifying assumption that the price of the product would not change over the 10-year timeframe. Exhibit 3 summarizes total start-up and operating costs on a per-power unit and an industry-wide basis. Detailed descriptions of the differing cost estimates are presented in the following section.

Exhibit 3. Summary of Start-up and Operating Costs

	Regulatory Option 1: 1X10 Remedial Directive	Regulatory Option 2: 2X10 Remedial Directive
Total Annualized Cost (millions)	$57	$5
Cost per Power Unit	$433	$433

[16] We base these cost estimates on the RouteTracker device sold by Turnpike Global and compatible with a Nextel cell phone. Other handheld devices or wireless networks can be used with the RouteTracker, but since Turnpike and Nextel market the system together this provides the best cost data.

[17] In some cases this calculation is done in reverse: the per power unit numbers are calculated first and then turned into total annual costs by multiplying by the number of power units in each option.

The device used for the cost estimate requires a $25 start-up fee and a monthly fee of $35 per truck per month. This cost includes the physical device as well as the software necessary to access the logs from a web-based application.

In addition to this hardware, drivers will need a handheld device – most likely a cell phone – with the following capabilities:

- Bluetooth, a protocol for wireless data transmission needed for the handset to communicate with the base unit installed in the CMV.
- The ability to run Java programs
- Sufficient data service, explained further below

The amount that this will cost depends on the current technology used by drivers: those with relatively new phones or other handheld devices may need no upgrade and may have the proper data service as well. Others may not currently use a phone. The least expensive phone confirmed by the vendor to work with the device currently has a base cost of $229.[18] Since only some drivers will need to upgrade and wireless companies tend to heavily discount the cost of phones,[19] we believe it is conservative to estimate a cost of $100 for phone upgrades for non-EOBR-ready units.[20] While drivers will likely purchase more than one phone in the 10 year time window, we assume that by the time they make a second phone purchase the cost of upgrading to a compatible phone will be negligible. As a result, we apply this cost in years 1-5 for Regulatory Options 1 and 2.

The data service required for the system analyzed currently costs an additional $10 per month.[21] We assume that all non-EOBR-ready units will need to make this upgrade, yielding total monthly costs of $45 per month. Promotional materials for the device analyzed here claim it can be installed in five to ten minutes.[22] Even if the installation takes up to an hour, we found this cost to be trivial and exclude it for simplicity.

EOBR-ready units incur considerably lower costs. Since they are already using the base system required, no additional start up costs or installation costs would occur. However, an additional monthly fee may be required for HOS functionality on these units: two vendors quoted a cost of $5 or $8 per month for this additional service.[23] We take the higher number and assume that EOBR-ready units pay $8 per month for EOBR functionality and that this is the only cost associated with these units.

Exhibits 4 and 5 summarize the start up and monthly costs as a total annual cost and annual cost per power unit.

Exhibit 4. Total Annual Purchase and Operating Cost (millions)

	Regulatory	Regulatory

[18] The turnpike website indicates that the Motorola i335 phone is compatible. Price estimate from the Sprint online store.
[19] As of 5/30/2008, the Motorla i335 costs only $30 for customers who commit to a contract.
[20] It may be more precise to cost this upgrade on a per-driver basis, but due to the uncertainty of the estimate we cost it per power unit to simplify the calculation.
[21] This is the Nextel "data pack."
[22] See http://www.turnpikeglobal.com/products_services/routetracker.php. Accessed 5/30/2008
[23] RouteTracker charges an additional $5 for HOS functionality and Qualcomm charges $8.

	Option 1: 1X10 Remedial Directive	Option 2: 2X10 Remedial Directive
Start-up Fee and Phone Upgrade	$4	<$1
Monthly Fees	$52	$5
Total Device Cost	$57	$5

Exhibit 5. Annual per-Power Unit Start-up and Operating Cost

	Regulatory Option 1: 1X10 Remedial Directive	Regulatory Option 2: 2X10 Remedial Directive
Start-up Fee and Phone Upgrade	$31	$31
Monthly Fees	$402	$402
Total Per Power unit Device Cost	$433	$433

3.2 Costs of Training

Training costs include the costs of training operators to use the EOBRs, training the carriers' office staff to handle the data they produce, and training for state personnel to detect violations using them. Training cost estimates were calculated as the number of hours required for training (based on Vendor input) times the value of the lost productive time, times the number of affected drivers and other staff. Training costs for state personnel were based on the costs of training for the 2003 HOS rules and estimates of the nationwide numbers of individuals needed to conduct inspections. These costs were annualized to account for the fact that they would not recur for individual drivers or staff.

Exhibit 6 shows the annual per power unit and total industry costs for training. A discussion of each component of training costs follows.

Exhibit 6. Total Annual and per Power Unit Costs of Training

	Regulatory Option 1: 1X10 Remedial Directive	Regulatory Option 2: 2X10 Remedial Directive
Total Annual Costs (millions)	$4	$1
Cost Per Power Unit	$26	$87

3.2.1 Office Staff Training Costs

Office personnel require training on accessing and analyzing electronic RODS, as well as using the handheld device to train drivers. To calculate this cost, we have assumed that a fully loaded hourly management rate would be the cost of attending one hour of training. According to BLS, the median wage per hour for first-line supervisors within the general freight category (NAICS 484100) is $24.32 per hour.[24] We have applied a fringe-benefit factor of 1.49[25] and an overhead factor of 1.59[26] to obtain a fully loaded staff cost per hour of $57.62.

To calculate office staff training costs we also estimate the number of employees per company that will need to be trained. We estimate that when a firm grows to six power units, the owner will stop driving and come into the office as a full-time manager. When the firm grows to 11 units, it will add another person, for both management and administrative tasks. We have made the assumption that even if no one is in the office (one to five power units), the owner will handle management and administrative functions and will train himself to analyze the EOBR data. Therefore, if a firm has one to ten power units, one person will be trained to handle data from the EOBR. If the company has 11 to 100 power units, two office staff will be trained; and firms with more than 100 power units will train four people in the office for this purpose. The increase in staff working with EOBR data in companies with more than 100 power units reflects the fact that very large companies could have many people, often people with managerial or analytical positions, working with this information needing to know how to extract it from electronic records.

An analysis of data on number and size of companies in regional and long-distance service, both for-hire and private carriage, and, applying the above rule, resulted in an average requirement of 1.3 trainees per firm, used for all carrier groups.[27]

A vendor representative estimated that managers would need 15 minutes of training to learn how to use the handheld device to train drivers[28] and 30 minutes to learn how to use the log checking software. As with driver training, we conservatively add these estimates and assume two hours of training time. To calculate costs, we multiplied the loaded hourly wage by the number of hours of training, then multiplied by the number of staff per firm and finally by the number of companies affected under each regulatory option. Costs were discounted, calculated on a per power unit basis and annualized over 10 years. Exhibit 7 summarizes the office staff training costs.

[24] Bureau of Labor Statistics (BLS), National Industry-specific Occupation, Employment, and Wage Estimates, wage of transportation manager in general-freight trucking.
[25] BLS, Employer Costs for Employee Compensation, March 2005.
[26] Grant Thornton, Seventh Annual Grant Thornton Government Contractor Industry Survey. While this number is derived from a study of government contractors, no more reliable source for managerial overhead was available. Since office staff training comprises a small fraction of the costs, even a large change to this estimate would have little impact on the analysis.
[27] Full details on the analysis of number and size of companies are in Appendix A.
[28] This may result in double counting for owner-operators, but this effect will be minimal.

Exhibit 7. Office Staff Training Costs

	Regulatory Option 1: 1X10 Remedial Directive	Regulatory Option 2: 2X10 Remedial Directive
Cost Per Company	$73	$73
Total Annual Costs (millions)	<$1	<$1
Cost Per Power Unit	$3	$5

3.2.2 Driver Training Costs

Driver training was based on the assumption that it would be done during on-duty not-driving time. Since most drivers are paid by the mile, the unloaded driver wage serves an acceptable measure for the value of their time. We assume that they will be trained by someone with the same wage presented in the office staff training section. This per-hour value was then multiplied by 30 minutes for the driver and office employee based on the vendor's suggested number of hours of training[29] to generate a total training cost per driver. We assume that after an initial retraining session, driver training on EOBRs would be part of HOS training, replacing log training, and the net effect for subsequent years would cancel each other out.[30]

For both Regulatory Options 1 and 2, driver training was assumed to take place in the first year of the two-year EOBR requirement. Since a new cohort of carriers would come under the rule each year, there would be training costs incurred in years 1 through 10.

Exhibit 8 summarizes the driver training cost estimates.

Exhibit 8. Annual Driver Training Costs

	Regulatory Option 1: 1X10 Remedial Directive	Regulatory Option 2: 2X10 Remedial Directive
Cost Per Driver	$18	$18
Total Annual Costs (millions)	$2	<$1
Cost Per Power Unit	$17	$18

3.2.3 Roadside Inspection Staff Training

Training of state and local CMV roadside inspection staff was also considered in this analysis. For all estimates it was assumed that 10,000 inspectors and other enforcement personnel would require training on EOBRs. This estimate was provided by FMCSA based on estimates it derived on the number of State personnel to be trained as part of the rollout of the 2005 HOS rule. The amount of time required to train inspectors on EOBRs was conservatively estimated to be 8 hours. The amount of time required for State

[29] A Turnpike representative suggested 15 minutes, so we take 30 as a conservatively high estimate.

[30] In reality, with driver turnover and product upgrades some re-training would likely take place over the 10 year timeframe. It is also plausible that, due to the more automated nature of EOBRs, training will be quicker than it was with paper RODS

enforcement personnel training was also estimated by FMCSA and is considered conservative (i.e., making it unlikely that training costs would be underestimated), given that any phase-in for an EOBR mandate is expected to occur over an extended period and it is possible that State personnel would receive this training as part of annual refresher training already anticipated. BLS indicates that the average hourly wage for state law enforcement personnel (a reasonable proxy for state inspectors) was $24.45 in 2006 dollars, which was converted to 2005 dollars and increased by a factor 1.51[31] for fringe and 1.12[32] for overhead. The estimated turnover rate in State enforcement personnel is 18 percent per year. Exhibit 9 summarizes state inspection training costs for each option.

Exhibit 9. State Inspector Training Costs

	Regulatory Option 1: 1X10 Remedial Directive	Regulatory Option 2: 2X10 Remedial Directive
Total Annual Cost (millions)	$1	$1
Cost Per Power Unit	$6	$63

3.2.4 Costs of Operational Changes

The use of EOBRs is anticipated to discourage violations of the HOS rules by providing inspectors with more reliable data on operations. Improved compliance is assumed to come at a cost for the affected operators and their carriers, as drivers will be less able to extend their working and driving hours or shorten their off-duty periods. The costs of these changes in operations are estimated as a fraction of 2003 HOS RIA's estimate of the productivity costs of shifting from the pre-2003 "status quo" (a situation of imperfect compliance) to the "FMCSA option" with full compliance (the 2003 rule). The need to base the analysis of the effects of improved compliance on the 2003 HOS RIA, rather than the 2005 RIA, is that the more recent analysis did not examine a partial compliance baseline. The 2003 HOS RIA's estimates of the impacts of improved compliance are only an approximation to the actual impacts because both the baseline situation (with imperfect compliance) and the final situation (with full compliance) differ somewhat from the baseline and final situations for the EOBR rule. See section 1.4 for the discussion of the baseline scenario.

The 2003 HOS RIA estimated the costs of the operational changes necessary for shifting from partial compliance to full compliance by calculating the percentage drop in total driver productivity that would result if drivers stopped violating the rules. Carriers were assumed to respond to this drop in productivity by hiring more drivers, which would bring with it a need for more wages, benefits, and overhead. Offsetting these costs, however, would be savings in wages for existing drivers whose working hours would be reduced. The savings in labor costs resulting from a reduction in average working hours for existing drivers was calculated using data on weekly hours of work and income of more than 11,000 truck drivers. This analysis showed that the increased spending on wages for new drivers and the reduced spending on wages for existing drivers would

[31] BLS, Employer Costs for Employee Compensation, Table 4. March 2007.
[32] OMB Circular A-76

largely cancel each other out. Total spending on benefits and overhead, however, would rise as the number of drivers increased. Details on these estimates are available at http://www.fmcsa.dot.gov/espanol/english/pdfs/240882_web.htm. The overall cost of the operational changes needed for full compliance with the 2003 HOS rules are presented in Exhibit 10.

The relevant fraction of that productivity cost estimate that should be attributed to the use of EOBRs depends on the size of the affected population, judgments about the effectiveness of EOBRs in averting violations, and the likely rate of violations among the affected population relative to the industry-wide average.

Exhibit 10. Direct Cost Changes Relative to Status Quo (Millions of 2000$ per Year)

Cost Category	FMCSA
LH Driver Labor Costs	$550
LH Other Costs	$332
Total Costs, LH	$882
SH Driver Labor Costs	$233
SH Other Costs	$168
Total Costs, SH and LH	$1,283

Source: Adapted from the 2003 HOS RIA, Exhibit 9-15

Total costs of operational changes for LH operations were expected to be $882 million, and costs for SH and LH operations combined were expected to be $1,283 million. Using these as a starting point, we will look at the costs of operational changes for all the carrier groups being evaluated.

We began our analysis by taking the values from the 2003 HOS RIA and adjusting them upwards for inflation, the inclusion of buses, and growth in the affected population.[33]

To determine the cost of compliance for Regulatory Options 1 and 2, we need to know what their HOS violation rates are relative to the general population of motor carriers subject to HOS regulations. For this analysis, we have assumed that violation rates for Regulatory Option 1 and 2 carriers are twice as high as the general LH population, based on an analysis of FMCSA databases (see Appendix B for further discussion). Since nearly all Regulatory Option 1 and 2 carriers are in LH service, we assume that they are a subset of the LH population. Thus, to estimate the operational costs of bringing them into compliance we take the benefits from the LH population and multiply by the ratio of Regulatory Option 1 and 2 carriers to LH carriers, and then multiply by two.

This estimate assumes that all violations within the defined carrier population would be eliminated. Based on discussions between FMCSA and ICF, we believe that the EOBR rule would eliminate half of current violations. To reach consensus on this estimate, FMCSA analysts held discussions with FMCSA enforcement staff with extensive experience conducting compliance reviews of motor carriers, including several that have recently deployed EOBRs for HOS compliance. At this meeting, FMCSA enforcement and analytical staff discussed the potential for EOBRs to reduce or eliminate specific types of HOS violations, such as daily driving and duty time limits, weekly duty limits, false logs (both out-of-service and non-out-of-service violations), “no log” violations,

[33] We assume that the costs grow proportionally to the number of drivers, and thus apply a growth factor of 8.8%. Details regarding this number are provided in Appendix A.

"form and manner" log violations, and non-current logs. The collective opinion of experienced FMCSA enforcement staff was that EOBR installation would significantly reduce or practically eliminate several particular types of violations for those carriers for whom EOBRs are mandated, and that an assumption of a 50 percent reduction of violations would be reasonable. The FMCSA case study research of a Southeastern motor carrier known to have recently installed AOBRDs, EOBRs, or EOBR-like devices on its entire fleet for the specific purpose of monitoring HOS compliance of its drivers revealed that this company's HOS violations decreased by 79 percent over the three years since EOBRs were installed. However, given the limited data on EOBR safety benefits and the qualitative nature of the FMCSA assumptions made for this analysis, FMCSA also subjected this assumption to a sensitivity analysis, where it varied the assumption on relative effectiveness of EOBR deployment on compliance rates (see below).

If we assume that operational costs are proportional to the percentage of violations prevented, then a 50 percent reduction in violations would lead to a 50 percent decrease in the HOS compliance costs per power unit. Finally, we annualize the costs to the beginning of the year and calculate the cost per power unit. Exhibit 11 below shows total costs of operational changes as well as costs per power unit.

Exhibit 11. Operational Cost Calculations for EOBRs

	Regulatory Option 1: 1X10 Remedial Directive	Regulatory Option 2: 2X10 Remedial Directive
Cost of Full HOS Compliance, 2003 RIA (millions, year 2000 dollars)	$143	$14
Cost of Full HOS Compliance with Truck Growth and Buses (millions, year 2000 dollars)	$143	$14
Cost of Full HOS Compliance, (millions, year 2005 dollars)	$161	$15
Cost of Predicted HOS Compliance (millions, year 2005 dollars)	$81	$8
Annualized Cost of HOS Compliance (millions, year 2005 dollars)	$78	$7
Annualized Cost of HOS Compliance per Power Unit (year 2005 dollars)	$561	$561

3.3 Paperwork Savings

In addition to the costs of the EOBRs, the analysis took into account the potential for cost savings when paper logs are eliminated. The two most prominent cost savings are the duty-time savings when drivers are no longer required to keep paper logs, and the reduced costs of storing all drivers' logs. Time savings for drivers and the office employees who perform filing were estimated by FMCSA and multiplied by the value of their time. In addition, we consider the costs of purchasing the logs themselves and storing them. Exhibit 12 summarizes the paperwork savings.

Exhibit 12. Summary of Paperwork Savings

	Regulatory Option 1: 1X10 Remedial Directive	Regulatory Option 2: 2X10 Remedial Directive
Total Annualized Cost (millions)	$59	$6
Annual Cost per Power Unit	$421	$454

3.3.1 Log Book Time Savings

Log book time savings are based on the assumption that EOBRs allow drivers and office employees to spend less time filling out, checking, and filing RODS. EOBRs automate the process of creating RODS, saving time for drivers who no longer need to fill them out by hand. We have assumed that there would be some office staff time savings since employees no longer have to physically file RODS and can more easily use automated methods to check them.

Our estimates for the time saved are based on the Information Collection Request for the Hours of Service rules.[34] According to these estimates, each log requires 6.5 minutes of time for the driver and 3 minutes for the office employee. While the use of EOBRs will reduce the time needed to create and process RODS, it will not completely eliminate it: drivers must log on, enter their time and shipment information, review the logs, and transmit them; they may have to annotate their logs. Office employees will do some manual checking of logs. We assume that this will take two minutes per log for the driver and office employee, leaving a time savings of 4.5 minutes for the driver and 1 minute for the office staff.

The value of the time savings for the driver depends on whether the time to fill out paper RODS currently cuts into the productive time of the operator, or if it cuts into off-duty time. Since most LH drivers will fill out their logs during on-duty time when they are not being paid for driving, we use an unloaded driver wage to value this time. To calculate the value of office employee time, we take the clerical wage for the truck transportation industry, and then apply a fringe and overhead factor, yielding $36.22 per hour. Combining these estimates with the time estimates at one log per driver per day yields a cost of $1.85 per driver per day. Assuming 240 working days per year,[35] annualized to the beginning of the year, this works out to $430 per driver.

The total annual benefits and benefits per power unit for log book savings are shown in Exhibit 13.

Exhibit 13. Log Book Time Savings

	Regulatory Option 1: 1X10 Remedial Directive	Regulatory Option 2: 2X10 Remedial Directive

[34] OMB Control number 2126-0001

[35] Drivers are required to complete logs for off-duty time, but FMCSA assumes that this takes minimal time for both paper and electronic logs and, therefore, has not estimated cost-savings for those days.

Total Annualized Cost Savings (millions)	$55	$6
Annual Cost Savings per Power Unit	$398	$429

3.3.2 Paper Printing and Storage Savings

Paper reduction savings are the cost reductions from purchasing less paper. It is assumed that there are 340 log days per year[36] and that one log sheet per driver per day will be used at a per-sheet cost of $0.07.[37] We have made a simplifying assumption that all paper used for driver logs will be eliminated. To calculate paper reduction savings, we multiply the number of log days by the number of sheets of paper used by the cost per sheet of paper and discount to the beginning of the year. Exhibit 14 shows the benefits of reduced paper purchasing.

Exhibit 14. Paper Purchase Time Savings

	Regulatory Option 1: 1X10 Remedial Directive	Regulatory Option 2: 2X10 Remedial Directive
Total Annual Savings (millions)	$2	<$1
Annualized Savings PPU	$15	$16

Paper storage savings are derived from the reduction in physical space required to store paper RODS. Companies may be able to sell unused filing cabinets or purchase fewer in the future, but we estimate this effect to be minimal. We estimate that a basic file cabinet holds 2,120 sheets of paper and takes up 5.52 square feet of floor space at a cost of $20 per square foot per year.[38] We then use the paper reduction estimates to calculate the square footage saved by no longer needing to store the logs. Exhibit 15 summarizes paper storage savings.

Exhibit 15. Paper Storage Savings

	Regulatory Option 1: 1X10 Remedial Directive	Regulatory Option 2: 2X10 Remedial Directive
Total Annualized Cost Savings (millions)	$1	<$1
Annual Cost Savings per Power Unit	$8	$9

[36] Drivers are required to complete logs for days on which they were off-duty to determine compliance with weekly limits and restart provisions. We assume that they do not keep logs for vacation periods.
[37] Cost is from J.J. Keller & Associates; www.jjkeller.com, accessed 5/27/08.
[38] Dimensions of filing cabinets based on information from Home Depot. Cost per square foot based on Marcus and Millichap National Real Estate Index 4 quarter 2002, median rental price.

3.4 Unquantified Costs: Office Equipment Upgrades

Most vendors indicated that the only office equipment that would be required would be a PC with an Internet connection. We have assumed that the vast majority of companies currently have an Internet-capable computer and that no office upgrades would be needed. For companies that do not currently have a computer, purchasing one would have enough benefits outside of the context of HOS compliance that it would not be appropriate to fully count the costs. In some cases, firms may elect to download and maintain a copy of their driver logs on a computer or server. We assume that any carrier that decides to do this will have adequate storage space on existing computers or servers. If carriers were required to maintain a back-up version at a separate location, those carriers that had only one location might incur additional costs. Because many of the EOBR service providers host the HOS records, we have assumed that the service providers' records will serve as the backup location.

4 Analysis of Safety and Other Benefits

EOBRs are expected to have beneficial effects on safety, driver health, and economic competitiveness of some carriers. In the analysis provided below, benefits from increased safety are quantified based on an expected reduction in fatigue and fatigue-related crashes due to improved HOS compliance. In addition, EOBRs will have some general health effects, which are discussed qualitatively below. Finally, economic effects of EOBR requirements on compliant motor carriers are discussed as an unquantified benefit.

4.1 Safety Benefits from Improved Compliance

To the extent that EOBRs reduce HOS violations, they are also expected to reduce fatigue and fatigue-related crashes. Though estimating the magnitude of these safety benefits is difficult, they can be approximated using the same source that was used to estimate operational costs: the 2003 HOS RIA. For this analysis, we take the benefits the 2003 HOS rules relative to the “status quo” baseline, adjust for an updated crash cost, and multiply by the percentage of violations assumed to be eliminated. For both Regulatory Options 1 and 2, an adjustment in the benefit calculations was made to account for the higher crash rates among the carriers with higher rates of violations.

As with our analysis of operational costs, we will begin our analysis of safety benefits with information from the 2003 HOS RIA, presented in Exhibits 16 and 17 below. These estimates were made by constructing operational patterns (taking into account work, driving, rest, and sleep); assessing the drivers’ level of fatigue under each pattern using a modified version of the Walter Reed Sleep Performance Model; and translating these levels of fatigue into crash rates based on simulated driving performance for drivers with varying levels of fatigue. Using these estimates of crash rates for different operational patterns, the RIA found the effects of different compliance scenarios by calculating the change in weighted average crash rates as drivers using illegal patterns were shifted to patterns that complied with the HOS rules. The changes in weighted average crash rates were then multiplied by FMCSA estimates of the total damages caused by truck-related crashes, which are updated in the following section. Details on these calculations are presented in the RIA for the 2003 HOS rules (http://www.fmcsa.dot.gov/espanol/english/pdfs/240882_web.htm).

As with the estimates of the costs of the operational changes, these estimates do not directly measure the effect of shifting from partial to full compliance with the 2005 HOS rules, but are reasonable approximations and the best estimates that are available.

Total safety benefits for SH and LH operations were expected to be $685 million, and $653 for just LH. To estimate the benefits of ending all Regulatory Option 1 and 2 violations we need to know how often the carriers within a particular option violate relative to other carriers. FMCSA analysis of roadside inspection data implies that carriers in Regulatory Options 1 and 2 have about twice as many HOS violations as the general population (See Appendix B). Since nearly all Regulatory Option 1 and 2 carriers are in LH service, we assume that they are a subset of the LH population. Thus, to estimate the safety benefits of bringing them into compliance we take the benefits from LH carriers and multiply by the ratio of Regulatory Options 1 and 2 carriers to LH carriers, and then multiply by two.

First, we adjust these numbers to account for the presence of buses in this rule. Bringing buses into compliance will likely generate less safety benefits per unit than it will for trucks, but this results in a very small adjustment and is offset by the fact that we over count costs of operational changes for buses as well. While the safety benefits are based on the average number of crashes from 1997 to 2000, we do not adjust this factor because the changes in the number of crashes could result from sampling error of the source data.[39]

These numbers were adjusted for recent estimates for the cost of a crash and a new DOT guidance on the value of a statistical life (VSL). Following the estimates of Zaloshnja and Miller (2006) and a VSL of $5.8 million, we use a crash cost of $135,110 (in 2005 dollars). The 2003 HOS numbers use an average crash cost of $75,637, so we scale up the estimated benefits by a factor of 1.73 to account for the new crash cost. We then divided by the number of affected power units to generate a benefit per power unit.

Next, we made an adjustment to the benefits per power unit based on the assumption that 50 percent of violations would be prevented (just as in the operational cost calculations). As stated in the cost of operational changes section, this 50 percent reduction in violations was based on discussions with FMCSA staff.

A final step is to account for the higher overall crash rates of these Regulatory Option 1 and 2 carriers. The crash rate for Option 1 and 2 carriers is double that of other carriers, but crashes related to HOS violations account for a small percentage of total crashes. One would not expect such high crash rates for these carriers if crash risk was proportional to HOS compliance across all motor carriers; that is, the crash rates of Option 1 and Option 2 carriers are disproportionately large relative to their HOS violation rates and how prevalent HOS violations are in crashes. The fact that the actual crash rates for these carriers are so much greater than those of the general population makes it clear that they have safety problems that go well beyond low HOS compliance rates. These other safety problems could independently result in higher crash rates, or interact with the crash risk associated with HOS violations to produce worse than expected safety outcomes per HOS violation. Data on HOS violations do not capture the severity of the violations, and is reasonable to assume that carriers with relatively high HOS violation rates would also have relatively more severe violations (for example, pushing their drivers farther beyond the daily drive time limits than other carriers cited for this violation do). Higher severity per violation would also lead to worse safety outcomes per HOS violation. Consequently, we believe that a violation prevented for Option 1 and Option 2 drivers should produce a greater safety benefit.

We conservatively assume that the higher safety benefit will be proportional to the ratio of the crash rate of the Regulatory Option 1 and 2 populations to the crash rates of other carriers that have undergone compliance reviews. To determine the relative crash rate of the Regulatory Option 1 and 2 motor carriers, data were analyzed from the MCMIS database and from the compliance review database at FMCSA. Total crashes were

[39] The 2003 HOS RIA assumed 426,000 crashes per year involving trucks subject to HOS requirements; GES estimates for crashes from 2003-2006 fluctuated between 368,000 and 436,000. The GES manual (ftp://ftp.nhtsa.dot.gov/GES/GES06/Manuals/1988_2006%20GES%20Analytical%20Users%20Manual.pdf) indicates estimates of 400,000 crashes have a standard error of 27,800.

divided by each carrier's number of power units to find a total crash rate. Crash rates were compared between the Regulatory Option 1 and 2 motor carrier population and other carriers that had undergone compliance reviews. Due to data limitations, the general population group was limited to motor carriers with interstate business, and to motor carriers that have received at least one compliance review since 1994. Using this methodology, we found that the Regulatory Option 1 motor carriers had a 40 percent higher crash rate, and Regulatory Option 2 motor carriers had a 90 percent higher crash rate, than other motor carriers. Exhibit 16 below shows total safety benefits as well as benefits per power unit.

Exhibit 16. Safety Benefit Calculations for EOBRs

	Regulatory Option 1: 1X10 Remedial Directive	Regulatory Option 2: 2X10 Remedial Directive
Benefits of Ending All HOS Violations from 2003 HOS RIA (millions, year 2000 dollars)	$106	$10
Benefits of Ending All HOS Violations from 2003 HOS RIA with Buses (millions, year 2000 dollars)	$106	$10
Benefits of Ending All HOS Violations, VSL and Inflation Adjusted (millions, year 2005 dollars)	$177	$17
Benefits of Preventing Half of HOS Violations (millions, year 2005 dollars)	$88	$8
Benefits of Preventing Half of HOS Violations with Increased Crash Risk for Options 1 and 2 (millions, year 2005 dollars)	$124	$16
Per Power Unit Benefits of Preventing Half of HOS Violations (year 2005 dollars)	$890	$1,208

Source: 2003 HOS RIA, Exhibit 9-16, and ICF Analysis

4.2 Unquantified Benefits: Non-Safety Related Health Benefits from EOBR Use

A review of the literature revealed little scientific documentation regarding the health effects of driving time monitoring on commercial vehicle operators. There is, on the other hand, substantial literature regarding the health effects of electronic monitoring of workers, and on the general health effects of operating commercial vehicles.

Studies to date suggest that monitoring an employee is likely to increase stress levels in certain cases. Those cases are likely limited to people who must work harder to meet performance expectations as a result of being monitored. This may not be analogous to commercial vehicle operators, who would be monitored to ensure compliance with safety regulations. Although some functions of EOBRs may enable fleet managers to monitor the performance of their drivers as well as their compliance with HOS regulations, the rule will not require the use of such functionality.

The FMCSA is concerned that truck drivers' exposure to high levels of air pollutants and mobile air toxics for potentially long periods of time may lead to acute and/or long term cognitive impairments. The Agency commissioned a study in 2007 (detailed in Appendix A to the Environmental Assessment for this final rule) which found that very little is known regarding the cognitive impact of exposure to diesel exhaust emissions. Certainly, the potential for an effect exists, but cognitive ability is generally confounded with other "lifestyle" factors for truck drivers. Consequently, questions on impacts are currently difficult to answer.

Research documented in a recent Transportation Research Board (TRB) literature review indicates that detrimental health effects can be associated with the operation of a commercial motor vehicle for long periods of time, particularly with varying work shift assignments (Orris and Buchanan, 2005). The TRB report found that certain cancers may be related to diesel exhaust (DE) exposure and that risk may rise with the length of exposure. However, EPA has not categorized DE as a carcinogen, and therefore has not developed a dose-response curve for cancer risk from DE. Consequently, FMCSA could not include this factor in the cost benefit analysis for this rule. Cardiovascular disease is also linked to truck driving and its risk increases with duration of driving as well as sleep disruption. Hearing loss is generally related to length and level of exposure. TRB found the evidence of musculoskeletal effects from longer driving to be less conclusive. TRB found that the literature suggested, but did not establish, that disruptions of circadian rhythms had negative impacts on health. However, it remains difficult to quantify with any precision the extent to which the use of EOBRs would generate health benefits by improving compliance with HOS regulations.

4.3 Unquantified Benefits: Improved Competition

Firms that are currently complying with HOS regulations have a competitive disadvantage because they can be undersold by competitors whose drivers can cover more miles by driving beyond their legal limits. They are also at a marketing disadvantage because non-compliant firms can promise same-day deliveries which, in some cases, can be achieved by violating the HOS regulations. By inhibiting HOS violations (and, in the case of Regulatory Options 1 and 2, imposing costs on violating carriers), FMCSA moves the motor carrier industry toward a level playing field, where complying with FMCSA regulations is not a handicap in pricing or marketing. This is a transfer payment between non-complying carriers and complying carriers, and is therefore neutral from the standpoint of total social cost. Because it should be seen as a reduction in injustice, however, it has a social value that cannot be quantified. Furthermore, that the majority of motor carriers routinely comply with HOS regulations shows that violating these regulations is not necessary for remaining profitable in this industry. Eliminating their source of competitive advantage may force some non-compliant carriers to implement efficiency changes that they had previously ignored, changes that may have broader benefits to society.

5 Net Benefits

Costs and benefits are summarized in the following exhibits. Exhibit 17 shows the categories of costs, offsets to costs (such as paperwork savings), and benefits that constitute total annual net benefits on a nationwide basis. Exhibit 18 shows the same components of net benefits on a per power unit basis.

Regulatory Option 1 yields the highest total net benefit. Although Regulatory Option 2 performs better on a per power unit basis, the small number of carriers affected results in small total net benefits. The final rule, therefore, adopts the 1X10 violation-based trigger for mandatory EOBR installation, maintenance, and use.

Exhibit 17. Summary of Total Annual Costs and Benefits ($millions)

Totals	Regulatory Option 1: 1X10 Remedial Directive	Regulatory Option 2: 2X10 Remedial Directive
Cost of EOBRs	($57)	($5)
Cost of Training	($4)	($1)
Cost of Operational Changes	($78)	($7)
Total Costs	($138)	($14)
Paperwork Savings	$59	$6
Safety Benefits	$124	$16
Total Benefits	$182	$22
Net Benefits	$44	$8

Exhibit 18. Summary of Costs and Benefits per Power Unit

Per Power Unit	Regulatory Option 1: 1X10 Remedial Directive	Regulatory Option 2: 2X10 Remedial Directive
Cost of EOBRs	($407)	($407)
Cost of Training	($26)	($87)
Cost of Operational Changes	($561)	($561)
Total Costs	($993)	($1,054)
Paperwork Savings	$421	$454
Safety Benefits	$890	$1,208
Total Benefits	$1,311	$1,662
Net Benefits	$318	$608

6 Sensitivity Analyses

The next series of analyses shows the degree to which the results are sensitive to the discount rate, assumed effectiveness of the EOBRs in discouraging violations, the inclusion of the costs of the operational changes needed to eliminate violations, the cost savings that could result from preexisting market penetration by EOBRs, and the possibility that EOBRs could provide operational benefits as well as costs.

6.1 Discount Rates

For simplicity, all of the results presented above were calculated using a real (i.e., inflation adjusted) discount rate of 7 percent. The costs and benefits were also calculated for an alternative rate of 3 percent, which tends to lower the annualized costs for items that involve up-front investments (such as EOBR equipment and training costs). Exhibits 19 and 20 show the effects of the change in discount rate on the net benefits. The effect is minor, which is related to the fact that most of the costs and benefits are spread evenly over time, and their annualized values are not affected by changes in the discount rate.

Exhibit 19. Summary of Total Annual Net Benefits with a 3 Percent Discount Rate ($millions)

	Regulatory Option 1: 1X10 Remedial Directive	Regulatory Option 2: 2X10 Remedial Directive
Cost of EOBRs	($57)	($5)
Cost of Training	($4)	($1)
Cost of Operational Changes	($79)	($8)
Total Costs	($140)	($14)
Paperwork Savings	$60	$6
Safety Benefits	$129	$17
Total Benefits	$188	$23
Net Benefits (3% Discount Rate)	$48	$9
Net Benefits (7% Discount Rate)	$44	$8
Change in Net Benefits	$4	$1

Exhibit 20. Summary of Annual Net Benefits per Power Unit with a 3 Percent Discount Rate

	Regulatory Option 1: 1X10 Remedial Directive	Regulatory Option 2: 2X10 Remedial Directive
Cost of EOBRs	($412)	($412)
Cost of Training	($25)	($83)
Cost of Operational Changes	($572)	($572)
Total Costs	($1,009)	($1,067)
Paperwork Savings	$429	$463
Safety Benefits	$926	$1,257
Total Benefits	$1,355	$1,720
Net Benefits	$346	$653
Net Benefits (Baseline)	$318	$608
Change in Net Benefits	$28	$45

6.2 Market Penetration

Though we believe our methodology for lowering the costs of EOBRs for carriers that are EOBR-ready is relatively accurate, it is possible that we overestimate the cost reduction or overestimate the number of EOBR-ready units. The following tables show how the final net benefits tables would change under the condition of no current AOBRD and EOBR use, and the assumption that no carriers owned EOBR-ready units.

Exhibit 21. Summary of Annual Net Benefits with No Market Penetration ($millions)

Total Annual Costs	**Regulatory Option 1: 1X10 Remedial Directive**	**Regulatory Option 2: 2X10 Remedial Directive**
Cost of EOBRs	($75)	($7)
Cost of Training	($4)	($1)
Cost of Operational Changes	($78)	($7)
Total Costs	($156)	($16)
Paperwork Savings	$59	$6
Safety Benefits	$124	$16
Total Benefits	$182	$22
Net Benefits	$26	$6
Net Benefits (Baseline)	$44	$8
Change in Net Benefits	($18)	($2)

Exhibit 22. Summary of Annual Net Benefits per Power Unit with No Market Penetration

Annual Costs PPU	Regulatory Option 1: 1X10 Remedial Directive	Regulatory Option 2: 2X10 Remedial Directive
Cost of EOBRs	($539)	($539)
Cost of Training	($26)	($87)
Cost of Operational Changes	($561)	($561)
Total Costs	($1,125)	($1,186)
Paperwork Savings	$421	$454
Safety Benefits	$890	$1,208
Total Benefits	$1,311	$1,662
Net Benefits	$186	$476
Net Benefits (Baseline)	$318	$608
Change in Net Benefits	($132)	($132)

6.3 EOBR Effectiveness

The estimate that EOBRs will prevent 50 percent of HOS violations could be too high or too low. Below we show how the net benefits change on a total and per power unit basis when effectiveness rates of 25 percent and 75 percent are used. The net benefits go up for both Regulatory Options 1 and 2.

Exhibit 23. Summary of Annual Net Benefits with Varying EOBR Effectiveness ($millions)

	Regulatory Option 1: 1X10 Remedial Directive	Regulatory Option 2: 2X10 Remedial Directive
Net Benefits (25%)	$21	$4
Net Benefits (50%)	$44	$8
Net Benefits (75%)	$67	$12

Exhibit 24. Summary of Annual Net Benefits per Power Unit with Varying EOBR Effectiveness

	Regulatory Option 1: 1X10 Remedial Directive	Regulatory Option 2: 2X10 Remedial Directive
Net Benefits (25%)	$153	$284
Net Benefits (50%)	$318	$608
Net Benefits (75%)	$483	$932

6.4 Value of a Statistical Life

Current DOT guidance requires a sensitivity analysis using a VSL of $3.2 million and $8.4 million.[40] The results of this analysis are presented below. Regulatory Options 1 and 2 are cost beneficial for all VSLs, with Regulatory Option 1 always providing the highest net benefits of the two and Regulatory Option 2 providing the highest net benefits per power unit for all VSLs, although this option also provides the smallest total net benefits.

Exhibit 25. Summary of Annual Net Benefits with Different VSL ($millions)

	Regulatory Option 1: 1X10 Remedial Directive	Regulatory Option 2: 2X10 Remedial Directive
Net Benefits ($3.2 million)	($2)	$2
Net Benefits ($5.8 million)	$44	$8
Net Benefits ($8.4 million)	$90	$14

Exhibit 26. Summary of Annual Net Benefits per Power Unit with Different VSL

	Regulatory Option 1: 1X10 Remedial Directive	Regulatory Option 2: 2X10 Remedial Directive
Net Benefits ($3.2 million)	($12)	$160
Net Benefits ($5.8 million)	$318	$608
Net Benefits ($8.4 million)	$648	$1,056

6.5 Alternative Device Costs

Comments received on the NPRM for this rule and research conducted by the American Transportation Research Institute indicate that the carriers would be willing to pay about $500-$1,000 per EOBR unit, with the upper price being for EOBRs with extra fleet management functions. With the addition of the monthly operation costs, this is roughly consistent with the median-price unit analyzed in the RIA that accompanied the NPRM for this rule.

To account for the possibility of a higher cost device, we conducted a sensitivity analysis with a device with a purchase cost of $1000. For Regulatory Options 1 and 2 we assumed that devices have a five-year operational life and are resold and reused when one cohort's remedial directive ends and another's begins.[41] All other costs and benefits remain unchanged. Exhibits 27 and 28 summarize the change to net benefits with the more expensive device. While this change reduces net benefits in all cases, it does not change the general results presented in the main text.

[40] http://ostpxweb.dot.gov/policy/reports/080205.htm

[41] This cost could also represent how much vendors would charge to lease these higher cost devices for two years.

Exhibit 27. Summary of Annual Net Benefits Higher Purchase Cost ($millions)

	Regulatory Option 1: 1X10 Remedial Directive	Regulatory Option 2: 2X10 Remedial Directive
Net Benefits (Baseline)	$44	$8
Net Benefits (Higher-Priced EOBRS)	$23	$6
Change in Net Benefits	($21)	($2)

Exhibit 28. Summary of per Power Unit Net Benefits Higher Purchase Cost

	Regulatory Option 1: 1X10 Remedial Directive	Regulatory Option 2: 2X10 Remedial Directive
Net Benefits (Baseline)	$318	$608
Net Benefits (Higher-Priced EOBRS)	$164	$453
Change in Net Benefits	($155)	($155)

6.6 Operational Efficiencies

Devices that could be used to comply with the rule provide additional functionality in addition to HOS compliance. A recent study of the effects of electronic systems incorporating wireless communications with FMS found that they offered potentially large improvements in operational efficiency for motor carriers.[42] Sources of efficiency gains were reported to include reduced call stops, reductions in the per-power unit costs of dispatchers, reductions in out-of-route miles, and reductions in empty miles. As detailed below, we do not anticipate that the rule will provide significant gains in these areas. Because of this and the relative complexity of the calculation, we chose to exclude it from the main analysis and present it here instead.

We would not expect to see carriers adopting FMS technology as a result of the EOBR mandate to achieve the same benefits as those who voluntarily use the technology: if they could realize substantial benefits from the technology we expect that they would have voluntarily adopted it. In addition, small carriers, particularly those not large enough to have a dispatcher would not likely gain much from having an FMS. There is, however, a "middle group" between those that would not gain at all and those that voluntarily adopt FMS that could recoup some of the cost of the system but not enough to do it without a mandate. It is this group of carriers that will achieve some operational efficiency benefits.

[42] Science Applications International Corporation (2004). Hazardous Materials Safety and Security, Technology Field Operational Test, Volume II: Evaluation Final Report Synthesis. Submitted to USDOT ITS Joint Program Office and USDOT Federal Motor Carrier Safety Administration. Accessed at: http://www.fmcsa.dot.gov/documents/hazmat/fot/FINAL-Volume-II-HAZMAT-Synthesis-11-12-04.pdf

To calculate these benefits, we need to know the size of this "middle" group and how much they would benefit. In the market penetration calculation, we assume that 40 percent of carriers in general, 50 percent of LH carriers, and 70 percent of Regulatory Option 1 and 2 carriers will not adopt FMS voluntarily. To estimate the size of the middle group for the high-cost estimate, we need to subtract from these totals the carriers that are too small to benefit from the technology. We assume that carriers with fewer than 10 power units are too small to realize operational efficiency benefits. From an analysis of all carriers in MCMIS and the Regulatory Option 1 and 2 carriers, we estimate that 50 percent of power units are part of fleets with fewer than 10 power units for both groups, and we assume that the LH sector has the same proportion of small carriers. This leaves 15 percent of SH and LH carriers, 25 percent of LH carriers, and 30 percent of Regulatory Option 1 and 2 carriers in the group that could gain some operational benefits but would not voluntarily adopt an FMS.

Although it is difficult to determine exactly how much these carriers could gain from an FMS, if we assume that carriers behave rationally it will be bounded by the net cost to a carrier of adopting an FMS when the operational efficiency benefits are excluded. In other words, the most benefit they can achieve is slightly less than the amount needed to make it cost-beneficial.

We estimate the net cost to the carrier excluding operational efficiency using a modified version of the final net benefits calculation (which can be interpreted as the net cost to society as opposed to the carrier). To isolate the costs to the carrier, we leave out the costs of training for state officials, and 90 percent of the safety benefits.[43] In addition, we adjust the training costs for Regulatory Options 1 and 2 to those of SH and LH since there would be no retraining after the first year. The operational efficiencies do not have a large impact on the total net benefits, since they only apply to a minority of carriers and the effects are bounded by the fact that they do not voluntarily adopt the technology. Exhibit 29 shows the effects of including operational efficiencies.

[43] Carriers bear some of the costs of crashes in terms of equipment damage, potential for increased insurance premiums, lost productivity, and damage to their reputation. However, the majority of the cost of crashes is the loss of life, which is not a direct cost to the company.

Exhibit 29. Net Benefits per Power Unit with Operational Efficiencies – 10 Percent of Safety Benefits Allocated to Carrier

	Regulatory Option 1: 1X10 Remedial Directive	Regulatory Option 2: 2X10 Remedial Directive
Cost of Device	($565)	($565)
Cost of Training	($7)	($7)
Cost of Operational Changes	($561)	($561)
Total Costs	($1,132)	($1,132)
Paperwork Savings	$421	$454
Safety Benefits (10%)	$89	$121
Total Benefits	$510	$575
Net Benefits to Carrier	($622)	($558)
Operational Efficiency Benefits	$59	$59
Net Benefits to Society with No Operational efficiency	$318	$608
Net Benefits to Society with Operational efficiency	$377	$667

7 Impacts on Small Entities

Any EOBR requirement would impose costs on several thousand carriers, almost all of which would be considered small. Under criteria established by the Small Business Administration, firms with annual revenues of less than $23.5 million are considered small for all North American Industrial Classification System (NAICS) codes falling under the truck transportation sub-sector (NAICS 484). Carriers typically exceed this threshold when they operate about 145 power units or more.[44] Based on MCMIS data on the number of power units employed by carriers, ICF estimates that fewer than 1 percent operate more than 145 power units, though these larger firms account for half of the power units.

The costs imposed by this rule are, however, relatively small. Exhibit 30 shows the per-power unit costs that would fall on carriers (see the sensitivity analysis regarding operational efficiencies for more detail). These net costs are a small fraction of the $100,000 in annual revenues per power unit realized by a typical small carrier, as shown in the last row of the exhibit.

Exhibit 30. Average Impacts per Power Unit

	Regulatory Option 1: 1X10 Remedial Directive	Regulatory Option 2: 2X10 Remedial Directive
Cost of Device	($433)	($433)
Cost of Training	($7)	($7)
Cost of Operational Changes	($561)	($561)
Total Costs	($1,000)	($1,000)
Paperwork Savings	$421	$454
Safety Benefits (10%)	$89	$121
Total Benefits	$510	$575
Net Benefits to Carrier	($490)	($426)
Costs as a Proportion of Annual Revenue	-0.49%	-0.43%

Though the impacts are generally quite small as a percentage of typical carrier revenues, there could be substantial variability in these impacts across the set of affected carriers. Lower revenues per power unit, and lower paperwork savings, could both result in higher impacts on a fraction of affected carriers than the estimates shown in Exhibit 30.

[44] For details on estimate of revenue per power unit, see note on revenue per power unit in Appendix A.

References

American Society for Industrial Security (1992). ASIS Speaks Out on Electronic Monitoring. *Security Management*, vol. 35, no. 4, p. 93.

Barton, J., Folkard, S., Smith, L., and Poole, ClJ. (1994). Effects on health of a change from a delaying to an advancing shift system. *Occupational and Environmental Medicine.* Nov: 51(11), pp. 749-755.

Battie M.C., Videman T., Gibbons L.E., Manninen H., Gill K, Pope M, and Kaprio J. (2003). Occupational driving and lumbar disc degeneration: a case control study. *Lancet*. Feb 8; 361(9356), p. 531.

Bhatia, R., Lopipero, P., and Smith, A.H. (1998). Diesel Exhaust Exposure and Lung Cancer. *Epidemiology.* Jan: 9(1), pp. 84.

Boshuizen HC, Bongers PM, and Hulshof CT. (1990). Self-reported back pain in power unit drivers exposed to whole-body vibration. *Int Arch Occup Environ Health*. 62(2), pp. 109-115.

Bruske-Hohlfeld I., Mohner M., Ahrens W., Pohlabeln H, Heinrich J., Kreuzer M., Jockel K.H., and Wichmann H.E. (1999). Lung cancer risk in male workers occupationally exposed to diesel motor emissions in Germany. *American Journal of Independent Medicine.* Oct: 36(4), pp. 405-414.

Cann A., Samoni A., and Egers, T. (2004). Predictors of whole-body vibration exposure experienced by highway transport truck operators. *Ergonomics*. Oct; 47(13), pp. 1432-1453.

Caruso, C.C., Lusk, S.L., and Gillespie, B.W. (2004). Relationship of work schedules to gastrointestinal diagnoses, symptoms, and medication use in auto factory workers. *American Journal of Independent Medicine*. Dec: 46(6), pp. 586-598.

Colt, J.S., Baris, D., Stewart, P., Schned, A.R., Heaney, J.A., Mott, L.A., Silverman, D., and Karagas, M. (2004). Occupation and bladder cancer risk in a population-based case control study in New Hampshire. *Cancer Causes Control*. Oct: 15(8), pp. 759-769.

Davidson, R. and Henderson, R. (2000). Performance Monitoring: A Laboratory Investigation of the Influence of Monitoring and Difficulty on Task Performance, Mood State, and Self-Reported Stress Levels. *Journal of Applied Social Psychology*, vol. 30, no. 5.

Ferreira, M., Jr., Conceicao, G.M.S., and Saldiva, P.H.N. (1997). Work Organization is Significantly Associated with Upper Extremity Musculoskeletal Disorders Among Employees Engaged in Interactive Computer-Telephone Tasks of an International Bank Subsidiary in Sao Paulo, Brazil. *American Journal of Industrial Medicine*, 31, pp. 468-473.

Gustavsson P., Plato N., Hallqvist J., Hogstedt C., Lewne M., Reuterwall C., and Scheele P. (2001). A population-based case-referent study of myocardial infarction and occupational exposure to motor exhaust, other combustion products, organic solvents, lead, and dynamite. Stockholm Heart Epidemiology Program (SHEEP) Study Group. *Epidemiology*. March: 12(2), pp. 222-228.

Federal Motor Carrier Safety Admninstration (2003). Regulatory Impact Analysis, Hours of Service Regulations. Accessed at http://www.fmcsa.dot.gov/espanol/english/pdfs/240882_web.htm

Hoekstra, E. J., Hurrell, J., Swanson, N. G., and Tepper, A. (1996). Ergonomic, Job Task, and Psychosocial Risk Factors for Work-related Musculoskeletal Disorders Among Teleservice Center Representatives. *International Journal of Human-Computer Interaction*, 8, pp. 421-431.

Insurance Institute for Highway Safety (IIHS) (2005). Unpublished survey data.

Jansen, N., Kant, I., Van Amelsvoort, L., Nijhuis, F., and Van den Brandt, P. (2003). Need for recovery from work: evaluating short-term effects of working hours, patterns and schedules. *Ergonomics*. Jun 10: 46(7), pp. 664-680.

Kolb, K.J., and Aiello, J.R. (1996). The Effects of Electronic Performance Monitoring on Stress: Locus of Control as a Moderator Variable. *Computers in Human Behavior*, vol. 13, no. 3, pp. 407-423.

Magnusson M.L., Pope M.H., Wilder D.G., and Areskoug B. (1996). Are occupational drivers at an increased risk for developing musculoskeletal disorders? *Spine Magazine.* Mar 15; 21(6), pp. 710-717.

Miyamoto M., Shirai Y., Nakayama Y., Gembun Y., and Kaneda K. (2000). An epidemiologic study of occupational low back pain in truck drivers. *Journal of Nippon Medical School*. Jun; 67(3), pp. 186-190.

Morgan, L., Arendt, J., Owens, D., Folkard, S., Hampton, S., Deacon, S., English, J., Ribeiro, D., and Taylor, K. (1998). Effects of the endogenous clock and sleep time on melatonin, insulin, glucose, and lipid metabolism. *Journal of Endocrinology*. Jun: 157(3), pp. 443-451.

Orris, P. and Buchanan, S. (2005). Literature Review on Health and Fatigue Issues Associated with Commercial Motor Vehicle Driver Hours of Work. Transportation Research Board Report. CTBSSP Synthesis 9. MC No. 08.

Robinson, G.S., Casali, J.G., Lee, S.E. (1997) The Role of Driver Hearing in Commercial Motor Vehicle Operation: An Evaluation of the FHWA Hearing Requirement. FHWA Contract No. DTFH61-C-00172.

Rogers, K. J. S.., Smith, M.J., and Sainfort, P.C (1990). Electronic Performance Monitoring, Job Design, and Psychological Stress. *Proceedings of the Human Factors Society*, 34, pp. 854-858.

Schleifer, L.M., Galinsky, T.L., and Pan, C.S. (1996). Mood Disturbances and Musculoskeletal Discomfort: Effects of Electronic Performance Monitoring under Different Levels of VDT Data-entry Performance. *International Journal of Human-Computer-Interaction*, 8, pp. 369-384.

Schleifer, L.M., Shell, R.L. (1992). A Review and Reappraisal of Electronic Performance Monitoring, Performance Standards and Stress Allowances. *Applied Ergonomics*, vol. 23, no. 1, pp. 49-53.

Science Applications International Corporation (2004). Hazardous Materials Safety and Security, Technology Field Operational Test, Volume II: Evaluation Final Report Synthesis. Submitted to USDOT ITS Joint Program Office and USDOT Federal Motor Carrier Safety Administration. . Accessed at: http://www.fmcsa.dot.gov/documents/hazmat/fot/FINAL-Volume-II-HAZMAT-Synthesis-11-12-04.pdf

Seshagiri, B. (1998). Occupational noise exposure of operators of heavy trucks. American Ind Hyg Assoc Journal. Mar; 59(3), pp. 205-213.

Smith, M.J., Carayon, P., Sanders, K. J., Lim, S-Y., and LeGrande, D (1992). Employee Stress and Health Complaints in Jobs with and without Electronic Monitoring. *Applied Ergonomics*, 23, pp. 17-28.

Sokejima S., and Kagamimori S. (1998). Working hours as a risk factor for acute myocardial infarction in Japan: case-control study. *BMJ*. Sep 19: 317(7161), pp. 775-80.

Steenland K., Deddens J., and Stayner L. (1998). Diesel exhaust and lung cancer in the trucking industry: exposure-response analyses and risk assessment. *American Journal of Independent Medicine.* Sep: 34(3), pp. 220-228.

Teschke, K., Nicol, A.M., Davies, H. and Ju, S. (1999). Whole body vibration and back disorders among motor vehicle drivers and heavy equipment operators: A review of the scientific evidence. Report to Workers Compensation Board of British Columbia, Vancouver, BC, Canada, April 14.

Wouters, P. I.J. and Bos, J.M.J. (2000) Traffic accident reduction by monitoring driver behaviour with in-car data recorders. Accident Analysis and Prevention 32, pp. 643–650.

Zaloshnja, E. and Miller, T. (2006). Unit Costs of Medium and Heavy Truck Crashes, Final Report for Federal Motor Carrier Safety Administration, Federal Highway Administration.

Appendix A

Note on Number of Companies and Staffing Requirements

Long Haul Population

For-hire

We wish to estimate the number of for-hire, over-the-road, TL companies. This is our target group of for-hire companies in LH. LTL companies are unlikely to be affected by the rule; in any event, there are so few of them that they would not affect estimates of total numbers of trucking firms.

We break this estimate into two parts: one for owner-operators and one for all other companies. We define owner-operators as firms with one-to-five tractors; all other firms have six or more tractors. (This definition is consistent with the one favored by OOIDA. As we will see later in this discussion, a firm with six or more tractors requires, and can support, a full-time office staff of at least one person.)

For the owner-operators, we put our reliance on a special run of VIUS data done by OOIDA.[45] These data show 145,667 tractors owned by firms with one to five tractors. OOIDA estimates, from their own survey data, that the average owner-operator has 1.4 tractors; 145,667÷1.4 = 104,048 owner-operators. We round this to 105,000. OOIDA also estimates that 30.0 percent of their members operate under their own authority, not leased to a larger TL firm; 0.30 x 105,000 = 31,500 owner-operators as independent firms. We assume virtually all of these firms are in over-the-road operations. Aside from draymen, owner-operators with tractors are rarely engaged in local service.[46]

For firms with more than five tractors, we consider three sources: the 2002 Economic Census[47], the American Trucking Associations' (ATA) Truck Fleet Directory (TFD) and the Transportation Technical Services (TTS) National Motor Carrier Directory (NMCD).

The Economic Census gives us data on numbers of establishments. For long-distance, general-freight, TL operation (NAICS 484121), 29,935 establishments are reported. For long-distance, specialized-freight (NAICS 48423), 11,837 establishments are reported. (All specialized freight is TL service.) Our first step is to convert number of establishments to number of firms. An establishment can be any place where a firm has an office or facility on a permanent basis with employees on hand. Therefore, a trucking company's terminals are establishments. We receive help in estimating number of firms from Table 4 of the Economic Census; this table is concerned with degree of concentration; it provides data on the top 50 firms which allow us to draw inferences regarding the rest of the firms.

For general freight, we see that firms below the top 50 have 27,474 establishments. We know that the number of terminals per firm falls away rapidly as firm size decreases. Indeed, the great preponderance of long-haul TL firms have only a home terminal. They

[45] John Siebert, "OOIDA Analysis of the 2002 VIUS to Determine the Owner-operator Role in the American Trucking Industry," OOIDA Foundation, April 2005, p. 3.
[46] These data based on conversations with John Siebert, July 27, 2005.
[47] 2002 Economic Census, Transportation and Warehousing

have neither the resources nor the requirement to maintain staffed terminals at other locations.[48] On this basis, we assume 1.2 terminals per firm; 27,474÷1.2 = 22,895. Adding back the top 50, we have 22,945, which we round to 23,000 for our estimate of OTR, general-freight TL companies.

For specialized freight (long distance—NAICS 48423), we follow the same procedure. The under-top-50 firms have 11,162 establishments; 11,162÷1.2 = 9302; we add back the 50 and round to 9,300; 9,300 + 23,000 = 32,300 or 32,000 for an estimate of long-distance TL companies from the Economic Census.

From the ATA TFD and the NMCD, we get somewhat different numbers. From the TFD and NMCD, we can extract firms with more than five tractors. From the TFD we got data on for-hire, TL firms—from the NMCD, for-hire firms with interstate authority. For firms with more than five tractors, we obtained: TFD 17,471 firms, NMCD 19,519 firms.

We can take these two numbers and average them for an estimate of 18,500 firms not owner-operators compared to 32,000 from the Economic Census. Part of the difference from the Economic Census is that the latter includes some owner-operators, since it includes any trucking firms with employees; some owner-operators have employees. Part of the difference is also that neither of the directories captures the full universe. The fact, however, that the TFD and NMCD numbers are so close suggests they are getting a high fraction of the universe. Nonetheless, we make our estimate by averaging the numbers from the Economic Census and the directories; the average is 25,250 which we round for an estimate of 25,000 over-the-road TL firms with more than five tractors. In this we err in the direction of over-estimating costs.

As we see from the discussion of staffing requirements later in this Appendix, we need to estimate the number of firms in the following size categories: one-to-10 tractors; 11-to-100 tractors; and more than 100 tractors.

The first step is to estimate the size distribution for companies with more than five tractors. The following table shows that distribution for both the TFD and the NMCD.

Exhibit A-1. Comparison of Size Distribution Estimates, ATA and NMCD

	ATA	Percent	NMCD	Percent
6-10	6,094	34.9%	6,837	35.0%
11-100	10,065	57.6%	11,232	57.5%
>100	1,312	7.5%	1,450	7.4%
Total	17,471	100.0%	19,519	100.0%

Since the percentage distributions across these size categories are nearly identical, we can use them to allocate the estimated 25,000 firms with more than five tractors as follows: 6-10—35.0 percent; 11-100—57.5 percent; >100—7.5 percent. This gives the following result.

[48] Conversation with George Edwards, trucking-industry expert, July 28, 2005.

Exhibit A-2. Calculations for Firm Size

	Percent	# of firms
6-10	35	8,750
11-100	57.5	14,375
>100	7.5	1,875
Total		25,000

Then we add the owner-operator estimate of 31,500 in the one-to-five group to the six-to-ten group to get the one-to-10 group and, thus, a complete distribution of for-hire firms. (31,500 + 8,750 = 40,250)

Exhibit A-3. Calculations for Firm Size

Number of Power Units	For-hire
1-10	40,250
11-100	14,375
>100	1,875
Total	56,500

Private Carriers

In general, data on private carriers are more difficult to come by and less comprehensive than is the case for for-hire carriage. In particular, private carriage, as such, is not found in the Economic Census, so there is nothing against which to check the available directories. Two directories are available and do give some useful data. The ATA TFD lists private carriers separately. TTS, in conjunction with the National Private Truck Council and Fleet Owner Magazine, publishes the Private Fleet Directory (PFD). These two sources give us data as follows:

Exhibit A-4. Comparison of Fleet Size Data

ATA Private	# of firms	%	PFD	# of firms	%
1-10	18,319	78.8%	1-14	15,234	73.9%
11-100	4,513	19.4%	15-99	4,818	23.4%
>100	409	1.8%	>99	564	2.7%
Total	23,241	100.0%		20,616	100.0%

The size classes are different, because of the way the PFD data are presented. We note that the number of firms and size distribution from the two sources are similar. ATA has more firms, and the difference is all in the smaller firms; because ATA has more companies, and more small companies, we will follow the ATA size distribution for allocating total companies across the size classes.

We also need to adjust the total number of firms upward. It is a certainty that the ATA total is less than the actual total. It is not possible that all of the private carriers in long-haul and regional operation have chosen to register in these directories. We choose 30,000 as an estimate of private carriers in long-haul and regional operation. This is a substantial increase over the figure of 23,241 from the ATA directory, especially in view of the fact that the ATA number necessarily includes some short-haul operations. (We believe that, by excluding firms without tractors, we have eliminated many private short-haul carriers but certainly not all.) Therefore, we find 30,000 to be an acceptable assumption for this purpose.

Given the similarity between the ATA and PFD numbers for the larger fleets, we take these numbers as good estimates for those fleets and add all the additional firms to the one-to-10 group. This process is shown in the following table. The first column of data is the ATA numbers. In the second column, the total is increased to 30,000, all the increase being in the smallest category. In the last column the results are rounded to provide our estimate of number and size distribution of private carries in regional and long-haul operations.

Exhibit A-5. Estimated Motor Carriers by Size Category

Number of Power Units	ATA #s	+6759	rounded
1-10	18,319	25,078	25,000
11-100	4,513	4,513	4,500
>100	409	409	500
Total	23,241	30,000	30,000

Correction for Time

The figures presented here come from estimates for 2000 and 2002, while the rest of the population estimates are from 2005-2007 data. While minor changes in the populations have very little effect on the absolute and relative net benefits of the various options, we believe this is a large enough time different to warrant a correction. Based on BLS data, we estimate the industry grew by 8.8% in this period.[49] Final estimates for LH trucks, then, are 97,000 companies, 1,718,000 power units, and 1,882,000 drivers.

Buses

Our estimates for the number of buses come from a 2006 run of MCMIS that had counts of all power units as well as counts excluding buses, vans, and limousines. To estimate the population sizes for the entire industry, we subtracted out the buses, vans, and limousines, resulting in an estimate of 162,000 passenger vehicles. A similar calculation resulted in an estimate of 7,500 companies. Finally, we assume a 1:1 ratio of drivers to vehicles, giving 162,000 drivers.

Data limitations make it difficult to come up with a precise number of how many of these buses, drivers, and companies would fall into LH. As a rough estimate, we count vehicles classified as motorcoaches as roughly analogous to LH, and thus place 75,000 buses and drivers in LH. Finally, we apply the ratio LH buses to SH and LH buses to the number of companies to come up with 3,500 in LH service.

[49] BLS, Employment, Hours, and Earnings from the Current Employment Statistics survey. The number of Employees in General Freight Trucking, Long Distance grew from 629,100 to 684,700 from 2000 to 2006.

Staffing Requirements

To estimate training costs, we need to estimate number of persons to be trained. The first step is to consider the total number of people in the office of small trucking firms. Obviously, for the smallest firms there are no people in the office. OOIDA states that that is the case for firms with one-to-five tractors; their view is that, with the sixth tractor, the owner has to come into the office full time to manage the company.[50]

Data from the TTS Blue Book on general-freight TL firms, tell us that, for companies with revenue under $5.0 million, average revenue per person of management and administrative staff is $630,000.[51] For the same firms, the Blue Book shows average revenue per tractor of $133,000; round it down to $130,000 for this group. This number supports the OOIDA assertion that with six or more tractors a company needs someone in the office full time. Five tractors will generate $650,000 in revenue, enough to support one person in the office; cautious owners may wait until they have six tractors. Ten tractors will generate $1.3 million in revenue, enough to support two persons; we assume that owners are cautious and do not hire that second person until they have 11 tractors.

We assume that a firm with zero people in the office will have to train one of the drivers. In practice, that would mean that the owner would have to take the time to train himself. A firm with one person in the office will have to train that person. Therefore, firms with one-to-10 tractors will have to train one person. A firm with two people in the office will have to train both of them. With two people, both of them have to be able to perform virtually all of the tasks required in the office. Therefore, firms with 11 or more tractors will have to train at least two people. At some point, as firm size increases, more people will have to be able to process and work with EOBR data. We assume that firms with 11-to-100 tractors train two people; firms with more than 100 tractors will train an average of four people. In the following exhibit, the estimates of number of for-hire and private firms are combined, and the above rules on number of trainees are applied to obtain an estimate of total number of persons to be trained.

Exhibit A-6. Estimated Personnel to be Trained for EOBR Use

Number of Power Units	For-hire	Private	Total Firms	Trainees
1-10	40,250	25,000	65,250	65,250
11-100	14,375	4,500	18,875	37,750
>100	1,875	500	2,375	9,500
Total	56,500	30,000	86,500	112,500

We note that this leads to an average of 1.3 trainees per firm (112,500 ÷ 86,500 = 1.3). We use this number to estimate office training costs for all options. We believe that the relationships between firm size and number of people in the office will be approximately the same for short-haul firms covered in the industry and the targeted firms in Regulatory Options 1 and 2.

[50] John Siebert, "OOIDA Analysis of the 2002 VIUS to Determine the Owner-operator Role in the American Trucking Industry," OOIDA Foundation, April 2005, p. 2.
[51] Transportation Technical Services, "Blue Book of Trucking Companies," 2004-2005 edition, p. S-3.

Appendix B

Violation Richness Analysis

Data from FMCSA roadside inspections from years 2004 - 2007 were analyzed for the rate of part 395 violations (those related to hours of service). Within these inspections, those of motor carriers who would be subject to the EOBR requirement under Regulatory Options 1 and 2 were compared to rest of the population.

The Regulatory Option 1 and 2 populations show higher rates of violations per records checked than the rest of the population, varying by the type of part 395 violation. Exhibits C-1 and C-2 show the differing rates of violation by regulation section.

Exhibit B-1: Comparative Rate of Hours-of-Service Violations Among Option 1 Population

Hours-of-Service Violation Category	Option 1 Population	Inspections Excluding Option 1 Population	Ratio of Option 1 Violation Rate to Others
11 Hour Rule [3(a)(1)]	4.61%	2.17%	2.12
14 Hour Rule [3(a)(2)]	6.39%	3.13%	2.04
60 or 70 Hour Rule [3(b)]	0.71%	0.28%	2.54
Paper RODS Altered, Not on File for 6 Months [8(k)(2)]	2.56%	1.48%	1.73
False Logs [8(e)]	2.95%	1.29%	2.29
Form and Manner of Records [8(f)(1)]	11.59%	7.12%	1.63
No Log [8(a)]	1.27%	1.44%	0.88
Other [8(Unspec.)]	10.74%	6.60%	1.63

Exhibit B-2: Comparative Rate of Hours-of-Service Violations Among Option 2 Population

Hours-of-Service Violation Category	Option 2 Population	Inspections Excluding Option 2 Population	Ratio of Option 2 Violation Rate to Others
11 Hour Rule [3(a)(1)]	3.51%	2.17%	1.62
14 Hour Rule [3(a)(2)]	5.93%	3.13%	1.89
60 or 70 Hour Rule [3(b)]	0.56%	0.28%	1.99
Paper RODS Altered, Not on File for 6 Months [8(k)(2)]	1.98%	1.48%	1.34
False Logs [8(e)]	2.87%	1.29%	2.23
Form and Manner of Records [8(f)(1)]	9.45%	7.12%	1.33
No Log [8(a)]	1.12%	1.44%	0.78
Other [8(Unspec.)]	11.02%	6.60%	1.67

After calculating the rate of violations discovered for each category, the Regulatory Option 1 and 2 population violation rates were compared to the rate for that category in the rest of the population. The resulting ratio is shown in the far-right columns, above.

In most violation categories, the Regulatory Option 1 violation rate exceeded that of the rest of the compliance review population, by a factor ranging from 1.63 to 2.29; the Regulatory Option 2 violation rate exceeded that of the rest of the compliance review population, by a factor ranging from 1.33 to 2.23, illustrating a slight improvement in

HOS compliance after the first compliance review. For both options, the lone exception was the 8(a) category, a violation type that indicates no log at all. It is likely that short-haul drivers, unaware of the regulatory requirements, contribute to the anomalous ratio. Obviously calculating this ratio entails a large degree of uncertainty, but the evidence in Exhibits C-1 and C-2 shows that 2:1 is a suitable estimate for both options.

It is important to note that these are conservative estimates of the difference between the Regulatory Option 1 and 2 populations and the general motor carrier population. Motor carriers undergoing roadside inspections are targeted to some degree. Therefore, this population of motor carriers should perform worse than the overall motor carrier population in general.