Regulatory Impact Analysis:
Restricting Railroad Operating Employees' Use of Cellular Telephones and Other Distracting Electronic Equipment

49 CFR Part 220
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1. Executive Summary

The Federal Railroad Administration (FRA) is amending the Federal Railroad Communications regulation to promote the safety of railroad operations. FRA is converting to an FRA regulation most of the existing restrictions found in FRA Emergency Order No. 26 (EO 26 or Order) issued under 49 U.S.C. 20104(a) on the use by railroad operating employees of cellular telephones (cell phones) and other distracting electronic and electrical devices (electronic devices). This rulemaking will largely codify the requirements of EO26; however, this rulemaking is also modifying some of the substantive requirements of EO 26 as well as its scope to accommodate changes previously recommended by a Petition for Review of EO 26. This rule addresses several concerns that were raised regarding EO 26, including the following: deadheading employees' use of electronic devices; the use of cameras; and the use of calculators. The rule will provide relief in these areas without sacrificing any of the safety benefits of EO 26. Relative to the requirements of EO 26, the only additional burdens produced by the requirements of this rule are those related to revising programs and initial instruction focused on the exceptions that this rule will introduce; the potential cost associated with purchasing cameras and calculators or carrying ones previously purchased and available for use should the need arise, which were banned under EO 26, but are permitted under this rule; and nominal costs associated with seeking FRA approval for use of railroad-supplied electronic devices for taking photographs and videos.

. This added burden, estimated over a 20-year period, could total as much as $696,000, discounted at an annual rate of 3%, or $613,000, discounted at a rate of 7% and is broken down as follows.

	PV (3%)	PV(7%)
Program revision	$ 39,660	$ 39,660
Initial instruction	246,610	246,610
Potential cost of cameras	334,951	252,435
Potential cost of calculators	75,081	74,084
Total	$696,302	$612,789

When EO 26 was issued on October 1, 2008, FRA was responding to what it believed to be "an emergency situation involving a hazard of death or personal injury."[1] As an emergency requires prompt action, EO 26 was issued without an accompanying economic analysis. To provide a more meaningful and comprehensive analysis of the impact of government intervention and develop an alternative regulatory approach to consider, this economic analysis contains estimates of the costs and benefits of EO 26 in addition to those of this rule. Specifically, this economic analysis estimates the costs likely to be induced by EO 26 and this rule, over the first twenty years after promulgation. This analysis also includes break-even analyses, or estimates of the monetized benefits that would be necessary to achieve to offset the total costs.

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[1] FRA Emergency Order No. 26, Notice No. 1. *Federal Register*, Vol. 73, No. 195. October 7, 2008. 58702. Available at: http://www.fra.dot.gov/downloads/pubaffairs/emergencyorder26.pdf.

Clearly, the benefits associated with a more cost effective program will justify the additional costs associated with the program revisions and initial training focused on the exceptions introduced by the rule. The benefits associated with the allowance for use of cameras and calculators will equal or exceed the costs associated with carrying and using these devices in accordance with this regulation. Given that this is not a mandatory requirement, but rather a permissive one, cameras and calculators will only be used to the extent that perceived benefits exceed perceived costs. The benefits of seeking FRA approval for use of railroad-supplied electronic devices for taking photographs and videos will be the avoidance of unwarranted use of such devices, which would equal or exceed the nominal costs associated with meeting this requirement.

The assumptions and approach used in this analysis are generally quite conservative. Based on break-even analyses, FRA finds prevention of one fatal accident every two years would make the rule at least break even and likely have positive net benefits. Over the period from 2000 to 2008, electronic device usage in trains likely caused or contributed to accidents resulting in at least 30 fatalities and over 100 injuries – an average of over three deaths per year, as well as significant train delay and property damages. Given the continuing proliferation of cell phones and other electronic devices, it seems highly likely that, absent regulatory intervention, the unsafe use of electronic devices would continue to extract a gruesome toll on the nation in the form of lives lost, injuries incurred, and property damaged. Table 1 below presents the benefits that are

considered in this analysis, benefits that would arise if accidents are avoided as a result of this rule preventing the unsafe usage of electronic devices in railroad operations.

Table 1: Summary of Safety benefits of Restrictions on Use of Electronic Devices

Benefit
Fatalities avoided
Injuries avoided
Property damage avoided

The frequency and severity of accidents together with the observed rising incidence of improper uses of cell phones and other electronic devices strongly suggest that the elimination of improper electronic device usage by railroad operating employees, as required in this rule, will yield safety benefits that exceed the costs. The costs that may be induced by EO 26 and this rule over the twenty-year period considered include the following: the cost of revising operational testing and inspections programs; the cost of conducting additional operational testing and inspections; the cost of instructing employees; the potential cost of calculators and cameras for train crew use; and the opportunity cost of railroad operating employees' time spent in safety briefings. The summed total of the estimated direct costs over the first twenty years of EO 26 and this rule equals about $12.7 million at a 3 percent discount rate and about $9.5 million at a 7 percent discount rate (in 2009 dollars). Additionally, indirect costs that would result from this rule are estimated to equal about $30.2 million at a 3 percent discount rate and $22.4 million at a 7 percent discount rate. The majority of these costs are already being incurred because of the implementation of EO 26. Table 2 below summarizes both the

direct and indirect costs considered in this analysis, summed over the twenty-year period analyzed and discounted to present value using 3 percent and 7 percent discount rates.

Table 2: Summary of present discounted costs of the rule and EO 26 over first twenty years

Direct costs	Twenty-year total (3% discount rate)	Twenty-year total (7% discount rate)
Revising programs *	$ 8,348.02	$ 6,175.35
Revising programs for rule	$39,659.62	$39.659.62
Performing operational tests	$633,087.44	$468,318.78
Instruction *	$11,339,537.79	$8,388,404.44
Instruction on rule	$246,610.00	$246,610.00
Cameras (potential)	$334,951.39	$252,434.85
Calculators (potential)	$75,080.95	$74,083.90
Total direct costs	$12,677,415.21	$9,475,686.94
Indirect Costs	Twenty-year total (3% discount rate)	Twenty year total (7% discount rate)
Opportunity cost of additional time spent in safety briefings*	$30,238,989.11	$22,368,926.84
Total indirect costs	$30,238,989.11	$22,368,926.84

* Costs already being incurred under EO 26

The costs of EO 26 alone are similar to those of this rule, with three exceptions. Under EO 26, the usage of cameras and calculators was prohibited in many railroad operating situations, and therefore neither railroads nor employees would have incurred the costs of their provision or the benefits of their usage in those situations. Additionally, one of the costs of EO 26 is the opportunity cost of preventing deadheading employees from using electronic devices under many circumstances. The summed total of the estimated direct costs over the first twenty years after the promulgation of EO 26 equals about $12.3 million at a 3 percent discount rate and about $9.2 million at a 7 percent discount rate (in

2009 dollars). Additionally, indirect costs incurred because of EO 26 are estimated to equal about $30.2 million at a 3 percent discount rate and about $22.4 million at a 7 percent discount rate, plus the unquantifiable costs of restricting railroad operating employees from using calculators and cameras and of restricting deadheading employees from using electronic devices.

Between the Notice of Proposed Rulemaking (NPRM) and Final Rule stages, FRA modified some provisions of the rule. Two of these modifications were to remove potentially costly provisions that were very unlikely be beneficial. The first of these modifications was with respect to a proposal in the NPRM, at §220.307(c), which had allowed a limited set of railroad-supplied electronic devices to be used by railroad operating employees not in deadhead status, other than locomotive engineers, under certain circumstances and only following a crew safety briefing and unanimous agreement amongst the crew that such use would be safe.[2] Specifically, in the NPRM, §220.307(c) had limited the railroad-supplied electronic devices that could be used in certain circumstances to "a mobile phone or remote computing device."[3] This limitation could have inadvertently stifled the development or adoption of new technologies that could be used by railroads to enhance productivity, safety, or for some other purpose. To avoid this unintended cost of potentially hindering the growth or adoption of technology,

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[2] Federal Railroad Administration (2010). "Notice of Proposed Rulemaking: Restrictions on Railroad Operating Employees' Use of Cellular Telephones and Other Electronic Devices." *Federal Register*, May 18, Vol 75, No. 95. Available online: http://www.regulations.gov/search/Regs/home.html#documentDetail?R=0900006480aef96d.

[3] Ibid., p. 27688.

FRA removed the limitation, instead adopting language that would allow the use of any railroad-supplied electronic device under prescribed circumstances and following a safety briefing and unanimous agreement amongst crewmembers that it is safe to use the device.

The second modification was with respect to §220.307(d)(2) in the NPRM, which had required that, among other conditions, operations be suspended when a crewmember not in deadhead status outside a cab of a controlling locomotive used a railroad-supplied electronic device. The requirement that operations be suspended could have inadvertently prevented the development or adoption of technologies that potentially enhance productivity or safety while performing operations. For example, if some operations are currently performed using printed or handwritten instructions, FRA recognizes that such instructions could just as easily be followed on an electronic device – a device that might also allow the automatic updating of data or instructions and through such updating increase safety for crewmembers. Thus, in the Final Rule, FRA removed the requirement that all operations be suspended before a crewmember uses a railroad-supplied electronic device outside the cab of a controlling locomotive, while still requiring that the crewmember not be fouling a track and that all crewmembers agree that it is safe to use the device prior to its use.

Each of the modifications discussed above removed a potentially costly provision of the NPRM. However, no change in expected costs, vis-à-vis the preliminary RIA, is

reflected in this final RIA because the preliminary RIA accompanying the NPRM had not accounted for these potential costs. FRA had not intended to create such burden.

2. Background

2.1 Rulemaking History

Based on the historical record, rail transportation in the United States is an extremely safe mode of transportation.[4] However, some recent incidents and a number of recent scientific publications have caused FRA to have very serious concerns about possible decreases in safety resulting from the improper usage of cell phones and other electronic devices by railroad operating employees. FRA's concerns led to the issuance of FRA Emergency Order No. 26, Notice No. 1 (EO 26), which restricted on-duty and certain other railroad operating employees from certain uses of electronic devices.[5]

Prior to the issuance of EO 26, FRA had taken a series of actions designed to address the issue of the improper usage of electronic devices by railroad operating employees. When FRA amended 49 CFR part 220, Radio Standards and Procedures (part 220), on January 4, 1999, the part was re-titled, "Railroad Communications," to reflect its coverage of other means of wireless communications such as cell phones, data radio terminals, and other forms of wireless communications used to convey emergency and other essential

[4] See, for example, the push-pull report containing intermodal safety comparisons, available online at: http://www.fra.dot.gov/us/content/1778.

[5] EO 26 also covered railroad operating employees in the circumstances specified in the Order who were deadheading from duty to the point of final release and were therefore neither on duty nor off duty. See 49 U.S.C. 21103; 49 CFR part 228, app. A; and Federal Register, Vol. 74, p. 30665 (June 26, 2009).

information. The revisions to part 220 were the result of recommendations by the Railroad Safety Advisory Committee's (RSAC) Working Group, which consisted of a diverse group of subject matter experts representing a wide array of railroad industry stakeholders.[6]

The RSAC Working Group examined extensive safety data, discussed how to improve compliance with existing Federal regulations on radio standards and procedures, and considered whether to mandate radios and other forms of wireless communications to convey emergency and other critical information. After the RSAC Working Group's deliberations and consideration of comments, FRA decided, at that time, not to promulgate non-radio wireless communications procedures, based primarily on the fact that the RSAC Working Group did not consider in depth how to ensure the accuracy and completeness of non-radio wireless communications. Accordingly, in the final rule amending 49 CFR part 220, FRA addressed only the testing and failure of non-radio wireless communications equipment.[7] However, FRA emphasized in the preamble to the final rule that the procedures in 49 CFR 220.61 (radio transmission of mandatory directives) should be followed even when a cell phone or other form of wireless communication is used to transmit mandatory directives. FRA stated at the time that it

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[6] For a discussion of the RSAC approach to rulemaking, see
Cothen et al. (2005) "Consensus Rulemaking at the Federal Railroad Administration: All Aboard for Railway Safety Measures." TR News, 236 January-February 2005, pp. 8 – 14.
[7] 49 CFR 220.37 and 220.38.

reserved the right to revisit the issue of non-radio wireless communications procedures, if necessary.

On March 17, 2004, FRA met with the National Transportation Safety Board (NTSB) at what was termed a "Safety With A Team" (SWAT) meeting. NTSB had issued Safety Recommendation R-03-01 as a result of NTSB's investigation of the collision between two BNSF freight trains, near Clarendon, Texas, on May 28, 2002.[8] Safety Recommendation R-03-01 recommended that FRA "[p]romulgate new or amended regulations that will control the use of cellular telephones and similar wireless communication devices by railroad operating employees while on duty so that such use does not affect operational safety." Subsequently, FRA told NTSB that it had instructed its inspectors to increase its monitoring of unauthorized use of cell phones, but that enforcement of any regulation in this area would be challenging. FRA stated that it was in the process of gathering copies of enhanced railroad operating rules that strengthened the restrictions railroads placed on the use of cell phones and that it would review all of these rules and procedures governing cell phone use to look for gaps, and consider options, including the issuance of a FRA Safety Advisory.

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[8] NTSB's investigation concluded that the primary cause of the accident was "the coal train engineer's use of a cell phone during the time he should have been attending to the requirements of the track warrant his train was operating under." See NTSB's investigation summary online at-- http://www.ntsb.gov/publictn/2003/RAR0301.htm.

FRA also stated to NTSB that FRA would discuss the subject of cell phone usage with members of the full RSAC, and determine what actions, if any, FRA should pursue in relation to this safety recommendation. At the full RSAC meeting conducted on April 27, 2004, FRA asked that the members of all organizations come to the next full RSAC meeting prepared to discuss what their current instructions were for cell phone use, whether they need to be improved, and whether this is a subject that should be tasked to a new RSAC Working Group.

Also at this time, FRA contacted the General Code of Operating Rules (GCOR) Committee concerning the enhancement of GCOR Rule 1.10 (use of electronic devices) in the next edition of the GCOR, due to be published on April 3, 2005. The GCOR Committee, however, decided not to amend the GCOR rule at the time, holding the position that each member railroad should address the cell phone issue in its individual special instructions.

Subsequently, in a letter to NTSB dated May 26, 2004, FRA provided copies of all relevant railroad operating rules and procedures relating to the use of cell phones and other wireless communication devices. FRA's initial review of this material indicated that, while there is some disparity with respect to the detail of prohibitions and restrictions concerning the usage of cell phones and other electronic devices, all railroads canvassed did have a rule that prevented or limited cell phone use. In this letter, FRA recounted its initial response to NTSB Safety Recommendation R-03-01, which was that

FRA had changed the title of part 220 to "Railroad Communications" to reflect coverage of other means of wireless communications such as cell phones, data radio terminals, and other forms of wireless communications used to convey emergency and other essential information. FRA also reminded NTSB that the revisions to part 220 that went into effect in 1999 were the result of a recommendation by the full RSAC. FRA acknowledged that, as in all forms of transportation, there are many distractions in the course of day-to-day train operations that could momentarily divert a crewmember's attention, and that cell phones were just one of those distractions mentioned. FRA still believed, at that time, that the operating rules of railroads adequately addressed these situations and that responsibility for compliance rested with company officers and supervisors. Therefore, FRA concluded that the railroads' enforcement of their operating rules governing cell phone use was sufficient to address the issue without the intrusiveness of a Federal intervention.

At the full RSAC meeting on September 22, 2004, members came prepared to discuss the issue of cell phone use and particularly whether current railroad operating rules adequately addressed cell phone use, whether the rules needed to be improved, and whether this was a subject that should be tasked to a new RSAC Working Group. FRA pointed out that the proliferation of cell phone technology has now made the devices a necessity, although FRA also noted that there are many examples of how the use of electronic devices such as cell phones by railroad employees in locomotive cabs of moving trains can be distracting.

The RSAC members present at the meeting unanimously restated that virtually all of them restrict cell phone use in one form or another, but also acknowledged that the use of cell phones and other electronic or electrical devices allows more effective communication among employees, and that many railroads provide cell phones to their employees. It was also mentioned that 49 CFR part 220 required redundant communication devices, and that cell phones were one acceptable example of redundant communication devices. The members present at the meeting came to consensus that cell phone usage was a complex issue and that they were not yet prepared to consider a Federal regulation in this area. Notwithstanding, while FRA had not yet decided what course of action it would follow, FRA agreed to reexamine current railroad operating rules and instruction on cell phone use and develop from that review what "best practices" emerged. FRA would then circulate a "best practices" document among RSAC members for comments before forwarding it to NTSB.

In a letter to NTSB dated August 18, 2006, FRA provided NTSB with an update on the status of its recommendation R-03-01 with respect to cell phone use in the railroad industry. FRA noted that NTSB had renewed its interest in the use of cell phones by railroad employees as the result of a collision between two BNSF freight trains near Gunter, Texas, on May 19, 2004.[9] NTSB had determined that 25 calls were made by

[9] See NTSB's report at: http://www.ntsb.gov/publictn/2006/RAR0602.htm.

crewmembers from both trains during the trip and up to the time of the collision, and that 22 of those calls were of a personal nature. FRA's update indicated to NTSB that it had not yet decided what final course of action it would follow, but that, with the assistance and cooperation of the railroad's operating rules departments, it was still developing a "best practices" document. It was subsequently decided to task the RSAC Operating Rules Working Group with developing this document.

At a meeting of the Operating Rules Working Group on September 27 – 28, 2007, in Fort Worth, Texas, also attended by a representative of the NTSB, it was discussed and agreed that if the railroad industry, with a representative from FRA to facilitate the process, would develop, adopt, and enforce a "best practices" operating rule, that approach would be considered by NTSB in lieu of Federal intervention.

At the next meeting of the GCOR Committee, on November 14 – 15, 2007, which was also attended by rules officers from NORAC and other major Eastern railroads not signatory to the GCOR, and the ASLRRA, and which was also facilitated by a representative from FRA, a "best practices" operating rule was developed. Subsequently, a draft of that "best practices" operating rule was shared with the RSAC Operating Rules Working Group at a meeting held on January 17 – 18, 2008, in Washington, DC. After extensive deliberations, the Working Group decided that the "best practices" operating rule required further enhancements. It was suggested that FRA develop a Safety Advisory that would contain the additional enhancements, some of which were proposed

at the meeting. FRA accepted this task and subsequently developed a proposed Safety Advisory on the use of cell phones and similar wireless communications devices by railroad operating employees.

At a meeting of the Operating Rules Working Group held in Grapevine, Texas, on May 21 – 22, 2008, the proposed Safety Advisory on cell phone use was discussed, and the document was further refined and enhanced to include many valuable suggestions. A final draft was then prepared for discussion at the next Working Group meeting.

In the meantime, a series of accidents involving cell phone use and observations by FRA inspectors of unsafe behavior involving cell phone or other distracting electronic or electrical devices, some of which are discussed below, led FRA to change its view on the necessity of immediate action. Subsequently, at a meeting of the Operating Rules Working Group held in Chicago, Illinois, on September 25 -26, 2008, a draft of FRA's proposed Emergency Order on the use of cell phones and other forms of wireless communications was discussed and much valuable input was received. The Emergency Order – EO 26 – was published October 7, 2008.

Subsequently, FRA initiated regulatory action to codify EO 26, with some modifications. This regulatory action resulted in the publication of a Notice of Proposed Rulemaking (NPRM) on May 18, 2010, which is being followed by this final rule.

2.2 History of Accidents and Unsafe Practices Involving Electronic Devices

Below are some of the accidents that have occurred over the past ten years that were caused by or linked to the usage of electronic devices.

1. *Chatsworth, California.* On September 12, 2008, a head-on collision occurred between a Southern California Regional Rail Authority (Metrolink) commuter train and a Union Pacific Railroad Company (UP) freight train in Chatsworth, California, which resulted in the deaths of 25 people, the injury of numerous others, and more than $7,100,500 in damages. NTSB stated that a cell phone owned by the locomotive engineer was being used to send a text message within 30 seconds of the time of the accident.
2. *Harris County, Texas.* On June 8, 2008, a UP brakeman was struck and killed by the train to which he was assigned. FRA's investigation indicated that the brakeman instructed the locomotive engineer via radio to back the train up and that the brakeman subsequently walked across the track, into the path of the moving train. The brakeman was talking on his cell phone at the time of the accident.
3. *Marshall, Texas.* On July 1, 2006 a northbound BNSF Railway Company (BNSF) freight train collided with the rear of a standing BNSF freight train at Marshall, Texas. Although there were no injuries, damages were estimated at $413,194. Both trains had two-person crews. The striking train had passed a "Stop and Proceed at Restricted Speed" signal indication and was moving at 20 mph. FRA determined that the collision was caused by the failure of the locomotive engineer

on the striking train to comply with restricted speed and that he was engaged in cell phone conversations immediately prior to the accident.

4. *San Antonio, Texas.* On May 27, 2006, an eastbound UP freight train collided head on with a westbound UP freight train at San Antonio, Texas. There were four injuries, and damages were estimated at $401,779. Both trains had two-person crews. FRA determined that the collision was caused by the eastbound train locomotive engineer's inattentiveness because he was engaged in a cell phone conversation and by the conductor's failure to supervise safe operations.
5. *Gunter, Texas.* One locomotive engineer died and a train conductor suffered serious burns when two BNSF freight trains collided head on near Gunter, Texas on May 19, 2004. The collision resulted in the derailment of 5 locomotives and 28 cars, with damages estimated at $ 2,615,016. Approximately 3,000 gallons of diesel fuel were released from the locomotives, which resulted in a fire. NTSB investigators obtained records that showed the number and duration of cell phone calls made by crewmembers on both trains between 1:50 p.m. and the time of the accident, approximately 5:46 p.m. During this time, a total of 22 personal cell phone calls were made or received by the five crewmembers on both trains while the trains were in motion.
6. *Clarendon, Texas.* At 8:57 a.m. on May 28, 2002, an eastbound BNSF coal train collided head on with a westbound BNSF intermodal train near Clarendon, Texas.

The conductor and engineer of the coal train received critical injuries. The engineer of the intermodal train was killed. The cost of the damages exceeded $8,000,000. The NTSB found that all four crewmembers involved in this accident had personal cell phones. It also found that the use of a cell phone by the engineer of one of the trains may have distracted him to the extent that he was unaware of the dispatcher's instructions that he stop his train at a designated point.

7. *Copeville, Texas.* On December 21, 2005, a contractor working on property of The Kansas City Southern Railway Company at Copeville, Texas, was struck and killed when he stepped into the path of an approaching freight train. FRA's investigation indicated that the contractor was talking on a cell phone at the time of the accident.
8. *Gillette, Wyoming.* On December 29, 2000, a BNSF freight train was stopped on a siding at Gillette, Wyoming, to allow another train to pass. The conductor of the stopped train exited the leading locomotive and crossed over the track immediately in front of the passing train and was struck and killed. The FRA investigation revealed the strong possibility that the conductor may have been distracted by his cell phone use.

Additionally, in the period from the effective date of the Order, October 27, 2008, through December 7, 2009, FRA inspectors discovered approximately 200 instances in which the Order may have been violated. FRA's Office of Railroad Safety recommended

enforcement action against the employee or railroad in 36 of these instances. All 36 of these actions were based on a railroad employee's using an electronic device, failing to have its earpiece removed from the employee's ear, or failing to have the device turned off in a potentially unsafe situation. Of these 36 instances, approximately half of them involved an employee using or failing to have a cell phone turned off while in the cab of a locomotive during a potentially hazardous time. In addition, 33 of the incidents recommended for enforcement action involved personal, as opposed to railroad-supplied, devices. The hazard of distracting electronic devices has been made abundantly and, at times, tragically clear. FRA inspectors have noticed a decrease in the unsafe use of electronic devices within locomotives cabs since the Order became effective, but the problem still exists.

2.3 Scientific Research on Electronic Devices as a Distraction to Vehicle Operation

In addition to continued observations of accidents and unsafe practices related to electronic device usage, much recent scientific research has indicated that the operation of a vehicle while distracted is a growing problem. Indeed, statistics show that distraction from the primary task of driving presents a serious and potentially deadly danger. In 2008, 5,870 people lost their lives, and an estimated 515,000 people were injured, in police-reported crashes in which at least one form of driver distraction was

reported on the crash report.[10] While these numbers are significant, they may not state the true size of the problem for a couple of reasons.

First, the data are based largely on police accident reports that are conducted after the crash has occurred. The content of these reports varies across police jurisdictions, thus creating potential inconsistencies in reporting. Some police accident reports identify distraction as a distinct reporting field, while others identify distraction in the narrative portion of the report. Further, the data include only those crashes in which at least one form of driver distraction was actually reported by law enforcement, thus creating the potential for an undercount.

Second, in addition to, and contributing to, inconsistent reporting of distraction on police accident reports, there are challenges in determining whether the driver was distracted at the time of the crash. Self-reporting of negative behavior, such as distracted driving, is likely lower than the actual occurrence of that behavior, since drivers are reluctant to admit that they were engaged in a distracting activity that contributed to the crash. Law enforcement must also rely on crash investigation information to determine if distraction was involved in those crashes in which the driver did not survive. The information available to law enforcement may not indicate the involvement of distraction even where

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[10] National Highway Traffic Safety Administration (2009) "Traffic Safety Facts Research Note: An Examination of Driver Distraction as Recorded in NHTSA Databases." DOT HS 811 216. Available online: http://www.dot.gov/affairs/DOT%20HS%20811%20216.pdf.

it was a cause of, or a factor in, the accident. For these reasons, reported crashes involving distraction may be undercounted.

Due to differences in methodology and definitions of distraction, any study or survey conducted may arrive at different results and conclusions with respect to the involvement of driver distraction in causing a crash. A 20008 research paper sponsored by the National Highway Traffic Safety Administration (NHTSA) entitled, *Driver Distraction: A Review of the Current State-of-Knowledge*, discusses multiple means of measuring the effects of driver distraction including observational studies of driver behavior, crash-based studies, and experimental studies of driving performance. Each type of study has its own set of advantages and disadvantages.[11]

National Motor Vehicle Crash Causation Survey (NMVCCS)

NHTSA recently conducted a nationwide survey of crashes involving light passenger vehicles with a focus on factors related to pre-crash events.[12] The NMVCCS investigated a total of 6,950 crashes during the three-year period from January 2005 to December

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[11] Ranney, Thomas A. (2008) "Driver Distraction: A Review of the Current State-of-Knowledge." DOT HS 810 787. Available online at: http://www.scribd.com/doc/12073978/Driver-Distraction-A-Review-of-the-Current-StateofKnowledge. A more comprehensive listing of research on distracted driving, which includes links to many of the reports discussed in this analysis, can be found online at: http://www.nhtsa.dot.gov/portal/site/nhtsa/template.MAXIMIZE/menuitem.8f0a414414e99092b477cb30343c44cc/?javax.portlet.tpst=4670b93a0b088a006bc1d6b760008a0c_ws_MX&javax.portlet.prp_4670b93a0b088a006bc1d6b760008a0c_viewID=detail_view&itemID=97b964d168516110VgnVCM1000002fd17898RCRD&overrideViewName=Article.

[12] National Highway Traffic Safety Administration (2009). "National Motor Vehicle Crash Causation Survey: Report to Congress." DOT HS 811 059. Available online at: http://www-nrd.nhtsa.dot.gov/Pubs/811059.PDF.

2007. The report used a nationally representative sample of 5,471 crashes that were investigated during a two-and-a-half-year period from July 3, 2005, to December 31, 2007. Based on the sampling method of the survey, findings were representative of the nation as a whole.

Survey researchers were able to assess the critical event that preceded the crash, the reason for this event, and any other associated factors that might have played a role. Examples of the critical event preceding the crash include running off the edge of the road, failure to stay in the proper lane, or loss of control of the vehicle. Researchers assessed the reason underlying this critical event and attributed that reason to either the driver, the condition of the vehicle, failure of the vehicle systems, adverse environmental conditions, or roadway design. Each of these areas was further broken down to determine more specific critical reasons. For the driver, critical reasons included facets of driver distraction and, therefore, NMVCCS was able to quantify driver distraction involvement in crashes. The percentages included in this discussion are based on 5,471 crashes.

In addition to reporting distraction as the critical reason for the pre-crash event, NMVCCS also reported crash-associated factors. These are factors such as interior distractions that likely added to the probability of a crash occurrence. In cases where the researchers attributed the critical reason of the pre-crash event to a driver, researchers also attempted to determine the role and type of distraction. Of the crashes studied, about 18 percent of the drivers were engaged in at least one interior (i.e., in-vehicle) non-

driving activity (e.g., looking at other occupants, dialing or hanging up a phone, or conversing with a passenger). For the most part, that activity was conversing either with other passengers or on a cell phone, as a total of about 12 percent of drivers in these crashes were engaged in conversation. Drivers between ages of 16 to 25 demonstrated the highest rate of being engaged in at least one interior non-driving activity.

100-Car Naturalistic Driving Study

The 100-Car Naturalistic Driving Study was an observational study—via instrumented vehicles—to provide details on driver performance, behavior, environment, and other factors associated with critical incidents, near-crashes, and crashes for 100 cars over a one-year period.[13] This exploratory study was conducted to determine the feasibility of a larger-scale study that would be more representative of the nation's driving behavior. Despite the small scale of the 100-Car study, extensive information was obtained on 241 primary and secondary drivers over a 12- to 13-month period occurring between January, 2003, and July, 2004. The data covered approximately 2 million vehicle miles driven and 43,000 hours of driving. As stated in *An Overview of the 100-Car Naturalistic Study and Findings*, "the goal of this study was to maximize the potential to record crash or near crash events through the selection of subjects with higher than average crash or near

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[13] Dingus, T.A. et al. (2006). "The 100-Car Naturalistic Driving Study, Phase II – Results of the 100-Car Field Experiment." DOT HS 810-593. Available online at--
http://www.nhtsa.dot.gov/staticfiles/DOT/NHTSA/NRD/Multimedia/PDFs/Crash%20Avoidance/Driver%20Distraction/100CarMain.pdf.
Neale et al. (2005). "An Overview of the 100-Car Naturalistic Study and Findings." NHTSA Paper Number 05-0400. Available online at--
http://www.nhtsa.dot.gov/staticfiles/DOT/NHTSA/NRD/Multimedia/PDFs/Crash%20Avoidance/Driver%20Distraction/100Car_ESV05summary.pdf.

crash risk exposure."[14] In order to achieve this goal, the 100-car study selected a larger sample of drivers who were 18-25 years of age and who drove more than average.

Additionally, the subjects were selected from the Northern Virginia/Washington, DC metropolitan area which offers primarily urban and suburban driving conditions, often in moderate to heavy traffic. This type of purposive sample served well the intentions of the study; however, it also created limitations on the application of the findings. The findings of the 100-car study cannot be generalized to represent the behavior of the nation's population or the potential causal factors for the crashes that occur across the nation's roadways.

During the 100-car study, complete information was collected on 69 crashes, 761 near-crashes, and 8,295 incidents. The encompassing term *inattention* was classified during this study as 1) secondary task involvement, 2) fatigue, 3) driving-related inattention to the forward roadway, and 4) non-specific eye glance away from the forward roadway. Secondary task involvement is defined for the study as driver behavior that diverts the driver's attention away from the driving task; this may include talking on a cell phone, eating, talking to a passenger, and other distracting tasks. Results of the 100-car study indicate that secondary task distraction contributed to over 22 percent of all the crashes

[14] Neale et al., supra note 9.

and near-crashes recorded during the study period.[15] This study found that when a secondary task took the driver's eyes off of the road for more than 2.0 seconds (out of a 6.0-second time interval), the odds of a crash or near-crash event occurring significantly increased.

National Occupant Protection Use Survey (NOPUS)

NHTSA's annual survey of occupant protection also collects data on electronic device use. NOPUS provides the only probability-based observed data on driver electronic device use in the United States.[16] Based on the sampling method of the survey, findings are representative of the nation as a whole. In 2008, it was estimated that about 6 percent of all drivers were using hand-held cell phones while driving during daylight hours. This finding means that about 812,000 vehicles on the road at any given daylight moment were being driven by someone using a hand-held cell phone in 2008. Survey data from the previous year yielded an even higher figure: according to NOPUS, in 2007 about 1,005,000 vehicles were being driven by someone using a hand-held cell phone at any given daylight moment.[17] Another finding was that in both 2007 and 2008 an estimated

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[15] Klauer et al. (2006). "The Impact of Driver Inattention on Near-Crash/Crash Risk: An Analysis Using the 100-Car Naturalistic Driving Study Data." DOT HS 810 594. Available online at--http://www.nhtsa.dot.gov/staticfiles/DOT/NHTSA/NRD/Multimedia/PDFs/Crash%20Avoidance/Driver%20Distraction/810594.pdf.

[16] National Highway Traffic Safety Administration (2009). "Driver Electronic Device Use in 2008." DOT HS 811 184. Available online: http://www-nrd.nhtsa.dot.gov/Pubs/811184.PDF.

[17] National Highway Traffic Safety Administration (2008). "Driver Electronic Device Use in 2007." DOT HS 810 963. Available online: http://www-nrd.nhtsa.dot.gov/Pubs/810963.PDF.

11 percent of vehicles in a typical daylight moment were driven by someone who was using some type of electronic device, either hand-held or hands-free.[18]

Motor Vehicle Occupant Safety Survey (MVOSS)

The MVOSS is a periodic national telephone survey on occupant protection issues. The most recent administration of the survey was in 2007. *Volume 4, Crash Injury and Emergency Medical Services Report,* includes discussion of questions pertaining to wireless phone use in the vehicle.[19] According to the report summarizing the 2007 data, 81 percent of drivers age 16 and older usually have a wireless phone in the vehicle with them when they drive. Drivers over the age of 54 were less likely than younger drivers to have them – 87 percent of 16- to 54-year olds, 74 percent of 55- to 64-year-olds, and 63 percent of drivers age 65 and older. Of those drivers who usually have a wireless phone in the vehicle, 85 percent said they keep the phone on during all or most of their trips. Among drivers who keep the phone turned on when they drive, 64 percent always or usually answer incoming phone calls.

Of the drivers who usually have a wireless phone in the vehicle with them when they drive, 16 percent said they talk while driving during most or all of their trips, and 17 percent said they talk on their wireless phone during about half of their trips. On the

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[18] NHTSA (2008) supra note 15 and NHTSA (2009) supra note 14.
[19] Boyle, J. M and C. Lampkin (2008). "2007 Motor Vehicle Occupant Safety Survey Volume 4: Crash Injury and Emergency Medical Services Report." DOT HS 810 977.
See report summary dated March 2009 online at--
http://www.nhtsa.dot.gov/staticfiles/DOT/NHTSA/Communication%20&%20Consumer%20Information/Traffic%20Tech%20Publications/Associated%20Files/tt371.pdf.

other hand, 22 percent of individuals reported never talking on their phone while driving. When driving and wanting to dial the phone, 32 percent of those who at least occasionally talk on the phone while driving tend to dial the phone while driving the vehicle. An additional 37 percent tend to wait until they are temporarily stopped, and 19 percent tend to pull over to a stop to place the call. About 10 percent stated they never dial while driving.

3. Statement of Need for Federal Regulatory Action

In 2008, FRA determined that public safety compelled the issuance of EO 26 restricting the improper use by railroad operating employees of certain electronic devices. Although most railroads had rules and procedures in place even prior to the issuance of that emergency order that prohibited or restricted the use of electronic devices, these railroad rules and procedures had not proven effective enough in preventing serious train accidents caused by the unsafe use of such devices.

The accident history discussed in Section 2 of this analysis elucidates the problem that required the issuance of EO 26: despite railroad operating rules prohibiting or restricting the use of electronic devices, in some cases it was apparent that railroad operating employees disregarded these prohibitions or restrictions. Performing railroad operations while distracted creates potential externality costs in the form of increased risk to the safety of other crewmembers, passengers, bystanders, and nearby residents, and increased risk of property damage, including property damage to entities other than the operating

railroad. One way of correcting an externality cost is by increasing the cost of taking the action that produces the externality, such as through a tax or a fee on the action.[20] In this case, the action was performing railroad operations while distracted by electronic devices. The corrective, regulatory action taken by FRA was the issuance of EO 26 with possible sanctions for violations, including civil penalties for any individual railroad operating employee who willfully violates the order, the removal of the individual railroad operating employee from safety-sensitive service on the railroad and disqualification from safety-sensitive service on any railroad, civil penalties for any railroad that violates the order, and injunctive relief issued by the courts through a civil action requested by FRA and instituted by the Attorney General. By including possible sanctions in EO 26, both to the individual and to the railroad, FRA effectively increased the cost of performing railroad operations while distracted by electronic devices, as well as the probability of being observed doing so by FRA inspectors. FRA believes, in accordance with economic theory, that such an increase in the cost of performing railroad operations while distracted by electronic devices will lead individuals to choose to engage in such activities less often, resulting in safer railroad operations.

FRA emphasizes that neither this rule nor EO 26 supplants railroad operating rules that restrict the improper usage of electronic devices. Rather, this rule complements railroad operating rules. The safety impact of promulgating federal restrictions on the use of

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[20] Viscusi, Kip et al, (2005). *Economics of Regulation and Antitrust*, *Fourth Edition*. Cambridge: MIT Press. Page 2.

electronic devices is incremental in nature. The benefits of the safety impact of federal intervention are not attributable solely to the issuance of this rule; instead, the impact is largely attributable to the restrictions instituted by EO 26. FRA believes that federal prohibitions on the unsafe use of electronic devices, taken together with existing railroad operating rules, will have a greater effect than solely railroad operating rules on the use of electronic devices or accidents attributable to their use. The deterrent effect of the federal restrictions is cumulative with that of railroad operating rules. That is, operating rules presumably already have some deterrent effect on the improper use of electronic devices because of the implicit or explicit threat of punitive actions, such as dismissal from employment, that employers could take in response to violations of its operating rules prohibiting the improper use of electronic devices. Federal intervention adds yet another possible consequence to the improper use of electronic devices: possible sanctions. These sanctions would not exist absent federal regulatory action. Federal intervention also raises awareness of use of electronic devices as a safety issue.

Thus, the initial problem that required regulatory action was addressed with EO 26 through its sanctions against individuals and railroads for non-compliance and through raised awareness of the safety issue. However, as the requirements of EO 26 were implemented, it became clear that some aspects of EO 26 may not have contributed to the increases in safety but may have created some economic costs. This rule seeks to redress those aspects of EO 26. Specifically, some restrictions on the usage of electronic devices by employees in deadhead status have been revised to allow for limited usage of

electronic devices under certain circumstances. Additionally, this rule allows for the use of calculators and cameras under certain circumstances. These revisions and changes are discussed in further detail below, in Section 5 of this analysis.

4. Alternatives Considered

FRA considered in this analysis the regulatory approach used in EO 26 as well as that of this rule. Both approaches prohibit the unsafe use of electronic devices by railroad operating employees except under certain circumstances. Also, both approaches attempt to deter unsafe behavior by establishing federal regulations with civil penalties for non-compliance, which increase the cost to railroad operating employees of choosing to disregard railroad operating rules restricting the use of cell phones and other electronic devices. The main difference between the two approaches considered is that this rule gives relief for the use of electronic devices by deadhead status employees and for the use of cameras and calculators, under certain circumstances.

Each of these approaches is compared to a baseline state of the world in which railroads have already adopted operating rules that prohibit the dangerous use of electronic devices while performing railroad operations. In the baseline state, even though railroad operating rules exist that are very similar to EO 26 and this rule, railroad operating employees sometimes choose to disregard those rules, as evidenced by the accident history and unsafe behavior observed and discussed in Section 2 of this analysis. Thus, the beneficial outcomes that federal intervention may deliver compared to the baseline derive from increasing the costs to operating employees of choosing to use electronic

devices which may distract them while they are engaged in train operating activities resulting in potentially dangerous situations.

5. Major Provisions of this Rule

This rule addresses three concerns that were raised regarding EO 26:

(1) EO 26 did not exempt deadheading employees.

(2) EO 26 prohibited employees from taking a picture or video of a safety hazard with an electronic camera.

(3) EO 26 prohibited use of calculators.

To address the first concern, this rule allows deadheading railroad operating employees to use electronic devices if that use does not interfere with an employee's personal safety or performance of safety-related duties. This rule also requires deadheading employees within the cab of controlling locomotive to have electronic devices turned off when the train is moving or in other situations in which the crewmembers responsible for operating the train need to be able to focus. Employees may use such devices in other areas of the train.

Regarding the second concern, FRA believes that allowing employees to document safety hazards could be useful in certain situations, but realizes that cameras can be exceptionally distracting. To that end, FRA, with this rule, is permitting a camera to be used only to document a safety hazard or violation, if it is a stand-alone device and turned

off immediately after the picture is taken. Additionally, locomotive engineers may not take pictures in the cab of a moving train. This rule does not allow the use of the camera function of a cell phone.

Third, this rule excludes stand-alone calculators from all restrictions within this subpart as long as the calculators are used for an authorized business purpose and do not interfere with the performance of safety-related duties. This rule, however, does not allow the use of a calculator function of a cell phone or electronic timepiece.

6. Examination of Costs and Benefits

This rulemaking is somewhat atypical in that it follows an emergency order whose economic effects are presumably already being realized, at least to some extent. As such, this analysis assesses costs in two ways: costs attributable to issuance of EO 26, and costs attributable to this rule.

Based on the available literature and the train accident history discussed above, FRA believes that a decrease in railroad operating employees' use of electronic devices will lead to fewer or less severe accidents. Because it is not possible for FRA to estimate how many accidents EO 26 and this rule will likely prevent, FRA relies on break-even analyses to develop a cost-benefit framework to use in considering EO 26 and this rule.

6.1 Costs

As explained in Section 5 of this analysis, the major differences between EO 26 and this rule include allowing the use of calculators and cameras under certain circumstances and allowing deadheading employees to use electronic devices under certain circumstances. Otherwise, most of the costs listed below that are incurred by railroads under EO 26 will continue to be incurred under this rule. These costs can be usefully categorized as two types: direct costs and indirect costs. Direct costs may include the cost of the following:

- revising programs of operational tests and inspections to reflect the requirements of the regulation;
- performing operational tests and inspections required to demonstrate compliance with the regulation;
- instructing railroad operating employees and supervisors of railroad operating employees concerning the requirements of the regulation;
- acquiring cameras for employees who, absent the regulation, would have used an electronic device other than a camera to document a safety hazard or a violation of a rail safety law, regulation, order, or standard;
- acquiring calculators for employees who, absent the regulation, would have used an electronic device other than a calculator for performing calculations; and
- providing radios in locomotives of trains that previously used a wireless communication device, such as a cell phone, for communicating across distances.

Indirect costs may include the following:

- the opportunity cost of on-duty crewmembers' time spent in safety briefings and in coming to an agreement that it is safe to use a wireless communication device for those who are not operating controls.

The primary difference in costs between EO 26 and this rule arises as a result of the relief from some restrictions on the use of electronic devices granted to employees in deadhead status and crewmembers other than the locomotive engineer, under certain circumstances. Thus, the following indirect cost may be incurred in a state of the world in which EO 26 were maintained in effect, but it would not be incurred after this rule goes into effect:

- the opportunity cost of deadheading employees or other crewmembers who may have used some time to perform various activities using electronic devices (such as check a schedule with a PDA).

Tables 3 and 4 below summarize the estimates of each of these costs under EO 26 (Table 3) and this rule (Table 4), summed over the first twenty years after the promulgation of each. Each of these potential costs and how they were estimated are addressed in further detail below.

Table 3: Summary of total cost estimates of EO 26, year 2009 dollars

Direct costs	Twenty-year total (3% discount rate)	Twenty-year total (7% discount rate)
Revising programs	$48,007.64	$47,497.15
Performing operational tests	$633,087.44	$468,318.78
Instruction	$11,586,287.79	$8,635,014.44
Radios	$0.00	$0.00
Total direct costs	$12,267,382.87	$9,150,830.37

Indirect Costs	Twenty year total (3% discount rate)	Twenty year total (7% discount rate)
Opportunity cost of additional time spent in safety briefings	$30,238,989.11	$22,368,926.84
Opportunity cost of being unable to use cameras or calculators	Unquantifiable	Unquantifiable
Opportunity cost of deadheading employees being unable to use electronic devices	Unquantifiable	Unquantifiable
Total indirect costs	$30,238,989.11	$22,368,926.84

The summed total of the estimated direct costs over the first twenty years after the promulgation of EO 26 equals about $12.3 million at a 3 percent discount rate and about $9.2 million at a 7 percent discount rate (in 2009 dollars). Additionally, indirect costs incurred because of EO 26 are estimated to equal about $30.2 million at a 3 percent discount rate and about $22.4 million at a 7 percent discount rate, plus the unquantifiable opportunity cost of restricting the use of calculators and cameras and of restricting deadheading employees from using electronic devices.

Table 4: Summary of total cost estimates of EO 26 and this rule, year 2009 dollars

Direct costs	Twenty-year total (3% discount rate)	Twenty-year total (7% discount rate)
Revising programs *	$ 8,348.02	$ 6,175.35
Revising programs for rule	$39,659.62	$39.659.62
Performing operational tests	$633,087.44	$468,318.78
Instruction *	$11,339,537.79	$8,388,404.44
Instruction on rule	$246,610.00	$246,610.00
Cameras (potential)	$334,951.39	$252,434.85
Calculators (potential)	$75,080.95	$74,083.90
Total direct costs	$12,677,415.21	$9,475,686.94
Indirect Costs	Twenty-year total (3% discount rate)	Twenty year total (7% discount rate)

Opportunity cost of additional time spent in safety briefings *	$30,238,989.11	$22,368,926.84
Total indirect costs	$30,238,989.11	$22,368,926.84

* Costs already being incurred under EO 26

As shown in Table 4 above, the total cost estimates of this rule are exactly the same as those of EO 26, except for the potential cost of calculators and cameras and the unquantifiable opportunity cost of restricting some employees from using electronic devices and nominal costs associated with seeking FRA approval for use of railroad-supplied electronic devices for taking photographs and videos. The main difference between EO 26 and this rule is the relief from some of the restrictions of EO 26. As a result of this relief, deadheading employees will be able to use personal electronic devices while on a moving train and for functions other than voice communication in certain circumstances, railroad rules permitting. The opportunity cost of restricting these employees from using electronic devices will no longer be incurred under this rule. Furthermore, under this rule, it is possible that some railroads or employees will buy calculators or cameras (or carry with them ones they already own) to use in lieu of cell phones with calculator or camera functions, which adds a possible direct cost to this rule while simultaneously removing the (unquantifiable) indirect cost arising from EO 26's restrictions on their usage. The summed total of the estimated direct costs of EO 26 and this rule over the first twenty years after this rule goes into effect equals about $12.7 million at a 3 percent discount rate and about $9.5 million at a 7 percent discount rate (in

2009 dollars). Additionally, indirect costs incurred because of EO 26 and this rule are estimated to equal about $30.2 million at a 3 percent discount rate and $22.4 million at a 7 percent discount rate. With the exception of the program revision costs, the potential cost of cameras and calculators, and the cost for initial instruction for the exceptions newly introduced, the majority of the cost burden is transferred from EO 26.

Relative to the requirements of EO 26, the requirements of this rule will create additional costs. This burden stems from the revisions to instruction programs that existing railroads will have to perform in the first year after this rule goes into effect, which FRA estimates will cost $39,660, and from the instruction of employees who otherwise would not have received instruction on policies regarding electronic device usage, which FRA estimates will cost $246,610.00,[21] in year one and potential costs of purchasing cameras and calculators, which could total up to $410,000 over twenty years. In addition, there will be nominal costs associated with seeking FRA approval for use of railroad-supplied electronic devices for taking photographs and videos. Thus, as detailed below, the total costs directly attributable to this rule alone could be as high as $696,000 (PV, 3%) or $613,000 (PV, 7%) over a 20-year period.

[21] See Sections 6.1.1 and 6.1.3, which discuss costs of revising programs and costs of instruction, respectively. To compare instruction costs under the requirements of EO26 and this rule, FRA estimated that 75% of safety-related employees would have undergone electronic device usage instruction in Year 1 under EO26, whereas this rule will require that 100% undergo such instruction in Year 1. Thus, this rule will require 22,750 additional employees to undergo additional instruction in Year 1 that they would not have otherwise, at a cost of $10.84 per employee.

	PV (3%)	PV(7%)
Program revision	$ 39,660	$ 39,660
Initial instruction	246,610	246,610
Potential cost of cameras	334,951	252,435
Potential cost of calculators	75,081	74,084
Total	$696,302	$612,789

It is also useful to consider total annual costs, rather than simply the twenty-year summed total. These annual costs are presented in Tables A-1 and A-2, located in the appendix. Table A-1 shows the annual costs prior to discounting to present value, broken down by category of cost, while Table A-2 shows total annual direct costs and total annual costs including indirect costs, discounted to present value at 3 percent and 7 percent discount rates.

6.1.1 Costs of Complying with EO 26 Transferred to the Final Rule

6.1.1.a Revising Programs of Operational Tests and Inspections to comply with EO 26 transferred to the final rule

Under 49 CFR part 217, each railroad is required to have a program of operational tests and inspections, except for railroads that operate only on track inside an installation that

is not part of the general railroad system of transportation or rapid transit operations in an urban area that are not connected with the general railroad system of transportation.[22] Railroads formed in the future will also have to include provisions in their programs of operational tests and inspections. FRA has assumed that approximately ten new railroads will form in an average year of the twenty-year period considered, each of which will require one hour to appropriately include provisions in its program of operational tests and inspections to comply with this rule. Holding wage rates, measured in 2009 dollars, and the fringe and benefit multiplier constant, the annual cost to newly formed railroads will also be $54.48 per railroad. Summed over the ten new railroads assumed to form each year, the annual cost to new railroads is estimated to equal $544.78 dollars (in year 2009 dollars), prior to discounting. Table 5 below summarizes these estimations and calculations. The final two columns of Table 5 show the estimated present discounted cost to new railroads of including provisions in their programs of operational tests and inspections to comply with this rule, as incurred each year for the first twenty years after this rule becomes effective. The summed present discounted value of these costs incurred over the first twenty years equals $8,348.02 at a 3 percent discount rate and $6,175.35 at a 7 percent discount rate (in year 2009 dollars).

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[22] 49 CFR 217.9. "Program of operational tests and inspections; recordkeeping." Available online at--http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&sid=45ed62c19f43db15393b5d0449cfa7ca&rgn=div5&view=text&node=49:4.1.1.1.12&idno=49#49:4.1.1.1.12.1.11.7.

Table 5: Costs of revising programs of operational tests and inspections, new railroads, in year 2009 dollars (cost transferred from EO 26)

Year	Hours required to revise programs	Average wage rate of "Professional & Administrative" employees	Fringe and overhead multiplier	Cost per hour	Number of new railroads	Total cost of revising programs	Present discounted annual cost (3% discount rate)	Present discounted annual cost (7% discount rate)
1	1	$31.13	1.75	$54.48	10	$544.78	$544.78	$544.78
2	1	$31.13	1.75	$54.48	10	$544.78	$528.91	$509.14
3	1	$31.13	1.75	$54.48	10	$544.78	$513.50	$475.83
4	1	$31.13	1.75	$54.48	10	$544.78	$498.55	$444.70
5	1	$31.13	1.75	$54.48	10	$544.78	$484.03	$415.61
6	1	$31.13	1.75	$54.48	10	$544.78	$469.93	$388.42
7	1	$31.13	1.75	$54.48	10	$544.78	$456.24	$363.01
8	1	$31.13	1.75	$54.48	10	$544.78	$442.95	$339.26
9	1	$31.13	1.75	$54.48	10	$544.78	$430.05	$317.06
10	1	$31.13	1.75	$54.48	10	$544.78	$417.52	$296.32
11	1	$31.13	1.75	$54.48	10	$544.78	$405.36	$276.94
12	1	$31.13	1.75	$54.48	10	$544.78	$393.56	$258.82
13	1	$31.13	1.75	$54.48	10	$544.78	$382.09	$241.89
14	1	$31.13	1.75	$54.48	10	$544.78	$370.97	$226.06
15	1	$31.13	1.75	$54.48	10	$544.78	$360.16	$211.27
16	1	$31.13	1.75	$54.48	10	$544.78	$349.67	$197.45
17	1	$31.13	1.75	$54.48	10	$544.78	$339.49	$184.53
18	1	$31.13	1.75	$54.48	10	$544.78	$329.60	$172.46
19	1	$31.13	1.75	$54.48	10	$544.78	$320.00	$161.18
20	1	$31.13	1.75	$54.48	10	$544.78	$310.68	$150.63
Total present discounted cost							$8,348.02	$6,175.35

The total cost of revising or implementing programs of operational tests and inspections is the sum of the estimated total cost to existing railroads and the estimated total cost to new railroads over the twenty years to comply with EO 26, while it was in effect, and the final rule thereafter. At a 3 percent discount rate, this sum is estimated to equal $39,659.62 plus $8,348.02 or $48,007.64. At a 7 percent discount rate, the total cost of revising or implementing these programs is estimated to equal $39,659.62 plus $6,175.35, or $45,834.97.

6.1.1.b Conducting operational tests and inspections to comply with EO 26 while it is in effect and with the final rule thereafter

Except for railroads that operate only on track inside an installation that is not part of the general railroad system of transportation or rapid transit operations in an urban area that are not connected with the general railroad system of transportation, each railroad is required under 49 CFR 217.9 to "periodically conduct operational tests and inspections to determine the extent of its compliance with its code of operating rules, timetables, and timetable special instructions, specifically including tests and inspections sufficient to verify compliance with the requirements of subpart F" of 49 CFR 218.[23] EO 26 and this rule add the requirement that a railroad's program of operational tests and inspections be revised as necessary to include the new requirements of the regulation, as discussed above in section 6.1.1 of this analysis. The requirement that railroads' operational tests and inspections verify compliance with EO 26, while it is in effect, and with the final rule thereafter, in addition to compliance with 49 CFR part 218, means that these tests and inspections may take longer.

Additionally, EO 26 limits the fashion in which operational tests and inspections to verify compliance can be performed. This final rule adopts this limitation. For example, a supervisor may not simply call the cell phone of a locomotive engineer while the engineer is on a moving train in order to test whether that engineer would violate EO 26

[23] 49 CFR 217.9, *supra note* 8.

or this rule by answering the call, as this would create a potentially dangerous situation. Instead, railroads must devise other means of verifying compliance.

Even given this restriction on the form of operational tests and inspections, FRA estimates that over the course of a year such operational tests or inspections designed to verify compliance will require an additional half of one minute per employee from the railroad officer, manager, or supervisor who is administering the test. Multiplying the additional time spent performing these tests and inspections by the hourly cost to the railroad of the employees performing them yields the cost to the railroad of being required to verify compliance through tests and inspections. Average wage rates and the number of employees of the two groups likely affected by EO 26 and this rule are presented below in Table 6.

Table 6: Categories of employees, number of employees, wage rates, and costs to railroads[24]

Group	Wage rate (year 2009 dollars)	Fringe & overhead multiplier	Cost per hour
Transportation (Train & Engine)	$24.78	1.75	$43.37
Professional & Administrative	$31.13	1.75	$54.48

Using the costs per hour shown above, Table 7 below shows the cost of performing these operational tests or inspections to verify compliance with EO 26 or this rule, assuming

[24] Sources for Table 7 data are as follows: Data on the number of employees come from Annual Wage Forms A and B, submitted by Class I railroads to STB and on file at STB. These are available upon request to authorized DOT personnel. For the number of employees at Class II and Class III railroads, data were collected by FRA staff while performing analysis for 49 CFR part 219. Average wage rates also come from Annual Wage Forms A and B at STB. The fringe benefits and overhead multiplier is assumed.

one test or inspection per railroad operating employee is extended due to this additional element annually. It is assumed that each test requires one test administrator to observe an employee while that employee works. The cost per employee tested equals the cost per hour of the test administrator, who is assumed to be from the "Professional & Administrative" group, multiplied by the number of hours required to perform additional testing. FRA assumes 91,000 employees will be tested every year over the twenty year period considered in this analysis. The total annual cost of additional testing time required by EO26 and this rule then equals the cost per employee tested multiplied by the number of employees tested each year. The final two columns of Table 7 show these annual costs over twenty years, discounted to present value at 3 percent and 7 percent discount rates.

Table 7: Cost of performing operational tests and inspections under EO 26 or this rule

Year	Hours required to perform additional testing, per employee tested	Cost per hour of test administrators	Cost per employee tested	Number of tested employees	Total cost of additional testing time	Present discounted annual cost (3% discount rate)	Present discounted annual cost (7% discount rate)
1	0.008	$54.48	$0.45	91,000	$41,314.00	$41,314.00	$41,314.00
2	0.008	$54.48	$0.45	91,000	$41,314.00	$40,110.68	$38,611.21
3	0.008	$54.48	$0.45	91,000	$41,314.00	$38,942.41	$36,085.25
4	0.008	$54.48	$0.45	91,000	$41,314.00	$37,808.16	$33,724.53
5	0.008	$54.48	$0.45	91,000	$41,314.00	$36,706.95	$31,518.25
6	0.008	$54.48	$0.45	91,000	$41,314.00	$35,637.82	$29,456.31
7	0.008	$54.48	$0.45	91,000	$41,314.00	$34,599.82	$27,529.26
8	0.008	$54.48	$0.45	91,000	$41,314.00	$33,592.06	$25,728.28
9	0.008	$54.48	$0.45	91,000	$41,314.00	$32,613.65	$24,045.12
10	0.008	$54.48	$0.45	91,000	$41,314.00	$31,663.74	$22,472.08
11	0.008	$54.48	$0.45	91,000	$41,314.00	$30,741.50	$21,001.94
12	0.008	$54.48	$0.45	91,000	$41,314.00	$29,846.11	$19,627.98

13	0.008	$54.48	$0.45	91,000	$41,314.00	$28,976.81	$18,343.91
14	0.008	$54.48	$0.45	91,000	$41,314.00	$28,132.82	$17,143.84
15	0.008	$54.48	$0.45	91,000	$41,314.00	$27,313.42	$16,022.28
16	0.008	$54.48	$0.45	91,000	$41,314.00	$26,517.88	$14,974.09
17	0.008	$54.48	$0.45	91,000	$41,314.00	$25,745.52	$13,994.48
18	0.008	$54.48	$0.45	91,000	$41,314.00	$24,995.65	$13,078.95
19	0.008	$54.48	$0.45	91,000	$41,314.00	$24,267.62	$12,223.32
20	0.008	$54.48	$0.45	91,000	$41,314.00	$23,560.80	$11,423.67
Total present discounted cost						$633,087.44	$468,318.78

Under the assumptions described above, the total cost of spending additional time performing the revised operational tests and inspections required by EO 26 and this rule over twenty years is estimated to be $633,087.44 at a 3 percent discount rate and $468,318.78 million at a 7 percent discount rate. These totals are shown in the last row of Table 7 above.

6.1.1.c Instruction

EO 26 and this rule require that each railroad instruct each of its railroad operating employees and supervisors of railroad operating employees concerning the regulation's requirements and the implementing railroad's rules and instructions. FRA estimates that it will require approximately fifteen minutes annually per employee instructed to instruct railroad operating employees or supervisors of railroad operating employees concerning the requirements of the new regulation and the operating rules and instructions of the implementing railroad.[25] Following a methodology similar to that used above to estimate the costs of performing operational tests and inspections, FRA has estimated the cost of

[25] Paperwork Reduction Act analysis accompanying EO 26, *supra note* 2.

additional instruction required by EO 26 and this rule. The estimation of these costs is further described below.

The cost per employee instructed is assumed to equal the cost per hour of the employee instructed, multiplied by the number of hours required to perform additional instruction. The employees instructed are assumed to be from the "Transportation (Train & Engine)" group. Costs for the group are assumed to equal average wage rates observed in 2008 (converted to 2009 dollars) multiplied by the fringe and overhead multiplier, and are also assumed to remain constant (in 2009 dollars), as was done in Table 7 above.[26] FRA assumes 91,000 employees will be instructed in the first year. Subsequently, FRA assumes that 75 percent of 91,000 employees will be instructed in each remaining year in the twenty-year period considered. This is because approximately 50 percent of railroads perform training and instruction of employees on a yearly basis, while the other 50 percent do so on a biannual basis. Thus, not all 91,000 employees will be instructed concerning this rule's requirements and the implementing railroad's rules and instructions every year.[27] The total annual cost of additional instruction time required by this rule then equals the cost per employee instructed multiplied by the number of employees instructed each year. The numbers used to make these calculations, as well as the total annual undiscounted costs and the total present discounted costs at 3 percent and 7 percent discount rates are presented below in Table 8.

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[26] See Table 7 in Section 6.1.2 of this analysis for calculations of costs for each employee group.
[27] There may a very limited number of railroads that perform instruction every three years.

Table 8: Cost of instruction (EO 26 and the final rule)

Year	Hours required to instruct	Cost per hour of employee instructed	Cost per employee instructed	Number of employee instructed	Total cost of additional instruction time	Present discounted annual cost (3% discount rate)	Present discounted annual cost (7% discount rate)
1	0.25	$43.37	$10.84	91,000	$986,667.50	$986,667.50	$986,667.50
2	0.25	$43.37	$10.84	68,250	$740,000.63	$718,447.21	$691,589.37
3	0.25	$43.37	$10.84	68,250	$740,000.63	$697,521.56	$646,345.20
4	0.25	$43.37	$10.84	68,250	$740,000.63	$677,205.40	$604,060.94
5	0.25	$43.37	$10.84	68,250	$740,000.63	$657,480.97	$564,542.93
6	0.25	$43.37	$10.84	68,250	$740,000.63	$638,331.04	$527,610.22
7	0.25	$43.37	$10.84	68,250	$740,000.63	$619,738.87	$493,093.66
8	0.25	$43.37	$10.84	68,250	$740,000.63	$601,688.23	$460,835.20
9	0.25	$43.37	$10.84	68,250	$740,000.63	$584,163.33	$430,687.10
10	0.25	$43.37	$10.84	68,250	$740,000.63	$567,148.86	$402,511.31
11	0.25	$43.37	$10.84	68,250	$740,000.63	$550,629.96	$376,178.79
12	0.25	$43.37	$10.84	68,250	$740,000.63	$534,592.20	$351,568.97
13	0.25	$43.37	$10.84	68,250	$740,000.63	$519,021.55	$328,569.13
14	0.25	$43.37	$10.84	68,250	$740,000.63	$503,904.42	$307,073.95
15	0.25	$43.37	$10.84	68,250	$740,000.63	$489,227.59	$286,985.00
16	0.25	$43.37	$10.84	68,250	$740,000.63	$474,978.24	$268,210.28
17	0.25	$43.37	$10.84	68,250	$740,000.63	$461,143.92	$250,663.81
18	0.25	$43.37	$10.84	68,250	$740,000.63	$447,712.55	$234,265.25
19	0.25	$43.37	$10.84	68,250	$740,000.63	$434,672.38	$218,939.48
20	0.25	$43.37	$10.84	68,250	$740,000.63	$422,012.02	$204,616.34
Total present discounted cost						$11,586,287.79	$8,635,014.44

Over the first twenty years after this rule goes into effect, the additional instruction required by the rule is estimated to cost approximately $11.6 million at a 3 percent discount rate (in 2009 dollars), and approximately $8.6 million at a 7 percent discount rate (in 2009 dollars). These totals are shown in the last row of Table 8 above.

6.1.1.d Indirect costs: opportunity cost of time spent in safety briefings, etc.

While FRA is prohibiting the locomotive engineer from using any sort of electronic device when on a moving train, when any member of the crew is on the ground or riding

rolling equipment during a switching operation, or when any railroad employee is assisting in preparation of the train, the rule does allow other crewmembers to use electronic devices under certain circumstances. This rule permits a railroad operating employee other than the locomotive engineer to use a railroad-supplied electronic device under certain circumstances, but only after a safety briefing that includes all crewmembers is held and all crewmembers agree that it is safe to use the device. EO 26 permitted the use of certain specified electronic devices. Thus the rule is more flexible.

These conditions allowing limited usage of electronic devices appear consistent with most railroad operating rules. Indeed, of the operating rules reviewed in the preparation for this analysis, all rulebooks included sections addressing cell phone and other electronic device usage, although only some included the requirements that railroad operating employees must perform a safety briefing and that all employees must agree that the usage of an electronic device is safe prior to a railroad operating employee using such a device. It is thus possible that EO 26 has and this rule will induce railroad operating crews to spend more time performing safety briefings and coming to accordance regarding the safety of the use of electronic devices than they would have absent this rule. FRA has estimated the opportunity cost of this additional time, under the assumption that all railroad operating employees will be required to spend an average of one additional hour per year in safety briefings or in coming to agreement that it is safe to operate an electronic or electrical device. Given that some railroads already have provisions for such briefings, it is possible that there may be no additional time spent by

some operating employees. Others may spend more than an additional hour a year participating in briefings. FRA believes that an average of an additional hour is a reasonably conservative estimate. In the RIA that accompanied the NPRM, FRA emphasized that its estimate of the opportunity cost of this additional time spent in safety briefings was tentative and requested comments on what activities, and the monetized value of those activities, members of the industry believed may be supplanted by the additional safety briefings proposed. FRA did not receive any comments in response to this request and is therefore using the estimate presented in that RIA. Finally, FRA emphasizes that it believes that this estimate of the opportunity cost of safety briefings is likely towards the high end of the range of possible estimates, primarily because the assumption of one hour per employee is very conservative.

To estimate the value of the opportunity cost of activities that must be given up in order to perform additional safety briefings, FRA constructed a range of estimates based on varying assumptions about the activity displaced. At the high end of the range, the opportunity cost equals the cost to railroad of the employee's time, under the assumption that the marginal benefit to the railroad of the activity displaced equals the marginal cost to the railroad of paying the employee for the time to perform the activity. On the other hand, it is possible that the activity being displaced yields very low or no benefits to the railroad – activities that may include typical ways of idling away time such as reading or doing crossword puzzles. In this case, the opportunity cost to the railroad may equal zero, although the subjective opportunity cost to the employee is still likely positive. For

this analysis, FRA has assumed that the opportunity cost of activities displaced by safety briefings is equal to the midpoint between these two extremes – the cost of employee time to the railroad and zero. Table 9 below repeats from Table 6 the estimated wage rates of the groups typically observed in a train crew, the fringe and overhead multiplier, the estimated cost per hour of employee time, and the estimated amount of time that will be spent in safety briefings and in coming to accordance with other crewmembers regarding the safety of the use of electronic devices.

Table 9: Information on employees likely to spend additional time in safety briefings, etc.

Group	Average wage rate (year 2009 dollars)	Fringe & overhead multiplier	Cost per hour	Hours in briefings, etc., per year
Transportation (Train & Engine)	$24.78	1.75	$43.37	1

Table 10 below shows this estimated annual cost over the first twenty years, discounted to present value using 3 percent and 7 percent discount rates. This cost estimation includes the assumption that the opportunity cost of employee time being displaced by the additional safety briefings required by this rule is equal to the midpoint of the range of possible values of that employee time. The endpoints of the range are $43.37 and $0.00; the midpoint is therefore $21.69. Also, Table 10 includes the assumption that there will be 91,000 railroad operating employees in the first year after the rule goes into effect, and that that figure will remain constant over the next nineteen years.

Table 10: Opportunity cost of safety briefings

Year	Hours spent in briefings	Midpoint of opportunity cost range	Number of employees	Total cost of briefing testing time	Present discounted annual cost (3% discount rate)	Present discounted annual cost (7% discount rate)
1	1.00	$21.69	91,000	$1,973,335.00	$1,973,335.00	$1,973,335.00
2	1.00	$21.69	91,000	$1,973,335.00	$1,915,859.22	$1,844,238.32
3	1.00	$21.69	91,000	$1,973,335.00	$1,860,057.50	$1,723,587.21
4	1.00	$21.69	91,000	$1,973,335.00	$1,805,881.07	$1,610,829.17
5	1.00	$21.69	91,000	$1,973,335.00	$1,753,282.59	$1,505,447.82
6	1.00	$21.69	91,000	$1,973,335.00	$1,702,216.11	$1,406,960.58
7	1.00	$21.69	91,000	$1,973,335.00	$1,652,637.00	$1,314,916.43
8	1.00	$21.69	91,000	$1,973,335.00	$1,604,501.94	$1,228,893.86
9	1.00	$21.69	91,000	$1,973,335.00	$1,557,768.87	$1,148,498.94
10	1.00	$21.69	91,000	$1,973,335.00	$1,512,396.96	$1,073,363.49
11	1.00	$21.69	91,000	$1,973,335.00	$1,468,346.57	$1,003,143.45
12	1.00	$21.69	91,000	$1,973,335.00	$1,425,579.19	$937,517.24
13	1.00	$21.69	91,000	$1,973,335.00	$1,384,057.47	$876,184.34
14	1.00	$21.69	91,000	$1,973,335.00	$1,343,745.11	$818,863.87
15	1.00	$21.69	91,000	$1,973,335.00	$1,304,606.91	$765,293.34
16	1.00	$21.69	91,000	$1,973,335.00	$1,266,608.65	$715,227.42
17	1.00	$21.69	91,000	$1,973,335.00	$1,229,717.13	$668,436.84
18	1.00	$21.69	91,000	$1,973,335.00	$1,193,900.13	$624,707.32
19	1.00	$21.69	91,000	$1,973,335.00	$1,159,126.34	$583,838.62
20	1.00	$21.69	91,000	$1,973,335.00	$1,125,365.38	$545,643.57
Total present discounted cost					$30,238,989.11	$22,368,926.84

Summed over the first twenty years, the estimated total present discounted opportunity cost of additional time spent in safety briefings and in coming to agreement with other crewmembers regarding whether it is safe to use an electronic device is $30,328,989.11 at a 3 percent discount rate and $22,368,926.84 at a 7 percent discount rate.

6.1.2 The incremental costs of this Rule

The costs that this rule adds onto the cost of EO 26 come from three sources: potential purchases of camera and calculators, and further revisions to programs and initial instruction focused on this rule

6.1.2.a Cameras

EO 26 basically prohibits the use of electronic devices without exception for cameras and calculators. This rule prohibits the utilization of personal electronic devices whose primary function is not for taking photographs or videos, such as cell phones with camera functions, to document safety hazards or violations of rail safety laws, regulations, orders, or standards. Only electronic devices whose primary function is as a camera for taking still pictures or videos would be allowed to be used to document safety hazards or violations.

FRA does not believe that it is a common practice at any railroad for railroad operating employees to use the camera or video function of electronic devices other than cameras to document safety hazards or violations of rail safety laws, regulations, orders, or standards. There exists no FRA requirement that such documentation through photograph or video by railroad operating employees must occur, and any choice to do so would be that of the railroad or the railroad operating employee. As such, it does not appear that this rule will require the purchase of cameras for use by railroad operating employees to replace the camera function of electronic devices other than cameras.

Nevertheless, FRA has entertained the possibility that all railroads or crewmembers would want to be able to supplement their documentation of safety hazards or violations of rail safety laws, regulations, orders, or standards with a photograph or video. For purposes of this analysis, FRA has assumed an average of one camera per locomotive to be used for such purpose. In such a scenario, the prohibition on using cell phones as cameras would increase the cost of photographically documenting safety hazards or violations. Assuming that no locomotives currently have cameras, the total initial cost of providing a camera for each locomotive in operation would equal the number of locomotives in operation multiplied by the average cost of cameras. Furthermore, there would be some ongoing costs as cameras require replacement.

A search of online retailer Amazon.com shows prices for basic 35-millimeter disposable cameras capable of 27 exposures to range from $1.97 to $18.00, with most versions costing between $2.00 and $5.00.[28] FRA has assumed an average price of $3.00 per camera and an average price of $3.00 to develop the film in each camera.[29] FRA considered the costs of providing cameras in 25%, 50%, 75%, and 100% of the existing fleet of operating locomotives, which are shown in Tables A-3, A-4, A-5, and A-6 in the

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[28] Searching for "disposable camera" and then sorting by price on Amazon.com yielded the following results on December 3, 2009: http://www.amazon.com/s/qid=1259853850/ref=sr_st?keywords=disposable+camera&rs=172282&page=1&rh=i%3Aaps%2Ck%3Adisposable+camera%2Ci%3Aelectronics%2Cn%3A172282%2Cn%3A!493964&sort=price.

[29] The cost to develop and print a roll of film was listed at $2.99 at snapfish.com on 12/3/09: http://www.snapfish.com/helppricing#developing.

Appendix. The cost of providing cameras for 50% of the fleet was used for the remainder of this analysis. Table 11 below shows the estimated total cost of purchasing a number of cameras equal to half of the existing fleet of approximately 28,500 locomotives in operation in the first year after this rule goes into effect, so that 14,250 cameras are purchased in the first year. Additionally, because disposable cameras' film degrades over time, they may need to be replaced periodically to guarantee adequate photo quality. For this analysis, unused cameras were assumed to be replaced every two years. Table 11 also shows the estimated costs of developing the film of and replacing 50 used cameras once every year, under the assumption that 50 cameras are used, their film is developed, and the cameras are replaced.

Table 11: Potential Cost of providing cameras in operating locomotives

Year	Number of locomotives furnished	Number of cameras replaced without being developed	New camera cost	Number of cameras developed and replaced	Film development and camera replacement cost	Total cost	Present discounted annual cost (3% discount rate)	Present discounted annual cost (7% discount rate)
1	14250	0	$3.00	50	$6.00	$43,050.00	$43,050.00	$43,050.00
2	0	0	$3.00	50	$6.00	$300.00	$291.26	$280.37
3	0	14150	$3.00	50	$6.00	$42,750.00	$40,295.98	$37,339.51
4	0	0	$3.00	50	$6.00	$300.00	$274.54	$244.89
5	0	14150	$3.00	50	$6.00	$42,750.00	$37,982.82	$32,613.77
6	0	0	$3.00	50	$6.00	$300.00	$258.78	$213.90
7	0	14150	$3.00	50	$6.00	$42,750.00	$35,802.45	$28,486.13
8	0	0	$3.00	50	$6.00	$300.00	$243.93	$186.82
9	0	14150	$3.00	50	$6.00	$42,750.00	$33,747.24	$24,880.89
10	0	0	$3.00	50	$6.00	$300.00	$229.93	$163.18
11	0	14150	$3.00	50	$6.00	$42,750.00	$31,810.01	$21,731.93
12	0	0	$3.00	50	$6.00	$300.00	$216.73	$142.53
13	0	14150	$3.00	50	$6.00	$42,750.00	$29,983.99	$18,981.51
14	0	0	$3.00	50	$6.00	$300.00	$204.29	$124.49
15	0	14150	$3.00	50	$6.00	$42,750.00	$28,262.79	$16,579.19
16	0	0	$3.00	50	$6.00	$300.00	$192.56	$108.73

17	0	14150	$3.00	50	$6.00	$42,750.00	$26,640.39	$14,480.90
18	0	0	$3.00	50	$6.00	$300.00	$181.50	$94.97
19	0	14150	$3.00	50	$6.00	$42,750.00	$25,111.12	$12,648.18
20	0	0	$3.00	50	$6.00	$300.00	$171.09	$82.95
Total present discounted cost							$334,951.39	$252,434.85

Under the assumptions described above, the total cost of providing cameras over the first twenty years after this rule goes into effect equals $334,951.39 at a 3 percent discount rate and $252,434.85 at a 7 percent discount rate. These totals are shown in the bottom row of Table 11 above. Additionally, Tables A-2, A-3, A-4, and A-5 in the Appendix show the estimated costs of providing 25%, 50%, 75%, and 100% of the current locomotive fleet with cameras. The use of any of these alternative assumptions on the number of locomotives furnished with cameras does not significantly alter the results of this analysis.

FRA emphasizes that the assumptions going into the calculation of the cost of providing cameras are likely very conservative. As was stated previously, FRA believes it is rare for employees to use cameras to document safety hazards or violations of rail safety laws, regulations, orders, or standards. It therefore also seems unlikely that railroads or employees would suddenly decide to alter their practices and begin such documentation with cameras.

6.1.2.b Calculators

Calculators may sometimes be used by railroad operating employees, although their use is not required by an FRA regulation or by any railroad operating rules of which FRA is aware. Similar to the exception for cameras, this rule makes an exception for using an electronic device for an authorized business purpose if the device is a calculator that is not part of another electronic device. In other words, railroad operating employees would be permitted to use calculators and only calculators for performing calculations, if those calculations are required for authorized business purposes. FRA is unaware of any instances where electronic devices other than calculators, such as cell phones with calculator functions or laptop computers, are used by railroad operating employees to perform calculations. Such a practice is nevertheless conceivable, and, under EO 26 or this rule, would be prohibited. Thus, any railroads or employees that may have relied on cell phones or other (non-calculator) devices to perform calculations would be permitted to use calculators to do so under this rule.

FRA has entertained the possibility that all railroads would want crewmembers to be able to perform calculations, and that all railroads would achieve this capability by furnishing a calculator for each locomotive in operation. Assuming that no locomotives currently have calculators, the total initial cost of providing a calculator for each locomotive in operation would equal the number of locomotives in operation multiplied by the average cost of a calculator. Furthermore, there would be some ongoing costs as some calculators require replacement.

A quick search of online retailer Amazon.com shows basic calculator prices to range from $0.99 to $7.50, with most versions costing around $2.00 to $3.00. Assuming an average price of $2.50 per calculator, Table 12 below shows the calculation of the estimated total cost of furnishing the existing fleet of approximately 28,500 locomotives in operation with new calculators in the first year of the period considered, and subsequently replacing 100 calculators each year.

Table 12: Potential Cost of providing calculators in operating locomotives

Year	Number of locomotives furnished with new calculators	Number of calculators replaced	New calculator cost	Total annual cost	Present discounted annual cost (3% discount rate)	Present discounted annual cost (7% discount rate)
1	28,500	100	$2.50	$71,500.00	$71,500.00	$71,500.00
2	0	100	$2.50	$250.00	$242.72	$233.64
3	0	100	$2.50	$250.00	$235.65	$218.36
4	0	100	$2.50	$250.00	$228.79	$204.07
5	0	100	$2.50	$250.00	$222.12	$190.72
6	0	100	$2.50	$250.00	$215.65	$178.25
7	0	100	$2.50	$250.00	$209.37	$166.59
8	0	100	$2.50	$250.00	$203.27	$155.69
9	0	100	$2.50	$250.00	$197.35	$145.50
10	0	100	$2.50	$250.00	$191.60	$135.98
11	0	100	$2.50	$250.00	$186.02	$127.09
12	0	100	$2.50	$250.00	$180.61	$118.77
13	0	100	$2.50	$250.00	$175.34	$111.00
14	0	100	$2.50	$250.00	$170.24	$103.74
15	0	100	$2.50	$250.00	$165.28	$96.95
16	0	100	$2.50	$250.00	$160.47	$90.61
17	0	100	$2.50	$250.00	$155.79	$84.68
18	0	100	$2.50	$250.00	$151.25	$79.14
19	0	100	$2.50	$250.00	$146.85	$73.97
20	0	100	$2.50	$250.00	$142.57	$69.13
Total present discounted cost					$75,080.95	$74,083.90

Under the assumptions described above, the total cost of performing the revised operational tests and inspections over the twenty years considered is estimated to equal $75,080.95 at a 3 percent discount rate and $74,083.90 at a 7 percent discount rate. These totals are shown in the last row of Table 12 above.

6.1.2.c Providing new working radios or working wireless communications devices

FRA believes neither EO 26 nor this rule require any railroads to purchase new working radios or working wireless communications devices as a result of the limitations set on the use of electronic devices.

Railroads must have some way of communicating across distances to perform certain train or switching operations. In most circumstances, communication across distances is performed using working radios, defined as radios that can communicate with the control center of the railroad (through repeater stations, if necessary to reach the center) from any location within the rail system, except in tunnels or other localized places of extreme topography or during temporary lapses of coverage due to atmospheric or topographic conditions. See 49 CFR 220.5. In some circumstances, however, railroads may rely on other devices, such as cell phones, for communication across distances. This rule does not apply when a radio failure occurs and an electronic device is used in accordance with railroad rules.

FRA believes EO 26 and this rule limiting cell phone and other electronic or electrical device usage would not require railroads to purchase any new working radios or working wireless communications devices, for two reasons. First, under 49 CFR part 220, railroads are already required to equip controlling locomotives in trains with working radios except under certain circumstances where exemptions were granted.[30] Specifically, since July 1, 1999, each occupied controlling locomotive in a train under FRA jurisdiction has been required to have a working radio.[31] Additionally, each train has been required to have communications redundancy, which means a working radio on another locomotive in the consist or other means of working wireless communications.[32] Exemptions to these requirements under 49 CFR 220.9 were granted to railroads that have fewer than 400,000 annual employee work hours, unless those railroads were operating trains that transported passengers; operated at speeds greater than 25 miles per hour; engaged in joint operations on track where the maximum authorized speed for freight trains exceeds 25 miles per hour; or engaged in joint operations on a track adjacent to and within 30 feet of another track on which the maximum authorized speed for passenger trains exceeds 40 miles per hour.

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[30] 9 CFR 220.9. "Railroad communications: requirements for trains." Available online at: http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr;sid=9779a815c1443b1fdda57ab1a724c4be;rgn=div5;view=text;node=49%3A4.1.1.1.15;idno=49;cc=ecfr#49:4.1.1.1.15.1.11.7

[31] Ibid.

[32] Ibid.

Second, those locomotives in trains that are exempt from the requirement to have working radios under 49 CFR part 220 must operate under the conditions set forth in 49 CFR 220.9. These conditions for exemption from the requirement of a working radio under 49 CFR part 220 were unaffected by EO 26 and would remain unaffected under this rule. Thus, EO 26 and this rule permit those railroads that previously performed train or switching operations using working wireless communications to continue to do so, and railroads will therefore not be required to furnish any more working radios than 49 CFR part 220 already requires.

Because this same exemption is granted to railroads with fewer than 400,000 annual employee work hours, such railroads will not be required to install radios in lead locomotives unless operating trains under the conditions specified in 49 CFR 220.9 and summarized above. Communication across distances may still be performed by exempt railroads using working wireless communications (e.g., a cell phone) in the specified circumstances. For all other trains – trains of railroads with more than 400,000 annual employee work hours and trains of railroads with less than 400,000 annual employee work hours operating under the conditions that preclude exemption to 49 CFR 220.9 – communication across distances must be performed using working radio, which must be in the controlling locomotive of these trains under 49 CFR part 220.

6.1.2.d Indirect costs: opportunity cost of restrictions on using electronic devices

Some requirements of EO 26 exceeded the restrictions on electronic devices that railroads had previously, voluntarily put in place, as discussed in Section 5 of this analysis. These requirements of EO 26 limited or completely eliminated the ability of some deadhead status employees to use electronic devices in manners that would not have interfered with railroad operations or created safety hazards. This rule removes or softens those requirements of EO 26, where possible, that appeared to limit the opportunities of railroad operating employees without increasing safety. As a result, while EO 26 imposes an opportunity cost of restrictions on using electronic devices because the restrictions of EO 26 exceeded those of railroad operating rules in general, this rule does not impose such an opportunity cost. In some cases, the rule would restore conditions present prior to issuance of EO 26.

The estimation of the opportunity cost of restrictions on using electronic devices is, like the estimation of the opportunity cost of time spent in safety briefings, rife with uncertainty. First, the estimation of the number of railroad operating employees that may be presented with opportunities to safely use electronic devices in a given year seems an impossible task. Second, the number and length of opportunities to safely use electronic devices that would have actually been used, absent EO 26, is likely equally impossible to quantify. Third, even if one could estimate those numbers, the value of the opportunities forgone is, to at least some degree, subjective, although its range is likely bounded by the marginal cost to the railroad of the employee's time and zero.

Given these difficulties, this analysis leaves the opportunity cost of EO 26's restrictions on deadhead status employees using electronic devices and its restrictions on the use of cameras and calculators unestimated, noting only that while EO 26 imposed these costs, this rule in turn removes them.

6.1.2.e Program Revisions

This rule requires railroads to revise their programs of operational tests and inspections under 49 CFR part 217 such that their programs include the requirements of this rule. FRA has estimated that this required revision will take approximately one hour to complete.[33] FRA estimates that there are approximately 728 railroads that will be required, in the first year after this rule goes into effect, to revise their programs of operational tests and inspections under 49 CFR part 217. To calculate the cost of revising these programs, FRA assumed that the revisions will be performed by employees of the "Professional & Administrative" group reported on Annual Wage Forms A and B by Class I railroads.[34] The average wage rate of "Professional & Administrative" railroad employees was reported at approximately $31.00 per hour in 2008 dollars, which equals $31.13 when converted to 2009 dollars.[35] On top of the wage rate, a railroad's costs typically include fringe benefits and overhead. FRA assumes a multiplier of 1.75 to

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[33] This estimation was derived in the Paperwork Reduction Act analysis first performed in conjunction with the issuance of Emergency Order 26, Notice No. 1.
[34] Annual Wage Forms A and B, submitted by Class I railroads to the Surface Transportation Board (STB) and on file at STB. These are available upon request to authorized DOT personnel.
[35] Converted using Bureau of Labor Statistics' Consumer Price Index (CPI). For CPI info, see--http://www.bls.gov/CPI/.

cover fringe and overhead costs, yielding an hourly cost of $54.48. Thus, by multiplying the cost of $54.48 per hour by one hour, FRA estimates that the revision of programs of operational tests and inspections will represent a cost of $54.48 per railroad, or $39,659.62 dollars (in year 2009 dollars) in total when summed over all 728 railroads currently in existence. These estimates are described below in Table 13.

Table 13: Costs of revising programs of operational tests and inspections to comply with final rule, existing railroads, in year 2009 dollars

Year	Hours required to revise programs	Average wage rate of "Professional & Administrative" employees	Fringe and overhead multiplier	Cost per hour	Number of railroads	Total cost of revising programs
1	1	$31.13	1.75	$54.48	728	$39,659.62

6.1.2.f Additional Instruction in First Year of this Rule

Railroads will have to instruct all train crews on the exceptions introduced by this rule. This will require employees not scheduled for EO 26 instruction to receive instruction in year one of the final rule. This cost will total approximately $246,610.

6.1.2.g FRA Approval of Use of Railroad-Supplied Devices

Nominal costs will arise in year one from seeking FRA approval for use of railroad-supplied electronic devices for taking photographs and videos.

6.2 Benefits of Restrictions on Use of Electronic Devices

The benefits of a safety-related rule or other government intervention such as an emergency order can be stated as the reduction in risk resulting from the change in railroad operations induced by the intervention, or:

$$B = \Delta R = (P_b - P_a)C \qquad (1)$$

where B is the benefits of the intervention, ΔR is the change in risk, P_b is the probability of an accident attributable to distraction due to usage of an electronic device before the regulation, P_a is the probability of such an accident after the regulation, and C is the economic cost of such an accident.[36] Because for EO 26 and this final rule FRA is unable to reasonably estimate P_a or P_b, FRA has performed a break-even analysis in order to offer some sort of cost-benefit framework with which to consider the requirements of EO 26 and this rule. Even without knowing P_a or P_b, a break-even analysis can provide the following two useful products, so long as C can be reasonably estimated: first, a break-even analysis can produce estimates of the annual risk reductions necessary for the rule to break even, and second, a break-even analysis can produce a break-even frontier, or a bound on the risk reduction necessary for benefits to exceed costs when the baseline probability of an accident is uncertain or variable over time. The remainder of this section details the following: the estimation of C, or the economic cost of accidents attributable to distraction due to usage of an electronic device; the estimation of the

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[36] Model adapted from Shapiro (2008). Shapiro, Stuart (2008). "Analysis of Homeland Security Regulations, Small Steps Forward, Giant Leaps to Go." Regulatory Analysis 08-03. Reg-Markets Center. Available online: http://reg-markets.org/admin/authorpdfs/redirect-safely.php?fname=../pdffiles/RA08-03_topost.pdf.

annual risk reductions necessary for the rule to break even; and the estimation of break-even frontiers, each of which depends on the assumptions underpinning the estimation of *C*.

FRA notes that the benefits considered in these break-even analyses represent the benefits from this rule's restrictions on the unsafe usage of electronic devices by railroad operating employees, although some of these benefits have likely already been realized because EO 26 has been in effect since late 2008, just as some of the costs have probably been realized. This rule represents a lower-cost way of achieving the same regulatory goal as EO 26, so any break-even analysis of EO 26 itself would only show that the required risk reduction for EO 26 to break even is greater than the required risk reduction for this rule to break even. As such, formal break-even analyses for EO 26 itself were not performed in this RIA.

6.2.1 Estimation of C

FRA believes that the requirements of EO 26 and this rule have and will lead to safer railroad operations, from which FRA expects fewer accidents attributable to distractions arising from use of electronic devices. The economic costs of an accident may include but are not limited to fatalities, injuries, property damage, and environmental damage. Benefits from a safety improvement are most likely to accrue in the form of economic costs avoided and particularly fatalities and injuries avoided. The standard metric for ascertaining the value of improvements to safety is the value of a statistical life (VSL),

defined as the value of improvements in safety that result in a reduction by one in the expected number of fatalities. FRA emphasizes that the VSL is a statistical value that is useful for regulatory estimation and comparison, and that VSL does not suggest that the actual value of a life can be stated in dollar terms. Table 14 below lists these benefits, or economic costs avoided, along with the metrics and values that DOT guidance suggests.[37] In accordance with DOT guidance, injuries avoided have been assigned fractions of the VSL corresponding to the severity of the injury, as reflected in the VSL multiplier column in Table 14.

Table 14: Values of a statistical life and of injuries, year 2009 dollars

Benefit	Metric	VSL multiplier	DOT standard VSL	Alternative VSL 1	Alternative VSL 2
Fatalities avoided	Value of a statistical life (VSL)	1	$6,000,000	$3,200,000	$8,400,000
Injuries avoided - minor	Fraction of a VSL	0.002	$12,000	$6,400	$16,800
Injuries avoided - moderate	Fraction of a VSL	0.0155	$93,000	$49,600	$130,200
Injuries avoided - serious	Fraction of a VSL	0.0575	$345,000	$184,000	$483,000
Injuries avoided - severe	Fraction of a VSL	0.1875	$1,125,000	$600,000	$1,575,000

[37] U.S. Department of Transportation memorandum, (2009). "Treatment of the Economic Value of a Statistical Life in Departmental Analyses – 2009 Annual Revision." Office of the Secretary of Transportation, March 18, 2009. Available online at: http://ostpxweb.dot.gov/policy/reports/VSL%20Guidance%20031809%20a.pdf. DOT guidance recommends using $6,000,000 as the VSL, but also performing calculations using alternative VSL figures of $3,200,000 and $8,400,000; all of these figures on based on recent meta-analyses and scholarly publications, which are cited in the DOT memorandum linked to in this footnote.

Injuries avoided - critical	Fraction of a VSL	0.7625	$4,575,000	$2,440,000	$6,405,000

Furthermore, a safety improvement may lead to avoidance of property damage, and, as sometimes accidents create environmental hazards, environmental damages avoided may also arise as benefits. However, none of the accidents listed in the accident history in Section 2.2 of this analysis appear to have caused extensive environmental damage. Significant train delay, road closures, emergency response, and accident clean-up costs can also result.

To offer perspective on both the estimation of *C* and on how feasible it may be to achieve benefits that will at least offset the costs, Table 15 below summarizes only the fatalities, injuries, and property damages estimated to have been caused by the accidents recounted above in the accident history in Section 2.2 of this analysis.

Table 15: Summary of damages from accidents, years 2000 – 2008

Location	Date	Fatalities	Injuries	Property damage (current dollars)	Property damage (2009 dollars)
Chatsworth, CA	9/12/2008	25	96[38]	$7,100,500	$7,129,324
Harris County, TX	6/8/2008	1	0	$0	$0
Marshall, TX	7/1/2006	0	0	$413,194	$443,071
San	5/27/2006	0	4	$401,779	$430,830

[38] The estimate of the number injuries caused by the Chatsworth incident is still tentative. Some sources have indicated as many as 105 injuries occurred.

Antonio, TX					
Gunter, TX	5/19/2004	1	1	$2,615,016	$2,992,622
Clarendon, TX	5/28/2002	1	3	$8,000,000	$9,613,207
Copeville, TX	12/21/2005	1	0	$0	$0
Gillette, WY	12/29/2000	1	0	$0	$0
Total		30	104	$18,530,489.00	$20,609,054.00

Of the injuries listed in Table 15, at least half seem likely to have been either severe or critical injuries.[39] Using the data summarized in Table 15 and the three VSLs listed in Table 14, Tables A-7, A-8, and A-9 in the appendix show hypothetical values (in 2009 dollars) of avoiding accidents similar to specific accidents that occurred between 2000 and 2008. In Table A-7, for example, the value of implementing enough safety activities to somehow avoid an incident similar to the Chatsworth incident is shown to equal approximately $377,304,324 (in 2009 dollars). Similarly, avoiding a series of accidents similar to all eight accidents discussed in the accident history would be valued at approximately $439,133,054 (in 2009 dollars). These estimates are conservative because they do not include costs associated with train delay, road closures, emergency response, or accident clean-up.

The types and severity of accidents caused by distraction due to the usage of an electronic device that may be prevented by a new regulation vary widely and depend on a number of immeasurable factors. Thus, for purposes of this analysis, FRA considered four

[39] ABC reported that 80 of the injured people in the Chatsworth incident were in "critical condition." See http://abclocal.go.com/kabc/story?section=news/local&id=6388256, retrieved December 9, 2009.

different accident scenarios and estimated the monetized losses resulting from each, using the monetized losses as values for *C* in the break-even analysis. These scenarios are motivated and informed by the estimates presented in Table A-7, which uses the standard VSL estimate of $6.0 million provided by DOT guidance. The four scenarios considered were designed to represent a broad range of possible outcomes in the absence of federal restrictions on electronic device use. The first two scenarios represent what FRA believes to be realistic outcomes, while the second two scenarios describe extreme outcomes. The first two scenarios are called the base scenarios. The latter two scenarios, called extreme scenarios, were considered in order to further test the sensitivity of the results of this analysis to changes in assumptions. Each scenario is described in detail below.

Base Scenarios:

Scenario 1

Scenario 1 involves a projection of trends observed in both accident data and FRA inspections. As noted in Section 2.2 of this analysis, FRA has noted a disturbingly high rate of electronic device usage by railroad operating employees even when railroad rules prohibited such uses. Given the increasing penetration rate of electronic devices, and particularly of cell phones, FRA expects that, absent new regulation, the rate of dangerous usage of electronic devices by railroad operating employees would increase.

Along with the observations of dangerous usage of electronic devices discussed in the preamble, the accident history seems to point to a trend of growth in the number of accidents attributable to electronic devices usage. It seems likely that this growth would have continued, had EO 26 not been promulgated and followed up by this rule, given the growing penetration of electronic devices and the number of observations of unsafe usage of such devices made by FRA inspectors. As shown in Table 15, in the year 2008 alone, prior to the promulgation of EO 26, at least two accidents were attributed to distraction due to electronic device usage. Scenario 1 was constructed under the assumption that the annual count of accidents attributable to usage of electronic devices would continue to grow, and that three such accidents would occur in a given year, absent this rule. Each accident is assumed to cause losses equal to the average losses caused by the accidents listed in Table A-7, which equals $54,891,632. Three such accidents in a year would result in annual losses equal to $164,674,895 (in 2009 dollars).

Scenario 2

Scenario 2 is similar to Scenario 1 in the assumption that three accidents would occur in a given year. In Scenario 2, however, the average is calculated as the mean loss of all accidents listed in Table 15 *excluding* the most costly (Chatsworth) and the least costly (Marshall). Excluding those two incidents decreases the average to $10,230,777. Three such "average" incidents would incur annual losses of $30,692,330 (in 2009 dollars).

Extreme Scenarios:

Both Scenario 3 and Scenario 4 were considered as exercises in testing the sensitivity of the results of these break-even analyses to drastic changes in the estimated annual cost, *C*. Scenario 3 yields an extremely high value for C, while in Scenario 4 produces an extremely low value for C.

Scenario 3

Scenario 3 involves an accident occurring similar in consequence to the Chatsworth incident each year. Table A-7 gives an estimate of the economic losses due to the Chatsworth incident, although as noted earlier this estimate ignores many costs. In other words, FRA considers this estimate of the economic losses of the Chatsworth incident to be a conservative estimate. The estimate given in Table A-7 for the losses due to the Chatsworth incident is $377,304,324 (in 2009 dollars).

Scenario 4

Scenario 4 produces an extremely low value for annual estimated losses, *C*. Scenario 4 was constructed under the assumption that only one "low-cost" accident would occur in a given year, despite the proclivity to use electronic devices observed by FRA over recent years as well as the growing number of accidents and near-misses caused by electronic devices use. The losses from the "low-cost" accident are calculated in two steps. First, by excluding the most costly and least costly accidents in the accident history, as in Scenario 2 above, the losses for an "average" accident are estimated to equal $10,230,777.

Second, to make Scenario 4 an extreme, low-cost scenario, the losses from an "average" accident are halved, yielding a figure of $5,115,389 (in 2009 dollars).

6.2.2 Required risk reductions for each scenario

According to the cost analysis performed above in Section 6.1, the average annual cost of this rule, including indirect costs and without any discounting, equals $2,794,863.[40] By comparing the scale of losses that would occur under the four scenarios to the estimated cost of the rule, this analysis demonstrates the annual risk reduction that would be necessary in order for the new regulation to break even under the assumption that the losses estimated to occur in the scenario would certainly occur in the absence of new regulation. The annual risk reduction that would be required in each scenario equals the ratio between the average annual cost of this rule and losses that would be incurred under the scenario. The resulting required risk reductions by scenario, the annual costs, including indirect costs, and annual losses under each scenario are shown below in Table 16.

Table 16: Required risk reductions to break even, where costs include indirect costs

Scenario	Average annual cost of this rule (millions of 2009 dollars)	Losses (millions of 2009 dollars)	Required risk reduction
Base Scenarios			
1	$2.8	$164.7	0.017

[40] This estimation arises from summing all of the costs (i.e., each of the component costs such as the cost of revising programs or the cost of calculators) in a given year, then summing these totals over all twenty years and dividing by twenty.

2	$2.8	$30.7	0.091
Extreme Scenarios			
3	$2.8	$377.3	0.007
4	$2.8	$5.1	0.546

Given the uncertainty in estimating the indirect costs that may result from EO 26 or this rule, it may be appropriate and informative to also conduct a break-even analysis using only the annual direct costs stemming from revising and performing operating test and inspection programs, instruction, and acquiring cameras and calculators. The average annual cost without any discounting and without including direct costs equals $821,528.23. The corresponding required risk reductions are shown below in Table 17.

Table 17: Required risk reductions to break even, where costs do not include indirect costs

Scenario	Average annual cost of this rule (millions of 2009 dollars)	Losses (millions of 2009 dollars)	Required risk reduction
Base Scenarios			
1	$0.8	$164.7	0.005
2	$0.8	$30.7	0.027
Extreme Scenarios			
3	$0.8	$377.3	0.002
4	$0.8	$5.1	0.161

6.2.3 Break-even frontiers

Another useful product of a break-even analysis is the break-even frontier. Without knowing either the baseline probability of an accident occurring that is caused by distraction due to usage of an electronic device or the risk reduction that would result

from EO 26 or this rule, a break-even frontier graphically presents the required risk reduction necessary in a given year to offset the costs in that year, given an assumed baseline probability of an accident. For example, under an assumption that the baseline probability of an accident equals 0.50, then the expected annual losses from Scenario 3 would equal that probability multiplied by the estimated losses under Scenario 3 (that is, 0.50*$377,304,324 = $188,652,662). The costs of the requirements transferred from EO 26 coupled with actual and potential costs associated with this rule, which costs on average about $2.8 million per year when including indirect costs, would need to reduce the probability of an accident by at least $2.8 million to break even, making the expected annual losses under Scenario 3 become $185,857,799 if annual losses are reduced by exactly annual cost. Such a result requires a probability reduction equal to 0.015. This figure is calculated by dividing the expected annual cost by the expected annual losses under each scenario, assuming a baseline probability of 0.50.

Performing similar calculations for all baseline probabilities yields a break-even frontier. A break-even frontier was calculated for each of the four scenarios, and the four frontiers are graphically depicted below in Figure 1. The frontiers in Figure 1 were calculated using average annual costs of $2,794,863, which includes indirect costs. Later in the analysis, Figure 2 shows break-even frontiers based on average annual costs of $821,528, which does not include indirect costs. In both of these figures, areas to the northeast of each frontier show combinations of baseline probabilities and probability reductions that would result in positive net benefits. Along the frontiers themselves are combinations of

baseline probabilities and probability reductions that would result in costs exactly equaling benefits. Areas southwest of the frontiers show combinations of baseline probabilities and probability reductions that would result in negative net benefits. In both figures, the base scenarios (Scenarios 1 and 2) are shown with thick lines, while the extreme scenarios (Scenarios 3 and 4) are depicted with thin lines.

Figure 1: Break-even frontiers of Scenarios 1 through 4, where costs include indirect costs

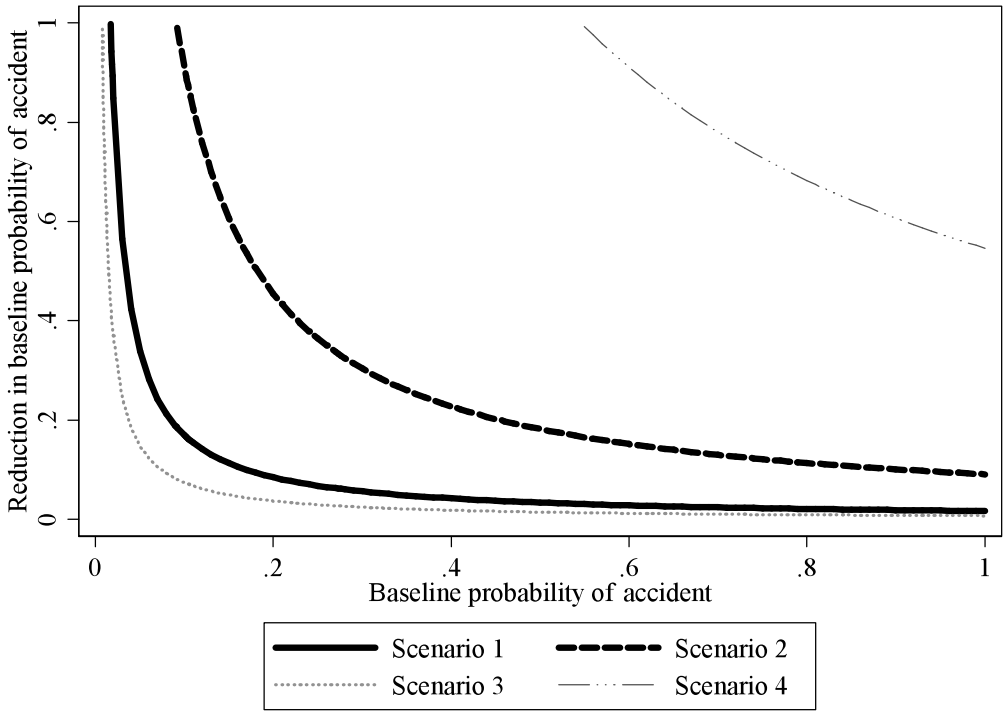
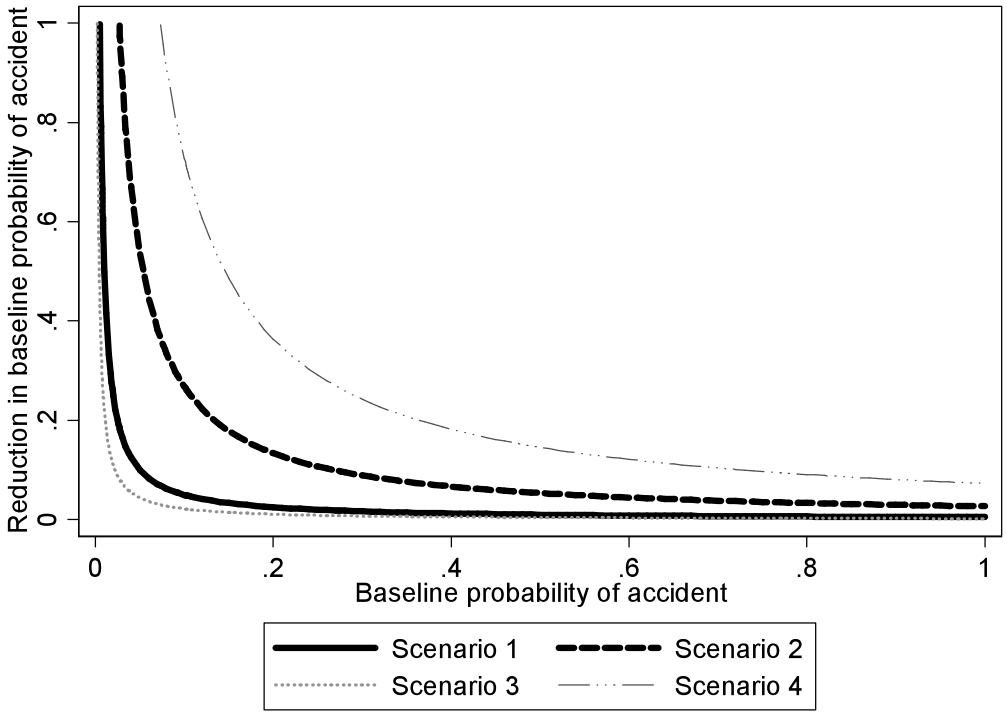


Figure 2 below shows similar break-even frontiers, except that these frontiers were calculated using average annual costs of $821,528 – a figure that does not include indirect costs. As explained above, given the uncertainty involved in estimating the

indirect costs that may be induced by new regulation, a break-even analysis that focuses simply on direct costs may be appropriate and informative.

Figure 2: Break-even frontiers of Scenarios 1 through 4, where costs do not include indirect costs



Examined individually, each figure shows that, for the base scenarios, the risk reduction required to break even is relatively small. Under Scenario 1, for most baseline probabilities, it requires a risk reduction of less than 0.10 to break even. For Scenario 2, a risk reduction of less than 0.20 will result in breaking even for most baseline probabilities. The graphs of the break-even frontiers of the extreme scenarios also indicate a likely break even for nearly all baseline probabilities of Scenario 3 and many baseline probabilities of Scenario 4. For Scenario 3 (one of the extreme scenarios), even

a slight reduction in the probability of an accident will result in at least a break even situation, given almost any baseline probability of an accident. Scenario 4 (the other extreme scenario) requires higher risk reductions to break even.

More specifically, Figure 1 shows for Scenario 4 – the scenario with the lowest expected annual losses – that if the baseline probability is less than approximately 0.54, then the requirements are not cost beneficial regardless of how much they reduce risk. At the other extreme, for Scenario 3, in which the size of the expected annual losses is quite large compared to the estimated implementation cost, if the baseline risk were 0.25, the requirements are cost beneficial if they reduces risk by as little as 0.03. When ignoring indirect costs, as in Figure 2, only at baseline probabilities of 0.16 or less would it be the case that the new regulation cannot be cost beneficial in Scenario 4. For Scenario 3, on the other hand, if the baseline probability were 0.07, the new regulation would have to reduce risk by just 0.03 in order to break even.

A comparison of Figure 1 and Figure 2 demonstrates graphically another potentially important point, which is the degree to which the costs of the combined government intervention are dominated by indirect costs. When removing indirect costs from the break-even analysis, the break-even frontiers of all four scenarios shift dramatically southwest, meaning at any given baseline, the minimum risk reduction needed to break even decreases.

6.2.4 Discussion of interaction with positive train control

Congress recently mandated widespread implementation of positive train control (PTC) systems. Some of the accidents discussed above may have been prevented had PTC systems been in place. Based on available accident information, FRA performed a retrospective analysis to determine which of the eight accidents may have been prevented by PTC systems had the locomotive and the wayside been equipped with PTC. FRA has concluded that the following accidents fall into that category (accidents listed by location): Chatsworth, CA; San Antonio, TX; Gunter, TX; and Clarendon, TX.
FRA has considered what the total estimated losses from train accidents caused by distraction might equal if PTC had been implemented on the lines where the accidents occurred. The total monetized damages of the four accidents that would likely not have been prevented had the recently mandated PTC systems been in place equal $18,443,071, using VSL of $6,000,000. If we assume these accidents represent the "average" accident caused by distraction, then the estimated losses of one such "average" accident would equal $4,610,768, and three such "average" accidents would equal $13,832,303 in 2009 dollars.

Note however that some PTC-preventable accidents still may occur; no accident prevention system is 100% effective. As noted in the RIA accompanying the PTC rulemaking, although PTC is very effective, the technology associated with currently available systems may not completely eliminate all collision risks. For example, a PTC system may not and is not required to prevent a collision caused by a train that derails

and moves onto a neighboring or adjacent track (i.e., a secondary collision), and PTC systems may not prevent certain collisions (such as a rear end collision) that might occur at restricted speed. The result is that some accidents in PTC-equipped areas may still be caused by distraction over the next several years if the use of electronic devices is not restricted. Thus, in its regulatory impact analysis of PTC, FRA estimated that PTC systems will prevent 80% of PTC-preventable accidents on lines equipped with PTC.

In addition, a substantial portion of the Class I freight network and much of the switching and terminal railroad mileage over which Class I crews operate, will not be equipped under the current mandate and perhaps not for many years. The preponderance of Class II and III railroad lines and equipment will not be equipped with PTC. Roughly 45% of PTC-preventable accidents that FRA has reviewed between the six year period 2003 and 2008 occurred on rail lines that will not be on the PTC network and 25% of the accidents occurred on non-Class I rail lines. Furthermore, PTC will not be fully implemented until 2015 or later in some cases.

Thus, until 2015 the estimation of the losses of the "average" accident can reasonably be performed equivalently to the scenarios described above. After implementation of PTC, then the expected losses from PTC-preventable accidents should be reduced by 80% in accordance with FRA's assessment of the effectiveness of PTC. Table 18 below details the expected annual losses under each scenario using the assumption that PTC is fully implemented in the fifth year.

Table 18: Estimated annual losses under each scenario if PTC is fully implemented by Year 5

Year	Scenario 1	Scenario 2	Scenario 3	Scenario 4
1	$164,674,895	$30,692,330	$377,305,324	$5,115,389
2	$164,674,895	$30,692,330	$377,305,324	$5,115,389
3	$164,674,895	$30,692,330	$377,305,324	$5,115,389
4	$164,674,895	$30,692,330	$377,305,324	$5,115,389
5	$38,467,900	$13,338,466	$75,461,065	$2,223,078
6	$38,467,900	$13,338,466	$75,461,065	$2,223,078
7	$38,467,900	$13,338,466	$75,461,065	$2,223,078
8	$38,467,900	$13,338,466	$75,461,065	$2,223,078
9	$38,467,900	$13,338,466	$75,461,065	$2,223,078
10	$38,467,900	$13,338,466	$75,461,065	$2,223,078
11	$38,467,900	$13,338,466	$75,461,065	$2,223,078
12	$38,467,900	$13,338,466	$75,461,065	$2,223,078
13	$38,467,900	$13,338,466	$75,461,065	$2,223,078
14	$38,467,900	$13,338,466	$75,461,065	$2,223,078
15	$38,467,900	$13,338,466	$75,461,065	$2,223,078
16	$38,467,900	$13,338,466	$75,461,065	$2,223,078
17	$38,467,900	$13,338,466	$75,461,065	$2,223,078
18	$38,467,900	$13,338,466	$75,461,065	$2,223,078
19	$38,467,900	$13,338,466	$75,461,065	$2,223,078
20	$38,467,900	$13,338,466	$75,461,065	$2,223,078
Mean estimated annual losses	$63,709,299	$16,809,239	$135,829,917	$2,801,540

For consistency and clarity, FRA considered the means of the estimated annual losses when accounting for the effects of PTC, given in the last row of Table 18. Each of the means for Scenarios 1, 2, and 3 are still much greater than the mean estimated annual losses of $5,115,389 given in Scenario 4 prior to the implementation of PTC. This indicates that while the break-even frontiers for Scenarios 1, 2, and 3 would shift northeast, they would still be much farther southwest than the original frontier of

Scenario 4 in either of the figures in Section 6.2.3. For further consideration, Table 19 below shows the required risk reductions to break even using the means calculated under the assumption that PTC is fully implemented in Year 5, wherein all calculations were performed identically to those in Table 16.

Table 19: Required risk reductions to break even, where costs include indirect costs and where PTC is fully implemented in Year 5

Scenario	Average annual cost (millions of 2009 dollars)	Losses (millions of 2009 dollars)	Required risk reduction
Base Scenarios			
1	$2.8	$63.6	0.044
2	$2.8	$16.8	0.167
Extreme Scenarios			
3	$2.8	$135.6	0.021
4	$2.8	$2.8	0.998

Similarly, Table 20 presents required risk reductions to break even when not considering indirect costs, under the assumption that PTC is fully implemented in Year 5. Table 20 was calculated in the same way as Table 17.

Table 20: Required risk reductions to break even, where costs do not include indirect costs and where PTC is fully implemented in Year 5

Scenario	Average annual cost (millions of 2009 dollars)	Losses (millions of 2009 dollars)	Required risk reduction
Base Scenarios			
1	$0.8	$63.6	0.013
2	$0.8	$16.8	0.049

Extreme Scenarios			
3	$0.8	$135.6	0.006
4	$0.8	$2.8	0.293

The consideration of PTC does increase the required risk reduction needed to break even, but the thresholds remain in very feasible territory for all scenarios except the extreme scenario Scenario 4. Given the seeming ubiquity of cell phones and the proliferation of unsafe usage of electronic devices witnessed over the past several years, FRA concludes that the restrictions placed on use of electronic devices will likely break even and probably even yield positive net benefits even under the assumption of full implementation of PTC by Year 5.

6.3 Net Benefits of Restrictions on Use of Electronic Devices

An estimation of net benefits resulting from restrictions placed on traincrew use of electronic devices cannot be performed in this analysis, as FRA believes that the actual changes in the probability of an accident occurring cannot be reasonably estimated. However, the break-even analyses can be relied upon to inform a discussion of likely net benefit outcomes. The break-even analyses show that, in most scenarios considered, it would not require an unreasonable decrease in the probability of an accident in order to at least break even.

As an alternative framework, the costs of the regulation can be compared to the minimum number of statistical fatalities that would need to be prevented for the government intervention to be cost-beneficial. Table 21 below shows the estimated, undiscounted

annual costs of the government intervention alongside the fraction of the VSL that would be required to break even in each year.

Table 21: Costs and break-even fractions of VSL

Year	Total annual direct costs, not discounted	Fraction of VSL (VSL=$6,000,000)	Total annual costs including indirect costs, not discounted	Fraction of VSL (VSL=$6,000,000)
1	$1,182,735.90	0.20	$3,156,070.90	0.53
2	$782,409.41	0.13	$2,755,744.41	0.46
3	$824,859.41	0.14	$2,798,194.41	0.47
4	$782,409.41	0.13	$2,755,744.41	0.46
5	$824,859.41	0.14	$2,798,194.41	0.47
6	$782,409.41	0.13	$2,755,744.41	0.46
7	$824,859.41	0.14	$2,798,194.41	0.47
8	$782,409.41	0.13	$2,755,744.41	0.46
9	$824,859.41	0.14	$2,798,194.41	0.47
10	$782,409.41	0.13	$2,755,744.41	0.46
11	$824,859.41	0.14	$2,798,194.41	0.47
12	$782,409.41	0.13	$2,755,744.41	0.46
13	$824,859.41	0.14	$2,798,194.41	0.47
14	$782,409.41	0.13	$2,755,744.41	0.46
15	$824,859.41	0.14	$2,798,194.41	0.47
16	$782,409.41	0.13	$2,755,744.41	0.46
17	$824,859.41	0.14	$2,798,194.41	0.47
18	$782,409.41	0.13	$2,755,744.41	0.46
19	$824,859.41	0.14	$2,798,194.41	0.47
20	$782,409.41	0.13	$2,755,744.41	0.46

Table 21 shows that, if considering only estimated direct costs, if the new regulation prevents the loss of one-fifth of the VSL each year of the twenty-year period examined, the regulation will yield positive net benefits. If considering direct and indirect costs, the regulation will yield positive net benefits if it prevents the loss of just half of the VSL

each year over the twenty-year period examined. In other words, prevention of one fatal accident every two years would justify the requirements of this rule from a cost-benefit perspective.

Given the number of accidents caused by and observations of unsafe usage of electronic devices by railroad operating employees, it appears that one way to reduce fatalities, injuries, and other losses in the railroad industry is to reduce such usage. This analysis shows that in many scenarios and under most assumptions of baseline risk, the restrictions placed to reduce unsafe usage of electronic devices can at least break even. Indeed, the frequency and severity of accidents together with the observed rising incidence of improper uses of cell phones and other electronic devices strongly suggest that the elimination of improper electronic device usage by railroad operating employees, as required, will prevent more than one fatality every two years and, therefore, that the benefits of implementing these restrictions will exceed its costs.

6.5 Incremental Benefits of Final Rule

This rule maintains virtually all of the safety benefits of EO 26, but adds benefits by allowing railroad employees to use cameras and calculators in ways that do not negatively impact safety and allow for more cost-effective train operations. Use of cameras will assist employees in documenting safety hazards and may help prevent accidents and slowing of trains. Allowing employees to use calculators will improve their ability to quickly and accurately make any necessary mathematical calculations. Although we are not able to quantify these benefits, we believe they will exceed

the$696,000 (PV, 3%) or $613,000 (PV, 7%) in costs that are expected to accrue over 20 years.

6.6 Incremental Net Benefits of Final Rule

The costs of this rule are not large—**the total cost of the rule is not expected to exceed $696,000 (PV, 3%) or $613,000 (PV, 7%) over 20 years. FRA** believes that the **added flexibility afforded for using** calculators and cameras **along with the clear understanding employees will have regarding the changes in the requirements** will exceed that cost, **resulting in net benefits.**

Appendix

Table A-1: Annual costs, by category of cost, not discounted

Year	Cost of revising programs of operational tests and inspections, existing railroads	Cost of revising programs of operational tests and inspections, new railroads	Cost of additional operational tests and inspections	Cost of additional instruction	Cost of providing cameras	Cost of providing calculators	Opportunity cost of time spent in safety briefings, etc.
1	$39,659.62	$544.78	$41,314.00	$986,667.50	$43,050.00	$71,500.00	$1,973,335.00
2	$0.00	$544.78	$41,314.00	$740,000.63	$300.00	$250.00	$1,973,335.00
3	$0.00	$544.78	$41,314.00	$740,000.63	$42,750.00	$250.00	$1,973,335.00
4	$0.00	$544.78	$41,314.00	$740,000.63	$300.00	$250.00	$1,973,335.00
5	$0.00	$544.78	$41,314.00	$740,000.63	$42,750.00	$250.00	$1,973,335.00
6	$0.00	$544.78	$41,314.00	$740,000.63	$300.00	$250.00	$1,973,335.00
7	$0.00	$544.78	$41,314.00	$740,000.63	$42,750.00	$250.00	$1,973,335.00
8	$0.00	$544.78	$41,314.00	$740,000.63	$300.00	$250.00	$1,973,335.00
9	$0.00	$544.78	$41,314.00	$740,000.63	$42,750.00	$250.00	$1,973,335.00
10	$0.00	$544.78	$41,314.00	$740,000.63	$300.00	$250.00	$1,973,335.00
11	$0.00	$544.78	$41,314.00	$740,000.63	$42,750.00	$250.00	$1,973,335.00
12	$0.00	$544.78	$41,314.00	$740,000.63	$300.00	$250.00	$1,973,335.00
13	$0.00	$544.78	$41,314.00	$740,000.63	$42,750.00	$250.00	$1,973,335.00
14	$0.00	$544.78	$41,314.00	$740,000.63	$300.00	$250.00	$1,973,335.00
15	$0.00	$544.78	$41,314.00	$740,000.63	$42,750.00	$250.00	$1,973,335.00
16	$0.00	$544.78	$41,314.00	$740,000.63	$300.00	$250.00	$1,973,335.00
17	$0.00	$544.78	$41,314.00	$740,000.63	$42,750.00	$250.00	$1,973,335.00
18	$0.00	$544.78	$41,314.00	$740,000.63	$300.00	$250.00	$1,973,335.00
19	$0.00	$544.78	$41,314.00	$740,000.63	$42,750.00	$250.00	$1,973,335.00
20	$0.00	$544.78	$41,314.00	$740,000.63	$300.00	$250.00	$1,973,335.00

Table A-2: Total annual costs, not discounted, and discounted at 3 percent and 7 percent discount rates

Year	Total annual direct costs, not discounted	Total annual direct costs, 3% discount rate	Total annual direct costs, 7% discount rate	Total annual costs including indirect costs, not discounted	Total annual costs including indirect costs, 3% discount rate	Total annual costs including indirect costs, 7% discount rate
1	$1,182,735.90	$1,182,735.90	$1,182,735.90	$3,156,070.90	$3,156,070.90	$3,156,070.90
2	$782,409.41	$759,620.78	$731,223.74	$2,755,744.41	$2,675,480.00	$2,575,462.06
3	$824,859.41	$777,509.10	$720,464.15	$2,798,194.41	$2,637,566.60	$2,444,051.36
4	$782,409.41	$716,015.44	$638,679.14	$2,755,744.41	$2,521,896.51	$2,249,508.31
5	$824,859.41	$732,876.90	$629,281.29	$2,798,194.41	$2,486,159.49	$2,134,729.11
6	$782,409.41	$674,913.23	$557,847.09	$2,755,744.41	$2,377,129.33	$1,964,807.67
7	$824,859.41	$690,806.77	$549,638.65	$2,798,194.41	$2,343,443.76	$1,864,555.08
8	$782,409.41	$636,170.45	$487,245.26	$2,755,744.41	$2,240,672.38	$1,716,139.12
9	$824,859.41	$651,151.63	$480,075.68	$2,798,194.41	$2,208,920.50	$1,628,574.62
10	$782,409.41	$599,651.66	$425,578.88	$2,755,744.41	$2,112,048.62	$1,498,942.37
11	$824,859.41	$613,772.86	$419,316.69	$2,798,194.41	$2,082,119.43	$1,422,460.15
12	$782,409.41	$565,229.20	$371,717.07	$2,755,744.41	$1,990,808.39	$1,309,234.32
13	$824,859.41	$578,539.79	$366,247.44	$2,798,194.41	$1,962,597.26	$1,242,431.78
14	$782,409.41	$532,782.73	$324,672.09	$2,755,744.41	$1,876,527.85	$1,143,535.96
15	$824,859.41	$545,329.24	$319,894.70	$2,798,194.41	$1,849,936.15	$1,085,188.03
16	$782,409.41	$502,198.82	$283,581.17	$2,755,744.41	$1,768,807.47	$998,808.59
17	$824,859.41	$514,025.11	$279,408.42	$2,798,194.41	$1,743,742.24	$947,845.26
18	$782,409.41	$473,370.56	$247,690.78	$2,755,744.41	$1,667,270.69	$872,398.11
19	$824,859.41	$484,517.97	$244,046.13	$2,798,194.41	$1,643,644.30	$827,884.76
20	$782,409.41	$446,197.15	$216,342.72	$2,755,744.41	$1,571,562.53	$761,986.29
Total present discounted costs		$12,677,415.28	$9,475,686.99		$42,916,404.39	$31,844,613.83

Table A-3: Cost of providing cameras in 25% of operating locomotives

Year	Number of locomotives furnished	Number of cameras replaced without being developed	New camera cost	Number of cameras developed and replaced	Film development and camera replacement cost	Total cost	Present discounted annual cost (3% discount rate)	Present discounted annual cost (7% discount rate)
1	7125	0	$3.00	25	$6.00	$21,525.00	$21,525.00	$21,525.00
2	0	0	$3.00	25	$6.00	$150.00	$145.63	$140.19
3	0	7075	$3.00	25	$6.00	$21,375.00	$20,147.99	$18,669.75
4	0	0	$3.00	25	$6.00	$150.00	$137.27	$122.44
5	0	7075	$3.00	25	$6.00	$21,375.00	$18,991.41	$16,306.89
6	0	0	$3.00	25	$6.00	$150.00	$129.39	$106.95
7	0	7075	$3.00	25	$6.00	$21,375.00	$17,901.23	$14,243.07
8	0	0	$3.00	25	$6.00	$150.00	$121.96	$93.41
9	0	7075	$3.00	25	$6.00	$21,375.00	$16,873.62	$12,440.44
10	0	0	$3.00	25	$6.00	$150.00	$114.96	$81.59
11	0	7075	$3.00	25	$6.00	$21,375.00	$15,905.01	$10,865.97
12	0	0	$3.00	25	$6.00	$150.00	$108.36	$71.26
13	0	7075	$3.00	25	$6.00	$21,375.00	$14,991.99	$9,490.76
14	0	0	$3.00	25	$6.00	$150.00	$102.14	$62.24
15	0	7075	$3.00	25	$6.00	$21,375.00	$14,131.39	$8,289.59
16	0	0	$3.00	25	$6.00	$150.00	$96.28	$54.37
17	0	7075	$3.00	25	$6.00	$21,375.00	$13,320.19	$7,240.45
18	0	0	$3.00	25	$6.00	$150.00	$90.75	$47.49
19	0	7075	$3.00	25	$6.00	$21,375.00	$12,555.56	$6,324.09
20	0	0	$3.00	25	$6.00	$150.00	$85.54	$41.48
Total present discounted cost							$167,475.70	$126,217.43

Note: As the assumption of the number of locomotives furnished with cameras changes, the number of cameras replaced without being developed and the number of cameras developed and replaced also change.

Table A-4: Cost of providing cameras in 50% of operating locomotives

Year	Number of locomotives furnished	Number of cameras replaced without being developed	New camera cost	Number of cameras developed and replaced	Film development and camera replacement cost	Total cost	Present discounted annual cost (3% discount rate)	Present discounted annual cost (7% discount rate)
1	14250	0	$3.00	50	$6.00	$43,050.00	$43,050.00	$43,050.00
2	0	0	$3.00	50	$6.00	$300.00	$291.26	$280.37
3	0	14150	$3.00	50	$6.00	$42,750.00	$40,295.98	$37,339.51
4	0	0	$3.00	50	$6.00	$300.00	$274.54	$244.89
5	0	14150	$3.00	50	$6.00	$42,750.00	$37,982.82	$32,613.77
6	0	0	$3.00	50	$6.00	$300.00	$258.78	$213.90
7	0	14150	$3.00	50	$6.00	$42,750.00	$35,802.45	$28,486.13
8	0	0	$3.00	50	$6.00	$300.00	$243.93	$186.82
9	0	14150	$3.00	50	$6.00	$42,750.00	$33,747.24	$24,880.89
10	0	0	$3.00	50	$6.00	$300.00	$229.93	$163.18
11	0	14150	$3.00	50	$6.00	$42,750.00	$31,810.01	$21,731.93
12	0	0	$3.00	50	$6.00	$300.00	$216.73	$142.53
13	0	14150	$3.00	50	$6.00	$42,750.00	$29,983.99	$18,981.51
14	0	0	$3.00	50	$6.00	$300.00	$204.29	$124.49
15	0	14150	$3.00	50	$6.00	$42,750.00	$28,262.79	$16,579.19
16	0	0	$3.00	50	$6.00	$300.00	$192.56	$108.73
17	0	14150	$3.00	50	$6.00	$42,750.00	$26,640.39	$14,480.90
18	0	0	$3.00	50	$6.00	$300.00	$181.50	$94.97
19	0	14150	$3.00	50	$6.00	$42,750.00	$25,111.12	$12,648.18
20	0	0	$3.00	50	$6.00	$300.00	$171.09	$82.95
Total present discounted cost							$334,951.39	$252,434.85

Note: As the assumption of the number of locomotives furnished with cameras changes, the number of cameras replaced without being developed and the number of cameras developed and replaced also change.

Table A-5: Cost of providing cameras in 75% of operating locomotives

Year	Number of locomotives furnished	Number of cameras replaced without being developed	New camera cost	Number of cameras developed and replaced	Film development and camera replacement cost	Total cost	Present discounted annual cost (3% discount rate)	Present discounted annual cost (7% discount rate)
1	21375	0	$3.00	75	$6.00	$64,575.00	$64,575.00	$64,575.00
2	0	0	$3.00	75	$6.00	$450.00	$436.89	$420.56
3	0	21225	$3.00	75	$6.00	$64,125.00	$60,443.96	$56,009.26
4	0	0	$3.00	75	$6.00	$450.00	$411.81	$367.33
5	0	21225	$3.00	75	$6.00	$64,125.00	$56,974.23	$48,920.66
6	0	0	$3.00	75	$6.00	$450.00	$388.17	$320.84
7	0	21225	$3.00	75	$6.00	$64,125.00	$53,703.68	$42,729.20
8	0	0	$3.00	75	$6.00	$450.00	$365.89	$280.24
9	0	21225	$3.00	75	$6.00	$64,125.00	$50,620.87	$37,321.33
10	0	0	$3.00	75	$6.00	$450.00	$344.89	$244.77
11	0	21225	$3.00	75	$6.00	$64,125.00	$47,715.02	$32,597.90
12	0	0	$3.00	75	$6.00	$450.00	$325.09	$213.79
13	0	21225	$3.00	75	$6.00	$64,125.00	$44,975.98	$28,472.27
14	0	0	$3.00	75	$6.00	$450.00	$306.43	$186.73
15	0	21225	$3.00	75	$6.00	$64,125.00	$42,394.18	$24,868.78
16	0	0	$3.00	75	$6.00	$450.00	$288.84	$163.10
17	0	21225	$3.00	75	$6.00	$64,125.00	$39,960.58	$21,721.36
18	0	0	$3.00	75	$6.00	$450.00	$272.26	$142.46
19	0	21225	$3.00	75	$6.00	$64,125.00	$37,666.68	$18,972.27
20	0	0	$3.00	75	$6.00	$450.00	$256.63	$124.43
Total present discounted cost							$502,427.09	$378,652.28

Note: As the assumption of the number of locomotives furnished with cameras changes, the number of cameras replaced without being developed and the number of cameras developed and replaced also change.

Table A-6: Cost of providing cameras in 100% of operating locomotives

Year	Number of locomotives furnished	Number of cameras replaced without being developed	New camera cost	Number of cameras developed and replaced	Film development and camera replacement cost	Total cost	Present discounted annual cost (3% discount rate)	Present discounted annual cost (7% discount rate)
1	28500	0	$3.00	100	$6.00	$86,100.00	$86,100.00	$86,100.00
2	0	0	$3.00	100	$6.00	$600.00	$582.52	$560.75
3	0	28300	$3.00	100	$6.00	$85,500.00	$80,591.95	$74,679.01
4	0	0	$3.00	100	$6.00	$600.00	$549.08	$489.78
5	0	28300	$3.00	100	$6.00	$85,500.00	$75,965.64	$65,227.54
6	0	0	$3.00	100	$6.00	$600.00	$517.57	$427.79
7	0	28300	$3.00	100	$6.00	$85,500.00	$71,604.90	$56,972.26
8	0	0	$3.00	100	$6.00	$600.00	$487.85	$373.65
9	0	28300	$3.00	100	$6.00	$85,500.00	$67,494.49	$49,761.78
10	0	0	$3.00	100	$6.00	$600.00	$459.85	$326.36
11	0	28300	$3.00	100	$6.00	$85,500.00	$63,620.03	$43,463.86
12	0	0	$3.00	100	$6.00	$600.00	$433.45	$285.06
13	0	28300	$3.00	100	$6.00	$85,500.00	$59,967.98	$37,963.02
14	0	0	$3.00	100	$6.00	$600.00	$408.57	$248.98
15	0	28300	$3.00	100	$6.00	$85,500.00	$56,525.57	$33,158.37
16	0	0	$3.00	100	$6.00	$600.00	$385.12	$217.47
17	0	28300	$3.00	100	$6.00	$85,500.00	$53,280.77	$28,961.81
18	0	0	$3.00	100	$6.00	$600.00	$363.01	$189.94
19	0	28300	$3.00	100	$6.00	$85,500.00	$50,222.24	$25,296.36
20	0	0	$3.00	100	$6.00	$600.00	$342.17	$165.90
Total present discounted cost							$669,902.78	$504,869.70

Note: As the assumption of the number of locomotives furnished with cameras changes, the number of cameras replaced without being developed and the number of cameras developed and replaced also change.

Table A-7: Hypothetical values of avoiding specific accidents, calculated using VSL = $6,000,000

Assumed values:	VSL: $6,000,000			Injuries: 50% at $4,575,500; 50% at $12,000		
Location	Fatalities	Injuries	Fatalities avoided	Injuries avoided	Property damage avoided	Total
Chatsworth, CA	25	96	$150,000,000	$220,176,000	$7,129,324	$377,305,324
Harris County, TX	1	0	$6,000,000	$0	$0	$6,000,000
Marshall, TX	0	0	$0	$0	$443,071	$443,071
San Antonio, TX	0	4	$0	$9,174,000	$430,830	$9,604,830
Gunter, TX	1	1	$6,000,000	$2,293,500	$2,992,622	$11,286,122
Clarendon, TX	1	3	$6,000,000	$6,880,500	$9,613,207	$22,493,707
Copeville, TX	1	0	$6,000,000	$0	$0	$6,000,000
Gillette, WY	1	0	$6,000,000	$0	$0	$6,000,000
Total	30	104	$180,000,000	$238,524,000	$20,609,054	$439,133,054

Table A-8: Hypothetical values of avoiding specific accidents, calculated using VSL = $3,200,000

Assumed values:	VSL: $3,200,000			Injuries: 50% at $2,440,000; 50% at $6,400		
	Fatalities	Injuries	Fatalities avoided	Injuries avoided	Property damage avoided	Total
Chatsworth, CA	25	96	$80,000,000	$117,427,200	$7,129,324	$204,556,524
Harris County, TX	1	0	$6,000,000	$0	$0	$6,000,000
Marshall, TX	0	0	$0	$0	$443,071	$443,071
San Antonio, TX	0	4	$0	$4,892,800	$430,830	$5,323,630
Gunter, TX	1	1	$6,000,000	$1,223,200	$2,992,622	$10,215,822
Clarendon, TX	1	3	$6,000,000	$3,669,600	$9,613,207	$19,282,807
Copeville, TX	1	0	$6,000,000	$0	$0	$6,000,000
Gillette, WY	1	0	$6,000,000	$0	$0	$6,000,000
Total	30	104	$110,000,000	$127,212,800	$20,609,054	$257,821,854

Table A-9: Hypothetical values of avoiding specific accidents, calculated using VSL = $8,400,000

Assumed values:	VSL: $8.400,000			Injuries: 50% at $6,405,000; 50% at $16,800		
Location	Fatalities	Injuries	Fatalities avoided	Injuries avoided	Property damage avoided	Total
Chatsworth, CA	25	96	$210,000,000	$308,246,400	$7,129,324	$525,375,724
Harris County, TX	1	0	$8,400,000	$0	$0	$8,400,000
Marshall, TX	0	0	$0	$0	$443,071	$443,071
San Antonio, TX	0	4	$0	$12,843,600	$430,830	$13,274,430
Gunter, TX	1	1	$8,400,000	$3,210,900	$2,992,622	$14,603,522
Clarendon, TX	1	3	$8,400,000	$9,632,700	$9,613,207	$27,645,907
Copeville, TX	1	0	$8,400,000	$0	$0	$8,400,000
Gillette, WY	1	0	$8,400,000	$0	$0	$8,400,000
Total	30	104	$252,000,000	$333,933,600	$20,609,054	$606,542,654