Draft Regulatory Analysis of the Proposed Rulemaking to Amend the Fitness-for-Duty Rule (10 CFR Part 26)

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ABSTRACT

The purpose of this document is to present the U.S. Nuclear Regulatory Commission's regulatory analysis of proposed revisions to the Fitness-for-Duty (FFD) rule as set forth in Title 10, Part 26, of the Code of Federal Regulations (10 CFR Part 26). It analyzes the proposed rule's benefits and costs, and it presents a backfit analysis as required by 10 CFR 50.109, 10 CFR 70.76, and 10 CFR 76.76. The analysis is conducted in accordance with the Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission, NUREG/BR-0058, Revision 4.

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EXECUTIVE SUMMARY

The U.S. Nuclear Regulatory Commission (NRC) is proposing to amend the current Fitness-for-Duty (FFD) regulations contained in Title 10, Part 26, of the *Code of Federal Regulations* (10 CFR Part 26). The NRC is proposing to amend these regulations to update them and to improve their effectiveness, efficiency, and clarity. With respect to licensee drug and alcohol testing programs, the amendments enhance consistency with the Department of Health and Human Services (HHS) Mandatory Guidelines for Federal Workplace Drug Testing Programs (HHS Guidelines) and other Federal drug and alcohol testing programs (e.g., Department of Transportation [DOT] programs) that impose similar requirements. Another goal of the amendments is to further consistency with the NRC's access authorization requirements for nuclear power plants. A third area the rule addresses is fatigue management. While licensees already maintain a variety of work hour controls, the proposed rule would standardize and strengthen licensee programs in this area. The proposed rule's drug and alcohol testing and authorization provisions would apply to licensees authorized to operate a nuclear power reactor; licensees authorized to possess, use, or transport formula quantities of strategic special nuclear material (SSNM); corporations that obtain certificates of compliance or approved compliance plans involving formula quantities of SSNM; combined operating license holders; mixed oxide fuel fabrication facilities; and construction permit holders with a plant under active construction. The proposed fatigue management provisions would apply to nuclear power reactors. The propose rule also would apply to contractor/vendors (C/Vs) who implement FFD programs or program elements, to the extent that licensees and other entities rely upon those C/V FFD programs or program elements to meet the requirements of Part 26.

The main analysis presented in this document examines the benefits and costs of the proposed FFD requirements relative to the baseline of existing FFD requirements, including current regulations (including enforcement discretion), and relevant orders. The key findings of the analysis are as follows:

- Total Cost to Industry: The proposed rule would result in a one-time cost to the nuclear industry of approximately $20.7 million, followed by annual costs on the order of $33.0 million. The total present value of these costs is estimated at $469.1 million (using a 7-percent discount rate) and $729.9 million (using a 3-percent discount rate) over the next 49 years.

- Average Cost per Program. The average FFD program, which may include multiple plants and units, would incur a one-time cost of approximately $660,000, followed by annual costs of approximately $1,096,000. The total present value of these costs is estimated at $13,378,000 (using a 7-percent discount rate) and $21,398,000 (using a 3-percent discount rate).

- Relative Costs of Fatigue Management Provisions. The substantial costs of the fatigue management provisions in Subpart I dominate the cost results of the proposed rule as a whole. For the industry these fatigue management costs are estimated at between $584.7 million (present value using a 7-percent discount rate) and $912.9 million (assuming a 3-percent discount rate). When the other (non-fatigue) provisions are

evaluated independently, the results show a savings to industry estimated at approximately $115.6 million (present value using a 7-percent discount rate) or $183.1 million (assuming a 3-percent discount rate).

- Value of Benefits Not Reflected Above. With the exception of most of the direct monetary savings to industry, the cost figures shown above *do not* reflect the value of the benefits of the proposed rule. These benefits are evaluated qualitatively in Section 4.1.2 (for drug and alcohol testing and authorization provisions) and in Section 4.1.3 (for fatigue management provisions).[1] *In addition,* Addendum 1 to this regulatory analysis uses risk-based methods to calculate some of the safety- and security-related benefits associated with four selected fatigue management provisions contained in the proposed rule, and arrives at a quantified safety benefit (i.e., of between $103 million (using a 7-percent discount rate) and $167 million (using a 3-percent discount rate), exclusive of productivity gains, for those four provisions. This regulatory analysis concluded the costs of the rule are fully justified in view of the qualitative benefits. The quantified benefits of the selected fatigue management provisions provide further support for the proposed rule.

- Costs to NRC. The rule would result in a one-time cost to NRC of approximately $30,000, followed by annual costs of approximately $45,000. The total present value of these costs is estimated at $615,000 (using a 7-percent discount rate) and $947,000 (using a 3-percent discount rate).

- Decision Rationale. Although the NRC did not quantify the benefits of this rule, except as noted above, the staff did qualitatively examine benefits and concluded that the rule would provide safety and security-related benefits. The rule would accomplish this by improving the management of worker fatigue at nuclear reactor facilities and by increasing the effectiveness of drug and alcohol testing. It would update and enhance the consistency of 10 CFR Part 26 with advances in other relevant federal rules and guidelines, including the U.S. Department of Health and Human Services Mandatory Guidelines for Federal Workplace Drug Testing Programs (HHS Guidelines) and other Federal drug and alcohol testing programs (e.g., those required by the U.S. Department of Transportation [DOT]) that impose similar requirements on the private sector. The rule also would enhance regulatory efficiency and effectiveness by improving clarity and, thereby, reducing the need for enforcement discretion, interpretations of rule language and/or exemption requests, and by enhancing consistency between the Part 26 rule and access authorization programs. The NRC also believes that the proposed rule would provide additional assurance to members of the public that their health and safety is protected due to the FFD of personnel at nuclear facilities.

Pre-Order Baseline Sensitivity Analysis. The regulatory analysis contains a sensitivity analysis that is not required by NRC's Regulatory Analysis Guidelines and has not been used for decision-making purposes. It reflects the fact, which has been voiced by stakeholders, that many requirements in the area of fitness-for-duty and access authorization have been imposed or modified as a result of the NRC's "Issuance of Order for Compensatory Measures Related to Access Authorization" (also known as the Access Authorization Order, or AAO), dated January 7, 2003, and "Issuance of Order for Compensatory Measures Related to Fitness-for-Duty

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[1] See Section 3.2 of this document for a discussion of the issues that would be involved in quantifying the benefits of the proposed rule.

Enhancements Applicable to Nuclear Facility Security Force Personnel" (also known as Order EA-03-038), dated April 29, 2003. Therefore, this sensitivity analysis examines the rule relative to a "Pre-Order Baseline."[2] Under this pre-order baseline, the proposed rule would result in a one-time cost to industry of approximately $27.6 million, followed by annual costs on the order of $23.6 million. The total present value of these costs is estimated at $345.9 million (using a 7-percent discount rate) and $532.3 million (using a 3-percent discount rate) over the next 49 years. For the average licensee's FFD program, which may include multiple plants and units, this equates to a one-time cost of approximately $861,000, followed by annual costs of approximately $881,000. The total present value of these costs is estimated at $9,813,000 (using a 7-percent discount rate) and $15,291,000 (using a 3-percent discount rate).

[2] This sensitivity analysis considers only the FFD portions of the requirements in the Access Authorization Order (AAO). Industry savings resulting from these portions of the AAO do not represent the financial impact on the industry of the AAO as a whole.

ABBREVIATIONS

AAO	Access Authorization Order
ASD	Alcohol Screening Device
BAC	Blood Alcohol Concentration
CFR	*Code of Federal Regulations*
CPL	Conforming Products List
CRGR	Committee to Review Generic Requirements
C/V	Contractor/Vendor
CY	Calendar Year
DOT	U.S. Department of Transportation
EBT	Evidential-grade Breath Alcohol Analysis Device
FFD	Fitness for Duty
FR	*Federal Register*
GL	Generic Letter
HHS	U.S. Department of Health and Human Services
INPO	Institute for Nuclear Power Operations
KA	Knowledge and Ability
MRO	Medical Review Officer
NEI	Nuclear Energy Institute (formerly NUMARC)
NHTSA	U.S. National Highway Transportation Safety Administration
NIDA	National Institute on Drug Abuse (now SAMHSA)
NMSS	Office of Nuclear Material Safety and Safeguards (NRC)
NRC	U.S. Nuclear Regulatory Commission
NRR	Office of Nuclear Reactor Regulation (NRC)
NSIR	Office of Nuclear Security and Incident Response (NRC)
NUMARC	Nuclear Management and Resources Council (now NEI)
OMB	Office of Management and Budget
QA	Quality Assurance
SAE	Substance Abuse Expert
SAMHSA	Substance Abuse and Mental Health Services Administration (formerly NIDA)
SRM	Staff Requirements Memorandum
SSNM	Strategic Special Nuclear Material

1. INTRODUCTION

This document presents a draft regulatory analysis of proposed revisions to the Fitness-for-Duty (FFD) rule as set forth by the U.S. Nuclear Regulatory Commission (NRC) in Title 10, Part 26, of the Code of Federal Regulations (10 CFR Part 26). This introduction is divided into three sections. Section 1.1 states the problem and the reasons for the proposed rulemaking, Section 1.2 provides background information on the Part 26 rulemaking, and Section 1.3 discusses backfit considerations related to adoption of the proposed revisions to the Part 26 rule.

1.1 Statement of the Problem and Reasons for the Rulemaking

This proposed rulemaking would ensure that 10 CFR Part 26 continues to effectively address the related concerns of reliability and trustworthiness of workers at nuclear facilities as demonstrated by the avoidance of substance abuse. Evidence has shown that the use of alcohol or drugs can impair a worker's motor skills and judgment sufficiently that it increases the likelihood of accidents arising from neglect or human error (see Section 4.1.2.1). Licensee or contractor/vendor (C/V) employees who knowingly use illegal drugs, or abuse legal drugs or alcohol, willingly violate the standards set by the licensee as well as society's laws and norms. The Part 26 FFD program requirements are designed to provide high assurance that individuals are trustworthy and reliable in carrying out their duties as demonstrated by the avoidance of substance abuse.

When the NRC published the Part 26 rule in June 1989, the Commission directed the NRC staff to continue to analyze licensee programs, assess the effectiveness of the rule, and recommend appropriate improvements or changes (SRM dated March 22, 1989). The NRC reviewed information from several sources, including inspections, periodic reports by licensees on FFD program performance, reports of significant FFD events, industry-sponsored meetings and current literature, and initiatives by the Nuclear Management and Resources Council [NUMARC, now the Nuclear Energy Institute (NEI)] and the Substance Abuse and Mental Health Services Administration [SAMHSA, formerly the National Institute on Drug Abuse (NIDA)] and its Drug Testing Advisory Board.

On the basis of that extensive review, the NRC has concluded that the regulatory approach in 10 CFR Part 26 is fundamentally sound and provides a means for both detecting and deterring substance abuse at licensee facilities. However, lessons learned during implementation of the existing rule indicate that NRC should address a number of issues. These issues include:

- *Subversion*. Testing neither detects nor deters substance abuse if testing is easily subverted through the exploitation of vulnerabilities in the testing process.

- *Inefficiencies.* Some Part 26 requirements contribute little to the effectiveness of licensee's FFD programs relative to the resources (time and money) required to meet these requirements.

- *Regulatory efficiency.* NRC licensees are subject to regulation by State and Federal agencies other than the NRC. Additions or changes to the regulatory requirements for drug testing by other agencies, such as Health and Human Services (HHS) and the Department of Transportation (DOT), as well as new legislation since 1989 (e.g., the Americans with Disabilities Act) have created incompatibilities and redundancies with NRC's requirements.

- *Confusion regarding the original intent of the NRC.* Ambiguities in the language of the rule have created some confusion regarding the Commission's original intent in Part 26. Resolving these ambiguities would save NRC staff time, increase consistency in the interpretation of the regulation industry-wide, and thus reduce licensee time in interpreting the regulation.

- *Technical developments.* Recent improvements in drug and alcohol testing practices can increase the effectiveness of licensee's and C/V's FFD programs.

The NRC is issuing this proposed rule to address these issues through a comprehensive revision of 10 CFR Part 26.

The NRC's continuing analysis of appropriate improvements or changes to the Part 26 rule also has led the NRC to conclude that strengthened fatigue management provisions should be added to 10 CFR Part 26. Research and experience have shown that fatigue can substantially degrade an individual's ability to safely and competently perform a wide range of work-related duties. The degradation in an individual's cognitive functioning resulting from inadequate rest includes, but is not limited to, a reduced ability to sustain attention; maintain situational awareness and make timely and conservative decisions; and communicate and work effectively as a team member. Such degradations in performance, if exhibited by individuals performing risk-significant functions, can adversely affect the safety and security of a nuclear power plant, and can cause levels of worker impairment comparable to those prohibited by Part 26 for alcohol. Although the NRC has established guidelines limiting work hours for personnel performing safety-related functions at nuclear power reactors, conditions that contribute to worker fatigue continue to exist. These conditions include:

- *Extended work shifts*, including the use of 12-hour shifts during normal operations and/or the use of 6 or more consecutive 12-hour shifts during plant outages, have become increasingly common at U.S. nuclear power plants. During outages, some licensees have scheduled personnel for three or more weeks of consecutive 12-hour shifts without intervening days off.

- *Extensive use of overtime.* Extensive use of overtime creates a combined effect of long work hours with reduced break periods.

- *Work schedules affecting normal biological cycles*. Because the nuclear power industry is a round-the-clock operation requiring individuals to be awake and working at times when they would normally be asleep, workers are cyclically affected by a daily biological clock, which runs on about a 24-hour (circadian) cycle. A substantial amount of scientific literature on circadian variations in alertness has demonstrated the significant roles worker fatigue, sleep loss and circadian rhythms play in contributing to errors and accidents.

In addition, the NRC has determined that ambiguities in the existing regulatory framework for matters pertaining to working hours and fatigue should be removed and that the effectiveness of FFD programs should be strengthened by establishing clear and enforceable requirements concerning the management of fatigue of nuclear power plant personnel.

Goals

Specifically, the goals of the rulemaking are as follows:

1. Update and enhance the consistency of 10 CFR Part 26 with advances in other relevant federal rules and guidelines, including the U.S. Department of Health and Human Services Mandatory Guidelines for Federal Workplace Drug Testing Programs (HHS Guidelines) and other Federal drug and alcohol testing programs (e.g., those required by the U.S. Department of Transportation [DOT]) that impose similar requirements on the private sector.

2. Strengthen the effectiveness of FFD programs at nuclear power plants in ensuring against worker fatigue adversely affecting public health and safety and the common defense and security by establishing clear and enforceable requirements for the management worker fatigue.

3. Improve the effectiveness and efficiency of FFD programs.

4. Improve consistency between FFD requirements and access authorization requirements established in 10 CFR 73.56, as supplemented by orders to nuclear power plant licensees dated January 7, 2003.

5. Improve 10 CFR Part 26 by eliminating or modifying unnecessary requirements.

6. Improve clarity in the organization and language of the rule.

7. Protect the privacy and due process rights of individuals who are subject to 10 CFR Part 26.

1.2 Background

1.2.1 Drug and Alcohol Testing Provisions, and General Fitness-for-Duty Provisions

In a June 7, 1989, Federal Register (54 FR 24468), the Commission announced the adoption of a new rule, 10 CFR Part 26, Fitness for Duty Programs, that required each licensee authorized to operate or construct a nuclear power reactor to implement a FFD program for all personnel having unescorted access to the protected area of its plant. A subsequent final rule published in the Federal Register on June 3, 1993 (58 FR 31467), expanded the scope of Part 26 to include licensees authorized to handle formula quantities of Strategic Special Nuclear Materials (SSNM).

When the Part 26 rule was published in 1989, the Commission directed the NRC staff to continue to analyze licensee programs, assess the effectiveness of the rule, and recommend appropriate improvements or changes. The NRC staff reviewed information from several sources including inspections, periodic reports by licensees on FFD program performance, reports of significant FFD events, industry sponsored meetings and current literature, as well as initiatives by industry, the Substance Abuse and Mental Health Services Administration (SAMHSA, formerly the National Institute on Drug Abuse [NIDA]) and SAMHSA's Drug Testing Advisory Board, and recommended improvements and changes.

As a result, the NRC published proposed amendments to the Part 26 rule in the Federal Register on May 9, 1996 (61 FR 21105). The 90-day public comment period for the proposed rulemaking closed on August 7, 1996. The NRC staff reviewed and considered public comments on the proposed rule, and submitted a final rule to the Commission in a Commission paper (SECY-00-0159), dated July 26, 2000. The Commission affirmed the rule in a staff requirements memorandum (SRM) dated December 4, 2000. Subsequently, the affirmed rule was sent to the Office of Management and Budget (OMB) to obtain a clearance under the Paperwork Reduction Act. The request for comments on the clearance was published in the Federal Register on February 2, 2001 (66 FR 8812). OMB and NRC received public comments that objected to some aspects of the rule (responses to those comments are included in the Federal Register notice for the proposed rule). Consequently, in SECY-01-0134, dated July 23, 2001, the NRC staff recommended withdrawing the request for clearance and preparing a new proposed rule. By SRM, dated October 3, 2001, the Commission approved the staff's recommendation to prepare this new proposed rule, rather than incorporating the 1996 proposed amendments into a final rule.

1.2.2 Worker Fatigue Rulemaking

The NRC's "Policy on Factors Causing Fatigue of Operating Personnel at Nuclear Reactors" (NRC's Policy on Worker Fatigue) was first published in the Federal Register on February 18, 1982, (47 FR 7352), and later issued through Generic Letter (GL) 82-12, "Nuclear Power Plant Staff Working Hours," on June 15, 1982. In GL 82-12, the NRC requested that licensees revise the administrative section of their technical specifications to ensure that plant administrative procedures were consistent with the working hours guidelines. Those guidelines are:

(1) An individual should not be permitted to work more than 16 hours straight (excluding shift turnover time);

(2) An individual should not be permitted to work more than 16 hours in any 24-hour period, nor more than 24 hours in any 48-hour period, nor more than 72 hours in any seven day period (all excluding shift turnover time);

(3) A break of at least 8 hours should be allowed between work periods (including shift turnover time); and

(4) Except during extended shutdown periods, the use of overtime should be considered on an individual basis and not for the entire staff on a shift.

Further, the guidelines permit deviations from these limits in very unusual circumstances if authorized by the plant manager, his or her deputy, or higher levels of management. The NRC's Policy on Worker Fatigue was incorporated, directly or by reference, and with variations in wording and detail, into the technical specifications of all but three nuclear power plant sites. Those three sites implemented the concept using other administrative controls.

When 10 CFR Part 26 was issued on June 7, 1989 (54 FR 24468), it focused on establishing requirements for preventing and detecting personnel impairment from drugs and alcohol. However, several requirements addressed other causes of impairment, including fatigue. Those requirements included general performance objectives (§§26.10(a) and (b)) that required licensees to provide "...reasonable assurance that nuclear power plant personnel...are not under the influence of any substance, legal or illegal, or mentally or physically impaired from

any cause..." and "...early detection of persons who are not fit to perform activities within the scope of this part..." A requirement was also included in §26.20(a) for licensee policies to "...address other factors that could affect fitness for duty such as mental stress, fatigue and illness."

In a letter dated February 25, 1999, Congressmen Dingell, Klink, and Markey expressed concerns to former NRC Chairman Shirley Ann Jackson that low staffing levels and excessive overtime may present a serious safety hazard at some commercial nuclear power plants. The Union of Concerned Scientists (UCS) expressed similar concerns on March 18, 1999, in a letter from David Lochbaum to Chairman Jackson, and in the UCS report "Overtime and Staffing Problems in the Commercial Nuclear Power Industry," dated March 1999. In a letter dated May 18, 1999, to the Congressmen, the Chairman stated that the NRC staff would assess the need to revise the policy.

Soon thereafter, the Commission received a petition for rulemaking (PRM-26-2), dated September 28, 1999, from Barry Quigley. The petition requested that the NRC amend 10 CFR Parts 26 and 55 to establish clear and enforceable work hour limits to mitigate the effects of fatigue for nuclear power plant personnel performing safety-related work. (A discussion of the petition, which is addressed by the proposed rulemaking, is included in the Federal Register notice for the proposed rule.)

The Union of Concerned Scientists petitioned the NRC on April 24, 2001, pursuant to 10 CFR 2.206, to issue a Demand for Information (DFI) to specified licensees. The petition asserted that Wackenhut Corporation has the contractual right to fire security guards who refuse to report for mandatory overtime, and that this contractual right conflicts with 10 CFR Part 26.10(a) and (b). The NRC denied the DFI (ADAMS Accession No. ML013230169), but, as described below, addressed the concern highlighted by the petition through the NRC's generic communication process.

On January 10, 2002, in SRM-SECY-01-0113, the Commission approved a rulemaking plan, "Fatigue of Workers at Nuclear Power Plants," dated June 22, 2001. The Commission decided to initiate a rulemaking to incorporate fatigue management into 10 CFR Part 26 in order to strengthen the effectiveness of FFD programs by establishing clear and enforceable requirements concerning the management of fatigue of nuclear power plant personnel that would reduce the potential for worker fatigue to adversely affect public health and safety and the common defense and security.

On May 10, 2002, the NRC issued NRC Regulatory Issue Summary (RIS) 2002-07: "Clarification of NRC Requirements Applicable to Worker Fatigue and Self-Declarations of Fitness-for-Duty." The RIS addressed the applicability of 10 CFR Part 26 to worker fatigue, the potential that a work environment conducive to reporting FFD concerns might be adversely affected if sanctions were to be imposed on workers raising FFD concerns, and the protections afforded workers who make self-declarations by 10 CFR 50.7, "Employee Protection."

During the development of proposed requirements, the NRC observed an increase in concerns (e.g, media and public stakeholder reports, allegations from security personnel) regarding the workload and fatigue of security personnel following the terrorist attacks of September 11, 2001. Following an NRC review of the control of work hours for security force personnel, the NRC issued Order EA-03-038 on April 29, 2003, requiring compensatory measures to reduce fatigue among security personnel at nuclear power plants, including work hour limits.

The compensatory measures imposed by Order EA-03-038 were similar to the guidelines of the NRC's Policy on Worker Fatigue. The compensatory measures differed from the policy guidelines in a few areas in which the NRC believed it was necessary to address previously identified deficiencies in the guidelines, including the need to address cumulative fatigue from prolonged use of extended work hours, matters unique to security personnel, and matters identified through stakeholder input obtained through public meetings concerning the proposed worker fatigue rulemaking and the order. The requirements in the order were imposed to provide the NRC with reasonable assurance that the public health and safety and common defense and security continue to be adequately protected. The NRC plans to withdraw Order EA-03-038 once the fatigue management provisions proposed in Subpart I for security force personnel take effect. Differences between the proposed requirements in Subpart I and the requirements imposed by order, and the rationale for those differences, are discussed in Section VI of the Federal Register notice for this proposed rule.

1.2.3 Combined Part 26 Rulemaking

On March 29, 2004, in COMSECY-04-0014, the NRC staff informed the Commission of the status of both rulemakings. The NRC staff also noted that because both rulemakings were being completed in parallel, the proposed fatigue rule draft language was based on the draft language in the overall revision of Part 26, rather than on the current language in Part 26. As a result, meaningful public comment could be confounded by the simultaneous promulgation of two draft rules which are somewhat interdependent and staff action to address a comment on one proposed rule could easily impact the other proposed rule, creating a high potential for the need to repropose one or both rules. In SRM-COMSECY-04-0014, dated May 25, 2004, the Commission directed the staff to combine the rulemaking related to nuclear power plant worker fatigue with the ongoing Part 26 rulemaking activity.

1.3 Backfit Rule Considerations

Section 4.4 of this regulatory analysis presents the NRC's evaluation of changes in the proposed rule in accordance with the backfit provisions of 10 CFR §50.109, 10 CFR §70.76, and 10 CFR §76.76. Section 4.4.1 examines the aggregation of proposed requirements that constitute backfits, and explains why many proposed provisions have been appropriately excluded from the backfit analysis. Section 4.4.2 describes a screening analysis conducted in accordance with NRC's Regulatory Analysis Guidelines to ensure that the aggregate analysis does not mask the inclusion of individual rule provisions that are (1) not cost-beneficial when considered individually and (2) not necessary to meet the goals of the rulemaking.

2. IDENTIFICATION AND PRELIMINARY ANALYSIS OF ALTERNATIVE APPROACHES

This section presents preliminary analysis of the alternatives that the staff considered to meet the regulatory goals identified in the previous section. (Section 4 presents a more detailed analysis of the proposed rule option.) The staff considered three alternatives for revising Part 26's substance abuse and authorization provisions, and five alternatives addressing fatigue management,[3] as discussed below.

2.1 Alternatives Considered for Part 26 Substance Abuse and Authorization Provisions

The staff considered the following three alternatives relative to the substance abuse and authorization provisons in Part 26:

(1) Take no action.

(2) Revise 10 CFR Part 26 (either in part or in whole).

(3) Address problems through means other than revising 10 CFR Part 26 (e.g., regulatory guides, generic communications, stakeholder meetings).

2.1.1 Option 1: Take No Action

One alternative to proposing rule changes would be to take no action. The no-action alternative would allow current practices to continue, or require the NRC staff to continue to address certain outstanding FFD issues on a case-by-case basis. Taking no action would allow licensees continued flexibility in determining the course of action when they are not constrained by other agencies, legal requirements, or labor negotiations. This would also avoid certain cost increases that the proposed rule would impose. However, taking no action would disregard the staff and industry recommendations regarding areas for improvement (as described in Section 1.1) and would continue to impose avoidable costs on licensees. Moreover, taking no action at this time would not yield any positive impact on the effectiveness of the rule.

Advantages:

- Licensees would not have to bear the implementation costs of certain rule changes and the NRC would save on rulemaking costs.
- Licensees would have continued flexibility to determine courses of action, thereby avoiding more restrictive regulatory approaches.

[3] Until mid-year 2004, NRC had addressed the possibility of a fatigue management rulemaking separately from the previously-initiated rulemaking to revise the Part 26 substance abuse and authorization regulations.

Disadvantages:

- The identified concerns and lessons learned regarding the current Part 26 rule (described in Section 1.1) would not be resolved.
- Licensee and C/V FFD programs would not realize the potential savings from particular rule changes, including elimination or modification of unnecessary requirements.
- This alternative would not yield permanent solutions to a variety of problems.
- Licensees would have a less comprehensive set of requirements.
- NRC staff and licensees would still be compelled to interpret ambiguous rule language and these interpretations would vary by program. Also, the NRC staff would continue to face difficulties in maintaining consistency among licensees' inspection and enforcement programs.
- This alternative disregards licensees' preference, expressed at meetings with stakeholders, that program implementation details be included in the rule language.
- Depending on whether issues such as the protection of individual rights are addressed as rule requirements or as guidance, this alternative may provide less protection of individual rights.

By definition, the no-action alternative has no incremental benefits or costs, as it does not change the status quo. This option is inconsistent with NRC's goals for the rulemaking.

2.1.2 Option 2: Revise 10 CFR Part 26

This option provides the opportunity to resolve the identified issues and concerns regarding Part 26 (described in Section 1.1). This option includes two alternatives:

(1) Revise the regulation comprehensively to address the identified issues.

(2) Revise portions of the regulation to address only those issues that cannot be resolved through other means (e.g., a regulatory guide, stakeholder meetings).

2.1.2.1 Comprehensive Rule Revision

A comprehensive rulemaking would provide a means of addressing the identified issues and concerns with respect to Part 26. Through a comprehensive revision, the NRC staff could (1) ensure that all licensees would consistently implement measures to prevent subversion; (2) eliminate or modify unnecessary requirements; (3) address adjustments and changes to regulatory positions and requirements of other government agencies; (4) clarify the language of the rule; and (5) incorporate changes to take advantage of technical developments in drug and alcohol testing practices.

Advantages:

- The revised rule would address all requirements for licensee and C/V FFD programs.

- Regulatory change would enhance consistency across programs and provide opportunities for savings (e.g., allowing generic training to be accepted across licensees) that would not be available with more informal approaches.

- The revised rule would provide clear inspection guidance and, therefore, would result in a more efficient inspection process.

Disadvantages:

- Some rule revisions would impose costs on licensees.

- The revised rule would give licensees less flexibility in the implementation of their FFD programs (as a result of the rule's increased clarity).

The NRC has pursued this alternative and estimated the benefits and costs of this option as described in Section 4 of this regulatory analysis.

2.1.2.2 Partial Rule Revision with Other Agency and Licensee Actions

Some problems, such as varying interpretations of the regulation, could be addressed through other means, such as a regulatory guide, generic communications, or stakeholder meetings.

Advantages:

- This alternative would address some problems in some manner.

- This alternative would reduce changes to the regulation (compared to the more comprehensive revision discussed in Section 2.1.2.1) and may have a lower implementation cost to licensees.

- This alternative would allow more informal and potentially more flexible resolutions to some problems, which may be less costly.

Disadvantages:

- This alternative would not yield permanent solutions to a variety of problems.

- This alternative may involve preparation of more documents than comprehensive revision would and could be more time-consuming and costly to the NRC, and less efficient for licensees.

- Licensees would have a less comprehensive set of requirements.

- NRC staff and licensees would still be compelled to interpret ambiguous rule language and these interpretations would vary by program. Also, the NRC staff would continue to face difficulties in maintaining consistency among licensees' inspection and enforcement programs.

- Because various rule changes are interrelated, it may be inappropriate to have some required in rule text and some suggested in guidance.

- This alternative disregards licensees' preference, expressed at meetings with stakeholders, that program implementation details be included in the rule language.

- Depending on whether issues such as the protection of individual rights are addressed as rule requirements or as guidance, this alternative may provide less protection of individual rights.

The NRC considered this alternative, but determined that the disadvantages are too significant relative to the comprehensive rule revision described in Section 2.1.2.1. Therefore, this regulatory analysis does not evaluate the quantitative benefits and costs of this alternative.

2.1.3 Option 3: Address Issues through Means Other than Revising Part 26

Under this alternative, the NRC staff would not revise 10 CFR Part 26 at all. This alternative differs from the no-action alternative discussed in Section 2.1.1 because this alternative would address FFD concerns through other means, such as new or revised regulatory guides, generic communications, stakeholder meetings, and other agency initiatives.

Advantages:

- This alternative would allow greater flexibility both for NRC staff and licensees.

Disadvantages:

- This alternative would not be able to address all of the identified issues (see Section 1.1), because many issues require direct regulatory changes.

- This alternative would not yield permanent solutions to a variety of issues.

- Preparing multiple documents to address issues could be more time-consuming and costly to the NRC, and less efficient for licensees.

- Inconsistency in program implementation, inspection, and enforcement would be more likely to persist. Some licensees currently have aggressive programs, while other licensee programs address only the licensees' interpretation of the requirements of the rule. Such discrepancies would be likely to continue in areas where changes are not included in the regulation.

- Licensees would not have a single comprehensive source of guidance.

- The process of developing guidance can be as burdensome as rulemaking for both NRC staff and licensees.

- This alternative disregards licensees' preference, expressed at meetings with stakeholders, that the rule language should include program implementation details.

- Depending on whether issues such as the protection of individual rights are addressed as rule requirements or as guidance, there may be less protection of individual rights.

The NRC considered this alternative, but determined that the disadvantages are too significant relative to the alternative described in Section 2.1.2.1. Therefore, this regulatory analysis does not evaluate the quantitative benefits and costs of this alternative.

2.2 Alternatives Considered for Fatigue Management

In PRM-26-2 (December 1, 1999; 64 FR 67202), a petitioner requested that the NRC establish clear and enforceable work hour limits to mitigate the effects of fatigue for nuclear power plant personnel performing safety-related work and presented a detailed proposal for managing fatigue through regulation.[4] The staff evaluated the merits of PRM-26-2 and the comments received in response to the PRM and assessed the policy statement. The staff concluded that the petitioner proposed a comprehensive set of requirements that could reasonably be expected to effectively address fatigue from individual and programmatic causes. However, the staff also began considering whether it would be possible to achieve the petitioner's objectives through alternative requirements that are more flexible, more directly focused on risk, and more aligned and integrated with current regulatory requirements.

The staff developed four potential alternatives, plus the no-action alternative, which were presented in the rulemaking plan attached to SECY-01-0113 (June 22, 2001).[5] These four alternatives are as follows:

(1) Implement the proposals in PRM-26-2.

(2) Amend Part 26 to establish thresholds for work hour controls. Provide flexibility and ensure focus on safety through a risk-informed deviation process. Amend Part 26 and RG 1.134, "Medical Evaluation of Licensed Personnel at Nuclear Power Plants," to ensure that fatigue from any cause is addressed through existing licensee programs.

(3) Amend Part 26 to establish thresholds for work hour controls and a defined process for controlling exceptions.

(4) Amend Part 26 to establish requirements for assessing and managing the risks associated with schedules and conditions that cause fatigue and impaired alertness. Amend Part 26 and RG 1.134 to ensure that fatigue from any cause is addressed through licensee programs.

With respect to the proposal contained in PRM-26-2, the staff determined that implementing the proposals in the petition would (1) ensure that personnel are not impaired and are responsive to

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[4] More specifically, the petition requested that the NRC (1) add enforceable working hour limits to 10 CFR Part 26; (2) add a criterion to 10 CFR 55.33(a)(1) to require evaluation of known sleeping disorders; (3) revise the NRC Enforcement Policy to include examples of working hour violations that warrant various NRC sanctions; and (4) revise NRC Form 396 to include self-disclosure of sleeping disorders by licensed operators.

[5] NRC prepares a rulemaking plan to establish the goals of a rulemaking, help define potential regulatory alternatives (including whether regulatory action is necessary to resolve the problem), begin specifying the research efforts that should be undertaken, consider schedules and milestones, and undertake preliminary assessments of whether a rule will be cost-effective and feasible to implement.

plant risk and the likelihood of personnel impairment; (2) establish clear expectations; and (3) increase public confidence.

The rulemaking plan also evaluated each of the other alternatives. The evaluation found that Option 2, in particular, would be equally effective as the petition proposals, while also affording the added benefits of increased scheduling flexibility, stronger focus on risk, and improved alignment and integration with existing programs, including the use of licensee corrective action programs to support a performance based approach. Based on this preliminary analysis, the rulemaking plan recommended Option 2 rather than the other alternatives, including the approach proposed in the petition.

In a Staff Requirements Memorandum (January 10, 2002), the Commission accepted the recommendation presented in SECY-01-0113 and directed the staff to develop a rule using Option 2 as described in the rulemaking plan.

3. EVALUATION OF BENEFITS AND COSTS

This section describes the analysis conducted to identify and evaluate the benefits (values) and costs (impacts) of the proposed rule. Section 3.1 identifies the attributes that the proposed rulemaking is expected to affect. Section 3.2 describes the methodology used to analyze the benefits and costs associated with changes to the affected attributes. The results of the analysis are presented in Section 4.

3.1 Identification of Affected Attributes

This section identifies the factors within the public and private sectors that the proposed rulemaking is expected to affect. These factors are classified as "attributes" using the list of potential attributes provided in Chapter 5 of the NRC's "Regulatory Analysis Technical Evaluation Handbook."[6] Affected attributes from the handbook include the following:

- *Industry Implementation.* The proposed rulemaking would require licensees to modify written policies, procedures, and training materials. In addition, some licensees may be required to modify equipment used to conduct drug and alcohol testing. Some licensees also may be required to modify personnel practices to address fatigue management requirements.

- *Industry Operation.* The proposed rulemaking would require licensees to change their existing practices with respect to authorization (e.g., self-disclosures, suitable inquiries, recordkeeping), behavioral observation and training, drug and alcohol collection and testing practices (e.g., cutoff levels for marijuana and opiates, validity testing, quality assurance procedures, testing of offsite FFD program personnel, reporting), and FFD determinations. Licensees also would be required to change their existing practices with respect to work hours and related controls (e.g., breaks between work periods, waivers from work hour limitations, and fatigue assessments).

- *Safeguards and Security Considerations.* The proposed rule would clarify and modify certain authorization procedures, which should result in improved safeguards and security. The proposed rule also would revise certain drug and alcohol testing provisions to increase assurance that individuals are trustworthy and reliable by enhancing provisions to detect attempts to subvert the testing process. The proposed rule, which includes security force personnel within the scope of workers covered by fatigue provisions, should result in improved safeguards and security.

- *Public Health (Accident).* The proposed rule would reduce the risk that public health will be affected by accidents that are attributable to the undetected use of drugs or alcohol or to fatigue.

- *Occupational Health (Accident).* The proposed rule would reduce the risk that occupational health will be affected by accidents that are attributable to the undetected use of drugs or alcohol or to fatigue.

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[6] NUREG/BR-0184, "Regulatory Analysis Technical Evaluation Handbook: Final Report," U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, January 1997.

- *Occupational Health (Routine).* The proposed rule would reduce the risk that workers will be subject to unnecessary exposures either as the direct result of cognitive impairments attributable to the influence of drugs or alcohol or to fatigue, or as the result of conducting mitigative and/or cleanup activities following an event caused by cognitive impairment attributable to the influence of drugs or alcohol or to fatigue.

- *Off-Site Property*. The proposed rule would reduce the risk that off-site property will be affected by accidents that are attributable to the undetected use of drugs or alcohol or to fatigue.

- *On-Site Property.* The proposed rule would reduce the risk that on-site property will be affected by accidents that are attributable to the undetected use of drugs or alcohol or to fatigue.

- *Environmental Considerations.* The proposed rule would reduce the risk that the environment will be affected by accidents that are attributable to the undetected use of drugs or alcohol or to fatigue.

- *Regulatory Efficiency.* The proposed rule would reduce uncertainties in the current rule, Orders, and guidance, including guidance on fatigue management, improve consistency of practices among licensee and C/V FFD programs, and improve consistency between the NRC's FFD requirements and guidance and those of other Federal agencies (e.g., HHS, DOT).

- *NRC Implementation.* The proposed rulemaking likely would cause NRC to incur one-time costs to train NRC staff reviewers and inspectors on the rule revisions.[7]

- *NRC Operation.* Modified program reporting requirements related to program performance data, reportable FFD events, and collective work hours would have an impact on NRC staff operations, as would the need to train NRC staff and inspectors on the revised rule changes.

- *Other Considerations.* The proposed rule may improve *public perceptions* regarding the safe operation of nuclear facilities, and may increase *workplace productivity and efficiency* of affected workforces.

The proposed rulemaking is *not* expected to affect the following attributes:

- Public Health (Routine);
- Other Government;
- General Public;
- Improvements in Knowledge; and
- Antitrust Considerations.

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[7] Consistent with direction in Section 5.7.9 of the NRC's "Regulatory Analysis Technical Evaluation Handbook", this analysis does not include the predecisional costs of analyzing and promulgating the revised requirements.

3.2 Analytical Methodology

This section describes the methodology used to analyze the benefits and costs associated with the proposed rule. The benefits of the rule include any desirable changes in affected attributes (e.g., improved safety, monetary savings) while the costs include any undesirable changes in affected attributes (e.g., monetary costs).

The analysis evaluates several attributes on a quantitative basis. (These include industry implementation, industry operation, NRC implementation, and NRC operation.) Quantitative analysis requires a baseline characterization of factors such as the number and size of individual FFD programs, the remaining operating life of licensee facilities, hours worked by staff during normal operations and during outages, the use of onsite versus offsite collection and testing facilities, the number of authorization actions conducted annually, the number of drug and alcohol tests conducted annually by type, the number of positive tests, cost information, and a range of other current licensee practices relating to specific program elements. Sections 3.2.1–3.2.4 describe the most significant analytical data, variables, and assumptions used in the quantitative analysis of these attributes.

This analysis relies on a primarily qualitative (rather than quantitative) evaluation of several other affected attributes (safeguards and security considerations, public health, occupational health, offsite property, onsite property, environment considerations, public perception, and workplace productivity/efficiency) due to the difficulty in quantifying the impact of the current rulemaking.[8] These attributes would be affected by the proposed regulatory option through the associated reduction in the risks of accidents within the protected area due to worker fatigue or the undetected use of drugs or alcohol, or due to potential inconsistencies between the FFD and the authorization functions. These risks range in severity from workplace safety incidents up to damage to the reactor core. Quantification of any of these attributes would require estimation of factors such as the types, frequencies, and results of damage that now occur (i.e., pre-rule) and would occur post-rule. [The analysis does quantify some of the benefits attributable to selected fatigue management provisions. The methodology and findings of this effort are presented in Addendum 1.]

Additional details regarding the calculations used in the analysis are presented in two appendices. Appendix 1 provides the specific cost equations used to quantify costs and savings, along with any necessary assumptions not presented elsewhere. Appendix 1 contains 11 sections, one for each of the 11 subparts, A-K, of the proposed revision to 10 CFR Part 26. Appendices 2-3 present data and input calculations referenced in Appendix 1, including data on unit costs, hourly wage rates, FFD programs, costs of eliminating work hour deviations, and other information.

3.2.1 Baselines for Analysis

This regulatory analysis measures the incremental impacts of the proposed rule relative to a baseline, which reflects anticipated behavior in the event that the proposed regulation is not imposed. The baseline used in this analysis assumes full licensee compliance with existing

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[8] The regulatory efficiency attribute also is evaluated qualitatively, by definition, in accordance with NRC guidelines. See Section 5.5.14 of the NRC's "Regulatory Analysis Technical Evaluation Handbook."

NRC requirements, including current regulations and relevant orders.[9] (The current regulations, as included in the baseline, take into account the enforcement discretion issued in October 2002.[10]) This is consistent with NUREG/BR-0058, "Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission," Rev. 4, which states that, "...in evaluating a new requirement for existing plants, the staff should assume that all existing NRC and Agreement State requirements have been implemented." Section 4.1 presents the estimated incremental costs and savings associated with the proposed rule relative to this baseline. Unless otherwise noted, the estimated costs and savings presented in this document reflect this baseline and are referred to as the "main analysis."

The NRC staff also has prepared two sensitivity analyses as part of this regulatory analysis, in accordance with the agency's regulatory analysis guidelines. The primary sensitivity analysis, like the main analysis, estimates all incremental savings and costs of the proposed rule, but it assumes an alternative baseline consisting of only the regulations that were in effect before the NRC issued the Access Authorization Order (AAO) on January 7, 2003, and before it issued Order EA-03-038 on April 29, 2003. This analysis is referred to as the "pre-order baseline analysis," and its results appear in Section 4.2.

The purpose of the second sensitivity analysis is to account for the situation that some licensees have interpreted certain provisions of the existing Part 26 rule differently than has NRC. For these provisions, some licensees' practices have only recently changed to comply with the current rule. Therefore, this sensitivity analysis considers a third baseline that reflects industry practices in the recent past, that is, prior to both the AAO and the recent enforcement discretion, and in accordance with licensees' interpretations of existing regulations. For this "industry practices baseline," therefore, the cost of complying with the proposed rule will exceed the cost estimated using the pre-order baseline. Section 4.3 presents the results of this sensitivity analysis.

3.2.2 FFD Programs and Program Characteristics

This analysis considers 36 individual FFD programs, as follows:

- The analysis models 31 FFD programs that govern 65 facilities with a total of 103 operating power reactors. Each program administered by a nuclear power reactor operator licensee is known to govern a specific number of reactors, which may be located at one or more "facilities." Each facility may include several reactor units that are adjacent to one another. Information on the specific number of reactors and facilities operated by individual licensee FFD programs is taken from NUREG-1350, *NRC Information Digest, 2004-2005 Edition.* The analysis assumes that licensees will

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[9] The Commission issued orders to nuclear power plant licensees for Compensatory Measures Related to Access Authorization on January 7, 2003. The Commission issued Order EA-03-038 requiring compensatory measures to reduce fatigue among security personnel at nuclear power plants, including work hour limits, on April 29, 2003.

[10] The NRC published a revision to NUREG-1600, "General Statement of Policy and Procedure for NRC Enforcement Actions" in the *Federal Register* (67 FR 66311) on October 31, 2002 to include an interim enforcement policy regarding enforcement discretion for certain FFD issues.

seek and obtain a 20-year operating license renewal for each operating reactor and to operate each reactor until the expiration of its renewed license. Thus, for each FFD program, the analysis estimates program-specific costs as a function of (1) the number of facilities operated by the program, (2) the number of reactors operated by the program, (3) the actual remaining operating lives of each reactor, and (4) whether the program uses onsite or offsite collection and onsite or offsite testing, as discussed below. However, the analysis assumes that all operating power reactors have the same average annual number of personnel covered by the various provisions of Part 26, regardless of operator, facility design or age, or other factors (e.g., periodic need to refuel).

- The analysis models two fuel-cycle facilities, including Nuclear Fuel Services (in Erwin, Tennessee) and BWX Technologies (in Lynchburg, Virginia). Information on these two programs was obtained from NRC documents.

- The analysis models two contractors/vendors (C/Vs) that operate their own FFD programs. The two C/Vs provided information on their own programs.

- The analysis models one additional program to account for a mixed-oxide fuel fabrication facility that would be built under a new license application submitted to the NRC by Duke, Cogema, Stone & Webster. Although this facility does not yet exist, it would be subject to the current requirements of Part 26 once it becomes operational.[11] The model for this facility draws upon information available to the NRC.

For many provisions of the rule, this analysis estimates that licensee costs will vary, depending on whether a particular licensee operates its collection facilities onsite (using licensee personnel or a contractor), or whether the licensee sends personnel to offsite collection facilities at the time of testing. Where known, the model reflects actual practices (i.e., onsite or offsite collection) for each licensee. For most licensees, however, this information is not readily available, so the analysis calculates costs assuming that these licensees operate “hybrid” collection facilities which reflect a weighted average of 95 percent onsite collection and 5 percent offsite collection.

Similarly, costs may vary depending on whether a particular licensee operates its own drug testing laboratory (“onsite testing”) in order to conduct initial tests, or whether the licensee sends all specimens for drug testing to an HHS-certified laboratory (“offsite testing”). Information regarding the specific licensees that operate onsite testing laboratories and those that use only offsite testing facilities was obtained from the nuclear industry and is believed to be current as of May 2003.

3.2.3 Incremental Requirements in the Proposed Rule

The NRC evaluated every provision contained in the proposed rule relative to the applicable baselines described in Section 3.2.1. Based on this analysis, the NRC developed equations to estimate costs and savings using available data, augmented by assumptions when necessary. Appendix 1 documents this analysis, including the rationale for why specific provisions do or do not result in incremental impacts and the specific equations used to quantify costs and savings.

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[11] The analysis assumes the facility will be operational beginning in 2009.

3.2.4 Other Data and Assumptions

The analysis estimates benefits and costs of the proposed rule for 36 individual licensee and C/V FFD programs based on several program-specific variables, as discussed in Section 3.2.2. The analysis assumes that the rule is promulgated in January 2007. The timeframe for which costs are estimated differs by program based on the remaining operating lives of the relevant facilities. For the analysis as a whole, however, costs and savings are estimated over 49 years, with each year's costs or savings discounted back at a 7-percent and 3-percent discount rate, in accordance with NUREG/BR-0184, "Regulatory Analysis Technical Evaluation Handbook." (See Section 4.1 for these results.)

The analysis assumes that licensees and C/Vs incur all costs associated with FFD programs. To the extent that testing laboratories or collection facilities conduct any of the incremental activities required by the rule, the analysis assumes that the costs of those activities are passed on to the licensee. Therefore, the analysis assumes that neither testing laboratories nor collection facilities will incur incremental costs or savings as a result of the proposed rule.

Qualitative information concerning attributes affected by the rule (e.g., the nature and magnitude of environmental impacts) has been obtained from, or developed primarily in consultation with, staff from the NRC's Office of Nuclear Reactor Regulation (NRR), Office of Nuclear Security and Incident Response (NSIR), and Office of Nuclear Material Safety and Safeguards (NMSS). Other data for the analysis have been derived from information sources including the NRC, licensees (including FFD program managers), experts in drug testing analytical methods and practices, other Federal agencies (including HHS and DOT contacts and information sources), and NEI. For the analysis of the proposed rule's fatigue management provisions, the NRC used data submitted voluntarily by six nuclear power plants in 2004, as well as survey results for 47 plants submitted by NEI in August, 2000.

Finally, the analysis assumes the only impairments to be prevented or mitigated by the proposed rule are those relating to substance abuse and worker fatigue. Although other types of impairments may be prevented or mitigated as well (e.g., emotional distress), these other impairments are assumed to be infrequent and they cannot be quantified easily due to a lack of data.

4. RESULTS

This section presents the analytical results, which are organized into six separate sections:

- Section 4.1 presents findings on the overall benefits and costs of the proposed rule under the main analysis.
- Section 4.2 summarizes the results relative to the pre-order baseline.
- Section 4.3 discusses a sensitivity analysis addressing recent industry practices.
- Section 4.4 considers the findings relative to NRC's backfit rule.
- Section 4.5 addresses the applicability of a safety goal evaluation to the current rulemaking.
- Section 4.6 describes the information required for review by the Committee to Review Generic Requirements (CRGR).

4.1 Benefits and Costs — Main Analysis

This section summarizes the benefits (values) and costs (impacts) estimated for the proposed rule. Most of the proposed rule's implementation and operational costs and savings, both to industry and to the NRC, is analyzed quantitatively with the *net* impacts calculated and presented below. However, some benefits could be evaluated only on a qualitative basis (as noted in Section 3.2). Section 4.1.1 provides the detailed results of the quantitative analysis of industry implementation and operation costs and savings for each of the specific provisions in the proposed rule. Section 4.1.2 presents additional detail on the benefits analyzed qualitatively for the drug and alcohol testing and authorization portions of Part 26. Section 4.1.3, similarly, presents additional detail on the benefits of the proposed fatigue management provisions. Finally, Section 4.1.4 considers the proposed rule provisions on a disaggregated basis.

Exhibit 4-1 summarizes the results of the benefit-cost analysis. Relative to the no-action alternative, the proposed rule would result in an estimated net quantitative cost to the industry and the NRC of approximately $470 million (total present value), assuming a 7-percent discount rate, or approximately $731 million assuming a 3-percent discount rate. Exhibits 4-2 and 4-3 show how the total net cost to the industry breaks out under the 7-percent and 3-percent discount rate assumptions, respectively, for each subpart (A–K) of 10 CFR Part 26:

- Subpart A: Administrative Provisions
- Subpart B: Program Elements
- Subpart C: Granting and Maintaining Authorization
- Subpart D: Management Actions and Sanctions to be Imposed
- Subpart E: Collecting Specimens for Testing
- Subpart F: Licensee Testing Facilities
- Subpart G: Laboratories Certified by the HHS
- Subpart H: Determining FFD Policy Violations and Determining Fitness
- Subpart I: Managing Fatigue
- Subpart J: Recordkeeping and Reporting Requirements
- Subpart K: Inspections, Violations, Penalties

Exhibit 4-1
Summary of Benefits and Costs

Net Monetary Savings (+) or Costs (-) (Total Present Value)	Non-Monetary Benefits/Costs
Industry:* ($469.1 million) using a 7% discount rate ($729.9 million) using a 3% discount rate **NRC:** ($615,000) using a 7% discount rate ($947,000) using a 3% discount rate	***Qualitative Benefits:*** *Safeguards and Security Considerations.* Improved FFD enhances safety and reduces security risks. *Public Health (Accident); Occupational Health (Accident); Occupational Health (Routine); Offsite Property; Onsite Property; Environmental Considerations.* Improved FFD reduces the risk that these attributes will be affected by accidents that are attributable to the undetected use of drugs or alcohol, to fatigue, to potential inconsistencies between the FFD and access authorization functions, or to ambiguities in the existing fatigue management guidelines and programs. *Regulatory Efficiency.* An improved Part 26 rule results in better, less costly compliance because it reduces misinterpretation. It also improves consistency across licensee programs and between the NRC's FFD and access authorization rules. In addition, it enhances the consistency of regulations and policies across Federal agencies (e.g., HHS, DOT). *Public Perception.* The proposed rule may improve the public's perception of NRC's protection of public health and safety and the common defense and security. *Workplace Productivity and Efficiency.* Improved FFD reduces absenteeism, improves productivity, lowers medical and insurance costs, and reduces plant downtime attributable to human-related errors caused by FFD problems. ***Qualitative Costs:*** *None.*
* An additional quantified benefit (not included above) of between $103 million (using a 7% discount rate) and $167 million (using a 3% discount rate) is calculated in Addendum 1 to this regulatory analysis. Addendum 1 analyzes some of the benefits associated with four selected fatigue management provisions contained in the proposed rule.	

NRC incurs a net cost under the rule, due to various new reporting provisions and the need to develop implementation materials for NRC staff and inspectors. Most significantly, proposed §26.219(b) will lead to increased processing and review costs associated with an expected increase in the number of reports filed by FFD programs regarding significant policy violations related to validity testing. This cost is estimated at $45,900 annually. In addition, the one-time development of procedures and training for NRC staff reviewers and inspectors on the rule

revisions will result in an initial cost of $28,200. The net effect of all annual costs and savings is an annual cost to the NRC of $45,000, and this contributes to a net present value cost of approximately $615,300, assuming a 7-percent discount rate or $946,800, assuming a 3-percent discount rate.

Exhibit 4-2
Industry Savings and Costs by Subpart (7% discount rate)

Sub-part	Average Per FFD Program			Total - All FFD Programs		
	One-Time Saving (Cost)	Annual Saving (Cost)	Net Present Value	One-Time Saving (Cost)	Annual Saving (Cost)	Net Present Value
A	-	-	-	-	-	-
B	($41,100)	$240,600	$3,225,500	($1,438,000)	$8,420,000	$112,892,000
C	-	($1,600)	($22,600)	-	($58,000)	($787,000)
D	-	-	-	-	-	-
E	($8,600)	$13,300	$173,900	($300,000)	$467,000	$6,071,000
F	($5,300)	($15,800)	($221,200)	($187,000)	($554,000)	($7,764,000)
G	-	($2,200)	($31,800)	-	($76,000)	($1,088,000)
H	-	$12,600	$172,800	-	$442,000	$6,032,000
I	($605,300)	($1,344,200)	($16,681,900)	($18,766,000)	($41,671,000)	($584,722,000)
J	-	$500	$7,800	($4)	$19,000	$266,000
K	-	-	-	-	-	-
Total	**($660,300)**	**($1,096,800)**	**($13,377,500)**	**($20,690,000)**	**($33,011,000)**	**($469,100,000)**

* Net present value is calculated using a discount rate of 7 percent.
** A licensee's FFD program may include more than one facility. The average annual savings (costs) presented are for the initial years of the analysis and change over time as programs decrease in size with the closure of specific plants. Consequently, the total net present values cannot be derived using only the one-time and annual values shown above.

Exhibit 4-2 is based on an assumed 7-percent discount rate, consistent with NUREG/BR-0184 as well as current OMB "best practices" for regulatory analyses.[12] These NRC and OMB guidelines also indicate that results should be presented using a 3-percent discount rate. Therefore, Exhibit 4-3 below presents the savings (costs) of the rule to the nuclear industry using a discount rate of 3 percent. As shown, industry costs under the 3-percent discount rate increase to approximately $730 million.

4.1.1 Costs and Savings Attributable to Industry Implementation and Industry Operation

This analysis quantitatively evaluates the proposed rule's costs and savings associated with the industry implementation and industry operation attributes. The presentation is organized by subpart of the rule (A–K).

[12] Circular A-4, Office of Management and Budget, September 17, 2003.

Exhibit 4-3
Industry Savings and Costs by Subpart (3% discount rate)

Subpart	Average Per FFD Program			Total - All FFD Programs		
	One-Time Saving (Cost)	Annual Saving (Cost)	Net Present Value	One-Time Saving (Cost)	Annual Saving (Cost)	Net Present Value
A	-	-	-	-	-	-
B	($41,100)	$240,600	$5,286,300	($1,438,000)	$8,420,000	$178,606,000
C	-	($1,600)	($37,100)	-	($58,000)	($1,243,000)
D	-	-	-	-	-	-
E	($8,600)	$13,300	$291,400	($300,000)	$467,000	$9,755,000
F	($5,300)	($15,800)	($357,300)	($187,000)	($554,000)	($12,237,000)
G	-	($2,200)	($56,300)	-	($76,000)	($1,787,000)
H	-	$12,600	$284,300	-	$442,000	$9,523,000
I	($605,300)	($1,344,200)	($26,822,800)	($18,766,000)	($41,671,000)	($912,903,000)
J	-	$500	$13,800	($4)	$19,000	$433,000
K	-	-	-	-	-	-
Total	**($660,300)**	**($1,096,800)**	**($21,397,700)**	**($20,690,000)**	**($33,011,000)**	**($729,853,000)**

* Net present value is calculated using a discount rate of 3 percent.
** A licensee's FFD program may include more than one facility. The average annual savings (costs) presented are for the initial years of the analysis and change over time as programs decrease in size with the closure of specific plants. Consequently, the total net present values cannot be derived using only the one-time and annual values shown above.

4.1.1.1 Savings and Costs of Subpart A Provisions

Subpart A sets forth requirements and standards for establishing and maintaining FFD programs, describes to whom the regulation applies, defines terms used throughout Part 26, and addresses administrative matters. No incremental costs or savings have been estimated for this subpart.

4.1.1.2 Savings and Costs of Subpart B Provisions

Subpart B requires that each licensee subject to Part 26 establish and implement a FFD program, and identifies FFD program performance objectives, individuals subject to the FFD program, training requirements, and drug and alcohol testing requirements. Although industry will incur a one-time cost of $1,438,000 (an average of $41,100 per program) in the first year following implementation of the rule, annual savings are estimated to total $8,420,000 thereafter (an average of $240,600 per program).

The most significant annual savings of this subpart result from provisions under §26.29(c)(2) that allow individuals to take a comprehensive annual examination (i.e., a "challenge exam") in place of the annual refresher training course required under this paragraph. The shorter length of the challenge examination relative to the refresher course would result in significant employee labor burden reductions, estimated at an annual industry-wide savings of $8,590,000 (or an average of $245,400 per program). Additional savings result from several other

provisions as well, including §26.25(c), which addresses individuals subject to another acceptable FFD program. Some of these savings will be offset by the annual costs of other provisions including §26.39(c), which addresses the review of FFD policy violations, and §26.31(d)(2), which specifies requirements for tracking individuals who are randomly selected for testing but are off-site when selected.

Exhibit 4-4B
Industry Savings and Costs from Proposed Revisions to Subpart B: Program Elements

Section/ Activity	Average Per FFD Program		Total - All FFD Programs	
	One-Time Saving (Cost)	Annual Saving (Cost)	One-Time Saving (Cost)	Annual Saving (Cost)
26.27(a) Policy and Procedure Revisions - Overall Program	($29,095)	-	($1,018,308)	-
26.29(a) Revise and Implement Training, Including Behavioral Observation	($1,243)	-	($43,516)	-
26.29(b) Comprehensive Examination	($10,734)	($2,541)	($375,682)	($88,949)
26.31(d)(3) Forensic Toxicologist Review of More Stringent Cutoff Levels	($10)	-	($343)	-
26.25(c) Individuals Subject to Another Acceptable Program	-	$6,354	-	$222,374
26.29(c)(2) Comprehensive Examination in Lieu of Refresher Training	-	$245,424	-	$8,589,828
26.31(b)(1)(i) Background Checks, Psychological Evaluations, Credit History, Criminal History	-	$597	-	$20,880
26.31(b)(2) DOT-Approved Specimen Collection Facilities	-	$121	-	$4,219
26.31(d)(2) Reasonable Effort to Track Randomly Selected Individuals for Testing	-	($3,113)	-	($108,947)
26.33 Behavioral Observation	-	($1,199)	-	($41,976)
26.37(d) Disclosure requirements positive test results	-	($540)	-	($18,886)
26.39(c) Review of FFD Policy Violations	-	($5,462)	-	($191,168)
26.41(b) Audit Frequency	-	$369	-	$12,899
26.41(c)(2) Elimination of Audit Duplication of HHS-Certified Laboratories	-	$577	-	$20,200
Total	($41,081)	$240,585	($1,437,849)	$8,420,473

Although this subpart yields substantial savings on an annual basis, industry will incur a substantial cost in the first year following the rule's promulgation. The largest of these one-time costs will be incurred to undertake policy and procedure revisions under proposed §26.27(a). The cost of this provision is estimated at $1,018,000 industry-wide (or an average of $29,100 per program).

4.1.1.3 Savings and Costs of Subpart C Provisions

Subpart C contains FFD requirements for granting and maintaining authorization for unescorted access to protected areas in nuclear facilities and for assignment to perform authorization activities. Industry-wide annual costs are estimated at $58,000 (or an average of $1,600 per program). To a substantial degree, this subpart adopts requirements, contained in NRC's Access Authorization Order (AAO), which have been implemented in advance of this proposed rule. (See Section 4.2 for estimates of the costs and savings using the alternative pre-AAO baseline.)

Costs under this subpart result from provisions in §§26.55(a)(4), 26.57(a)(4), 26.59(a)(4), and 26.59(c)(3), which require licensees to conduct random drug and alcohol tests on individuals who are seeking authorization for unescorted access. (Currently, only individuals who already have authorization are subject to random testing.) Additional costs result from §26.59(c)(2), which requires licensees to conduct a pre-access drug and alcohol test on randomly-selected individuals seeking authorization reinstatements following a period of interruption of 6-30 days. (The AAO does not require licensees to conduct any pre-access tests on individuals who are seeking reinstatement after an interruption of 30 days or less.)

Exhibit 4-4C
Industry Savings and Costs from Proposed Revisions to Subpart C: Granting and Maintaining Authorization

Section/ Activity	Average Per FFD Program		Total - All FFD Programs	
	One-Time Saving (Cost)	Annual Saving (Cost)	One-Time Saving (Cost)	Annual Saving (Cost)
26.55(a)(4) Random Testing Pool for Initial Applicants	-	($447)	-	($15,646)
26.57(a)(4) Random Testing Pool for Update Applicants	-	($66)	-	($2,312)
26.59(a)(4) Random Testing Pool for Reinstatement Applicants with 31-365 Day Interruption	-	($482)	-	($16,871)
26.59(c)(3) Random Testing Pool for Reinstatement Applicants with Less than 31 Day Interruption	-	($652)	-	($22,825)
Total	-	($1,647)	-	($57,654)

4.1.1.4 Savings and Costs of Subpart D Provisions

Subpart D ("Management Actions and Sanctions to be Imposed") specifies sanctions to be imposed when an individual has violated the FFD policy. These requirements do not prohibit the licensee or C/V from taking more stringent action, except for certain limitations on terminating an individual's authorization based solely on a non-negative initial test result. No incremental costs or savings have been estimated for this subpart.

4.1.1.5 Savings and Costs of Subpart E Provisions

Subpart E specifies the requirements for collecting specimens for drug and alcohol testing. This subpart defines the specimens to be collected, collector qualifications and responsibilities, collection sites, acceptable devices for conducting alcohol tests, and procedures for collecting drug and alcohol specimens. Following a one-time industry cost of approximately $300,000, or $8,600 for the average program, the industry is expected to realize an annual industry saving of $467,000 or $13,300 per average program.

Exhibit 4-4E
Industry Savings and Costs from Proposed Revisions to Subpart E: Collecting Specimens for Testing

Section/ Activity	Average Per FFD Program		Total - All FFD Programs	
	One-Time Saving (Cost)	Annual Saving (Cost)	One-Time Saving (Cost)	Annual Saving (Cost)
26.83(a) Blood Collection for Confirmatory Alcohol Testing	-	$248	-	$8,687
26.85(a),(b) Urine and Alcohol Collector Training	($3,531)	-	($123,579)	-
26.89(b)(2) Urine Collection: Donors Without Adequate ID	-	$1,489	-	$52,122
26.89(b)(3) Urine Collection: Eliminate Listing Medications on the CCF Form and add description of testing process	-	$5,722	-	$200,268
26.91(b) Purchase of EBT and Calibration Equipment and Related Training	($5,041)	($75)	($176,447)	($2,625)
26.91(c) Required Use of an EBT on the NHTSA CPL for Confirmatory Testing	-	$8	-	$277
26.95(c) One Breath Specimen Collection for Initial Alcohol Test	-	$9,807	-	$343,251
26.99(b) Lowering Initial BAC Requiring Confirmatory Test to BAC 0.02	-	($108)	-	($3,777)
26.103 FFD Manager Determines Confirmed Positive Test for Alcohol (BAC 0.02 < 0.04)	-	($10)	-	($361)
26.105(b) Urine Collection: Inspecting Contents of Donor's Pockets	-	($9,441)	-	($330,443)

Section/ Activity	Average Per FFD Program		Total - All FFD Programs	
	One-Time Saving (Cost)	Annual Saving (Cost)	One-Time Saving (Cost)	Annual Saving (Cost)
26.109(a) Urine Specimen Quantity: Minimum Quantity of 30 mL	-	$7,188	-	$251,587
26.109(b)(2) Urine Specimen: At Least 30 mL, but Less than Predetermined Quantity	-	($177)	-	($6,186)
26.119 Shy Bladder Medical Evaluation	-	($1,317)	-	($46,098)
Total	($8,572)	$13,334	($300,027)	$466,703

The one-time costs result from two provisions. §26.85(a),(b) requires urine and alcohol collector training ($124,000 industry, $3,500 per average program) and §26.91(b) requires the use of an evidential breath testing device meeting the specifications in proposed §26.91(c) ($176,000 industry, $5,000 per average program).

Most of the annual savings from Subpart E provisions will result from §26.95(c), which reduces the number of breath specimens collected during initial alcohol tests from two to one ($343,000 industry, $9,800 per average program); §26.109(a), which reduces the minimum quantity of urine for a specimen collection from 60 mL to 30 mL, thereby decreasing the need for second collections due to fewer “shy bladder” instances ($252,000 industry, $7,200 per program); and §26.89(b)(3), which reduces specimen collection time by eliminating the requirement that donors must list all prescription medications on the custody-and-control form ($200,000 industry, $5,700 per average program). Some of the annual savings will be offset by other annual costs, most notably those from §26.105(b), which requires an inspection of the contents of each donor's pockets before each urine collection ($330,000 industry, $9,400 per program).

4.1.1.6 Savings and Costs of Subpart F Provisions

Subpart F specifies the requirements for licensee testing facilities. This subpart defines the testing facility capabilities, personnel, laboratory procedures, and drug (initial) and validity (screening and initial) testing. The annual industry cost is $554,000 (or approximately $15,800 for the average program). One-time costs, primarily from revisions to licensee testing facility policies and procedures, will result in industry costs of $187,000 (or approximately $5,300 per average program).

The majority of annual costs result from two rule provisions, §26.131(b) and §26.137(e)(7). §26.131(b) requires that licensee testing facilities conduct validity testing on urine specimens. The analysis assumes that all licensee testing facilities will only conduct validity screening tests on urine specimens and send any specimens with a non-negative validity screening results to HHS-certified laboratories for further testing. The annual industry cost is estimated at $447,000 or approximately $12,800 per average program. §26.137(e)(7) amends the current quality control provisions to include quality control specimens in each analytical run to licensee testing facilities. The annual industry cost is estimated at approximately $106,400 or $3,000 per average program.

Exhibit 4-4F
Industry Savings and Costs from Proposed Revisions to Subpart F: Licensee Testing Facilities

Section/ Activity	Average Per FFD Program		Total - All FFD Programs	
	One-Time Saving (Cost)	Annual Saving (Cost)	One-Time Saving (Cost)	Annual Saving (Cost)
26.127 Licensee Testing Facility Policy and Procedure Revisions	($4,769)	-	($166,907)	-
26.131(b) Initial Validity Tests - Onsite Testing Facilities	($568)	($12,773)	($19,863)	($447,040)
26.133 Change Cutoff Levels for Marijuana and Opiates - Onsite Testing Facilities	-	($439)	-	($15,349)
26.137(e)(7) Quality Control Specimens in Each Analytical Run - Onsite Testing Facilities	-	($3,040)	-	($106,414)
26.139(d) Licensee Testing Facility Reporting of Testing Data to FFD program (Monthly to Annually)	-	$420	-	$14,700
Total	($5,336)	($15,831)	($186,770)	($554,102)

4.1.1.7 Savings and Costs of Subpart G Provisions

Subpart G specifies the requirements for HHS-certified laboratories used by licensees and C/Vs to conduct drug and validity testing on urine specimens. This subpart defines HHS-certified laboratory capabilities, personnel, laboratory procedures, and drug (initial and confirmatory) and validity (screening, initial, and confirmatory) testing. The annual industry cost is $76,000, or approximately $2,200 for the average program.

The majority of the annual costs result from the requirement in §26.161(b)(1) for licensees and C/Vs to conduct validity testing on urine specimens ($374,000 industry or $10,700 per average program). Much of the annual costs are offset by annual savings that include §26.167(f)(2), which reduces the number of blind specimens required to be submitted for testing after the first quarter of a new contract with an HHS-certified laboratory ($306,000 industry, $8,700 per average program).

Exhibit 4-4G

Industry Savings and Costs from Proposed Revisions to Subpart G: Laboratories Certified by the DHHS

Section/ Activity	Average Per FFD Program		Total - All FFD Programs	
	One-Time Saving (Cost)	Annual Saving (Cost)	One-Time Saving (Cost)	Annual Saving (Cost)
26.153(e) Pre-Award Inspections of HHS-Certified Laboratories	-	($168)	-	($5,876)
26.153(g) Memorandum to HHS-Certified Laboratory for Incorrect CCF Form	-	($24)	-	($837)
26.161(b)(1) All Validity Testing Conducted at HHS-Certified Laboratories	-	($10,695)	-	($374,319)
26.161(g) Unidentified Interfering Substance/Adulterant - Contact MRO and Specimen Retesting	-	($355)	-	($12,425)
26.163(a)(1) Change Cutoff Levels for Marijuana and Opiates - HHS-Certified Laboratories	-	($699)	-	($24,473)
26.165(b) Retesting of Single Collection Specimens with Non-Negative Confirmed Drug Test Results	-	($9)	-	($305)
26.167(f)(1) Blind Sample Testing - 1st Quarter of Contract with a HHS-Certified Laboratory	-	$678	-	$23,713
26.167(f)(2) Blind Sample Testing - Contracts with HHS-Certified Laboratories Older Than 90 Days	-	$8,745	-	$306,077
26.169(k) HHS-Certified Laboratory Reporting of Testing Data to FFD program (Monthly to Annually)	-	$351	-	$12,268
Total	-	($2,176)	-	($76,177)

4.1.1.8 Savings and Costs of Subpart H Provisions

Subpart H contains requirements for determining whether a FFD policy violation has occurred and for making a determination of fitness. It establishes requirements for MROs, procedures for verification of FFD policy violations, and requirements for substance abuse experts (SAEs) and determinations of fitness. Industry-wide annual savings are estimated at $442,000 (or an average of $12,600 per program). No incremental one-time costs or savings are expected as a result of this subpart.

Requirements contained in proposed §26.189(b)(3), in conjunction with §26.69(a)(2), is expected to result in annual savings estimated at $539,000 (or an average of $15,400 per program). These savings occur because licensees and C/Vs will not need to conduct determinations of fitness on individuals with potentially disqualifying FFD information, if the information has previously been evaluated by another licensee.

Offsetting some of these savings, proposed §26.189(c) requires determinations of fitness that are conducted for-cause to be conducted through face-to-face interaction between management and the individual under review. The annual industry-wide costs of conducting these face-to-face determinations of fitness are estimated at $98,000 (or an average of $2,800 per program).

Exhibit 4-4H
Industry Savings and Costs from Proposed Revisions to Subpart H: Determining FFD Policy Violations and Determining Fitness

Section/ Activity	Average Per FFD Program		Total - All FFD Programs	
	One-Time Saving (Cost)	Annual Saving (Cost)	One-Time Saving (Cost)	Annual Saving (Cost)
26.189(b)(3) Definition of "Potentially Disqualifying Information"	-	$15,411	-	$539,402
26.189(c) Face-to-Face Determinations of Fitness	-	($2,789)	-	($97,625)
Total	-	$12,622	-	$441,777

4.1.1.9 Savings and Costs of Subpart I Provisions

Subpart I contains the rule's proposed provisions governing fatigue management. It applies only to Part 50 licensees, combined license holders under §52.103, and contractor/vendors to nuclear power plant licensees who rely upon contractor/vendor FFD programs or program elements. It does not apply to material licensees.

The annual industry cost is $41,671,000, or approximately $1,344,200 for the average program. One-time industry costs of Subpart I are estimated at $18,766,000, or $605,300 for the average program. The majority of the cost results from two requirements.

Proposed §26.199(d)(2) would establish several mandatory breaks for individual workers, including a biweekly 48-hour break. While licensees are unlikely to be limited by this requirement during normal operations, it will have some impact during refueling outages and other extended outages given the common industry practice of using "super-crews," which typically work six or seven 12-hour shifts per week during the outage. As implemented in the proposed rule, the biweekly break in effect would reduce the maximum allowable number of work hours to an average of 68 hours per week (about a 5 percent reduction from what is currently allowed), so licensees would have to bring on additional staff to make up for the lost hours during the outage. Given the large number of people working long hours during refueling outages, this results in considerable cost. Most of this new staff will be temporary workers who must be hired, processed, and paid, thereby generating costs. With respect to the additional need for operators during these periods, the analysis assumes that licensees will maintain a pool of formerly-licensed, semi-retired operators who will be available to provide operations expertise during the outage for duties that do not require a license. The annual cost of this provision is estimated at $532,200 for the average program.

§26.199(d)(3), which places restrictions on the use of waivers as a means of bypassing worker hour limits when necessary, will cost the industry an estimated $531,200 per program annually. This is an average and there is expected to be a large variation in the cost of implementing this provision between licensees because some licensees currently authorize a much larger number of waivers than others. The analysis of this provision is described in Appendix 1 and Appendix 3.

Licensees also will incur costs related to revising and implementing their fatigue policies and procedures, developing systems to track work hours in the manner specified in the rule, paying a scheduler to plan work schedules, and training staff on the fatigue provisions.

Exhibit 4-4l
Industry Savings and Costs from Proposed Revisions to Subpart I: Managing Fatigue

Section/ Activity	Average Per FFD Program		Total - All FFD Programs	
	One-Time Saving (Cost)	Annual Saving (Cost)	One-Time Saving (Cost)	Annual Saving (Cost)
26.197(a)-(b) Policy and Procedures	($29,888)	-	($926,542)	-
26.197(c) Training	($214,262)	($99,880)	($6,642,126)	($3,096,270)
26.197(d) Retaining Fatigue Records	-	($2,254)	-	($69,871)
26.197(e)(1) Summarize Waiver Data	-	($140)	-	($4,332)
26.197(e)(2) Summarize Collective Work Hour Issues	-	($294)	-	($9,100)
26.197(e)(3) Summarize Fatigue Assessment Data	-	($557)	-	($17,264)
26.199(b) Calculating Work Hours	($104,839)	($31,089)	($3,250,000)	($963,747)
26.199(c) Scheduling Work Hours	($12,611)	($72,125)	($390,950)	($2,235,870)
26.199(d)(2) Breaks (bi-weekly breaks)	-	($532,180)	-	($16,497,579)
26.199(d)(3) Waivers from Individual Work Hour Limits	-	($531,197)	-	($16,467,100)
26.199(e) Self-Declarations of Fatigue	-	($1,305)	-	($40,443)
26.199(f)(1)-(2) Collective Work Hour Limits	($243,746)	($41,254)	($7,556,113)	($1,278,889)
26.199(f)(5) Exceeding Collective Work Hour Limits with NRC Approval	-	($1,334)	-	($41,369)
26.199(j) Work Hour Control Reviews	-	($4,224)	-	($130,950)
26.201(a)-(d) Fatigue Assessments	-	($7,652)	-	($237,226)
26.201(e) Post-Fatigue Assessment Controls and Conditions	-	($16,308)	-	($505,533)
26.201(f) Documenting Fatigue Assessments	-	($2,422)	-	($75,075)
Total	($605,346)	($1,344,213)	($18,765,731)	($41,670,618)

4.1.1.10 Savings and Costs of Subpart J Provisions

Subpart J describes recordkeeping and reporting requirements for licensees and C/Vs with approved FFD programs. Industry-wide annual savings are estimated at $19,000 (or an average of approximately $500 per average program). No significant one-time costs or savings are expected as a result of this subpart. Savings result from a decrease in the required reporting frequency for licensee performance data reporting and the elimination of duplicative reporting of C/V performance data. (Note that these savings do not reflect new costs resulting from the need to report fatigue management data within the performance data reports. These costs are calculated under Subpart I.) These savings are partly offset by higher costs associated with the increased number of "reportable events" that will result from the rule's new validity testing requirements and modified thresholds for positive test results.

Exhibit 4-4J
Industry Savings and Costs from Proposed Revisions to Subpart J: Recordkeeping and Reporting Requirements

Section/ Activity	Average Per FFD Program		Total - All FFD Programs	
	One-Time Saving (Cost)	Annual Saving (Cost)	One-Time Saving (Cost)	Annual Saving (Cost)
26.213(g) Filing of Forensic Toxicologist's Evaluation	($0)	-	($4)	-
26.217(e), (f) FFD Programs: Performance Data Reporting and Review	-	$1,343	-	$47,008
26.217(g) Contractor/Vendor Submission of Performance Data to NRC	-	$26	-	$910
26.219(b) Reporting and Review of Reportable Events Due to New Validity Testing Requirements	($0)	($831)	($4)	($29,088)
Total	($0)	$538	($7)	$18,829

4.1.1.11 Savings and Costs of Subpart K Provisions

Subpart K ("Inspections, Violations, Penalties") contains provisions covering the inspection of licensee and C/V programs by NRC representatives, written agreements between licensees and C/Vs, violations, and criminal penalties resulting from violations. No incremental activities are included in this subpart and, therefore, no costs or savings are estimated.

4.1.2 Additional Benefits and Qualitative Cost Savings of Proposed Part 26 Revisions - Drug and Alcohol Testing and Authorization Provisions

The analysis evaluates nine affected attributes on a qualitative basis, as described in the following three sections. Section 4.1.2.1 collectively examines seven of these attributes (safeguards and security considerations; public health [accident]; occupational health [accident]; occupational health [routine]; offsite property; onsite property; environmental considerations). Section 4.1.2.2 considers regulatory efficiency. Finally, Sections 4.1.2.3 and 4.1.2.4 address the "other considerations" attribute, which in this case involves (1) public perception, and (2) workplace productivity and efficiency.

The regulatory options would affect these nine attributes by reducing the risks of accidents and/or security events within the protected area due to the undetected use of drugs or alcohol, or due to potential inconsistencies between the FFD and the access authorization functions. These risks could lead to a variety of workplace safety incidents, including damage to the reactor core. Quantification of any of these attributes would require estimation of such factors as the types, frequencies, and results of damages that now occur (i.e., pre-rule) and would occur (i.e., post-rule) as a result of factors related to the current and proposed rule.

4.1.2.1 Safeguards and Security Considerations; Public Health (Accident); Occupational Health (Accident); Occupational Health (Routine); Offsite Property; Onsite Property; Environmental Considerations

The NRC estimates that this proposed rule would result in benefits (i.e., safeguards and security considerations, public health, occupational health, occupational health, offsite property, onsite property, environmental considerations) by providing assurance that individuals who are subject to the rule are not under the influence of any legal or illegal substance or mentally or physically impaired from any cause that in any way adversely affects their ability to safely and competently perform their duties. Qualitative benefits primarily accrue from increased safety, which the rule would achieve by ensuring that workers are fit for duty,[13] and from the increased effectiveness of the Part 26 rule in addressing performance objectives.

Drug and alcohol use and abuse can impair job performance. This impairment significantly threatens the safety of workers themselves, and may also endanger the health and safety of the public. Drug use or alcohol consumption on the job can adversely affect behavior and diminish both physical and cognitive abilities. The effects of withdrawal, hangover, and long-term chronic abuse resulting from off-duty drug and alcohol use also can affect job performance. Drug and alcohol abuse can have a significant impact on safety-related jobs. Drug use remains prevalent in American society and is an ongoing occupational and safety concern in American industry.[14] More importantly, drug or alcohol abuse by nuclear industry

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[13] For discussions of safety-related FFD concerns, see NUREG/CR-5227 (Barnes et al., 1988), NUREG/CR-5227 Supplement 1 (Moore et al., 1989), NUREG/CR-5784 (Durbin et al., 1991), and NUREG/CR 6470 (Durbin & Grant, 1996).

[14] NUREG/CR-5784 and NUREG/CR-6470, Ch. 6.

personnel indicates a lack of reliability and trustworthiness and remains a legitimate safety concern for the NRC.[15]

The NRC's backfit analysis, prepared in 1989 in conjunction with promulgation of the Part 26 rule, concluded that drug abuse significantly increases the risk of accidents that are attributable to neglect or human error.[16] Although the NRC did not quantify the reduction in risk associated with the implementation of FFD programs, the 1989 backfit analysis stated that drug and alcohol testing (as part of a comprehensive FFD program) can significantly increase the assurance that employees will be fit for duty. The NRC concluded that FFD program implementation costs would be justified by increasing the assurance of public health and safety.

During 1990, the first calendar year of FFD program implementation, 0.87 percent of tests administered under 10 CFR Part 26 requirements were confirmed as positive for the presence of illegal drugs or the abuse of alcohol. In 1993, the fourth year of program implementation, 0.62 percent of such tests were confirmed as positive for the presence of illegal drugs or the abuse of alcohol. In 1995, the confirmed positive test rate was 0.98 percent. In 2000, the confirmed positive test rate was 1.11 percent. Exhibit 4-5 shows the breakdown by test

Exhibit 4-5
FFD Test Results for CY 1990, 1993, 1995, 2000

Test Category	Positive Test Rate by Year			
	1990 (274,599 tests)	1993 (242,966 tests)	1995 (150,121 tests)	2000 (125,713 tests)
Pre-employment/ Pre-access	1.26%	1.04%	1.41%	1.41%
Random	0.37%	0.23%	0.27%	0.39%
For-Cause/ Post Accident	29.23%	21.70%	18.22%	15.63%
Follow-Up	2.47%	1.35%	1.07%	1.71%
Other*	-	-	-	2.44%
Total	**0.87%**	**0.62%**	**0.98%**	**1.11%**

* Includes results from the periodic testing done by some reporting units during annual physicals or similar periodic activities. Although some reporting units specified the nature of the "Other" tests (e.g., return to work), most did not give this information.
Sources: "Fitness For Duty in the Nuclear Power Industry: Annual Summary of Program Performance Reports," NUREG/CR-5758, and NRC Information Notice 2003-04, Summary of Fitness-for-Duty Program Performance Reports for Calendar Year 2000, February 6, 2002.

category. The 1995 confirmed positive test rate should not be compared directly to the rates from previous years because of several changes that occurred during the intervening years. Further, the total number of tests administered decreased between 1993 and 1995 because of changes to testing requirements (58 FR 31467), effective January 1994, which reduced the random testing rate from 100 percent to an annual rate equal to 50 percent of all persons covered by the FFD regulation.

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[15] 54 FR 24470, "Fitness-For-Duty Programs; Final Rule and Statement of Policy," June 7, 1989.

[16] SECY-00-0159, July 26, 2000. Attachment F, Analysis of the Application of the Backfit Rule to the Revisions to the Fitness-for-Duty Rule.

The NRC believes that ensuring that workers are not impaired by drugs or alcohol will decrease the probability of human error and reduce the risk to plant personnel of radiological exposures and exposures to hazardous chemicals produced from licensed material. This reasoning is applicable to the current rulemaking in that changes to improve the effectiveness of the rule should further decrease the risk of accidental exposure attributable to human error caused by an FFD problem. Although there may be a low probability of a significant accidental radiological release, or a release of hazardous chemicals produced from licensed material, due to drug abuse, such a release could have great consequences. Furthermore, any accident attributed to drug or alcohol use could undermine public perceptions of nuclear industry safety. The relatively low positive test rates reported in the exhibit indicate that drug abuse among nuclear facility personnel may not be as prevalent as in the national work force. Although the positive test rates may not reveal all drug and alcohol abuse and, therefore, may understate drug and alcohol abuse within the industry, the data do indicate a continuous detection of previously undetected drug use through the FFD program. The positive test results presented in this section indicate that there continues to be an occasional nuclear industry worker with a drug or alcohol abuse problem. Therefore, NRC believes efforts to improve the effectiveness of the current Part 26 requirements are warranted.

4.1.2.2 Regulatory Efficiency

An important benefit of this rulemaking would be an increase in regulatory efficiency and effectiveness. Increased clarity in the intent of many requirements would reduce NRC and licensee costs associated with interpreting this rule. When the specifics of a regulatory requirement are not clear, a licensee could enact programs that are more burdensome than the agency intended or could spend unproductive time trying to understand the requirements. Similarly, lack of clarity could result in licensees inadvertently not complying with the true intent of the regulatory action, which could lead to intervention by the NRC or even enforcement action and litigation. Thus, increasing the clarity of this rule may significantly reduce the costs associated with different interpretations of regulatory requirements. In addition, this rule would increase regulatory efficiency and effectiveness by increasing consistency between this rule and access authorization requirements. Furthermore, it also enhances the consistency of regulations and policies across Federal agencies (e.g., HHS, DOT). The NRC believes that these agency and licensee savings could potentially be significant, although they are not easily quantified. The NRC has attempted to analyze many of the savings attributable to this rule, but these estimates do not include all of the savings that the agency anticipates as a result of this increase in regulatory efficiency. In addition, increasing the clarity of this rule (i.e., clarifying intent) may enhance its effectiveness and safety-related benefits.

4.1.2.3 Public Perception

By increasing the effectiveness and clarity of the requirements for FFD programs, this proposed rule would enhance the public's confidence in the NRC's protection of public health and safety and the common defense and security. The proposed changes would give the public additional assurance that the NRC is addressing safety concerns raised by the use of drugs and alcohol, and by any other causes of impairment or questionable reliability or trustworthiness, such as an increase in the probability of safety-significant accidents or other safeguards and security risks.

4.1.2.4 Workplace Productivity and Efficiency

Affected licensees may accrue benefits from the improved effectiveness of the rule, including enhanced workforce productivity, reduced absenteeism, lower medical and insurance costs, and less plant downtime. The effects of human-related errors caused by FFD problems can have direct and indirect effects on overall plant operating costs. For example, a 24-hour outage caused by an FFD-related error may result in a direct revenue loss of several hundred thousand to more than a million dollars. Furthermore, the long-term effects of FFD problems arising from increased absenteeism, lower productivity on the job, and increased use of medical benefits can also result in higher costs to the licensee.[17] These secondary benefits would result in additional savings for FFD programs beyond those quantified for industry implementation and operations.

4.1.3 Additional Benefits and Qualitative Cost Savings of Proposed Part 26 Revisions - Fatigue Management Provisions

This analysis evaluates nine affected attributes, as described in the following five sections. Section 4.1.3.1 collectively examines six of these attributes: public health (accident); occupational health (accident); occupational health (routine); offsite property; onsite property; environmental considerations. Section 4.1.3.2 considers safeguards and security. Section 4.1.3.3 addresses regulatory efficiency. Finally, Sections 4.1.3.4 and 4.1.3.5 address the "other considerations" attribute, which in this case involves (1) public perception, and (2) workplace productivity and efficiency.

The regulatory options would affect these attributes by reducing the risks of accidents, fires, property damage, and/or security events due to the effects of worker fatigue. By clarifying the provisions of the regulatory framework relating to fatigue management, the regulatory options would indirectly affect these attributes by increasing the likelihood of identifying and addressing worker fatigue.

4.1.3.1 Public Health (Accident); Occupational Health (Accident); Occupational Health (Routine); Offsite Property; Onsite Property; Environmental Considerations

The NRC estimates that the fatigue management provisions of the proposed rule would result in benefits (i.e., the attributes of public health, occupational health, offsite property, onsite property, environmental considerations) by providing assurance that individuals who are subject to the rule are not impaired from acute or cumulative fatigue that will adversely affect their ability to safely and competently perform their duties. The Federal Register notice accompanying the proposed rule presents a detailed discussion of NRC's considerations related to including fatigue management within the Part 26 rulemaking.

In evaluating the anticipated benefits from the fatigue management provisions in proposed Subpart I, the NRC reviewed and assessed the research available on the degradation of worker

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[17] See, for instance, Crouch, et al. (1989), "A Critical Evaluation of the Utah Power and Light Company's Substance Abuse Management Program: Absenteeism, Accidents and Costs," in: Gust & Walsh (Eds.), Drugs in the Workplace: Research and Evaluation Data, NIDA Research Monograph 91, U.S. Government Printing Office, Washington, DC, pp. 169-193.

abilities that are important to safe plant operation. Many studies have shown that fatigue impairs human alertness and performance. Recent studies have shown that fatigue can cause performance degradations that are comparable to the levels observed from blood alcohol concentrations (BACs) in excess of those that would result in a positive breath alcohol test under the current provisions of 10 CFR Part 26. In those studies, individuals who were awake for 17 to 19 hours had cognitive psychomotor performance comparable to individuals with a BAC of 0.05 percent, which is greater than the current breath alcohol cutoff level of 0.04 percent established by 10 CFR Part 26.[18] The NRC considers the insight that fatigue can impair a worker at levels comparable to those prohibited for alcohol to be particularly significant.

The lack of adequate days off and extended workdays (overtime) can result in a cumulative sleep debt (i.e., the difference between the amount of sleep an individual needs and the amount of sleep that individual actually obtains) and degraded performance Studies concerning extended work hours suggest that fatigue-induced personnel impairment can increase human error probabilities by a factor of more than 2 to 3 times. Studies of the nuclear power industry indicate that normal daily variations in alertness associated with human circadian rhythms (i.e., physiological processes that vary on an approximate 24-hour cycle) may be responsible for daily variations in the incidence of personnel errors at nuclear power plants. The findings of these studies are consistent with the results of a survey of more than 100 nuclear power plant shift supervisors — over 90 percent stated that they notice times of day or days in the schedule when control room operators are less alert, less vigilant, or make more mistakes.

Many of the cognitive tasks performed by nuclear power plant personnel that are important to the protection of public health and safety and the common defense and security rely on individual workers' abilities to sustain attention, analyze problems, make clear decisions and work as a team. Vigilance and attention to detail are fundamental for plant safety, whether an individual is operating or maintaining equipment important to plant safety, conducting surveillance in the plant, monitoring system status in the control room, or monitoring plant security systems or barriers. Tasks requiring sustained attention (e.g., vigilance tasks) are among the most susceptible to fatigue-induced degradation. Conservative decision-making also is a cornerstone of safe nuclear power plant operations. Fatigue has been associated with an increased frequency of low effort and more risky decisions and strategies. Fatigue has been found to contribute to poor problem-solving performance, characterized by an individual or group of individuals maintaining a faulty diagnosis or mitigation plan despite contrary information. Sleep-deprived workers fail to appropriately allocate attention, set task priorities, and sample for sources of potentially faulty information. Mental fatigue also contributes to decreased originality and flexibility in problem solving and sub-optimal planning. Fatigue affects skills important to written and oral communication and teamwork. Fatigue degrades speech articulation, verbal fluency, grammatical reasoning and memory. Fatigued individuals also tend to be less communicative and have greater difficulty performing multiple tasks concurrently. As a result, fatigue can not only degrade the fitness of an individual, but also the overall performance of a crew.

Conditions that contribute to worker fatigue, resulting from an individual remaining awake continuously for an excessive period of time, or from the individual obtaining an inadequate

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[18] Dawson, D. and Reid, K. (1997). "Fatigue, alcohol and performance impairment." Nature, 388:235; Williamson, A.M. and Feyer, A. (2000). "Moderate sleep deprivation produces impairments in cognitive and motor performance equivalent to legally prescribed levels of alcohol intoxication." Occupational and Environmental Medicine, 57, 649-655.

amount or quality of sleep, or both, are present in the U.S. nuclear power industry. These conditions include the following:

- Extended work shifts with five or more consecutive work days. The use of 12-hour shifts during normal operations has become increasingly common at U.S. nuclear power plants. Furthermore, the use of 6 or more consecutive 12-hour shifts is now standard practice during plant outages. During outages, some licensees have scheduled personnel for three or more weeks of consecutive 12-hour shifts without intervening days off.

- Extensive use of overtime. Recent studies indicated that at approximately one-fourth of the nuclear power plant sites studied, more than 20 percent of the personnel covered by current working hour limits work more than 600 hours of overtime annually. The NRC has found that some licensees authorized hundreds to several thousand deviations from the current limits of 16 hours of work in any 24-hour period, 24 hours of work in any 48-hour period, 72-hours of work in a 7 day period, and from the minimum break requirement of 8 hours between work periods. The NRC also noted the continued excessive use of such deviations in research used for this rulemaking (see Appendix 3). Extensive use of overtime creates a combined effect of long work hours with reduced break periods.

- Night work. Because the nuclear power industry is a round-the-clock operation requiring individuals to be awake and working, at times when they would normally be asleep, workers are cyclically affected by the daily biological clock, which runs on about a 24-hour (circadian) cycle. A substantial amount of scientific literature on circadian variations in alertness demonstrates the significant roles that worker fatigue, sleep loss, and circadian rhythms play in contributing to errors and accidents. Instances of operators falling asleep in the control rooms at the Pilgrim nuclear power station (2004) and the test and research reactor at the Massachusetts Institute of Technology (2003), and a nuclear power plant security guard falling asleep while driving a patrol vehicle (2004), despite these individuals recognizing the potential safety and disciplinary consequences, underscore the powerful drive for sleep associated with circadian factors and the fact that shiftwork is a daily influence on the alertness of all shiftworkers at nuclear power plants.

- Site-specific factors. Extended commutes, which are common for some nuclear power plants, contribute to the potential for fatigue associated with early start times.

- Workforce characteristics. In the general U.S. population, sleep disorders, such as sleep apnea, are not uncommon. The incidence of sleep apnea may in fact be higher for shiftworkers at power plants, as this condition is more common in middle-age adult males, who constitute a significant proportion of the power plant workforce, than in the general population.

Considering the above factors, the NRC believes that fatigue can have a significant adverse effect on worker abilities, and that the impairment can result in safety significant deteriorations in worker performance. Further, the likelihood of a nuclear power plant worker being impaired from fatigue is likely far greater than the likelihood of impairment from drugs and alcohol, which the NRC currently requires licensees to address through their FFD programs.

Many provisions of Subpart I are expected to lead to benefits that, while difficult or impossible to analyze quantitatively, are quite substantial in magnitude. Three such provisions, in particular, are the requirement that all workers be trained to recognize the factors contributing to worker fatigue and to identify symptoms of worker fatigue, the provision for worker self-declarations of fatigue, and the provision for for-cause fatigue assessments when workers exhibit symptoms of fatigue to managers or co-workers. These provisions will help ensure that individual variations in susceptibility to fatigue, arising from physiology, personal obligations, or life style, will be addressed in ways beyond the individual and collective work hour limits in the proposed rule. The training, self-declaration, and fatigue assessment provisions will help avoid potential adverse consequences caused by workers who, for whatever reason, are affected by fatigue irrespective of the other provisions of Subpart I. These provisions thus are primary contributors to safety.

A quantitative analysis of some potential benefits, measured in terms of reduced costs of plant trips, at-power severe accidents and accidents during outages, fires, and lost work, is reported in Addendum 1 for the following four proposed fatigue management provisions: restrictions on waivers of the individual work hour limits; the requirement for a 10-hour break between successive work periods, the requirement for a collective work hour limit of an average of 48 hours per week for specified job duty groups; and the requirement for a 24-hour break in any 7-day period and a 48-hour break in any 14 day period for individual members of the specified job duty groups. The NRC expects that these four provisions also will provide substantial benefits beyond those quantified. By limiting the work hours during normal conditions, individuals will be better rested and less susceptible to cumulative fatigue from the long work hours that are common during plant and security system outages. This may increase the potential for shorter outages. Other potential benefits include improved productivity, lower radiological exposures, less re-work, which can increase the availability of important safety systems, and improved environmental protection through the avoidance of inadvertent oil spills or other non-nuclear environmental events or inadvertent radiological releases. The fatigue management provisions provide reasonable assurance that individuals will be better rested prior to an emergency or increased threat condition.

4.1.3.2 Safeguards and Security

Following the terrorist attacks of September 11, 2001, the NRC received numerous allegations from nuclear security officers that certain licensees required them to work excessive amounts of overtime over long periods due to the post-September 11, 2001, threat environment. These individuals questioned their readiness and ability to perform their required job duties due to the adverse effects of cumulative fatigue. In order to ensure that these individuals are able to meet their responsibilities for maintaining the common defense and security, it is necessary to ensure that they are not subject to fatigue, which could reduce their alertness and ability to perform the critical job duties of identifying and promptly responding to plant security threats. The NRC reviewed the actual hours worked by security personnel and determined that, in the vast majority of cases, individual work hours did not exceed the guidelines specified in the NRC's Policy on Worker Fatigue. However, the review confirmed that some individuals had been working up to 60 hours per week for extended periods. Individual concerns regarding their fitness-for-duty, in light of work schedules that did not exceed the specific guidelines of the policy, as well as relevant technical research supporting the basis for cumulative fatigue, caused the NRC to conclude that the work hour guidelines of the policy were inadequate for addressing cumulative fatigue of security personnel. The NRC therefore issued Order EA-03-038 on April 29, 2003. The compensatory measures imposed by Order EA-03-038 differed from the policy guidelines in a few areas in which the NRC believed it

was necessary to address previously identified deficiencies in the guidelines, including cumulative fatigue from prolonged use of extended work hours and matters unique to security personnel. The requirements in Order EA-03-038 were imposed to provide the NRC with reasonable assurance that the public health and safety and common defense and security continue to be adequately protected.

The NRC plans to withdraw Order EA-03-038 once the fatigue management provisions proposed in Subpart I for security force personnel take effect. The security force personnel who are subject to work hour controls in the Order are the same individuals who would be subject to the proposed work hour controls. Subpart I largely incorporates provisions in the Order, including provisions designed to minimize the use of deviations from the individual work hour limits, and limits that minimize the potential for cumulative fatigue. The requirements established by the Order and incorporated into proposed Subpart I ensure adequate protection of public health and safety and the common defense and security.

Subpart I adds a new requirement not contained in Order EA-03-038 for security personnel to obtain a break of 24 hours every 7 days and a break of 48 hours every 14 days. That requirement is also expected to result in improved nuclear power plant security. It will support the individual work hour controls by both preventing and mitigating cumulative sleep debt. Although licensees would be permitted under the group averaging requirements to distribute overtime among plant security staff based on their assessment of individuals' abilities and desires to work overtime, the break requirement ensures opportunities for days off, limits forced overtime, and also may support improved morale and safety culture. The training, self-declaration, and for-cause provisions of Subpart I also are expected to have the same qualitative benefits for security personnel as they do for other categories of nuclear plant personnel. Addendum 1 to this regulatory analysis quantifies some of the security-related benefits associated with selected fatigue management provisions in the proposed rule.

4.1.3.3 Regulatory Efficiency

Currently, even if licensees have incorporated the NRC's Policy on Worker Fatigue into a license condition, technical specification, or administrative procedure, consistent implementation and/or enforcement of the guidance in the policy is complicated by several factors:

- The language in plant technical specifications is largely advisory (e.g., an individual *should* not be permitted to work more than 16 hours straight).
- The technical specifications have inconsistent levels of detail from one nuclear power plant licensee to another.
- Licensees have inconsistently interpreted the scope of personnel who must be subject to the technical specification work hour limits.
- The technical specifications contain varying scopes for other requirements.
- The basic measure–work hours–used to determine whether an individual's situation is within or above the technical specification limits is not implemented consistently from one nuclear power plant to another.

Currently, Part 26 does not include prescriptive requirements regarding fatigue. Rather, §26.20 uses general, non-mandatory language to state that FFD policy "should" address other factors that can affect a worker's ability to safely and competently perform his or her duties, "such as mental stress, fatigue, and illness." As a result, it is difficult for the NRC to justify a violation of the regulation based on a licensee's failure to limit work hours. In addition, without a numerical

limit on work hours, or a provision limiting work hours, a range of work hour practices could be viewed as "reasonable," and therefore in compliance with the regulation. When the specifics of a regulatory requirement are not clear, a licensee could enact programs that are less effective than the agency intended or could spend unproductive time trying to understand the requirements. Similarly, lack of clarity could lead licensees to inadvertently not comply with the true intent of the regulatory action, which could lead to intervention by the NRC or even enforcement action and litigation. Increasing the clarity of the fatigue management provisions will enhance their effectiveness and safety-related benefits.

4.1.3.4 Public Perception

Many public comments on PRM-26-2 expressed concern that NRC appeared to "look the other way" in matters concerning worker fatigue. More recently, concerns regarding security personnel fatigue and instance of nuclear plant operators and guards falling asleep on the job have been the subject of newspaper articles. By increasing the effectiveness and clarity of the requirements for fatigue management programs, this proposed rule would enhance the public's confidence in the NRC's protection of public health and safety and the common defense and security. The proposed changes would give the public additional assurance that the NRC is addressing the safety concern that worker fatigue may increase the probability of safety-significant accidents or may pose safeguards and security risks at power reactors.

4.1.3.5 Workplace Productivity and Efficiency

Affected licensees may accrue cost savings from the improved effectiveness of the rule, including enhanced workforce productivity, reduced absenteeism, lower medical and insurance costs, and less plant downtime. The effects of human-related errors caused by fatigue can have direct and indirect effects on overall plant operating costs. For example, a 24-hour outage caused by a fatigue-related error may result in a direct revenue loss of several hundred thousand to more than a million dollars. Furthermore, the long-term effects of problems arising from increases in illnesses and sick time, increased use of medical benefits, increased industrial accident rates, increased absenteeism, and lower productivity on the job, all of which have been associated with extended work hours and cumulative fatigue, can result in higher costs to the licensee. These secondary benefits would result in additional savings for fatigue management programs beyond those discussed above. Addendum 1 to this regulatory analysis quantifies some of the worker productivity benefits associated with selected fatigue management provisions in the proposed rule.

4.1.4 Disaggregation

This section addresses the proposed rule provisions on a disaggregated basis. Section 4.1.4.1 considers the need to examine each requirement on an individual (i.e., fully-disaggregated) basis. Section 4.1.4.2 disaggregates the collection of provisions related to fatigue management from the remainder of the proposed rule.

4.1.4.1 Screening Review for Disaggregation

In order to comply with the guidance provided in Section 4.3.2 ("Criteria for the Treatment of Individual Requirements") of the Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission, NUREG/BR-0058, Revision 4, the NRC conducted a screening review to ensure that the aggregate analysis does not mask the inclusion of individual rule provisions that are not

cost-beneficial when considered individually and not necessary to meet the goals of the rulemaking. The NRC identified all individual Part 26 rule changes where the total present value cost to industry is expected to reach or exceed approximately $50,000 per program (assuming a 7-percent discount rate), and/or where total initial industry costs are estimated to reach or exceed approximately $1,000,000. Because the NRC determined that all individual changes that meet the above thresholds are also backfits, the complete discussion of the screening review is included in the Backfit Analysis portion of this document (see Section 4.4.2).

4.1.4.2 Disaggregating Fatigue Management from Other Part 26 Revisions

This section summarizes the division of costs and savings of the proposed rule between fatigue-related provisions (i.e., the provisions in proposed Subpart I) and all other provisions.[19] The NRC is not required to present this information but is doing so as a courtesy to stakeholders.

As can be seen in Exhibit 4-6, the substantial costs of Subpart I (Fatigue Management) dominate the cost results of the proposed rule as a whole. When the other (non-fatigue) provisions are evaluated separately, the results show a considerable savings to industry.

For a discussion of the benefits of the fatigue management provisions, refer to Section 4.1.3 of this regulatory analysis. The NRC believes the qualitative benefits of the fatigue management provisions are fully justified relative to the costs. Addendum 1 quantifies some of the benefits described in Section 4.1.3 for four selected fatigue management provisions contained in the proposed rule, and provides further support for NRC's conclusion.

Exhibit 4-6
Industry Savings and Costs of Fatigue Relative to Other Proposed Revisions

	Average Per FFD Program			Total for All FFD Programs		
	One-Time Saving (Cost)	Annual Saving (Cost)	Net Present Value	One-Time Saving (Cost)	Annual Saving (Cost)	Net Present Value
Fatigue (Subpart I)	($605,300)	($1,344,200)	($16,681,900)	($18,766,000)	($41,671,000)	($584,722,000)
Rest of Proposed Rule	(55,000)	$247,400	$3,304,400	($1,924,000)	$8,660,000	$115,622,000
Total	**($660,300)**	**($1,096,800)**	**($13,377,500)**	**($20,690,000)**	**($33,011,000)**	**($469,100,000)**

* Net present value assumes a discount rate of 7 percent. Using a discount rate of 3 percent, the net present values are estimated as follows: Fatigue provisions result in a cost estimated at$26,822,800 per program, or a cost of $912,903,000 to industry as a whole. The rest of the proposed rule results in a savings estimated at $5,425,100 per program, or savings of $183,050,000 to industry as a whole. Total net present value for the entire rulemaking is estimated at a cost of $21,397,700 per program, or a cost of $729,853,000 to industry as a whole.
** A licensee's FFD program may include more than one facility.

[19] The "other provisions" consists of all other Part 26 revisions including, in particular, provisions related to drug and alcohol testing and authorization, as well as other FFD matters covered by the rule.

4.2 Benefits and Costs — Pre-Order Baseline

The NRC has performed a sensitivity analysis using an alternative baseline (called the "pre-order baseline") that considers the incremental impacts of the Part 26 rule relative to only those regulations that were in effect before the NRC issued the AAO on January 7, 2003, and Order EA-03-038 on April 29, 2003. The purpose of this sensitivity analysis is to account for relevant impacts of the orders in addition to those that are incremental to the proposed rule.[20] These impacts already have been incurred, but they have not previously been quantified.

The results of the sensitivity analysis show lower costs for licensees when compared to the main analysis, both under a 7-percent discount rate and a 3-percent discount rate, as shown in Exhibits 4-7 and 4-8 respectively. Under the pre-order baseline, NRC estimates the present value cost of the proposed rule at $345,880,000 (or $9,813,400 for the average FFD program) using a 7-percent discount rate and $532,281,000 (or $15,291,300 for the average FFD program) using a 3-percent discount rate. Industry will incur a one-time cost totaling $27,553,000 (or $861,200 for the average program) to implement the rule and will incur subsequent annual costs estimated at $23,557,000 (or $880,900 for the average program).

Exhibit 4-7
Industry Savings and Costs by Subpart under the Pre-Order Baseline (7% discount rate)

Subpart	Average Per FFD Program			Total - All FFD Programs		
	One-Time Saving (Cost)	Annual Saving (Cost)	Net Present Value	One-Time Saving (Cost)	Annual Saving (Cost)	Net Present Value
A	-	-	-	-	-	-
B	($199,900)	$212,100	$2,678,200	($6,998,000)	$7,423,000	$93,754,000
C	-	$716,100	$9,814,700	-	$25,065,000	$342,232,000
D	-	-	-	-	-	-
E	($8,600)	$13,300	$173,900	($300,000)	$467,000	$6,071,000
F	($5,300)	($15,800)	($221,200)	($187,000)	($554,000)	($7,764,000)
G	-	($2,200)	($31,800)	-	($76,000)	($1,088,000)
H	-	$12,600	$172,800	-	$442,000	$6,032,000
I	($647,400)	($1,817,500)	($22,407,800)	($20,069,000)	($56,342,000)	($785,384,000)
J	-	$500	$7,800	($0,000)	$19,000	$266,000
K	-	-	-	-	-	-
Total	**($861,200)**	**($880,900)**	**($9,813,400)**	**($27,553,000)**	**($23,557,000)**	**($345,880,000)**

* Net present value is calculated using a discount rate of 7 percent.
** A licensee's FFD program may include more than one facility. The average annual savings (costs) presented are for the initial years of the analysis and change over time as programs decrease in size with the closure of specific plants. Consequently, the total net present values cannot be derived using only the one-time and annual values shown above.

[20] The sensitivity analysis considers only those AAO provisions that are relevant to this rulemaking and, therefore, does not quantify the impact of the AAO as a whole.

Exhibit 4-8
Industry Savings and Costs by Subpart under the Pre-Order Baseline (3% discount rate)

Subpart	Average Per FFD Program			Total - All FFD Programs		
	One-Time Saving (Cost)	Annual Saving (Cost)	Net Present Value	One-Time Saving (Cost)	Annual Saving (Cost)	Net Present Value
A	-	-	-	-	-	-
B	($199,900)	$212,100	$4,490,900	($6,998,000)	$7,423,000	$151,636,000
C	-	$716,100	$16,172,100	-	$25,065,000	$539,745,000
D	-	-	-	-	-	-
E	($8,600)	$13,300	$291,400	($300,000)	$467,000	$9,755,000
F	($5,300)	($15,800)	($357,300)	($187,000)	($554,000)	($12,237,000)
G	-	($2,200)	($56,300)	-	($76,000)	($1,787,000)
H	-	$12,600	$284,300	-	$442,000	$9,523,000
I	($647,400)	($1,817,500)	($36,130,200)	($20,069,000)	($56,342,000)	($1,229,348,000)
J	-	$500	$13,800	($0,000)	$19,000	$433,000
K	-	-	-	-	-	-
Total	**($861,200)**	**($880,900)**	**($15,291,300)**	**($27,553,000)**	**($23,557,000)**	**($532,281,000)**

* Net present value is calculated using a discount rate of 3 percent.
** A licensee's FFD program may include more than one facility. The average annual savings (costs) presented are for the initial years of the analysis and change over time as programs decrease in size with the closure of specific plants. Consequently, the total net present values cannot be derived using only the one-time and annual values shown above.

Exhibit 4-9 presents only the *additional* costs and savings that accrue under the pre-order baseline relative to the main analysis. As shown, the rule yields additional one-time costs of $6,863,000 ($200,900 for the average program) and additional annual savings of $9,453,000 ($216,000 for the average program), all of which relates to requirements in Subparts B, C, and I.

Exhibit 4-9
Industry Savings and Costs by Subpart: Additional Savings (Costs) under the Pre-Order Baseline Relative to the Main Analysis

Subpart	Average Per FFD Program		Total - All FFD Programs	
	One-Time Saving	Annual Saving	One-Time Saving	Annual Saving
A	-	-	-	-
B	($158,800)	($28,500)	($5,560,000)	($997,000)
C	-	$717,700	-	$25,122,000
D	-	-	-	-
E	-	-	-	-
F	-	-	-	-
G	-	-	-	-
H	-	-	-	-
I	($42,100)	($473,300)	($1,303,000)	($14,672,000)
J	-	-	-	-
K	-	-	-	-
Total	**($200,900)**	**$216,000**	**($6,863,000)**	**$9,453,000**

* A licensee's FFD program may include more than one facility. The average annual savings (costs) presented are for the initial years of the analysis and change over time as programs decrease in size with the closure of specific plants.

Exhibit 4-10 shows the specific provisions within Subparts B, C, and I that contribute added costs and savings under the pre-order baseline. A total of over $25 million in annual savings (over $700,000 per program) results from various revisions to requirements in §§26.55-59 governing the granting of authorization under Subpart C. Some of these provisions eliminate the need to administer pre-access drug and alcohol tests to initial applicants, update applicants, and reinstatement applicants if the applicants have previously had authorization and have been covered by a licensee-approved behavioral observation program and random drug and alcohol testing program throughout the period of interruption. Other provisions would allow licensees to forego obtaining self-disclosures from, or undertaking suitable inquiries about, applicants that have previously had authorization and have been covered by a licensee-approved behavioral observation program throughout the period of interruption.

The largest annual cost that appears under the pre-order baseline results from the collective work hour limits specified in §§26.199(f)(1)-(2), as applied to security personnel. These costs are estimated at $14.7 million, or about $473,300 for the average program.

Finally, a large one-time cost results from requiring all employees to be trained in behavioral observation and other aspects of the rule under proposed §26.29(a). As a result, licensees will be required to update the training of all existing employees that were previously trained at the non-supervisory-level, resulting in one-time industry-wide costs of $5,560,000 (or an average of $158,900 per program). Proposed §26.29(a) also generates lesser annual costs, which are attributable to the need to continue such training in future years.

Exhibit 4-10
Pre-Order Baseline: Industry Savings and Costs from Proposed Revisions to Subparts B, C, and I

Section/ Activity	Average Per FFD Program		Total - All FFD Programs	
	One-Time Saving (Cost)	Annual Saving (Cost)	One-Time Saving (Cost)	Annual Saving (Cost)
26.29(a) Revise and Implement Training, Including Behavioral Observation	($158,856)	($28,487)	($5,559,945)	($997,038)
26.55(a)(1) Self-Disclosure for Initial Applicants	-	$8,859	-	$310,051
26.55(a)(2) Suitable Inquiry for Initial Applicants	-	$19,181	-	$671,352
26.55(a)(3) Pre-Access Testing for Initial Applicants	-	$57,953	-	$2,028,350
26.57(a)(1) Self Disclosure for Update Applicants	-	$680	-	$23,803
26.57(a)(2) Suitable Inquiry for Update Authorization	-	$2,863	-	$100,195
26.57(a)(3) Pre-Access Testing for Update Applicants	-	$8,562	-	$299,672
26.59(a)(1) Self-Disclosure for Reinstatement Applicants with 31-365 Day Interruption	-	$4,964	-	$173,725
26.59(a)(2) Suitable Inquiry for Reinstatement Applicants with 31-365 Day Interruption	-	$20,964	-	$733,729
26.59(a)(3) Pre-Access Testing for Reinstatement Applicants with 31-365 Day Interruption	-	$213,808	-	$7,483,278
26.59(c)(1) Self-Disclosure (and Suitable Inquiry) for Reinstatement Applicants with Less than 31 Day Interruption	-	$44,658	-	$1,563,028
26.59(c)(2) Pre-Access Testing for Reinstatement Applicants with Less than 31 Day Interruption	-	$335,287	-	$11,735,044
26.199(f)(1)-(2) Collective Work Hour Limits	($42,035)	($473,284)	($1,303,088)	($14,671,800)
Total	($200,891)	$216,007	($6,863,032)	$9,453,389

4.3 Sensitivity Analysis — Industry Practices

This sensitivity analysis considers a baseline that reflects industry practices prior to the AAO and recent enforcement discretion and is in accordance with licensees' interpretation of existing regulations. For a few rule provisions, until recently, some licensees interpreted the existing Part 26 rule inconsistently with the NRC interpretation. For these provisions, some licensees'

practices have recently changed (subsequent to enforcement discretion and issuance of the AAO) to comply with the current rule. Measured relative to the previous practices, therefore, the cost of complying with the relevant provisions in the proposed rule will exceed that estimated in the pre-order baseline.

Exhibits 4-11 and 4-12 summarize the results of this "Industry Practices" sensitivity analysis, using a 7-percent discount rate and a 3-percent discount rate, respectively. Under this baseline, the present value of net costs to industry is estimated to be $446,386,000, or $12,696,000 for the average program, assuming a 7-percent discount rate. Assuming a 3-percent discount rate, the costs are estimated to be $690,803,000, or $20,039,000 for the average program.

Exhibit 4-11
Industry Savings and Costs by Subpart under the Industry Practices Baseline
(7% discount rate)

Subpart	Average Per FFD Program			Total - All FFD Programs		
	One-Time Saving (Cost)	Annual Saving (Cost)	Net Present Value	One-Time Saving (Cost)	Annual Saving (Cost)	Net Present Value
A	-	-	-	-	-	-
B	($200,400)	$211,900	$2,675,300	($7,013,000)	$7,418,000	$93,655,000
C	-	$506,000	$6,935,500	-	$17,711,000	$241,825,000
D	-	-	-	-	-	-
E	($8,600)	$13,300	$173,900	($300,000)	$467,000	$6,071,000
F	($5,300)	($15,800)	($221,200)	($187,000)	($554,000)	($7,764,000)
G	-	($2,200)	($31,800)	-	($76,000)	($1,088,000)
H	-	$12,600	$172,800	-	$442,000	$6,032,000
I	($647,400)	($1,817,500)	($22,407,800)	($20,069,000)	($56,342,000)	($785,384,000)
J	-	$500	$7,800	($0,000)	$19,000	$266,000
K	-	-	-	-	-	-
Total	**($862,000)**	**($1,091,000)**	**($12,696,000)**	**($27,569,000)**	**($30,917,000)**	**($446,386,000)**

* Net present value is calculated using a discount rate of 7 percent.
** A licensee's FFD program may include more than one facility. The average annual savings (costs) presented are for the initial years of the analysis and change over time as programs decrease in size with the closure of specific plants. Consequently, the total net present values cannot be derived using only the one-time and annual values shown above.

Exhibit 4-12
Industry Savings and Costs by Subpart under the Industry Practices Baseline
(3% discount rate)

Subpart	Average Per FFD Program			Total - All FFD Programs		
	One-Time Saving (Cost)	Annual Saving (Cost)	Net Present Value	One-Time Saving (Cost)	Annual Saving (Cost)	Net Present Value
A	-	-	-	-	-	-
B	($200,400)	$211,900	$4,486,100	($7,013,000)	$7,418,000	$151,482,000
C	-	$506,000	$11,429,300	-	$17,711,000	$381,375,000
D	-	-	-	-	-	-
E	($8,600)	$13,300	$291,400	($300,000)	$467,000	$9,755,000
F	($5,300)	($15,800)	($357,300)	($187,000)	($554,000)	($12,237,000)
G	-	($2,200)	($56,300)	-	($76,000)	($1,787,000)
H	-	$12,600	$284,300	-	$442,000	$9,523,000
I	($647,400)	($1,817,500)	($36,130,200)	($20,069,000)	($56,342,000)	($1,229,348,000)
J	-	$500	$13,800	($0,000)	$19,000	$433,000
K	-	-	-	-	-	-
Total	**($862,000)**	**($1,091,000)**	**($20,039,000)**	**($27,569,000)**	**($30,917,000)**	**($690,803,000)**

* Net present value is calculated using a discount rate of 3 percent.
** A licensee's FFD program may include more than one facility. The average annual savings (costs) presented are for the initial years of the analysis and change over time as programs decrease in size with the closure of specific plants. Consequently, the total net present values cannot be derived using only the one-time and annual values shown above.

Exhibit 4-13 details the specific provisions for which costs are higher under the industry practices baseline than under the pre-order baseline.[21] As shown, the NRC estimates that industry would have incurred a total annual cost of about $7,360,000 (or about $210,300 for the average program), as well as a total one-time cost of $15,000 (approximately $400 for the average program), to modify recent practices. Most of these costs are associated with licensees' practices for reinstating the authorization of applicants with interruptions of 30 days or less. Appendix 1, which documents the calculation of savings and costs for individual rule requirements (including those cited in Exhibit 4-13), describes the industry practices at issue in this sensitivity analysis.

[21] Exhibit 4-13 measures the cost of industry coming into compliance with the pre-AAO requirements. Note, however, that the AAO relaxed or eliminated some of the Part 26 requirements with which some licensees had not been complying. Therefore, industry's subsequent compliance actually was achieved partly as a result of a change in its practices and partly as a result of the NRC changing the requirements. For this reason, industry did not "incur" all of the costs shown in Exhibit 4-13. Use of this analytical approach avoids double-counting the results presented in these Exhibits 4-11 and 4-12.

Exhibit 4-13
Industry Savings and Costs Attributable to Activities Affected by Recent Changes in Industry Practices

Section/ Activity	Average Per FFD Program		Total - All FFD Programs	
	One-Time Saving (Cost)	Annual Saving (Cost)	One-Time Saving (Cost)	Annual Saving (Cost)
26.25(a)(4) FFD Program Personnel Subject to the Rule	($438)	($167)	($15,341)	($5,833)
26.55(a)(2) Suitable Inquiry for Initial Applicants	-	($4,161)	-	($145,649)
26.57(a)(2) Suitable Inquiry for Update Authorization	-	($615)	-	($21,518)
26.59(a)(2) Suitable Inquiry for Reinstatement Applicants with 31-365 Day Interruption	-	($4,487)	-	($157,052)
26.59(c)(1) Self-Disclosure (and Suitable Inquiry) for Reinstatement Applicants with Less than 31 Day Interruption	-	($31,757)	-	($1,111,510)
26.59(c)(2) Pre-Access Testing for Reinstatement Applicants with Less than 31 Day Interruption	-	($169,088)	-	($5,918,072)
Total	($438)	($210,275)	($15,341)	($7,359,636)

4.4 Backfit Analysis

This section presents the NRC's evaluation of changes in the proposed rule in accordance with the Backfit Rule, 10 CFR §50.109, 10 CFR §70.76, and 10 CFR §76.76. The backfit provision of 10 CFR §70.76 is applicable to currently operational fuel fabrication facilities. These facilities have been considered in the aggregate backfit analysis. The planned mixed-oxide fuel fabrication facility also would be licensed under Part 70, but has not yet submitted a Part 26 program description. Therefore, the consideration of the costs to the mixed-oxide fuel fabrication facility in the regulatory analysis (see Section 3.2.2) is sufficient for consideration of the impacts to that facility. Although the backfit provision of 10 CFR §76.76 is applicable, there are no backfit impacts because the gaseous diffusion plants licensed by the NRC are not currently authorized to possess formula quantities of strategic special nuclear material.

Section 4.4.1 examines the aggregation of the individual Part 26 rule requirements that constitute backfits, which excludes (1) matters that are not subject to the Backfit Rule, and (2) matters that do not fall within the definition of "backfitting" as defined in the Backfit Rule and discussed below. Section 4.4.2 describes a screening analysis conducted in accordance with NRC's Regulatory Analysis Guidelines to ensure that the aggregate analysis does not mask the inclusion of individual rule provisions that are (1) not cost-beneficial when considered individually and (2) not necessary to meet the goals of the rulemaking. Both analyses examine

the impacts of the rule relative to the baseline used in the main analysis, which consists of existing requirements including the recently issued orders and enforcement discretion.

4.4.1 Aggregated Backfit Analysis

The backfit analysis examines the aggregation of the subset of proposed Part 26 regulatory requirements that constitute backfits as defined in 10 CFR §50.109(a)(1), 10 CFR §70.76(a)(1), and 10 CFR §76.76(a)(1). These provisions are identified in two exhibits. Exhibit 4-14 presents the proposed requirements that both constitute backfits and result in incremental savings or costs. Exhibit 4-15 specifies proposed requirements that constitute backfits that either do not result in incremental costs or savings or that result in incremental costs or savings only in conjunction with other requirements. The analysis excludes individual requirements that are not subject to the Backfit Rule or that are not backfits by definition, which include requirements that fall into one or more of the following categories.

- *Administrative matters*. Revisions that make minor administrative changes, such as correction of typographic errors, correction of inconsistencies, relocating requirements from one section to another, and combining existing requirements into a single section.

- *Information collection and reporting requirements*. Revisions that either amend existing information collection and reporting requirements or impose new information and collection and reporting requirements, which are not considered to be backfits, as set forth in the Committee to Review Generic Requirements (CRGR) charter.

- *Clarifications*. Revisions that clarify current requirements to assure consistent understanding and implementation of the NRC's original intent for these requirements. Without changing the underlying requirements stated in these sections, these revisions remove the ambiguities that produced regulatory uncertainty.

- *Permissive relaxations/Voluntary alternatives*. Revisions that permit, but not require, relaxations or alternatives to current requirements (i.e., licensees are free to either comply with current requirements or adopt the relaxed requirements/voluntary alternative as a binding requirement).

- *Provisions required under the NRC's AAO or Order EA-03-038.* Provisions that have been addressed in a recent FFD AAO and/or Order EA-03-038 and/or enforcement discretion are excluded from the backfit analysis under the exclusion in 10 CFR §50.109(a)(4), 10 CFR §70.76(a)(4), and 10 CFR §76.76(a)(4).

(Exhibit 4-16 presents the rationale for excluding particular requirements from the backfit analysis. This exhibit does not address numerous requirements that were excluded because they merely restate, clarify, or move requirements in the current rule.)

The NRC then evaluated the aggregated set of requirements constituting backfits in accordance with 10 CFR §50.109, 10 CFR §70.76, and 10 CFR §76.76 to determine if the costs of implementing the rule would be justified by a substantial increase in public health and safety

or common defense and security. In performing this analysis, the NRC considered the quantitative and qualitative costs and benefits of the rule, as discussed below.

Exhibit 4-14
FFD Regulatory Requirements that Constitute Backfits and Result in Incremental Costs or Savings

Section/ Activity	Average Per FFD Program		Total - All FFD Programs	
	One-Time Saving (Cost)	Annual Saving (Cost)	One-Time Saving (Cost)	Annual Saving (Cost)
26.27(a) Policy and Procedure Revisions - Overall Program	($29,095)	-	($1,018,308)	-
26.29(a) Revise and Implement Training, Including Behavioral Observation	($1,243)	-	($43,516)	-
26.29(b) Comprehensive Examination	($10,734)	-	($375,682)	-
26.31(d)(3) Forensic Toxicologist Review of More Stringent Cutoff Levels	($10)	-	($343)	-
26.85(a),(b) Urine and Alcohol Collector Training	($3,531)	-	($123,579)	-
26.91(b) Purchase of EBT and Calibration Equipment and Related Training	($5,041)	-	($176,447)	-
26.127 Licensee Testing Facility Policy and Procedure Revisions	($4,769)	-	($166,907)	-
26.131(b) Initial Validity Testing - Onsite Licensee Testing Facilities	($568)	-	($19,863)	-
26.197(a)-(b) Policy and Procedures	($29,888)	-	($926,542)	-
26.197(c) Training	($214,262)	-	($6,642,126)	-
26.199(b) Calculating Work Hours	($104,839)	-	($3,250,000)	-
26.199(c) Scheduling Work Hours	($12,611)	-	($390,950)	-
26.199(f)(1)-(2) Collective Work Hour Limits	($243,746)	-	($7,556,113)	-
26.29(b) Comprehensive Examination	-	($2,541)	-	($88,949)
26.31(b)(1)(i) Background Checks, Psychological Evaluations, Credit History, Criminal History	-	$597	-	$20,880
26.31(b)(2) DOT-Approved Specimen Collection Facilities	-	$121	-	$4,219
26.31(d)(2) Reasonable Effort to Track Randomly Selected Individuals for Testing	-	($3,113)	-	($108,947)
26.33 Behavioral Observation	-	($1,199)	-	($41,976)
26.39(c) Review of FFD Policy Violations	-	($5,462)	-	($191,168)
26.41(b) Audit Frequency	-	$369	-	$12,899

Section/ Activity	Average Per FFD Program		Total - All FFD Programs	
	One-Time Saving (Cost)	Annual Saving (Cost)	One-Time Saving (Cost)	Annual Saving (Cost)
26.55(a)(4) Random Testing Pool for Initial Applicants	-	($447)	-	($15,646)
26.57(a)(4) Random Testing Pool for Update Applicants	-	($66)	-	($2,312)
26.59(a)(4) Random Testing Pool for Reinstatement Applicants with 31-365 Day Interruption	-	($482)	-	($16,871)
26.59(c)(3) Random Testing Pool for Reinstatement Applicants with Less than 31 Day Interruption	-	($652)	-	($22,825)
26.83(a) Blood Collection for Confirmatory Alcohol Testing	-	$248	-	$8,687
26.89(b)(2) Urine Collection: Donors Without Adequate ID	-	$1,489	-	$52,122
26.89(b)(3) Urine Collection: Eliminate Listing Medications on the CCF Form and add description of testing process	-	$5,722	-	$200,268
26.91(b) Purchase of EBT and Calibration Equipment and Related Training	-	($75)	-	($2,625)
26.91(c) Required Use of an EBT on the NHTSA CPL for Confirmatory Testing	-	$8	-	$277
26.95(c) One Breath Specimen Collection for Initial Alcohol Test	-	$9,807	-	$343,251
26.99(b) Lowering Initial BAC Requiring Confirmatory Test to BAC 0.02	-	($108)	-	($3,777)
26.103 FFD Manager Determines Confirmed Positive Test for Alcohol (BAC 0.02 < 0.04)	-	($10)	-	($361)
26.105(b) Urine Collection: Inspecting Contents of Donor's Pockets	-	($9,441)	-	($330,443)
26.109(a) Urine Specimen Quantity: Minimum Quantity of 30 mL	-	$7,188	-	$251,587
26.109(b)(2) Urine Specimen: At Least 30 mL, but Less than Predetermined Quantity	-	($177)	-	($6,186)
26.119 Shy Bladder Medical Evaluation	-	($1,317)	-	($46,098)
26.131(b) Initial Validity Testing - Onsite Licensee Testing Facilities	-	($12,773)	-	($447,040)
26.133 Change Cutoff Levels for Marijuana and Opiates - Onsite Testing Facilities	-	($439)	-	($15,349)
26.137(e)(7) Quality Control Specimens in Each Analytical Run -	-	($3,040)	-	($106,414)

Section/ Activity	Average Per FFD Program		Total - All FFD Programs	
	One-Time Saving (Cost)	Annual Saving (Cost)	One-Time Saving (Cost)	Annual Saving (Cost)
Onsite Testing Facilities				
26.161(b)(1) All Validity Testing Conducted at HHS-Certified Laboratories	-	($10,695)	-	($374,319)
26.161(g) Unidentified Interfering Substance/Adulterant - Contact MRO and Specimen Retesting	-	($355)	-	($12,425)
26.163(a)(1) Change Cutoff Levels for Marijuana and Opiates - HHS-Certified Laboratories	-	($699)	-	($24,473)
26.165(b) Retesting of Single Collection Specimens with Non-Negative Confirmed Drug Test Results	-	($9)	-	($305)
26.167(f)(1) Blind Sample Testing - 1st Quarter of Contract with a HHS-Certified Laboratory	-	$678	-	$23,713
26.167(f)(2) Blind Sample Testing - Contracts with HHS-Certified Laboratories Older Than 90 Days	-	$8,745	-	$306,077
26.189(c) Face-to-Face Determinations of Fitness	-	($2,789)	-	($97,625)
26.197(c) Training	-	($99,880)	-	($3,096,270)
26.199(b) Calculating Work Hours	-	($31,089)	-	($963,747)
26.199(c) Scheduling Work Hours	-	($72,125)	-	($2,235,870)
26.199(d)(2) Breaks (bi-weekly breaks)	-	($532,180)	-	($16,497,579)
26.199(d)(3) Waivers from Individual Work Hour Limits	-	($531,197)	-	($16,467,100)
26.199(e) Self-Declarations of Fatigue	-	($1,305)	-	($40,443)
26.199(f)(1)-(2) Collective Work Hour Limits	-	($41,254)	-	($1,278,889)
26.199(f)(5) Exceeding Collective Work Hour Limits with NRC Approval	-	($1,334)	-	($41,369)
26.199(j) Work Hour Control Reviews	-	($4,224)	-	($130,950)
26.201(a)-(d) Fatigue Assessments	-	($7,652)	-	($237,226)
26.201(e) Post-Fatigue Assessment Controls and Conditions	-	($16,308)	-	($505,533)
Total	($660,336)	($1,359,466)	($20,690,377)	($42,227,128)

The exhibit presents the proposed requirements that both constitute backfits and result in incremental savings or costs. Proposed backfits that do not result in incremental savings or costs, or that result in incremental savings or costs only in conjunction with other requirements, are identified in Exhibit 4-15. Other requirements do not qualify as backfits for reasons explained in Exhibit 4-16, except that Exhibit 4-16 does not address proposed requirements that do not constitute backfits because they represent administrative changes, restatements, or clarifications of requirements in the current rule.

Exhibit 4-15
Proposed Backfits Resulting in No Direct Incremental Costs or Savings

Subpart A	
None.	
Subpart B	
§§26.23(a)–(d)	§26.31(b)(1)
§26.23(e)	§§26.31(b)(1)(ii)– (iv)
§26.25(a)(4)	§26.31(c)(3)
§26.25(d)	§26.31(d)(1)
§26.27(b)	§26.31(d)(1)(I)
§§26.27(b)(1)–26.27(b)(10)	§26.31(d)(1)(ii)
§26.27(b)(11)	§26.31(d)(4)
§§26.27(c)(2)(iii)–(v)	§26.39(a)
§26.27(c)(4)	§26.41(d)(2)
Subpart C	
§26.53(b)	§26.69(b)
§26.55(a)(1)	§26.69(c)
§26.55(a)(2)	§26.69(d)
§26.55(a)(3)	§26.71(b)
Subpart D	
§26.75(b)	§26.75(f)
§26.75(c)	§26.75(g)
§26.75(d)	§26.77(b)
§26.75(e)	
Subpart E	
§26.85(c)	§26.105(e)
§26.85(d)	§26.107(a)
§26.87(b)	§26.107(b)
§26.87(c)	§26.107(c)
§26.87(e)(1)	§26.109(b)(1)
§26.87(e)(3)	§26.109(b)(3)

§26.87(f)(4)	§26.109(b)(4)
§26.89(a)	§26.111(a)
§26.89(c)	§26.111(b)
§26.91(c)	§26.111(d)
§26.91(e)	§26.111(e)
§26.93(a)(1)	§26.111(f)
§§26.93(a)(2)-(3)	§§26.113(a)-(c)
§26.93(a)(4)	§26.115(b)
§26.93(a)(5)	§26.115(c)
§26.93(b)	§26.115(f)
§26.99(a)	§26.115(g)
§26.101(a)	§26.115(h)
§26.101(b)	§26.117(j)
§26.101(c)	§26.117(k)
Subpart F	
§26.123	§26.137(c)
§§26.125(a)-(c)	§26.137(d)
§26.127(c)	§26.137(e)(1)
§26.127(e)	§26.137(e)(2)
§26.129(b)	§26.137(e)(5)
§26.129(c)	§26.137(e)(6)
§26.129(e)	§26.137(e)(8)
§26.129(f)	§26.137(f)
§26.129(h)	§26.139(a)
§26.131(a)	§26.139(f)
§26.137(b)	
Subpart G	
§26.153(a)	§26.165(d)
§26.153(b)	§26.165(e)
§26.153(f)	§26.165(f)

§26.155(b)	§26.167(a)
§26.157(a)	§26.167(b)
§26.157(b)	§26.167(c)
§26.159(b)	§26.167(d)
§26.159(c)	§26.167(e)
§26.159(f)	§§26.167(f)(3)-(4)
§26.159(g)	§26.167(f)(5)
§26.159(i)	§26.167(g)
§26.159(j)	§26.167(i)
§26.161(a)	§26.169(a)
§26.161(b)(2)	§26.169(d)
§§26.161(c)-(f)	§26.169(e)
§26.161(h)	§26.169(f)
§26.163(a)(2)	§26.169(g)
§26.163(b)	§26.169(h)
§26.165(a)	§26.169(j)
§26.165(c)	
Subpart H	
§26.183(a)	§§26.185(h)(2)–(3)
§26.183(b)	§26.185(i)
§26.183(c)	§26.185(j)(1)
§26.183(d)	§26.185(j)(4)
§26.185(a)	§26.185(j)(5)
§26.185(b)	§26.185(j)(6)
§26.185(d)	§26.185(n)
§26.185(e)	§26.185(o)
§26.185(f)(1)	§26.187
§26.185(f)(2)	§26.189(a)(1)
§26.185(f)(3)	§§26.189(a)(2)–(5)
§26.185(g)(1)	§26.189(b)(4)

§26.185(g)(2)	§26.189(c)(1)
§26.185(g)(3)	§26.189(c)(2)
§26.185(h)(1)	§26.189(d)
Subpart I	
§26.199(a)	§26.199(f)(4)
§26.199(f)(3)	§26.199(g)
Subpart J	
§26.219(d)	
Subpart K	
None.	

The exhibit presents the proposed requirements that constitute backfits but either do not result in incremental savings or costs or result in incremental savings or costs only in conjunction with other requirements. For proposed requirements that both constitute backfits and result in incremental savings or costs, refer to Exhibit 4-14. Other requirements do not qualify as backfits for reasons explained in Exhibit 4-16, except that Exhibit 4-16 does not address proposed requirements that do not constitute backfits because they represent administrative changes, restatements, or clarifications of requirements in the current rule.

Exhibit 4-16
Rationale for Excluding Particular Requirements from the Backfit Analysis

Requirement	**Reason**
Subpart A	
§26.11	This revision does not constitute a backfit because it is an information collection and reporting requirement.
Subpart B	
§26.25(b)(1)	This revision does not constitute a backfit because licensees are free to continue to comply with the existing requirement or to adopt the proposed provision.
§26.25(c)	This revision does not constitute a backfit because licensees are free to continue to comply with the existing requirement or to adopt the proposed provision.
§26.29(c)(2)	This revision does not constitute a backfit because licensees are free to continue to comply with the existing requirement or to adopt the proposed provision.
§26.29(c)(3)	This revision does not constitute a backfit because licensees are free to continue to comply with the existing requirement or to adopt the proposed provision.
§26.29(d)	This revision does not constitute a backfit because licensees are free to continue to comply with the existing requirement or to adopt the proposed provision.
§26.31(b)(1)(i)	This revision does not constitute a backfit because licensees are free to continue to comply with the existing requirement or to adopt the proposed provision.

Requirement	Reason
§26.31(b)(2)	This revision does not constitute a backfit because licensees are free to continue to comply with the existing requirement or to adopt the proposed provision.
§26.31(c)(1)	This revision does not constitute a backfit because the actions addressed in this provision are already required under the NRC's AAO.
§26.31(d)(5)	This revision does not constitute a backfit because licensees are free to continue to comply with the existing requirement or to adopt the proposed provision.
§26.37(c)	This revision does not constitute a backfit because it is an information collection and reporting requirement.
§26.37(d)	This revision does not constitute a backfit because it is an information collection and reporting requirement.
§26.41(c)(2)	This revision does not constitute a backfit because licensees are free to continue to comply with the existing requirement or to adopt the proposed provision.
Subpart C	
§26.53(a)	This revision does not constitute a backfit because the actions addressed in this provision are already required under the NRC's AAO.
§26.53(d)	This revision does not constitute a backfit because licensees are free to continue to comply with the existing requirement or to adopt the proposed provision.
§26.55(a)	This revision does not constitute a backfit because the actions addressed in this provision are already required under the NRC's AAO.
§26.57(a)	This revision does not constitute a backfit because the actions addressed in this provision are already required under the NRC's AAO.
§26.57(a)(1)	This revision does not constitute a backfit because it restates existing requirements and because the actions addressed in this provision are already required under the NRC's AAO.
§26.57(a)(2)	This revision does not constitute a backfit because it restates existing requirements and because the actions addressed in this provision are already required under the NRC's AAO.
§26.57(a)(3)	This revision does not constitute a backfit because it restates existing requirements and because the actions addressed in this provision are already required under the NRC's AAO.
§26.59(a)	This revision does not constitute a backfit because the actions addressed in this provision are already required under the NRC's AAO.
§26.59(a)(1)	This revision does not constitute a backfit because it restates existing requirements and because the actions addressed in this provision are already required under the NRC's AAO.
§26.59(a)(2)	This revision does not constitute a backfit because the actions addressed in this provision are already required under the NRC's AAO.

Requirement	Reason
§26.59(a)(3)	This revision does not constitute a backfit because the actions addressed in this provision are already required under the NRC's AAO.
§26.59(b)	This revision does not constitute a backfit because the actions addressed in this provision are already required under the NRC's AAO.
§26.59(c)	This revision does not constitute a backfit because the actions addressed in this provision are already required under the NRC's AAO.
§26.59(c)(1)	This revision does not constitute a backfit because it restates existing requirements and because the actions addressed in this provision are already required under the NRC's AAO.
§26.59(c)(2)	This revision does not constitute a backfit because it restates existing requirements and because the actions addressed in this provision are already required under the NRC's AAO.
§26.61(a)	These provisions are not independent requirements, and their applicability depends upon the provisions in §§26.55 through 26.59. Therefore, any backfitting implications are addressed in the backfit discussion of those sections.
§§26.61(a)(1)–(2)	These provisions are not independent requirements, and their applicability depends upon the provisions in §§26.55 through 26.59. Therefore, any backfitting implications are addressed in the backfit discussion of those sections.
§§26.61(b)(1)–(3)	These provisions are not independent requirements, and their applicability depends upon the provisions in §§26.55 through 26.59. Therefore, any backfitting implications are addressed in the backfit discussion of those sections.
§26.61(c)	These provisions are not independent requirements, and their applicability depends upon the provisions in §§26.55 through 26.59. Therefore, any backfitting implications are addressed in the backfit discussion of those sections.
§26.63(a)	These provisions are not independent requirements, and their applicability depends upon the provisions in §§26.55 through 26.59. Therefore, any backfitting implications are addressed in the backfit discussion of those sections.
§26.63(b)	These provisions are not independent requirements, and their applicability depends upon the provisions in §§26.55 through 26.59. Therefore, any backfitting implications are addressed in the backfit discussion of those sections.
§26.63(c)	These provisions are not independent requirements, and their applicability depends upon the provisions in §§26.55 through 26.59. Therefore, any backfitting implications are addressed in the backfit discussion of those sections.
§26.63(d)	These provisions are not independent requirements, and their applicability depends upon the provisions in §§26.55 through 26.59. Therefore, any backfitting implications are addressed in the backfit discussion of those sections.
§26.63(f)(1)	These provisions are not independent requirements, and their applicability depends upon the provisions in §§26.55 through 26.59. Therefore, any backfitting implications are addressed in the backfit discussion of those sections.
§26.63(f)(2)	These provisions are not independent requirements, and their applicability depends upon the provisions in §§26.55 through 26.59. Therefore, any backfitting implications are addressed in the backfit discussion of those sections.

Requirement	Reason
§26.63(f)(3)	These provisions are not independent requirements, and their applicability depends upon the provisions in §§26.55 through 26.59. Therefore, any backfitting implications are addressed in the backfit discussion of those sections.
§26.65(b)	These provisions are not independent requirements, and their applicability depends upon the provisions in §§26.55 through 26.59. Therefore, any backfitting implications are addressed in the backfit discussion of those sections.
§26.65(c)	These provisions are not independent requirements, and their applicability depends upon the provisions in §§26.55 through 26.59. Therefore, any backfitting implications are addressed in the backfit discussion of those sections.
§26.65(d)(1)	These provisions are not independent requirements, and their applicability depends upon the provisions in §§26.55 through 26.59. Therefore, any backfitting implications are addressed in the backfit discussion of those sections.
§26.65(d)(2)	These provisions are not independent requirements, and their applicability depends upon the provisions in §§26.55 through 26.59. Therefore, any backfitting implications are addressed in the backfit discussion of those sections.
§26.65(e)(1)	These provisions are not independent requirements, and their applicability depends upon the provisions in §§26.55 through 26.59. Therefore, any backfitting implications are addressed in the backfit discussion of those sections.
§§26.65(e)(2)(i) and (iii)	These provisions are not independent requirements, and their applicability depends upon the provisions in §§26.55 through 26.59. Therefore, any backfitting implications are addressed in the backfit discussion of those sections.
§26.65(e)(2)(ii)	These provisions are not independent requirements, and their applicability depends upon the provisions in §§26.55 through 26.59. Therefore, any backfitting implications are addressed in the backfit discussion of those sections.
§26.65(e)(3)	These provisions are not independent requirements, and their applicability depends upon the provisions in §§26.55 through 26.59. Therefore, any backfitting implications are addressed in the backfit discussion of those sections.
§26.65(f)	These provisions are not independent requirements, and their applicability depends upon the provisions in §§26.55 through 26.59. Therefore, any backfitting implications are addressed in the backfit discussion of those sections.
§26.65(g)	These provisions are not independent requirements, and their applicability depends upon the provisions in §§26.55 through 26.59. Therefore, any backfitting implications are addressed in the backfit discussion of those sections.
§26.65(h)	These provisions are not independent requirements, and their applicability depends upon the provisions in §§26.55 through 26.59. Therefore, any backfitting implications are addressed in the backfit discussion of those sections.
§26.67(a)	These provisions are not independent requirements, and their applicability depends upon the provisions in §§26.55 through 26.59. Therefore, any backfitting implications are addressed in the backfit discussion of those sections.
§26.67(a)(2)	These provisions are not independent requirements, and their applicability depends upon the provisions in §§26.55 through 26.59. Therefore, any backfitting implications are addressed in the backfit discussion of those sections.

Requirement	Reason
§26.67(b)	These provisions are not independent requirements, and their applicability depends upon the provisions in §§26.55 through 26.59. Therefore, any backfitting implications are addressed in the backfit discussion of those sections.
§26.67(c)	These provisions are not independent requirements, and their applicability depends upon the provisions in §§26.55 through 26.59. Therefore, any backfitting implications are addressed in the backfit discussion of those sections.
Subpart D	
None.	
Subpart E	
§§26.97(a)-(e)	This revision does not constitute a backfit because licensees are free to continue to comply with the existing requirement or to adopt the proposed provision.
§26.101(d)	This revision does not constitute a backfit because licensees are free to continue to comply with the existing requirement or to adopt the proposed provision.
§26.111(c)	This revision does not constitute a backfit because it is an information collection and reporting requirement.
§26.115(d)	This revision does not constitute a backfit because it is an information collection and reporting requirement.
Subpart F	
§26.135(b)	This revision does not constitute a backfit because licensees are free to continue to comply with the existing requirement or to adopt the proposed provision.
§26.137(e)(3)	This revision does not constitute a backfit because licensees are free to continue to comply with the existing requirement or to adopt the proposed provision.
§26.137(h)	This revision does not constitute a backfit because licensees are free to continue to comply with the existing requirement or to adopt the proposed provision.
§26.139(b)	This revision does not constitute a backfit because licensees are free to continue to comply with the existing requirement or to adopt the proposed provision.
§26.139(d)	This revision does not constitute a backfit because it is an information collection and reporting requirement.
§26.139(e)	This revision does not constitute a backfit because it is an information collection and reporting requirement.
Subpart G	
§26.153(e)	This revision does not constitute a backfit because licensees are free to continue to comply with the existing requirement or to adopt the proposed provision.
§26.153(g)	This revision does not constitute a backfit because it is an information collection and reporting requirement.
§26.155(d)	This revision does not constitute a backfit because it is an information collection and reporting requirement.
§26.155(f)	This revision does not constitute a backfit because licensees are free to continue to comply with the existing requirement or to adopt the proposed provision.
§26.157(c)	This revision does not constitute a backfit because licensees are free to continue to comply with the existing requirement or to adopt the proposed provision.

Requirement	Reason
§26.159(a)	This revision does not constitute a backfit because licensees are free to continue to comply with the existing requirement or to adopt the proposed provision.
§26.169(b)	This revision does not constitute a backfit because it is an information collection and reporting requirement.
§26.169(c)	This revision does not constitute a backfit because it is an information collection and reporting requirement.
§26.169(i)	This revision does not constitute a backfit because licensees are free to continue to comply with the existing requirement or to adopt the proposed provision.
§26.169(k)	This revision does not constitute a backfit because it is an information collection and reporting requirement.
Subpart H	
§26.185(c)	This revision does not constitute a backfit because licensees are free to continue to comply with the existing requirement or to adopt the proposed provision.
§26.185(g)(4)	This revision does not constitute a backfit because licensees are free to continue to comply with the existing requirement or to adopt the proposed provision.
§26.189(b)(3)	This revision does not constitute a backfit because licensees are free to continue to comply with the existing requirement or to adopt the proposed provision.
Subpart I	
§26.197(d)	This revision does not constitute a backfit because it is an information collection and reporting requirement.
§26.197(e)	This revision does not constitute a backfit because it is an information collection and reporting requirement.
§26.197(e)(1)	This revision does not constitute a backfit because it is an information collection and reporting requirement.
§26.197(e)(2)	This revision does not constitute a backfit because it is an information collection and reporting requirement.
§26.197(e)(3)	This revision does not constitute a backfit because it is an information collection and reporting requirement.
§26.199(d)(1)	This provision does not constitute a backfit, except for three reactors, because licensees are free to comply with the existing Technical Specification requirement or to adopt the permissive relaxation. The three reactors that do not have this requirement within their Technical Specifications have implemented it as part of their administrative procedures. For these three reactors, this provision constitutes a backfit. The cost of this backfit would be very small, however, and is not significant to the analysis. (The cost would include some administrative costs related to authorizing work hour deviations under certain high workload situations. Any other costs related to the new requirement are addressed under appropriate provisions.)
§26.201(f)	This revision does not constitute a backfit because it is an information collection and reporting requirement.
Subpart J	

Requirement	Reason
§26.211(b)	This revision does not constitute a backfit because it is an information collection and reporting requirement.
§§26.213(a)	This revision does not constitute a backfit because it is an information collection and reporting requirement.
§§26.213(b)	This revision does not constitute a backfit because it is an information collection and reporting requirement.
§§26.213(c)	This revision does not constitute a backfit because it is an information collection and reporting requirement.
§§26.213(d)	This revision does not constitute a backfit because it is an information collection and reporting requirement.
§§26.213(e)	This revision does not constitute a backfit because it is an information collection and reporting requirement.
§§26.213(f)	This revision does not constitute a backfit because it is an information collection and reporting requirement.
§§26.213(g)	This revision does not constitute a backfit because it is an information collection and reporting requirement.
§§26.215(a) and 26.215(b)	This revision does not constitute a backfit because it is an information collection and reporting requirement.
§26.217(b)	This revision does not constitute a backfit because it is an information collection and reporting requirement.
§26.217(c)	This revision does not constitute a backfit because it is an information collection and reporting requirement.
§§26.217(e) and 26.217(f)	This revision does not constitute a backfit because licensees are free to continue to comply with the existing requirement or to adopt the proposed provision.
§26.217(g)	This revision does not constitute a backfit because it is an information collection and reporting requirement.
§26.219(b)	This revision does not constitute a backfit because it is an information collection and reporting requirement.
§26.219(c)(3)	This revision does not constitute a backfit because it is an information collection and reporting requirement.
Subpart K	
None.	

The exhibit presents the proposed requirements that do not constitute backfits, along with the reasons the proposed requirements do not constitute backfits, but excludes proposed requirements that do not constitute backfits because they represent administrative changes, restatements, or clarifications of requirements in the current rule. For proposed requirements that both constitute backfits and result in incremental savings or costs, refer to Exhibit 4-14. Exhibit 4-15 identifies proposed requirements that constitute backfits that either do not result in incremental savings or costs or that result in incremental savings or costs only in conjunction with other requirements.

Collectively, the individual requirements in the proposed rule that qualify as backfits result in an estimated net cost of approximately $594 million to industry over the next 49 years (present

value), assuming a 7-percent discount rate, or approximately $927 million assuming a 3-percent discount rate.[22] The present value of these costs to the average program is calculated to be approximately $19,679,000 assuming a 7-percent discount rate, and approximately $32,264,200 using a 3-percent discount rate.

For the average licensee FFD program, these backfits would mean an initial one-time cost of approximately $660,300, followed by annual costs of about $1,359,500 per year. For industry as a whole, NRC estimates that the backfits would result in approximately $20.7 million in one-time costs, and about $42.2 million in annual costs.

With regard to safety benefits afforded by the Part 26 rule's provisions, as documented in both this regulatory analysis and the statement of considerations of the proposed Part 26 rule, the NRC considered them in qualitative terms. (See Section 3.2 of this document for a discussion of the issues that would be involved in quantifying the benefits of the proposed rule.) NRC also qualitatively determined whether the costs of the rule would be justified in light of the safety benefits. By contrast, the NRC evaluated costs and cost reductions in quantitative terms, as documented in the regulatory analysis and in the statement of considerations of the proposed rule.

In performing this analysis, the NRC considered the nine factors in 10 CFR §50.109, 10 CFR §70.76, and 10 CFR §76.76, as follows:

(i) *Statement of the specific objectives that the proposed backfit is designed to achieve.*

The rulemaking constitutes an integrated regulatory initiative directed at the singular regulatory matter of FFD requirements at nuclear facilities. The goals of the proposed rule would be as follows:

1. Update and enhance the consistency of 10 CFR Part 26 with advances in other relevant Federal rules and guidelines, including the U.S. Department of Health and Human Services Mandatory Guidelines for Federal Workplace Drug Testing Programs (HHS Guidelines) and other Federal drug and alcohol testing programs (e.g., those required by the U.S. Department of Transportation [DOT]) that impose similar requirements on the private sector.

2. Strengthen the effectiveness of FFD programs at nuclear power plants in ensuring against worker fatigue adversely affecting public health and safety and the common defense and security by establishing clear and enforceable requirements for the management of worker fatigue.

3. Improve the effectiveness and efficiency of FFD programs.

4. Improve consistency between Part 26 requirements and access authorization requirements established in 10 CFR 73.56, as

[22] For more information regarding the derivation of these cost estimates and assumptions employed, see Section 3.2 and Appendix 1.

supplemented by orders to nuclear power plant licensees dated January 7, 2003.

5. Improve 10 CFR Part 26 by eliminating or modifying unnecessary requirements.

6. Improve clarity in the organization and language of the rule.

7. Protect the privacy and due process rights of individuals who are subject to 10 CFR Part 26.

(ii) *General description of the activity that would be required by the licensee or applicant in order to complete the backfit.*

In general terms, the proposed Part 26 rule would: require licensees to modify their procedures for training, scheduling and monitoring work hours, granting authorization, and conducting onsite testing; require offsite laboratories used by licensees and C/Vs to comply with HHS guidelines, perform additional testing in specific circumstances, and comply with certain procedures intended to protect the rights of tested individuals; and ensure that persons who are impaired and/or are using illegal drugs do not perform safety or security functions at a nuclear facility. Detailed discussions of what activities and procedural changes would be required by the Part 26 rule are set forth in this analysis and the statement of considerations of the proposed Part 26 rule.

(iii) *Potential change in the risk to the public from the accidental offsite release of radioactive material or hazardous chemicals produced from licensed material.*

The rulemaking is intended to provide added assurance that the risk of offsite releases, of either radioactive material or hazardous chemicals produced from licensed materials, as a result of cognitive impairment from fatigue or the use of legal and illegal drugs is acceptably low and consistent with the NRC's Safety Goals. However, the reduction in risk to the public from offsite releases of radioactive materials and hazardous chemicals has not been fully quantified because there is insufficient information and modeling to support such quantification (see Section 3.2).

(iv) *Potential impact on facility employees from radiological exposure or exposure to hazardous chemicals produced from licensed material .*

The rulemaking would provide added assurance that nuclear industry workers are not subjected to unnecessary radiological or hazardous chemical exposures either directly as the result of cognitive impairment (*e.g.*, where a worker receives an exposure which is greater than expected because of impairment while performing a work function), or because cognitive impairment causes an accident leading to a release of radiation or hazardous chemicals produced from licensed material, which workers then are exposed to as the result of mitigative and/or clean-up activities.

(v) *Installation and continuing costs associated with the backfit, including the cost of facility downtime or the cost of construction delay.*

Part 26 is primarily programmatic in nature and does not involve changes to the licensed facility itself; hence there are no installation or direct downtime costs associated with implementing this rule. The regulatory analysis for the Part 26 rule sets forth the NRC's estimate of the initial costs for implementing the major elements of the proposed Part 26 rule, and the ongoing costs and savings to the licensees. The estimated one-time industry net cost of this rule would be approximately $20.7 million (or $0.7 million for the average program), and the annually recurring cost would be slightly more than $42.2 million (or $1.4 million for the average program). Combining these initial and annual costs, this analysis estimates that the proposed Part 26 rule would cost industry approximately $594 million (present value, assuming a 7-percent discount rate) to $927 million (present value, assuming a 3-percent discount rate).

(vi) *The potential safety impact of changes in plant or operational complexity, including the relationship to proposed and existing regulatory requirements.*

The proposed Part 26 rule would make no change with respect to the design of a nuclear power plant or other facility. Therefore, this rule is not expected to have any effect on facility complexity.

The proposed rule also does not affect the direct procedures for operating the plant. For example, the duties of operators are not affected by the rule, although the number of hours that any given operator works each week may be affected. Rather, the changes to Part 26 in the proposed rule are directed at ancillary procedures and supporting administrative organization associated with operating the plant. The proposed rule would require modified work schedules, additional testing (*e.g.*, employees who are offsite when selected for testing), and changes to Part 26 program procedures to ensure greater integrity of tests and to reduce tampering of specimens and subversion of tests. These "costs" in terms of increased complexity in FFD procedures are discussed in this Part 26 regulatory analysis, which indicates that the added FFD program complexity is not significant and will not substantially impact licensees' operational practices or result in substantial indirect costs.

(vii) *The estimated resource burden on the NRC associated with the proposed backfit and the availability of such resources.*

The rulemaking would not result in a substantial increase in expenditures of agency resources, as the NRC is already inspecting licensees' implementation of FFD programs required by Part 26, and the proposed Part 26 rule does not substantially expand the FFD activities currently required under Part 26 for which NRC oversight is needed. The regulatory analysis estimates an annual cost to NRC of $45,000.

(viii) *The potential impact of differences in facility type, design or age on the relevancy and practicality of the proposed backfit.*

The proposed requirements for FFD in Part 26 do not relate to, and are independent of, the facility type, design or age. Therefore, the benefits and costs attributable to the proposed Part 26 rule do not vary based upon the facility type, design or age.

(ix) *Whether the proposed backfit is interim or final and, if interim, the justification for imposing the backfit on an interim basis.*

The proposed backfit, when implemented later at the final rule stage, would be final.

The NRC finds that the backfits contained in the proposed Part 26 rule, when considered in the aggregate, would constitute a substantial increase in protection to public health and safety and security, by addressing the following seven key areas that have been identified by the Staff as posing recurring and, in some cases, significant problems with respect to the effectiveness, integrity, and efficiency of FFD programs at nuclear facilities.

(i) High potential for worker fatigue

Although all power reactor licensees have implemented work hour controls, these controls vary considerably across licensees due in part to differing interpretations of NRC guidance. NRC has found that some licensees authorized hundreds to several thousand deviations from current work hour limits, resulting in substantial overtime hours for workers. The use of 12-hour shifts, including 6 or more consecutive 12-hour shifts per week during outages, is very common. (The average refueling outage lasts 39 days.) These and other factors, discussed in Section 4.1.3 of the regulatory analysis, contribute to a high potential for worker fatigue and degradation of worker fitness for duty at power reactors. For example, there have been instances of operators falling asleep in the control rooms at a nuclear power station and at a test and research reactor, as well as a security officer falling asleep at a nuclear power plant while driving a patrol vehicle, despite these individuals recognizing the potential safety and disciplinary consequences. Since September 11, 2001, the NRC has received reports of nuclear security officers found asleep while on duty. In addition, the NRC received numerous allegations from nuclear security officers that certain licensees have required them to work excessive amounts of overtime over long periods due to the post-September 11 threat environment. The NRC believes that the proposed rule's work hour controls will reduce the potential for worker fatigue, and that other proposed provisions will increase the likelihood that workers experiencing fatigue (from any cause) are removed from duty. Considering the importance of reliable human performance to the safe operation of nuclear power plants, the NRC concludes that these protections constitute a substantial increase in protection to public health and safety, and contribute to Goal 2 for the rulemaking. (Proposed Subpart I would not apply to the materials licensees who are otherwise subject to Part 26 because there is no evidence of excessive overtime use by these materials licensees.)

(ii) Subversion of the detection/testing process

The NRC's intent when it first adopted Part 26 was that FFD programs have a high degree of effectiveness such that nuclear facilities would be essentially "drug-free" (54 FR 24468; June 7, 1989). To that end, the current Part 26 rule contains several provisions aimed at preventing subversion. However, subversion techniques have evolved and grown more sophisticated since the adoption of the anti-subversion provisions of the 1989 rule. The NRC believes that the adoption of the anti-subversion provisions in the proposed Part 26 rule

would serve to keep pace with the evolution of subversion techniques, thereby maintaining the level of effectiveness that the Commission originally intended when it adopted the 1989 Part 26 rule. Accordingly, the NRC concludes that provisions in the proposed Part 26 rule aimed at preventing subversion constitute a substantial increase in protection to public health and safety, and contribute to Goals 1 and 3 for the rulemaking.

(iii) Regulatory efficiency

The 1989 Part 26 rule requirements were based upon, and keyed to, the drug testing provisions in the HHS Guidelines. HHS, as the lead Federal agency for the development of FFD programs and drug testing requirements, has periodically revised its guidelines based upon its review and experience with both Federal and private-sector FFD and drug testing programs. The NRC believes that there is substantial benefit to conforming its regulations to the most recent HHS Guidelines, taking into account the unique characteristics of the nuclear industry which may warrant departures from specific aspects of the HHS Guidelines. As the Commission stated in its June 30, 1993, SRM, conformance with national standards may be a basis for finding substantial increase in protection. In view of the nature of the HHS Guidelines, the NRC believes that the FFD changes to conform Part 26 to the HHS Guidelines do represent such an instance, and contribute to Goal 1 for the rulemaking.

(iv) Ineffective/unnecessary Part 26 requirements

A significant number of the proposed Part 26 rule's changes would remove requirements from Part 26 which implementation experience shows are either unnecessary or ineffective in achieving the intended objective of the requirement. Removing such requirements simplifies the FFD program and permits licensees to focus their attention on Part 26 requirements that have a more direct impact on FFD program effectiveness. Accordingly, the NRC regards these provisions as providing a substantial increase in protection to public health and safety, and contributing to Goals 3 and 5 for the rulemaking.

(v) Ambiguous or imprecise regulatory language in Part 26

A substantial number of provisions in the proposed Part 26 rule are intended to clarify current Part 26 requirements and other NRC guidance that use ambiguous or imprecise language. These changes are based upon the NRC Staff's experience with the implementation of Part 26 and fatigue management, which has included situations where the licensee's interpretation resulted in increased work hour deviations, increased opportunities for subversion, decreased assurance of FFD test integrity, and ineffective corrective action in response to confirmed positive results. Utilizing more precise regulatory language should result in a higher level of performance by licensees or other entities and provide a clear regulatory basis for enforcement action against licensees or other entities who fail to meet the clarified regulatory requirements. Accordingly, the NRC concludes that these provisions, which are intended to correct the deficiencies attributable to ambiguous or imprecise regulatory language, provide a substantial increase in protection, and contribute to Goal 6 for the rulemaking.

(vi) Technical developments resulting in higher levels of effectiveness

A number of the proposed Part 26 rule provisions are intended to reflect the technological improvements in testing methodologies, which improve the capability to identify specific drug metabolites and isomers indicative of illegal drugs and which have increased sensitivity permitting detection at lower levels. Such improvements can reduce false positives, thereby reducing the adverse effects to individuals, and they can reduce licensee resources currently expended on validating false positives. The improvements also have the capability to reduce false negatives, thus providing greater assurance that persons who have reduced cognitive functions due to illegal drug use are detected and prevented from performing safety-related work. There also would be greater assurance that those who are less trustworthy and reliable, on average (as evidenced by drug and alcohol abuse) do not have access to the protected area and, therefore, do not pose a safeguards or security risk. The NRC concludes that these provisions constitute a substantial increase in protection to public health and safety, and contribute to Goals 1, 3, and 4 for the rulemaking.

(vii) Part 26 program integrity and protection of individual rights

Several of the proposed Part 26 rule provisions are intended to ensure that the FFD program requirements are implemented fairly by the licensee, and that individuals with significant responsibilities are not inappropriately influenced when performing their duties. Other provisions are intended to protect the rights of tested workers by providing a fair opportunity to address any findings of illegal drug use. The NRC concludes that these changes, when considered collectively, provide a substantial increase in protection to public health and safety, and contribute to Goal 7 for the rulemaking. A successful FFD program, and more generally a positive regulatory environment, depends in part upon the perception of workers at nuclear facilities that the NRC's regulatory requirements and their implementation by licensees are fair and appropriate. Workers who do not believe that NRC requirements are fair may be less likely to regard other NRC requirements, or licensee procedures which implement NRC requirements, as justified and may be more likely to disregard them.

These key areas, and the manner in which specific Part 26 rule provisions address these areas and issues, are discussed in detail in the Statement of Considerations of the proposed Part 26 rule.

In light of the findings above, the NRC submits that the qualitative safety benefits of the proposed Part 26 rule provisions that qualify as backfits, considered in the aggregate, would constitute a substantial increase in protection to public health and safety and the common defense and security, and that the costs of this rule would be justified in view of the increase in protection to safety and security provided by the backfits embodied in the proposed rule.

4.4.2 Screening Review for Disaggregation

This section presents a screening analysis conducted to ensure that the aggregate analysis does not mask the inclusion of individual rule provisions that are not cost-beneficial when considered individually and not necessary to meet the goals of the rulemaking. This analysis

has been conducted in accordance with direction provided in the Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission, NUREG/BR-0058, Revision 4.

The NRC conducted a two-step screening review to determine whether any proposed rule provisions should be evaluated on a disaggregated basis before including it in the overall rule.

In the first step of the screening review, the NRC identified all individual Part 26 rule changes that qualify as backfits where the total present value cost to industry is expected to reach or exceed approximately $50,000 per program (assuming a 7-percent discount rate), and/or where total initial industry costs are estimated to reach or exceed approximately $1,000,000. This step is necessary due to the large number of changes contained in this particular rulemaking. The threshold levels have been selected to be relatively inclusive (i.e., conservatively low) in recognition of the differing opinions expressed on various provisions during extensive stakeholder involvement. The $50,000 threshold also corresponds roughly to the cost of paying one worker for one year. The Staff believes the $1,000,000 threshold is a reasonable figure to consider significant for one-time costs to industry as a whole. Exhibit 4-17 presents the proposed rule provisions identified in this initial step.

Exhibit 4-17
Identification of Requirements to Analyze Individually

Individual Requirement	Per Program Total Cost > $50,000 (Present Value)	Initial Cost to Industry > $1,000,000
26.27(a) Policy and Procedure Revisions - Overall Program	No	$1,018,308
26.39(c) Review of FFD Policy Violations	$74,790	No
26.105(b) Inspecting Contents of Donor's Pockets	$129,278	No
26.131(b) Onsite Lab Initial Validity Tests	$174,842	No
26.161(b)(1) HHS Lab Validity Testing	$146,868	No
26.197(a)-(b) Fatigue Policy and Procedures	No	$926,542
26.197(c) Training and Examinations for Fatigue	$1,597,030	$6,642,126
26.199(b) Calculating Work Hours	$540,263	$3,250,000
26.199(c) Work Hours Scheduling	$1,022,786	No
26.199(d)(2) Individual Rest Breaks	$7,453,672	No
26.199(d)(3) Waiver of Individual Work Hour Controls	$7,439,901	No
26.199(f)(1)-(2) Collective Work Hours	$821,553	$7,556,113
26.199(j) Work Hour Control Reviews	$59,164	No
26.201(a)-(d) Fatigue Assessments	$107,180	No
26.201(e) Post- Assessment Controls and Conditions	$228,402	No

In the second step of the screening review, the NRC determined whether each of the provisions identified in Exhibit 4-17 is necessary to meet one or more of the stated goals of the rule, as listed below (and discussed in additional detail in the Federal Register notice accompanying the proposed rule):

1. Update and enhance the consistency of 10 CFR Part 26 with advances in other relevant federal rules and guidelines, including the U.S. Department of Health and Human Services Mandatory Guidelines for Federal Workplace Drug Testing Programs (HHS Guidelines) and other Federal drug and alcohol testing programs (e.g., those required by the U.S. Department of Transportation [DOT]) that impose similar requirements on the private sector.

2. Strengthen the effectiveness of FFD programs at nuclear power plants in ensuring against worker fatigue adversely affecting public health and safety and the common defense and security by establishing clear and enforceable requirements for the management worker fatigue.

3. Improve the effectiveness and efficiency of FFD programs.

4. Improve consistency between FFD requirements and access authorization requirements established in 10 CFR 73.56, as supplemented by orders to nuclear power plant licensees dated January 7, 2003.

5. Improve 10 CFR Part 26 by eliminating or modifying unnecessary requirements.

6. Improve clarity in the organization and language of the rule.

7. Protect the privacy and due process rights of individuals who are subject to 10 CFR Part 26.

The results of the second step of the screening review, which are discussed in the remainder of this section and summarized in Exhibit 4-18, show that all of the individual requirements identified in the first step of the review are necessary to meet one or more goals of the rulemaking. Consequently, it is not necessary to evaluate any of the requirements independently to determine whether they are cost-justified on a stand-alone basis.

[The NRC is aware of some stakeholder comments arguing that proposed provisions related to the second goal of the rulemaking, which relates to fatigue management, should be proposed as a separate rulemaking. Inclusion of fatigue management within the current rulemaking, however, is consistent with the NRC's current rule, which in §26.20(a) explicitly identifies fatigue as a factor that could affect fitness for duty and that should be addressed by FFD programs. It also is consistent with the NRC's long-held policy, stated in 1982 in Generic Letter 82-12, that seeks to "prevent situations where fatigue could reduce the ability of operating personnel to keep the reactor in a safe condition." Nevertheless, in response to these stakeholder comments, the NRC has evaluated the costs and savings of the proposed rule's fatigue management provisions considered as a discrete set of requirements. This evaluation is presented in Section 4.1.4 of this regulatory analysis.]

Exhibit 4-18
Relationship of Individual "Step 1" Requirements to the Goals of the Rulemaking

Individual Requirement	Necessary to Rulemaking?
26.27(a) Policy and Procedure Revisions - Overall Program	Yes, necessary for goal 3
26.39(c) Review of FFD Policy Violations	Yes, necessary for goal 7
26.105(b) Inspecting Contents of Donor's Pockets	Yes, necessary for goals 1 and 3
26.131(b) Onsite Lab Initial Validity Tests	Yes, necessary for goals 1 and 3
26.161(b)(1) HHS Lab Validity Testing	Yes, necessary for goals 1 and 3
26.197(a)-(b) Fatigue Policy and Procedures	Yes, necessary for goals 2 and 3
26.197(c) Training and Examinations for Fatigue	Yes, necessary for goals 2 and 3
26.199(b) Calculating Work Hours	Yes, necessary for goals 2 and 3
26.199(c) Work Hours Scheduling	Yes, necessary for goal 2
26.199(d)(2) Individual Rest Breaks	Yes, necessary for goal 2
26.199(d)(3) Waiver of Individual Work Hour Controls	Yes, necessary for goal 2
26.199(f)(1)-(2) Collective Work Hours	Yes, necessary for goal 2
26.199(j) Work Hour Control Reviews	Yes, necessary for goal 2
26.201(a)-(d) Fatigue Assessments	Yes, necessary for goal 2 and 7
26.201(e) Post- Assessment Controls and Conditions	Yes, necessary for goal 2 and 3

§26.27(a), Policy and Procedure Revisions - Overall Program, is necessary for improving the effectiveness and efficiency of FFD programs (Goal 3). Clearly written FFD policy and procedures will make the programs more effective by ensuring that individuals subject to the rule know what is expected of them and what consequences may result from a lack of adherence to the policy and procedures. Development of the policy and procedures by management, and implementation of procedural controls within the facilities, are necessary to ensure that licensees' FFD management programs are properly and consistently implemented, and to avoid potential impacts on public health and safety and security if individuals are not fit to perform work safely. In addition, written policies and procedures will help to make adherence to the policy and procedures easier and more efficient for individuals who move from program to program.

§26.39(c), Review of FFD Policy Violations, is necessary for the protection of the privacy and due process rights of individuals who are subject to 10 CFR Part 26 (Goal 7). Reviews of FFD policy violations by multiple reviewers who are not associated with the administration of the FFD program will provide individuals who are subject to the rule with an appeals process. This section is necessary to provide assurance that FFD determinations are based on sufficient and appropriate information. FFD policy violation reviews establish a basis for management decisions and actions, and protect the due process rights of individuals who are subject to 10 CFR Part 26.

§26.105(b), Inspecting Contents of Donor's Pockets, is necessary for updating and enhancing the consistency of 10 CFR Part 26 with advances in other relevant federal rules and guidelines, including the U.S. Department of Health and Human Services Mandatory Guidelines for Federal Workplace Drug Testing Programs (HHS Guidelines) and other Federal drug and alcohol testing programs (e.g., those required by the U.S. Department of Transportation [DOT]) that impose similar requirements on the private sector (Goal 1). Similar to this section of the proposed rule, DOT drug testing regulations require that a donor is asked to empty his or her pockets and display the items in them so the collector can identify items that the donor could use to adulterate or substitute his or her urine. This section is necessary to enhance the consistency of urine collection procedures in 10 CFR Part 26 with other relevant federal rules.

§26.105(b) also is necessary for improving the effectiveness and efficiency of FFD programs (Goal 3). Because collectors are required to ask the donor to empty his or her pockets, this section is necessary to provide assurance that the donor is not able to subvert the drug testing process. As a result, this section is necessary to improve the effectiveness and efficiency of FFD programs.

§26.131(b), Onsite Lab Initial Validity Tests, is necessary for updating and enhancing the consistency of 10 CFR Part 26 with advances in other relevant federal rules and guidelines, including HHS Guidelines and other Federal drug and alcohol testing programs (e.g., those required by DOT) that impose similar requirements on the private sector (Goal 1). Current HHS Guidelines contain requirements regarding initial validity tests and criteria for determining whether a specimen must be forwarded to the HHS-certified laboratory for further validity testing. This section adds similar requirements relative to testing each urine specimen for its creatinine concentration, pH, and the presence of one or more oxidizing adulterants, such as nitrite or bleach. This section is necessary because it harmonizes a licensee's initial validity testing procedures with HHS Guidelines. As a result, this section is necessary to enhance the consistency of 10 CFR Part 26 with other relevant federal rules.

§26.131(b) also is necessary for improving the effectiveness and efficiency of FFD programs (Goal 3). Because FFD programs would not be permitted to establish more stringent cutoff levels for validity screening and initial validity testing, this section is necessary to decrease the risk of obtaining false non-negative test results and would ensure that donors are not subject to sanctions on the basis of inaccurate test results. As a result, this section is necessary to improve the effectiveness and efficiency of FFD programs.

§26.161(b)(1), HHS Lab Validity Testing, is necessary for updating and enhancing the consistency of 10 CFR Part 26 with advances in other relevant federal rules and guidelines, including HHS Guidelines and other Federal drug and alcohol testing programs (e.g., those required by DOT) that impose similar requirements on the private sector (Goal 1). Current HHS Guidelines contain requirements regarding methods for conducting specimen validity testing at HHS-certified laboratories. This section adds similar requirements relative to HHS-certified laboratory testing requirements for validity tests. As a result, this section is necessary to enhance the consistency of 10 CFR Part 26 with other relevant federal rules.

§26.161(b)(1) also is necessary for improving the effectiveness and efficiency of FFD programs (Goal 3). Because HHS-certified laboratories would be required to conduct initial validity tests, this section is necessary to decrease the risk of obtaining false non-negative test results and would ensure that donors are not subject to sanctions on the basis of inaccurate test results. As a result, this section is necessary to improve the effectiveness and efficiency of FFD programs.

§§26.197(a)-(b), Fatigue Policy and Procedures, are necessary for strengthening the effectiveness of FFD programs by establishing clear and enforceable requirements concerning the management of fatigue (Goal 2) Requiring each licensee to develop a written policy statement that describes management's expectations and methods for managing fatigue, and requiring licensees to incorporate their fatigue management policy statement into written FFD policies and procedures will help to ensure that fatigue does not adversely affect individuals' abilities to safely and competently perform their duties. The NRC's past experience with worker fatigue, such as that documented in NRC Regulatory Issue Summary (RIS) 2002-007, Clarification of NRC Requirements Applicable to Worker Fatigue and Self-declarations of Fitness-For-Duty, dated May 10, 2002, indicates that there is a need for individuals to clearly understand their fatigue management responsibilities and those of the licensee. These requirements will ensure that there is a written record of how each FFD program subject to Subtitle I meets the objectives and requirements of Part 26, Subpart I, and also a record of any allowable variations in the program. Clearly written fatigue policy and procedures will make the programs more effective by ensuring that individuals subject to the rule know what is expected of them and what consequences may result from a lack of adherence to the policy and procedures. In addition, because some licensees may choose to impose sanctions on individuals for failing to comply with the fatigue management policy or procedures, communication of the policy and its sanctions is necessary in order to protect individuals' rights to due process under the rule. Development of the policy and procedures by management and implementation of procedural controls within the plant are both necessary to ensure that licensees' fatigue management programs are properly and consistently implemented to avoid potential impacts on public health and safety and national security if individuals are too fatigued to perform work safely.

§§26.197(a)-(b) also are necessary for improving the effectiveness and efficiency of FFD programs generally (Goal 3). Written policies and procedures will help to make adherence to the policy and procedures easier and more efficient for individuals who move from program to program.

§26.197(c), Training and Examinations for Fatigue, is necessary for strengthening the effectiveness of FFD programs by establishing clear and enforceable requirements concerning the management of fatigue (Goal 2). Training will provide nuclear plant workers with knowledge of specific, fatigue-related topics that will facilitate personal decisions and actions that are consistent with the objective of preventing, detecting, and mitigating the adverse effects of fatigue on worker job performance. Individual workers typically do not possess these KAs (knowledge and abilities) without training. Training and examinations are the most effective and efficient means of ensuring that all individuals assigned to duties within the scope of Part 26, Subpart I, have the KAs necessary to detect conditions that arise from fatigue, know the personal and public health and safety hazards associated with fatigue, know the proper actions to be initiated to respond to those hazards, and understand their roles and responsibilities in the implementation of the FFD program as it addresses fatigue. Training will ensure that individuals are able to: (1) self-manage fatigue that is due to causes other than work hours; (2) take actions to maintain their alertness at work; and (3) recognize and seek treatment for sleep disorders that might be creating or exacerbating their own fatigue. This knowledge will also allow workers to make use of the provision for worker self-declarations of fatigue and the provision for for-cause fatigue assessments when workers exhibit symptoms of fatigue to managers or co-workers. The training, self-declaration, and fatigue assessment provisions will help ensure that individual variations in susceptibility to fatigue, arising from physiology, personal obligations, or life style, will be addressed outside and in addition to the individual and collective work hour limits in the proposed rule. The training provision will help avoid potential

adverse consequences being caused by workers who, for whatever reason, are affected by fatigue irrespective of the other provisions of Subpart I.

§26.197(c) also is necessary for improving the effectiveness and efficiency of FFD programs generally (Goal 3). Training in specified KAs will help to make FFD programs more consistent from licensee to licensee, thereby making adherence to the policy and procedures easier and more efficient for individuals who move from program to program.

§26.199(b), Calculating Work Hours, is necessary for strengthening the effectiveness of FFD programs by establishing clear and enforceable requirements concerning the management of fatigue (Goal 2). A consistent method of calculating work hours is a key component of any fatigue-management program, necessary to ensure that other program components are implemented effectively. Because under the NRC's Policy on Worker Fatigue, the concept of "work hours" was not defined and criteria for calculating work hours were not established, licensees have been inconsistent in defining and calculating work hours when implementing the Policy through their technical specifications and administrative procedures. Proper implementation of individual and collective work hour requirements established in §26.199(b), (c), and (d), is not possible in the absence of accurate calculation of work hours. This provision therefore is necessary to ensure that the safety benefits and other benefits of the work hours requirements are achieved. The proposed rule would define work hours and requirements for calculating them to ensure consistent and accurate implementation of the work hour controls.

§26.199(b) also is necessary for improving the effectiveness and efficiency of FFD programs generally (Goal 3). The provision will help to make FFD programs more consistent from licensee to licensee, thereby enabling the NRC to focus its inspection resources more efficiently.

§26.199(c), Work Hour Scheduling, is necessary for strengthening the effectiveness of FFD programs by establishing clear and enforceable requirements concerning the management of fatigue (Goal 2). This provision complements other fatigue-management provisions, including collective work hour limits, limits on individual waivers of work hour controls, and requirements for breaks at specified frequencies. Because human alertness and the propensity to sleep vary markedly through the course of a 24-hour period, as a consequence of circadian physiological rhythms that are outside the control of the individual, work scheduling (i.e., the sequencing of day, evening, and night shifts and the use of break periods between these shifts) can either optimize the ability of personnel to obtain adequate sleep and effectively transition from one shift to another, or challenge the individual's ability to get adequate rest. The duration of shifts, the number of consecutive shifts, the duration of breaks between blocks of shifts, and the direction of shift rotation, particularly for personnel who work rotating shifts, are critical elements of fatigue management. This section would require licensees to schedule the work hours of individuals in a manner that is consistent with the objective of preventing impairment from fatigue and consequent safety-related risks due to the duration, frequency, or sequencing of successive shifts. This requirement provides a benefit separate from the maximum work hour and minimum break requirements that are specified in proposed §26.199(d), which are intended for infrequent, temporary circumstances, and not as guidelines or limits for routine work scheduling. In addition, proposed §26.199(d) does not address several elements of routine schedules that can significantly affect worker fatigue, such as shift length. Although proposed §26.199(c) would require licensees to schedule personnel consistent with preventing impairment from fatigue from these scheduling factors, the NRC recognizes that the complexity of effectively addressing and integrating each of these factors in work scheduling decisions

precludes a prescriptive requirement. Therefore, proposed §26.199(c) would establish a non-prescriptive, performance-based requirement.

§26.199(d)(2), Individual Rest Breaks, is necessary for strengthening the effectiveness of FFD programs by establishing clear and enforceable requirements concerning the management of fatigue (Goal 2). This provision is a key component of fatigue management, because it requires licensees to provide adequate rest breaks for individuals who are performing the duties listed in proposed §26.199(a). The requirement for a 10-hour break between successive work periods (shifts) would allow, taking into consideration time for shift turnover, commuting, meals, personal hygiene, and other necessary activities, for a total of 7.4 hours for sleep, which is very close to the sleep needs of adults in the U.S. The proposed 24-hour break in any 7-day period and 48-hour break in any 14 day period would serve both to prevent and mitigate cumulative sleep debt, by providing opportunities for mitigative sleep and also provide time that individuals need to meet the many daily living obligations that they cannot otherwise readily meet (although due to individual variations in susceptibility to cumulative fatigue, arising from physiology, personal obligations, or life style, the other individual and group work hour controls and work scheduling provisions contained in Subpart I also are necessary). Without such long break opportunities, individuals must either forego activities that can be important to general mental and physical fitness (e.g., family interactions, exercise, recreation, doctor appointments) or sacrifice sleep and increase their sleep debt, which will result in impairment on the job. The 24 and 48 hour break provisions are necessary in addition to the requirement in §26.199(d)(2)(ii) for a 10-hour break between work periods because the 10-hour break periods between shifts are not sufficient to prevent the buildup of cumulative fatigue. A 10-hour break between successive work periods provides an opportunity for 8 hours of sleep only if minimal time is devoted to meals, hygiene, and commuting, with no other daily living obligations, and such deferral of other obligations cannot be sustained over time. The 24-hour and 48-hour break provisions are important for mitigating fatigue of individuals who work during extended plant outages, such as a series of weeks in which individuals are required to work six consecutive 12-hour shifts with only one day off. The 48-hour break provision is particularly important for addressing acute and cumulative fatigue, because shorter break periods have been shown to be insufficient to allow an individual to recover from acute and cumulative fatigue. All three rest break provisions therefore are necessary components of the FFD fatigue management program.

§26.199(d)(3), Waiver of Individual Work Hour Controls, is necessary for strengthening the effectiveness of FFD programs by establishing clear and enforceable requirements concerning the management of fatigue (Goal 2). The section provides for limited use of waivers allowing individuals to exceed the individual work hour limits. The waiver must be justified by circumstances in which compliance with the work hour controls could have immediate adverse consequences for the protection of public health and safety or the common defense and security. The provision specifies that an operations shift manager must determine that the waiver is necessary to mitigate or prevent a condition adverse to safety, or a security shift manager must determine that the waiver is necessary to maintain the security of the facility, or a site senior-level manager with requisite signature authority must make either determination. This provision will ensure that waivers of individual work hour controls are not used inappropriately. NRC's reviews of industry work scheduling practices during outages and of records of deviations from technical specification work hour controls indicated that previously the most common deviation was to permit individuals to work more than 72 hours in 7 days, frequently by working more than six consecutive 12-hour days, and that this practice was used

extensively at a number of sites.[23] Some licensees were scheduling outages with several weeks of 12-hour shifts with no scheduled days off. The NRC's Policy on Worker Fatigue recognized that "very unusual circumstances may arise requiring deviation from the [work hour] guidelines." However, in SECY-01-0113, the NRC noted that the frequency of guideline deviations at a substantial proportion of sites appeared to be inconsistent with the intent of the policy. The proposed criteria for granting waivers from the individual work hour controls in §26.199(d)(3) are expected to significantly reduce the granting of waivers for work schedules that exceed the individual work hour limits. Such waivers would be justified only for limited circumstances in which compliance with the work hour controls could have immediate adverse consequences for the protection of public health and safety or the common defense and security. The provision is intended to ensure that licensees grant waivers only to address circumstances that the licensee could not have reasonably controlled. This provision therefore is consistent with the objective of preventing impairment from fatigue and consequent safety-related risks due to the duration, frequency, or sequencing of work. This requirement supports the maximum work hour and minimum break requirements that are specified in proposed §26.199(d) by limiting the circumstances in which the work hour provisions may be waived to conditions in which granting a waiver is consistent with maintaining safety.

§§26.199(f)(1)-(2), Collective Work Hours, is necessary for strengthening the effectiveness of FFD programs by establishing clear and enforceable requirements concerning the management of fatigue (Goal 2). This provision, by requiring licensees to control the collective work hours of each group of individuals who are performing the job duties listed in proposed §26.199(a) and to ensure that the collective work hours of each job duty group do not exceed an average of 48 hours per person per week in any averaging period, will control work hours over extended periods of time, and thereby complement the short-term work hour controls for individuals. The proposed collective work hour limit of 48 hours per person per week, including the 8-week exclusion from the limit during outages, will ensure that staffing is adequate to provide reasonable assurance that cumulative fatigue (i.e., fatigue from successive weeks of overwork or inadequate rest) will not adversely affect the abilities of individuals to perform functions that are important to maintaining the safety and security of the plant. During normal operations, and following the first 8 weeks of a plant outage, licensees would be required to control the work hours of affected individuals in accordance with the 48-hour collective work hour controls, unless the licensee encounters a circumstance that cannot reasonably be controlled (see §26.199(f)(3)(i)), or the licensee has received prior approval from the NRC under §26.199(f)(5)). The policy reflects the NRC's recognition that outages are unique, relatively short-term, plant circumstances involving levels of activity that are substantially higher than most non-outage operating periods. The policy also reflects the NRC's understanding that although individuals are capable of working with limited rest without degraded performance for short periods of time, research has shown that the ability to sustain performance without adequate rest is clearly limited. Among the factors that the NRC considered in setting the exclusion period for plant outages at 8 weeks were the number of hours, including overtime, that nuclear plant workers could work during the 8-week period and the number of normally scheduled days off that such workers would have missed. During the exclusion period, individuals would only be assured of a 24-hour break every 7 days and a 48-hour break every 14 days. Individuals who work 12-hour shifts would average 66-68 hours per week, a rate of more than 150 percent of their normally scheduled hours with less than half of their normally scheduled days off for recovery. This schedule would substantively increase the potential for cumulative fatigue and fatigue-

[23] As part of the NRC's rulemaking development efforts, the NRC reviewed information submitted voluntarily by six nuclear power plants in 2004.

related personnel errors. With each passing week of an outage involving increased work hours and decreased time off, the ability of individuals to defer daily living obligations becomes increasingly difficult, causing increased pressure to reduce sleep time in order to meet the demands of both work and daily life, resulting in an increased potential for cumulative fatigue. In addition to considering the potential for cumulative fatigue, the NRC considered current industry data on the duration of plant outages, noting that during the period studied eighty-five percent of plant outages were less than 8 weeks in duration. In reviewing the frequency of outages, by duration, the NRC found that it would be necessary to increase the exclusion period substantially to include a marginal number of additional outages of longer lengths. This increase in the exclusion period would substantially increase the period of time that work hours would not be controlled by the proposed 48-hour collective work hour limit, thus substantially increasing the likelihood of cumulative fatigue.

§26.199(j), Work Hour Control Reviews, is necessary for strengthening the effectiveness of FFD programs by establishing clear and enforceable requirements concerning the management of fatigue (Goal 2). Requiring licensees to periodically self-assess their performance with respect to controlling the work hours of those individuals who perform duties within one or more of the job duty groups will help maintain reasonable assurance that the specific work hour control provisions of proposed §26.199 are implemented consistent with the general performance objective in proposed §26.23(e). Such periodic assessments are necessary because the work hour controls that would be required by proposed §26.199 establish performance-based requirements that allow licensees substantial flexibility. Licensees can schedule personnel; obtain waivers, in limited circumstances, of the individual work hour controls; distribute work hours among individuals in accordance with collective work hour controls and the licensee's judgment of the relative ability of individuals to work extended hours; and, in limited circumstances, permit job duty collective work hours to exceed the collective work hour controls. Accordingly, periodic self-assessments are necessary to provide an indication of whether the licensee has effectively managed worker fatigue consistent with general performance of the proposed rule, and to identify corrective measures. For example, a high number of waivers for an individual, or a high number of waivers for several individuals within a job duty group, may indicate a programmatic weakness or staffing inadequacy that the licensee should address. The self-assessments will help to ensure that licensees are effectively managing the fatigue of their workers who are subject to the requirements of Subpart I. The NRC also can use the results of the self-assessments to focus its inspection resources more efficiently.

§§26.201(a)-(d), Fatigue Assessments, is necessary for strengthening the effectiveness of FFD programs by establishing clear and enforceable requirements concerning the management of fatigue (Goal 2). By providing that fatigue assessments should be performed for cause, after a self-declaration, after an event that would require post-event drug and alcohol testing, as a followup to returning an individual to work after a self-declaration, and as a followup to a plant event that would require drug or alcohol testing, the provision will help to ensure that individuals who are observed to be in a condition creating a reasonable suspicion of impaired individual alertness or have indicated that they are not fit for duty because of fatigue are evaluated to determine whether they can, in fact, safely and competently perform their duties Fatigue assessments provide a necessary complement to work hour controls. Appropriately assessing fatigue is important because workers who are experiencing either acute or cumulative fatigue may not be able to perform their duties safely and competently. Worker fatigue, and its effects on worker alertness and performance, can result from many causes in addition to work hours (e.g., stress, sleep disorders, daily living obligations). In addition, there are substantial individual differences in the ability of individuals to work for extended periods

without performance degradation from fatigue. Therefore, the work hours controls of proposed §26.199 would provide only partial assurance that individuals are not fatigued. The objective of the fatigue assessments would be for licensees to appropriately identify and address instances of worker fatigue, including those that are not prevented by the work hour controls, regardless of the number of hours the individual has worked or rested. Proposed §26.201(b) and (c) specify who may perform the assessment, and the factors that must be addressed. Ensuring that the assessments are conducted by appropriate persons and cover appropriate topics is essential because, following a finding of fatigue, licensees are required by §26.201(e) to determine and implement the controls and conditions that are necessary if the individual who was the subject of the assessment is to resume performing duties for the licensee. Fatigue assessments are important for effective fatigue management because they provide the basis for fatigue management actions that may be necessary to address individual or programmatic issues contributing to recurring instances of fatigue.

§26.201(e), Post-Assessment Controls and Conditions, is necessary for strengthening the effectiveness of FFD programs by establishing clear and enforceable requirements concerning the management of fatigue (Goal 2). The fatigue assessments would provide the basis for licensees to appropriately address instances of worker fatigue, including those that are not prevented by the work hour controls, regardless of the number of hours that the subject individual has worked or rested. Licensee actions for fatigue management could include either short-term corrective actions necessary to ensure that individuals are able to safely and competently perform their duties or long-term corrective actions that may be necessary to address issues contributing to recurring instances of fatigue.

§26.201(e) also is necessary for the protection of the privacy and due process rights of individuals who are subject to 10 CFR Part 26 (Goal 7). Because the corrective actions following a fatigue assessment could include relieving an individual of duties, this section is necessary to provide assurance that fatigue assessments include sufficient and appropriate information to support a valid assessment of the individual relative to fatigue and therefore an appropriate basis for management decisions and actions and protection of the due process rights of individuals who are subject to 10 CFR Part 26.

4.5 Safety Goal Evaluation

Safety goal evaluations are applicable only to regulatory initiatives considered to be generic safety enhancement backfits subject to the substantial additional protection standard at 10 CFR 50.109(a)(3).[24] The current rulemaking would provide added assurance that individuals working at nuclear facilities are fit for duty and, consequently, the rule would reduce safety and security risks ranging from workplace safety incidents up to radiological damage to the reactor core. The proposed requirements may qualify, therefore, as generic safety enhancements because they may affect the likelihood of core damage, which generally is the focus of a quantitative safety goal evaluation. However, the magnitude of this change is not readily quantifiable due to uncertainties discussed in Section 3.2 of this analysis. A more dominant effect of the rule is to reduce the probability of other types of accidents and damages associated with a wide array of acts related to drug and alcohol abuse and fatigue, although this effect is equally difficult to quantify. Because the change in safety associated with the

[24] A safety goal evaluation is not needed, therefore, for new requirements falling within the backfit exceptions of 10 CFR 50.109(a)(4)(i)-(iii).

rulemaking cannot be quantified, the proposed regulatory changes cannot be compared to the NRC's safety goals.

Certain aspects of the current rulemaking qualify as relaxations of requirements because they would result in incrementally fewer activities needed to achieve the same goals. However, relaxations of requirements affecting nuclear power plants are not subject to safety goal evaluation. Therefore, no safety goal evaluation is needed for these requirements.

4.6 CRGR Results

This section addresses regulatory analysis information requirements for rulemaking actions or staff positions subject to review by the Committee to Review Generic Requirements (CRGR). All information called for by the CRGR is presented in this regulatory analysis, or in the Federal Register Notice for the proposed Part 26 rule. As a reference aid, Exhibit 4-19 provides a cross-reference between the relevant information and its location in this document or the Federal Register Notice.

Exhibit 4-19
Specific CRGR Regulatory Analysis Information Requirements

CRGR Charter Citation	Information Item to be Included in a Regulatory Analysis Prepared for CRGR Review	Where Item is Discussed
IV.B(1)	Proposed generic requirement or staff position as it is proposed to be sent out to licensees. When the objective or intended result of a proposed generic requirement or staff position can be achieved by setting a readily quantifiable standard that has an unambiguous relationship to a readily measurable quantity and is enforceable, the proposed requirements should specify the objective or result to be attained rather than prescribing how the objective or result is to be attained.	Proposed rule text in Section XVI of the Federal Register Notice.
IV.B(iii)	The sponsoring office's position on whether the proposed action would increase requirements or staff positions, implement existing requirements or staff positions, or relax or reduce existing requirements or staff positions.	Regulatory Analysis, Section 4.1.
IV.B(iv)	The proposed method of implementation.	Regulatory Analysis, Section 6.
IV.B(vi)	Identification of the category of power reactors or nuclear materials facilities/activities to which the generic requirement or staff position will apply.	Regulatory Analysis, Section 3.2.2.
IV.B(vii) IV.B(viii)	If the proposed action involves a power reactor backfit and the exceptions at 10 CFR 50.109(a)(4) are not applicable, the items required at 10 CFR 50.109(c) and the required rationale at 10 CFR 50.109(a)(3) are to be included.	Regulatory Analysis, Section 4.4.

CRGR Charter Citation	Information Item to be Included in a Regulatory Analysis Prepared for CRGR Review	Where Item is Discussed
IV.B(x)	For proposed relaxations or decreases in current requirements or staff positions, a rationale is to be included for the determination that (a) the public health and safety and the common defense and security would be adequately protected if the proposed reduction in requirements or positions were implemented, and (b) the cost savings attributed to the action would be substantial enough to justify taking the action.	Section V, "Section-by-Section Analysis of Substantive Changes," in the Federal Register Notice for the proposed rule.
IV.B(xii)	Preparation of an assessment of how the proposed action relates to the Commission's Safety Goal Policy Statement.	Regulatory Analysis, Section 4.5.

Exhibit has been adapted from NUREG/BR-0184, Table 2.3.

5. DECISION RATIONALE

5.1 Regulatory Analysis

Relative to the “no-action” alternative, the proposed rule would result in a net cost estimated as approximately $469.7 million (total present value over a 49-year period), assuming a 7-percent discount rate, or approximately $730.8 million assuming a 3-percent discount rate. All of this cost would accrue to industry, except for approximately $615,000 (7 percent) or $947,000 (3 percent) that would accrue to the NRC. The rule would result in one-time industry costs of approximately $20.7 million ($660,300 for the average program), and then would generate annual costs of about $33.0 million ($1.1 million per program).

Offsetting this net cost, the NRC believes that the rule would result in substantial non-quantified benefits related to safety and security, as well as enhanced regulatory efficiency and effectiveness, public perceptions, and improved workplace productivity and efficiency. These benefits are discussed in Sections 4.1.2 and 4.1.3 of this document. Based on the NRC's assessment of the costs and benefits of the propose rule on licensee facilities, the agency has concluded that the proposed rule provisions would be justified.

5.2 Backfit Analysis

The NRC conducted a backfit analysis of the proposed Part 26 rule relative to the backfit requirements in 10 CFR §50.109, 10 CFR §70.76, and 10 CFR §76.76. The analysis evaluates the aggregation of proposed provisions that constitute backfits under the backfit rules. This analysis estimates that these provisions would result in a net cost to industry of $594.3 million (present value) assuming a 7-percent discount rate, or $927.1 million assuming a 3-percent discount rate. The provisions would cost industry about $20.7 million in initial costs and would generate about $42.2 million in annual costs. For the average program, this equates to about $660,300 in one-time costs, and about $1.4 million in annual costs. Nevertheless, the NRC concludes that these impacts would be justified by the substantial increase in the protection of public health and safety provided by this rule.

The NRC also conducted a screening analysis in accordance with NRC’s Regulatory Analysis Guidelines to ensure that the aggregate analysis does not mask the inclusion of individual rule provisions that are (1) not cost-beneficial when considered individually and (2) not necessary to meet the goals of the rulemaking. As discussed in Section 4.4.2, this review concludes that each of the individual backfit requirements are necessary to meet the goals of the rulemaking.

6. IMPLEMENTATION

This section identifies how and when the proposed action would be implemented, the required NRC actions to ensure implementation, and the impact on NRC resources.

6.1 Schedule

The action would be enacted through a proposed rule, resolution of public comments, and a final rule, with promulgation of the final rule within 90 days from the date of publication. The staff has not identified any impediments to implementing the recommended alternatives.

6.2 Impact on Other Requirements

As discussed in Section 4.1, affected licensee and C/V FFD programs would experience the principal impact of the revisions to 10 CFR Part 26. The NRC further expects that the revisions will have relatively small impacts on NRC resources, as also discussed in Section 4.1. Since 1982, the NRC has used existing personnel for regulatory activities concerning FFD programs, and the NRC does not anticipate the need to add staff or administrative personnel because current personnel would absorb the administration of the revised rule. Moreover, it is expected that the rule would reduce NRC's annual expenditures associated with implementation of the FFD program.

7. OTHER PROCEDURAL REQUIREMENTS

This proposed rule would affect only licensees who are authorized to operate nuclear power reactors or to possess, use, or transport formula quantities of strategic special nuclear material (SSNM); corporations that obtain certificates of compliance or approved compliance plans involving formula quantities of SSNM; combined operating license holders; mixed oxide fuel fabrication facilities; and construction permit holders who have a plant under active construction. The companies that own these facilities do not fall within the definition of “small entities” set forth in the Regulatory Flexibility Act or the size standards adopted by the NRC on April 11, 1995 (60 FR 1834; 10 CFR 2.810). Therefore, this rule would not have a significant economic impact on a substantial number of small entities, as applicable under the Regulatory Flexibility Act of 1980 [(5 U.S.C. 605(b))].

APPENDIX 1: INCREMENTAL ACTIVITIES AND COST EQUATIONS FOR INDIVIDUAL PROVISIONS OF THE PROPOSED RULE

This appendix presents a detailed analysis of the incremental activities (including activities that qualify as backfits) required by each individual provision in the proposed rule. It also specifies the equations that the NRC staff used to estimate any costs or savings resulting from the individual rule provisions.

The appendix contains 11 “subparts” that directly correspond to the 11 subparts of the proposed Part 26 rulemaking:

Subpart A: Administrative Provisions

Subpart B: Program Elements

Subpart C: Granting and Maintaining Authorization

Subpart D: Management Actions and Sanctions to be Imposed

Subpart E: Collecting Specimens for Testing

Subpart F: Licensee Testing Facilities

Subpart G: Laboratories Certified by the DHHS

Subpart H: Determining FFD Policy Violations and Determining Fitness

Subpart I: Managing Fatigue

Subpart J: Recordkeeping and Reporting Requirements

Subpart K: Inspections, Violations, and Penalties

Subpart A: Administrative Provisions

26.1 Purpose

This section of the proposed rule imposes no cost and affords no saving because it merely simplifies and amends §26.1 of the current rule by removing certain references and provisions that are addressed elsewhere in the rule.

26.3 Scope

Proposed §26.3 reorganizes and amends §26.2 of the current rule, as discussed below.

Paragraphs 26.3(a) through 26.3(c)

These paragraphs of the proposed rule impose no incremental cost and afford no saving because they merely clarify those licensees who are subject to the rule as already stated in paragraph 26.2(a) of the current rule.

Paragraph 26.3(d)

This paragraph of the proposed rule imposes no cost and affords no saving because it states that the regulations in this part also apply to contractor vendors (C/Vs) who implement FFD programs or program elements to the extent that licensees and other entities rely upon those C/V FFD programs or program elements to meet the requirements of this part. C/Vs are already subject to the requirements of the current rule as stated in §26.23 of the current rule.

Paragraph 26.3(e)

This paragraph of the proposed rule [including subparagraphs 26.3(e)(1)–(3)] imposes no cost and affords no saving because it addresses requirements for construction permit holders already contained in paragraph 26.2(c) of the current rule.

Paragraph 26.3(f)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it restates requirements contained in paragraph 26.2(b) of the current rule that stipulate that the regulations of this part do not apply to those licensees who possess, use, or transport formula quantities of irradiated SSNM.

26.5 Definitions

This section of the proposed rule re-states, clarifies, and adds definitions that are used throughout the entire proposed FFD rule. A number of these added and revised definitions will require licensees and C/Vs to modify or update their interpretation of current FFD policy, thereby resulting in incremental costs or savings. These costs and savings, however, are discussed in relevant sections of this analysis. The proposed section adds a number of definitions, including those listed below, which are addressed later in this analysis within the context of the requirements that reference them.

- acute fatigue
- alertness
- best effort
- circadian variation in alertness and performance
- cumulative fatigue
- directing
- fatigue
- formula quantity
- increase in threat condition
- other entity
- validity screening test

26.7 Interpretations

This section of the proposed rule imposes no incremental cost and affords no saving because it merely restates §26.4 of the current rule and provides that interpretation of the meaning of the regulations requires a written interpretation by the General Counsel in order to be recognized as binding upon the Commission.

26.8 Information Collection Requirements: OMB Approval

This section of the proposed rule [including paragraphs 26.8(a) and (b)] imposes no incremental cost and affords no saving because it merely renumbers and amends §26.8 of the current rule to reference the revised recordkeeping requirements of the proposed rule. The proposed information collection requirements and their associated costs are discussed in subsequent sections.

26.9 Specific Exemptions

This section of the proposed rule imposes no incremental cost and affords no saving because it merely restates §26.6 of the current rule and provides that the NRC may (in instances authorized by law and deemed not to endanger life, property, or the public interest) grant exemptions from the requirements of proposed Part 26.

26.11 Communications

This proposed section provides consistency with other 10 CFR parts and states that all communications, applications, and reports concerning the regulations in this part must be sent to a specified NRC address. The section will, however, add a requirement that copies of all communications to the NRC be sent to the appropriate regional office and resident inspector. No incremental costs arise from this requirement, however, as the additional cost to send the additional copies electronically is negligible.

Subpart B: Program Elements

26.21 Fitness-for-Duty Program

This section of the proposed rule imposes no incremental cost and affords no saving because it merely states that licensees and other entities who are subject to this part must implement FFD programs that comply with this part, as required by paragraph 26.3(b) of the current rule.

26.23 Performance Objectives

Paragraphs 26.23(a)–(d)

These paragraphs of the proposed rule amend and clarify the rule language for program performance objectives contained in paragraphs 26.10(a)–(c) of the current rule to require high assurance that individuals are trustworthy and reliable as demonstrated by the avoidance of substance abuse. The analysis assumes that any incremental costs and savings related to these objectives would be imposed by subsequent provisions that implement these objectives.

Paragraph 26.23(e)

This paragraph of the proposed rule amends the performance objectives of the FFD program to include reasonable assurance that the effects of fatigue and degraded alertness on individuals' abilities to safely and competently perform their duties are managed commensurate with maintaining public health and safety. Additional costs associated with the addition of this performance objective are presented in the analysis of relevant subsections that implement this performance objective, particularly the provisions in Subpart I.

26.25 Individuals Subject to the Fitness-for-Duty Program

Paragraphs 26.25(a) and 26.25(b)

These proposed paragraphs specify those individuals who are subject to the FFD program.

Subparagraph 26.25(a)(1)–26.25(a)(3)

These subparagraphs of the proposed rule impose no incremental cost and afford no saving because they merely rename and divide paragraph 26.2(a) of the current rule to enhance clarity.

Subparagraph 26.25(a)(4)

Proposed subparagraph 26.25(a)(4) clarifies that FFD program personnel shall be subject to the provisions and policies of the FFD program. Although the language of the existing rule does not explicitly state that FFD program personnel are subject to the current rule, this was the

Commission's intent. Further, FFD program personnel are required to meet the highest standards for honesty and integrity to ensure that the program yields valid results that are not being subverted (as addressed by Appendix A §2.3 of the current rule). Consequently, the proposed subparagraph imposes no incremental cost and affords no saving.

Sensitivity Analysis - Industry Practices

Most licensees already subject FFD program personnel to drug and alcohol testing, as well as behavioral observation programs in order to meet the requirements of the existing rule. Until recently, however, some licensee practices were inconsistent with the NRC staff's interpretation of the requirements and did not subject their medical review officers (MROs) to the provisions and policies of the FFD program. These licensees will incur additional one-time and annual costs to cover their MROs under their FFD programs in compliance with existing regulation. The *one-time cost per program* results from the sum of the following costs:[1]

- One-time costs per program to subject their MROs to pre-access drug and alcohol testing to comply with the existing regulation are calculated as follows:

  $NUM_{MROs} \times COST_{Test} \times PER_{Compliance}$

- One-time costs per program to pay for MRO travel to a licensee collection facility to comply with the existing regulation are calculated as follows:

  $NUM_{MROs} \times HOURS_{Travel} \times WAGE_{MRO} \times PER_{Compliance}$

- One-time costs per program to conduct FFD training and to administer the comprehensive examination on their MROs to comply with existing regulation are calculated as follows:

  $NUM_{MROs} \times HOURS_{Training} \times WAGE_{MRO} \times PER_{Compliance}$

Parameter	**Description**
$COST_{Test}$	Drug and alcohol testing cost per test (as described in Appendix 2, Exhibit A2-13)
$HOURS_{Training}$	Length of FFD program training for MROs (as described in assumptions below)
$HOURS_{Travel}$	Hours of MRO travel, waiting, and specimen collection time (as described in assumptions below)

[1] The analysis assumes that licensees already test and appropriately train in-house FFD program personnel as required under Appendix A §2.3 of the current rule. The analysis also assumes that 25 percent of licensees will each need to address two contracted MROs under their testing and training programs in order to comply with this proposed paragraph.

Parameter	Description
NUM_{MROs}	Number of MROs per program (as described in assumptions below)
$PER_{Compliance}$	Percentage multiplier to spread compliance costs across all programs (as described in assumptions below)
$WAGE_{MRO}$	MRO wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- Number of MROs per program: 2.

- Length of FFD program training for MROs: 2 hours.

- Hours of MRO travel, waiting, and specimen collection time, on average, under the current rule: 6 hours.

- Given their small number, the MROs will be added to existing training sessions and will not require incremental costs of providing additional training sessions.

- The per-unit cost of a pre-access drug and alcohol test for an MRO working for a licensee with *onsite testing facilities* includes the following factors:
  (1) collection of drug and alcohol specimens (labor of the collector only and collection materials)
  (2) onsite licensee testing costs per urine specimen for drugs and validity
  (3) labor of FFD manager to process paperwork for negative test results.

- The per-unit cost of a pre-access drug and alcohol test for an MRO working for a licensee with *offsite testing facilities* includes the following factors:
  (1) collection of drug and alcohol specimens (labor of the collector only and collection materials);
  (2) HHS-certified laboratory costs per urine specimen for drugs and validity
  (3) labor of FFD manager to process paperwork for negative test results.

- No positive drug or alcohol test results are anticipated for the MRO.

- Licensees have estimated that 25 percent of licensees may not interpret the current regulation to require inclusion of the MRO under the FFD program. Because the analysis cannot identify which facilities are interpreting the current rule correctly and which are not, the analysis assumes that each program will incur the incremental cost of 25 percent of the activity.

Annual costs will arise from adding MROs to the random drug and alcohol testing program. The *annual costs per program* result from the sum of the following costs:

- Annual cost per program to administer a random drug and alcohol testing program for FFD program personnel to comply with the existing regulation are calculated as follows:

  $NUM_{MROs} \times PER_{Random} \times COST_{Test} \times PER_{Compliance}$

- Annual cost per program to pay for MROs selected for random drug and alcohol testing to travel to the specimen collection facility and provide a specimen to comply with the existing regulation are calculated as follows:

  $NUM_{MROs} \times PER_{Random} \times HOURS_{Travel} \times WAGE_{MRO} \times PER_{Compliance}$

Parameter	**Description**
$COST_{Test}$	Drug and alcohol testing cost per test (as described in Appendix 2, Exhibit A2-13)
$HOURS_{Travel}$	Hours of MRO travel, waiting, and specimen collection time (as described in assumptions below)
NUM_{MROs}	Number of MROs per program (as described in assumptions below)
$PER_{Compliance}$	Percentage multiplier to spread compliance costs across all programs (as described in assumptions below)
PER_{Random}	Percentage tested by a random drug and alcohol testing program per year (as described in assumptions below)
$WAGE_{MRO}$	MRO wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- Number of MROs per program: 2.

- Percentage tested by a random drug and alcohol testing program: 50%.

- Hours of MRO travel, waiting, and specimen collection time, on average, under the current rule: 6 hours.

- The per-unit cost of a random drug and alcohol test for an MRO working for a licensee with onsite testing facilities includes the following factors:
  (1) collection of drug and alcohol specimens (labor of the collector only and collection materials)
  (2) onsite licensee testing costs per urine specimen for drugs and validity
  (3) labor of FFD manager to process paperwork for negative test results.

- The per-unit cost of a random drug and alcohol test for an MRO working for a licensee with offsite testing facilities includes the following factors:
  (1) collection of drug and alcohol specimens (labor of the collector only and collection materials)
  (2) HHS-certified laboratory costs per urine specimen for drugs and validity
  (3) labor of FFD manager to process paperwork for negative test results.

- No positive drug or alcohol test results are anticipated for the MRO.

- Licensees have estimated that 25 percent of licensees may not interpret the current regulation to require inclusion of the MRO under the FFD program. Because the analysis cannot identify which facilities are interpreting the current rule correctly and which are not, the analysis assumes that each program will incur the incremental cost of 25 percent of the activity.

Subparagraph 26.25(b)(1)

This subparagraph of the proposed rule imposes no incremental cost and affords no saving because it merely states that persons who are not employed by, nor routinely provide services for, the licensee's or other entity's FFD program but who may be called upon to provide an FFD program service are not covered under the proposed rule. Some licensees have indicated that their auditors have insisted that local hospitals, treatment facilities, or other facilities providing infrequent FFD program services must be audited annually. Nevertheless, this analysis calculates no savings because the prevalence of such auditing practices is unknown.

Subparagraph 26.25(b)(2)

This subparagraph of the proposed rule imposes no incremental cost and affords no saving because it merely restates requirements contained in paragraph 26.2(b) of the current rule, which states that NRC employees, law enforcement personnel, and offsite emergency fire and medical response personnel responding onsite are not subject to the proposed rule.

Subparagraph 26.25(b)(3)

This subparagraph of the proposed rule imposes no incremental cost and affords no saving because it merely restates requirements contained in existing paragraph 26.2(b) of the current rule. The subparagraph states that strategic special nuclear material (SSNM) transporter personnel who are subject to U.S. Department of Transportation drug and alcohol fitness programs that require random testing for drugs and alcohol are not subject to the FFD program.

Paragraph 26.25(c)

This proposed paragraph is a new requirement that would allow licensee's FFD programs to exclude individuals who are covered by another program that is regulated by a Federal or State agency, provided that the program meets the general performance objectives of the FFD rule, as well as the requirements under proposed subparagraphs 26.25(c)(1)–(6). Licensees need only subject these individuals to those elements of the FFD program that are not included in the other program. This proposed revision would reduce the burden on some individuals who are currently subject to Federal and State programs with requirements that duplicate those of Part 26. This proposed revision will yield annual savings by eliminating the duplication of pre-access testing, training (non-supervisory level training under the current rule), and comprehensive examinations (including retesting and remedial training for those who fail the comprehensive examinations) for applicants for initial authorization. Savings from being able to forego the suitable inquiry are not calculated because licensees would still be required to verify that the other program provides adequate coverage and complies with the requirements in this part. The provision also will yield an annual savings by eliminating duplicate random drug and alcohol testing coverage for existing employees. Harmonized cutoff levels (under proposed §§26.131 and 26.163) also increase the likelihood that other programs will be acceptable.

The annual savings per program result from the sum of the following savings:

- The *annual savings per program* from bypassing pre-access drug and alcohol testing for the percentage of applicants covered by an acceptable program are calculated as follows:[2]

  - Pre-access drug and alcohol tests need not be performed at *facilities with onsite testing laboratories* for the percentage of applicants who are covered by an acceptable program. The associated savings are estimated as follows:

    $$NUM_{Applicants} \times PER_{Covered} \times COST_{Onsite} \times NUM_{Units}$$

  - Pre-access drug and alcohol tests need not be performed at *facilities with offsite testing laboratories* for the percentage of applicants who are covered by an acceptable program. The associated savings are estimated as follows:

    $$NUM_{Applicants} \times PER_{Covered} \times COST_{Offsite} \times NUM_{Units}$$

[2] These incremental savings will vary for programs depending on whether the program has onsite testing capabilities or utilizes an offsite HHS-certified testing laboratory.

- The *annual savings per program* from bypassing the training and examination requirements for the percentage of applicants covered by an acceptable program are calculated as follows:

  $NUM_{Applicants} \times PER_{Covered} \times (HOURS_{Non\text{-}Supervisory} + HOURS_{Exam}) \times WAGE_{Worker} \times NUM_{Units}$

- The *annual savings per program* from requiring fewer contracted trainer hours to conduct trainings and examinations on the percentage of applicants who are covered by acceptable program are calculated as follows:

  $NUM_{Sessions} \times (HOURS_{Non\text{-}Supervisory} + HOURS_{Exam} + HOURS_{Preparation}) \times WAGE_{Trainer} \times NUM_{Units}$

- The *annual savings per program* from not conducting remedial training and reexamining the percentage of applicants who are covered by an acceptable program and fail the comprehensive examination are calculated as follows:

  $PER_{Failing} \times [(NUM_{Applicants} \times PER_{Covered}) \times (HOURS_{Remedial\ Training} + HOURS_{Exam}) \times WAGE_{Worker}] \times NUM_{Units}$

- The *annual savings per program* from requiring fewer contracted trainer hours to conduct remedial training and reexamining those applicants covered by an acceptable program that fail the comprehensive examination are calculated as follows:

  $[NUM_{Sessions} \times (HOURS_{Remedial} + HOURS_{Exam}) \times WAGE_{Trainer}] \times PER_{Failing} \times NUM_{Units}$

- The *annual savings per program* from not subjecting existing employees who are covered by another acceptable program to a duplicative random drug and alcohol testing program are calculated as follows.

  $(NUM_{Employees} \times PER_{Covered}) \times (COST_{Test} \times PER_{Random}) \times NUM_{Units}$

Parameter	**Description**
$COST_{Offsite}$	Drug and alcohol testing cost at facilities with offsite testing laboratories per test (as described in assumptions below and in Appendix 2, Exhibit A2-13)
$COST_{Onsite}$	Drug and alcohol testing cost at facilities with onsite testing laboratories per test (as described in assumptions below and in Appendix 2, Exhibit A2-13)
$HOURS_{Exam}$	Length of comprehensive examination (as described in assumptions below)
$HOURS_{Non\text{-}Supervisory}$	Length of non-supervisory-level training (as described in assumptions below)

Parameter	Description
$HOURS_{Preparation}$	Hours of preparation and examination grading per session (as described in assumptions below)
$HOURS_{Remedial}$	Length of remedial non-supervisory-level training (as described in Appendix 2, Exhibit A2-3)
$NUM_{Applicants}$	Annual number of applicants for initial authorization per unit who are covered by any other Federal or State program (as described in assumptions below)
$NUM_{Employees}$	Number of existing employees covered by any other Federal or State program (described in assumption below)
NUM_{Units}	Number of units per program (as described in Appendix 2, Exhibit A2-14)
$NUM_{Sessions}$	Annual number of training and examination sessions (as described in assumptions below)
$PER_{Covered}$	Percentage of Federal or State programs qualifying under subparagraph 26.25(c)(1) per year (as described in assumptions below)
$PER_{Failing}$	Percentage failing comprehensive examination (as described in assumptions below)
PER_{Random}	Percentage tested by a random drug and alcohol testing program per year (as described in assumptions below)
$WAGE_{Trainer}$	Trainer wage rate (as described in Appendix 2, Exhibit A2-11)
$WAGE_{Worker}$	Facility worker wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- Annual number of applicants for initial authorization per unit covered by any other Federal or State Program: 10.
- Percentage of Federal or State Programs qualifying under subparagraph 26.25(c)(1): 50%.
- Length of non-supervisory-level training: 2 hours.
- Length of comprehensive examination: 0.5 hours.
- Percentage failing comprehensive examination: 10%.
- Percentage tested by random drug and alcohol testing program per year: 50%.
- Number of training sessions assumes 20 workers per session.

- Hours of preparation and examination grading: 2 hours.

- Number of existing employees covered by any other Federal or State program: 40.

- All affected personnel take non-supervisory-level training under the current rule.[3]

- The per-unit cost of an onsite pre-access and random drug and alcohol test includes the following factors:
  (1) travel time of the worker
  (2) collection of drug and alcohol specimens (labor of the collector and the worker, as well as collection materials)
  (3) onsite licensee testing costs per urine specimen for drugs
  (4) labor of FFD manager to process paperwork for negative test results

- The per-unit cost of an offsite pre-access and random drug and alcohol test includes the following factors:
  (1) travel time of the worker
  (2) collection of drug and alcohol specimens (labor of the collector and the worker, as well as collection materials)
  (3) HHS-certified laboratory costs per urine specimen for drugs
  (4) labor of FFD manager to process paperwork for negative test results.

- Individuals whose pre-access drug and alcohol tests yield positive results will be eliminated from the hiring process.

Paragraph 26.25(d)

This paragraph of the proposed rule would add a provision specifying that individuals who have applied for authorization to have the types of access or perform the activities described in paragraph 26.25(a) must be subject to the applicable requirements of this part and provided with the applicable protections of this part. The incremental costs and savings from these provisions are calculated in their respective sections.

[3] This assumption has been made to simplify the above calculation for MROs. Elsewhere the analysis assumes that 85 percent of personnel are being trained at the non-supervisory-level under the current rule, and that the remaining 15 percent are being trained at the supervisory-level.

26.27 Written Policy and Procedures

Paragraph 26.27(a)

This proposed paragraph would amend requirements, currently in §26.20 of the current rule, regarding the establishment, implementation, and maintenance of written policies and procedures designed to meet the general performance objectives and requirements of this part. Licensees and other entities must revise their existing policies, procedures, and contracts with labs or other C/Vs according to paragraphs 26.27(b) and (c), resulting in incremental costs. The costs of the revisions will include policy and procedure development and revision, legal support, and clerical support. Costs associated with revisions to the FFD training program are calculated separately in connection with paragraph 26.29(a).

The *one-time cost per program* results from the sum of the following costs:

- One-time costs per program to account for FFD manager and clerical personnel time and to contract a legal consultant are calculated as follows:

  $(HOURS_{Manager} \times WAGE_{Manager}) + (HOURS_{Legal} \times WAGE_{Legal}) + (HOURS_{Clerical} \times WAGE_{Clerical})$

- One-time costs per program to account for facility supervisor time to implement the corporate policies at the facility level are calculated as follows:

  $HOURS_{Facility\ Supervisor} \times WAGE_{Facility\ Supervisor} \times NUM_{Facilities}$

Parameter	Description
$HOURS_{Clerical}$	Hours of clerical personnel to support revision of policies, procedures, and contracts per program (as described in assumptions below)
$HOURS_{Facility\ Supervisor}$	Hours of facility supervisor time to implement revised corporate policies and procedures per facility (as described in assumptions below)
$HOURS_{Legal}$	Hours of legal assistance to review and revise policies, procedures, and contracts per program (as described in assumptions below)
$HOURS_{Manager}$	Hours of FFD program manager labor to develop and revise policies, procedures, and contracts per program (as described in assumptions below)
$NUM_{Facilities}$	Number of facilities (as described in Appendix 2, Exhibit A2-14)
$WAGE_{Clerical}$	Clerical personnel wage rate (as described in Appendix 2, Exhibit A2-11)
$WAGE_{Facility\ Supervisor}$	Facility supervisor wage rate (as described in Appendix 2, Exhibit A2-11)
$WAGE_{Legal}$	Legal consultant wage rate (as described in Appendix 2, Exhibit A2-11)
$WAGE_{Manager}$	FFD program manager wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- Hours of FFD program manager labor to develop and revise policies, procedures, and contracts per program: 370 hours.
- Hours of legal assistance to review and revise policies, procedures, and contracts per program: 95 hours.
- Hours of clerical personnel to support revision of policies, procedures, and contracts per program: 95 hours.
- Hours of facility supervisor time to implement revised corporate policies and procedures: 40 hours.
- Policy and procedure revisions are developed once per operating firm, regardless of the number of sites or facilities the firm operates.

Paragraph 26.27(b)

This paragraph of the proposed rule establishes regulatory requirements regarding the content of policy statements. The proposed paragraph requires that written policies and procedures be clear, concise and readily available to all individuals subject to the policy such that they may

understand what is expected of them and what consequences may result from lack of adherence to the policy. These requirements amend the requirements contained in §26.20 of the current rule. The analysis calculates the cost of this revision as part of the related revisions required under proposed paragraph 26.27(a) except as discussed below.

Subparagraphs 26.27(b)(1)–26.27(b)(10)

These subparagraphs of the proposed rule establish regulatory requirements regarding the content of policy statements. These proposed subparagraphs of the proposed rule highlight the minimum content of the written policies and procedures available to individuals subject to the policy. These subparagraphs provide more detail on what to include in the written policies and procedures than is currently contained in paragraph 26.20(a). The analysis calculates the cost of this revision as part of the related revisions required under proposed paragraph 26.27(a).

Subparagraph 26.27(b)(11)

This proposed paragraph requires licensees' written policies and procedures to describe the responsibility of individuals subject to the FFD program (i.e., other than the supervisors, managers, and escorts who are addressed in 26.27(b)(10)) to report FFD concerns (e.g., concerns identified as a result of behavioral observation). The cost of revising the policies and procedures to include this description is included in the calculation under 26.27(a). The new policy will be communicated to employees through the training program required under 26.29 (the costs of which are calculated under 26.29). As a result of the new policy, there will be an increase in the number of for-cause referrals, the number of drug and alcohol tests performed, and the number of positive test results that must undergo confirmatory testing. The analysis calculates the cost of these activities under proposed paragraph 26.33.

Paragraph 26.27(c)

Subparagraph 26.27(c)(1)

This subparagraph of the proposed rule imposes no incremental cost and affords no saving because it only describes the written procedures that must be prepared, implemented, and maintained by licensees and other entities related to testing for drugs and alcohol. The requirement to address these procedures is already contained in paragraph 26.20(c) of the current rule.

Subparagraph 26.27(c)(2)(i) and (ii)

These subparagraphs of the proposed rule impose no incremental cost and afford no saving because they merely state that licensee and other entity written policies and procedures must describe the immediate and follow-up actions to be taken and procedures to be followed when an individual has been involved in the use, sale, or possession of illegal drugs and when an

individual has consumed alcohol during the abstinence period, while on duty, or to excess before reporting to duty. These requirements are already contained in paragraph 26.20(d) of the current rule.

Subparagraph 26.27(c)(2)(iii)–(v)

These subparagraphs of the proposed rule impose no incremental cost and afford no saving because they merely state that licensee and other entity written policies and procedures must describe the follow-up actions to be taken and procedures to be followed when an individual has attempted to subvert the testing process, refused to provide a specimen for analysis, and had legal action taken on a drug or alcohol related charge. The costs associated with revising licensee and other entity written policy and procedures to address these violations of FFD policy are addressed in proposed paragraph 26.27(a).

Subparagraph 26.27(c)(3)

This subparagraph of the proposed rule imposes no incremental cost and affords no saving because it only requires that licensee and other entity written policies and procedures must describe (1) the process to ensure that persons called in to perform an unscheduled working tour are fit for duty, and (2) the requirements for licensee and other entity personnel who are scheduled by licensee emergency plans and procedures to physically report to a licensee's Technical Support Center or Emergency Operations Facility. The current rule already requires these descriptions to be contained in licensee written policies and procedures under existing subparagraph 26.20(e).

Subparagraph 26.27(c)(4)

This subparagraph of the proposed rule requires that licensee and other entity written policies and procedures must describe the process to be followed if an individual's behavior indicates a potential FFD concern. Although licensees have indicated that the written procedure for managers, supervisors, and escorts to report FFD concerns is well established, the proposed rule, in conjunction with 26.27(b)(11), adds provisions that all employees are required to report FFD concerns. As a result, the procedures may need to be revised. The incremental cost of these revisions are included in the complete written policy revision calculated under 26.27(a) of this analysis, and the cost of implementing the policy and process is calculated under 26.33.

Paragraph 26.27(d)

This subparagraph of the proposed rule imposes no incremental cost and affords no saving because it merely retains requirements contained in paragraph 26.20(f) of the current rule stating that the NRC may review licensee or other entity written policies and procedures at any time to assure that the performance objectives of this part are met.

26.29 Training

Paragraph 26.29(a)

This proposed paragraph requires licensees to revise their training programs and training materials to account for the new FFD provisions in the proposed rule and to include behavioral observation training for all individuals subject to the rule. (Currently, behavioral observation is included only in supervisory-level training.) Licensees will incur costs to revise their training programs and materials to reflect the new regulatory provisions. However, the provision to include behavioral observation training for all individuals subject to the rule is already in effect due to the AAO. Therefore, there will be no incremental costs associated with the behavioral observation training provision, except under the alternative Pre-Order Baseline.

The *one-time cost per program* associated with revising the training program and training materials to account for new FFD provisions in the proposed rule are calculated as follows:

$$(HOURS_{Trainer} \times WAGE_{Trainer}) + (HOURS_{Training_Manager} \times WAGE_{Training_Manager}) + (HOURS_{Manager} \times WAGE_{Manager}) + (HOURS_{Clerical} \times WAGE_{Clerical})$$

Parameter	Description
$HOURS_{Manager}$	One-time hours of FFD program manager time per program to review the revised training program and revised training materials to account for new FFD provisions in the proposed rule (described in assumptions below)
$HOURS_{Trainer}$	One-time hours of trainer time per program to revise the training program and training materials to account for new FFD provisions in the proposed rule (described in assumptions below)
$HOURS_{Training_Manager}$	One-time hours of training manager time per program to review the revised training program and revised training materials to account for new FFD provisions in the proposed rule (described in assumptions below)
$HOURS_{Clerical}$	One-time hours of clerical personnel per program to support the revision of the training program and training materials to account for new FFD provisions in the proposed rule (described in assumptions below)
$WAGE_{Trainer}$	Trainer wage rate (described in Appendix 2, Exhibit A2-11)
$WAGE_{Training_Manager}$	Training manager wage rate (described in Appendix 2, Exhibit A2-11)
$WAGE_{Manager}$	FFD program manager wage rate (described in Appendix 2, Exhibit A2-11)
$WAGE_{Clerical}$	Clerical personnel wage rate (described in Appendix 2, Exhibit A2-11)

Assumptions:

- Hours of trainer time per program to revise the training program and training materials to address new FFD provisions in the proposed rule: 20 hours.

- Hours of training manager time per program to review the revised training program and revised training materials to address new FFD provisions in the proposed rule: 2 hours.

- Hours of FFD program manager time per program to review the revised training program and revised training materials to address new FFD provisions in the proposed rule: 2 hours.

- Hours of clerical personnel to support the revision of the training program and training materials addressing new FFD provisions in the proposed rule: 4 hours.

Sensitivity Analysis Note - Pre-Order Baseline

Relative to the regulations in effect prior to NRC's issuance of the Access Authorization Order, this proposed paragraph results in additional incremental costs. The additional costs arise from the proposed requirement to include behavioral observation training for all individuals subject to the rule. (Currently, behavioral observation is included only in supervisory-level training.)

The revisions to the training program and processes related to behavioral observation training will cause licensees to incur incremental costs for the following activities:

- Training course revisions
- Upgrade to supervisory-level training addressing behavioral observation
  - One-time
  - Annual
- Refresher training

Training Course Revisions. The incremental changes presented in subparagraph 26.29(a)(9) (as well as the AAO) will require licensees to revise their training programs to incorporate behavioral observation training for all individuals subject to the rule. *The one-time cost per program* associated with revising the training program result from the following:

$$(HOURS_{Trainer} \times WAGE_{Trainer}) + (HOURS_{Training_Manager} \times WAGE_{Training_Manager}) + (HOURS_{Manager} \times WAGE_{Manager}) + (HOURS_{Clerical} \times WAGE_{Clerical})$$

Parameter	Description
$HOURS_{Trainer}$	Hours of trainer time per program to make revisions to the training program (as described in assumptions below)
$HOURS_{Training_Manager}$	Hours of training manager time per program to review the revised training program (as described in assumptions below)
$HOURS_{Clerical}$	Hours of clerical personnel per program to support the training program revisions process (as described in assumptions below)
$HOURS_{Manager}$	Hours of FFD program manager time per program to review the revised training program (as described in assumptions below)
$WAGE_{Trainer}$	Trainer wage rate (as described in Appendix 2, Exhibit A2-11)
$WAGE_{Training_Manager}$	Training manager wage rate (as described in Appendix 2, Exhibit A2-11)
$WAGE_{Clerical}$	Clerical personnel wage rate (as described in Appendix 2, Exhibit A2-11)
$WAGE_{Manager}$	FFD program manager wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- Hours of trainer time per program to make revisions to the training program addressing behavioral observation for all individuals subject to the rule: 12 hours.

- Hours of training manager time per program to review revisions to the training program addressing behavioral observation for all individuals subject to the rule: 2 hours.

- Hours of FFD program manager time per program to review revisions to the training program addressing behavioral observation for all individuals subject to the rule: 2 hours.

- Hours of clerical personnel per program to support the training program revisions process: 4 hours.

Initial Behavioral Observation Training for All Individuals Who Are Subject to the Rule. Proposed §26.29(a) would also require training in behavioral observation for all individuals who are subject to the rule, rather than only for supervisors and escorts as required in §26.22 of the current rule. In other words, all individuals must receive what currently is supervisory-level training. As a result of this new training requirement, licensees will incur a one-time cost to retrain all existing employees who have not previously received training in behavioral observation, an annual cost to train newly hired employees in behavioral observation and an annual cost to provide behavioral observation refresher training as required under proposed subparagraph 26.29(c)(2).

Licensees will incur a *one-time incremental cost* in order to provide updated training to all individuals who are already covered by the FFD program, but who have not already had full supervisory-level training. The *one-time cost per program* results from the sum of the following costs:[4]

- One-time costs per program for employees not previously trained at the supervisory level to take updated behavioral observation training and a comprehensive examination are calculated as follows:

  $$[NUM_{Employees} \times PER_{Non\text{-}Supervisory} \times (HOURS_{Training} + HOURS_{Examination}) \times WAGE_{Worker} \times NUM_{Units}] \times PER_{Cost}$$

- One-time costs per program for trainers to administer behavioral observation training to those employees not previously trained at the supervisory level are calculated as follows:[5]

  $$[NUM_{Sessions} \times (HOURS_{Training} + HOURS_{Examination} + HOURS_{Preparation}) \times WAGE_{Trainer} \times NUM_{Units}] \times PER_{Cost}$$

Parameter	**Description**
$HOURS_{Examination}$	Length of comprehensive examination (as described in assumptions below)
$HOURS_{Preparation}$	Hours of preparation and examination grading per session (as described in assumptions below)
$HOURS_{Training}$	Length of updated supervisory-level training (as described in assumptions below)
$NUM_{Employees}$	Number of employees per unit (as described in Appendix 2, Exhibit A2-14)
NUM_{Units}	Number of units per program (as described in Appendix 2, Exhibit A2-14)
$NUM_{Sessions}$	Number of training sessions per unit (as described in assumptions below)
PER_{Cost}	Percentage of cost applied to a given unit (as described in assumptions below)
$PER_{Non\text{-}Supervisory}$	Percentage of employees trained at the non-supervisory level under the current rule (as described in assumptions below)
$WAGE_{Trainer}$	Trainer wage rate (as described in Appendix 2, Exhibit A2-11)
$WAGE_{Worker}$	Facility worker wage rate (as described in Appendix 2, Exhibit A2-11)

[4] This calculation includes costs associated with administering a comprehensive examination because the entire activity of requiring existing employees to update their training and pass an examination represents an incremental requirement.

[5] Although many licensees may be conducting computer-based trainings, the analysis utilizes a class-based format, which may result in an overestimate of the cost of incremental training activities.

Assumptions:

- Percentage of employees trained at the non-supervisory level under the current rule: 85%.
- Length of updated training, including behavioral observation: 4 hours.
- Length of comprehensive examination: 0.5 hours.
- Number of training sessions assumes 50 workers per session.
- Hours of preparation and examination grading per session: 2 hours.
- Licensees have indicated that 75 percent of facilities already train all employees at this higher supervisory level and, therefore, would not incur any incremental cost under this requirement. Because the analysis cannot identify which facilities are already training at the higher level and which are not, the analysis assumes that each unit will incur the incremental cost of 25 percent of the activity.

Annual Initial Training. An incremental cost for annual training for individuals, such as new workers not yet covered under FFD programs or workers updating their authorization, will also lead to increased costs. This is attributable to the longer length of supervisory-level training in relation to training previously conducted under the existing rule. The *annual cost per program* results from the sum of the following costs:[6]

- Annual costs per program for incoming employees to take the longer training course addressing behavioral observation are calculated as follows:

  $[NUM_{Applicants} \times PER_{Non\text{-}Supervisory} \times (HOURS_{Supervisory} - HOURS_{Non\text{-}Supervisory}) \times WAGE_{Worker} \times NUM_{Units}] \times PER_{Cost}$

- Annual costs per program for trainers to administer the longer behavioral observation training to incoming employees are calculated as follows:[7]

  $[NUM_{Sessions} \times (HOURS_{Supervisory} - HOURS_{Non\text{-}Supervisory}) \times WAGE_{Trainer} \times NUM_{Units}] \times PER_{Cost}$

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[6] This calculation does not include the costs associated with administering the comprehensive examination required under paragraph 26.29(b) because new hires are already required to take a comprehensive examination. Therefore, the examination does not represent an incremental requirement.

[7] Although many licensees may be conducting computer-based trainings, the analysis utilizes a class-based format, which may result in an overestimate of the cost of incremental training activities.

Parameter	Description
$HOURS_{Non\text{-}Supervisory}$	Length of non-supervisory-level training course per applicant (as described in assumptions below)
$HOURS_{Supervisory}$	Length of supervisory-level training course per applicant (as described in assumptions below)
$NUM_{Applicants}$	Annual number of applicants for initial and update authorization per unit (as described in Appendix 2, Exhibit A2-12)
NUM_{Units}	Number of units per program (as described in Appendix 2, Exhibit A2-14)
$NUM_{Sessions}$	Annual number of supervisory-level training sessions per unit (as described in assumptions below)
PER_{Cost}	Percentage of cost applied to a given facility (as described in assumptions below)
$PER_{Non\text{-}Supervisory}$	Percentage of applicants for initial and update authorization trained at the non-supervisory-level under the current rule (as described in assumptions below)
$WAGE_{Trainer}$	Trainer wage rate (as described in Appendix 2, Exhibit A2-11)
$WAGE_{Worker}$	Facility worker wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- Percentage of applicants for initial and update authorization trained at the non-supervisory level under the current rule: 85%.
- Length of supervisory-level training course per applicant: 4 hours.
- Length of non-supervisory-level training course per applicant: 2 hours.
- Annual number of supervisory-level training sessions per unit assumes 20 workers per session.
- Licensees have indicated that 75 percent of facilities already train all employees at this higher supervisory level and, therefore, would not incur any incremental cost under this requirement. Because the analysis cannot identify which facilities are already training at the higher level and which are not, the analysis assumes that each unit will incur the incremental cost of 25 percent of the activity.

Annual Refresher Training. Licensees will have to conduct refresher training. As a result, licensees will incur an incremental cost for some employees (i.e., those who are currently taking non-supervisory-level refresher training) because of the increased time required to conduct behavioral observation refresher training instead of non-supervisory-level training as required by the current rule. Although providing only one level of training (as opposed to two) may represent a potential savings, the savings are difficult to quantify and may be negligible when considering

administrative costs associated with providing an optional comprehensive examination in lieu of refresher training under subparagraph 26.29(c)(2). Despite the provision of this optional comprehensive "challenge" examination, the savings of which are presented separately, some workers will continue to take refresher training. The *annual costs per program* result from the sum of the following costs:

- Annual costs per program for employees to take the longer behavioral observation refresher training are calculated as follows:

  $$[NUM_{Employees} \times PER_{Non\text{-}Supervisory} \times PER_{Refresher} \times (HOURS_{Supervisory} - HOURS_{Non\text{-}Supervisory}) \times WAGE_{Worker} \times NUM_{Units}] \times PER_{Cost}$$

- Annual costs per program for trainers to administer the longer behavioral observation refresher training are calculated as follows:[8]

  $$[NUM_{Sessions} \times (HOURS_{Supervisory} - HOURS_{Non\text{-}Supervisory}) \times WAGE_{Trainer} \times NUM_{Units}] \times PER_{Cost}$$

Parameter	**Description**
$HOURS_{Non\text{-}Supervisory}$	Length of non-supervisory-level refresher training course (described in assumptions below)
$HOURS_{Supervisory}$	Length of new refresher training course including behavioral observation (described in assumptions below)
$NUM_{Employees}$	Annual number of employees per unit covered by FFD program (as described in Appendix 2, Exhibit A2-14)
NUM_{Units}	Number of units per program (as described in Appendix 2, Exhibit A2-14)
$NUM_{Sessions}$	Annual number of refresher training sessions per unit (as described in assumptions below)
PER_{Cost}	Percentage of cost applied to a given facility (as described in assumptions below)
$PER_{Non\text{-}Supervisory}$	Percentage of employees trained at the non-supervisory level under the current rule (as described in assumptions below)
$PER_{Refresher}$	Percentage of employees taking refresher training instead of the comprehensive "challenge" examination (described in assumptions below)
$WAGE_{Trainer}$	Trainer wage rate (as described in Appendix 2, Exhibit A2-11)
$WAGE_{Worker}$	Facility worker wage rate (as described in Appendix 2, Exhibit A2-11)

[8] Although many licensees may be conducting computer-based trainings, the analysis utilizes a class-based format, which may result in an overestimate of the cost of incremental training activities.

Assumptions:

- Percentage of employees trained at the non-supervisory level under the current rule: 85%.

- Percentage of employees taking refresher instead of the comprehensive "challenge" examination: 20%.

- Length of new training course including behavioral observation: 4 hours.

- Length of non-supervisory-level training course per applicant: 2 hours.

- Annual number of supervisory-level refresher training sessions assumes 20 workers per session.

- Licensees have indicated that 75 percent of facilities already train all employees at this higher supervisory level and, therefore, would not incur any incremental cost under this requirement. Because the analysis cannot identify which facilities are already training at the higher level and which are not, the analysis assumes that each unit will incur the incremental cost of 25 percent of the activity.

Paragraph 26.29(b)

This proposed paragraph adds an explicit requirement to administer a comprehensive examination following FFD training. Although the current rule does not explicitly require comprehensive examinations, it does require licensees to ensure that training is achieving the desired results, and licensees normally accomplish this goal through examinations. Licensees have indicated that they already administer comprehensive examinations in order to ensure employee understanding. Thus, the clarified requirement to administer a comprehensive examination imposes no incremental cost and affords no saving. Note that even though there is no incremental cost to administer examinations, the content of the examination must now reflect new material, as discussed above in connection with proposed paragraph 26.29(a). The cost of updating the training course itself also is addressed in connection with proposed paragraph 26.29(a).

This proposed paragraph also requires that individuals who fail the comprehensive examination must take remedial training and retake the examination. The remedial training would require workers to review specific areas of the examination in which they performed poorly. Although licensees have indicated that they already retest individuals who fail the comprehensive examination, they may not be retraining them. Therefore, this analysis assumes that the new rule will result in incremental costs to retrain existing employees who fail the comprehensive examination following the updated training as well as those applicants for initial and update authorization who fail the examination after initial training.

Licensees will incur a *one-time cost* to require licensees to retrain individuals who fail the comprehensive examination after first taking the updated training addressing behavioral observation. The costs associated with the initial training update are calculated separately above. The *one-time cost per program* results from the following costs:

- One-time costs per program for employees to take remedial training after failing the initial comprehensive examination when updating their training are calculated as follows:

  $$[NUM_{Employees} \times PER_{Non\text{-}Supervisory} \times PER_{Failing} \times HOURS_{Remedial} \times WAGE_{Worker}] \times NUM_{Units}$$

- One-time costs per program for trainers to administer remedial training on those employees who fail the initial comprehensive examination when updating training are calculated as follows:[9]

  $$NUM_{Sessions} \times HOURS_{Remedial} \times WAGE_{Trainer} \times NUM_{Units}$$

Parameter	**Description**
$HOURS_{Remedial}$	Length of remedial supervisory-level training (as described in assumptions below)
$NUM_{Employees}$	Number of employees per unit (as described in Appendix 2, Exhibit A2-14)
NUM_{Units}	Number of units per program (as described in Appendix 2, Exhibit A2-14)
$NUM_{Sessions}$	Number of supervisory-level update training sessions per facility (as described in assumptions below)
$PER_{Failing}$	Percentage of employees failing the comprehensive examination (as described in assumptions below)
$PER_{Non\text{-}Supervisory}$	Percentage of employees trained at the non-supervisory level under the current rule (as described in assumptions below)
$WAGE_{Trainer}$	Trainer wage rate (as described in Appendix 2, Exhibit A2-11)
$WAGE_{Worker}$	Facility worker wage rate (as described in Appendix 2, Exhibit A2-11)

[9] Although many licensees may be conducting computer-based trainings, the analysis utilizes a class-based format, which may result in an overestimate of the cost of incremental training activities.

Assumptions:

- Length of remedial supervisory-level training: 0.75 hours.
- Percentage of employees trained at the non-supervisory level under the current rule: 85%.
- Percentage of employees failing comprehensive examination: 10%.
- Number of supervisory-level update retraining sessions per facility assumes 20 workers per session.

In addition to the one-time costs, licensees will incur an annual cost as a result of the new requirement to retrain all subsequent applicants who fail the comprehensive examination for initial and updated authorization. The *annual costs per program* result from the sum of the following costs:

- Annual costs per program for applicants to take remedial training after failing the initial comprehensive examination are calculated as follows:

  $$NUM_{Applicants} \times PER_{Failing} \times HOURS_{Remedial} \times WAGE_{Worker} \times NUM_{Units}$$

- Annual costs per program for trainers to administer remedial training on applicants who fail the initial comprehensive examination are calculated as follows:[10]

  $$NUM_{Sessions} \times HOURS_{Remedial} \times WAGE_{Trainer} \times NUM_{Units}$$

Parameter	**Description**
$HOURS_{Remedial}$	Length of remedial supervisory-level training (as described in assumptions below)
$NUM_{Applicants}$	Annual number of applicants per unit who would take the examination for initial and updated authorization (as described in Appendix 2, Exhibit A2-12)
NUM_{Units}	Number of units per program (as described in Appendix 2, Exhibit A2-14)
$NUM_{Sessions}$	Annual number of supervisory-level training sessions per unit (as described in assumptions below)
$PER_{Failing}$	Percentage of applicants failing the comprehensive examination per year (as described in assumptions below)

[10] Although many licensees may be conducting computer-based trainings, the analysis utilizes a class-based format, which may result in an overestimate of the cost of incremental training activities.

Parameter	Description
$WAGE_{Trainer}$	Trainer wage rate (as described in Appendix 2, Exhibit A2-11)
$WAGE_{Worker}$	Facility worker wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- Length of remedial supervisory-level training: 0.75 hours.
- Percentage of applicants failing the comprehensive examination per year: 10%.
- Number of supervisory-level training sessions per facility assumes 20 workers per session.

Paragraph 26.29(c)

Subparagraph 26.29(c)(1)

This subparagraph of the proposed rule imposes no incremental cost and affords no saving because it merely requires licensee employees to complete their training before being assigned activities under Part 26, as required under paragraph 26.21(b) of the existing rule. Additionally, this proposed subparagraph eliminated an existing provision to allow 3 months to upgrade training for newly assigned supervisors. The elimination of this provision will impose no additional cost because all employees will be required to train at the same supervisory level under proposed paragraph 26.29(a).

Subparagraph 26.29(c)(2)

This proposed subparagraph requires refresher training on a 12-month frequency, as required under paragraphs 26.21(b) and 26.22(c) of the current rule. Thus, no incremental cost or saving will result specifically from this requirement. However, the proposed subparagraph also adds a provision to allow workers to take a comprehensive annual examination in lieu of refresher training (i.e., a “challenge” exam). This provision represents potential incremental savings, as the examination requires less time to complete than the refresher training. The amount of the savings per employee depends on whether the employee who chooses to take the comprehensive examination is currently taking supervisory-level or non-supervisory-level refresher training. Although incremental savings are associated with workers taking less training, the savings will be partially offset because the cost of examination grading must be considered and subtracted. Licensees will also incur a one-time cost to develop procedures for administering the challenge examination, the cost of which is included in the calculations described in 26.29(a).

The *annual savings per program* result from the sum of the following savings:

- Annual savings per program for those employees choosing to take the shorter comprehensive examination in lieu of (the current non-supervisory-level) refresher training are calculated as follows:

  $NUM_{Employees} \times PER_{Non\text{-}Supervisory} \times PER_{Examination} \times (HOURS_{Non\text{-}Supervisory} - HOURS_{Exam}) \times WAGE_{Worker} \times NUM_{Units}$

- Annual savings per program for those employees choosing to take the shorter comprehensive examination in lieu of (the current supervisory-level) refresher training are calculated as follows.

  $NUM_{Employees} \times PER_{Supervisory} \times PER_{Examination} \times (HOURS_{Refresher} - HOURS_{Exam}) \times WAGE_{Worker} \times NUM_{Units}$

- Annual savings per program from reduced training costs due to employees choosing to take the shorter comprehensive examination in lieu of (the current non-supervisory-level) refresher training are calculated as follows:[11]

  $[NUM_{Sessions\ Non\text{-}Supervisory} \times (HOURS_{Non\text{-}Supervisory} + HOURS_{Preparation} - HOURS_{Exam} - HOURS_{Grading}) \times WAGE_{Trainer}] \times NUM_{Units}$

- Annual savings per program from reduced training costs due to employees choosing to take the shorter comprehensive examination in lieu of (the current supervisory-level) refresher training are calculated as follows:

  $[NUM_{Sessions\ Supervisory} \times (HOURS_{Refresher} + HOURS_{Preparation} - HOURS_{Exam} - HOURS_{Grading}) \times WAGE_{Trainer}] \times NUM_{Units}$

Parameter	**Description**
$HOURS_{Exam}$	Length of comprehensive examination per exam (as described in assumptions below)
$HOURS_{Grading}$	Hours of examination grading per session (as described in assumptions below)
$HOURS_{Non\text{-}Supervisory}$	Length of non-supervisory-level refresher training course per session (as described in assumptions below)
$HOURS_{Preparation}$	Hours of trainer time to prepare for training course per session (as described in assumptions below)

[11] Although many licensees may be conducting computer-based trainings, the analysis utilizes a class-based format, which may result in an overestimate of the cost of incremental training activities.

Parameter	Description
$HOURS_{Refresher}$	Length of new refresher course per session (as described in assumptions below)
$NUM_{Employees}$	Number of employees per unit (as described in Appendix 2, Exhibit A2-14)
NUM_{Units}	Number of units per program (as described in Appendix 2, Exhibit A2-14)
$NUM_{Sessions\ Supervisory}$	Annual number of comprehensive examination sessions per unit replacing supervisory-level refresher training (as described in assumptions below)
$NUM_{Sessions\ Non\text{-}Supervisory}$	Annual number of comprehensive examination sessions per unit replacing non-supervisory-level refresher training (as described in Appendix 2, Exhibit A2-3)
$PER_{Examination}$	Percentage of employees choosing to take comprehensive examination in lieu of refresher training (as described in assumptions below)
$PER_{Non\text{-}Supervisory}$	Percentage of employees trained at the non-supervisory level under the current rule (as described in assumptions below)
$PER_{Supervisory}$	Percentage of employees trained at the supervisory level under the current rule (as described in assumptions below)
$WAGE_{Trainer}$	Trainer wage rate (as described in Appendix 2, Exhibit A2-11)
$WAGE_{Worker}$	Facility worker wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- Percentage of employees trained at the non-supervisory level under the current rule: 85%.
- Percentage of employees choosing to take the comprehensive examination in lieu of refresher training: 80%.
- Percentage of employees trained at the supervisory level under the current rule: 15%.
- Length of non-supervisory-level refresher training course per session: 2 hours.
- Length of comprehensive examination per exam: 0.5 hours.
- Length of new refresher course per session: 4 hours.
- Number of comprehensive examination sessions replacing refresher course assumes 20 workers per training session.

- Hours of trainer time to prepare for training course per session: 1 hour.
- Hours of examination grading per session: 0.5 hours.

Subparagraph 26.29(c)(3)

This subparagraph of the proposed rule imposes no incremental cost and affords no saving because the added provision only authorizes licensees to conduct training via a variety of mediums. Alternative training mediums might allow licensees to take advantage of more effective and more efficient techniques. The proposed subparagraph clarifies the existing requirements in paragraph 26.21 of the current rule. Any savings that result from this provision are considered to be insignificant.

Subparagraph 26.29(d)

This subparagraph of the proposed rule imposes no incremental cost and affords no saving because it merely allows licensees to forego training and testing of individuals who have taken Part 26 training within the prior 12 months. The NRC and licensees have indicated that this provision is already practiced under the existing rule, in accordance with guidance in NUREG-1385.

26.31 Drug and Alcohol Testing

Paragraph 26.31(a)

This paragraph of the proposed rule imposes no incremental cost or saving because it merely retains the existing requirements in paragraph 26.24(a) of the current rule which relates to the implementation of drug and alcohol testing programs for persons who are subject to the FFD rule.

Paragraph 26.31(b)

Subparagraph 26.31(b)(1)

This proposed subparagraph amends Appendix A, §2.3 of the current rule to include FFD program personnel in the drug and alcohol testing program requirements. Incremental costs associated with adding FFD program personnel to the testing program are calculated in the discussion of subparagraph 26.25(a)(4).

Subparagraph 26.31(b)(1)(i)

This proposed subparagraph revises the existing requirements in Appendix A, paragraph 2.3(2), of the current rule. The proposed rule clarifies that the background investigations, credit and

criminal history checks, and psychological evaluations that are required for persons who are granted unescorted access to protected areas in nuclear power plants and other affected facilities are acceptable means for meeting this requirement addressing the honesty and integrity of FFD program personnel. The analysis assumes that a criminal history and credit check are included in the background check already required in order to grant unescorted access authorization under a licensee's access authorization program and, therefore, assumes no incremental cost. The proposed rule also relaxes a current provision that requires licensees to update the background investigation every three years, thereby realizing an incremental saving. Although licensees must continue to update the psychological assessment and criminal history and credit checks, the proposed rule reduces the frequency of such updates from every 3 years to every 5 years, resulting in additional incremental savings.

The *annual savings per program* result from the *sum* of the following factors:

- The *base annual savings per program* (i.e., regardless of whether the program uses onsite or offsite collection facilities and testing laboratories) from eliminating the requirement to update background checks every 3 years are estimated as follows:

  $NUM_{Personnel\text{-}Base} \times COST_{Background\ Investigation\ Update} \times PER_{Annualized\text{-}1} \times NUM_{Units}$

- Additional savings per program from eliminating the requirement to update background checks every 3 years *per program with onsite testing* are estimated as follows:

  $NUM_{Personnel\text{-}Onsite\ Testing} \times COST_{Background\ Investigation\ Update} \times PER_{Annualized\text{-}1} \times NUM_{Facilities}$

- Additional savings per program from eliminating the requirement to update background checks every 3 years *per program with onsite collection* are estimated as follows:

  $NUM_{Personnel\text{-}Onsite\ Collection} \times COST_{Background\ Investigation\ Update} \times NUM_{Facilities} \times PER_{Collection} \times PER_{Annualized\text{-}1}$

- *Base annual savings per program* (i.e., regardless of whether the program uses onsite or offsite collection and testing facilities) from reducing the frequency with which licensees must update the psychological evaluations and the criminal history and credit checks are estimated as follows:

  $NUM_{Personnel\text{-}Base} \times [COST_{Criminal/Credit\ Update} + COST_{Psychological\ Evaluation\ Update}] \times NUM_{Units} \times PER_{Annualized\text{-}2}$

- Additional savings per program from reducing the frequency with which licensees must update the psychological evaluations and the criminal history and credit check *per program with onsite testing laboratories* are estimated as follows:

  $NUM_{Personnel\text{-}Onsite\text{-}Testing} \times [COST_{Criminal/Credit\ Update} + COST_{Psychological\ Evaluation\ Update}] \times PER_{Annualized\text{-}2} \times NUM_{Facilities}$

- Additional savings per program from reducing the frequency with which licensees must update psychological evaluations and the criminal history and credit check update *per program with onsite collection facilities* are estimated as follows:

  $NUM_{Personnel\text{-}Onsite\text{-}Collection} \times [COST_{Criminal/Credit\ Update} + COST_{Psychological\ Evaluations}] \times PER_{Collection} \times PER_{Annualized\text{-}2} \times NUM_{Facilities}$

Parameter	**Description**
$COST_{Background\ Investigation\ Update}$	Cost of updating an individual's background investigations, excluding the credit check and criminal history check (as described in assumptions below)
$COST_{Criminal/Credit\ Update}$	Cost of updating an individual's criminal and credit history (as described in assumptions below)
$COST_{Psychological\ Evaluation\ Update}$	Cost of updating an individual's psychological evaluation (as described in assumptions below)
$NUM_{Facilities}$	Number of facilities per program (as described in Appendix 2, Exhibit A2-14)
$NUM_{Personnel\text{-}Base}$	Base number of FFD program personnel per unit for each program (as described in the assumptions below)
$NUM_{Personnel\text{-}Onsite\text{-}Testing}$	Additional number of FFD program personnel per facility for programs with onsite testing laboratories (as described in assumptions below)
$NUM_{Personnel\text{-}Onsite\text{-}Collection}$	Additional number of FFD program personnel per facility for programs with onsite collection facilities (described in assumption below)
NUM_{Units}	Number of units per program (as described in Appendix 2, Exhibit A2-14)
$PER_{Annualized\text{-}1}$	Factor to adjust the periodic savings (every 3 years) to an annual savings (as described in assumptions below)
$PER_{Annualized\text{-}2}$	Factor to adjust to the periodic savings (two updates eliminated every 15 years) to an annual savings (as described in assumptions below)
$PER_{Collection}$	Percentage of facilities with onsite collection per program (as described in Appendix 2, Exhibit A2-1)

Assumptions:

- Base number of FFD program personnel (i.e., regardless of whether the program uses onsite or offsite collection facilities or testing laboratories) per unit: 1.5.

- Additional number of FFD program personnel per facility with onsite testing laboratories: 1.

- Additional number of FFD program personnel per facility for programs with onsite collection facilities: 0.5.

- Each facility in a program with onsite testing will have a separate testing laboratory with its own testing staff.

- Each facility in a program with onsite collection will have a separate collection site with its own collection staff.

- Cost of updating an individual's background investigations (excluding the credit and criminal history check): $150.

- Cost of updating an individual's psychological evaluation: $300.

- Cost of updating an individual's criminal and credit history: $50.

- Factor to annualize the 3-year periodic saving equals 1/3, or 33.3 percent (i.e., the proposed rule eliminates one background check update and one psychological evaluation, the savings of which are spread over 3 years).

- Factor to annualize the periodic saving from reducing a 3-year review frequency to a 5-year review frequency equals 2/15, or 13.3 percent (i.e., the proposed rule eliminates two criminal and credit history updates are eliminated, the savings of which are spread over 15 years).

Subparagraph 26.31(b)(1)(ii)– (iv)

These subparagraphs of the proposed rule impose no incremental cost and afford no saving because they merely amend the existing requirements in Appendix A, paragraph 2.3(1) to prohibit assessment or evaluation by a person having a personal relationship with the individual being tested or by an FFD program supervisor or co-workers within the same work group of the individual being tested. The proposed subparagraphs would add a requirement prohibiting determinations of fitness (discussed with respect to proposed §26.189) by FFD program personnel if the FFD program staff member has a personal relationship with the individual being

tested. Specimen collection that does not require direct observation can be conducted by an individual who has a personal relationship with the donor so long as the collection process is monitored by a second individual who is trained to monitor specimen collections and the preparation of specimens for transfer or shipping and who does not have a personal relationship with the donor. When directly observed specimen collection is required, however, the collector may have no personal relationship with the donor.

Subparagraph 26.31(b)(1)(v)

This subparagraph of the proposed rule imposes no incremental cost and affords no saving because it merely restates the existing requirements in Appendix A, paragraph 2.3(3), which require licensees to subject all persons "responsible for administering the testing program" (including the MRO when on site) to a behavioral observation program.

Subparagraph 26.31(b)(2)

This proposed subparagraph relaxes current requirements by authorizing FFD program personnel who are undergoing drug and alcohol testing to use collection services at a local hospital or other organization, provided that the facility conforms to DOT drug and alcohol testing requirements. This provision would result in incremental cost and saving by allowing offsite FFD personnel (i.e., MROs) to utilize local collection services rather than traveling to the licensee's facility. Specifically, licensees may incur higher testing costs at local collection facilities, as opposed to licensee testing facilities. This analysis assumes that the costs associated with periodic collections at non-licensee collection facilities will be greater than the collection cost at licensee facilities. Offsetting some of these costs, MROs and other offsite contracted personnel will experience reduced travel, waiting, and specimen collection time, on average.

The *annual costs per program* from allowing MROs and other offsite contracted personnel to utilize other facilities conforming to DOT requirements are calculated as follows:

$$[(NUM_{MROs} \times PER_{Random} \times PER_{Distance} \times (COST_{Local\ facility} - COST_{Licensee\ facility})] \times NUM_{Facilities}$$

Parameter	**Description**
$COST_{Local\ facility}$	Cost to conduct specimen collection at a local DOT-approved facility (as described in Appendix 2, Exhibit A2-13)
$COST_{Licensee\ facility}$	Cost to conduct specimen collection at the licensee facility (as described in Appendix 2, Exhibit A2-13)
$NUM_{Facilities}$	Number of facilities per program (as described in Appendix 2, Exhibit A2-14)
NUM_{MROs}	Number of offsite contracted MROs per facility (as described in assumptions below)

Parameter	Description
$PER_{Distance}$	Percentage of contracted FFD personnel who live closer to a DOT-approved collection facility than to a licensee's standard collection facility (as described in assumptions below)
PER_{Random}	Percentage tested by a random drug and alcohol testing program per year (as described in assumptions below)

Assumptions:

- Number of offsite contracted MROs per facility: 2.
- Percentage tested by a random drug and alcohol testing program per year: 50%.
- Percentage of contracted FFD personnel who live closer to a DOT-approved collection facility than to a licensee's standard collection facility: 33.3%.

The *annual savings per program* from allowing MROs and other offsite contracted personnel to utilize other facilities conforming to DOT requirements are calculated as follows:

$$[(NUM_{MROs} \times PER_{Random} \times PER_{Distance} \times (HOURS_{Travel} \times WAGE_{MRO}))] \times NUM_{Facilities}$$

Parameter	Description
$HOURS_{Travel}$	Hours of travel, waiting, and specimen collection time (on average) saved by utilizing DOT-approved facility (as described in assumptions below)
$NUM_{Facilities}$	Number of facilities per program (as described in Appendix 2, Exhibit A2-14)
NUM_{MROs}	Number of offsite contracted MROs per facility (as described in assumptions below)
$PER_{Distance}$	Percentage of contracted FFD personnel who live closer to a DOT-approved collection facility than to a licensee's standard collection facility (as described in assumptions below)
PER_{Random}	Percentage tested by a random drug and alcohol testing program per year (as described in assumptions below)
$WAGE_{MRO}$	MRO wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- Number of offsite contracted MROs per facility: 2.
- Percentage tested by a random drug and alcohol testing program per year: 50%.
- Percentage of contracted FFD personnel who live closer to a DOT-approved collection facility than to a licensee's standard collection facility: 33.3%.
- Hours of MRO travel time saved by utilizing DOT-approved facility in lieu of the licensee's collection site: 2 hours.

Paragraph 26.31(c)

Subparagraph 26.31(c)(1)

This subparagraph of the proposed rule imposes no incremental cost and affords no saving because it merely clarifies that licensees and other entities with licensee-approved FFD programs must administer pre-access drug and alcohol testing in order to grant initial, updated, and reinstated authorization as specified in proposed §26.65. Although pre-access testing is already required under 26.24(a)(1) of the current rule, the proposed rule adopts provisions from the AAO that create different requirements for individuals with different lengths of interruptions between periods of authorization. As a result, this subparagraph of the proposed rule imposes no incremental costs and affords no savings because it is based on non-safeguards information requirements imposed by the NRC's AAO dated January 7, 2003, and published in the Federal Register on January 13, 2003 (68 FR 1643).

Sensitivity Analysis-Pre-Order Baseline

Relative to the regulations that were in effect before the NRC issued the AAO, the proposed subparagraph does not directly result in incremental costs or savings. The specific pre-access drug and alcohol testing requirements for the three authorization types are contained in proposed §26.65, and the incremental costs and savings of these requirements are calculated there.

Subparagraph 26.31(c)(2)

This subparagraph of the proposed rule imposes no incremental cost and affords no saving because it merely describes the situations that warrant for-cause drug and alcohol testing, retaining provisions that are already included in subparagraph 26.24(a)(3) of the current rule.

Subparagraph 26.31(c)(3)

This subparagraph of the proposed rule imposes no incremental cost and affords no saving because it merely describes situations that warrant post-event drug and alcohol testing, renumbering and clarifying provisions that are already included in subparagraph 26.24(a)(3) of the current rule. The proposed subparagraph does provide a new requirement establishing a threshold for the types of workplace personal injuries and illnesses for which post-event testing would be required. Further, the proposed subparagraph changes a current requirement such that post-event testing would be required regardless of whether there was "reasonable suspicion" that the individual was abusing drugs or alcohol for the consequences listed in the proposed paragraph.

Subparagraph 26.31(c)(4)

This subparagraph of the proposed rule imposes no incremental cost and affords no saving because it merely prescribes that licensees must conduct followup drug and alcohol testing on individuals who have violated FFD policy in the past to ensure continued abstinence, as required under subparagraph 26.24(a)(4) of the current rule.

Subparagraph 26.31(c)(5)

This subparagraph of the proposed rule imposes no incremental cost and affords no saving because it merely rephrases existing requirements in subparagraph 26.24(a)(2) of the current rule and requires licensees to conduct random drug and alcohol testing on a statistically random and unannounced basis.

Paragraph 26.31(d)

Subparagraph 26.31(d)(1)

This subparagraph of the proposed rule imposes no incremental cost and affords no saving because it merely reorganizes paragraph 26.24(c) and Appendix A, paragraphs 2.1(a)–(c), of the current rule. This subparagraph clarifies the six types of drugs for which each urine specimen must be analyzed and permits licensees and other entities to conduct testing for drugs or other substances that are not explicitly specified by the rule. The proposed subparagraph adds a requirement such that licensees and other entities must test for adulterants when conducting drug and alcohol testing.

Subparagraph 26.31(d)(1)(i)

This subparagraph of the proposed rule imposes no incremental cost and affords no saving because it merely retains the permission provided in paragraph 26.24(c) of the current rule for licensees to consult with local law enforcement or other sources to identify additional drugs that

are likely to be used in the particular geographic locale of the FFD program. This subparagraph also extends this permission to other entities with licensee-approved FFD programs and provides procedures for testing additional substances that are identified. The proposed subparagraph adds requirements that an independent and qualified forensic toxicologist must certify that testing results for other substances not explicitly identified by proposed subparagraph 26.31(d)(1) are scientifically sound and legally defensible. The qualifications of the forensic toxicologist are also defined in this paragraph. Although these additional testing requirements may result in additional costs, the identification of additional substances to test for is rare and the costs are, therefore, assumed to be negligible.

Subparagraph 26.31(d)(1)(ii)

This subparagraph of the proposed rule imposes no incremental cost and affords no saving because it merely clarifies that licensees and other entities are allowed to test for any suspected drugs, drug metabolites, or any other substances and adulterants that the licensee or other entity suspects that an individual may have abused when conducting post-event, followup, and for-cause testing. These requirements are already contained in Appendix A, paragraphs 2.1(b) and (e) of the existing rule. The proposed subparagraph, however, adds a requirement that testing at the confirmatory assay's LOD may only be performed if the initial test result suggests the presence of a drug or metabolite within 35% of the established cutoff concentration for drugs that the licensee or other entity suspects an individual may have abused. This limitation has been added to assure the due process rights of individuals whose urine specimens may be tested under this provision. As licensees and other entities are already abiding by these protections, no incremental cost is anticipated.

Subparagraph 26.31(d)(2)

This proposed paragraph revises subparagraph 26.24(a)(2) of the current rule to clarify that licensees are required to ensure that all persons in the population subject to testing have an equal probability of being randomly selected and tested. Under the proposed subparagraph, in the event that a selected individual cannot be tested immediately, (i.e., on leave, out sick, etc.), the licensee must make reasonable efforts to test the individual at the earliest reasonable and practical opportunity when both the donor and collectors are available. Thus, licensees will incur an incremental cost to satisfy the "reasonable effort" requirement by tracking the randomly selected individuals who are unavailable during the selected testing date and testing them at the next (earliest) reasonable and practical opportunity. This subparagraph also further clarifies that licensees must conduct testing on an unpredictable schedule, including weekends, backshifts, and holidays." This provision imposes no additional costs because existing subparagraph 26.24(a)(2) included these time periods, as described in Section 4.6 of NUREG-1385.

The *annual costs per program* from requiring greater effort to track individuals selected for random drug and alcohol testing result from the following:[12]

$$NUM_{Employees} \times PER_{Random} \times PER_{Unavailable} \times HOURS_{Manager} \times WAGE_{Manager} \times NUM_{Units}$$

Parameter	**Description**
$HOURS_{Manager}$	Hours of FFD manager tracking time per randomly selected employee who is unavailable for the scheduled test (as described in assumptions below)
$NUM_{Employees}$	Number of employees per unit (as described in Appendix 2, Exhibit A2-14)
NUM_{Units}	Number of units per program (as described in Appendix 2, Exhibit A2-14)
PER_{Random}	Percentage of employees per year who are randomly selected for drug and alcohol testing (as described in assumptions below)
$PER_{Unavailable}$	Percentage of randomly selected employees per year who are unavailable for the scheduled test (as described in assumptions below)
$WAGE_{Manager}$	FFD manager wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- Percentage of employees per year who are randomly selected for drug and alcohol testing: 50%.
- Percentage of randomly selected employees per year who are unavailable for the scheduled test: 25%.
- Hours of FFD manager tracking time per randomly selected employee who is unavailable for the scheduled test: 0.25 hours.

Subparagraph 26.31(d)(3)

This proposed subparagraph specifies general requirements for drug testing and combines paragraph 26.24(f) and Appendix A paragraphs 1.1(3), 2.8(e)(1), 4.1(a) and (b) of the current rule. An amendment would add validity testing, the costs of which are described under §26.131 in Subpart F and subparagraph 26.161(b)(1) in Subpart G. This proposed paragraph also establishes requirements for FFD programs that use more stringent cutoff levels for drug testing.

[12] This analysis assumes that all licensees will be affected by the added provision. However, because some licensees may already be tracking and testing individuals unavailable at the time of random selection, the results may overestimate the true incremental cost.

(Each licensee and other entity must apply consistent cutoffs to all tests performed.) This paragraph also requires documentation of the more stringent cutoff levels in the FFD program policy and procedures. The proposed subparagraph adds a new requirement such that, before implementing the more stringent cutoffs, an independent forensic toxicologist must evaluate and certify them as technically sound and legally defensible, with two exceptions. An evaluation by an independent forensic toxicologist would not be required if the U.S. Department of Health and Human Services revises the cutoff levels in the HHS Guidelines and the FFD program adopts the lower HHS cutoffs. Certification by a forensic toxicologist also would not be required if the licensee previously received written approval from the Commission to apply lower cutoff levels, in accordance with Appendix A, paragraph 1.1(2) of the current rule.

The one-time costs per FFD program to employ more stringent cutoff level(s) for drugs result from the following:

$$[(HOURS_{tox.review} + HOURS_{tox.report}) \times WAGE_{toxicologist}] \times PER_{more\ stingent\ cutoffs} \times PER_{non\text{-}report} + (HOURS_{Manager} \times WAGE_{Manager} \times PER_{more\ stingent\ cutoffs} \times PER_{non\text{-}report})$$

Parameter	**Description**
$HOURS_{Manager}$	Hours of FFD program manager labor to review the results of the forensic toxicologist's evaluation of the FFD program's more stringent cutoff levels per program (as described in assumptions below)
$HOURS_{tox.report}$	Hours of time spent by a forensic toxicologist to write an evaluation of the cutoff levels per FFD program (as described in assumptions below)
$HOURS_{tox.review}$	Hours of review by a forensic toxicologist per FFD program using more stringent cutoff level(s) for drug testing (as described in assumptions below)
$PER_{more\ stringent}$	Percentage likelihood that the FFD program uses more stringent cutoff levels for drug testing (as described in assumptions below)
$PER_{non\text{-}report}$	Percentage likelihood that the FFD program, if it uses more stringent cutoff levels for drug testing, has not reported to the Commission (as described in assumptions below)
$WAGE_{Manager}$	FFD program manager wage rate (as described in Appendix 2, Exhibit A2-11)
$WAGE_{toxicologist}$	Toxicologist wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- Hours of review by a forensic toxicologist per FFD program using more stringent cutoff level(s) for drug testing: 3.5 hours.

- Hours of time spent by a forensic toxicologist to write an evaluation of the cutoff levels per FFD program: 0.5 hours.

- Hours of time spent by FFD program manager to review the results of the forensic toxicologist's evaluation per FFD program: 0.5 hours.

- Percentage likelihood that the FFD program will use more stringent cutoff levels for drug testing after the proposed rule is enacted: 10 percent.

- Percentage likelihood that the FFD program, if it will use more stringent cutoff levels for drug testing after the proposed rule in enacted, did not previously use these more stringent cutoff levels (and, therefore, has not reported to the Commission): 25 percent.

Subparagraph 26.31(d)(4)

This proposed subparagraph revises existing requirements in 26.24(g) of the current rule, which pertain to alcohol testing. Specifically, this subparagraph modifies the applicable threshold requirement by reducing the threshold level of breath alcohol concentration from 0.04 to 0.02 for an initial breath test requiring confirmatory testing. Incremental costs associated with this revision are calculated and discussed in connection with §26.97. Another revision permits the use of oral fluids for initial breath testing and is discussed in §26.95 of this analysis.

Subparagraph 26.31(d)(5)

This proposed subparagraph permits the MRO to authorize alternative specimen collection and evaluation procedures in instances in which an individual has a medical condition that makes it difficult or hazardous to collect breath, oral fluids, or urine specimens. Although this clarification offers licensees more flexibility in collecting specimens, the analysis assumes that these situations are extremely rare, making any potential savings speculative and negligible.

Subparagraph 26.31(d)(6)

This subparagraph of the proposed rule imposes no incremental cost and affords no saving because it restates that specimens collected can only be used for Part 26 testing, and clarifies that specimens may only be collected and tested within a licensee or licensee-approved other entity FFD program that meets the requirements of this part, as required by paragraph 2.1(d) of Appendix A of the current rule.

26.33 Behavioral Observation

This section of the proposed rule represents a new requirement, which requires that individuals with authorization (i.e., other than supervisors, managers, and escorts as required under proposed subparagraph 26.27(b)(10)) are required to report fitness concerns to persons designated by the licensee. Costs associated with behavioral observation training are calculated in connection with §26.29. In addition, the new behavioral observation requirements and the additional requirement

for individuals with authorization to report FFD concerns about other individuals who are subject to this part may result in additional for-cause referrals. As a result, there will be an increase in both the number of drug and alcohol tests performed, and the number of positive test results that must undergo confirmatory testing. The analysis calculates the cost of these activities below. The observation and reporting provisions of this paragraph impose no incremental cost and afford no saving.

The *annual costs per program* result from the sum of the following costs:

- Annual costs per program to review additional for-cause referrals are calculated as follows:

  $NUM_{For\text{-}Cause} \times PERI_{For\text{-}Cause} \times [(HOURS_{Worker} \times WAGE_{Worker}) + (HOURS_{Manager} \times WAGE_{Manager})] \times NUM_{Units}$

- Annual cost per program to conduct additional drug and alcohol tests due to increased for-cause referrals are calculated as follows:[13]

  - Annual costs per program to conduct additional drug and alcohol tests due to increased for-cause referrals at programs with onsite testing laboratories (yielding negative results) result from the following:

    $NUM_{For\text{-}Cause} \times PERI_{For\text{-}Cause} \times PER_{Negative} \times COST_{Onsite\text{-}Negative} \times NUM_{Units}$

  - Annual costs per program to conduct additional drug and alcohol tests due to increased for-cause referrals at programs with offsite testing laboratories (yielding negative results) result from the following:

    $NUM_{For\text{-}Cause} \times PERI_{For\text{-}Cause} \times PER_{Negative} \times COST_{Offsite\text{-}Negative} \times NUM_{Units}$

  - Annual costs per program to conduct additional drug and alcohol tests due to increased for-cause referrals at programs with onsite testing laboratories (yielding non-negative results) result from the following:

    $NUM_{For\text{-}Cause} \times PERI_{For\text{-}Cause} \times (1\text{-}PER_{Negative}) \times COST_{Onsite\text{-}Non\text{-}Negative} \times NUM_{Units}$

[13] The increased costs will vary for programs depending on whether the program has onsite testing capabilities or utilizes an offsite HHS-certified testing laboratory.

- Annual costs per program to conduct additional drug and alcohol tests due to increased for-cause referrals at programs with offsite testing laboratories (yielding negative results) result from the following:

$$NUM_{For\text{-}Cause} \times PERI_{For\text{-}Cause} \times (1\text{-}PER_{Negative}) \times COST_{Offsite\text{-}Non\text{-}Negative} \times NUM_{Units}$$

- Annual costs per program to retest confirmed positive drug test results at a second HHS-certified laboratory at the request of the donor are calculated as follows:

$$NUM_{For\text{-}Cause} \times PERI_{For\text{-}Cause} \times (1\text{-}PER_{Negatives}) \times PER_{Retest} \times COST_{Retest} \times NUM_{Units}$$

- Annual costs per program for the percentage of workers with confirmed positive test results who initiate an appeals process are calculated as follows:

$$NUM_{For\text{-}Cause} \times PERI_{For\text{-}Cause} \times (1\text{-}PER_{Negatives}) \times PER_{Appeals} \times COST_{Appeals} \times NUM_{Units}$$

Parameter	**Description**
$COST_{Appeals}$	Cost of appeals process per appeal (as described in Appendix 2, Exhibit A2-11, Exhibit A2-13)
$COST_{Offsite\text{-}Negative}$	For-cause testing cost for a negative result per test at programs with offsite testing laboratories (as described in assumptions below and in Appendix 2, Exhibit A2-13)
$COST_{Offsite\text{-}Non\text{-}Negative}$	For-cause testing cost for a non-negative result per test at programs with offsite testing laboratories (as described in assumptions below and in Appendix 2, Exhibit A2-13)
$COST_{Onsite\text{-}Negative}$	For-cause testing cost for a negative result per test at programs with onsite testing laboratories (as described in assumptions below and in Appendix 2, Exhibit A2-13)
$COST_{Onsite\text{-}Non\text{-}Negative}$	For-cause testing cost for a non-negative result per test at programs with onsite testing laboratories (as described in assumptions below and in Appendix 2, Exhibit A2-13)
$COST_{Retest}$	Cost of drug retest per test (as described in assumptions below and in Appendix 2, Exhibit A2-13)
$HOURS_{Manager}$	Hours of FFD program manager review per for-cause referral (as described in assumptions below)
$HOURS_{Worker}$	Hours of facility worker hours under review per for-cause referral (as described in assumptions below)
$NUM_{For\text{-}Cause}$	Pre-rule annual number of for-cause tests/referrals per unit (as described in Appendix 2, Exhibit A2-12)
NUM_{Units}	Number of units per program (as described in Appendix 2, Exhibit A2-14)

Parameter	Description
$PER_{Appeals}$	Percentage of workers who have positive test results and initiate an appeals process (as described in assumptions below and in Appendix 2, Exhibit A2-6)
$PERI_{For\text{-}Cause}$	Percentage increase in for-cause tests/referrals as a result of the proposed rule (as described in assumptions below)
$PER_{Negative}$	Percentage of for-cause tests that yield negative test results (as described in Appendix 2, Exhibit A2-12)
PER_{Retest}	Percentage of workers who have positive test results and request retesting (as described in assumptions below)
$WAGE_{Manager}$	FFD program manager wage rate (as described in Appendix 2, Exhibit A2-11)
$WAGE_{Worker}$	Facility worker wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- Percentage increase in for-cause tests/referrals beginning with new rule: 10%.

- Hours of facility worker hours under review per for-cause referral: 4 hours per review.

- Hours of FFD program manager review per for-cause referral: 4 hours per review.

- Percentage of workers who have positive test results and request retesting: 5%.

- Percentage of workers who have positive test results and initiate an appeals process: 1%.

- The per-unit cost of an *onsite for-cause drug and alcohol test yielding negative results* includes the following factors:
  (1) travel time of the worker
  (2) collection of drug and alcohol specimens (labor of the collector and the worker, as well as collection materials)
  (3) onsite licensee testing costs per urine specimen for drugs and validity
  (4) labor of FFD manager to process paperwork for negative test results.

- The per-unit cost of an *offsite for-cause drug and alcohol test yielding negative results* includes including the following factors:
  (1) travel time of the worker
  (2) collection of drug and alcohol specimens (labor of the collector and the worker, as well as collection materials)
  (3) HHS-certified laboratory costs per urine specimen for drugs and validity;
  (4) labor of FFD manager to process paperwork for negative test results

- The per-unit cost of *an onsite for-cause drug and alcohol test yielding positive results* includes the following factors:
  (1) travel time of the worker
  (2) collection of drug and alcohol specimens (labor of the collector and the worker, as well as collection materials)
  (3) onsite licensee testing costs per urine specimen for drugs
  (4) HHS-certified laboratory cost per specimen for drugs and validity
  (5) cost of subsequent actions resulting from a confirmatory positive drug/validity test result

- The per-unit cost of *an offsite for-cause drug and alcohol test yielding positive results* includes the following factors:
  (1) travel time of the worker
  (2) collection of drug and alcohol specimens (labor of the collector and the worker, as well as collection materials)
  (3) HHS-certified laboratory costs per urine specimen for drugs and validity
  (4) cost of subsequent actions resulting from a confirmatory positive drug/validity test result

26.35 Employee Assistance Programs

Paragraph 26.35(a)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it merely restates and clarifies the existing language in §26.25 of the current rule, which requires licensees and other entities to have EAPs.

Paragraph 26.35(b)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it merely clarifies existing language in §26.25 of the current rule, which requires that licensees and other entities are not required to provide EAP services to C/V employees nor to individuals who have applied for, but have not yet been granted, authorization.

Paragraph 26.35(c)

This paragraph of the proposed rule [including subparagraphs 26.35(c)(1)–(3)] imposes no incremental cost and affords no saving because it merely restates and clarifies the existing language in §26.25 of the current rule regarding the role of EAP staff in protecting the identity and privacy of any individual's seeking assistance. The proposed paragraph does allow the EAP to bypass the privacy requirement in the event that the individual waives the right to privacy in writing or if a determination of fitness deems an individual's condition or actions pose or have posed an immediate hazard to himself or herself or others. In such cases, EAP personnel shall

inform FFD management. The proposed paragraph also adds specificity to the current rule, providing examples of individual conditions or actions that require EAP personnel to report the individual to management. This paragraph parallels elements covered in §26.25 of the existing rule.

26.37 Protection of Information

Paragraph 26.37(a)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it merely combines and retains wording from paragraph 26.29(a) and Appendix A, paragraph 3.1, of the current rule.

Paragraph 26.37(b)

This paragraph of the proposed rule [including subparagraphs 26.37(b)(1)–(8)] imposes no incremental cost and affords no saving because it restates and separates elements of paragraph 26.29(b) of the current rule.

Paragraph 26.37(c)

This paragraph of the proposed rule requires licensees and other entities to disclose personal information collected under this part to other licensees or other entities, including C/Vs, legitimately seeking the information for authorization decisions. As indicated by NRC guidance in NUREG-1600, "Revision to the NRC Enforcement Policy" (per 67 FR 66311, October 31, 2002) licensees are already sharing this information. The analysis also assumes that C/Vs are already sharing such information with other C/Vs. Whether licensees are sharing information with C/Vs is unknown, but such instances are assumed to be rare. Therefore, the proposed paragraph imposes no incremental cost and affords no saving.

Paragraph 26.37(d)

This proposed paragraph combines elements of paragraph 26.29(b) of the current rule to clarify information disclosure requirements for individuals. Although the existing rule requires similar disclosure processes, some licensees have interpreted the existing provisions in a manner that complicates the process through which employees can have access to their records. In an effort to clarify the NRC's original intent, the proposed paragraph requires licensees to give requesting individuals copies of all of their own records pertaining to a violation of FFD policy. The copying, packaging, and shipping of these records will result in an incremental cost to licensees.

The *annual costs per program* to provide individuals with easier access to personal documents result from the following:[14]

$$NUM_{Positives} \times PER_{Requesting} \times [(HOURS_{Clerical} \times WAGE_{Clerical}) + COST_{Shipping}] \times NUM_{Units}$$

Parameter	**Description**
$COST_{Mailing}$	Cost of mailing (express mail) per information disclosure request (as described in Appendix 2, Exhibit A2-6)
$HOURS_{Clerical}$	Additional clerical personnel hours to copy, package, and ship records per disclosure request (as described in assumptions below)
$NUM_{Positives}$	Annual number of drug tests yielding positive results per unit (as described in Appendix 2, Exhibit A2-12)
NUM_{Unit}	Number of units per program (as described in Appendix 2, Exhibit A2-14)
$PER_{Requesting}$	Percentage of employees who have positive test results and request records (as described in assumptions below)
$WAGE_{Clerical}$	Clerical personnel wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- Percentage of employees who have positive test results and request records: 50%.
- Additional clerical personnel hours to copy, package, and mail records per disclosure request: 1 hour.

Paragraph 26.37(e)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it retains a portion of §3.1 of Appendix A to the current rule.

Paragraph 26.37(f)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it retains a portion of paragraph 26.29(b) of the existing rule.

[14] The analysis assumes that all licensees will incur costs as a result of this provision. However, because some licensees may already be providing adequate access to records, the results may overestimate the true incremental cost.

26.39 Review Process for Fitness-for-Duty Policy Violations

Paragraph 26.39(a)

This paragraph of the proposed rule, which states that an objective and impartial review process for FFD policy violations must be established, imposes no incremental cost and affords no saving because any incremental costs associated with revising or rewriting procedures are calculated in connection with proposed §26.27. The proposed paragraph, however, adds requirements to the language in paragraph 26.28 of the current rule by requiring an objective and impartial review of the facts.

Paragraph 26.39(b)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it requires that an individual under review must be allowed to offer additional relevant information, as provided under §26.28 of the current rule.

Paragraph 26.39(c)

This proposed paragraph requires that a review of potential FFD policy violations be conducted by more than one individual and that those individuals involved must not be associated with FFD program administration. Under the subparagraph 26.27(b)(3) of the current rule, licensees simply were required to establish satisfactory management and medical assurance of an individual's fitness for duty before granting unescorted access following a previous violation of policy. According to NRC guidance contained in NUREG-1385, "Fitness for Duty in the Nuclear Power Industry: Responses to Implementation Questions," licensees were free to interpret how best to meet the "satisfactory assurance" requirement, which at a minimum would involve a review by a single individual. The proposed rule, however, requires that the review must be conducted by at least two individuals, thereby resulting in additional licensee labor burden for additional non FFD-management personnel to be devoted to reviews of FFD policy violations.

The *annual costs per program* to require FFD policy violations to be reviewed by more than one individual both of whom must be unaffiliated with FFD program administration result from the following:

$$NUM_{Positives} \times HOURS_{Manager} \times WAGE_{Manager} \times NUM_{Units}$$

Parameter	Description
$HOURS_{Manager}$	Additional hours of non-FFD manager review per FFD policy violation (as described in assumptions below)

Parameter	Description
$NUM_{Positives}$	Annual number of drug tests yielding positive results per unit (as described in Appendix 2, Exhibit A2-12)
NUM_{Units}	Number of units per program (as described in Appendix 2, Exhibit A2-14)
$WAGE_{Manager}$	Licensee manager wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- Additional hours of non-FFD manager review of FFD policy violations: 4 hours.

Paragraph 26.39(d)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it merely requires licensees to update their records in the event that review finds in favor of the individual. Further, the proposed paragraph clarifies paragraph 26.28 of the current rule, which implicitly requires corrections of records after a successful appeal.

Paragraph 26.39(e)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it merely clarifies provisions in paragraph 26.28 of the existing rule. Specifically, this paragraph states that licensees are *not* required to give C/V employees a review procedure for violations identified through a C/V's drug and alcohol testing program.

26.41 Audits and Corrective Action

Paragraph 26.41(a)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it merely clarifies the licensee's responsibility for ensuring the continued effectiveness of all elements of the FFD program, including programs and program elements implemented by C/Vs, as well as programs implemented by HHS-certified laboratories. These requirements are addressed in connection with paragraph 26.80 of the current rule.

Paragraph 26.41(b)

This proposed paragraph reduces the audit frequency for licensees and other entities (with onsite collection services) from every 12 months under paragraph 26.80(a) of the current rule to "as needed, but no less frequently than every 24 months," resulting in a potential incremental savings. Total annual savings will depend on whether a given licensee has onsite or offsite collection and testing facilities (i.e., because the proposed rule [in paragraph 26.41(c)(1)] does

not reduce the frequency of licensee audits of HHS-certified laboratories or offsite collection facilities that do not maintain their own FFD program). The reduced audit frequency will also yield savings from reduced auditor travel costs, which are calculated separately below.

The *annual savings per program*, excluding travel savings (which are calculated separately later in the discussion), are calculated as the *sum* of the following factors:

- The *annual base saving per program* (regardless of whether the program uses onsite or offsite testing and collection facilities) from the reduced audit frequency are estimated as follows:

  $$[(HOURS_{Auditor\text{-}Base} \times WAGE_{Auditor}) + (HOURS_{Manager\text{-}Base} \times WAGE_{Manager}) + (HOURS_{Clerical\text{-}Base} \times WAGE_{Clerical})] \times PER_{Annualized} \times NUM_{Facilities}$$

- The additional *annual savings per program* from the audit frequency reduction that accrue to programs with *onsite testing* are estimated as follows:

  $$[(HOURS_{Auditor\text{-}Onsite\ Testing} \times WAGE_{Auditor}) + (HOURS_{Manager\text{-}Onsite\ Testing} \times WAGE_{Manager}) + (HOURS_{Clerical\text{-}Onsite\ Testing} \times WAGE_{Clerical}) + (HOURS_{Lab\ Manager} \times WAGE_{Lab\ Manager}) + (HOURS_{Lab\ Staff} \times WAGE_{Lab\ Staff})] \times PER_{Annualized} \times NUM_{Facilities}$$

- The additional *annual savings per program* from the audit frequency reduction that accrue *to programs with onsite collection* are estimated as follows:

  $$[(HOURS_{Auditor\text{-}Onsite\ Collection} \times WAGE_{Auditor}) + (HOURS_{Manager\text{-}Onsite\ Collection} \times WAGE_{Manager}) + (HOURS_{Clerical\text{-}Onsite\ Collection} \times WAGE_{Clerical}) + [NUM_{Facilities} \times ((HOURS_{Collection\ Manager} \times WAGE_{Collection\ Manager}) + (HOURS_{Collection\ Staff} \times WAGE_{Collection\ Staff}))]] \times PER_{Collection} \times PER_{Anualized} \times NUM_{Facilities}$$

Parameter	**Description**
$HOURS_{Auditor\text{-}Base}$	Base hours of contracted auditor time that each facility saves per full program audit (as described in assumptions below)
$HOURS_{Auditor\text{-}Onsite\ Collection}$	Additional hours (i.e., above the base described previously) of contracted auditor time saved per full program audit of a facility with onsite collection facilities (as described in assumptions below)
$HOURS_{Auditor\text{-}Onsite\ Testing}$	Additional hours (i.e., above the base described previously) of contracted auditor time saved per full program audit of a facility with onsite testing laboratories (as described in assumptions below)
$HOURS_{Clerical\text{-}Base}$	Base hours of clerical personnel time that each facility saves per full program audit (as described in assumptions below)

Parameter	Description
$HOURS_{Clerical\text{-}Onsite\ Collection}$	Additional hours (i.e., above the base described previously) of clerical personnel time saved per full program audit of a facility with onsite collection facilities (as described in assumptions below)
$HOURS_{Clerical\text{-}Onsite\ Testing}$	Additional hours (i.e., above the base described previously) of clerical personnel time saved per full program audit of a facility with onsite testing laboratories (as described in assumptions below)
$HOURS_{Collection\ Staff}$	Hours of collection site staff time saved per full program audit of a facility with onsite collection facilities (as described in assumptions below)
$HOURS_{Collection\ Manager}$	Hours of collection site manager time saved per year per facility with onsite collection facilities (as described in assumptions below)
$HOURS_{Lab\ Manager}$	Hours of testing laboratory manager time saved per full program audit of a facility with onsite testing laboratories (as described in assumptions below)
$HOURS_{Lab\ Staff}$	Hours of testing laboratory staff time saved per full program audit of a facility with onsite testing laboratories (as described in assumptions below)
$HOURS_{Manager\text{-}Base}$	Base hours of FFD program manager time that each facility saves per full program audit (as described in assumptions below)
$HOURS_{Manager\text{-}Onsite\ Testing}$	Additional hours (i.e., above the base described previously) of FFD program manager time saved per full program audit of a facility with onsite testing laboratories (as described in assumptions below)
$HOURS_{Manager\text{-}Onsite\ Collection}$	Additional hours (i.e., above the base described previously) of FFD program manager time saved per full program audit of a facility with onsite collection facilities (as described in assumptions below)
$NUM_{Facilties}$	Number of facilities per program (as described in Appendix 2, Exhibit A2-14)
$PER_{Annualized}$	Percentage multiplier to yield annualized savings (as described in assumptions below)
$PER_{Collection}$	Percentage of facilities with onsite collection per program (as described in Appendix 2, Exhibit A2-4)
$WAGE_{Auditor}$	Contract auditor wage rate (as described in Appendix 2, Exhibit A2-11)
$WAGE_{Clerical}$	Clerical personnel wage rate (as described in Appendix 2, Exhibit A2-11)
$WAGE_{Collection\ Manager}$	Collection site manager wage rate (as described in Appendix 2, Exhibit A2-11)
$WAGE_{Collection\ Staff}$	Collection site staff wage rate (as described in Appendix 2, Exhibit A2-11)

Parameter	Description
$WAGE_{Lab\ Staff}$	Laboratory staff wage rate (as described in Appendix 2, Exhibit A2-11)
$WAGE_{Lab\ Manager}$	Laboratory manager wage rate (as described in Appendix 2, Exhibit A2-11)
$WAGE_{Manager}$	FFD program manager wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- Percentage multiplier to yield annualized savings is 50% because the frequency reduction allows facilities to eliminate 1 audit over a 2-year period.

- Base hours of contracted auditor time that each facility saves per full program audit: 25 hours.

- Base hours of FFD program manager time that each facility saves per full program audit: 13 hours.

- Base hours of clerical personnel time that each facility saves per full program audit: 5 hours.

- Additional hours (i.e., above the base described above) of contracted auditor time saved per full program audit of a facility with onsite testing laboratories: 12 hours.

- Additional hours (i.e., above the base described above) of FFD program manager time saved per full program audit of a facility with onsite testing laboratories: 7 hours.

- Additional hours (i.e., above the base described above) of clerical personnel time saved per full program audit of a facility with onsite testing laboratories: 0 hours.

- Each program with onsite testing maintains a separate onsite testing laboratory.

- Additional hours (i.e., above the base described above) of contracted auditor time saved per full program audit of a facility with onsite collection facilities: 5 hours.

- Additional hours (i.e., above the base described above) of FFD program manager time saved per full program audit of a facility with onsite collection facilities: 0 hours.

- Additional hours (i.e., above the base described above) of clerical personnel time saved per full program audit of a facility with onsite collection facilities: 0 hours.

- Hours of testing laboratory manager time saved per full program audit of a facility with onsite testing laboratories: 2 hours.

- Hours of testing laboratory staff time saved per full program audit of a facility with onsite testing laboratories: 1 hours.

- Hours of collection site manager time saved per full program audit of a facility with onsite collection facilities: 2 hours.

- Hours of collection site staff time saved per full program audit of a facility with onsite collection facilities: 1 hour.

- Each facility in a program with onsite collection maintains a separate onsite collection site.

The proposed audit frequency reduction will also result in reduced travel costs. The *annual savings per program* result from the sum of the following savings:

- The reduced audit frequency will result in reduced travel costs for auditors. The associated *annual base savings per program* from the reduced travel at each facility (i.e., regardless of whether a program uses onsite or offsite collection facilities and testing laboratories) are calculated as follows:

  $$[NUM_{Auditors\text{-}Base} \times (COST_{Travel} + (COST_{Lodging} \times NUM_{Nights\text{–}Base}) + (HOURS_{Travel} \times WAGE_{Auditor}))] \times PER_{Annualized}$$

- Additional annual savings per program that accrue due to reduced auditor travel to facilities with *onsite testing laboratories* are estimated as follows:

  $$NUM_{Auditors\text{-}Onsite\ Testing} \times COST_{Lodging} \times NUM_{Nights\text{-}Onsite\ Testing} \times PER_{Annualized}$$

- Additional annual savings per program that accrue due to reduced auditor travel to facilities with *onsite collection facilities* are estimated as follows:

  $$NUM_{Auditors\text{-}Onsite\ Collection} \times COST_{Lodging} \times NUM_{Nights\text{-}Onsite\ Collection} \times PER_{Collection} \times PER_{Annualized}$$

Parameter	**Description**
$COST_{Lodging}$	Cost of lodging and per diem per night (as described in assumptions below)

Parameter	Description
$COST_{Travel}$	Cost of round trip travel per auditor per audit (as described in assumptions below)
$HOURS_{Travel}$	Hours of round trip travel auditor per audit (as described in assumptions below)
$NUM_{Auditors\text{-}Base}$	Base number of auditors per program audit (as described in assumptions below)
$NUM_{Auditors\text{-}Onsite\ Testing}$	Additional number of auditors per program with onsite testing laboratories (as described in assumptions below)
$NUM_{Auditors\text{-}Onsite\ Collection}$	Additional number of auditors per program with onsite collection facilities (as described in assumptions below)
$NUM_{Nights\text{-}Base}$	Base number of nights of lodging that each program saves per full program audit (as described in assumptions below)
$NUM_{Nights\text{-}Onsite\ Testing}$	Additional number of nights of lodging each program saves per full program audit of a program with onsite collection and offsite testing (as described in assumptions below)
$NUM_{Nights\text{-}Onsite\ Collection}$	Additional number of nights of lodging each program saves per full program audit of a program with offsite collection and offsite testing (as described in assumptions below)
$PER_{Annualized}$	Percentage multiplier to yield annual savings (as described in assumptions below)
$PER_{Collection}$	Percentage of facilities with onsite collection per program (as described in Appendix 2, Exhibit A2-4)
$WAGE_{Auditor}$	Auditor wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- Base number of auditors per program audit (regardless of whether the program uses onsite or offsite collection sites and testing laboratories): 1.
- Additional number of auditors per program with onsite testing laboratories: 1.
- Additional number of auditors per program with onsite collection facilities: 0.[15]
- Cost of round trip travel per auditor per audit: $300.

[15] Programs with onsite testing laboratories are also believed to operate onsite collection facilities. In this case, the additional auditor calculated for the onsite collection facility is also assumed to audit the onsite testing facility.

- Cost of lodging and per diem per night: $150.
- Hours of round trip travel per auditor per audit: 4 hours.
- Base number of nights of lodging each program saves per full program audit: 3 nights.
- Additional number of nights of lodging each program saves per full program audit of a program with onsite testing laboratories: 1 night.
- Additional number of nights of lodging each program saves per full program audit of a program with onsite collection facilities: 0 nights.
- Percentage multiplier to yield annualized savings is 50% because the frequency reduction allows facilities to eliminate 1 audit over a 2-year period.
- Each facility in a program with onsite collection maintains a separate onsite collection site.

Although licensees and other entities with approved FFD programs would be allowed to audit less frequently, they would be expected to conduct additional auditing activities when performance indicators suggest a potential area of weakness in the FFD program. The cost of these additional, focused audits, which would target specific FFD program activities and would require a shorter amount of time to complete than a full program audit, would partially offset the savings resulting from the reduced frequency of full program audits. The *annual costs per program* to conduct focused audits addressing problem areas of the FFD program result from the following:

$$[(HOURS_{Focused\ Auditor} \times WAGE_{Auditor}) + (HOURS_{Focused\ Manager} \times WAGE_{Manager}) + (HOURS_{Focused\ Clerical} \times WAGE_{Clerical})] \times NUM_{Facilities} + [NUM_{Auditors} \times (COST_{Travel} + (COST_{Lodging} \times NUM_{Nights\text{-}Focused}) + (HOURS_{Travel} \times WAGE_{Auditor}))]$$

Parameter	**Description**
$COST_{Lodging}$	Cost of lodging and per diem per night (as described in assumptions below)
$COST_{Travel}$	Cost of round trip travel per focused audit (as described in assumptions below)
$HOURS_{Focused\ Clerical}$	Hours of clerical personnel time per focused audit per facility (as described in assumptions below)
$HOURS_{Focused\ Manager}$	Hours of FFD program manager time per focused audit per facility (as described in assumptions below)

Parameter	Description
$HOURS_{Focused\ Auditor}$	Hours of contracted auditor time per focused audit per facility (as described in assumptions below)
$HOURS_{Travel}$	Hours of round trip auditor travel per focused audit (as described in assumptions below)
$NUM_{Auditors}$	Number of auditors per focused audit (as described in assumptions below)
$NUM_{Facilities}$	Number of Facilities per program (as described in Appendix 2, Exhibit A2-14)
$NUM_{Nights\text{-}Focused}$	Number of nights of lodging required by the auditor to complete a focused audit (as described in assumptions below)
$WAGE_{Auditor}$	Contract auditor wage rate (as described in Appendix 2, Exhibit A2-11)
$WAGE_{Clerical}$	Clerical personnel wage rate (as described in Appendix 2, Exhibit A2-11)
$WAGE_{Manager}$	FFD program manager wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- Hours of contracted auditor time conducting a focused audit per facility: 4 hours.
- Hours of FFD program manager time per a focused audit per facility: 3 hours.
- Hours of clerical personnel time conducting a focused audit per facility: 1 hours.
- Number of auditors per focused audit: 2.
- Cost of round trip travel per focused audit: $300.
- Cost of lodging and per diem per night: $150.
- Hours of round trip auditor travel per focused audit: 4 hours.
- Number of nights of lodging required by the auditor to complete a focused audit: 1 night.

Paragraph 26.41(c)

Subparagraph 26.41(c)(1)

This subparagraph of the proposed rule imposes no incremental cost and affords no saving because it merely clarifies that C/Vs located offsite or not under the direct supervision or observation of licensee personnel must be audited at a 12-month frequency, as specified in paragraph 26.80(a) of the current rule. The C/V services subject to this requirement include contracted MRO services, EAP or specimen collection services, and the services provided by HHS-certified laboratories. As described and calculated in 26.41(b), those C/V services that are provided onsite under the direct daily supervision of licensee personnel will be audited at a frequency of at least once every 24 months.

Subparagraph 26.41(c)(2)

This proposed subparagraph adds a provision that allows licensees and other entities to rely upon the HHS certification reports and audits of HHS-certified laboratories, thereby eliminating audit duplication. Services provided to the licensee or other entity not addressed in the certification review must continue to be audited. Further duplication is eliminated by exempting organizations that do not routinely provide FFD services to a licensee or other entity, such as local hospitals or substance abuse treatment facilities. The elimination of audit duplication under this proposed subparagraph will result in incremental savings.

The *annual savings per program* from eliminating audit duplication result from the following:

$$(HOURS_{Auditor} \times WAGE_{Auditor}) + (HOURS_{Manager} \times WAGE_{Manager}) + (HOURS_{Clerical} \times WAGE_{Clerical})$$

Parameter	**Description**
$HOURS_{Auditor}$	Hours of contracted auditor time saved annually per program in elimination of audit duplication (as described in assumptions below)
$HOURS_{Clerical}$	Hours of clerical personnel time saved annually per program in elimination of audit duplication (as described in assumptions below)
$HOURS_{Manager}$	Hours of FFD program manager time saved annually per program in elimination of audit duplication (as described in assumptions below)
$WAGE_{Auditor}$	Contracted auditor wage rate (as described in Appendix 2, Exhibit A2-11)
$WAGE_{Clerical}$	Clerical personnel wage rate (as described in Appendix 2, Exhibit A2-11)
$WAGE_{Manager}$	FFD program manager wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- Hours of contracted auditor time saved annually per program in elimination of audit duplication: 7 hours.

- Hours of FFD program manager time saved annually per program in elimination of audit duplication: 4 hours.

- Hours of clerical personnel time saved annually per program in elimination of audit duplication: 1 hour.

Paragraph 26.41(d)

Subparagraph 26.41(d)(1)

This subparagraph of the proposed rule imposes no incremental cost and affords no saving because it merely restates the existing provision in Appendix A, paragraph 2.7(m) regarding the reservation of the right to audit C/Vs, the C/V's subcontractors providing FFD services, and the HHS-certified laboratories at any time.

Subparagraph 26.41(d)(2)

This subparagraph of the proposed rule adds a new requirement stating that licensees' and other entities' contracts with C/Vs or HHS-certified laboratories must permit the licensee or other entity to obtain copies of any documents to assure that the C/V or the laboratory are performing their functions properly and that staff and procedures meet applicable requirements. The C/V or HHS-certified laboratory, however, does have the ability to reasonably limit the use and dissemination of any documents to ensure the protection of proprietary information and donors' privacy. Although not explicitly required in the current rule, the analysis assumes that current industry practices provide for the sharing of such information. As a result, no incremental costs or savings result from this proposed subparagraph.

Subparagraph 26.41(d)(3)

This subparagraph of the proposed rule imposes no incremental cost and affords no saving because it merely restates requirements in Appendix A, paragraph 2.7(m) of the existing rule. The proposed subparagraph requires licensees to conduct pre-award inspections and audits of the procedural aspects of HHS laboratory operations, except as provided in 26.41(g)(5), discussed below.

Paragraph 26.41(e)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it merely states that audits must focus on the effectiveness of FFD programs and auditors must remain independent of FFD program management and other personnel responsible for implementing the FFD program, as required by paragraph 26.80(b) of the current rule.

Paragraph 26.41(f)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it merely states licensees must document audit results and report them to senior corporate and site management, who must take and document appropriate corrective actions, including possible re-auditing of deficient areas (as discussed in proposed paragraph 26.41(b)). These provisions are contained in paragraph 26.80(c) of the current rule.

Paragraph 26.41(g)

This paragraph of the proposed rule [including subparagraphs 26.41(g)(1)–(5)] imposes no incremental cost and affords no saving because it clarifies and/or explicitly sets forth implementation requirements under paragraph 26.80(a) of the current rule, and permitted practices regarding the sharing of audits. Proposed subparagraph 26.41(g)(5) would allow licensees and other entities to immediately use another HHS-certified laboratory in the event that their contracted HHS-laboratory loses its certification (the effect of which is discussed in paragraph 26.153(e) of this analysis).

Subpart C: Granting and Maintaining Authorization

26.51 Purpose

This section of the proposed rule imposes no incremental cost and affords no saving because it merely states that the purpose of Subpart C is to define the requirements for granting and maintaining authorization to have the types of access and be assigned to perform the job duties that are specified in paragraph 26.25(a) of the proposed rule.

26.53 General Provisions

Paragraph 26.53(a)

This paragraph establishes categories of individuals applying for authorization and states that licensees must meet the requirements applicable for the individual's category before granting authorization to initial authorizations, authorization updates, authorization reinstatements, and authorization with potentially disqualifying FFD information. This paragraph of the proposed rule is based on non-safeguards information requirements imposed by the NRC's Access Authorization Order (AAO) dated January 7, 2003, and published in the Federal Register on January 13, 2003. As a result, the proposed paragraph imposes no incremental costs and affords no savings.

Sensitivity Analysis - Pre-Order Baseline

Relative to regulations that were in effect before the NRC issued the AAO, the proposed paragraph indirectly results in incremental costs and savings for the different categories of applicants (as described in §§26.55, 26.57, 26.59, and 26.69 of the proposed rule). The incremental costs and savings that result from these differences are calculated in subsequent relevant sections of this analysis.

Paragraph 26.53(b)

This paragraph of the proposed rule defines new requirements for the beginning and ending dates of an individual's period of interruption of authorized status. The period of interruption begins on the day after authorization was previously terminated and ends with the day the licensee or other entity actually grants or denies authorization. Costs and savings associated with each category of authorization are presented below in the analysis of §§26.55, 26.57, and 26.59.

Paragraph 26.53(c)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it merely states that FFD training requirements must be met by an applicant for authorization before licensees can grant authorization, which parallels the existing regulation in paragraph 26.21(b) of the current rule.

Paragraph 26.53(d)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it merely clarifies that licensees and other entities seeking to grant authorization to an individual who is subject to another FFD program may rely on that other program to satisfy the requirements of this part. This practice is already allowed under §26.23 and subparagraph 26.24(a)(1) of the current rule, as well as guidance contained in NUREG-1385, "Fitness for Duty in the Nuclear Power Industry: Responses to Implementation Questions."

26.55 Initial Authorization

Paragraph 26.55(a)

This paragraph of the proposed rule establishes that an initial applicant is any individual who either has never held authorization or whose authorization was terminated favorably and has been interrupted for a period of 3 or more years. No incremental costs or savings result from this provision because it is based on non-safeguards information requirements imposed by the NRC's Access Authorization Order (AAO) dated January 7, 2003, and published in the Federal Register on January 13, 2003.

Sensitivity Analysis - Pre-Order Baseline

Relative to the regulations in effect before the NRC issued the AAO, the proposed paragraph indirectly results in incremental costs and savings because it imposes different requirements for the different categories of applicants than does the current rule. The incremental costs and savings associated with these changes are presented and calculated in the subparagraphs below.

Subparagraph 26.55(a)(1)

This subparagraph of the proposed rule requires licensees to obtain and review self-disclosures, as described by proposed §26.61, from applicants for initial authorization before granting authorization. This paragraph imposes no incremental cost and affords no saving because, under provisions of the AAO, applicants for unescorted access are subject to similar self-disclosure requirements.

Sensitivity Analysis - Pre-Order Baseline

Relative to the regulations that were in effect before the NRC issued the AAO, the proposed subparagraph, in conjunction with proposed subparagraph 26.61(a)(1), does result in incremental savings. The savings result from provisions that state that applicants for initial authorization whose last authorization was terminated favorably and who have been covered by a behavioral observation and arrest-reporting program throughout the period of interruption do not need to submit self-disclosures to licensees and other entities. The *annual savings per program* result from the *sum* of the following savings:

- The annual savings per program from reduced facility worker labor burden for those initial applicants who qualify for the self-disclosure relaxation are estimated as follows:

  $NUM_{Applicants}$ x $PER_{Qualify}$ x $HOURS_{Worker}$ x $WAGE_{Worker}$ x NUM_{Units}

- The annual savings per program resulting from a reduced clerical personnel labor burden (because fewer self-disclosures submitted by initial applicants will need to be processed) are calculated as follows:

  $NUM_{Applicants}$ x $PER_{Qualify}$ x $HOURS_{Clerical}$ x $WAGE_{Clerical}$ x NUM_{Units}

Parameter	**Description**
$HOURS_{Clerical}$	Clerical personnel hours saved in a self-disclosure (as described in assumptions below)
$HOURS_{Worker}$	Facility worker hours saved in a self-disclosure (as described in assumptions below)
$NUM_{Applicants}$	Annual number of applicants for initial authorization per unit (as described in Appendix 2, Exhibit A2-12)
NUM_{Units}	Number of units per program (as described in Appendix 2, Exhibit A2-14)
$PER_{Qualify}$	Percentage of $NUM_{Applicants}$ who qualify for the relaxation (as described in assumptions below)
$WAGE_{Clerical}$	Clerical personnel wage rate (as described in Appendix 2, Exhibit A2-11)
$WAGE_{Worker}$	Facility worker wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- Percentage $NUM_{Applicants}$ who qualify for the relaxation: 50%.
- Facility worker hours saved in a self-disclosure: 0.25 hours per update.
- Clerical personnel hours saved in a self-disclosure: 0.25 hours per update.

Subparagraph 26.55(a)(2)

This subparagraph of the proposed rule requires licensees to conduct a suitable inquiry, as described by proposed §26.63, on applicants for initial authorization before granting authorization. This subparagraph imposes no incremental cost and affords no saving because, under provisions in the AAO, applicants for unescorted access are subject to similar suitable inquiry requirements.

Sensitivity Analysis - Pre-Order Baseline

Relative to the regulations that were in effect before the NRC issued the AAO, the proposed subparagraph, in conjunction with proposed subparagraph 26.63(a), does result in incremental savings. The savings result from provisions that state that licensees and other entities do not need to conduct suitable inquiries on applicants for initial authorization whose last authorization was terminated favorably and who have been covered by a behavioral observation and arrest-reporting program throughout the period of interruption. The *annual savings per program* from not conducting the suitable inquiry on initial applicants qualifying for the relaxation result from the following:

$$NUM_{Applicants} \times PER_{Qualify} \times HOURS_{HR} \times WAGE_{HR} \times NUM_{Units}$$

Parameter	**Description**
$HOURS_{HR}$	HR personnel hours saved per applicant due to the relaxation of a suitable inquiry under current rule, but prior to the AAO (as described in assumptions below)
$NUM_{Applicants}$	Annual number of applicants for initial authorization per unit (as described in Appendix 2, Exhibit A2-12)
NUM_{Units}	Number of units per program (as described in Appendix 2, Exhibit A2-14)
$PER_{Qualify}$	Percentage of $NUM_{Applicants}$ who qualify for the behavioral observation relaxation (as described in assumptions below)
$WAGE_{HR}$	HR personnel wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- Percentage of $NUM_{Applicants}$ who qualify for the behavioral observation relaxation: 50%.

- HR personnel hours saved in the relaxation of a suitable inquiry under the current rule, but prior to the AAO: 1 hour per inquiry.

In addition, the proposed subparagraph, in conjunction with subparagraph 26.63(f)(1), results in additional incremental savings relative to the regulations in effect before the NRC issued the AAO. The savings result from provisions that reduce the licensees' labor burden to conduct suitable inquiries on applicants that have not identified any potentially disqualifying FFD information on their self-disclosures. This labor burden is reduced in three ways by (1) reducing the time period that the suitable inquiry must cover from 5 years under the current rule to 3 years, if no potentially disqualifying information is identified, (2) requiring licensees to contact only those employers whom the applicant identified as having worked for the longest in a given

calender month during the first and second years of the 3 year period,[1] and (3) by allowing licensees to take credit for a portion of the suitable inquiry that has been conducted by other licensees. The *annual savings per program* due to the reduced suitable inquiry coverage period and scope for those initial applicants qualifying for the relaxation result from the following:

$$NUM_{Applicants} \times PER_{Not\ Qualifying} \times PER_{Non\text{-}PDFFDI} \times HOURS_{HR} \times WAGE_{HR} \times NUM_{Units}$$

Parameter	**Description**
$HOURS_{HR}$	HR personnel hours saved per applicant as a result of the reduced suitable inquiry coverage period and the reduced number of employers who must be contacted (as described in assumptions below)
$NUM_{Applicants}$	Annual number of applicants for initial authorization per unit (as described in Appendix 2, Exhibit A2-12)
NUM_{Units}	Number of units per program (as described in Appendix 2, Exhibit A2-14)
$PER_{Not\ Qualifying}$	Percentage of applicants for initial authorization per year who do not qualify for the behavioral observation relaxation under subparagraph 23.63(a) (as described in assumptions below)
$PER_{Non\text{-}PDFFDI}$	Percentage of $NUM_{Applicants}$ who have no potentially disqualifying FFD information to disclose on their self-disclosures (as described in assumptions below)
$WAGE_{HR}$	HR personnel wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- Percentage of applicants for initial authorization per year who do not qualify for the behavioral observation relaxation: 50%

- Percentage of $NUM_{Applicants}$ who have no potentially disqualifying FFD information to disclose on their self-disclosures: 95%

- Hours of HR personnel time saved per applicant as a result of the reduced suitable inquiry coverage period and the reduced number of employers who must be contacted: 0.5 hours.

Sensitivity Analysis - Industry Practices

The current rule stipulates that a suitable inquiry must address all employers for whom the applicant worked over the past 5 years. Nonetheless, until recently, industry practices were inconsistent with NRC's interpretation of the requirements such that licensees conducting

[1] Licensees must contact all employers for the year immediately preceding the request for authorization, as required by subparagraph 26.63(f)(1).

suitable inquiries did not call those employers for whom an applicant worked for less than 30 days. As a result, licensees will incur an incremental cost to comply with requirements in the current rule regarding applicants for initial authorization. The *annual costs per program* to conduct a more thorough suitable inquiry on applicants for initial authorization to comply with the existing regulation result from the following:

$$NUM_{Applicants} \times HOURS_{HR} \times WAGE_{HR} \times NUM_{Units}$$

Parameter	**Description**
$HOURS_{HR}$	Additional HR personnel hours required to conduct a suitable inquiry consistent with existing regulations (as described in assumptions below)
$NUM_{Applicants}$	Annual number of applicants for initial authorization per unit (as described in Appendix 2, Exhibit A2-12)
NUM_{Units}	Number of units at a given program (as described in Appendix 2, Exhibit A2-14)
$WAGE_{HR}$	HR personnel wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- Additional HR personnel hours required to conduct a suitable inquiry consistent with existing regulations: 10 minutes (a 20-percent increase over the current estimate of 50 minutes per applicant).

Subparagraph 26.55(a)(3)

This subparagraph of the proposed rule requires licensees to administer a pre-access drug and alcohol test, as described in proposed §26.65, on applicants for initial authorization before granting authorization. This subparagraph imposes no incremental cost and affords no saving because, under provisions of the AAO, applicants for unescorted access are subject to similar drug and alcohol testing requirements.

Sensitivity Analysis - Pre-Order Baseline

Relative to the regulations that were in effect before the NRC issued the AAO, the proposed paragraph, in conjunction with proposed paragraph 26.65(c), does result in incremental savings. The savings result from provisions that allow licensees and other entities to grant authorization without administering a pre-access drug and alcohol test to applicants whose previous authorization was terminated favorably and who have been covered by both a licensee-approved random drug and alcohol testing program and a behavioral observation and arrest reporting

program throughout the period of interruption.[2] The *annual savings per program* result from the sum of the following savings:

- The annual savings per program from not administering a pre-access drug and alcohol test on initial applicants covered by both a random drug and alcohol testing program and a behavioral observation and arrest-reporting program throughout the period of interruption are calculated as follows:[3]

  - Pre-access drug and alcohol tests need not be performed at facilities with onsite testing laboratories for the percentage of applicants who are covered by both a random drug and alcohol testing program and a licensee-approved behavioral observation and arrest-reporting program throughout the period of interruption. The associated savings are estimated as follows:

    $$NUM_{Applicants} \times PER_{Qualify} \times COST_{Onsite} \times NUM_{Units}$$

  - Pre-access drug and alcohol tests need not be performed at facilities with offsite testing laboratories for the percentage of applicants who are covered by both a random drug and alcohol testing program and a licensee-approved behavioral observation and arrest-reporting program throughout the period of interruption. The associated savings are calculated as follows:

    $$NUM_{Applicants} \times PER_{Qualify} \times COST_{Offsite} \times NUM_{Units}$$

- The annual savings per program from bypassing required worker labor in the administration of a pre-access drug and alcohol tests for initial applicants covered by both a random drug and alcohol testing program and a behavioral observation and arrest-reporting are calculated as follows:

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[2] In conjunction with §26.65, licensees and other entities are also allowed to grant authorization without administering a pre-access drug and alcohol test to applicants relying upon negative results from drug and alcohol tests conducted before the individual applied for authorization if the individual has been subject to a behavioral observation and arrest reporting program since the testing was conducted. This provision, however, will not generate any savings that are not already captured by the calculation of savings for §26.65(b).

[3] The incremental savings from this provision will vary per individual program depending on whether the program has onsite testing capabilities or utilizes an offsite HHS-certified testing laboratory.

- The proposed paragraph reduces the number of hours of lost worker productivity awaiting negative test result verification from *onsite testing laboratories*. The associated savings are calculated as follows:

  $NUM_{Applicants} \times PER_{Qualify} \times HOURS_{Onsite\ Worker} \times WAGE_{Worker} \times NUM_{Units}$

- The proposed paragraph reduces the number of hours of lost worker productivity awaiting negative test result verification from *offsite testing laboratories*. The associated savings are calculated as follows:

  $NUM_{Applicants} \times PER_{Qualify} \times HOURS_{Offsite\ Worker} \times WAGE_{Worker} \times NUM_{Units}$

Parameter	**Description**
$COST_{Offsite}$	Pre-access drug and alcohol testing cost at a facility with offsite testing laboratories (described in the assumption below and in Appendix 2, Exhibit A2-13)
$COST_{Onsite}$	Pre-access drug and alcohol testing cost at a facility with onsite testing laboratories (described in the assumptions below and in Appendix 2, Exhibit A2-13)
$HOURS_{Offsite\ Worker}$	Hours of facility worker time at a unit with offsite testing laboratories awaiting a negative test verification and not working under the existing rule (as described in assumptions below)
$HOURS_{Onsite\ Worker}$	Hours of facility worker time at a unit with onsite testing laboratories awaiting a negative test verification and not working under the existing rule (as described in assumptions below)
$NUM_{Applicants}$	Annual number of applicants for initial authorization per unit (as described in Appendix 2, Exhibit A2-12)
NUM_{Units}	Number of units per program (as described in Appendix 2, Exhibit A2-14)
$PER_{Qualify}$	Percentage of $NUM_{Applicants}$ who qualify for the pre-access drug and alcohol test relaxation per year (as described in assumptions below)

Assumptions:

- Percentage of $NUM_{Applicants}$ who qualify for the pre-access drug and alcohol test relaxation per year: 25%.

- Hours of facility worker time at a unit with onsite testing laboratories awaiting negative test verification and not working under the existing rule: 4 hours per reinstatement.[4]

[4] Verification usually requires 1 to 3 business days, depending on whether the given licensee engages in onsite or offsite testing. Although some of the time awaiting verification may be used by applicants for other work-related activities, the analysis assumes that applicants are paid, but unproductive, for a portion of this waiting period.

- Hours of facility worker time at a unit with offsite testing laboratories awaiting negative test verification and not working under the existing rule: 8 hours per reinstatement.

- The per-unit cost of an *onsite pre-access drug and alcohol test* includes the following factors:
  (1) travel time of the worker
  (2) collection of drug and alcohol specimens (labor of the collector and the worker, as well as collection materials)
  (3) onsite licensee testing costs per urine specimen for drugs
  (4) labor of FFD manager to process paperwork for negative test results

- The per-unit cost of an *offsite pre-access drug and alcohol test* includes the following factors:
  (1) travel time of the worker
  (2) collection of drug and alcohol specimens (labor of the collector and the worker, as well as collection materials)
  (3) HHS-certified laboratories costs per urine specimen for drugs
  (4) labor of FFD manager to process paperwork for negative test results

- Applicants who qualify for the relaxation are not expected to yield positive drug and alcohol test results under the existing regulations.

Subparagraph 26.55(a)(4)

This subparagraph of the proposed rule adds provisions that require licensees and other entities to include applicants for initial authorization in a random drug and alcohol testing pool, in accordance with proposed §26.67. Licensees and other entities are expected to use the same random testing pool for this purpose as specified under proposed subparagraph 26.31(d)(2). Licensees and other entities must administer a drug and alcohol test on those applicants randomly selected, although authorization can be granted before results have been verified provided that all other applicable requirements for authorization have been met. The current rule does not contain these provisions.

The *annual costs per program* from the implementation of a random drug and alcohol testing program on initial applicants in applicant status are calculated as follows:[5]

[5] The costs from this provision will vary by individual program depending on whether the program has onsite testing capabilities or utilizes an offsite HHS-certified testing laboratory.

- The proposed paragraph increases the number of random drug and alcohol tests performed at facilities with *onsite testing laboratories*. The associated costs are estimated as follows:

  $NUM_{Applicants} \times PER_{Random} \times COST_{Onsite} \times NUM_{Units}$

- The proposed paragraph increases the number of random drug and alcohol tests performed at facilities with *offsite testing laboratories*. The associated costs are calculated as follows:

  $NUM_{Applicants} \times PER_{Random} \times COST_{Offsite} \times NUM_{Units}$

Parameter	**Description**
$COST_{Offsite}$	Offsite random drug and alcohol testing cost (as described in assumptions below and in Appendix 2, Exhibit A2-13)
$COST_{Onsite}$	Onsite random drug and alcohol testing cost (as described in assumptions below and in Appendix 2, Exhibit A2-13)
$NUM_{Applicants}$	Annual number of applicants for initial authorization per unit (as described in Appendix 2, Exhibit A2-12)
NUM_{Units}	Number of units per program (as described in Appendix 2, Exhibit A2-14)
PER_{Random}	Percentage of $NUM_{Applicants}$ selected for random drug and alcohol testing (as described in assumptions below)

Assumptions:

- Percentage of $NUM_{Applicants}$ selected for random drug and alcohol testing: 1.0%.[6]

- The per-unit cost of an *onsite random drug and alcohol test* includes the following factors:
  (1) travel time of the worker
  (2) collection of drug and alcohol specimens (labor of the collector and the worker, as well as collection materials)
  (3) onsite licensee testing costs per urine specimen for drugs
  (4) labor of FFD manager to process paperwork for negative test results

[6] This figure is calculated by assuming that on any given day an individual in applicant status has a chance of being selected equivalent to the following: (1 day / 365 days) x required annual testing rate of 50% x number of days in applicant status. Initial applicants are assumed to be in applicant status for an average period of 7 days.

- The per-unit cost of an *offsite random drug and alcohol test* includes the following factors:
  (1) travel time of the worker
  (2) collection of drug and alcohol specimens (labor of the collector and the worker, as well as collection materials)
  (3) HHS-certified laboratory costs per urine specimen for drugs
  (4) labor of FFD manager to process paperwork for negative test results

Paragraph 26.55(b)

This paragraph of the proposed rule requires licensees and other entities to take the management action specified in proposed §26.69 when potentially disqualifying FFD information is disclosed or discovered for an applicant for initial authorization. This paragraph imposes no incremental cost and affords no saving because, under §26.27 of the current rule, applicants for unescorted access are subject to similar requirements. These management actions are further discussed in relevant sections of the analysis.

26.57 Authorization Update

Paragraph 26.57(a)

This paragraph of the proposed rule establishes that an update applicant is any individual whose authorization has been interrupted for more than 365 days but less than 3 years and whose last period of authorization was terminated favorably. No incremental costs or savings result from this provision, however, because it is based on non-safeguards information requirements imposed by the NRC's Access Authorization Order (AAO) dated January 7, 2003, and published in the Federal Register on January 13, 2003.

Sensitivity Analysis - Pre-Order Baseline

Relative to the regulations in effect before the NRC issued the AAO, the proposed paragraph indirectly results in incremental costs and savings because it imposes different requirements for the different categories of applicants than does the current rule. The incremental costs and savings associated with these changes are presented and calculated in the subparagraphs below.

Subparagraph 26.57(a)(1)

This subparagraph of the proposed rule requires licensees to obtain and review self-disclosures, as described by proposed §26.61, from applicants updating authorization before granting authorization. This paragraph imposes no incremental cost and affords no saving because, under §26.27(a)(1) of the current rule and provisions of the AAO, applicants for unescorted access are subject to similar self-disclosure requirements.

Sensitivity Analysis - Pre-Order Baseline

Relative to the regulations that were in effect before the NRC issued the AAO, the proposed subparagraph, in conjunction with proposed subparagraph 26.61(a)(1), does result in incremental savings. The savings result from provisions that state that update authorization applicants whose last authorization was terminated favorably and who have been covered by a behavioral observation and arrest-reporting program throughout the period of interruption do not need to submit self-disclosures to licensees and other entities. The *annual savings per program* result from the *sum* of the following savings:

- The annual savings per program from reduced facility worker labor burden for those applicants for updated authorization who qualify for the self-disclosure relaxation are calculated as follows:

  $$NUM_{Applicants} \times PER_{Qualify} \times HOURS_{Worker} \times WAGE_{Worker} \times NUM_{Units}$$

- The annual savings per program resulting from reduced clerical personnel labor burden (because fewer self-disclosures submitted by applicants for updated authorization will need to be processed) are calculated as follows:

  $$NUM_{Applicants} \times PER_{Qualify} \times HOURS_{Clerical} \times WAGE_{Clerical} \times NUM_{Units}$$

Parameter	**Description**
$HOURS_{Clerical}$	Clerical personnel hours saved in a self-disclosure (as described in assumptions below)
$HOURS_{Worker}$	Facility worker hours saved in a self-disclosure (as described in assumptions below)
$NUM_{Applicants}$	Annual number of applicants for authorization updates per unit (as described in Appendix 2, Exhibit A2-12)
NUM_{Units}	Number of units per program (as described in Appendix 2, Exhibit A2-14)
$PER_{Qualify}$	Percentage of applicants for authorization updates who qualify for the relaxation (as described in assumptions below)
$WAGE_{Clerical}$	Clerical personnel wage rate (as described in Appendix 2, Exhibit A2-11)
$WAGE_{Worker}$	Facility worker wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- Percentage of applicants for authorization updates who qualify for the relaxation: 50%.

- Facility worker hours saved in a self-disclosure: 0.25 hours per update.

- Clerical personnel hours saved in a self-disclosure: 0.25 hours per update.

Subparagraph 26.57(a)(2)

This subparagraph of the proposed rule requires licensees to conduct a suitable inquiry, as described by proposed §26.63, on applicants updating authorization. This subparagraph imposes no incremental cost and affords no saving because, under §26.27 of the current rule and provisions in the AAO, applicants for unescorted access are subject to similar suitable inquiry requirements.

Sensitivity Analysis - Pre-Order Baseline

Relative to the regulations that were in effect before the NRC issued the AAO, the proposed subparagraph, in conjunction with proposed subparagraph 26.63(a), does result in incremental savings. The savings result from provisions that state that licensees and other entities do not need to conduct suitable inquiries on update applicants whose last authorization was terminated favorably and who have been covered by a behavioral observation and arrest-reporting program throughout the period of interruption. The *annual savings per program* from not conducting the suitable inquiry on applicants for updated authorization qualifying for the relaxation result from the following:

$$NUM_{Applicants} \times PER_{Qualify} \times HOURS_{HR} \times WAGE_{HR} \times NUM_{Units}$$

Parameter	**Description**
$HOURS_{HR}$	HR personnel hours saved per applicant due to the relaxation of a suitable inquiry under current rule, but prior to the AAO (as described in assumptions below)
$NUM_{Applicants}$	Annual number of applicants for authorization updates per unit (as described in Appendix 2, Exhibit A2-12)
NUM_{Units}	Number of units per program (as described in Appendix 2, Exhibit A2-14)
$PER_{Qualify}$	Percentage of applicants for authorization updates who qualify for the behavioral observation relaxation (as described in assumptions below)
$WAGE_{HR}$	HR personnel wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- Percentage of applicants for authorizations updates who qualify for the behavioral observation relaxation: 50%.

- HR personnel hours saved in the relaxation of a suitable inquiry under the current rule, but prior to the AAO: 1 hour per inquiry.

In addition to the relaxation discussed above, additional incremental savings result from this subparagraph, in conjunction with proposed paragraph 26.63(b) and subparagraph 26.63(f)(2) relative to the regulations that were in effect before the NRC issued the AAO. These savings result from provisions that reduce the licensee labor burden to conduct a suitable inquiry on individuals who have no potentially disqualifying FFD information to disclose and who do not qualify for the relaxation discussed above. The scope of the suitable inquiry is reduced in three ways: (1) by reducing the time period required to be covered by the suitable inquiry from 5 years under the current rule to the period since authorization was last terminated favorably, (2) by requiring licensees to contact only those employers whom the applicant identified as having worked for the longest in a given calendar month after the first year of interruption (for which licensees must contact all employers, regardless of the duration of employment) until authorization was terminated, and (3) by allowing licensees to take credit for a portion of the suitable inquiry that has been conducted by other licensees. The *annual savings per program* due to the reduced suitable inquiry coverage period and scope for applicants for updated authorization qualifying for the relaxation result from the following:

$$NUM_{Applicants} \times PER_{Not\ Qualifying} \times PER_{Non\text{-}PDFFDI} \times HOURS_{HR} \times WAGE_{HR} \times NUM_{Units}$$

Parameter	**Description**
$HOURS_{HR}$	Hours of HR personnel time saved per suitable inquiry as a result of the reduced coverage period and number of employees who must be contacted (as described in assumptions below)
$NUM_{Applicants}$	Annual number of applicants for updated authorization per unit (as described in Appendix 2, Exhibit A2-12)
NUM_{Unit}	Number of units per program (as described in Appendix 2, Exhibit A2-14)
$PER_{Non\text{-}PDFFDI}$	Percentage of $NUM_{Applicants}$ who have no potentially disqualifying FFD information to disclose on their self-disclosures (as described in assumptions below)
$PER_{Not\ Qualifying}$	Percentage of applicants for updated authorization per year who do not qualify for the relaxation under proposed subparagraph 26.63(a) (as described in assumptions below)
$WAGE_{HR}$	HR personnel wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- Percentage of $NUM_{Applicants}$ who have no potentially disqualifying FFD information to disclose on their self-disclosures: 98%.

- Percentage of applicants for updated authorization per year who do not qualify for the relaxation under proposed subparagraphs 26.63(a): 50%.

- Hours of HR personnel time saved per suitable inquiry as a result of the reduced scope of coverage: 0.5 hours.

Sensitivity Analysis - Industry Practices

Current regulations stipulate that a suitable inquiry must address all employers for whom applicants for authorization updates worked over the past 5 years. Nonetheless, until recently, industry practices were inconsistent with the NRC's interpretation of the requirements such that licensees conducting suitable inquiries did not call those employers for whom an applicant worked for less than 30 days. As a result, licensees will incur an incremental cost to comply with existing requirements for suitable inquiries. The *annual costs per program* to conduct a more thorough suitable inquiry on applicants for updated authorization to comply with the existing regulation result from the following:

$$NUM_{Applicants} \times HOURS_{HR} \times WAGE_{HR} \times NUM_{Units}$$

Parameter	**Description**
$HOURS_{HR}$	Additional HR personnel hours required to conduct suitable inquiries consistent with existing regulations (as described in assumptions below)
$NUM_{Applicants}$	Annual number of applicants for authorization updates per unit (as described in Appendix 2, Exhibit A2-12)
NUM_{Units}	Number of units per program (as described in Appendix 2, Exhibit A2-14)
$WAGE_{HR}$	HR personnel wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- Additional HR personnel hours required to conduct suitable inquiries consistent with existing regulations: 10 minutes (i.e., a 20-percent increase over the current estimate of 50 minutes per applicant).

Subparagraph 26.57(a)(3)

This subparagraph of the proposed rule requires licensees to administer a pre-access drug and alcohol test, as described in proposed §26.65, on applicants updating authorization before granting authorization. This subparagraph imposes no incremental cost and affords no saving because, under §26.24(a) of the current rule and provisions of the AAO, applicants for unescorted access are subject to similar drug and alcohol testing requirements.

Sensitivity Analysis - Pre-Order Baseline

Relative to the regulations that were in effect before the NRC issued the AAO, the proposed paragraph, in conjunction with proposed paragraph 26.65(c), does result in incremental savings. The savings result from provisions that allow licensees and other entities to grant authorization without administering a pre-access drug and alcohol test to applicants whose previous

authorization was terminated favorably and who have been covered by both a licensee-approved random drug and alcohol testing program and a behavioral observation and arrest reporting program throughout the period of interruption.[7] The *annual savings per program* result from the sum of the following savings:

- The annual savings per program from not administering a pre-access drug and alcohol test on update applicants covered by both a random drug and alcohol testing program and a behavioral observation and arrest-reporting program throughout the period of interruption are calculated as follows:[8]

  - Pre-access drug and alcohol tests need not be performed at facilities with onsite testing laboratories for the percentage of applicants who are covered by both a random drug and alcohol testing program and a licensee-approved behavioral observation and arrest-reporting program throughout the period of interruption. The associated savings are estimated as follows:

    $$NUM_{Applicants} \times PER_{Qualify} \times COST_{Onsite} \times NUM_{Units}$$

  - Pre-access drug and alcohol tests need not be performed at facilities with offsite testing laboratories for the percentage of applicants who are covered by both a random drug and alcohol testing program and a licensee-approved behavioral observation and arrest-reporting program throughout the period of interruption. The associated savings are calculated as follows:

    $$NUM_{Applicants} \times PER_{Qualify} \times COST_{Offsite} \times NUM_{Units}$$

- The annual savings per program from bypassing required worker labor in the administration of a pre-access drug and alcohol tests for update applicants covered by both a random drug and alcohol testing program and a behavioral observation and arrest-reporting are calculated as follows:

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[7] In conjunction with §26.65, licensees and other entities are also allowed to grant authorization without administering a pre-access drug and alcohol test to applicants relying upon negative results from drug and alcohol tests conducted before the individual applied for authorization if the individual has been subject to a behavioral observation and arrest reporting program since the testing was conducted. This provision, however, will not generate any savings that are not already captured by the calculation of savings for §26.65(b).

[8] The incremental savings from this provision will vary per individual program depending on whether the program has onsite testing capabilities or utilizes an offsite HHS-certified testing laboratory.

- The proposed paragraph reduces the number of hours of lost worker productivity awaiting negative test result verification from *onsite testing laboratories*. The associated savings are calculated as follows:

$$NUM_{Applicants} \times PER_{Qualify} \times HOURS_{Onsite\ Worker} \times WAGE_{Worker} \times NUM_{Units}$$

- The proposed paragraph reduces the number of hours of lost worker productivity awaiting negative test result verification from *offsite testing laboratories*. The associated savings are calculated as follows:

$$NUM_{Applicants} \times PER_{Qualify} \times HOURS_{Offsite\ Worker} \times WAGE_{Worker} \times NUM_{Units}$$

Parameter	**Description**
$COST_{Offsite}$	Pre-access drug and alcohol testing cost at a facility with offsite testing laboratories (described in the assumption below and in Appendix 2, Exhibit A2-13)
$COST_{Onsite}$	Pre-access drug and alcohol testing cost at a facility with onsite testing laboratories (described in the assumptions below and in Appendix 2, Exhibit A2-13)
$HOURS_{Offsite\ Worker}$	Hours of facility worker time at a unit with offsite testing laboratories awaiting a negative test verification and not working under the existing rule (as described in assumptions below)
$HOURS_{Onsite\ Worker}$	Hours of facility worker time at a unit with onsite testing laboratories awaiting a negative test verification and not working under the existing rule (as described in assumptions below)
$NUM_{Applicants}$	Annual number of applicants for authorization updates per unit (as described in Appendix 2, Exhibit A2-12)
NUM_{Units}	Number of units per program (as described in Appendix 2, Exhibit A2-14)
$PER_{Qualify}$	Percentage of $NUM_{Applicants}$ who qualify for the pre-access drug and alcohol test relaxation per year (as described in assumptions below)

Assumptions:

- Percentage of $NUM_{Applicants}$ who qualify for the pre-access drug and alcohol test relaxation per year: 25%.

- Hours of facility worker time at a unit with onsite testing laboratories awaiting negative test verification and not working under the existing rule: 4 hours per reinstatement.[9]

[9] Verification usually requires 1 to 3 business days, depending on whether the given licensee engages in onsite or offsite testing. Although some of the time awaiting verification may be used by applicants for other work-related activities, the analysis assumes that applicants are paid, but unproductive, for a portion of this waiting period.

- Hours of facility worker time at a unit with offsite testing laboratories awaiting negative test verification and not working under the existing rule: 8 hours per reinstatement.

- The per-unit cost of an *onsite pre-access drug and alcohol test* includes the following factors:
  (1) travel time of the worker
  (2) collection of drug and alcohol specimens (labor of the collector and the worker, as well as collection materials)
  (3) onsite licensee testing costs per urine specimen for drugs
  (4) labor of FFD manager to process paperwork for negative test results

- The per-unit cost of an *offsite pre-access drug and alcohol test* includes the following factors:
  (1) travel time of the worker
  (2) collection of drug and alcohol specimens (labor of the collector and the worker, as well as collection materials)
  (3) HHS-certified laboratories costs per urine specimen for drugs
  (4) labor of FFD manager to process paperwork for negative test results

- Applicants who qualify for the relaxation are not expected to yield positive drug and alcohol test results under the existing regulations.

Subparagraph 26.57(a)(4)

This subparagraph of the proposed rule adds provisions that require licensees and other entities to include applicants for updated authorization in a random drug and alcohol testing pool, in accordance with proposed §26.67. Licensees and other entities are expected to use the same random testing pool for this purpose as is specified under subparagraph 26.31(d)(2) of the proposed rule. Licensees and other entities must administer a drug and alcohol test on those applicants randomly selected, although applicants can be granted authorization before results have been verified, provided that all other applicable requirements for authorization have been met.

The *annual costs per program* due to the increase in the number of random drug and alcohol tests performed on applicants for updated authorization are calculated as follows:[10]

[10] The costs from this provision will vary by individual program depending on whether the program has onsite testing capabilities or utilizes an offsite HHS-certified testing laboratory.

- The proposed paragraph increases the number of random drug and alcohol tests performed at facilities with *onsite testing laboratories*. The associated costs are estimated as follows:

  $NUM_{Applicants} \times PER_{Random} \times COST_{Onsite} \times NUM_{Units}$

- The proposed paragraph increases the number of random drug and alcohol tests performed at facilities with *offsite testing laboratories*. The associated costs are calculated as follows:

  $NUM_{Applicants} \times PER_{Random} \times COST_{Offsite} \times NUM_{Units}$

Parameter	**Description**
$COST_{Offsite}$	Offsite random drug and alcohol testing cost (as described in assumptions below and in Appendix 2, Exhibit A2-13)
$COST_{Onsite}$	Onsite random drug and alcohol testing cost (as described in assumptions below and in Appendix 2, Exhibit A2-13)
$NUM_{Applicants}$	Annual number of applicants for updated authorization per unit (as described in Appendix 2, Exhibit A2-12)
NUM_{Units}	Number of units per program (as described in Appendix 2, Exhibit A2-14)
PER_{Random}	Percentage of $NUM_{Applicants}$ selected for random drug and alcohol testing (as described in assumptions below)

Assumptions:

- Percentage of $NUM_{Applicants}$ selected for random drug and alcohol testing: 1.0%.[11]

- The per-unit cost of an *onsite random drug and alcohol test* includes the following factors:
  (1) travel time of the worker
  (2) collection of drug and alcohol specimens (labor of the collector and the worker, as well as collection materials)
  (3) onsite licensee testing costs per urine specimen for drugs
  (4) labor of FFD manager to process paperwork for negative test results

[11] This figure is calculated by assuming that on any given day, an individual in applicant status has a chance of being selected equivalent to the following: (1 day / 365 days) x required annual testing rate of 50% x number of days in applicant status. Initial applicants are assumed to be in applicant status for an average period of 7 days.

- The per-unit cost of an *offsite random drug and alcohol test* includes the following factors:
  (1) travel time of the worker
  (2) collection of drug and alcohol specimens (labor of the collector and the worker, as well as collection materials)
  (3) HHS-certified laboratory costs per urine specimen for drugs
  (4) labor of FFD manager to process paperwork for negative test results

Paragraph 26.57(b)

This paragraph of the proposed rule requires licensees and other entities to take the management action specified in proposed §26.69 when potentially disqualifying FFD information is disclosed or discovered for an applicant for updated authorization. This paragraph imposes no incremental cost and affords no saving because, under §26.27 of the current rule, applicants for unescorted access are subject to similar requirements. These management actions are further discussed in relevant sections of the analysis.

26.59 Authorization Reinstatement

Paragraph 26.59(a)

This paragraph of the proposed rule [including subparagraphs 26.59(a)(1) – (3)] addresses reinstatement applicants with an interruption of more than 30 days but not more than 365 days and whose last period of authorization was terminated favorably. No incremental costs or savings result from this provision, however, because it is based on non-safeguards information requirements imposed by the NRC's Access Authorization Order (AAO) dated January 7, 2003, and published in the Federal Register on January 13, 2003.

Sensitivity Analysis - Pre-Order Baseline

Relative to the regulations in effect before the NRC issued the AAO, the proposed paragraph indirectly results in incremental costs and savings because it imposes different requirements for the different categories of applicants relative to the requirements of the current rule. These incremental costs and savings are presented and calculated in the subparagraphs below.

Subparagraph 26.59(a)(1)

This subparagraph of the proposed rule requires licensees to obtain and review self-disclosures, as described by proposed §26.61, from applicants for reinstatement authorization with an interruption of more than 30 days but not more than 365 days, before granting authorization. This subparagraph imposes no incremental cost and affords no saving because, under §26.27 of the current rule and provisions of the AAO, applicants for unescorted access are subject to similar self-disclosure requirements.

Sensitivity Analysis - Pre-Order Baseline

Relative to the regulations that were in effect before the NRC issued the AAO, the proposed subparagraph, in conjunction with proposed subparagraph 26.61(a)(1), does result in incremental savings. The savings result from provisions that state that previously authorized applicants whose last authorizations were terminated favorably and who have been covered by a behavioral observation and arrest-reporting program throughout the period of interruption do not need to submit self-disclosures to licensees and other entities. The *annual savings per program* result from the *sum* of the following savings:

- The annual savings per program from reduced facility worker labor burden for those applicants for authorization reinstatement who qualify for the self-disclosure relaxation are calculated as follows:

  $$NUM_{Applicants} \times PER_{Qualify} \times HOURS_{Worker} \times WAGE_{Worker} \times NUM_{Units}$$

- The annual savings per program from reduced clerical personnel labor burden (because fewer self-disclosures submitted by applicants for authorization reinstatement will need to be processed) are calculated as follows:

  $$NUM_{Applicants} \times PER_{Qualify} \times HOURS_{Clerical} \times WAGE_{Clerical} \times NUM_{Units}$$

Parameter	**Description**
$HOURS_{Clerical}$	Clerical personnel hours saved in a self-disclosure (as described in assumptions below)
$HOURS_{Worker}$	Facility worker hours saved in a self-disclosure (as described in assumptions below)
$NUM_{Applicants}$	Annual number of applicants for authorization reinstatement with an interruption of more than 30 days but not more than 365 days per unit (as described in Appendix 2, Exhibit A2-12)
NUM_{Units}	Number of units per program (as described in Appendix 2, Exhibit A2-14)
$PER_{Qualify}$	Percentage of applicants for authorization reinstatement who qualify for the relaxation (as described in assumptions below)
$WAGE_{Clerical}$	Clerical personnel wage rate (as described in Appendix 2, Exhibit A2-11)
$WAGE_{Worker}$	Facility worker wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- Percentage of applicants for authorization reinstatements who qualify for the relaxation: 50%.

- Facility worker hours saved in a self-disclosure: 0.25 hours per update.

- Clerical personnel hours saved in a self-disclosure: 0.25 hours per update.

Subparagraph 26.59(a)(2)

This subparagraph of the proposed rule requires licensees to conduct a suitable inquiry, as described by proposed §26.63, on applicants for reinstatement authorization with an interruption of more than 30 days but not more than 365 days, before granting authorization. This subparagraph imposes no incremental cost and affords no saving because, under §26.27 of the current rule, applicants for unescorted access are subject to similar suitable inquiry requirements. The proposed subparagraph also adopts provisions from the NRC's AAO that (1) eliminate the suitable inquiry requirement for the subset of applicants whose previous authorization was terminated favorably and who have been covered by a licensee-approved behavioral observation and arrest-reporting program throughout the period of interruption [in conjunction with 26.63(a)], (2) reduce the labor burden associated with conducting a suitable inquiry, and (3) allow licensees to grant authorization prior to the completion of a suitable inquiry, provided that it is completed within 10 business days. There is no incremental savings from these provisions, except under the alternative Pre-Order Baseline as discussed below, because they are based on non-safeguards information requirements imposed by the NRC's AAO dated January 7, 2003, and published in the Federal Register on January 13, 2003 (68 FR 1643).

Sensitivity Analysis - Pre-Order Baseline

Relative to the regulations in effect before the NRC issued the AAO, the proposed subparagraph does result in incremental savings by not requiring suitable inquiries for reinstatement applicants with interruptions of 31–365 days if their last authorization was terminated favorably and they were covered by a licensee-approved behavioral observation and arrest-reporting program throughout the period of interruption. The *annual savings per program* from not conducting the suitable inquiry on applicants for authorization reinstatement qualifying for the relaxation result from the following:

$$NUM_{Applicants} \times PER_{Qualify} \times HOURS_{HR} \times WAGE_{HR} \times NUM_{Units}$$

Parameter	**Description**
$HOURS_{HR}$	HR personnel hours saved per applicant by not conducting a suitable inquiry due to the relaxation (as described in assumptions below)
$NUM_{Applicants}$	Annual number of applicants per unit for authorization reinstatement with interruption of more than 30 days but not more than 365 days per unit (as described in Appendix 2, Exhibit A2-12)
NUM_{Units}	Number of units per program (as described in Appendix 2, Exhibit A2-14)

Parameter	Description
$PER_{Qualify}$	Percentage of $NUM_{Applicants}$ covered by a licensee-approved behavioral observation and arrest-reporting program throughout the period of interruption (as described in assumptions below)
$WAGE_{HR}$	HR personnel wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- Percentage of authorization reinstatement applicants who qualify for the behavioral observation relaxation: 50%.

- HR personnel hours saved per applicant by not conducting a suitable inquiry due to the relaxation: 1 hour per suitable inquiry.

In addition to the relaxation discussed above, this subparagraph of the proposed rule, in conjunction with proposed paragraph 26.63(b) and 26.63(f)(3), adopts provisions from the NRC's AAO that result in incremental savings by reducing the scope (and associated labor burden) of the suitable inquiry for reinstatement applicants with interruptions of 31–365 days who have no potentially disqualifying FFD information to disclose and who do not qualify for the relaxations discussed above. The scope is reduced in three ways: (1) by reducing the time period required to be covered by the suitable inquiry from 5 years under the current rule to the period since authorization was last terminated favorably, (2) by requiring licensees to contact only those employers whom the applicant identified as having worked for the longest in a given calender month (as opposed to all employers under the current rule), and (3) by allowing licensees to take credit for a portion of the suitable inquiry that has been conducted by other licensees. The *annual savings per program* due to the reduced suitable inquiry coverage period and scope for applicants for authorization reinstatement qualifying for the relaxation result from the following:

$$NUM_{Applicants} \times PER_{Not\ Qualifying} \times PER_{Non\text{-}PDFFDI} \times HOURS_{HR} \times WAGE_{HR} \times NUM_{Units}$$

Parameter	Description
$HOURS_{HR}$	Hours of HR personnel time saved per suitable inquiry due to reduced suitable inquiry coverage period and a reduction in the number of employees that must be contacted (as described in assumptions below)
$NUM_{Applicants}$	Annual number of applicants per unit for authorization reinstatement with interruption of more than 30 days but not more than 365 days per unit (as described in Appendix 2, Exhibit A2-12)
NUM_{Units}	Number of units per program (as described in Appendix 2, Exhibit A2-14)
$PER_{Non\text{-}PDFFDI}$	Percentage of $NUM_{Applicants}$ who have no potentially disqualifying FFD information to disclose on their self-disclosures (as described in assumptions below)

Parameter	Description
$PER_{Not\ Qualifying}$	Percentage of $NUM_{Applicants}$ not covered by a licensee-approved behavioral observation and arrest-reporting program throughout the period of interruption (as described in assumptions below)
$WAGE_{HR}$	HR personnel wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- Percentage of $NUM_{Applicants}$ not covered by a licensee-approved behavioral observation and arrest-reporting program throughout the period of interruption: 50%.

- Percentage of $NUM_{Applicants}$ who have no potentially disqualifying FFD information to disclose on their self-disclosures: 99%.

- Hours of HR personnel time saved per suitable inquiry as a result of the reduced scope of coverage: 0.5 hours.

In addition to the relaxation discussed above, this proposed subparagraph adopts provisions from the AAO that allow for applicants for authorization reinstatement with an interruption of 31–365 days to be granted authorization *prior to* the completion of a suitable inquiry, provided that the inquiry is completed within 10 business days of granting reinstated authorization. If after 10 business days the suitable inquiry has not been completed, authorization must be administratively withdrawn until it is completed. This provision does not change the activities that must be conducted. It could lead to savings, however, by reducing the amount of lost worker productivity while awaiting completion of the inquiry. The analysis assumes, however, that workers are engaged in other work-related activities (such as training, testing, and other non-FFD-related activities) that do not require authorization while the suitable inquiry is being conducted.

Sensitivity Analysis - Industry Practices

Current regulations stipulate that a suitable inquiry must address all employers for whom applicants for authorization worked over the past 5 years. Nonetheless, until recently, industry practices were inconsistent with NRC's interpretation of the requirements such that industry practice has been that licensees conducting suitable inquiries did not call employers for whom an applicant worked for 30 days or less. As a result, licensees should have incurred an incremental

cost to comply with existing requirements for suitable inquiries on applicants with an interruption of 31–365 days. The *annual cost per program* to conduct a more thorough suitable inquiry on applicants for authorization reinstatement to comply with the existing regulation result from the following:

$$NUM_{Applicants} \times HOURS_{HR} \times WAGE_{HR} \times NUM_{Units}$$

Parameter	**Description**
$HOURS_{HR}$	Additional HR personnel hours required to conduct a suitable inquiry consistent with the existing regulations (as described in assumptions below)
$NUM_{Applicants}$	Annual number of applicants for authorization reinstatement with an interruption of more than 30 days but not more than 365 days (as described in Appendix 2, Exhibit A2-12)
NUM_{Units}	Number of units per program (as described in Appendix 2, Exhibit A2-14)
$WAGE_{HR}$	HR personnel wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- Additional HR personnel hours required to conduct suitable inquiries consistent with the existing regulations: 10 minutes (i.e., a 20-percent increase over the current estimate of 50 minutes per applicant).

Subparagraph 26.59(a)(3)

This subparagraph of the proposed rule requires licensees to administer a pre-access drug and alcohol test, as described in proposed §26.65, on applicants for reinstatement authorization with an interruption of more than 30 days but not more than 365 days, before granting authorization. The proposed subparagraph imposes no incremental cost and affords no saving because, under the current rule, applicants for unescorted access are subject to similar drug and alcohol testing requirements under 26.24(a). The proposed subparagraph does, however, adopt provisions from the NRC's AAO that eliminate the pre-access drug and alcohol testing requirement for those applicants whose previous authorization was terminated favorably and who have been covered both by behavioral observation and arrest program and by a licensee-approved random drug and alcohol testing program throughout the period of interruption. Other provisions adapted from the AAO allow licensees to grant authorization reinstatement to applicants prior to receiving verification of negative drug test results as long as verification occurs within 5 business days. If verification does not occur during this time frame, authorization must be administratively withdrawn until completed. There is no incremental savings from these provisions, except under the alternative *Pre-Order Baseline* as discussed below, because they are based on non-safeguards information requirements imposed by the NRC's AAO dated January 7, 2003, and published in the Federal Register on January 13, 2003 (68 FR 1643).

Sensitivity Analysis - Pre-Order Baseline

Relative to the regulations in effect before the NRC issued the AAO, the proposed subparagraph, in conjunction with proposed §26.65(d), does result in incremental saving. According to §26.24 of the current rule as well as guidance provided by the NRC in NUREG-1385, "Fitness for Duty in the Nuclear Power Industry: Responses to Implementation Questions," licensees may not grant authorization without administering a drug and alcohol test and verifying negative test results. Provisions in this proposed rule, however, allow applicants for authorization reinstatement with an interruption of 31–365 days to forego pre-access drug and alcohol testing if covered by a licensee-approved random drug and alcohol testing program and a behavioral observation and arrest reporting program throughout the period of interruption.[12] As a result, savings arise from the reduction in the number of pre-access tests administered and the reduction in the loss of worker productivity awaiting negative test results.

The *annual savings per program* result from the *sum* of the following savings:

- Annual savings per program from allowing reinstatement applicants covered by a random drug and alcohol testing program and a behavioral observation and arrest reporting program throughout the period of interruption to forego pre-access drug and alcohol testing are calculated as follows:[13]

  - The proposed paragraph reduces the number of pre-access drug and alcohol tests performed at facilities with *onsite testing laboratories*. The associated savings are calculated as follows:

    $$NUM_{Applicants} \times PER_{Qualify} \times COST_{Onsite} \times NUM_{Units}$$

  - The proposed paragraph reduces the number of pre-access drug and alcohol tests performed at facilities with *offsite testing laboratories*. The associated savings are calculated as follows:

    $$NUM_{Applicants} \times PER_{Qualify} \times COST_{Offsite} \times NUM_{Units}$$

- Annual savings per program from reducing the number of hours of lost worker productivity for reinstatement applicants covered by both a random drug and

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[12] In conjunction with §26.65, licensees and other entities are also allowed to grant authorization without administering a pre-access drug and alcohol test to applicants relying upon negative results from drug and alcohol tests conducted before the individual applied for authorization if the individual has been subject to a behavioral observation and arrest reporting program since the testing was conducted. This provision, however, will not generate any savings that are not already captured by the calculation of savings for §26.65(b).

[13] The incremental savings from this provision will vary by individual program depending on whether the program has onsite testing capabilities or utilizes an offsite HHS-certified testing laboratory.

alcohol testing program and a behavioral observation and arrest reporting program are calculated as follows:[14]

- The proposed paragraph reduces the number of hours of lost worker productivity awaiting negative test result verification from *onsite testing laboratories*. The associated savings are calculated as follows:

  $$NUM_{Applicants} \times PER_{Qualify} \times HOURS_{Onsite\ Worker} \times WAGE_{Worker} \times NUM_{Units}$$

- The proposed paragraph reduces the number of hours of lost worker productivity awaiting negative test result verification from *offsite testing laboratories*. The associated savings are calculated as follows:

  $$NUM_{Applicants} \times PER_{Qualify} \times HOURS_{Offsite\ Worker} \times WAGE_{Worker} \times NUM_{Units}$$

Parameter	**Description**
$COST_{Offsite}$	Offsite pre-access drug and alcohol testing cost (as described in assumptions below and in Appendix 2, Exhibit A2-13)
$COST_{Onsite}$	Onsite pre-access drug and alcohol testing cost (as described in assumptions below and in Appendix 2, Exhibit A2-13)
$HOURS_{Offsite\ Worker}$	Hours of facility worker time at a unit with offsite testing laboratories awaiting a negative test verification and not working under the existing rule (as described in assumptions below)
$HOURS_{Onsite\ Worker}$	Hours of facility worker time at a unit with onsite testing laboratories awaiting a negative test verification and not working under the existing rule (as described in assumptions below)
$NUM_{Applicants}$	Annual number of applicants for authorization with an interruption of more than 30 days but not more than 365 days per unit (as described in Appendix 2, Exhibit A2-12)
NUM_{Units}	Number of units per program (as described in Appendix 2, Exhibit A2-14)
$PER_{Qualify}$	Percentage of $NUM_{Applicants}$ covered by a licensee approved random drug and alcohol testing program and a behavioral observation and arrest reporting program (as described in assumptions below)
$WAGE_{Worker}$	Facility worker wage rate (as described in Appendix 2, Exhibit A2-11)

[14] The incremental savings from this provision will vary by individual program depending on whether the program has onsite testing capabilities or utilizes an offsite HHS-certified testing laboratory.

Assumptions:

- Percentage of $NUM_{Applicants}$ covered by a licensee approved random drug and alcohol testing program and behavioral observation and arrest reporting program: 25%.

- Hours of facility worker time at a unit with onsite testing laboratories awaiting negative test verification and not working under the existing rule: 4 hours per reinstatement.[15]

- Hours of facility worker time at a unit with offsite testing laboratories awaiting negative test verification and not working under the existing rule: 8 hours per reinstatement.

- The per-unit cost of an *onsite pre-access drug and alcohol test* includes the following factors:
  (1) travel time of the worker
  (2) collection of drug and alcohol specimens (labor of the collector and the worker, as well as collection materials)
  (3) onsite licensee testing costs per urine specimen for drugs
  (4) labor of FFD manager to process paperwork for negative test results

- The per-unit cost of an *offsite pre-access drug and alcohol test* includes the following factors:
  (1) travel time of the worker
  (2) collection of drug and alcohol specimens (labor of the collector and the worker, as well as collection materials)
  (3) HHS-certified laboratory costs per urine specimen for drugs
  (4) labor of FFD manager to process paperwork for negative test results

In addition, this proposed subparagraph adopts provisions from the AAO that allow licensees to grant authorization reinstatement to applicants with interruptions of 31–365 days prior to receiving verification of negative drug test results as long as verification occurs within 5 business days of specimen collection. (This applies only to those applicants that must take a pre-access test, thereby excluding those covered by the preceding relaxation). Verification usually requires 1 to 3 business days, depending on whether the given licensee engages in onsite or offsite testing. Although some of the time awaiting verification may be used by applicants for other work-related activities, the analysis assumes that applicants are paid, but unproductive, for a portion of this waiting period. *The annual savings per program* resulting from this group of

[15] Verification usually requires 1 to 3 business days, depending on whether the given licensee engages in onsite or offsite testing. Although some of the time awaiting verification may be used by applicants for other work-related activities, the analysis assumes that applicants are paid, but unproductive, for a portion of this waiting period.

applicants not having to await verification of negative results before granting authorization are calculated as follows:[16]

- The proposed paragraph decreases the number of hours of lost worker productivity awaiting negative test result verification from *onsite testing laboratories*. The associated savings are calculated as follows:

  $$NUM_{Applicants} \times PER_{Not\ Qualifying} \times HOURS_{Onsite\ Worker} \times WAGE_{Worker} \times NUM_{Units}$$

- The proposed paragraph decreases the number of hours of lost worker productivity awaiting negative test result verification from *offsite testing laboratories*. The associated savings are calculated as follows:

  $$NUM_{Applicants} \times PER_{Not\ Qualifying} \times HOURS_{Offsite\ Worker} \times WAGE_{Worker} \times NUM_{Units}$$

Parameter	**Description**
$HOURS_{Offsite\ Worker}$	Hours of facility worker time at a unit with offsite testing laboratories awaiting a negative test verification and not working under the existing rule (as described in assumptions below)
$HOURS_{Onsite\ Worker}$	Hours of facility worker time at a unit with onsite testing laboratories awaiting a negative test verification and not working under the existing rule (as described in assumptions below)
$NUM_{Applicants}$	Annual number of applicants for authorization reinstatement with an interruption of more than 30 days but not more than 365 days per unit (as described in Appendix 2, Exhibit A2-12)
NUM_{Units}	Number of units per program (as described in Appendix 2, Exhibit A2-14)
$PER_{Not\ Qualifying}$	Percentage of $NUM_{Applicants}$ not covered by a licensee-approved random drug and alcohol testing program and a behavioral observation and arrest reporting program throughout the period of interruption (as described in assumptions below)
$WAGE_{Worker}$	Facility worker wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- Percentage of $NUM_{Applicants}$ not covered by a licensee-approved random drug and alcohol testing program and a behavioral observation and arrest reporting program throughout the period of interruption: 75%.

[16] The incremental savings from this provision will vary by individual program depending on whether the program has onsite testing capabilities or utilizes an offsite HHS-certified testing laboratory.

- Hours of facility worker time at a unit with onsite testing laboratories awaiting negative test verification and not working under the existing rule: 4 hours per reinstatement.[17]

- Hours of facility worker time at a unit with offsite testing laboratories awaiting negative test verification and not working under the existing rule: 8 hours per reinstatement.

Subparagraph 26.59(a)(4)

This subparagraph of the proposed rule adds provisions that require licensees and other entities to include applicants for reinstatement authorization with an interruption of more than 30 days but not more than 365 days in a random drug and alcohol testing pool, in accordance with proposed §26.67. Licensees and other entities are expected to use the same random testing pool for this purpose as specified under subparagraph 26.31(d)(2) of the proposed rule. Licensees and other entities must administer a drug and alcohol test on those applicants randomly selected. Authorization may be granted before results have been verified provided that all other applicable requirements for authorization have been met.

The *annual costs per program* to conduct random drug and alcohol tests on applicants randomly selected while awaiting the granting of authorization are calculated as follows:[18]

- The proposed paragraph increases the number of drug and alcohol tests performed at facilities with *onsite testing laboratories*. The associated costs are calculated as follows:

  $$NUM_{Applicants} \times PER_{Random} \times COST_{Onsite} \times NUM_{Units}$$

- The proposed paragraph increases the number of pre-access drug and alcohol tests performed at facilities with *offsite testing laboratories*. The associated costs are calculated as follows:

  $$NUM_{Applicants} \times PER_{Random} \times COST_{Offsite} \times NUM_{Units}$$

[17] Verification usually requires 1 to 3 business days, depending on whether the given licensee engages in onsite or offsite testing. Although some of the time awaiting verification may be used by applicants for other work-related activities, the analysis assumes that applicants are paid, but unproductive, for a portion of this waiting period.

[18] The incremental savings from this provision will vary by individual program depending on whether the program has onsite testing capabilities or utilizes an offsite HHS-certified testing laboratory.

Parameter	Description
$COST_{Offsite}$	Offsite random drug and alcohol testing cost (as described in assumptions below and in Appendix 2, Exhibit A2-13)
$COST_{Onsite}$	Onsite random drug and alcohol testing cost (as described in assumptions below and in Appendix 2, Exhibit A2-13)
$NUM_{Applicants}$	Annual number of applicants for authorization reinstatement with an interruption of more than 30 days but not more than 365 days per unit (as described in Appendix 2, Exhibit A2-12)
NUM_{Units}	Number of units per program (as described in Appendix 2, Exhibit A2-14)
PER_{Random}	Percentage of $NUM_{Applicants}$ selected for random drug and alcohol testing (as described in assumptions below)

Assumptions:

- Percentage of $NUM_{Applicants}$ selected for random drug and alcohol testing: 1.0%.[19]

- The per-unit cost of an *onsite random drug and alcohol test* includes the following factors:
  (1) travel time of the worker
  (2) collection of drug and alcohol specimens (labor of the collector and the worker, as well as collection materials)
  (3) onsite licensee testing costs per urine specimen for drugs
  (4) labor of FFD manager to process paperwork for negative test results

- The per-unit cost of an *offsite random drug and alcohol test* includes the following factors:
  (1) travel time of the worker
  (2) collection of drug and alcohol specimens (labor of the collector and the worker, as well as collection materials)
  (3) HHS-certified laboratory costs per urine specimen for drugs
  (4) labor of FFD manager to process paperwork for negative test results

Paragraph 26.59(b)

This subparagraph of the proposed rule imposes no incremental cost and affords no saving because it is added to ensure that the administrative withdrawal of an individual's authorization

[19] This figure is calculated by assuming that on any given day, an individual in applicant status has a chance of being selected equivalent to the following: (1 day / 365 days) x required annual testing rate of 50% x number of days in applicant status. The analysis assumed an average applicant status of 7 days. Applicants for reinstatement authorization, however, are likely to have a much shorter review period. Consequently, the analysis likely overstates these costs.

is not recorded as an unfavorable termination. No incremental costs or savings result from this provision, however, because it is based on non-safeguards information requirements imposed by the NRC's Access Authorization Order (AAO) dated January 7, 2003, and published in the Federal Register on January 13, 2003.

Paragraph 26.59(c)

This paragraph of the proposed rule [including subparagraphs 26.59(c)(1) – (3)] addresses reinstatement applicants with an interruption of no more than 30 days and whose last period of authorization was terminated favorably. No incremental costs or savings result from this provision, however, because it is based on non-safeguards information requirements imposed by the NRC's Access Authorization Order (AAO) dated January 7, 2003, and published in the Federal Register on January 13, 2003.

Sensitivity Analysis - Pre-Order Baseline

Relative to the regulations in effect before the NRC issued the AAO, the proposed paragraph indirectly results in incremental costs and savings because it imposes different requirements for the different categories of applicants relative to the requirements of the current rule. The incremental costs and savings associated with these changes are presented and calculated in the subparagraphs below.

Subparagraph 26.59(c)(1)

This paragraph of the proposed rule requires licensees to obtain and review self-disclosures, as described by proposed §26.61, from applicants for reinstatement authorization with an interruption of no more than 30 days. This subparagraph imposes no incremental cost and affords no saving because, under the current rule, applicants for unescorted access are subject to similar self-disclosure requirements under §26.27. In addition, the proposed paragraph does not require licensees and other entities to conduct suitable inquiries on these applicants, as required by the current rule under §26.27. There are no incremental savings from this provision, except under the alternative *Pre-Order Baseline* as discussed below, because it is based on non-safeguards information requirements imposed by the NRC's AAO dated January 7, 2003, and published in the Federal Register on January 13, 2003 (68 FR 1643).

Sensitivity Analysis - Pre-Order Baseline

Relative to the regulations that were in effect before the NRC issued the AAO, the proposed subparagraph, in conjunction with proposed subparagraph 26.61(a)(1), does result in incremental savings. The savings result from provisions that state that previously authorized applicants whose last authorizations were terminated favorably and who have been covered by a behavioral observation and arrest-reporting program throughout the period of interruption do not need to submit self-disclosures to licensees and other entities. The *annual savings per program* result from the *sum* of the following savings:

- The annual savings per program from reduced facility worker labor burden for those applicants for authorization reinstatement who qualify for the self-disclosure relaxation are calculated as follows:

  $NUM_{Applicants}$ x $PER_{Qualify}$ x $HOURS_{Worker}$ x $WAGE_{Worker}$ x NUM_{Units}

- The annual savings per program from reduced clerical personnel labor burden (because fewer self-disclosures submitted by applicants for authorization reinstatement will need to be processed) are calculated as follows:

  $NUM_{Applicants}$ x $PER_{Qualify}$ x $HOURS_{Clerical}$ x $WAGE_{Clerical}$ x NUM_{Units}

Parameter	**Description**
$HOURS_{Clerical}$	Clerical personnel hours saved in a self-disclosure (as described in assumptions below)
$HOURS_{Worker}$	Facility worker hours saved in a self-disclosure (as described in assumptions below)
$NUM_{Applicants}$	Annual number of applicants for authorization reinstatement with an interruption of not more than 30 days per unit (as described in Appendix 2, Exhibit A2-12)
NUM_{Units}	Number of units per program (as described in Appendix 2, Exhibit A2-14)
$PER_{Qualify}$	Percentage of applicants for authorization updates who qualify for the relaxation (as described in assumptions below)
$WAGE_{Clerical}$	Clerical personnel wage rate (as described in Appendix 2, Exhibit A2-11)
$WAGE_{Worker}$	Facility worker wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- Percentage of $NUM_{Applicants}$ who qualify for the relaxation: 50%.
- Facility worker hours saved in a self-disclosure: 0.25 hours per update.
- Clerical personnel hours saved in a self-disclosure: 0.25 hours per update.

In addition to the relaxation discussed above, the proposed subparagraph, like the AAO, but in contrast to the existing rule, allows licensees and other entities to grant authorization reinstatement to applicants with interruptions of not more than 30 days without conducting a suitable inquiry. Under subparagraph 26.27(a)(2) of the current rule, licensees must conduct a

suitable inquiry on all applicants before granting authorization. The *annual savings per program* from not conducting the suitable inquiry on applicants for authorization reinstatement with an interruption of not more than 30 days result from the following:

$$NUM_{Applicants} \times HOURS_{HR} \times WAGE_{HR} \times NUM_{Units}$$

Parameter	**Description**
$HOURS_{HR}$	HR personnel hours saved in suitable inquiries under existing regulations (as described in assumptions below)
$NUM_{Applicants}$	Annual number of applicants for authorization reinstatement with an interruption of not more than 30 days per unit (as described in Appendix 2, Exhibit A2-12)
NUM_{Units}	Number of units per program (as described in Appendix 2, Exhibit A2-14)
$WAGE_{HR}$	HR personnel wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- HR personnel hours saved in suitable inquiries under existing regulations: 1 hour per inquiry.
- Percentage of individuals who have potentially disqualifying FFD information is assumed to be negligible.

Sensitivity Analysis - Industry Practices

As previously noted, existing subparagraph 26.27(a)(1) requires licensees to obtain self-disclosures from applicants before granting authorization reinstatement. Nonetheless, until recently, industry practices were inconsistent with NRC's interpretation of the requirements such that licensees did not consider it a requirement to obtain self-disclosures from applicants for reinstatement who have experienced an interruption of authorization of not more than 30 days. This fraction of licensees (assumed to be 50 percent) should have incurred additional costs to meet current requirements. The *annual costs per program* result from the sum of the following costs:[20]

[20] Based on current industry practices, this cost is expected to accrue to the 50 percent of facilities that have not previously interpreted the current rule as requiring a self-disclosure for applicants with an interruption of authorization of not more than 30 days. NRC believes that the remaining 50 percent of facilities interpret the current FFD rule correctly, so costs for them should not be calculated. However, as the identity of licensees falling within the two groups is not known, this analysis assumes that 100 percent of facilities will incur costs of 50 percent of the calculated amount.

- The annual costs per program for applicants for authorization reinstatement with interruptions of not more than 30 days to submit self-disclosures to comply with self-disclosure requirements are estimated as follows:

  $NUM_{Applicants} \times PER_{Non\text{-}Compliance} \times HOURS_{Worker} \times WAGE_{Worker} \times NUM_{Unit}$

- The annual costs per program for clerical personnel to process additional self-disclosures for applicants for authorization reinstatement with interruptions of not more than 30 days to comply with self-disclosure requirements are estimated as follows:

  $NUM_{Applicants} \times PER_{Non\text{-}Compliance} \times HOURS_{Clerical} \times WAGE_{Clerical} \times NUM_{Unit}$

Parameter	**Description**
$HOURS_{Clerical}$	Clerical personnel hours required to process a self-disclosure (as described in assumptions below)
$HOURS_{Worker}$	Facility worker hours required to complete a self-disclosure (as described in assumptions below)
$NUM_{Applicants}$	Annual number of applicants for authorization reinstatement with an interruption of not more than 30 days per unit (as described in Appendix 2, Exhibit A2-12)
NUM_{Unit}	Number of units per program (as described in Appendix 2, Exhibit A2-14)
$PER_{Non\text{-}Compliance}$	Percentage of cost applied to a given program (as described in assumptions below)
$WAGE_{Clerical}$	Clerical personnel wage rate (as described in Appendix 2, Exhibit A2-11)
$WAGE_{Worker}$	Facility worker wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- Facility worker hours required to complete a self-disclosure: 0.25 hours per self-disclosure.

- Clerical personnel hours required to process self-disclosure: 0.25 hours per self-disclosure.

- Licensees have indicated that 50 percent of licensees do not interpret the current regulation as requiring a self-disclosure for applicants with interruptions of not more than 30 days. Because the analysis cannot identify which facilities are or are not appropriately interpreting the requirement, the analysis assumes that each unit will incur the incremental cost of 50 percent of the activity.

In addition to the incremental activities discussed above, some licensees should have conducted additional suitable inquiries. As previously noted, existing paragraph 26.27(a) of the current rule requires licensees to conduct suitable inquiries on all reinstatement applicants before granting authorization. Nonetheless, until recently, many licensees did not consider it a requirement to conduct suitable inquiries on reinstatement applicants with interruptions of not more than 30 days. This fraction of licensees (assumed to be 50 percent) should have incurred additional costs to conduct suitable inquires in a manner that meets current requirements. The *annual cost per program* to conduct suitable inquiries on applicants for authorization reinstatement with an interruption of not more than 30 days to comply with the existing regulations result from the *sum* of the following costs:[21]

$$NUM_{Applicants} \times PER_{Non\text{-}Compliance} \times HOURS_{HR} \times WAGE_{HR} \times NUM_{Units}$$

Parameter	**Description**
$HOURS_{HR}$	HR personnel hours saved in suitable inquiries under existing regulations (as described in assumptions below)
$NUM_{Applicants}$	Annual number of applicants for authorization reinstatement with an interruption of not more than 30 days per unit (as described in Appendix 2, Exhibit A2-12)
NUM_{Units}	Number of units per program (as described in Appendix 2, Exhibit A2-14)
$PER_{Non\text{-}Compliance}$	Percentage cost applied to a given program (as described in assumptions below)
$WAGE_{HR}$	HR personnel wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- HR personnel hours required to conduct a suitable inquiry under existing regulations: 1 hour per inquiry.

- Licensees have indicated that 50 percent of licensees do not interpret the current regulations as requiring a suitable inquiry to be conducted on applicants with interruptions of not more than 30 days. Because the analysis cannot identify which facilities are or are not appropriately interpreting the requirement, the analysis assumes that each facility will incur 50 percent of the incremental cost of the activity.

[21] Based on current industry practices, this cost is expected to accrue to the 50 percent of facilities that have not previously interpreted the current rule as requiring a suitable inquiry to be conducted for reinstatement applicants with an interruption of not more than 30 days. The remaining 50 percent of facilities interpret the current FFD rule correctly, costs for them should not be calculated. However, because data are not available regarding which specific facilities will incur costs, this analysis assumes that 100 percent of facilities will incur costs of 50 percent of the calculated amount.

In addition to the incremental activities discussed above, some licensees also should have conducted more thorough suitable inquiries. As previously noted, current regulations stipulate that a suitable inquiry must address all employers for whom applicants for authorization reinstatements worked over the past 5 years. Nonetheless, until recently, industry practice was that licensees conducting background investigations did not call those employers for whom an applicant worked for less than 30 days. As a result, the portion of licensees that are interpreting the current rules incorrectly should have incurred an incremental cost to comply with existing requirements for suitable inquiries. The *annual cost per program* to conduct a more thorough suitable inquiry on applicants for authorization reinstatement with an interruption of 5 days or less to comply with the existing regulation result from the following:

$$NUM_{Applicants} \times HOURS_{HR} \times WAGE_{HR} \times NUM_{Units}$$

Parameter	**Description**
$HOURS_{HR}$	Additional HR personnel hours required to conduct suitable inquiries consistent with the existing regulation (as described in assumptions below)
$NUM_{Applicants}$	Annual number of applicants for authorization reinstatement with an interruption of not more than 30 days per unit (as described in Appendix 2, Exhibit A2-12)
NUM_{Units}	Number of units per program (as described in Appendix 2, Exhibit A2-14)
$WAGE_{HR}$	HR personnel wage rate (as described in Appendix 2, Exhibit A2-11)

Assumption:

- Additional HR personnel hours required to conduct suitable inquires consistent with the existing regulation: 10 minutes (i.e., a 20-percent increase over the current estimate of 50 minutes per applicant).

Paragraph 26.59(c)(2)

This subparagraph of the proposed rule requires licensees and other entities to administer pre-access drug and alcohol testing on all applicants with an interruption of more than 5 days but not more than 30 days in accordance with proposed §26.65. This paragraph imposes no incremental cost and affords no saving because, under the current rule, applicants for unescorted access are subject to similar drug and alcohol testing requirements under paragraph 26.24(a). The proposed paragraph does, however, allow licensees and other entities to forego the pre-access testing requirement for those applicants with an interruption of 5 days or less. There are no incremental savings from this provision, except under the alternative Pre-Order Baseline as discussed below, because it is based on non-safeguards information requirements imposed by the NRC's AAO dated January 7, 2003, and published in the Federal Register on January 13, 2003 (68 FR 1643).

Sensitivity Analysis - Pre-Order Baseline

Relative to the regulations that were in effect before the NRC issued the AAO, the proposed subparagraph, does result in incremental savings. The proposed subparagraph, like the AAO, but in contrast to the existing rule, allows licensees to grant authorization reinstatement to applicants with interruptions of 5 days or less without administering a pre-access drug and alcohol test. According to §26.24 of the current rule as well as guidance provided by the NRC in NUREG-1385, "Fitness for Duty in the Nuclear Power Industry: Responses to Implementation Questions," licensees currently may not grant authorization without administering a drug and alcohol test and verifying negative test results. The *annual savings per program* associated with the administration of fewer pre-access drug and alcohol tests results from the *sum* of the following savings:[22]

- The annual savings per program from not administering a pre-access drug and alcohol test on applicants for authorization reinstatement with an interruption of 5 days or less are calculated as follows:

  - Pre-access drug and alcohol tests need not be performed at facilities with onsite testing laboratories. The associated savings are estimated as follows:

    $NUM_{Applicants} \times COST_{Onsite} \times NUM_{Units}$

  - Pre-access drug and alcohol tests need not be performed at facilities with offsite testing laboratories. The associated savings are calculated as follows:

    $NUM_{Applicants} \times COST_{Offsite} \times NUM_{Units}$

- The annual savings per program from bypassing required worker labor in the administration of a pre-access drug and alcohol tests for applicants for authorization reinstatement with an interruption of 5 days or less are calculated as follows:

  - The proposed paragraph reduces the number of hours of lost worker productivity awaiting negative test result verification from *onsite testing laboratories*. The associated savings are calculated as follows:

    $NUM_{Applicants} \times HOURS_{Onsite\ Worker} \times WAGE_{Worker} \times NUM_{Units}$

[22] The incremental savings from this provision will vary per individual program depending on whether the program has onsite testing capabilities or utilizes an offsite HHS-certified testing laboratory.

- The proposed paragraph reduces the number of hours of lost worker productivity awaiting negative test result verification from *offsite testing laboratories*. The associated savings are calculated as follows:

$$NUM_{Applicants} \times HOURS_{Offsite\ Worker} \times WAGE_{Worker} \times NUM_{Units}$$

Parameter	**Description**
$COST_{Offsite}$	Offsite pre-access drug and alcohol testing cost (as described in assumptions below and in Appendix 2, Exhibit A2-13)
$COST_{Onsite}$	Onsite pre-access drug and alcohol testing cost (as described in assumptions below and in Appendix 2, Exhibit A2-13)
$HOURS_{Offsite\ Worker}$	Hours of facility worker time at a unit with offsite testing laboratories awaiting a negative test verification and not working under the existing rule (as described in assumptions below)
$HOURS_{Onsite\ Worker}$	Hours of facility worker time at a unit with onsite testing laboratories awaiting a negative test verification and not working under the existing rule (as described in assumptions below)
$NUM_{Applicants}$	Annual number of applicants for authorization reinstatement with an interruption of 5 days or less per unit (as described in Appendix 2, Exhibit A2-12)
NUM_{Units}	Number of units per program (as described in Appendix 2, Exhibit A2-14)
$WAGE_{Worker}$	Facility worker wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- Hours of facility worker time at a unit with onsite testing laboratories awaiting negative test verification and not working under the existing rule: 4 hours per reinstatement.[23]

- Hours of facility worker time at a unit with offsite testing laboratories awaiting negative test verification and not working under the existing rule: 8 hours per reinstatement.

- The per-unit cost of an *onsite pre-access drug and alcohol test* includes the following factors:
  (1) travel time of the worker
  (2) collection of drug and alcohol specimens (labor of the collector and the worker, as well as collection materials)

[23] Verification usually requires 1 to 3 business days, depending on whether the given licensee engages in onsite or offsite testing. Although some of the time awaiting verification may be used by applicants for other work-related activities, the analysis assumes that applicants are paid, but unproductive, for a portion of this waiting period.

(3) onsite licensee testing costs per urine specimen for drugs
(4) labor of FFD manager to process paperwork for negative test results

- The per-unit cost of an *offsite pre-access drug and alcohol test* includes the following factors:
  (1) travel time of the worker
  (2) collection of drug and alcohol specimens (labor of the collector and the worker, as well as collection materials)
  (3) HHS-certified laboratory costs per urine specimen for drugs
  (4) labor of FFD manager to process paperwork for negative test results

- Applicants who qualify for the relaxation are not expected to yield positive drug and alcohol test results under the existing regulations.

In addition to the incremental changes discussed above, the subparagraph results in additional pre-order baseline incremental savings. According to §26.24 of the current rule as well as guidance provided by the NRC in NUREG-1385, "Fitness for Duty in the Nuclear Power Industry: Responses to Implementation Questions," licensees could not grant authorization to any applicant without administering a drug and alcohol test and verifying negative test results. Provisions in the proposed subparagraph, however, allow licensees and other entities to forego pre-access drug and alcohol testing on applicants that are either covered by a licensee-approved random drug and alcohol testing program and behavioral observation and arrest-reporting program, or are not randomly selected for a pre-access drug and alcohol test under the requirements of proposed subparagraph 26.59(c)(3) discussed below. As a result, savings accrue from the reduction in the number of pre-access tests administered and the reduction in the loss of worker productivity awaiting negative test results.[24] The *annual savings per program* result from the *sum* of the following savings:[25]

- The annual savings per program from allowing reinstatement applicants who have been covered by a random drug and alcohol testing program and by a behavioral observation and arrest-reporting program throughout the period of interruption to forego the pre-access drug and alcohol test are calculated as follows:

  - The proposed paragraph reduces the number of pre-access drug and alcohol tests performed at facilities with *onsite testing laboratories*. The associated savings are calculated as follows:

$$NUM_{Applicants} \times PER_{Covered} \times COST_{Onsite} \times NUM_{Units}$$

[24] These savings are calculated in replacement of the costs calculated in the main analysis under proposed paragraph 26.59(c)(2).

[25] The incremental savings from this provision will vary by individual program depending on whether the program has onsite testing capabilities or utilizes an offsite HHS-certified testing laboratory.

- The proposed paragraph reduces the number of pre-access drug and alcohol tests performed at facilities with *offsite testing laboratories*. The associated savings are calculated as follows:

  $NUM_{Applicants} \times PER_{Covered} \times COST_{Offsite} \times NUM_{Units}$

- Annual savings per program from bypassing required worker labor in the administration of a pre-access drug and alcohol tests for reinstatement applicants who have been covered by a random drug and alcohol testing program and by a behavioral observation and arrest-reporting program throughout the period of interruption are calculated as follows:

  - The proposed paragraph reduces the number of hours of lost worker productivity at facilities with *onsite testing laboratories*. The associated savings are calculated as follows:

    $NUM_{Applicants} \times PER_{Covered} \times HOURS_{Onsite\ Worker} \times WAGE_{Worker} \times NUM_{Units}$

  - The proposed paragraph reduces the number of hours of lost worker productivity at facilities with *offsite testing laboratories*. The associated savings are estimated as follows:

    $NUM_{Applicants} \times PER_{Covered} \times HOURS_{Offsite\ Worker} \times WAGE_{Worker} \times NUM_{Units}$

- Annual savings per program from allowing reinstatement applicants who have not been covered by a random drug and alcohol testing program and by a behavioral observation and arrest-reporting program throughout the period of interruption, but who have not been randomly selected for pre-access testing, to forego the pre-access drug and alcohol test are calculated as follows:

  - The proposed paragraph reduces the number of pre-access drug and alcohol testing at facilities with *onsite testing laboratories*. The associated savings are calculated as follows:

    $NUM_{Applicants} \times (1\text{-}PER_{Covered}) \times PER_{Not\ Selected} \times COST_{Onsite} \times NUM_{Units}$

  - The proposed paragraph reduces the number of pre-access drug and alcohol tests at facilities with *offsite testing laboratories*. The associated savings are calculated as follows:

    $NUM_{Applicants} \times (1\text{-}PER_{Covered}) \times PER_{Not\ Selected} \times COST_{Offsite} \times NUM_{Units}$

- Annual savings per program from reducing the number of hours of lost worker productivity for reinstatement applicants who are not covered and are not selected for random pre-access drug and alcohol testing are calculated as follows:

  - The proposed paragraph reduces the number of hours of lost worker productivity at facilities with *onsite testing laboratories*. The associated savings are calculated as follows:

    $$NUM_{Applicants} \times (1\text{-}PER_{Covered}) \times PER_{Not\ Selected} \times HOURS_{Onsite\ Worker} \times WAGE_{Worker} \times NUM_{Units}$$

  - The proposed paragraph reduces the number of hours of lost worker productivity at facilities with *offsite testing laboratories*. The associated savings are calculated as follows:

    $$NUM_{Applicants} \times (1\text{-}PER_{Covered}) \times PER_{Not\ Selected} \times HOURS_{Offsite\ Worker} \times WAGE_{Worker} \times NUM_{Units}$$

Parameter	**Description**
$COST_{Offsite}$	Offsite pre-access drug and alcohol testing cost (as described in assumptions below and in Appendix 2, Exhibit A2-13)
$COST_{Onsite}$	Onsite pre-access drug and alcohol testing cost (as described in assumptions below and in Appendix 2, Exhibit A2-13)
$HOURS_{Offsite\ Worker}$	Hours of facility worker time at a unit with offsite testing laboratories awaiting a negative test verification and not working under the existing rule (as described in assumptions below)
$HOURS_{Onsite\ Worker}$	Hours of facility worker time at a unit with onsite testing laboratories awaiting a negative test verification and not working under the existing rule (as described in assumptions below)
$NUM_{Applicants}$	Annual number of applicants for reinstatement authorization with an interruption of more than 5 days but not more than 30 days per unit (as described in Appendix 2, Exhibit A2-12)
NUM_{Units}	Number of units per program (as described in Appendix 2, Exhibit A2-14)
$PER_{Covered}$	Percentage of $NUM_{Applicants}$ covered by a licensee-approved random drug and alcohol testing program and a behavioral observation and arrest-reporting program (as described in assumptions below)
$PER_{Not\ Selected}$	Percentage of qualifying applicants not randomly selected for pre-access drug and alcohol testing (as described in assumptions below)
$WAGE_{Worker}$	Facility worker wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- Percentage of $NUM_{Applicants}$ covered by a licensee-approved random drug and alcohol testing program and a behavioral observation and arrest-reporting program: 50%.

- Percentage of qualifying applicants not randomly selected for pre-access drug and alcohol testing: 97.95%.

- Hours of facility worker time at a unit with onsite testing laboratories awaiting negative test verification and not working under the existing rule: 4 hours per reinstatement.[26]

- Hours of facility worker time at a unit with offsite testing laboratories awaiting negative test verification and not working under the existing rule: 8 hours per reinstatement.

- The per-unit cost of an *onsite pre-access drug and alcohol test* includes the following factors:
  (1) travel time of the worker
  (2) collection of drug and alcohol specimens (labor of the collector and the worker, as well as collection materials)
  (3) onsite licensee testing costs per urine specimen for drugs
  (4) labor of FFD manager to process paperwork for negative test results

- The per-unit cost of an *offsite pre-access drug and alcohol test* includes the following factors:
  (1) travel time of the worker
  (2) collection of drug and alcohol specimens (labor of the collector and the worker, as well as collection materials)
  (3) HHS-certified laboratory costs per urine specimen for drugs
  (4) labor of FFD manager to process paperwork for negative test results

Sensitivity Analysis - Industry Practices

In addition to incremental activities discussed above, some licensees should have administered additional pre-access tests. As previously noted, existing §26.24 of the current rule requires licensees to administer pre-access drug and alcohol tests on all reinstatement applicants before

[26] Verification usually requires 1 to 3 business days, depending on whether the given licensee engages in onsite or offsite testing. Although some of the time awaiting verification may be used by applicants for other work-related activities, the analysis assumes that applicants are paid, but unproductive, for a portion of this waiting period.

granting authorization. Nonetheless, until recently, many licensees did not consider it a requirement to administer pre-access drug and alcohol tests on reinstatement applicants with interruptions of 30 days or less. This fraction of licensees (assumed to be 50 percent) should have incurred additional costs to administer pre-access drug and alcohol tests in a manner that meets current requirements. The *annual costs per program* to comply with pre-access drug and alcohol testing requirements for applicants with interruptions of not more than 30 days result from the *sum* of the following costs:[27]

- The annual costs per program to administer additional pre-access drug and alcohol tests are calculated as follows:[28]
  - Additional pre-access drug and alcohol tests need to be performed at facilities with onsite testing laboratories. The associated costs are calculated as follows:

    $$NUM_{Applicants} \times PER_{Compliance} \times COST_{Onsite} \times NUM_{Units}$$

  - Additional pre-access drug and alcohol tests need to be performed at facilities with offsite testing laboratories. The associated costs are calculated as follows:

    $$NUM_{Applicants} \times PER_{Compliance} \times COST_{Offsite} \times NUM_{Units}$$

- The annual costs per program from increased lost worker productivity awaiting verification of negative test results are calculated as follows:
  - Additional hours of lost worker productivity awaiting negative test result verification from *onsite testing laboratories* will be expended. The associated savings are calculated as follows:

    $$NUM_{Applicants} \times PER_{Compliance} \times HOURS_{Onsite\ Worker} \times WAGE_{Worker} \times NUM_{Units}$$

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[27] Based on current industry practices, this cost is expected to accrue to the 50 percent of facilities that have not previously interpreted the current rule as requiring a pre-access drug and alcohol test to be administered for reinstatement applicants with an interruption of not more than 30 days. The remaining 50 percent of facilities interpret the current FFD rule correctly, so costs for them should not be calculated. However, because data are not available regarding which specific facilities will incur costs, this analysis assumes that 100 percent of facilities will incur costs of 50 percent of the calculated amount.

[28] The incremental savings from this provision will vary per individual program depending on whether the program has onsite testing capabilities or utilizes an offsite HHS-certified testing laboratory.

- Additional hours of lost worker productivity awaiting negative test result verification from *offsite testing laboratories* will be expended. The associated savings are calculated as follows:

$$NUM_{Applicants} \times PER_{Compliance} \times HOURS_{Offsite\ Worker} \times WAGE_{Worker} \times NUM_{Units}$$

Parameter	**Description**
$COST_{Offsite}$	Offsite pre-access drug and alcohol testing cost (as described in assumptions below and in Appendix 2, Exhibit A2-13)
$COST_{Onsite}$	Onsite pre-access drug and alcohol testing cost (as described in assumptions below and in Appendix 2, Exhibit A2-13)
$HOURS_{Offsite\ Worker}$	Hours of facility worker time at a unit with offsite testing laboratories awaiting a negative test verification and not working under the existing rule (as described in assumptions below)
$HOURS_{Onsite\ Worker}$	Hours of facility worker time at a unit with onsite testing laboratories awaiting a negative test verification and not working under the existing rule (as described in assumptions below)
$NUM_{Applicants}$	Annual number of applicants for authorization reinstatement with an interruption of not more than 30 days per unit (as described in Appendix 2, Exhibit A2-12)
NUM_{Units}	Number of units per program (as described in Appendix 2, Exhibit A2-14)
$PER_{Compliance}$	Percentage cost applied to a given program (as described in assumptions below)
$WAGE_{Worker}$	Facility worker wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- Hours of facility worker time at a unit with onsite testing laboratories awaiting negative test verification and not working under the existing rule: 4 hours per reinstatement.[29]

- Hours of facility worker time at a unit with offsite testing laboratories awaiting negative test verification and not working under the existing rule: 8 hours per reinstatement.[30]

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[29] Verification usually requires 1 to 3 business days, depending on whether the given licensee engages in onsite or offsite testing. Although some of the time awaiting verification may be used by applicants for other work-related activities, the analysis assumes that applicants are paid, but unproductive, for a portion of this waiting period.

[30] Verification usually requires 1 to 3 business days, depending on whether the given licensee engages in onsite or offsite testing. Although some of the time awaiting verification may be used by applicants for other work-related activities, the analysis assumes that applicants are paid, but unproductive, for a portion of this waiting period.

- The per-unit cost of an *onsite pre-access drug and alcohol test* includes the following factors:
  (1) travel time of the worker
  (2) collection of drug and alcohol specimens (labor of the collector and the worker, as well as collection materials)
  (3) onsite licensee testing costs per urine specimen for drugs
  (4) labor of FFD manager to process paperwork for negative test results

- The per-unit cost of an *offsite pre-access drug and alcohol test* includes the following factors:
  (1) travel time of the worker
  (2) collection of drug and alcohol specimens (labor of the collector and the worker, as well as collection materials)
  (3) HHS-certified laboratory costs per urine specimen for drugs
  (4) labor of FFD manager to process paperwork for negative test results

- Licensees have indicated that 50 percent of licensees do not interpret the current regulations as requiring a pre-access drug and alcohol test to be administered on applicants with interruptions of 30 days or less. Because the analysis cannot identify which facilities are or are not appropriately interpreting the requirement, the analysis assumes that each unit will incur 50 percent of the incremental cost of the activity.

Subparagraph 26.59(c)(3)

This subparagraph of the proposed rule adds provisions that require licensees and other entities to include applicants for reinstatement authorization with an interruption of not more than 30 days in a random drug and alcohol testing pool, in accordance with proposed §26.67. Licensees are expected to use the same random testing pool for this purpose as is specified under subparagraph
26.31(d)(2) of the proposed rule. Licensees and other entities must administer a drug and alcohol test on those applicants randomly selected although verification of results does not delay the granting of authorization.

The *annual costs per program* to conduct additional random drug and alcohol tests on reinstatement applicants selected for random testing are calculated as follows:[31]

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[31] The incremental costs of this provision will vary by individual program depending on whether the program has onsite testing capabilities or utilizes an offsite HHS-certified laboratory.

- The proposed paragraph increases the number of random drug and alcohol tests performed at facilities with *onsite testing laboratories*. The associated costs are estimated as follows:

  $NUM_{Applicants} \times PER_{Random} \times COST_{Onsite} \times NUM_{Units}$

- The proposed paragraph increases the number of random drug and alcohol tests performed at facilities with *offsite testing laboratories*. The associated costs are estimated as follows:

  $NUM_{Applicants} \times PER_{Random} \times COST_{Offsite} \times NUM_{Units}$

Parameter	**Description**
$COST_{Offsite}$	Offsite random drug and alcohol testing cost (as described in assumptions below and in Appendix 2, Exhibit A2-13)
$COST_{Onsite}$	Onsite random drug and alcohol testing cost (as described in assumptions below and in Appendix 2, Exhibit A2-13)
$NUM_{Applicants}$	Annual number of applicants for authorization reinstatement with an interruption of not more than 30 days per unit (as described in Appendix 2, Exhibit A2-12)
NUM_{Units}	Number of units per program (as described in Appendix 2, Exhibit A2-14)
PER_{Random}	Percentage of $NUM_{Applicants}$ selected for random drug and alcohol testing (as described in assumptions below)

Assumptions:

- Percentage of $NUM_{Applicants}$ selected for random drug and alcohol testing: 1.0%.[32]

- The per-unit cost of an *onsite random drug and alcohol test* includes the following factors:
  (1) travel time of the worker
  (2) collection of drug and alcohol specimens (labor of the collector and the worker, as well as collection materials)
  (3) onsite licensee testing costs per urine specimen for drugs
  (4) labor of FFD manager to process paperwork for negative test results

[32] This figure is calculated by assuming that on any given day, an individual in applicant status has a chance of being selected equivalent to the following: (1 day / 365 days) x required annual testing rate of 50% x number of days in applicant status. The analysis assumes an average applicant status of 7 days. Applicants for reinstatement authorization, however, are likely to have a much shorter review period. Consequently, the analysis likely overstates these costs.

- The per-unit cost of an *offsite random drug and alcohol test* includes the following factors:
  (1) travel time of the worker
  (2) collection of drug and alcohol specimens (labor of the collector and the worker, as well as collection materials)
  (3) HHS-certified laboratory costs per urine specimen for drugs
  (4) labor of FFD manager to process paperwork for negative test results

Paragraph 26.59(d)

This paragraph of the proposed rule requires licensees and other entities to take the management action specified in proposed §26.69 when potentially disqualifying FFD information is disclosed or discovered for an applicant for reinstatement authorization. This paragraph imposes no incremental cost and affords no saving because, under §26.27 of the current rule, applicants for unescorted access are subject to similar requirements. These management actions are further discussed in relevant sections of the analysis.

26.61 Self-Disclosure and Employment History

Paragraph 26.61(a)

This paragraph of the proposed rule requires that licensees obtain a self-disclosure and employment history from all applicants for authorization before authorization may be granted. Under the current rule, licensees are required to obtain an equivalent "written statement" from these applicants under subparagraph 26.27(a)(1).

Subparagraphs 26.61(a)(1)–(2)

These paragraphs of the proposed rule add provisions that allow licensees to forego the self-disclosure requirement for those applicants who have previously held authorization, had their previous termination terminated favorably, and have been covered by a licensee-approved behavioral observation and arrest-reporting program throughout the period of interruption. Additionally, those applicants who have had their authorizations terminated favorably within the last 30 days, regardless of whether they were covered by a behavioral observation and arrest-reporting program, need not submit an employment history. For applicants for updated or reinstated authorization, there is no incremental cost or saving due to this provision because this proposed paragraph is based on non-safeguards information requirements imposed by the NRC's AAO dated January 7, 2003, and published in the Federal Register on January 13, 2003 (68 FR 1643). For applicants for initial authorization, however, this represents a relaxation over the current rule. Savings associated with this provision are calculated under subparagraph 26.55(a)(1).

Sensitivity Analysis - Pre-Order Baseline

Relative to the regulations that were in effect before the NRC issued the AAO, the proposed paragraph does result in incremental savings relative to the current rule. Savings associated with this provision are calculated and discussed in the *Sensitivity Analysis - Pre-Order Baseline* under §§26.57 and 26.59.

Paragraph 26.61(b)

Subparagraphs 26.61(b)(1)–(3)

These subparagraphs of the proposed rule describe the types of events and the time period that must be addressed in the self-disclosure. The disclosure of most of this information already is required under subparagraphs 26.27(a)(1) and (2) of the current rule. Although the proposed paragraphs include additional information disclosure requirements and allow individuals to address only events that have occurred within the past 5 years, rather than all relevant events that have ever occurred, there is no incremental cost or saving due to these added provisions (discussed below) because this proposed paragraph is based on non-safeguards information requirements imposed by the NRC's Access Authorization Order dated January 7, 2003, and published in the Federal Register on January 13, 2003 (68 FR 1643).

Sensitivity Analysis Note - Pre-Order Baseline

Relative to the regulations that were in effect before the NRC issued the AAO, these proposed paragraphs do result in incremental changes. The reduction in the time period within which events must be disclosed on the self-disclosure may reduce the amount of applicant time required to complete one. Simultaneously, however, the additional events that must be reported (i.e., any legal or employment action taken for alcohol or drug use) may increase the amount of time required to complete a self-disclosure. The analysis assumes that the two incremental changes offset each other, thereby resulting in no discernable net incremental costs or savings.

Paragraph 26.61(c)

This paragraph of the proposed rule requires applicants for authorization to submit an employment history report for verification during the suitable inquiry. This paragraph imposes no incremental cost and affords no saving because, under the current rule and guidance contained in NUMARC 89-01: Industry Guidelines for Nuclear Power Plant Access Authorization Programs, applicants already must submit an employment history. The proposed paragraph does reduce the scope of the employment history from the past 5-years under current regulations to the shortest of (1) the past 3 years; (2) since the individual's eighteenth birthday; or (3) since authorization was last terminated, if authorization was terminated favorably. This provision, however, is based on non-safeguards information requirements imposed by the NRC's Access Authorization Order dated January 7, 2003, and published in the Federal Register on January 13, 2003 (68 FR 1643).

Sensitivity Analysis Note - Pre-Order Baseline

Relative to the regulations that were in effect before the NRC issued the AAO, the proposed paragraph does not result in incremental costs or savings. These proposed paragraphs adopt provisions that reduce the period of time that an individual must address in an employment history. This reduction, however, is not anticipated to result in any significant reductions in the amount of labor required to fill out an employment history and, therefore, no savings result.

Paragraph 26.61(d)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it merely allows certain management actions in the event of falsification of or failure to disclose information. These provisions are already included in subparagraph 26.27(a)(4) of the current rule (as well as the NRC's AAO).

26.63 Suitable Inquiry

Paragraph 26.63(a)

This subparagraph of the proposed rule [including subparagraphs 26.63(a)(1)–(3)] imposes no incremental cost and affords no saving because it merely requires licensees and other entities to conduct a suitable inquiry on the self-disclosures submitted by applicants for authorization in order to verify the information contained therein and to determine whether any potentially disqualifying FFD information exists. Under the current rule, applicants for unescorted access are subject to similar suitable inquiry requirements under §26.27. The proposed provision also adds a provision that allows licensees and other entities to forego the suitable inquiry requirement on those applicants who have previously held authorization, had that authorization terminated favorably, and who have been covered by a licensee-approved behavioral observation and arrest-reporting program throughout the period of interruption. This provision, however, is based on non-safeguards information requirements imposed by the NRC's Access Authorization Order dated January 7, 2003, and published in the Federal Register on January 13, 2003 (68 FR 1643).

Sensitivity Analysis Note - Pre-Order Baseline

Relative to the regulations that were in effect before the NRC issued the AAO, the proposed paragraph does result in incremental savings relative to the current rule. Savings associated with this provision are calculated and discussed as appropriate in the *Sensitivity Analysis - Pre-Order Baseline* under §§26.57 and 26.59.

Paragraph 26.63(b)

This paragraph of the proposed rule allows licensees to rely upon information gathered by other licensees and other entities for previous periods of authorization for the purpose of completing suitable inquiries and determinations of fitness. Although this represents a relaxation of the existing regulations, there is no incremental savings because this proposed paragraph is based on non-safeguards information requirements imposed by the NRC's Access Authorization Order dated January 7, 2003, and published in the Federal Register on January 13, 2003 (68 FR 1643).

Sensitivity Analysis - Pre-Order Baseline

Relative to the regulations that were in effect before the NRC issued the AAO, the proposed paragraph does not result in incremental costs or savings because licensees have indicated that they were already sharing information extensively and relying on such information to complete suitable inquiries, as noted in NRC guidance in NUREG-1600, "Revision to the NRC Enforcement Policy" (per 67 FR 66311, October 31, 2002).

Paragraph 26.63(c)

This paragraph of the proposed rule [including subparagraphs 26.63(c)(1)–(3)] imposes no incremental cost and affords no saving because it merely clarifies the manner in which licensees must conduct a suitable inquiry for periods of claimed employment, military service, and education (in lieu of employment). Existing provisions under subparagraph 26.27(a)(2) of the current rule require a suitable inquiry, but do not explicitly describe how licensees should conduct the suitable inquiry. The analysis assumes that licensees are already conducting suitable inquiries in a manner similar to that described in the proposed rule, although the proposed rule more explicitly describes the required process.

Paragraph 26.63(d)

This paragraph mandates that licensees and other entities, when presented with a signed release by the individual in question, must share information regarding a denial of authorization or unfavorable termination with other licensees and other entities for the purpose of conducting a suitable inquiry. This paragraph imposes no incremental cost and affords no saving because licensees have indicated that they already share information, as noted in the NRC guidance in NUREG-1600, "Revision to the NRC Enforcement Policy" (per 67 FR 66311, October 31, 2002). In addition, the proposed requirement states that an individual's refusal to authorize the release of information for the suitable inquiry can be grounds for denial of authorization (although it does not require denial).

Paragraph 26.63(e)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it merely clarifies the media (i.e., telephone, email, facsimile) that licensees may use to conduct a suitable inquiry. The proposed paragraph also requires licensees to make a written record of any suitable inquiry conducted over the telephone. Licensees must maintain such records (along with other documents and electronic files) in accordance with the recordkeeping requirements of the proposed rule. No costs are calculated for this provision because paragraph 26.71(a) of the current rule already requires licensees to retain records of suitable inquiries.

Paragraph 26.63(f)

Subparagraph 26.63(f)(1)

This paragraph of the proposed rule defines the scope of suitable inquiries conducted on applicants for initial authorization. The suitable inquiry must address the past 3-year period or since the applicants eighteenth birthday, whichever is shorter. The suitable inquiry must address every employer the applicant identified as having worked for during the 1-year period immediately preceding the application for authorization. For the remaining 2-year period, the suitable inquiry must address the employer for whom the applicant identified as having worked for the longest in each calendar month, if applicable. There is no incremental cost or saving due to this provision because this proposed paragraph is based on non-safeguards information requirements imposed by the NRC's Access Authorization Order dated January 7, 2003, and published in the Federal Register on January 13, 2003 (68 FR 1643).

Sensitivity Analysis - Pre-Order Baseline

Relative to the regulations that were in effect before the NRC issued the AAO, the proposed paragraph does result in incremental savings relative to the current rule. Savings associated with this provision are calculated and discussed in the *Sensitivity Analysis - Pre-Order Baseline* for subparagraph 26.55(a)(2).

Subparagraph 26.63(f)(2)

This paragraph of the proposed rule defines the scope of suitable inquiries conducted on applicants for updated authorization. The suitable inquiry must address the period since authorization was last terminated. The suitable inquiry must address every employer the applicant identified as having worked for during the 1-year period immediately preceding the application for authorization. For each remaining calendar month in the period since authorization was terminated, the suitable inquiry must address the employer for whom the applicant identified as having worked for the longest, if applicable. There is no incremental cost or saving due to this provision because this proposed paragraph is based on non-safeguards information requirements imposed by the NRC's Access Authorization Order dated January 7, 2003, and published in the Federal Register on January 13, 2003 (68 FR 1643).

Sensitivity Analysis - Pre-Order Baseline

Relative to the regulations that were in effect before the NRC issued the AAO, the proposed paragraph does result in incremental savings relative to the current rule. Savings associated with this provision are calculated and discussed in the *Sensitivity Analysis - Pre-Order Baseline* for subparagraph 26.57(a)(2).

Subparagraph 26.63(f)(3)

This paragraph of the proposed rule defines the scope of suitable inquiries conducted on applicants for authorization reinstatement after an interruption of more than 30 days. The suitable inquiry must address the period since authorization was last terminated. The suitable inquiry must address the applicant's current employer. In addition, for each calendar month since authorization was terminated, the suitable inquiry must address the employer whom the applicant identified as having worked the longest for, if applicable. There is no incremental cost or saving due to this provision because this proposed paragraph is based on non-safeguards information requirements imposed by the NRC's Access Authorization Order dated January 7, 2003, and published in the Federal Register on January 13, 2003 (68 FR 1643).

Sensitivity Analysis - Pre-Order Baseline

Relative to the regulations that were in effect before the NRC issued the AAO, the proposed paragraph does result in incremental savings relative to the current rule. Savings associated with this provision are calculated and discussed in the *Sensitivity Analysis - Pre-Order Baseline* for subparagraph 26.59(c)(2).

26.65 Pre-Access Drug and Alcohol Testing

Paragraph 26.65(a)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it describes the purpose of this section as containing the pre-access testing requirements for granting authorization. The current rule already requires pre-access testing under subparagraph 26.24(a)(1).

Paragraph 26.65(b)

This paragraph of the proposed rule allows licensees and other entities to forego the pre-access drug and alcohol testing requirement for those applicants who have had negative test results from a drug and alcohol test performed in accordance with this part within the 30-day period ending the day authorization is granted or denied. Although this provision is based on existing subparagraph 26.24(a)(1) of the current rule, the proposed subparagraph reduces the period within which a previous drug and alcohol test will be accepted from 60 to 30 days. There is no incremental cost or saving due to this provision because this proposed paragraph is based on

non-safeguards information requirements imposed by the NRC's AAO dated January 7, 2003, and published in the Federal Register on January 13, 2003 (68 FR 1643).

Sensitivity Analysis - Pre-Order Baseline

Relative to the regulations that were in effect before the NRC issued the AAO, the proposed paragraphs do not result in any incremental costs. Although the proposed paragraphs adopt provisions from the AAO that reduce the time period within which pre-access drug and alcohol testing must be completed from 60 days under the current rule to 30 days, licensees and other entities are expected to adjust their pre-access testing schedules to accommodate the smaller time frame. The analysis anticipates that this adjustment will not result in any additional costs.

Paragraph 26.65(c)

This paragraph of the proposed rule [including subparagraphs 26.65(c)(1) and (2)] requires licensees to administer a pre-access drug and alcohol test and verify negative results before granting authorization to any applicant for initial authorization (i.e., an applicant who has never been authorized or who has not been authorized within the past 3 years) or for updated authorization (i.e., an applicant with an interruption of more than 365 days, but not more than 3 years). Under the current rule, applicants for unescorted access are subject to similar drug and alcohol testing requirements under 26.24(a). The subparagraphs do, however, adopt provisions from NRC's AAO that allow licensees and C/Vs to forego the pre-access drug and alcohol test requirement for those applicants whose previous authorization had been terminated favorably and who have been covered by licensee-approved behavioral observation and arrest-reporting and random drug and alcohol testing programs throughout the period of interruption or who have had a negative result from a licensee-approved drug and alcohol test within the past 30 days. For applicants for updated authorization, the provision affords no savings except under the alternative Pre-Order Baseline, because it is based on non-safeguards information requirements imposed by the NRC's AAO dated January 7, 2003, and published in the Federal Register on January 13, 2003 (68 FR 1643). For applicants for initial authorization, however, this represents a relaxation relative to the current rule. Savings associated with this provision are calculated under subparagraph 26.55(a)(3).

Sensitivity Analysis - Pre-Order Baseline

Relative to the regulations that were in effect before the NRC issued the AAO, the proposed subparagraph does result in incremental savings relative to the current rule. Savings associated with this provision are calculated and discussed in the *Sensitivity Analysis - Pre-Order Baseline* for proposed paragraph 26.57(a)(3).

Paragraph 26.65(d)

Subparagraph 26.65(d)(1)

This subparagraph of the proposed rule requires licensees to verify results of the pre-access alcohol test and collect a specimen for pre-access drug testing before granting authorization to any reinstatement applicant with an interruption of more than 30 days but no more than 365 days. Verification of negative drug test results must be completed within 5 business days of specimen collection. If verification has not occurred within this time frame, authorization must be administratively withdrawn until negative results have been received. Under the current rule, applicants for unescorted access are subject to similar drug and alcohol testing requirements under 26.24(a), except that licensees must verify negative results of both the drug and alcohol tests before authorization may be granted. The provision affords no savings, however, except under the alternative Pre-Order Baseline, because it is based on non-safeguards information requirements imposed by the NRC's AAO dated January 7, 2003, and published in the Federal Register on January 13, 2003 (68 FR 1643).

Sensitivity Analysis - Pre-Order Baseline

Relative to the regulations that were in effect before the NRC issued the AAO, the proposed subparagraph does result in incremental savings relative to the current rule. Savings associated with this provision are calculated and discussed in the *Sensitivity Analysis - Pre-Order Baseline* for proposed paragraph 26.59(c)(2).

Subparagraph 26.65(d)(2)

This subparagraph of the proposed rule allows licensees to forego the pre-access drug and alcohol testing requirements on applicants for authorization reinstatement with interruptions of more than 30 days but not more than 365 days whose previous authorization had been terminated favorably and who have been covered by licensee-approved behavioral observation and arrest-reporting and random drug and alcohol testing programs throughout the period of interruption, or who have had a negative result from a licensee-approved drug and alcohol test within the past 30 days. For these reinstatement applicants, the provision affords no savings except under the alternative Pre-Order Baseline, because it is based on non-safeguards information requirements imposed by the NRC's AAO dated January 7, 2003, and published in the Federal Register on January 13, 2003 (68 FR 1643).

Sensitivity Analysis - Pre-Order Baseline

Relative to the regulations that were in effect before the NRC issued the AAO, the proposed subparagraph does result in incremental savings relative to the current rule. Savings associated with this provision are calculated and discussed in the *Sensitivity Analysis - Pre-Order Baseline* for proposed paragraph 26.59(a)(3).

Paragraph 26.65(e)

Subparagraph 26.65(e)(1)

This subparagraph of the proposed rule allows licensees to forego the pre-access drug and alcohol tests for applicants for reinstatement authorization with an interruption of 5 days or less. Under paragraph 26.24(a) of the current rule, all applicants for unescorted access are required to be subjected to a pre-access drug and alcohol test before authorization can be granted. The provision affords no savings, however, except under the alternative Pre-Order Baseline, because it is based on non-safeguards information requirements imposed by the NRC's AAO dated January 7, 2003, and published in the Federal Register on January 13, 2003 (68 FR 1643).

Sensitivity Analysis - Pre-Order Baseline

Relative to the regulations that were in effect before the NRC issued the AAO, the proposed paragraphs do result in incremental savings. Savings associated with this provision are calculated and discussed in the *Sensitivity Analysis - Pre-Order Baseline* for proposed subparagraph 26.59(c).

Subparagraph 26.65(e)(2)

Subparagraph 26.65(e)(2)(i) and (iii)

This subparagraph of the proposed rule adds provisions that require licensees and other entities to subject applicants for authorization reinstatement with an interruption of more than 5 days but not more than 30 days to random selection for a pre-access drug and alcohol test at a one-time probability that is equal to or greater than the normal random testing rate specified in proposed subparagraph 26.31(d)(2) calculated for a 30-day period. For applicants randomly selected for pre-access drug and alcohol testing, licensees and other entities must verify negative results of the alcohol test and collect a drug test specimen before granting authorization. Drug test results must be verified within 5 business days of the granting of authorization or authorization must be administratively terminated. Costs associated with this provision are calculated and discussed under 26.59(c)(2).

Subparagraph 26.65(e)(2)(ii)

This subparagraph of the proposed rule adds provisions that allow licensees and other entities to forego the pre-access drug and alcohol testing requirement for those reinstatement applicants with interruptions of more than 5 days but not more than 30 days if not randomly selected. Under paragraph 26.24(a) of the current rule, all applicants for unescorted access are required to be subjected to a pre-access drug and alcohol test before authorization can be granted. The provision affords no savings, however, except under the alternative Pre-Order Baseline, because it is based on non-safeguards information requirements imposed by the NRC's AAO dated January 7, 2003, and published in the Federal Register on January 13, 2003 (68 FR 1643).

Sensitivity Analysis - Pre-Order Baseline

Relative to the regulations that were in effect before the NRC issued the AAO, the proposed paragraphs do result in incremental savings. Savings associated with this provision are calculated and discussed in the *Sensitivity Analysis - Pre-Order Baseline* for proposed subparagraph 26.59(c)(2).

Subparagraph 26.65(e)(3)

This paragraph of the proposed rule adds a provision that allows licensees and other entities to forego the pre-access drug and alcohol testing requirement for those applicants for authorization with an interruption of fewer than 30 days whose previous authorization was terminated favorably and who have been covered by a licensee-approved drug and alcohol testing program that included random testing and a licensee-approved behavioral observation and arrest-reporting program throughout the period of interruption. Under paragraph 26.24(a) of the current rule, all applicants for unescorted access are required to be subjected to a pre-access drug and alcohol test before authorization can be granted. There is no incremental cost or saving due to this provision, however, because this proposed paragraph is based on non-safeguards information requirements imposed by the NRC's AAO dated January 7, 2003, and published in the Federal Register on January 13, 2003 (68 FR 1643).

Sensitivity Analysis - Pre-Order Baseline

Relative to the regulations that were in effect before the NRC issued the AAO, the proposed paragraph does result in incremental savings relative to the current rule. Savings associated with this provision are calculated and discussed in the *Sensitivity Analysis - Pre-Order Baseline* under §26.59(c)(2).

Paragraph 26.65(f)

This paragraph of the proposed rule specifies the time period within which licensees and other entities must collect drug test specimens for pre-access drug and alcohol testing. Although not explicitly stipulated in the current rule, the analysis assumes that licensees and other entities already comply with this requirement. As a result, the proposed paragraph imposes no incremental cost and affords no saving.

Paragraph 26.65(g)

This subparagraph of the proposed rule imposes no incremental cost and affords no saving because it is added to ensure that the administrative withdrawal of an individual's authorization is not recorded as an unfavorable termination.

Paragraph 26.65(h)

This paragraph of the proposed rule [including subparagraphs 26.65(h)(1)–(3)] describes the minimum management actions and sanctions that must be met in the event of a non-negative random drug, validity, or alcohol test after selection during the applicant period. Licensees and other entities are required to either deny authorization [as required by proposed paragraphs 26.75(b), (d), (e)(2), or (g)], terminate authorization if it has been granted [in accordance with proposed paragraphs 26.75(e)(1) or (f)], or grant authorization in accordance with §26.69. No incremental costs are anticipated to result from this proposed paragraph because the management actions are similar to those already required under the current rule.

26.67 Random Drug and Alcohol Testing of Individuals who have Applied for Authorization

Paragraph 26.67(a)

This paragraph of the proposed rule [including subparagraphs 26.67(a)(1) and (2)] adds a requirement for licensees and other entities to subject applicants for authorization to random drug and alcohol testing in accordance with proposed subparagraph 26.31(d)(2) once the licensee collects specimens from an individual for any pre-access testing that may be required under §§26.65 or 26.69. This added provision will result in incremental costs. These costs, however, are presented separately for each applicant type under §§26.55, 26.57, and 26.59.

Subparagraph 26.67(a)(1)

This proposed subparagraph states that licensees and other entities can forego the random drug and alcohol testing requirement presented in proposed paragraph 26.67(a) if authorization is not granted. This requirement imposes no incremental activity relative to the current rule and, therefore, results in no incremental cost or saving.

Subparagraph 26.67(a)(2)

This proposed subparagraph states that if the licensee or other entity, to meet the applicable requirements for pre-access testing, relies upon drug and alcohol testing conducted before the individual applied for authorization from the licensee, the licensee or other entity shall subject the individual to random testing beginning upon arrival at the facility for in-processing. Because this requirement ultimately will not change the time period within which random testing must be conducted, this requirement imposes no incremental cost or saving.

Paragraph 26.67(b)

This paragraph of the proposed rule states that if an individual is selected for random drug and alcohol testing after the requirement for pre-access testing has been meet, the licensee or other entity may grant authorization before test results are verified, provided that they are available

within the time period specified in §26.65 (10 business days). No incremental costs or savings result because licensees already allow access to be granted following the completion of pre-access drug and alcohol testing.

Paragraph 26.67(c)

This paragraph of the proposed rule [including subparagraphs 26.67(c)(1)–(3)] describes the minimum management actions and sanctions that must be met in the event of a non-negative random drug, validity, or alcohol test after selection during the applicant period. Licensees and other entities are required to either deny authorization [as required by proposed paragraphs 26.75(b), (d), (e)(2), or (g)], terminate authorization if it has been granted [as required by proposed paragraphs 26.75(e)(1) or (f)], or grant authorization in accordance with §26.69. No incremental costs are anticipated to result from this proposed paragraph because the management actions are similar to those of current industry practice.

26.69 Authorization with Potentially Disqualifying Fitness-for-Duty Information

Paragraph 26.69(a)

This paragraph of the proposed rule states that the purpose of §26.69 is to define the management actions for granting authorization when potentially disqualifying information has been discovered. Such management actions are defined in subparagraph 26.27(a)(3) of the current rule. In addition, the proposed paragraph allows licensees and other entities to rely on past reviews and determinations of potentially disqualifying FFD information conducted by previous licensees. This proposed provision may result in incremental savings as the number of applicants that require a determination of fitness is likely to decrease. These incremental savings are calculated and presented under subparagraph 26.189(b)(3).

Paragraph 26.69(b)

This paragraph of the proposed rule describes the procedures for licensees and other entities to follow in granting and maintaining authorization for an individual whose authorization was denied for 5 years under §26.75(c), (d), (e)(2), or (f) or terminated unfavorably for a first confirmed positive drug or alcohol test result by a licensee or other entity. This procedure includes a more thorough suitable inquiry than required under proposed paragraph 26.61,[33] a determination of fitness (as required by 26.27(a)(3) of the current rule), verification of negative results of a pre-access drug and alcohol test with collection under direct observation, and completion of or compliance with any follow-up testing program. Although this proposed paragraph includes some new provisions that may require additional labor burden, the analysis assumes that licensees and other entities will rarely hire or grant authorization to individuals

[33] This more thorough suitable inquiry is equivalent to what is currently called for under the existing rule.

with confirmed first positive drug and alcohol test results. Consequently, the requirements impose no added cost or savings.

Paragraph 26.69(c)

This paragraph of the proposed rule describes the procedures for licensees and other entities to follow in granting authorization to an applicant for whom potentially disqualifying FFD information, other than a first confirmed drug or alcohol test result, has been discovered or disclosed. This procedure includes a more thorough suitable inquiry than required under proposed paragraph 26.61, a determination of fitness (as required by 26.27(a)(3) of the current rule) if necessary, verification of negative results of a pre-access drug and alcohol test, and completion of or compliance with any follow-up testing program. Although this proposed paragraph includes some new provisions that may require an additional labor burden, the analysis assumes that licensees and other entities will rarely hire or grant authorization to individuals who have been denied authorization for a period of 5 years. Consequently, the requirements impose no added cost or savings.

Paragraph 26.69(d)

This paragraph of the proposed rule describes the procedures for licensees and other entities to follow in order to maintain authorization of an individual when potentially disqualifying FFD information is discovered or disclosed after authorization has been granted. The procedure requires that the licensee's or other entity's designated reviewing official complete a review of the circumstances associated with the information. Upon the direction of the reviewing official, the appropriate professional (e.g., SAE) must conduct a determination of fitness and verify that the individual is fit to safely and competently perform his or her duties. Authorization may be maintained with the approval of the reviewing official and following the implementation of any recommendations for treatment and followup drug and alcohol testing as well as assurance of compliance with any such recommendations and treatments. The proposed provisions impose no incremental cost and afford no saving because paragraph 26.27(b) of the current rule already requires licensees and other entities to determine whether an individual who is suspected of potential impairment or questionable fitness is fit to safely and competently perform activities required under this part.

Paragraph 26.69(e)

This proposed paragraph [including subparagraphs 26.69(e)(1) and (2)] addresses the transfer of an individual who is in a treatment and follow-up testing plan to a different FFD program. The proposed paragraph will require the receiving licensee to ensure that the treatment and follow-up testing requirements are met. No incremental costs or savings are expected to result from this requirement because the current rule already requires (in subparagraph 26.27(a)(3)) that follow-up testing requirements apply to an individual wherever he or she goes, and as such, this paragraph represents a clarification of existing requirements. The proposed language clarifies that the receiving licensee may take credit for the portion of a follow-up drug and alcohol testing

program that was completed under a previous licensee, and that individuals will not need to start over with follow-up testing when transferring to a new licensee. Although these provisions may result in incremental savings for those licensees who have been hiring such individuals and restarting the follow-up testing program, the analysis does not quantify them given the rarity of situations in which a licensee will chose to hire such individuals.

Paragraph 26.69(f)

This paragraph of the proposed rule describes the sanctions that licensees and other entities must implement in the event that an applicant applying for authorization with potentially disqualifying FFD information receives confirmed non-negative drug, validity, or alcohol test results. In such situations, licensees and other entities are required to either deny authorization or terminate an individual's authorization (if they already have been authorized). These procedures are already contained in paragraph 26.27(b)(2) of the current rule. As a result, the proposed paragraph imposes no incremental costs and affords no savings.

26.71 Maintaining Authorization

Paragraph 26.71(a)

Subparagraph 26.71(a)(1)

This paragraph of the proposed rule states that individual's must comply with licensee and other entity FFD policies in order to maintain authorization. This subparagraph imposes no incremental cost and affords no saving because the current rule already requires individuals to conform to this provision based on the actions that would warrant revocation of the individual's authorization in paragraph 26.27(b) of the current rule.

Subparagraph 26.71(a)(2)

This paragraph of the proposed rule states that individuals must remain subject to an approved drug and alcohol testing program in order to maintain authorization. It imposes no incremental costs and affords no saving because this already is required under §26.24 of the current rule.

Subparagraph 26.71(a)(3)

This proposed paragraph states that individuals must be subject to a behavioral observation program in order to maintain authorization, as required by subparagraph 26.22(a)(4) of the current rule. Incremental costs indirectly related to this provision are addressed in connection with proposed §26.29.

Subparagraph 26.71(a)(4)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because FFD policy training already is required under §26.21 of the current rule. Costs or savings associated with changes to training requirements are calculated and discussed in connection with proposed §26.29.

Paragraph 26.71(b)

This paragraph of the proposed rule adds provisions that require the licensee or other entity to terminate authorization of any authorized individual who for a period of 30 days has not been subject to a licensee-approved FFD program that meets the requirements of this part. The analysis assumes that current industry practice already allows a limited period of time during which authorized individuals may be away from the FFD program to account for vacations and other approved short-term leaves of absence. Therefore, the analysis assumes the proposed paragraph imposes no incremental costs and affords no savings.

Subpart D: Management Actions and Sanctions to be Imposed

26.75 Sanctions

Paragraph 26.75(a)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it merely introduces the subsequent provisions regarding minimum sanctions required in the event of violations of the drug and alcohol provisions of an FFD policy, which are similar to those required by paragraph 26.27(b) of the current rule.

Paragraph 26.75(b)

Licensees may realize incremental savings as a result of this proposed paragraph, which requires licensees to deny authorization permanently to individuals who refuse to be tested or have engaged, or attempted to engage, in subversion of the testing process. This is a new requirement that is not addressed in the current rule. Requiring permanent denial of authorization may prevent, currently and in the future, disputes which require lengthy discussion or questioning of the grounds for denial in such instances. This analysis does not quantify any associated savings, however, because neither refusals nor subversion attempts are common, and data are not available to support a meaningful estimate.

Paragraph 26.75(c)

This paragraph of the proposed rule revises paragraph 26.27(b)(3) of the current rule to require licensees and other entities to deny authorization for a period of at least 5-years if an employee is determined to have been involved in the sale, use, or possession of illegal drugs or the consumption of alcohol within a protected area of any nuclear power plant, within a facility that is licensed to possess or use formula quantities of SSNM, within a transporter's facility or vehicle, or while performing activities that are subject to this part. Although the addition of the consumption of alcohol to this requirement represents a new requirement, no incremental cost or savings is anticipated to result because it is assumed that licensees already impose similar sanctions under their current policies.

Paragraph 26.75(d)

This paragraph of the proposed rule revises the requirements currently located in paragraph 26.27(c) to require licensees and other entities to deny authorization for a period of at least 5 years if an employee resigns or withdraws his application for authorization in anticipation of having their authorization terminated unfavorably as a result of a violation of the drug and alcohol provisions of the FFD policy. Although this is a new requirement, no incremental saving is estimated, even though future authorizing licensees or other entities may realize some savings by avoiding initial processing of these individuals.

Paragraph 26.75(e)

This paragraph revises the requirement currently located in subparagraph 26.27(b)(2) by requiring the presumption that alcohol consumption (in addition to drug use) occurred off-site unless evidence suggests otherwise. Although the addition of the consumption of alcohol to this requirement represents a new requirement, no incremental cost or savings is anticipated to result because it is assumed that licensees already impose similar sanctions under their current policies.

Paragraph 26.75(f)

This paragraph of the proposed rule revises requirements contained in subparagraph 26.27(b)(5) of the current rule. The current rule states that current licensee sanctions for confirmed misuse of alcohol, valid prescription drugs, and over-the-counter drugs must be sufficient to deter such abuse, and therefore it does not apply certain management actions to such misuse specified in this section. The proposed rule removes confirmed alcohol use from this category and specifically applies the management actions in proposed 26.75(e) to such abuse. Although this is a new requirement, the proposed paragraph imposes no incremental cost and affords no saving, however, because it is not a significant change to licensee and other entity policy and because there is no incremental cost or saving associated with 26.75(e).

Paragraph 26.75(g)

This paragraph of the proposed rule requires licensees and other entities to permanently deny authorization to any individual who violates the drug and alcohol provisions of FFD policy after already having a denial of authorization of at least 5 years under paragraphs 26.75(c)–(f). Under the current rule, only a second positive test result, or sale, use, or possession of drugs while on duty can result in a permanent denial of authorization. Although this new requirement may result in additional permanent denials of authorization that will require additional record-keeping activities in conjunction with proposed paragraph 26.213(c), no incremental costs are expected to result because licensees already store records of such violations under §26.71 of the current rule and the incremental activities associated with recording the violation as a permanent denial is anticipated to be negligible. Additionally, the longer 40-year retention period [specified in proposed §26.213(c)], as compared to the 5-year period under the current rule, is not expected to result in incremental costs because the most substantial costs associated with retaining the records (filing, removal) do not change as a result of this proposed paragraph.

Paragraph 26.75(h)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it merely renumbers and revises paragraph 26.24(d)(2) of the current rule. The revisions add terminology to be consistent with the rest of the rule, as well as references to validity testing.

Paragraph 26.75(i)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it merely renumbers and revises paragraph 26.24(d)(2) of the current rule. The revisions add terminology to be consistent with the rest of the rule, as well as references to validity testing.

26.77 Management Actions Regarding Possible Impairment

Paragraph 26.77(a)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it merely states the purpose of the section, which is to describe management actions that licensees and other entities must take when an individual who is subject to this part shows indications of not being fit to safely and competently perform activities within the scope of this part.

Paragraph 26.77(b)

This paragraph of the proposed rule imposes no incremental costs and affords no savings because it merely requires licensees and other entities to take immediate action with drug and alcohol testing if an employee exhibits an indication of possible impairment while performing activities within the scope of this part, as already required under paragraph 26.27(b)(1) of the current rule. The proposed paragraph does, however, add provisions allowing licensees and other entities the option of conducting only an alcohol test (but not a drug test) when the evidence of possible impairment is the smell of alcohol. The analysis has not quantified any incremental savings from this provision. Additionally, the proposed provision requires that observed behaviors or physical conditions suggesting impairment solely from fatigue shall result in a fatigue assessment in accordance with §26.199(e) and (f) rather than a determination of fitness. Additional costs associated with the fatigue assessment are calculated under §26.201 of this analysis.

Paragraph 26.77(c)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it merely renumbers paragraph 26.27(d) of the current rule, which states that licensees must provide escorted access to NRC employees or contractors when there are indications of questionable fitness to perform activities within the scope of this part.

Subpart E: Collecting Specimens for Testing

26.81 Purpose

This section of the proposed rule imposes no incremental cost and affords no saving because it merely explains that Subpart E presents the requirements associated with collecting specimens for drug and alcohol testing.

26.83 Specimens to be collected

Paragraph 26.83(a)

This paragraph of the proposed rule revises the existing requirements in §26.24(g), which specify the types of specimens permitted to be analyzed for alcohol testing. Existing requirements in §26.24(g) of the current rule permit the use of breath specimens for initial and confirmatory alcohol tests and blood specimens for additional confirmatory alcohol testing. The proposed rule eliminates the use of blood specimens for confirmatory alcohol testing which is currently permitted in §2.2(d)(4) in Appendix A to Part 26. The proposed rule adds a new provision permitting the collection of oral fluids (in addition to breath) for initial alcohol tests. The use of oral fluids is a permissive relaxation of the existing rule requirements providing licensees with flexibility in using an alternative specimen testing (saliva) method to conduct initial alcohol testing (see the discussion of §26.91(a) of this analysis). Elimination of blood samples for confirmatory alcohol testing will result in minor licensee savings by eliminating the costs associated with collecting blood specimens from donors, analyzing blood specimens, lost worker productivity, and MRO time to review and communicate blood test results to the worker and FFD management.

The *annual savings per FFD program* are estimated as follows:

$$NUM_{blood} \times [(COST_{blood\ draw} + COST_{blood\ testing}) + (HOURS_{worker} \times WAGE_{worker}) + (HOURS_{MRO} \times WAGE_{MRO})]$$

Parameter	Description
NUM_{blood}	Number of blood tests per FFD program per year under the current rule (as discussed in the assumptions below)
$COST_{blood\ draw}$	Cost per blood test for a phlebotomist/RN to arrive at the onsite collection site and conduct a blood draw (as discussed in Appendix 2, Exhibit A2-13).
$COST_{blood\ testing}$	Cost per blood test for a laboratory to analyze a blood specimen for alcohol (as discussed in Appendix 2, Exhibit A2-13)
$HOURS_{worker}$	Hours of lost worker productivity resulting from receiving a blood test (as discussed in the assumptions below)
$WAGE_{worker}$	Facility worker wage rate (as discussed in Appendix 2, Exhibit A2-13)

Parameter	Description
$HOURS_{MRO}$	Hours of MRO time to review blood test results and communicate the results to the worker and FFD management (as discussed in the assumptions below)
$WAGE_{MRO}$	MRO wage rate (as discussed in Appendix 2, Exhibit A2-13)

Assumptions:

- Number of blood tests per FFD program per year under the current rule: 1.
- Hours of lost worker productivity per test resulting from receiving a blood test includes waiting time for phlebotomist/RN to arrive at the onsite collection site, conduct a blood draw, and complete paperwork: 45 minutes.
- Hours of MRO time to review blood test results and communicate the results to worker and FFD management: 45 minutes.
- Blood specimen is collected at the same collection site where the confirmatory evidential breath testing device (EBT) testing is conducted.

Paragraph 26.83(b)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it clarifies existing requirements which only describe urine specimen collection and urine drug testing. For example, §26.24(f) of Part 26 mandates "urine drug testing" on all specimens. Since no other type of specimen is described in the existing rule language as acceptable alternative for drug testing, this proposed paragraph simply clarifies the existing rule requirements.

26.85 Collector qualifications and responsibilities

Paragraphs 26.85(a) and (b)

Paragraph 26.85(a) addresses urine collector qualifications and training requirements and paragraph 26.85(b) addresses alcohol collector qualifications and training. These proposed paragraphs revise existing requirements in §2.2(d) in Appendix A to Part 26, which addresses training of collection site personnel. The existing requirements specify collector training in maintaining the integrity of the specimen collection and transfer process, donor privacy issues, and appropriate collector conduct. The proposed rule adds requirements that collectors must be knowledgeable about Part 26, as well as the FFD policy and procedures of licensees and other entities, and must keep up to date with urine and alcohol collection procedures. It also requires all collectors to receive qualification training on problem collections and the correction of

problems associated with collections.[1] FFD programs will incur incremental costs associated with conducting one-time collector training classes and the labor costs for all collectors to attend a training class.[2]

The *one-time costs per FFD program* are estimated as follows:

$$NUM_{collectors} \times [(HOURS_{collector\ training} \times WAGE_{collector}) + COST_{training\ course})] \times NUM_{facilities}$$

Parameter	**Description**
$NUM_{collectors}$	Number of collectors per licensee facility (as discussed in the assumptions below)
$HOURS_{collector\ training}$	Length of training course (as discussed in the assumptions below)
$WAGE_{collector}$	Collection site personnel wage rate (as discussed in Appendix 2, Exhibit A2-11)
$COST_{training\ course}$	Cost of a commercial vendor to conduct an onsite collector training course per facility (as discussed in the assumptions below)
$NUM_{facilities}$	Number of facilities in a given FFD program (as discussed in Appendix 2, Exhibit A2-14)

Assumptions:

- Each facility uses a unique collection site.
- Each collector is trained to conduct urine and breath collections.
- Number of collectors per licensee facility: 4.
- Length of training course (includes urine and breath collections): 8 hours.
- Cost of collector training course for a commercial vendor to conduct onsite at a collection site: $1,000.

[1] All urine and breath collectors used by a licensee or other entity's collection site will receive re-training to meet the requirements in §26.85(a) and (b) as well as to receive training on all new collection procedures resulting from the rule revision. Some of the urine collectors at a licensee collection site may be medical professionals, technologists, or technicians who are no longer exempted from the existing rule requirement in §2.2(d)(2) in Appendix A due to the proposed provision in §26.85(c), and thus, may be receiving training for the first time.

[2] The analysis estimates no incremental cost for future training (e.g., due to normal employee turnover) because it is believed that new collectors already receive on-the-job training as part of their normal training activities given that the topics for qualification training are necessary for fulfilling job responsibilities (e.g., completing the custody-and-control form, shy bladder procedures, specimen integrity procedures, donor privacy protections).

Paragraph 26.85(c)

This paragraph of the proposed rule revises the existing requirements in §2.2(d)(2) in Appendix A to Part 26, which permits medical professionals, technologists, and technicians to collect urine specimens without receiving training or demonstrating proficiency in specimen collections, as long as these collectors receive the instructions in §2.2(3) in Appendix A to Part 26 and perform collections in accordance with those instructions. The proposed paragraph adds a requirement that limits the persons excused from the training and demonstration of proficiency requirements for specimen collections to medical professionals, technologists, or technicians who are not employed by the licensee's or other entity's FFD program and whose workplace is not at the licensee's or other entity's facility. This revision will increase the incremental cost per FFD program associated with the training costs for medical professionals, technologists, and technicians who serve as collectors, but who are no longer excused from training. The incremental cost resulting from additional training required under the new provision is discussed in connection with §§26.85(a) and (b).

Paragraph 26.85(d)

This paragraph of the proposed rule revises the existing requirements in §2.7(o)(5) in Appendix A to Part 26, which require licensee testing facility and HHS-certified laboratory personnel to be available to testify in an administrative or disciplinary proceeding against an individual when that proceeding is based on positive breath analysis or urinalysis results reported by the licensee's testing facility or the HHS-certified laboratory. This proposed paragraph extends this requirement to qualified collection site personnel. The analysis estimates no incremental cost or saving will result from this proposed rule provision because the requirement is consistent with existing licensee and collection site actions with respect to personnel appearing for administrative or disciplinary proceedings related to a specimen collection.

26.87 Collection sites

Paragraph 26.87(a)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it merely clarifies existing requirements in §2.4(a) in Appendix A to Part 26, which relate to designated collection sites.

Paragraph 26.87(b)

This paragraph of the proposed rule adds a new requirement that each collection site must provide visual privacy while a donor and collector view the results of a breath alcohol test. The existing requirements in §2.4(g)(8) and §2.4(f) in Appendix A to Part 26 require only that a donor must be permitted to provide a urine specimen in the privacy of a stall or otherwise partitioned area. The proposed requirement is estimated to result in no incremental cost or saving because collection sites that need to modify existing collection procedures to meet this

new requirement can do so using readily available office supplies. For example, a piece of cardboard may be affixed over the EBT readout to prevent anyone other than the collector and donor from viewing test results.

Paragraph 26.87(c)

This paragraph of the proposed rule extends and existing requirement in §2.7(m) in Appendix A to Part 26, which mandates that licensees must include in contracts for collection site services a provision that both NRC and licensees have the authority to conduct unannounced inspections and audits. The proposed paragraph adds a requirement that the provisions in §2.7(m) in Appendix A extend to other entities and their contracts for collection site services. The incremental costs associated with modifying other entity contracts with collection sites is discuss in connection with proposed §26.27(a).

Paragraph 26.87(d)

This paragraph of the proposed rule clarifies existing requirements in §2.4(c) in Appendix A to Part 26 regarding collection site security procedures. The proposed §26.87(d)(2) provides examples of methods that may be used to assure the security of a collection site such as locking doors, using alarms, or visually monitoring the collection site, and clarifies that designated collection sites must be secure at all times. Existing §2.4(c) instructs that "security procedures shall provide for the designated collection site to be secure" while existing requirement in §2.4(c)(1) requires that for specimen collections in a public rest rooms, the rest rooms be posted against access during the collection process. This paragraph of the proposed rule imposes no incremental cost and affords no saving because it clarifies existing requirements by providing examples of methods to secure a collection site, but does not prescribe how the facility is to be secured.

Paragraph 26.87(e)

This section of the proposed rule discusses collection procedures that urine collectors must follow prior to and after a specimen collection to deter and detect instances where a donor attempts to adulterate, dilute, or substitute their urine specimen.

Subparagraph 26.87(e)(1)

This proposed subparagraph amends the existing requirement in §2.4(g)(1) in Appendix A to Part 26, which mandates the addition of toilet bluing agents to the water in the toilet tank in the enclosure where a urine specimen collection is conducted. By contrast, the proposed rule provides added flexibility for collection sites to use coloring agents other than blue (excluding yellow). However, this new provision prohibits the use of any coloring agent that could interfere with drug and validity tests. This paragraph of the proposed rule imposes no incremental cost and affords no saving because many similarly priced coloring agents existing on the market today that can meet the proposed provision. Because collection sites regularly replace coloring agent

stocks as a part of normal business operations, purchasing a coloring agent that does not interfere with drug and validity testing is a choice of product and not price.

Subparagraph 26.87(e)(2)

This proposed subparagraph imposes no incremental cost and affords no saving because it restates an existing requirement in §2.4(g)(1) in Appendix A to Part 26, which requires that sources of water present in an enclosure used for a specimen collection must be secured or monitored to detect and prevent specimen dilution.

Subparagraph 26.87(e)(3)

This proposed subparagraph establishes a new provision under which a urine collector, before each collection, must inspect and secure or remove from the privacy enclosure all chemicals and products that could be used by a donor to adulterate their urine specimen. This proposed subparagraph imposes no incremental cost or saving because it is consistent with existing collection site security procedures.

Paragraph 26.87(f)

This paragraph restates and clarifies existing requirements in §2.4(c)(1)–(2) in Appendix A to Part 26 regarding procedures for collecting urine specimens at locations other than designated collection sites (e.g., public restroom, on-site restroom, hospital examining room). In addition, as described in the subparagraph discussions below, several of the proposed subparagraphs include new provisions. However, no incremental costs or savings will result from the proposed provisions in this paragraph because urine specimen collections at non-designated collection sites are rare events (i.e., they apply to only some post-event tests and some for-cause tests).

Subparagraph 26.87(f)(1)

This subparagraph of the proposed rule adds a new provision to require that either an individual be assigned to prevent unauthorized access to a public restroom being used during a urine collection or that a sign be posted, as already required under §2.4(c)(1) in Appendix A to Part 26. No incremental cost or saving will result from this proposed subparagraph because the new provision is a relaxation, permitting an alternative method to prevent unauthorized access to a public restroom.

Subparagraph 26.87(f)(2)

This subparagraph of the proposed rule revises existing requirement §2.4(g)(10) in Appendix A to Part 26 pertaining to the addition of a toilet bluing agent in the bowl and any accessible toilet tank by the collector who is conducting a specimen collection in a location other than a dedicated collection site. The proposed subparagraph provides added flexibility by permitting collection sites to use coloring agents in addition to blue (excluding yellow) as described in proposed §26.87(e)(1) and clarifies that the urine collector must add a water coloring agent to any accessible source of standing water within the enclosure where a donor is to provide a specimen. No incremental cost or saving is estimated to result from these proposed provisions which provide flexibility in the use additional types of coloring agents, and clarify existing collection practices to add coloring agents to accessible water sources within the privacy enclosure.

Subparagraph 26.87(f)(3)

This subparagraph of the proposed rule amends existing requirements in §2.4(g)(10) of Appendix A to Part 26 regarding the use of a same gender urine collector to accompany a donor into the area used for a specimen collection, if a multi-stalled bathroom is used. If a collector of the same gender is unavailable, the proposed subparagraph provides additional flexibility by adding a provision that permits another person of the same gender who has been instructed in the requirements of proposed Subpart E to assist in the collection. This subparagraph also adds a new requirement that the name of the same gender person must be documented on the custody-and-control form in situations where a same-gender collector is not available. No incremental cost or saving will result from this proposed subparagraph because the new provisions provide an alternative method to existing collection practices at non-dedicated collection sites.

Subparagraph 26.87(f)(4)

This subparagraph of the proposed rule imposes an additional inspection requirement which is not currently included in §2.4(g) of Appendix to Part 26. The new requirement pertains to specimen collections at non-designated collection site. Upon receiving a urine specimen from a donor, the collector must inspect the privacy enclosure where the specimen was provided to ensure that there is no evidence of a donor subversion attempt. This proposed subpargraph also adds a requirement that the collector and not the donor flush the toilet at the completion of a specimen donation. The existing requirements in §2.4(g)(10) permit the donor to flush the toilet under certain circumstances. No incremental cost or saving is estimated to result from this proposed subparagraph due to the rarity of collections at non-dedicated collection sites.

Subparagraph 26.87(f)(5)

This subparagraph of the proposed rule revises existing requirements in §2.4(c)(2) in Appendix A to Part 26 which pertain to urine specimen collections conducted at non-dedicated collection facilities and which direct urine collectors to maintain physical control of donor urine specimens.

The proposed provision relaxes the existing requirement by permitting the collector to designate another individual to maintain custody of the specimen until it is shipped (i.e., in the case of an opposite gender collector who instructs a same gender individual to assist in a urine collection). This subparagraph also requires that, in the case where the collector uses an individual to assist in the collection process, the individual's name must be documented on the custody-and-control form. No incremental cost or saving is estimated to result from this proposed subparagraph due to the rarity of collections at non-dedicated collection sites.

26.89 Preparing to collect specimens for testing

Paragraph 26.89(a)

This paragraph of the proposed rule revises existing requirements in §2.4(g)(3) in Appendix A to Part 26 regarding the actions to take if a donor does not arrive at the collection site for drug and/or alcohol testing. The existing requirement instructs the collection site staff to contact "the appropriate authority to obtain guidance on the action to be taken." The proposed paragraph adds a new requirement that mandates that FFD program management investigate and determine whether the absence or tardiness of a donor is an attempt to subvert the testing process and to take appropriate action when necessary. This revision is believed to be consistent with long-term licensee practice and, therefore, will not result in incremental costs or savings.

Paragraph 26.89(b)

Subparagraphs 26.89(b)(1)–(2)

The proposed subparagraphs revise existing requirements in §2.4(g)(2) in Appendix A to Part 26, which describe the process for identifying a donor before collecting a specimen. Proposed §26.89(b)(1) clarifies existing requirements pertaining to acceptable donor identification. Proposed §26.89(b)(2) now requires (rather than prohibits) a collection to proceed in cases where the donor does not produce acceptable identification, except for pre-access testing. The collector will now proceed with the specimen collection even without positively identifying the donor and will inform FFD program management that the employee could not be positively identified. FFD program management must then investigate the circumstances and determine whether the employee's behavior was an attempt to subvert the testing process. As a result, FFD programs may realize savings related to reduced worker productivity losses because workers will no longer have to leave the collection site, obtain appropriate identification, and return to the collection site for a test. Management time is not expected to change based on whether the manager's investigation occurs prior to or subsequent to the collection, in accordance with the current and proposed rules, respectively.

Subparagraph 26.89(b)(2) also adds a provision prohibiting a specimen collection in these cases if the test is a pre-access test. The analysis estimates no incremental cost or saving will result from this provision due to the rarity of these situations.

The *annual savings per FFD program* resulting from §26.89(b)(2) are estimated as follows:

$$NUM_{selected\ individuals} \times PER_{no\text{-}ID} \times (HOURS_{worker} \times WAGE_{worker}) \times NUM_{units}$$

Parameter	**Description**
$NUM_{selected\ individuals}$	Number of individuals selected for drug and alcohol testing per unit per year (as discussed in the assumptions below and in Appendix 2, Exhibit A2-12)
$PER_{no\text{-}ID}$	Percentage of individuals without identification (as discussed in the assumptions below)
$HOURS_{worker}$	Time a donor without identification would spend to leave the collection site, obtain appropriate identification, and return to the collection site for drug and alcohol testing (as discussed in the assumptions below)
$WAGE_{worker}$	Facility worker wage rate (as discussed in Appendix 2, Exhibit A2-11)
NUM_{units}	Number of units per FFD program (as discussed in Appendix 2, Exhibit A2-14)

Assumptions:

- Number of individuals selected for drug and alcohol testing per unit per year is equivalent to the number of drug tests conducted per unit per year (a drug and alcohol test is conducted each time an individual is tested). This assumes that each individual selected for testing is actually tested.

- Percentage of individuals without identification: 1 percent.
  The analysis assumes only 1 percent because employees subject to FFD program requirements must have identification with them at all times while at a licensed facility and, therefore, cases where an employee does not have adequate identification are rare.

- Time a donor without identification would spend to leave the collection site, obtain appropriate identification, and return to the collection site for drug and alcohol testing: 45 minutes.

- FFD management will incur no incremental costs or savings related to the proposed rule revisions. The analysis assumes that, under the current rule, the collection site notifies FFD management after an employee arrives for a specimen collection without adequate identification, and FFD management investigate the situation with the employee. The proposed rule requires the collection site to contact FFD management after completing a test, but the activities and time required of the FFD management would be similar.

Subparagraph 26.89(b)(3)

This proposed subparagraph restates the existing requirements in §§2.4(g)(4) and (g)(23)(ii) in Appendix A to Part 26 with the exception of the requirement for the collector to direct the donor to list on the chain-of-custody form the prescription medications and over-the-counter (OTC) preparations taken within 30 days prior to their urine specimen collection. This proposed subparagraph now prohibits the donor from listing prescription medications and OTC preparations recently used. This proposed subparagraph also adds a new requirement for the collector to explain the testing procedure to each donor. Each FFD program will recognize incremental savings per urine collection resulting from the reduced time of the collection process due to the elimination of the donor listing medications and OTC preparations on the custody-and-control form. Theses savings are offset to a small extent by the increase in time related to the collector describing the testing process to each donor. Overall, a reduction in lost worker productivity and reduced collector wages will be realized by FFD programs.[3]

The *annual savings per FFD program* are estimated as follows:

$$NUM_{collections} \times [(HOURS_{saved} - HOURS_{added}) \times (WAGE_{worker} + WAGE_{collector})] \times NUM_{units}$$

Parameter	**Description**
$NUM_{collections}$	Number of urine collections per unit per year (as discussed in the assumptions below and in Appendix 2, Exhibit A2-12)
$HOURS_{saved}$	Time saved per average collection because the donor does not list medications on the chain-of-custody form (as discussed in the assumptions below)
$HOURS_{added}$	Time added per average collection for the collector to explain the testing process to the donor (as discussed in the assumption below)
$WAGE_{worker}$	Facility worker wage rate (as discussed in Appendix 2, Exhibit A2-11)
$WAGE_{collector}$	Collection site personnel wage rate (as discussed in Appendix 2, Exhibit A2-11)
NUM_{units}	Number of units per FFD program (as discussed in Appendix 2, Exhibit A2-14)

Assumptions:

- Number of urine collections per unit per year is equal to the number of drug tests per unit per year.

[3] In order to capture total costs and savings, the analysis assumes that savings incurred by any offsite collection sites are passed back to licensees (i.e., through lower costs per collection). This assumption depends on the degree to which the offsite collection site industry is price competitive. To the extent that it is not price competitive, savings will accrue as estimated, but will benefit the offsite collection site rather than licensees (i.e., offsite collection sites will recognize savings in labor costs because of the reduced collection time, but will not reduce the cost per collection charged to the licensee).

- Time saved per average collection because the donor does not list medications on the CCF: 2 minutes.

- Time added per average collection for the collector to explain the testing process to the donor: 45 seconds.

Paragraph 26.89(c)

This paragraph of the proposed rule adds a new requirement directing the collector to inform the donor that leaving the collection site before the collection procedures are completed, or refusing to cooperate with the collection procedures, will be considered as a refusal to test. No incremental cost or saving is estimated to result from this proposed paragraph because providing the directions to the donor will only take seconds per collection, and the number of instances in which a donor will leave the collection site before testing or will refuse to cooperate with the collection process will be very low due to the severity of the consequences.

Paragraph 26.89(d)

This proposed paragraph restates existing requirements in §§2.4(e) in Appendix A to Part 26 which require that a collector only conduct one urine specimen collection at a time and defines when a collection process is complete, that is, when the donor has left the collection site.

26.91 Acceptable devices for conducting initial and confirmatory tests for alcohol and methods of use

Paragraph 26.91(a)

This paragraph of the proposed rule expands the acceptable breath alcohol testing devices beyond the existing requirement in §26.24(g). The proposed paragraph permits for initial tests for alcohol to include NHTSA-certified alcohol screening devices (ASDs), including devices that test specimens of oral fluids or breath, that are on the NHTSA Conforming Products List (CPL). This affords licensees added flexibility in conducting initial tests for alcohol. However, because an EBT compliant with proposed §26.91(c) is required for confirmatory tests, the ability to use ASDs does not eliminate the need for an evidential breath testing device (EBT). The analysis assumes that licensees, in order to simplify their testing and training procedures, will conduct alcohol testing using only EBTs under normal circumstances, and that licensees will use ASDs only when a screening test must be conducted at a non-standard location (e.g., in the case of some post-event tests or possibly some for-cause tests). Because the need to conduct tests at non-standard locations is infrequent, the analysis assumes that any costs associated with the use of ASDs are insignificant to the analysis.

Paragraph 26.91(b)

This paragraph of the proposed rule adds a new requirement that all EBTs used to conduct confirmatory alcohol testing must meet the specific functionalities (e.g., those that provide a printed result for each breath test and test an air blank) as stated in proposed §26.91(c). This proposed paragraph also revises existing requirements in §§26.24(g) and 2.4(g)(18) in Appendix A to Part 26 which mandate the use of two different EBTs for initial versus confirmatory alcohol testing. This proposed paragraph permits licensees to use a single EBT for both initial and confirmatory breath alcohol testing if the EBT meets the specifications in proposed §26.91(c). This proposed paragraph will result in an incremental one time cost for some FFD programs to purchase EBTs (along with necessary calibration equipment) meeting the specifications in §26.91(c) for confirmatory breath alcohol testing, along with the one time cost to train breath alcohol collectors in the use of the new EBTs. Incremental annual costs incurred by FFD programs that purchase EBTs to comply with proposed §26.91(c) will consist of the cost to purchase calibration equipment to conduct quality control checks on the new EBTs.

One time costs per FFD program are estimated as the *sum* of the following*:*

- Purchase EBTs meeting the specifications in proposed §26.91(c):

  $COST_{EBT} \ x \ NUM_{new\ EBTs} \ x \ PER_{purchase\ EBT} \ x \ NUM_{facilities}$

- Purchase a regulator used in calibrating new EBT equipment[4]:

  $COST_{regulator} \ x \ PER_{purchase\ EBT} \ x \ NUM_{facilities}$

- Breath alcohol collector training on use of new EBTs:

  $[COST_{training\ course} + (NUM_{collectors} \ x \ (HOURS_{collector\ training} \ x \ WAGE_{collector}))] \ x \ NUM_{facilities} \ x \ PER_{purchase\ EBT}$

Annual costs per FFD program are estimated as follows:

- Purchase calibration device for new EBTs:

  $COST_{calibration\ device} \ x \ PER_{purchase\ EBT} \ x \ NUM_{facilities}$

[4] A regulator is a piece of equipment used to attach a calibration canister to an EBT in order to conduct quality control checks. One regulator can calibrate multiple EBTs.

Parameter	Description
$COST_{EBT}$	Cost of an EBT compliant with proposed §26.91(c) (as discussed in Appendix 2, Exhibit A2-8)
$NUM_{new\ EBTs}$	Number of new EBTs compliant with proposed §26.91(c) purchased per facility (as discussed below and in Appendix 2, Exhibit A2-8)
$PER_{purchase\ EBT}$	Percentage of collection sites that will purchase an EBT meeting the specifications in proposed §26.91(c) (as discussed in the assumptions below)
$COST_{regulator}$	Cost of purchasing a regulator which attaches the calibration canister to the EBT (as discussed in the assumptions below and in Appendix 2, Exhibit A2-13)
$COST_{training\ course}$	Cost of EBT manufacturer to conduct an onsite training course per collection site (as discussed in the assumptions below)
$NUM_{collectors}$	Number of breath alcohol collectors per collection site (as discussed in Appendix 2, Exhibit A2-8)
$HOURS_{collector\ training}$	Length of training course (as discussed in the assumptions below)
$WAGE_{collector}$	Collection site personnel wage rate (as discussed in Appendix 2, Exhibit A2-11)
$COST_{calibration\ canister}$	Cost of purchasing a calibration canister for quality control checks on new EBTs compliant with proposed §26.91(c) (as discussed in the assumptions below and in Appendix 2, Exhibit A2-13)
$NUM_{facilities}$	Number of facilities per FFD program (as discussed in Appendix 2, Exhibit A2-14)

Assumptions:

- Each facility uses one collection site.
- Percentage of collection sites that will purchase an EBT meeting the specifications in proposed §26.91(c): 50 percent.[5]
- Each collection site that purchases an EBT meeting the specifications in this proposed §26.91(c) will purchase one EBT.

[5] The 50 percent estimate is based on an NEI industry survey (May 2004) in which 21 FFD programs that represent 32 facilities reported on the number of EBTs that would be purchased to meet the proposed requirements in 26.91(c). Of the 32 facilities, 24 facilities had EBTs compliant with proposed §26.91(c) and would not purchase any new equipment. The remaining 8 facilities in the survey reported that 16 new EBTs would be purchased. As an industry, 16 new EBTs would be purchased for the 32 facilities surveyed, or an average of 0.5 EBTs per facility. Therefore, 50 percent of collection sites will purchase one EBT.

- The EBTs purchased by any given collection site will be of the same manufacturer make and model and therefore, only one breath collector training class and only one regulator will be needed.

- Each calibration canister provides enough product to calibrate one EBT for two year of use. The annual cost of the calibration canister is the price of the canister divided by 2 years.

Paragraph 26.91(c)

This paragraph of the proposed rule establishes the required functionalities that an EBT must have to be used to conduct confirmatory alcohol testing. The incremental costs associated with some licensees purchasing EBTs meeting the functionalities in this proposed paragraph are described in §26.91(b). This proposed paragraph also revises the existing requirements in §26.24(g) and §2.4(g)(18) in Appendix A to Part 26 which require the use of different EBTs for initial and confirmatory alcohol tests. This provision provides flexibility for licensees using an EBT meeting the criteria specified in this proposed paragraph by permitting the use of the same EBT for both initial and confirmatory tests. Incremental savings for FFD programs with collection sites that use EBTs meeting the specifications in this proposed paragraph will consist of a reduction in the time between conducting initial and confirmatory breath alcohol tests.

Annual savings per FFD program are estimated as follows:

$$NUM_{confirmatory\ alcohol\ tests} \times PER_{new\ EBT} \times [HOURS_{saved} \times (WAGE_{worker} + WAGE_{collector})] \times NUM_{units}$$

Parameter	Description
$NUM_{confirmatory\ alcohol\ tests}$	Number of confirmatory alcohol tests per unit per year (as discussed in Appendix 2, Exhibit A2-12)
$PER_{new\ EBT}$	Percentage of collection sites that will use an EBT meeting the specifications in proposed paragraph 26.91(c) for both initial and confirmatory alcohol tests (as discussed in the assumptions below)
$HOURS_{saved}$	Time per test to set-up a second EBT (locate the EBT, turn on the equipment) to conduct confirmatory testing as required under the existing requirements in §26.24(g) and §2.4(g)(18) (as discussed in the assumptions below)
$WAGE_{worker}$	Facility worker wage rate (as discussed in Appendix 2, Exhibit A2-11)
$WAGE_{collector}$	Collection site personnel wage rate (as discussed in Appendix 2, Exhibit A2-11)
NUM_{units}	Number of units per FFD program (as discussed in Appendix 2, Exhibit A2-14)

Assumptions:

- Number of confirmatory alcohol tests conducted per unit per year is equivalent to the number of confirmatory positive alcohol test results per unit per year.

- Time per test to set-up a second EBT to conduct confirmatory testing: 2 minutes. If a second EBT is needed, the collector must prepare the second EBT to be used for the confirmatory test.

- Percentage of collection sites that will use an EBT meeting the specifications in proposed paragraph 26.91(c) for both initial and confirmatory alcohol test: 50 percent.

Paragraph 26.91(d)

This proposed paragraph establishes the quality assurance and quality control requirements for ASDs. The proposed paragraph requires that licensees using ASDs must implement the quality assurance plan (QAP) submitted by the manufacturer to NHTSA. No incremental cost or saving is estimated to result from this proposed provision because the use of ASDs provides an alternative to existing requirements for conducting initial alcohol testing.

Paragraph 26.91(e)

This proposed paragraph establishes a new requirement that licensees and other entities implement the quality assurance and quality control requirements for EBTs as described in the most recent quality assurance plan (QAP) submitted by each EBT manufacturer to NHTSA. Adherence to the QAP for an EBT is consistent with existing collection site practices given that the specifications in the QAP are necessary for normal equipment operation and for accurate and defensible results.

26.93 Preparing for alcohol testing

Paragraph 26.93(a)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it clarifies existing requirements in §2.4(g)(18) in Appendix A to Part 26 regarding testing procedures for conducting initial breath alcohol tests, including a mandatory 15 minute waiting period if the donor has consumed any potential sources of mouth alcohol (e.g., breath fresheners) or has ingested or expelled any other substances (e.g., via eating, smoking, regurgitation of stomach contents from vomiting or burping). This paragraph of the proposed rule also adds several requirements as described in the subparagraph discussions below.

Subparagraph 26.93 (a)(1)

This subparagraph of the proposed rule clarifies an existing requirement in §2.4(g)(18) in Appendix A to Part 26. This subparagraph also adds a new requirement for a collector to instruct the donors to avoid eating, drinking, belching, or putting anything in their mouth during the collection process. No incremental cost or saving will result from this proposed subparagraph because this activity will only take seconds to complete.

Subparagraphs 26.93 (a)(2)–(3)

These subparagraphs of the proposed rule clarify existing breath collection requirements in §2.4(g)(18) in Appendix A to Part 26 which directs the collector to proceed with a collection if a donor has not consumed any substance prior to the test. Subparagraph 26.93(a)(3) adds a requirement for the breath collector to inform the donor that a mandatory 15-minute waiting period is necessary to prevent an accumulation of mouth alcohol from leading to an artificially high breath alcohol reading if the donor has consumed a substance (e.g., ate, smoked) or belched prior to a test. No significant incremental cost or saving will result from proposed §26.93(a)(2) as it restates existing requirements, nor from §26.93(a)(3), which requires an activity that will only take seconds to complete.

Subparagraph 26.93(a)(4)

This subparagraph of the proposed rule adds a new requirement to the existing breath collection procedures in §2.4(g)(18) in Appendix A to Part 26. This proposed subparagraph requires that breath alcohol collectors explain to each donor, when needed, that during the mandatory 15-minute waiting period it is to the donor's benefit to avoid the activities described by the collector in §26.93(a)(1). No significant incremental cost or saving will result from this proposed subparagraph because this activity will only take seconds to complete.

Subparagraph 26.93(a)(5)

This subparagraph of the proposed rule adds a new requirement to the existing breath collection procedures in §2.4(g)(18) in Appendix A to Part 26. The new provision adds a requirement for breath alcohol collectors to inform each donor who indicated that they have demonstrated behaviors described in §26.93(a)(1) within 15-minutes before an initial alcohol test, that an initial test (and confirmatory test, when necessary) will be performed at the end of the 15-minute waiting period, even if the donor did not follow the instructions given by the collector during the waiting period. No significant incremental cost or saving will result from this proposed subparagraph because this activity will only take seconds to complete.

Subparagraph 26.93(a)(6)

This subparagraph of the proposed rule adds a new requirement to the existing breath collection procedures in §2.4(g)(18) in Appendix A to Part 26. The new provision requires that breath collectors document that directions regarding the breath alcohol collection process were communicated to each donor. This activity will result in no significant incremental cost or saving because the activity will take only seconds to complete (i.e., the collector notes on the testing form the phrase "instructions given to donor").

Paragraph 26.93(b)

This proposed paragraph adds a new requirement to the existing drug and alcohol testing procedures in §26.24(a)(3). The new provision directs licensees to minimize delays in administering for-cause drug and alcohol tests. This paragraph also adds a requirement that specifies the sequence of specimen testing in for-cause testing situations (i.e., requires alcohol testing be conducted before drug testing). The existing rule does not specify the order that drug and alcohol testing is to be conducted in for-cause testing situations. No incremental cost or saving will result from the proposed paragraph because for-cause drug and/or alcohol testing is already required by the existing requirement in §26.24(a)(3). The proposed paragraph only specifies that delays in testing should be minimized and specifies the sequence for conducting for-cause alcohol and drug testing.

26.95 Conducting an initial test for alcohol using a breath specimen

This proposed section, including paragraphs (a)–(c), revises existing requirements in §2.4(g)(18) in Appendix A to Part 26, which mandate the collection of two breath specimens for each screening alcohol test using an EBT. The tests must be conducted no less than 2 minutes and no more than 10 minutes apart. The proposed §26.95(c) reduces the number of breath specimens collected from two to one unless problems arise. FFD programs will realize a reduction in alcohol testing costs by decreasing the duration of the testing process, reducing equipment costs (using fewer exhalent tubes), decreasing worker productivity losses, and reducing collector labor costs.[6]

The *annual savings per FFD program* resulting from proposed §26.95(c) are estimated as follows:

$$NUM_{alcohol\ tests} \times [HOURS_{saved} \times (WAGE_{worker} + WAGE_{collector}) + COST_{exhalent\ tube}] \times NUM_{units}$$

[6] In order to capture the total costs and savings, the analysis assumes that savings incurred by offsite collection sites are passed back to licensees (i.e., lower costs per collection). This assumption depends on the degree to which the offsite collection site industry is price-competitive. To the extent that it is not price competitive, savings will accrue as estimated, but will benefit the offsite collection site rather than licensees (i.e., offsite collection sites will realize savings in labor costs because of the reduced collection time, but will not reduce the cost per collection charged to licensees).

Parameter	Description
$NUM_{alcohol\ tests}$	Number of alcohol tests per unit per year (as discussed in Appendix 2, Exhibit A2-12)
$HOURS_{saved}$	Reduction in collection time from one fewer breath collection per initial screening test (as discussed in the assumptions below)
$WAGE_{worker}$	Facility worker wage rate (as discussed in Appendix 2, Exhibit A2-11)
$WAGE_{collector}$	Collection site personnel wage rate (as discussed in Appendix 2, Exhibit A2-11)
$COST_{exhalent\ tube}$	Cost per exhalent tube (as discussed in Appendix 2, Exhibit A2-13)
NUM_{units}	Number of units per FFD program (as discussed in Appendix 2, Exhibit A2-14)

Assumptions:

- Reduction in collection time resulting from one fewer breath collection per initial screening test: 2 minutes/60 minutes = 0.033 hours.

- Each breath specimen collection requires a new exhalent tube (i.e., for a screening test under the existing regulations, two exhalent tubes would be used).

26.97 Conducting an initial test for alcohol using a specimen of oral fluids

This proposed section, including paragraphs (a)–(e), establishes collection procedures for conducting initial alcohol tests using ASDs. The existing requirements in §26.24(g) only permits the collection of breath specimens (for initial and confirmatory alcohol tests) and blood specimens (for confirmatory alcohol testing). The use of ASDs provides licensees with flexibility in conducting alcohol testing by allowing for the collection of an alternative specimen type (i.e., saliva) to breath for initial alcohol testing as discussed in proposed §26.91(a).

26.99 Determining the need for a confirmatory test for alcohol

Paragraph 26.99(a)

This paragraph of the proposed rule establishes that a breath alcohol concentration (BAC) of less than 0.02 percent constitutes a negative alcohol test result. This proposed revision modifies existing requirements in §26.24(g) and §2.7(e)(1) in Appendix A to Part 26 which specify that a breath alcohol testing result less than 0.04 is a negative test result. Incremental costs associated with the proposed paragraph are described in the discussion of proposed §26.99(b).

Paragraph 26.99(b)

This paragraph of the proposed rule revises existing requirements in §§26.24(g) and 2.7(e)(1) in Appendix A to Part 26 by reducing the BAC of an initial alcohol test that requires a confirmatory test from 0.04 percent to 0.02 percent. FFD programs will incur incremental costs because of an increase in the number of initial alcohol tests requiring confirmatory testing and the costs of FFD administrative actions resulting from additional confirmed positive alcohol tests. This paragraph also adds a new provision that directs the collector to document the time of the initial breath alcohol test result (if 0.02 percent or greater) and inform the donor that a confirmatory test is required. The requirements to document the time of the test result and notify the employee that a confirmatory test must be performed are consistent with existing collection practices and will result in no incremental cost or saving.

The *annual costs per FFD program* are estimated as follows:

$$(NUM_{IPAT} \times PERI_{IPAT}) \times [(HOURS_{CAT} \times (WAGE_{worker} + WAGE_{collector}) + COST_{exhalent\ tube} + (HOURS_{FFD\ manager} \times WAGE_{FFD\ manager})] \times NUM_{units}$$

Parameter	**Description**
NUM_{IPAT}	Number of initial positive breath alcohol tests (IPAT) per unit per year under the current requirements (as discussed in the assumptions below and in Appendix 2, Exhibit A2-12)
$PERI_{IPAT}$	Percentage increase in the number of initial positive alcohol tests under the proposed lower screening level BAC that remain positive after confirmatory testing (as discussed in the assumptions below)
$HOURS_{CAT}$	Time to conduct a confirmatory alcohol test under the proposed rule (as discussed in the assumptions below)
$WAGE_{worker}$	Facility worker wage rate (as discussed in Appendix 2, Exhibit A2-11)
$WAGE_{collector}$	Collection site personnel wage rate (as discussed in Appendix 2, Exhibit A2-11)
$COST_{exhalent\ tube}$	Cost of an exhalent tube for a confirmatory alcohol test (as discussed in Appendix 2, Exhibit A2-13)
$HOURS_{FFD\ manager}$	Hours of FFD manager time associated with personnel activities and administrative actions resulting from a confirmed positive alcohol test result (as discussed in the assumptions below)
$WAGE_{FFD\ manager}$	FFD management wage rate (as discussed in Appendix 2, Exhibit A2-11)
NUM_{units}	Number of units per FFD program (as discussed in Appendix 2, Exhibit A2-14)

Assumptions:

- Number of initial positive breath alcohol tests (IPAT) per unit per year under the current requirements is assumed to be equal to the number of confirmed positive alcohol tests under the existing rule per unit per year.

- Percentage increase in the number of initial positive breath alcohol tests under the proposed lower screening level BAC that will remain positive after confirmatory testing: 20 percent.

- Time to conduct a confirmatory alcohol test under the proposed rule: 3 minutes.

- Hours of FFD manager time associated with personnel activities and administrative actions resulting from a confirmed positive alcohol test result (i.e., worker notification interview, paperwork, and administrative proceedings: 2.5 hours.

- All initial positive alcohol tests are confirmed positive.

26.101 Conducting a confirmatory test for alcohol

Paragraph 26.101(a)

This paragraph of the proposed rule revises existing requirements in §2.4(g)(18) in Appendix A to Part 26, which relate to confirmatory alcohol testing. The proposed rule will require that a confirmatory alcohol test be conducted as soon as possible following an initial alcohol test result of 0.02 BAC or greater and no later than 30-minutes after the initial test result. This paragraph of the proposed rule is estimated to impose no incremental cost and afford no saving because (even though the current rule does not specify a 30-minute time frame for testing), licensees will still incur testing costs, and the instances when a confirmatory test could not be conducted as soon as possible after an initial breath test are very low (delays in testing would most likely only result from equipment malfunctions which are rare).

Paragraph 26.101(b)

This proposed paragraph establishes collection procedures for conducting a confirmatory alcohol test using an EBT as required in proposed rule provisions in §§26.91(b) and (c). This proposed provision will result in one time training costs of breath alcohol collectors which is discussed in this analysis in connection with §§26.85(a) and (b).

Paragraph 26.101(c)

This proposed paragraph revises existing requirements in §2.4(g)(18) in Appendix A to Part 26, which require when necessary, two additional breath specimens be collected from an individual

for a confirmatory test. This proposed paragraph reduces the number of breath specimens collected from two to one unless problems encountered while administering the confirmatory breath test require an additional collection. This paragraph also prohibits an activity permitted under the existing requirements in §2.4(g)(18) in Appendix A to Part 26. Specifically, the proposed paragraph prohibits licensees from calculating an average or otherwise combine results from two or more breath specimens to determine the confirmatory breath alcohol test result. FFD programs will realize minor savings in confirmatory alcohol testing costs resulting from decreasing the duration of the testing process, reducing equipment costs (using fewer exhalent tubes), decreasing worker productivity losses, and reducing collector labor costs.[7] However, the analysis does not calculate any savings because of the infrequency of confirmatory alcohol testing events (less than 2 per reactor per year),[8] and the minor savings (2 minutes and the cost of one exhalent tube per confirmatory - see assumptions in §26.95).

Paragraph 26.101(d)

This paragraph of the proposed rule establishes that if an EBT that meets the requirements of §§26.91(b) and (c) was used for the initial alcohol test, the same EBT may be used for confirmatory testing. The existing requirements in §26.24(g) require that initial and confirmatory alcohol testing be conducted using different EBTs. Incremental savings associated with this proposed provision are discussed in connection with §26.91(c).

26.103 Determining a confirmed positive test result for alcohol

This proposed section, including paragraphs (a)–(b), revises existing requirements in §26.24(g) and §2.7(f)(2) in Appendix A to Part 26 pertaining to the screening alcohol test result that constitutes a positive test result for a confirmatory alcohol test. The proposed rule establishes BACs that are more stringent than the current BAC level of 0.04, depending on the length of time an employee has been in work status. Thus, a confirmatory test may yield a positive result with a BAC that is equal to or greater than 0.02 BAC. Each FFD program will incur incremental costs

[7] In order to capture the total costs and savings, the analysis assumes that all savings incurred by offsite collection sites are passed back to licensees (i.e., through lower costs per collection). This assumption depends on the degree to which the offsite collection site industry is price-competitive. To the extent that it is not price competitive, savings will accrue as estimated, but will benefit the offsite collection site rather than licensees (i.e., offsite collection sites will realize savings in labor costs because of the reduced collection time, but will not reduce the cost per collection charged to licensees).

[8] The NRC Information Notice 2003-04 “Summary of Fitness-for-Duty Program Performance Reports for Calendar Year 2000" reported 211 confirmed positive alcohol test results for all licensees.

for FFD manager labor, to determine status for confirmatory BAC test results that are equal to or greater than 0.02 and less than 0.04.[9]

The *annual costs per FFD program* are estimated as follows:

$$(NUM_{CPAT} \times PERI_{CPAT}) \times (HOURS_{FFD\ manager} \times WAGE_{FFD\ manager}) \times NUM_{units}$$

Parameter	**Description**
NUM_{CPAT}	Number of confirmed positive breath alcohol tests (CPAT) per unit per year under current requirements (as discussed in Appendix 2, Exhibit A2-12)
$PERI_{CPAT}$	Percentage increase in the number of confirmed positive alcohol test (CPAT) results under the proposed BACs (as discussed in the assumptions below)
$HOURS_{FFD\ manager}$	Time (per test) for the FFD manager to determine the length of time the employee has been in work status for BACs equal to or greater than 0.02 and less than 0.04 (as discussed in the assumptions below)
$WAGE_{FFD\ manager}$	FFD manager wage rate (as discussed in Appendix 2, Exhibit A2-11)
NUM_{units}	Number of units per FFD program (as discussed in Appendix 2, Exhibit A2-14)

Assumptions:

- Percentage increase in the number of confirmed positive breath alcohol test (CPAT) results under the proposed BACs: 20 percent.

- Time (per test) for the FFD manager to determine the length of time the employee has been in work status for BACs equal to or greater than 0.02 and less than 0.04: 15 minutes.

26.105 Preparing for urine collection

This proposed section restates existing requirements in §2.4(g)(5)–(7) in Appendix A to Part 26, which require the collector to instruct donors to remove any unnecessary outer garments, wash their hands, and remain in the presence of the collector until proceeding to the privacy enclosure to provide a urine specimen. This section also adds a new requirement in §26.105(b) for the collector to inspect the pockets of each donor before a specimen donation can commence.

[9] The incremental costs of other activities resulting from additional confirmed positive alcohol test results attributable to the proposed BAC thresholds are estimated and discussed in connection with proposed paragraph 26.99(b).

Paragraph 26.105(a)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it restates existing requirements in §2.4(g)(5) in Appendix A to Part 26.

Paragraph 26.105(b)

This paragraph of the proposed rule adds a new requirement for donors to empty their pockets and display the items to the collector. If the donor refuses to show the collector the contents of their pockets, this action is considered a refusal to test. If the collector identifies something in a donor's pockets which appears to be a potential adulterant, the collector must contact the FFD program manager or the MRO for direction as to whether a directly observed collection is warranted. If an item is identified in a donor's pocket which the collector determines to be inadvertently brought to the collection site, the collector is to secure the item and continue with a normal collection process. The numbers of instances in which a donor may attempt to conceal a potential adulterant in their pocket is deemed low (due to the donor's knowledge of the inspection process) as is the likelihood of a donor refusing to display the contents of his/her pockets (given the consequences of their action). Incremental costs will result from additional time per collection to empty and inspect the contents of a donor's pockets. Each FFD program will incur a per test cost of additional lost worker productivity and additional collector labor.

The *annual costs per FFD program* are estimated as follows:

$$NUM_{collections} \times HOURS_{inspection} \times (WAGE_{worker} + WAGE_{collector}) \times NUM_{units}$$

Parameter	Description
$NUM_{collections}$	Number of urine collections per unit per year (as discussed in the assumptions below and in Appendix 2, Exhibit A2-12)
$HOURS_{inspection}$	Time per collection to empty and inspect contents of a donor's pockets (as discussed in the assumptions below)
$WAGE_{worker}$	Facility worker wage rate (as discussed in Appendix 2, Exhibit A2-11)
$WAGE_{collector}$	Collection site personnel wage rate (as discussed in Appendix 2, Exhibit A2-11)
NUM_{units}	Number of units per FFD program (as discussed in Appendix 2, Exhibit A2-14)

Assumptions:

- Number of urine collections per unit per year is assumed to be equal to the number of drug tests per unit per year.

- Time per collection to empty and inspect the contents of a donor's pockets: 2 minutes.

Paragraphs 26.105(c) - (d)

These paragraphs of the proposed rule impose no incremental cost and afford no saving because they restate existing requirements in §2.4(g)(6) - (7) in Appendix A to Part 26.

Paragraph 26.105(e)

This paragraph of the proposed rule establishes collection site procedures for the collector/donor to select and unwrap collection kit materials. This proposed paragraph imposes no incremental cost and affords no saving because this collection procedure will not increase the time of a specimen collection. The same activity of selecting and unwrapping the collection materials will still occur, but the donor rather than the collector may conduct the activity.

26.107 Collecting a urine specimen

This proposed section restates and clarifies existing requirements in §2.4 in Appendix A to Part 26, which address collector responsibilities during the urine collection process. This section also adds several new requirements, as indicated in the paragraph discussions below.

Paragraph 26.107(a)

This paragraph of the proposed rule restates an existing requirement in §2.4(g)(8) in Appendix A to Part 26. This paragraph also adds a provision which provides the urine collector with discretion as to setting "a reasonable time limit for voiding" by the donor. No significant incremental cost or saving will result from the proposed revision because on average, it is uncommon for donors to take long periods of time to provide specimens.

Paragraph 26.107(b)

This paragraph of the proposed rule clarifies the existing requirements in §§2.4(g)(9) and (25) in Appendix A to Part 26 which currently require the collector to consult with a "higher level supervisor in the drug testing program to review and concur that a collection under direct observation should proceed." This proposed paragraph clarifies that the collector must contact "FFD program management" to receive direction as to whether an observed collection is warranted in cases where a donor attempts to subvert the collection process (e.g., bringing in a substituted urine specimen or adulterant). No incremental cost or saving will result from this proposed provision as it only clarifies who the collector is to contact regarding a direct observation. In addition, this proposed paragraph directs the collector to document on the custody and control form a description of the donor's actions that demonstrated an attempt to subvert the testing process. This proposed collector requirement to document the reason for believing a donor has attempted to subvert the testing process offers an employee protection from unwarranted observed collections as the collector must justify the reason that an observed collection is needed. Because the collector's action of documenting a description of the donor's

actions on the custody and control form will be very rare, no significant cost or saving will be incurred.

Paragraph 26.107(c)

This paragraph of the proposed rule restates an existing requirement in §2.4(g)(12) in Appendix A to Part 26. This proposed paragraph also adds a new requirement for the collector to inspect the toilet bowl and private area used by a donor for a specimen collection for evidence of a subversion attempt. No significant incremental cost or saving will result from the proposed provision because this action is both consistent with current collection site practices, and because inspecting a privacy enclosure takes only a matter of seconds per collection.

26.109 Urine specimen quantity

Paragraph 26.109(a)

This paragraph of the proposed rule revises the existing requirement in §2.4(g)(11) in Appendix A to Part 26, under which the minimum quantity of urine to be collected for a drug test is 60 mL. The proposed rule introduces the term, "predetermined quantity" of urine to describe that a donor must provide a specific quantity of urine based on the licensee's or other entity's testing program. The new provision reduces the minimum quantity of urine to be collected from 60 mL to 30 mL. That is, at a minimum, the donor must provide 30 mL of urine to permit an HHS-certified laboratory to conduct initial (and confirmatory, when necessary) validity and drug tests as required by 10 CFR Part 26. An additional 15 mL of urine is permitted to be collected for split-specimen collections. The proposed rule also permits licensee and other entity testing programs to collect additional quantities of urine as part of the predetermined quantity based on their own additional specific testing and collection procedures. No incremental change is estimated for the added flexibility in permitting licensees to conduct additional testing beyond the rule requirements in 10 CFR Part 26, as that is allowed as an accommodation to licensees. The reduction in the minimum quantity of urine required (from 60 mL to 30 mL) will reduce the number of instances in which a donor cannot provide the minimum specimen quantity on a first attempt. Therefore, FFD programs will recognize incremental savings attributable to a reduction in lost worker productivity and reduced collector labor resulting from fewer shy bladder instances.[10]

[10] In order to capture the total costs and savings, this analysis assumes that savings incurred by offsite collection sites are passed back to licensees (i.e., lower costs per collection). The validity of this assumption depends on the degree to which the offsite collection site industry is price-competitive. To the extent that it is not price-competitive, savings will accrue as estimated, but will benefit the offsite collection site rather than licensees (i.e., offsite collection sites will realize savings in labor costs because of the reduced collection time, but will not reduce the cost per collection charged to licensees).

The *annual savings per FFD program* are estimated as follows:

$$(NUM_{collections} \times PER_{low\ quantity} \times PERD_{low\ quantity}) \times (HOURS_{saved} \times (WAGE_{worker} + WAGE_{collector})) \times NUM_{units}$$

Parameter	**Description**
$NUM_{collections}$	Number of urine collections per unit per year (as discussed in Appendix 2, Exhibit A2-12)
$PER_{low\ quantity}$	Percentage of collections that are of inadequate quantity after the initial attempt to provide a specimen under the current requirements (as discussed in the assumptions below)
$PERD_{low\ quantity}$	Percentage decrease in the number of shy bladder tests per year that produce inadequate specimens resulting from the reduction in the minimum specimen quantity (from 60 mL to 30 mL) (as discussed in the assumptions below)
$HOURS_{saved}$	Average time per test saved because a donor can provide a sufficient specimen under the proposed rule (as discussed in the assumptions below)
$WAGE_{worker}$	Facility worker wage rate (as discussed in Appendix 2, Exhibit A2-11)
$WAGE_{collector}$	Collection site personnel wage rate (as discussed in Appendix 2, Exhibit A2-11)
NUM_{units}	Number of units per FFD program (as discussed in Appendix 2, Exhibit A2-14)

Assumptions:

- Number of urine collections per unit per year is assumed to be equal to the number of drug tests per unit per year.
- Percentage of collections (per year) that are of inadequate quantity after the initial attempt to provide a specimen under the current requirements : 6.7 percent.[11]
- Percentage decrease in the number of shy bladder tests per year that produce inadequate specimens: 25 percent.
- Average time per test saved because a donor can provide a sufficient specimen under the proposed rule: 1.5 hours.

[11] Landers, Peter. April 22, 2003. "Looking for Relief, Shy bladder syndrome is widespread. But in many cases it can be treated successfully." Special Report: Personal Health Quarterly 2003-2, The Wall Street Journal. The article cites a 1994 study indicating that 6.7 percent of Americans suffer from shy-bladder syndrome, or what is called paruresis.

Paragraph 26.109(b)

This paragraph of the proposed rule [including subparagraphs (b)(1)–(4)] revises existing requirements in §2.4(g)(11) in Appendix A to Part 26, which describe the collection procedures in the event that a donor provides less than the minimum quantity of urine needed to complete a specimen collection during his or her initial attempt. The incremental costs and savings for this proposed paragraph are discussed in connection with subparagraphs (b)(1)–(4).

Subparagraph 26.109(b)(1)

This proposed subparagraph revises an existing requirement in §2.4(g)(11) in Appendix A to Part 26, which permits a donor to be provided with "a reasonable amount of liquid to drink for this purpose (e.g., a glass of water)" if they cannot provide a urine specimen that meets the minimum quantity requirement during their initial attempt. The proposed revision directs the collector to encourage the donor to drink up to a specific amount of fluid (i.e., 24 ounces) over a three-hour time period. The existing rule contains no such maximum restriction on fluid consumption. This analysis assumes that no incremental cost or saving will result from this proposed subparagraph because the activity (of providing fluids to the donor) is common to both the current and proposed rules.

Subparagraph 26.109(b)(2)

This proposed subparagraph adds three new requirements. First, this subparagraph prohibits a licensee or other entity from requiring a donor to provide additional urine specimens to try to meet the licensee's or other entity's predetermined quantity if the donor's initial specimen is at least 30 mL, but less than the predetermined quantity (greater than 30 mL). That is, a donor cannot be compelled to make additional attempts to provide a specimen that meets the licensees's or other entity's predetermined quantity, after the donor has successfully provided an initial specimen of at least 30 mL. Second, this proposed subparagraph prohibits any sanctions from being imposed on a donor who provides a specimen of at least 30 mL but less than the predetermined quantity. Third, this proposed subparagraph requires that a specimen of 30 mL but less than the predetermined quantity be forwarded directly to the an HHS-certified laboratory for testing. The three new requirements in this subparagraph will not result in any incremental costs or savings for FFD programs that send all urine specimens to HHS-certified laboratories. However, the proposed provisions will result in incremental costs for FFD programs with onsite licensee testing facilities because specimens meeting the minimum 30 mL quantity (but less than the predetermined quantity) cannot be tested at the licensee testing facility and must be forwarded directly to an HHS-certified laboratory for testing.

The *annual incremental costs per FFD program with onsite testing facilities* are estimated as follows:

$$(NUM_{drug\ tests} \times PER_{not\ predetermined\ quantity}) \times (COST_{test\ at\ HHS\ lab} - COST_{test\ at\ licensee\ lab}) \times NUM_{units}$$

Parameter	Description
$NUM_{drug\ tests}$	Number of drug tests per unit per year (as discussed in Appendix 2, Exhibit A2-12)
$PER_{not\ predetermined\ quantity}$	Percentage of urine specimens at least 30 mL in volume, but less than the licensee's or other entity's predetermined quantity of urine (as discussed in the assumptions below)
$COST_{test\ at\ HHS\ lab}$	Cost to conduct initial drug testing and initial validity testing on a urine specimen at an HHS-certified laboratory for FFD programs that primarily use onsite testing facilities (as discussed in Appendix 2, Exhibit A2-13)
$COST_{test\ at\ licensee\ lab}$	Cost to conduct initial drug testing and initial validity testing on a urine specimen at an onsite licensee testing facility (as discussed in the assumptions below and in Appendix 2, Exhibit A2-13)
NUM_{units}	Number of units per FFD program (as discussed in Appendix 2, Exhibit A2-14)

Assumptions:

- FFD programs that conduct initial drug testing at onsite testing facilities send fewer specimens to HHS-certified laboratories than do FFD programs that do not operate onsite testing facilities, and so must pay a higher per specimen cost for drug and validity testing (both initial and confirmatory, when necessary).

- Percentage of urine specimens of at least 30 mL in volume, but less than the licensee or other entity's predetermined quantity: 1 percent.

Subparagraph 26.109(b)(3)

The proposed paragraph revises existing requirements in §2.4(g)(11) in Appendix A to Part 26. In situations where a donor has not provided a urine specimen of adequate volume (at least 30 mL) within 3 hours of the initial unsuccessful attempt, this proposed subparagraph instructs the collector to terminate the testing process and notify the FFD manager or MRO to initiate the shy bladder procedures in proposed §26.119. The existing rule only requires that the collector contact the appropriate authority to obtain guidance on the action to be taken. The proposed paragraph provides a specific requirement for the collector to notify the FFD manager or MRO to initial the shy bladder procedures. This proposed subparagraph will not result in any incremental costs or savings because the collector must still contact an individual to initiate additional actions related to the shy bladder situation.

Subparagraph 26.109(b)(4)

This proposed subparagraph revises the existing requirement in §2.4(g)(11) in Appendix A to Part 26, to prohibit, rather than require, the pooling of successive urine specimens. Donors must

now provide a minimum of 30 mL of urine in a single specimen collection attempt. The proposed rule also requires that urine collectors must discard specimens of less than 30 mL. If the collector has a reason to believe that a donor has diluted, adulterated, substituted, or tampered with their specimen of 15 mL or more but less than 30 mL, the specimen must be sent to an HHS-certified laboratory for testing. Although FFD programs may realize an additional cost to send specimens to an HHS-certified laboratory that are 15 mL or more but less than 30 mL and collected from a donor who is suspected of diluting, adulterating, substituting, or tampering with their specimen, the analysis assumes that no incremental costs or savings will result because of the infrequency of these situations.

26.111 Checking the validity of the urine specimen

Paragraph 26.111(a)

This paragraph of the proposed rule revises existing requirements in §2.4(g)(13) in Appendix A to Part 26, which require collectors to measure the temperature of a urine specimen within 4 minutes of receiving the specimen from the donor. The proposed rule informs the collector that if the ambient temperature is low or the specimen quantity is less than 30 mL, this measurement may need to be completed in less than 4 minutes after receiving the specimen from the donor. This proposed paragraph imposes no incremental cost and affords no saving because temperature is usually measured immediately upon receiving the specimen from the donor and, thus, is well within 4 minutes, even under the current rule.

Paragraph 26.111(b)

This paragraph of the proposed rule revises existing urine specimen temperature requirements in §2.4(g)(14) in Appendix A to Part 26. Specifically, the proposed rule expands the acceptable urine specimen temperature range from (90.5°F – 99.8°F) to (90°F – 100°F). Any specimen outside the (90°F – 100°F) temperature range indicates that a donor may have attempted to subvert the testing process. Therefore, a second specimen collection under direct observation is required as specified in proposed §26.111(d). This proposed paragraph imposes no incremental cost and affords no saving because the change in the temperature range is minor and is being proposed to be consistent with the requirements used by other Federal agencies.

Paragraph 26.111(c)

This paragraph of the proposed rule revises existing requirements in §2.4(g)(15) in Appendix A to Part 26, which requires "immediately after a urine specimen is collected, the collection site person shall also inspect the specimen to determine its color and look for any signs of contaminants. Any unusual findings shall be noted in the permanent record book." This proposed paragraph requires that immediately after a urine specimen is collected, "the collector shall also inspect the specimen to determine its color and clarity and look for any signs of contaminants or adulteration. Any unusual findings must be noted on the custody-and-control

form." This proposed paragraph changes the required location that the information is to be recorded from a permanent recordbook to the custody-and-control form. This proposed paragraph imposes no incremental cost and affords no saving because the collector must still inspect each specimen and document any unusual findings (even if in a different place).

Paragraph 26.111(d)

This paragraph of the proposed rule revises existing requirements in §§2.4(g)(17) and 2.4(g)(25) in Appendix A to Part 26, which instruct the urine collector, after receiving approval from a "higher level supervisor in the drug testing program," to perform a second collection under direct observation "whenever there is a reason to believe that a particular individual may alter or substitute the urine specimen." The proposed paragraph specifies that the collector should contact the designated FFD program manager if there is reason to believe the individual may have diluted, substituted, or adulterated the specimen based upon temperature or other observations. It also permits the FFD manager to consult with the MRO to determine whether a subversion attempt has occurred. There are no incremental costs or savings attributable to these clarifications.

Paragraph 26.111(e)

This paragraph of the proposed rule revises §2.4(g)(16) in Appendix A to Part 26, which currently requires all urine specimens suspected of being adulterated or diluted to be "forwarded to the laboratory for testing." This proposed paragraph specifies that a specimen of sufficient quantity (at least 15 mL) that is suspected of having been diluted, substituted, or adulterated must be "sent directly to the HHS-certified laboratory for testing." The only minor incremental costs or savings that may result from the proposed requirement pertain to FFD programs with onsite licensee testing facilities, because FFD programs that send all specimens offsite for testing at an HHS-certified laboratory already comply with this requirement. The analysis assumes, however, that even FFD programs with onsite testing facilities already send any suspect urine specimens directly to an HHS-certified laboratory because HHS-certified laboratories have more sophisticated equipment to identify potential specimen validity concerns.

Paragraph 26.111(f)

This paragraph of the proposed rule revises §2.4(g)(16) in Appendix A to Part 26, which currently requires all urine specimens suspected of being adulterated or diluted to be forwarded to an HHS-certified laboratory. This paragraph specifies that the collector must also preserve a suspect urine specimen for possible testing. This paragraph of the proposed rule imposes no incremental cost and affords no saving because it is consistent with existing collection site practices.

Paragraph 26.111(g)

This paragraph of the proposed rule defines the specific criteria to be used by a collector to determine whether a urine specimen is acceptable (i.e., is free of apparent contaminants, meets the required quantity of at least 30 mL, and is within acceptable temperature range). This analysis assumes no incremental costs or savings are attributable to this proposed paragraph because collectors currently use these criteria to determine whether a urine specimen is acceptable, although the minimum quantity of urine has been reduced from 60 mL to 30 mL, as discussed in connection with §26.109.

26.113 Splitting the urine specimen

This section of the proposed rule [including paragraphs (a)–(c)] imposes no incremental costs and affords no savings because it clarifies the existing requirements in §§2.4(g)(20) and 2.7(j) in Appendix A to Part 26, which detail the procedures for collecting split specimens. Proposed paragraph 26.113(b) revises the existing requirement in §2.7(j) which instructs the urine collector to pour one half of the urine specimen into each specimen bottle. Paragraph 26.113(b) instructs the collector to pour a minimum of 15 mL of urine into Bottle B. The quantities apportioned to each split specimen bottle have been revised, but no cost or saving will result from this modified procedure.

26.115 Collecting a urine specimen under direct observation

Paragraph 26.115(a)

This paragraph of the proposed rule restates without substantive change existing requirements in §2.4(f)(1)-(3) in Appendix A to Part 26 which specify the criteria indicating exclusive grounds that a donor has attempted to alter or substitute their urine specimen.

Paragraph 26.115(b)

This paragraph establishes a new requirement that in instances where an observed collection is deemed warranted by the collector, the collector must obtain agreement of the FFD manager or MRO to obtain a specimen under direct observation. No incremental cost or savings will result from this proposed paragraph because situations where an observed collection is warranted are rare.

Paragraphs 26.115(c)

The paragraph of the proposed rule adds a requirement that the collector inform the donor of the reason(s) for the directly observed collection so that the donor is aware of the nature of the concern that has initiated a directly observed collection. No costs or savings will result from this proposed paragraph because situations where an observed collection is warranted are rare.

Proposed §26.115(d)

The paragraph of the proposed rule establishes new recordkeeping requirements related to the directly observed collection. The proposed paragraph would require the collector to record on the specimen's custody-and-control form that the specimen was collected under direct observation and the reason for the directly observed collection. The proposed requirement is necessary to ensure that the HHS-certified laboratory and the MRO have this information available when the specimen is tested and the MRO conducts his or her review of the test results, as would be required under proposed §26.185. No costs or savings will result from this proposed paragraph because situations where an observed collection is warranted are rare.

Paragraph 26.115(e)

This paragraph of the proposed rule retains and combines the existing requirements in Sections 1.2, 2.4(b), 2.4(g)(14), (g)(17), and (g)(25) in Appendix A to Part 26, which require that the individual who observes the specimen collection must be of the same gender as the donor. Consistent with the current requirements, the proposed rule would permit another individual of the same gender to serve as the observer if a qualified urine collector of the same gender is not available, as long as the observer receives the instructions specified in proposed §26.115(f).

Paragraph 26.115(f)

The paragraph of the proposed rule would be added new requirements for conducting directly observed collections. These more detailed procedures are necessary because devices and techniques to subvert the testing process have been developed since Part 26 was first published that can be used under direct observation without detection. Therefore, the proposed changes would be made to increase the likelihood of detecting such attempts to subvert the testing process and, thereby, increase the effectiveness of directly observed collections in assuring that a valid specimen is obtained from the donor. No costs or savings will result from this proposed paragraph because situations where an observed collection is warranted are rare.

Paragraph 26.115(g)

This paragraph of the proposed rule would be added to clarify that a donor's refusal to participate in the directly observed collection would constitute a refusal to test and, therefore, would be considered to be an act to subvert the testing process, under proposed §26.75(b). Current Section 2.4(j) in Appendix A to Part 26 requires the collector to inform the MRO, and the MRO to inform licensee management, if a donor fails to cooperate with the specimen collection process, including, but not limited, to a refusal to provide a complete specimen, complete paperwork, or initial the specimen bottles. The current requirement does not specifically mention that a refusal to participate in a directly observed collection is also an instance of a failure to cooperate. In addition, the current rule does not require the licensee or other entity to impose

sanctions on a donor for refusing to be tested. No costs or savings will result from this proposed paragraph because situations where an observed collection is warranted are rare.

Paragraph 26.115(h)

This paragraph of the proposed rule adds new collection requirements for collectors to follow if a directly observed collection was required, but was not performed. The collector would inform the FFD program manager or designee of the omission, who would ensure that a directly observed collection is immediately performed. No costs or savings will result from this proposed paragraph because situations where an observed collection is warranted are rare.

26.117 Preparing urine specimens for storage and shipping

Paragraph 26.117(a)

This paragraph of the proposed rule restates without substantive change existing requirements in §2.4(g)(20) in Appendix A to Part 26, which pertain to the collector keeping the urine specimen in view of the donor at all times before sealing and labeling the specimen. This paragraph of the proposed rule imposes no incremental cost and affords no saving because it is consistent with existing licensee collection practices.

Paragraph 26.117(b)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it restates existing requirements in §2.4(g)(21) in Appendix A to Part 26.

Paragraph 26.117(c)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it restates existing requirements in §2.4(g)(22) in Appendix A to Part 26.

Paragraph 26.117(d)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it restates existing requirement in §§2.4(g)(23) in Appendix A to Part 26.

Paragraph 26.117(e)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it restates without substantive changes the existing requirements in §2.4(g)(26) in Appendix A to Part 26.

Paragraph 26.117(f)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it restates existing requirements in §2.4(g)(27) in Appendix A to Part 26.

Paragraph 26.117(g)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it restates existing requirements in §2.4(g)(28) in Appendix A to Part 26.

Paragraph 26.117(h)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it restates existing requirements in §2.4(c)(2) in Appendix A to Part 26.

Paragraph 26.117(i)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it restates without substantive changes existing requirements in §2.4(i) in Appendix A to Part 26 which pertain to specimen packaging procedures.

Paragraph 26.117(j)

This paragraph of the proposed rule clarifies and revises existing requirements (primarily in §2.7(c) in Appendix A to Part 26) regarding refrigerating specimens to protect them from degradation. This proposed paragraph restates portions of the existing rule and adds a performance standard regarding "appropriate and prudent actions" to minimize specimen degradation. Licensees would likely achieve the performance standard by implementing the more specific criteria from the current rule, which are also restated in the proposed rule. The proposed paragraph also relaxes refrigeration criteria for most specimens, but tightens them for specimens that are suspected of having been substituted, adulterated, or tampered with. Finally, the proposed paragraph adds a requirement that the collection site must send specimens to a licensee testing facility or HHS-certified laboratory as soon as reasonably practical, with a time limit of 2 business days from the shipping of a specimen to the receipt of the specimen at the appropriate laboratory, except under unusual circumstances. It is believed that the new provisions in this proposed paragraph are consistent with current industry practices. To the extent (if any) that the new refrigeration standards (some relaxed, some tightened) might require licensees to change their operating practices, the net effect is likely to be small. As a result of these uncertainties (including a lack of data) and the likelihood that any impact would be small, this analysis does not quantify costs or savings resulting from the proposed paragraph.

Paragraph 26.117(k)

This paragraph of the proposed rule clarifies existing requirements in §2.4(h) in Appendix A to Part 26, stating that the date and purpose be documented on the chain-of-custody form for a specimen each time the specimen is handled or transferred, and every individual in the chain of custody shall be identified. This proposed paragraph clarifies that because couriers, express carriers, and postal service personnel do not have access to the custody-and-control forms, these individuals are not required to document chain of custody during transit of a urine specimen. However, this proposed paragraph adds a new requirement that the custody accountability of the shipping containers during shipment must be maintained by a tracking system provided by the courier, express carrier, or postal service. This paragraph of the proposed imposes no incremental cost and affords no saving because it describes existing courier, express carrier, and postal service shipment tracking practices.

26.119 Determining "shy" bladder

This section of the proposed rule replaces existing requirements in §2.4(g)(11) in Appendix A to Part 26, which require that the collection site must contact the appropriate authority to obtain guidance on the action to be taken when a donor cannot provide an adequate volume of urine. This proposed paragraph adopts "shy bladder procedures" consistent with U.S. DOT regulations (49 CFR 40.193). All costs are considered incremental because this is a new requirement. Specific incremental costs include labor (or productivity losses) associated with the donor, the FFD manager, the MRO, and a licensed physician, and are described in the paragraph discussions below.

The equation presented at the end of this section calculates the incremental costs combined for all seven paragraphs within §26.119, as follows:

- Proposed paragraph 26.119(a) establishes a new requirement for the FFD program personnel to direct the donor to obtain a medical evaluation from a licensed physician within 5 business days of a donor's inability to provide an adequate urine specimen of at least 30 mL. The MRO must approve the physician to conduct the evaluation (an MRO can perform the evaluation if he or she possesses appropriate expertise). Incremental costs per FFD program consist of lost worker productivity while obtaining the medical evaluation, MRO labor to evaluate and agree with the selection of physician, and the cost of the medical evaluation.

- Proposed paragraphs 26.119(b), (c), and (d) establish new requirements necessitating that the MRO provide the physician selected to perform a medical evaluation with the physical and psychological conditions that constitute a medical condition that could preclude a donor from providing an adequate quantity of urine. The MRO must also instruct the physician to provide a written statement of the conclusions of the evaluation

to the MRO. The incremental costs include MRO labor to communicate the specific evaluation requirements to the examining physician.

- Proposed paragraphs 26.119(e) and (f) require the physician evaluating the donor to provide a written statement to the MRO regarding the findings and conclusions from his or her evaluation. The report must state whether a medical condition exists that precludes the donor from providing sufficient specimens in future collections. The incremental cost consists of the cost of obtaining the physician's written statement.

- Proposed paragraph 26.119(g) describes the required MRO findings, which are to be based on results of the physician's evaluation of the donor. Incremental costs consist of MRO labor to review the physician evaluation, make a determination on the donor's condition, and communicate the results.

The annual costs per FFD program associated with proposed section 26.119 are estimated as follows:

$$NUM_{shy\ bladder} \times [COST_{medical\ evaluation} + ((HOURS_{medical\ evaluation} \times WAGE_{worker}) + (HOURS_{FFD\ manager} \times WAGE_{FFD\ manager}) + (HOURS_{MRO} \times WAGE_{MRO}))] \times NUM_{facilities}$$

Parameter	**Description**
$NUM_{shy\ bladder}$	Number of urine collections unable to be completed because of inadequate specimen volume after 3 hours, per facility per year (as discussed in the assumptions below)
$COST_{medical\ evalutaion}$	Cost of a medical evaluation and written report from a licensed physician per incident where an employee is unable to provide the minimum quantity of urine after 3 hours (as discussed in the assumptions below)
$HOURS_{medical\ evaluation}$	Time per medical evaluation (including travel to and from the physician's office) (as discussed in the assumptions below)
$WAGE_{worker}$	Facility worker wage rate (as discussed in Appendix 2, Exhibit A2-11)
$HOURS_{FFD\ manager}$	Time for an FFD manager per incident where an employee is unable to provide the minimum quantity of urine after 3 hours (as discussed in the assumptions below)
$WAGE_{FFD\ manager}$	FFD manager wage rate (as discussed in Appendix 2, Exhibit A2-11)
$HOURS_{MRO}$	MRO time per incident where a donor is unable to provide the minimum quantity of urine after 3 hours to select a physician, instruct the physician on the medical evaluation that must be conducted, and review and communicate the medical evaluation results to the FFD manager and worker (as discussed in the assumptions below)
$WAGE_{MRO}$	MRO wage rate (as discussed in Appendix 2, Exhibit A2-11)

Parameter	Description
$NUM_{facilities}$	Number of facilities per FFD program (as discussed in Appendix 2, Exhibit A2-14)

Assumptions:

- Number of urine collections unable to be completed because of inadequate specimen volume after 3 hours, per facility per year: 1.

- Cost of a medical evaluation and written report from a physician per incident where a donor is unable to provide the minimum quantity of urine after 3 hours: $300.00.

- Time per medical evaluation (including travel to and from the physician's office): 1.5 hours.

- Time for an FFD program manager per incident where an employee is unable to provide the minimum quantity of urine after 3 hours to direct an employee to proceed to a physician for a medical evaluation, to consult with the MRO regarding an appropriate physician to conduct a shy bladder examination, and to perform administrative activities associated with the MRO's results: 2 hours.

- MRO time per incident where an employee is unable to provide the minimum quantity of urine after 3 hours to select a physician, instruct the physician on the medical evaluation that must be conducted, and communicate the medical evaluation results to the FFD manager and worker: 2 hours.

Subpart F: Licensee Testing Facilities

26.121 Purpose

This section of the proposed rule imposes no incremental cost and affords no saving because it merely states that Subpart F contains requirements for laboratories operated by licensees to perform initial drug testing and validity testing on urine specimens.

26.123 Testing facility capabilities

This section of the proposed rule revises existing requirements in §2.7(l)(2) in Appendix A to Part 26, which require that licensee testing facilities must have the capability to perform initial drug tests on urine specimens for each of the five drugs and drug metabolites as required in §2.7(e)(1). Under the proposed rule add a requirement that licensee testing facilities also must have the capability to perform validity screening or initial validity tests on urine specimens. This analysis captures any incremental costs associated with this proposed section in proposed §26.131.

26.125 Licensee testing facility personnel

This section of the proposed rule [including paragraphs (a)–(c)] imposes no incremental cost and affords no saving because it restates and clarifies existing requirements in §2.6(a)–(c) in Appendix A to Part 26, which pertain to the requirements for licensee testing facility personnel responsible for the day-to-day management of operations and supervision of testing technicians, other technicians, non-technical staff, and licensee testing facility personnel files. Proposed §26.125(b) revises existing requirement in §2.6(c) which describes collector proficiency requirements by adding a new requirement that technicians who perform urine specimen testing have documented proficiency in operating the testing instruments and devices used at the testing facility. This new provision will result in no incremental cost or saving because it is consistent with existing licensee testing facility training practices and documentation procedures.

26.127 Procedures

This section of the proposed rule clarifies existing requirements in §§2.2 and 2.7 in Appendix A to Part 26 as discussed in paragraphs (a)–(f) below. No incremental costs or savings will result directly from the clarifications in this proposed section. However, FFD programs with onsite licensee testing facilities will incur incremental costs to comply with the requirements in this section and therefore must revise current laboratory policies and procedures to incorporate necessary changes related to other sections of Subpart F (e.g., validity testing, modified cutoff levels for marijuana and opiates, blind performance specimen testing, quality assurance procedures). The analysis evaluates the incremental costs of all licensee testing facility policy revisions required because of the proposed rule revisions in this section of the analysis.

The one-time cost per FFD program with onsite licensee testing facilities is estimated as follows:

$$(HOURS_{FFD\ manager} \times WAGE_{FFD\ manager}) + (HOURS_{Lab\ supervisor} \times WAGE_{Lab\ supervisor}) + (HOURS_{Clerical} \times WAGE_{Clerical}) + (HOURS_{Legal} \times WAGE_{Legal})$$

Parameter	**Description**
$HOURS_{FFD\ manager}$	Hours of FFD manager's time to revise the laboratory procedures manual (as discussed in the assumptions below)
$WAGE_{FFD\ manager}$	FFD manager wage rate (as discussed in Appendix 2, Exhibit A2-11)
$HOURS_{Lab\ supervisor}$	Hours of laboratory supervisor's time to revise the laboratory procedures manual (as discussed in the assumptions below)
$WAGE_{Lab\ supervisor}$	Laboratory supervisor wage rate (as discussed in Appendix 2, Exhibit A2-11)
$HOURS_{Clerical}$	Hours of clerical personnel time to revise the laboratory procedures manual (as discussed in the assumptions below)
$WAGE_{Clerical}$	Clerical personnel wage rate (as discussed in Appendix 2, Exhibit A2-11)
$HOURS_{Legal}$	Hours of legal time to review the laboratory procedures manual (as discussed in the assumptions below)
$WAGE_{Legal}$	Legal wage rate (as discussed in Appendix 2, Exhibit A2-11)

Assumptions:

- Hours for procedure revisions per FFD program with onsite licensee testing facilities by labor category (total of 360 hours):
  - FFD manager: 120 hours.
  - Laboratory supervisor: 160 hours.
  - Clerical: 40 hours.
  - Legal: 40 hours.

- Each FFD program with onsite licensee testing facilities uses a single procedures manual for all testing facilities.

Paragraph 26.127(a)

The paragraph of the proposed rule imposes no incremental cost and affords no saving because it restates without substantive change existing requirements within §2.2 in Appendix A to Part 26, which relate to the maintenance and documentation of procedures for the collection, shipment, and accession of urine specimens.

Paragraph 26.127(b)

The paragraph of the proposed rule imposes no incremental cost and affords no saving because it restates without substantive change the existing requirements in §2.7(a)(2) in Appendix A to Part 26, which pertain to the content and implementation of specimen chain-of-custody procedures for licensee testing facilities.

Paragraph 26.127(c)

The paragraph of the proposed rule revises without substantive change existing requirements within §2.7(o)(1) in Appendix A to Part 26 which specify that licensee testing facilities must maintain a procedures manual detailing the numerous components of the drug testing process. The proposed paragraph extends the current requirement to include a provision requiring documentation of standard operating procedures for each specimen validity testing assay performed (instrumented and non-instrumented methods, as applicable). In addition, this proposed paragraph requires that the licensee testing facility maintain written procedures, but no longer specifies that these procedures must be maintained in a "procedure manual." Incremental costs associated with revisions to the licensee testing facility policy and procedures are discussed in connect with §26.127.

Paragraph 26.127(d)

The paragraph of the proposed rule imposes no incremental cost and affords no saving because it restates an existing requirement in §2.7(o)(3)(iii) in Appendix A to Part 26.

Paragraph 26.127(e)

The paragraph of the proposed rule imposes no incremental cost and affords no saving because it restates and clarifies existing requirements in §2.7(o)(4) in Appendix A to Part 26, which maintain that a licensee testing facility must develop, implement, and maintain procedures for remedial actions if systems are out of acceptable limits or errors are detected. This paragraph adds a new requirement for licensee testing facilities that use validity screening testing devices to maintain procedures for non-instrumented testing. As discussed in §26.131(a) of the analysis, the analysis assumes that no licensee testing facilities will conduct validity screening tests. Therefore, this proposed provision will result in no incremental cost or saving because license testing facilities will not have to maintain procedures for non-instrumented validity screening devices.

26.129 Assuring specimen security, chain of custody, and preservation

Paragraph 26.129(a)

There are no incremental costs or savings from this proposed paragraph because it clarifies existing requirements in §2.7(a)(1) in Appendix A to Part 26.

Paragraph 26.129(b)

This paragraph of the proposed rule revises existing requirements in §2.7(b)(1) in Appendix A to Part 26, which require that licensee testing facility personnel must inspect each package containing urine specimens to identify any evidence of possible tampering and must notify licensee officials of any tampering as soon as possible, but within 8 hours of identifying a potential tampering incident. By contrast, the provisions in this paragraph will require each licensee testing facility to conduct an investigation into possible tampering and take corrective actions when necessary. If the licensee testing facility personnel identify any reason to believe that the integrity and/or identity of a specimen is in question, the specimen is not to be tested and the licensee or other entity must ensure that another collection occurs as soon as reasonably practicable. This analysis estimates that no incremental costs or savings will result from this proposed paragraph because the requirements are believed to be consistent with existing licensee practices.

Paragraph 26.129(c)

This paragraph of the proposed rule clarifies and revises existing requirements in §2.7(b)(2) in Appendix A to Part 26, which pertain to the handling of urine specimens at licensee testing facilities and the use of chain-of-custody forms. Specifically, this paragraph clarifies that licensee testing facilities must use laboratory chain-of-custody forms or other appropriate methods of tracking aliquot custody and control while conducting validity testing (screening and/or initial) and initial drug testing on urine specimens. This proposed paragraph also establishes that both the original specimen and the original specimen custody-and-control form must remain in secure storage. Finally, this paragraph clarifies that licensee testing facilities may discard specimens as soon as practical after receiving negative results for validity screening and/or initial validity and initial drug tests. No incremental costs or savings will result from this proposed paragraph because it is considered to be consistent with existing licensee testing facility practices for urine specimen handling, storage, and disposal. The analysis does not quantify the costs for any licensee testing facilities to use alternative custody and control tracking methods to accommodate validity testing, as these costs, if any, are deemed to be insignificant.

Paragraph 26.129(d)

This proposed paragraph restates without substantive change existing requirements in §2.7(a)(2) in Appendix A to Part 26, which pertain to chain-of-custody procedures and information required to be included on custody-and-control forms used to track urine specimens at licensee testing

Paragraph 26.129(e)

This paragraph of the proposed rule clarifies and revises existing requirements in §2.7(d) in Appendix A to Part 26, which pertain to the shipment of "presumptive positive" urine specimens to an HHS-certified laboratory for confirmatory testing. The current requirements do not designate a time by which the licensee testing facility must send a non-negative specimen to an HHS-certified laboratory. The proposed paragraph replaces the term "presumptive positive" with "non-negative" and directs licensee testing facilities to send "non-negative" specimens to an HHS-certified laboratory as soon as reasonably practical. No incremental costs or savings are estimated because the proposed provision is consistent with current specimen shipping practices used by licensee testing facilities.

Paragraph 26.129(f)

This paragraph of the proposed rule clarifies and revises existing requirements (which primarily appear in §2.7(c) in Appendix A to Part 26), as they relate to refrigerating specimens to protect them from degradation. This proposed paragraph restates portions of the existing rule and adds a performance standard regarding "appropriate and prudent actions" to minimize specimen degradation. (Licensees would likely meet the performance standard by implementing the more specific criteria from the current rule, which are also restated in the proposed rule.) The proposed paragraph also relaxes the refrigeration criteria for most specimens, but tightens them for non-negative specimens for validity screening, initial validity, or initial drug testing. The analysis assumes that the proposed provisions are consistent with current industry practice. To the extent (if any) that the proposed refrigeration standards (some relaxed, some tightened) might require licensees to change their operating practices, the net effect is likely to be negligible. As a result of these uncertainties (including a lack of data) and the likelihood that any impact would be negligible, this analysis does not quantify costs or savings resulting from this proposed paragraph.

Paragraph 26.129(g)

This paragraph of the proposed rule clarifies existing requirements in §2.4(i) in Appendix A to Part 26, which specify packaging and shipping requirements for urine specimens that are sent from a licensee testing facility to an HHS-certified laboratory. No incremental costs or savings will result from this proposed paragraph because it is consistent with current requirements.

Paragraph 26.129(h)

This paragraph of the proposed rule clarifies that because couriers, express carriers, and postal service personnel do not have access to the custody-and-control forms or the specimen bottles, they are not required to document chain-of-custody of a urine specimen in transit. However, this paragraph adds a new requirement that the custody accountability of the shipping containers during shipment must be maintained by a tracking system provided by the courier, express carrier, or postal service. No incremental costs or savings will result from the proposed paragraph because it describes existing courier, express carrier, and postal service shipment tracking practices.

26.131 Cutoff levels for validity screening and initial validity tests

Paragraph 26.131(a)

This paragraph of the proposed rule establishes that licensee testing facilities must conduct validity screening and/or initial validity testing on all urine specimens collected under the requirements in 10 CFR Part 26. Specimens with non-negative validity screening and/or initial validity test results must be sent to an HHS-certified laboratory for further validity testing. The analysis assumes that all licensee testing facilities will choose to conduct initial validity testing (rather than validity screening) on all urine specimens. As discussed in the Statement of Considerations, NRC is allowing the use of non-instrumented validity screening devices for the potential future benefit of licensees and other entities even though no such devices currently meet the quality assurance and quality control requirements in proposed §26.137(b). All validity testing costs are considered incremental because this is a new regulatory requirement.[1] The analysis estimates all specimen validity testing costs in the discussion of proposed §26.131(b).

Paragraph 26.131(b)

This paragraph of the proposed rule establishes specimen validity testing requirements for licensee testing facilities and requires that each urine specimen be analyzed for creatinine, pH, and one or more oxidizing adulterants and specifies the cutoff levels for each validity test (screening and initial validity). The provisions in this paragraph prohibit licensees and other entities from using more stringent cutoff levels for validity tests than those specified in 10 CFR Part 26.

The regulatory analysis calculates under this paragraph not only the costs related to conducting initial validity testing at licensee testing facilities, but also the subsequent costs for some specimens to receive initial and confirmatory validity and drug testing at an HHS-certified

[1] By assuming that no licensees currently conduct validity testing, the analysis overstates the incremental costs to be incurred by FFD programs as a result of the proposed validity testing provisions. This assumption is necessary, however, because of the lack of available data regarding the types of validity testing being conducted throughout the industry.

laboratory, and the associated costs resulting from non-negative confirmatory test results. Even though many of these costs are directly related to other proposed provisions, as referenced below, this approach consolidates the series of actions that are initiated under §26.131, allowing for a unified (hence clearer) presentation of related actions and a simpler analysis.

One-time costs captured below consist of training laboratory technicians at licensee testing facilities in the methods and procedures to conduct initial validity testing, and the annual costs associated with conducting initial validity testing at licensee testing facilities on all urine specimens (including calibrating validity testing equipment), conducting initial and confirmatory validity testing at an HHS-certified laboratory for specimens with non-negative initial validity test results, the labor costs of MRO and FFD personnel for administrative activities for confirmed non-negative validity test results, the costs of retesting some specimens with confirmed non-negative test result at the donor's request, and the costs of the appeals process for some non-negative test results that donors choose to contest. In addition, because HHS certified laboratory testing procedures and required licensee actions vary based on the type of confirmatory validity test result (e.g., dilute, invalid), the analysis discusses the costs for each validity test result type separately (designated below as "Results A, B, and C").

- "Result A": adulterated and substituted specimens
- "Result B": dilute specimens
- "Result C": invalid specimens

Annual costs per FFD program with an onsite licensee testing facility are estimated as the *sum* of the following:

- Cost to conduct initial validity testing at onsite licensee testing facilities for all urine specimens

  $$NUM_{validity} \times [(COST_{validity\ test\ reagents} + (HOURS_{lab\ tech} \times WAGE_{lab\ tech})] \times NUM_{units}$$

- Cost to conduct daily calibration of validity testing equipment

  $$NUM_{days} \times [COST_{calibration\ reagents} + (HOURS_{lab\ tech\text{-}calibrate} \times WAGE_{lab\ tech})] \times NUM_{facilities}$$

- Annualized cost of purchasing validity testing equipment (i.e., pH meter)[2]

  $NUM_{pH\ meter} \times COST_{pH\ meter} \times NUM_{facilities}$

- Cost of sending and testing all urine specimens with non-negative initial validity test results at an HHS-certified laboratory for initial and confirmatory validity testing (and drug testing under specific instances), as described by the following validity test result cases (Results A, B, and C).

  - Result A: HHS-certified laboratory validity testing costs for specimens with non-negative test results of adulterated or substituted consist of the following:

    $NUM_{validity} \times (PER_{adulterated} + PER_{substituted}) \times COST_{HHS\ validity\ testing} \times NUM_{units}$

  - Result B: HHS-certified laboratory validity testing costs for specimens with non-negative test results of dilute. Additional costs include initial drug testing using FDA-approved analytical kits with the lowest detection concentration levels available and confirmatory testing to the level of detection (LOD) as discussed in proposed §26.163(a)(2).[3] The costs include the following:

    $NUM_{validity} \times PER_{dilute} \times (COST_{HHS\ validity\ testing} + COST_{HHS\ LOD\ testing}) \times NUM_{units}$

  - Result C: HHS-certified laboratory validity testing costs for specimens with a non-negative test results of invalid. Additional costs include collecting a second urine specimen under direct observation, as specified in proposed §26.185(f)(3), and then validity and drug testing the second specimen at an HHS-certified laboratory. The costs include the following:

    $NUM_{validity} \times PER_{invalid} \times [COST_{HHS\ validity\ testing} + (COST_{2nd\ collection} + COST_{HHS\ validity\ \&\ drug\ testing})] \times NUM_{units}$

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[2] The analysis assumes that each licensee testing facility will only need to purchase one pH meter to comply with the proposed validity testing requirements because all licensee testing facilities already either lease or have purchased a desk-top sized drug testing instrument using enzyme immunoassay (EIA) technology to comply with the current requirements in 10 CFR Part 26. Reagents are commercially available for testing of creatinine and some adulterants using EIA based testing equipment. Creatinine and adulterant testing is performed on urine specimens using the same basic testing procedures as employed in conducting testing for each of the five drugs.

[3] Proposed §26.163(a)(2) requires initial drug testing of dilute specimens using analytical kits approve by the FDA that have the lowest concentration levels marketed for the technology(ies) being used to conduct initial testing of the specimen for drugs or drug metabolites. If any of the responses of the initial drug test are within 50% of the cutoff level, the HHS-certified laboratory reports the drug test result to the licensee's or other entity's MRO. Based on each FFD program's policy, the MRO may direct the HHS-certified laboratory to test the urine specimen at the confirmatory assay's LOD for that drug or drug class.

- Cost of subsequent actions for all non-negative confirmatory validity test results and non-negative drug test results identified because of the proposed validity testing requirements in §26.131(b) and §26.185(f)(3) (sum of non-negative confirmatory validity test results and non-negative drug tests from Results A, B, and C). FFD programs with onsite licensee testing facilities may also incur costs associated with some donors requesting the testing of their split specimen and/or some donors appealing their non-negative validity and/or drug test results.

  - Cost for actions subsequent to confirmed non-negative validity and/or drug test results

    $$NUM_{validity} \times [(PER_{adulterated} + PER_{substituted} + (PER_{dilute} \times PER_{non\text{-}negative\ at\ LOD}) + (PER_{invalid} \times PER_{drug\ non\text{-}neg\ 2nd\ collection}))] \times COST_{subsequent\ actions} \times NUM_{units}$$

  - When requested by some donors, the cost of retesting specimens with confirmed non-negative validity and drug test results at a second HHS-certified laboratory

    $$NUM_{validity} \times [(PER_{adulterated} + PER_{substituted} + (PER_{dilute} \times PER_{non\text{-}negative\ at\ LOD}) + (PER_{invalid} \times PER_{drug\ non\text{-}neg\ 2nd\ collection}))] \times PER_{retest} \times COST_{retest} \times NUM_{units}$$

  - When requested by some donors, the cost of the appeals process for confirmed non-negative validity and drug test results

    $$NUM_{validity} \times [(PER_{adulterated} + PER_{substituted} + (PER_{dilute} \times PER_{non\text{-}negative\ at\ LOD}) + (PER_{invalid} \times PER_{drug\ non\text{-}neg\ 2nd\ collection}))] \times PER_{appeal} \times [(HOURS_{FFD\ manager} \times WAGE_{FFD\ manger}) + (HOURS_{Worker} \times WAGE_{Worker})] \times NUM_{units}$$

One time costs per FFD program with onsite licensee testing facilities are estimated as the following:

- One time costs to train laboratory technicians in the procedures and methods to conduct initial validity tests.[4]

  $$[(NUM_{technicians} \times HOURS_{tech\ training} \times NUM_{training\ courses}) + COST_{training\ course}] \times NUM_{facilities}$$

[4] Additional laboratory technician training will be necessary because of normal employee turnover at onsite licensee testing facilities. However, this analysis estimates no incremental cost because it is assumed that laboratory technicians will receive on-the-job training as part of their normal training activities.

Parameter	Description
$NUM_{validity}$	Number of validity tests per unit per year (as discussed in the assumptions below and in Appendix 2, Exhibit A2-12)
$COST_{validity\ test\ reagents}$	Cost of reagents used to perform initial validity testing (pH, creatinine, and one adulterant) per urine specimen at an onsite licensee testing facility (as discussed in Appendix 2, Exhibit A2-13)
$HOURS_{lab\ tech}$	Hours of time for a laboratory technician to conduct initial validity testing (pH, creatinine, and one adulterant) per urine specimen at an onsite licensee testing facility (as discussed in Appendix 2, Exhibit A2-13)
$WAGE_{lab\ tech}$	Laboratory technician wage rate (as discussed in Appendix 2, Exhibit A2-11)
NUM_{days}	Number of days that a licensee testing facility conducts drug and validity testing per year (as discussed in assumptions below)
$COST_{calibration\ reagents}$	Cost of reagents used to perform daily calibration of validity testing equipment at a licensee testing facility (as discussed in Appendix 2, Exhibit A2-13)
$HOURS_{lab\ tech\ calibrate}$	Hours of time per day for a laboratory technician at a licensee testing facility to conduct daily calibration of validity testing equipment (as discussed in Appendix 2, Exhibit A2-13)
$NUM_{pH\ meter}$	Number of pH meters purchased per licensee testing facility per year. (as discussed in the assumptions below)
$COST_{pH\ meter}$	Annualized cost per pH meter, which includes the cost of replacement probes (as discussed in the assumptions below and in Appendix 2, Exhibit A2-13)
$PER_{adulterated}$	Percentage of urine specimens with non-negative validity test results of adulterated (as discussed in Appendix 2, Exhibit A2-12)
$PER_{substituted}$	Percentage of urine specimens with non-negative validity test results of substituted (less than 2 mg/dL of creatinine) (as discussed in Appendix 2, Exhibit A2-12)
$COST_{HHS\ validity\ testing}$	Cost of conducting initial and confirmatory validity testing at an HHS-certified laboratory per urine specimen with a non-negative initial validity test result determined at an onsite licensee testing facility. Costs included preparation of urine specimen and shipping costs to the HHS-certified laboratory (as discussed in the assumptions below)
PER_{dilute}	Percentage of urine specimens with non-negative validity test results of dilute (as discussed in Appendix 2, Exhibit A2-12)
$COST_{HHS\ LOD\ testing}$	Cost per specimen to conduct initial drug testing using an FDA-approved analytical kit with the lowest concentration levels available for the initial testing technologies and confirmatory drug testing to the level of detection (LOD) for the drug(s) detected in the initial drug test as discussed in proposed §26.163(a)(2) (as discussed in Appendix 2, Exhibit A2-13)
$PER_{invalid}$	Percentage of urine specimens with non-negative validity test results of invalid (as discussed in Appendix 2, Exhibit A2-12)

Parameter	Description
$COST_{2nd\ collection}$	Cost of collecting a second urine specimen under direct observation from a donor with a confirmatory validity test result of invalid for the initial urine specimen collected. The cost of the second collection includes the labor for the donor's travel time to and from the collection site, donor's time spent at the collection site, as well as the labor of the collector (as discussed in Appendix 2, Exhibit A2-13)
$COST_{HHS\ validity\ \&\ drug\ testing}$	Cost of validity and drug testing a urine specimen that is sent by an onsite licensee testing facility to an HHS-certified laboratory for testing. Costs include confirmatory drug and/or validity testing when necessary (as discussed in Appendix 2, Exhibit A2-13)
$PER_{non\text{-}negative\ at\ LOD}$	Percentage of dilute specimens that test non-negative for drug(s) at LOD testing (as discussed in the assumptions below)
$PER_{drug\ non\text{-}negative\ 2nd\ collection}$	Percentage of specimens collected under direct observation as a result of an initial specimen with an invalid test result that test non-negative for drugs (as discussed in the assumptions below)
$COST_{subsequent\ actions}$	Labor costs associated with MRO and FFD program personnel activities and administrative actions resulting from a confirmed non-negative validity and/or drug test result (as discussed in Appendix 2, Exhibit A2-13)
PER_{retest}	Percentage of urine specimens with confirmed non-negative validity and/or drug test results retested at the request of the donor at a second HHS-certified laboratory (as discussed in the assumptions below)
$COST_{retest}$	Cost of specimen retesting at a second HHS-certified laboratory including specimen preparation and shipping costs (as discussed in Appendix 2, Exhibit A2-13)
PER_{appeal}	Percentage of confirmed non-negative validity and drug test results appealed by some donors (as discussed in the assumptions below)
$HOURS_{FFD\ manager}$	Average amount of FFD manager time per appeal for a confirmed non-negative validity and/or drug test result (as discussed in the assumptions below)
$WAGE_{FFD\ manger}$	FFD manager wage rate (as discussed in Appendix 2, Exhibit A2-11)
$HOURS_{Worker}$	Average amount of worker time per appeal process for a confirmed non-negative validity and/or drug test result (as discussed in the assumptions below)
$WAGE_{Worker}$	Facility worker wage rate (as discussed in Appendix 2, Exhibit A2-11)
$NUM_{technicians}$	Number of laboratory technicians per licensee testing facility (as discussed in the assumptions below)
$HOURS_{tech\ training}$	Length of laboratory technician training course (as discussed in assumptions below)
$NUM_{training\ courses}$	Number of laboratory technician training courses per licensee testing facility (as discussed in the assumptions below)

Parameter	Description
$COST_{training\ course}$	Cost per laboratory technician training course conducted by a commercial vendor at the licensee testing facility (as discussed in the assumptions below)
$NUM_{facilities}$	Number of licensee testing facilities per FFD program (as discussed in Appendix 2, Exhibit A2-14)
NUM_{units}	Number of units per FFD program (as discussed in Appendix 2, Exhibit A2-14)

Assumptions:

- Number of validity tests per unit per year is equivalent to the number of drug tests conducted per year per unit.

- Each licensee facility that conducts onsite testing has one testing facility.

- Each licensee testing facility purchases one pH meter, which is replaced every six years. Each pH meter requires a replacement probe every two years.

- Number of days a licensee testing facility operates per year: 365 days.

- Cost of conducting initial and confirmatory validity testing at an HHS-certified laboratory for urine specimens that have a non-negative initial validity test result at an onsite licensee testing facility: $1.50 + (cost of drug test at HHS-certified laboratory, as discussed in Appendix 2, Exhibit A2-13). FFD programs contract with HHS-certified laboratories at a fixed price per urine specimen analysis which includes drug testing (initial and confirmatory when necessary) and will also include specimen validity testing (initial and confirmatory when necessary) under the proposed rule. The analysis assumes that the testing cost per urine specimen will increase by $1.50 to account for validity testing in addition to drug testing costs. This testing event would not occur under the existing rule because no validity testing is required (i.e., no specimen would be sent to an HHS laboratory for further testing based on validity problems).

- All urine specimens that test non-negative for initial validity testing as adulterated, substituted (0 to less than 2 mg/dL creatinine), or invalid at an onsite licensee testing facility remain non-negative after initial and confirmatory validity testing at an HHS-certified laboratory.

- All FFD programs choose to conduct confirmatory drug testing to the LOD for any drug or drug class detected in dilute specimens during the initial drug testing using FDA-approved analytical kits with the lowest concentration levels available.

- Percentage of dilute specimens that test non-negative for drug(s) at LOD testing: 33 percent.

- For all urine specimens with non-negative validity test results of invalid, the analysis assumes that a second specimen is collected under direct observation.

- Percentage of specimens collected under direct observation as a result of an initial specimen with an invalid test result that test non-negative for drugs (as discussed in the assumptions below).[5]

- Percentage of urine specimens with confirmed non-negative validity and/or drug test results retested at the request of the donor at a second HHS-certified laboratory: 5 percent.

- Average amount of FFD manager time per appeal process for a confirmed non-negative validity and/or drug test result: 12.5 hours.

- Average amount of worker time per appeal process for a confirmed non-negative validity and/or drug test result: 2.0 hours.

- Percentage of confirmed non-negative drug test results appealed by some donors: 1 percent.

- Number of laboratory technicians per licensee testing facility: 4.

- Length of laboratory technician training course: 4 hours.

- Number of laboratory technician training courses per licensee testing facility: 1.

- Cost per laboratory technician training course conducted by a commercial vendor at a licensee testing facility: $500.00.

26.133 Cutoff levels for drugs and drug metabolites

This proposed paragraph section revises existing requirements in §2.7(e)(1) in Appendix A to Part 26, which pertain to the initial cutoff levels for drugs (marijuana, cocaine, opiate, phencyclidine, amphetamines). The proposed rule will lower the initial cutoff level for marijuana metabolites from 100 ng/mL to 50 ng/mL. FFD programs using onsite testing facilities will incur annual

[5] A second specimen is collected under direct observation for donors that have an initial specimen with an invalid test result to reduce the probability that their second specimen will be altered (e.g., use of adulterants) and therefore, the drug use that was attempted to be masked during the initial specimen donation will more likely be detected in the second specimen collected.

incremental costs as a result of the more stringent testing cutoff level, which will increase the number of non-negative drug tests for marijuana.[6] The additional costs will consist of the costs of initial and confirmatory drug testing at an HHS-certified laboratory, labor costs for the MRO and FFD personnel activities resulting from confirmed non-negative drug test results, the costs of retesting specimens at a second HHS-certified laboratory at the request of some donors, and the costs of the appeals process for some non-negative test results that donors choose to contest. The proposed rule will also raise the initial cutoff level for opiate metabolites from 300 ng/mL to 2,000 ng/mL. FFD programs using onsite licensee testing facilities will realize annual incremental savings as a result of the less stringent testing cutoff level, which will substantially reduce the number of non-negative opiate drug tests that MROs ultimately verify as negative. Savings are associated with eliminating specimen testing costs at an HHS-certified laboratory, labor costs of the MRO and FFD personnel activities resulting from non-negative drug tests results, the costs of retesting specimens at a second HHS-certified laboratory at the request of some donors, and the cost of the appeals process for some non-negative test results that donors choose to contest.

Annual costs per FFD program with an onsite licensee testing facility for additional confirmed non-negative marijuana drug tests are estimated as the sum of the following:

- Cost for initial and confirmatory drug tests at HHS-certified laboratories

  $(NUM_{marijuana} \times PERI_{marijuana} \times COST_{HHS\ validity\ \&\ drug\ testing}) \times NUM_{units}$

- Cost for actions subsequent to non-negative confirmatory marijuana drug test results from the HHS-certified laboratory

  $(NUM_{marijuana} \times PERI_{marijuana} \times COST_{subsequent\ actions}) \times NUM_{units}$

- Cost for retesting confirmed non-negative marijuana drug test specimens at a second HHS-certified laboratory at the request of some donors

  $(NUM_{marijuana} \times PERI_{marijuana} \times PER_{retest} \times COST_{retest}) \times NUM_{units}$

- Cost of appeals process for confirmed non-negative marijuana test results that some donors choose to contest

  $(NUM_{marijuana} \times PERI_{marijuana} \times PER_{appeal}) \times [(HOURS_{FFD\ manager} \times WAGE_{FFD\ manger}) + HOURS_{Worker} \times WAGE_{Worker})] \times NUM_{units}$

[6] The analysis over-estimates the costs of additional confirmed non-negative marijuana test results due to the proposed lower initial cut-off level (50 ng/mL) because some licensees may already be testing to the proposed cut-off level.

Annual savings per FFD program with an onsite licensee testing facility for fewer confirmed non-negative opiate drug test results are estimated as the sum of the following:

- Saving from fewer non-negative opiate drug test specimens requiring testing at HHS-certified laboratories

  $(NUM_{opiate} \times PERD_{opiate} \times COST_{HHS\ validity\ \&\ drug\ testing}) \times NUM_{units}$

- Saving from fewer confirmed non-negative opiate drug test results and the associated subsequent actions

  $(NUM_{opiate} \times PERD_{opiate} \times COST_{subsequent\ actions}) \times NUM_{units}$

- Saving from fewer confirmed non-negative opiate drug test specimens retested at another HHS-certified laboratory at the request of donors

  $(NUM_{opiate} \times PERD_{opiate} \times PER_{retest} \times COST_{retest}) \times NUM_{units}$

- Saving from fewer appeals for some confirmed non-negative opiate drug test results

  $(NUM_{opiate} \times PERD_{opiate} \times PER_{appeal}) \times [(HOURS_{FFD\ manager} \times WAGE_{FFD\ manger}) + HOURS_{Worker} \times WAGE_{Worker})] \times NUM_{units}$

Parameter	**Description**
$NUM_{marijuana}$	Number of confirmed non-negative marijuana drug test results per unit per year under the current rule (as discussed in Appendix 2, Exhibit A2-12)
$PERI_{marijuana}$	Percentage increase in non-negative marijuana drug tests results due to the more stringent cutoff level in the proposed rule (as discussed in the assumptions below)
$COST_{HHS\ validity\ \&\ drug\ testing}$	Cost of preparing and shipping a urine specimen with an initial non-negative drug test result to an HHS-certified laboratory and the cost of validity and drug testing at the HHS-certified laboratory (as discussed in Appendix 2, Exhibit A2-13)
$COST_{subsequent\ actions}$	Labor costs associated with MRO and FFD program personnel activities and administrative actions resulting from a confirmed non-negative drug test result (as discussed in Appendix 2, Exhibit A2-13)
PER_{retest}	Percentage of urine specimens with confirmed non-negative drug test results retested at the request of the donor at a second HHS-certified laboratory (as discussed in the assumptions below)
$COST_{retest}$	Cost of specimen retesting at second HHS-certified laboratory including specimen preparation and shipping costs (as discussed in Appendix 2, Exhibit A2-13)
NUM_{opiate}	Number of confirmed non-negative opiate drug test results per unit per year under current rule (as discussed in Appendix 2, Exhibit A2-12)

Parameter	Description
$PERD_{opiate}$	Percentage decrease in confirmed non-negative opiate drug test results due to the higher cutoff level in the proposed rule (as discussed in the assumptions below)
PER_{appeal}	Percentage of confirmed non-negative drug test results appealed by some donors (as discussed in the assumptions below)
$HOURS_{FFD\ manager}$	Average amount of FFD manager time per appeal process for a confirmed non-negative drug test result (as discussed in the assumptions below)
$WAGE_{FFD\ manager}$	FFD manager wage rate (as discussed in Appendix 2, Exhibit A2-11)
$HOURS_{Worker}$	Average amount of worker time per appeal process for a confirmed non-negative drug test result (as discussed in the assumptions below)
$WAGE_{Worker}$	Facility worker wage rate (as discussed in Appendix 2, Exhibit A2-11)
NUM_{units}	Number of units per FFD program (as discussed in Appendix 2, Exhibit A2-14)

Assumptions:

- Changing the cutoff thresholds for marijuana and opiates will not result in a change in assay costs, nor will the changes require the upgrading of testing facility equipment. Testing facilities will have to purchase new standards and controls specific for the changes in the cutoff thresholds; however, the purchasing of standards and controls is a normal operations cost and will not result in an incremental change.

- FFD programs pay HHS-certified laboratories a per specimen cost, which includes both initial and confirmatory drug testing.

- Percentage increase in non-negative marijuana drug tests results due to the more stringent cutoff level in the proposed rule: 40 percent.[7]

- Percentage decrease in confirmed non-negative opiate drug test results due to the higher cutoff level in the proposed rule: 75 percent.[8]

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[7] The experience of HHS-certified laboratories when U.S. DOT changed the marijuana metabolite cutoff level from 100 ng/mL to 50 ng/mL increased the number of non-negative marijuana test results from 25-40 percent. Several licensees currently test for marijuana metabolites at the proposed 50 ng/mL cutoff level. One licensee reported 49 additional non-negative test results over a two and one-half year period, (an increase of 57 percent over the 100 ng/ml cutoff level).

[8] Raising the initial cutoff level for opiate metabolites will almost eliminate poppy seed false positive results, and unless an individual consumes large prescribed doses of codeine based cough syrup or other cold prescriptions, the proposed threshold will significantly reduce non-negative screening results for opiates due to legitimate use of prescribed cold and cough prescriptions.

- Percentage of urine specimens with confirmed non-negative drug test results retested at the request of the donor at a second HHS-certified laboratory: 5 percent.

- Average amount of FFD manger time per appeal process for a confirmed non-negative drug test result: 12.5 hours.

- Average amount of worker time per appeal process for a confirmed non-negative drug test result: 2.0 hours.

- Percentage of confirmed non-negative drug test results appealed by some donors: 1 percent.

26.135 Split specimens

Paragraph 26.135(a)

No incremental costs or savings will result from this proposed paragraph, which restates without substantive change the existing requirements in §2.7(j) in Appendix A to Part 26, which pertain to split-specimen handling, testing, and storage procedures. The proposed revisions conform the current requirements with the terminology used in other parts of the proposed regulation, but they do not change the meaning of the existing requirements.

Paragraph 26.135(b)

This paragraph of the proposed rule restates and revises existing requirements in §2.7(j) in Appendix A to Part 26, which specify the specimen shipping procedures for licensee testing facilities when notified that a donor has requested that a split specimen be tested by a second HHS-certified laboratory. The current requirement maintains that the licensee testing facility may forward the split specimen to a second HHS-certified laboratory on the same day that the laboratory receives notice that a donor has requested testing of their split specimen. The proposed paragraph relaxes the existing requirement by providing one business day following the day of the donor's request for the specimen to be forwarded to a second HHS-certified laboratory. No incremental costs or savings will result from this proposed paragraph as it provides licensees with additional time to respond to a donor's request for specimen retesting, but does not change the required activity.

Paragraph 26.135(c)

There is no incremental cost or saving from this proposed paragraph as it clarifies existing requirements in §2.7(h) in Appendix A to Part 26, which pertain to long-term frozen storage of non-negative urine specimens (referred to in the proposed rule as "non-negative" specimens).

26.137 Quality assurance and quality control

Paragraph 26.137(a)

This paragraph of the proposed rule restates without substantive change the existing existing requirements in §2.8(a) in Appendix A to Part 26, which describe the elements of a licensee testing facility quality assurance program.

Paragraph 26.137(b)

This paragraph of the proposed rule establishes performance testing and quality control requirements for validity screening tests conducted at licensee testing facilities. As discussed in §26.131(a) of the analysis, the analysis assumes that no licensee testing facilities will conduct validity screening tests. However, given that the proposed rule in §26.131(a) now requires validity testing of each urine specimen (either validity screening and/or initial validity testing) by licensee testing facility, compliance with this proposed paragraph or that of §§26.137(c) or (d) is a new requirement. No incremental costs or savings will result from this proposed paragraph because the analysis assumes that licensees will conduct initial validity tests. The costs for all licensee testing facility validity tests costs are included in §26.137(d).

Paragraph 26.137(c)

This proposed paragraph establishes that if a licensee testing facility conducts validity screening tests on urine specimens, for specimens with non-negative validity screening results (i.e., adulterated, substituted, dilute, or invalid), the licensee testing facility must either then perform initial validity testing or must send the specimens to an HHS-certified laboratory for additional validity testing. As discussed in §26.131(a), the analysis assumes that no licensee testing facilities will conduct validity screening tests. Therefore, no incremental costs or savings will result from this proposed paragraph. However, given that the proposed rule in §26.131(a) now requires validity testing of each urine specimen (either validity screening and/or initial validity testing) by each licensee testing facility, compliance with this proposed paragraph or that of §§26.137(b) or (d) is a new requirement.

Paragraph 26.137(d)

This paragraph of the proposed rule establishes the quality control requirements that analytical equipment must meet in order to be used to perform initial validity tests and specifies the quality control samples that must be included in each analytical run. The incremental costs of initial validity testing (including quality control measures) are included in the per test cost to conduct initial validity testing, as discussed in connection with §26.131.

Paragraph 26.137(e)

This paragraph of the proposed rule revises quality control requirements for initial drug tests that are performed at licensee testing facilities, as discussed in §§26.137(e)(1)–(8).

Subparagraph 26.137(e)(1)

There are no incremental costs or savings from this proposed subparagraph as it clarifies existing requirements in §2.7(e)(1) in Appendix A to Part 26, which require licensee testing facilities to conduct initial drug tests using an immunoassay meeting the requirements of the Food and Drug Administration (FDA) for commercial distribution. This subparagraph also adds a new provision that prohibits non-instrumented immunoassay testing devices that are pending HHS/Substance Abuse and Mental Health Services Administration (SAMHSA) review and approval from being used for initial drug testing under this part. The subparagraph also adds a provision that licensees and other entities may not take management action against an individual based on any drug test results obtained from non-instrumented devices that may be used for validity screening tests. The new requirements in this subparagraph will result in no incremental costs or savings for licensee testing facilities because the provisions simply prohibit the use of specific analytical equipment and prevent management action based on non-instrumented devices.

Subparagraph 26.137(e)(2)

This subparagraph of the proposed rule establishes that negative urine specimens must be discarded or pooled for use in the licensee testing facility's internal quality control program, as long as the specimens are certified as drug-negative and valid by an HHS-certified laboratory. The analysis assumes that licensee testing facilities will choose the most cost-effective method of obtaining negative urine specimens to be used as their quality control testing specimens, and that licensee testing facilities already (1) purchase negative urine specimens directly from a vendor selling HHS-certified drug negative urine or from an HHS-certified laboratory, (2) pool the negative urine specimens analyzed at their testing facility and submit them to an HHS-certified laboratory for testing to certify that they are drug-negative. The proposed rule will not change these practices, so no incremental costs or savings will result.

Subparagraph 26.137(e)(3)

No incremental cost or saving will result from this proposed subparagraph as it affords licensee testing facilities the flexibility to conduct multiple initial drug tests for the same drug or drug class, provided that all tests meet the cutoffs and quality control requirements in this part.

Subparagraph 26.137(e)(4)

No incremental cost or saving will result from this proposed subparagraph, which restates existing requirements in §2.8(b) in Appendix A to Part 26.

Subparagraph 26.137(e)(5)

This subparagraph of the proposed rule revises an existing requirement in §2.8(b) in Appendix A to Part 26, which mandates that each licensee testing facility submit a "sampling" of urine specimens screening negative for drugs from each test run to an HHS-certified laboratory for additional drug testing to ensure that the drug testing process of the licensee testing facility is accurate, with no false negative tests results. This subparagraph revises the existing requirement by clarifying that the term "sampling" means a minimum of 5 percent (or at least 1) of the drug test specimens screening negative for drugs from every analytical run. Some FFD programs using onsite licensee testing facilities may realize annual incremental savings resulting from this proposed rule revision. Licensee testing facilities that submit a sample of negative drug test specimens from each analytical run below the 5 percent maximum proposed level will not be affected by this proposed subparagraph because current practice already meets the proposed rule requirement. Even though some onsite licensee testing facilities may be submitting more than 5 percent of negative drug test specimens per analytical run to an HHS-certified laboratory, an accurate estimate on savings is not possible due to a lack of data on current onsite licensee testing facility practices.

Subparagraph 26.137(e)(6)

This subparagraph of the proposed rule extends to licensee testing facilities the existing requirements in §2.8(c) in Appendix A to Part 26, which pertain to the quality control samples that must be included in each analytical run of initial drug tests performed by HHS-certified laboratories. The quality control samples must consist of: (1) specimen(s) certified to contain no drug (i.e., negative urine samples), (2) at least one control fortified with a drug or drug metabolite targeted at 25 percent above the cutoff, and (3) at least one control fortified with a drug or drug metabolite targeted at 75 percent of the cutoff. This subparagraph imposes no incremental cost and affords no saving because licensee testing facilities are assumed to use appropriate control specimens in each analytical run, as specified by the manufacturer's operating manuals for drug testing equipment.

Subparagraph 26.137(e)(7)

This subparagraph of the proposed rule extends to licensee testing facilities the existing requirements in §2.8(c) in Appendix A to Part 26, which mandate that HHS-certified laboratories must include a minimum of 10 percent of the total number of urine specimens in each analytical run as quality control samples, of which one percent (or a minimum of one quality control specimen) must be a blind performance test sample that appears normal to the laboratory

technician. The analysis estimates that all FFD programs with testing facilities will incur an incremental cost per urine specimen analyzed to comply with this proposed paragraph.

The *annual cost per FFD program with onsite licensee testing facilities* are estimated as follows:

$$(NUM_{specimens} \times COST_{specimen} \times PERI_{cost}) \times NUM_{units}$$

Parameter	Description
$NUM_{specimens}$	Number of urine specimens analyzed per unit per year for FFD programs with onsite licensee testing facilities (as discussed in the assumptions below and in Appendix 2, Exhibit A2-12)
$COST_{specimen}$	Cost per urine specimen to conduct drug testing as specified in the existing requirements (as discussed in Appendix 2, Exhibit A2-11)
$PERI_{cost}$	Percentage increase in the average urine specimen analysis cost based on the change in costs to comply with the proposed quality control specimen testing requirements (as discussed in the assumptions below)
NUM_{units}	Number of units per FFD program (as discussed in Appendix 2, Exhibit A2-14)

Assumptions:

- Number of urine specimens analyzed per unit per year for FFD programs with onsite licensee testing facilities is equivalent to the number of drug tests performed per unit per year for FFD programs with onsite licensee testing facilities.

- Percentage increase in the average urine specimen analysis cost based on the change in costs to comply with the proposed quality control specimen testing requirements [this includes the increase in costs per blind performance test specimen to comply with the inclusion of adulterated, substituted, dilute and invalid specimens as a part of the percentage of non-negative specimens as discussed in §26.167(f) of Subpart G]: 10 percent.

Subparagraph 26.137(e)(8)

This subparagraph of the proposed rule extends to licensee testing facilities the existing requirements in §2.8(c) in Appendix A to Part 26, which mandate that (HHS-certified) laboratories must implement procedures to ensure that carryover does not contaminate the testing of a donor's specimen. This subparagraph imposes no incremental cost and affords no savings because it is consistent with existing specimen handling procedures used by licensee testing facilities.

Paragraph 26.137(f)

This paragraph of the proposed rule clarifies that it is the licensees' responsibility to investigate errors in the testing of quality control samples, the testing of actual specimens, or the processing of management reviews and/or MRO reviews, as well as any other errors or matters that could reflect adversely on the licensees' testing process. The licensees' mandated responsibility also includes taking action to correct errors that are within the licensees' control. This analysis assumes that no incremental costs or savings will result from the proposed paragraph because licensees are currently responsible [under a performance standard in §2.8(a) in Appendix A to Part 26] for having "a quality assurance program which encompasses all aspects of the testing process."

Paragraph 26.137(g)

There is no incremental cost or saving from this proposed paragraph as it restates an existing rule requirement in §2.7(o)(3)(i) in Appendix A to Part 26.

Paragraph 26.137(h)

This paragraph of the proposed rule clarifies and revises existing requirements in §2.7(o)(2) in Appendix A to Part 26, which require licensee testing facilities to use "HHS-certified laboratory standards." The proposed rule relaxes the existing requirements by permitting licensee testing facilities to use "stock standard solutions obtained from other laboratories, or standard solutions obtained from commercial manufacturers." This analysis assumes that any incremental saving from this proposed paragraph will be insignificant.

26.139 Reporting initial validity and drug test results

Paragraph 26.139(a)

No incremental cost or saving is estimated for this proposed paragraph, which restates without substantive change requirements in §2.7(g)(2) in Appendix A to Part 26, as they relate to drug testing. Proposed §26.131(a) requires validity screening and/or initial validity test results. The new provisions in this paragraph add reporting requirements for negative and non-negative validity screening and initial validity test results. Licensee testing facilities are prohibited from reporting non-negative screening and/or initial validity test results to licensee or other entity management. The new provisions in this proposed paragraph will result in no incremental costs or savings because the provisions prohibit communication of specific types of test results rather than require any specific activity. In addition, because licensee testing facilities already have established communication methods to transmit drug tests results to licensee and FFD management, the inclusion of validity test results will result in an no incremental cost or saving.

Paragraph 26.139(b)

This paragraph of the proposed rule restates without substantive change an existing requirement in §26.24(d)(1), which limits access to initial drug test results to licensee testing staff, the MRO, the FFD manager, and EAP personnel (when appropriate). The proposed rule also authorizes additional individuals (the MRO, MRO's staff, the FFD program manager, and EAP staff) to access initial drug test results. No incremental cost or savings will result from the proposed paragraph because it clarifies who is permitted access to testing results.

Paragraph 26.139(c)

No incremental costs or savings will result from this proposed paragraph which restates the existing requirements in §2.7(o)(5) in Appendix A to Part 26, which mandate that a licensee testing facility must have qualified personnel available to testify at proceedings against an individual based on urinalysis results.

Paragraph 26.139(d)

This paragraph of the proposed rule revises the existing requirements in §2.7(g)(6) in Appendix A to Part 26, which specify that licensee testing facilities must provide a monthly statistical summary of urinalysis data to a licensee official responsible for coordinating the FFD program. The proposed paragraph only requires that licensee testing facilities must prepare the information required for the annual report that each FFD program must provide to NRC on an annual basis, as discussed in proposed §26.201. Therefore, licensee testing facilities will now prepare the statistical summary of urinalysis data only on an annual basis. Incremental savings will be realized by each FFD program due to the reduction in labor costs associated with the elimination of monthly statistical summary reports. Some of the savings will be offset by the labor costs associated with annual report preparation.

- *Annual savings per FFD program with onsite testing facilities* are estimated as follows:

$$(HOURS_{monthly\ report} \times WAGE_{laboratory\ supervisor} \times NUM_{monthly\ reports} \times NUM_{facilities}) - (HOURS_{annual\ report} \times WAGE_{laboratory\ supervisor} \times NUM_{facilities})$$

Parameter	Description
$HOURS_{monthly\ report}$	Time for a laboratory supervisor per licensee testing facility to prepare a monthly statistical summary report of urinalysis testing data (as discussed in the assumptions below)
$WAGE_{laboratory\ supervisor}$	FFD manager wage rate (as discussed in Appendix 2)
$NUM_{monthly\ reports}$	Number of monthly reports per FFD program per year

Parameter	Description
$HOURS_{annual\ report}$	Time for a laboratory supervisor per licensee testing facility to prepare an annual statistical summary report of urinalysis testing data (as discussed in the assumptions below)
$NUM_{facilities}$	Number of licensee testing facilities per FFD program (as discussed in Appendix 2)

Assumptions:

- Time for a laboratory supervisor per licensee testing facility to prepare a monthly statistical summary report of urinalysis testing data: 1.5 hours.

- Time per report for a laboratory supervisor to prepare an annual statistical summary report of drug testing data: 4 hours.

Paragraph 26.139(e)

This paragraph of the proposed rule revises the existing requirements in §2.7(g)(7) in Appendix A to Part 26, which pertain to the reporting of drug testing results to NRC. Under the current rule, if a licensee conducts drug testing using more stringent cutoff levels than required in 10 CFR Part 26, the licensee must report the drug test results for the cutoff levels mandated by Part 26, as well as more stringent levels. The proposed rule relaxes the reporting requirements and only requires licensees to report in the annual report to NRC the drug testing information for either the cutoff levels specified in §26.31(d)(1) or for any more stringent cutoff levels used by the FFD program. In addition, if the licensee tests for additional drugs beyond those specified in §26.31(d)(1), this proposed paragraph adds a requirement that the annual report also include the number of positive test results and the cutoff levels used for those additional drugs and drug metabolites. No incremental costs or savings are estimated for the proposed paragraph because licensee testing facilities conducting drug testing using more stringent cutoff levels and/or testing for additional drugs beyond Part 26 requirements already tabulate the necessary testing data under the current rule.

Paragraph 26.139(f)

This paragraph of the proposed rule adds a new requirement that the designated FFD program official use the available information from the licensee testing facility's validity and drug test results, the results of quality control testing performed at the licensee testing facility, and the results from testing the quality control samples that the licensee testing facility submits to the HHS-certified laboratory to evaluate continued testing program effectiveness and detect any local trends in drugs of abuse that may require management action or FFD program adjustments. No incremental costs or savings are estimated because this requirement is consistent with current oversight practices of existing FFD programs.

Subpart G: Laboratories Certified by the Department of Health and Human Services

26.151 Purpose

This section of the proposed rule imposes no incremental cost and affords no saving because it merely states that the purpose of this subpart is to present requirements pertaining to HHS-certified laboratories used by licensees and C/Vs for specimen validity and drug testing.

26.153 Using certified laboratories for testing urine specimens

Paragraph 26.153(a)

This paragraph of the proposed rule revises existing requirements in §26.24(f) and §§1.1(3), 2.7(l)(1), and 4.1(a) in Appendix A to Part 26, which authorizes licensees to use only HHS-certified laboratories to perform urine drug testing, except for initial drug tests conducted at a licensee's testing facility as permitted by §26.24(d)(2). This proposed paragraph only authorizes the use of HHS-certified laboratories that have the capability at the same location to perform drug testing and specimen validity testing, except for initial validity and initial drug tests that are authorized to be conducted at a licensee's testing facility, as stated in §26.31(d)(3)(ii). These requirements impose no incremental cost and afford no saving because HHS-certified laboratories are already qualified to conduct validity testing (the incremental costs associated with validity testing are discussed in §26.161(b)(1)).

Paragraph 26.153(b)

This paragraph of the proposed rule revises existing requirements in §2.7(l)(2) in Appendix A to Part 26, which direct licensees to use only HHS-certified laboratories that have the capability to conduct, at the same location, both initial and confirmatory testing for the drugs required in Part 26. The proposed paragraph requires that HHS-certified laboratories must also have the capability to perform initial and confirmatory tests for specimen validity. These requirements impose no incremental cost and afford no saving because HHS-certified laboratories already have this capability and have been conducting validity testing for U.S. DOT-regulated entities.

Paragraph 26.153(c)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it restates without substantive change existing requirements in §2.7(k) in Appendix A to Part 26, which prohibit HHS-certified laboratories from subcontracting work unless authorized by the licensee. This paragraph clarifies that this restriction also applies to HHS-certified laboratories used by other entities who have licensee approved FFD programs.

Paragraph 26.153(d)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it restates without substantive change existing requirements in §4.1(b) in Appendix A to Part 26, which pertain to the use of HHS-certified laboratories when conducting drug testing beyond Part 26 requirements.

Paragraph 26.153(e)

This paragraph of the proposed rule clarifies and amends existing requirements in §2.7(m) in Appendix A to Part 26, which require licensees to conduct a pre-award inspection and evaluation of the procedural aspects of a laboratory's drug testing operation before awarding a contract to the laboratory. The proposed paragraph clarifies that pre-award inspections and evaluations must be conducted by qualified personnel. Also, the proposed paragraph adds a provision allowing licensees to immediately begin using the services of a second HHS-certified laboratory without first conducting a pre-award inspection if the licensee's first laboratory loses its certification and the second laboratory is already conducting drug testing for another licensee or other entity subject to 10 CFR Part 26. Incremental savings will result from the elimination of pre-award inspection and evaluation costs for FFD programs that need to replace a decertified laboratory with a new HHS-certified laboratory that is already in use by another FFD program.

The *annual savings per FFD program* are estimated as follows:

$$HOURS_{inspection} \times WAGE_{FFD\ manager} \times PER_{decertification} \times PER_{known\ HHS\ lab}$$

Parameter	**Description**
$HOURS_{inspection}$	Hours per pre-award inspection of an HHS-certified laboratory conducted by licensee personnel or a designee (as discussed in the assumptions below)
$WAGE_{FFD\ manager}$	FFD manager wage rate (as discussed in Appendix 2, Exhibit A2-11)
$PER_{decertification}$	Percentage of FFD programs that must change to a new HHS-certified laboratory per year because their current HHS-certified laboratory loses its certification (as discussed in the assumptions below)
$PER_{known\ HHS\ lab}$	Percentage of instances in which a replacement HHS-certified laboratory is being used by another FFD program (also identified in this analysis as a "known" HHS lab) (as discussed in the assumptions below)

Assumptions:

- Hours per pre-award inspection: 100 hours, assumed to be the FFD manager.
- Each FFD program only contracts with one HHS-certified laboratory at a time.

- Percentage of FFD programs that must change to a new HHS-certified laboratory per year because their current HHS-certified laboratory loses its HHS-certification or withdraws from the certification program: 10 percent.

- Percentage of instances in which a replacement HHS-certified laboratory is being used by another FFD program (also identified in this analysis as "known" HHS lab): 50 percent.

Paragraph 26.153(f)

This paragraph of the proposed rule restates existing requirements in §2.7(m) in Appendix A to Part 26, which mandate that licensees require their HHS-certified laboratories to implement and comply with all applicable requirements in Part 26.[1] The proposed subparagraphs specify the minimum contractual terms between a licensee or C/V and their HHS-certified laboratory as discussed below:

- Subparagraph 26.153(f)(1) restates existing requirements in §2.7(l)(1) in Appendix A to Part 26.

- Subparagraph 26.153(f)(2) clarifies existing requirements in §2.7(o)(5) in Appendix A to Part 26.

- Subparagraph 26.153(f)(3) clarifies existing requirements in §3.1 in Appendix A to Part 26.

- Subparagraph 26.153(f)(4) clarifies existing requirements in §3.2 in Appendix A to Part 26.

- Subparagraph 26.153(f)(6) clarifies existing requirements in §2.7(m) in Appendix A to Part 26.

Proposed paragraph 26.153(f) also adds one new contract term as discussed below:

- Subparagraph 26.153(f)(5) prohibits HHS-certified laboratories from entering into any relationships with a licensee's or other entity's MRO when such relationships may be construed as potential conflicts of interest. Although this is a new requirement, it is consistent with ethical business practices and with HHS' mandatory guidelines for HHS-certified labs. Consequently, although programs may incur an incremental cost to revise

[1] HHS-certified laboratories will pass on the costs associated with specific rule revisions to licensees through increased specimen testing costs. The analysis accounts for these incremental costs associated with implementation of validity testing requirements in §§26.131(a) and 26.161(b), the most significant testing change resulting from the proposed rule revisions.

certain contracts to incorporate the new provision, such costs would fall only on programs with contracts that (a) do not already contain such a provision, and (b) will not update themselves automatically by incorporating the NRC provisions "by reference." The analysis assumes that any costs resulting from this provision are reflected within the legal and managerial costs calculated for §26.27(a).

Paragraph 26.153(g)

This paragraph of the proposed rule adds a requirement that licensees and other entities must provide their HHS-certified laboratory with an explanatory memorandum for the record in situations where a non-Federal custody-and-control form is used for a specimen collection. The memorandum must describe why the form is being used and must state that the form contains all information required in the Federal custody-and-control form. Incremental costs per FFD program result from the labor costs of collection site personnel to write each memorandum.

The *annual costs per FFD program* are estimated as follows:

$$[NUM_{memoranda} \times (HOURS_{collector} \times WAGE_{collector})] \times NUM_{facilities}$$

Parameter	**Description**
$NUM_{memoranda}$	Number of memoranda per year a collection site used by a facility will write because it uses a non-Federal custody-and-control form for a specimen collection (as discussed in the assumptions below)
$HOURS_{collector}$	Time for collection staff to draft a memorandum(as discussed in the assumptions below)
$WAGE_{collector}$	Wage of collection site personnel (as discussed in Appendix 2, Exhibit A2-11)
$NUM_{facilities}$	Number of facilities per FFD program (as discussed in Appendix 2, Exhibit A2-14)

Assumptions:

- Number of memoranda per year a collection site used by a facility will write because it uses a non-Federal custody-and-control form for a specimen collection: 2.

- Time for collection staff to draft a memorandum: 15 minutes.

26.155 Laboratory personnel

Paragraph 26.155(a)

The proposed paragraph restates without substantive change an existing requirement in §2.5(a)(1) in Appendix A to Part 26 by replacing the term "qualified individual" with the term

"responsible person." The proposed subparagraphs (a)(1)–(6) restate the existing requirements in §§2.5(a)(2)–(7) in Appendix A to Part 26 by defining the qualifications and responsibilities of the individual responsible for the HHS-certified laboratory's testing facility. Therefore, this proposed paragraph imposes no incremental costs and affords no savings.

Paragraph 26.155(b)

This paragraph of the proposed rule revises an existing requirement in §2.5(b) in Appendix A to Part 26, which describes the "qualified individual who reviews all pertinent data and quality control results in order to attest to the validity of the laboratory's test reports." The proposed paragraph introduces the term "certifying scientist" to clarify the term "qualified individual" in the existing requirement. The proposed rule also establishes the qualifications for a certifying scientist. No incremental costs or savings are expected to result from this proposed paragraph because the proposed qualifications for a certifying scientist are consistent with existing HHS-laboratory personnel qualification requirements.

Paragraph 26.155(c)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it restates without substantive change existing requirements in §2.5(c) in Appendix A to Part 26.

Paragraph 26.155(d)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it restates without substantive change existing requirements in §2.5(d) in Appendix A to Part 26.

Paragraph 26.155(e)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it restates without substantive change existing requirements in §2.5(e) in Appendix A to 10 CFR Part 26.

Paragraph 26.155(f)

This paragraph of the proposed rule simplifies existing requirements in §2.5(f) in Appendix A to Part 26, which mandate that laboratory personnel files must include: "resume of training and experience; certification or license, if any; references; job descriptions; records of performance evaluation and advancement; incident reports; and results of tests which establish employee competency for the position he or she holds . . ." Under the proposed paragraph, personnel files will no longer need to include: references, referrals, and incident reports, but must still include "a resume, any professional certification(s) or license(s), a job description, and documentation to show that the individual has been properly trained to perform his or her job." Even though the proposed paragraph represents a relaxation of the existing recordkeeping requirements applicable

to HHS-certified laboratories, the analysis assumes that laboratories will not alter their file maintenance practices (and will not incur savings) because businesses commonly maintain the aforementioned documents that are no longer required.

26.157 Procedures

Paragraph 26.157(a)

This paragraph of the proposed rule revises existing requirements in §2.2 in Appendix A to Part 26, which pertain to the maintenance and documentation of procedures for collecting, shipping, and accessing urine specimens. The proposed rule clarifies that the HHS-certified laboratory must also maintain procedures for receiving and testing specimens. The proposed paragraph imposes no incremental cost and affords no saving because it is consistent with the procedures and practices of existing HHS-laboratories.

Paragraph 26.157(b)

This paragraph of the proposed rule revises existing requirements in §2.7(a)(2) in Appendix A to Part 26, which pertain to the content and implementation of specimen chain-of-custody procedures for HHS-certified laboratories. The proposed rule adds that the HHS-certified laboratory must have written chain-of-custody procedures for shipping specimens to another HHS-certified laboratory. The proposed paragraph imposes no incremental cost and affords no saving because the new requirement is consistent with the existing specimen chain-of custody procedures used by HHS-certified laboratories.

Paragraph 26.157(c)

The proposed paragraph revises existing requirements in §2.7(o)(1) in Appendix A to Part 26, which require that each HHS-certified laboratory maintain a "procedure manual." The proposed paragraph adds flexibility as to how HHS-certified laboratories maintain laboratory procedures. This proposed paragraph only requires that HHS-certified laboratories maintain written procedures, but does not indicate that the procedures must be located in a procedures manual. The proposed revision imposes no incremental costs or savings because laboratory procedures must still be maintained.

Paragraph 26.157(d)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it restates without substantive change an existing requirement in §2.7(o)(3)(iii) in Appendix A to Part 26.

Paragraph 26.157(e)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it restates without substantive change existing requirements in §2.7(o)(4) in Appendix A to Part 26, which mandate that licensee testing facilities must develop, implement, and maintain procedures for remedial actions if systems do not meet acceptable limits or errors are detected.

26.159 Assuring specimen security, chain of custody, and preservation

Paragraph 26.159(a)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it restates without substantive change existing requirements in §2.7(a)(1) in Appendix A to Part 26, which pertain to laboratory security. This proposed paragraph provides added flexibility to existing security requirements mandating escorted access to all visitors, maintenance, and service personnel by enumerating individuals who are permitted to be unescorted in an HHS-certified laboratory (e.g., personnel conducting inspections and audits on behalf of licensees, other entities, the NRC, the Secretary of the DHHS, and emergency personnel).

Paragraph 26.159(b)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it restates existing requirements in §2.7(b)(1) in Appendix A to Part 26. The proposed rule also requires each licensee to investigate possible tampering and take corrective actions when necessary. If there is a reason to believe that the integrity or identity of a specimen is in question, the specimen is not to be tested and the licensee or C/V must ensure that another collection occurs as soon as reasonably practicable. The analysis estimates that this proposed paragraph will impose no incremental costs and afford no savings because the requirements are consistent with existing licensee practices.

Paragraph 26.159(c)

This paragraph of the proposed rule revises existing requirements in §2.7(b)(2) in Appendix A to Part 26, which pertain to the handling of urine specimens at HHS-certified laboratories and the use of internal custody and control forms. The proposed rule clarifies that laboratory chain-of-custody forms must be used while conducting initial and confirmatory testing on aliquots of the original urine specimen. The proposed rule also establishes that the original specimen and original specimen custody-and-control form must remain in secure storage. This proposed paragraph will impose no incremental cost and affords no saving because it is consistent with the existing urine specimen handling and storage practices of HHS-certified laboratories.

Paragraph 26.159(d)

This paragraph of the proposed rule revises existing requirements in §2.7(a)(2) in Appendix A to Part 26, which pertain to the use of internal custody and control forms by HHS-certified laboratories. The proposed rule expands the required information contained on the laboratory custody-and-control form to now include the identity of the donor. Adding this information to the custody-and-control form will not result in any incremental costs.

Paragraph 26.159(e)

This paragraph of the proposed rule restates without substantive change existing requirements in §2.7(a)(2) in Appendix A to Part 26, which pertain to completing the custody-and-control form each time a specimen is handled or transferred within the laboratory. The proposed paragraph imposes no incremental cost and affords no saving because the requirements are believed to be consistent with existing specimen chain-of-custody procedures used by HHS-certified laboratories.

Paragraph 26.159(f)

The proposed paragraph revises existing requirements in §2.4(d) in Appendix A to Part 26, which pertain to specimen chain of custody procedures. This proposed paragraph also extends to HHS-certified laboratories the specimen packaging and shipping requirements in §2.4(i) in Appendix A to Part 26, which currently only apply to collection sites. The proposed paragraph imposes no incremental cost and affords no saving because it is consistent with current HHS-certified laboratory practices.

Paragraph 26.159(g)

This paragraph of the proposed rule clarifies that couriers, express carriers, and postal service personnel do not have access to the custody-and-control forms or to the specimen bottles and, therefore, are not required to document chain-of-custody on the custody and control form of a urine specimen in transit. However, this paragraph adds a new requirement that the custody accountability of the shipping containers during shipment must be maintained by a tracking system provided by the courier, express carrier, or postal service. The proposed paragraph imposes no incremental cost and affords no saving because it describes existing courier, express carrier, and postal service specimen shipping practices.

Paragraph 26.159(h)

The proposed paragraph imposes no incremental cost and affords no saving because it restates without substantive change existing requirements in §2.7(c) in Appendix A to Part 26, which pertain to short-term refrigeration storage procedures of urine specimens.

Paragraph 26.159(i)

This paragraph of the proposed rule revises existing requirements in §2.7(h) in Appendix A to Part 26, which specify long-term storage requirements for non-negative urine specimens so that they can be made available for any necessary retesting. The proposed paragraph adds specimens with non-negative validity test results (adulterated, substituted, and invalid specimens) to those that already must be stored for possible further testing. The analysis assumes that the storage costs for any additional urine specimens that must be retained by the HHS-laboratory as a result of non-negative validity test results will be accounted for in the per test cost that an HHS-certified laboratory charges each licensee. Therefore, any incremental cost resulting from the proposed paragraph would be captured in the new validity test costs estimated in connection with §§26.131 and 26.161(b)(1).

Paragraph 26.159(j)

This paragraph of the proposed rule establishes a new requirement that specimens testing negative on initial or confirmatory drug testing be discarded or may be pooled for use in the HHS-certified laboratory's internal quality control program, unless validity testing indicates that the specimen is invalid. The proposed paragraph imposes no incremental cost and affords no saving because it is consistent with current practices of HHS-certified laboratories.

26.161 Cutoff levels for validity testing

Paragraph 26.161(a)

This paragraph of the proposed rule establishes that each initial validity test must be performed on one aliquot of a donor's urine specimen, and a confirmatory validity test must be performed on a second aliquot of the donor's urine specimen. All costs associated with validity testing are considered to be incremental[2] because validity testing is a new regulatory provision. Incremental costs associated with validity testing are discussed in connection with §26.161(b)(1).

Paragraph 26.161(b)

Subparagraph 26.161(b)(1)

This subparagraph of the proposed rule establishes initial validity testing requirements, including the types of initial tests to be performed (creatinine, pH, adulterants) and the specific criteria to determine whether a specimen may be adulterated, substituted, diluted, or invalid, and thus,

[2] By assuming that no licensees currently conduct validity testing, the analysis overstates the incremental costs to be incurred by FFD programs as a result of the proposed validity testing provisions. This assumption is necessary, however, because of the lack of available data regarding the types of validity testing being conducted throughout the industry.

require confirmatory validity testing. The analysis accounts for validity testing costs under this requirement based on a per specimen testing cost at HHS-certified laboratories (i.e., initial validity testing or initial and confirmatory validity testing have the same cost).

The regulatory analysis calculates under this subparagraph not only the costs related to conducting initial and confirmatory validity testing, but also the subsequent costs for some specimens to receive initial and confirmatory drug testing, and the associated costs resulting from non-negative confirmatory validity and drug test results. Even though many of these costs are directly related to other proposed provisions, as referenced below, this approach consolidates the series of actions that are initiated under §26.161(b)(1), allowing for a unified (hence clearer) presentation of related actions and a simpler analysis.

FFD programs using HHS-certified laboratories for all drug testing will incur a per specimen incremental cost to conduct validity testing, as well as the labor costs of the MRO and FFD personnel for administrative activities associated with confirmed non-negative validity and drug test results, the costs of retesting some confirmed non-negative test result specimens at a second HHS-certified laboratory at the donor's request, and the costs of the appeals process for non-negative test results that some donors choose to contest. In addition, because HHS laboratory analytical procedures and required licensee actions vary based on the type of confirmed validity test result (e.g., dilute, invalid), the analysis discusses the costs for each validity result type separately (designated below as "Results A, B, and C").

- "Result A": adulterated and substituted specimens
- "Result B": dilute specimens
- "Result C": invalid specimens

Annual costs per FFD program that conducts all drug testing (and validity testing) at an HHS-certified laboratory are estimated as follows:[3]

- Cost to conduct validity testing (initial and confirmatory when necessary) at an HHS-certified laboratory:

  $NUM_{validity} \times COST_{HHS\ validity\ testing} \times NUM_{units}$

- Additional testing may be required based on specific confirmatory validity test results, as described by the following result cases (Results A, B, and C).

[3] Incremental costs associated with validity testing for FFD programs using onsite licensee testing facilities are discussed in connection with §26.131.

- Result A: Specimens with HHS-certified laboratory confirmatory validity test results of non-negative adulterated or substituted (creatinine concentration less than 2 mg/dL). No additional testing procedures.

- Result B: Specimens with HHS-certified laboratory confirmatory validity test results of non-negative dilute. Additional costs include initial drug testing using FDA-approved analytical kits with the lowest detection concentration levels available and confirmatory testing to the level of detection (LOD) as required by proposed §26.163(a)(2).[4] The costs include the following:

  $$NUM_{validity} \times PER_{dilute} \times COST_{HHS\ LOD\ testing} \times NUM_{units}$$

- Result C: Specimens with HHS-certified laboratory confirmatory validity test results of non-negative invalid. Additional costs include collecting a second urine specimen under direct observation, as specified in proposed §26.185(f)(3), and then validity and drug testing the second specimen at an HHS-certified laboratory. The costs include the following:

  $$NUM_{validity} \times PER_{invalid} \times [(COST_{2nd\ collection} + COST_{HHS\ validity\ \&\ drug\ testing})] \times NUM_{units}$$

• Cost of subsequent actions for all non-negative confirmatory validity test results and any confirmed non-negative drug test results identified as a result of the proposed validity testing requirements in this paragraph (sum of non-negative confirmatory validity and drug test results from Results A, B, and C). FFD programs may also incur costs associated with some donors requesting testing of their split specimen and/or some donors appealing their non-negative validity and/or drug test results.

  - Cost for actions subsequent to confirmed non-negative validity and drug test results

    $$(NUM_{validity} \times [(PER_{adulterated} + PER_{substituted}) + (PER_{dilute} \times PER_{non\text{-}negative\ at\ LOD}) + (PER_{invalid} \times PER_{drug\ non\text{-}neg\ 2^{nd}\ collection})] \times COST_{subsequent\ actions}) \times NUM_{units}$$

[4] Proposed §26.163(a)(2) requires initial drug testing of dilute specimens using analytical kits approve by the FDA that have the lowest concentration levels marketed for the technology(ies) being used to conduct initial testing of the specimen for drugs or drug metabolites. If any of the responses of the initial drug test are within 50% of the cutoff level, the HHS-certified laboratory reports the drug test result to the licensee's or C/V's MRO. Based on each FFD program's policy, the MRO may direct the HHS-certified laboratory to test the urine specimen at the confirmatory assay's LOD for that drug or drug class.

- When requested by some donors, the cost for retesting specimens with confirmed non-negative validity and/or drug test results at a second HHS-certified laboratory

$$(NUM_{validity} \times [(PER_{adulterated} + PER_{substituted}) + (PER_{dilute} \times PER_{non\text{-}negative\ at\ LOD}) + (PER_{invalid} \times PER_{drug\ non\text{-}neg\ 2^{nd}\ collection})] \times PER_{retest} \times COST_{retest}) \times NUM_{units}$$

- When requested by some donors, the cost of appeal process for confirmed non-negative validity and drug test results

$$NUM_{validity} \times [(PER_{adulterated} + PER_{substituted}) + (PER_{dilute} \times PER_{non\text{-}negative\ at\ LOD}) + (PER_{invalid} \times PER_{drug\ non\text{-}neg\ 2^{nd}\ collection})] \times PER_{appeal} \times [(HOURS_{FFD\ manager} \times WAGE_{FFD\ manger}) + HOURS_{Worker} \times WAGE_{Worker})] \times NUM_{units}$$

Parameter	**Description**
$NUM_{validity}$	Number of validity tests per unit per year (as discussed in the assumptions below and in Appendix 2, Exhibit A2-12)
$COST_{HHS\ validity\ testing}$	Incremental cost per urine specimen to conduct validity testing (initial validity test and confirmatory validity test when necessary) at an HHS-certified laboratory (as discussed in the assumptions below)
PER_{dilute}	Percentage of urine specimens with non-negative validity test results of dilute (as discussed in Appendix 2, Exhibit A2-12)
$COST_{HHS\ LOD\ testing}$	Cost per specimen to conduct initial drug testing using an FDA-approved analytical kit with the lowest concentration levels available for the initial testing technologies and confirmatory drug testing to the level of detection (LOD) for drug(s) detected in the initial drug test as discussed in proposed §26.163(a)(2) (as discussed in Appendix 2, Exhibit A2-13)
$PER_{invalid}$	Percentage of urine specimens with non-negative validity test results of invalid (as discussed in Appendix 2, Exhibit A2-12)
$COST_{2nd\ collection}$	Cost of collecting a second urine specimen under direct observation from a donor with a confirmatory validity test result of invalid for the initial urine specimen collected. The cost of the second collection includes the labor for the donor's travel time to and from the collection site, donor's time spent at the collection site, as well as the labor of the collector (as discussed in Appendix 2, Exhibit A2-13)
$COST_{HHS\ validity\ \&\ drug\ testing}$	Cost per specimen to conduct initial drug and initial validity testing at an HHS-certified laboratory, as well as confirmatory drug and/or validity testing when necessary (as discussed in Appendix 2, Exhibit A2-13)
$PER_{adulterated}$	Percentage of urine specimens with non-negative validity test results of adulterated (as discussed in Appendix 2, Exhibit A2-12)
$PER_{substituted}$	Percentage of urine specimens with non-negative validity test results of substituted (less than 2 mg/dL creatinine) (as discussed in Appendix 2, Exhibit A2-12)

Parameter	Description
$PER_{non\text{-}negative\ LOD}$	Percentage of dilute specimens that test non-negative for drug(s) at LOD testing (as discussed in the assumptions below)
$PER_{drug\ non\text{-}negative\ 2nd\ collection}$	Percentage of specimens collected under direct observation as a result of an initial specimen with a confirmatory validity test result of invalid that test non-negative for drugs (as discussed in the assumptions below)
$COST_{subsequent\ actions}$	Labor costs associated with MRO and FFD program personnel activities and administrative actions resulting from a confirmed non-negative validity and drug test results (as discussed in Appendix 2, Exhibit A2-13)
PER_{retest}	Percentage of urine specimens with confirmed non-negative validity and/or drug test results retested at the request of the donor at a second HHS-certified laboratory (as discussed in the assumptions below)
$COST_{retest}$	Cost of specimen retesting at a second HHS-certified laboratory, including specimen preparation and shipping costs (as discussed in Appendix 2, Exhibit A2-13)
PER_{appeal}	Percentage of confirmed non-negative validity and drug test results appealed by some donors (as discussed in the assumptions below)
$HOURS_{FFD\ manager}$	Average amount of FFD manager time per appeal of a confirmed non-negative validity and/or drug test result (as discussed in the assumptions below)
$WAGE_{FFD\ manger}$	FFD manager wage rate (as discussed in Appendix 2, Exhibit A2-11)
$HOURS_{Worker}$	Average amount of worker time per appeal of a confirmed non-negative validity and/or drug test result (as discussed in the assumptions below)
$WAGE_{Worker}$	Facility worker wage rate (as discussed in Appendix 2, Exhibit A2-11)
NUM_{units}	Number of units per FFD program (as discussed in Appendix 2, Exhibit A2-14)

Assumptions:

- Number of validity tests per unit per year is equivalent to the number of drug tests conducted by each unit per year.

- Each FFD program contracting with an HHS-certified laboratory to conduct all drug and validity testing of urine specimens will pay a fixed cost per specimen, which will account for initial drug and validity testing and confirmatory drug and validity testing when necessary.[5]

[5] Some HHS-certified laboratories may not charge licensees to conduct initial and confirmatory validity testing, given the other tests that are being performed. However, to be conservative, the analysis assumes that a validity test at an HHS-certified laboratory will cost $1.50.

- All FFD programs choose to conduct confirmatory drug testing to the LOD for any drug or drug class detected in dilute specimens during the initial drug testing using FDA-approved analytical kits with the lowest concentration levels available.

- All urine specimens that test non-negative for initial validity testing as adulterated, substituted (< 2 mg/dL creatinine), and invalid, remain non-negative after confirmatory validity testing.

- Percentage of dilute specimens that test non-negative for drug(s) at LOD testing: 33 percent.

- For all urine specimens with non-negative validity test results of invalid, the analysis assumes that a second specimen is collected under direct observation.

- Percentage of specimens collected under direct observation as a result of an initial specimen with a confirmatory validity test result of invalid that test non-negative for drugs: 33 percent.[6]

- Percentage of urine specimens with confirmed non-negative validity and/or drug test results retested at the request of the donor at a second HHS-certified laboratory: 5 percent.

- Percentage of confirmed non-negative validity and drug test results appealed by some donors: 1 percent.

- Average amount of FFD manager time per appeal of a confirmed non-negative validity and/or drug test result: 12.5 hours.

- Average amount of worker time per appeal of a confirmed non-negative validity and/or drug test result: 2.0 hours.

Subparagraph 26.161(b)(2)

This proposed subparagraph establishes the testing requirements for confirmatory validity testing, including the types of tests to be performed (creatinine, specific gravity, pH, adulterants; and the specifications that each type of validity test must meet. All costs associated with the validity

[6] A second specimen is collected under direct observation for donors that have an initial specimen with an invalid test result to reduce the probability that their second specimen will be altered (e.g., use of adulterants) and therefore, the drug use that was attempted to be masked during the initial specimen donation will more likely be detected in the second specimen collected.

testing provisions in the proposed rule are considered incremental. Therefore, all validity testing costs are included in the analysis (see §§26.131 and 26.161(b)(1)).

Paragraphs 26.161(c), (d), (e), and (f)

The proposed paragraphs establish the analytical test result thresholds, which indicate that a urine specimen is adulterated, substituted, dilute, or invalid. The incremental costs associated with validity testing are discussed in connection with §§26.131 and 26.161(b)(1).

Paragraph 26.161(g)

This paragraph of the proposed rule adds a new requirement that if a urine specimen is suspected of containing an unidentified interfering substance or adulterant that could make a validity test invalid, the HHS-certified laboratory must consult with the licensee's or other entity's MRO to obtain instruction as to whether to send the specimen to a second HHS-certified laboratory that has the capability to identify the suspected substance or adulterant.

The *annual costs per FFD program* are estimated as follows:

$$NUM_{new\ adulterant} \times [COST_{retest} + (HOURS_{MRO} \times WAGE_{MRO})] \times NUM_{facilities}$$

Parameter	Description
$NUM_{new\ adulterant}$	Number of urine specimens per facility per year that are suspected of having a new adulterant or interfering agent that could make a test result invalid and are sent to a second HHS-certified laboratory for additional validity testing (as discussed in the assumptions below)
$COST_{retest}$	Cost per specimen to conduct validity retesting at a second HHS-certified laboratory, including specimen preparation and shipping costs (as discussed in Appendix 2, Exhibit A2-13)
$HOURS_{MRO}$	Time per specimen for an MRO to speak with the HHS-certified laboratory and determine whether a specimen is to be retested at a second HHS-certified laboratory, and the time to review the results of validity testing at the second HHS-certified laboratory (as discussed in the assumptions below)
$WAGE_{MRO}$	MRO wage rate (as discussed in Appendix 2, Exhibit A2-11)
$NUM_{facilities}$	Number of facilities per FFD program (as discussed in Appendix 2, Exhibit A2-14)

Assumptions:

- Number of urine specimens per facility per year that are suspected of having a new adulterant or interfering agent that could make a test result invalid and are sent to a second HHS-certified laboratory for additional validity testing: 1.

- Time per specimen for an MRO to speak with the HHS-certified laboratory and determine whether a specimen is to be retested at a second HHS-certified laboratory, and the time to review the results of validity testing at the second HHS-certified laboratory: 30 minutes.

- MRO chooses to retest all specimens that are suspected of containing adulterants or interfering agents that could make a test result invalid.

Paragraph 26.161(h)

The proposed paragraph imposes no incremental cost and affords no saving because it prohibits licensees and C/Vs from using validity testing cutoff levels that are more stringent than those specified in Part 26. The costs associated with validity testing are discussed in connection with proposed §§ 26.131 and 26.161(b)(1).

26.163 Cutoff levels for drugs and drug metabolites

Subparagraph 26.163(a)(1)

This proposed subparagraph revises existing requirements in §2.7(e)(1) in Appendix A to Part 26 , which pertain to the initial cutoff levels for drugs and drug metabolites (marijuana, cocaine, opiates, phencyclidine, amphetamines). The proposed rule will lower the initial cutoff level for marijuana metabolites from 100 ng/mL to 50 ng/mL. FFD programs conducting initial drug testing at HHS-certified laboratories will incur annual incremental costs attributable to the more stringent cutoff testing level, which will increase the number of non-negative drug tests for marijuana. The additional costs will consist of labor costs for the MRO and FFD personnel activities resulting from confirmed non-negative drug test results, the costs of retesting specimens at a second HHS-certified laboratory at the request of some donors, and the costs of the appeals process for some non-negative test results that donors choose to contest. The proposed rule will also raise the initial cutoff level for opiate metabolites from 300 ng/mL to 2,000 ng/mL. FFD programs conducting initial drug testing at HHS-certified laboratories will realize annual incremental savings resulting from the less stringent cutoff level, which will significantly reduce the number of non-negative opiate drug tests that MROs will ultimately verify as negative. Incremental savings will result from eliminating labor costs associated with the MRO and FFD personnel activities as a result of fewer confirmed non-negative drug test results, savings associated with fewer donors requesting retesting of their specimen at a second HHS-certified laboratory, and the savings from fewer appeals for some non-negative drug test results that donors choose to contest.

Annual costs per FFD program using HHS-certified laboratories for initial drug testing for additional non-negative marijuana drug tests are estimated as the sum of the following:

- Cost for actions subsequent to additional non-negative confirmatory marijuana drug test results:

  $(NUM_{marijuana} \times PERI_{marijuana} \times COST_{subsequent\ actions}) \times NUM_{units}$

- Cost for retesting confirmed marijuana drug test specimens at a second HHS-certified laboratory at the request of some donors:

  $(NUM_{marijuana} \times PERI_{marijuana} \times PER_{retest} \times COST_{retest}) \times NUM_{units}$

- Cost of appeal process for some confirmed non-negative marijuana drug test results that donors choose to contest:

  $(NUM_{marijuana} \times PERI_{marijuana} \times PER_{appeal}) \times [(HOURS_{FFD\ manager} \times WAGE_{FFD\ manager}) + HOURS_{worker} \times WAGE_{worker})] \times NUM_{units}$

Annual savings per FFD program using HHS-certified laboratories for initial drug testing for fewer non-negative opiate drug tests are estimated as the sum of the following:

- Saving from fewer actions subsequent to fewer non-negative confirmatory opiate drug test results:

  $(NUM_{opiate} \times PERD_{opiate} \times COST_{subsequent\ actions}) \times NUM_{units}$

- Saving from fewer non-negative opiate drug test specimens retested at another HHS-certified laboratory at the request of some donors:

  $(NUM_{opiate} \times PERD_{opiate} \times PER_{retest} \times COST_{retest}) \times NUM_{units}$

- Saving from fewer appeals for confirmed non-negative opiate drug test results that some donors choose to contest:

  $(NUM_{opiate} \times PERD_{opiate} \times PER_{appeal}) \times [(HOURS_{FFD\ manager} \times WAGE_{FFD\ manager}) + HOURS_{worker} \times WAGE_{worker})] \times NUM_{units}$

Parameter	Description
$NUM_{marijuana}$	Number of confirmed marijuana non-negative drug test results under the current rule per unit per year (as discussed in Appendix 2, Exhibit A2-12)
$PERI_{marijuana}$	Percentage increase in non-negative marijuana drug test results due to the more stringent cutoff level in the proposed rule (as discussed in the assumptions below)
$COST_{subsequent\ actions}$	Labor costs associated with MRO and FFD program personnel activities and administrative actions resulting from a confirmatory non-negative drug test result (as discussed in Appendix 2, Exhibit A2-13)
NUM_{units}	Number of units per FFD program (as discussed in Appendix 2, Exhibit A2-14)
PER_{retest}	Percentage of urine specimens with confirmed non-negative drug test results which the donors request specimen retesting at a second HHS-certified laboratory (as discussed in the assumptions below)
$COST_{retest}$	Cost of specimen retesting at a second HHS-certified laboratory, including specimen preparation and shipping costs, per specimen (as discussed in Appendix 2, Exhibit A2-13)
PER_{appeal}	Percentage of confirmed non-negative drug test results appealed by some donors (as discussed in the assumptions below)
$HOURS_{FFD\ manager}$	Average amount of FFD manager time per appeal of a confirmed non-negative validity test result (as discussed in the assumptions below)
$WAGE_{FFD\ manager}$	FFD manager wage rate (as discussed in Appendix 2, Exhibit A2-11)
$HOURS_{worker}$	Average amount of worker time per appeal of a confirmed non-negative validity test result (as discussed in the assumptions below)
$WAGE_{worker}$	Facility worker wage rate (as discussed in Appendix 2, Exhibit A2-11)
NUM_{opiate}	Number of confirmed non-negative opiate drug test results under the current rule per unit per year (as discussed in Appendix 2, Exhibit A2-12)
$PERD_{opiate}$	Percentage decrease in non-negative opiate drug test results due to the higher cutoff level in the proposed rule (as discussed in the assumptions below)

Assumptions:

- Percentage increase in non-negative marijuana drug test results due to the more stringent cutoff level in the proposed rule: 40 percent.[7]

[7] When U.S. DOT changed the marijuana metabolite cutoff level from 100 ng/mL to 50 ng/mL, HHS-certified laboratories experienced an increase in the number of non-negative marijuana test results from 25 to 40 percent. Several licensees currently test for marijuana metabolites at the proposed 50 ng/mL cutoff level. One licensee reported 49 additional non-negative test results over a 2½-year period (an increase of 57 percent over the 100 ng/ml cutoff level).

- Percentage of urine specimens with confirmed non-negative drug test results which the donors request specimen retesting at a second HHS-certified laboratory (as discussed in the assumptions below): 5 percent.

- Percentage decrease in non-negative opiate drug test results due to the higher cutoff level in the proposed rule: 75 percent.[8]

- Percentage of non-negative drug test results: 0.76 percent.[9]

- Changing the cutoff thresholds for marijuana and opiates will not result in a change in assay costs and will not require upgrading testing facility equipment because HHS-certified laboratories currently conduct testing to the proposed cut-off levels for DOT regulated entities covered by 49 CFR Part 40.

- Percentage of confirmed non-negative drug test results appealed by some donors: 1 percent.

- Average amount of FFD manager time per appeal of a confirmed non-negative validity test result: 12.5 hours.

- Average amount of worker time per appeal of a confirmed non-negative validity test result: 2.0 hours.

Subparagraph 26.163(a)(2)

This proposed subparagraph establishes that if the confirmatory validity test result of a urine specimen is dilute, initial testing of the specimen for drugs or drug metabolites must be conducted using analytical kits approved by the Food and Drug Administration that have the lowest concentration levels marketed for the technology(ies) being used to conduct initial testing of the specimen for drugs or drug metabolites. Based on the response of the initial test, the MRO may direct the specimen be tested to the confirmatory assay's limit of detection (LOD). These incremental costs are estimated and discussed in connection with §§26.131 and 26.161(b)(1).

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[8] Relaxing the initial cutoff level for opiate metabolites will almost entirely eliminate the false positive issue associated with consuming poppy seeds and, unless an individual consumes large prescribed doses of codeine-based cough syrup or other cold prescriptions, the proposed threshold will significantly reduce the number of tests that screen non-negative for opiates as a result of legitimate use of prescribed cold and cough prescriptions.

[9] Of 125,713 drug tests conducted in calendar year 2000, 957 (0.76 percent) were confirmed as non-negative. (See NRC Information Notice 2003-04 "Summary of Fitness-for-Duty Program Performance Reports for Calendar Year 2000").

Paragraph 26.163(b)

This proposed paragraph revises existing requirements in §2.7(f)(2) in Appendix A to Part 26, which pertain to the cutoff levels for confirmatory drug testing. The proposed rule will increase the cutoff levels used in confirmatory tests for morphine and codeine from 300 ng/mL to 2,000 ng/mL. The proposed paragraph will also establish a cutoff level of 10 ng/mL for 6-acetylmorphine, which is to be evaluated for specimens in which morphine is detected at or above the 2,000 ng/mL cutoff level. The incremental costs of the proposed rule changes are estimated and discussed in connection with §§26.133 and 26.163(a)(1) and include additional confirmed non-negative marijuana drug test results and fewer non-negative opiate drug test results.

26.165 Testing split specimens and retesting single specimens

Paragraph 26.165(a)

This paragraph of the proposed rule revises existing requirements in §2.7(j) in Appendix A to Part 26, which pertain to the split specimen testing procedures for Bottles A and B of a urine specimen, based on whether the licensee testing facility or HHS-certified laboratory analyzed the specimen in Bottle A. Specifically, this paragraph adds a provision that permits a donor to request the testing of their split specimen in Bottle B, when the specimen in Bottle A yields a non-negative validity test result. The proposed rule also specifies that once the initial HHS-certified laboratory has been notified of a donor's request for the testing of a split specimen, the HHS-certified laboratory has one business day following the day of the donor's request to forward the specimen to another HHS-certified laboratory. The incremental costs associated with retesting split specimens that initially yield non-negative validity test results are estimated in connection with §§26.131 and 26.161(b)(1).

Paragraph 26.165(b)

This paragraph of the proposed rule establishes a new provision under which a donor from an FFD program that does not follow split specimen collection procedures may request (through the MRO) a retest of a confirmed non-negative single urine specimen (provided that the specimen quantity is 30 mL or more and that the specimen is not invalid). Incremental costs associated with the proposed rule will include an increased number of retests for FFD programs that currently use single specimen collections, given that donors do not currently have the option to request a retest. The incremental costs estimated in this section account only for the retesting of single test specimens that are confirmed non-negative for drugs. The incremental costs calculated here do not include those associated with retesting single specimens for non-negative validity test results, which are estimated separately in connection with §§26.131 and §26.161(b)(1). Similarly, changes in cutoff levels for marijuana and opiates are estimated in connection with §§26.133, and 26.163(a)(1).

The *annual incremental costs per FFD program* are estimated as follows:

$$(NUM_{confirmed} \ x \ PER_{retest} \ x \ PERI_{retest} \ x \ COST_{retest}) \ x \ NUM_{units}$$

Parameter	Description
$NUM_{confirmed}$	Number of confirmed non-negative drug test results per unit per year (as discussed in Appendix 2, Exhibit A2-12)
PER_{retest}	Percentage of urine specimens with confirmed non-negative drug test results retested at the request of the donor at a second HHS-certified laboratory (as discussed in the assumptions below)
$PERI_{retest}$	Percentage increase in retesting of confirmed non-negative urine specimens based on the proposed rule provision to allow retesting of single specimens (as discussed in the assumptions below)
$COST_{retest}$	Cost of specimen retesting at a second HHS-certified laboratory including, specimen preparation and shipping costs (as discussed in Appendix 2, Exhibit A2-13)
NUM_{units}	Number of units per FFD program (as discussed in Appendix 2, Exhibit A2-14)

Assumptions:

- Percentage of urine specimens with confirmed non-negative drug test results retested at the request of the donor at a second HHS-certified laboratory (as discussed in the assumptions below): 5 percent.

- Percent increase in retesting of confirmed non-negative drug test specimens based on the proposed rule provision to allow retesting of single specimens: 10 percent.

Paragraph 26.165(c)

This paragraph of the proposed rule revises existing requirements in §2.7(i) and (j) in Appendix A to Part 26, which pertain to the procedures for testing split specimens for drugs at a second HHS-certified laboratory. The proposed rule adds procedures for retesting single specimens. The retesting of a urine specimen must be confirmatory testing for drugs and drug metabolites and only for the drugs(s) for which the specimen tested non-negative at the first HHS-certified laboratory. If the second HHS-certified laboratory fails to reconfirm the presence of the drug(s) detected at the initial HHS-certified laboratory, the second HHS-certified laboratory shall conduct specimen validity testing. The incremental costs for retesting single specimens is calculated and discussed in connection with§ 26.165(b).

Paragraph 26.165(d)

This paragraph of the proposed rule establishes procedures for retesting non-negative urine specimens (i.e., those containing adulterants) at a second HHS-certified laboratory. Retesting of adulterated urine specimens is limited to conducting confirmatory testing only for the adulterant(s) identified by the first HHS-certified laboratory that tested the specimen. The incremental costs associated with retesting urine specimens for adulterants are estimated and discussed in connection with §§26.131 and 26.161(b)(1).

Paragraph 26.165(e)

This paragraph of the proposed rule establishes procedures for retesting non-negative urine specimens (i.e., those that are substituted) at a second HHS-certified laboratory. Retesting of substituted urine specimens is limited to conducting confirmatory testing only for creatinine and specific gravity. The incremental costs associated with retesting urine specimens for substitution are estimated and discussed in connection with §§26.131 and 26.161(b)(1).

Paragraph 26.165(f)

This paragraph of the proposed rule establishes FFD management actions and sanctions pertaining to situations where a donor has a confirmed non-negative drug and/or validity test result and requests the retesting of their specimen at a second HHS-certified laboratory. If the results of the retest do not confirm the initial result, that is, the second test indicates a negative drug and/or validity test result, this paragraph specifies specific procedures that the licensee and C/V must follow. The procedures and actions include not imposing any sanctions on the individual; eliminating any records from the individual's files pertaining to the temporary administrative actions; prohibiting the disclosure of temporary administrative action in response to a suitable inquiry, a background investigation, or any other inquiry or investigation; and providing a written statement to the individual that the temporary administrative action that was taken will not be disclosed and need not be disclosed by the individual in response to requests for self-disclosure of potentially disqualifying FFD information. The analysis does not estimate the costs of the administrative actions (FFD program management labor to discard records and draft a written statement) associated with this proposed paragraph due to the infrequency of instances where the retesting of a non-negative validity and/or drug test specimen at a second HHS-certified laboratory fails to confirm the initial HHS-certified laboratory non-negative test result.

26.167 Quality assurance and quality control

Paragraph 26.167(a)

This paragraph of the proposed rule clarifies existing requirements in §2.8(a) and (d) in Appendix A to Part 26, which specify that HHS-certified laboratories must implement a quality assurance program that encompasses all aspects of the testing process. The proposed rule adds a

new requirement for the quality assurance program to encompass the certification of calibrators and controls to ensure that calibrators and controls are accurate. This proposed paragraph will impose no incremental costs and afford no savings because the requirements are consistent with the existing quality assurance programs implemented by HHS-certified laboratories

Paragraph 26.167(b)

This paragraph of the proposed rule revises existing requirements in §§2.8(c) and (d) in Appendix A to Part 26, which require HHS-certified laboratories to include appropriate calibrators and controls in each analytical run of initial and confirmatory drug test specimens. The proposed paragraph adds the requirement that appropriate calibrators and controls must be included in each analytical run for initial and confirmatory validity test specimens. The incremental costs resulting from validity testing are discussed in connection with §26.161.

Paragraph 26.167(c)

This proposed paragraph establishes quality control requirements for conducting initial and confirmatory validity tests at HHS-certified laboratories. This proposed paragraph will impose incremental costs per FFD program on a per specimen test basis. That is, the per test cost to conduct validity testing includes the costs to comply with the quality control requirements in this paragraph. The incremental cost for FFD programs to conduct validity testing is calculated in §§26.131 and 26.161(b)(1).

Paragraph 26.167(d)

This paragraph of the proposed rule revises existing requirements in §2.7(e)(1) in Appendix A to Part 26, which mandate that initial drug tests must be performed using an immunoassay that meets the FDA requirements for commercial distribution. The proposed rule prohibits the use of non-instrumented immunoassay testing devices pending HHS/SAMHSA review and approval from being used for initial drug testing under this part. The proposed rule also revises existing requirements in §2.8(c) in Appendix A to Part 26, which pertain to the quality control requirements for performing initial drug tests at HHS-certified laboratories. This proposed paragraph imposes no incremental costs and affords no savings because the provisions are consistent with the existing practices of HHS-certified laboratories.

Paragraph 26.167(e)

This paragraph of the proposed rule revises existing requirements in §§2.7(f)(2) and 2.8(d) in Appendix A to Part 26, which pertain to quality control requirements for performing confirmatory drug tests at HHS-certified laboratories. This proposed paragraph imposes no incremental costs and affords no savings because the provisions are consistent with existing practices of HHS-certified laboratories.

Paragraph 26.167(f)

This paragraph of the proposed rule revises existing requirements in §2.8(e)(2)–(3) in Appendix A to Part 26, which pertain to blind performance test samples. This revision will result in incremental savings for each FFD program, as discussed in connection with §26.167(f)(1)–(2).

Subparagraph 26.167(f)(1)

This proposed subparagraph revises existing requirements in §2.8(e)(2) in Appendix A to Part 26, which pertain to the number of blind performance test samples that licensees and C/Vs must submit to their HHS-certified laboratory during the initial 90 days of any contract (not including rewritten or renewed contracts). Under the existing requirements, during the initial 90 days of a contract, 50 percent of the total number of specimens submitted must be blind performance test samples (up to a maximum of 500 samples). The proposed subparagraph will reduce the required number of blind performance test samples submitted to 20 percent (up to a maximum of 100 blind samples) or 30 blind samples, whichever is greater. The proposed subparagraph will result in incremental savings for some FFD programs and costs for other FFD programs, as follows:

- FFD programs that conduct all testing at HHS-certified laboratories ("offsite laboratories") will recognize savings related to the reduced number of blind performance test samples purchased from commercial vendors and analyzed at HHS-certified laboratories.

- In contrast, FFD programs that conduct initial validity and drug testing of specimens at onsite licensee testing facilities send HHS-certified laboratories many fewer urine specimens for testing under the current requirements.[10] Unlike the current rule, the proposed rule will require an FFD program to submit a minimum number of blind performance test samples to their HHS-certified laboratory. Therefore, this provision will increase the number of blind samples that FFD programs with onsite licensee testing facilities must submit to HHS-certified laboratories. For this reason, FFD programs using onsite licensee testing facilities will incur incremental costs for an increased number of blind samples purchased from commercial vendors and analyzed at HHS-certified laboratories.

[10] Specifically, FFD programs with onsite licensee testing facilities submit to HHS-certified laboratories only non-negative initial drug test specimens, and a "sampling" of negative urine specimens (assumed to be 1 percent) analyzed at the licensee testing facility.

Annual savings per FFD program that uses an HHS-certified laboratory for all validity and drug testing of urine specimens are calculated as the difference between the current costs and costs after implementation of the proposed rule, as follows:

$$[(NUM_{drug\ tests\ per\ quarter} \times PER_{blind\ samples,\ initial\ 90\ days,\ existing\ rule} \times COST_{blind\ sample\ and\ testing,\ existing\ rule} \times NUM_{units}) - (NUM_{drug\ tests\ per\ quarter} \times PER_{blind\ samples,\ initial\ 90\ days,\ proposed\ rule} \times COST_{blind\ sample\ and\ testing,\ proposed\ rule} \times NUM_{units})] \times PER_{change\ HHS\ lab}$$

Annual costs per FFD program that conducts initial validity and drug testing of specimens at an onsite licensee testing facility are calculated as the difference between the current costs and costs after implementation of the proposed rule, as follows:

$$[(NUM_{specimens\ to\ HHS\ lab\ per\ quarter\ from\ LTF} \times PER_{blind\ samples,\ initial\ 90\ days,\ existing\ rule} \times COST_{blind\ sample\ and\ testing,\ existing\ rule} \times NUM_{units}) - (NUM_{specimens\ to\ HHS\ per\ quarter\ from\ LTF} \times PER_{blind\ samples,\ initial\ 90\ days,\ proposed\ rule} \times COST_{blind\ sample\ and\ testing,\ proposed\ rule} \times NUM_{units})] \times PER_{change\ HHS\ lab}$$

Parameter	**Description**
$NUM_{drug\ tests\ per\ quarter}$	Number of drug tests per unit per quarter (as discussed in the assumptions below and in Appendix 2, Exhibit A2-14)
$PER_{blind\ samples,\ initial\ 90\ days,\ existing\ rule}$	Percentage of drug test specimens under the existing rule that must be blind performance test samples submitted in the first 90 days of a contract with an HHS-certified laboratory (as discussed in the assumptions below)
$COST_{blind\ sample\ and\ testing,\ existing\ rule}$	Cost per blind specimen under the existing rule for an FFD program to purchase a blind performance test sample from a commercial vendor, prepare the sample (fill out custody-and-control form, submit the sample for testing to an HHS-certified laboratory, drug test the specimen, and labor to verify that the test results are accurate (as discussed in Appendix 2, Exhibit A2-13)
$PER_{blind\ samples,\ initial\ 90\ days,\ proposed\ rule}$	Percentage of drug test specimens under the proposed rule that must be blind performance test samples submitted in the first 90 days of a contract with an HHS-certified laboratory (as discussed in the assumptions below)
$COST_{blind\ sample\ and\ testing,\ proposed\ rule}$	Cost under the proposed rule provisions for an FFD program to purchase a blind performance test sample from a commercial vendor, prepare the sample (fill out custody-and-control form), submit the sample for testing to an HHS-certified laboratory, drug and validity test the specimen, and labor to verify that the test results are accurate (as discussed in Appendix 2, Exhibit A2-13)
$PER_{change\ HHS\ lab}$	Percentage of years that an FFD program enters a contract with a different HHS-certified laboratory (as discussed in the assumptions below)
$NUM_{specimens\ to\ HHS\ lab\ per\ quarter\ from\ LTF}$	Number of urine specimens per unit per quarter submitted to an HHS-certified laboratory by FFD programs that conduct initial specimen testing at an onsite licensee testing facility (LFT) (as discussed in the assumptions below and in Appendix 2, Exhibit A2-12)

Parameter	Description
NUM_{units}	Number of units per FFD program (as discussed in Appendix 2, Exhibit A2-14)

Assumptions:

- The number of drug tests conducted per unit per quarter is equivalent to the number of drug tests per conducted per unit per year (see Appendix 2, Exhibit A2-14) divided by 4 quarters in the year.

- Percentage of years that a FFD program enters a contract with a different HHS-certified laboratory: 10 percent. That is, on average, a FFD program will choose to use a different HHS-certified laboratory every 10 years.

- Percentage price increase per blind performance test sample purchased from a commercial vendor under the proposed rule due to the inclusion of non-negative validity test specimens (i.e., adulterated, diluted, or substituted) as §§26.167(h)(3)–(4): 25 percent.

- The number of urine specimens per unit per quarter submitted to an HHS-certified laboratory by FFD programs that conduct initial specimen testing at an onsite licensee testing facility (LFT) is equal to the total per quarter of the following:
  - positive initial drug test specimens
  - a "sampling" of negative urine specimens [assumed to be 1 one percent] as a check on false negative rate

Subparagraph 26.167(f)(2)

This subparagraph of the proposed rule revises existing requirements in §2.8(e)(2) in Appendix A to Part 26, which pertain to the number of blind performance test specimens that licensees and C/Vs must submit to their HHS-certified laboratory during each quarter after the initial 90 days of the contract with the laboratory. Under the existing regulations, 10 percent of the total number of samples submitted per quarter (up to a maximum of 250 samples) must be blind performance test specimens. The proposed rule will reduce that number to a minimum of 1 percent of the total number of samples submitted per quarter (up to a maximum of 100 samples) or 10 blind specimens, whichever is greater. This proposed subparagraph will result in incremental savings for some FFD programs and costs for other FFD programs, as follows:

- FFD programs that send all urine specimens to HHS-certified laboratories ("offsite laboratories") will recognize incremental savings related to the reduced number of blind performance test specimens purchased from commercial vendors and validity and drug tested at HHS-certified laboratories.

- In contrast, FFD programs that conduct testing at onsite licensee testing facilities send HHS-certified laboratories many fewer specimens for testing under the current requirements.[11] Unlike the current rule, the proposed rule requires a minimum number of blind specimens to their HHS-certified laboratories. Therefore, this provision will increase the number of blind specimens that onsite licensee testing facilities must submit to HHS-certified laboratories. For this reason, FFD programs that conduct testing of urine specimens at onsite licensee testing facilities will incur incremental costs for an increased number of blind specimens purchased from commercial vendors and submitted to HHS-certified laboratories for drug and validity testing.

Annual savings per FFD program that uses an HHS-certified laboratory to conduct all urine specimen testing. The savings per FFD program with a contract with an HHS-certified laboratory that has been in place for more than 90 days are calculated as the difference between the current costs and the costs after implementation of the proposed rule, as follows:

$$(NUM_{drug\ tests\ per\ quarter} \times PER_{blind\ specimens,\ existing\ rule} \times COST_{blind\ specimen\ testing,\ existing\ rule} \times NUM_{units} \times NUM_{quarters\ in\ year}) - (NUM_{drug\ tests\ per\ quarter} \times PER_{blind\ specimens,\ proposed\ rule} \times COST_{blind\ specimen\ testing,\ proposed\ rule} \times NUM_{units} \times NUM_{quarters\ in\ year})$$

Annual costs per FFD program that conducts testing of urine specimens at a licensee testing facility (LTF) are calculated as the difference between the current costs and costs after implementation of the proposed rule, as follows:

$$(NUM_{drug\ tests\ to\ HHS\ lab\ per\ quarter,\ LTF} \times PER_{blind\ specimens,\ existing\ rule} \times COST_{blind\ specimen\ testing,\ existing\ rule} \times NUM_{units} \times NUM_{quarters\ in\ year}) - (NUM_{drug\ tests\ to\ HHS\ lab\ per\ quarter,\ LTF} \times PER_{blind\ specimens,\ proposed\ rule} \times COST_{blind\ specimen\ testing,\ proposed\ rule} \times NUM_{units} \times NUM_{quarters\ in\ year})$$

Parameter	**Description**
$NUM_{drug\ tests\ per\ quarter}$	Number of drug tests per unit per quarter (as discussed in the assumptions below)
$PER_{blind\ specimens,\ existing\ rule}$	Percentage of drug tests under the existing rule that must be blind performance test specimens submitted during each quarter for a contract with an HHS-certified laboratory that has been in place for more than 90 days (as discussed in the assumptions below)
$COST_{blind\ specimen\ testing,\ existing\ rule}$	Cost per blind specimen under the existing rule for an FFD program to purchase a blind performance test specimen from a commercial vendor, prepare the specimen for testing (fill out custody-and-control form), submit the specimen for testing at the HHS-certified laboratory, and verify that the test results are accurate (as discussed in Appendix 2, Exhibit A2-13)

[11] Specifically, FFD programs with onsite licensee testing facilities submit to HHS-certified laboratories only non-negative initial drug test specimens, and a “sampling” of negative urine specimens [assumed one percent].

Parameter	Description
$PER_{\text{blind specimens, proposed rule}}$	Percentage of drug tests under the proposed rule that must be blind performance test specimens submitted during each quarter for a contract with an HHS-certified laboratory that has been in place for more than 90 days (as discussed in the assumptions below)
$COST_{\text{blind specimen testing, proposed rule}}$	Cost per blind specimen under the current rule for an FFD program to purchase a blind performance test specimen from a commercial vendor, prepare the specimen for testing (fill out custody-and-control form), submit the specimen for testing at the HHS-certified laboratory, and verify that the test results are accurate (as discussed in Appendix 2, Exhibit A2-13)
$NUM_{\text{drug tests to HHS lab per quarter, LTF}}$	Number of drug tests submitted to an HHS-certified laboratory per unit per quarter for licensees that conduct testing of urine specimens at onsite licensee testing facilities (LTF) (as discussed in the assumptions below)
$NUM_{\text{quarters in year}}$	Number of quarters in a year (as discussed in the assumptions below)
NUM_{units}	Number of units per FFD program (as discussed in Appendix 2, Exhibit A2-14)

Assumptions:

- The number of drug tests per unit per quarter is equivalent to the number of drug tests per unit per year (see Appendix 2, Exhibit A2-14) divided by the number of quarters in a year.

- The number of quarters in a year:[12] 4.

- The number of specimens per unit per quarter submitted to an HHS-certified laboratory from FFD programs with onsite licensee testing facilities (LTF) is equal to the total per quarter of:
  - positive initial drug test specimens
  - a “sampling” of negative urine specimens [assumed to be 1 one percent] as a check on the false negative rate

[12] The §26.167(f)(2) equations for FFD programs that have onsite licensee testing facilities and those that send all specimens to an HHS-certified laboratory for testing both account for four quarters of blind specimen testing costs. For the ten percent of FFD programs accounted for in §26.167(f)(1) that switch to new HHS-certified laboratories, this means that there is one quarter of over counting of costs/savings under §26.167(f)(2). Consequently, the equations in §26.167(f)(2) somewhat overstate the savings/costs for those FFD programs accounted for in §26.167(f)(1). The net overstatement is small, however, and does not merit the complication that would be needed to provide a more precise estimate.

- Percentage price increase per blind performance test sample purchased from a commercial vendors under the proposed rule due to the inclusion of non-negative validity test specimens (i.e., adulterated, diluted, or substituted) as §§26.167(h)(3)–(4): 25 percent.

Subparagraphs 26.167(f)(3) and (f)(4)

These proposed subparagraphs revise existing requirements in §2.8(e)(3) in Appendix A to Part 26, which describe the percentages of blank and non-negative blind performance test specimens that licensees and C/Vs must submit to their HHS-certified laboratories. Under the existing regulations, 20 percent of the total number of blind performance test specimens submitted per quarter must be non-negative for one or more drugs. The proposed rule will decrease that number to 15 percent, with 5 percent of the non-negative drug specimens replaced with non-negative validity test specimens (i.e., adulterated, diluted, or substituted). By contrast, under the existing regulations, 80 percent of the total number of blind performance test specimens submitted per quarter must be "blank." Licensees will realize an incremental increase in costs associated with the increased number of more costly adulterated, diluted, and substituted blind performance test specimens. These incremental costs are accounted for in connection with §§26.169(f)(1)–(2).

Subparagraph 26.167(f)(5)

This proposed subparagraph establishes that blind performance test specimens must be certified by the supplier to be negative (i.e., certified by immunoassay and confirmatory testing as containing no drug), drug positive (i.e., certified by immunoassay and confirmatory testing as containing one or more drug(s)/and/or metabolite(s)), adulterated (i.e., certified using one or more appropriate analytical procedure(s)) as being adulterated with a specific adulterant), or substituted (i.e., certified as having a creatinine concentration and a specific gravity that satisfy the criteria for a substituted specimen). The provisions in this proposed subparagraph will result in incremental costs to FFD programs as discussed in connection with §26.167(f)(2).

Paragraph 26.167(g)

This paragraph of the proposed rule clarifies existing requirements in §§2.8(e)(4)–(6) in Appendix A to Part 26, which pertain to errors in HHS-certified laboratory testing of blind performance test specimens and actual specimens, as well as errors identified through processing reviews and any matters that may adversely affect the testing process. The proposed paragraph requires licensees and C/Vs to ensure that the HHS-certified laboratory conducts investigations into any testing errors and takes corrective action when necessary. The proposed paragraph will impose no incremental costs and affords no savings because the requirement is consistent with current quality assurance procedures used by HHS-certified laboratories.

Paragraph 26.167(h)

This paragraph of the proposed rule imposes no cost and affords no savings because it restates existing requirements in §2.7(o)(3)(i) in Appendix A to Part 26.

Paragraph 26.167(i)

This paragraph of the proposed rule revises without substantive change the existing requirements in §2.7(o)(2) in Appendix A to Part 26 which describes the preparation and handling procedures for standards and controls. This paragraph clarifies that HHS-certified laboratories may prepare calibrators and controls from stock solutions obtained from other laboratories or commercial manufacturers. This proposed paragraph also adds a provision that prohibits HHS-certified laboratories from using calibrators and controls prepared from the same stock solution. No incremental cost or saving will result from the proposed provisions in this paragraph because they are consistent with existing laboratory practices pertaining to calibrator and control preparation.

26.169 Reporting results

Paragraph 26.169(a)

This paragraph of the proposed rule revises existing requirements in §2.7(g)(1) in Appendix A to Part 26, which pertain to HHS-certified laboratories reporting drug test results to MROs. The proposed rule will add a requirement that the laboratory's reports must include validity testing results and any indications of tampering, adulteration, or substitution. The proposed paragraph will impose no incremental costs and affords no savings because HHS-certified laboratories already conduct validity testing for U.S. DOT-regulated entities and, therefore, have the capability to report validity testing results, using existing automated systems.

Paragraph 26.169(b)

This paragraph of the proposed rule clarifies and amends existing requirements in §2.7(g)(2) in Appendix A to Part 26, which pertain to HHS-certified laboratories reporting negative and non-negative drug test results. The proposed rule will also require HHS certified laboratories to report both negative and non-negative validity test results. The proposed paragraph will impose no incremental costs and affords no savings because HHS-certified laboratories already conduct validity testing for U.S. DOT-regulated entities and, therefore, have the capability to report validity testing results, using existing automated systems.

Paragraph 26.169(c)

This paragraph of the proposed rule revises existing requirements in §2.7(g)(7) in Appendix A to Part 26, which pertain to HHS-certified laboratories reporting test results for licensees who use

cutoff levels that are more stringent than those required in Part 26. Currently, HHS-certified laboratories must report drug test results for both the Part 26 cutoff levels, and the licensee's more stringent cutoff levels. By contrast, under the proposed rule HHS-certified laboratories would only be required to report the results for the more stringent cutoff levels. Given that HHS-certified laboratories use automated systems to tabulate testing data, printing fewer data items for the test results is unlikely to result in any incremental costs or savings to either FFD programs or HHS-certified laboratories.

Paragraph 26.169(d)

This paragraph of the proposed rule establishes requirements for how HHS-certified laboratories must report validity testing results. The proposed paragraph will impose no incremental costs and afford no savings because HHS-certified laboratories already conduct validity testing for U.S. DOT-regulated entities and, therefore, have the capability to report validity testing results using existing automated systems.

Paragraph 26.169(e)

This paragraph of the proposed rule establishes that HHS-certified laboratories may report more than one test result for a single urine specimen. For example, a urine specimen may be both adulterated and non-negative for one or more specific drugs. The proposed paragraph will impose no incremental costs and afford no saving because it is consistent with the current practices of HHS-certified laboratories.

Paragraph 26.169(f)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it restates without substantive change existing requirements in §2.7(g)(3) in Appendix A to Part 26. This proposed paragraph also includes new provisions related to reporting of validity test result results. The analysis discusses the costs associated with specimen validity testing in §26.131(a) and 26.161(b). Any costs associated with the new provisions will be included in the validity testing specimen costs charged to licensees by HHS-certified laboratories.

Paragraph 26.169(g)

This paragraph of the proposed rule establishes that HHS-certified laboratories shall routinely report to MROs the quantitative values for confirmed non-negative results for morphine or codeine when those values are greater than or equal to 15,000 ng/mL. The proposed paragraph will require HHS-certified laboratories to make a minor change to a reporting parameter in their computer systems for NRC licensee testing programs covered by 10 CFR Part 26. Therefore, the analysis calculates no incremental costs or savings attributable to the proposed paragraph. HHS-certified laboratories have been complying with this requirement since 1998 for DOT covered entities under 49 CFR Part 40.

Paragraph 26.169(h)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it restates existing requirements within §2.7(g)(4) in Appendix A to Part 26 pertaining to the acceptable transmission methods to send test results from the HHS-certified laboratory to the MRO. This proposed paragraph also revises an existing requirement in §2.7(g)(4) in Appendix A to Part 26 which requires the HHS-certified laboratory to ensure that security of data transmission, data access, storage, and retrieval systems. This proposed paragraph clarifies that the licensee or other entity, directly or through the HHS-certified laboratory, must ensure the security of data transmission, data storage, and data retrieval systems. Under the current rule the licensee or other entity is still ultimately responsible for the compliance of the HHS-certified laboratory (given licensee and other entity oversight requirements) even though the text in §2.7(g)(4) did not clearly specify this responsibility. This proposed revision will result in no increment cost or savings because it is consistent with existing licensee and other entity data security evaluation procedures.

Paragraph 26.169(i)

This paragraph of the proposed rule revises existing requirements in §2.7(g)(5) in Appendix A to Part 26, which pertain to acceptable methods for HHS-certified laboratories to use in transmitting the custody-and-control form to the MRO. Currently, HHS-certified laboratories are required to transmit a certified copy of the original custody-and-control form with a copy of the test report. The proposed paragraph expands the acceptable methods of transmitting the custody-and-control form to include fax, courier, mail, and electronic transmission. Although this proposed paragraph provides flexibility in the transmission mechanism, it will result in insignificant incremental costs or savings.

Paragraph 26.169(j)

This paragraph of the proposed rule clarifies that the HHS-certified laboratory must retain the original custody-and-control form for any specimen with a non-negative result and transmit to the MRO a copy of the original custody-and-control form signed by the certifying scientist. No incremental costs or savings will result from the proposed paragraph as it is consistent with existing HHS-certified laboratory recordkeeping practices.

Paragraph 26.169(k)

This paragraph of the proposed rule revises and amends existing requirements in §§2.7(g)(6) and (g)(7) in Appendix A to Part 26, which currently require HHS-certified laboratories to prepare statistical summary reports of each licensee's drug test results, and submit those reports to the licensee official on a monthly basis. By contrast, the proposed paragraph will reduce the reporting frequency from monthly to annually thereby providing more flexibility in the reporting

of this data. However, the proposed rule adds a new requirement that summary reports must also account for the proposed requirement of validity testing (i.e., reporting information for specimens that were identified as adulterated, substituted, diluted, or invalid). No incremental costs are expected to result from the requirement to include validity test summary data, because HHS-certified laboratories already have the capability to provide this information. However, this proposed paragraph will yield incremental savings by reducing the required frequency of statistical summary reports (i.e., reduced labor and postage costs).

The *annual savings per FFD program* are estimated as follows:[13]

$$[(HOURS_{lab\ tech} \times WAGE_{lab\ tech}) + COST_{postage}] \times NUM_{reports} \times NUM_{facility}$$

Parameter	**Description**
$HOURS_{lab\ tech}$	Time for the laboratory technician to generate and send an annual or monthly statistical summary report per facility (as discussed in the assumptions below)
$WAGE_{lab\ tech}$	Laboratory technician wage rate (as discussed in Appendix 2, Exhibit A2-11)
$COST_{postage}$	Cost to send an annual or monthly statistical summary report via the U.S. Postal Service (as discussed in the assumptions below)
$NUM_{reports}$	Number of reports that will no longer be sent to a facility per year (as discussed in the assumptions below)
$NUM_{facilities}$	Number of facilities per FFD program (as discussed in Appendix 2, Exhibit A2-14)

Assumptions:

- Time for the laboratory technician to generate an send annual or monthly statistical summary report per facility: 30 minutes.
- Cost to send an annual or monthly statistical summary report via the U.S. Postal Service: $2.00.
- Number of reports that will no longer be sent to a facility per year: 11.
- An annual summary report requires the same amount of labor and postage as a monthly summary report.

[13] In order to capture total costs and savings, the analysis assumes that savings recognized by HHS-certified laboratories will be passed back to licensees (i.e., lower specimen testing costs).

Subpart H: Determining Fitness-for-Duty Policy Violations and Determining Fitness

26.181 Purpose

This section of the proposed rule imposes no incremental cost and affords no saving because it merely describes the purpose of Subpart H.

26.183 Medical Review Officer

Paragraph 26.183(a)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it merely clarifies the qualifications of the medical review officer (MRO), as currently defined under §26.3 and Appendix A, paragraph 2.9(b), of the current rule. In addition, proposed subparagraph 26.25(a)(4) added MROs to the list of FFD program personnel subject to this part. The proposed paragraph also adds a requirement that within 2 years of the implementation of this rule, all MROs must pass an examination administered by a nationally recognized MRO certification board. However, licensees have indicated that most MROs currently meet the clarified MRO qualifications and that the 2-year phase-in period, in conjunction with revised hiring practices, will ensure that costs will be insignificant.

Paragraph 26.183(b)

This paragraph of the proposed rule establishes requirements regarding the relationships between the MRO and HHS-certified laboratories. The proposed requirements add more explicit conflict-of-interest requirements to prohibit MROs from having a relationship or vested financial interest in a laboratory or contracted operator of a licensee testing facility for which the MRO reviews drug testing results for the licensee or other entity. Although this is a newly required provision, it is consistent with standard ethical business practices. Consequently, this analysis assumes that the only incremental costs that might result from this provision would involve the revision of employee labor contracts to incorporate these prohibited relationships. However, the analysis also assumes that existing contracts incorporate “by reference” the applicable provisions of 10 CFR Part 26. Consequently, the proposed provision is believed to take effect automatically when the rule is promulgated and, therefore, it will not result in any incremental cost or saving.

Paragraph 26.183(c)

This paragraph of the proposed rule [including subparagraphs 26.183(c)(1)–(2)] imposes no incremental cost and affords no saving because it renumbers and retains the requirements contained in paragraph 2.9(b) of Appendix A to the current rule, as they relate to overall MRO responsibilities. The proposed paragraph does add a provision that requires the MRO to advise and assist licensee and other entity management in planning and overseeing the overall FFD program. The analysis anticipates no incremental cost from this added provision, however, because the MRO already meets these obligations given current industry practice.

Paragraph 26.183(d)

This paragraph of the proposed rule [including subparagraphs 26.183(d)(1)–(2)] imposes no incremental cost and affords no saving because it merely clarifies and explicitly states the MRO staff responsibilities that are already effective under the current rule. The paragraph also adds requirements to ensure that MRO staff are properly supervised by the MRO and are independent from the licensee or other entity management. This provision does not result in an incremental cost because it incorporates existing practices into written regulation and makes the procedures consistent with HHS-recommended practices.

26.185 Determining a Fitness-for-Duty Policy Violation

Paragraph 26.185(a)

This proposed paragraph amends existing requirements in Appendix A, paragraph 2.9(a), that describe the MRO's responsibility to review drug and alcohol test results. The proposed paragraph amends language to include validity testing in the reviewing process. The paragraph would also reference other entities as subject to this requirement. In addition, the proposed paragraph eliminates the blood testing option for the alcohol test, resulting in savings that are calculated under paragraph 26.83(b) of the analysis.

Paragraph 26.185(b)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it merely retains requirements in the last sentence of Appendix A, paragraph 2.9(a) of the current rule. The proposed paragraph also adds a new provision that would prohibit the MRO and MRO staff from communicating non-negative initial test results to management, except as specified under paragraph 26.75(h), but that provision would not result in any incremental costs.

Paragraph 26.185(c)

This paragraph of the proposed rule would renumber and amend existing requirements in Appendix A, paragraph 2.9(c), of the current rule. Specifically, the proposed paragraph would retain requirements for the MRO to discuss a non-negative drug test result or other occurrence with the donor before determining whether a violation of FFD policy has occurred. The MRO would be required to discuss non-negative validity test results with the donor as part of the verification process. Contacting the EAP is no longer required and is at the discretion of the MRO. Potential savings are assumed to be insignificant because the MRO must still contact management.

Paragraph 26.185(d)

This paragraph of the proposed rule [including subparagraphs 26.185(d)(1)–(3)] specifies three circumstances in which the MRO may determine that a non-negative test result or other occurrence is an FFD policy violation without having discussed the result or occurrence directly with the donor: (1) the donor expressly declining the opportunity to discuss the test result or other occurrence with the MRO; (2) the donor failing to contact the MRO after a representative of the licensee has successfully made contact and instructed them to contact the MRO directly or (3) a failure on the part of the MRO to contact the donor after making reasonable efforts to contact the donor over a 24-hour period. For all circumstances, the MRO or the licensee's representative must clearly document the attempted contacts, the successful contact, and any declination of opportunities to discuss the possible violation with the MRO. Although the requirement to document such interactions represents a new provision, the analysis assumes that MROs already document such attempts in a manner that meets the requirements of this proposed paragraph.

Paragraph 26.185(e)

This paragraph of the proposed rule imposes no cost and affords no saving because it merely provides more detailed guidance than contained in Appendix A, paragraph 2.9, of the existing rule. The proposed provision allows donors, in circumstances in which the MRO has not discussed a non-negative test result or other occurrence directly with the donor, to present information documenting the circumstances that prevented the donor from contacting or being contacted by the MRO in a timely manner. Although this provision may require additional MRO time when these events occur, NRC believes this will happen very infrequently. Therefore, the analysis estimates no incremental costs for this provision.

Paragraph 26.185(f)

This paragraph of the proposed rule describes the actions that an MRO must take when a urine specimen has an invalid test result.

Subparagraph 26.185(f)(1)

This subparagraph of the proposed rule establishes a provision directing the MRO, in instances when a urine specimen has an invalid test result, to consult with the HHS-certified laboratory to determine whether additional testing could help in determining whether the specimen is drug-positive, adulterated, or substituted. This subparagraph also permits the MRO to send a specimen with an invalid test result to a second HHS-certified laboratory for additional testing when appropriate. The incremental costs per FFD program associated with this subparagraph are discussed in connection with §26.161(g).

Subparagraph 26.185(f)(2)

This subparagraph of the proposed rule establishes a new requirement that requires the MRO, in instances where a urine specimen has an invalid test result with no technical explanation for the result, to contact the donor to determine if an acceptable medical explanation can explain the invalid test result. If an acceptable medical explanation exists, the MRO must report to the licensee or other entity that a negative test result was not obtained. If the medical reason for the invalid result is a temporary condition, the licensee or other entity must collect a second urine specimen (unobserved collection) from the donor and rely upon the MRO's review of the test results from the second specimen. If the medical reason for the invalid result would similarly affect the testing of another urine specimen, the MRO may authorize an alternative method for drug testing. The analysis estimates that the incremental cost per FFD program associated with the requirements in this subparagraph are insignificant due to the infrequency of such invalid test results.

Subparagraph 26.185(f)(3)

This subparagraph of the proposed rule establishes a new requirement that requires the licensee, in instances where a urine specimen has an invalid test result with no technical or medical explanation, to obtain a second collection under direct observation. The analysis estimates that the incremental cost associated with the requirements in this subparagraph are insignificant due to the infrequency of such invalid test results.

Paragraph 26.185(g)

This paragraph of the proposed rule describes the actions that an MRO must take when a urine specimen has a dilute test result.

Subparagraph 26.185(g)(1)

This subparagraph of the proposed rule adds a requirement to §2.7(f)(2) of Appendix A to 10 CFR Part 26 of the current rule, which specifies the confirmatory cut-off levels for drug metabolites, indicating a laboratory positive drug test result. This subparagraph of the proposed rule provides that the MRO must declare a violation of FFD policy if the HHS-certified laboratory reports a specimen as dilute with drug(s) or drug metabolites at or above the cutoff levels and if there is no legitimate medical explanation for the result. This analysis assumes that no incremental cost or saving will result from this new provision.

Subparagraph 26.185(g)(2)

This subparagraph of the proposed rule establishes procedures for the MRO to follow in the event that an attempt at subversion through dilution of the collected specimen is suspected. If evidence of potential subversion [of the sort defined in subparagraphs 26.185(g)(2)(i)–(iii)] is

present, the MRO may require the laboratory to conduct confirmatory testing of the specimen at the level of detection for any drugs or drug metabolites. NRC believes that this provision will apply in very few instances and, therefore, the analysis estimates no incremental cost for this provision.

Subparagraph 26.185(g)(3)

This subparagraph of the proposed rule allows the MRO to conduct confirmatory testing of a dilute specimen at the levels of detection if it was collected under direct observation as required under §26.69. No incremental cost or saving will result from this proposed subparagraph as discussed in connection with §26.69.

Subparagraph 26.185(g)(4)

This subparagraph of the proposed rule revises existing requirements in §2.9(d) of Appendix A to 10 CFR Part 26 under which the MRO must evaluate donors with opiate positives through clinical examination and a review of prescription medication use before determining that the donor has violated the FFD policy. The proposed subparagraph permits the MRO to select a designee (who must be a licensed physician) to conduct a clinical evaluation in situations where drugs detected in a dilute specimen are opium, opiate, or opium derivative or over-the-counter medications. No incremental costs or savings will result from the proposed requirements in this subparagraph.

Paragraph 26.185(h)

This paragraph of the proposed rule describes the actions that an MRO must take when a urine specimen has a substituted test result.

Subparagraph 26.185(h)(1)

This subparagraph of the proposed rule adds new provisions that require the MRO to allow the donor to provide an acceptable medical explanation for the substituted result when the creatinine concentration is less than 2 mg/dL and the specific gravity is less than or equal to 1.0010 or equal to or greater than 1.0200. The donor must then present creditable evidence within 5 business days of the specimen collection. This analysis estimates the costs associated with urine specimens having creatinine concentrations below 2 mg/dL in connection with §§26.131 and 26.161(b)(1).

Subparagraph 26.185(h)(2)–(3)

These subparagraphs of the proposed rule establish procedures for the MRO to follow when a medical explanation is provided by the donor of a urine specimen with a substituted test result. If an acceptable medical explanation is not identified, the MRO must declare the specimen to be substituted and a violation of FFD policy. If an acceptable medical explanation is provided by

the donor, the MRO is required to report to the licensee or other entity that no FFD violation has occurred. The incremental cost associated with the proposed requirements in this subparagraph are discussed in connection with §§26.131 and 26.161(b)(1).

Paragraph 26.185(i)

This proposed paragraph describes the procedure to be followed in the event that the laboratory reports a specimen as adulterated. The proposed paragraph requires the MRO to allow the donor an opportunity to provide a medical explanation for the adulterated specimen. Depending on the donor's evidence, the MRO will determine whether an FFD policy violation has occurred. This procedure differs from that established in the current rule under Appendix A, paragraph 2.4. The incremental cost of the revised procedures are described in connection with §§26.131(f) and 26.161(b).

Paragraph 26.185(j)

Subparagraph 26.185(j)(1)

This subparagraph of the proposed rule revises and expands upon the existing requirements in 2.9(d) in Appendix A to 10 CFR Part 26 pertaining to determining whether a legitimate medical explanation for positive test results for opiates and prescription medication use. The current rule requires the MRO to confirm a positive drug test result for unauthorized use of opium, opiate, or opium derivative (e.g., morphine/codeine) through clinical evidence. This proposed subparagraph permits a designee of the MRO, who must be a licensed physician, to conduct the clinical examination. In addition, this subparagraph includes a provision that limits the circumstances where an MRO may find a medically acceptable reason for opiate consumption. Food products may not be considered as a legitimate medical explanation for morphine or codeine concentrations at or above 15,000 ng/mL. No significant incremental costs or savings will result from the proposed revisions given the low number of opiate positive drug test results under the current cut-off levels, as well as the increase in the initial cut-off level for opiate metabolites as discussed in §§26.133 and 26.163(a)(1).

Subparagraph 26.185(j)(2)

This subparagraph of the proposed rule imposes no incremental cost and affords no saving because it restates requirements contained under Appendix A, paragraph 2.9(d), of the current rule. The provision requires that if the MRO determines that no legitimate medical explanation for positive test results exists, the MRO must determine whether there is clinical evidence of unauthorized use of certain prescription drugs or over-the-counter preparations.

Subparagraph 26.185(j)(3)

This subparagraph imposes no incremental cost and affords no saving because it merely clarifies procedures [contained in Appendix A, paragraph 2.9(d) of the current rule] for the MRO to follow when a non-negative test result is due to unauthorized use of another individual's prescription medication. In such situations, the MRO must determine whether there exists clinical evidence of abuse. If no clinical evidence of abuse is detected, the MRO would report to the appropriate licensee or other entity management that the donor has misused a prescription medication. If clinical evidence of abuse is detected, the MRO must report to the licensee that the donor has violated the FFD policy.

Subparagraph 26.185(j)(4)

This proposed subparagraph has been added to provide guidance to help define the procedure for determining whether the use of a prescription medication from a foreign country qualifies as a legitimate medical explanation for a positive test result. Although this provision is not explicitly contained in the current rule, it likely is the case that when an individual with a non-negative drug test result acknowledges use of a valid prescription obtained in a foreign country, the MRO takes the information into consideration when making the decision to verify non-negative test results as positive.

Subparagraph 26.185(j)(5)

This subparagraph of the proposed rule imposes no incremental cost and affords no saving because it merely states that the consumption of food products, supplements, or other preparations that contain substances which may trigger a positive drug test result may not be considered a legitimate medical explanation when the presence of drugs or drug metabolites in the urine specimen exceeds the cutoff levels specified in proposed section 26.163. This proposed subparagraph explicitly limits the discretion of the MRO, as provided under Appendix A, paragraph 2.9(f) of the current rule.

Subparagraph 26.185(j)(6)

This subparagraph of the proposed rule revises existing requirements in paragraph 1.2 in Appendix A to 10 CFR Part 26, which defines illegal drugs as "Those drugs included in Schedules I through V of the Controlled Substances Act (CSA), but not when used pursuant to a valid prescription or when used as otherwise authorized by law." The proposed subparagraph establishes that the MRO cannot consider the use of any drug contained in Schedule I of section 202 of the Controlled Substances Act [21 U.S.C. 012] as a legitimate medical explanation for a positive confirmatory drug test result, even if the drug may be legally prescribed and used under State law. No incremental cost or saving will result from this revision because licensees must currently have written policies governing the prescription drug use of covered employees, as specified in §26.20(a). This analysis assumes that FFD programs effectively train and inform covered employees regarding the use of prescription drugs and, therefore, that no situations

would arise where an individual has a laboratory positive test result due to the consumption of a prescription drug.

Paragraph 26.185(k)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it merely clarifies Appendix A, paragraph 2.9(f), of the current rule requiring the MRO to assess the likely public health and safety risk of an individual's legitimate drug use. If the MRO determines a potential risk, a determination of fitness would be required.

Paragraph 26.185(l)

This paragraph of the proposed rule restates without change existing requirements in §2.9(e) of Appendix A to 10 CFR Part 26, which permit the MRO to request a retest of a donor's specimen at a second HHS-certified laboratory at the request of the donor. No incremental cost or saving will result from the proposed clarification.

Paragraph 26.185(m)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it merely renumbers existing requirements contained in Appendix A, paragraph 2.9(g), of the current rule.

Paragraph 26.185(n)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it provides the procedure and policy to be followed for MRO verification decisions based on retests by a second laboratory. Although the proposed paragraph contains new requirements, the analysis assumes that licensees already follow these procedures to comply with elements of the current rule, including Appendix A, paragraph 2.9(e).

Paragraph 26.185(o)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it provides the procedure and policy to be followed by the MRO when evaluating drug test results from individuals seeking re-authorization following a first violation of the FFD policy based on a confirmed positive drug test result. Although the proposed paragraph contains new requirements, the analysis assumes that this circumstance is infrequent. Therefore, no incremental cost or saving will result from the proposed revisions.

Paragraph 26.185(p)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it merely limits to 10 days the time within which the MRO must review test results and notify licensee and other entity management. These provisions are currently required under paragraph 26.24(e) of the existing rule.

26.187 Substance Abuse Expert

This section of the proposed rule creates a new position of a substance abuse expert (SAE), with paragraphs 26.187(a)–(g) describing requirements for credentials, basic knowledge, qualifications training, continuing education, responsibilities and prohibitions, and documentation to demonstrate that the SAE meets the required qualifications under this section. In conjunction with proposed subparagraph 26.189(a)(1), the proposed paragraph requires that when substance abuse is involved an SAE must conduct all determinations of fitness instead of the MRO as required by the current rule. Licensees whose MROs do not qualify as SAEs would need to contract additional labor to have an SAE perform the necessary determinations of fitness. (The analysis estimates that the SAE wage rate is approximately equivalent to that of the MRO.) This provision, however, imposes no incremental costs and affords no savings because most MROs will also qualify as an SAE.

26.189 Determination of Fitness

Paragraph 26.189(a)

Subparagraph 26.189(a)(1)

This subparagraph of the proposed rule establishes requirements that allow determinations of fitness associated with suspected or confirmed substance abuse to be conducted by an individual qualifying as an SAE, as defined in §26.187. The SAE is required to make determinations of fitness following an unfavorable termination or denial of authorization under this part. The incremental impacts of this requirement area discussed in more depth under §26.187.

Subparagraphs 26.189(a)(2)–(5)

These proposed subparagraphs of the proposed rule establish requirements that allow determinations of fitness associated with use of psychoactive medications, illness, injury, fatigue, or use of legal medications to be conducted by relevant professionals, such as clinical psychologists, psychiatrists, or physicians, provided that a substance abuse problem is not involved. Although in some instance, using such individuals may result in incremental savings due to a lower wage rate, the analysis assumes that there will be no savings on average, as quantified under §26.187.

Paragraph 26.189(b)

Subparagraphs 26.189(b)(1) and 26.189(b)(2)

These subparagraphs of the proposed rule impose no incremental cost and afford no saving because they merely renumber and clarify elements that are already covered in Appendix A, paragraph 2.9(f) and §26.27(b)(1) and §26.27(b)(4) the existing rule .

Subparagraph 26.189(b)(3)

This subparagraph, in conjunction with §§26.69 and 26.65, requires licensees to conduct determinations of fitness in cases where potentially disqualifying FFD information is identified, as is already required under the current rule. The proposed subparagraph adds a provision [in conjunction with §26.69(a)(2)], however, that eliminates the requirement to conduct the determination of fitness in cases where the potentially disqualifying FFD information has previously been evaluated by another licensee. As a result, fewer determinations of fitness will be conducted under the proposed rule. NRC anticipates that this decrease will more than offset the slight increase in the number of determinations of fitness that otherwise would result from this provision due to the effects of revisions to the definition of "potentially disqualifying FFD information" (discussed in proposed §26.5) and the additional information that will have to be reported by individuals on their self-disclosures [as required by proposed §26.61(b)]. Therefore, the net result of these changes will be a savings for licensees and other entities, as quantified below.

The *annual savings per program* result from the sum of the following savings:

- Annual savings per program from the reduction in the number of determinations of fitness requiring SAE review are calculated as follows:

  $[(NUM_{Applicants} \times PER_{PDFFDI\text{-}Current}) - (NUM_{Applicants} \times PER_{PDFFDI\text{-}Proposed})] \times HOURS_{SAE} \times WAGE_{SAE} \times NUM_{Units}$

- Annual savings per program from the reduction in the number of determinations of fitness requiring FFD program manager review are calculated as follows:

  $[(NUM_{Applicants} \times PER_{PDFFDI\text{-}Current}) - (NUM_{Applicants} \times PER_{PDFFDI\text{-}Proposed})] \times HOURS_{Manager} \times WAGE_{Manager} \times NUM_{Units}$

- Annual savings per program from the reduction in the number of determinations of fitness requiring clerical personnel support are calculated as follows:

  $[(NUM_{Applicants} \times PER_{PDFFDI\text{-}Current}) - (NUM_{Applicants} \times PER_{PDFFDI\text{-}Proposed})] \times HOURS_{Clerical} \times WAGE_{Clerical} \times NUM_{Units}$

Parameter	Description
$HOURS_{Clerical}$	Clerical personnel hours of support per determination of fitness (as described in assumptions below)
$HOURS_{Manager}$	FFD program manager hours of review per determination of fitness (as described in assumptions below)
$HOURS_{SAE}$	SAE hours of review per determination of fitness (as described in assumptions below)
$NUM_{Applicants}$	Annual number of applicants for authorization per unit (as described in Appendix 2, Exhibit A2-12)
NUM_{Units}	Number of units per program (as described in Appendix 2, Exhibit A2-14)
$PER_{PDFFDI\text{-}Current}$	Percentage of applicants for authorization requiring a determination of fitness based on potentially disqualifying FFD information under the current rule (as described in assumptions below)
$PER_{PDFFDI\text{-}Proposed}$	Percentage of applicants for authorization requiring a determination of fitness based on potentially disqualifying FFD information under the proposed rule (as described in assumptions below)
$WAGE_{Clerical}$	Clerical personnel wage rate (as described in Appendix 2, Exhibit A2-11)
$WAGE_{Manager}$	FFD program manager wage rate (as described in Appendix 2, Exhibit A2-11)
$WAGE_{SAE}$	SAE wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- Percentage of applicants for authorization requiring a determination of fitness under the current rule: 10%.
- Percentage of applicants for authorization requiring a determination of fitness under the proposed rule: 5%.
- SAE hours of review per determination of fitness: 2 hours.
- FFD program manager hours of review per determination of fitness: 2 hours.
- Clerical personnel hours of support per determination of fitness: 2 hours.

Subparagraph 26.189(b)(4)

This subparagraph imposes no incremental cost and affords no saving because it simply clarifies elements covered in §26.69 of the proposed rule. The provision requires determinations of fitness when potentially disqualifying FFD information is identified and the licensee's or other entity's reviewing official determines that a determination of fitness is warranted under §26.69.

Paragraph 26.189(c)

This proposed paragraph adds a new requirement that all determinations of fitness that are conducted for-cause be conducted through face-to-face interaction with the individual under review to ensure that the professional who is performing the determination has available all of the sensory information that may be required for the assessment. Determinations of fitness for other purposes, however, can continue to be conducted in the absence of the individual under review or over the phone. This added requirement will result in lost labor productivity for the individual under review.

The *annual costs per program* from requiring that a for-cause determination of fitness be conducted face-to-face with the individual under review results from lost worker productivity for the individuals under review, calculated as follows:

$$NUM_{For\text{-}Cause} \times HOURS_{Worker} \times WAGE_{Worker} \times NUM_{Units}$$

Parameter	**Description**
$HOURS_{Worker}$	Hours of worker time required per face-to-face determination of fitness (as described in assumptions below)
$NUM_{For\text{-}Cause}$	Number of for-cause referrals per unit per year (as described in Appendix 2, Exhibit A2-12)
NUM_{Units}	Number of units per program (as described in Appendix 2, Exhibit A2-14)
$WAGE_{Worker}$	Facility worker wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- Hours of worker time required per face-to-face determination of fitness: 2 hours.

Subparagraph 26.189(c)(1)

This subparagraph imposes no incremental cost and affords no saving because it merely requires that when a for-cause determination of fitness is conducted, as required by proposed paragraph 26.189(b), individuals shall be determined to be fit for duty when no conclusive evidence and no significant basis for concern exists. The proposed subparagraph does, however, provide a more specific procedure that must be followed when making a determination of fitness.

Subparagraph 26.189(c)(2)

This subparagraph imposes no incremental cost and affords no saving because it merely requires that individuals being reviewed in a for-cause determination of fitness must be determined to be unfit for duty when there is a significant basis for concern, even when there is no conclusive

evidence of an FFD policy violation. This provision does, however, provide a more specific procedure that must be followed when making a determination of fitness.

Paragraph 26.189(d)

This subparagraph imposes no incremental cost and affords no saving because it merely requires that the professional who performed the initial determination of fitness be responsible for any changes or modifications made to the determination, and prohibits individuals, licensees, and other entities from seeking a second determination of fitness if one has already been performed.

Subpart I: Managing Fatigue

Note: For analytical purposes, the regulatory analysis calculates an average cost per program for each provision in Subpart I. The NRC notes, however, that actual programs vary considerably in terms of (1) the number of sites and units per program, and (2) the staffing levels per site. Consequently, some programs will have much lower costs or savings than estimated, and others will have much higher costs or savings than estimated.

26.195 Applicability

This section of the proposed rule indicates that Subpart I contains the rule's proposed provisions governing fatigue management. It applies only to Part 50 licensees, combined license holders under §52.103, and contractor/vendors to nuclear power plant licensees who rely upon contractor/vendor FFD programs or program elements. It does not apply to material licensees. Incremental costs associated with the new provisions of this subpart are addressed in relevant paragraphs.

26.197 General Provisions

Paragraph 26.197(a)-(b)

These paragraphs of the proposed rule require licensees to establish a policy and develop, implement, and maintain procedures for the management of fatigue in accordance with the proposed rule. Procedures must address self-declarations, work hour controls, fatigue assessments, and sanctions. Licensees and C/Vs will incur incremental costs to revise their existing policies and procedures to include the fatigue provisions.

The *one-time cost per program* to address fatigue policies and procedures, including self-declarations, work hour controls, fatigue assessments, and sanctions, includes the sum of the following factors:

- One-time costs per program to account for FFD staff, manager, and clerical labor and to contract a legal consultant to incorporate fatigue provisions into the written policies and procedures are calculated as follows:

  $$(HOURS_{FFD_Staff} \times WAGE_{FFD_Staff}) + (HOURS_{Manager} \times WAGE_{Manager}) + (HOURS_{Legal} \times WAGE_{Legal}) + (HOURS_{Clerical} \times WAGE_{Clerical})$$

- One-time costs per program for facility supervisors to implement the corporate policies on the management of fatigue at the facility level (e.g., for development of any site-specific implementing procedures, delineation and delegation of roles and responsibilities under revised policies and procedures, and for other miscellaneous administrative implementation costs not accounted for under other provisions) are calculated as follows:

  $HOURS_{Supervisor} \times WAGE_{Supervisor} \times NUM_{Facilities}$

Parameter	Description
$HOURS_{Clerical}$	One-time hours of clerical personnel to support revision of policies and procedures per program (described in assumptions below)
$HOURS_{Manager}$	One-time hours of labor of various managers to review and approve policies and procedures for fatigue per program (described in assumptions below)
$HOURS_{FFD_Staff}$	One-time hours of FFD program staff labor to develop and revise policies and procedures for fatigue provisions per program (described in assumptions below)
$HOURS_{Legal}$	One-time hours of legal assistance to review and revise policies and procedures for provisions per program (described in assumptions below)
$HOURS_{Supervisor}$	One-time hours of facility supervisor time to implement revised corporate policies and procedures for fatigue per facility (e.g., for development of any site-specific implementing procedures, delineation and delegation of roles and responsibilities under revised policies and procedures, and for other miscellaneous administrative implementation costs not accounted for under other provisions) (described in assumptions below)
$NUM_{Facilities}$	Number of facilities (described in Appendix 2, Exhibit A2-14)
$WAGE_{Manager}$	FFD program manager wage rate (described in Appendix 2, Exhibit A2-11)
$WAGE_{FFD_Staff}$	FFD staff wage rate (described in Appendix 2, Exhibit A2-11)
$WAGE_{Legal}$	Legal consultant wage rate (described in Appendix 2, Exhibit A2-11)
$WAGE_{Clerical}$	Clerical personnel wage rate (described in Appendix 2, Exhibit A2-11)
$WAGE_{Supervisor}$	Facility supervisor wage rate (described in Appendix 2, Exhibit A2-11)

Assumptions:

- Hours of FFD program staff labor to develop and revise policies and procedures for fatigue provisions per program: 80 hours.

- Hours of labor of various managers to review and approve policies and procedures for fatigue provisions per program: 40 hours.

- Hours of legal assistance to review and revise policies and procedures for fatigue provisions per program: 20 hours.

- Hours of clerical personnel to support revision of policies and procedures for fatigue provisions per program: 40 hours.

- Hours of facility supervisor time to implement revised corporate fatigue policies and procedures (e.g., for development of any site-specific implementing procedures, delineation and delegation of roles and responsibilities under revised policies and procedures, and for other miscellaneous administrative implementation costs not accounted for under other provisions): 160 hours.

- Policy and procedure revisions are developed once per operating firm, regardless of the number of sites or facilities the firm operates.

Paragraph 26.197(c)

This paragraph of the proposed rule requires licensees and C/Vs to incorporate the fatigue-related knowledge and abilities (KAs) into the training that is required in proposed paragraph 26.29(a) and the comprehensive examination required in proposed paragraph 26.29(b). Licensees and C/Vs will incur incremental costs for the following activities:

- Training course revisions
- Employee training addressing new fatigue KAs
  - one-time initial training of covered employees
  - annual initial training of new employees
- Annual refresher training for all covered employees

Training Course Revisions. The proposed provision will require licensees to revise their training programs to address the fatigue-related KAs presented in proposed subparagraphs 26.197(c)(1) and (2).

The *one-time cost per program* associated with revising the training program to include fatigue KAs results from the following:

$$(HOURS_{Consultant} \times WAGE_{Consultant}) + (HOURS_{Trainer} \times WAGE_{Trainer}) + (HOURS_{Training_Manager} \times WAGE_{Training_Manager}) + (HOURS_{Manager} \times WAGE_{Manager}) + (HOURS_{Clerical} \times WAGE_{Clerical})$$

Parameter	Description
$HOURS_{Consultant}$	Hours of industry consultant time per program to develop generic training materials for use by the entire industry (described in assumptions below)
$HOURS_{Manager}$	One-time hours of FFD program manager time per program revise the training materials to address fatigue KAs (described in assumptions below)
$HOURS_{Clerical}$	One-time hours of clerical personnel to support the revision of the training materials to include fatigue KAs (described in assumptions below)
$HOURS_{Trainer}$	One-time hours of trainer time per program to revise the training materials to address fatigue KAs (described in assumptions below)
$HOURS_{Training_Manager}$	One-time hours of training manager time per program to revise the training materials to address fatigue KAs (described in assumptions below)
$WAGE_{Manager}$	FFD program manager wage rate (described in Appendix 2, Exhibit A2-11)
$WAGE_{Clerical}$	Clerical personnel wage rate (described in Appendix 2, Exhibit A2-11)
$WAGE_{Consultant}$	Consultant wage rate (described in Appendix 2, Exhibit A2-15)
$WAGE_{Trainer}$	Trainer wage rate (described in Appendix 2, Exhibit A2-11)
$WAGE_{Training_Manager}$	Training manager wage rate (described in Appendix 2, Exhibit A2-11)

Assumptions:

- Hours of industry consultant time per program to develop generic training materials for use by the entire industry: 2.6 hours (i.e., 80 hours divided by 31 programs).
- Hours of trainer time per program to revise the training materials to address fatigue KAs: 8 hours.
- Hours of training manager time per program to review the training materials addressing fatigue KAs: 2 hours.
- Hours of FFD program manager time per program to review the training materials addressing fatigue KAs: 2 hours.
- Hours of clerical personnel to support the revision of the training materials addressing fatigue KAs: 4 hours.

Initial Fatigue KA Training for All Individuals Subject to the Rule. Licensees and C/Vs will be required to incur a one-time cost to retrain affected employees to be familiar with the fatigue-related KAs, an annual cost to train newly hired employees in the additional KAs, and an annual cost to provide refresher training that includes the fatigue KAs.

Licensees and C/Vs will incur a one-time incremental cost to train affected individuals who are already covered by the FFD program, but who must now be retrained in the additional fatigue-related KAs. The costs calculated below assume that the fatigue training will be presented as an incremental unit of the training already conducted under §26.29. The *one-time cost per program* results from the sum of the following costs:

- One-time costs per program to retrain existing employees on the fatigue-related KAs are calculated as follows:

  $$NUM_{Employees} \times (HOURS_{Training\text{-}Fatigue} + HOURS_{Examination\text{-}Fatigue}) \times WAGE_{Worker} \times NUM_{Units}$$

- One-time costs per program for trainers to administer the training on the fatigue-related KAs are calculated as follows:[1]

  $$NUM_{Sessions} \times (HOURS_{Training\text{-}Fatigue} + HOURS_{Examination\text{-}Fatigue} + HOURS_{Preparation\text{-}Fatigue}) \times WAGE_{Trainer} \times NUM_{Units}$$

Parameter	**Description**
$HOURS_{Training\text{-}Fatigue}$	Length of training increment addressing the fatigue-related KAs (described in assumptions below)
$HOURS_{Examination\text{-}Fatigue}$	Length of comprehensive examination increment addressing the fatigue-related KAs (described in assumptions below)
$HOURS_{Preparation\text{-}Fatigue}$	Hours of incremental preparation and examination grading per session addressing the fatigue-related KAs (described in assumptions below)
$NUM_{Employees}$	Number of employees per unit covered by FFD program requirements (described in Appendix 2, Exhibit A2-14)
NUM_{Units}	Number of units per program (described in Appendix 2, Exhibit A2-14)
$NUM_{Sessions}$	Number of training sessions per facility (described in assumptions below)
$WAGE_{Worker}$	Utility worker wage rate (described in Appendix 2, Exhibit A2-11)
$WAGE_{Trainer}$	Trainer wage rate (described in Appendix 2, Exhibit A2-11)

Assumptions:

- Length of training addressing the fatigue-related KAs per session: 1 hour.

[1] Although many licensees may be conducting computer-based trainings, the analysis assumes a class-based format and may overestimate the cost of incremental training activities.

- Length of comprehensive examination increment addressing the fatigue-related KAs per session: 10 minutes.

- Number of training sessions assumes 50 workers per session.

- Hours of preparation and examination grading per session addressing the fatigue-related KAs: 0.5 hours.

Annual Initial Training for other affected individuals, such as new workers not yet covered under FFD programs will also lead to increased costs due to the additional fatigue-related KAs. The costs calculated below assume that the fatigue training will be presented as an incremental unit of the training already conducted under §26.29. The *annual cost per program* results from the sum of the following factors:

- Incoming employees must take the training course increment for fatigue-related KAs:

  $$NUM_{Applicants} \times HOURS_{Training\text{-}Fatigue} \times WAGE_{Worker} \times NUM_{Units}$$

- Annual costs per program for trainers to administer the training course increment for fatigue-related KAs are calculated as follows:[2]

  $$NUM_{Sessions} \times HOURS_{Training\text{-}Fatigue} \times WAGE_{Trainer} \times NUM_{Units}$$

Parameter	**Description**
$HOURS_{Training\text{-}Fatigue}$	Length of fatigue-related KA training increment (described in assumptions below)
$NUM_{Applicants}$	Number of applicants (e.g., new hires including outage workers) covered by FFD program requirements per year (described in Appendix 2, Exhibit A2-14 and in assumptions below)
$NUM_{Sessions}$	Number of training sessions per unit (described in assumptions below)
NUM_{Units}	Number of units per program (described in Appendix 2, Exhibit A2-14)
$WAGE_{Worker}$	Utility worker wage rate (described in Appendix 2, Exhibit A2-11)
$WAGE_{Trainer}$	Trainer wage rate (described in Appendix 2, Exhibit A2-11)

Assumptions:

- Length of training increment addressing the fatigue-related KAs: 1 hour.

[2] Although many licensees may be conducting computer-based trainings, the analysis assumes a class-based format and may overestimate the cost of incremental training activities.

- Hours of incremental preparation and examination grading per session addressing the fatigue-related KAs: 0.5 hours.

- Number of training sessions assumes 20 workers per session.

- Number of applicants (e.g., new hires including outage workers) covered by FFD program requirements per facility per year represents new employees due to staff turnover. The analysis assumes a turnover rate of 25%.

Annual Refresher Training. Licensees and C/Vs also will be required to reflect the fatigue-related KAs in the required annual refresher training. As a result, licensees and C/Vs will incur an incremental cost. The costs calculated below assume that the fatigue training will be presented as an incremental unit of the training already conducted under §26.29. The *annual costs per program* result from the sum of the following costs:

- Annual costs per program for employees to take the refresher training increment addressing fatigue-related KAs are calculated as follows:

  $$NUM_{Employees} \times PER_{Refresher} \times HOURS_{Fatigue\ Training} \times WAGE_{Worker} \times NUM_{Units}$$

- Annual costs per program for trainers to administer the refresher training increment addressing fatigue-related KAs are calculated as follows:[3]

  $$NUM_{Sessions} \times (HOURS_{Fatigue\ Training} + HOURS_{Preparation\text{-}Fatigue}) \times WAGE_{Trainer} \times NUM_{Units}$$

Parameter	**Description**
$HOURS_{Preparation\text{-}Fatigue}$	Hours of training preparation and examination grading for fatigue-related training (described in assumptions below)
$HOURS_{Fatigue\ Training}$	Length of fatigue-related refresher training course (described in assumptions below)
$NUM_{Employees}$	Number of employees per program covered by FFD program requirements (described in Appendix 2, Exhibit A2-14)
$NUM_{Sessions}$	Annual number of additional refresher training sessions per facility (described in assumptions below)
NUM_{Units}	Number of units per program (described in Appendix 2, Exhibit A2-14)

[3] Although many licensees may be conducting computer-based trainings, the analysis assumes a classroom-based format and may overestimate the cost of incremental training activities.

$PER_{Refresher}$	Percentage of employees taking refresher training (described in assumptions below)
$WAGE_{Worker}$	Utility worker wage rate (described in Appendix 2, Exhibit A2-11)
$WAGE_{Trainer}$	Trainer wage rate (described in Appendix 2, Exhibit A2-11)

Assumptions:

- Percentage of employees taking refresher training rather than the comprehensive "challenge" exam described under §26.29(c)(2): 20%.
- Hours of training preparation and examination grading addressing the fatigue-related KAs: 0.5 hours.
- Length of fatigue-related refresher training increment: 1 hour.
- Annual number of refresher training sessions assumes 20 workers per session.

Paragraph 26.197(d)

This paragraph of the proposed rule [including subparagraphs 26.197(d)(1)–(5)] requires each licensee to retain records associated with certain fatigue requirements for a period of at least three years or until completion of all related legal proceedings, whichever is later. These records include (1) records of work hours for individuals subject to the work hour controls as specified in proposed paragraph 26.199, (2) documentation of waivers required under proposed subparagraph 26.199(d)(3)(iv), (3) documentation of work hour reviews conducted in accordance with proposed subparagraph 26.199(j),(4) documentation of any fatigue assessments conducted in accordance with proposed paragraph 26.201(g), and (5) documentation of the collective work hours of each job duty group, as calculated in accordance with proposed subparagraph 26.199(b)(2). The burden of preparing the documents covered by this recordkeeping requirement (e.g., preparing records of fatigue assessments) is calculated under the respective sections of the rule (e.g., 26.201(d) for fatigue assessments). However, licensees will incur annual costs for recordkeeping under subparagraphs (1) - (5) of this paragraph, as discussed below.

Licensees will incur incremental annual costs to physically place the documentation required under 26.197(d)(1), (3), (4), and (5) into storage.

The *annual cost per program* is estimated as follows:

$$[(HOURS_{Work_Hours} + HOURS_{Reviews} + HOURS_{Assessments}) \times WAGE_{Clerical}] \times NUM_{Facilities}$$

Parameter	Description
$HOURS_{Work_Hours}$	Annual number of hours per facility to store individuals' work hours and the collective work hours of each job duty group under proposed rule (described in assumptions below)
$HOURS_{Reviews}$	Annual number of hours per facility to store work hour reviews under proposed rule (described in assumptions below)
$HOURS_{Assessments}$	Annual number of hours per facility to store fatigue assessment documentation under proposed rule (described in assumptions below)
$WAGE_{Clerical}$	Utility clerical wage rate (described in Appendix 2, Exhibit A2-11)
$NUM_{Facilities}$	Number of facilities per program (described in Appendix 2, Exhibit A2-14)

Assumptions:

- Annual number of hours per facility to store individuals' work hours and records of the collective work hours of each job duty group under proposed rule: 40 hours.
- Annual number of hours per facility to store work hour reviews under proposed rule: 4 hours.
- Annual number of hours per facility to store fatigue assessment documentation under proposed rule: 10 hours.

Subparagraph 26.197(d)(2) of the proposed rule requires licensees to document waivers as required in proposed subparagraph 26.199(d)(3)(iv). This subparagraph modifies recordkeeping activities that licensees currently undertake under their plant technical specifications. These currently require licensees to keep on file each authorized deviation from the extended work hour limits contained in their specifications. The provision will result in annual savings because fewer waivers will be issued after the proposed rule takes effect.

The *annual savings cost per program* are estimated as the difference between the new costs and the current costs as follows:

$$(HOURS_{WaiverNew} - HOURS_{WaiverTS}) \times WAGE_{Clerical} \times NUM_{Facilities}$$

Parameter	Description
$HOURS_{WaiverTS}$	Annual number of hours per facility to file deviation authorizations under existing licensee technical specifications (described in assumptions below)
$HOURS_{WaiverNew}$	Annual number of hours per facility to file waivers under proposed rule (described in assumptions below)
$NUM_{Facilities}$	Number of facilities per program (described in Appendix 2, Exhibit A2-14)
$WAGE_{Clerical}$	Utility clerical wage rate (described in Appendix 2, Exhibit A2-11)

Assumptions:

- Annual number of hours per facility to file deviation authorizations under existing licensee technical specifications: 12 hours.
- Annual number of hours per facility to file waivers under proposed rule: 1 hour.

Paragraph 26.197(e)

This paragraph of the proposed rule specifies the fatigue-related information that licensees must include in the annual FFD program performance report required under Section 26.217. Incremental costs and savings to licensees are addressed below under the relevant subparagraph.

In addition, NRC will experience annual costs under this provision in conjunction with the requirements of §26.217. Under the current rule, FFD program performance reports do not address fatigue requirements. NRC, therefore, will incur incremental costs related to the increased effort needed to review the annual FFD program performance reports. On an annual basis, a member of the NRC staff reads, reviews, and summarizes the performance reports in an annual agency report. The *annual cost to the NRC* from reviewing and summarizing the additional information on fatigue is calculated as follows:

$$(HOURS_{Clerical} \times WAGE_{Clerical}) + (HOURS_{NRC_Staff} \times WAGE_{NRC_Staff})$$

Parameter	Description
$HOURS_{NRC_Staff}$	NRC staff hours per year to review and summarize the additional information addressing fatigue (described in assumptions below)
$WAGE_{NRC_Staff}$	NRC staff wage rate (described in Appendix 2, Exhibit A2-11)
$HOURS_{Clerical}$	NRC clerical hours per year to assist in reviewing and summarizing the additional information addressing fatigue (described in assumptions below)
$WAGE_{Clerical}$	NRC clerical wage rate (described in Appendix 2, Exhibit A2-11)

Assumptions:

- NRC staff hours per year to review and summarize the additional information addressing fatigue: 24 hours.

- NRC clerical hours per year to assist in reviewing and summarizing the additional information addressing fatigue: 24 hours.

Subparagraph 26.197(e)(1)

This subparagraph of the proposed rule requires licensees to include, within the annual FFD program performance report required under §26.217, a summary of the number of waivers of the work hour controls specified in §26.199(d)(1) and (2) that were granted during the previous calendar year. Licensees must categorize waivers by work hour control(s) and job duty group(s) affected.

This analysis assumes that licensees will incur an annual cost to review their waiver documentation, categorize the number of waivers of each type, and report the number in the FFD program performance report.

The *annual cost per program* is calculated as follows:

$$[(HOURS_{Clerical} \times WAGE_{Clerical}) + (HOURS_{Manager} \times WAGE_{Manager})] \times NUM_{Facilities}$$

Parameter	**Description**
$HOURS_{Clerical}$	Annual hours of clerical worker labor per facility to tally the annual number of waivers of each type and report it in the FFD program report (described in assumptions below)
$HOURS_{Manager}$	Annual hours of managerial labor per facility to review the number of waivers included in the FFD program report (described in assumptions below)
$WAGE_{Manager}$	Utility managerial wage rate (described in Appendix 2, Exhibit A2-11)
$WAGE_{Clerical}$	Utility clerical wage rate (described in Appendix 2, Exhibit A2-11)
$NUM_{Facilities}$	Number of facilities per program (described in Appendix 2, Exhibit A2-14)

Assumptions

- Hours of clerical worker labor per facility to tally the annual number of waivers of each type and report it in the FFD program report: 2 hours.

- Hours of managerial labor to review the number of waivers included in the FFD program report: 1 hour.

Subparagraph 26.197(e)(2)

This subparagraph of the proposed rule requires licensees to report, within the annual FFD program performance report required under §26.217, the collective work hours of any job duty group listed in 26.199(a) that exceeds an average of 48 hours per person per week in any averaging period during the previous calendar year in accordance with §26.199(f)(3) and (5). Licensees also must specify the dates that defined the averaging period, the job duty group(s), and the conditions that caused the groups to exceed the limit.

This analysis assumes that licensees will incur an annual cost to review their collective work hour documentation prepared under §26.199(b) and stored under §26.197(d)(5), tally the number of job groups that exceed 48 hours in each averaging period, identify the conditions that caused the limits to be exceeded, and include this information in the FFD program performance report.

The *annual cost per program* is calculated as follows:

$$(HOURS_{Supervisor} \times WAGE_{Supervisor}) \times NUM_{Facilities}$$

Parameter	Description
$Hours_{Supervisor}$	Annual hours of supervisor labor per facility to review and summarize the collective work hour information in the FFD program report(described in assumptions below)
$NUM_{Facilities}$	Number of facilities per program (described in Appendix 2, Exhibit A2-14)
$WAGE_{Supervisor}$	Utility supervisor wage rate (described in Appendix 2, Exhibit A2-11)

Assumption:

- Hours of supervisor labor per facility to review and summarize the collective work hour information in the FFD program report: 2 hours.

Subparagraph 26.197(e)(3)

This subparagraph of the proposed rule requires licensees to report the number of fatigue assessments conducted during the previous calendar year, the conditions under which each fatigue assessment was conducted (i.e., self-declaration, for cause, post-event, followup), and the management actions, if any, resulting from each fatigue assessment. This information should be readily available based on documentation prepared under 26.201(f). This analysis assumes that

licensees will incur an annual cost to review and summarize the relevant fatigue assessment documentation.

The *annual cost per program* is calculated as follows:

$$[(HOURS_{Clerical} \times WAGE_{Clerical}) + (HOURS_{Manager} \times WAGE_{Manager})] \times NUM_{Facilities}$$

Parameter	Description
$Hours_{Clerical}$	Annual hours of clerical labor per facility to review and tally the number of fatigue assessments conducted during the previous calendar year, the conditions under which each fatigue assessment was conducted, and the management actions, if any, resulting from each fatigue assessment included in the FFD program report (described in assumptions below)
$Hours_{Manager}$	Annual hours of manager labor per facility to review the summary information to be sent to NRC (described in assumptions below)
$NUM_{Facilities}$	Number of facilities per program (described in Appendix 2, Exhibit A2-14)
$WAGE_{Clerical}$	Utility clerical wage rate (described in Appendix 2, Exhibit A2-11)
$WAGE_{Worker}$	Utility manager wage rate (described in Appendix 2, Exhibit A2-11)

Assumptions:

- Hours of clerical labor per facility to review and tally the number of fatigue assessments conducted during the previous calendar year, the conditions under which each fatigue assessment was conducted, and the management actions, if any, resulting from each fatigue assessment included in the FFD program report: 12 hours.

- Hours for manager per facility to review the summary information to be sent to NRC : 2 hours.

26.199 Work Hour Controls

Paragraph 26.199(a)

This paragraph of the proposed rule describes the individuals subject to the work hour controls of §26.199. NRC's Generic Letter 82-12 and existing plant work hour technical specifications require that licensees establish administrative procedures to limit the working hours of "plant staff who perform safety-related functions (e.g., licensed SROs, licensed ROs, health physicists, auxiliary operators, and key maintenance personnel)." The proposed paragraph would require that individuals be subject to the work hour controls if they perform duties within one of the following five job duty groups: (1) operating or on-site directing of the operation of systems and

components that a risk-informed evaluation process has shown to be significant to public health and safety; (2) performing maintenance or on-site directing of the maintenance of structures, systems, and components that a risk-informed evaluation process has shown to be significant to public health and safety; (3) performing Health Physics or Chemistry duties required as a member of the on-site emergency response organization minimum shift complement; (4) performing the duties of a Fire Brigade member who is responsible for understanding the effects of fire and fire suppressants on safe shutdown capability; or (5) performing security duties as an armed security force officer, alarm station operator, response team leader, or watchperson, hereinafter referred to as security personnel. Incremental costs related to this provision are addressed in the analysis of proposed paragraphs 26.199(b)-(j). In addition, substantial savings are expected to accrue to numerous licensees that will likely apply fatigue management rules to fewer workers than they do currently.[4] NRC believes these savings might be as high as one-third of all fatigue management costs incurred under the current requirements. These savings have not been quantified, however.

Paragraph 26.199(b)

This proposed paragraph, including subparagraphs (1) - (2), specifies the work hours to be included when calculating individual and collective work hours. The analysis assumes that licensees will incur costs to modify their existing timekeeping systems and to monitor, manage, and document the actual hours worked by individuals covered under 26.199.[5]

Licensees will incur a one-time cost to modify their existing timekeeping systems in order to record, track, and document the actual hours worked by individuals covered under (1) the individual work hour controls of paragraph 26.199(d), and (2) the collective work hour limits of paragraph 26.199(f). The *one-time costs per program* result from the following:

$$COST_{System} \times NUM_{Facilities}$$

Licensees will incur an annual cost associated with monitoring and managing the hours actually worked by individuals and by collective job duty groups, including filing or backing up work hour records. The *annual costs per program* result from the following:

$$[(HOURS_{Supervisor} \times WAGE_{Supervisor}) + (HOURS_{Clerical} \times WAGE_{Clerical})] \times NUM_{Facilities}$$

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[4] Relative to Generic Letter 82-12 and existing plant work hour technical specifications, the proposed rule more precisely identifies workers subject to fatigue management provisions. This could lead licensees not to cover workers that had been covered unnecessarily due to ambiguity in the rules or for administrative ease.

[5] Based on available information, NRC believes that licensees will use timekeeping systems (e.g., electronic timesheets) or access control systems (e.g., electronic card-key badge readers) to record employee work hour data.

Parameter	Description
$COST_{System}$	One-time cost per facility to modify a facility's existing timekeeping systems, or develop new systems, to record and track work hour data (described in Appendix 2, Exhibit A2-16)
$HOURS_{Supervisor}$	Annual hours of supervisory labor to monitor and manage the hours actually worked by individuals and by collective job duty groups at one facility, including filing or backing up work hour records (described in assumptions below)
$HOURS_{Clerical}$	Annual hours for clerical labor to monitor and manage the hours actually worked by individuals and by collective job duty groups at one facility, including filing or backing up work hour records (described in assumptions below)
$NUM_{Facilities}$	Number of facilities per program (described in Appendix 2, Exhibit A2-14)
$WAGE_{Supervisor}$	Utility managerial wage rate (described in Appendix 2, Exhibit A2-11)
$WAGE_{Clerical}$	Utility clerical wage rate (described in Appendix 2, Exhibit A2-11)

Assumptions:

- One-time cost to modify a facility's existing systems, or develop a new system, to record, track, and document workers' actual hours worked is inclusive of all labor, management, contractor, and software.

- Annual hours of supervisory labor to monitor and manage the hours actually worked by individuals and by collective job duty groups, including filing or backing up copies of work hour records: 200 hours.

- Annual hours for clerical labor to monitor and manage the hours actually worked by individuals and by collective job duty groups, including filing or backing up copies of work hour records: 50 hours.

Sensitivity Analysis - Pre-Order Baseline

The preceding analysis addresses the cost of modifying timekeeping systems and tracking hours of all workers covered by §26.199, including security personnel, operators, maintenance, health physics/chemistry emergency response, and fire brigade. For one subset of these workers – security personnel – licensees already have undertaken activities similar to those described above due to the requirements of Order EA-03-038. In particular, licensees already have developed modified timekeeping systems to track hours of security personnel as necessary to implement certain individual and collective work hour limits. These timekeeping systems are inadequate, however, with respect to conducting the tracking necessary to implement the various break provisions required under §26.199(d)(2), including the biweekly 48-hour break. This analysis

assumes, therefore, that licensees will replace the systems developed in response to Order EA-03-038 in favor of new systems, as costed above.

Paragraph 26.199(c)

This proposed paragraph requires licensees to schedule the work hours of individuals who are subject to §26.199 consistent with the objective of preventing impairment from fatigue due to the duration, frequency, or sequencing of successive shifts.

Licensees may incur one-time costs to renegotiate collective bargaining agreements, or discuss changes with employee committees (for non-union facilities), in order to address issues related to the assignment of overtime. *One-time costs per program* are calculated as follows:

$$[(HOURS_{Management} \times WAGE_{Management}) + (HOURS_{Legal} \times WAGE_{Legal})] \times PER_{Negotiation} \times NUM_{Facilities}$$

Licensees will incur annual costs to prepare modified work schedules on an ongoing basis for all employees covered by the rule as required by this paragraph, as well as by other provisions of the proposed rule. *Annual costs per program* are calculated as follows:

$$HOURS_{Scheduler} \times WAGE_{Scheduler} \times NUM_{Facilities}$$

Parameter	Description
$HOURS_{Scheduler}$	Annual hours needed for workers to support supervisors in reviewing, analyzing, and modifying schedules (described in the assumptions below)
$HOURS_{Management}$	One-time hours needed for licensee management to work with union representatives in collective bargaining (described in the assumptions below)
$HOURS_{Legal}$	One-time hours needed for licensee legal staff to work with union representatives in collective bargaining (described in the assumptions below)
$NUM_{Facilities}$	Number of facilities per program (described in Appendix 2, Exhibit A2-14)
$PER_{Negotiation}$	Percentage of licensees whose schedule modifications lead to revisions to collective bargaining agreements or to discussions with employee committees (for non-union facilities) (described in the assumptions below)
$WAGE_{Scheduler}$	Utility worker wage rate (described in Appendix 2, Exhibit A2-11)
$WAGE_{Management}$	Licensee management wage rate (described in Appendix 2, Exhibit A2-11)
$WAGE_{Legal}$	Licensee legal wage rate (described in Appendix 2, Exhibit A2-11)

Assumptions:

- Hours needed for licensee management to prepare for and bargain with union representatives or discuss changes with employee committees: 60 hours.

- Hours needed for licensee legal staff to prepare for and bargain with union representatives or discuss changes with employee committees: 40 hours.

- Percentage of facilities whose schedule modifications lead to revisions to collective bargaining agreements or to discussions with employee committees (for non-union facilities): 100 percent.

- An additional level of effort averaging one FTE per site will be needed to prepare and maintain all worker schedules in a manner that complies with new fatigue requirements, including the proposed break requirements.

Sensitivity Analysis - Pre-Order Baseline

The preceding analysis addresses the cost of preparing modified work schedules on an ongoing basis for all employees covered by the proposed rule (including security personnel, operators, maintenance, health physics/chemistry emergency response, and fire brigade) consistent with the objective of preventing impairment from fatigue due to the duration, frequency, or sequencing of successive shifts. For one subset of these workers – security personnel – licensees already have undertaken activities similar to those described above due to the requirements of Order EA-03-038. In particular, licensees already have developed modified work schedules for security personnel as necessary to implement certain individual and collective work hour limits. These schedules may not be adequate, however, with respect to implementing the various break provisions required under §26.199(d)(2), including in particular the biweekly 48-hour break. This analysis assumes, therefore, that licensees will replace the schedules developed in response to Order EA-03-038 in favor of new scheduling practices, as costed above.

Paragraph 26.199(d)

Subparagraph 26.199(d)(1)

This subparagraph of the proposed rule establishes work hour limits for individuals subject to §26.199(a). Except as allowed by the waiver provisions of subparagraphs 26.199(d)(3), licensees must ensure that employee work hours do not exceed the following individual work hour limits:

- 16 work hours in any 24-hour period;
- 26 work hours in any 48-hour period; and
- 72 work hours in any 7-day period.

This paragraph imposes no incremental cost and affords no savings because licensees' existing technical specifications, based on Generic Letter 82-12, contain almost identical requirements. The only change is that under the proposed rule employee work hours must not exceed 26 hours (instead of 24 hours) in any 48-hour period. This slight relaxation in the work hour limit relieves licensees from the requirement of granting a waiver in those cases where it would have permitted the employee to work up to two additional hours. The associated savings are accounted for in the analysis of proposed subparagraph 26.199(d)(3). Order EA-03-038 imposed the requirements of proposed §26.199(d)(1) on security personnel. Therefore, the proposed provision results in no incremental costs for security personnel.

Although licensees' existing plant technical specifications contain almost identical requirements, some licensees are applying them more broadly to encompass some plant workers who would not be subject to individual work hour controls under proposed §26.199(d)(1). For those workers, the proposed rule would result in savings because licensees would no longer be required to complete paperwork when necessary to waive the individual work hour limits. These savings also are accounted for under §26.199(d)(3).

Sensitivity Analysis - Pre-Order Baseline

Relative to the requirements that were in effect before the NRC issued Order EA-03-038, which established certain fatigue management provisions for security personnel, the proposed subparagraph represents an entirely new requirement as applied to security personnel. NRC, however, believes that even prior to Order EA-03-038, security personnel rarely exceeded the proposed individual work hour limits. A 72-hour work week consisting of six 12-hour days, for example, would meet the proposed limits, and NRC believes that security personnel worked substantially fewer hours. Therefore, the analysis assumes that any incremental costs resulting from this subparagraph are insignificant to the analysis.

Subparagraph 26.199(d)(2)

This subparagraph of the proposed rule revises and amends requirements related to mandatory rest breaks. License work hour technical specifications based on Generic Letter 82-12 currently require that individuals performing safety-related functions must receive a minimum break of at least 8 hours, including shift turnover time, between work periods. There currently is no required weekly or biweekly break. The proposed rule would extend the minimum break between shifts to 10 hours (or a minimum 8-hour break when a break of less than 10 hours is necessary to accommodate a crew's scheduled transition between work schedules or shifts).

In addition, the proposed subparagraph introduces both a weekly break and a biweekly break applicable to affected workers:

- A 24-hour break in any 7-day period; and
- A 48-hour break in any 14-day period, except during the first 14 days of any plant outage (for non-security personnel).

NRC expects that licensees will be able to meet the proposed break provisions at no incremental cost other than the scheduling cost described under Paragraph 26.199(c), except for the 48-hour break in any 14 day period during refueling outages as discussed below, and except under unusual circumstances, as addressed under Paragraph 26.199(d)(3). This includes any costs during power operation to ensure staff coverage over weekends as well as the availability of personnel during and after unscheduled call-ins.

With respect to the 48-hour break in any 14 day period, however, NRC expects that most licensees will need to draw upon additional workers in order to continue obtaining the same level of effort during refueling outage periods as they obtain during refueling outages in the baseline.[6] These staff may be permanent part-time staff or temporary contract staff hired to work during the outage, depending on the relevant job duty group, as follows:

- Operators - the analysis assumes that licensees will meet the additional need for operators by (1) maintaining a pool of semi-retired, formerly-licensed, operators that work only during outages and (2) obtaining some additional contract operator staff (i.e., fuel handlers). (Licensees are assumed to obtain contracted operator staff, such as refueling floor operators, only to the extent that current contract operator staffing levels cease to be adequate.) The analysis assumes there is no "slack" in available operator staff, and may, therefore, overstate costs. This may be particularly true if operators work fewer than 72 hours during some portions of an outage. Licensees will incur annual costs to coordinate, maintain, and pay a small pool of semi-retired, formerly-licensed operators to work during outages. These costs, however, are more than offset by savings associated with reduced overtime wages paid to current operators. These savings have not been calculated because they will vary depending on (1) whether the semi-retired operators are any less efficient than the current operators, and (2) the size of the pool of semi-retired operators (e.g., if the pool is large enough, then none of the semi-retired operators will be paid for overtime, thereby maximizing savings to licensees).

[6] NRC estimates that licensee staff working as many hours during outages as permitted under the current standards (i.e., 72 hours per week) might need to average up to 5.6 percent fewer hours (i.e., to a reduced total of 68 hours per week) in order to comply with the proposed break provisions. This calculation is based on a 6-week outage period where total hours per week (post-rule) are 72, 72, 72, 60, 72, and 60.

- Maintenance - the analysis assumes that licensees will obtain additional contract maintenance staff during the period of the outage (but after the first 14 days of the outage).

- Health Physics/Chemistry Emergency Response - the analysis assumes that additional health physics/chemistry emergency response staff are not needed during outage periods.[7]

- Fire Brigade - the analysis assumes that additional fire brigade staff also are operators and are costed only as part of that group in order to avoid double counting.

- Security Personnel - the analysis assumes that additional security personnel will not be needed to comply with the 48-hour break requirement. Under Order EA-03-038, these staff already must average no more than 60 hours per week during planned outages and are not limited during unplanned outages. A typical 60-hour schedule of five 12-hour days would not need to be modified, and other possible schedules (e.g., six 10-hour days) could be adjusted (e.g., to five 12-hour days) without changing staffing levels.

As a result of the additional hires, licensees also will incur some savings due to a reduction in overtime hours.

The *annual costs per program* result from the following:

- Licensees will incur annual costs to pay for in-processing of additional contract operator staff at the time of an outage:

  $NUM_{Contract_Ops_Affected} \times RATE_{Est._Util._Decrease} \times COST_{Process_Contract_Ops} \times FACTOR_{Outage} \times NUM_{Facilities}$

- Licensees will incur annual costs to pay for additional contract operator staff during an outage (except for the first 14 days of the outage):

  $[NUM_{Contract_Ops_Affected} \times RATE_{Est._Util._Decrease}] \times (WEEKS_{Outage} - 2) \times WCOST_{Contract_Ops} \times FACTOR_{Outage} \times NUM_{Facilities}$

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[7] Although HP/Chemistry staff typically work large number of hours during an outage, the only HP/Chemistry staff covered by the proposed rule are the small number actually assigned emergency response duties (a number that does not change depending on whether or not the plant is in outage). Therefore, even if any licensees respond to the proposed rule by shifting hours from the HP/Chemistry emergency response team to other HP/Chemistry personnel, this will not result in incremental costs beyond the scheduling costs calculated under paragraph 26.199(c).

- Licensees will incur annual costs to pay for in-processing of additional contract maintenance staff at the time of an outage:

  $[((NUM_{Perm_Maint} \times PER_{Maintenance_Affected}) + NUM_{Contract_Maint_Aff}) \times RATE_{Est._Util._Decrease}]$
  $\times COST_{Process_Maint} \times FACTOR_{Outage} \times NUM_{Facilities}$

- Licensees will incur annual costs to pay for additional contract maintenance staff during an outage (except for the first 14 days of the outage):

  $[((NUM_{Perm_Maint} \times PER_{Maintenance_Affected}) + NUM_{Contract_Maint_Aff}) \times RATE_{Est._Util._Decrease}]$
  $\times (WEEKS_{Outage} - 2) \times WCOST_{Contract_Maint} \times FACTOR_{Outage} \times NUM_{Facilities}$

The above costs will be partly offset by the *annual savings per program,* which result from the following factors:

- Licensees will incur savings related to overtime wages paid to contract operator staff (i.e., current contract outage operators will have to work less overtime during outages due to the hiring of additional operators):

  $NUM_{Contract_Ops_Affected} \times HOURS_{Lost_OT} \times (WEEKS_{Outage} - 2)$
  $\times WAGE_{Contract_Ops_OT} \times FACTOR_{Reduction_for_Incentive} \times NUM_{Facilities}$

- Licensees will incur savings related to overtime wages paid to permanent maintenance staff (i.e., current maintenance staff will have to work less overtime during outages due to the hiring of additional maintenance staff):

  $(NUM_{Perm_Maint} \times PER_{Maintenance_Affected}) \times (HOURS_{Lost_OT} \times WEEKS_{Outages}$
  $\times WAGE_{Maint_OT}) \times NUM_{Facilities}$

- Licensees will incur savings related to overtime wages paid to contract maintenance staff (i.e., current contract outage maintenance staff will have to work less overtime during outages due to the hiring of additional maintenance staff):

  $NUM_{Outage_Maint_Aff.} \times HOURS_{Lost_OT} \times (WEEKS_{Outage} - 2) \times WAGE_{Outaget_Maint_OT}$
  $\times FACTOR_{Reduction_for_Incentive}) \times NUM_{Facilities}$

Parameter	Description
$HOURS_{Non_OT}$	The average annual number of non-overtime hours worked by one newly hired operator that would have been worked as overtime if this new worker had not been hired (described in assumptions below)
$HOURS_{Lost_OT}$	The average weekly reduction in overtime hours for affected staff (described in assumptions below)
$COST_{Ops_Hire}$	The one-time cost to hire, process, and conduct initial training of one operator (described in the assumptions below)
$COST_{Process_Contract_Ops}$	The average cost to conduct in-processing of one contract operator (described in assumptions below)
$COST_{Process_Maint}$	The average cost to conduct in-processing of one contract maintenance staff person (described in assumptions below)
$FACTOR_{Outage}$	Adjustment factor to annualize modeled outages that do not occur annually (described in the assumptions below)
$FACTOR_{Reduction_for_Incentive}$	Adjustment factor to reduce overtime savings to account for the higher wage rates that transient outage workers might demand as compensation for reduced hours (described in assumptions below)
$NUM_{Contract_Ops_Affected}$	The average current number of affected contract operator staff per facility (described in Appendix 2, Exhibit A2-16)
$NUM_{Outage_Maint_Aff.}$	The average current number of affected contract maintenance staff per facility (described in Appendix 2, Exhibit A2-16)
NUM_{Perm_Maint}	The average current number of affected permanent maintenance staff per facility (described in Appendix 2, Exhibit A2-16)
$NUM_{Facilities}$	Number of facilities per program (described in Appendix 2, Exhibit A2-14)
$PER_{Maintenance_Affected}$	Percentage of maintenance staff for which licensees will have to modify current outage work schedules to comply with the 48-hour break requirement during outages (described in the assumptions below)
$RATE_{Est._Util._Decrease}$	The percentage of a maximum 72-hour week that can no longer be worked due to the proposed 48-hour break requirement (described in the assumptions below)
$WAGE_{Outage_Maint_OT}$	The current average hourly overtime wage rate for contract outage maintenance staff (described in assumptions below)
$WAGE_{Contract_Ops_OT}$	The current average hourly overtime wage rate for the average contract outage operator (described in Appendix 2, Exhibit A2-16)
$WAGE_{Maint_OT}$	The current average hourly overtime wage rate for permanent maintenance staff (described in assumptions below)

$WCOST_{Contract_Ops}$	The weekly cost of one contract operator (described in Appendix 2, Exhibit A2-16)
$WCOST_{Contract_Maint}$	The weekly cost of one contract maintenance worker (described in Appendix 2, Exhibit A2-16)
$WEEKS_{Outage}$	Number of weeks in modeled refueling outage (described in Appendix 2, Exhibit A2-15)

Assumptions:

- Percentage of maintenance staff for which licensees will have to modify current outage work schedules to comply with the 48-hour break requirement during outages: 75 percent.[8]

- The percentage of a maximum 72-hour week that can no longer be worked due to the proposed 48-hour break requirement: 5.6 percent.[9]

- Significant outages (refueling outages) are assumed to occur only once every 18 months at some reactors and once every 24 months at other reactors. The analysis assumes that each facility (which, on average, has 1.6 units) experiences one significant outage per year. Therefore, the equation applies an "outage factor" ($FACTOR_{Outage}$) of 1 as a means of annualizing the above cost.

- The average reduction in overtime hours for affected staff, per week of outage: 4 hours.

- Adjustment factor to reduce overtime savings to account for the higher wage rates that skilled outage workers might demand as compensation for reduced hours:[10] 10%.

- The current average hourly overtime wage rate for permanent maintenance staff: $50 per hour.

- The current average hourly overtime wage rate for contract outage maintenance staff: $50 per hour.

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[8] This 50 percent figure is less than the 75 percent figure assumed for maintenance staff because operators typically do not work as many hours during refueling outages as do maintenance staff, except at the beginning and at the end of the outage.

[9] Based on a 6-week outage where the maximum hours worked per person per week average 68 per week (i.e., the average of 72, 72, 72, 60, 72, 60).

[10] In contrast, the analysis assumes that permanent staff will accept reduced overtime at current wage rates.

Sensitivity Analysis Note - Pre-Order Baseline

Relative to the requirements that were in effect before the NRC issued Order EA-03-038, the proposed subparagraph also establishes mandatory breaks for security personnel. NRC expects that licensees will be able to meet the proposed break provisions at no incremental cost other than the scheduling cost described under Paragraph 26.199(c) and the calculation and monitoring cost described under Paragraph 26.199(b), except under unusual circumstances, as addressed under Paragraph 26.199(d)(3). Even during refueling outages, NRC does not expect licensees to need additional security staff given that proposed subparagraphs 26.199(f)(1)-(2) allow security personnel to collectively work no more than an average of 60 hours per week during refueling outages.

Subparagraph 26.199(d)(3)

Under NRC's Generic Letter No. 82-12 and licensees' existing technical specifications, a deviation from extended work hour limits may be authorized in advance by the plant manager or his deputy or higher levels of management but must be documented and available for NRC review.

Under the proposed subparagraph, licensees may grant a waiver of the individual work hour controls contained in paragraphs (d)(1) and (2) only if an operations shift manager determines that the waiver is necessary to mitigate or prevent conditions adverse to safety, or a security shift manager determines that the waiver is necessary to maintain the security of the facility, or a site senior-level manager with requisite signature authority makes either determination. In addition, a qualified supervisor must assess the individual and determine that there is reasonable assurance that the individual will be able to safely and competently perform his or her duties during the additional work period for which the waiver will be granted. To the extent practicable, licensees must only rely upon the granting of waivers to address circumstances that could not have been reasonably controlled. Licensees also must document the basis for individual waivers.

As a result of the proposed subparagraph, licensees will be unable to issue waivers to address most of the situations that they currently handle using deviations. Incremental costs result from licensees addressing the situation through means other than a waiver. This may entail using replacement staff who are fully qualified, but less efficient or less familiar with the job. This analysis assumes that this is the case for all instances and estimates the related costs on a weekly basis, both for outage and non-outage periods. Appendix 3 describes the derivation of these weekly costs. In addition, for those waivers that can be granted under the proposed rule, incremental costs arise from the need to conduct and document a fatigue assessment. This cost is calculated under §26.199 and §26.201.

The *annual cost per program* is calculated as follows:

$$[(Weeks_{Outage} \times WeeklyCosts_{Outage}) + (Weeks_{Power} \times WeeklyCosts_{Power})] \times Num_{Facilities}$$

Parameter	Description
$Num_{Facilities}$	Number of facilities per program (described in Appendix 2, Exhibit 2-14)
$Weeks_{Outage}$	Number of weeks per year during which facilities experience outage conditions (described in assumptions below)
$Weeks_{Power}$	Number of weeks per year during which facilities experience full power conditions (described in assumptions below)
$WeeklyCosts_{Outage}$	The costs per week under outage conditions incurred by facilities as a result of their restricted ability to grant waivers (described in Appendix 3)
$WeeklyCosts_{Power}$	The costs per week under at-power conditions incurred by facilities as a result of their restricted ability to grant waivers (described in Appendix 3)

Assumptions:

- Number of weeks per year during which an average facility experiences outage conditions: 8 weeks.
- Number of weeks per year during which facilities experience full power conditions: 44 weeks.

Paragraph 26.199(e)

This proposed paragraph requires licensees to stop any individual from performing any duties listed in paragraph 26.199(a) if the individual is performing, or being assessed for, work under a waiver of the requirements contained in 26.199(d)(1) and (2) and declares that he or she is unable to safely and competently perform his or her duties due to fatigue. If the individual is required to continue performing those duties by certain other requirements, then the licensee must immediately take action to relieve the individual. The licensee must permit or require the individual to take a rest break of at least 10 hours or, alternatively, the licensee may reassign the individual to other duties if a fatigue assessment indicates that the individual is fit to safely and competently perform those other duties.

The analysis calculates costs for this provision by assuming that, in the event of a self-declaration, licensees (1) send the fatigued worker home to take a rest break of at least 10 hours, and (2) call in a replacement worker. Note that the assumed licensee actions may overstate the costs of the proposed provision, which also allows licensees to perform a fatigue assessment and

then reassign fatigued individuals to other duties. To the extent that licensees are able to reassign fatigued staff, there would be an offset to the costs calculated below.

Licensees will incur management and labor costs related to replacing fatigued workers. The *annual cost per program* is calculated as follows:

- Licensees will incur incremental management costs to call in replacement workers to substitute for any workers who are sent home to rest following a self-declaration:

  $$NUM_{Waivers} \times PER_{Self\text{-}Declare} \times (HOURS_{Supervisor} \times WAGE_{Supervisor}) \times NUM_{Facilities}$$

- Licensees also will incur incremental labor costs due to the extra time for the worker to "turn over" his/her duties to the replacement worker and other lost labor productivity:

  $$NUM_{Waivers} \times PER_{Self\text{-}Declare} \times (HOURS_{Turnover} \times WAGE_{Worker}) \times NUM_{Facilities}$$

- Licensees also will incur incremental labor costs associated with the replacement worker:[11]

  $$NUM_{Waivers} \times PER_{Self\text{-}Declare} \times (HOURS_{Substitute} \times WAGE_{Worker}) \times NUM_{Facilities}$$

Parameter	**Description**
$HOURS_{Supervisor}$	Supervisor hour expended to identify and call in a replacement worker (described in the assumptions below)
$HOURS_{Turnover}$	Labor hours resulting from an additional turnover due to the replacement of a fatigued worker with a substitute worker (described in the assumptions below)
$HOURS_{Substituted}$	Average number of hours worked by the replacement worker per incident (described in the assumptions below)
$NUM_{Facilities}$	Number of facilities per program (described in Appendix 2, Exhibit A2-14)
$NUM_{Waivers}$	Total annual number of persons, per site, granted waivers from the requirements contained in 26.199(d)(1) and (2) (described in Appendix 3)

[11] The analysis assumes that replacement workers are drawn from staff who are present at the site but have flexibility to change assignments for the remainder of the day. Therefore, this cost represents an opportunity cost. The analysis assumes that wages paid to the replacement worker are offset by wages not paid to the fatigued worker.

$PER_{Self\text{-}Declare}$	Percentage of $NUM_{Waivers}$ that self-declare to a condition of fatigue (described in the assumptions below)
$WAGE_{Worker}$	Utility worker wage rate (described in Appendix 2, Exhibit A2-11)

Assumptions:

- Total annual number of persons, per site, granted waivers from the proposed requirements contained in 26.199(d)(1) and (2): 15.
- Percentage of $NUM_{Waivers}$ that self-declare to a condition of fatigue: 10 percent.
- Supervisor hours expended to identify and call in a replacement worker: 1/2 hour.
- Labor hours resulting from an additional turnover due to the replacement of a fatigued worker with a substitute worker: 1 hour (i.e., 30 minutes for each of two workers).
- Average number of hours worked by the replacement worker per incident: 6 hours.

Paragraph 26.199(f)

Subparagraphs 26.199(f)(1)-(2)

These subparagraphs of the proposed rule, including subparagraphs (f)(1)-(2), establish requirements limiting collective work hours of individuals included in the five job duty groups specified in Paragraph 26.199(a)(1)-(5). In particular, each of the five job duty groups must average, collectively, no more than 48 hours per person per week in any averaging period (not to exceed 13 weeks). This represents a new requirement for licensees, except as it pertains to the security personnel job duty group, which already is subject to collective work hour limits. In April 2003, NRC issued Order EA-03-038 requiring licensees to limit the average number of hours actually worked by security force personnel (including armed members of the security force, central alarm station operators, secondary alarm station operators, security shift supervisors, and watchpersons[12]) to no more than 48 hours per week averaged over consecutive periods not to exceed six weeks.

[12] The proposed rule, in Paragraph 26.199(a), identifies affected security personnel slightly differently (i.e., as any "armed security force officer, alarm station operator, response team leader, or watchperson"). This group is largely equivalent to the group specified in Order EA-03-038, as discussed above, and this analysis assumes they are interchangeable for cost-benefit purposes.

NRC estimates that some job duty groups (other than security personnel, which is discussed in the Pre-Order Baseline sensitivity analysis later in this section) in approximately 15 percent of plants currently exceed a 48-hour average per person during non-outage periods, and groups in approximately 75 percent of plants exceed a 48-hour average per person during outage periods. NRC expects the industry's cost of complying with the collective work hour requirements will differ for periods when the site is (or is not) in outage, as discussed below. Note, however, that this provision does not preclude individuals from exceeding a 48-hour weekly average so long as the collective average for each job duty group does not exceed 48-hours.

Outage Periods. The proposed provision allows licensees not to impose the collective work hour limits on four of the job duty groups (operators, maintenance, health physics/chemistry emergency response, fire brigade) during the first 8 weeks of any plant outage. Therefore, the provision results in no costs related to outages lasting 8 or fewer weeks. This accounts for a substantial majority of all outages, including most refueling outages, which average less than 6 weeks. For outages of longer than 8 weeks, licensees will incur incremental costs related to this provision, but these costs are addressed under paragraphs 26.199(f)(3) and (f)(5). Similarly, for the security personnel job duty group, licensees need not impose the collective work hour limits during first 8 weeks of an unplanned security system outage or an increased threat condition. Licensees must limit security personnel to a collective average of up to 60 hours during the first 8 weeks of a plant outage, a planned security system outage, or during the actual conduct of force-on-force tactical exercises.

Non-Outage Periods. The proposed provision will generate incremental costs related to three activities: (1) scheduling work hours in compliance with the collective limits, as addressed under Paragraph 26.199(c); (2) calculating and monitoring collective work hours, as addressed under Paragraph 26.199(b); and (3) for some sites, increasing staffing levels sufficiently to reduce the collective average to allowable levels, as discussed below for each job duty group:

- *Operators.* The analysis assumes that licensees will hire additional permanent operator staff as needed.

- *Maintenance.* The analysis assumes that licensees will hire additional permanent maintenance staff as needed.

- *Health Physics/Chemistry Emergency Response.* The only HP/Chemistry staff covered by the proposed rule are the small number of staff who are actually assigned emergency response duties. Therefore, even if any licensees need to respond to the proposed rule by shifting excess overtime hours from the HP/Chemistry emergency response team to other HP/Chemistry personnel who are not covered by the rule, this will not result in incremental costs.

- *Fire Brigade.* Based on discussions with stakeholders, NRC believes that most licensees choose to assign fire brigade responsibilities primarily to staff who

already have full-time duties under one of the other four affected job duty groups, particularly operators. The analysis calculates incremental costs for these staff under their primary job duty group and, to avoid double counting, does not calculate further costs due to these staff's fire brigade duties. Although some licensees may employ a limited number of dedicated fire brigade staff, NRC believes the total number of such dedicated staff is small enough to be immaterial to the analysis.

- *Security Personnel.* Security personnel already are subject to a collective average limit of 48 hours per week due to NRC's Order EA-03-038. The proposed rule would increase the maximum allowed averaging period from 6 weeks to 13 weeks, which might result in incremental savings, both as a result of fewer annual averaging calculations and as a result of the increased operational flexibility possible under a longer averaging period. Nevertheless, the analysis does not calculate any savings associated with security personnel and, as a result, may overstate the actual costs of the paragraph.

Only the fraction of licensees that presently exceed the proposed collective work hour limits would incur costs under the proposed provision. The remainder of licensees already meet the proposed requirements and would not incur costs. However, as the identity of licensees falling within the two groups is not known, this analysis assumes that 100 percent of facilities would incur a prorated portion of the calculated amount.

The *one-time costs per program* result from the following:

- Licensees will incur a one-time cost to hire, process, and conduct initial training of additional permanent operator staff:

  Only if positive: $[((AVG_{Ops_Current} - 48) \times NUM_{Perm_Ops}) \div 48] \times COST_{Ops_Hire} \times PER_{Facilities_with_Affected_Ops} \times NUM_{Facilities}$

- Licensees will incur a one-time cost to hire and process additional permanent maintenance staff beyond those hired as a result of proposed §26.199(d)(2):

  Only if positive: $[((AVG_{Maint_Current} - 48) \times NUM_{Perm_Maint}) \div 48] \times COST_{Maint_Hire} \times PER_{Facilities_with_Affected_Maint} \times NUM_{Facilities}$

The *annual costs per program* result from the following:

- Licensees will incur annual costs to pay for additional permanent operator staff on an ongoing basis:

  Only if positive: $[((AVG_{Ops_Current} - 48) \times NUM_{Perm_Ops}) \div 48] \times COST_{Operator} \times PER_{Facilities_with_Affected_Ops} \times NUM_{Facilities}$

- Licensees will incur annual costs to pay for additional maintenance staff on an ongoing basis:

  Only if positive: $[((AVG_{Maint_Current} - 48) \times NUM_{Perm_Maint}) \div 48] \times COST_{Maintenance} \times PER_{Facilities_with_Affected_Maint} \times NUM_{Facilities}$

The above costs will be partly offset by the *annual savings per program,* which result from a reduction in overtime hours, as follows:

- Licensees will incur savings related to overtime wages paid to permanent operator staff (i.e., current operator staff will have to work less overtime due to the hiring of additional maintenance staff):

  Only if positive: $((AVG_{Ops_Current} - 48) \times NUM_{Perm_Ops}) \times RATE_{Convert_to_Non\text{-}OT} \times WEEKS_{Non_Outage} \times WAGE_{Ops_OT} \times PER_{Facilities_with_Affected_Ops} \times NUM_{Facilities}$

- Licensees will incur savings related to overtime wages paid to permanent maintenance staff (i.e., current maintenance staff will have to work less overtime due to the hiring of additional maintenance staff):

  Only if positive: $((AVG_{Maint_Current} - 48) \times NUM_{Perm_Maint}) \times RATE_{Convert_to_Non\text{-}OT} \times WEEKS_{Non_Outage} \times WAGE_{Maint_OT} \times PER_{Facilities_with_Affected_Maint} \times NUM_{Facilities}$

Parameter	**Description**
$AVG_{Ops_Current}$	Weekly collective average number of work hours for operators during non-outage periods prior to the proposed rule (described in Appendix 2, Exhibit A2-16)
$AVG_{Maint_Current}$	Weekly collective average number of work hours for maintenance during non-outage periods (described in Appendix 2, Exhibit A2-16)
$COST_{Ops\text{-}Hire}$	The one-time cost to hire, process, and conduct initial training of one operator (described in the assumptions below)

$COST_{Maint_Hire}$	The one-time cost to hire and process an additional maintenance worker (described in the assumptions below)
$COST_{Operator}$	The fully-loaded annual cost of an average operator, but without overtime, including periodic requalification training for licensed operators (described in Appendix 2, Exhibit A2-16)
$COST_{Maintenance}$	The fully-loaded annual cost of an average maintenance worker, but without overtime (see described in Appendix 2, Exhibit A2-16)
NUM_{Perm_Ops}	Current average number of permanent operators per facility (described in Appendix 2, Exhibit A2-16)
$NUM_{Facilities}$	Number of facilities per program (described in Appendix 2, Exhibit A2-14)
NUM_{Perm_Maint}	Current average number of permanent maintenance staff per facility (described in Appendix 2, Exhibit A2-16)
$PER_{Individuals_Affected}$	Percentage of individuals for which licensees will have to modify current outage work schedules to comply with the 48-hour break requirement during outages (described in the assumptions below)
$PER_{Facilities_with_Affected_Ops}$	Percentage of facilities where operator collective work hours average more than 48 per week described in Appendix 2, Exhibit A2-16)
$PER_{Facilities_with_Affected_Maint}$	Percentage of facilities where maintenance staff collective work hours average more than 48 per week (described in Appendix 2, Exhibit A2-16)
$RATE_{Convert_to_Non\text{-}OT}$	Percentage of total overtime hours converted to non-overtime hours due to new hires made under this provision (described in assumptions below)
$WEEKS_{Non_Outage}$	Total annual number of weeks that a facility is not in outage (described in assumptions below)
$WAGE_{Ops_OT}$	The current average hourly overtime wage rate for the average operator (described in Appendix 2, Exhibit A2-16)
$WAGE_{Maint_OT}$	The current average hourly overtime wage rate for permanent maintenance staff (described in Appendix 2, Exhibit A2-16)

Assumptions:

- NRC assumes this cost will accrue to the relatively few facilities that do not already meet the proposed collective work hour requirements, with the remainder incurring no incremental costs. However, as the identity of licensees falling

within the two groups is not known, the analysis prorates the calculated amount across all facilities.

- The one-time cost to hire, process, and conduct initial training of one operator: $232,000.

- The one-time cost to hire and process an additional maintenance worker: $1,750.

- Licensees will not use subsets of the job duty groups specified in 26.199(a) to calculate a collective average, as use of larger-sized averaging groups will tend to reduce the average and lower costs.

- The current average hourly overtime wage rate for permanent maintenance staff: $50 per hour.

- The current average hourly overtime wage rate for contract outage maintenance staff: $50 per hour.

- Percentage of total overtime hours converted to non-overtime hours due to new hires made under this provision: 83% (equals 40 of every 48 hours transferred to a new hire).

- Total annual number of weeks that a facility is not in outage: 44 weeks.

Sensitivity Analysis - Pre-Order Baseline

For the security personnel job duty group, licensees need not impose the collective 48-hour work limit during the first 8 weeks of an unplanned security system outage or an increased threat condition; and licensees may apply a collective average of up to 60 hours during the first 8 weeks of a plant outage, a planned security system outage, or during the actual conduct of force-on-force tactical exercises.

As part of the NRC's efforts to develop Order EA-03-038, the NRC collected data on hours worked by security personnel prior to the issuance of the order. The NRC's analysis of these data found that approximately one-third of sites would be expected to increase the size of their security staff, by an average of 9 staff, in order to comply with the 48-hour collective limit applicable during normal operations. The NRC's analysis also indicated that no sites would be expected to hire additional security staff to meet the collective 60-hours per person per week limit that applies during the first 8 weeks of a plant outage.

The analysis assumes that increased threat conditions and/or unplanned security outages last fewer than 8 weeks. In these cases, licensees need not impose the collective work hour controls. Consequently, this situation does not contribute to incremental costs, regardless of the collective

average hours worked by the security personnel job duty group during these times.[13] For outages of longer than 8 weeks, licensees will incur incremental costs related to this provision, but these costs are addressed under Paragraphs 26.199(f)(3) and (f)(5).

Relative to the requirements that were in effect before the NRC issued Order EA-03-038, therefore, incremental costs result from the need to increase the number of security personnel to comply with the collective work hour limit of 48 hours per week during normal operations, as discussed above. More specifically, the proposed provision will generate incremental costs related to three activities: (1) scheduling work hours in compliance with the collective limits, as addressed under Paragraph 26.199(c); (2) calculating and monitoring collective work hours, as addressed under Paragraph 26.199(b); and (3) for some sites, increasing staffing levels sufficiently to reduce the collective average to allowable levels, as discussed below.

The *one-time costs per program* result from the following:

- Licensees will incur a one-time cost to hire, process, and conduct initial training of additional permanent security staff as needed to comply with the 48-hour collective work hour limit:

  $$PER_{Facilities_with_Affected_Sec} \; x \; NUM_{Sec_Hires} \; x \; COST_{Sec_Hire} \; x \; NUM_{Facilities}$$

The *annual costs per program* result from the following:

- Licensees will incur annual costs to pay for additional permanent security staff on an ongoing basis as needed to comply with the 48-hour collective work hour limit:

  $$PER_{Facilities_with_Affected_Sec} \; x \; NUM_{Sec_Hires} \; x \; COST_{Security} \; x \; NUM_{Facilities}$$

The above costs will be partly offset by the *annual savings per program,* calculated as follows:

- Licensees will incur savings related to the overtime wage premium that no longer will have to be paid (i.e., as some of the pre-rule overtime hours worked by current staff are converted to post-rule standard hours worked by new hires):

  $$PER_{Facilities_with_Affected_Sec} \; x \; NUM_{Sec_Hires} \; x \; HOURS_{Standard} \; x \; WAGE_{OT_Premium} \; x \; NUM_{Facilities}$$

[13] This analysis does not address the temporary increase in security hours worked as a result of the heightened threat conditions that existed for some time following the 9/11 terrorist attacks. As noted above, the proposed rule does not require licensees to impose collective work hour limits during the first 8 weeks of an unplanned security system outage or an increased threat condition. Although the post-9/11 conditions lasted longer than 8 weeks, NRC does not believe those conditions will be representative of conditions likely to occur after the proposed rule becomes effective.

Parameter	Description
$COST_{Sec_Hire}$	The one-time cost to hire, process, and conduct initial training of one security worker (described in the assumptions below)
$COST_{Security}$	The fully-loaded annual cost of an average security worker, but without overtime (described in assumptions below)
$HOURS_{Standard}$	The annual number of pre-rule overtime hours that will be converted to standard hours by each new security hire (described in assumptions below)
NUM_{Sec_Hires}	Average number of new security staff that must be hired per affected facility in order to meet the collective work hour limits (described in assumptions below)
$NUM_{Facilities}$	Number of facilities per program (described in Appendix 2, Exhibit A2-14)
$PER_{Facilities_with_Affected_Sec}$	Percentage of facilities where security staff collective work hours average more than 48 per week (described in the assumptions below)
$WAGE_{OT_Premium}$	The difference between the standard hourly wage rate and the overtime hourly wage rate for the average security worker (described in assumptions below)

Assumptions:

- This cost will accrue to those facilities that do not already meet the proposed collective work hour requirements, with the remainder incurring no incremental costs. However, as the identity of licensees falling within the two groups is not known, the analysis prorates the calculated amount across all facilities.

- Percentage of facilities where security staff collective work hours average more than 48 per week: 33%.

- Average number of new security staff (armed and unarmed) that must be hired per affected facility in order to meet the collective work hour limits: 9 new staff per facility.

- The one-time cost to hire, process, and conduct initial training of one security worker (average of armed and unarmed): $6,750.[14]

[14] Estimate includes hiring, processing, and training. Estimate assumes that new security hires are comprised of armed security staff, with five weeks of training.

- The fully-loaded annual cost of an average security worker, but without overtime: $120,000.

- The annual number of pre-rule overtime hours that will be converted to standard hours by each new security hire: 1,600 hours per year.

- The difference between the standard hourly wage rate and the overtime hourly wage rate for the average security worker: $15 per hour.

- Licensees will not use subsets of the job duty groups specified in 26.199(a) to calculate collective averages, as use of larger-sized averaging groups will tend to reduce the average and lower costs.

Subparagraph 26.199(f)(3)

This proposed subparagraph allows licensees to exceed the collective 48-hour limit, up to a collective limit of 54 hours per person per week, for any job duty group in one averaging period provided that the circumstances that cause the extra hours cannot be reasonably controlled and the extra hours are worked only to address those circumstances.

Non-Outage Periods. The analysis assumes the following work hours and frequencies occur under relevant non-outage conditions (i.e., where the circumstances that cause the extra hours to be worked cannot be reasonably controlled, and the extra hours are worked only to address those circumstances) in the absence of the proposed rule:

- Once in 30 years, operators would need to collectively average 70 work hours per week.
- Once in 20 years, maintenance workers would need to collectively average 70 work hours per week.
- Once in 20 years, operators would need to collectively average 60 work hours per week.
- Once in 10 years, maintenance workers would need to collectively average 60 work hours per week.

Under the proposed rule, however, licensees will reduce work hours for current staff and redistribute the hours to added staff as necessary to comply with the provision. Therefore, the proposed provision will generate incremental costs related to three activities: (1) scheduling work hours in compliance with the 54-hour collective limit, which is included within the costs calculated under Paragraph 26.199(c); (2) calculating and monitoring collective work hours, as addressed under Paragraph 26.199(b); and (3) increasing staffing levels sufficiently to reduce the collective average to allowable levels, either by obtaining additional contract staff or using other means of staff augmentation. In light of the low frequency of such periods, the analysis assumes that the incremental costs associated with paying and processing the additional staff would be offset by savings associated with reduced overtime wages.

Outage Periods. NRC anticipates this provision would apply to most instances in which workers exceed the 48-hour limit following the first 8 weeks of extended outages. Under these circumstances, staff in affected job duty groups would be allowed to work up to a collective average of 54 hours per week over a 13-week period. NRC anticipates that licensees, in order to bring the outage to an end as soon as possible, would "front-load" hours during the 13-week averaging period to the fullest extent possible. For example, over a 13-week averaging period, a job duty group could meet the average by working as much as possible for the first half of the period [i.e., a maximum of about 68 hours per week, due to the proposed 48-hour break every 14 days required under 26.199(d)(2)] and working 40 hours per week for the second half of the period. Therefore, no additional incremental costs [beyond those already calculated under 26.199(d)(2)] would result from this provision for outages of up to 14.5 weeks [i.e., the initial 8 weeks during which collective work limits do not apply under 26.199(f)(1), plus the first half (6.5 weeks) of the 13-week averaging period in which hours can be front-loaded, as discussed above].

In the very rare instances when a plant outage extends beyond 14.5 weeks, the NRC believes that this proposed provision generally will not be used. This is because by the 8th week of the outage, the number of affected workers would be down to a relatively low number of maintenance workers or others dealing with the specific circumstance that could not be reasonably controlled. While this number would increase again at the beginning of preparations for start-up, NRC predicts that the collective average for each job duty group over the entire 13-week averaging period would not exceed the 48-hour collective work limits because, for much of the time spent in the extended portion of the outage, only the few workers dealing with the specific circumstance that could not be reasonably controlled would have been working significantly extended hours.

The analysis does assume, however, that once every two years a single plant (all units) will be "troubled" and in an extended shutdown that lasts two years. During this time, the proposed provision will require licensees to maintain collective work hours within the 54-hour limit. This will require redistribution of hours from existing staff, who are assumed to otherwise work an average of 60 hours, with the hours shifted to contract staff or other temporary staff. As discussed in additional detail above for non-outage periods, the analysis assumes that the incremental costs associated with redistributing hours to these staff would be offset by savings associated with reduced overtime wages paid to current staff.

Subparagraph 26.199(f)(4)

This proposed subparagraph prohibits any job duty group from exceeding the collective 48-hour per person per week limit in an averaging period if the collective hours for the job duty group exceeded 48 hours per person per week in the previous averaging period or in any other averaging period that ended within the past 26 weeks. In effect, this provision places an upper limit on the frequency and length of time that licensees may take advantage of Paragraph 26.199(f)(3). The length of this upper limit would vary depending on particular circumstances during the current averaging period. For example, it would equal one and one-half averaging periods (a total of 19½ weeks) if, during the current (second consecutive) averaging period, the collective average were 56 hours for the first 6½ weeks and 40 hours for the remaining 6½ weeks. NRC believes that this provision will have an effect only in very unusual circumstances (e.g., due to unusual situations in extremely long outages). The resulting incremental costs, if any, would be both small and speculative. Therefore, the analysis does not calculate any incremental cost for this provision.

Subparagraph 26.199(f)(5)

This proposed subparagraph allows licensees to exceed any collective work hour limits if the licensee has received prior approval from the NRC. In a written request for approval from NRC, licensees must describe the relevant circumstances (including affected job duty groups, limits being exceeded, and period of time that limits will be exceeded) and must describe fatigue mitigation strategies to be employed (including rest breaks and work hour limits) to ensure that the individuals affected will be fit to safely and competently perform their duties.

Industry costs resulting from this provision include the cost of preparing and submitting to NRC a written request for approval to exceed the collective work hour limits, and the costs associated with implementing the applicable fatigue mitigation strategies (i.e., those specified in the licensee's written request for NRC approval).[15] NRC believes that licensees will employ mitigation strategies best suited to their particular circumstances. For purposes of this analysis only, however, these mitigation strategies are assumed to include: (1) briefing first-line supervisors to alert them to the situation and the need to be vigilant regarding signs of fatigue among affected workers; (2) preparation and distribution of an e-mail or memorandum to affected workers to alert them to be vigilant regarding signs of fatigue and to self-declare if necessary; and (3) increasing the frequency of behavioral observation of workers conducting high-risk activities, workers with substantial overtime hours, and workers on backshifts.

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[15] Industry also would incur savings associated with avoiding the collective work hour requirements. Such savings might include increased labor productivity and reduced replacement power costs resulting from a shortened outage. These savings, however, are not incremental relative to the pre-rule baseline because they are savings of costs that will not be incurred until after the proposed collective work hour limits take effect.

NRC anticipates that this provision would apply only during planned extended outages, such as may occur in the event of a steam generator replacement. NRC estimates that 3 reactors per year will undergo steam generator replacements, pressurizer replacements, or reactor vessel head replacements for several years in after the proposed rule takes effect. This analysis conservatively assumes that 3 sites per year, over the life of the facilities, will seek and receive NRC's approval to exceed collective work hour limits under 26.199(f)(5), and that all operator staff, maintenance staff, and security staff are affected.[16]

The *annual cost per program* result from the following factors:[17]

- Additional labor will be needed to prepare and submit to NRC a written request for approval to exceed the collective work hour limits. The associated costs are calculated using the following equation:

  $$PER_{Apply} \times HOURS_{Manager} \times WAGE_{Manager} \times NUM_{Facilities}$$

- Additional labor will be needed to brief first-line supervisors to alert them to the situation and the need to be vigilant regarding signs of fatigue among affected workers. The associated costs are calculated using the following equation:

  $$PER_{Apply} \times HOURS_{Briefing} \times (NUM_{Supervisor} \times WAGE_{Supervisor}) \times NUM_{Facilities}$$

- Additional labor will be needed to prepare and distribute an e-mail or memorandum to affected workers to alert them to be vigilant regarding signs of fatigue and to self-declare if necessary. The associated costs are calculated using the following equation:

  $$PER_{Apply} \times [(HOURS_{Drafting} \times WAGE_{Manager}) + (HOURS_{Distribute} \times WAGE_{Clerical}) + (HOURS_{Reading} \times (NUM_{Perm_Operators} \times WAGE_{Perm_Operators}) + (NUM_{Contract_Operators} \times WAGE_{Contract_Operators}) + (NUM_{Perm_Maintenance} \times WAGE_{Perm_Maintenances}) + (NUM_{Contract_Maintenance} \times WAGE_{Contract_Maintenance}) + (NUM_{Perm_Security} \times WAGE_{Perm_Security}) + (NUM_{Contract_Security} \times WAGE_{Contract_Security}))] \times NUM_{Facilities}$$

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[16] The analysis assumes that additional HP/chemistry emergency response staff do not need to work extended hours during outage periods, as discussed under 26.199(d)(2). The analysis assumes that the fire brigade is composed of operator staff and are costed only as part of the operator job duty group in order to avoid double counting.

[17] Although this is a one-time cost, the analysis treats it as an annual cost because it is assumed to re-occur (for different units) in each year of the analysis.

- Additional labor will be needed to increase the frequency of behavioral observation addressing workers conducting high-risk activities, workers with substantial overtime hours, and workers on backshifts. The associated costs are calculated using the following equation:

$$PER_{Apply} \times HOURS_{Supervisor} \times WEEKS_{SG_Outage} \times WAGE_{Supervisor} \times NUM_{Facilities}$$

Parameter	Description
PER_{Apply}	The percentage of facilities that will seek and receive NRC's approval to exceed collective work hour limits (described in the assumptions below)
$HOURS_{Briefing}$	Number of hours per briefing of first-line supervisors to alert them to the situation and the need to be vigilant regarding signs of fatigue among affected workers (described in assumptions below)
$HOURS_{Drafting}$	Number of hours for the FFD Program Manager to prepare an e-mail or memo to alert affected staff to be vigilant regarding signs of fatigue and to self-declare if necessary (described in assumptions below)
$HOURS_{Distribute}$	Number of hours for clerical staff to distribute an e-mail or memo to alert affected staff to be vigilant regarding signs of fatigue and to self-declare if necessary (described in assumptions below)
$HOURS_{Reading}$	Number of hours per person for affected staff to read an e-mail or memo to alert them to be vigilant regarding signs of fatigue and to self-declare if necessary (described in assumptions below)
$HOURS_{Manager}$	FFD Program Manager hours to prepare and submit to NRC a written request for approval to exceed the collective work hour limits (described in assumptions below)
$HOURS_{Supervisor}$	Additional weekly supervisory labor to increase the frequency of behavioral observation addressing workers conducting high-risk activities, workers with substantial overtime hours, and workers on backshift, during an outage involving a steam generator replacement (described in assumptions below)
$NUM_{Contract_Maintenance}$	Number of contract maintenance workers (described in Appendix 2, Exhibit A2-16)
$NUM_{Contract_Operators}$	Number of contract operators (described in Appendix 2, Exhibit A2-16)
$NUM_{Contract_Security}$	Number of contract security personnel (described in Appendix 2, Exhibit A2-16)
$NUM_{Facilities}$	Number of affected facilities per program (described in Appendix 2, Exhibit 14)

$NUM_{Perm_Maintenance}$	Number of permanent maintenance workers (described in Appendix 2, Exhibit A2-16)
$NUM_{Perm_Operators}$	Number of permanent operators (described in Appendix 2, Exhibit A2-16)
$NUM_{Perm_Security}$	Number of permanent security personnel (described in Appendix 2, Exhibit A2-16)
$NUM_{Supervisor}$	Number of first-line supervisors to be briefed per facility (described in assumptions below)
$WAGE_{Manager}$	FFD Program Manage wage rate (described in Appendix 2, Exhibit A2-11)
$WAGE_{Perm_Operators}$	Permanent Operator wage rate (described in Appendix 2, Exhibit A2-11)
$WAGE_{Clerical}$	Clerical personnel wage rate (described in Appendix 2, Exhibit A2-11)
$WAGE_{Contract_Operators}$	Contract Operator wage rate (described in Appendix 2, Exhibit A2-16)
$WAGE_{Perm_Maintenance}$	Permanent Maintenance wage rate (described in Appendix 2, Exhibit A2-16)
$WAGE_{Contract_Maintenance}$	Contract Maintenance wage rate (described in Appendix 2, Exhibit A2-16)
$WAGE_{Perm_Security}$	Permanent Security wage rate (described in Appendix 2, Exhibit A2-16)
$WAGE_{Contract_Security}$	Contract Security wage rate (described in Appendix 2, Exhibit A2-16)
$WAGE_{Supervisor}$	Utility supervisory wage rate (described in Appendix 2, Exhibit A2-11)
$WEEKS_{SG_Outage}$	Number of outage weeks to complete a planned steam generator replacement (described in assumptions below)

Assumptions:

- FFD Program Manager hours to prepare and submit to NRC a written request for approval to exceed the collective work hour limits: 6 hours per request.

- NRC assumes that 4.6 percent of facilities (3 out of 65) each year will seek and receive NRC's approval, under 26.199(f)(5), to exceed collective work hour limits, with the remainder incurring no cost because they already meet the proposed requirements. However, as the identity of licensees

falling within the two groups is not known, this analysis assumes that 100 percent of facilities will incur costs of 4.6 percent of the calculated amount.

- Number of hours per briefing of first-line supervisors to alert them to the situation and the need to be vigilant regarding signs of fatigue among affected workers: ½ hour.

- Number of first-line supervisors needing to be briefed per facility is assumed equal to 10% of the number of staff in affected job duty groups.

- Number of hours for the FFD Program Manager to prepare an e-mail or memo to alert affected staff to be vigilant regarding signs of fatigue and to self-declare if necessary: 1 hour.

- Number of hours for clerical staff to distribute an e-mail or memo to alert affected staff to be vigilant regarding signs of fatigue and to self-declare if necessary: ½ hour.

- Number of hours per person for affected staff to read an e-mail or memo to alert them to be vigilant regarding signs of fatigue and to self-declare if necessary: 5 minutes.

- Additional weekly supervisory labor to increase the frequency of behavioral observation addressing workers conducting high-risk activities, workers with substantial overtime hours, and workers on backshift, during an outage involving a steam generator replacement: 14 hours per week.

- Number of outage weeks to complete a planned steam generator replacement: 10 weeks.

The NRC also will incur costs under this proposed provision to review and approve licensees' written requests for approval to exceed the collective work hour limits based on the fatigue mitigation strategies specified in the request. The *annual cost to the NRC* is calculated using the following equation:

$$NUM_{Requests} \times (HOURS_{NRC_Manager} \times WAGE_{NRC_Manager})$$

Parameter	Description
$HOURS_{NRC_Manager}$	NRC manager hours to review and approve one written requests from a licensee seeking approval to exceed the collective work hour limits (described in assumptions below)
$WAGE_{NRC_Manager}$	NRC manager wage rate (described in Appendix 2, Exhibit A2-11)
$NUM_{Requests}$	Annual number of facilities seeking NRC approval to exceed collective work hour limits under 26.199(f)(5) (described in assumptions below)

Assumptions:

- NRC assumes that 3 facilities per year will seek NRC's approval to exceed collective work hour limits under 26.199(f)(5).

- NRC manager hours (for various managers) to review and approve one written requests from a licensee seeking approval to exceed the collective work hour limits: 6 hours.

Paragraph 26.199(g)

This proposed paragraph specifies that if two or more plant outages occur at a licensee's site and the interval(s) between the successive outages is (are) less than 2 weeks, then the requirements of 26.199 must be applied based upon the beginning of the first plant outage. In effect, this provision requires licensees to treat certain instances of two or more outages as a single outage for purposes of controlling work hours. The analysis addresses outage-related costs under the proposed rule provisions that would give rise to the costs [e.g., under §26.199(d)(2)-(3) and §26.199(f)(5)]. NRC believes, however, that instances of successive outages at a site are uncommon and that, in the vast majority of instances, the latter outage(s) and the "combined" outage period is not long enough to materially affect the costs calculated under the other proposed rule provisions.

Paragraph 26.199(h)

This proposed paragraph states that licensees need not meet the requirements of this section when informed in writing by the NRC that the requirements are waived for security personnel in order to assure the common defense and security during the period defined by the NRC. This provision could result in savings to licensees under unusual security conditions. These savings will occur very infrequently, however, and are not calculated in the analysis.

Paragraph 26.199(i)

This proposed paragraph states that licensees need not meet the requirements of paragraphs (c)-(f) of this section during declared emergencies, as defined in the licensee's emergency plan. This provision could result in savings to licensees under unusual conditions. These savings will occur very infrequently, however, and are not calculated in the analysis.

Paragraph 26.199(j)

This paragraph of the proposed rule requires licensees to review the control of work hours for individuals who are subject to this section for each averaging period. Licensees must complete this review within 30 days of the end of the averaging period. If any outages or increased threat conditions occurred since the licensee completed the most recent review, the licensee must include in the review an assessment of the control of work hours during the outages or increased threat conditions.

The *annual costs per program* to conduct work hour control reviews include the following:

$$[(NUM_{Reviews} \times HOURS_{Review} \times NUM_{Managers}) \times WAGE_{Manager}) - (HOURS_{Current_Review} \times WAGE_{Manager})] \times NUM_{Facilities}$$

Parameter	Description
$HOURS_{Review}$	Time per participating supervisor to review overtime hours under proposed rule, per review (described in the assumptions below)
$HOURS_{Current_Review}$	Annual time for manager to review overtime hours under existing technical specifications (described in assumptions below)
$NUM_{Facilities}$	Number of affected facilities (described in Appendix 2, Exhibit A2-14)
$NUM_{Manager}$	Number of manager participating in the review (described in assumptions below)
$NUM_{Reviews}$	Annual number of times a facility will review the control of work hours for individuals who are subject to this subpart (described in the assumptions below)
$WAGE_{Manager}$	Utility manager wage rate (described in Appendix 2, Exhibit A2-11)

Assumptions:

- Annual number of times a facility will review the control of work hours for individuals who are subject to this subpart: 4.

- Annual hours for participating managers to review overtime hours under proposed rule: 4 hours.

- Number of managers participating in the review: 4 supervisors.

- Annual time for managers to review overtime hours under existing technical specifications: 4 hours.

26.201 Fatigue Assessments

Paragraph 26.201(a)–(d)

These proposed paragraphs introduce a requirement that fatigue assessments must be conducted under four conditions: (1) for-cause; (2) self-declarations; (3) post-event; and (4) follow-up. A manager or a staff member of the FFD program, trained in accordance with the requirements of §§26.29 and 26.197(c), must conduct the fatigue assessment face to face with the individual whose alertness may be impaired. The fatigue assessment must address acute fatigue, cumulative fatigue, and circadian variations in alertness and performance, and must provide the information necessary for management decisions and actions in response to the circumstance that initiated the assessment. Individuals subject to the fatigue assessment must provide complete and accurate information needed by the licensee to conduct the assessment. If an individual disagrees with the results of a fatigue assessment, the licensee must follow the procedures developed under §26.197(b)(1)(iii). Incremental costs associated with these fatigue assessments are addressed below.

The *annual costs per program* result from the following factors:

- Licensees must conduct a fatigue assessment for cause, for self-declarations, post-event, and follow-up.[18]

  $$[NUM_{Assessments} \times HOURS_{Assessment} \times (WAGE_{Worker} + WAGE_{Supervisor})] \times NUM_{Facilities}$$

- Licensees will incur costs to resolve challenges that may be brought by workers who, after self-declaring to a state of fatigue, object to negative results from their fatigue assessment:

[18] If a fatigue assessment is conducted for-cause or in response to a self-declaration, and the licensee returns the individual to duty following a rest break of less than 10 hours in duration, the licensee must reassess the individual for fatigue as well as the need to implement controls and conditions before permitting the individual to resume performing any job duties. Incremental costs associated with these paragraphs are reflected in the analysis of proposed paragraph 26.201(e).

$$(NUM_{Self\text{-}Declarations} \times PER_{Not_Fatigued} \times PER_{Object}) \times [(HOURS_{Worker} \times WAGE_{Worker}) + (HOURS_{ECM} \times WAGE_{ECM}) + (HOURS_{Supervisor} \times WAGE_{Supervisor})] \times NUM_{Facilities}$$

Parameter	**Description**
$HOURS_{Worker}$	Amount of worker time to raise and resolve one incident (described in assumptions below)
$HOURS_{ECM}$	Number of hours of Employee Concerns Manager time to raise and resolve one incident (described in assumptions below)
$HOURS_{Supervisor}$	Number of hours of supervisor time to raise and resolve one incident (described in assumptions below)
$HOURS_{Assessment}$	Hours needed to complete one fatigue assessment (described in the assumptions below)
$NUM_{Facilities}$	Number of facilities per program (described in Appendix 2, Exhibit A2-14)
$NUM_{Assessments}$	Total annual number of fatigue assessments per unit, including those conducted for-cause, self-declared, post-event, and follow-up (described in assumptions below)
$NUM_{Self\text{-}Declarations}$	Annual number of self-declarations of fatigue per facility (described in assumptions below)
$PER_{Not_Fatigued}$	Percent of $NUM_{Self_Declarations}$ where the results of the fatigue assessment are negative (described in assumptions below)
PER_{Object}	Percent of negative fatigue assessment results that are challenged by workers (described in assumptions below)
$WAGE_{Worker}$	Average hourly wage of worker (described in Appendix 2, Exhibit A2-11)
$WAGE_{ECM}$	Average hourly wage of Employee Concerns Manager (described in Appendix 2, Exhibit A2-11)
$WAGE_{Supervisor}$	Average hourly wage of supervisor (described in Appendix 2, Exhibit A2-11)
$WAGE_{Worker}$	Utility worker wage rate (described in Appendix A2-11)
$WAGE_{Supervisor}$	Utility supervisory wage rate (described in Appendix A2-11)

Assumptions:

- Annual number of self-declarations of fatigue per facility: 20.
- Total annual number of fatigue assessments per facility, including those conducted for-cause, self declarations, post-event, and follow-up: 50 [including approximately 5 for cause, 20 for self declarations, 5 post-event, 5 follow-up, and 15 related to the waiver provisions of §26.199(d)(3).]
- Time needed to conduct a fatigue assessment (including supervisor transit to the worker): 0.5 hours.
- Percent of $NUM_{Self_Declarations}$ where the results of the fatigue assessment are negative: 50%.
- Percent of negative fatigue assessment results that are challenged by workers: 30%.
- Amount of worker time to raise and resolve one incident: ½ hour (i.e., two 15-minute meetings).
- Number of hours of Employee Concerns Manager time to address and resolve one incident: 2.5 hours.
- Number of hours of supervisor time to address and resolve one incident: 1 hour.

Paragraph 26.201(e)

This proposed paragraph requires licensees, following a fatigue assessment [the cost of which is calculated under subparagraph 26.201(a) - (d)], to determine and implement the controls and conditions, if any, that are necessary to allow the individual to resume performing duties for the licensee, including the need for a rest break.

The analysis calculates costs for this provision by assuming that licensees take the following actions depending on the result of the fatigue assessment.

Results of Fatigue Assessment	*Modeled Licensee Actions*
Finding of no fatigue	Licensee allows the worker to return to duty with no further controls and no further cost to the licensee (except if the assessment was performed under §26.199(d)(3), which is costed under that provision).
Finding of acute fatigue, either from work-related or non-work-related causes, or circadian variations in alertness and performance	Licensee sends the worker home for a 24 hour rest break and calls in a replacement worker
Finding of cumulative fatigue, either from work-related or non-work-related causes	Licensee sends the worker home for a 48-hour rest break and calls in a replacement worker

Note that the modeled licensee actions may be more than anticipated by the proposed rule, which allows licensees to return workers to duty under suitable controls and conditions following a fatigue assessment, and allows licensees not to conduct fatigue assessments in most cases if the licensee permits or requires the individual to take a rest break of at least 10 hours before returning to duty. Consequently, by calculating the cost of the actions shown above, the analysis likely overstates the cost of the proposed provision. However, it follows that if licensees take the assumed actions (i.e., send workers home for rest breaks in the event of any finding of fatigue), then licensees will not incur the lesser costs of developing and implementing controls or conditions related to sending fatigued workers back to duty. In addition, the analysis overstates costs further because it does not give licensees any credit for the actions they currently take with respect to workers who they find to be fatigued.

Licensees will incur management and labor costs related to replacing fatigued workers. The *annual cost per program* results from the sum of the following factors:

- Licensees will incur incremental management costs to call in replacement workers to substitute for any workers who are sent home to rest following a fatigue assessment:

  $NUM_{Assessments} \times PER_{Fatigue} \times (HOURS_{Supervisor} \times WAGE_{Supervisor}) \times NUM_{Facilities}$

- Licensees also will incur incremental labor costs due to the extra "turnover" of duties to the replacement worker and other lost labor productivity:

  $NUM_{Assessments} \times PER_{Fatigue} \times (HOURS_{Turnover} \times WAGE_{Worker}) \times NUM_{Facilities}$

- Licensees also will incur incremental labor costs associated with the replacement worker:[19]

$$NUM_{Assessments} \times PER_{Fatigue} \times (HOURS_{Substituted} \times WAGE_{Worker}) \times NUM_{Facilities}$$

Parameter	Description
$HOURS_{Supervisor}$	Supervisory hour expended to identify and call in a replacement worker (described in assumptions below)
$HOURS_{Turnover}$	Labor hours resulting from an additional turnover due to the replacement of a fatigued worker with a substitute worker (described in assumptions below)
$HOURS_{Substituted}$	Average number of hours worked by the replacement worker per incident (described in assumptions below)
$NUM_{Assessments}$	Total annual number of fatigue assessments per unit, including those conducted for-cause, self-declared, post-event, and follow-up (described in assumptions below)
$NUM_{Facilities}$	Number of facilities per program (described in Appendix 2, Exhibit A2-14)
$PER_{Fatigue}$	Percentage of fatigue assessments that result in a finding of fatigue (described in assumptions below)
$WAGE_{Worker}$	Utility worker wage rate (described in Appendix A2-11)
$WAGE_{Supervisor}$	Utility supervisory wage rate (described in Appendix A2-11)

Assumptions:

- The analysis assumes that worker breaks are accounted for as annual leave or are otherwise uncompensated.

- Total annual number of fatigue assessments per facility, including those conducted for-cause, self declarations, post-event, and follow-up: 50 [including approximately 5 for cause, 20 for self declarations, 5 post-event, 5 follow-up, and 15 related to the waiver provisions of §26.199(d)(3).]

- Percentage of fatigue assessments that result in a finding of fatigue: 37.5%[20].

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[19] The analysis assumes that replacement workers are drawn from staff who are present at the site but have flexibility to change assignments for the remainder of the day. Therefore, this cost represents an opportunity cost. The analysis assumes that wages paid to the replacement worker are offset by wages not paid to the fatigued worker. The analysis assumes that worker breaks are accounted for as annual leave or are otherwise uncompensated.

[20] This represents a weighted average based on the following results depending on the reason for the assessment: for cause - 90%; self-declarations - 50%; post-event - 5%; follow-up - 50%; waivers under §26.199(d)(3) - 25%.

- Manager hours expended to identify and call in a replacement worker: 0.5 hours.

- Labor hours resulting from an additional "turnover" due to the replacement of a fatigued worker with a substitute worker: 1 hour (i.e., 0.5 hours for each of two workers).

- Average number of hours worked by the replacement worker per incident: 6 hours.

Paragraph 26.201(f)

This proposed paragraph requires licensees to document the results of any fatigue assessments conducted, the circumstances that necessitated the fatigue assessment, and any controls and conditions that were implemented.

Annual costs per program result from the following:

$$NUM_{Assessments} \times HOURS_{Document} \times WAGE_{Supervisor} \times NUM_{Facilities}$$

Parameter	Description
$HOURS_{Document}$	Time needed to document a fatigue assessment (described in the assumptions below)
$NUM_{Assessments}$	Total annual number of fatigue assessments per unit (described in assumptions)
$NUM_{Facilities}$	Number of facilities per program (described in Appendix 2, Exhibit A2-14)
$WAGE_{Supervisor}$	Utility supervisory wage rate (described in Appendix A2-11)

Assumption:

- Time needed to document a fatigue assessment: 20 minutes.

- Total annual number of fatigue assessments per facility, including those conducted for-cause, self declarations, post-event, and follow-up: 50 [including approximately 5 for cause, 20 for self declarations, 5 post-event, 5 follow-up, and 15 related to the waiver provisions of §26.199(d)(3).]

Subpart J: Recordkeeping and Reporting Requirements

26.211 General Provisions

Paragraph 26.211(a)

This paragraph of the proposed rule restates existing requirements, presented in §§26.71 and 26.73 of the current rule, which state that licensees and other entities that have approved FFD programs must maintain records and submit reports to the NRC. The paragraph adds a provision specifying that required records must be retained until license termination if the rule does not specify another retention period. Although this may extend the period of retention of certain records (depending on current licensee practices), the most substantial costs associated with retaining the records (filing, removal, etc.) do not change as a result of this proposed paragraph. The incremental burden of maintaining the necessary storage space for those particular records until the time of license termination is insignificant to this analysis.

Paragraph 26.211(b)

This paragraph of the proposed rule adds provisions to allow licensees to use electronic recordkeeping. Although this provision may result in savings for some licensees, such savings are likely to be small and are not calculated for purposes of this analysis.

26.213 Recordkeeping Requirements for Licensees and Other Entities

Paragraphs 26.213(a)

This paragraph of the proposed rule [including subparagraphs (1)–(4)] requires that records of self-disclosures, employment histories, and suitable inquiries that are required under §§26.55, 26.57, 26.59, and 26.69 as well as those pertaining to denials and granting of authorization, be retained for a period of at least 5 years or until completion of any related legal proceeding, whichever is later. Although extending the period of retention beyond 5 years represents a new requirement, the most substantial costs associated with retaining the records (filing, removal, etc.) do not change as a result of this proposed paragraph. The incremental burden of maintaining the necessary storage space for those particular records for which legal proceedings continue beyond the 5 year period is insignificant to this analysis. In addition, the ability to store these records electronically under proposed subparagraph 26.211(b) will likely reduce or offset the potential costs associated with the longer retention period.

Paragraphs 26.213(b)

This paragraph of the proposed rule [including subparagraphs (1) and (2)] requires that records of trainings conducted under §26.29 as well as audits, audit findings, and corrective actions taken under §26.41, be retained for a period of at least 3 years or until completion of any related legal

proceeding, whichever is later. Although extending the period of retention beyond 3 years in the case of legal proceedings represents a new requirement, the most substantial costs associated with retaining the records (filing, removal, etc.) do not change as a result of this proposed paragraph. The additional burden of maintaining the necessary storage space for those particular records beyond the 3 year period is insignificant to this analysis. In addition, the ability to store these records electronically under proposed subparagraph 26.211(b) will likely reduce or offset the potential costs associated with the longer retention period.

Paragraphs 26.213(c)

This paragraph of the proposed rule extends to 40 years (or until the NRC deems adequate) the period for which licensees must retain records pertaining to any 5-year denial of authorization under proposed paragraph 26.75(c), (d), or (e)(2) and any a permanent denial of authorization under proposed paragraphs 26.75(b) and 26.75(g). Paragraph 26.71(c) of the current rule imposes similar requirements, but specifies a minimum 3-year period for retaining records. Despite this difference, however, removal of records would still require a management determination that the records are no longer needed. The most substantial costs associated with retaining the records (filing, removing, etc.) do not change as a result of the proposed rule. Although licensees will incur some additional burden to maintain the necessary storage space for 40 years instead of 3 years, these costs are insignificant to this analysis. In addition, the ability to store these records electronically under proposed subparagraph 26.211(b) will likely reduce or offset the potential costs associated with the longer retention period.

Paragraphs 26.213(d)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it merely revises existing requirements in §26.20 of the current rule, which pertain to retaining for at least three years records of written, superceded FFD policies and procedures. By contrast, the proposed rule extends the retention period to 5 years or until completion of all legal proceedings related to the FFD policy violation. The most substantial cost associated with retaining the records (filing, removing, etc.) do not change as a result of the new rule. Although licensees will incur some additional burden to maintain the necessary storage space for 5 years instead of 3 years, these costs are insignificant to this analysis. In addition, the ability to store these records electronically under proposed subparagraph 26.211(b) will likely reduce or offset the potential costs associated with the longer retention period.

Paragraphs 26.213(e)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it merely retains the requirement that written agreements between licensees and other entities must be stored for the life of the agreement. The proposed paragraph also adds that licensees must retain such agreements until the completion of all legal proceedings related to FFD violations that involve those services, if that is later than the life of the agreement. This revision is

consistent with long-term licensee practices relating to documents governing FFD-related contracts. Consequently, no incremental cost or saving would result.

Paragraphs 26.213(f)

This paragraph of the proposed rule requires that records of background investigations, credit and criminal history checks, and psychological assessments of FFD program personnel, conducted under §26.31(b)(1)(ii) be retained for the length of the individual's employment by or contractual relationship with the licensee or other entity, or until the completion of all related legal proceedings, whichever is later. Although this represents a new requirement, the incremental burden associated with retaining the necessary records is insignificant to this analysis. In addition, the ability to store these records electronically under proposed subparagraph 26.211(b) will likely reduce or offset the potential costs associated with the proposed paragraph.

Paragraphs 26.213(g)

This paragraph of the proposed rule requires that licensees or other entities whose FFD program includes tests for drugs in addition to those specified in the proposed rule, or uses more stringent cutoff levels than those specified in the proposed rule, retain documentation certifying the scientific and technical suitability of the assays and cutoff levels used, as required under §§26.31(d)(1)(i) and 26.31(d)(3)(iii)(C). This paragraph of the proposed rule represents a new requirement, and imposes incremental costs associated with filing and retaining the specified documentation for the length of time the FFD program follows these practices or until the completion of all related legal proceedings, whichever is later. The cost of retaining documentation of these procedures, once filed, is negligible.

The *one-time cost per program* results from clerical support to file and store the forensic toxicologist's evaluation of the FFD program's more stringent cutoff levels.

$$HOURS_{Clerical} \times WAGE_{Clerical} \times PER_{more\ stringent\ cutoffs} \times PER_{non\text{-}report}$$

Parameter	**Description**
$HOURS_{Clerical}$	Hours of clerical personnel to file and store the forensic toxicologist's evaluation of the FFD program's more stringent cutoff levels per program (as described in assumptions below)
$PER_{more\ stringent\ cutoffs}$	Percentage likelihood that the FFD program uses more stringent cutoff levels for drug testing (as described in assumptions below)
$PER_{non\text{-}report}$	Percentage likelihood that the FFD program, if it uses more stringent cutoff levels for drug testing, has not reported to the Commission (as described in assumptions below)
$WAGE_{Clerical}$	Clerical personnel wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- Hours of clerical personnel to file and store the forensic toxicologist's evaluation per program: 15 minutes.

- Percentage likelihood that the FFD program will use more stringent cutoff levels for drug testing after the proposed rule is enacted: 10 percent.

- Percentage likelihood that the FFD program, if it will use more stringent cutoff levels for drug testing after the proposed rule in enacted, did not previously use these more stringent cutoff levels (and, therefore, has not reported to the Commission): 25 percent.

26.215 Recordkeeping Requirements for Collection Sites, Licensee Testing Facilities, and Laboratories Certified by the Department of Health and Human Services

Paragraphs 26.215(a) and 26.215(b)

These paragraphs of the proposed rule impose no incremental cost and afford no saving because they merely restate existing requirements in §26.71 and Appendix A paragraphs 2.5(f), 2.6(c), and 2.7(n) of the current rule. Specifically, these paragraphs of the current rule require collection sites, licensee testing facilities, and HHS-certified laboratories to maintain documentation concerning all aspects of the testing process (including personnel files for individuals who have been authorized to have access to specimens but are no longer under contract to or employed by the entity) for at least 2 years. The proposed paragraph adds that collection sites, licensee testing facilities, and HHS-certified laboratories must also retain such records until the completion of any legal proceedings related to an FFD violation, if that is later than the 2-year period. Nonetheless, the most substantial costs associated with retaining the records (filing, removing, etc.) do not change as a result of the new rule. Although licensees will incur some additional burden to store these records for a longer period in certain instances, these costs are insignificant to this analysis.

26.217 Fitness-for-Duty Program Performance Data

Paragraph 26.217(a)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it merely restates existing requirements in paragraph 26.71(d) of the current rule, which pertain to the collection and compilation of FFD program performance data.

Paragraph 26.217(b)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it merely renumbers existing requirements in paragraph 26.71(d) of the current rule, which specify the performance data that licensees and C/Vs must compile and collect under proposed paragraph 26.217(a). Although this proposed paragraph does add a provision requiring FFD programs to report the number of subversion attempts by type, the rarity of such events makes the incremental cost insignificant.

Paragraph 26.217(c)

This paragraph of the proposed rule requires licensees and other entities to analyze performance data annually. Incremental costs and savings attributable to this provision are analyzed under related paragraphs 26.217(e) and (f). Licensees and other entities also must retain records of the data, analyses, and corrective actions taken for at least 3 years or until the completion of any related legal proceedings, whichever is later. Although the provision to record corrective actions taken is not contained in the current rule, no incremental costs are expected to result because the burden of recording such events is incidental to that of the corrective actions themselves.

Paragraph 26.217(d)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it merely restates requirements in paragraph 26.71(d) of the current rule, which addresses how licensees must report information on terminations of authorization or other administrative actions resulting from positive drug tests to the NRC.

Paragraph 26.217(e) and 26.217(f)

These paragraphs of the proposed rule require FFD programs to report performance data to the NRC every 12 months, rather than every 6 months as specified under the existing regulation. The new requirement represents an incremental savings in that it requires licensees to prepare and submit to the NRC only one performance data report (instead of two) each year. Proposed paragraph 26.217(f) allows licensees to submit the FFD program performance data as a consolidated report, provided that the data are reported separately for each facility. There is no incremental cost or saving associated with this latter report consolidation provision.[1]

[1] The analysis assumes that licensees will not opt to change their reporting practices if doing so increases costs. Savings are assumed not to accrue given that licensees must still report data separately for each facility addressed in the consolidated report.

The *annual savings per program* associated with eliminating one performance data report per year are calculated as follows:

$$HOURS_{Manager} \times WAGE_{Manager} \times NUM_{Facilities}$$

Parameter	**Description**
$HOURS_{Manager}$	FFD program manager hours saved in reducing the reporting frequency per facility (as described in assumptions below)
$NUM_{Facilities}$	Number of units at the given facility (as described in Appendix 2, Exhibit A2-14)
$WAGE_{Manager}$	FFD program manager wage rate (as described in Appendix 2, Exhibit A2-11)

Assumption:

- FFD program manager hours saved in reducing the reporting frequency per facility: 20 hours.

The NRC also will experience savings under this proposed paragraph. Under the current rule, performance reports are submitted twice each year. As the NRC received the performance reports, clerical personnel process and file them in a manner that facilitates annual review by an NRC manager. On an annual basis, the NRC manager reads, reviews, and summarizes the performance reports in an annual industry report. The proposed reduction in the frequency of performance reports will result in savings for the NRC. The *annual savings to the NRC* from processing fewer licensee reports are calculated as follows:

$$(HOURS_{Clerical} \times WAGE_{Clerical}) + (HOURS_{Manager} \times WAGE_{Manager})$$

Parameter	**Description**
$HOURS_{Clerical}$	NRC clerical hours saved in reducing the reporting frequency per year (as described in assumptions below)
$HOURS_{Manager}$	NRC manager hours saved in reducing the reporting frequency per year (as described in assumptions below)
$WAGE_{Clerical}$	NRC clerical wage rate (as described in Appendix 2, Exhibit A2-11)
$WAGE_{Manager}$	NRC manager wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- NRC manager hours saved in reducing the reporting frequency per year: 20 hours.
- NRC clerical hours saved in reducing the reporting frequency per year: 24 hours.

Paragraph 26.217(g)

This paragraph of the proposed rule adds a requirement that would include C/Vs in the reporting of performance data, but would preclude duplicate information from being submitted to the NRC. Currently, C/Vs who maintain their own FFD programs are reporting performance data to multiple licensees for whom they work. Incremental savings will result from the proposed paragraph because it will reduce the number of report summaries that C/Vs must distribute each year.

The *annual savings per C/V* program result from the sum of the following savings:

- The proposed paragraph will reduce the C/V manager labor burden because managers will be able to submit to the NRC a single report that consolidates all performance data that the C/V previously prepared for each licensee. The associated costs are estimated as follows:

  $HOURS_{Manager} \times WAGE_{Manager} \times PER_{Consolidation}$

- The proposed paragraph will reduce mailing costs because C/Vs will only need to submit a single performance data report to the NRC. The associated savings are estimated as follows:

  $(NUM_{Licenees} - 1) \times COST_{Mailing}$

Parameter	**Description**
$COST_{Mailing}$	Cost of mailing (express mail) one performance data report to each licensee (as described in Appendix 2, Exhibit A2-10)
$HOURS_{Manager}$	Hours of C/V manager time to compile all licensee performance data reports (as described in assumptions below)
$NUM_{Licensees}$	Number of licensees to whom each C/V submits performance data under the current rule (as described in assumptions below)
$PER_{Consolidation}$	Percentage savings achieved by consolidating performance data into a single report submitted to the NRC (as described in assumptions below)
$WAGE_{Manager}$	C/V manager wage rate (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- Number of licensees to whom each C/V submits performance data to under the current rule: 9.

- Hours of C/V manager time to compile all licensee performance data reports: 30 hours.

- Percentage savings achieved by consolidating performance data into a single report submitted to the NRC: 25%.

- Under the current rule, C/Vs submit performance data reports to each licensee for whom they work, but not to the NRC. Under the proposed rule, C/Vs will opt to report only to the NRC.

26.219 Reporting Requirements

Paragraphs 26.219(a)

This paragraph of the proposed rule imposes no incremental cost and affords no saving because it merely clarifies that licensees must report to the NRC all significant violations of the FFD policy (as required in §26.73 of the current rule), significant FFD program failures, and errors in drug and alcohol testing (as required in Appendix A, subparagraphs 2.8(e)(4)–(6) of the current rule). The proposed paragraph also clarifies that other entities (C/Vs) who have licensee-approved FFD programs must also report significant violations, failures, or errors to the NRC.

Paragraph 26.219(b)

This paragraph of the proposed rule [including subparagraphs (1)–(4)] lists the significant FFD policy violations and program failures that must be reported to the NRC Operations Center. Under the clarifications in proposed §26.219(b)(2)(ii), additional reportable FFD policy violations may result in incremental costs per FFD program because of:

- the reduction in the non-negative breath alcohol concentration (BAC) level for initial alcohol testing from 0.04 to 0.02 BAC as discussed in §26.97(b),

- the reduction in the initial cutoff level for marijuana metabolites from 100 ng/mL to 50 ng/mL (somewhat offset by raising of the initial cutoff level for opiate metabolites from 300 ng/mL to 2,000 ng/mL) as discussed in §§26.133 and 26.163(a)(1), and

- the addition of validity testing on all urine specimens as discussed in §§26.131 and 26.161(b).

Incremental costs will result from the added time that the FFD program manager must spend to collect, analyze, and report information concerning the additional events.

The *annual costs per program* associated with the increase in reported FFD events are calculated as follows:

$$NUM_{Events} \times PER_{Staff} \times (HOURS_{Manager} \times WAGE_{Manager}) \times NUM_{Units}$$

Parameter	**Description**
$HOURS_{Manager}$	FFD program manager hours required to investigate, analyze, and report a FFD event (as described in assumptions below)
NUM_{Events}	Annual number of additional non-negative specimen test results for validity and drugs testing per unit under the proposed rule (as described in Appendix 2)
NUM_{Units}	Number of units at the given facility (described in Appendix 2)
PER_{Staff}	Percentage of tested staff subject to reporting provisions of §26.219(b)(2) (as described in assumptions below)
$WAGE_{Manager}$	FFD program manager wage rate (described in Appendix 2)

Assumptions:

- Percentage of tested staff subject to reporting provisions of §26.219(b)(2): 15%.
- FFD program manager hours required to investigate, analyze, and report an event: 4 hours.

The NRC also will incur incremental costs as a result of the additional reportable events. The increase in the number of reported FFD events will result in additional reports being sent to the NRC, as required by paragraph 26.219(a), thereby increasing the labor burden associated with processing and reviewing the licensee reports. The NRC's *annual costs* are calculated as follows:

- The NRC manager labor burden will increase as a result of the increased number of reported FFD events. The associated costs are estimated as follows:

$$NUM_{Events} \times PER_{Staff} \times (HOURS_{Manager} \times WAGE_{Manager}) \times NUM_{Units}$$

Parameter	**Description**
$HOURS_{Manager}$	NRC manager hours required to review a reported FFD event (as described in assumptions below)

Parameter	Description
NUM_{Events}	Annual number of additional non-negative specimen test results for validity and drugs testing per unit under the proposed rule (as described in Appendix 2)
NUM_{Units}	Number of units per program (as described in Appendix 2, Exhibit A2-14)
PER_{Staff}	Percentage of tested staff subject to reporting provisions of 26.219(b)(2) (as described in assumptions below)
$WAGE_{Manager}$	NRC program manager wage (as described in Appendix 2, Exhibit A2-11)

Assumptions:

- Percentage of tested staff subject to reporting provisions of §26.219(b)(2): 15%.
- NRC manager hours required to review a reported FFD event: 3 hours.

Paragraph 26.219(c)

Subparagraph 26.219(c)(1)

This subparagraph of the proposed rule imposes no incremental cost and affords no saving because it merely retains and renumbers existing requirements in Appendix A, paragraphs 2.8(e)(4)–2.8(e)(6) of the existing rule, which state that licensees must report to the NRC within 30 days of completing an investigation of testing errors or unsatisfactory performance in blind performance testing.

Subparagraph 26.219(c)(2)

This subparagraph of the proposed rule imposes no incremental cost and affords no saving because it merely clarifies that the requirement in existing paragraph 26.73(a) involving the reporting of significant FFD events includes reporting false positive errors on a blind performance test specimen submitted to an HHS-certified laboratory.

Subparagraph 26.219(c)(3)

This subparagraph of the proposed rule requires licensees to report to NRC within 24 hours in the event of a false negative during quality assurance checks of validity screening devices. Although this represents a new requirement, it imposes no incremental cost and affords no saving for the foreseeable future because there currently are no approved validity screening devices that can be used by licensees (as discussed in more detail under §26.131).

Paragraph 26.219(d)

This paragraph of the proposed rule requires licensees to document, trend, and correct other non-reportable FFD issues that identify programmatic weaknesses under the licensee's corrective action program in a manner that will not permit the identification of individuals. Although not explicitly required under the current rule, the analysis assumes that licensees and other entities are already tracking and trending FFD program weaknesses in their corrective action programs. As a result, the proposed paragraph imposes no incremental cost and affords no saving.

Subpart K: Inspections, Violations, and Penalties

26.221 Inspections

This section of the proposed rule [including paragraphs 26.221(a) and (b)] imposes no incremental cost and affords no saving because it merely retains requirements contained in §26.70 of the current rule, which pertain to inspection of records and written agreements between licensees and C/Vs.

26.223 Violations

Paragraphs 26.223(a) and 26.223(b)

These paragraphs of the proposed rule impose no incremental cost and afford no saving because they merely renumber and retain the existing requirements in §26.90 of the current rule as they relate to violations of policy.

26.225 Criminal Penalties

Paragraphs 26.225(a) and 26.225(b)

These paragraphs of the proposed rule impose no incremental cost and afford no saving because they merely renumber and retain existing requirements in §26.91 of the current rule, as they relate to criminal penalties.

APPENDIX 2: DATA USED IN THE ANALYSIS

Exhibit A2-1: Individuals Subject to the FFD Program

Exhibit A2-2: Written Policies and Procedures

Exhibit A2-3: Training and Examinations

Exhibit A2-4: Audits, Inspections, Certifications and Corrective Actions

Exhibit A2-5: Authorizations

Exhibit A2-6: Activities Related to Potential Policy Violations

Exhibit A2-7: Urine Specimen Collections

Exhibit A2-8: Alcohol Testing

Exhibit A2-9: Drug and Validity Testing (Licensee Testing Facilities and HHS-Certified Laboratories)

Exhibit A2-10: Reporting Requirements

Exhibit A2-11: Hourly Wage Rates

Exhibit A2-12: Testing and Applicant Information

Exhibit A2-13: Drug and Alcohol Testing Data

Exhibit A2-14: FFD Programs

Exhibit A2-15: Fatigue Inputs

Exhibit A2-16: Fatigue Input Data

Crosswalk Index of Subpart Sections and Exhibits

Exhibit A2 - 1

Individuals Subject to the FFD Program

Activity	Equation	Parameter Description	Parameter	Value	Source	Section
FFD Program Personnel Subject to the Rule					**Subpart B**	**26.25(a)(4)**
	These parameters are used in the equations below:					
		Number of MROs per program	NUM mros	2	Assumption	
		% multiplier to spread compliance costs across all programs	PER compliance	25%	Assumption	
	Industry Practices: One-time cost per program to subject MROs to pre-access drug and alcohol testing to comply with the existing regulation					
			No additional parameters			
	Industry Practices: One-time cost per program to pay for MRO travel to a licensee collection facility to comply with the existing regulation					
		Hours of MRO travel, waiting, and specimen collection time	HOURS travel	6.0 hr	Assumption	
	Industry Practices: One-time cost per program to conduct FFD training and to administer the comprehensive examination on their MROs to comply with the existing regulation					
		Length of FFD program training for MROs	HOURS training	2.0 hr	Assumption	
	Industry Practices: Annual cost per program to administer a random drug and alcohol testing program for FFD program personnel to comply with the existing regulation					
		% tested by a random drug program per year	PER random	50%	Rule requirement	
	Industry Practices: Annual cost per program to pay for MROs selected for random drug and alcohol testing to travel to the specimen collection facility and provide a specimen to comply with the existing regulation					
		% tested by a random drug program per year	PER random	50%	Rule requirement	
		Hours of MRO travel, waiting, and specimen collection time	HOURS travel	6.0 hr	Assumption	
Individuals Subject to Another Acceptable Program					**Subpart B**	**26.25(c)**
	These parameters are used in the equations below:					
		Annual number of applicants for initial authorization covered by other federal or state program per unit	NUM applicants	10	Assumption	
		% of fed or state programs that qualify	PER covered	50%	Assumption	
	Annual savings per program from bypassing pre-access drug and alcohol testing for the percentage of applicants covered by an acceptable program					
			No additional parameters			
	Annual savings per program from bypassing the training and examination requirement for the percentage of applicants covered by an acceptable program					
		Length of non-supervisory level training	HOURS non-supervisory	2.00 hr	Assumption	
		Length of comprehensive examination	HOURS examination	0.5 hr	Assumption	
	Annual savings per program from requiring fewer contracted trainer hours to conduct trainings and examinations on the percentage of applicants who are covered by an acceptable program					
		Length of non-supervisory level training	HOURS non-supervisory	2.00 hr	Assumption	
		Length of comprehensive examination	HOURS examination	0.5 hr	Assumption	
		Hours of training preparation and examination grading	HOURS preparation	2.0 hr	Assumption	
	Annual savings per program from not conducting remedial training and reexamining the percentage of applicants who are covered by an acceptable program and fail the comprehensive examination					
		Length of remedial supervisory-level training	HOURS remedial	0.75 hr	Assumption	
		Length of comprehensive examination	HOURS examination	0.5 hr	Assumption	
		% failing comprehensive exam	PER failing	10%	Assumption	
	Annual savings per program from requiring fewer contracted trainer hours to conduct remedial training and reexamining those applicants covered by an acceptable program that fail the comprehensive examination					
		Length of remedial supervisory-level training	HOURS remedial	0.75 hr	Assumption	
		Length of comprehensive examination	HOURS examination	0.5 hr	Assumption	
		% failing comprehensive exam	PER failing	10%	Assumption	
	Annual savings per program from not subjecting existing employees who are covered by an acceptable program to a duplicative random drug and alcohol testing program					
		Annual number of existing employees covered by another federal or state program	NUM employees	40	Assumption	
		% tested by a random drug program per year	PER random	50%	Rule requirement	

Activity	Equation	Parameter Description	Parameter	Value	Source	Section
Background Checks, Psychological Evaluations, Credit History, Criminal History					**Subpart B**	**26.31(b)(1)(i)**
	Base annual savings per program from eliminating the requirement to update background checks every three years					
		Base number of FFD program personnel per unit for each program	NUM personnel-base	1.5	Assumption	
		Cost of updating background investigation	COST background investigation update	$150	Assumption	
		Factor to adjust the periodic cost (every three years) to an annual cost	PER annualized-1	33.3%	Calculated	
	Additional savings per program from performing fewer background check updates for programs with onsite testing					
		Additional number of FFD program personnel per facility with onsite testing	NUM personnel-onsite testing	1	Assumption	
		Cost of updating background investigation	COST background investigation update	$150	Assumption	
		Factor to adjust the periodic cost (every three years) to an annual cost	PER annualized-1	33.3%	Calculated	
	Additional savings per program from performing fewer background check updates for programs with onsite collection					
		Additional number of FFD program personnel per facility for programs with onsite collection	NUM personnel-onsite collection	0.5	Assumption	
		Cost of updating background investigation	COST background investigation update	$150	Assumption	
		Percentage of facilities with onsite collection per program	PER collection	95.0%	Assumption	
		Factor to adjust the periodic cost (every three years) to an annual cost	PER annualized-1	33.3%	Calculated	
	Base annual savings per program from reducing the frequency of the psychological evaluation and criminal history and credit check update					
		Base number of FFD program personnel per unit for each program	NUM personnel-base	1.5	Assumption	
		Cost of updating psychological evaluation	COST psychological evaluation update	$300	Assumption	
		Cost of updating individual's credit and criminal history	COST criminal/credit update	$50	Assumption	
		Factor to adjust the periodic savings to an annual savings	PER annualized-2	13.3%	Calculated	
	Additional per program savings from reducing the frequency of the psychological evaluation and criminal history and credit check update for programs with onsite testing					
		Additional number of FFD program personnel per facility with onsite testing	NUM personnel-onsite testing	1	Assumption	
		Cost of updating psychological evaluation	COST psychological evaluation update	$300	Assumption	
		Cost of updating individual's credit and criminal history	COST criminal/credit update	$50	Assumption	
		Factor to adjust the periodic savings to an annual savings	PER annualized-2	13.3%	Calculated	
	Additional savings per program from reducing the frequency of the psychological evaluation and criminal history and credit check update for programs with onsite collection					
		Additional number of FFD program personnel per facility for programs with onsite collection	NUM personnel-onsite collection	0.5	Assumption	
		Cost of updating psychological evaluation	COST psychological evaluation update	$300	Assumption	
		Cost of updating individual's credit and criminal history	COST criminal/credit update	$50	Assumption	
		Percentage of facilities with onsite collection per program	PER collection	95.0%	Assumption	
		Factor to adjust the periodic savings to an annual savings	PER annualized-2	13.3%	Calculated	
DOT-Approved Specimen Collection Facilities					**Subpart B**	**26.31(b)(2)**
	Annual savings per program from allowing MROS and other offsite contracted personnel to utilize facilities conforming to DOT requirements					
		Number of MROs per program	NUM mros	2	Assumption	
		% tested by a random drug program per year	PER random	50.0%	Rule requirement	
		% of contracted FFD personnel that live closer to a DOT-approved collection facility than to a licensee's standard collection facility	PER distance	33.3%	Assumption	
		MRO hours of saved travel, waiting and specimen collection	HOURS travel	2.0 hr	Assumption	

Exhibit A2 - 2
Written Policies and Procedures

Activity	Equation	Parameter Description	Parameter	Value	Source	Section
Policy and Procedure Revisions - Overall Program					**Subpart B**	**26.27(a)**
	One-time cost per program to account for FFD manager and clerical personnel time and to contract a legal consultant to revise FFD policies and procedures					
		Hours of FFD program manager labor to develop and revise policies and procedures	HOURS manager	370.0 hr	Assumption	
		Hours of clerical personnel support of revision of policies and procedures	HOURS clerical	95.0 hr	Assumption	
		Hours of legal assistance to review and revise policies and procedures	HOURS legal	95.0 hr	Assumption	
	One-time cost per program to account for facility supervisor time to implement the corporate policies at the facility level					
		Hours of facility supervisor time to implement revised corporate policies and procedures	HOURS facility supervisor	40.0 hr	Assumption	
Licensee Testing Facility Policy and Procedure Revisions					**Subpart E**	**26.127**
	One time costs per FFD program with onsite testing					
		Hours FFD manager	HOURS FFD manager	120.0 hr	Assumption	
		Hours Lab supervisor	HOURS lab supervisor	160.0 hr	Assumption	
		Hours Clerical	HOURS clerical	40.0 hr	Assumption	
		Hours Legal	HOURS legal	40.0 hr	Assumption	
NRC Implementation - One-time Revision of Inspecion Procedures						
	One-time cost for NRC to revise inspection procedures					
		Time for FFD manager to revise the drug and alcohol testing / access authorization inspection procedures	HOURSFFDmanager	20.0 hr	Assumption	
		Time for FFD manager to write fatigue inspection procedures	HOURSFFDmanager	20.0 hr	Assumption	

Exhibit A2 - 3
Training and Examinations

Activity	Equation	Parameter Description	Parameter	Value	Source	Section
Revise and Implement Training, Including Behavioral Observation					**Subpart B**	**26.29(a)**
	These parameters are used in the equations below:					
		Number of training sessions per unit	NUM sessions	50	Assumption	
		% of cost applied to a given facility	PER cost	25%	Assumption	
		% of employees trained at the non-supervisory level under the current rule	PER non-supervisory	85%	Assumption	
		Length of FFD program training	HOURS training	4.00 hr	Assumption	
		Length of comprehensive examination	HOURS examination	0.5 hr	Assumption	
	One-time cost per program associated with revising the training program and training materials to account for new FFD provisions in the proposed rule					
		Hours of trainer time per program to revise the training program and training materials	HOURStrainer	20.0 hr	Assumption	
		Hours of training manager time per program to revise the training program and training materials	HOURStraining manager	2.0 hr	Assumption	
		Hours of FFD program manager time per program to revise the training program and training materials	HOURSmanager	2.0 hr	Assumption	
		Hours of clerical personnel to support the revision of the training program and training materials	HOURSclerical	4.0 hr	Assumption	
	One-time cost per program associated with revising the training program to include fatigue KAs					
		Hours of FFD program manager time per program revise the training program to include fatigue KAs	HOURS ffd manager-fatigue	60.0 hr	Assumption	
		Hours of clerical personnel to support the revision of the training program to include fatigue KAs	HOURS clerical-fatigue	8.0 hr	Assumption	
	One-time costs per program to retrain existing employees on the fatigue-related KAs					
		Length of training increment addressing the fatigue-related KAs	HOURS training-fatigue	0.25 hr	Assumption	
		Length of comprehensive examination increment addressing the fatigue-related KAs	HOURS examination-fatigue	0.08 hr	Assumption	
	One-time costs per program for trainers to adminster the training on the fatigue-related KAs					
		Length of training increment addressing the fatigue-related KAs	HOURS training-fatigue	0.25 hr	Assumption	
		Length of comprehensive examination increment addressing the fatigue-related KAs	HOURS examination-fatigue	0.08 hr	Assumption	
		Hours of preparation and examination grading	HOURS preparation-fatigue	0.50 hr		

Activity	Equation	Parameter Description	Parameter	Value	Source	Section
	Annual costs per program for incoming employees to take the training for fatigue-related KAs					
		Length of training increment addressing the fatigue-related KAs	HOURS training-fatigue	0.25 hr	Assumption	
		Length of comprehensive examination increment addressing the fatigue-related KAs	HOURS examination-fatigue	0.08 hr	Assumption	
	Annual costs per program for trainers to administer the training course for fatigue-related KAs					
		Length of training increment addressing the fatigue-related KAs	HOURS training-fatigue	0.25 hr	Assumption	
		Length of comprehensive examination increment addressing the fatigue-related KAs	HOURS examination-fatigue	0.08 hr	Assumption	
	Annual cost per program for employees to take the refresher training increment addressing fatigue-related KAs					
		Length of fatigue-related KA refresher training modules	HOURS training-fatigue	0.50 hr	Assumption	
	Annual cost per program for trainers to administer the refresher training increment addressing fatigue-related KAs					
		Length of fatigue-related KA refresher training modules	HOURS training-fatigue	0.50 hr	Assumption	
		Hours of training preparation and examination grading for fatigue-related increment	HOURS preparation-fatigue	1.50 hr		
	Annual costs per program for employees to take the comprehensive challenge examination increment addressing the fatigue-related KAs					
		Length of comprehensive examination increment addressing the fatigue-related KAs	HOURS examination-fatigue	0.08 hr		
		% of employees taking the challenge examination	PER examination	80%	Assumption	
	Annual costs per program for trainers to administer the comprehensive challenge examination					
		Length of comprehensive examination increment addressing the fatigue-related KAs	HOURS examination-fatigue	0.08 hr		
		Hours of examination grading	HOURS grading	0.08 hr		
		% of employees taking the challenge examination	PER examination	80%	Assumption	
	Pre-Order Baseline: One-time cost per program associated with revising the training program					
		Hours of FFD program manager time per program to make knowledge and abilities revisions to training program	HOURS trainer	12.0 hr	Assumption	
		Hours of training manager time per program to review knowledge and abilities revisions to training program	HOURStraining manager	2.0 hr	Assumption	
		Hours of FFD program manager time per program to review knowledge and abilities revisions to training program	HOURS ffd manager	2.0 hr	Assumption	
		Hours of clerical personnel time to support training program revisions process	HOURS clerical	4.0 hr	Assumption	
	Pre-Order Baseline: One-time cost per program for employees not previously trained at the supervisory level to take updated supervisory-level training and a comprehensive examination					
			No additional parameters			
	Pre-Order Baseline: One-time cost per program for trainers to administer supervisory-level training on those employees not previously trained at the supervisory level					
		Hours of training preparation and examination grading	HOURS preparation	2.0 hr	Assumption	
	Pre-Order Baseline: Annual cost per program for incoming employees to take the longer supervisory-level training course					
		Length of supervisory-level training	HOURS supervisory	4.00 hr	Assumption	
		Length of non-supervisory-level training	HOURS non-supervisory	2.00 hr	Assumption	
	Pre-Order Baseline: Annual cost per program for trainers to administer the longer supervisory-level training course on incoming employees					
		Length of supervisory-level training	HOURS supervisory	4.00 hr	Assumption	
		Length of non-supervisory-level training	HOURS non-supervisory	2.00 hr	Assumption	
		Hours of training preparation and examination grading	HOURS preparation	2.00 hr	Assumption	
	Pre-Order Baseline: Annual cost per program for employees to take the longer supervisory-level refresher training					
		% of employees taking the refresher training course	PER refresher	20%	Assumption	
		Length of supervisory-level refresher training	HOURS supervisory	4.0 hr	Assumption	
		Length of non-supervisory-level refresher training	HOURS non-supervisory	2.0 hr	Assumption	
	Pre-Order Baseline: Annual cost per program for trainers to administer the longer supervisory-level refresher training					
		% of employees taking the refresher training course	PER refresher	20%	Assumption	
		Length of supervisory-level refresher training	HOURS supervisory	1.5 hr	Assumption	
		Length of non-supervisory-level refresher training	HOURS non-supervisory	2.0 hr	Assumption	
Urine and Alcohol Collector Training					**Subpart E**	**26.85(a),(b)**
	One time cost per facility					
		Number of collectors per collection site	NUM collectors	4	Assumption	
		Duration of training course	HOURS collector training	8.0 hr	Assumption	
		Number of training courses per facility	NUM courses per facility	1	Assumption	
		On-site Training of Collection Personnel, supplied by commercial vendor	COST training course	$ 1,000	Assumption	

Activity	Equation	Parameter Description	Parameter	Value	Source	Section
Initial Validity Testing - Onsite Licensee Testing Facilities					**Subpart F**	**26.131(b)**
	One time cost per onsite licensee testing facility					
		Number of laboratory technicians per licensee testing facility	NUM technicians	4	Assumption	
		Duration of training course	HOURS technician training	4.0 hr	Assumption	
		Number of training courses per licensee testing facility	NUM courses per facility	1	Assumption	
		Cost per training course	COST training course	$ 500.00	Assumption	
Comprehensive Examination					**Subpart B**	**26.29(b)**
	These parameters are used in the equations below:					
		% employees failing exam	PER failing	10%	Assumption	
		% of employees trained at the non-supervisory level under the current rule	PER non-supervisory	85%	Assumption	
		Length of remedial supervisory-level training	HOURS remedial	0.75 hr	Assumption	
	One-time cost per program for employees to take remedial training after failing the initial comprehensive examination when updating their training					
			No additional parameters			
	One-time cost per program for trainers to administer remedial training on those employees who fail the initial comprehensive examination when updating training					
			No additional parameters			
	Annual cost per program for applicants to take remedial training after failing the initial comprehensive examination					
			No additional parameters			
	Annual cost per program for trainers to administer remedial training on applicants who fail the initial comprehensive examination					
			No additional parameters			
Comprehensive Examination in Lieu of Refresher Training					**Subpart B**	**26.29(c)(2)**
	These parameters are used in the equations below:					
		% of employees choosing to take comprehensive refresher exam in lieu of refresher training	PER examination	80%	Assumption	
		Length of comprehensive examination	HOURS exam	0.5 hr	Assumption	
		Trainer time to prepare for training course	HOURS preparation	1.0 hr	Assumption	
		Trainer time to prepare for exam and grade	HOURS grading	0.5 hr	Assumption	
	Annual savings per program for those employees choosing to take the shorter comprehensive examination in lieu of non-supervisory-level refresher training					
		% of employees trained at the non-supervisory level under the current rule	PER non-supervisory	85%	Assumption	
		Length of non-supervisory-level refresher training	HOURS non-supervisory	2.0 hr	Assumption	
	Annual savings per program for those employees choosing to take the shorter comprehensive examination in lieu of supervisory-level refresher training					
		% of employees trained at the supervisory-level under the current rule	PER supervisory	15%	Assumption	
		Length of supervisory-level refresher training	HOURS supervisory	4.0 hr	Assumption	
	Annual savings per program from reduced training costs due to employees choosing to take the shorter comprehensive examination in lieu of non-supervisory-level refresher training.					
		% of employees trained at the non-supervisory-level under the current rule	PER non-supervisory	85%	Assumption	
		Length of non-supervisory-level refresher training	HOURS non-supervisory	2.0 hr	Assumption	
	Annual savings per program from reduced training costs due to employees choosing to take the shorter comprehensive examination in lieu of supervisory-level refresher training.					
		% of employees trained at the supervisory-level under the current rule	PER supervisory	15%	Assumption	
		Length of supervisory-level refresher training	HOURS supervisory	4.0 hr	Assumption	
NRC Implementation - One-time Training						
	Cost to develop NRC staff training workshop					
		Hours of NRC staff time to develop training workshop curriculum and materials	NRC Staff Hours	40.0 hr	Assumption	
	Cost to train NRC staff from Rockville Headquarters					
		Hours to train NRC staff reviewers and inspectors	NRC HQ Staff Hours	24 hr	Assumption	
		Number of local NRC staff participating in training (including instructor)	NUM NRC HQ staff	3	Assumption	
	Cost to train NRC staff from regional NRC offices					
		Hours to train NRC staff reviewers and inspectors	HOUR training	24 hr	Assumption	
		Cost of roundtrip travel	COST travel	$500	Assumption	
		Cost of lodging and per diem per night	COST lodging & food	$150	Assumption	
		Number of nights of lodging for auditor to complete focused audit	NUM nights hotel	3	Assumption	
		Hours of roundtrip auditor travel per audit	HOURS travel	8 hr	Assumption	
		Number personnel from NRC regional offices	NUM NRC regional staff	4	Assumption	

Exhibit A2 - 4

Audits, Inspections, Certifications and Corrective Action

Activity	Equation	Parameter Description	Parameter	Value	Source	Section
Audit Frequency					**Subpart B**	**26.41(b)**
	These parameters are used in the equations below:					
		% multiplier to yield annualized savings	PER annualized	50.0%	Calculated	
		Cost of roundtrip travel	COST travel	$300	Assumption	
		Cost of lodging and per diem per night	COST lodging	$150	Assumption	
	Annual base saving per program from the reduced audit frequency					
		Contracted auditor hours at facility with offsite collection and testing	HOURS auditor-base	25.0 hr	NRC staff estimate	
		FFD program manager hours at facility with offsite collection and testing	HOURS manager-base	13.0 hr	NRC staff estimate	
		Clerical personnel hours at facility with offsite collection and testing	HOURS clerical-base	5.0 hr	NRC staff estimate	
	Additional annual savings per program from audit frequency reduction that accrue to programs with onsite testing					
		Contracted auditor hours saved at facility with onsite testing	HOURS auditor-onsite collection	12.0 hr	NRC staff estimate	
		FFD program manager hours saved at facility with onsite testing	HOURS manager-onsite collection	7.0 hr	NRC staff estimate	
		Clerical personnel hours saved at facility with onsite testing	HOURS clerical-onsite collection	0.0 hr	NRC staff estimate	
		Laboratory manager hours saved at facility with onsite testing	HOURS laboratory manager	5.0 hr	NRC staff estimate	
		Laboratory staff hours saved at facility with onsite testing	HOURS laboratory staff	2.0 hr	NRC staff estimate	
	Additional annual savings per program from audit frequency reduction that accrue to programs with onsite collection					
		Contracted auditor hours saved at facility with onsite collection	HOURS auditor-onsite testing	5.0 hr	NRC staff estimate	
		FFD program manager hours saved at facility with onsite collection	HOURS manager-onsite testing	0.0 hr	NRC staff estimate	
		Clerical personnel hours saved at facility with onsite collection	HOURS clerical-onsite testing	0.0 hr	NRC staff estimate	
		Collection manager hours saved at facility with onsite collection	HOURS collection manager	2.0 hr	NRC staff estimate	
		Collection staff hours saved at facility with onsite collection	HOURS collection staff	1.0 hr	NRC staff estimate	
		Percentage of facilities with onsite collection per program		95.0%	Assumption	
	Base annual savings per program from reduced audit frequency					
		Base number of auditors per program audit	NUM auditors-base	1	Assumption	
		Number of auditor overnights saved at facility with offsite collection and offsite testing	NUM nights-base	3	NRC staff estimate	
		Contracted auditor hours traveling	HOURS travel	4.0 hr	Assumption	
	Additional annual savings per program that accrue due to reduced auditor travel to facilities with onsite testing laboratories					
		Additional number of auditors per program with onsite testing laboratories	NUM auditors-onsite testing	1	Assumption	
		Additional number of overnights per program with onsite testing	NUM nights-onsite testing	1	NRC staff estimate	
	Additional annual savings per program that accrue due to reduced auditor travel to facilities with onsite collection facilities					
		Additional number of auditors per program with onsite collection facilities	NUM auditors-onsite collection	0	Assumption	
		Additional number of overnights per program with onsite collection	NUM nights-onsite collection	0	NRC staff estimate	
	Annual cost per program to conduct focused audits addressing problem areas of the FFD program					
		Hours of contracted auditor time conducting a focused audit	HOURS auditor	4.0 hr	NRC staff estimate	
		Hours of FFD program manager time during a focused audit	HOURS manager	3.0 hr	NRC staff estimate	
		Hours of clerical personnel time during a focused audit	HOURS clerical	1.0 hr	NRC staff estimate	
		Number of auditors per program audit	NUM auditors	2	Assumption	
		Cost of lodging and per diem per night	COST lodging	$ 150.00	Assumption	
		Cost of roundtrip travel	COST travel	$ 300.00	Assumption	
		Number of nights of lodging for auditor to complete focused audit	NUM nights-focused	1	NRC staff estimate	
		Hours of roundtrip auditor travel per audit	auditor travel time	4.0 hr	Assumption	

Activity	Equation	Parameter Description	Parameter	Value	Source	Section
Elimination of Audit Duplication of HHS-Certified Laboratories					**Subpart B**	**26.41(c)(2)**
	Annual savings per program from eliminating audit duplication					
		Hours of contracted auditor time saved annually per program in elimination of audit duplication	HOURS auditor	7.0 hr	Assumption	
		Hours of FFD program manager time saved annually in elimination of audit duplication	HOURS manager	4.0 hr	Assumption	
		Hours of clerical personnel time saved annually in elimination of audit duplication	HOURS clerical	1.0 hr	Assumption	
Forensic Toxicologist Review of More Stringent Cutoff Levels					**Subpart B**	**26.31(d)(3)**
	One time cost per program to employ more stringent cutoff level(s) for drugs					
		Hours of review by forensic toxicologist of more stringent cut-off levels for drug testing	HOURS toxicologist	3.5 hr	Assumption	
		Hours of time for the forensic toxicologist to produce a certification statement regarding the more stringent cut-off levels	HOURS certification	0.5 hr	Assumption	
		Percentage of FFD programs that use more stringent cut-off levels for drug testing	PERmore stringent cutoffs	10%	Assumption	
		Percentage of FFD programs who use more stringent cut-off levels for drug testing, but have not reported to the Commission	PER non-report	25%	Assumption	
		Hours of time spent by FFD program manager to review the results of the forensic toxicologist's evaluation per FFD program	HOURS manager	0.5 hr	Assumption	
Pre-Award Inspections of HHS-Certified Laboratories					**Subpart G**	**26.153(e)**
	Annual costs per FFD program					
		Hours per pre-award inspection for an HHS-certified lab conducted by licensee personnel or a designate	HOURS inspection	100 hr	Discussion with NEI staff, May 23, 2003	
		Percentage of FFD programs that must change to a new HHS lab because their current HHS-lab loses HHS certification	PER decertification	10%	Assumption	
		Percentage of instances in which a replacement HHS-certified lab is being used by another FFD program (a "known" HHS lab)	PER known	50%	Assumption	

Exhibit A2 - 5
Authorizations

Activity	Equation	Parameter Description	Parameter	Value	Source	Section
Initial Authorization						
Self-Disclosure for Initial Applicants					**Subpart C**	**26.55(a)(1)**
	Pre-Order Baseline: Annual savings per program from reduced facility worker labor burden for those initial applicants who qualify for the self-disclosure relaxation					
		% of applicants for initial authorization qualifying for relaxation	PER qualifying	50%	Assumption	
		Facility worker hours saved in foregone self-disclosure	HOURS worker	0.25 hr	NRC staff estimate	
	Pre-Order Baseline: Annual savings per program from reduced clerical personnel labor burden because fewer self-disclosures submitted by initial applicants need to be processed					
		% of applicants for initial authorization qualifying for relaxation	PER qualifying	50%	Assumption	
		Clerical personnel hours saved in foregone self-disclosure	HOURS clerical	0.25 hr	NRC staff estimate	
Suitable Inquiry for Initial Applicants					**Subpart C**	**26.55(a)(2)**
	Pre-Order Baseline: Annual savings per program from not conducting the suitable inquiry on initial applicants qualifying for relaxation					
		% of applicants for initial authorization qualifying for relaxation	PER qualifying	50%	Assumption	
		HR personnel hours saved in exempted suitable inquiry under the current rule, but prior to the AAO	HOURS hr	1.0 hr	NRC staff estimate	
	Pre-Order Baseline: Annual savings per program due to reduced suitable inquiry coverage period and scope for those applicants qualifying for the relaxation					
		HR personnel hours saved due to reduced suitable inquiry coverage period and a reduction in the number of employers that must be contacted	HOURS hr	0.5 hr	NRC staff estimate	
		% of applicants for initial authorization per year who do not qualify for the relaxation under proposed subparagraph 23.63(a)	PER not qualifying	50%	Assumption	
		% of initial applicants who have no potentially disqualifying FFD information to disclose	PER non-PDFFDI	95%	Assumption	
	Industry Practices: Annual cost per program to conduct a more thorough suitable inquiry on applicants for initial authorization to comply with the existing regulation					
		Additional HR personnel hours required to conduct a suitable inquiry compliant with existing regulation	HOURS hr	0.2 hr	Assumption	
Pre-Access Testing for Initial Applicants					**Subpart C**	**26.55(a)(3)**
	Pre-Order Baseline: Annual savings per program from not administering a pre-access drug and alcohol test on initial applicants covered by a behavioral observation and arrest-reporting program throughout the period of interruption					
		% applicants of applicants for initial authorization qualifying for pre-access drug test relaxation	PER qualifying	25%	Assumption	
	Pre-Order Baseline: Annual savings per program from bypassing required worker labor in the administration of a pre-access drug and alcohol tests for initial applicants covered by a behavioral observation and arrest-reporting					
		Facility worker hours saved at facility with onsite testing laboratory	HOURS onsite	4.0 hr	Assumption	
		Facility worker hours saved at facility with offsite testing laboratory	HOURS offsite	8.0 hr	Assumption	
		% of initial applicants qualifying for pre-access drug test relaxation	PER qualifying	25%	Assumption	
Random Testing Pool for Initial Applicants					**Subpart C**	**26.55(a)(4)**
	Annual costs per program from the implementation of a random drug and alcohol testing program on initial applicants in applicant status					
		% of initial applicants selected for random drug and alcohol testing	PER random	1%	Assumption	
Authorization Updates						
Self Disclosure for Update Applicants					**Subpart C**	**26.57(a)(1)**
	Pre-Order Baseline: Annual savings per program from reduced facility worker labor burden for those applicants for updated authorization who qualify for the self-disclosure relaxation					
		% of applicants for authorization updates qualifying for relaxation	PER qualifying	50%	Assumption	
		Facility worker hours saved in foregone self-disclosure	HOURS worker	0.25 hr	NRC staff estimate	
	Pre-Order Baseline: Annual savings per program from reduced clerical personnel labor burden because fewer self-disclosures submitted by applicants for updated authorization will need to be processed					
		% of applicants for authorization updates qualifying for relaxation	PER qualifying	50%	Assumption	
		Clerical personnel hours saved in foregone self-disclosure	HOURS clerical	0.25 hr	NRC staff estimate	

Activity	Equation	Parameter Description	Parameter	Value	Source	Section
Suitable Inquiry for Update Authorization					**Subpart C**	**26.57(a)(2)**
	Pre-Order Baseline: Annual savings per program from not conducting the suitable inquiry on applicants for updated authorization qualifying for the relaxation					
		% of applicants for authorization updates qualifying for relaxation	PER qualifying	50%	Assumption	
		HR personnel hours saved in exempted suitable inquiry under the current rule, but prior to the AAO	HOURS hr	1.0 hr	NRC staff estimate	
	Pre-Order Baseline: Annual savings per program due to reduced suitable inquiry coverage period and scope for applicants for updated authorization qualifying for the relaxation					
		% of applicants for updated authorization not qualifying for relaxation	PER non qualifying	50%	Assumption	
		% of applicants for updated authorization who have no potentially disqualifying FFD information to disclose	PER non-PDFFDI	98%	Assumption	
		HR personnel hours saved due to reduced suitable inquiry coverage period and a reduction in the number of employers that must be contacted	HOURS hr	0.5 hr	NRC staff estimate	
	Industry Practices: Annual cost per program to conduct a more thorough suitable inquiry on applicants for updated authorization to comply with the existing regulation					
		Additional HR personnel hours required to conduct a suitable inquiry compliant with existing regulation	HOURS hr	0.2 hr	Assumption	
Pre-Access Testing for Update Applicants					**Subpart C**	**26.57(a)(3)**
	Pre-Order Baseline: Annual savings per program from not administering a pre-access drug and alcohol test on update applicants covered by a behavioral observation and arrest-reporting program throughout the period of interruption					
		% applicants for authorization updates qualifying for pre-access drug test relaxation	PER qualifying	25%	Assumption	
	Pre-Order Baseline: Annual savings per program from bypassing required worker labor in the administration of a pre-access drug and alcohol tests for update applicants covered by a behavioral observation and arrest-reporting					
		Facility worker hours saved at facility with onsite testing laboratory	HOURS onsite	4.0 hr	Assumption	
		Facility worker hours saved at facility with offsite testing laboratory	HOURS offsite	8.0 hr	Assumption	
		% applicants for authorization updates qualifying for pre-access drug test relaxation	PER qualifying	25%	Assumption	
Random Testing Pool for Update Applicants					**Subpart C**	**26.57(a)(4)**
	Annual costs per program from the implementation of a random drug and alcohol testing program on update applicants in applicant status					
		% of initial applicants selected for random drug and alcohol testing	PER random	1%	Assumption	
Authorization Reinstatements with Interruptions						
Self-Disclosure for Reinstatement Applicants with 31-365 Day Interruption					**Subpart C**	**26.59(a)(1)**
	Pre-Order Baseline: Annual savings per program from reduced facility worker labor burden for those applicants for authorization reinstatement who qualify for the self-disclosure relaxation					
		Facility worker hours saved in foregone self-disclosure	HOURS worker	0.25 hr	NRC staff estimate	
		% of applicants for authorization reinstatement qualifying for self-disclosure relaxation	PER qualifying	50%	Assumption	
	Pre-Order Baseline: Annual savings per program from reduced clerical personnel labor burden because fewer self-disclosures submitted by applicants for authorization reinstatement will need to be processed					
		Clerical personnel hours saved in foregone self-disclosure	HOURS clerical	0.25 hr	NRC staff estimate	
		% of applicants for authorization reinstatement qualifying for self-disclosure relaxation	PER qualifying	50%	Assumption	
Suitable Inquiry for Reinstatement Applicants with 31-365 Day Interruption					**Subpart C**	**26.59(a)(2)**
	Pre-Order Baseline: Annual savings per program from not conducting the suitable inquiry on applicants for authorization reinstatement qualifying for the relaxation					
		HR personnel hours saved in exempted suitable inquiry under the current rule, but prior to the AAO	HOURS hr	1.0 hr	NRC staff estimate	
		% of applicants qualifying for the suitable inquiry relaxation	PER qualifying	50%	Assumption	

Activity	Equation	Parameter Description	Parameter	Value	Source	Section
	Pre-Order Baseline: Annual savings per program due to reduced suitable inquiry coverage period and scope for applicants for authorization reinstatement qualifying for the relaxation					
		HR personnel hours saved due to reduced suitable inquiry coverage period and a reduction in the number of employers that must be contacted	HOURS hr	0.5 hr	NRC staff estimate	
		% of applicants not qualifying for the suitable inquiry relaxation	PER covered	50%	Assumption	
		% of update applicants who have no potentially disqualifying FFD information to disclose on their self-disclosures	PER non-pdffdi	99%	Assumption	
	Industry Practices: Annual cost per program to conduct a more thorough suitable inquiry on applicants for authorization reinstatement to comply with the existing regulation					
		Additional HR personnel hours required to conduct a suitable inquiry compliant with existing regulation	HOURS hr	0.2 hr	Assumption	
Pre-Access Testing for Reinstatement Applicants with 31-365 Day Interruption					**Subpart C**	**26.59(a)(3)**
	Pre-Order Baseline: Annual savings per program from allowing reinstatement applicants covered by a random drug and alcohol testing program throughout the period of interruption to forego pre-access drug and alcohol testing					
		% of applicants for authorization reinstatement covered by a random drug and alcohol testing program	PER qualifying	25%	Assumption	
	Pre-Order Baseline: Annual savings per program from reducing the number of hours of lost worker productivity for reinstatement applicants covered by both a random drug and alcohol testing program and a behavioral observation and arrest reporting program					
		Facility worker hours saved at facility with onsite testing laboratory	HOURS onsite	4.0 hr	Assumption	
		Facility worker hours saved at facility with offsite testing laboratory	HOURS offsite	8.0 hr	Assumption	
		% of applicants for authorization reinstatement covered by a random drug and alcohol testing program	PER qualifying	25%	Assumption	
	Pre-Order Baseline: Annual savings per program resulting from this group of applicants not having to await verification of negative results before granting authorization					
		Facility worker hours saved at facility with onsite testing laboratory	HOURS onsite	4.0 hr	Assumption	
		Facility worker hours saved at facility with offsite testing laboratory	HOURS offsite	8.0 hr	Assumption	
		% of applicants for authorization reinstatement not covered by a random drug and alcohol testing program	PER not qualifying	75%	Assumption	
Random Testing Pool for Reinstatement Applicants with 31-365 Day Interruption					**Subpart C**	**26.59(a)(4)**
	Annual costs per program to conduct random drug and alcohol tests on applicants randomly selected while awaiting the granting of authorization					
		% of initial applicants selected for random drug and alcohol testing	PER random	1%	Assumption	
Self-Disclosure (and Suitable Inquiry) for Reinstatement Applicants with Less than 31 Day Interruption					**Subpart C**	**26.59(c)(1)**
	Pre-Order Baseline: Annual savings per program from reduced facility worker labor burden for those applicants for authorization reinstatement who qualify for the self-disclosure relaxation					
		% of reinstatement applicants qualifying for relaxation	PER qualifying	50%	Assumption	
		Facility worker hours saved in foregone self-disclosure	HOURS worker	0.25 hr	NRC staff estimate	
	Pre-Order Baseline: Annual savings per program from reduced clerical personnel labor burden because fewer self-disclosures submitted by applicants for authorization reinstatement will need to be processed					
		% of reinstatement applicants qualifying for relaxation	PER qualifying	50%	Assumption	
		Clerical personnel hours saved in foregone self-disclosure	HOURS clerical	0.25 hr	NRC staff estimate	
	Pre-Order Baseline: Annual savings per program from not conducting suitable inquiries on applicants for authorization reinstatement with an interruption of not more than 30 days					
		HR personnel hours saved in exempted suitable inquiry under the current rule, but prior to the AAO	HOURS hr	1.0 hr	NRC staff estimate	
	Industry Practices: Annual cost per program for applicants for authorization reinstatement with interruptions of not more than 30 days to submit self-disclosures to comply with self-disclosure requirements					
		Facility worker hours required to complete and submit self-disclosure	HOURS worker	0.25 hr	NRC staff estimate	
		% cost applied to each program	PER cost	50%	Assumption	
	Industry Practices: Annual cost per program for clerical personnel to process additional self-disclosures for applicants for authorization reinstatement with interruptions of not more than 30 days to comply with self-disclosure requirements					
		Clerical personnel hours required to process received self-disclosures	HOURS clerical	0.25 hr	NRC staff estimate	
		% cost applied to each program	PER cost	50%	Assumption	

Activity	Equation	Parameter Description	Parameter	Value	Source	Section
	Industry Practices: Annual cost per program to conduct suitable inquiries on applicants for authorization reinstatement with an interruption of not more than 30 days to comply with the existing regulations					
		Additional HR personnel hours required to conduct a suitable inquiry as required by	HOURS hr	1.0 hr	NRC staff estimate	
		% cost applied to each program	PER cost	50%	Assumption	
	Industry Practices: Annual cost per program to conduct a more thorough suitable inquiry on applicants for authorization reinstatement with an interruption of not more than 30 days to comply with the existing regulation					
		Additional HR personnel hours required to conduct a suitable inquiry compliant with existing regulation	HOURS hr	0.2 hr	Assumption	
Pre-Access Testing for Reinstatement Applicants with Less than 31 Day Interruption					**Subpart C**	**26.59(c)(2)**
	Pre-Order Baseline: Annual savings per program from not administering a pre-access drug and alcohol test on applicants for authorization reinstatement with an interruption of 5 days or less					
		No additional Parameters	No Parameters			
	Pre-Order Baseline: Annual savings per program from bypassing worker labor in the administration of a pre-access drug and alcohol test for authorization reinstatements with an interruption of 5 days or less					
		Facility worker hours saved at facility with onsite testing laboratory	HOURS onsite	4.0 hr	Assumption	
		Facility worker hours saved at facility with offsite testing laboratory	HOURS offsite	8.0 hr	Assumption	
	Pre-Order Baseline: Annual savings per program from allowing reinstatement applicants who have been covered by a behavioral observation and arrest-reporting program throughout the period of interruption to forego the pre-access drug and alcohol test					
		% of applicants qualifying for the relaxation	PER covered	50%	Assumption	
	Pre-Order Baseline: Annual savings per program from bypassing required worker labor in the administration of a pre-access drug and alcohol tests for reinstatement applicants who have been covered by a behavioral observation and					
		% of applicants qualifying for the relaxation	PER covered	50%	Assumption	
		Facility worker hours saved at facility with onsite testing laboratory	HOURS onsite	4.0 hr	Assumption	
		Facility worker hours saved at facility with offsite testing laboratory	HOURS offsite	8.0 hr	Assumption	
	Pre-Order Baseline: Annual savings per program from allowing reinstatement applicants who have not been covered by a behavioral observation and arrest-reporting program throughout the period of interruption but who have not been randomly selected for pre-access testing to forego the pre-access drug and alcohol test					
		% of applicants not qualifying for the relaxation	PER not covered	50%	Assumption	
		% of applicants subject to random testing but not selected	PER not selected	98%	Assumption	
	Pre-Order Baseline: Annual savings per program from reducing the number of hours of lost worker productivity for reinstatement applicants who are not covered and are not selected for random pre-access drug and alcohol testing					
		% of applicants not qualifying for the relaxation	PER not covered	50%	Assumption	
		% of applicants subject to random testing but not selected	PER not selected	98%	Assumption	
		Facility worker hours saved at facility with onsite testing laboratory	HOURS onsite	4.0 hr	Assumption	
		Facility worker hours saved at facility with offsite testing laboratory	HOURS offsite	8.0 hr	Assumption	
	Industry Practices: Annual cost per program to comply with existing pre-access drug and alcohol testing provisions					
		Facility worker hours saved at facility with onsite testing laboratory	HOURS onsite	4.0 hr	Assumption	
		Facility worker hours saved at facility with offsite testing laboratory	HOURS offsite	8.0 hr	Assumption	
		% of cost applied to a given program due to non-compliance	PER compliance	50%	Assumption	
	Industry Practices: Annual cost per program of increased lost worker productivity awaiting negative test result verification to comply with existing pre-access drug and alcohol testing provisions					
		Facility worker hours saved at facility with onsite testing laboratory	HOURS onsite	4.0 hr	Assumption	
		Facility worker hours saved at facility with offsite testing laboratory	HOURS offsite	8.0 hr	Assumption	
		% of cost applied to a given program due to non-compliance	PER compliance	50%	Assumption	
Random Testing Pool for Reinstatement Applicants with Less than 31 Day Interruption					**Subpart C**	**26.59(c)(3)**
	Annual costs per program to subject applicants for authorization reinstatement to one-time random selection for a pre-access drug and alcohol test					
		% rate of random test selection	PER randomly selected	2%	Assumption	
		% rate of random test selection	PER randomly selected	1%	Assumption	
	Annual costs per program from reduced labor productivity to subject applicants for authorization reinstatement to one-time random selection for a pre-access drug and alcohol test					
		% rate of random test selection	PER random	2%	Assumption	
		Facility worker hours saved at facility with onsite testing laboratory	HOURS onsite	4.0 hr	Assumption	
		Facility worker hours saved at facility with offsite testing laboratory	HOURS offsite	8.0 hr	Assumption	

Exhibit A2 - 6

Activities Related to Potential Policy Violations

Activity	Equation	Parameter Description	Parameter	Value	Source	Section
Reasonable Effort to Track Randomly Selected Individuals for Testing					**Subpart B**	**26.31(d)(2)**
	Annual costs per program from requiring greater effort to track individuals selected for random drug and alcohol testing					
		% tested by a random drug program per year	PER random	50.0%	Rule requirement	
		% of randomly selected employees per year that are unavailable for the scheduled test	PER unavailable	25%	Assumption	
		Hours of FFD program manager tracking time per randomly selected employee unavailable for the scheduled test	HOURS manager	0.25 hr	Assumption	
Behavioral Observation					**Subpart B**	**26.33**
	This parameter is used in the equations below:					
		% increase in for-cause tests/referrals per year	PERI for-cause	10%	Assumption	
	Annual cost per program to review additional for-cause referrals					
		Hours of FFD program manager review per for-cause referral	HOURS manager	4.0 hr	Assumption	
		Hours of facility worker hours under review per for-cause referral	HOURS worker	4.0 hr	Assumption	
	Annual cost per program to conduct additional drug and alcohol tests due to increased for-cause referrals					
			No additional parameters			
	Annual cost per program to conduct additional pre-access drug and alcohol tests yielding non-negative results due to increased for-cause referrals					
			No additional parameters			
	Annual cost per program to retest confirmed positive drug test results at a second HHS-certified laboratory at the request of the donor					
		% of confirmed positive drug tests that donors request retesting of the specimen at a second HHS-certified laboratory	PER retest	5%	Assumption	
	Annual costs per program for the percentage of workers with confirmed positive test results who initiate an appeals process					
		% of workers with confirmed positive test results that initiate appeals process	PER appeals	1%	Assumption	
Disclosure requirements positive test results					**Subpart B**	**26.37(d)**
	Annual costs per program to provide individuals with easier access to personal documents					
		% of employees with positive test results who request records	PER requesting	50%	Assumption	
		Additional clerical personnel hours copying, packaging, and shipping records per disclosure request	HOURS clerical	1.0 hr	Assumption	
		Cost of mailing (express mail) one performance data report to each licensee	COSTMailing	$ 10.00	Assumption	
Review of FFD Policy Violations					**Subpart B**	**26.39(c)**
	Annual cost per program to require FFD policy violations to be reviewed by more than one individual both of whom must be unaffiliated with FFD program administration					
		Additional hours of non-FFD manager review of FFD policy violations	HOURS manager	4.0 hr	Assumption	
Definition of "Potentially Disqualifying Information"					**Subpart H**	**26.189(b)(3)**
	These parameters are used in the equations below:					
		% of applicants for authorization requiring a determination of fitness based on potentially disqualifying FFD information under the current rule	PER PDFFDI-current	10%	Assumption	
		% of applicants for authorization requiring a determination of fitness based on potentially disqualifying FFD information under the proposed rule	PER PDFFDI-proposed	5%	Assumption	
	Annual savings per program from the reduction in the number of determinations of fitness requiring SAE review					
		SAE hours of review per determination of fitness	HOURS sae	2.0 hr	Assumption	
	Annual savings per program from the reduction in the number of determinations of fitness requiring FFD program manager review					
		FFD program manager hours of review per determination of fitness	HOURS manager	2.0 hr	Assumption	
	Annual savings per program from the reduction in the number of determinations of fitness requiring clerical personnel support					
		Clerical personnel hours to support determination of fitness	HOURS clerical	2.0 hr	Assumption	
Face-to-Face Determinations of Fitness					**Subpart H**	**26.189(c)**
	Annual costs per program from requiring that a determination of fitness that is conducted for-cause be conducted face-to-face with the individual under review					
		Hours of worker time required per face-to-face determination of fitness	HOURS worker	2.0 hr	Assumption	

Exhibit A2 - 7
Urine Specimen Collections

Activity	Equation	Parameter Description	Parameter	Value	Source	Section
Urine Collection: Donors Without Adequate ID					**Subpart E**	**26.89(b)(2)**
	Annual savings per FFD program per year					
		Percentage of individuals without identification	PER no-ID	1.0%	Assumption	
		Time a donor without ID would spend to leave the collection site, obtain appropriate ID, and return to the collection site to be drug and alcohol tested	HOURS worker	0.75 hr	Assumption	
Urine Collection: Eliminate Listing Medications on the CCF Form and add description of testing process					**Subpart E**	**26.89(b)(3)**
	Annual savings per FFD program per year					
		Time per collection to list medications on CCF	HOURS saved	0.033 hr	Assumption	
		Time per collection for collector to explain testing process to donor	HOURS added	0.013 hr		
Urine Collection: Inspecting Contents of Donor's Pockets					**Subpart E**	**26.105(b)**
	Annual costs per FFD program per year					
		Time to inspect contents of a donors pockets per test	HOURS inspection	0.033 hr	Assumption	
Urine Specimen Quantity: Minimum Quantity of 30 mL					**Subpart E**	**26.109(a)**
	Annual savings per FFD program					
		Percentage of collections considered to be of inadequate quantity under the current requirements	PER low quantity	6.7%	4.22.03 Wall Street Journal article, see RA	
		Percentage decrease in the number of inadequate specimens resulting from reduction in the minimum specimen quantity from 60 mL to 30 mL	PERD low quantity	25.0%	Assumption	
		Time per test saved because donor can provide a sufficient specimen under the new rule	HOURS saved	1.50 hr	Assumption	
Urine Specimen: At Least 30 mL, but Less than Predetermined Quantity					**Subpart E**	**26.109(b)(2)**
	Annual costs per FFD program with onsite testing facility					
		Percentage of urine specimens at least 30 mL in volume, but less than the licensee or C/Vs predetermined quantity of urine	PER not predetermined quantity	1.0%	Assumption	
Shy Bladder Medical Evaluation					**Subpart E**	**26.119**
	Annual costs per FFD program					
		Number of urine collections unable to be completed because of inadequate specimen volume per facility per year	NUM shy bladder	1	Assumption	
		Cost of a medical evaluation and written report from a licensed physician (per shy bladder event)	COST medical evaluation	$ 300.00	Assumption	
		Time per medical evaluation (including travel to and from the physician's office)	HOURS medical evaluation	1.50 hr	Assumption	
		Time for a FFD manager per incident where an employee is unable to provide the minimum quantity of urine after 3 hours	HOURS FFD manager	2.0 hr	Assumption	
		MRO time to select a physician, instruct the physician on the medical evaluation that must be conducted, and review and communicate the medical evaluation results	HOURS MRO	2.0 hr	Assumption	

Exhibit A2 - 8
Alcohol Testing

Activity	Equation	Parameter Description	Parameter	Value	Source	Section
Blood Collection for Confirmatory Alcohol Testing					**Subpart E**	**26.83(a)**
	Annual savings per FFD program per year					
		Number of blood tests per FFD program per year	NUM blood	1	NEI data	
		Hours MRO to review test result & communicate with employee and donor	HOURS mro	0.75 hour	Assumption	
		Hours lost worker productivity resulting from receiving a blood test	HOURS worker	0.75 hour	Assumption	
Purchase of EBT and Calibration Equipment and Related Training					**Subpart E**	**26.91(b)**
	This parameter is used in the equations below:					
		Percentage of collection sites that will purchase an EBT meeting the specifications in paragraph 26.91(c).	PER purchased	50%	Assumption	
	One time equipment purchases per facility					
		Number of compliant EBTs purchased per collection site	NUM EBTs	2	Assumption	
	One time training cost per facility					
		Cost of alcohol collector training course on purchased EBT	COST training course	$ 250	Assumption	
		Number of alcohol collectors per collection site	NUM collectors	4		
		Length of alcohol collector training course	HOURS collector training	2 hours	Assumption	
Required Use of an EBT on the NHTSA CPL for Confirmatory Testing					**Subpart E**	**26.91(c)**
	Annual savings per FFD program per year					
		Time per test to set-up a second EBTs (locate the EBT, turn on the equipment) to conduct confirmatory testing	HOURS saved	0.033 hour	Assumption	
		Percentage of collections sites that will use a compliant EBT for all collections	PER compliant, proposed rule	50%	Assumption	
One Breath Specimen Collection for Initial Alcohol Test					**Subpart E**	**26.95(c)**
	Annual savings per FFD program per year					
		Savings in collection time from one fewer breath collection per breath test	HOURS breath collection	0.033 hour	Assumption	
Lowering Initial BAC Requiring Confirmatory Test to BAC 0.02					**Subpart E**	**26.99(b)**
	Annual costs per FFD program per year					
		Percentage increase in number of initial positive alcohol tests under the lower screening level BAC	PERI IPAT	20%	Assumption	
		Time to conduct a confirmatory alcohol test under the proposed rule	HOURS CAT	0.05 hour	Assumption	
		Hours of FFD manager time associated with personnel activities and administrative actions resulting from a confirmed positive alcohol test result	HOURS FFD manager	2.5 hour	Assumption	
FFD Manager Determines Confirmed Positive Test for Alcohol (BAC 0.02 < 0.04)					**Subpart E**	**26.103**
	Annual costs per FFD program per year					
		% increase in the number of confirmed positive breath alcohol tests per FFD program under the proposed BACs	PERI CPAT	20%	Assumption. Note: this is the same rate as in 26.97(b) PERI IPAT	
		Time per test result for FFD manager to determine the length of time an employee has been in work for BACs equal to or greater than 0.02 and less than 0.4	HOURS FFD management	0.25 hour	Assumption	

Exhibit A2 - 9

Drug and validity testing (licensee testing facilities and HHS-certified laboratories)

Activity	Equation	Parameter Description	Parameter	Value	Source	Section
Validity Testing (On-site Licensee Testing Facilities and HHS-Certified Laboratories)					**Subpart F**	**26.131(b)**
					Subpart G	**26.161(b)(1)**
	Cost to Conduct Daily Calibration Validity Testing Equipment at Onsite Licensee Testing Facility					
		Number of days per year a licensee testing facility operates	NUMdays	365 days	Assumption	
	Costs for confirmed positive drug tests and confirmed non-negative validity test results					
		Percentage of initial validity tests with non-negative test results	PER non-negative validity - initial	2.69%	Equals the sum of the Percentage of dilute, adulterated, and invalid specimens)	
		Percentage of Dilute Specimens drug positive at LOD testing	PER dilute positive drugs	33%	Assumption	
		Percentage of Adulterated, Substituted (0-<2 mg/dL creatinine), and Invalid Specimens confirmed as non-negative validity	PER adulterated, substituted, Invalid confirmed	100%	Assumption	
		Percentage of specimens collected under direct observation as a result of an initial specimen with an Invalid test result that test non-negative for drugs (as discussed in the assumptions below)	PERdrug non-neg 2nd collection	33%	Assumption	
Retesting of Non-Negative Urine Specimens (Drug and/or Validity)					**Subpart F**	**26.131(b)**
	This parameter is used in the equations below:					
		% of confirmed positive drug tests that donors request retesting of the specimen at a second HHS-certified laboratory	PER retest	5.0%	Assumption	
	Cost for retesting confirmed non-negative validity test at second HHS lab					
			No additional parameters			
	Cost for retesting confirmed non-negative validity test at second HHS lab					
			No additional parameters			
	Marijuana - cost for retesting of confirmed positive drug test specimens at a second HHS-certified laboratory at the request of some donors					
			No additional parameters			
	Opiate - saving for retesting of confirmed positive drug test specimens at a second HHS-certified laboratory at the request of some donors					
			No additional parameters			
Appeals of Confirmed Non-Negative Urine Specimen Drug/Validity Test Results					**Subpart F**	**26.131(b)**
	This parameter is used in the equations below:					
		% of workers with confirmed positive test results that initiate appeals process	PER appeals	1.0%	Assumption	
	Cost of Appeals for some confirmed non-negative validity test results					
			No additional parameters			
	Cost for appeals for some confirmed non-negative validity test results					
			No additional parameters			
	Marijuana - cost for appeals for some confirmed positive drug test results					
			No additional parameters			
	Opiate - saving for appeals for some confirmed positive drug test results					
			No additional parameters			

Change Cutoff Levels for Marijuana and Opiates - Onsite Testing Facilities			**Subpart F**	**26.133**
Change Cutoff Levels for Marijuana and Opiates - HHS-Certified Laboratories			**Subpart G**	**26.163(a)(1)**
Percentage increase in marijuana positive drug tests resulting from reduced cutoff level in new rule	PERI marijuana	40%	Assumption	
Percentage decrease in opiate positive drug tests resulting from the increased cutoff level in the new rule	PERD opiate	75%	Assumption	
Quality Control Specimens in Each Analytical Run - Onsite Testing Facilities			**Subpart F**	**26.137(e)(7)**
Annual costs per unit with onsite testing facilities				
Percentage cost increase per average urine specimen	PERI cost	10%	Assumption	
Unidentified Interfering Substance/Adulterant - Contact MRO and Specimen Retesting			**Subpart G**	**26.161(g)**
Annual costs per FFD program				
Number of urine specimens per facility per year suspected of having a new adulterant or interfering agent that could make a test result invalid that are sent to a second HHS-certified laboratory	NUM new adulterant	1	Assumption	
Time per specimen for an MRO to speak with the HHS-certified laboratory and determine whether a specimen is to be retested at a second HHS-certified laboratory, and the time to review the results of validity testing at the second HHS-certified laboratory	HOURS MRO	0.50 hr	Assumption	
Retesting of Single Collection Specimens with Non-Negative Confirmed Drug Test Results			**Subpart G**	**26.165(b)**
% of confirmed positive drug tests that donors request retesting of the specimen at a second HHS-certified laboratory	PER retest	5%	Assumption	
Percentage increase in retesting of confirmed positive urine specimens based on the new rule provision to afford retesting of single specimens	PERI retest	10%	Assumption	
Blind Sample Testing - 1st Quarter of Contract with a HHS-Certified Laboratory			**Subpart G**	**26.167(h)(1)**
Annual savings per FFD program which conduct all drug tests at an HHS-certified lab				
Percentage of urine specimens that must be blind test specimens submitted in initial 90 days of a contract with an HHS-certified lab, existing rule	PER blind specimens, initial 90 days, existing rule	50%	Existing rule requirement, 2.8(e)(2) of Appendix A	
Maximum number of blind specimens to be submitted in the first 90 days of a contract with an HHS-certified lab, existing rule	NUM blinds, max, initial 90 days, existing rule	500	Existing rule requirement, 2.8(e)(2) of Appendix A	
Percentage of urine specimens that must be blind test specimens submitted in the first 90 days of a contract with an HHS-certified lab - new rule	PER blind specimens, initial 90 days, new rule	20%	Proposed rule requirement	
Maximum number of blind specimens to be submitted in the first 90 days of a contract with an HHS-certified lab, new rule	NUM blinds, max, initial 90 days, new rule	100	Proposed rule requirement	
Minimum number of blind specimens to be submitted in the first 90 days of a contract with an HHS-certified lab, new rule	NUM blinds, min, initial 90 days, new rule	30	Proposed rule requirement	
Percentage of years that a FFD program enters contracts with a different HHS-certified lab	PER FFD programs change HHS lab	10%	Assumption	
Number of quarters in a year	NUM quarters	4		
Annual costs per FFD program which conducts initial drug testing at an on-site licensee testing facility				
Percentage of specimens analyzed by a licensee testing facility that must be QA specimen	PER QA specimens	10.0%	Licensee testing facilities include 10 percent of total specimens analyzed as controls, complying with existing rule 2.7(d) of Appendix A	
Percentage of QA specimens that must be a blind specimen	PER QA specimens, blinds	10.0%	Assumption	
Percentage of blind specimens that must be positive under existing requirements	PER Blind specimens, positive	20.0%	Existing rule requirement, 2.8(e)(3) of Appendix A	
Percentage of negative initial drug test result specimens submitted to a HHS-certified laboratory for initial drug testing	PER neg. urine specimens to HHS	1.0%	Assumption	

Activity	Equation	Parameter Description	Parameter	Value	Source	Section
Blind Sample Testing - Contracts with HHS-Certified Laboratories Older Than 90 Days					**Subpart G**	**26.167(f)(2)**
	Annual savings per FFD program which conduct all drug tests at an HHS-certified lab					
		Percentage of urine specimens that must be blind test specimens submitted per quarter for an existing contract with an HHS-certified laboratory - existing rule	PER blind specimens, per quarter, existing rule	10%	Existing rule requirement, 2.8(e)(2) of Appendix A	
		Maximum number of blind specimens to be submitted in the first 90 days of a contract with an HHS-certified lab, existing rule	NUM blinds, max, per quarter, existing rule	250	Existing rule requirement, 2.8(e)(2) of Appendix A	
		Percentage of urine specimens that must be blind performance test specimens submitted per quarter for an existing contract with an HHS-certified laboratory - new rule	PER blind specimens, per quarter, new rule	1%	Proposed rule requirement	
		Maximum number of blind specimens to be submitted per quarter for an existing contract with an HHS-certified lab, new rule	NUM blinds, max, per quarter, new rule	100	Proposed rule requirement	
		Minimum number of blind specimens to be submitted per quarter for an existing contract with an HHS-certified lab, new rule	NUM blinds, min, per quarter, new rule	10	Proposed rule requirement	
		Maximum percentage of urine specimens that must be blind specimens submitted per quarter for an existing contract with an HHS-certified laboratory (if total number of specimens submitted is less than 10 specimens), new rule	PER cap on min. num. blinds per quarter	25%	Proposed rule requirement. The number of blind specimens per quarter is proposed at a minimum of 3 percent (up to a maximum of 25 percent) or 10 blinds specimens, whichever is greater.	
		Increase in the cost per blind performance test specimen due to the change in the mix of the positive to negative ratio of blind specimens in the new rule	PERIcost blind specimen	25%	Assumption, costs increase by 25 percent because of change in mix of positive to non-negative validity test blinds (I.e., fewer positive drug test specimens (from 20% to 15%), but inclusion of validity test specimens(5%) which increases specimen costs)	
	Annual costs per FFD program which conducts initial drug testing at on-site licensee testing facility					
		Percentage of specimens analyzed by a licensee testing facility that must be QA specimens (controls)	PER QA specimens	10.0%	Licensee testing facilities include 10 percent of total specimens analyzed as controls, complying with existing rule 2.7(d) of Appendix A	
		Percentage of QA specimens that must be a blind specimen	PER QA specimens, blinds	10.0%	Assumption	
		Percentage of blind specimens that must be positive under current rule	PER Blind specimens, positive, current rule	20.0%	Existing rule requirement, 2.8(e)(3) of Appendix A	
		Percentage of negative initial drug test result specimens submitted to a HHS-certified laboratory for initial drug testing	PER neg. urine specimens to HHS	1.0%	Value under Section 26.167(h)(1), cell E749	

Exhibit A2 - 10

Reporting Requirements

Activity	Equation	Parameter Description	Parameter	Value	Source	Section
FFD Programs: Performance Data Reporting and Review					**Subpart J**	**26.217(e), (f)**
	Annual savings per program by reducing reporting requirements					
		FFD program manager hours saved in frequency reduction	HOURS manager	20.0 hr	NRC staff estimate	
	Savings from NRC reviewing fewer licensee reports					
		NRC clerical personnel hours saved in reduction in reporting frequency	HOURS clerical	24.0 hr	NRC staff estimate	
		NRC manager hours saved in reduction in reporting frequency	HOURS manager	20.0 hr	NRC staff estimate	
					Subpart J	**26.217(g)**
		Number of licensee to whom each C/V submits performance data to under the current rule	NUM licensees	9	Assumption	
		Cost of mailing (express mail) per information disclosure request	COSTMailing	$ 10.00	Assumption	
	C/V manager labor burden reduced by only having to produce consolidated report for submission to NRC					
		Hours of C/V manager time to compile one licensee performance data report	HOURS manager	30.0 hr	Assumption	
		% savings achieved by consolidating performance data into a single report submitted to NRC	PER consolidation	25%	Assumption	
	Reduced Mailing costs					
		No Additional Parameters	**No additional parameters**			

Reporting and Review of Reportable Events Due to New Validity Testing Requirements					**Subpart J**	**26.219(b)**
This parameter is used in the equations below:						
		Percentage of tested staff covered by 26.203(b)(2)	PER staff	15%	Assumption	
Annual cost per unit due to new validity testing requirements						
		FFD program manager hours required to investigate, analyze, and report an event	HOURS manager	4.0 hr	Assumption	
					Subpart J	**26.219(b)**
Increase in NRC manager labor to review increased number of reportable events						
		NRC manager hours required to review a reported event	HOURS manager	3.0 hr	NRC staff	
Increase in NRC clerical labor due to increased number of reportable events						
		NRC clerical hours required to process a reported event	HOURS clerical	1.0 hr	NRC staff	
Filing of Forensic Toxicologist's Evaluation					**Subpart J**	**26.213(g)**
One-time cost per program from clerical support to file and store the forensic toxicologist's evaluation of the FFD program's more stringent cutoff levels.						
		Hours of clerical personnel to file and store the forensic toxicologist's evaluation of the FFD program's more stringent cutoff levels per program	HOURSClerical	0.25 hr		
		Percentage of FFD programs that use more stringent cut-off levels for drug testing	PERmore stringent cutoffs	10%	Assumption	
		Percentage of FFD programs who use more stringent cut-off levels for drug testing, but have not reported to the Commission	PER non-report	25%	Assumption	
Memorandum to HHS-Certified Laboratory for Incorrect CCF Form					**Subpart G**	**26.153(g)**
Annual costs per FFD program						
		Number of memoranda per year a collection site used by a facility will write because it uses an expired Federal custody-and-control form or a non-Federal custody-and-control form was used for a specimen collection	NUM memoranda	2	Assumption	
		Time for collection staff to draft a memorandum	HOURS collector	0.25 hr	Assumption	
Licensee Testing Facility Reporting of Testing Data to FFD program (Monthly to Annually)					**Subpart F**	**26.139(d)**
Annual savings per FFD program with Licensee Testing Facility						
		Time for a laboratory supervisor per licensee testing facility to prepare a monthly statistical summary report of urinalysis testing data	HOURS monthly report	1.50 hr	Assumption	
		Time for a laboratory supervisor per licensee testing facility to prepare an annual statistical summary report of urinalysis testing data	HOURS annual report	4.00 hr	Assumption	
		Number of monthly reports per licensee testing facility per year	NUM monthly reports	12	Number of months in a year.	
Activity	**Equation**	**Parameter Description**	**Parameter**	**Value**	**Source**	**Section**
HHS-Certified Laboratory Reporting of Testing Data to FFD program (Monthly to Annually)					**Subpart G**	**26.169(k)**
		Time to generate and send an annual or monthly statistical summary report per facility	HOURS lab tech	0.50 hour	Assumption	
		Number of reports per month per facility	NUM reports per month	1	Current requirement	
		Number of reports that will no longer be sent to a facility	NUM reports	11	Proposed requirement to move from montly to annual reporting	
		Cost to send an annual or monthly statistical summary report via the U.S. Postal Service	COSTpostage	$ 2.00	Assumption	
NRC Review of Fatigue Information in Annual FFD Performance Reports					**Subpart I**	**26.197(e)**
Annual cost to NRC to review and summarize annual reports on fatigue						
		NRC clerical hours per year to assist in reviewing and summarizing the additional information addressing fatigue	HOURS Clerical	24.0 hr	Assumption	
		NRC manager hours per year to review and summarize the additional information addressing fatigue	HOURS Manager	24.0 hr	Assumption	
NRC Review and Approval of Licensee Written Requests to Exceed Collective Work Hour Limits					**Subpart I**	**26.199(f)(5)**
Annual cost to NRC to review and approve licensees' written requests for aproval to exceed collective work hour limits						
		Annual number of facilities seeking NRC approval to exceed collective work hour limits under 26.199(f)(5)	NUM Requests	3	Assumption	
		NRC manager hours to review and approve one written reqeust from a licensee seeking approval to exceed the collective work hour limits	HOURS Manager	6.0 hr	Assumption	

Exhibit A2 - 11:
Hourly Wage Rates

Worker Type	Hourly Wage Rate (2002 $)	Hourly Wage Rate (Adjust 2004 $)	Source/Comments
C/V manager		$ 50.00 /hour	Assumption
Clerical	$ 15.75 /hour	$ 16.54 /hour	Model Facility Data from NEI Jan to May 2002
Collection Site Supervisor		$ 50.00 /hour	Assumption
Collector or Collection Site Personnel	$ 22.78 /hour	$ 23.92 /hour	Model Facility Data from NEI Jan to May 2002
EAP	$ 28.85 /hour	$ 30.29 /hour	Model Facility Data from NEI Jan to May 2002
Facility Supervisor		$ 70.00 /hour	Assumption
FFD Program Manager	$ 31.98 /hour	$ 33.58 /hour	Model Facility Data from NEI Jan to May 2002
FFD Staff		$ 30.00 /hour	Assumption
Forensic Toxicologist		$ 93.75 /hour	Derived from quote from a drug testing expert
HR personnel		$ 50.00 /hour	Assumption
Contractor/Vendor Worker	$ 58.00 /hour	$ 60.90 /hour	Model Facility Data from NEI Jan to May 2002
Lab supervisor		$ 50.00 /hour	Assumption
Lab Technician	$ 26.54 /hour	$ 27.87 /hour	Model Facility Data from NEI Jan to May 2002
Legal		$ 100.00 /hour	Assumption
MRO	$ 100.00 /hour	$ 105.00 /hour	Model Facility Data from NEI Jan to May 2002
NRC Clerical		$ 40.00 /hour	NRC staff , 2004
NRC Staff		$ 87.00 /hour	NRC staff , 2004
SAE	$ 28.85 /hour	$ 30.29 /hour	Same as SAP wage rate
Trainer		$ 50.00 /hour	Assumption
Training Manager		$ 55.00 /hour	Assumption
Facility Worker (weighted average facility workers & C/Vs)	$ 51.67 /hour	$ 54.26 /hour	Model Facility Data from NEI Jan to May 2002
Facility Worker (not weighted)	$ 36.21 /hour	$ 38.02 /hour	Model Facility Data from NEI Jan to May 2002

2002 dollars have been adjusted to 2004 Q4 using implicit price deflators for GDP, as reported by the U.S. Department of Commerce, Bureau of Economic Analysis. www.bea.gov/bea/newsrel/gdpnewsrelease.htm, January 28, 2005.

Exhibit A2 - 12:
Testing and Applicant Information

Parameter Description	Value	Source
Drug & Alcohol Testing Information		
Total Number of Drug Tests per year for all FFD Programs	125,713	2000 Information Notice, NRC Table 1. Test results for each test category
Total Number of Drug Tests per Unit per year	1,186 tests/unit	Calculated
Total Number of Alcohol Tests per year for all FFD Programs	125,713	125,713 testing events in 2000 (one alcohol test and one drug test conducted)
Total Number of Alcohol Tests per year per Unit	1,186 tests/unit	Calculated
Total Number of Random Drug and Alcohol Tests per year for all programs	51,955	2000 Information Notice, NRC Table 1. Test results for each test category
Total Number of Random Drug and Alcohol Tests per year per unit	490 tests/unit	Calculated
Negative Random Drug and Alcohol Test Rate in 2000	99.61%	Calculated
Non-Negative Random Drug and Alcohol Test Rate in 2000	0.39%	Calculated
Number of confirmed positive alcohol tests per year for all FFD programs	211	2000 Information Notice, NRC Table 5. Number of confirmed positives by substance
Number of confirmed positive alcohol tests per unit per year	1.99 tests/unit	Calculated
Number of positive drug test results per year for all FFD programs	957	2000 Information Notice, NRC Table 5. Number of confirmed positives by substance
Number of positive drug test results per unit	9.03 tests/unit	Calculated
Positive drug test result rate in 2000	0.76%	Calculated
Number of marijuana positive drug test results per year for all FFD programs	620	2000 Information Notice, NRC Table 10. Trends in substances identified (1990-2000)
Number of marijuana positive drug test results per unit	5.85 tests/unit	Calculated
Positive marijuana drug test result rate in 2000	0.49%	Calculated
Number of opiate positive drug test results per year for all FFD programs	32	2000 Information Notice, NRC Table 10. Trends in substances identified (1990-2000)
Number of opiate positive drug test results per unit	0.30 tests/unit	Calculated
Positive opiate drug test result rate in 2000	0.03%	Calculated

Exhibit A2 - 12:
Testing and Applicant Information

Parameter Description	Value	Source
Drug & Alcohol Testing Information (continued)		
Annual number of drug and alcohol tests yielding positive results for all programs	1,397	2000 Information Notice, NRC Table 3. 2000 Test results by test category
Annual number of drug and alcohol tests yielding positive results per unit	13.18 tests/unit	Calculated
Annual number of positive pre-access drug and alcohol test results for all programs	965	2000 Information Notice, NRC Table 3. 2000 Test results by test category
Annual number of positive pre-access drug and alcohol test results per unit	9.10 tests/unit	Calculated
Annual number of positive random drug and alcohol test results for all programs	204	2000 Information Notice, NRC Table 3. 2000 Test results by test category
Annual number of positive random drug and alcohol test results per unit	1.92 tests/unit	Calculated
Annual number of positive post-event drug and alcohol test results for all programs	6	2000 Information Notice, NRC Table 3. 2000 Test results by test category
Annual number of positive post-event drug and alcohol test results per unit	0.06 tests/unit	Calculated
Annual number of follow-up drug and alcohol test results for all programs	49	2000 Information Notice, NRC Table 3. 2000 Test results by test category
Annual number of follow-up drug and alcohol test results per unit	0.46 tests/unit	Calculated
Annual number of positive other drug and alcohol test results for all programs	41	2000 Information Notice, NRC Table 3. 2000 Test results by test category
Annual number of positive other drug and alcohol test results per unit	0.39 tests/unit	Calculated
Annual number of for-cause referrals for all programs	883	2000 Information Notice, NRC Table 3. 2000 Test results by test category
Annual number of for-cause referrals per unit	8.33 tests/unit	Calculated
Annual number of for-cause tests yielding non-negative test results	138	2000 Information Notice, NRC Table 1. 2000 Test results for each test category
Non-negative for-cause testing rate in 2000	15.63%	Calculated

Exhibit A2 - 12:
Testing and Applicant Information

Parameter Description	Value	Source
Validity Test Data		
Percentage of non-negative validity test specimens (total)	2.691%	Consists of the sum of dilute (2-5, 5-20 mg/dL), substituted, adulterated, and invalid
Percentage of specimens - Dilute (>5 and <20 mg/dL creatinine)	2.60%	Quest Diagnostics, n=435,309, likely a quarter's data for all Quest Labs (presented 2/2003)
Percentage of specimens - Dilute (2 - 5 mg/dL creatinine)	0.015%	DHHS National Laboratory Certification Program, data from 7/01-6/02 based on n=5,266,000
Percentage of specimens - Substituted (<2 mg/dL creatinine)	0.016%	DHHS National Laboratory Certification Program, data from 7/01-6/02 based on n=5,266,000
Percentage of specimens - Adulterated	0.025%	DHHS National Laboratory Certification Program, data from 7/01-6/02 based on n=5,266,001
Percentage of specimens - Invalid	0.035%	DHHS National Laboratory Certification Program, data from 7/01-6/02 based on n=5,266,002
Applicant information		
Annual number of applicants for authorization for all programs	65,845	NEI Estimate
Annual number of applicants for authorization per unit	621	Calculated
Annual number of reportable events for all programs	125,713	2000 FFD Performance Reports
Annual number of reportable events per unit	1,186	Calculated
Annual number of applicants for initial and updated authorization for all programs	20,509	NEI Estimate
Annual number of applicants for initial and updated authorization per unit	193.48	Calculated
Annual number of applicants for initial authorization for all programs	17,869	NEI Estimate
Annual number of applicants for initial authorization per unit	168.58	Calculated

Exhibit A2 - 12:
Testing and Applicant Information

Parameter Description	Value	Source
Applicant information (continued)		
Annual number of applicants for updated authorization for all programs	2,640	NEI Estimate
Annual number of applicants for updated authorization per unit	24.91	Calculated
Annual number of applicants for authorization reinstatement with an interruption of 30 days or less for all programs	26,068	NEI Estimate
Annual number of applicants for authorization reinstatement with an interruption of 30 days or less per unit	245.92	Calculated
Annual number of applicants for authorization reinstatement with an interruption of 5 days or less	40.99	Calculated
Annual number of applicants for authorization reinstatement with an interruption of 6-30 days	204.94	Calculated
Annual number of applicants for authorization reinstatement with an interruption of between 31 and 365 days for all programs	19,268	NEI Estimate
Annual number of applicants for authorization reinstatement with an interruption of between 31 and 365 days per unit	181.77	Calculated
Number of applicants per training session	20	Assumption

Exhibit A2 - 13:
Drug and Alcohol Testing Data

Drug and Alcohol Specimen Collection - LABOR COSTS (Source: Model Facility Data from NEI Jan to May 2002)

Time per activity for a drug and alcohol collection	Time	Activity	Activity definitions
Worker travel time (to test and back to work)	0.60 hr	w	w= worker
ID Worker	0.03 hr	w, c	c= collector
Complete Initial Paperwork	0.09 hr	w, c	
Perform Alcohol Test	0.09 hr	w, c	
Perform Drug Screen	0.18 hr	w, c	
Labor costs for a drug and alcohol collection	**Time for collection (drug & alcohol)**	**Wage rate**	**Cost per test**
Labor collector - per testing process (one urine collection - initial breath collection)	0.39 hr	$ 23.92	$ 9.29
Labor worker - per testing process (one urine collection - initial breath collection)	0.99 hr	$ 51.67	$ 51.26
Labor costs of drug and alcohol specimen collection (collector & worker)			**$ 60.55**

Time per activity for a drug specimen collection	Time	Activity	Activity definitions
Worker travel time (to test and back to work)	0.60 hr	w	w= worker
ID Worker	0.03 hr	w, c	c= collector
Complete Initial Paperwork	0.09 hr	w, c	
Perform Drug Screen	0.18 hr	w, c	
Labor costs for a drug specimen collection	**Time for collection (drug & alcohol)**	**Wage rate**	**Cost per test**
Labor collector - per testing process (one urine collection)	0.30 hr	$ 23.92	$ 7.17
Labor worker - per testing process (one urine collection)	0.90 hr	$ 51.67	$ 46.68
Labor costs of drug specimen collection (collector & worker)			**$ 53.84**

NEGATIVE TEST RESULTS - SUMMARY OF COSTS (labor, equipment and specimen testing costs)

Negative Result - Alcohol test and Drug test (onsite testing) current rule		Description
Labor costs of drug and alcohol collection (collector & worker)	$ 60.55	Costs include: (1) travel time of worker; (2) collection of drug and alcohol specimens (the labor of collector and worker, collection materials), (3) onsite licensee testing costs per urine specimen for drugs; (4) labor of FFD manager to process negative test results paperwork
Equipment cost for alcohol testing (initial test - 2 breath collections)	$ 0.20	
Initial drug test - onsite licensee testing facility	$ 24.25	
FFD manager labor per negative test result	$ 3.36	
Total per test	**$ 88.36 /test**	

Negative Result - Alcohol test and Drug test (all testing at HHS certified lab), current rule		Description
Labor costs of drug and alcohol collection (collector & worker)	$ 60.55	Costs include: (1) travel time of worker; (2) collection of drug and alcohol specimens (the labor of collector and worker, collection materials), (3) HHS-certified lab costs per urine specimen for drugs; (4) labor of FFD manager to process negative test results paperwork
Equipment cost for alcohol testing (initial test - 2 breath collections)	$ 0.20	
Drug testing (initial & confirmatory when necessary) - HHS certified laboratory (all licensee testing conducted at HHS lab) certified lab	$ 20.57	
FFD manager labor per negative test result	$ 3.36	
Total per test	**$ 84.68 /test**	

Negative Result - Alcohol test and Drug & Validity test (onsite testing facility), proposed rule		Description
Labor costs of drug and alcohol collection (collector & worker)	$ 60.55	Costs include: (1) travel time of worker; (2) collection of drug and alcohol specimens (the labor of collector and worker, collection materials), (3) onsite licensee testing costs per urine specimen for drugs & validity; (4) labor of FFD manager to process negative test results paperwork
Equipment cost for alcohol testing (initial test - 1 breath collection)	$ 0.10	
Validity Testing (onsite) - Total Labor and Reagents cost per specimen	$ 4.11	
Initial drug test - onsite licensee testing facility	$ 24.25	
FFD manager labor per negative test result	$ 3.36	
Total per test	**$ 92.37 /test**	

Negative Result - Alcohol test and Drug & Validity test (all testing at HHS lab) - proposed rule		Description
Labor costs of drug and alcohol collection (collector & worker)	$ 60.55	Costs include: (1) travel time of worker; (2) collection of drug and alcohol specimens (the labor of collector and worker, collection materials), (3) HHS-certified lab costs per urine specimen for drugs & validity; (4) labor of FFD manager to process negative test results paperwork
Equipment cost for alcohol testing (initial test - 1 breath collection)	$ 0.10	
Validity testing incremental (at HHS-certified lab - initial and confirmatory testing)	$ 1.50	
Drug testing (initial & confirmatory when necessary) - HHS certified laboratory (all licensee testing conducted at HHS lab) certified lab	$ 20.57	
FFD manager labor per negative test result	$ 3.36	
Total per test	**$ 86.08 /test**	

MRO Testing - Negative Result - Alcohol test and Drug & Validity test (at onsite testing facility) - proposed rule		Description
Labor costs of drug and alcohol collection (collector)	$ 9.29	Same cost as: Negative Result - Alcohol test and Drug & Validity test (onsite testing facility), proposed rule, no MRO labor for travel or the collection process, the labor is accounted for separately
Equipment cost for alcohol testing (initial test - 1 breath collection)	$ 0.10	
Validity Testing (onsite) - Total Labor and Reagents cost per specimen	$ 4.11	
Initial drug test - onsite licensee testing facility	$ 24.25	
FFD manager labor per negative test result	$ 3.36	
Total per test	**$ 41.10 /test**	

MRO Testing - Negative Result - Alcohol test and Drug & Validity test (all testing at HHS lab) - proposed rule		Description
Labor costs of drug and alcohol collection (collector only)	$ 9.29	Same cost as: Negative Result - Alcohol test and Drug & Validity test (all testing at HHS lab) - proposed rule, no MRO labor for travel or the collection process, the labor is accounted for separately
Equipment cost for alcohol testing (initial test - 1 breath collection)	$ 0.10	
Validity testing incremental (at HHS-certified lab - initial and confirmatory testing)	$ 1.50	
Drug testing (initial & confirmatory when necessary) - HHS certified laboratory (all licensee testing conducted at HHS lab) certified lab	$ 20.57	
FFD manager labor per negative test result	$ 3.36	
Total per test	**$ 34.81 /test**	

MRO Testing - Incremental Cost for Alcohol and Drug Specimen Collection at a Non-Licensee Collection Facility		Description
Additional drug and alcohol specimen collection and shipping costs from non-licensee collection facilities	**$ 29.00**	Twice the labor cost of drug and alcohol collection (collector only) plus shipping cost

NON-NEGATIVE (DRUG/VALIDITY/ALCOHOL) TEST RESULT - LABOR COSTS

Subsequent actions - non-negative test result	Time	Wage rate	Source
Labor MRO	0.42 hr	$ 105.00	Model Facility Data from NEI Jan to May 2002
FFD manager	2.58 hr	$ 33.58	
Worker	0.47 hr	$ 51.67	
Total cost subsequent actions per confirm.non-negative drug/validity/alcohol test result		**154.76**	

Appeal of non-negtiave drug/validity test result (no change existing or new rule)	Wage rate	Units	Source
FFD manager (average labor per result)	$ 33.58	12.50 hr	Discussion with NEI staff, May 23, 2003
Worker	$ 51.67	2.00 hr	
Total cost per appeal (non-negative drug/validity/alcohol test result)		**$523 /appeal**	

NON-NEGATIVE (DRUG/VALIDITY/ALCOHOL) TEST RESULT - SUMMARY OF COSTS (labor, equipment and specimen testing costs)

Positive Result - Alcohol test and Drug & Validity test (onsite testing facility), proposed rule		Description
Labor costs of drug and alcohol collection (collector & worker)	$ 60.55	Costs include: (1) travel time of worker; (2) collection of drug and alcohol specimens (the labor of collector and worker, collection materials), (3) onsite licensee testing costs per urine specimen for drugs; (4) HHS-certified lab cost per specimen for drugs and validity; (5) cost of subsequent actions resulting from a confirmatory positive drug/validity test result.
Equipment cost for alcohol testing (initial test - 1 breath collection)	$ 0.10	
Validity Testing (onsite) - Total Labor and Reagents cost per specimen	$ 4.11	
Initial drug test - onsite licensee testing facility	$ 24.25	
Drug testing (intial & confirmatory when necessary) at HHS-certified lab (after initial non-negative drug/validity test at licensee testing facility)	$ 31.69	
Validity testing incremental (at HHS-certified lab - initial and confirmatory testing)	$ 1.50	
Subsequent actions - non-negative test result	$ 154.76	
Total per test	**$ 276.96 /test**	

Positive Result - Alcohol test and Drug & Validity test (all testing at HHS certified lab) - proposed rule		Description
Labor costs of drug and alcohol collection (collector & worker)	$ 60.55	Costs include: (1) travel time of worker; (2) collection of drug and alcohol specimens (the labor of collector and worker, collection materials), (3) HHS-certified lab costs per urine specimen for drugs and validity; (4) cost of subsequent actions resulting from a confirmatory positive drug/validity test result.
Equipment cost for alcohol testing (initial test - 1 breath collection)	$ 0.10	
Validity Testing (onsite) - Total Labor and Reagents cost per specimen	$ 4.11	
Initial and confirmatory (when necessary) drug test	$ 20.57	
Subsequent actions - non-negative test result	$ 154.76	
Total per test	**$ 240.09 /test**	

VALIDITY TESTING (labor & equipment) - Onsite Licensee Testing Facility - New Rule

Validity testing - Lab Techinican Labor costs per urine specimen	time/test	wage rate
Time per urine specimen for validity testing		
pH test	0.02 hr	$ 27.87
creatinine	0.02 hr	$ 27.87
one adulterant assay	0.03 hr	$ 27.87
Validity testing (onsite) - Total Assay Labor cost per specimen		**$ 1.86 /specimen**

Validity testing - Reagants Cost - per urine specimen	Cost per test
Reagent costs of validity testing per urine specimen	
pH test	$ 0.25
creatinine	$ 1.00
one adulterant assay	$ 1.00
Validity Testing (onsite) - Total Reagents cost per specimen	**$ 2.25 /specimen**
Validity Testing (onsite) - Total Labor and Reagents cost per specimen	**$ 4.11 /specimen**

Validity testing - Lab Techinican Labor Costs - Daily Calibration of Equipment	time/calibration	wage rate
Daily calibration of validity testing equipment		
pH test	0.08 hr	$ 27.87
creatinine	0.17 hr	$ 27.87
one adulterant assay	0.17 hr	$ 27.87
Validity Testing (onsite) - Total Labor cost per day to calibrate equipment		**$ 11.61 /day**

Validity testing - Reagants Cost - Daily Calibration of Equipment	Cost per test
Reagent costs of validity testing per urine specimen	
pH test	$ 0.50 / day
creatinine	$ 1.00 / day
one adulterant assay	$ 1.00 / day
Validity Testing (onsite) - Total Reagent Costs per Daily Calibration	**$ 2.50 / day**

Validity Testing - pH meter & accessories per Licensee Testing Facility	Cost	Equipment life	Annualized cost
ph meter	$ 600.00	6.0 years	**$ 100.00**
ph meter probe	$ 150.00	2.0 years	**$ 75.00**

VALIDITY TESTING - HHS-certified laboratory - New Rule

		Source
Validity testing incremental (at HHS-certified lab - initial and confirmatory testing)	$ 1.50 /test	Assumption, range of testing costs from $0.00 to $3.00.

DRUG TESTING - LICENSEE TESTING FACILITY

		Source
Drug test (initial) - at onsite licensee testing facility	$ 24.25 /test	Model Facility Data from NEI Jan to May 2002

DRUG TESTING - HHS- CERTIFIED LABORATORY

Test Type	Cost/test	Source
Drug testing (intial & confirmatory when necessary) at HHS-certified lab (after initial non-negative drug/validity test at licensee testing facility)	$ 31.69 /test	Model Facility Data from NEI Jan to May 2002
Drug testing (initial & confirmatory when necessary) - HHS certified laboratory (all licensee testing conducted at HHS lab)	$ 20.57 /test	Model Facility Data from NEI Jan to May 2002
Dilute Specimen (>=2-20 mg/dL Creatinine) Testing - GC/MS Level of Detection Testing (LOD)	$ 75.00 /test	Assumption
Cost of retesting - a confirmed non-negative drug/validity test specimen at second HHS-certified lab (includes specimen preparation and shipping costs)	$ 62.50 /test	Assumption, range of testing costs from $50.00 to $75.00
Retesting a specimen at a second HHS lab when the initial HHS lab could not identify a suspected interfering substance/adulterant (includes specimen preparation, packaging, and shipping)	$ 125.00 /test	Costs for to analyze new adulterants at a second HHS-certified lab (cost ranges from $50.00 to $200.00 depending

ALCOHOL TESTING EQUIPMENT

Evidential Breath Testing Device (EBT) - purchase		Source	
EBT - compliant with proposed 26.91(c) - included printer and carrying case	$ 2,250	Equipment manufacturer of NHTSA certified EBT (fuel cell)	
EBT Calibration Equipment		**Source**	
Regulator (to attach calibration canister to EBT)	$ 100.00	EBT equipment manufacturer of NHTSA certified EBT (fuel	
Calibration canister	$ 75.00	EBT equipment manufacturer of NHTSA certified EBT (fuel	
EBT Exhalent tubes (source: discussion with NEI staff, May 2003)	**Unit cost**	**# of tubes**	**Cost per test**
Exhalent tubes (per test = 2 breath specimens) - existing rule	$ 0.10 /tube	2	**$ 0.20**
Exhalent tubes (per test = 1 breath specimen) - new rule	$ 0.10 /tube	1	**$ 0.10**
Blood Alcohol testing - Existing Rule			
Blood alcohol testing - Cost per blood specimen to conduct laboratory analysis	$ 28.75	Model Facility Data from NEI Jan to May 2002	
Cost per blood test for a phlebotomist/RN to arrive at the onsite collection site and conduct the blood draw	$ 100.00	Assumption	

BLIND PERFORMANCE SAMPLE & TESTING COSTS

Subpart G **26.167(f)(1)** **26.167(f)(2)**

Cost per blind perfomrance sample & testing - existing rule (all testing at HHS-lab)		Source
Cost per blind specimen, existing rule: purchased from a vendor, prepared, and shipped to the HHS-certified laboratory for testing, and FFD manager follow-up to check results (existing rule)	$ 26.38 /test	Model Facility Data from NEI Jan to May 2002
Drug testing (initial & confirmatory when necessary) - HHS certified laboratory (all licensee testing conducted at HHS lab)	$ 20.57 /test	Model Facility Data from NEI Jan to May 2002
Total per test	**$ 46.94**	
Cost per blind performance sample & testing - new rule (all testing at HHS-lab)		**Source**
Cost per blind specimen, existing rule: purchased from a vendor, prepared, and shipped to the HHS-certified laboratory for testing, and FFD manager follow-up to check results (existing rule)	$ 26.38 /test	Model Facility Data from NEI Jan to May 2002
Increase in the cost per blind performance test specimen due to the change in the mix of the positive to negative ratio of blind specimens in the new rule	$ 6.59 /test	Assumption
Drug testing (initial & confirmatory when necessary) - HHS certified laboratory (all licensee testing conducted at HHS lab)	$ 20.57 /test	Model Facility Data from NEI Jan to May 2002
Validity testing incremental (at HHS-certified lab - initial and confirmatory testing)	$ 1.50 /test	Assumption
Total per test	**$ 55.04**	
Cost per blind performance sample & testing - existing rule (for FFD programs with onsite licensee testing facilities)		**Source**
Cost per blind specimen, existing rule: purchased from a vendor, prepared, and shipped to the	$ 26.38 /test	Model Facility Data from NEI Jan to May 2002
Drug testing (intial & confirmatory when necessary) at HHS-certified lab (after initial non-negative drug/validity test at licensee testing facility)	$ 31.69 /test	Model Facility Data from NEI Jan to May 2002
Total per test	**$ 58.06**	
Cost per blind performance sample & testing - new rule (or FFD programs with onsite licensee testing facilities)		**Source**
Cost per blind specimen, existing rule: purchased from a vendor, prepared, and shipped to the HHS-certified laboratory for testing, and FFD manager follow-up to check results (existing rule)	$ 26.38 /test	Model Facility Data from NEI Jan to May 2002
Increase in the cost per blind performance test specimen due to the change in the mix of the positive to negative ratio of blind specimens in the new rule	$ 6.59 /test	Assumption
Drug testing (intial & confirmatory when necessary) at HHS-certified lab (after initial non-negative drug/validity test at licensee testing facility)	$ 31.69 /test	Model Facility Data from NEI Jan to May 2002
Validity testing incremental (at HHS-certified lab - initial and confirmatory testing)	$ 1.50 /test	Assumption
Total per test	**$ 66.16**	

PAPER WORK REQUIREMENTS - Drug and Alcohol Testing

Information Collection Burden Activities - Negative and Positive Test Results		Source
File paper work per negative drug and/or alcohol test result	0.05 hr	Assumption
File paperwork per positive drug and/or alcohol test result	0.25 hr	Assumption
File paperwork per appealed positive drug and/or alcohol test result	0.50 hr	Assumption

Exhibit A2 - 14:
FFD Programs

FFD Program/Licensee	Number of Facilities per Program	Number of Units per Program	On-Site or Off-Site Testing	Number of Employees per Unit	Total Number of Employees per Program
Ameren UE	1	1	On-site	980	980
AmerGen Energy Co., LLC	3	3	On-site	980	2,941
Arizona Public Service Co.	1	3	On-site	980	2,941
Carolina Power & Light Co.	3	4	Off-site	980	3,921
Constellation Nuclear	2	4	Off-site	980	3,921
Detroit Edison Co.	1	1	Off-site	980	980
Dominion Generation	3	6	Off-site	980	5,882
Duke Energy Nuclear, LLC	3	7	Off-site	980	6,862
Energy Northwest	1	1	On-site	980	980
Entergy Nuclear Generation Co.	6	7	Off-site	980	6,862
Entergy Nuclear Operations, Inc.	2	3	Off-site	980	2,941
Exelon Generation Co., LLC	7	14	On-site	980	13,724
FirstEnergy Nuclear Operating Co.	3	4	Off-site	980	3,921
Florida Power & Light Co.	2	4	Off-site	980	3,921
Florida Power Corp.	1	1	Off-site	980	980
FPL Energy Seabrook	1	1	Off-site	980	980
Indiana/Michigan Power Co.	1	2	On-site	980	1,961
Nebraska Public Power District	1	1	Off-site	980	980
Nuclear Management Co.	6	8	Off-site	980	7,842
Omaha Public Power District	1	1	Off-site	980	980
Pacific Gas & Electric Co.	1	2	Off-site	980	1,961
PPL Susquehanna, LLC	1	2	On-site	980	1,961
PSEG Nuclear, LLC	2	3	On-site	980	2,941
Rochester Gas & Electric Corp.	1	1	Off-site	980	980
South Carolina Electric & Gas Co.	1	1	Off-site	980	980
Southern California Edison Co.	1	2	On-site	980	1,961
Southern Nuclear Operating Co.	3	6	On-site	980	5,882
STP Nuclear Operating Co.	1	2	Off-site	980	1,961
Tennessee Valley Authority	3	5	Off-site	980	4,901
TXU Generation Company, LP	1	2	Off-site	980	1,961
Wolf Creek Nuclear Operating Corp.	1	1	Off-site	980	980
Westinghouse	2	2	Off-site	750	1,500
Inpo	1	1	Off-site	250	250
BWX Technologies	1	1	Off-site	811	811
Nuclear Fuel Services	1	1	Off-site	300	300
MOX Facility	1	1	Off-site	400	400

Exhibit A2-15
Fatigue Inputs

Activity	Equation	Parameter Description	Parameter	Value	Source	Section
Policy and Procedures					**Subpart I**	**26.197(a)-(b)**
	The following variables are used in several of the equations in this section					
		FFD staff wage rate	WAGE FFD_Staff	$ 25.00 /hour	Assumption	
	One-time costs per program to account for FFD manager and clerical personnel time and to contract a legal consultant to implement fatigue provisions into the written policies and procedures					
		Hours of FFD program staff to develop and revise policies and procedures for fatigue provisions per program	HOURS ffd_staff	80.0 hr	Assumption	
		Hours of labor of various managers to review and approve policies and procedures for fatigue provisions per program	HOURS manager-fatigue	40.0 hr	Assumption	
		Hours of legal assistance to review and revise policeis and procedures for fatigue provisions	HOURS legal-fatigue	20.0 hr	Assumption	
		Hours of clerical personnel to support revision of policies and procedures for fatigue provisions	HOURS clerical-fatigue	40.0 hr	Assumption	
	One-time costs per program to provide additional facility supervisor time to implement the corporate policies on the management of fatigue at the facility level					
		Hours of facility supervisor time to implement revised corporate policies and procedures for fatigue	HOURS facility supervisor-fatigue	160.0 hr	Assumption	
Training					**Subpart I**	**26.197(c)**
	The following variables are used in several of the equations in this section					
		Length of training addressing the fatigue-related Kas per session	HOURS Training-Fatigue	1	Assumption	
		Length of comprehensive examination increment addressing the fatigue-related Kas	HOURS Examination-Fatigue	0.17	Assumption	
		Hours of incremental preparation and examination grading per session addressing the fatigue-related Kas	HOURS Preparation-Fatigue	0.5	Assumption	
	One-time cost per program associated with revising the training program to include fatigue Kas					
		Hours of industry consultant time per program to develop generic training materials for use by the entire industry	HOURS Consultant	2.6 hr	Assumption	
		Hourly wage for industry consultant to develop generic training materials for use by the entire industry	WAGE Training_Consultant_Loaded	$ 90.00 /hour		
		Hours of training time per program to revise the training materials to address fatigue Kas	HOURS Trainer	8.0 hr	Assumption	
		Hours of training manager per program to revise the training materials to address fatigue Kas	HOURS Training Manager	2.0 hr	Assumption	
		Hours of FFD proram manager time per program to revise the training program address fatigue Kas	HOURS Manager	2.0 hr	Assumption	
		Hours of clerical personnel time to support the revision of the training proram to address fatigue Kas	HOURS Clerical	4.0 hr	Assumption	
	One-time costs per program to retrain existing employees on the fatigue related Kas					
			No additional parameters			
	One-time costs per program for trainers to adiminister the training on the fatigue-related Kas					
		Number of workers per training session per facility	NUM Sessions	50	Assumption	
	Annual cost per program for incoming employees to take the training course incremement for fatigue-related Kas					
		Turnover Rate (e.g., new hires including outage workers) covered by fatigue provision per facility per year	PER Applicants	25%	Assumption	
	Annual cost per program for trainers to administer training course for fatigue-related Kas					
		Number of workers per training session per facility	NUM Sessions	20	Assumption	
	Annual costs per program for employees to take the refresher training increment addressing fatigue-related Kas					
		Percentage of employees taking refresher training	PER Refresher	20%	Assumption	
		Length of fatigue-related portion of refresher training course	HOURS Fatigue Training	1.00 hr	Assumption	

Activity	Equation	Parameter Description	Parameter	Value	Source	Section
	Annual costs per program for trainers to administer the refresher training increment addressing fatigue-related Kas					
		Annual number of additional supervisory-level refresher training sessions per facility	NUM Sessions	20	Assumption	
		Length of fatigue-related refresher training course	HOURS Fatigue Training	0.25 hr	see Appendix 2, Exhibit A2-3	
	Annual costs per program for employees to take the comprehensive challenge examination increment addressing the fatigue-related Kas					
		Percentage of employees taking the comprehensive challenge examination	PER Examination	80%	Assumption	
	Annual costs per program for trainers to administer the comprehensive challenge examination incremement addressing the fatigue-reltaed Kas					
		Annual number of additional supervisory-level refresher training sessions per facility	NUM Sessions	20	Assumption	
Retaining Fatigue Records					**Subpart I**	**26.197(d)**
	Annual cost per program to physically place the documentation required under 26.197(d)(1), (3), and (4) into the appropriate filing cabinets or storage facilities					
		Annual number of hours per facility to store individuals' work hours and the collective work hours of each job duty group under proposed rule	HOURS Work Hours	40.0 hr	Assumption	
		Annual number of hours per facility to store work hour reviews under proposed rule	HOURS Reviews	4.0 hr	Assumption	
		Annual number of hours per facility to store fatigue assessment documentation under proposed rule	HOURS Assessments	10.0 hr	Assumption	
	Annual savings per program as a result of fewer waivers being issued					
		Annual number of hours per facility to file deviation authorizations under existing licensee technical specifications	HOURS WaiverTS	12.0 hr	Assumption	
		Annual number of hours per facility to file waivers under proposed rule	HOURS WaiverNew	1.0 hr	Assumption	
Summarize Waiver Data					**Subpart I**	**26.197(e)(1)**
	Annual cost per program to include, within the annual FFD program performance report, summaries of the number of waivers of the work hour controls specified in 26.199(d)(1) and (2) that were granted during the previous calendar year					
		Annual hours of clerical worker labor to tally the annual number of waivers of each type and report it in the FFD program report	HOURS Clerical	2.0 hr	Assumption	
		Annual hours of managerial labor to review the number of waivers included in the FFD program report	HOURS Manager	1.0 hr	Assumption	
Summarize Collective Work Hour Issues					**Subpart I**	**26.197(e)(2)**
	Annual cost per program to review their collective work hour documentation, tally the number of job groups that exceed 48 hours in each averaging period, identify and document the conditions that caused the limits to be exceeded, and include this information in the FFD program performance report					
		Annual hours of supervisor labor to review and summarize the collective work hour information in the FFD program report	HOURS Supervisor	2.0 hr	Assumption	
Summarize Fatigue Assessment Data					**Subpart I**	**26.197(e)(3)**
	Annual cost per program to report the number of fatigue assessments conducted during the previous calendar year, the conditions under which each fatigue assessment was conducted, and the management actions, if any, resulting from each fatigue assessment					
		Annual number of clerical labor hours to review and tally the number of fatigue assessments conducted during the previous calendar year, the conditions under which each fatigue assessment was conducted, and the management actions, if any, resulting from each fatigue assessment included in the FFD program report	HOURS Clerical	12.0 hr	Assumption	
		Annual number of manager labor hours to review the summary information to be sent to NRC	HOURS Manager	2.0 hr	Assumption	

Activity	Equation	Parameter Description	Parameter	Value	Source	Section
Calculating Work Hours					**Subpart I**	**26.199(b)**
	One-time cost per program to modify existing timekeeping systems in order to record, track, and document the actual hours worked by individiuals covered under (1) the individual work hour controls of paragraph 26.199(d) and the					
		One-time cost per facility to modify existing timekeeping systems, or develop new systems, to record and track work hour data	COST System	$50,000	Exhibit A2-16	
	Annual costs per program associated with monitoring and managing the hours actually worked by individuals and by collective job duty groups, including filing or backing up work hour records					
		Annual hours of supervisor labor to monitor and manage the hours actually worked by individuals and by collective job duty groups at one facility, including filing or backing up work hour records	HOURS Supervisor_Annual	200.0 hr	Assumption	
		Annual hours for clerical labor to monitor and manage the hours actually worked by individuals and by collective job duty groups at one facility, including filing or backing up work hour records	HOURS Clerical_Annual	50.0 hr	Assumption	
Scheduling Work Hours					**Subpart I**	**26.199(c)**
	One-time cost per program to renegotiate collective bargaining agreements in order to address issues related to the assignment of overtime					
		One-time hours needed for licensee management to work with union representatives in collective bargaining	HOURS Management	60.0 hr	Assumption	
		One-time hours needed for licensee legal staff to work with union representatives in collective bargaining	HOURS Legal	40.0 hr	Assumption	
		Percentage of licensees whose schedule modifications lead to revisions to collective bargaining agreements or to discussions with employee committees	PER Negotiation	100%	Assumption	
	Annual costs per program to prepare modified work schedules on an ongoing basis for all employees covered by the rule					
		Annual hours needed for workers to support supervisors in reviewing, analyzing, and modifying schedules	HOURS Scheduler	2,080 hr	Assumption	
Breaks (bi-weekly breaks)					**Subpart I**	**26.199(d)(2)**
	The following variables are used in several of the equations in this section					
		The average current number of affected permanent operators per facility	NUM Perm_Ops	103 operators	Exhibit A2-16	
		Percentage of individuals for which licensees will have to modify current outage work schedules to comply with the 48-hour break requirement during outages	PER Maintenance_Affected	75%	Assumption	
		Percentage of operators for which licensees will have to modify current outage work schedules to comply with the 48-hour break requirement during outages	PER Ops_Affected	50%	Assumption	
		The percentage of a maximum 72-hour week that can no longer be worked due to the proposed 48-hour break requirement	RATE Est_Util_Decrease	5.6%	Assumption	
		The one-time cost to hire and conduct initial training of one operator	COST Ops_Hire	$232,000	Exhibit A2-16	
		Number of weeks in modeled refueling outage	WEEKS Outage	6	Exhibit A2-16	
		Adjustment factor to annualize modeled outages that do not occur annually	FACTOR Outage	1	Assumption	
		The average current number of affected permanent maintenance staff	NUM Perm_Maint	178	Exhibit A2-16	
		The average current number of affected contract maintenance staff	NUM Contract_Maint_Affected	641	Exhibit A2-16	
		The average current number of affect contract operators per facility	NUM Contract_Ops_Affected	12	Exhibit A2-16	
		The average current number of affect contract operators per facility	NUM Outage_Maint	12	Exhibit A2-16	
		The average weekly reduction in overtime hours for affected operators	HOURS Lost_OT	4.0 hr	Assumption	
		Adjustment factor to reduce overtime savings to account for the higher wage rates that transient outage workers might demand as compensation for reduced hours	FACTOR Reduction_for_Incentive	10%	Assumption	
		The average pre-order number of affected permanent security staff per facility	NUM Perm_Sec	77	Assumption	
		Percentage of current permanent security staff for which licensees will have to modify current outage work schedules to comply with the 48-hour break requirement during outages	PER Sec_Individuals_Affected	25%	Assumption	
		The average weekly reduction in overtime hours for affected staff	HOURS Lost_OT	4.0 hr	Assumption	
		Number of weeks (2) corresponding to number of days (14) during which licensees will not need to hire additional staff	WEEKS Exempt	2	Subpart I	

Activity	Equation	Parameter Description	Parameter	Value	Source	Section
	One-time costs per program to hire and conduct initial training of additional permanent operator staff					
			No additional parameters			
	Annual costs per program to pay for additional permanent operator staff on an ongoing basis					
		The fully-loaded annual cost of an average operator, but without overtime	COST Operator	$ 129,000.00	Exhibit A2-16	
		Number of hours per operator per year spent training to maintain operator training qualifications	HOURS Training_Ops	400.0 hr	Assumption	
		The current average hourly wage rate for the average operator	WAGE Ops	$ 32.00 /hour	Exhibit A2-16	
	Annual cost per program to pay for in-processing of additional contract operator staff at the time of an outage					
		The average cost to conduct in-processing of one contract operator	COST Process_Contract_Ops	$ 1,000.00	Assumption	
	Annual costs per program to pay for additional contract operator staff at the time of an outage					
		Weekly wage of a contract operator	WAGE Contract_Operator	$ 25.00 /hour	Exhibit A2-16	
		The average hourly overtime wage rate for the average contract operator	WAGE Contract_Ops_OT	$ 40.00 /hour	Exhibit A2-16	
		The weekly cost of one contract operator	WCOST Contract_Ops	$2,120	Is equal to the regular wage * 40 + the overtime wage * 28	
	Annual cost to pay for additional contract maintenance staff during an outage					
		Contract Maintenance worker wage	WAGE Contract_Maintenance	$ 25.00 /hour	Assumption	
		The current average hourly overtime wage rate for contract outage maintenance staff	WAGE Contract_Maint_OT	$ 50.00 /hour	Assumption	
		The weekly cost of one contract maintenance worker	WCOST Contract_Maint	$2,400	Is equal to the regular wage * 40 + the overtime wage * 28	
	Annual cost per program to pay for in-processing of additional contract maintenance staff during an outage					
		The average cost to conduct in-processing of one contract maintenance staff person	COST Process_Maint	$1,000	Assumption	
	Annual savings per program related to overtime wages paid to permanent operator staff					
		The average annual number of non-overtime hours worked by one newly hired operator that should have been worked as overtime if this new worker had not been hired	HOURS Non_OT	1000.0 hr	Assumption	
		The current average hourly overtime wage rate for the average operator	WAGE Ops_OT	$ 51.00 /hour	Exhibit A2-16	
	Annual savings per program related to overtime wages paid to contract operator staff					
		The current average hourly overtime wage rate for the average contract outage operator	WAGE Contract_Ops_OT	$ 40.00 /hour	Exhibit A2-16	
	Annual savings per program related to overtime wages paid to permanent maintenance staff					
		The current average hourly overtime wage rate for permanent maintenance staff	WAGE Maint_OT	$ 50.00 /hour	Assumption	
	Annual savings per program related to overtime wages paid to contract maintenance staff					
		The current average hourly overtime wage rate for contract outage maintenance staff	WAGE Contract_Maint_Ot	$ 50.00 /hour	Assumption	
	Annual cost per program to pay for in-processing of additional outage (non-permanent) security staff at the time of a refueling outage					
		The average cost to conduct in-processing of one contract security staff person	COST Process_Sec	$ 1,000.00	Assumption	
	Annual cost per program to pay for additional outage (non-permanent) security staff during a refueling outage					
		Average outage security wage	WAGE Outage_Sec	$ 25.00 /hour	Assumption	
		Average outage security wage with overtime	WAGE Outage_Sec_OT	$ 37.50 /hour	Assumption	
		The weekly cost of one outage (non-permanent) security person	WCOST Outage_Sec	$ 1,750	Is equal to the regular wage * 40 + the overtime wage * 20	
	Annual savings per program related to overtime wage paid to permanent security staff					
		The current average hourly overtime wage rate for the average security staff person	WAGE Sec_OT	$ 37.50 /hour	Assumption	
	Annual savings per program related to overtime wages paid to contract security staff					
		The current average hourly overtime wage rate for outage (non-permanent) security staff person	WAGE Outage_Sec_OT	$ 37.50 /hour	Assumption	

Activity	Equation	Parameter Description	Parameter	Value	Source	Section
Waivers from Individual Work Hour Limits					**Subpart I**	**26.199(d)(3)**
	Annual cost per program to conduct and document a fatigue assessment					
		Number of weeks in modeled refueling outage	WEEKS Outage	6	Exhibit A2-16	
		Number of weeks per year during which facilities experience outage conditions (refueling and unplanned outages)	WEEKS Outage	8	Assumption	
		The costs per week under outage conditions incurred by facilities as a result of their restricted ability to grant waivers	WEEKLYCOSTS Outage	$25,689.00	Appendix 3	
		Number of weeks per year during which facilities experience full power conditions	WEEKS Power	44	Exhibit A2-16	
		The costs per week under at-power conditions incurred by facilities as a result of their restricted ability to grant waivers	WEEKLYCOSTS Power	$1,087.00	Appendix 3	
Self-Declarations of Fatigue					**Subpart I**	**26.199(e)**
	The following variables are used in several of the equations in this section					
		Total annual number of persons, per site, granted waivers from the requirements contained in 26.199(d)(1) and (2)	NUM Waivers	15	Assumption	
		Percentage of NUM Waivers that self-declare to a condition of fatigue	PER Self-Declare	10%	Assumption	
	Annual management cost per program to call in replacement workers to substitute for any workers who are sent home to rest following a fatigue assessment					
		Supervisor hours expended to identify and call in a replacement worker	HOURS Supervisor	0.5	Assumption	
	Annual cost per program due to the extra turnover associated with the replacement worker and other lost productivity					
		Labor hours resulting from an additional turnover due to the replacement of a fatigued worker with a substitute worker	HOURS Turnover	1.0 hr	Assumption	
	Annual incremental labor costs associated with the replacement worker					
		Average number of hours worked by the replacement worker per incident	HOURS Substitute	6.0 hr	Assumption	
Collective Work Hour Limits					**Subpart I**	**26.199(f)**
	The following variables are used in several of the equations in this section					
		Weekly collective average number of work hours for operators during non-outage periods prior to the proposed rule	AVG Ops_Current	49.76 hrs	Exhibit A2-16	
		The average current number of affected permanent operators per facility	NUM Perm_Ops	103.175	Exhibit A2-16	
		The percentage by which NUM Ops_Affected must be increased in order to comply with the proposed 48-hour break requirement in 26.199(d)(2)	RATE Hire_for_Breaks_Req	5.60%	Assumption	
		Percentage of individuals for which licensees will have to modify current outage work schedules to comply with the 48-hour break requirement during outages	PER Maintenance_Affected	75%	Assumption	
		Percentage of operators for which licensees will have to modify current outage work schedules to comply with the 48-hour break requirement during outages	PER Ops_Affected	50%	Assumption	
		The one-time cost to hire, process, and conduct initial training of one operator	COST Maint_Hire	$ 1,750	Exhibit A2-16	
		Percentage of facilities where operator collective work hours average more than 48 per week	PER Facilities_with_Affected_Ops	13.51%	Exhibit A2-16	
		Weekly collective average number of work hours for maintenance during non-outage periods	AVG Maint_Current	48.32 hrs	Exhibit A2-16	
		Percentage of facilities where maintenance staff collective work hours average more than 48 per week	PER Facilities_with_Affected_Maint	5.41%	Exhibit A2-16	
		Current average number of permanent maintenance staff per facility	NUM Perm_Maint	178.1 hrs	Exhibit A2-16	
		Percentage of total overtime hours converted to non-overtime hours due to new hires made under this provision	RATE Convert_to_Non-OT	83.00%	Assumption	
		Total annual number of weeks that a facility is not in outage	WEEKS Non_Outage	44 weeks	Assumption	
		The percentage of facilities that will seek and receive NRC's approval to exceed collective work hour limits	PER Apply	4.60%	Assumption	
		Percentage of facilities where security staff collective work hours average more than 48 per week	PER Facilities_with_Affected_Sec	33%	Assumption	
		Average number of new security staff that must be hired per affected facility in order to meet the collective work hour limits	NUM Sec_Hires	9	Assumption	
		Collective work hour limit - Each of the five job duty groups must average, collectively, no more than 48 hours per person per week in any averaging period (not to exceed 13 weeks)	AVG maximum allowed	48.0 hrs	Subpart I	

Activity	Equation	Parameter Description	Parameter	Value	Source	Section
	One time cost to hire, process, and conduct initial training of additional permanent operator staff					
		The one-time cost to hire, process, and conduct initial training of one operator	COST Ops_Hire	$ 232,000	Exhibit A2-16	
	One time cost to hire and process additional maintenance staff					
	One time cost to hire, process, and conduct initial training of additional permanent security staff					
		The one-time cost to hire, process, and conduct initial training of one security worker	COST Sec_Hire	$ 6,750	Assumption	
	Annual cost per program to pay for additional permanent operator staff on an ongoing basis					
		The fully-loaded annual cost of an average operator, but without overtime	COST Operator	$ 129,000	$ 129,000	
	Annual cost per program to pay for additional maintenance staff on an ongoing basis					
		The fully-loaded annual cost of an average maintenance worker, but without overtime	COST Maintenance	$ 100,000	Exhibit A2-16	
	Annual savings per program related to overtime wages paid to permanent operator staff					
		The current hourly overtime wage rate for the average operator	WAGE Ops_OT	$ 51.00 /hour	Exhibit A2-16	
	Annual savings per program related to overtime wages paid to permanent maintenance staff					
		The current average hourly overtime wage rate for permanent maintenance staff	WAGE Maint_OT	$ 50.00 /hour	Assumption	
	Annual cost per program to prepare and submit to NRC a written request for approval to exceed the collective work hour limits					
		FFD Program Manager hours to prepare and submit to NRC a written request for approval to exceed the collective work hour limits	HOURS Manager	6.0 hrs	Assumption	
	Annual cost per program to brief first-line supervisors to alert them to the situation and the need to be vigilant regarding signs of fatigue among affected workers					
		Number of hours per briefing of first-line supervisors to alert them to the situation and the need to be vigilant regarding signs of fatigue among affected workers	HOURS Briefing	0.5 hrs	Assumption	
		Current number of permanent employees covered by the fatigue provisions per facility	NUM current permanent workers	425	NRC 2004 data for 6 facilities	
		Number of first-line supervisors needed to be briefed per facility	NUM Supervisor	10%	Assumption	
	Annual cost per program to prepare and distribute an e-mail or memorandum to affected workers to alert them to be vigilant regarding signs of fatigue and to self-declare if necessary					
		Number of hours for the FFD Program Manager to prepare an e-mail or memo to alert affected staff to be vigilant regarding signs of fatigue and to self-declare if necessary	HOURS Drafting	1.0 hr	Assumption	
		Number of hours for clerical staff to distribute an e-mail or memo to alert affected staff to be vigilant regarding signs of fatigue and to self-declare if necessary	HOURS Distribute	0.5 hr	Assumption	
		Number of hours per person for affected staff to read an e-mail or memo to alert them to be vigilant regarding signs of fatigue and to self-declare if necessary	HOURS Reading	0.08 hr	Assumption	

Activity	Equation	Parameter Description	Parameter	Value	Source	Section
		Number of contract operators	NUM Contract_Operators	12	Exhibit A2-16	
		Wage of a contract operator	WAGE Contract_Operators	$ 40.00	Exhibit A2-16	
		Number of permanent operators	NUM Perm_Operators	103	Exhibit A2-16	
		Wage of a permanent operator	WAGE Perm_Operators	32	Exhibit A2-16	
		Number of permanent maintenance	NUM Perm_Maintenance	178	Exhibit A2-16	
		Wage of a permanent maintenance worker	WAGE Perm_Maintenance	$ 25.00 /hour	Assumption	
		Number of contract maintenance workers	NUM Contract_Maintenance	641	Exhibit A2-16	
		Wage of a contract mainteance worker	WAGE Contract_Maintenance	$ 25.00 /hour	Assumption (text says see Appendix 2)	
		Number of permanent security personnel	NUM Perm_Security	104	Assumption	
		Wage of a permanent security worker	WAGE Perm_Security	$ 25.00 /hour	Exhibit A2-16	
		Number of contract security personnel	NUM Contract_Security	32	Assumption	
		Wage of a contract security worker	WAGE Contract_Security	$ 25.00 /hour	Exhibit A2-16	
	Annual cost per program resulting from the increasing frequency of behavioral observation addressing workers conducitng high-risk activities, workers with substantial overtime hours, and workers on backshifts					
		Additional weekly supervisory labor to increase the frequency of behavioral observation addressing workers conducting high-risk activities, workers with substantial overtime hours, and workers on backshift, during an outage involving a steam generator replacement	HOURS Supervisor	14.0 hr	Assumption	
		Number of outage weeks to complete a planned steam generator replacement	WEEKS SG_Outage	10 weeks	Assumption	
	Annual cost per program to pay for additional permanent security staff on an ongoing basis as needed to comply with the 48-hour collective work hour limit					
		The fully-loaded annual cost of an average security worker, but without overtime	COST Security	$100,000	Assumption	
	Annual savings per program related to the overtime wage premium that no longer will have to be paid					
		The annual number of pre-rule overtime hours that will be converted to standard hours by each new security hire	HOURS Standard	1,600 hrs	Assumption	
		The difference between the standard hourly wage rate and the overtime hourly wage rate for the average security worker	WAGE OT_Premium	$ 15.00 /hour	Assumption	
Work Hour Control Reviews					**Subpart I**	**26.199(j)**
	Annual cost per program to conduct work hour control reviews					
		Annual number of times a facility will review the control of work hours for individuals who are subject to this subpart	NUM Reviews	4	Assumptions	
		Time per participating supervisor to review overtime hours under proposed rule, per review	HOURS Review	4.0 hr	Assumption	
		Number of supervisors participating in the review	NUM Manager	4	Assumption	
		Annual time for manager to review overtime hours under existing technical specifications	HOURS Current_Review	4.0 hr	Assumption	

Activity	Equation	Parameter Description	Parameter	Value	Source	Section
Fatigue Assessments					**Subpart I**	**26.201(a)-(d)**
	The following variables are used in several of the equations in this section					
		Total annual number of fatigue assessments per reactor, including those conducted for-cause, self-declared, post-event, and follow-up	NUM Assessments	50	Assumption	
		Percentage of fatigue assessments that result in a finding of fatigue	PER Fatigue	37.5%	Assumption	
	Annual cost per program to conduct a fatigue assessment for cause, for self-declaration, post-event, and follow-up					
		Hours needed to complete one fatigue assessment	HOURS Assessment	0.5 hr	Assumption	
	Annual cost per program to resolve challenges that may be brought by workers who, after self-declaring to a state of fatigue, object to negative results from their fatigue assessment					
		Annual number of self-declarations of fatigue per facility	NUM Self-Declarations	20	Assumption	
		Percent of annual number of self-declarations of fatigue per facility where the results of the fatigue assessment are negative	PER Not_Fatigued	50%	Assumption	
		Percent of negative fatigue assessment results that are challenged by workers	PER Object	30%	Assumption	
		Amount of worker time to raise and resolve one incident	HOURS Worker	0.5 hr	Assumption	
		Number of hours of Employee Concerns Manager time to raise and resolve one incident	HOURS ECM	2.5 hr	Assumption	
		Number of hours of supervisor time to raise and resolve one incident	HOURS Supervisor	1	Assumption	
Post-Fatigue Assessment Controls and Conditions					**Subpart I**	**26.201(e)**
	The following variables are used in several of the equations in this section					
		Total annual number of fatigue assessments per reactor, including those conducted for-cause, self-declared, post-event, and follow-up	NUM Assessments	50	Assumption	
		Percentage of fatigue assessments that result in a finding of fatigue	PER Fatigue	37.5%	Assumption	
	Annual cost per program to call in replacement workers to substitute for any workers who are sent home to rest following a fatigue assessment					
		Supervisory hours expended to identify and call in a replacement worker	HOURS Supervisor	0.5 hr	Assumption	
	Annual cost per program resulting from extra "turnover" of duties to the replacement worker and other lost labor productivity					
		Labor hours resulting from an additional turnover due to the replacement of a fatigued worker with a substitute worker	HOURS Turnover	1.0 hr	Assumption	
	Annual costs per program associated with the replacement worker					
		Average number of hours worked by the replacement worker per incident	HOURS Substituted	6.0 hr	Assumption	
Documenting Fatigue Assessments					**Subpart I**	**26.201(f)**
	Annual costs per program to document the results of any fatigue assessments conducted, the circumstances that necessitated the fatigue assessment, and any controls and conditions that were implemented					
		Total annual number of fatigue assessments per reactor, including those conducted for-cause, self-declared, post-event, and follow-up	NUM Assessments	50	Assumption	
		Time needed to document a fatigue assessment	HOURS Document	0.33 hr	Assumption	

Exhibit A2 - 16:
Fatigue Input Data

FATIGUE - OPERATOR COMPENSATION AND HIRING COSTS

Source: NRC analysis. Compensation information is based in part on discussions with Professional Reactor Operators Society (PROS)

Total Compensation - Operators	**SRO**	**RO**	**NLO**
1. Base salary per year	$100,000	$60,000	$50,000
2. Loaded base per year @ 100%	$200,000	$120,000	$100,000
3. Pay per hour	$50	$30	$25
4. Assumed OT pay per hour	$75	$50	$40
5. Annual license premium - $750 x 12 months for SROs and ROs only	$9,000	$9,000	$0
6. Annual bonus @ 10%	$10,000	$6,000	$5,000
7. Quarterly bonus	$0	$0	$0
8. Annual operator evaluation bonus	$2,200	$2,200	$0
9. OT @ (32 hours x 8 weeks) and (4 hours x 44 weeks)	$32,400	$21,600	$17,280
Total Compensation (1+5+6+7+8+9)	$154,000	$99,000	$72,000
COST/Ops_Hire: Average cost to hire, process, and conduct initial training of one operator	**SRO**	**RO**	**NLO**
Years	2	2	0.25
Loaded base	$200,000	$120,000	$100,000
Total Training Attendance for 2 years	$400,000	$240,000	$25,000
Trainer Expense per operator for 2 years	$50,000	$50,000	$50,000
Percent	22%	33%	44%
Weighted Cont.	$100,000	$96,667	$33,333
Total labor costs of training operators	$230,000		
Hire and Process	$1,500		
ROUNDED TOTAL	**$232,000**		
COST/Operator: The fully-loaded annual cost of an average operator, but without overtime	**SRO**	**RO**	**NLO**
Loaded base	$200,000	$120,000	$100,000
Percent	22%	33%	44%
Weighted Cont.	$44,444	$40,000	$44,444
ROUNDED TOTAL	**$129,000**		
WAGE/Perm_Operators: The hourly wage of an average operator	**SRO**	**RO**	**NLO**
Loaded base	$50	$30	$25
Percent	22%	33%	44%
Weighted Cont.	$11	$10	$11
ROUNDED TOTAL	**$32**		

Exhibit A2 - 16 (continued)

WAGE/Ops_OT: The average hourly overtime wage rate for the average operator	SRO	RO	NLO
OT Rate	$75	$50	$40
Percent	22%	33%	44%
Weighted Cont.	$17	$17	$18
ROUNDED TOTAL	**$51**		
WAGE/Contract_Ops_OT: The avg. hourly overtime wage rate for the avg. contract operator	**SRO**	**RO**	**NLO**
OT Rate	$75	$50	$40
Percent	0%	0%	100%
Weighted Cont.	$0	$0	$40
ROUNDED TOTAL	**$40**		
WAGE/Contract_Operators	**SRO**	**RO**	**NLO**
Rate	$50	$30	$25
Percent	0%	0%	100%
Weighted Cont.	$0	$0	$25
ROUNDED TOTAL	**$25**		

FATIGUE - SECURITY COMPENSATION AND HIRING COSTS

Data Element	Estimate	Source
WAGE/Perm_Security - Permanent Security wage rate	$25	Assumption
WAGE/Contract_Security - Contract Security wage rate	$25	Assumption
WAGE/Security_OT - The current average hourly overtime wage rate for the average security staff person	$37.50	Assumption
WAGE/Outage_Security_OT - The current average hourly overtime wage rate for outage (non-permanent) security staff person	$37.50	Assumption
WAGE/OT_Premium - The difference between the standard hourly wage rate and the overtime hourly wage rate for the average security worker	$15	Assumption
COST/Sec_Hire_Contract - The one-time cost to hire, process, and conduct initial training of an outage security worker	$1,000	Assumption
COST/Security - The fully-loaded annual cost of an average security worker, but without overtime	$100,000	Assumption
HOURS/Standard - The annual number of pre-rule overtime hours that will be converted to standard hours by each new security hire	$1,600	Assumption

Exhibit A2 - 16 (continued)

FATIGUE - MAINTENANCE COMPENSATION AND HIRING COSTS

Data Element	Estimate	Source
WAGE/Contract_Maint_OT - The current average hourly overtime wage rate for contract outage maintenance staff	$50	Assumption
WAGE/Maint_OT - The current average hourly overtime wage rate for permanent maintenance staff	$50	Assumption
COST/Maintenance - The fully-loaded annual cost of an average maintenance worker, but wihtout overtime	$100,000	Assumption
COST/Maint_Hire - The one-time cost to hire and process an additional maintenance worker	$1,750	Assumption
COST/Process_Maint - The average cost to conduct in-processing of one contract maintenance staff person	$1,000	Assumption

AVERAGE NUMBER OF EMPLOYEES COVERED BY FATIGUE PROVISIONS

Data Element	Estimate	Source
NUM/Employees - Number of employees, including outage workers, covered by work hour controls per facility	**1,097**	Estimate was developed from data provided by six facilities. The estimate is a weighted average per site based on the number of units.
NUM/Applicants - Number of applicants covered by fatigue provisions per	**274**	Estimate represents 25% of NUM/Employees
NUM/Permanent Operators - The average current number of affected permanent operators per facility	**103**	Estimate was developed from data provided by six facilities. The estimate is a weighted average per site based on the number of units.
NUM/Permanent Maintenance Staff - The average current number of	**178**	Estimate was developed from data provided by five facilities. The
NUM/Contract Operators Affected	**12**	Estimate was developed from data provided by one facility.
NUM/Contract Maintenance Staff Affected	**641**	Estimate was developed from data provided by one facility.
NUM/Supervisors	**33**	Estimate represents sum of 10% of each affected labor category (non-

Exhibit A2 - 16 (continued)

FATIGUE PROVISIONS - IMPLEMENTATION COST VARIABLES

Cost/System - One-time cost per facility to modify existing timekeeping systems, or develop new systems, to record and track work hour data

PLANT	Estimate	Source Data	Comments
A		$500	Source data were provided by six facilities.
B		$250,000	
C		minimal	
D		TBD	
E		no estimate	
F		$50,000	
Cost/System	**$50,000**		

PER/Facilities_with_Affected_Maint - Percentage of facilities where maintenance staff collective work hour average exceeds 48 per week

Data Element	Estimate	Source Data	Comments
Number of respondents providing data for Question #5		37	NEI, August 29, 2000. Plant Staff Working Hour Limits Survey
Number of respondents providing data for "All Others" in Question #5 that exceed 48 hour collective average		2	
PER/Facilities_with_Affected_Maint	**5.4%**		

AVG/Maint_Current - Weekly collective average number of work hours for maintenance staff during non-outage periods prior to the proposed rule for facilities exceeding an average

Data Element	Estimate	Source Data	Comments
NEI Facility #2			Source: NEI, August 29, 2000. Plant Staff Working Hour Limits Survey, Question #5
Weighted Average - Number of Annual OT Hours per "All Other" employee		479.25	Used mid-point estimate for ranges of overtime hours worked
Plus: Estimated Number of Annual Regular Hours Worked		2,080	Assumption: 40 Hours per Week
Minus: Average Number of Additional Annual Hours Worked per "All		54.57	Based on work hour datasets provided by
Estimated Weekly Average		48.17	Sum of the above, and divided by 52 weeks to derive weekly average.
NEI Facility #16			
Weighted Average - Number of Annual OT Hours per "All Other"		495.68	Used mid-point estimate for ranges of
Plus: Estimated Number of Annual Regular Hours Worked		2,080	Assumption: 40 Hours per Week
Minus: Average Number of Additional Annual Hours Worked per "All		54.57	Based on work hour datasets provided by
Estimated Weekly Average		48.48	Sum of the above, and divided by 52 weeks to derive weekly average.
AVG/Maint_Current	**48.32**		Averaged two facilities exceeding 48 hour

Exhibit A2 - 16 (continued)

PER/Facilities_with_Affected_Ops - Percentage of facilities where operator collective work hour average exceeds 48 per week

Data Element	Estimate	Source Data	Comments
Number of respondents providing data for Question #5		37	NEI, August 29, 2000. Plant Staff Working Hour Limits Survey
Number of respondents providing data for RO/SRO and NLO in Question #5 that exceed 48 hour collective average		5	
PER/Facilities_with_Affected_Ops	**13.5%**		

AVG/Ops_Current - Weekly collective average number of work hours for operators during non-outage periods prior to the proposed rule for facilities exceeding an average of 48

Data Element	Estimate	Source Data	Comments
NEI Facility #2			Source: NEI, August 29, 2000. Plant Staff Working Hour Limits Survey, Question #5
Weighted Average - Number of Annual OT Hours per Operator		592.38	Used mid-point estimate for ranges of overtime hours worked
Plus: Estimated Number of Annual Regular Hours Worked		2,080	Assumption: 40 Hours per Week
Minus: Average Number of Annual Hours Worked by an Operator During		80.29	Based on work hour datasets provided by
Estimated Weekly Average		49.85	Sum of the above, and divided by 52 weeks to derive weekly average.
NEI Facility #8			
Weighted Average - Number of Annual OT Hours per Operator		529.92	Used mid-point estimate for ranges of overtime hours worked
Plus: Estimated Number of Annual Regular Hours Worked		2,080	Assumption: 40 Hours per Week
Minus: Average Number of Annual Hours Worked by an Operator During		80.29	Based on work hour datasets provided by
Estimated Weekly Average		48.65	Sum of the above, and divided by 52 weeks to derive weekly average.
NEI Facility #16			
Weighted Average - Number of Annual OT Hours per Operator		568.81	Used mid-point estimate for ranges of overtime hours worked
Plus: Estimated Number of Annual Regular Hours Worked		2,080	Assumption: 40 Hours per Week
Minus: Average Number of Annual Hours Worked by an Operator During Outages		80.29	Based on work hour datasets provided by five facilities. The source data represents the difference in hours worked during an outage quarter versus a non-outage quarter.
Estimated Weekly Average		49.39	Sum of the above, and divided by 52 weeks to derive weekly average.

Exhibit A2 - 16 (continued)

NEI Facility #21		Source: NEI, August 29, 2000. Plant Staff Working Hour Limits Survey,	
Weighted Average - Number of Annual OT Hours per Operator		570.89	Used mid-point estimate for ranges of overtime hours worked
Plus: Estimated Number of Annual Regular Hours Worked		2,080	Assumption: 40 Hours per Week
Minus: Average Number of Annual Hours Worked by an Operator During Outages		80.29	Based on work hour datasets provided by five facilities. The source data represents the difference in hours worked during an outage quarter versus a non-outage quarter.
Estimated Weekly Average		49.43	Sum of the above, and divided by 52 weeks to derive weekly average.
NEI Facility #28			
Weighted Average - Number of Annual OT Hours per Operator		677.83	Used mid-point estimate for ranges of overtime hours worked
Plus: Estimated Number of Annual Regular Hours Worked		2,080	Assumption: 40 Hours per Week
Minus: Average Number of Annual Hours Worked by an Operator During Outages		80.29	Based on work hour datasets provided by five facilities. The source data represents the difference in hours worked during an outage quarter versus a non-outage quarter.
Estimated Weekly Average		51.49	Sum of the above, and divided by 52 weeks to derive weekly average.
AVG/OPS_Current	**49.76**		Averaged five facilities exceeding 48 hour collective average
WEEKS/Outage - Number of weeks in modeled outage (refueling outages only)			
Data Element	**Estimate**	**Source Data**	**Comments**
Average U.S. Nuclear Refueling Outage: NEI - Plant Performance data, in weeks		5.71	Accessed 1/5/2005
Rounded Estimate	**6**		
WEEKS/Outage - Number of weeks per year during which facilities experience outage conditions (refueling and unplanned outages)			
Data Element	**Estimate**	**Source Data**	**Comments**
Assuming capacity factor of 85%		7.80	Multiply 15% by 52 weeks
Rounded Estimate	**8**		
WEEKS/Power - Number of weeks per year during which facilities experience full power conditions			
Data Element	**Estimate**	**Source Data**	**Comments**
Assuming capacity factor of 85%		44.20	Multiply 85% by 52 weeks
Rounded Estimate	**44**		

Crosswalk Index of Subpart Sections and Exhibits

Subpart	Section	Section Description	Exhibits
NA	NA	NRC Implementation - One-time Training	Exhibit A2 - 2: Written Policies and Procedures
NA	NA	NRC Implementation - One-time Revision of Inspecion Procedures	Exhibit A2 - 3: Training and Examinations
Subpart B	26.25(a)(4)	FFD Program Personnel Subject to the Rule	Exhibit A2 - 1: Individuals Subject to the FFD Program
Subpart B	26.25(c)	Individuals Subject to Another Acceptable Program	Exhibit A2 - 1: Individuals Subject to the FFD Program
Subpart B	26.27(a)	Policy and Procedure Revisions - Overall Program	Exhibit A2 - 2: Written Policies and Procedures
Subpart B	26.29(a)	Revise and Implement Training, Including Behavioral Observation	Exhibit A2 - 3: Training and Examinations
Subpart B	26.29(b)	Comprehensive Examination	Exhibit A2 - 3: Training and Examinations
Subpart B	26.29(c)(2)	Comprehensive Examination in Lieu of Refresher Training	Exhibit A2 - 3: Training and Examinations
Subpart B	26.31(b)(1)(i)	Background Checks, Psychological Evaluations, Credit History, Criminal History	Exhibit A2 - 1: Individuals Subject to the FFD Program
Subpart B	26.31(b)(2)	DOT-Approved Specimen Collection Facilities	Exhibit A2 - 1: Individuals Subject to the FFD Program
Subpart B	26.31(d)(2)	Reasonable Effort to Track Randomly Selected Individuals for Testing	Exhibit A2 - 6: Activities Related to Potential Policy Violations
Subpart B	26.31(d)(3)	Forensic Toxicologist Review of More Stringent Cutoff Levels	Exhibit A2 - 4: Audits, Inspections, Certifications and Corrective Action
Subpart B	26.33	Behavioral Observation	Exhibit A2 - 6: Activities Related to Potential Policy Violations
Subpart B	26.37(d)	Disclosure requirements positive test results	Exhibit A2 - 6: Activities Related to Potential Policy Violations
Subpart B	26.39(c)	Review of FFD Policy Violations	Exhibit A2 - 6: Activities Related to Potential Policy Violations
Subpart B	26.41(b)	Audit Frequency	Exhibit A2 - 4: Audits, Inspections, Certifications and Corrective Action
Subpart B	26.41(c)(2)	Elimination of Audit Duplication of HHS-Certified Laboratories	Exhibit A2 - 4: Audits, Inspections, Certifications and Corrective Action
Subpart C	26.55(a)(1)	Self-Disclosure for Initial Applicants	Exhibit A2 - 5: Authorizations
Subpart C	26.55(a)(2)	Suitable Inquiry for Initial Applicants	Exhibit A2 - 5: Authorizations
Subpart C	26.55(a)(3)	Pre-Access Testing for Initial Applicants	Exhibit A2 - 5: Authorizations
Subpart C	26.55(a)(4)	Random Testing Pool for Initial Applicants	Exhibit A2 - 5: Authorizations
Subpart C	26.57(a)(1)	Self Disclosure for Update Applicants	Exhibit A2 - 5: Authorizations
Subpart C	26.57(a)(2)	Suitable Inquiry for Update Authorization	Exhibit A2 - 5: Authorizations
Subpart C	26.57(a)(3)	Pre-Access Testing for Update Applicants	Exhibit A2 - 5: Authorizations
Subpart C	26.57(a)(4)	Random Testing Pool for Update Applicants	Exhibit A2 - 5: Authorizations
Subpart C	26.59(a)(1)	Authorization Reinstatements with Interruptions: Self-Disclosure for Reinstatement Applicants with 31-365 Day Interruption	Exhibit A2 - 5: Authorizations
Subpart C	26.59(a)(2)	Authorization Reinstatements with Interruptions: Suitable Inquiry for Reinstatement Applicants with 31-365 Day Interruption	Exhibit A2 - 5: Authorizations
Subpart C	26.59(a)(3)	Authorization Reinstatements with Interruptions: Pre-Access Testing for Reinstatement Applicants with 31-365 Day Interruption	Exhibit A2 - 5: Authorizations
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Subpart I	26.197(e)(2)	Summarize Collective Work Hour Issues	Exhibit A2-15: Fatigue Inputs
Subpart I	26.197(e)(3)	Summarize Fatigue Assessment Data	Exhibit A2-15: Fatigue Inputs
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Subpart I	26.199(c)	Scheduling Work Hours	Exhibit A2-15: Fatigue Inputs
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Subpart J	26.219(b)	Reporting and Review of Reportable Events Due to New Validity Testing Requirements	Exhibit A2 - 10: Reporting Requirements

Appendix 3: Analysis of Section 26.199(d)(3)(i)

Overview

Section 26.199(d)(3)(i) of the proposed worker fatigue provisions establishes new waiver requirements. Among other provisions, the section restricts the granting of waivers from work hour requirement guidelines to cases where the waiver is needed to mitigate or prevent a condition adverse to safety or to maintain security. The rule also clarifies that work hour limits apply only to workers who perform safety-related functions, which will eliminate the need to grant waivers to other staff. This appendix describes a methodology for estimating the incremental costs and savings associated with eliminating waivers that would no longer be permitted under the proposed rule.

NRC used this methodology to estimate the net cost per week of the new waiver requirements. The resulting estimate of $1,087 per week while at-power and $25,689 per week during plant shutdowns are used as inputs to the cost analysis of §26.199(d)(3), which is presented in Appendix A2-15. Table 3-1 provides a summary of the waiver data used in this appendix. Table 3-2 provides a breakdown of these data by work-hour provision.

The methodology is based on a review of selected 2003 - 2004 waiver data from six facilities. The analysis categorizes each waiver into one of eight groups and calculates the cost or saving associated with that waiver based on how the situation would be addressed under the proposed rule. Results for the six facilities are summed and averaged to calculate the net weekly cost of the provision for the average facility (1) while at power, and (2) during an outage.

The remainder of this appendix describes how the analysis estimates the cost or saving of each type of waiver. The discussion is organized into nine sections:

- A3.1 Waivers No Longer Required Under the Proposed Rule;
- A3.2 Waivers Unaffected by the Proposed Rule;
- A3.3 Outage Shift Changes that Will Not Meet the New Proposed Waiver Requirements;
- A3.4 Outage Activities Without Direct Impact on Critical Path;
- A3.5 Outage Activities With Critical Path Impact;
- A3.6 At-Power Costs Associated With Individuals Who Will Not Meet the Proposed Waiver Requirements;
- A3.7 At-Power Costs Associated With Individuals Involved in Tests or Integrated Evolution Who Will Not Meet the Proposed Waiver Requirements;
- A3.8 At-Power Costs Associated With Individuals Involved in Return to Full Power Who Will Not Meet the Proposed Waiver Requirements; and
- A3.9 Generic Costing Assumptions

Table 3-1
Waiver Data Summary

	Description	Total	Plants					
			A	B	C	D	E	F
	Outage Days	295	76	64	30	62	34	29
	At-Power Days	452	30	301	31	30	30	30
A3.1	Waivers No Longer Required*	506	114	81	6	48	25	232
A3.2	Waivers Unaffected*	20	15	1	2	1	0	1
A3.3	Outage Shift Change*	158	133	0	5	18	1	1
A3.4	Outage Activities without Direct Impact on Critical Path*	827	150	6	56	330	112	173
A3.5	Outage Activities with Critical Path Impact*	300	40	4	14	186	36	20
A3.6	At-Power Activities*	28	6	1	5	16	0	0
A3.7	At-Power Activities associated with Test and Integrated Activities*	16	7	7	1	1	0	0
A3.8	At-Power Activities Impacting Return to Full Power*	10	0	1	6	3	0	0
	TOTAL*	1,865	465	101	95	603	174	427

* The numbers in these rows represent the number of personnel with authorized work-hour rule waivers. Consecutively issued waivers for personnel working 12-hour days without an off-day were counted as one occurrence per person for each 7-day period when allowed by the available data.

Table 3-2
Work-hour Provision Breakdown

Provision	Personnel Waived	Percent of Waivers where only a Single Provision is Waived	Percent of Total*
8-hour break	18	6% (1 of 18)	1%
16-hours in 24-hour period	175	28% (49 of 175)	9%
24-hours in a 48-hour period	434	44% (192 of 434)	23%
72-hours in a 7-day period	1536	71% (1333 of 1536)	82%
Total Waived	1865	84% (1575 of 1865)	100%

* Note that since 16% of the waivers address multiple provisions, the sum of provision percentages exceeds 100%.

A3.1 Waivers No Longer Required Under the Proposed Rule

Numerous work hour waivers that were granted prior to the proposed rule will no longer be needed (i.e., waivers for engineering staff, waivers that would be eliminated due to the 26-hour in 48-hour rule change and for work not adverse to safety). Licensees will be free to use staff as they did under these waivers, but they will realize incremental savings because they will not have to undertake the administrative exercise of granting the waiver.

The *facility savings per waiver* result from the saved management costs as follows:

$$HOURS_{Manager} \times WAGE_{Management}$$

Parameter	Description
$HOURS_{Manager}$	Manager labor saved for each waiver that no longer needs to be processed (described in assumptions below)
$WAGE_{Management}$	Hourly management labor rate (described in Section A3.9)

Assumption:

- Manager labor saved as a result of reduced planning, coordination and administration for each waiver processed: 1 hour.

A3.2 Waivers Unaffected by the Proposed Rule

Some of the work hour waivers examined will not be affected by the proposed rule. These are waivers that satisfy the two required elements of the proposed rule: (a) the activity is necessary to mitigate or prevent a condition adverse to safety or security and (b) there is reasonable assurance that the individual will be able to safely and competently perform his or her duties during the additional work period. There are no incremental costs or savings associated with this category.

A3.3 Outage Shift Changes that Will Not Meet the Proposed Waiver Requirements

Another group of work hour waivers includes those granted to accommodate a shift schedule change that will not meet the new waiver requirements. This group includes waivers associated with:

- Shifting between day and night schedules or other outage schedule changes; and
- Shifting personnel due to down-staffing.

All but two of the 158 waivers in this category (99%) authorize a variance from the 72-hour work hour control requirement. Due to the limited information provided on many waiver authorization forms, it is often unclear whether the 72-hour limit is exceeded by only a few hours or an entire shift. In addition to the 72-hour limit, about 23% of these waivers also allow individuals to exceed the 16-hours in 24-hour limit.

Contractor - Local Craft

This category estimates the cost associated with eliminating work hour waivers addressing an outage shift change that will not meet the proposed waiver requirements. The category applies to local contractors supporting an outage that do not require travel or per diem. Activities addressed by this category are not associated with a test or integrated evolution.

The management cost of this section is the additional management burden for planning and coordination. The additional management burden for waivers that address a single person is assumed to be 1 hour. For waivers that address more than one person, this analysis assumes that the additional management burden will be 2 hours.

The *facility cost per waiver* results from the sum of the following factors:

- The labor cost of this waiver is the difference between the cost of labor for the extended period under the proposed rule and the cost of labor pre-rule. The labor cost is calculated as follows:

  $(NUM_{Local\ Craft} \times HOURS_{Local\ Craft} \times WAGE_{Local\ Craft} \times CONTINGENCY_{Shift_Schedule_Change}) - (NUM_{Local\ Craft} \times HOURS_{Local\ Craft} \times WAGE_{Local\ Craft})$

- The management cost of this waiver is the additional management burden for planning and coordination. The management cost is calculated as follows:

  If waiver addresses one person, then $(1\ hour \times WAGE_{Manager})$
  If waiver addresses multiple people, then $(2\ hours \times WAGE_{Manager})$

Parameter	**Description**
$NUM_{Local\ Craft}$	The number of local craft workers impacted by shift schedule changes that will no longer be allowed
$HOURS_{Local\ Craft}$	Hours worked per local craft worker that exceeded the work hour requirements under one waiver
$CONTINGENCY_{Shift_Schedule_Change}$	Contingency factor measuring the significance of expected resource loading associated with shift schedule changes (described in assumptions below)
$WAGE_{Local\ Craft}$	The estimated hourly rate of local craft labor (described in Section A3.9)
$WAGE_{Manager}$	Average manager wage rate (described in Section A3.9)

Assumption:

- A scaling factor is used to adjust baseline costs to reflect higher costs under the proposed waiver provisions. For this equation, the contingency factor value equals 1. Effective management planning should avoid the need for waivers associated with changes in shift schedules.

Contractor - Specialty Vender

This category estimates the cost associated with eliminating work hour waivers addressing an outage shift change. The category is applicable to contractors supporting an outage that are expected to incur transportation and per diem costs.

The labor cost of this waiver is the difference between the cost of labor for the extended period under the proposed rule and the cost of labor pre-rule. Although transportation and per diem costs are likely for this labor category, these costs are excluded from the cost estimate because it is assumed that effective management planning should avoid such a burden.

The management cost of this section is the additional management burden for planning and coordination. The additional management burden for waivers that address a single person is assumed to be 1 hour. For waivers that address more than one person, this analysis assumes that the additional management burden will be 2 hours.

The *facility cost per waiver* results from the sum of the following factors:

- The labor cost of this waiver is the difference between the cost of labor for the extended period under the proposed rule and the cost of labor pre-rule. The labor cost is calculated as follows:

  $(NUM_{Specialty\ Vender} \times HOURS_{Specialty\ Vender} \times WAGE_{Specialty\ Vender} \times CONTINGENCY_{Shift_Schedule_Change}) - (NUM_{Specialty\ Vender} \times HOURS_{Specialty\ Vender} \times WAGE_{Specialty\ Vender})$

- The management cost of this waiver is the additional management burden for planning and coordination. The management cost is calculated as follows:

  If waiver addresses one person, then $(1\ hour \times WAGE_{Manager})$
  If waiver addresses multiple people, then $(2\ hours \times WAGE_{Manager})$

Parameter	**Description**
$NUM_{Specialty\ Vender}$	The number of specialty venders impacted by shift schedule changes that will no longer be allowed
$HOURS_{Specialty\ Vender}$	Hours worked per specialty vender that exceeded the work hour requirements under one waiver
$CONTINGENCY_{Shift_Schedule_Change}$	Contingency factor measuring the significance of expected resource loading associated with shift schedule changes (described in assumptions below)
$WAGE_{Specialty\ Vender}$	The estimated hourly rate of specialty vender labor (described in Section A3.9)
$WAGE_{Manager}$	Average manager wage rate (described in Section A3.9)

Assumption:

- A scaling factor is used to increase baseline costs to reflect higher costs under the proposed provision. For this equation, the contingency factor value equals 1. Effective management planning should avoid the need for waivers associated with changes in shift schedules.

Utility

This category estimates the cost associated with eliminating work hour waivers addressing an outage shift change. The category is applicable to utility workers supporting an outage. Activities addressed by this category are not associated with a test or integrated evolution that requires a formal job brief.

The management cost represented by this section is the additional management burden for planning and coordination. The additional management burden for waivers that address a single person is assumed to be 1 hour. For waivers that address more than one person, this analysis assumes that the additional management burden will be 2 hours.

The *facility cost per waiver* results from the sum of the following factors:

- The labor cost of this waiver is the difference between the cost of labor for the extended period under the proposed rule and the cost of labor pre-rule. The labor cost is calculated as follows:

$$(NUM_{Utility\ Worker} \times HOURS_{Utility\ Worker} \times WAGE_{Utility\ Worker} \times CONTINGENCY_{Shift_Schedule_Change}) - (NUM_{Utility\ Worker} \times HOURS_{Utility\ Worker} \times WAGE_{Utility\ Worker})$$

- The management cost represented by this section is the additional management burden for planning and coordination. The management cost is calculated as follows:

If waiver addresses one person, then $(1\ hour \times WAGE_{Manager})$
If waiver addresses multiple people, then $(2\ hours \times WAGE_{Manager})$

Parameter	**Description**
$NUM_{Utility\ Worker}$	The number of utility workers impacted by shift schedule changes that will no longer be allowed
$HOURS_{Utility\ Worker}$	Hours worked per utility worker that exceeded the work hour requirements
$CONTINGENCY_{Shift_Schedule_Change}$	Contingency factor measuring the significance of expected resource loading associated with shift schedule changes (described in assumptions below
$WAGE_{Utility\ Worker}$	The estimated hourly rate of utility labor (described in Section A3.9)
$WAGE_{Manager}$	Average manager wage rate (described in Section A3.9)

Assumption:

- A scaling factor is used to increase baseline costs to reflect higher costs under the proposed provision. For this equation, the contingency factor value equals 1. Effective management planning should avoid the need for waivers associated with changes in shift schedules.

A3.4 Outage Activities Without Direct Impact on Critical Path

Contractor - Local Craft

This category estimates the cost associated with eliminating work hour waivers addressing an outage activity that extends beyond a shift. The category is applicable to local contractors supporting an outage that do not require travel or per diem. Activities addressed by this category are not associated with a test or integrated evolution and do not have a direct critical path impact. This group includes waivers associated with:

- Continuation of on-going work activities (not identified or assessed as critical path);
- Equipment de-contamination and temporary shielding activities; and
- Worker contingency actions (personnel on standby).

The management cost of this section is the additional management burden for planning and coordination. The additional management burden for waivers that address a single person is assumed to be 2 hours. For waivers that address more than one person, this analysis assumes that the additional management burden will be 4 hours.

The *facility cost per waiver* results from the sum of the following factors:

- The labor cost of this waiver is the difference between the cost of labor for the extended period under the proposed rule and the cost of labor pre-rule. The labor cost is calculated as follows:

  $(NUM_{Local\ Craft} \times HOURS_{Local\ Craft} \times WAGE_{Local\ Craft} \times CONTINGENCY_{Non\text{-}Critical\ Path})$
  $- (NUM_{Local\ Craft} \times HOURS_{Local\ Craft} \times WAGE_{Local\ Craft})$

- The management cost of this waiver is the additional management burden for planning and coordination. The management cost is calculated as follows:

  If waiver addresses one person, then $(2\ hours \times WAGE_{Manager})$
  If waiver addresses multiple people, then $(4\ hours \times WAGE_{Manager})$

Parameter	Description
$NUM_{Local\ Craft}$	The number of local craft workers impacted by shift schedule changes that will no longer be allowed
$HOURS_{Local\ Craft}$	Hours worked per local craft worker that exceeded the work hour requirements under one waiver
$CONTINGENCY_{Non\text{-}Critical\ Path}$	Contingency factor measuring the significance of expected resource loading associated with non-critical path resources changes (described in assumptions below)
$WAGE_{Local\ Craft}$	The estimated hourly rate of local craft labor (described in Section A3.9)
$WAGE_{Manager}$	Average manager wage rate (described in Section A3.9)

Assumption:

- A scaling factor is used to increase baseline costs to reflect higher costs under the proposed provision. The contingency factor value in this equation is assumed to be equal to 2. The contingency factor value is based on an evaluation of special conditions, including individuals' level of specialization, potential difficulty in establishing alternative arrangements, the likelihood of cost premiums like travel per diem and the potential impact to outage duration. In this section of the appendix, the contingency value ranges from 1 to 5. For this category, the contingency factor equals 2 due to the low level of specialization, local availability of labor and limited impact on the outage critical path.

Contractor - Specialty Vender

This category estimates the cost associated with eliminating work hour waivers addressing an outage activity that extends beyond a shift. The category is applicable to contractors supporting an outage that are expected to incur transportation and per diem cost. Activities addressed by this category are not associated with a test or integrated evolution and do not have a direct critical path impact. This group includes waivers associated with:

- Continuation of on-going work activities (not identified or assessed as critical path);
- Motor-operated valve and air-operated valve testing; and
- Worker contingency actions (personnel on standby).

The labor cost of this waiver is the difference between the cost of labor for the extended period under the proposed rule and the cost of labor pre-rule. The contingency cost includes the expected additional per diem cost. The analysis also assumes that a travel cost of $1,000 per person per waiver will be incurred.

The management cost of this section is the additional management burden for planning and coordination. The additional management burden for waivers that address a single person is

assumed to be 2 hours. For waivers that address more than one person, this analysis assumes that the additional management burden will be 4 hours.

The *facility cost per waiver* results from the sum of the following factors:

- The labor cost of this waiver is the difference between the cost of labor for the extended period under the proposed rule and the cost of labor pre-rule. The labor cost is calculated as follows:

  $$(NUM_{Specialty\ Vender} \times HOURS_{Specialty\ Vender} \times WAGE_{Specialty\ Vender} \times CONTINGENCY_{Non\text{-}critical\ Path}) + (NUM_{Specialty\ Vender} \times COST_{Travel}) - (NUM_{Specialty\ Vender} \times HOURS_{Specialty\ Vender} \times WAGE_{Specialty\ Vender})$$

- The management cost of this waiver is the additional management burden for planning and coordination. The management cost is calculated as follows:

  If waiver addresses one person, then $(2\ hour \times WAGE_{Manager})$
  If waiver addresses multiple people, then $(4\ hours \times WAGE_{Manager})$

Parameter	**Description**
$NUM_{Specialty\ Vender}$	The number of specialty venders impacted by shift schedule changes that will no longer be allowed
$HOURS_{Specialty\ Vender}$	Hours worked per specialty vender that exceeded the work hour requirements under one waiver
$CONTINGENCY_{Non\text{-}Critical\ Path}$	Contingency factor measuring the significance of expected resource loading associated with shift schedule changes (described in assumptions below)
$WAGE_{Specialty\ Vender}$	The estimated hourly rate of specialty vender labor (described in Section A3.9)
$COST_{Travel}$	The estimated round trip travel fee used for specialty venders (described in Section A3.9)
$WAGE_{Manager}$	Average manager wage rate (described in Section A3.9)

Assumption:

- A scaling factor is used to increase baseline costs to reflect higher costs under the proposed provision. The contingency factor value in this equation is assumed to be equal to 4. The contingency factor value is based on an evaluation of special conditions, including individuals' level of specialization, potential difficulty in establishing alternative arrangements, the likelihood of cost premiums like travel per diem and the potential impact to outage duration. In this section of the appendix, the contingency value ranges from 1 to 5. For this category, the contingency factor equals 4 due to the

high level of specialization, potential difficulty in making alternative arrangements, likely need to pay a premium, and the limited impact on the outage critical path.

Utility

This category estimates the cost associated with eliminating work hour waivers addressing an outage activity that extends beyond a shift. The category is applicable to utility workers supporting an outage. Activities addressed by this category are not associated with a test or integrated evolution and do not have a direct critical path impact. This group includes waivers associated with:

- Continuation of on-going work activities (not identified or assessed as critical path);
- Operations outage support (valve manipulations, clearing danger tags, surveillance support, etc.);
- Health Physics survey and job coverage support; and
- Training and qualification support (welders).

The management cost represented by this section is the additional management burden for planning and coordination. The additional management burden for waivers that address a single person is assumed to be 2 hours. For waivers that address more than one person, this analysis assumes that the additional management burden will be 4 hours.

The *facility cost per waiver* results from the sum of the following factors:

- The labor cost of this waiver is the difference between the cost of labor for the extended period under the proposed rule and the cost of labor pre-rule. The labor cost is calculated as follows:

  $(NUM_{Utility\ Worker} \times HOURS_{Utility\ Worker} \times WAGE_{Utility\ Worker} \times CONTINGENCY_{Non\text{-}critical\ Path}) - (NUM_{Utility\ Worker} \times HOURS_{Utility\ Worker} \times WAGE_{Utility\ Worker})$

- The management cost represented by this section is the additional management burden for planning and coordination. The management cost is calculated as follows:

  If waiver addresses one person, then $(2\ hours \times WAGE_{Manager})$
  If waiver addresses multiple people, then $(4\ hours \times WAGE_{Manager})$

Parameter	**Description**
$NUM_{Utility\ Worker}$	The number of utility workers impacted by shift schedule changes that will no longer be allowed
$HOURS_{Utility\ Worker}$	Hours worked per utility worker that exceeded the work hour requirements

Parameter	Description
$CONTINGENCY_{Non\text{-}critical\ Path}$	Contingency factor measuring the significance of expected resource loading associated with shift schedule changes (described in assumptions below
$WAGE_{Utility\ Worker}$	The estimated hourly rate of utility labor (described in Section A3.9)
$WAGE_{Manager}$	Average manager wage rate (described in Section A3.9)

Assumption:

- A scaling factor is used to increase baseline costs to reflect higher costs under the proposed provision. The contingency factor value in this equation is assumed to be equal to 2. The contingency factor value is based on an evaluation of special conditions, including individuals' level of specialization, potential difficulty in establishing alternative arrangements, the likelihood of cost premiums like travel per diem and the potential impact to outage duration. In this section of the appendix, the contingency value ranges from 1 to 5. For this category, the contingency factor equals 2 due to the assignment flexibility of in-house staff and limited impact on the outage critical path.

A3.5 Outage Activities With Critical Path Impact

Contractor - Local Craft

This section estimates the local contractor cost associated with activities that have a critical path impact. The category is applicable to local contractors supporting an outage that do not require travel or per diem. This group includes waivers associated with:

- Support of critical path activities (only 4 waivers were identified as being applicable to the Local Craft portion of this category).

The management cost of this section is the additional management burden for planning and coordination. The additional management burden for waivers that address a single person is assumed to be 2 hours. For waivers that address more than one person, this analysis assumes that the additional management burden will be 4 hours.

The outage portion of this section is used to represent the cost associated with extending the outage as a result of allocating resources without the availability of a waiver. This waiver cost section addresses the potential impact of the job brief on the critical path.

The *facility cost per waiver* results from the sum of the following factors:

- The labor cost of this waiver is the difference between the cost of labor for the extended period under the proposed rule and the cost of labor pre-rule. The labor cost is calculated as follows:

$$(NUM_{Local\ Craft} \times HOURS_{Local\ Craft} \times WAGE_{Local\ Craft} \times CONTINGENCY_{Critical\ Path}) - (NUM_{Local\ Craft} \times HOURS_{Local\ Craft} \times WAGE_{Local\ Craft})$$

- The management cost represented by this section is the additional management burden for planning and coordination. The management cost is calculated as follows:

If waiver addresses one person, then $(2\ hours \times WAGE_{Manager})$
waiver addresses multiple people, then $(4\ hours \times WAGE_{Manager})$

- The outage portion of this section represents the cost associated with extending the outage as a result of allocating resources without the availability of a waiver. The outage cost is calculated as follows:

$$HOURS_{Turnover} \times HCOST_{Outage}$$

If the waiver is associated with the 72-hour provision, then this analysis assumes that there is no cost for critical path turnover. The analysis makes this assumption because the 72-hour provision is typically exceeded for a seventh 12-hour day in 7 days. As a result, a brief would be required regardless of whether this provision is waived or not.

Parameter	**Description**
$NUM_{Local\ Craft}$	The number of local craft workers impacted by shift schedule changes that will no longer be allowed
$HOURS_{Local\ Craft}$	Hours worked per local craft worker that exceeded the work hour requirements
$HOURS_{Turnover}$	The estimated amount of time (in hours) associated with a turnover job briefing (described in assumptions below)
$CONTINGENCY_{Critical\ Path}$	Contingency factor measuring the significance of expected resource loading associated with critical path activities (described in assumptions below)
$WAGE_{Local\ Craft}$	The estimated hourly rate of local craft labor (described in Section A3.9)
$WAGE_{Manager}$	Average manager wage rate (described in Section A3.9)
$HCOST_{Outage}$	The hourly cost of delaying the completion of an outage (described in Section A3.9)

Assumptions:

- A scaling factor is used to increase baseline costs to reflect higher costs under the proposed provision. The contingency factor value in this equation is assumed to be equal to 3. The contingency factor value is based on an evaluation of special conditions, including individuals' level of specialization, potential difficulty in establishing alternative arrangements, the likelihood of cost premiums like travel per diem and the potential impact to outage duration. In this section of the appendix, the contingency value ranges from 1 to 5. For this category, the contingency factor equals 3 due to the low level of specialization, local availability of labor but a potential impact on the outage critical path.

- The estimated amount of time (in hours) associated with a turnover job briefing: 0.5 hours.

Contractor - Specialty Vender

This section estimates the specialty cost associated with activities that have a critical path impact that will not meet the new waiver requirements. This group includes waivers associated with:

- Refueling path (fuel off-load, on-load, equipment repair, etc.);
- Steam generator eddy current testing;
- Reactor mid-loop operations; and
- Critical path repair/maintenance activities.

The labor cost of this waiver is the difference between the cost of labor for the extended period under the proposed rule and the cost of labor pre-rule. The cost estimate includes a travel cost of $1,000 per person per waiver.

The management cost of this section is the additional management burden for planning and coordination. The additional management burden for waivers that address a single person is assumed to be 2 hours. For waivers that address more than one person, this analysis assumes that the additional management burden will be 4 hours.

The outage portion of this section is used to represent the cost associated with extending the outage as a result of allocating resources without the availability of a waiver. This waiver cost section addresses the potential impact of the job brief on the critical path.

The *facility cost per waiver* results from the sum of the following factors:

- The labor cost of this waiver is the difference between the cost of labor for the extended period under the proposed rule and the cost of labor pre-rule. The labor cost is calculated as follows:

$$(NUM_{Specialty\ Vender} \times (HOURS_{Specialty\ Vender} + HOURS_{Turnover} \times 2) \times WAGE_{Specialty\ Vender} \times CONTINGENCY_{Critical\ Path}) + (NUM_{Specialty\ Vender} \times COST_{Travel}) - (NUM_{Specialty\ Vender} \times HOURS_{Specialty\ Vender} \times WAGE_{Specialty\ Vender})$$

- The management cost represented by this section is the additional management burden for planning and coordination. The management cost is calculated as follows:

If waiver addresses one person, then $(2\ hours \times WAGE_{Manager})$
If waiver addresses multiple people, then $(4\ hours \times WAGE_{Manager})$

- The outage portion of this section represents the cost associated with extending the outage as a result of allocating resources without the availability of a waiver. The outage cost is calculated as follows:

$$HOURS_{Turnovers} \times HCOST_{Outage}$$

If the waiver is associated with the 72-hour provision, then this analysis assumes that there is no cost for critical path turnover. The analysis makes this assumption because the 72-hour provision is typically exceeded for a seventh 12-hour day in 7 days. As a result, a brief would be required regardless of whether this provision is waived or not.

Parameter	**Description**
$NUM_{Specialty\ Vender}$	The number of specialty vender impacted by shift schedule changes that will no longer be allowed
$HOURS_{Specialty\ Vender}$	Hours worked per specialty vender that exceeded the work hour requirements
$HOURS_{Turnover}$	The estimated amount of time (in hours) associated with a turnover job briefing (described in assumptions below)
$CONTINGENCY_{Critical\ Path}$	Contingency factor measuring the significance of expected resource loading associated with shift schedule changes (described in assumptions below)
$WAGE_{Specialty\ Vender}$	The estimated hourly rate of specialty vender labor (described in Section A3.9)
$COST_{Travel}$	The estimated round trip travel fee used for contractor workers (described in Section A3.9)
$WAGE_{Manager}$	Average manager wage rate (described in Section A3.9)
$HCOST_{Outage}$	The hourly cost of delaying the completion of an outage (described in Section A3.9)

Assumptions:

- A scaling factor is used to increase baseline costs to reflect higher costs under the proposed provision. The contingency factor value in this equation is assumed to be equal to 5. The contingency factor value is based on an evaluation of special conditions, including individuals' level of specialization, potential difficulty in establishing alternative arrangements, the likelihood of cost premiums like travel per diem and the potential impact to outage duration. In this section of the appendix, the contingency value ranges from 1 to 5. For this category, the contingency factor equals the maximum value of 5 due to the high level of specialization, potential difficulty in making alternative arrangements, likely need to pay a premium, and the potential impact on the outage critical path.

- The estimated amount of time (in hours) associated with a turnover job briefing: 0.5 hours

Utility

This category addresses utility workers and estimates the cost associated with an outage test or integrated evolution that will not meet the new waiver requirements. This group includes waivers associated with:

- Refueling path (fuel off-load, on-load, equipment repair, etc.);
- Steam generator eddy current testing;
- Reactor mid-loop operations;
- Reactor startup activities; and
- Critical path repair/maintenance activities.

The management cost represented by this section is the additional management burden for planning and coordination. The additional management burden for waivers that address a single person is assumed to be 2 hours. For waivers that address more than one person, this analysis assumes that the additional management burden will be 4 hours.

The outage portion of this equation is used to represent the cost associated with extending the outage as a result of allocating resources without the availability of a waiver. This waiver cost section includes the potential impact of the job brief on the critical path. The full weight of this additional activity is included in this cost estimate.

The *facility cost per waiver* results from the sum of the following factors:

- The labor cost of this waiver is the difference between the cost of labor for the extended period under the proposed rule and the cost of labor pre-rule. The labor cost is calculated as follows:

$$(NUM_{Utility\ Worker} \times (HOURS_{Utility\ Worker} + HOURS_{Turnover} \times 2) \times WAGE_{Utility\ Worker} \times CONTINGENCY_{Critical\ Path}) - (NUM_{Utility\ Worker} \times HOURS_{Utility\ Worker} \times WAGE_{Utility\ Worker})$$

- The management cost represented by this section is the additional management burden for planning and coordination. The management cost is calculated as follows:

If waiver addresses one person, then $(2\ hours \times WAGE_{Manager})$
If waiver addresses multiple people, then $(4\ hours \times WAGE_{Manager})$

- The outage portion of this section represents the cost associated with extending the outage as a result of allocating resources without the availability of a waiver. The outage cost is calculated as follows:

$$HOURS_{Turnover} \times HCOST_{Outage}$$

If the waiver is associated with the 72-hour provision, then this analysis assumes that there is no cost for critical path turnover. The analysis makes this assumption because the 72-hour provision is typically exceeded for a seventh 12-hour day in 7 days. As a result, a brief would be required regardless of whether this provision is waived or not.

Parameter	**Description**
$NUM_{Utility\ Worker}$	The number of utility workers impacted by shift schedule changes that will no longer be allowed
$HOURS_{Utility\ Worker}$	Hours worked per utility worker that exceeded the work hour requirements
$HOURS_{Turnover}$	The estimated amount of time (in hours) associated with a turnover job briefing (described in assumptions below)
$CONTINGENCY_{Critical\ Path}$	Contingency factor measuring the significance of expected resource loading associated with shift schedule changes (described in assumptions below)
$WAGE_{Utility\ Worker}$	The estimated hourly rate of utility worker labor (described in Section A3.9)
$HCOST_{Outage}$	The hourly cost of delaying the completion of an outage (described in Section A3.9)
$WAGE_{Manager}$	Average manager wage rate (described in Section A3.9)

Assumptions:

- A scaling factor is used to increase baseline costs to reflect higher costs under the proposed provision. The contingency factor value in this equation is assumed to be equal to 3. The contingency factor value is based on an evaluation of special conditions, including individuals' level of specialization, potential difficulty in establishing alternative arrangements, the likelihood of cost premiums like travel per diem and the potential impact to outage duration. In this section of the appendix, the contingency value ranges from 1 to 5. For this category, the contingency factor equals 3 due to the assignment flexibility of in-house staff and the potential impact on the outage critical path.

- The estimated amount of time (in hours) associated with a turnover job briefing: 0.5 hours.

A3.6 At-Power Costs Associated with Individuals Who Will Not Meet the Proposed Waiver Requirements

This category addresses a general estimate of the at-power cost associated with individuals who will not meet the new waiver requirements. This group includes waivers associated with training, meetings and other miscellaneous activities.

The *facility cost per waiver* results from the sum of the following factors:

- The labor cost associated with a shift schedule change that will not meet the new waiver requirements is the difference between the cost of labor for the proposed rule and the cost of labor pre-rule. The labor cost is calculated as follows:

  $$(NUM_{Utility\ Worker} \times HOURS_{Utility\ Worker} \times WAGE_{Utility\ Worker} \times CONTINGENCY_{Power}) - (NUM_{Utility\ Worker} \times HOURS_{Utility\ Worker} \times WAGE_{Utility\ Worker})$$

- The management cost associated with a shift schedule change that will not meet the new waiver requirements is the cost of the additional management burden for planning and coordination. The management cost is calculated as follows:

  $$(1\ hour \times WAGE_{Manager})$$

Parameter	**Description**
$NUM_{Utility\ Worker}$	The number of utility workers impacted by shift schedule changes that will no longer be allowed
$HOURS_{Utility\ Worker}$	Hours worked per utility worker that exceeded the work hour requirements

Parameter	Description
$CONTINGENCY_{Power}$	Contingency factor measuring the significance of expected resource loading associated with at-power activities (described in assumptions below
$WAGE_{Utility\ Worker}$	The estimated hourly rate of utility worker labor (described in Section A3.9)
$WAGE_{Manager}$	Average manager wage rate (described in Section A3.9)

Assumptions:

- A scaling factor is used to increase baseline costs to reflect higher costs under the proposed provision. The contingency factor value in this equation is assumed to be equal to 2. The contingency factor value is based on an evaluation of special conditions, including individuals' level of specialization, potential difficulty in establishing alternative arrangements, the likelihood of cost premiums like travel per diem and the potential impact on at-power operation. In this section of the appendix, the contingency value ranges from 1 to 5. For this category, the contingency factor equals 2 due to the assignment flexibility of in-house staff and the lack of impact on at-power operation.

- The estimated level of effort to process an at-power waiver is 1 hour.

A3.7 At-Power Costs Associated With Individuals Involved in Tests or Integrated Evolution Who Will Not Meet the Proposed Waiver Requirements

This category addresses an estimate of the at-power cost associated with individuals involved in test or integrated evolution who will not meet the new waiver requirements. This group includes waivers associated with testing and other operational activities.

The *facility cost per waiver* results from the sum of the following factors:

- The labor cost associated with a shift schedule change that will not meet the new waiver requirements is the difference between the cost of labor for the proposed rule and the cost of labor pre-rule. The labor cost is calculated as follows:

  $$(NUM_{Utility\ Worker} \times (HOURS_{Utility\ Worker} + HOURS_{Turnover} \times 2) \times WAGE_{Utility\ Worker} \times CONTINGENCY_{Power_Test}) - (NUM_{Utility\ Worker} \times HOURS_{Utility\ Worker} \times WAGE_{Utility\ Worker})$$

- The management cost associated with a shift schedule change that will not meet the new waiver requirements is the cost of the additional management burden for planning and coordination. The management cost is calculated as follows:

  $$(1\ hour \times WAGE_{Manager})$$

Parameter	Description
$NUM_{Utility\ Worker}$	The number of utility workers impacted by shift schedule changes that will no longer be allowed
$HOURS_{Utility\ Worker}$	Hours worked per utility worker that exceeded the work hour requirements
$CONTINGENCY_{Power_Test}$	Contingency factor measuring the significance of expected resource loading associated with at-power test activities (described in assumptions below
$WAGE_{Utility\ Worker}$	The estimated hourly rate of utility worker labor (described in Section A3.9)
$HOURS_{Turnover}$	The estimated amount of time (in hours) associated with a turnover job briefing (described in assumptions below)
$WAGE_{Manager}$	Average manager wage rate (described in Section A3.9)

Assumptions:

- A scaling factor is used to increase baseline costs to reflect higher costs under the proposed provision. The contingency factor value in this equation is assumed to be equal to 3. The contingency factor value is based on an evaluation of special conditions, including individuals' level of specialization, potential difficulty in establishing alternative arrangements, the likelihood of cost premiums like travel per diem and the potential impact on at-power operation. In this section of the appendix, the contingency value ranges from 1 to 5. For this category, the contingency factor equals 3 due to the assignment flexibility of in-house staff and the increased importance of on-going operational activities.

- The estimated level of effort to process an at-power waiver is 1 hour.

- The estimated amount of time (in hours) associated with a turnover job briefing: 0.5 hours.

A3.8 At-Power Costs Associated With Individuals Involved in Return to Full Power Who Will Not Meet the Proposed Waiver Requirements

This category addresses an estimate of the at-power cost associated with individuals involved in activities that are associated with the return to full power who will not meet the new waiver requirements. This group includes waivers for individuals involved in repair activities that are not associated with technical specification equipment and that likely result in a power reduction. This analysis assumes that a facility will operate at 75% of its capacity.

The *facility cost per waiver* results from the sum of the following factors:

- The labor cost associated with a shift schedule change that will not meet the new waiver requirements is the difference between the cost of labor for the proposed rule and the cost of labor pre-rule. The labor cost is calculated as follows:

  $(NUM_{Utility\ Worker} \times (HOURS_{Utility\ Worker} + HOURS_{Turnover} \times 2) \times WAGE_{Utility\ Worker} \times CONTINGENCY_{Return\ to\ Rull\ Power}) - (NUM_{Utility\ Worker} \times HOURS_{Utility\ Worker} \times WAGE_{Utility\ Worker})$

- The management cost associated with a shift schedule change that will not meet the new waiver requirements is the cost of the additional management burden for planning and coordination. The management cost is calculated as follows:

  $(1\ hour \times WAGE_{Manager})$

- The return to power cost associated with operating at a reduced power level is the cost of allocating resources without the availability of a waiver. The return to power cost is calculated as follows:

  $HOURS_{Turnovers} \times REDUCED_POWER \times HCOST_{Outage}$

Parameter	**Description**
$NUM_{Utility\ Worker}$	The number of utility workers impacted by shift schedule changes that will no longer be allowed
$HOURS_{Utility\ Worker}$	Hours worked per utility worker that exceeded the work hour requirements
$CONTINGENCY_{Return\ to\ Full\ Power}$	Contingency factor measuring the significance of expected resource loading associated with return to full power activities (described in assumptions below)
$WAGE_{Utility\ Worker}$	The estimated hourly rate of utility worker labor (described in Section A3.9)
$HOURS_{Turnover}$	The estimated amount of time (in hours) associated with a turnover job briefing (described in assumptions below)
REDUCED_POWER	Percent of total power lost per hour from operating at a reduced power level (described in assumptions below)
$HCOST_{Outage}$	The hourly cost of delaying the completion of an outage (described in Section A3.9)
$WAGE_{Manager}$	Average manager wage rate (described in Section A3.9)

Assumptions:

- A scaling factor is used to increase baseline costs to reflect higher costs under the proposed provision. The contingency factor value in this equation is assumed to be equal to 5. The contingency factor value is based on an evaluation of special conditions, including individuals' level of specialization, potential difficulty in establishing alternative arrangements, the likelihood of cost premiums like travel per diem and the potential impact on at-power operation. In this section of the appendix, the contingency value ranges from 1 to 5. For this category, the contingency factor equals 5 due to the direct impact waivers have on production output.

- The estimated amount of time (in hours) associated with a turnover job briefing: 0.5 hours.

- The estimated level of effort to process an at-power waiver is 1 hour.

- Percent of total power lost per hour from operating at a reduced power level: 25%.

A3.9 Generic Costing Assumptions

- Management labor rate: $100/hour.

- The estimated hourly rate of utility craft labor: $40/hour.

- The estimated hourly rate of specialty contractors: $80/hour.

- The estimated hourly rate of local labor: $25/hour.

- The effectiveness of additional resources relative to those that are being augmented: 100%.

- The hourly cost of delaying the completion of an outage: $10,000.

- The estimated round trip travel fee used for contractor workers: $1,000.

- The estimated level of effort to process a waiver is 1 hour.

Addendum 1

METHODOLOGY AND ESTIMATED BENEFITS OF FOUR FATIGUE MANAGEMENT PROVISIONS OF THE PROPOSED FITNESS FOR DUTY RULE

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EXECUTIVE SUMMARY

This addendum analyzes the benefits associated with selected proposed worker fatigue provisions in Subpart I of 10 CFR Part 26. It quantifies only some of the benefits attributable to the proposed fatigue management provisions. As discussed in the main body of NRC's Regulatory Analysis of the proposed rule, the NRC has determined that the rulemaking would result in substantial additional benefits beyond those captured here. This addendum reviews four work-hour control provisions and assesses the benefits of these provisions. The four provisions were selected because they most directly affect licensee actions concerning the control of work hours and personnel work/rest schedules, were expected to result in significant benefits, and could be quantitatively analyzed. Other proposed fatigue management provisions (e.g., training, fatigue assessments) were not selected for quantitative analysis, although many are expected to result in significant benefits as discussed in the main body of the Regulatory Analysis, because their specific characteristics are less amenable to quantitative analysis. The four provisions were selected based on NRC staff judgment of the fatigue management provisions most likely to result in significant changes in worker fitness for duty. These provisions are:

§26.199(d)(3)	Restrictions on Granting Waivers
§26.199(d)(2)(i)	10-Hour Break Between Work Periods
§26.199(f)	48/54 Collective Average Work Hour Limit for Job Duty Groups
§26.199(d)(2)(ii-iii)	24-Hour Break Every Seven Days and 48-Hour Break Every 14 Days

Eight benefit areas were identified that are expected to represent the areas in which the majority of the benefits from a reduction in worker fatigue would be achieved. The eight benefit areas are:

- Reduction in the Frequency of Plant Trips
- Reduction in the Frequency of At-Power Severe Accidents
- Reduction in the Frequency of Shutdown Accidents
- Improved Fire Mitigation
- Reduction in Lost and Restricted Work Cases
- Improved Security Performance
- Improved Worker Productivity - Efficiency
- Improved Worker Productivity - Reduction in Rework

The Subpart I provisions that were not explicitly analyzed would establish requirements that support the selected provisions or provide various qualitative benefits, as discussed in the *Federal Register* notice for the proposed rule, or are provisions that did not change from current nuclear power plant technical specification requirements.

This analysis used quantitative human performance studies to determine the potential improvement in human performance and productivity associated with each of the four selected provisions. It estimated the applicability of the improved performance/productivity for each job duty group covered by the provision. It also determined applicability by examining the expected change in hours worked and also in the number of work-hour waivers authorized during at-power and shutdown conditions. The calculated benefit results from a comparison between the

current condition and the condition that would be expected following implementation of each fatigue management provision analyzed. The adverse impact due to the expected increase in job turnovers (the handoff of an in-progress job from one worker or group of workers to another worker or group of workers) is also addressed.

The benefits analysis calculated a $161 million dollar benefit (using a 7 percent discount rate) when compared to a baseline industry before the implementation of the NRC's April 29, 2003, order EA-03-038 limiting work hours for the security force (order 03-038). A $103 million dollar benefit was achieved if the baseline includes the implementation of order EA-03-038.

This report provides a systematic assessment of the benefits of implementing the proposed worker fatigue provisions. This report is organized into 10 sections as described below.

Section 1.0, **Introduction**, includes background information and presents the methodology used to determine the estimated benefits. This section also includes a summary of the quantitative results. A full discussion of the results is contained in Section 10.

Section 2.0, **Human Performance Studies**, provides a summary of the human performance studies used in this report. It also includes a discussion of the applicability of experimental test data to nuclear power workers. This discussion introduces the concepts of vigilant and reactionary responses as used in this report.

Section 3.0, **Job Duty Group Baseline Schedules**, discusses the baseline work schedules used as the point-of-reference for each work-hour provision assessed in this report. The section also includes an introductory discussion of the super-crew concept and contract maintenance personnel.

Section 4.0, **Areas of Potential Benefit**, presents the eight benefit areas used in this analysis.

Section 5.0, **Applicability of Job Duty Groups to Benefit Areas**, provides a discussion of the applicability of each job duty group discussed in Section 3.0 to each benefit area identified in Section 4.0.

Sections 6.0 to 9.0 of the report systematically assess each of the four selected provisions. Each section includes a discussion of the potential improvement in human performance and productivity that could result from implementation of the proposed provision, the applicability of this potential improvement to the different job duty groups, and the impact of the performance/productivity improvement on each of the benefit areas. The following provisions are addressed:

Section 6.0	§26.199(d)(3)	Restrictions on Granting Waivers
Section 7.0	§26.199(d)(2)(i)	10-Hour Break Between Work Periods
Section 8.0	§26.199(f)	48/54 Collective Average Work Hour Limit for Job Duty Groups
Section 9.0	§26.199(d)(2)(ii-iii)	24-Hour Break Every Seven Days and 48-Hour Break Every 14 Days

Section 10.0, **Conclusions**, summarizes the results of this analysis and includes a discussion of the insights and limitations.

The Appendices address eight areas (e.g., reduction in frequency of at-power severe accidents, improved fire mitigation, etc.) in which a significant quantifiable potential for improvement as a result of implementation of the proposed provision would be expected.

Results

Tables EX-1 through EX-4 summarize the results of this benefit analysis. These results are developed through the analysis described in Sections 6 through 9 and discussed more fully in Section 10. The benefit shown in these tables is the present value (using both a 7 and 3 percent discount rate) calculated to correspond to the average remaining life of all 103 nuclear power plants. The present values assume the rule would be implemented on January 1, 2007, and consider a 32.67 year average plant life. The tables present the data in two formats. Tables EX-1 and EX-2 show the benefit by job duty group using a 7 percent and 3 percent discount rate, respectively. Tables EX-3 and EX-4 show the benefit for each benefit area evaluated in this analysis using a 7 percent and 3 percent discount rate, respectively.

Table EX-1
Benefits of the Proposed Provisions By Job Duty Group Using a 7 Percent Discount Rate (In Millions)*

Job Duty Group	§26.199 (d)(1)(i-iii) and (d)(3) Waiver Provisions	§26.199 (d)(2)(i) 10-Hour Break Provision	§26.199(f) 48/54-Hour Average Provisions	§26.199 (d)(2)(ii-iii) Individual 24 & 48-Hour Break Provisions	Total
Operators	$0.81	$3.49	$7.99	$49.35	$61.6
Staff Maintenance	$0.36	$3.72	$2.05	$8.87	$15.0
Contract Maintenance	$0.13	$0.18	$0.50	$7.78	$8.6
HP/Chemistry	$0.10	$0.04	$0.18	$0.65	$1.0
Fire Brigade	$0.19	$0.60	$0.76	$11.23	$12.8
Security (before order EA-03-038)[1]	$0.81 [2]	$3.49 [3]	$7.99 [3]	$49.35 [3]	$61.6
Security (after order EA-03-038)[1]	$0 [4]	$0 [4]	$0 [4]	$4.03 [4]	$4.0
Total (before order EA-03-038)[1]	**$2.4**	**$11.5**	**$19.47**	**$127.2**	**$161****
Total (after order EA-03-038)[1]	**$1.6**	**$8.0**	**$11.5**	**$81.9**	**$103****

* *Footnotes follow Table EX-4.*

** *Consideration of productivity related issues of efficiency and rework could add as much as $290 million in additional benefit.*

Table EX-2
Benefits of the Proposed Provisions By Job Duty Group Using a 3 Percent Discount Rate
(In Millions)*

Job Duty Group	§26.199 (d)(1)(i-iii) and (d)(3) Waiver Provisions	§26.199 (d)(2)(i) 10-Hour Break Provision	§26.199(f) 48/54-Hour Average Provisions	§26.199 (d)(2)(ii-iii) Individual 24 & 48-Hour Break Provisions	Total
Operators	$1.32	$5.66	$12.96	$80.08	$100.0
Staff Maintenance	$0.58	$6.03	$3.33	$14.40	$24.3
Contract Maintenance	$0.21	$0.29	$0.81	$12.62	$13.9
HP/Chemistry	$0.16	$0.06	$0.30	$1.06	$1.6
Fire Brigade	$0.30	$0.98	$1.23	$18.22	$20.7
Security (before order EA-03-038)[1]	$1.32 [2]	$5.66 [3]	$12.96 [3]	$80.08 [3]	$100.0
Security (after order EA-03-038)[1]	$0 [4]	$0 [4]	$0 [4]	$6.54 [4]	$6.5
Total (before order EA-03-038)[1]	**$3.9**	**$18.7**	**$31.6**	**$206.4**	**$261****
Total (after order EA-03-038)[1]	**$2.6**	**$13.0**	**$18.6**	**$132.9**	**$167****

* *Footnotes follow Table EX-4.*
** *Consideration of productivity related issues of efficiency and rework could add as much as $471 million in additional benefit.*

Table EX-3
Benefits of the Proposed Provisions By Benefit Area Using a 7 Percent Discount Rate
(In Millions)*

Benefit Area	§26.199 (d)(1)(i-iii) and (d)(3) Waiver Provisions	§26.199 (d)(2)(i) 10-Hour Break Provision	§26.199(f) 48/54-Hour Average Provisions	§26.199 (d)(2)(ii-iii) Individual 24 & 48-Hour Break Provisions	Total
Trips	$0.08	$2.38	$4.89	$4.37	$11.7
At-Power Severe Accidents	$0.01	$1.99	$1.71	$1.68	$5.4
Shutdown Accidents	$0.52	$0.28	$0.77	$23.88	$25.5
Fire	$0.70	$2.87	$3.20	$36.67	$43.4
Lost Work Cases	$0.27	$0.50	$0.91	$11.28	$13.0
Security (before order EA-03-038)[1]	$0.81 [2]	$3.49 [3]	$7.99 [3]	$49.35 [3]	$61.6
Security (after order EA-03-038)[1]	$0 [4]	$0 [4]	$0 [4]	$4.03 [4]	$4.0
Total (before order EA-03-038)[1]	**$2.4**	**$11.5**	**$19.5**	**$127.2**	**$161****
Total (after order EA-03-038)[1]	**$1.6**	**$8.0**	**$11.5**	**$81.9**	**$103****

* *Footnotes follow Table EX-4.*

** *Consideration of productivity related issues of efficiency and rework could add as much as $290 million in additional benefit.*

Table EX-4
Benefits of the Proposed Provision By Benefit Area Using a 3 Percent Discount Rate
(In Millions)*

Benefit Area	§26.199 (d)(1)(i-iii) and (d)(3) Waiver Provisions	§26.199 (d)(2)(i) 10-Hour Break Provision	§26.199(f) 48/54-Hour Average Provisions	§26.199 (d)(2)(ii-iii) Individual 24 & 48-Hour Break Provisions	Total
Trips	$0.13	$3.87	$7.93	$7.08	$19.0
At-Power Severe Accidents	$0.02	$3.23	$2.78	$2.73	$8.8
Shutdown Accidents	$0.84	$0.46	$1.24	$38.75	$41.3
Fire	$1.14	$4.66	$5.19	$59.49	$70.5
Lost Work Cases	$0.44	$0.82	$1.48	$18.30	$21.0
Security (before order EA-03-038)[1]	$1.32 [2]	$5.66 [3]	$12.96 [3]	$80.08 [3]	$100.0
Security (after order EA-03-038)[1]	$0 [4]	$0 [4]	$0 [4]	$6.54 [4]	$6.5
Total (before order EA-03-038)[1]	**$3.9**	**$18.7**	**$31.6**	**$206.4**	**$261****
Total (after order EA-03-038)[1]	**$2.6**	**$13.0**	**$18.6**	**$132.9**	**$167****

* *Footnotes follow this table.*

** *Consideration of productivity related issues of efficiency and rework could add as much as $471 million in additional benefit.*

Footnote 1: Security Order

There were no NRC -specific requirements limiting work hours for security force personnel prior to the April 29, 2003, issuance of order EA-03-038 limiting their work hours. Order EA-03-038 established compensatory measures in the aftermath of the events of September 11, 2001. The requirements contained in order EA-03-038 are similar to those of the proposed provisions, with the exception of the new provisions associated with a 24-hour break in any 7-day period and a 48-hour break in any 14-day period.

Footnote 2: Waivers

Order EA-03-038 noted that work hour demands on security force personnel had increased substantially over the preceding 18 months, and the current terrorist threat environment continued to required heightened security measures. While security forces had no NRC-specific work hour limits prior to order EA-03-038, security work hours were generally within the technical specification limits for operations personnel. Therefore, this estimate is based on the assumption that the role of security is equal to the performance role of operations.

Footnote 3: Work Hour Provisions - Before Order EA-03-038

The security force benefit was estimated by using the applicable performance benefits from operations, with the exception of the benefit from the waiver provisions (See Footnote 2). This estimate is considered to have large uncertainty, given the unknown likelihood of future security events. The role of security was assumed to be equal to the role of operations in preventing core damage. See the Improved Security Benefit Area, Appendix F.

Footnote 4: Work Hour Provisions - After Order EA-03-038

The requirements contained in order EA-03-038 are similar to those of the proposed provisions, with the exception of the proposed provisions associated with a 24-hour break in any 7-day period and a 48-hour break in any 14-day period. Therefore, because order EA-03-038 has already been implemented, only the individual break provisions would provide further benefit. Because order EA-03-038 included a requirement for a 60-hour average during outages, the benefit from the 24- and 48-hour break provisions was conservatively assumed to be 0. The break provisions are expected to result in savings during outages that were not quantified, as some sub-sets of the security force may work over 60 hours a week, and not receive the breaks. However, the analysis conservatively assumed no outage benefit. See the Improved Security Benefit Area, Appendix F, for a qualitative discussion on security and a further discussion on the assumptions for the security force.

ABBREVIATIONS

AOC	Averted Offsite Property Damage Costs
AOE	Averted Offsite Exposure
AOSC	Averted Onsite Costs
APE	Averted Public Exposure
BLS	Bureau of Labor Statistics
BWR	Boiling Water Reactor
CDF	Core Damage Frequency
CDP	Core Damage Probability
DOE	Department of Energy
EIA	Energy Information Administration
EU	European Union
FFD	Fitness-for-Duty
FIVE	Fire-Induced Vulnerability Evaluation
FPRAIG	Fire PRA Implementation Guide
GEIS	Generic Environmental Impact Statement for License Renewal of Nuclear Plants
GL	Generic Letter
HP	Health Physics
IEP	Improved Efficiency Productivity
IHP	Improved Human Performance
INEEL	Idaho National Engineering and Environmental Laboratory
IPE	Individual Plant Examination
IPEEE	Individual Plant Examination of External Events
LER	Licensee Event Reports

MAB	Maximum Attainable Benefit
MAC	Maximum Avoided Cost
NECA	National Electrical Contractors Association
NEI	Nuclear Energy Institute
NI	Net Improvement
NRC	Nuclear Regulatory Commission
O&M	Operations and Maintenance
PA	Performance Applicability
POGO	Project on Government Oversight
POS	Plant Operational State
PVT	Psychomotor Vigilance Task
PRA	Probabilistic Risk Assessment
PROS	Professional Reactor Operator Society
PSF	Performance Shaping Factor
PWR	Pressurized Water Reactor
RPC	Replacement Power Costs
SAMA	Severe Accident Mitigation Alternatives
SER	Safety Evaluation Report
SIC	Standard Industrial Classification
SPAR	Standardized Plant Analysis Risk (Model)

1. INTRODUCTION

1.1 Objective

The purpose of this addendum is to provide the methodology and technical bases for the NRC staff's quantitative benefit analysis of selected proposed worker fatigue management provisions in Subpart I of proposed 10 CFR Part 26. It quantifies only some of the benefits attributable to the proposed fatigue management provisions. As discussed in the main body of NRC's Regulatory Analysis for the proposed rule, the NRC has determined that the rulemaking would result in substantial additional benefits beyond those described here.

1.2 Summary of Proposed Provision Changes

Proposed §26.199(a)(1-5) specifies the scope of personnel who would be subject to the work hour control provisions of proposed Subpart I, which includes any individual who performs duties within the following job duty groups:

(1) Operating or on-site directing of the operation of systems and components that a risk-informed evaluation process has shown to be significant to public health and safety,

(2) Performing maintenance or on-site directing of the maintenance of structures, systems, and components that a risk-informed evaluation process has shown to be significant to public health and safety,

(3) Performing Health Physics or Chemistry duties required as a member of the on-site emergency response organization minimum shift complement;

(4) Performing the duties of a Fire Brigade member who is responsible for understanding the effects of fire and fire suppressants on safe shutdown capability; and

(5) Performing security duties as an armed security force officer, alarm station operator, response team leader, or watchperson.

Proposed §26.199(d)(3) establishes the requirements for authorizing waivers for individuals subject to work hour controls. Under the proposed provision, two requirements would need to be satisfied before a waiver could be authorized. Proposed §26.199(d)(3)(i)(A) would require an operations shift manager to determine that the waiver was necessary to mitigate or prevent a condition adverse to safety, or a security shift manager to determine that the waiver was necessary to maintain the security of the facility, or a site senior-level manager with requisite signature authority would have to make either determination. Proposed §26.199(d)(3)(i)(B) would require that a supervisor, who is qualified to direct the work to be performed by the individual and who is trained in accordance with the requirements of proposed §§26.29 and 26.197(c), would have to assess the individual face to face and determine that there is reasonable assurance that the individual would be able to safely and competently perform his or her duties during the additional work period for which the waiver would be granted.

Introduction

Proposed §26.199(d)(2)(i) would require that workers be given a break of at least 10 hours between work periods in order to be provided the opportunity to get adequate sleep for the next work period. NRC's Policy on Factors Causing Fatigue of Operating Personnel at Nuclear Power Plants (NRC's Policy on Worker Fatigue) currently recommends that workers be provided 8 hours between work periods. Proposed §26.199(d)(2)(i) would specify that turnover activities are permitted during the 10-hour break between successive work periods. Some shift scheduling arrangements would also be permitted that would result in an occasional 8-hour break during scheduled shift transitions.

Proposed §26.199(f) specifies that licensees must not exceed a collective group average of 48 hours of work per week (over a period not to exceed 13 weeks) for each group of individuals who are performing similar job duties. However, the proposed provision would permit plant management to extend the average work hour limitations to 54 hours for conditions which could not reasonably be controlled. These collective work hour controls would address the long-term control of work hours, including the limited use of overtime for occasional short-term exigent circumstances (e.g., equipment failure, personnel illness or attrition).

The group average requirement is a new concept developed to meet the NRC's objectives while addressing the unique circumstances and specific concerns of the stakeholders. The intent of this proposed provision is to recognize and allow for individual differences in ability to work long hours, which may result from individual differences in sleep need, the ability to recover from work, and in the level of domestic and social responsibilities. Thus, the provision allows for some individuals within a job duty group to work longer than the 48 or 54 hours per week collective average limit, as long as their hours are offset by other individuals in that job duty group working fewer hours than the collective average limit.

The work hour controls in proposed §26.199(d) for the 24-hour period and the 7-day period are the same as stated in NRC's Policy on Worker Fatigue. The work hour control for the 48-hour period in proposed §26.199(d)(1)(ii), is 26 hours, in contrast with NRC's Policy on Worker Fatigue, which recommends limiting work hours to 24 hours in a 48-hour period. This change would be made to accommodate the fact that today most nuclear power plant sites routinely work 12-hour shifts for most job duty groups during outages, and many also work 12-hour shifts for some job duty groups during at-power conditions, in contrast with the routine 8-hour shifts that were prevalent when the policy was promulgated. The policy effectively permitted a worker to work one 16-hour double shift, followed by an 8-hour break, and then to start an 8-hour shift at the worker's normal starting time, but only in very unusual circumstances. Now that most plants are working routine 12-hour shifts, the proposed rule would increase the maximum work hours in a 48-hour period from 24 hours to 26 hours to decrease the administrative burden of approving waivers for personnel working 12-hour shifts who are held over for short periods to accommodate a delayed relief or similar circumstances. The proposed §26.199(d)(1)(i) provision that would permit 16 work hours in any 24-hour period and the proposed §26.199(d)(1)(iii) provision that would permit 72 work hours in any 7-day period were not assessed in this analysis due to their similarity with the current guidance. The proposed relaxation of the hours worked in a 48-hour period would provide a substantive reduction in burden with a negligible net effect on human performance reliability and therefore also was not assessed in this analysis.

Introduction

The arrangement of the discussion of the above provisions reflects the order in which the proposed provisions were evaluated. The discussion above does not suggest any evaluation of the relative importance of the proposed provisions.

1.3 Methods Used to Determine the Benefits of the Selected Proposed Provisions

Section 1.3.1 describes the overall benefit analysis process. The step-by-step analysis used for each proposed provision is described in Section 1.3.2.

1.3.1 Process Overview

The benefits of implementing the selected proposed worker fatigue provisions were estimated by analyzing four proposed provisions (see Table 1-1) in conjunction with a set of potential benefit areas. The four provisions were selected because they most directly affect licensee actions concerning the control of work hours and personnel work/rest schedules, were expected to result in significant benefits, and could be quantitatively analyzed. Other proposed fatigue management provisions (e.g., training, fatigue assessments) were not selected for quantitative analysis, although many are expected to result in significant benefits as discussed in the main body of the Regulatory Analysis, because their specific characteristics are less amenable to quantitative analysis. The four provisions were selected based on NRC staff judgment of the fatigue management provisions most likely to result in significant changes in worker fitness for duty. Eight benefit areas were identified that are expected to represent the areas in which the majority of the benefits from a reduction in worker fatigue would be achieved.

It is important to note the interactions between provisions. The implementation of one provision can change the benefit derived from another provision. To address this interaction, the provisions were assessed in a specific order, with each subsequent evaluation considering the impact of the previously evaluated provision(s). The selected order starts with provisions that principally address acute fatigue impacts (waiver and 10-hour break provisions) and progresses to provisions that are more focused on cumulative fatigue impacts (48 and 54 collective average work hour limits, and 24 and 48 hour break provisions).

Base: Current Industry Practices Concerning Work Scheduling and Worker Fatigue

To ensure a common frame of reference, a “base” starting point was established. The base represents the current industry practices concerning work scheduling and fatigue management (including current waiver practices). NRC’s Policy on Worker Fatigue uses the term “deviation” to refer to temporary exemptions from work-hour controls; proposed Subpart I uses the term “waiver.” A set of baseline schedules associated with each job duty group and applicable attribute (i.e., plant condition, shift or staff worker, etc.) was developed. However, because waivers would be authorized at different rates during at-power and shutdown conditions and between utility and contractor personnel, and because waivers would impact multiple requirements (8-hr break, 72-hour limit, etc.), including the impact of waivers in the set of baseline schedules would substantially increase the number of analyzed schedules. Therefore, the set of baseline schedules does not include the current approach of authorizing waivers for work-hour controls. That is, the baseline schedules represent the industry’s practice for scheduling its workers during at-power and shutdown operations, assuming full compliance with

the current work-hour controls and without waivers. The benefit associated with the proposed waiver restrictions was developed from a review of waiver data from a sample of 6 nuclear power plants rather than from establishing baseline schedules specific to the current waiver practices. The waiver data is summarized in Appendix 3 to the main body of the Regulatory Analysis.

Table 1-1 shows the evaluation order used in this analysis.

Table 1-1
Proposed Provision Reference Table

Tier		Description
Base		Current industry practices concerning work scheduling and fatigue management
1	§26.199(d)(3)	Licensees may grant a waiver of the individual work hour controls in (d)(1-2) only if it is necessary for the safety or security of the plant and the worker has been judged fit to work the additional hours
	§26.199(a)(1-5)	Specifies the job duty groups subject to work hour controls: (1) operations, (2) maintenance, (3) health physics and chemistry, (4) fire brigade and (5) security
	§26.199(d)(1)(i-iii)	Individual work hours must not exceed: (i)16 hours in any 24-hour period, (ii) 26 hours in any 48-hour period and (iii) 72 hours in any 7-day period
2	§26.199(d)(2)(i)	Individuals must receive a 10-hour rest break between successive work periods
3	§26.199(f)	Collective work hours of each job duty group cannot exceed an average of 48 hours per person per week in any 13-week averaging period except (i) during the first 8 weeks of a plant outage for job duty groups specified in (a)(1-4); (ii) under circumstances that cannot be reasonably controlled, the group average cannot exceed 54 hours per person per week
4	§26.199(d)(2)(ii-iii)	Individuals must receive: (ii) a 24-hour rest break in any 7-day period and (iii) a 48-hour rest break in any 14-day period (except during the first 14 days of an outage)

The analysis of tier 1 calculates the estimated benefit from the baseline to tier 1. The analyses of additional tiers calculate the estimated marginal benefit from the previous tier(s) to the proposed tier.

Introduction

Security

On April 29, 2003, following an NRC review of the control of work hours for security force personnel and public interaction with stakeholders, NRC issued order EA-03-038 to limit work schedules for security personnel. Prior to order EA-03-038, the NRC had not limited the work hours of security personnel. Order EA-03-038 followed the approach taken by work hour controls established in the NRC's Policy on Worker Fatigue. Security personnel is one of the job duty groups that would be subject to the work hour controls considered in this analysis. As a consequence of the unique history of this job duty group, the evaluation of proposed provisions for security is divided into two states: (1) before order EA-03-038 and (2) after order EA-03-038.

The estimated benefit of the work hour control provisions for the security force was determined differently from that of other job duty groups included in this analysis. Information relevant to the baseline work schedules and the effectiveness of the security force response to terrorist attacks is considered sensitive, non-publicly available information. Further, the likelihood of future security events is uncertain. Therefore, the approach avoids the direct assessment of work schedules and security force effectiveness by assuming the benefits estimated for operations are equivalent to those of the security force. The operator-related benefits were then adjusted as necessary to derive the benefits for the security force. The details of this approach are discussed in Appendix F. As a result of this approach, the work schedules for the security force are not addressed in Section 3 and the benefits for the security force are shown only at the summary level.

1.3.2 Detailed Methodology Used to Evaluate Each Proposed Provision

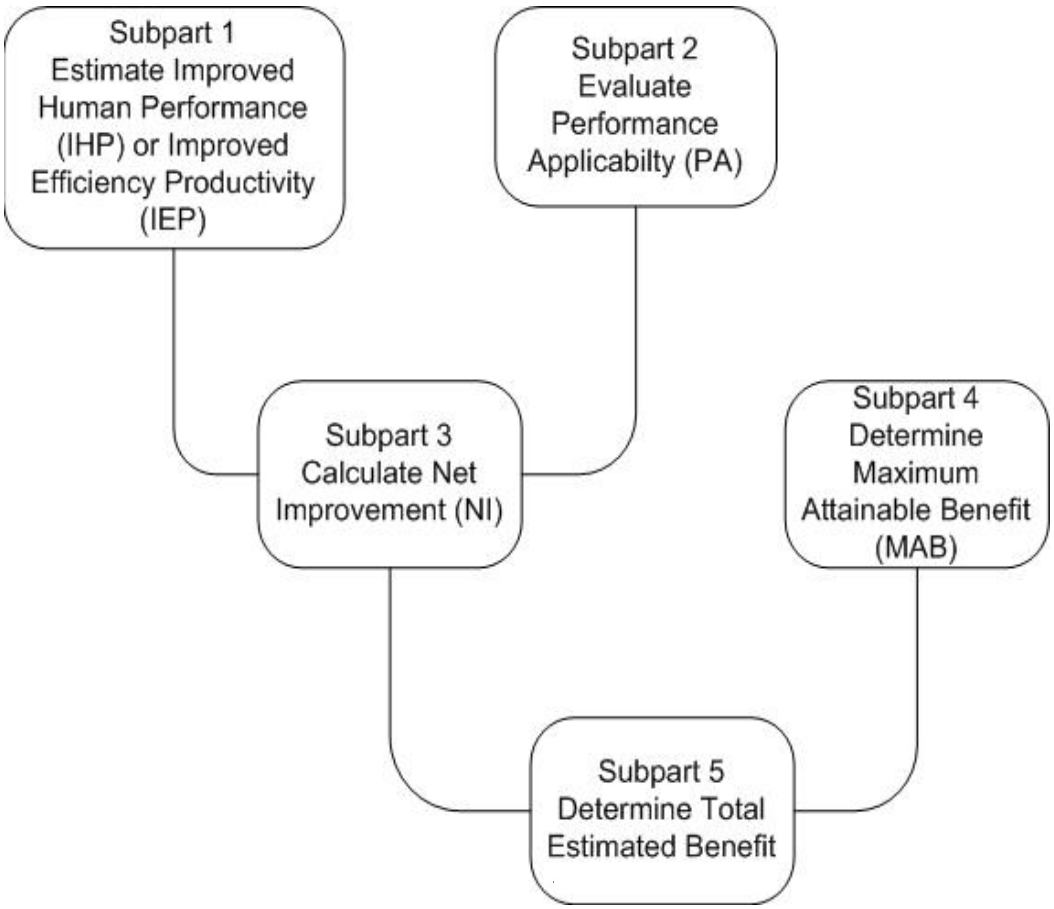
This benefit analysis determines both quantitative and qualitative benefits that are expected to result from implementing the four selected work hour control provisions of the proposed rule. The quantitative analysis contains the following subparts.

1. Improved Human Performance (IHP) or Improved Efficiency Productivity (IEP)
2. Performance Applicability (PA)
3. Net Improvement (NI)
4. Maximum Attainable Benefit (MAB)
5. Benefit Integration

Figure 1-1 shows the relationship between the quantitative analysis subparts.

Introduction

Figure 1-1
Quantitative Benefit Analysis Process



Each quantitative subpart is described below and is summarized in Table 1-2.

Analysis Subpart 1: Improved Human Performance (IHP) or Improved Efficiency Productivity (IEP)

This analysis subpart uses quantitative human performance studies to estimate the maximum attainable improvement in human performance for each analyzed provision.

Step 1a *Select provisions for quantitative analysis.*

The analyzed provisions are shown in Table 1-1. These provisions were selected because they most directly affect licensee actions concerning the control of work hours and personnel work/rest schedules, were expected to result in significant benefits, and could be quantitatively analyzed. Other proposed

fatigue management provisions (e.g., training, fatigue assessments) were not selected for quantitative analysis, although many are expected to result in significant benefits as discussed in the main body of the Regulatory Analysis, because their specific characteristics are less amenable to quantitative analysis.

Step 1b *Determine the analysis order of the selected provisions.*

The analysis of each provision was performed in a hierarchical order to prevent overestimating the benefit of any single provision, because the implementation of one provision could change the benefit derived from another requirement when considering the presence or absence of the first requirement. To address this interaction, the provisions were assessed in a specific order, with each subsequent evaluation considering the impact of the previously evaluated provisions. The selected order generally starts with acute fatigue impacts (waiver and 10-hour break provisions) and progresses to cumulative fatigue impacts (48 and 54 collective average work hour limits, and 24 and 48 hour break provisions). The order was selected for analytical convenience and should not be considered an indication of relative importance of each provision to fatigue management. Table 1-1 shows the provisions in the analyzed order.

Step 1c *Determine the change in the requirements between each proposed provision and the current work hour limits.*

This step evaluated the difference between the current work hour limits implemented in licensees' technical specifications or procedures and the proposed provisions. Each evaluation considered the previously assessed provisions, as discussed in Step 1b.

Step 1d *Calculate the maximum* ***Improved Human Performance (IHP)*** *or* ***Improved Efficiency Productivity (IEP)*** *for each provision.*

Improved Human Performance (IHP) indicates the change in performance of an average worker when fatigue is mitigated or eliminated. IHP represents the change in performance (i.e., the complications and errors which will be avoided by workers under the proposed provisions) for a typical worker on any one day that fatigue is mitigated by the proposed provisions.

Based on an assessment of human performance studies (see Section 2), this step evaluated the maximum IHP that could be attained if all workers adjusted their work hours from the limits of the current requirements to the limits of the proposed provisions. Because only a small percentage of a worker's time is worked at these limits, the actual improvement in performance would be significantly less than that calculated by this step. Analysis subpart 2 addressed this issue by assessing the expected change. The IHP quantifies the value of improved human performance as applied to the improved plant safety.

Introduction

Based on an assessment of human performance studies (see Section 2), this step evaluated the maximum Improved Efficiency Productivity (IEP) that could be attained if all workers adjusted their work hours from the limits of the current requirements to the limits of the proposed provisions. Because only a small percentage of a worker's time is worked at these limits, the actual improvement in performance would be significantly less than that calculated by this step. Analysis subpart 2 addressed this issue by assessing the expected change. The IEP quantifies the value of improved human performance as applied to the improved plant safety.

Analysis Subpart 2: Performance Applicability (PA)

The applicability of the IHP determined in Step 1d to a job duty group was determined by the work schedules (shift, non-shift, etc.) and practices (emergent maintenance, super-crew, etc.). This analysis subpart determine the change in the schedule and practices between the current practices and the provisions in the proposed rule.

Step 2a *Determine the baseline work schedule or practices for each job duty group.*

This step established the baseline work schedule or work practices for each job duty group. Often job duty groups were subdivided to reflect issues associated with plant operational modes and job duty group applicability. The baseline was determined consistent with the analysis order discussed in Step 1b. The initial baselines are described in Section 3. Changes to these baselines as a result of other analyzed provisions are discussed in the assessment sections of each provision (Sections 6, 7, 8 and 9).

Step 2b *Determine the projected work schedule or practices for each job duty group expected after implementation of the proposed provision.*

This step determined the estimated change in work schedule or work practice that results following implementation of each provision. These changes are detailed in the section describing each provision (Sections 6,7,8 and 9).

Step 2c *Based on the change in work schedule or practices, determine the **Performance Applicability (PA)**.*

This step evaluated the overall applicability of the IHP/IEP determined in Step 1d for each job duty group. The PA value represents the fraction of a job duty group's work time that would benefit from the improved human performance/productivity. The PA was determined by evaluating the change in the work schedules or practices between Steps 2a and 2b.

Analysis Subpart 3: Net Improvement (NI)

This subpart determined the net improvement expected from each job duty group. The improvement was calculated based on information derived from Subparts 1 and 2, and then

adjusted to account for the expected adverse impact of the increased number of job turnovers. The adverse impact is primarily concerned with communication errors that could result due to an expected increase in the number of job turnovers.

Step 3a: *Calculate the **Net Improvement (NI)***

The NI was determined by multiplying the applicable IHP/IEP (Analysis Subpart 1) by the applicable PA (Analysis Subpart 2). Net Improvement quantifies the change in worker performance/productivity over time. NI is the percentage of improvement in worker performance/productivity under each proposed provision.

Step 3b: *Determine the impact that results from a change in the number of shift turnovers.*

This step provides an estimate of the impact of increased shift turnovers. It considers both the expected increase in shift turnovers (which results in a potential increase in total communication errors due to the increased number of turnovers) and the improved human performance that will result from reduced worker fatigue during these turnovers. This determination is documented in Sections 6, 7, 8 and 9.

Step 3c *Adjust the NI by subtracting the impact of shift turnovers (Step 3b).*

This step calculated the final net improvement number for each job duty group that was used in analysis Subpart 5 to determine the estimated benefit.

Analysis Subpart 4: Maximum Attainable Benefit (MAB)

Benefit areas are improvements in the protection of public health and safety and reductions in plant operational costs that offset costs associated with implementation of the proposed requirements. For each identified benefit area, the maximum attainable benefit, assuming all human error is eliminated, was determined. Since there are many other sources of human error, only a portion of the benefit that could be achieved by eliminating all human error would be achieved by the proposed provisions.

Step 4a *Identify potential benefits that could result in improved human performance.*

Eight benefit areas were identified that are expected to represent the areas in which the majority of the benefits from a reduction in worker fatigue would be achieved. These are summarized in Section 4.

Step 4b *Determine the **Maximum Attainable Benefit (MAB)** for each identified benefit area.*

For each benefit area, two estimated MABs were obtained. These MABs are the present value equivalents, using both a 7 and 3 percent discount rate, that were calculated to correspond to the average remaining life of all 103 nuclear power

plants. The present values assume the rule would be implemented on January 1, 2007, and consider a 32.67 year average plant life. The MAB associated with the 7 percent discount rate is used throughout the evaluation. The results associated with the 3 percent discount rate are summarized in the 'Benefit of the Proposed Provision' tables (Section 10), but specific calculations using this discount rate are not shown throughout the evaluation.

Analysis Subpart 5: Benefit Integration

The estimated benefit was determined by evaluating the applicable MAB (Step 4b) associated with each benefit area in conjunction with the net improvement that was determined in Step 3c.

Step 5a *Determine the applicability of each benefit area.*

Not all benefit areas are applicable to a job duty group and/or plant mode of operation. This step evaluated the applicability of the net improvement determined in Step 3c to each benefit area.

Step 5b *Calculate the estimated benefit for each job duty group and benefit area.*

This step calculated the estimated benefit for each job duty group by multiplying the MAB of each benefit area by the job duty group's NI. Adjustments were sometimes made to reflect unique issues associated with a benefit area or job duty group, as discussed in the sections where adjustments were applied.

Step 5c *Determine the total estimated benefit.*

This was the final step in the quantitative benefit analysis. The results are summed by job duty groups in Tables EX-1 and EX-2 and by benefit area in Tables EX-3 and EX-4.

Introduction

Table 1-2
Quantitative Benefit Analysis - Methodology Summary

Analysis Subpart 1: Improved Human Performance (IHP) or Improved Efficiency Productivity (IEP)	
1a	Select provisions for quantitative analysis.
1b	Determine the analysis order of the selected provisions.
1c	Determine the change in the requirements between each proposed provision and the current work hour limits.
1d	Calculate the maximum Improved Human Performance (IHP) or Improved Efficiency Productivity (IEP) for each provision.
Analysis Subpart 2: Performance Applicability (PA)	
2a	Determine the base work schedule or practices for each job duty group.
2b	Determine the projected work schedule or practices for each job duty group expected after implementation of the proposed provision.
2c	Based on the change in work schedule or practices, determine the Improved Performance Applicability (IPA).
Analysis Subpart 3: Net Improvement (NI)	
3a	Calculate the Net Improvement (NI)
3b	Determine the impact that results from a change in the number of job turnovers.
3c	Adjust the NI by subtracting the impact of job turnovers (Step 3b).
Analysis Subpart 4: Maximum Attainable Benefit (MAB)	
4a	Identify potential benefits that could result in improved human performance.
4b	Determine the Maximum Attainable Benefit (MAB) for each identified benefit area.
Analysis Subpart 5: Benefit Integration	
5a	Determine the applicability of each benefit area.
5b	Calculate the estimated benefit for each job duty group and benefit area.
5c	Determine the total estimated benefit.

2. HUMAN PERFORMANCE STUDIES

This section describes how specific quantitative human performance studies associated with the effects of fatigue and work schedules were used in this analysis to quantify the impact of fatigue on worker performance and productivity.

2.1 Methods to Quantify the Degree of Fatigue in Workers

Scientists have developed several methods for quantifying the effects of fatigue on human performance. Studies using two of these methods are particularly useful for predicting the effects of fatigue and fatigue mitigation on nuclear industry workers.

One of the two tests is the Psychomotor Vigilance Test (PVT) which quantifies the effects of fatigue by observing human subjects attempting to respond to simple stimuli in various fatigue states. It is a simple but highly sensitive reaction test in which responses to a light signal are required on a serial basis for 5 or 10 minutes at a time. The behavior of interest in the test is the number of lapses that occur during the test. A lapse is an occasion in which the subject mentally “freezes up” and has an unusually slow response time.

The number of these lapses has been shown to be a good indication of fatigue, and the PVT has recently become the standard of performance measurement in sleep deprivation studies (e.g., Dinges, et al., 1997; Belenky, et al., 2003). The PVT has been used in ‘real-world’ studies to link fatigue experienced during nightwork to performance impairment (Lamond et al., 2004), to test the association between sleep apnea syndrome and an increased risk of automobile accidents (Barbe et al., 1998), and has been correlated to the Occupational Safety Performance Test (measuring hand-eye coordination) that has also been used as a fitness-for-duty measure in a variety of industries (Petrilli et al., 2005). Both the 10-minute and 5-minute PVT are considered viable performance metrics by the human performance community (Loh et al., 2004).

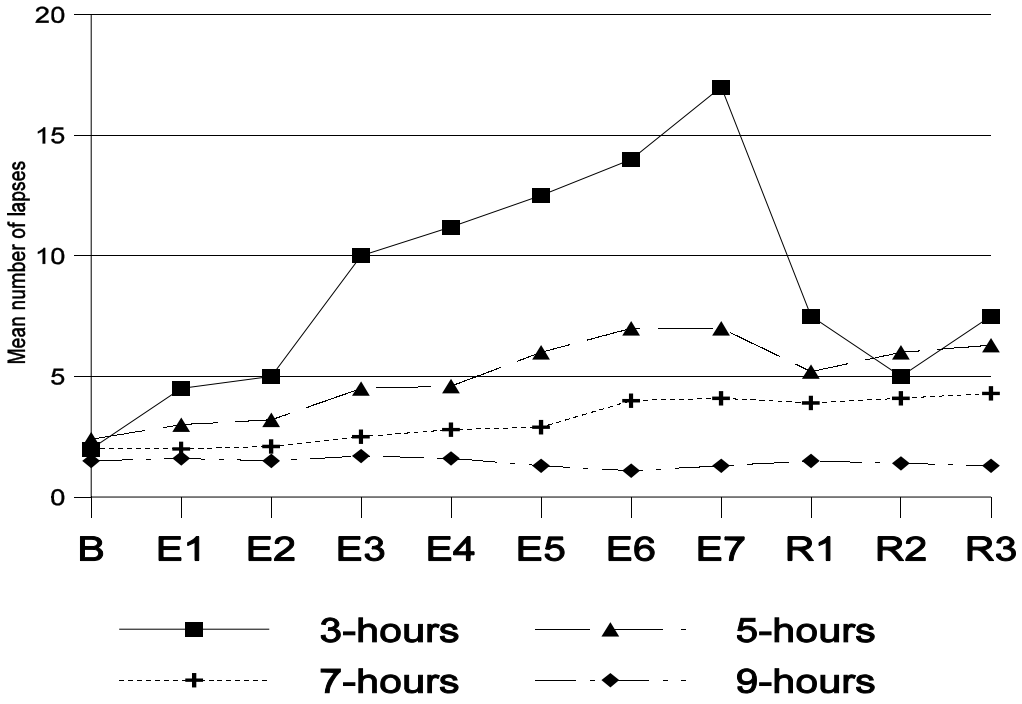
The second method is the observation of hours of work and the number of accidents in the work place. Recent studies have indicated that increasing occupational accident risk is proportional to increasing fatigue. Occupational risk as it pertains to a work shift duration is explored by Hanecke and colleagues (1998).

Human performance studies indicate that human tolerance for fatigue varies with work schedules and other individual factors. Most people perform best on a typical daytime work schedule, while some prefer an evening work schedule. Similarly, some workers perform best in short bursts of intense work periods, whereas other workers may be able to tolerate only a few very long days. This analysis did not consider the human performance variability associated with work performed during different times of day. The analysis also did not consider the varying constitutions of individual workers.

2.2 Data and Conclusions From Human Performance Studies

The relationship between partial sleep deprivation and lapses as evaluated by the PVT has been explored in several studies. The data used in this analysis were taken from a study performed by the Walter Reed Army Institute of Research, referred to here as the Belenky study (Belenky, et al 2003). The results are reproduced as a graph in Figure 2-1.

Figure 2-1
Sleepiness and Sleep Deprivation
(From Belenky, 2003)



Notes: In Figure 2-1, "B" (Baseline) is defined as the beginning of the first day of the study, before a workday with fully rested workers, "E" (End of Day) is defined as the end of a day during which the subject performed work duties, "R" (Rest) is defined as days in which the subject slept freely and did not perform work duties.

In the study, 66 subjects were held under controlled conditions. The subjects were given PVT tests four times a day over an eleven day period. One of the test days was used to establish the baseline, seven test days were associated with sleep restriction days and three were recovery days as shown in Figure 2-1. Two days prior to the baseline study day were used for indoctrination and sleep schedule standardization. The data points shown in Figure 2-1 were published in the Belenky study and are the average of the four tests that were performed each day. This pattern was continued for these subjects, who each received controlled periods of sleep of either 3, 5, 7, or 9 hours of sleep per day, as shown by the different lines in Figure 2-1. The mean lapses for the entire group are presented as the results of the study. The subjects in the study were commercial vehicle operators: 16 were women with a mean age of 43 years

and 50 were men with an average age of 37 years. Employees in the nuclear power industry are comparable in age to the study group, and of average health, which is expected to lead to a similar amount of fatigue-related task errors (Campbell, 1995; Carrier et al., 1997). Therefore, use of the Belenky study in this analysis is expected to be a reasonable estimate of the performance improvement of mitigated fatigue in the nuclear power industry.

The Belenky study was used extensively in developing this benefits analysis. Dr. Greg Belenky is a recognized expert in the field of human fatigue, directing the research program in Human Chronobiology and Sleep at the University of Washington. The study was published in the *Journal of Sleep Research*, one of two top journals in the field. The other top journal, *Sleep*, has published a number of articles that cite the Belenky study. Authors citing the work include leaders in the field such as Dr. Charles Czeisler and Dr. David Dinges. Since 2003, the Belenky study has been cited in at least 24 publications.

A study performed by Dr. Han Van Dongen et al. in 2003 titled "The Cumulative Cost of Additional Wakefulness" is consistent with the Belenky study. The Van Dongen study evaluated chronic sleep restriction in separate groups of individuals who each maintained one of three sleep periods (4 hours, 6 hours or 8 hours time in bed per night) for 14 consecutive days. The subjects were healthy adults who were screened to ensure they had no medical, psychiatric or sleep-related disorders and were drug-free. The subjects reported working neither regular night nor rotating shift work within the past 2 years, and their average age was 28 years. The same study also conducted a total sleep deprivation experiment involving 3 nights without sleep. The results show a slightly larger change in PVT lapses between the 6-hour and 8-hour periods than the change between the 7-hour and 9-hour period reported in the Belenky study. This difference shows that the Belenky study, which was used to determine the Improved Human Performance (IHP) in this benefits analysis, would underestimate the human performance improvement when compared to the Van Dongen study. Further, the data from the Van Dongen study showed a small increase in the mean number of lapses over time for individuals provided 8-hour sleep periods. This is consistent with the conclusions of the Belenky study, and the assumptions of this benefits analysis, that a constant number of lapses over time is only obtained with a full 9-hour sleep period, and some limited performance degradation still occurs with 7- or 8-hour sleep periods.

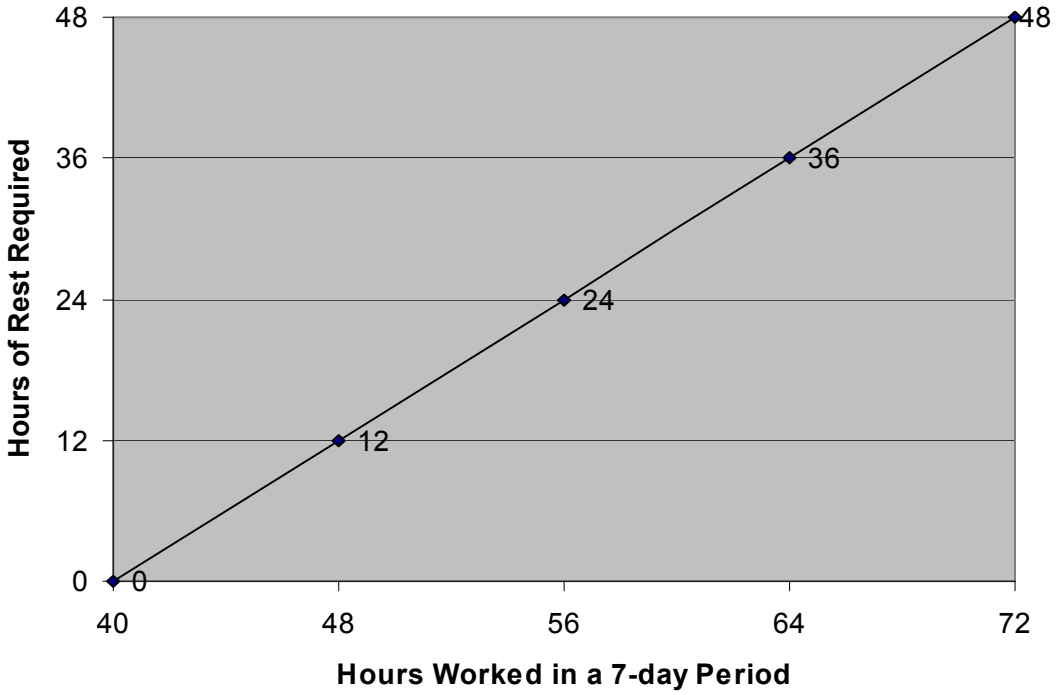
Another interesting observation of the Van Dongen study is associated with the comparison between cumulative sleep loss over 14 days to the total sleep deprivation over 3 days. The study noted that PVT performance lapses showed evidence of decreased behavioral alertness as a near-linear function of the number of days of sleep restriction. However, due to a much more significant rate of increase in lapses for the 3-day sleep deprivation, the study noted that cumulative sleep loss cannot explain the profiles of waking performance impairment for both chronic sleep restriction and total sleep impairment. The study found that focusing on cumulative wakefulness rather than sleep loss could reconcile the PVT performance profiles for these different modes of sleep loss and that performance impairment is generally proportional to the wakefulness in excess of a subject-specific critical wake period (statistically estimated at approximately 16 hours per day and consistent with an average sleep need of 8 hours per day). For the 14-day restricted period evaluated by the Van Dongen study, performance impairment was found to increase in a near-linear manner for both excess wakefulness and for sleep loss, indicating a cumulative performance degradation associated with limited sleep.

Human Performance Studies

This observation supports the concept of cumulative performance degradation, and the need for a recovery period, and was used in developing the assumed recovery period used in this benefits analysis.

This benefits analysis assumed that a worker can fully recover from the fatigue accumulated during a 72-hour workweek after a 48-hour (2-day) break. This full recovery was weighted such that personnel who receive less than a 48-hour break between work periods were assumed to partially recover from fatigue in a proportional manner. Additionally, personnel who work less than 72 hours in a week were assumed to need proportionally less break time to fully recover. Personnel working only 40 hours in a 7-day period were assumed to fully recover without any breaks. This weighted 2-day full recovery relationship between hours worked and hours of rest needed is shown in Figure 2-2. If a worker does not receive the required rest time in one week, this analysis further assumed that the amount of rest needed (that was not taken) will carry over to the next week and compound each week. Essentially, the worker will acquire a "rest debt" that will worsen each week that a 2-day break is not received. This rest debt will cause the amount of rest needed to fully recover to increase each week and, therefore, situations are possible in which a rest break of significantly greater than 2 days may be required.

Figure 2-2
Hours of Rest Required for Full Fatigue Recovery



Human Performance Studies

The assumption of a 2-day full recovery is justified by Dinges et al. (1997) observation that, "…recovery from these [sleep] deficits appeared to require two full nights of sleep." There is some uncertainty as to whether full recovery can always be achieved within two days. The Belenky study shows a three-day recovery period as being required for full recovery. There is also an expected variability between workers associated with necessary rest or with outside obligations that may keep a worker from receiving full recovery. Therefore, some personnel may not fully recover in 48-hours, but may instead need up to 72 hours. This 3-day (72-hour) period is the upper limit recorded in the Belenky study. This variation in individual need was not evaluated in the present analysis. However, the weighted manner in which the full recovery is analyzed and the inclusion of an accumulating rest debt are each employed to address some of this uncertainty.

The assumption of 48-hour recovery for 72-hours worked is also supported by the Van Dongen study in that the recovery period provides a reasonable opportunity to address the potentially excessive wakefulness. It is likely that a 72-hour workweek will typically consist of six 12-hour days. Assuming an individual works 12-hour shifts for one or more workweeks, 7 hours is a plausible amount of sleep an individual can obtain. This assumes 5 hours remain in the day for other activities, including 0.5 hours for shift turnover, 1.5 hours for a round trip commute, 0.5 hours for personal hygiene, 0.5 hours each for two meals and 1.5 hours for the minimum normal daily social and domestic commitments. Although individuals may typically defer even these minimum social and domestic commitments (parenting, pet care, personal finance management, critical car/home upkeep, etc.) for short periods of time (1 or 2 days) when working extended 14- or 16-hour shifts, these commitments must be considered during extended periods. Assuming the individual can obtain 7 hours of sleep, the sleep loss could therefore be several hours of sleep for the 72-hour work period, depending on each individual's sleep needs. The 48-hour recovery period provides the potential for two recovery periods in excess of the 8-hour sleep or less than the 16-hours wakefulness in order to recover the lost hours of sleep. Because it is unusual for an individual to sleep an excessive amount during one rest period, two recovery periods probably are necessary. It should be noted, though, that the Van Dongen study did not investigate the amount of sleep needed above the daily sleep need to recover from excessive wakefulness.

In addition to the minimum normal daily social and domestic commitments noted above, there are other recurring and important, but less urgent, social and domestic commitments (medical appointments, non-critical car and home maintenance, grocery shopping, laundry, physical fitness activities, social outings, etc.) that individuals who work 72- or 60-hour weeks for extended periods of time find it increasingly difficult to defer. To account for the compounding effect of these social and domestic commitments over time, the analysis developed a saturation of the 2-day weighted fatigue recovery. The concept followed was that the amount of actual rest an individual receives from a 48-hour break will lessen over time for individuals who work these extensive overtime schedules of 72- or 60-hour weeks for long periods of time because of these compounding commitments. The analysis assumed that it would take twice as long to recover (96 hours) from 72 hours of work after 180 days, as it would on the first day of work after being fully rested. In other words, an individual would only recover half of the amount on day 180 as on day 1, with the same break amount.

Human Performance Studies

A concept of fatigue saturation is also introduced in the current analysis as a tool to assist in the extrapolation of the Belenky data. The fatigue saturation concept is the lessening of fatigue-related performance degradation after each day of limited sleep until the point in which no additional degradation occurs. The point of no additional degradation is referred to as fatigue saturation. This technique was used to extend the limited data associated with the Belenky study to the multi-week durations of outages. Although consistent with the concept of cumulative fatigue and developed in consultation with Dr. T. Monk (Monk 2004), no studies were found supporting this concept.

The data used to find the relationship between accidents in the workplace and hours worked were taken from a study by Hanecke, et al. (1998). The Hanecke study has been cited in at least 18 articles, including at least one publication in the journal *Sleep*. This study is considered to be reputable (Monk 2004). This study analyzed 1.2 million accidents (which led to an absence from work of greater than 3 days) in the working population of Germany in 1994. Accidents were recorded with the time of day and the hours worked at the time of the event. Data were taken from a wide variety of occupations (e.g., from office work to the mining or steel industries), but did not include public service or agricultural accidents. Relative accident risks were calculated from the ratio of accident frequency to the exposure data. An eight hour shift was used as the baseline accident risk. Figure 2-3 shows the relative risk of accidents rising exponentially beyond the 9th hour of work. The relative risk was used proportionally in quantitative analyses in subsequent sections of this analysis. Data were not available beyond the 14th hour of work so the dashed line in Figure 2-3 represents an extrapolation of the data.

Figure 2-3
Overall Accident Risk by Shift Duration
(From Hanecke et al., 1998)

The estimated overall relative risk associated with work duties of different lengths (dashed line represents an extrapolation of the data).

2.3 Relationship Between Fatigue Data and Worker Performance

2.3.1 Mean Lapse Data

The mean lapse data presented in Section 2.2 is more a measure of failures of vigilance than of failures to implement emergency response procedures or recover failed equipment. To address this limitation, this analysis introduces two response types: "vigilant response" and "reactionary response." Different weights were then assigned to the mean lapse data for each response type. This assignment, although a simplified approach, supported the determination of the expected improved human performance that would result from the proposed provisions, in comparison to current requirements. Actions associated with plant trips, test and maintenance activities, and industrial and severe accident mitigation were allocated to one of these two response types. Each response type and its assigned weight is described in the next two sections.

2.3.1.1 Vigilant Response

Vigilant response is defined as a worker's response to an observable abnormal condition and is focused on the ability of a worker to recognize the abnormal condition in a timely fashion, enabling an appropriate response. Actions referred to as pre-initiating events (e.g., maintenance, test and calibration actions) in probabilistic risk analysis studies clearly fall into this category. The Belenky study mean lapse data are considered to be directly applicable to vigilant responses. The Belenky study measured the number of lapses in 10-minute periods using highly motivated subjects. Similarly, operators and security personnel must be vigilant for long periods of time – hours, watching for very low frequency events.

Vigilant response should not be confused with the response to automatic alarms and actions by various electronic and mechanical devices within the plant. Once an alarm has occurred, operators are expected to shift to perform reactionary actions (see Section 2.3.1.2). In addition, alarms are often coincident with automatic actions by plant control systems, offering no opportunity for operators to correct a problem before a trip occurs. An examination of the 33 trips evaluated in the trip reduction benefit area (Appendix A) showed that 25 trips occurred at the same time as the alarm indicating the condition which caused the trip. Therefore, alarms cannot be substituted for properly vigilant operators.

2.3.1.2 Reactionary Response

Reactionary response is a worker's response once an abnormal condition has been identified. This response typically occurs in a higher stress environment where added factors such as adrenaline and training play a significant role. Workers are assumed to suffer fewer fatigue-related effects during an emergency as a result of the physiological effects of the excitement during such emergencies. Under these conditions the Belenky study has less relevance. In a reactionary condition, fatigue will have an effect on cognitive abilities important to the diagnosis of abnormal events and the selection of appropriate mitigation strategies, but a lesser performance degradation from decreased alertness is expected. This analysis therefore reduces the estimated performance improvement seen in the Belenky study by 50% when applying it to reactionary response actions (Monk 2004).

2.3.2 Relationship Based on Relative Risk

The analysis assumes that the relationship of accident risk to an increased state of fatigue is similar to the mean lapse relationship described in Section 2.3.1. Lapses are considered analogous to when plant personnel "freeze up" while conducting certain tasks (Monk 2004). These delayed reactions may also lead to conditions that make the risk of an accident more likely. Therefore, the overall accident risk is considered to be directly applicable to vigilant response errors. Further, the estimated performance improvement associated with a decrease in accident risk was reduced by 50% when applying it to reactionary response actions (Monk 2004). This assumption is justified in the same manner as presented in Section 2.3.1.2.

2.3.3 Adjustment of Human Error Rates

Human errors documented in licensee event reports or inspection reports typically do not identify fatigue as a contributor to the error, and often do not identify any causal factors for the human errors. Therefore, the impact of worker fatigue is likely under-reported. This analysis did not attempt to identify fatigue-related errors. Instead, it assessed the impact of human errors on key benefit areas and the impact of fatigue on these human errors through the use of SPAR models and fatigue-related performance shaping factors (PSF). See Appendix B for more information on the SPAR models.

Within the SPAR models, the failure probabilities of human actions are determined using the SPAR-H Method. This method uses the following eight PSFs to modify the nominal or base human action failure rates to reflect the conditions under which the action is being performed: available time, stress, complexity, experience and training, procedures, ergonomics, fitness for duty, and work processes. This analysis assumes that all PSFs except fitness for duty are unchanged from their initial value. For the fitness for duty PSF, a modified approach from that used in the SPAR-H Method was employed. The fitness for duty PSF was changed based on the expected net improvement in performance derived from human performance studies and was used to modify human error rates within selected SPAR models, as described in Appendix B, based on applicability of that performance to the action being assessed.

The SPAR-H fitness-for-duty PSF includes the following options for degraded human performance:

Degraded Fitness	5
Nominal	1
Insufficient Information	1

In addition, for unfit conditions, the SPAR-H methodology sets the human failure rate to guaranteed failure. Using these PSF options, a degraded fitness-for-duty condition results in a factor of 5 increase in an action's failure probability. In this benefits analysis, the concern is not with degraded performance, but with improved performance with a significantly smaller magnitude of improvement than the SPAR-H methodology. The largest improvement used in the present analysis is about 15%. Using the same format as that of SPAR-H, 15% would be equivalent to a PSF of 0.85, which is a small adjustment compared to the typical range for the fitness-for-duty PSF of 1-5, above.

Example

Assume that the base failure probability of a human action is 1 failure in every 100 demands or 1E-2. Also assume that the calculated net improvement resulting from a proposed work hour provision is 1%. This results in an improved human action performance of 1E-2 x (1-0.01) = 9.9E-03. This human action failure probability is then used as an input to selected SPAR models in order to determine the change in the calculated core damage frequency.

2.4 Relationship Between Fatigue Data and Worker Productivity

For the purposes of this analysis, worker productivity is divided into two subcategories of productivity that are realized as increased efficiency and as productivity that leads to a reduction in errors that call for rework. Efficiency is defined as the speed at which a worker performs an assigned task. Rework is defined as tasks which must be repeated in order to correct a mistake. The analysis assumes that the increase in mean lapses or accident risk that is caused by fatigue is inversely proportional to the increase in productivity, leading to a reduction in errors that call for rework. This proportionality allows for the further assumption that the percentage increase in rework productivity is equal to the percentage increase observed in the mean lapse or accident risk data due to increased fatigue (presented in Section 2.2). An increase in rework productivity, though, is only applicable to a reduction in vigilant response errors since it is assumed that a worker would not knowingly perform a task incorrectly. Therefore, the estimated rework productivity improvement cannot be applied to reactionary response actions. Separate datasets are used to quantify the relationship between fatigue and the productivity that is realized as increased efficiency. These datasets are presented in the next section.

2.5 Data Relating Fatigue/Working Hours to Productivity

In work that is highly repetitive and requires sustained mental alertness but little decision making, fatigue reduces productivity during all hours worked. The relationship between labor hours per day (or per week) and labor efficiency has been explored in several studies. The data used in this analysis was taken from two studies, one performed by the Bureau of Labor Statistics of the U.S. Department of Labor (BLS) (Bureau of Labor Statistics, “Hours of Work and Output,” 1947) and the other by the National Electrical Contractors Association (NECA) (National Electrical Contractors Association 1989).

The BLS study involved 2,445 men and 1,060 women and covered 78 case studies at 34 facilities in a wide variety of manufacturing industries and settings such as foundries, machine shops, product packaging, and assembly and production lines. Packaging activities included biochemicals, pharmaceuticals, and cough drops. Production products included engines, airplanes, piston rings, metal bearings, airfield landing mats, hats and clothing, rubber hoses, office supplies, and cigars. Most of the work was indoors, some was machine paced, and most was highly repetitive. Moreover, some of the work evaluated in the BLS study was performed by incentive wage employees during wartime, on prolonged overtime schedules. Although published in 1947, the BLS study is widely cited as a reliable source (Brunies and Emir 2001; The Business Roundtable 1980).

Human Performance Studies

The BLS studies generally covered a period of one year or greater and the data collected for each selected worker included hours worked, volume produced and time lost. To measure output, the BLS used the formula:

Output = Scheduled Hours X (100% - % of time lost through absenteeism) X efficiency,

where:

Efficiency = Total Weekly Output (e.g. units produced) / Total Hours Worked.

The BLS study classified the types of physical demands made upon workers as either heavy work, which is work normally involving the handling of heavy materials, or light work, which is work normally involving the manual handling of materials up to about 5 pounds, or the mechanical handling of somewhat heavier objects. After reviewing the 78 case studies, the BLS Bulletin states, "For hours above 8 hours per day and 48 per week, it usually took 3 hours of work to produce 2 additional hours of output when work was light. When work was heavy, it took about 2 more hours of work to produce 1 hour of additional output."

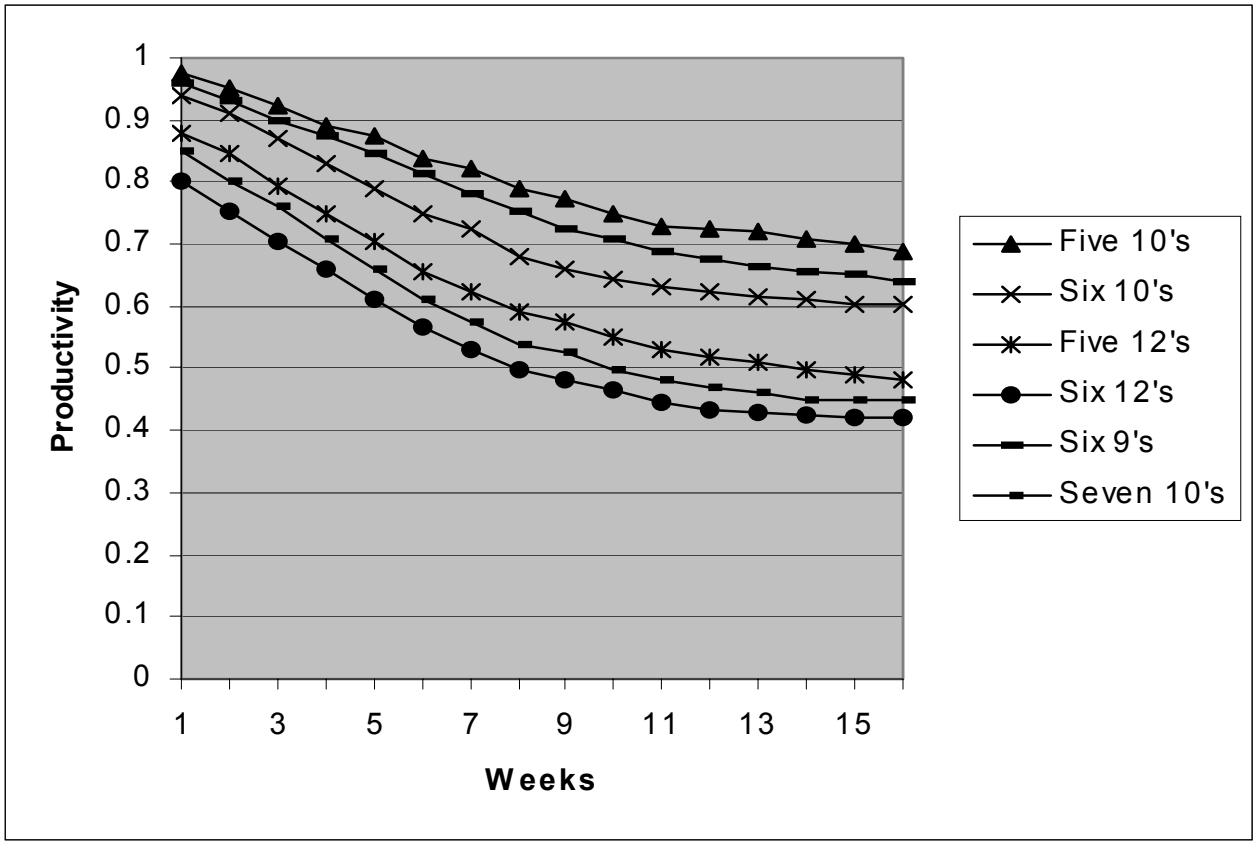
These relationships between hours worked and output hours are used in quantitative analyses that assess increased 'efficiency' productivity in subsequent sections of this analysis. The use of this study is expected to underestimate the benefit of fatigue mitigation since workers in the commercial nuclear field perform tasks which require substantially more decisionmaking and alertness than the tasks assigned to assembly line workers.

NECA published a study in 1989 relating the decline of productivity for workers with varying overtime work schedules (e.g. five 10s, or five 10-hour shifts per week) over periods of 1 to 16 successive weeks. These data are from electrical jobs worked since 1969, in which the number of feet of wire that workers were able to run was the productivity metric. Figure 2-4 shows the percent worker productivity for varying weekly work schedules for 16 consecutive weeks.

Worker productivity, measured as a percentage, is used in quantitative analyses that assess increased efficiency productivity in subsequent sections of this analysis. It is expected that these data are well correlated to workers in the nuclear industry since electrical contractor workers perform very similar types of tasks, with such attributes as independently following procedures, interpreting technical documentation, and assessing possible techniques in the performance of objectives. This analysis assumes that the correlation is proportional, though not exact. More specifically, the percent productivity used in the quantitative evaluation of efficiency is modified by job type and circumstance. Each job type is given a 'realized gain' percentage, which estimates the maximum increased productive output for each job duty group. The realized gain reflects the expected yield that a given performance improvement will have on productivity improvement. A low percentage means that productivity improvement has a low sensitivity to worker performance.

Human Performance Studies

Figure 2-4
Percent of Worker Productivity for Varying Weekly Work Schedules
(Reproduced from NECA 1989)



3. JOB DUTY GROUP BASELINE SCHEDULES

Proposed Subpart I identifies five job duty groups that would be subject to work hour controls. These job duty groups are described in Table 3-1 below. This section discusses the baseline work schedules for these job duty groups used in the benefit analysis.

Table 3-1
Job Duty Group Table

§26.199(a)	Short Description	Description
(1)	Operations	Operating or on-site directing of the operation of systems and components that a risk-informed evaluation process has shown to be significant to public health and safety
(2)	Maintenance	Performing maintenance or on-site directing of the maintenance of structures, systems, and component that a risk-informed evaluation process has shown to be significant to public health and safety
(3)	HP/Chemistry	Performing health physics or chemistry duties required as a member of the on-site emergency response organization minimum shift complement
(4)	Fire Brigade	Performing the duties of a fire brigade member who is responsible for understanding the effects of fire and fire suppressants on safe shutdown capability
(5)	Security	Performing security duties as an armed security force officer, alarm station operator, response team leader, or watchperson, hereinafter referred to as security personnel

3.1 Scheduling Impacts of At-Power and Outage Periods

For this analysis, commercial nuclear power plants are considered to be in one of two modes of operation: “at power” or “outage.” When at power, the reactor is critical, plant activities are routine, maintenance and repair are limited, and personnel are typically working their “regular” schedule. This analysis assumes plants are in the at-power condition on average 90% of the time. Outage periods represent the period when the reactor is shutdown. This includes scheduled refueling outages, maintenance outages, unplanned shutdowns and the transition period to and from at-power operation. Unplanned shutdowns due to plant trips are referred to as forced outages. Planned outages are normally thoroughly scheduled events during which personnel work aggressive schedules in order to minimize the duration of the outage. Forced outages also typically include aggressive work schedules. Plants are estimated to be in outages on average 10% of the time. Further, the analysis uses a probability (per year) that any unit will experience a refueling outage of 57.1%, based on actual industry refueling outage data (see Appendix H).

Job Duty Group Baseline Schedules

3.2 Operations

3.2.1 At Power

For this analysis, operations was divided into two groups: operating crew (shift operators) and staff (non-shift operators). The operating crew was considered to consist of those members of operations that are associated with the 24-7 operation of the power plant. This includes control room personnel and other licensed and non-licensed operators who monitor and manipulate auxiliary plant equipment. Staff or non-shift operators are typically licensed reactor and senior reactor operators that provide support to the operation of the power plant, including training, clearance tagging, and procedure development, as well as some non-licensed operators. Staff operators were included in this analysis because they periodically operate or provide on-site direction of the operation of systems and components that a risk-informed evaluation process has shown to be significant to public health and safety, and would therefore be subject to the proposed provisions. As a minimum, staff operators stand periodic proficiency watches and therefore would meet the requirements of the job duty group definition in §26.199(a)(1).

3.2.2 Outage

This analysis divided operating crew schedules during outages into three different types: (1) on-shift, (2) non-shift or staff and (3) super-crew. Shift operators were assumed to work an overtime schedule of six 12-hour days per week, rotating between days and nights, during outages or shift to a super-crew schedule of fixed days or nights of six 12-hour days per week. Staff operators were assumed to shift to an outage support schedule or to a super-crew schedule. This analysis assumed that the outage support schedule, as well as the super-crew schedule, provides the maximum hours of outage support while maintaining the total hours per week within the current 72-hour guidelines. Note that the outage support schedule currently may be extended to seven 12-hour shifts if authorized by waivers.

The super-crew schedule consists of plant personnel working either dedicated 12-hour day shifts or 12-hour night shifts for six 12-hour shifts per week. During outage conditions, this evaluation assumed shift operators work six 12-hour shifts per week when working a super-crew schedule and six 12-hour shifts when they continued their normal at-power shift schedule (with overtime for outage support) into the outage period. The analysis assumes that there is not a work-hour differential between these two schedule types because of the additional overtime assumed for the at-power schedule during outage periods. Non-shift operators were also assumed to work six 12-hour shifts per week and their performance improvement is reflected in the non-shift operator group whether or not they shifted to a super-crew schedule.

This analysis assumed that 75% of plants will shift to a super-crew schedule during outages and that 100% of personnel at these plants will shift to super-crew schedules. Because the work-hours between super-crew schedules and normal at-power schedules are similar, the assumed super-crew percentage does not impact the overall results of this benefits analysis.

3.3 Maintenance

3.3.1 At Power

This analysis assumed that maintenance personnel typically work a normal business schedule of five workdays per week. Although emergent maintenance may result in selected maintenance personnel working around-the-clock or weekends, this variation in schedule is explicitly addressed in the analysis of each proposed provision.

It is also possible that some maintenance organizations provide shift coverage as a standard practice. The impact of this practice was not explicitly evaluated.

3.3.2 Outage

During outages, maintenance workers were assumed to shift to an outage support schedule of 12 hours per day, six days a week. This assumption provides the maximum hours of outage support while maintaining the total hours per week within the current 72-hour technical specification/procedural limit. Note that the outage support schedule currently may be extended to seven 12-hour shifts if waivers are approved.

Another factor that was considered for maintenance personnel baseline schedules was that many plants shift to super-crew schedules during outages. Super-crew scheduling consists of plant personnel working either dedicated 12-hour day shifts or 12-hour night shifts. Therefore, the baseline schedule for super-crew maintenance personnel is of the same duration as that already assumed for maintenance during outages, six 12-hour shifts per week. This evaluation assumes that if a plant shifts to a super-crew schedule, all maintenance workers under at-power conditions would still be considered maintenance workers during outages.

3.3.3 Outage - Contract Maintenance Personnel

The analysis assumed that most contract personnel working outages would be performing maintenance duties. Contract maintenance workers were assumed to work a similar schedule to staff maintenance during outages.

For most cases, contract personnel were included as part of the maintenance analysis in this evaluation. In a few cases, the benefit to contract maintenance workers was considered separately. When contract maintenance workers were not explicitly considered, the analysis assumed that 75% of maintenance workers are staff maintenance workers and 25% are contract maintenance workers. The outage benefit for maintenance was then partitioned accordingly. Note that contract maintenance workers were only considered during outages.

3.4 HP/Chemistry

The work hour limits would be applicable to members of the health physics (HP) organization and chemistry technicians responsible for responding to the onset of a radiological emergency, assisting operations personnel with off-site dose calculations and ancillary radiological protection tasks, and for conducting analyses for the detection of hydrogen and oxygen gas

concentrations in both the reactor coolant and the containment atmosphere. Such actions support severe accident management decisions with regard to the protection of public health and safety by minimizing radiological release potential.

3.4.1 At Power and Outage

HP/chemistry personnel were assumed to be on a shift rotation similar to the shift operating crew. Therefore, this analysis assumed that the Performance Applicability (PA) (explained in Section 1.3.2) of HP/chemistry shift personnel would be the same as that for shift operators during both outages and at-power conditions. Some HP/chemistry personnel also may provide backup or rotational support but typically work a normal business schedule of five workdays a week. Finally, in the case of super-crew scheduling during outages, shift and non-shift HP/chemistry personnel baseline schedules would parallel those of shift and non-shift operators, respectively ('shift HP/chemisty' personnel become 'super-crew HP/chemistry' personnel, while 'non-shift HP/chemisty' personnel remain under their normal outage schedule).

3.5 Fire Brigade

The work hour limits would be applicable to the members of the fire brigade responsible for providing the control room operators and fire brigade leader information that is critical to implementing a fire mitigation strategy that maintains safe shutdown capability for the reactor.

3.5.1 At Power and Outage

Fire Brigade personnel were assumed to be on a shift rotation similar to the operating crew during both outages and at-power conditions. Some fire brigade personnel also may provide backup or rotational support but typically work a normal business schedule of five workdays a week. Finally, in the case of super-crew scheduling during outages, shift and non-shift fire brigade personnel baseline schedules would parallel those of shift and non-shift operators, respectively ('shift fire brigade' personnel become 'super-crew fire brigade' personnel, while 'non-shift fire brigade' personnel remain under their normal outage schedule).

3.6 Security

Nuclear security officers are the first line of defense in the event of an attack on the facility and have limited automatic or back-up systems to rely upon, in contrast to other types of plant workers (e.g., plant operators). Nuclear security officers often work alone for long periods with limited socialization or physical activity as a stimulus. As a result, special attention must be given to the security force to ensure that the effects of fatigue do not adversely impact the readiness of nuclear security officers.

Information relevant to the security force baseline work schedules and the nature of the security threat is considered safeguards information. Therefore, the estimated benefit of the work hour control provisions for the security force was determined differently from that of other job duty groups included in this analysis. Rather than directly assessing the work schedules and security force human performance, the benefits were estimated by considering the role of

security to be equal to the performance role of operations. The operator-related benefits were then adjusted as necessary to derive the benefits for the security force. The details of this approach are discussed in Appendix F. As a result of this approach, the work schedules for the security force are not addressed in Section 3 and the benefits for the security force are shown only at the summary level.

3.7 Impact of Turnover Frequency

While the proposed provisions would mitigate fatigue and improve worker performance, the new restrictions would also cause the number of shift turnovers or interactions with new workers unfamiliar with the specific status of the work being performed that occur per day to increase. Many of these shift or 'unfamiliar turnovers' involve a complex evolution (infrequent actions involving multiple personnel which changes the state of the plant in a substantial way). Each turnover involving a complex evolution has a risk of producing a plant error. This risk to the entire nuclear industry was calculated as follows:

A review of Licensee Event Reports (LER) for the years 2000 through 2002 indicated that of the 33 plant trips caused by human error that occurred in these 3 years, 9 included poor communication or turnover in the factors that contributed to the trip. The analysis assumed that these poor briefings could have occurred during shift turnovers. Therefore, the frequency of these poor briefings was equated to the frequency of errors (3 errors per year for the industry) caused by poor shift turnovers involving a complex evolution. Five percent of all shift turnovers per year for the entire nuclear industry were assumed to involve a complex evolution. Additionally, the average time that a plant is at power was determined in order to account for the fact that the error data was equated from plant trips, which must occur under at-power conditions. An average plant was assumed to be at power 90% of the time. Last, an average plant was assumed to have two shift turnovers per day (two 12-hour shifts). The number of shift turnovers (for the entire nuclear industry) in a year that involve a complex evolution is (2 shift turnovers per day) X (365 days per year) X (5% of shift turnovers involving a complex evolution) X (90% of a plant's time at-power per year) X (103 plants in the industry) = 3383.6. Therefore, the rate of errors for shift turnovers involving a complex evolution was calculated to be 3 errors per 3383.6 shift turnovers.

The number of shift or unfamiliar turnovers would be expected to increase under the proposed provisions, and therefore the risk of an error (or the number of errors) per year would also be expected to increase. However, as fatigue-related worker performance improves because of the proposed provisions, the risk of errors becomes less. In the evaluation of the benefit of the proposed provisions, the net impact of turnover errors was considered to reduce the overall benefits, although, as will be seen in the analysis of each provision, this reduction is quite minor. The manner in which these factors and the resulting turnover penalty were considered is explained the evaluation of each provision.

3.8 Latent Maintenance Errors

Some errors committed by maintenance workers are not discovered during the shutdown period due to limitations associated with post-maintenance testing or due to other human errors. These latent maintenance errors typically manifest themselves after a period of

operation or during subsequent at-power testing and can result in reduced accident mitigation capability. For example, if a mechanic replaces the grease in the bearings of a pump, but uses the wrong grease, it is possible that the grease in the bearings would perform adequately during follow-up testing but fail soon after being used at power. Improvements in the vigilance of maintenance workers is expected to avoid some portion of errors, such as this example. The Net Improvement in such costs would not be realized during a plant outage. The savings would be observable during at-power conditions. This analysis assumes that 10% of errors avoided during outage conditions represent cost savings during at-power conditions. In order to correctly account for the value of avoiding these costs, 10% of the Net Improvement (after reduction due to the turnover penalty) was applied to the Net Improvement under at-power conditions. The transfer of net improvement is expected to apply to maintenance workers, operations personnel, health physics and chemistry workers.

4. AREAS OF POTENTIAL BENEFIT

The analysis identified eight main benefit areas that were expected to be affected by the proposed provisions. Each of these areas is briefly described in the following sections.

The list of benefit areas is not all-inclusive nor does the benefit assessment within each area address all the potential benefits. The benefit areas included in this report were determined through an informal solicitation process, with the objective of identifying all areas that are expected to represent the areas in which the majority of the benefits from a reduction in worker fatigue would be achieved. Other benefits areas that are qualitatively considered include the potential lower equipment unavailability, lower radiological exposures, environmental protection (e.g., inadvertent oil spills, inadvertent radiological releases or any non-nuclear environmental event). In addition, benefits associated with increased worker satisfaction and morale, which may be related to improved human performance, were not explicitly addressed.

Each benefit area contains considerable uncertainty. This uncertainty is primarily associated with the risk assessment models used in each of the Appendixes and in the assumptions used to estimate risk when limited information was available.

4.1 Trips

This analysis addressed the potential benefit due to a reduction in plant trips, which would result from the reduction in human errors, estimated as a result of implementation of the proposed work hour control provisions. Appendix A summarizes the review of worker-related trips and provides an estimate of the maximum attainable benefit that would result if all worker-related trips were eliminated.

4.2 At-Power Accidents

The benefit addressed by this area was the potential reduction in the frequency of at-power internal event severe accidents that was estimated to result from the reduction in human errors. Internal events are defined as systemic plant challenges (e.g., loss of main feedwater, loss of offsite power, etc.) and excludes challenges such as fire and transportation hazards. This analysis captured the improvement in the risk associated with improved human actions performed prior to an operational event and those actions performed in response to an event. The analysis also captured the risk improvement associated with two other aspects of maintenance actions: equipment availability and undiscovered or latent maintenance errors. The first is the improved risk associated with shorter periods of equipment unavailability expected as a result of reduced errors and improved efficiency during plant maintenance activities. The second improvement is associated with the reduction in undiscovered maintenance errors improving equipment reliability and therefore the accident mitigation capability of the plant. Appendix B summarizes the approach used to determine the potential accident reduction and provides sensitivity studies of the impact improved human performance has on severe accident mitigation. The reduction was focused on core damage frequency and did not attempt to address radiological release.

4.3 Shutdown Accidents

The benefit addressed by this area was the potential reduction in the frequency of internal event shutdown severe accidents that is estimated to result from the reduction in human errors. Appendix C summarizes the approach used to determine the potential accident reduction. Fire related shutdown risk is addressed by Section 4.4. The reduction was focused on core damage frequency and did not attempt to address radiological release.

4.4 Fire

Fire risk has been identified as a significant contributor to severe accident risk at nuclear power plants. This benefit area addresses both at-power and shutdown fire risk. Appendix D summarizes the approach used to determine the potential reduction of severe fire accidents.

4.5 Lost and Restricted Work Cases

The benefit addressed by this area was the potential reduction in industrial injury cost associated with an improvement in fatigue-related worker performance. Appendix E summarizes the approach used to determine the maximum attainable benefit.

4.6 Security

The benefits associated with security are addressed in Appendix F.

4.7 Improved Worker Productivity - Efficiency

This benefit summarized the contribution of improvements in the effectiveness and speed with which workers perform tasks. The attainable benefit is quantified in Appendix G.

4.8 Improved Worker Productivity - Reduction in Rework

This benefit accounts for reductions in the frequency of worker mistakes which require a maintenance action to be performed a second time. The attainable benefit quantifies the value of avoiding rework occurrences. The benefit is quantified in Appendix H.

5. APPLICABILITY OF JOB DUTY GROUPS TO BENEFIT AREAS

An assessment was performed for each of the eight benefit areas described in Section 4 to determine the applicability of each job duty group identified in Section 3 to each benefit area.

5.1 Trips

The analysis described in Appendix A attributed thirty three trips in the years 2001 to 2003 to plant personnel. Of those, 61% were largely due to maintenance worker mistakes. Of the personnel-related plant trips, 39% were largely attributed to operations. No trips were found to have resulted from errors associated with HP/chemistry, fire brigade or security. Table 5-1 summarizes the applicability of each job duty group based on this applicability review.

Table 5-1
Trip Applicability

§26.199(a)	Short Description	Applicable	Discussion
(1)	Operations	Yes	Data indicate operator performance issues have contributed to reactor trips.
(2)	Maintenance	Yes	Data indicate maintenance performance issues have contributed to reactor trips.
(3)	HP/Chemistry	No	Not considered to play a significant role and therefore no benefit is evaluated.
(4)	Fire Brigade	No	Not considered to play a significant role and therefore no benefit is evaluated.
(5)	Security	No	See Appendix F.

5.2 At-Power Accidents

Human errors are important to both the likelihood of plant challenges (plant trips) and the effectiveness of mitigating a challenge once it has occurred. This section summarizes the applicability of each job duty group in reducing the frequency of at-power severe accidents and improving accident mitigation as a result of the proposed provisions.

A reduced frequency of severe accidents can be attributed to improved performance by operations and maintenance personnel. As discussed in Section 5.1, both operators and maintenance personnel impact the frequency of reactor trips. Therefore, the performance of these job duty groups plays an important role in the initiation of the plant challenge. In addition, following an at-power severe accident, operators have a critical role in ensuring effective command and control. Operator actions include the identification of abnormal conditions, the implementation of operating procedures and the cognitive ability to understand the overall condition of the plant and to coordinate activities to effectively mitigate an event.

Applicability of Job Duty Groups To Benefit Areas

Maintenance personnel contribute to the mitigation of severe accidents through effective maintenance, test, and calibration of plant equipment. This significant role primarily occurs before an event. Effective maintenance helps to ensure that equipment and systems necessary for safe shutdown operate as designed.

Because this benefit area does not consider the impact of fires, improvement in the fire brigade due to the proposed provisions was considered to have no impact. The role of HP/chemistry is also limited in the reduction in the likelihood of core damage and was considered to have no quantifiable impact to this benefit area. Security was not included in this benefit area since security does not play a role in the prevention or mitigation of internal plant events. Table 5-2 summarizes the job duty group applicability for at-power severe accidents.

Table 5-2
At-Power Severe Accident Applicability

§26.199(a)	Short Description	Applicable	Discussion
(1)	Operations	Yes	Critical in avoiding inadvertent trips and effective mitigation.
(2)	Maintenance	Yes	Critical in avoiding inadvertent trips and ensuring that equipment and systems operate as designed.
(3)	HP/Chemistry	Yes	Important in core damage assessment. Not quantitatively evaluated.
(4)	Fire Brigade	No	Not considered to play a significant role and therefore no benefit is evaluated.
(5)	Security	No	See Appendix F.

5.3 Shutdown Accidents

Operations and maintenance are critical organizations for the effective mitigation of plant events that occur during low power and shutdown operation. In addition, since extensive maintenance occurs during most outages, the effective coordination between these organizations is important to ensure that adequate defense-in-depth is maintained. Since fire events were treated in a separate benefit area, the role of the fire brigade was not addressed in this benefit area. HP and chemistry workers play a significant role in assessing the severity of an accident and off-site releases, and in accident recovery. However this analysis focused on the benefits of preventing severe accidents and therefore did not explicitly address these other supporting roles of the HP/chemistry workers. Security does not play a significant role in the prevention or mitigation of severe accidents during shutdown. Table 5-3 summarizes the job duty group applicability for Shutdown Severe Accidents.

Applicability of Job Duty Groups To Benefit Areas

Table 5-3
Shutdown Severe Accident Applicability

§26.199(a)	Short Description	Applicable	Discussion
(1)	Operations	Yes	Critical for effective mitigation of shutdown events.
(2)	Maintenance	Yes	Critical for ensuring that equipment and systems operate as designed.
(3)	HP/Chemistry	Yes	Important in core damage assessment. Not quantitatively evaluated.
(4)	Fire Brigade	No	Not quantitatively evaluated.
(5)	Security	No	See Appendix F.

5.4 Fire Mitigation

Operations and maintenance are important organizations for the effective mitigation of fire events. This benefit area addresses both at-power and shutdown fire mitigation. In this benefit area, the fire brigade is the critical last line of defense and the fire brigade members, who have the knowledge of plant safety-related systems and understand the effects of fire and fire suppressants, are significant contributors to mitigating fire-related events. HP and chemistry workers play a significant role once an accident has occurred, however this analysis accounted for the benefits of preventing severe accidents, and as such it is not applicable to HP/chemistry personnel. Security does not have a significant role in the prevention of severe accidents which involve fires. Table 5-4 summarizes the job duty group applicability for fire mitigation.

Table 5-4
Fire Mitigation Applicability

§26.199(a)	Short Description	Applicable	Discussion
(1)	Operations	Yes	Critical for effective mitigation of fire events.
(2)	Maintenance	Yes	Critical for ensuring that equipment and systems operate as designed.
(3)	HP/Chemistry	No	Important in core damage assessment. Not quantitatively evaluated.
(4)	Fire Brigade	Yes	Important for mitigation of fire events.
(5)	Security	No	See Appendix F.

Applicability of Job Duty Groups To Benefit Areas

5.5 Lost and Restricted Work Cases

The objective of this benefit area was to estimate the potential reduction in industrial injuries that would result from the implementation of the proposed provisions. Because all the job duty groups are associated with an industrial environment, the improvement in work-place safety would be expected to apply to all job duty groups. Table 5-5 summarizes the job duty group applicability for lost and restricted work cases.

Table 5-5
Lost and Restricted Work Cases

§26.199(a)	Short Description	Applicable	Discussion
(1)	Operations	Yes	Applicable to all job duty groups.
(2)	Maintenance	Yes	
(3)	HP/Chemistry	Yes	
(4)	Fire Brigade	Yes	
(5)	Security	Yes	

5.6 Security

The benefits associated with security are addressed in Appendix F.

5.7 Improved Worker Productivity - Efficiency

The objective of this benefit area was to estimate the value of improvement in the effectiveness and speed at which workers perform their assigned tasks. The benefit is applicable to those job types with control over the amount of tasks which can be accomplished during a work day. Some job functions are not applicable since these workers remain at a job station for a specified period of time regardless of the tasks presented during that time (e.g., panel monitoring). See Appendix G for an extended discussion. Table 5-6 summarizes the job duty group applicability for improved efficiency.

Applicability of Job Duty Groups To Benefit Areas

Table 5-6
Improved Worker Efficiency Cases

§26.199(a)	Short Description	Applicable	Discussion
(1)	Operations	Yes	Applicable to non-shift and super-crew workers. Not applicable to on-shift operators.
(2)	Maintenance	Yes	Applicable to all maintenance workers.
(3)	HP/Chemistry	Yes	Applicable to non-shift and super-crew workers. Not applicable to on-shift operators.
(4)	Fire Brigade	No	Fire brigade was evaluated as having no realized benefit from improved worker efficiency because of vigilant standby nature of their duties prior to an event and response nature of their duties during an event.
(5)	Security	No	Security officers were evaluated as having no realized benefit from improved worker efficiency because of vigilant standby nature of their duties prior to an event and response nature of their duties during an event.

5.8 Improved Worker Productivity - Reduction in Rework

The objective of this benefit area was to estimate the value of improvement in the accuracy with which workers perform their assigned tasks. The benefit is applicable to those job types with the possibility of correcting mistakes committed in the performance of a task. Some job functions are not evaluated for improvement due to the immediate consequences of a mistake that limit recovery ability (e.g., implementation of an incorrect fire suppression strategy where equipment is lost due to water spray). See Appendix H for an extended discussion. Table 5-7 summarizes the job duty group applicability for improved efficiency.

Applicability of Job Duty Groups To Benefit Areas

Table 5-7
Reduction in Rework Cases

§26.199(a)	Short Description	Applicable	Discussion
(1)	Operations	Yes	Applicable to non-shift and super-crew workers. Not applicable to on-shift operators.
(2)	Maintenance	Yes	Applicable to all maintenance workers.
(3)	HP/Chemistry	Yes	Applicable to non-shift and super-crew workers. Not applicable to on-shift operators.
(4)	Fire Brigade	No	Fire brigade have limited opportunity to correct mistakes.
(5)	Security	No	Security officers have limited opportunity to correct mistakes.

6. BENEFITS OF PROPOSED §26.199(d)(3), LICENSEE RESTRICTIONS ON GRANTING WAIVERS

The following analysis assesses the impact that the waiver restrictions, that would be required by proposed §26.199(d)(3), have on regular plant staff and contract worker performance, relative to the current technical specification requirements. Specifically, the proposed requirement was evaluated against the alternative of taking no action. The waiver restrictions were treated as a baseline for the analysis of other proposed revisions. That is, the benefit analysis for all other proposed provisions assumed that waivers would rarely be granted, compared to the current extensive use of waivers. The evaluation provides both quantitative and qualitative information suggesting that the proposed provision mitigates worker fatigue, which directly relates to performance. Table 6-1 shows the evaluation order used in this analysis.

Table 6-1
Proposed Provision Reference Table

Tier	Provision	Description
Base		Current industry practices concerning work scheduling and worker fatigue
1*	§26.199(d)(3)	Licensees may grant a waiver of the individual work hour controls in §26.199(d)(1-2) only if it is necessary for the safety or security of the plant and the worker has been judged fit to work the additional hours
	§26.199(a)(1-5)	Specifies the individuals subject to work hour controls: (1) operations, (2) maintenance, (3) health physics and chemistry, (4) fire brigade and (5) security
	§26.199(d)(1)(i-iii)	Individual work hours should not exceed: (i)16 hours in any 24-hour period, (ii) 26 hours in any 48-hour period and (iii) 72 hours in any 7-day period

* The analysis of tier 1 calculated the estimated benefit from the baseline to tier 1.

For this assessment, the 3-, 5-, and 7-hour Belenky sleep data were used. A 16- hour shift, or an 8-hour break, were assumed to provide an individual with 5 hours of sleep, and were corresponded to the 5-hour sleep data. Finally, a break of 6 hours was corresponded to the 3-hour sleep data.

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6.1 Performance and Productivity Improvement Resulting from Proposed Provision

6.1.1 Applicability to Performance at Nuclear Power Plants

This analysis quantified the impact of the new waiver restrictions in §26.199 on fatigue-related worker performance and productivity for units under plant outage conditions and guidelines. Under the current work hour limits (as set forth in GL-82-12), there are four limits that are currently waived: (1) an individual should not be permitted to work more than 16 hours in any 24-hour period, (2) nor more than 24 hours in any 48-hour period, (3) nor more than 72 hours in any seven day period and (4) a break of at least eight hours should be allowed between work periods. Therefore, each of these current limits was considered separately, under the assumption that the new waiver restrictions would discontinue the use of waivers for these limits during outages[1]. Fatigue-related worker performance and productivity was compared for each of these cases from the condition of easing the current requirements (allowing waivers) to the condition of strictly following these current limits.

6.1.1.1 Limit of 16 Hours of Work in Any 24-Hour Period

The first work hour control considered was the 16-hour limit per day. It was assumed that during outages, waivers may be approved to extend the 16-hour shift limit to a longer period of up to 8 additional hours. The 8 additional hours were used to calculate the maximum improvement that could be realized. The PA percentage accounts for the fact that, on average, only a percentage of the 8 hours are waived. This is explained in Section 6.1.2.

For the performance evaluation, the relative accident risk data from the Hanecke et al. study was extrapolated for duty durations longer than 14 hours. This extrapolation involved fitting the collected data points to an exponential curve to simulate a growth trend. It was assumed a larger relative accident risk equated to a degradation in worker performance. The relative accident risk of a 16-hour shift risk was calculated at 1.31 and the 8 additional hours beyond the 16-hour limit was calculated to be 1.86. This represents a 29.6% potential improvement in worker performance due to the elimination of waivers in this situation. Therefore, the IHP percentage for this scenario is 29.6%.

For the efficiency productivity evaluation, the labor output data from the BLS study was used. Specifically, the relationship for 'light work' was considered to represent work during outage conditions. Assuming that every hour of labor under 8 hours per day yields 1 output hour, but every hour of labor over 8 hours per day only yields 0.67 output hours, output hours were calculated for the 24-hour (16-hour shift with 8 additional hours) and 16-hour shifts. This resulted in 8+(16x0.67)=18.67 output hours for the 24-hour shift and 8+(8x0.67)=13.33 output hours for the 16-hour shift. The output hours for the 16-hour shift were then normalized to

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[1]Although the proposed provision would greatly reduce the use of waivers, the assumption that the use of waivers is eliminated was used for simplification because the percentage of waivers expected to be permitted under the proposed provision is very small (see Appendix 3 to the main body of the Regulatory Analysis).

account for the difference in shift length. Specifically, the 13.33 output hours (which were calculated for the 16-hour shift) were normalized for a 24-hour shift length. This resulted in equivalent input hours enabling a comparison of the output hours. The normalization resulted in (13.33 output hours) x (24-hour shift/16-hour shift)=20 normalized output hours. Therefore, the increase in productivity that could be realized as efficiency for the 16-hour limit is 20 output hours (a normalized quantity representing the 16-hour shift) -18.67 output hours (representing a 24-hour shift) = 1.33 output hours per worker per day. This equates to 1.33 x 365 = 486.67 output hours per worker per year. Thus, the Improved Efficiency Productivity (IEP) value for the 16-hour limit is 486.7. Note that the overall analysis recognizes the fact that only some smaller percentage of this productivity will actually be realized. This is addressed in Appendix G.

6.1.1.2 Limit of 24 Hours of Work in Any 48-Hour Period

The second provision considered was the 24-hour limit in 2-days. It was assumed that during outages, waivers may be approved to work more than an average of 12 hours per day. Two 16-hour shifts were assumed as a means of comparison to the current limit of two 12-hour shifts. As explained in the previous section, this two 16-hour shift scenario was used as an upper limit IHP/IEP calculation. The analysis recognized that this is a very rare scenario. This scenario was chosen to calculate the maximum improvement that could be realized by decreasing the number of hours worked from 32 to 24 hours in a 48-hour period. The PA percentage calculation accounts for the fact that, on average, only a percentage of the 8 possible hours are waived.

For the performance evaluation, the 5- and 7-hour mean lapse data from the Belenky study were used to simulate fatigue-related worker performance associated with a 16-hour shift and a 12-hour shift, respectively. The third and fourth day data were used from the study, assuming that the use of waivers could realistically occur mid-workweek. The cumulative mean lapses were compared from the 16-hour shift scenario to the 12-hour shift scenario. The percent improvement in worker performance, and in turn the IHP percentage, was calculated to be 40.5% for this two-day period.

For the efficiency productivity evaluation, the labor output data from the BLS study was used in a similar manner to that in the 16-hour limit analysis. Output hours were calculated for a 2-day period of 16-hour and 12-hour shifts. The output hours for the 16-hour shift were then normalized to account for the difference in shift length. The cumulative output hours were then compared from the 16-hour shift scenario to the 12-hour shift scenario. The increase in productivity that could be realized as efficiency for the 24-hour limit was calculated to be 1.78 output hours per worker per 2-day period. This equates to 1.78 x 182.5=324.4 output hours per worker per year. Thus, the Improved Efficiency Productivity (IEP) value for the 24-hour limit is 324.4. Note that the overall analysis recognized the fact that only some smaller percentage of this productivity would actually be realized. This is addressed in the Appendix G.

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6.1.1.3 Limit of 72 Hours of Work in Any 7-day Period

The third work hour control considered was the 72-hour limit in 7-days. It was assumed that during outages, waivers may be approved to work more than 72 hours in one week. Seven days of 12-hour shifts were assumed for a means of comparison to the current limit of six 12-hour shifts. As explained in the previous sections, this seven 12-hour shift scenario was used as an upper limit IHP/IEP calculation. The PA Percentage calculation accounts for the fact that, on average, only a percentage of the 12 possible hours (the difference between a 72-hour week and a 84-hour week) are waived.

For the performance evaluation, the 7-hour mean lapse data were used to simulate fatigue-related worker performance. The cumulative mean lapses were compared at the end of the 14th day from the seven 12-hour shift scenario to the six 12-hour shift scenario. A two-week exposure period was analyzed, as the effect of increased fatigue in this situation is not realized until the second week. This accounts for the scenario in which a worker receives a waiver for the 7th day of work and then works another six 12-hour shifts in the second week. As this is a rolling 7-day period, a waiver is needed each consecutive day worked after the first 6 in a row. The percent improvement in worker performance, and in turn the IHP percentage, was calculated to be 7.6% for this 14-day period.

For the efficiency productivity evaluation, the labor output data from the BLS study was used. Specifically, the relationship for 'light work' was considered to represent work during outage conditions. Based on findings from the BLS study, this benefits analysis assumed that every hour of labor under 48 hours per week yields 1 output hour and every hour of labor over 48 hours per week only yields 0.67 output hours. Output hours were calculated for a 7-day period with scenarios of a 84-hour week (seven 12-hour shifts) and a 72-hour week (six 12-hour shifts). This resulted in 48+(36x0.67)=72 output hours for the 84-hour week and 48+(24x0.67)=64 output hours for the 72-hour week. The output hours for the 72-hour week were then normalized to account for the difference in workweek length. This resulted in a normalized value of 74.67 output hours for the 72-hour week. Therefore, the increase in productivity that could be realized as efficiency for the 72-hour limit is 74.67 - 72 = 2.67 output hours per worker per week. This equates to 2.67 x 52 = 139 output hours per worker per year. Thus, the Improved Efficiency Productivity (IEP) value for the 72-hour limit is 139. Note that the overall analysis recognizes the fact that only some smaller percentage of this productivity will actually be realized. This is addressed in Appendix G.

6.1.1.4 Rest Break of 8 Hours Between Work Periods

The last work hour control considered was the 8-hour break requirement. It was assumed that during outages, waivers may be approved that would decrease the break time to 6 hours (a conservative estimate). Therefore, a 6-hour break was assumed for a means of comparison to the current limit of a 8-hour break.

For the performance evaluation, the 3- and 5- hour mean lapse data were used to simulate fatigue-related worker performance associated with a 6-hour and 8-hour break, respectively. The third day data were used from the Belenky study, assuming that the use of waivers could realistically occur mid-workweek. The percent improvement in worker performance (mean

lapses) from a 6-hour to 8-hour break was calculated to be 55%. Therefore, the IHP percentage for this scenario is 55%.

For the efficiency productivity evaluation, the IEP value for the 8-hour break provision was assumed to be approximately the same as that of the 16-hour limit. Thus, the Improved Efficiency Productivity (IEP) value for the 8-hour break is 486.7. Note that the overall analysis recognizes the fact that only some smaller percentage of this productivity would actually be realized. This is addressed in Appendix G.

6.1.2 Performance Applicability

The purpose of the calculations in this section was to differentiate the benefit for specific types of plant workers, as well as to account for the percentage of time in which these workers would be affected by the changed requirement. The analysis in this section determined the portion of the population that would be affected by the proposed change. This Percent of Population with Performance Applicability (PA) can be broken down into the five job duty group categories as listed in proposed §26.199(a)(1-5).

6.1.2.1 Operations and Maintenance

Under outage conditions, it was assumed that operators who work shifts will work overtime during outages. Proposed §26.199(d)(3) is expected to affect non-shift staff operators and maintenance workers, because waivers will be submitted for these job duty groups under outage conditions. If a plant shifts to a super-crew schedule during outages, the 72-hour limit also may be waived for these super-crew personnel. Therefore, super-crew operators are assumed to be affected by the new waiver restrictions for this scenario in a manner similar to non-shift operators.

Waiver data from 6 nuclear plants for years 2003 through 2004 were evaluated to obtain the percent of population that will benefit (PA value) from the new waiver restrictions.[2] This analysis calculated the number of waivers approved for each job duty group and the number of extra hours worked and compared this to the total worker-hours that could have been waived. For example, the IHP/IEP value for the 16-hour limit used an additional 8 hours worked as an upper limit. The waiver data showed that the average waived hours for this limit is approximately 4.07 hours per waiver. Therefore, the PA percentage calculation accounts for the fact that only 4.07/8 = 51% of the 8 possible hours waived (upper limit) are actually waived, according to the data. In this case, the PA value reduces the amount of the upper limit IHP/IEP by calculating a percent of the possible waived hours taken by personnel. This type of calculation was used for all PA percentage calculations in the analysis of this requirement.

The PA calculation also assumed that plants are in outage conditions 10% of the time and 75% of plants shift to a super-crew schedule during outages (and 100% of personnel at these plants

[2] This set of data submitted by six plants is considered to be limited and creates some uncertainty in the results.

shift to super-crew schedules). The percent of population with performance applicability (PA) calculated from this analysis is summarized in Table 6-2 below.

Table 6-2
Percent of Population with Performance Applicability (PA)

	16-hour Limit	24-hour Limit	72-hour Limit	8-hour Break
Operators (shift - overtime)	N/A	N/A	1.2%	N/A
Super-Crew Operators *	N/A	N/A	1.2%	N/A
Operators (non-shift)	0.01%	0.10%	1.2%	0.01%
Staff Maintenance	0.02%	0.07%	6.0%	0.02%
Contract Maintenance	0.02%	0.04%	1.1%	0.02%

** Note that super-crew operators in Table 6-2 refer to those shift operators that have moved to super-crew schedules due to the outage. While 75% of non-shift operators and maintenance workers are assumed to shift to super-crew schedules, the impact of the analysis for each job duty group during outages was the same whether they are on super-crews or working outages under the assumed conditions specified in 3.2.2 and 3.3.2 (because both have a baseline schedule duration of six 12-hour shifts). Therefore, differentiating the PA percentage by this criteria for these job duty groups is unnecessary.*

Note that Performance Applicability (PA) refers to the percent of population (associated with a job duty group under the specified condition) that would benefit from implementation of the proposed provision. This value was used in an analysis that will be described later to determine the overall benefit of the new waiver restrictions.

6.1.2.2 HP/Chemistry

HP/chemistry personnel were assumed to be on a shift rotation similar to the shift operating crew. Under outage conditions, HP/chemistry personnel who work shifts were assumed to also work an overtime schedule, and would therefore be affected by the new waiver restrictions. Some HP/chemistry personnel also may provide backup or rotational support, but typically will work a normal business schedule of five workdays a week. Proposed §26.199(d)(3) is expected to affect non-shift staff HP/chemistry personnel, because waivers would be submitted for these job duty groups under outage conditions. Further, HP/chemistry personnel were assumed to shift to a super-crew schedule during outage conditions if applicable at their specific plant. Under a super-crew schedule during outages, the 72-hour limit may be waived for these HP/chemistry super-crew personnel. Therefore, super-crew HP/chemistry personnel were assumed to be affected by the new waiver restrictions for this scenario in a manner similar to shift (overtime) and non-shift HP/chemistry personnel.

Waiver data from 6 nuclear plants for years 2003 through 2004 were evaluated to obtain the percent of population that will benefit from the new waiver restrictions. This analysis calculated the number of each job duty group submitting waivers and the number of extra hours worked and compared this to the total worker-hours that could have been waived. This calculation also assumed that plants are in outage conditions 10% of the time and 75% of plants shift to a

super-crew schedule during outages. The percent of population with Performance Applicability (PA) calculated from this analysis is summarized in Table 6-3 below.

Table 6-3
Percent of Population with Performance Applicability (PA)

	16-hour Limit	24-hour Limit	72-hour Limit	8-hour Break
HP/Chemistry (shift - overtime)	N/A	N/A	1.9%	N/A
Super-Crew HP/Chemistry *	N/A	N/A	1.9%	N/A
HP/Chemistry (non-shift)	0.03%	0.24%	1.9%	0.03%

** Note that super-crew HP/chemistry personnel in Table 6-3 refer to those shift HP/chemistry personnel that have moved to super-crew schedules due to the outage. While 75% of non-shift HP/chemistry workers were assumed to shift to super-crew schedules, the impact of the analysis for each job duty group during outages would be the same whether they are on super-crews or working outages under the assumed conditions specified in Section 3.4.1 (because both have a baseline schedule duration of six 12-hour shifts). Therefore, differentiating the PA percentage by this criteria for this job duty group is unnecessary.*

6.1.2.3 Fire Brigade

The waiver restrictions would be applicable to the members of the fire brigade responsible for providing the control room operators information that is critical to implementing a fire mitigation strategy that maintains the safe shutdown capability for the reactor. Fire brigade personnel meeting this requirement are assumed to be on a shift rotation similar to the operating crew. Therefore, the percent of population with Performance Applicability (PA) of fire brigade shift personnel was assumed to be the same as that for shift operators (explained in Section 6.1.2.1) during outage conditions. Some fire brigade personnel also may provide backup or rotational support but typically work a normal business schedule of five workdays a week. These non-shift fire brigade personnel therefore have similar PA percentages to those outlined for non-shift operators in Section 6.1.2.1. Further, fire brigade personnel are assumed to shift to a super-crew schedule during outage conditions if applicable at their specific plant. These super-crew fire brigade personnel were assumed to have PA percentages similar to those outlined for super-crew operators in Section 3.2.2. Assuming that plants are in outage conditions 10% of the time and that 75% of plants are on super-crew schedules during outages, the Performance Applicability for fire brigade is summarized in Table 6-4.

Table 6-4
Percent of Population with Performance Applicability (PA)

	16-hour Limit	24-hour Limit	72-hour Limit	8-hour Break
Fire Brigade (shift-overtime)	N/A	N/A	1.2%	N/A
Super-Crew Fire Brigade	N/A	N/A	1.2%	N/A
Fire Brigade (non-shift)	0.01%	0.10%	1.2%	0.01%

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6.1.3 Improved Human Performance and Productivity Summary

6.1.3.1 Initial Performance Net Improvement Calculation

Multiplying the generalized IHP percentages by the PA values for each type of worker yields a performance net improvement percentage for each job duty group, for outage conditions. An initial performance net improvement calculation by worker and response type for each of the four provisions that may be affected by the new waiver restrictions is found in Table 6-5.

Table 6-5
Performance Net Improvement Summary for the Four Requirements Affected by the Waiver Restrictions

Item	Job Duty Group and Condition	Response Type	Performance Applicability (PA)	Improved Human Performance (IHP)	Performance Net Improvement
16-Hour Limit in 24 Hours (Outage Conditions)					
1a	Operations, HP/Chemistry, Fire Brigade On-Shift	vigilant	N/A	29.6%	N/A
2a	Operations, HP/Chemistry, Fire Brigade On-Shift	reactionary	N/A	14.8%	N/A
3a	Operations, Fire Brigade, Super-Crew	vigilant	N/A	29.6%	N/A
4a	Operations, Fire Brigade, Super-Crew	reactionary	N/A	14.8%	N/A
5a	Operations, Fire Brigade Non-Shift	vigilant	0.01%	29.6%	0.002%
6a	Operations, Fire Brigade Non-Shift	reactionary	0.01%	14.8%	0.001%
7a	Staff Maintenance	vigilant	0.02%	29.6%	0.006%
8a	Staff Maintenance	reactionary	0.02%	14.8%	0.003%
9a	HP/Chemistry, Super-Crew	vigilant	N/A	29.6%	N/A
10a	HP/Chemistry, Super-Crew	reactionary	N/A	14.8%	N/A
11a	HP/Chemistry, Non-Shift	vigilant	0.03%	29.6%	0.009%

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Item	Job Duty Group and Condition	Response Type	Performance Applicability (PA)	Improved Human Performance (IHP)	Performance Net Improvement
12a	HP/Chemistry, Non-Shift	reactionary	0.03%	14.8%	0.005%
13a	Contract Maintenance	vigilant	0.02%	29.6%	0.006%
14a	Contract Maintenance	reactionary	0.02%	14.8%	0.003%
24-Hour Limit in 48 Hours (Outage Conditions)					
1b	Operations, HP/Chemistry, Fire Brigade On-Shift	vigilant	N/A	40.5%	N/A
2b	Operations, HP/Chemistry, Fire Brigade On-Shift	reactionary	N/A	20.3%	N/A
3b	Operations, Fire Brigade, Super-Crew	vigilant	N/A	40.5%	N/A
4b	Operations, Fire Brigade, Super-Crew	reactionary	N/A	20.3%	N/A
5b	Operations, Fire Brigade Non-Shift	vigilant	0.10%	40.5%	0.04%
6b	Operations, Fire Brigade Non-Shift	reactionary	0.10%	20.3%	0.02%
7b	Staff Maintenance	vigilant	0.07%	40.5%	0.03%
8b	Staff Maintenance	reactionary	0.07%	20.3%	0.02%
9b	HP/Chemistry, Super-Crew	vigilant	N/A	40.5%	N/A
10b	HP/Chemistry, Super-Crew	reactionary	N/A	20.3%	N/A
11b	HP/Chemistry, Non-Shift	vigilant	0.24%	40.5%	0.10%
12b	HP/Chemistry, Non-Shift	reactionary	0.24%	20.3%	0.05%
13b	Contract Maintenance	vigilant	0.04%	40.5%	0.02%
14b	Contract Maintenance	reactionary	0.04%	20.3%	0.01%
72-Hour Limit in 7 Days (Outage Conditions)					
1c	Operations, Fire Brigade On-Shift (Overtime)	vigilant	1.2%	7.6%	0.09%

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Item	Job Duty Group and Condition	Response Type	Performance Applicability (PA)	Improved Human Performance (IHP)	Performance Net Improvement
2c	Operations, Fire Brigade On-Shift (Overtime)	reactionary	1.2%	3.8%	0.05%
3c	Operations, Fire Brigade, Super-Crew	vigilant	1.2%	7.6%	0.09%
4c	Operations, Fire Brigade, Super-Crew	reactionary	1.2%	3.8%	0.05%
5c	Operations, Fire Brigade Non-Shift	vigilant	1.2%	7.6%	0.09%
6c	Operations, Fire Brigade Non-Shift	reactionary	1.2%	3.8%	0.05%
7c	Staff Maintenance	vigilant	6.0%	7.6%	0.46%
8c	Staff Maintenance	reactionary	6.0%	3.8%	0.23%
9c	HP/Chemistry, Super-Crew	vigilant	1.9%	7.6%	0.14%
10c	HP/Chemistry, Super-Crew	reactionary	1.9%	3.8%	0.07%
11c	HP/Chemistry, Non-Shift	vigilant	1.9%	7.6%	0.14%
12c	HP/Chemistry, Non-Shift	reactionary	1.9%	3.8%	0.07%
13c	Contract Maintenance	vigilant	1.1%	7.6%	0.08%
14c	Contract Maintenance	reactionary	1.1%	3.8%	0.04%
15c	HP/Chemistry, Shift	vigilant	1.9%	7.6%	0.14%
16c	HP/Chemistry, Shift	reactionary	1.9%	3.8%	0.07%
8-Hour Break (Outage Conditions)					
1d	Operations, HP/Chemistry, Fire Brigade On-Shift	vigilant	N/A	55.0%	N/A
2d	Operations, HP/Chemistry, Fire Brigade On-Shift	reactionary	N/A	27.5%	N/A
3d	Operations, HP/Chemistry, Fire Brigade, Super-Crew	vigilant	N/A	55.0%	N/A

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Item	Job Duty Group and Condition	Response Type	Performance Applicability (PA)	Improved Human Performance (IHP)	Performance Net Improvement
4d	Operations, HP/Chemistry, Fire Brigade, Super-Crew	reactionary	N/A	27.5%	N/A
3d	Operations, HP/Chemistry, Fire Brigade Non-Shift	vigilant	0.01%	55.0%	0.004%
4d	Operations, HP/Chemistry, Fire Brigade Non-Shift	reactionary	0.01%	27.5%	0.002%
5d	Staff Maintenance	vigilant	0.02%	55.0%	0.011%
6d	Staff Maintenance	reactionary	0.02%	27.5%	0.006%
9d	HP/Chemistry, Super-Crew	vigilant	N/A	55.0%	N/A
10d	HP/Chemistry, Super-Crew	reactionary	N/A	27.5%	N/A
11d	HP/Chemistry, Non-Shift	vigilant	0.03%	55.0%	0.017%
12d	HP/Chemistry, Non-Shift	reactionary	0.03%	27.5%	0.009%
13d	Contract Maintenance	vigilant	0.02%	55.0%	0.011%
14d	Contract Maintenance	reactionary	0.02%	27.5%	0.006%

6.1.3.2 Final Performance Net Improvement with Penalty for Increased Turnovers

As explained in Section 3.7, the new waiver restrictions are expected to increase the number of shift turnovers that occur per day during outages. Each turnover involving a complex evolution has a risk of producing a plant error. This risk was calculated in Section 3.7 to be 3 errors for every 3383.6 turnovers involving a complex evolution. As the number of turnovers increases, so will this risk. However, as fatigue-related worker performance improves, the risk of errors becomes less. Therefore, both factors were considered and the net improvement percentages presented in Section 6.1.3.1 were adjusted as described below.

An example of how these factors were considered for maintenance personnel (vigilance error response) in the 72-hour limit scenario follows:

Using the baseline number of turnovers of 3383.6, the new waiver restrictions on the 72-hour limit were estimated to increase this number by 6.0%. This factor is the percent of population affected (PA value) presented in Table 6-4. This percentage likely underestimates the

increase in turnovers due to the proposed provision, because multiple workers are normally involved in a shift turnover (with a complex evolution). Applying this percentage yields a new number of turnovers involving a complex evolution of 3586.6. This increase in turnovers equates to a larger new error number of (3 errors) X (3586.6 new turnovers) / (3383.6 turnovers) = 3.18 new errors. Accounting for the improvement in performance due to fatigue mitigation, these new errors decrease to (3.18 new errors) X (1 - 0.46% improvement) = 3.165 final errors. The improvement percentage of 0.17% was obtained from the net improvement in Table 6-5. Therefore, the change in errors is 3 - 3.165 = -0.165. Normalizing this by the original number of turnovers considered, a (-0.165) / (3383.6) = -0.005% penalty in fatigue-related worker performance (net improvement) was obtained. Incorporating this penalty with the performance net improvement percentage of 0.46% presented in Table 6-6 gives the final net improvement of 0.46% - 0.005% = 0.45%. In some cases (though not in this case), the calculated turnover penalty is so small that the precision of the original performance net improvement percentages does not allow for the combination of these values. In other words, the turnover penalty is more than one order of magnitude less than the net improvement number. Therefore, the turnover penalty is considered an insignificant contributor to the overall net improvement number.

These calculations were performed for all job duty groups and waiver restriction scenarios. Note that the turnover penalty is only warranted for the vigilance error response type, as complex evolution turnovers would most likely not occur under conditions in which a reactionary error response would be applicable (during uncommon plant events, etc.). The results are presented in Table 6-6.

Table 6-6
Final Performance Net Improvement (Including Turnover Penalty) for each Waiver Restriction Provision

Item	Job Duty Group and Condition	Response Type	Original Performance Net Improvement	Turnover Penalty	Final Performance Net * Improvement
16-Hour Limit in 24 Hours (Outage Conditions)					
1a	Operations, HP/Chemistry, Fire Brigade On-Shift	vigilant	N/A	N/A	N/A
2a	Operations, HP/Chemistry, Fire Brigade On-Shift	reactionary	N/A	N/A	N/A
3a	Operations, Fire Brigade, Super-Crew	vigilant	N/A	N/A	N/A
4a	Operations, Fire Brigade, Super-Crew	reactionary	N/A	N/A	N/A
5a	Operations, Fire Brigade Non-Shift	vigilant	0.002%	-0.0001%	0.002%

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Item	Job Duty Group and Condition	Response Type	Original Performance Net Improvement	Turnover Penalty	Final Performance Net * Improvement
6a	Operations, Fire Brigade Non-Shift	reactionary	0.001%	N/A	0.001%
7a	Staff Maintenance	vigilant	0.006%	-0.00001%	0.006%
8a	Staff Maintenance	reactionary	0.003%	N/A	0.003%
9a	HP/Chemistry, Super-Crew	vigilant	N/A	N/A	N/A
10a	HP/Chemistry, Super-Crew	reactionary	N/A	N/A	N/A
11a	HP/Chemistry, Non-Shift	vigilant	0.009%	-0.00002%	0.009%
12a	HP/Chemistry, Non-Shift	reactionary	0.005%	N/A	0.005%
13a	Contract Maintenance	vigilant	0.006%	-0.0001%	0.006%
14a	Contract Maintenance	reactionary	0.003%	N/A	0.003%
24-Hour Limit in 48 Hours (Outage Conditions)					
1b	Operations, HP/Chemistry, Fire Brigade On-Shift	vigilant	N/A	N/A	N/A
2b	Operations, HP/Chemistry, Fire Brigade On-Shift	reactionary	N/A	N/A	N/A
3b	Operations, Fire Brigade, Super-Crew	vigilant	N/A	N/A	N/A
4b	Operations, Fire Brigade, Super-Crew	reactionary	N/A	N/A	N/A
5b	Operations, Fire Brigade Non-Shift	vigilant	0.04%	-0.00005%	0.04%
6b	Operations, Fire Brigade Non-Shift	reactionary	0.02%	N/A	0.02%
7b	Staff Maintenance	vigilant	0.03%	-0.00004%	0.03%
8b	Staff Maintenance	reactionary	0.02%	N/A	0.02%
9b	HP/Chemistry, Super-Crew	vigilant	N/A	N/A	N/A
10b	HP/Chemistry, Super-Crew	reactionary	N/A	N/A	N/A
11b	HP/Chemistry, Non-Shift	vigilant	0.1%	-0.0001%	0.1%
12b	HP/Chemistry, Non-Shift	reactionary	0.05%	N/A	0.05%

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Item	Job Duty Group and Condition	Response Type	Original Performance Net Improvement	Turnover Penalty	Final Performance Net * Improvement
13b	Contract Maintenance	vigilant	0.02%	-0.00002%	0.02%
14b	Contract Maintenance	reactionary	0.01%	N/A	0.01%
72-Hour Limit in 7 Days (Outage Conditions)					
1c	Operations, Fire Brigade On-Shift (Overtime)	vigilant	0.09%	-0.001%	0.09%
2c	Operations, Fire Brigade On-Shift (Overtime)	reactionary	0.05%	N/A	0.05%
3c	Operations, Fire Brigade, Super-Crew	vigilant	0.09%	-0.001%	0.09%
4c	Operations, Fire Brigade, Super-Crew	reactionary	0.05%	N/A	0.05%
5c	Operations, Fire Brigade Non-Shift	vigilant	0.09%	-0.001%	0.09%
6c	Operations, Fire Brigade Non-Shift	reactionary	0.05%	N/A	0.05%
7c	Staff Maintenance	vigilant	0.46%	-0.005%	0.45%
8c	Staff Maintenance	reactionary	0.23%	N/A	0.23%
9c	HP/Chemistry, Super-Crew	vigilant	0.14%	-0.002%	0.14%
10c	HP/Chemistry, Super-Crew	reactionary	0.07%	N/A	0.07%
11c	HP/Chemistry, Non-Shift	vigilant	0.14%	-0.002%	0.14%
12c	HP/Chemistry, Non-Shift	reactionary	0.07%	N/A	0.07%
13c	Contract Maintenance	vigilant	0.08%	-0.001%	0.08%
14c	Contract Maintenance	reactionary	0.04%	N/A	0.04%
15c	HP/Chemistry, Shift	vigilant	0.14%	-0.001%	0.14%
16c	HP/Chemistry, Shift	reactionary	0.07%	N/A	0.07%
8-Hour Break (Outage Conditions)					
1d	Operations, HP/Chemistry, Fire Brigade On-Shift	vigilant	N/A	N/A	N/A
2d	Operations, HP/Chemistry, Fire Brigade On-Shift	reactionary	N/A	N/A	N/A

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Item	Job Duty Group and Condition	Response Type	Original Performance Net Improvement	Turnover Penalty	Final Performance Net * Improvement
3d	Operations, Fire Brigade, Super-Crew	vigilant	N/A	N/A	N/A
4d	Operations, Fire Brigade, Super-Crew	reactionary	N/A	N/A	N/A
3d	Operations, Fire Brigade Non-Shift	vigilant	0.004%	-0.000004%	0.004%
4d	Operations, Fire Brigade Non-Shift	reactionary	0.002%	N/A	0.002%
5d	Staff Maintenance	vigilant	0.01%	-0.00008%	0.01%
6d	Staff Maintenance	reactionary	0.006%	N/A	0.006%
9d	HP/Chemistry, Super-Crew	vigilant	N/A	N/A	N/A
10d	HP/Chemistry, Super-Crew	reactionary	N/A	N/A	N/A
11d	HP/Chemistry, Non-Shift	vigilant	0.02%	-0.00001%	0.02%
12d	HP/Chemistry, Non-Shift	reactionary	0.01%	N/A	0.01%
13d	Contract Maintenance	vigilant	0.01%	-0.00008%	0.01%
14d	Contract Maintenance	reactionary	0.006%	N/A	0.006%

** Note that, in all but one case, the calculated turnover penalty is so small that the precision of the original net improvement percentages does not allow for the combination of these values. In other words, when the turnover penalty was more than one order of magnitude less than the net improvement number, the turnover penalty is an insignificant contributor to the overall net improvement number.*

The four work hour controls waived were treated as mutually exclusive. While this treatment is an analysis simplification, the percent of waivers where more than a single requirement is waived is relatively small. Furthermore, the 72-hour limit, which is the dominant contributor to the overall net improvement percentages, is the requirement that is least likely to be waived at the same time as another provision. The other provisions that are more likely to be waived at the same time as another provision do not contribute significantly to the overall net improvement. Therefore, the final performance net improvement percentages of the four scenarios can be summed to obtain an overall net improvement percentage for outage personnel.

After the summation, the overall net improvement percentages for maintenance vigilance errors were reduced by a factor of 10%. This accounted for the assumption that 10% of the total improvement was actually for latent outage errors that would only be realized under at-power

conditions. Additionally, this portion of improvement (i.e. 10% of the outage net improvement percentage (vigilant)) was used to obtain an at-power net improvement percentage (vigilant) that represented the result of these latent outage errors during at-power conditions. These overall net performance improvement percentages for all job duty groups are summarized in Table 6-7. These values were combined with generalized benefit figures for each of the eight benefit areas, as will be described in Section 6.2, to obtain a final dollar value for the benefit resulting from implementation of the proposed provision restricting waivers.

Table 6-7
Performance Net Improvement Summary (Including Latent Outage Errors Adjustment)

Item	Job Duty Group and Condition	Response Type	Performance Net Improvement
Outage Conditions			
1	Operations, Fire Brigade On-Shift (Overtime)	vigilant	0.09%
2	Operations, Fire Brigade On-Shift (Overtime)	reactionary	0.05%
3	Operations, Fire Brigade, Super-Crew	vigilant	0.09%
4	Operations, Fire Brigade, Super-Crew	reactionary	0.05%
5	Operations, Fire Brigade Non-Shift	vigilant	0.14%
6	Operations, Fire Brigade Non-Shift	reactionary	0.07%
7	Staff Maintenance	vigilant	0.46%
8	Staff Maintenance	reactionary	0.25%
9	HP/Chemistry, Super-Crew	vigilant	0.14%
10	HP/Chemistry, Super-Crew	reactionary	0.07%
11	HP/Chemistry, Non-Shift	vigilant	0.27%
12	HP/Chemistry, Non-Shift	reactionary	0.13%
13	Contract Maintenance	vigilant	0.11%
14	Contract Maintenance	reactionary	0.06%

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Item	Job Duty Group and Condition	Response Type	Performance Net Improvement
15	HP/Chemistry, Shift	vigilant	0.14%
16	HP/Chemistry, Shift	reactionary	0.07%
At-Power Condition			
1	Staff Maintenance	vigilant	0.06% *

** The Net Improvement for staff maintenance at-power is the sum of the attributable latent outage error percentages for staff and contract maintenance*

6.1.3.3 Productivity Net Improvement Calculation

Multiplying the generalized IEP values by the PA values for each type of worker yields a productivity net improvement value for each job duty group, for outage conditions. The productivity net improvement calculation by worker type for each of the four requirements that may be affected by the new waiver restrictions is found in Table 6-8.

Table 6-8
Productivity Net Improvement Summary for the Four Requirements Affected by the Waiver Restrictions

Job Duty Group and Condition	Performance Applicability (PA)	Improved Efficiency Productivity (IEP)	Productivity Net Improvement
16-Hour Limit in 1 Day (Outage Conditions)			
Operations, HP/Chemistry, On-Shift	N/A	486.7	N/A
Operations, Super-Crew	N/A	486.7	N/A
Operations, Non-Shift	0.01%	486.7	0.039
Staff Maintenance	0.02%	486.7	0.097
HP/Chemistry, Super-Crew	N/A	486.7	N/A
HP/Chemistry, Non-Shift	0.03%	486.7	0.146
Contract Maintenance	0.02%	486.7	0.097
24-Hour Limit in 2 Days (Outage Conditions)			
Operations, HP/Chemistry On-Shift	N/A	324.4	N/A

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Job Duty Group and Condition	Performance Applicability (PA)	Improved Efficiency Productivity (IEP)	Productivity Net Improvement
Operations, Super-Crew	N/A	324.4	N/A
Operations, Non-Shift	0.10%	324.4	0.324
Staff Maintenance	0.07%	324.4	0.227
HP/Chemistry, Super-Crew	N/A	324.4	N/A
HP/Chemistry, Non-Shift	0.24%	324.4	0.779
Contract Maintenance	0.04%	324.4	0.130
72-Hour Limit in 7 Days (Outage Conditions)			
Operations, On-Shift (Overtime)	1.2%	139.1	1.669
Operations, Super-Crew	1.2%	139.1	1.669
Operations, Non-Shift	1.2%	139.1	1.669
Staff Maintenance	6.0%	139.1	8.343
HP/Chemistry, Shift	1.9%	139.1	2.642
HP/Chemistry, Super-Crew	1.9%	139.1	2.642
HP/Chemistry, Non-Shift	1.9%	139.1	2.642
Contract Maintenance	1.1%	139.1	1.530
8-Hour Break (Outage Conditions)			
Operations, HP/Chemistry, On-Shift	N/A	486.7	N/A
Operations, HP/Chemistry, Super-Crew	N/A	486.7	N/A
Operations, HP/Chemistry, Non-Shift	0.01%	486.7	0.039
Staff Maintenance	0.02%	486.7	0.097
HP/Chemistry, Super-Crew	N/A	486.7	N/A
HP/Chemistry, Non-Shift	0.03%	486.7	0.146
Contract Maintenance	0.01%	486.7	0.097

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The four requirements individuals are approved waivers to exceed were treated as mutually exclusive. Therefore, the final productivity net improvement values of the four scenarios was summed to obtain an overall net improvement value for outage personnel. These overall productivity net improvement values for all job duty groups are summarized in Table 6-9. These values were combined with generalized benefit figures for the efficiency productivity benefit area, as will be described in Section 6.2.7.

Table 6-9
Productivity Net Improvement Summary

Job Duty Group and Condition	Productivity Net Improvement
Outage Conditions	
Operations, On-Shift (Overtime)	1.67
Operations, Super-Crew	1.67
Operations, Non-Shift	2.07
Staff Maintenance	8.76
HP/Chemistry, Shift	2.64
HP/Chemistry, Super-Crew	2.64
HP/Chemistry, Non-Shift	3.71
Contract Maintenance	1.85

6.2 Relationship Between Worker Performance and Benefit Areas

6.2.1 Reduction in Frequency of Plant Trips

This benefit area addressed the reduction in human-performance related plant trips that would occur from the implementation of the new waiver restrictions. The new waiver restrictions were assumed to benefit workers primarily during outage conditions. Yet, there is a small at-power benefit attached to maintenance personnel at-power as a result of a reduction in latent outage errors. The first subsection addresses the applicability of this job duty group to this benefit area and the next subsection summarizes the plant trip benefits associated with the waiver restrictions provisions.

6.2.1.1 Applicability of Job Duty Groups on Plant Trips

This section summarizes the applicability of each job duty group and error response type to a reduction in plant trips. Trip-related human errors are thought to be caused by a lack of vigilance in plant personnel. Once a plant trip has occurred, the changes in reactionary

response do not impact this benefit area (but do impact the severe at-power accidents benefit area). Therefore, this analysis only accounted for the Net Improvement percentages in Table 6-7 that refer to a vigilance response type. While plant trips are attributable to human errors made by both operators and maintenance workers (see Appendix A), only maintenance workers are included in the evaluation of the benefit obtained from a reduction in frequency of plant trips due to latent errors. As explained earlier, maintenance workers would be the only job duty group to have attributable benefit from a reduction in latent outage errors during at-power conditions. Because plant trips only occur at-power, this was the only plant condition evaluated using the at-power Net Improvement percentages from Table 6-6.

The change in performance affecting trips associated with the waiver restriction provisions for the applicable job duty groups is presented in Table 6-10.

Table 6-10
Net Improvement Summary (Applicable to Plant Trips)

Job Duty Group and Condition	Response Type	Net Improvement *
At-Power		
Staff Maintenance	vigilant	0.06%

* *Net Improvement percentages obtained from appropriate items in Table 6-7.*

6.2.1.2 Estimated Benefits from the Reduction in Trip Frequency

The Net Improvement percentages by job duty group in Table 6-10 are equivalent to the potential reduction in cost from trips that can be attributed to the fatigue-related performance improvement for each job duty group. The average present value maximum attainable benefit (MAB) that would be obtained if all human-related trips could be eliminated was also calculated for each applicable job duty group in Appendix A. The total reduction in cost from elimination of plant trips for each job duty group is the average present value MAB multiplied by the potential reduction percentage displayed in Table 6-10. The amount of the benefit is presented in Table 6-11.

Table 6-11
Total Reduction in Trip Costs During At-Power Conditions

Job Duty Group	MAB** (Million)	Net Improvement*	Benefit (Million)
Staff Maintenance	$125.3	0.06%	$0.08
		Total	$0.08

* *Net Improvement percentages from Table 6-10*
** *MAB for each job duty group calculated in Appendix A*

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The table shows that the present value average benefit to the nuclear industry from a reduction in plant trips would be $80,000 for the proposed waiver restriction provisions.

6.2.2 Reduction in Frequency of Severe Accidents (At-Power)

This benefit area addresses the potential reduction in the frequency of at-power severe accidents that is associated with an improvement in fatigue-related worker performance. The new waiver restrictions were assumed to benefit workers primarily during outage conditions. Yet, there is a small at-power benefit attached to maintenance personnel as a result of a reduction in latent outage errors.

6.2.2.1 Applicability of Job Duty Group and Error Response Type on Severe Accidents (At Power)

This section summarizes the applicability of each job duty group and error response type to a reduction in at-power severe accidents. Human-related errors that result in core damage (at-power severe accidents) are thought to be caused by both a lack of vigilance and a lessened reactionary response in plant personnel. Actions that lead to core damage have response elements of vigilance (i.e., monitoring instrumentation for indications of an abnormal condition) and reactionary elements (i.e., taking the appropriate actions once an abnormal condition is determined). Additionally, core damage is attributable only to human errors made by operators on shift and maintenance workers (see Appendix B). As explained earlier, maintenance workers (vigilant type) were the only job duty group and error response type to have attributable benefit from a reduction in latent outage errors during at-power conditions. Because this benefit area is only applicable for personnel working while the plant is at power, this was the only plant condition evaluated using the at-power Net Improvement percentages from Table 6-7.

6.2.2.2 Functional Benefits of a Reduction in At-Power Severe Accidents

The risk of shutdown severe accidents was quantified using Standardized Plant Analysis Risk (SPAR) models developed for analysis of at-power internal event risk and was used as an estimate of the shutdown risk as described in Appendix C. The outage Net Improvement percentages in Table 6-14 (in the next section) were the input for the model. The analysis resulted in an improvement in core damage frequency (CDF) percentage that would result from the fatigue-related performance improvement due to implementation of the proposed provision (see Appendix B). The analysis assumed that the ratio between the Net Improvement percentages and Improvement in CDF percentages during shutdown conditions would be the same as that for at-power conditions (See Appendix C). For example, the Net Improvement for maintenance (vigilance, sum of staff and contract maintenance) during outage conditions is 0.57%. This resulted in an improvement in CDF of 0.08% (sum of staff and contract maintenance). Therefore, the improvement in CDF for maintenance workers (vigilance) at-power is the at-power Net Improvement percentage of 0.06% multiplied by the quantity (0.57%/0.08%). This resulted in an improvement in CDF for maintenance (vigilance) during shutdown of 0.01%. The results of this calculation are displayed in Table 6-12.

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Table 6-12
Improvement in Core Damage Frequency (CDF) (Applicable to At-Power Severe Accidents)

Job Duty Group	Response Type	Improvement in CDF *
At-Power		
Staff Maintenance	vigilant	0.01%
Total		0.01%

* *Note that the total improvement in CDF is the result of a SPAR model run (results displayed in Section 6.2.3).*

6.2.2.3 Expected Benefit of a Reduction in At-Power Severe Accidents

The improvement in CDF percentage in Table 6-12 is equivalent to the potential reduction in cost from the elimination of severe accidents that can be attributed to the fatigue-related performance improvement of maintenance. The average present value maximum attainable benefit (MAB) that could be obtained if all human-related severe accidents were eliminated for the entire nuclear industry was calculated in Appendix B. The total reduction in cost from the elimination of severe accidents for each job duty group was obtained by multiplying the average present value MAB by the potential reduction percentage displayed in Table 6-12. The calculations are summarized in Table 6-13.

Table 6-13
Total Reduction in Accident Costs During At-Power Conditions

Job Duty Group	MAB** (Million)	Improvement in CDF*	Benefit
Staff Maintenance	$153.1	0.01%	$13,779
		Total	$13,779

* *Improvement in CDF percentages from Table 6-12*
** *MAB for entire nuclear industry calculated in Appendix B*

The table shows that the present value average benefit to the nuclear industry from a reduction in at-power severe accidents would be $14,000 from implementation of the waiver restriction provisions.

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6.2.3 Reduction in Shutdown Risk

This benefit area addressed the potential reduction in the frequency of internal events during shutdown that are associated with an improvement in fatigue-related worker performance. This benefit is the on-site, off-site, and replacement power avoided costs of shutdown accidents.

The first subsection addresses the applicability of job duty group and error response type to this benefit area. The second subsection estimates the improvement in core damage frequency (CDF) that results from the improved performance associated with the new waiver restrictions, and the final subsection summarizes the shutdown severe accident benefits associated with new waiver restrictions.

6.2.3.1 Applicability of Job Duty Group and Error Response Type on Severe Accidents (Shutdown)

This section summarizes the applicability of each job duty group and error response type to a reduction in severe accidents during shutdown conditions. Human-related errors that result in core damage (shutdown severe accidents) are caused by both a lack of vigilance and a lessened reactionary response in plant personnel. Actions that lead to core damage have vigilance response elements (i.e., monitoring for indications of an abnormal condition) and reactionary response elements (i.e., taking the appropriate actions once an abnormal condition is determined). Because core damage is typically attributable only to human errors made by operators on shift, on super-crews and maintenance workers (both staff and contract personnel) (see Appendix C), only operators who work shifts and super-crews and maintenance workers are included in the evaluation of the benefit obtained from a reduction in core damage frequency. Therefore, this analysis accounts for the Net Improvement percentages in Table 6-7 that refer to both vigilance and reactionary response types and only to operators who work shifts and super-crews and maintenance workers (see Section 5.3 for a further discussion). Because this benefit area is only applicable for personnel working under outage conditions, this was the only plant condition evaluated using the outage Net Improvement percentages from Table 6-7. The applicable Net Improvement percentages from Table 6-7 are summarized in Table 6-14 below.

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Table 6-14
Net Improvement Summary (Applicable to Severe Accidents During Shutdown)

Job Duty Group and Condition	Response Type	Net Improvement *
Outage		
On Shift Operations, Fire Brigade (Overtime)	vigilant	0.09%
On-Shift Operations, Fire Brigade (Overtime)	reactionary	0.05%
Super-Crew Operations, Fire Brigade	vigilant	0.09%
Super-Crew Operations, Fire Brigade	reactionary	0.05%
Staff Maintenance	vigilant	0.46%
Contract Maintenance	vigilant	0.11%

* *Net Improvement percentages obtained from appropriate items in Table 6-7. Note if Net Improvement is N/A in Table 6-14, it was omitted from the remaining evaluation.*

6.2.3.2 Functional Benefit of a Reduction in Shutdown Severe Accidents

The risk of at-power severe accidents was quantified using Standardized Plant Analysis Risk (SPAR) Models developed for analysis of at-power internal event risk. The improvement in core damage frequency (CDF) percentages calculated for at-power internal event risk (using the Net Improvement numbers in Table 6-7 as the input for the model) were assumed to be the same as those for shutdown conditions. The analysis calculated an improvement in core damage frequency (CDF) percentage for the fatigue-related performance improvement due to implementation of the proposed provision (See Appendix C). The overall improvement in CDF, using the Net Improvement percentages for the applicable job duty groups, was calculated by the model to be 0.34%. Separate SPAR model runs were performed to calculate the percent of this improved CDF that would be attributable to each job duty group (See Appendix C). The results of the model runs are summarized in Table 6-15.

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Table 6-15
Improvement in Core Damage Frequency (CDF) (Applicable to Shutdown Severe Accidents)

Job Duty Group and Condition	Response Type	Percent of Attributable CDF *	Improvement in CDF **
Outage			
Shift Operations (Overtime)	vigilant	1.6%	0.01%
Shift Operations (Overtime)	reactionary	35.9%	0.12%
Super-Crew Operations	vigilant	1.6%	0.01%
Super-Crew Operations	reactionary	35.9%	0.12%
Staff Maintenance	vigilant	18.8%	0.06%
Contract Maintenance	vigilant	6.3%	0.02%
Total		100%	0.34%

* *Percent of Attributable CDF obtained from assumptions outlined in Appendix C.*
** *Note that the Improvement in CDF was the result of a SPAR model run, while the Improvement in CDF per job duty group was based on the assumptions outlined in Appendix C.*

6.2.3.3 Estimated Benefits from the Reduction in Severe Accidents During Shutdown

The improvement in CDF percentages by job duty group in Table 6-15 would be equivalent to the potential reduction in costs from the elimination of severe accidents that could be attributed to the fatigue-related performance improvement for each job duty group. The average present value maximum attainable benefit (MAB) that could be obtained if all human-related severe accidents were eliminated for the entire nuclear industry, calculated in Appendix B, is $153.1 million. The MAB of severe accidents during shutdown was assumed to be equivalent to that during at-power conditions. A total reduction in cost from elimination of severe accidents for each job duty group was then obtained by multiplying the average present value MAB by the potential reduction percentages shown in Table 6-15. Note that the CDF percentages for each response type in Table 6-5 were added together in Table 6-16, because the improvements due to each error response type were thought to be mutually exclusive. The calculations are summarized in Table 6-16.

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Table 6-16
Total Reduction in Severe Accident Costs During Shutdown Conditions

Job Duty Group	MAB** (Million)	Improvement in CDF*	Benefit
Operators	$153.1	0.26%***	$398,060
Staff Maintenance		0.06%	$91,860
Contract Maintenance		0.02%	$30,620
Total			$520,540

* *Improvement in CDF percentages from Table 6-15*
** *Methodology for selecting an MAB for shutdown accidents outlined in Appendix C, the MAB for entire nuclear industry used in Table 6-16 was calculated in Appendix B*
*** *Improvement in CDF for operators (super-crew and shift) is equal to the sum of the vigilance and reactionary response type CDFs in Table 6-15*

Table 6-16 shows that the present value average benefit to the nuclear industry from a reduction in shutdown severe accidents is estimated as $0.52 million for the new waiver restrictions.

6.2.4 Improved Security

Information relevant to the security force baseline work schedules and the nature of the security threat is considered safeguards information. Therefore, the estimated benefit of this provision for the security force was determined differently from that of other job duty groups included in this analysis. Rather than directly assessing the work schedules and security force human performance, the benefits were estimated by considering the role of security to be equal to the performance role of operations. The operator-related benefits were then adjusted as necessary to derive the benefits for the security force. The details of this approach are discussed in Appendix F. As a result of this approach, the work schedules for the security force are not addressed and the benefits for the security force are shown only at the summary level.

6.2.5 Improved Fire Protection

The benefit addressed by this area was the potential reduction in cost due to fire events that are associated with an improvement in fatigue-related worker performance. Attachment 1 to SECY-99-140 suggested that, "...The reported core damage frequency (CDF) contribution from fire events can, in some cases, approach (or even exceed) that from internal events." (see Appendix D). Basing the fire events analysis on this statement, the analysis assumed that the benefit attributed to operators and maintenance from improved fire protection due to the new waiver restrictions would be equal to the operator and maintenance benefit associated with severe accidents during both shutdown and at-power conditions (internal event risk). In addition, fire risk was attributed to a lessened reactionary response by fire brigade members. While important, the improvement in CDF attributable to fire brigade was assumed to be less than that of the operator and was estimated to have 50% of the impact. Further, the analysis assumed that only the reactionary response type is applicable. The improvement in CDF from

operators and maintenance and the MAB to the nuclear industry will be the same as those for severe accidents during shutdown, while the CDF improvement for fire brigade is calculated explicitly for this section. The summary table displaying the reduction in fire events costs is Table 6-17.

Table 6-17
Total Reduction in Fire Events Cost

Job Duty Group	MAB** (Million)	Improvement in CDF*	Benefit
At-Power			
Staff Maintenance	$153.1	0.01%	$13,779
Outage			
Operators	$153.1	0.26%***	$398,060
Staff Maintenance		0.06%	$91,860
Contract Maintenance		0.02%	$30,620
Fire Brigade		0.12%****	$199,030
Total			$718,039

* *Improvement in CDF percentages from Table 6-15*
** *Methodology for selecting an MAB for fire events outlined in Appendix D, this MAB for entire nuclear industry calculated in Appendix B*
*** *Improvement in CDF for operators (shift and super-crew) is equal to the sum of the vigilance and reactionary response type CDFs in Table 6-15*
**** *Improvement in CDF for fire brigade personnel is equal to 50 percent of the operator (reactionary) CDF improvement calculated for shutdown risk (shown in Table 6-15)*

Table 6-17 shows that the present value average benefit to the nuclear industry from a reduction in fire events was estimated as $0.72 million for the proposed new waiver restrictions.

6.2.6 Reduction in Frequency of Lost and Restricted Work Cases

The benefit addressed by this area was the potential reduction in industrial injury costs associated with an improvement in fatigue-related worker performance. The first subsection addresses the applicability of each job duty group and error response type. The next subsection summarizes the industrial injury benefits associated with the proposed change.

6.2.6.1 Functional Benefit

This section summarizes the applicability of each job duty group and error response type to a reduction in lost and restricted work cases. Industrial injuries are thought to be caused by a lack of vigilance in plant personnel. Therefore, this analysis only accounts for the Net Improvement percentages in Table 6-7 that refer to a vigilance response type. Additionally, a reduction in industrial injuries were assumed to be attributable to all job duty groups, because all workers are subject to injuries. All job duty groups in Table 3-1 are included in the

evaluation of the benefit obtained from a reduction in lost and restricted work cases. Further, Appendix E considered the benefit for staff and contract maintenance explicitly. The applicable Net Improvement percentages from Table 6-7 have been summarized in Table 6-18 below.

Table 6-18
Net Improvement Summary (Applicable to Industrial Injuries)

Job Duty Group and Condition	Response Type	Net Improvement
At-Power		
Staff Maintenance	vigilant	0.06%
Outage		
Shift Operations, Fire Brigade (Overtime)	vigilant	0.09%
Super-Crew Operations, Fire Brigade	vigilant	0.09%
Non-Shift Operations, Fire Brigade	vigilant	0.14%
Shift HP/Chemistry (Overtime)	vigilant	0.14%
Super-Crew HP/Chemistry	vigilant	0.14%
Non-Shift HP/Chemistry	vigilant	0.27%
Staff Maintenance	vigilant	0.46%
Contract Maintenance	vigilant	0.11%

6.2.6.2 Estimated Benefit from a Reduction in Industrial Injuries

The Net Improvement percentages by job duty group and plant condition in Table 6-18 are equivalent to the potential reduction in injury cost that can be attributed to the fatigue-related performance improvement for each scenario and job duty group. The average present value maximum attainable benefit (MAB) that can be obtained if all industrial injuries could be eliminated was also calculated in Appendix E for each job duty group. The total reduction in injury cost for each job duty group and scenario is the average present value MAB multiplied by the potential reduction percentage displayed in Table 6-18. The calculations are summarized in Table 6-19.

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Table 6-19
Total Reduction in Injury Costs During Outage Conditions

Job Duty Group	MAB** (In Millions)	Net Improvement*	Benefit
At-POwer			
Staff Maintenance	$17.7	0.06%	$11,172
Outage			
Shift Operators (Overtime)	$7.18	0.09%	$6,465
Super-Crew Operators	$7.18	0.09%	$6,465
Non-Shift Operators	$3.08	0.14%	$4,310
Staff Maintenance	$17.7	0.46%	$81,398
Contract Maintenance	$63.9	0.11%	$68,970
Shift HP/Chemistry (Overtime)	$6.39	0.14%	$89,406
Super-Crew HP/Chemistry	$3.56	0.14%	$4,979
Non-Shift HP/Chemistry	$1.52	0.27%	$4,116
Shift Fire Brigade (Overtime)	$1.52	0.09%	$1,372
Super-Crew Fire Brigade	$0.70	0.09%	$628
Non-Shift Fire Brigade	$0.30	0.14%	$418
		Total	**$279,699**

* *Net Improvement percentages from Table 6-7*
** *MAB for each job duty group calculated in Appendix E*

Table 6-19 shows that the present value average benefit to the nuclear industry from a reduction in lost and restricted work cases was estimated to be $279,699 for the proposed new waiver restrictions.

6.2.7 Improved Worker Productivity - Efficiency

The benefit addressed by this area was the potential improvement in worker efficiency associated with an improvement in fatigue-related worker productivity. This efficiency improvement considered the increase in productive output hours for every labor hour of input, which leads to a reduction in the cost of labor. The first subsection addresses the applicability to each job duty group. The next subsection summarizes the efficiency benefit associated with the proposed change.

Proposed §26.199(d)(3) Restrictions on Granting Waivers

6.2.7.1 Functional Benefit

This section summarizes the applicability of each job duty group to an improvement in worker productivity. Improvement in productivity was assumed to be attributable to super-crew and non-shift staff operators and HP/chemistry personnel, as well as staff and contract maintenance personnel. The productivity of these personnel may be improved, as they have the potential to save operations and maintenance costs by saving time. The applicable Productivity Net Improvement values from Table 6-9 have been summarized in Table 6-20 below.

Table 6-20
Productivity Net Improvement Summary (Applicable to Efficiency)

Job Duty Group and Condition	**Productivity Net Improvement ***
Outage Conditions	
Operations, On-Shift (Overtime)	1.67
Operations, Super-Crew	1.67
Operations, Non-Shift	2.07
Staff Maintenance	8.76
HP/Chemistry, Shift (Overtime)	1.85
HP/Chemistry, Super-Crew	2.64
HP/Chemistry, Non-Shift	2.64
Contract Maintenance	3.71

* *Productivity Net Improvement percentages from Table 6-9*

6.2.7.2 Estimated Benefit from a Improvement in Efficiency

The Productivity Net Improvement values by job duty group in Table 6-20 are equivalent to the potential reduction in labor cost that can attributed to the fatigue-related productivity improvement for each job duty group. The average present value maximum attainable benefit (MAB) of increased efficiency that can be obtained for each additional productive labor hour that is realized was also calculated in Appendix G for each job duty group. The total improvement in efficiency cost for each job duty group is the average present value MAB per hour multiplied by the potential improvement value (in labor hours) displayed in Table 6-20. The calculations are summarized in Table 6-21.

Proposed §26.199(d)(3) Restrictions on Granting Waivers

Table 6-21
Total Improvement in Efficiency Costs During Outage Conditions

Job Duty Group and Condition	MAB **	Productivity Net Improvement *	Benefit (In Millions)
Outage Conditions			
Operations, Shift (Overtime)	$57,171	1.67	$0.10
Operations, Super-Crew	$171,515	1.67	$0.29
Operations, Non-Shift	$ 98,008	2.07	$0.20
Staff Maintenance	$1,411,453	8.76	$12.36
HP/Chemistry, Shift (Overtime)	$28,308	2.64	$0.07
HP/Chemistry, Super-Crew	$84,925	2.64	$0.22
HP/Chemistry, Non-Shift	$48,528	3.71	$0.18
Contract Maintenance	$5,082,816	1.85	$9.40
Total			$22.83

* *Productivity Net Improvement values from Table 6-20*
** *MAB for each job duty group calculated in Appendix G, Table G-2*

Table 6-21 shows that the present value average benefit to the nuclear industry from an improvement in worker efficiency was estimated as $22.83 million for the proposed new waiver restrictions.

6.2.8 Improved Worker Productivity - Reduction in Rework

This section quantifies the benefit related to the elimination of fatigue related to mistakes in the performance of tasks assigned to workers included in the proposed provisions. The first subsection addresses the applicability of each job duty group. The next subsection summarizes the rework benefit associated with the proposed change.

Proposed §26.199(d)(3) Restrictions on Granting Waivers

6.2.8.1 Functional Benefit

This section summarizes the applicability of each job duty group to an improvement in worker productivity. Improvement in productivity was assumed to be attributable to super-crew and non-shift staff operators and HP/chemistry personnel, as well as staff and contract maintenance personnel. The productivity of these personnel may be improved, as they have the potential to rectify mistakes committed during operations and maintenance activities. A detailed discussion of job type applicability is presented in Appendix H. The applicable Net Improvement percentages from Table 6-7 have been summarized in Table 6-22 below.

Table 6-22
Performance Net Improvement Summary Applicable to Rework

Job Type	**Applicable Net Improvement** *
Shift Operations (Overtime)	0.09%
Non-Shift Operations	0.14%
Super-Crew Operations	0.09%
Shift HP/Chemistry (Overtime)	0.14%
Non-Shift HP/Chemistry	0.27%
Super-Crew HP/Chemistry	0.14%
Staff Maintenance	0.46%
Contract Maintenance	0.11%

** Productivity Net Improvement percentages obtained from appropriate items in Table 6-7.*

6.2.8.2 Estimated Benefit from a Improvement in Efficiency

The net improvement values in Table 6-22 indicate the portion of rework costs which are expected to be saved by implementation of the proposed provisions. The maximum attainable benefit (MAB) which could be realized by the elimination of rework was calculated in Appendix H. Table 6-23 presents the benefit expected by job duty type and plant condition.

Proposed §26.199(d)(3) Restrictions on Granting Waivers

Table 6-23
Total Reduced Rework Benefit During Outage Conditions

Job Type	Applicable Net Improvement *	MAB (in Millions)	Benefit (in Millions)
Shift Operations (Overtime)	0.09%	$25.6	$0.02
Non-Shift Operations	0.14%	$43.8	$0.06
Super-Crew Operations	0.09%	$76.7	$0.07
Shift HP/Chemistry (Overtime)	0.14%	$12.7	$0.02
Non-Shift HP/Chemistry	0.27%	$21.7	$0.06
Super-Crew HP/Chemistry	0.14%	$38.0	$0.05
Staff Maintenance	0.46%	$252.0	$1.16
Contract Maintenance	0.11%	$909.0	$0.98
Total			$2.42

** Productivity Net Improvement percentages obtained from appropriate items in Table 6-7.*

The total benefit expected due to mitigation of rework by the proposed provision is the sum of the benefit for each worker type, $2.42 million.

6.3 Conclusion

The assessment presented here demonstrates that the prevention of cumulative fatigue through the proposed waiver restrictions would decrease fatigue-induced errors, resulting in safer plant operations. Further, it would improve worker performance and productivity. The present value benefit for the eight benefit areas by job duty group using a 7 and 3 percent discount rate are summarized in Tables 6-20 and 6-21, respectively.

Proposed §26.199(d)(3) Restrictions on Granting Waivers

Table 6-24
Total Benefit of the New Waiver Restrictions Using a 7 Percent Discount Rate (In Millions)

	Plant Trips	Severe Accidents	Shutdown Risk	Fire	Injury Cost	Security	Total Safety Benefit	Efficiency	Rework	Total Benefit
Operations	N/A	N/A	$0.40	$0.40	$0.02	N/A	$0.81	$0.58	$0.15	$1.6
Staff Maintenance	$0.08	$0.01	$0.09	$0.09	$0.08	N/A	$0.36	$12.36	$1.16	$13.9
Contract Maintenance	N/A	N/A	$0.03	$0.03	$0.07	N/A	$0.13	$9.40	$0.98	$10.5
HP/ Chemistry	N/A	N/A	N/A	N/A	$0.10	N/A	$0.10	$0.48	$0.13	$0.7
Fire Brigade	N/A	N/A	N/A	$0.18	$0.00	N/A	$0.19	N/A	N/A	$0.2
Security (Before order EA-03-038)[1]	See Appendix F					$0.81 [2]	$0.81	N/A	N/A	$0.8 [2]
Total	$0.08	$0.01	$0.52	$0.70	$0.27	$0.81	$2.40	$22.83	$2.42	$27.7

Proposed §26.199(d)(3) Restrictions on Granting Waivers

Table 6-25
Total Benefit of the New Waiver Restrictions Using a 3 Percent Discount Rate (In Millions)

	Plant Trips	Severe Accidents	Shutdown Risk	Fire	Injury Cost	Security	Total Safety Benefit	Efficiency	Rework	Total Benefit
Operations	N/A	N/A	$0.65	$0.65	$0.03	N/A	$1.32	$0.95	$0.25	$2.5
Staff Maintenance	$0.13	$0.02	$0.15	$0.15	$0.13	N/A	$0.58	$20.06	$1.88	$22.5
Contract Maintenance	N/A	N/A	$0.05	$0.05	$0.11	N/A	$0.21	$15.26	$1.59	$17.1
HP/ Chemistry	N/A	N/A	N/A	N/A	$0.16	N/A	$0.16	$0.78	$0.21	$1.1
Fire Brigade	N/A	N/A	N/A	$0.30	$0.00	N/A	$0.30	N/A	N/A	$0.3
Security (Before order EA-03-038)[1]	See Appendix F					$1.32 [2]	$1.32	N/A	N/A	$1.3 [2]
Total	$0.13	$0.02	$0.84	$1.14	$0.44	$1.32	$3.89	$37.04	$3.93	$44.9

[1] There were no NRC specific requirements limiting work hours for the security force prior to the issuance of the April 29, 2003 order (EA-03-038) limiting their work hours. Order EA-03-038 established compensatory measures in the aftermath of the events of September 11, 2001. The requirements contained in order EA-03-038 are similar to those of the proposed provisions with the exception of the new provisions associated with a 24-hour break in any 7-day period and a 48-hour break in any 14 day period.

[2] In order EA-03-038 it was noted that work hour demands on security force personnel have increased substantially over the past 18 months, and the current terrorist threat environment continues to required heightened security measures. While security forces had no work controls prior to order EA-03-038, security work requirements were generally within the technical specification limits for operations personnel. Therefore, this estimate is based on the assumption that the role of security is equal to the performance role of operations (no productivity benefit attributed).

7. BENEFIT ANALYSIS OF PROPOSED §26.199(d)(2)(i), 10-HOUR BREAK BETWEEN WORK PERIODS

The following analysis assessed the impact of the proposed increase in the minimum break requirement from 8 hours to 10 hours in proposed §26.199(d)(2)(i) on both regular plant staff and contract worker performance and productivity. In this evaluation the baseline consisted of the current work hour limits as published in Generic Letter 82-12 and implemented through technical specifications or procedures with no waivers granted.

Upcoming sections of this benefit analysis considered this requirement as part of the baseline. This approach assured that the final benefit analysis of the entire proposed work hour controls did not double count the benefit of any individual provision. The table below shows the evaluation order used in this analysis.

Table 7-1
Proposed Provision Reference Table

Tier		Description
Base		Current industry practices concerning work scheduling and worker fatigue
1	§26.199(d)(3)	Licensees may grant a waiver of the individual work hour controls in §26.199(d)(1-2) only if it is necessary for the safety or security of the plant and the worker has been judged fit to work the additional hours
	§26.199(a)(1)-(a)(5)	Specifies the individuals subject to work hour controls: (1) operations, (2) maintenance, (3) health physics and chemistry, (4) fire brigade and (5) security
	§26.199(d)(1)(i-iii)	Individual work hours should not exceed: (i)16 hours in any 24-hour period, (ii) 26 hours in any 48-hour period and (iii) 72 hours in any 7-day period
2*	§26.199(d)(2)(i)	Individuals must receive a 10-hour rest break between successive work periods

* The analysis of tier 2 calculates the estimated marginal benefit from the previous tier(s) to the proposed tier.

The 10-hour break analysis was organized such that each section would produce one or more values that are pertinent to the final benefit calculation for the proposed change.

Proposed §26.199(d)(2)(i) 10-Hour Break Between Work Periods

7.1 Performance and Productivity Improvement Resulting from Proposed Provision

Under the current requirements, licensees must allow a minimum of 8 hours between work periods. For the performance improvement evaluation, this was translated to an estimated 5 hours of sleep between work periods when commuting time, personal hygiene, and meals are taken into account. The proposed provision would require a minimum break of 10 hours, resulting in an estimated 7 hours of sleep between work periods (see the *Federal Register* notice for this proposed rule for a discussion of the calculation of expected sleep time for these break periods).

The Belenky study indicates that a fully rested worker would average 3 lapses at the beginning of the first day following a rest period and that the average lapses remains fairly constant throughout the first day. (Note that the 5-hour and 7-hour rest break lines are the parameters of interest.) The study shows that a worker's performance improves at the end of the second day if baseline performance with a 5-hour break (4 mean lapses) is compared to the performance that results from a 7-hour break (3 mean lapses). Therefore, the performance benefit of the additional sleep, or IHP percentage, is estimated to result in a 25% improvement (1 lapse improvement/4 lapse baseline).

For the efficiency productivity evaluation, the labor output data from the BLS study was used. Specifically, the relationship for 'light work' was considered to represent work during outage and at-power conditions.

Assuming that every hour of labor during outage conditions under 8 hours per day yields 1 output hour, but every hour of labor over 8 hours per day only yields 0.67 output hours, output hours were calculated for a 16-hour shift, representing the baseline condition of an 8-hour break, and a 14-hour shift, representing the proposed conditions of a 10-hour break. This resulted in 8 + (8 x 0.67) = 13.33 output hours for the 16-hour shift and 8 + (6 x 0.67) = 12 output hours for the 14-hour shift. The output hours for the 14-hour shift were then normalized to account for the difference in shift length. Specifically, the 12 output hours (which were calculated for the 14-hour shift) were normalized for a 16-hour shift length. This resulted in equivalent input hours, enabling a comparison of the output hours. The calculation for the normalization results in (12 output hours) x (16-hour shift / 14-hour shift) = 13.71 normalized output hours. Therefore, the increase in productivity that could be realized as efficiency for the 10-hour break is 13.71 output hours (a normalized quantity representing the 14-hour shift) - 13.33 output hours (representing a 16-hour shift) = 0.38 output hours per worker per day. This equates to 0.38 x 365 = 139.05 output hours per worker per year. Thus, the Improved Efficiency Productivity (IEP) value for the 10-hour break for outage conditions is 139.05. Note that the overall analysis recognized the fact that only some smaller percentage of this productivity would actually be realized. This is addressed in Appendix G.

Consistent with the BLS study, this study assumed that every hour of labor during at-power conditions under 8 hours per day yields 1 output hour and every hour of labor over 8 hours per day only yields 0.67 output hours. This relationship is similar to that used in the IEP calculation for outage conditions presented in the last paragraph. Therefore, output hours were calculated in a similar manner as that for outage conditions. This resulted in an increase in productivity

that could be realized as efficiency for the 10-hour break of 0.38 output hours per worker per day. This equates to 0.38 x 365 = 139.05 output hours per worker per year. Thus, the Improved Efficiency Productivity (IEP) value for the 10-hour break for at-power conditions is 139.05. Note that the overall analysis recognized the fact that only some smaller percentage of this productivity will actually be realized. This is addressed in Appendix G.

It should also be noted that the analysis assumed it would be unlikely that an individual would be subjected to a series of short breaks. Short breaks are often due to emergent work where additional resources are not immediately available but can be brought to bear for the following day. Therefore, the impact of multiple short breaks was not evaluated, despite the rare chance that such breaks may occur.

7.1.1 Performance Applicability

Proposed §26.199(a)(1)-(a)(5) specifies the job duty groups that would be impacted by the proposed provision.

7.1.1.1 Operations And Maintenance

While at power, the operations staff was assumed to be able to maintain a rotating shift schedule with very few interruptions, such that the time the operators are given an 8-hour break rather than a 10-hour break will be small; estimated to occur 2% of the time. Operations day staff was expected to have an increased likelihood of 8-hour breaks, estimated at 5%. Maintenance was expected to have about the same likelihood of 8-hour breaks as the operators assigned to administrative and training duties. During outages, both groups were expected to be limited to 8-hour breaks 10% of the time. These estimates reflect the belief that the occurrence of a single short duration break is rare and that there is a measurable difference in the frequency of the occurrence between work groups. The analysis assumed that if a plant shifts to a super-crew schedule during outages, the 10 hour break provision would not affect super-crew operators, because they receive 12-hour breaks between their 12-hour shifts. Therefore, super-crew personnel were not considered in the 10-hour break analysis.

The Performance Applicability, the product of the time in a plant condition and the proportion of time that breaks are limited to 8-hours, is summarized in Table 7-2.

Proposed §26.199(d)(2)(i) 10-Hour Break Between Work Periods

Table 7-2
Percent of Population with Performance Applicability (PA)

Job Duty Group and Condition	Plant % in Mode	Frequency 10-Hr Break Requirement Not Met	Performance Applicability (PA)
At-Power			
On-Shift Operations	90%	2%	1.8%
Non-Shift Operations	90%	5%	4.5%
Maintenance	90%	5%	4.5%
Outage			
On-Shift Operations	10%	2%	0.2%
Non-Shift Operations	10%	10%	1.0%
Maintenance	10%	10%	1.0%

Note that Performance Applicability (PA) refers to the percent of population (associated with a job duty group under the specified condition) that would benefit from implementation of the proposed provision. This value was used to determine the overall benefit of the 10-hour break provision.

7.1.1.2 HP/Chemistry Personnel

While at power, HP/chemistry personnel were assumed to maintain a rotating shift schedule with very few interruptions, such that the frequency of 8-hour breaks is small, estimated to occur 2% of the time. HP/chemistry personnel performing other staff functions were expected to have an increased likelihood of 8-hour breaks, estimated at 5%. During outages, these HP/chemistry personnel would likely have increased challenges and therefore the frequency of breaks less than 10 hours was estimated to be 10%.

The Performance Applicability, the product of the time in a plant condition and the proportion of time that breaks are limited to 8-hours, is summarized in Table 7-3.

Proposed §26.199(d)(2)(i) 10-Hour Break Between Work Periods

Table 7-3
Percent of Population with Performance Applicability (PA)

Job Duty Group and Condition	Plant % in Mode	Frequency 10-Hr Break Requirement Not Met	Performance Applicability (PA)
At-Power			
On-Shift Chemistry/HP	90%	2%	1.8%
Non-Shift Chemistry/HP	90%	5%	4.5%
Outage			
On-Shift Chemistry/HP	10%	2%	0.2%
Non-Shift Chemistry/HP	10%	10%	1.0%

7.1.1.3 Fire Brigade

While at power, fire brigade personnel were assumed to maintain a rotating shift schedule with very few interruptions, such that the frequency of 8-hour breaks is small, estimated to occur 2% of the time. Fire brigade personnel performing other staff functions were expected to have an increased likelihood of 8-hour breaks, estimated at 5%. During outages, these fire brigade personnel would likely have increased challenges and therefore the frequency of breaks less than 10 hours was estimated to be 10%.

Table 7-4
Percent of Population with Performance Applicability

Job Duty Group and Condition	Plant % in Mode	Frequency 10-Hr Break Requirement Not Met	Performance Applicability (PA)
At-Power			
On-Shift Fire Brigade	90%	2%	1.8%
Non-Shift Fire Brigade	90%	5%	4.5%
Outage			
On-Shift Fire Brigade	10%	2%	0.2%
Non-Shift Fire Brigade	10%	10%	1.0%

Proposed §26.199(d)(2)(i) 10-Hour Break Between Work Periods

7.1.2 Improved Human Performance and Productivity Summary

7.1.2.1 Initial Performance Net Improvement Calculation

The table below summarizes the performance net improvement that would results from the proposed 10-hour break provision. This "Net Improvement" value represents the expected performance improvement that would result from implementation of the proposed 10-hour break provision and is the product of PA x IHP.

Table 7-5
Performance Net Improvement Percentages

Item	Job Duty Group and Condition	Response Type	Performance Applicability (PA)	Improved Human Performance (IHP)	Performance Net Improvement
At-Power					
1	On-Shift Operations, HP/Chemistry, Fire Brigade	vigilant	1.8%	25%	0.5%
2	On-Shift Operations, HP/Chemistry, Fire Brigade	reactionary	1.8%	12.5%	0.3%
3	Non-Shift Operations, HP/Chemistry, Fire Brigade	vigilant	4.5%	25%	1.1%
4	Non-Shift Operations, HP/Chemistry, Fire Brigade	reactionary	4.5%	12.5%	0.6%
5	Maintenance	vigilant	4.5%	25%	1.1%
6	Maintenance	reactionary	4.5%	12.5%	0.6%
Outage					
7	On-Shift Operations, HP/Chemistry, Fire Brigade	vigilant	0.2%	25%	0.05%
8	On-Shift Operations, HP/Chemistry, Fire Brigade	reactionary	0.2%	12.5%	0.03%
9	Non-Shift Operations , HP/Chemistry, Fire Brigade	vigilant	1.0%	25%	0.25%

Proposed §26.199(d)(2)(i) 10-Hour Break Between Work Periods

Item	Job Duty Group and Condition	Response Type	Performance Applicability (PA)	Improved Human Performance (IHP)	Performance Net Improvement
10	Non-Shift Operations, HP/Chemistry, Fire Brigade	reactionary	1.0%	12.5%	0.13%
12	Maintenance	vigilant	1.0%	25%	0.25%
13	Maintenance	reactionary	1.0%	12.5%	0.13%

7.1.2.2 Performance Net Improvement with Penalty for Increased Turnovers

As explained in Section 3.7, the 10 hour break provision would increase the number of shift turnovers that occur per day. Each turnover involving a complex evolution has a risk of producing a personnel error. This risk was calculated in Section 3.7 to be approximately 3 errors for every 33383 turnovers involving a complex evolution. As the number of turnovers increases, so would this risk. Yet, as fatigue-related worker performance improves, the risk of errors becomes less. Therefore, both factors were considered and the performance net improvement percentages presented in Section 7.1.2.1 were adjusted as described below.

The following example describes how these factors were considered for maintenance personnel (vigilance error response) during at-power conditions:

Using the baseline number of turnovers of 3383.6, it was assumed that the 10 hour break provision would increase this number by 10.0%. This factor is the percent of the worker's time affected presented in Table 7-2. This percentage likely underestimates the increase in turnovers due to the proposed provision, because multiple workers normally are involved in a shift turnover (with a complex evolution). Applying this percentage yields a new number of turnovers involving a complex evolution of 3721.9. This increase in turnovers equates to an increase in errors of (3 errors) X (3721.9 new turnovers) / (3383.6 turnovers) = 3.3 new errors. Accounting for the improvement in performance due to fatigue mitigation, these new errors decrease to (3.3 new errors) X (1 - 1.1% improvement) = 3.264 final errors. The improvement percentage of 1.1% was obtained from the net improvement Table 7-5. Therefore, the change in errors would be 3 - 3.264 = -0.264. Normalizing this by the original number of turnovers considered, a (-0.264) / (3383.6) = -0.008% penalty in fatigue-related worker performance (net improvement) was obtained. Incorporating this penalty with the net improvement percentage of 1.1% presented in Table 7-6 gave the final net improvement of 1.1% - 0.008% = 1.1%. In this case, the calculated turnover penalty was so small that the precision of the original net improvement percentages did not allow for the combination of these values. In other words, the turnover penalty was more than one order of magnitude less than the net improvement number. Therefore, the turnover penalty is an insignificant contributor to the overall net improvement number.

These calculations were performed for all job duty groups and both plant conditions. Note that the turnover penalty is only warranted for the vigilance error response type, as complex

evolution turnovers would most likely not occur under conditions in which a reactionary error response would be applicable (during uncommon plant events, etc.). After this calculation, the outage net improvement percentages for vigilance errors were reduced by a factor of 10%. This accounts for the assumption that 10% of the total improvement is actually for latent outage errors that would only be realized under at-power conditions. Therefore, this portion of improvement (i.e. 10% of the outage net improvement percentage (vigilant)) was added to the at-power net improvement percentage (vigilant). The results are presented in Table 7-6.

Table 7-6
Final Performance Net Improvement (Including Turnover Penalty and Latent Outage Errors Adjustment)

Item	Job Duty Group and Condition	Response Type	Performance Net Improvement	Turnover Penalty	Latent Outage Errors Adjustment	Final Performance Net Improvement *
At-Power						
1	On-Shift Operations, HP/Chemistry, Fire Brigade	vigilant	0.5%	-0.001%	N/A	0.5%
2	On-Shift Operations, HP/Chemistry, Fire Brigade	reactionary	0.3%	N/A	N/A	0.3%
3	Non-Shift Operations, HP/Chemistry, Fire Brigade	vigilant	1.1%	-0.003%	N/A	1.1%
4	Non-Shift Operations, HP/Chemistry, Fire Brigade	reactionary	0.6%	N/A	N/A	0.6%
5	Maintenance	vigilant	1.1%	-0.003%	0.115%	1.1%
6	Maintenance	reactionary	0.6%	N/A	N/A	0.6%
Outage						
7	On-Shift Operations, HP/Chemistry, Fire Brigade	vigilant	0.05%	-0.002%	N/A	0.05%
8	On-Shift Operations, HP/Chemistry, Fire Brigade	reactionary	0.03%	N/A	N/A	0.03%

Proposed §26.199(d)(2)(i) 10-Hour Break Between Work Periods

Item	Job Duty Group and Condition	Response Type	Performance Net Improvement	Turnover Penalty	Latent Outage Errors Adjustment	Final Performance Net Improvement *
9	Non-Shift Operations, HP/Chemistry, Fire Brigade	vigilant	0.25%	-0.009%	N/A	0.24%
10	Non-Shift Operations, HP/Chemistry, Fire Brigade	reactionary	0.13%	N/A	N/A	0.13%
12	Maintenance	vigilant	0.25%	-0.009%	-0.292%	0.22%
13	Maintenance	reactionary	0.13%	N/A	N/A	0.13%

** Note that in all cases the calculated turnover penalty was so small that the precision of the original net improvement percentages did not allow for the combination of these values. In other words, when the turnover penalty was more than one order of magnitude less than the Net Improvement number, the turnover penalty was an insignificant contributor to the overall Net Improvement number.*

These values were combined with generalized benefit figures for each of the benefit areas in Section 7.2 to obtain a final dollar value for the performance benefit resulting from implementation of the proposed 10-hour break provision.

7.1.2.3 Productivity Net Improvement Calculation

Multiplying the generalized IEP values by the PA values for each type of worker yielded a productivity net improvement value for each job duty group for outage and at-power conditions. These productivity net improvement values for all job duty groups and plants conditions are summarized in Table 7-7. These values were combined with generalized benefit figures for the efficiency productivity benefit area, as will be described later in Section 7.2.7.

Table 7-7
Productivity Net Improvement Summary

Job Duty Group and Condition	Performance Applicability (PA)	Improved Efficiency Productivity	Productivity Net Improvement
Outage Conditions			
Operations, HP/Chemistry, On-Shift	0.2%	139.04	0.28

Proposed §26.199(d)(2)(i) 10-Hour Break Between Work Periods

Job Duty Group and Condition	Performance Applicability (PA)	Improved Efficiency Productivity	Productivity Net Improvement
Operations, HP/Chemistry, Non-Shift	1.0%	139.04	1.39
Staff Maintenance	1.0%	139.04	1.39
At-Power Conditions			
Operations, HP/Chemistry, On-Shift	1.8%	139.04	2.50
Operations, HP/Chemistry, Non-Shift	4.5%	139.04	6.26
Staff Maintenance	4.5%	139.04	6.26

7.2 Relationship Between Worker Performance and Benefit Areas

7.2.1 Reduction in Frequency of Plant Trips

This Appendix addresses the reduction in fatigue-related plant trips that would occur from the implementation of the proposed 10-hour break provision. The first subsection addresses the applicability of job duty group to this benefit area and the next subsection summarizes the plant trip benefits associated with the 10-hour break provision.

7.2.1.1 Applicability of Job Duty Groups on Plant Trips

This section summarizes the applicability of each job duty group and error response type to a reduction in plant trips. Trip-related human errors are thought to be caused by a lack of vigilance in plant personnel. Once a plant trip has occurred, the changes in reactionary response do not impact this benefit area (but do impact the severe at-power accidents benefit area). Therefore, this analysis only accounted for the Net Improvement percentages in Table 7-6 that refer to a vigilance response type. Additionally, plant trips are attributable only to human errors made by operators on shift and maintenance workers (see Appendix A). Only operators who work shifts and maintenance workers are included in the evaluation of the benefit obtained from a reduction in frequency of plant trips. Because plant trips only occur at-power, this was the only plant condition evaluated using the at-power Net Improvement percentages from Table 7-6.

The change in performance affecting trips associated with the 10-hour break provision for the applicable job duty groups is presented in Table 7-8.

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Table 7-8
Net Improvement Summary (Applicable to Plant Trips)

Job Duty Group and Condition	Response Type	Net Improvement *
At-Power		
On-Shift Operations (HP/Chemistry, Fire Brigade excluded)	vigilant	0.5%
Maintenance	vigilant	1.1%

* *Net Improvement percentages obtained from appropriate items in Table 7-6. Note, if Net Improvement is N/A in Table 7-6, it is omitted from the subsequent evaluation.*

7.2.1.2 Estimated Benefits from the Reduction in Trip Frequency

The Net Improvement percentages by job duty group in Table 7-8 are equivalent to the potential reduction in cost from trips that can be attributed to the fatigue-related performance improvement for each job duty group. The average present value maximum attainable benefit (MAB) that can be obtained if all human-related trips could be eliminated was also calculated for each applicable job duty group in Appendix A. The total reduction in cost from elimination of plant trips for each job duty group is the average present value MAB multiplied by the potential reduction percentage displayed in Table 7-8. The amount of the benefit is presented in Table 7-9.

Table 7-9
Total Reduction in Trip Costs During At-Power Conditions

Job Duty Group	MAB** (Million)	Net Improvement*	Benefit (Million)
Operators On-Shift	$196.0	0.5%	$0.98
Maintenance Workers	$125.3	1.1%	$1.40
		Total	$2.38

* *Net Improvement percentages from Table 7-7*
** *MAB for each job duty group calculated in Appendix A*

The table shows that the present value average benefit to the nuclear industry from a reduction in plant trips is $2.38 million for the proposed 10-hour break provision.

7.2.2 Reduction in Frequency of Severe Accidents (At-Power)

The benefit addressed by this issue is the potential reduction in the frequency of at-power internal event severe accidents that is associated with an improvement in fatigue-related worker performance. This benefit will be expressed in terms of the avoided costs associated with on-site cost, off-site cost, and replacement power.

The first subsection addresses the applicability of job duty group and error response type to this benefit area. The second subsection estimates the improvement in core damage frequency that would result from the improved performance associated with the 10-hour break provision, and the final subsection summarizes the at-power severe accident benefits associated with the 10-hour break provision.

7.2.2.1 Applicability of Job Duty Group and Error Response Type on Severe Accidents (At-Power)

This section summarizes the applicability of each job duty group and error response type to a reduction in at-power severe accidents. Human-related errors that result in core damage (at-power severe accidents) are thought to be caused by both a lack of vigilance and a lessened reactionary response in plant personnel. Actions that lead to core damage have response elements of vigilance (i.e., monitoring instrumentation for indications of an abnormal condition) and reactionary elements (i.e., taking the appropriate actions once an abnormal condition is determined). Therefore, this analysis accounted for the Net Improvement percentages in Table 7-6 for both vigilance and reactionary response types. Additionally, core damage is attributable only to human errors made by operators on shift and maintenance workers (see Appendix B). Only operators who work shifts and maintenance workers were included in the evaluation of the benefit obtained from a reduction in core damage frequency. Because this benefit area is only applicable for personnel working under at-power conditions, this was the only plant condition evaluated using the at-power Net Improvement percentages from Table 7-6. The change in performance affecting at-power severe accidents associated with the 10-hour break provision for the applicable job duty groups is presented in Table 7-10.

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Table 7-10
Net Improvement Summary (Applicable to At-Power Severe Accidents)

Job Duty Group and Condition	Response Type	Net Improvement *
At-Power		
On-Shift Operations, (HP/Chemistry, Fire Brigade excluded)	vigilant	0.5%
Operations, HP/Chemistry, Fire Brigade On-Shift	reactionary	0.3%
Maintenance	vigilant	1.1%

* *Net Improvement percentages obtained from appropriate items in Table 7-6.*

7.2.2.2 Functional Benefits of a Reduction in At-Power Severe Accidents

The risk of at-power severe accidents was quantified using Standardized Plant Analysis Risk (SPAR) models developed for analysis of at-power internal event risk. The Net Improvement percentages in Table 7-10 were the input for the model. The analysis resulted in an improvement in core damage frequency (CDF) percentage that would be a result of the fatigue-related performance improvement due to implementation of the proposed provision (See Appendix B). The overall improvement in CDF, using the Net Improvement percentages for the applicable job duty groups, was calculated by the model to be 1.3%. Separate SPAR model runs also calculated the percent of this improved CDF that is attributable to each job duty group (See Appendix B). The estimated changes in core damage frequency are summarized in Table 7-11.

Table 7-11
Improvement in Core Damage Frequency (CDF) (Applicable to At-Power Severe Accidents)

Job Duty Group and Condition	Response Type	Percent of Attributable CDF *	Improvement in CDF **
At-Power			
Shift Operations	vigilant	1.5%	0.02%
Shift Operations	reactionary	54.2%	0.70%
Maintenance	vigilant	44.3%	0.58%
Total		100%	1.30%

* *Percent of Attributable CDF obtained from assumptions outlined in Appendix B.*
** *Note that the total improvement in CDF is the result of a SPAR model run, while the Improvement in CDF per job duty group is based on assumptions outlined in Appendix B.*

7.2.2.3 Expected Benefit of a Reduction in At-Power Severe Accidents

The improvement in CDF percentages by job duty group in Table 7-11 are equivalent to the potential reduction in cost from the elimination of severe accidents that can be attributed to the fatigue-related performance improvement for each job duty group. The average present value maximum attainable benefit (MAB) that could be obtained if all human-related severe accidents were eliminated for the entire nuclear industry was calculated in Appendix B. The total reduction in cost from the elimination of severe accidents for each job duty group was obtained by multiplying the average present value MAB by the potential reduction percentage displayed in Table 7-11. CDF percentages by response type in Table 7-11 for operators (shift) (items 1 and 2) were added together in Table 7-12, because the improvements due to each error response type were considered to be mutually exclusive. The calculations are summarized in Table 7-12.

Table 7-12
Total Reduction in Accident Costs During At-Power Conditions

Job Duty Group	MAB** (Million)	Improvement in CDF*	Benefit
On-Shift Operators	$153.1	0.72% ***	$1,102,320
Maintenance Workers		0.58%	$887,980
		Total	$1,990,300

* *Improvement in CDF percentages from Table 7-11*
** *MAB for entire nuclear industry calculated in Appendix B*
*** *Improvement in CDF for operators (shift) is equal to the sum of the vigilance and reactionary response type CDFs in Table 7-11*

The table shows that the present value average benefit to the nuclear industry from a reduction in at-power severe accidents would be $1.99 million from implementation of the 10-hour break provision.

7.2.3 Reduction in Shutdown Risk

This benefit area addressed the potential reduction in the frequency of internal events during shutdown that are associated with an improvement in fatigue-related worker performance. This benefit was expressed in terms of the avoided costs associated with on-site cost, off-site cost and replacement power.

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The first subsection addresses the applicability of job duty group and error response type to this benefit area. The second subsection estimates the improvement in core damage frequency (CDF) that results from the improved performance associated with the 10-hour provision and the final subsection summarizes the shutdown severe accident benefits associated with the 10-hour provision.

7.2.3.1 Applicability of Job Duty Group and Error Response Type on Severe Accidents at Shutdown

This section summarizes the applicability of each job duty group and error response type to a reduction in severe accidents during shutdown conditions. The analysis assumed that actions that lead to core damage during shutdown have the same response elements as those that lead to severe accidents. The job duty groups that contribute to core damage risk during shutdown conditions were assumed to be the same as those that contribute to severe accidents. Therefore, this analysis accounted for the Net Improvement percentages in Table 7-6 that refer to both vigilance and reactionary response types and is applicable to operators who work shifts and maintenance workers (see Section 5.3 for a further discussion). Because this benefit area is only applicable for personnel working under outage conditions, this was the only plant condition evaluated using the outage Net Improvement percentages from Table 7-6. The applicable Net Improvement percentages from Table 7-6 are summarized in Table 7-13.

Table 7-13
Net Improvement Summary (Applicable to Severe Accidents During Shutdown)

Job Duty Group and Condition	Response Type	Net Improvement *
Outage		
On-shift Operations, HP/Chemistry, Fire Brigade	vigilant	0.05%
Operations, HP/Chemistry, Fire Brigade (Shift)	reactionary	0.03%
Maintenance	vigilant	0.22%

* *Net Improvement percentages obtained from appropriate items in Table 7-6.*

7.2.3.2 Functional Benefit of a Reduction in Shutdown Severe Accidents

The risk of severe shutdown accidents was quantified using Standardized Plant Analysis Risk (SPAR) models developed for analysis of at-power internal event risk. The Net Improvement percentages in Table 7-13 were the input for the model. The analysis resulted in an improvement in core damage frequency (CDF) percentage that would result from the fatigue-related performance improvement due to provision implementation (See Appendix B). The analysis assumed that the ratio between the Net Improvement percentages and Improvement

in CDF percentages during shutdown conditions would be the same as that for at-power conditions (See Appendix C). For example, the Net Improvement for maintenance during at-power conditions is 1.1%. This resulted in an improvement in CDF of 0.58%. Therefore, the improvement in CDF for maintenance during shutdown is the outage Net Improvement percentage of 0.22% multiplied by the quantity (0.58%/1.1%). This resulted in a improvement in CDF for maintenance (vigilance) during shutdown of 0.11%. The estimated changes in CDF applicable to severe shutdown accidents are summarized in Table 7-14.

Table 7-14
Improvement in Core Damage Frequency (CDF) (Applicable to Severe Accidents During Shutdown)

Job Duty Group and Condition	Response Type	Improvement in CDF *
Outage		
On-shift Operations	vigilant	0.002%
On-shift Operations	reactionary	0.07%
Maintenance	vigilant	0.11%
Total		0.18%

* *Note that improvement in CDF per job duty group was based on assumptions outlined in Section 7.2.2.2, but the total Improvement in CDF is the sum of the changes for all job duty groups.*

7.2.3.3 Estimated Benefits from the Reduction in Severe Accidents During Shutdown

The Improvement in CDF percentages by job duty group in Table 7-11 are equivalent to the potential reduction in cost from elimination of severe accidents during shutdown that can be attributed to the fatigue-related performance improvement for each job duty group. The average present value maximum attainable benefit (MAB) that could be obtained if all worker-related severe accidents were eliminated for the entire nuclear industry was calculated in Appendix C. The analysis assumed that the MAB of severe accidents during shutdown is equivalent to severe accidents during at-power conditions. A total reduction in cost from elimination of severe accidents for maintenance workers was obtained by multiplying the average present value MAB by the potential reduction percentage displayed in Table 7-11. Note that CDF percentages by response type in Table 7-14 for on-shift operators were added together in Table 7-15, because the improvements due to each error response type were considered to be mutually exclusive. The calculations are summarized in Table 7-15.

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Table 7-15
Total Reduction in Severe Accident Costs During Shutdown Conditions

Job Duty Group	MAB** (Million)	Improvement in CDF*	Benefit
On-Shift Operators	$153.1	0.072% ***	$110,232
Maintenance		0.11%	$171,472
Total			$281,704

* *Improvement in CDF percentages from Table 7-14*
** *Methodology for selecting an MAB for shutdown accidents outlined in Appendix C, the MAB for entire nuclear industry used in Table 7-15 was calculated in Appendix B*
*** *Improvement in CDF for operators (shift) is equal to the sum of the vigilance and reactionary response type CDFs in Table 7-14*

The table shows that the present value average benefit to the nuclear industry from a reduction in at-power severe accidents during shutdown would be $0.28 million for implementation of the proposed 10-hour break provision.

7.2.4 Improved Security

Information relevant to the security force baseline work schedules and the nature of the security threat is considered safeguards information. Therefore, the estimated benefit of this provision for the security force was determined differently from that of other job duty groups included in this analysis. Rather than directly assessing the work schedules and security force human performance, the benefits were estimated by considering the role of security to be equal to the performance role of operations. The operator-related benefits were then adjusted as necessary to derive the benefits for the security force. The details of this approach are discussed in Appendix F. As a result of this approach, the work schedules for the security force are not addressed and the benefits for the security force are shown only at the summary level.

7.2.5 Improved Fire Protection

The benefit addressed by this issue was the potential reduction in costs due to fire events that are associated with an improvement in fatigue-related worker performance. Attachment 1 to SECY-99-140 suggests that, "...The reported core damage frequency (CDF) contribution from fire events can, in some cases, approach (or even exceed) that from internal events." (see Appendix D). The fire events analysis assumed, on the basis of this statement, that the benefit attributed to operators and maintenance from improved fire protection due to the proposed 10-hour break between work periods would be equal to the operator and maintenance benefit associated with severe accidents at-power and during shutdown (internal event risk). In addition, fire risk can be attributed to a lessened reactionary response by fire brigade members. While important, the improvement in CDF attributable to fire brigade personnel was assumed to be less than that of the operators and was estimated to have 50% of the impact. Further, fire brigade members would only be important in association with an improvement of

reactionary error responses. The improvement in CDF from operators and maintenance and the MAB to the nuclear industry would be the same as the sum of that for severe accidents at-power and during shutdown (outage), while the CDF improvement for fire brigade was calculated explicitly for this section. The reduction in fire events costs is shown in Table 7-16.

Table 7-16
Total Reduction in Fire Events Cost During At-Power and Shutdown Conditions

Job Duty Group	MAB** (Million)	Improvement in CDF*	Benefit
At-Power			
On-Shift Operators	$153.1	0.72% ***	$1,102,320
Maintenance		0.58%	$887,980
On-Shift Fire Brigade		0.35% ****	$535,850
Outage			
On-Shift Operators	$153.1	0.07% ***	$110,232
Maintenance		0.11%	$171,472
On-Shift Fire Brigade		0.04% ****	$61,240
Total			$2,869,094

* *Improvement in CDF percentages from Table 7-11 for at-power and in Table 7-14 for outages*

** *Methodology for selecting an MAB for fire events outlined in Appendix D, this MAB for entire nuclear industry calculated in Appendix B*

*** *Improvement in CDF for operators (shift) is equal to the sum of the vigilance and reactionary response type CDFs in Table 7-11 for at-power and in Table 7-14 for outages*

**** *Improvement in CDF for super-crew fire brigade is equal to 50 percent of the on-shift operator (reactionary) CDF improvement*

The present value average benefit to the nuclear industry from a reduction in fire events was estimated to be $2.87 million for implementation of the 10-hour break provision.

7.2.6 Reduction in Frequency of Lost and Restricted Work Cases

The benefit addressed by this issue was the potential reduction in industrial injury costs associated with an improvement in fatigue-related worker performance. The first subsection addresses the applicability of each job duty group and error response type to this benefit area. The second subsection summarizes the industrial injury benefits associated with the proposed provision.

7.2.6.1 Functional Benefit

This section summarizes the applicability of each job duty group and error response type to a reduction in lost and restricted work cases. Industrial injuries are thought to be caused by a lack of vigilance in plant personnel. Therefore, this analysis only accounted for the Net

Improvement percentages in Table 7-6 that refer to a vigilance response type. Additionally, a reduction in industrial injuries was considered to be attributable to all job duty groups, because all workers are subject to injuries. In this way, all job duty groups in Table 3-1 were included in the evaluation of the benefit obtained from a reduction in lost and restricted work cases. Note that contract maintenance personnel were considered explicitly for lost and restricted work cases during outages (explained in Appendix E). The applicable Net Improvement percentages from Table 7-6 are summarized in Table 7-17.

Table 7-17
Net Improvement Summary (Applicable to Industrial Injuries)

Job Duty Group and Condition	Response Type	Net Improvement *
At-Power		
On-Shift Operations, HP/Chemistry, Fire Brigade	vigilant	0.5%
Non-Shift Operations, HP/Chemistry, Fire Brigade	vigilant	1.1%
Maintenance	vigilant	1.1%
Outage		
Shift Operations, HP/Chemistry, Fire Brigade	vigilant	0.05%
Non-Shift Operations, HP/Chemistry, Fire Brigade	vigilant	0.24%
Staff Maintenance	vigilant	0.22%
Contract Maintenance	vigilant	0.22%

* *Net improvement percentages were obtained from appropriate items in Table 7-6.*

7.2.6.2 Expected Benefit of a Reduction in Industrial Injuries

The Net Improvement percentages by job duty group and plant condition in Table 7-17 are equivalent to the potential reduction in injury costs that can be attributed to the fatigue-related performance improvement for each scenario and job duty group. The average present value maximum attainable benefit (MAB) that could be obtained if all industrial injuries were eliminated was also calculated in Appendix E for each job duty group. The total reduction in injury cost for each job duty group and scenario is the average present value MAB multiplied by the potential reduction percentage displayed in Table 7-17. The benefits from reduction in

injury cost during outages and during at-power operations due to reduced fatigue are summarized in Tables 7-18 and 7-19.

Table 7-18
Total Reduction in Injury Costs During Outage Conditions

Job Duty Group	MAB (In Millions)**	Net Improvement *	Benefit
On-Shift Operators	$7.18	0.05%	$3,592
Non-Shift Operators	$3.08	0.24%	$7,388
Staff Maintenance Workers	$17.7	0.22%	$38,305
Contract Maintenance Workers	$63.9	0.22%	$137,940
On-Shift HP/Chemistry	$3.56	0.05%	$1,778
Non-Shift HP/Chemistry	$1.52	0.24%	$3,658
On-Shift Fire Brigade	$0.70	0.05%	$349
Non-Shift Fire Brigade	$0.30	0.24%	$717
		Total	**$193,728**

Table 7-19
Total Reduction in Injury Costs During At-Power Conditions

Job Duty Group	MAB (In Millions)**	Net Improvement *	Benefit
On-Shift Operators	$7.18	0.5%	$35,916
Non-Shift Operators	$3.08	1.1%	$33,863
Maintenance Workers	$17.7	1.1%	$198,618
On-Shift HP/Chemistry	$3.56	0.5%	$17,784
Non-Shift HP/Chemistry	$1.52	1.1%	$16,767
On-Shift Fire Brigade	$0.70	0.5%	$3,487
Non-Shift Fire Brigade	$0.30	1.1%	$3,288
		Total	**$309,722**

* *Net Improvement percentages from Table 7-6*
** *MAB for each job duty group calculated in Appendix E*

The benefits to the industry separated by job duty group and plant condition and in total for the reduction in lost and restricted work are shown in Table 7-20.

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Table 7-20
Benefits to Nuclear Industry Per Year For Reduction in Lost and Restricted Work Cases

	Outage	At-Power	Total
Operators	$10,980	$69,779	$80,759
Staff Maintenance	$38,305	$198,618	$236,922
Contract Maintenance	$137,940	N/A	$137,940
HP/Chemistry	$5.437	$34,551	$39,988
Fire Brigade	$1,066	$6,775	$7,941
Total	**$193,728**	**$309,722**	**$503,450**

The estimated average present value benefit to the nuclear industry from a reduction in lost and restricted work cases is $503,450 for implementation the 10-hour break provision.

7.2.7 Improved Worker Productivity - Efficiency

The benefit addressed by this area was the potential improvement in worker efficiency associated with an improvement in fatigue-related worker productivity. This efficiency improvement considered the increase in productive output hours for every labor hour of input, which would lead to a reduction in the cost of labor. The first subsection addresses the applicability of each job duty group. The next subsection summarizes the efficiency benefit associated with the proposed change.

7.2.7.1 Functional Benefit

This section summarizes the applicability of each job duty group to an improvement in worker productivity. Improvement in productivity was thought to be attributable to super-crew and non-shift staff operators and HP/chemistry personnel, as well as staff and contract maintenance personnel. The productivity of these personnel may be improved, as they have the potential to save operations and maintenance costs by saving time. The applicable Productivity Net Improvement values from Table 7-7 have been summarized in Table 7-21 below.

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Table 7-21
Productivity Net Improvement Summary (Applicable to Efficiency)

Job Duty Group and Condition	Productivity Net Improvement *
Outage Conditions	
Operations, HP/Chemistry, On-Shift	N/A
Operations, HP/Chemistry Super-Crew	N/A
Operations, HP/Chemistry Non-Shift	1.39
Staff Maintenance	1.39
Contract Maintenance	1.39 **
At-Power	
Operations, HP/Chemistry, On-Shift	N/A
Operations, HP/Chemistry Non-Shift	6.26
Staff Maintenance	6.26

* *Productivity Net Improvement values obtained from appropriate items in Table 7-7. Note if Net Improvement is N/A in Table 7-7, it was omitted from the subsequent evaluation.*

** *The Productivity Net Improvement value for contract maintenance was considered to be equal to staff maintenance.*

7.2.7.2 Estimated Benefit from a Improvement in Efficiency

The Productivity Net Improvement values by job duty group in Table 7-21 are equivalent to the potential reduction in labor cost that can be attributed to the fatigue-related productivity improvement for each job duty group. The average present value maximum attainable benefit (MAB) of increased efficiency that could be obtained for each additional productive labor hour that is realized was also calculated in Appendix G for each job duty group. Note that the MAB for contract maintenance was calculated explicitly. The total improvement in efficiency cost for each job duty group is the average present value MAB per hour multiplied by the potential improvement value (in labor hours) displayed in Table 7-21. The calculations are summarized in Table 7-22.

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Table 7-22
Total Improvement in Efficiency Costs

Job Duty Group and Condition	MAB **	Productivity Net Improvement *	Benefit (In Millions)
Outage Conditions			
Operations, Non-Shift	$98,009	1.39	$0.14
Staff Maintenance	$1,411,453	1.39	$1.96
HP/Chemistry, Non-Shift	$48,528	1.39	$0.07
Contract Maintenance	$5,082,817	1.39	$7.07
At-Power Conditions			
Operations, Non-Shift	$98,009	6.26	$0.61
Staff Maintenance	$1,411,453	6.26	$8.84
HP/Chemistry, Non-Shift	$48,528	6.26	$0.30

* *Productivity Net Improvement values from Table 7-21*
** *MAB for each job duty group calculated in Appendix G, Table G-2*

The productivity benefit to the industry separated by job duty group for the improvement in worker efficiency is shown in Table 7-23.

Table 7-23
Productivity Benefit to Nuclear Industry Per Year For Improvement in Worker Efficiency

	Outage and At-Power (In Millions)
Operators	$0.75
Staff Maintenance	$10.80
Contract Maintenance	$7.07
HP/Chemistry	$0.37
Total	**$18.98**

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Table 7-23 shows that the present value average benefit to the nuclear industry from an improvement in worker efficiency is estimated as $19 million for the proposed 10 hour break provision.

7.2.8 Improved Worker Productivity - Reduction in Rework

This section quantified the benefit related to the elimination of fatigue related mistakes in the performance of tasks assigned to workers included in the proposed provisions. The first subsection addresses the applicability of each job duty group. The next subsection summarizes the efficiency benefit associated with the proposed change.

7.2.8.1 Functional Benefit

This section summarizes the applicability of each job duty group to an improvement in worker productivity. Improvement in productivity is expected to be attributable to super-crew and non-shift staff operators and HP/chemistry personnel, as well as staff and contract maintenance personnel. The productivity of these personnel may be improved, as they have the potential to rectify mistakes committed during operations an maintenance activities. A detailed discussion of job type applicability is presented in Appendix H. The benefits for staff and contract maintenance were considered explicitly. The applicable Net Improvement percentages from Table 7-6 have been summarized in Table 7-24 below.

Table 7-24
Net Improvement Summary Applicable to Reduction in Rework At Power

Job Type	**Applicable Net Improvement** *
Non-Shift Operations	1.1%
Non-Shift HP/Chemistry	1.1%
Staff Maintenance	1.1%

** Productivity Net Improvement percentages obtained from appropriate items in Table 7-6. Note if Net Improvement is N/A in Table 7-6, it was omitted from the subsequent evaluation.*

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Table 7-25
Net Improvement Summary Applicable to Reduction in Rework During Outage Conditions

Job Type	Applicable Net Improvement *
Non-Shift Operations	0.24%
Non-Shift HP/Chemistry	0.24%
Staff Maintenance	0.22%
Contract Maintenance	0.22%

** Productivity Net Improvement percentages obtained from appropriate items in Table 7-6. Note if Net Improvement is N/A in Table 7-6, it was omitted from the subsequent evaluation.*

7.2.8.2 Estimated Benefit from a Improvement in Efficiency

The net improvement percentages in Table 7-25 indicate the portion of rework costs which are expected to be saved by implementation of the proposed provisions. The maximum attainable benefit (MAB) which could be realized by the elimination of rework was calculated in Appendix H. Table 7-26 and Table 7-27 presents the benefit expected by job duty type and plant condition.

Table 7-26
Total Reduced Rework Benefit At Power

Job Type	Applicable Net Improvement *	MAB (in Millions)	Benefit (in Millions)
Non-Shift Operations	1.1%	$47.00	$0.52
Non-Shift HP/Chemistry	1.1%	$23.30	$0.26
Staff Maintenance	1.1%	$271.00	$3.03
Total			$3.81

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Table 7-27
Total Reduced Rework Benefit During Outage Conditions

Job Type	**Applicable Net Improvement ***	**MAB (in Millions)**	**Benefit (in Millions)**
Non-Shift Operations	0.24%	$43.80	$0.11
Non-Shift HP/Chemistry	0.24%	$21.70	$0.05
Staff Maintenance	0.22%	$252.00	$0.05
Contract Maintenance	0.22%	$909.00	$2.00
Total			$2.70

The total benefit expected due to mitigation of rework by the proposed provision is sum of the benefit for each worker type, $2.7 million.

7.3 Conclusion

The present value benefit for the eight benefit areas by job duty group using a 7 and 3 percent discount rate are summarized in Tables 7-28 and 7-29, respectively.

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Table 7-28
Total Quantified Benefit of Proposed 10-hour Break Provision Using a 7 Percent Discount Rate (In Millions)

	Trips	Severe Accidents	Shut-down Risk	Fire	Injury Cost	Security	Total Safety Benefit	Efficiency	Rework	Total Benefit
Operations	$0.98	$1.10	$0.11	$1.21	$0.08	N/A	$3.49	$0.75	$0.62	$4.9
Staff Maintenance	$1.40	$0.89	$0.13 [3]	$1.06	$0.24	N/A	$3.72	$10.80	$3.58	$18.1
Contract Maintenance	N/A	N/A	$0.04 [3]	N/A	$0.14	N/A	$0.18	$7.07	$1.96	$9.2
HP/Chemistry	N/A	N/A	N/A	N/A	$0.04	N/A	$0.04	$0.37	$0.31	$0.7
Fire Brigade	N/A	N/A	N/A	$0.60	$0.00	N/A	$0.60	N/A	N/A	$0.6
Security (Before order EA-03-038)[1]	See Appendix F					$3.5 [2]	$3.49	N/A	N/A	$3.5 [2]
Total	$2.38	$1.99	$0.28	$2.87	$0.50	$3.5	$11.51	$18.98	$6.47	$37.0

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Table 7-29
Total Quantified Benefit of Proposed 10-hour Break Provision Using a 3 Percent Discount Rate (In Millions)

	Plant Trips	Severe Accidents	Shut-down Risk	Fire	Injury Cost	Security	Total Safety Benefit	Efficiency	Rework	Total Benefit
Operations	$1.59	$1.79	$0.18	$1.97	$0.13	N/A	$5.66	$1.22	$1.01	$7.9
Staff Maintenance	$2.28	$1.44	$0.21[3]	$1.72	$0.38	N/A	$6.03	$17.52	$5.81	$29.4
Contract Maintenance	N/A	N/A	$0.07 [3]	N/A	$0.22	N/A	$0.29	$11.46	$3.19	$14.9
HP/Chemistry	N/A	N/A	N/A	N/A	$0.06	N/A	$0.06	$0.60	$0.50	$1.2
Fire Brigade	N/A	N/A	N/A	$0.97	$0.01	N/A	$0.98	N/A	N/A	$1.0
Security (Before order EA-03-038)[1]	See Appendix F					$5.66 [2]	$5.66	N/A	N/A	$5.7[2]
Total	$3.87	$3.23	$0.46	$4.66	$0.82	$5.66	$18.68	$30.80	$10.51	$60.0

[1] There were no NRC specific requirements limiting work hours for the security force prior to the issuance of order EA-03-038) limiting their work hours. Order EA-03-038 established compensatory measures in the aftermath of the events of September 11, 2001. The requirements contained in order EA-03-038 are similar to those of the proposed provisions with the exception of the new provisions associated with a 24-hour break in any 7-day period and a 48-hour break in any 14 day period.

[2] The security force benefit was estimated by using the applicable benefits from operations. This was considered an estimate given the uncertainty of the security threat. It essentially assumed that the role of security is equal to the role (performance only) of operations in preventing core damage. See the Improved Security Benefit Area, Appendix F, for a qualitative discussion on security.

[3] While the benefit for Reduction in Injury Cost was explicitly differentiated between staff and contract maintenance, contract workers were embedded in the benefit calculation for “maintenance” for Reduction in Shutdown Risk in the analysis. In Table 7-29, the total “maintenance” benefit is weighted such that 75% of the outage benefit is attributable to staff and 25% is attributable to contract personnel.

8. BENEFIT ANALYSIS OF PROPOSED §26.199(f), 48/54-HOUR COLLECTIVE AVERAGE LIMIT FOR JOB DUTY GROUPS

The following analysis assessed the impact that the proposed collective work hour provisions in §26.199(f) would have on worker performance and productivity. Specifically, the proposed provisions were evaluated against the alternative of taking no action. In this evaluation, the work-hour control requirements in proposed §§26.199(d)(1)(i-iii) and 26.199(d)(2)(i) were assumed to have already been incorporated (the baseline condition). The final benefit analysis of the entire work hour controls therefore does not double count any individual provision's benefit. The evaluation provides both quantitative and qualitative information suggesting that the proposed provision mitigates worker fatigue, which directly relates to performance and productivity. Table 8-1 shows the evaluation order used in this analysis.

Table 8-1
Proposed Provision Reference Table

Tier		Description
Base		Current industry practices concerning work scheduling and worker fatigue
1	§26.199(d)(3)	Licensees may grant a waiver of the individual work hour controls in §26.199(d)(1-2) only if it is necessary for the safety or security of the plant and the worker has been judged fit to work the additional hours
	§26.199(a)(1-5)	Specifies the individuals subject to work hour controls: (1) operations, (2) maintenance, (3) health physics and chemistry, (4) fire brigade and (5) security
	§26.199(d)(1)(i-iii)	Individual work hours should not exceed: (i)16 hours in any 24-hour period, (ii) 26 hours in any 48-hour period and (iii) 72 hours in any 7-day period
2	§26.199(d)(2)(i)	Individuals must receive a 10-hour rest break between successive work periods
3 *	§26.199(f)	The collective work hours of each job duty group cannot exceed an average of 48 hours per person per week in any 13-week averaging period except (1) during the first 8 weeks of a plant outage for job duty groups specified in §§26.199(a)(1-4); and (2) under circumstances that cannot be reasonably controlled, the group average cannot exceed 54 hours per person per week

* The analysis of tier 3 calculates the estimated marginal benefit from the previous tier(s) to the proposed tier.

Proposed §26.199(f), 48/54-Hour Collective Average Limit for Job Duty Groups

For this assessment, the 7-hour and 9-hour Belenky sleep data were used. Shifts of 8 hours would provide individuals with good opportunity for sleep and therefore were corresponded to the 9-hour sleep data.

The NECA productivity data were also used for the efficiency analysis. Specifically, the data for the work schedules of six 10-hour shifts per week was used for outage conditions, and seven 10-hour shifts per week and six 10-hour shifts per week were used for at-power conditions. While these schedules show a productivity level less than 100%, the analysis assumes that a work schedule of five 8-hour shifts per week remains at 100% for every consecutive week.

8.1 Performance and Productivity Improvement Resulting from Proposed Provision

8.1.1 Applicability to Performance at Nuclear Power Plants

The 48 hour average provision was evaluated in this analysis in conjunction with the 54-hour average provision. Three at-power conditions and one outage plant condition were evaluated. The 48-hour average work limit was used in the following analysis to address the issue of chronic understaffing in plants at-power. This condition causes personnel to work more than an average of 48 hours per week. Implementing the 48-hour average provision would resolve this condition. The 54-hour average work limit was used in the following analyses for extended outages of longer than 300 days (assuming personnel work six 10-hour days per week) and certain infrequent at-power conditions when extensive overtime is worked (60 and 70 hours per week). The analysis assumed that when unplanned work results in high workload, the situation is not likely "reasonably controllable." For planned extended outages (> 8 weeks), licensees would likely apply under proposed §26.199(f)(5) to use alternate fatigue mitigation strategies, which are assumed to typically include a 54-hour average element for the purposes of this analysis, although other fatigue management strategies may be requested for approval in the future by licensees. Further assumptions are noted with bullets throughout this section.

8.1.1.1 Performance Under Extended Outage Conditions (54-hour Average)

Section 26.199(f) was assessed to quantify the impact of the new required collective work hour limits on fatigue-related worker performance in Pressurized Water Reactor (PWR) and Boiling Water Reactor (BWR) units under plant outage conditions. The analysis calculated the benefit of these new limits in comparison to a baseline that assumed plant staff work an overtime schedule of six 10-hour shifts per week and receive a 24-hour break at the end of that period.

Section 26.199(f)(1) provides for an exception to the 48 hour collective work hour provision during the first 8 weeks of any plant outage. For normal plant outages (i.e. of less than 175 days), the analysis assumed that only a limited number of personnel would work overtime schedules. Therefore, this scenario was considered to be limited to a sub-set of the job duty group, such that the effects of implementing the collective work hour limits would be minimal. Alternatively, the analysis evaluated the scenario of extended (i.e. greater than 300 days) outages. The work required during these periods was assumed to exceed the 48-hour average allowed by the proposed provision.

Proposed §26.199(f), 48/54-Hour Collective Average Limit for Job Duty Groups

Under proposed §26.199(f)(3), licensees would be permitted to increase the collective average work hour requirement to 54 hours per person per week in a single averaging period under conditions that cannot be reasonably controlled. This evaluation also assumed that licensees would use this exception for problems that cannot be reasonably controlled for the first averaging period starting in week 9 of an extended outage. Under proposed §26.199(f)(5), licensees would be permitted to seek approval from the NRC to exceed the 48-hour average for extended periods of time. This evaluation assumed that licensees would seek and obtain approval from the NRC for extended use of a 54-hour average for multiple averaging periods. This was a simplifying assumption that would understate the benefit if NRC did not actually approve such a request in some cases. Some of the assumptions used in this analysis include:

- Licensees would achieve a 54-hour average provision by keeping 50% of (the more essential) personnel at 60-hour weeks and requiring the other 50% of personnel to work a 48-hour week.

- The analysis assumed that personnel working a 48-hour week under the proposed conditions would work all of these hours in a 5-day period (four 10-hour days and one 8-hour day or some other 5-day combination) with a 48-hour break following.

Therefore, fatigue-related worker performance was compared from the current baseline conditions (using a baseline case that implies six consecutive 10-hour days per week) to the proposed provision (requiring a maximum average of 54 hours per person per week in any averaging period of 13 weeks after the first 8 weeks of an outage) for outage lengths greater than 300 days.

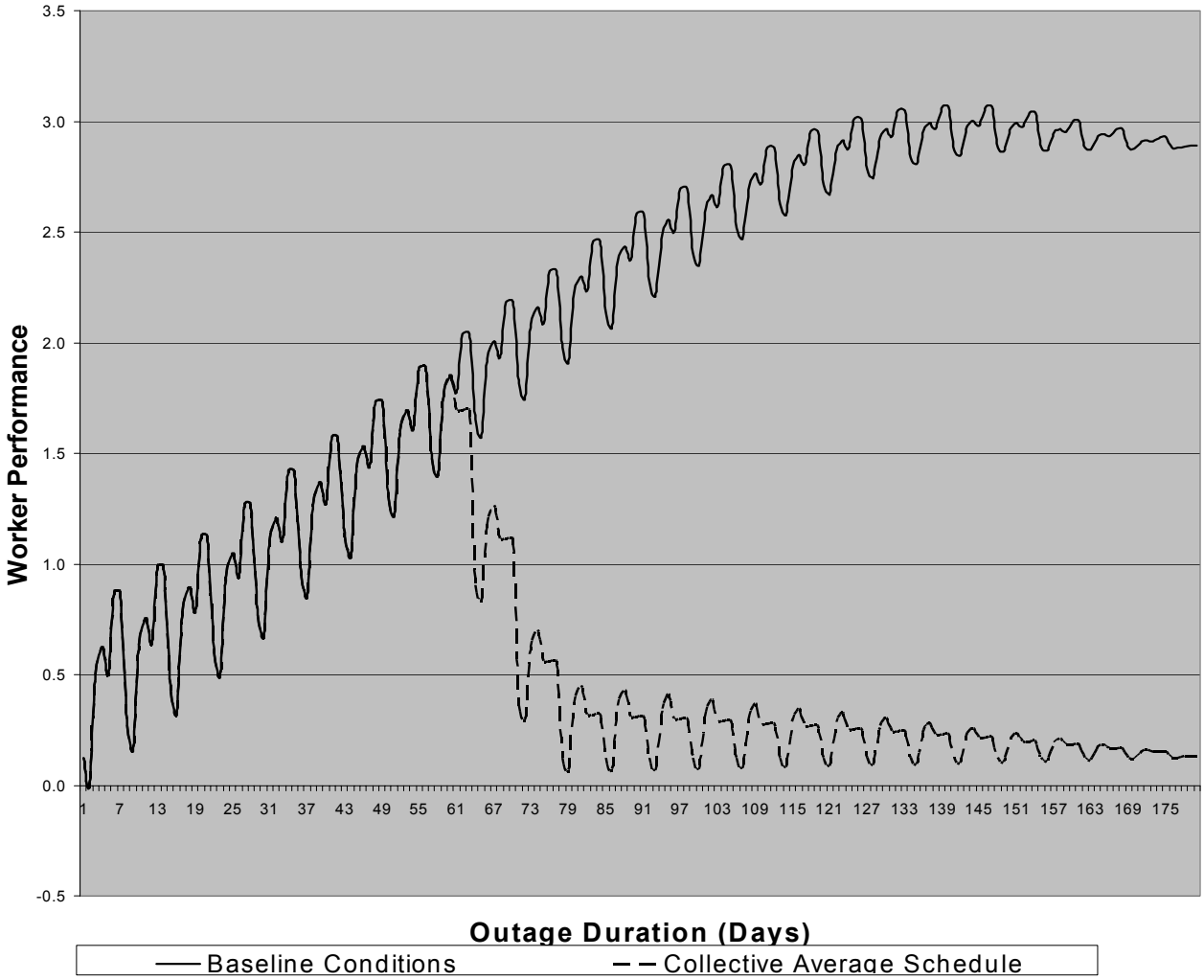
Figure 8-1 relates outage length to worker performance. Figure 8-1 was generated by extrapolating the mean lapse data described in Section 2.3.1 for the first 180 days of the extended outage, to simulate the compounding effect of cumulative fatigue on workers during a plant outage. The analysis assumes that an increase in 'mean lapses' is proportional to a degradation in worker performance. A large worker performance number equates to a worsening in performance. While only the first 180 days are shown in this figure, the analysis evaluated worker performance for extended outage conditions of up to 2 years. After the first 180 days, though, the analysis assumed that any worsening in performance would saturate to a steady state level (and remain at the 180-day worker performance percentage for the 2-year period).

Under the proposed provision, the 54-hour average requirement would not be applicable during the first 8 weeks (56 days) of an outage. Therefore, this analysis accounts for this provision from day 56 to day 730 (2-year mark). More assumptions that were made for this analysis include:

- The different levels of fatigue associated with 10-hour shifts and 8-hour shifts were quantified by using linear interpolation points between the 7- and 9-hour sleep mean lapse data for the 10-hour shifts and using the 9-hour sleep mean lapse data for the 8-hour shifts.

Proposed §26.199(f), 48/54-Hour Collective Average Limit for Job Duty Groups

Figure 8-1
Fatigue Impact of Change in Collective Work-Hour Provisions



Proposed §26.199(f), 48/54-Hour Collective Average Limit for Job Duty Groups

- The worsening seen in worker performance between each sleep day in the Belenky study's data would eventually lessen, as a worker's propensity to become fatigued will likely saturate (Monk 2004). The level of fatigue at this saturation point would be characterized by poor health and a "burned-out" affect. A saturation point of 180 days (6-months) was assumed for the analysis.

- An individual would not be able to fully recover from a state of fatigue (and return to baseline) while working the baseline schedule because the individual would be working six 10-hour shifts and, therefore, would never receive more than one 24-hour break each week. Instead, an individual's fatigue would accumulate, leading to increasing levels of cumulative fatigue.

- An individual may recover from fatigue acquired during consecutive workdays when given a 48-hour break (which occurs in the 48-hour/week scenario explained previously). This recovery may be partial or full (to baseline performance level) based on the relationship presented in Section 2.2.

This latter assumption is justified by the Dinges et al. (1997) observation that, "…recovery from these [sleep] deficits appeared to require two full nights of sleep." It should be noted that this assumption of a 'weighted 2-day full fatigue recovery' with a 48-hour break does not account for variability between workers associated with the severity of cumulative fatigue, necessary rest or with outside obligations that may effectively keep a worker from receiving their full 48 hour break. Therefore, some personnel may not fully recover in 48 hours, but may instead need up to 72 hours. This variation in individual need was not evaluated in this analysis. However, the weighting and saturation calculation with which the full recovery was analyzed and the inclusion of an accumulating 'rest debt' were each employed to account for some of this uncertainty.

"Full recovery" (performance at baseline levels) from fatigue becomes evident in Figure 8-1 for the proposed provision (dotted line) 5 weeks after the 8 week (56 day) mark. This 8-week mark is when the exception to §26.199(f) expires. At that time, 50% of personnel were assumed to begin working 48-hour weeks. The gradual drop (from week 8 to week 13) to baseline in the dotted line can be observed at this point, as those workers would begin to receive 48-hour breaks and finally begin to deplete their "rest debt". Overall, the worker performance numbers under the proposed provision for this evaluation remain at low (good) values. It should be noted again that only 50% of personnel were assumed to shift to this 48-hour week, as the other 50% stay at 60-hour weeks (which achieves the required 54-hour average). Therefore, only 50% of the increase in performance that is shown in Figure 8-1 would actually be achieved. The other 50% of the workers continue along the top line in Figure 8-1, and no benefit was assumed to result.

The solid line in Figure 8-1 also displays the extrapolation of worker performance under the baseline schedule, given that an individual's fatigue saturates after 180 days (6 months). As expected with saturation, the worker performance degradation curve for the current requirement begins to level off around 145 days. A 2-year period was ultimately assessed for this outage analysis. For the first 180 days, the percent improvement in performance (when comparing the current 60-hour week scenario to the proposed 48-hour week scenario) was calculated to be 33.0%. After the saturation point, the percent improvement in the second 180 days (second half

of the year) was calculated to be 81.7%. The second year improvement of 365 to 730 days was assumed to be the same as that of the latter 'saturation' percentage of 87.1%. Therefore, the 1-year average improvement over the 2-year period was calculated to be (87.1% X 3/4) + (33.0% X 1/4) = 69.6%. Further, accounting for the fact that the analysis assumed only 50% of personnel would change to the 48-hour week schedule, a final percent improvement (IHP) of 69.6% X 50% = 34.8% was calculated.

8.1.1.2 Performance During At-Power Conditions (48-hour Average)

Section 26.199(f) was assessed to quantify the impact of the new required collective work hour control provisions on fatigue-related worker performance in nuclear plants under at-power conditions. Fatigue-related worker performance was compared from the baseline conditions (described in the following paragraphs) to the proposed provision (requiring a maximum average of 48 hours per person per week in any averaging period of up to 13 weeks).

8.1.1.2.1 Extensive Overtime Conditions of 60-hour Weeks During At-Power Conditions

Data to quantify this performance assessment was taken from Belenky et al. (2003) (see Section 2.3.1). The 7- and 9-hour sleep mean lapse data were extrapolated for a 13-week period, because the full benefit of the 48-hour averaging provision on fatigue-related performance associated with extensive overtime must be observed through the end of the 13-week averaging period. The "at-power" worker performance extrapolation was designed, similar to the outage conditions assessment, to simulate the compounding effect of cumulative fatigue on workers during this time period. The assumption of a 2-day weighted fatigue recovery was also the same as that made for the outage conditions assessment.

Key assumptions that were used for the at-power analysis include:

- The baseline conditions used in the extensive overtime at-power analysis are expected to occur only in rare at-power situations that would require extensive overtime. Thus, plant personnel are assumed to work at full capacity under these baseline conditions. Given the current work hour controls, workers are assumed to expend up to the 72 allowable hours of work within the first 6 days.

- The schedule of six 10-hour days per week was used as the baseline case for the entire 13-week period.

Proposed §26.199(f) would require a 48 hour per week average to be met in the 13-week period. The analysis further assumed that:

- Licensees would meet this condition by requiring plant personnel to work six 10-hour shifts per week in the beginning of a 13-week averaging period and then, to achieve the 48-hour per week average, requiring plant personnel to work 40-hours per week (five 8-hour shifts, with a 48-hour break) toward the end of the averaging period.

Both the baseline and proposed scenarios are considered to occur rarely. The frequency of these scenarios is addressed in Section 8.1.2.

Proposed §26.199(f), 48/54-Hour Collective Average Limit for Job Duty Groups

The different levels of fatigue associated with the 10-hour and 8-hour shifts were quantified by using different sleep mean lapse data.

- A person working 8-hour shifts was assumed to be able to obtain 9 hours of sleep per night.
- A person working 10 hour shifts would get between 7 hours of sleep (the data used for 12-hour shifts) and 9 hours of sleep per night (the data used for 8-hour shifts).

Thus, mean lapse data for the 10-hour shift was obtained by linearly interpolating between the 7- and 9-hour mean lapse data and then choosing the appropriate interpolation points (halfway between the 7- and 9-hour points).

The improvement in worker performance under the proposed provision compared to the current provision/baseline conditions was calculated by comparing the performance (mean lapses) on a daily basis and then averaging that over the 13-week period. Assuming that an individual's fatigue saturates after 180 days, the percent change in worker performance under extensive overtime at-power conditions due to the provision change is 28.7%.

8.1.1.2.2 Understaffing Conditions While At Power

In addition to the extensive overtime scenario presented in Section 8.1.1.2.1, the analysis also considers the more frequent chronic understaffing conditions that result in exceeding the collective work hour limits of 48 hours per week. Based on a 2000 NEI survey of 37 representative plants, the at-power weekly average (of 52-weeks of data) of operations personnel was calculated at 49.76 hours per week as a result of the understaffing conditions[3].

To assess the improvement in worker performance that would occur if this understaffing issue was resolved (by implementing the 48-hour collective average provision), Belenky's mean lapse data was compared for a 13-week period. The analysis assumed that the baseline/current understaffing schedule consisted of 50% of operations personnel working six 10-hour shifts per week and the other 50% of operations personnel working five 8-hour shifts per week. This equates to a collective average of 50 hours per week, which was used as an estimate for the 49.76 average collected from the data. For the proposed schedule of a 48-hour collective average, this analysis assumed that 50% of operations personnel would work 56 hours per week (five 10-hour shifts and one 6-hour shift per week) and the other 50% of operations personnel would work five 8-hour shifts per week. This equates to a collective average of 48 hours per week. The assumption of a 2-day weighted fatigue recovery was also assumed for this analysis.

The analysis assumed that 50% of the personnel did not change schedules. Therefore, the improvement in worker performance under the proposed provision compared to the current baseline understaffed conditions was calculated by comparing the performance (mean lapses) of the 60-hour week and 56-hour week scenarios on a daily basis, averaging that over the 13-

[3] Data calculated from: NEI, August 29, 2000. Plant Staff Working Hour Limits Survey, Question #5.

week period and then multiplying by a factor of 0.5 to account for the exposure to only half of the population. The percent change in worker performance, or IHP, for chronically understaffed at-power conditions due to the proposed change was calculated to be 24.2%.

8.1.1.3 Performance During At-Power Conditions (54-hour Average)

The current provision/baseline conditions used in this analysis of extensive overtime while at power are expected to occur only in rare situations. The analysis assumed that licensees would use the 54-hour average exception (§26.199(f)(3)) during these rare at-power conditions that would require extensive overtime. Therefore, an analysis similar to the one presented in the last section was performed to account for the increased average.

8.1.1.3.1 Extensive Overtime Conditions of 60-hour Weeks During At-Power Conditions

The change in human performance under the base conditions (using the 48-hour average requirement) to the alternate condition (using the 54-hour average requirement) was considered. Mean lapse data were extrapolated for a 13-week period, as explained in the previous section.

- The base conditions of the 48-hour average were treated in the same manner as the prior analysis (five 6-day weeks of 10-hour shifts followed by eight 5-day weeks of 8-hour shifts).

- The alternate conditions of the 54-hour average were treated by applying nine 6-day weeks of 10-hour shifts, followed by four 5-day weeks of 8-hour shifts to achieve the 54-hour average in a 13-week averaging period.

The 54-hour average provision is less restrictive than the 48-hour average provision. Therefore, the change in worker performance from the 48-hour average to the 54-hour average would actually be a negative percentage or a reduced improvement in worker performance. The actual degradation in worker performance from the 48-hour average to the 54-hour average provision during at-power conditions, calculated in the same manner as the change in worker performance of the previous section, is -24.4%. This percentage and the percentage change in worker performance from baseline conditions to the 48-hour average provision of 28.7% (calculated in the last section) sum to a final percent improvement of 4.3% in worker performance due to the proposed 54-hour average provision. Therefore, the IHP percentage, defined in Section 1.4, for this rare 60-hour week extensive overtime scenario under at-power conditions is 4.3%. This percentage is used in Section 8.2 to calculate the actual fiscal benefit obtained from the proposed provision.

8.1.1.3.2 Extensive Overtime Conditions of 70-hour Weeks During At-Power Conditions

In addition to the 60-hour week extensive overtime scenario presented in section 8.1.1.3.1, the analysis also considered the even less frequent baseline conditions of seven 10-hour shifts per week. This scenario is still under the current limit of 72 hours per week in any 7 days and therefore, is a plausible scenario.

Proposed §26.199(f), 48/54-Hour Collective Average Limit for Job Duty Groups

This section used the methodology presented in the other extensive overtime at-power evaluations previously presented. Key assumptions that were used for the at-power analysis include:

- The baseline conditions used in the 70-hour extensive overtime at-power analysis are expected to occur only in rare at-power situations that would require extensive overtime. Thus, plant personnel were assumed to work at full capacity under these baseline conditions. The schedule of seven 10-hour days per week was used as the baseline case for the entire 13-week period.

- Licensees would meet the 54-hour collective average condition by requiring plant personnel to work seven 10-hour shifts per week in the beginning of a 13-week averaging period and then, to achieve the 54-hour per week average, requiring plant personnel to work 40-hours per week (five 8-hour shifts, with a 48-hour break) toward the end of the averaging period.

- The 7- and 9-hour sleep mean lapse data were extrapolated for a 13-week period to simulate these scenarios. The assumption of a 2-day weighted fatigue recovery was the same as that made for the other extensive overtime assessment.

The improvement in worker performance under the proposed provision compared to the current provision/baseline conditions was calculated by comparing the performance (mean lapses) on a daily basis and then averaging that over the 13-week period. The percent change in worker performance, or IHP, for the 70-hour week extensive overtime at-power conditions scenario was calculated to be 12.7%.

8.1.1.4 Efficiency Productivity Under Outage Conditions (54-hour Average)

This section, similar to the performance evaluations presented in the previous sections, accounts for the change in worker efficiency due to the 48/54-hour average provisions. The percent productivity data from the NECA study was extrapolated for 2 years for the productivity evaluation, to simulate the effect that cumulative fatigue has on the efficiency of workers during an extended plant outage of longer than 300 days. The evaluation used the data to estimate the difference in labor output between a baseline of six 10-hour shifts per week to the proposed conditions of meeting a 54-hour average (the work schedule is the same as that outlined in Section 8.1.1.1). For instance, one hour of labor in the first week of an outage by a worker on a schedule of six 10-hour shifts per week would equal 0.94 hours of output or 9.4 hours of output per day according to the NECA data, while one hour of labor for a worker on a schedule of five 8-hour shifts per week would equal 1 hour of output or 8 hours of output per day. When normalized to a 10-hour shift length, this 8 hours of output equals: 8 output hours x (10-hour shift/ 8-hour shift) = 10 hours of output. Therefore, the absolute change for this one day of labor would be 10 output hours (a normalized quantity representing the 8-hour shift) - 9.4 output hours (representing a 10-hour shift) = 0.6 hours of output.

The absolute change in cumulative output hours was calculated for each day of the 2-year exposure period and normalized on a weekly basis (the sum of the output hours for an entire week). The first 180 days were treated separately from the “saturated” exposure periods (the

second half of the first year and the entire second year), similar to the analysis of the performance data for outages in Section 8.1.1.1. This productivity analysis also assumed a weighted 2-day full fatigue recovery (similar to the performance analysis) such that when a worker "fully recovers" from fatigue, their productivity levels return to their baseline (week 1) percentage. The resulting mean absolute change in worker efficiency (IEP value) under outage conditions due to proposed §26.199(f) would be 41.5 output hours per worker per year.

8.1.1.5 Efficiency Productivity During At-Power Conditions

Similar to the productivity analysis in Section 8.1.1.4, proposed §26.199(f) was assessed to quantify the impact of the new required collective work hour control provisions on fatigue-related worker productivity in nuclear power plants under at-power conditions. The percent productivity data was taken from the NECA study for a 13-week period, to obtain an absolute change in output hours for the entire 13-week averaging period.

8.1.1.5.1 Understaffing Conditions During At-Power Conditions

To assess the improvement in efficiency that would result from the resolution of the chronic understaffing problem (by implementing a 48-hour collective average), the current/baseline conditions were compared to the proposed conditions of the 48-hour average (using the same 13-week schedule outlined in Section 8.1.1.2). This improvement was calculated as an absolute change in the cumulative output hours (after normalization, as described in Section 8.1.1.4) at the end of the 13-week period. For this specific case, the output hours were multiplied by 4, to obtain a yearly figure, then multiplied by a factor of 0.5 to account for the exposure to only half of the population (explained in Section 8.1.1.2.2). The understaffing analysis resulted in a mean absolute change in worker efficiency (IEP value) during at-power conditions due to the proposed collective work hours of 52.4 output hours per worker per year.

8.1.1.5.2 Extensive Overtime Conditions of 60-hour Weeks During At-Power Conditions

To assess the improvement in efficiency that would result from the implementation of a 54-hour collective average, the 60-hour week extensive overtime current/baseline conditions of six 10-hour shifts per week were compared to the proposed conditions of the 54-hour average (using the same 13-week schedule outlined in Section 8.1.1.3). This improvement was calculated as an absolute change in the cumulative output hours (after normalization, as described in the Section 8.1.1.4) at the end of the 13-week period. The 60-hour extensive overtime analysis resulted in a mean absolute change in worker efficiency (IEP value) during at-power conditions due to the proposed collective work hours of 64.2 output hours per worker per quarter.

8.1.1.5.3 Extensive Overtime Conditions of 70-hour Weeks During At-Power Conditions

To assess the improvement in efficiency that would result from the implementation of a 54-hour collective average, the 70-hour week extensive overtime current/baseline conditions of seven 10-hour shifts per week were compared to the proposed conditions of the 54-hour average (using the same 13-week schedule outlined in Section 8.1.1.3). This improvement was calculated as an absolute change in the cumulative output hours (after normalization, as described in the Section 8.1.1.4) at the end of the 13-week period. The 70-hour extensive

overtime analysis resulted in a mean absolute change in worker efficiency (IEP value) during at-power conditions, due to the proposed collective work hour limits, of 142.8 output hours per worker per quarter.

8.1.2 Performance Applicability

The calculations in this section differentiate the benefit for specific types of plant workers, as well as account for the percentage of time in which these workers would be affected by the provision. The analysis in this section determined the portion of the population that would be affected by the proposed change. This percent of population with Performance Applicability (PA) can be broken down into the five job duty group categories listed in §26.199(a)(1-5).

8.1.2.1 Operations and Maintenance

Plant refueling outage duration data for PWR and BWR nuclear units for the years 1999 through 2002 were analyzed to calculate the percent of plants that are in an extended outage in any one year. Three units showed durations of greater than 300 days. From this data, the analysis calculated that 1.1% of plants were in an extended outage, which is approximately equivalent to a single plant being in an extended outage at any time. Therefore, proposed §26.199(f) would be expected to affect shift (overtime) operators, super-crew operators, non-shift staff operators and staff and contract maintenance workers 1.1% percent of the time under outage conditions.

Under at-power conditions, the analysis assumes that the changed requirement would have less of an effect overall on the 60-hour weeks of extensive overtime worked by operators and maintenance workers compared to outage conditions. In Section 8.1.1.2, a 13-week exposure period was identified in which worker performance improvement could be observed. The percentage of time in which plant personnel work a 60-hour per week average (six 10-hour shifts) during at-power conditions was assumed to be very rare. As such, the analysis assumed that shift and non-shift operators and maintenance personnel would all be affected by the proposed provision (which would prohibit job duty groups from working sustained 60-hour weeks for 13 weeks) during only one 13-week period in 10 years (2.5%) [4].

For at-power conditions involving the 70-hour week extensive overtime scenario, the percentage of time in which plant personnel work a 70-hour per week average (seven 10-hour shifts) during at-power conditions was assumed to be more rare that the percentage for the 60-hour extended overtime scenario presented above. Only one 13-week period in 20 years (1.25%) was assumed in which shift and non-shift operators and maintenance personnel would work an average of 70 hours per week.

For the chronic understaffed condition, the NEI data indicates that only operators would be significantly affected by the proposed 48-hour average provision. The percent expected to be

[4] This assumption reflects 2003 work hour data reported by 4 nuclear facilities.

affected was calculated to be 13.5% from this data[5]. The outage and at-power assumptions are summarized in Table 8-2.

To obtain the actual percent of population with Performance Applicability (PA), the average percentage of time that a plant is at outage or at-power conditions was considered. Plants were assumed to be at power 90% of the time, and under outage conditions 10% of the time. As the percentage of time that a plant is under outage conditions has already been considered as part of the extended outage calculation presented in this section, the 10% figure did not need to be accounted for in this provision's PA calculation. Yet, the percent of plants that shift to a super-crew schedule during outages was considered. It was assumed that 75% of plants shift to this super-crew schedule (with 100 percent of all personnel at these plants shifting to a super-crew schedule). The PA value is the product of the time in/probability of a plant condition, the percent of workers (or plants) that would be shifting to a super-crew schedule, and the percent of workers' time affected by the provision change. Note that the super-crew consideration is only applicable during outage conditions. Calculations of this PA percentage for outage conditions are displayed in Table 8-3. At-power conditions PA percentages are displayed in Table 8-4.

Table 8-2
Percent of Workers' Time Affected by Proposed Provision

	At-Power Conditions (Understaffing)	At-Power Conditions (60-hour Overtime)	At-Power Conditions (70-hour Overtime)	Outage Conditions
On-Shift Operators	13.5%	2.5%	1.25%	1.1%
Super-Crew Operators		N/A	N/A	1.1%
Non-Shift Operators		2.5%	1.25%	1.1%
Staff Maintenance	N/A	2.5%	1.25%	1.1%
Contract Maintenance	N/A	N/A	N/A	1.1%

Table 8-3
Calculation of Percent of Population with Performance Applicability (PA) for Outage Conditions

	% Time Affected	% Super-Crew Weighting *	PA Percentage
On-Shift Operators (Overtime)	1.1%	25%	0.3%
Super-Crew Operators	1.1%	75%	0.8%
Non-Shift Operators	1.1%	N/A	1.1%
Staff Maintenance	1.1%	N/A	1.1%

[5] Data calculated from: NEI, August 29, 2000. Plant Staff Working Hour Limits Survey, Question #5.

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	% Time Affected	% Super-Crew Weighting *	PA Percentage
Contract Maintenance	1.1%	N/A	1.1%

** Note that while 75% of non-shift operators and maintenance workers are assumed to shift to super-crew schedules, the impact of the analysis for each job duty group during outages will be the same whether they are on super-crews or working outages under the assumed conditions specified in Sections 3.2 and 3.3 (because both have a baseline schedule duration of six 12-hour shifts). Therefore, differentiating the PA percentage by this criteria for these job duty groups is unnecessary.*

Table 8-4
Percent of Population with Performance Applicability (PA) for At-Power Conditions

	Understaffing Conditions	60-hour Overtime Conditions	70-hour Overtime Conditions
On-Shift Operators	12.2%	2.3%	1.1%
Super-Crew Operators		N/A	N/A
Non-Shift Operators		2.3%	1.1%
Staff Maintenance	N/A	2.3%	1.1%
Contract Maintenance	N/A	N/A	N/A

8.1.2.2 HP/Chemistry

HP/chemistry personnel meeting this requirement were assumed to be on a shift rotation similar to the shift operating crew. Therefore, it was assumed that the percent of population with Performance Applicability (PA) of HP/chemistry shift personnel would be the same as that for shift operators (explained in Section 8.1.2.1) during both outages and at-power (60-hour and 70-hour extensive overtime and understaffed) conditions. Some HP/chemistry personnel also may provide backup or rotational support but typically work a normal business schedule of five workdays a week. The analysis assumed that these non-shift HP/chemistry personnel would then have similar PA percentages as those outlined for non-shift operators in Section 8.1.2.1. Further, it assumed that HP/chemistry personnel would shift to a super-crew schedule during outage conditions if applicable at their specific plant. It also assumed that these super-crew HP/chemistry personnel would have similar PA percentages as those outlined for super-crew operators in Section 8.1.2.1. Assuming again that plants are in outage conditions 10% of the time, at-power 90% of the time, and that 75% of plants are on super-crew schedules during outages, the PA value is the product of the time in a plant condition, the percent of workers (or plants) that would be shifting to a super-crew schedule and the percent of workers' time affected by the provision change. The results of this calculation are summarized in Table 8-5.

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Table 8-5
Percent of Population with Performance Applicability (PA)

	At-Power Conditions (Understaff)	At-Power Conditions (60-hour Overtime)	At-Power Conditions (70-hour Overtime)	Outage Conditions
On-Shift HP/Chemistry	12.2%	2.3%	1.1%	0.3%
Super-Crew Chemistry/HP		N/A	N/A	0.8%
Non-Shift HP/Chemistry		2.3%	1.1%	1.1%

8.1.2.3 Fire Brigade

Fire brigade personnel meeting this requirement were assumed to be on a shift rotation similar to the operating crew. Therefore, the analysis assumed that the percent of population with Performance Applicability (PA) of fire brigade shift personnel would be the same as that for shift operators (explained in Section 8.1.2.1) during both outages and at-power conditions. Some fire brigade personnel who provide backup or rotational support typically work only a normal business schedule of five workdays a week. The analysis assumed that these non-shift fire brigade personnel would then have similar PA percentages as those outlined for non-shift operators in Section 8.1.2.1. Further, it assumed that fire brigade personnel would shift to a super-crew schedule during outage conditions if applicable at their specific plant. It assumed that these super-crew fire brigade personnel would then have similar PA percentages to those outlined for super-crew operators in Section 8.1.2.1. Assuming again that plants are in outage conditions 10% of the time, at-power 90% of the time, and that 75% of plants are on super-crew schedules during outages, the Performance Applicability is the product of the time in a plant condition, the percent of workers (or plants) that would be shifting to a super-crew schedule and the percent of workers' time affected by the provision change. The results of this calculation are summarized in Table 8-6.

Table 8-6
Percent of Population with Performance Applicability (PA)

	At-Power Conditions (Understaff)	At-Power Conditions (60-hour Overtime)	At-Power Conditions (70-hour Overtime)	Outage Conditions
On-Shift Fire Brigade *	12.2%	2.3%	1.1%	0.3%
Super-Crew Fire Brigade *		N/A	N/A	0.8%
Non-Shift Fire Brigade *		2.3%	1.1%	1.1%

These PA values are used in a later analysis to determine the overall benefit of the 48/54 hour average provision.

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8.1.3 Improved Human Performance and Productivity Summary

8.1.3.1 Initial Performance Net Improvement Calculation

Multiplying the generalized IHP percentage by the PA values for each type of worker yields a performance net improvement percentage for each job duty group, for outage and at-power conditions. The 60-hour and 70-hour extensive overtime scenarios were considered to be mutually exclusive and therefore, these net improvement percentages were summed for the overall performance net improvement percentages. The net improvement percentages for each of these separate scenarios are show in Table 8-7. The overall performance net improvement percentages by worker-type, plant condition and response type are displayed in Table 8-8.

Table 8-7
Extensive Overtime Performance Net Improvement Summary

Item	Job Duty Group and Condition	Response Type	Performance Applicability	Improved Human Performance	Performance Net Improvement
At-Power (60-hour Overtime)					
1	Operations, HP/Chemistry, Fire Brigade On-Shift	vigilant	2.3%	4.3%	0.10%
2	Operations, HP/Chemistry, Fire Brigade On-Shift	reactionary	2.3%	2.2%	0.05%
3	Operations, HP/Chemistry, Fire Brigade Non-Shift	vigilant	2.3%	4.3%	0.10%
4	Operations, HP/Chemistry, Fire Brigade Non-Shift	reactionary	2.3%	2.2%	0.05%
5	Maintenance	vigilant	2.3%	4.3%	0.10%
6	Maintenance	reactionary	2.3%	2.2%	0.05%
At-Power (70-hour Overtime)					
1	Operations, HP/Chemistry, Fire Brigade On-Shift	vigilant	1.1%	12.7%	0.14%
2	Operations, HP/Chemistry, Fire Brigade On-Shift	reactionary	1.1%	6.4%	0.07%

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Item	Job Duty Group and Condition	Response Type	Performance Applicability	Improved Human Performance	Performance Net Improvement
3	Operations, HP/Chemistry, Fire Brigade Non-Shift	vigilant	1.1%	12.7%	0.14%
4	Operations, HP/Chemistry, Fire Brigade Non-Shift	reactionary	1.1%	6.4%	0.07%
5	Maintenance	vigilant	1.1%	12.7%	0.14%
6	Maintenance	reactionary	1.1%	6.4%	0.07%

Table 8-8
Performance Net Improvement Summary

Item	Job Duty Group and Condition	Response Type	Performance Applicability	Improved Human Performance	Performance Net Improvement
At-Power					
1	Operations, HP/Chemistry, Fire Brigade On-Shift	vigilant	See Table 8-7 for Extensive Overtime PA and IHP percentages		0.24%
2	Operations, HP/Chemistry, Fire Brigade On-Shift	reactionary			0.12%
3	Operations, HP/Chemistry, Fire Brigade Non-Shift	vigilant			0.24%
4	Operations, HP/Chemistry, Fire Brigade Non-Shift	reactionary			0.12%
5	Maintenance	vigilant			0.24%
6	Maintenance	reactionary			0.12%
7	Operations, HP/Chemistry, Fire Brigade Understaffed	vigilant	12.2%	24.2%	3.0%
8	Operations, HP/Chemistry, Fire Brigade Understaffed	reactionary	12.2%	12.1%	1.5%

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Item	Job Duty Group and Condition	Response Type	Performance Applicability	Improved Human Performance	Performance Net Improvement
Outage					
9	Operations, HP/ Chemistry, Fire Brigade On-Shift (Overtime)	vigilant	0.3%	34.8%	0.10%
10	Operations, HP/ Chemistry, Fire Brigade On-Shift (Overtime)	reactionary	0.3%	17.4%	0.05%
11	Super-Crew Operations, HP/Chemistry, Fire Brigade	vigilant	0.8%	34.8%	0.28%
12	Super-Crew Operations, HP/Chemistry, Fire Brigade	reactionary	0.8%	17.4%	0.14%
13	Operations , HP/Chemistry, Fire Brigade Non-Shift	vigilant	1.1%	34.8%	0.38%
14	Operations, HP/Chemistry, Fire Brigade Non-Shift	reactionary	1.1%	17.4%	0.19%
15	Staff Maintenance	vigilant	1.1%	34.8%	0.38%
16	Staff Maintenance	reactionary	1.1%	17.4%	0.19%
17	Contract Maintenance	vigilant	1.1%	34.8%	0.38%
18	Contract Maintenance	reactionary	1.1%	17.4%	0.19%

8.1.3.2 Final Performance Net Improvement with Penalty for Increased Turnovers

As explained in Section 3.7, the 48/54-hour average provision would be expected to increase the number of shift turnovers that occur per day. Each turnover involving a complex evolution has a risk of producing a human error. This risk was calculated in Section 3.7 to be approximately 3 errors for every 3383.6 turnovers involving a complex evolution. As the number of turnovers increases, so would this risk. However, as fatigue-related worker performance improves, the risk of errors becomes less. Therefore, both factors were considered and the net improvement percentages presented in Section 8.1.3.1 were adjusted as described below.

An example of how these factors were considered for maintenance personnel (vigilance error response) during outage conditions follows:

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Using the baseline number of turnovers of 3383.6, it was assumed that the 48/54-hour average provision would increase this number by 1.1%. This factor is the percent of worker's time affected presented in Table 8-2. This percentage likely underestimates the increase in turnovers due to the provision, because multiple workers are normally involved in a shift turnover (with a complex evolution). Applying this percentage yields a new number of turnovers involving a complex evolution of 3420.2. This increase in turnovers equates to a larger new error number of (3 errors) X (3420.2 new turnovers) / (3383.6 turnovers) = 3.033 new errors. Accounting for the improvement in performance due to fatigue mitigation, these new errors decrease to (3.033 new errors) X (1 - 0.4% improvement) = 3.021 final errors. The improvement percentage of 0.5% was obtained from the net improvement Table 8-8. Therefore, the change in errors is 3 - 3.021= -0.021. Normalizing this by the original number of turnovers considered, a (-0.021) / (3383.6) = -0.0006% penalty in fatigue-related worker performance (net improvement) was obtained. Incorporating this penalty with the net improvement percentage of 0.4% presented in Table 8-8 gives the final net improvement of 0.4% - 0.0006% = 0.4%. In this case, the calculated turnover penalty was so small that the precision of the original net improvement percentages did not allow for the combination of these values. In other words, the turnover penalty is more than one order of magnitude less than the net improvement number. Therefore, it was thought that the turnover penalty was an insignificant contributor to the overall net improvement number.

These calculations were performed for all job duty groups and both plant conditions. Note that the turnover penalty is only warranted for the vigilance error response type, because complex evolution turnovers would most likely not occur under conditions in which a reactionary error response would be applicable (during uncommon plant events, etc.). After this calculation, the outage net improvement percentages for maintenance vigilance errors were reduced by a factor of 10%. This accounts for the assumption that 10% of the total improvement is actually for latent outage errors that would only be realized under at-power conditions. Therefore, this portion of improvement (i.e. 10% of the outage net improvement percentage (vigilant)) was added to the at-power net improvement percentage (vigilant). The results are presented in Table 8-9.

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Table 8-9
Final Performance Net Improvement (Including Turnover Penalty and Latent Outage Errors)

Item	Job Duty Group and Condition	Response Type	Performance Net Improvement	Turnover Penalty	Latent Outage Errors Adjustment	Final Performance Net * Improvement
At-Power						
1	Operations, HP/Chemistry, Fire Brigade On-Shift	vigilant	0.2%	-0.002%	N/A	0.2%
2	Operations, HP/Chemistry, Fire Brigade On-Shift	reactionary	0.1%	N/A	N/A	0.1%
3	Operations, HP/Chemistry, Fire Brigade Non-Shift	vigilant	0.2%	-0.002%	N/A	0.2%
4	Operations, HP/Chemistry, Fire Brigade Non-Shift	reactionary	0.1%	N/A	N/A	0.1%
5	Maintenance	vigilant	0.2%	-0.002%	0.068%	0.2%
6	Maintenance	reactionary	0.1%	N/A	N/A	0.1%
7	Operations, HP/Chemistry, Fire Brigade Understaffed	vigilant	3.0%	-0.009%	N/A	3.0%
8	Operations, HP/Chemistry, Fire Brigade Understaffed	reactionary	1.5%	N/A	N/A	1.5%
Outage						
9	Operations, HP/ Chemistry, Fire Brigade On-Shift (Overtime)	vigilant	0.10%	-0.0002%	N/A	0.10%
10	Operations, HP/Chemistry, Fire Brigade On-Shift (Overtime)	reactionary	0.05%	N/A	N/A	0.05%

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Item	Job Duty Group and Condition	Response Type	Performance Net Improvement	Turnover Penalty	Latent Outage Errors Adjustment	Final Performance Net * Improvement
11	Super-Crew Operations, HP/Chemistry, Fire Brigade	vigilant	0.28%	-0.0005% **	N/A	0.28%
12	Super-Crew Operations, HP/Chemistry, Fire Brigade	reactionary	0.14%	N/A	N/A	0.14%
13	Operations , HP/Chemistry, Fire Brigade Non-Shift	vigilant	0.38%	-0.0006%	N/A	0.38%
14	Operations, HP/Chemistry, Fire Brigade Non-Shift	reactionary	0.19%	N/A	N/A	0.19%
15	Staff Maintenance	vigilant	0.38%	-0.0006%	-0.021%	0.34%
16	Staff Maintenance	reactionary	0.19%	N/A	N/A	0.19%
17	Contract Maintenance	vigilant	0.38%	-0.0006%	-0.04%	0.34%
18	Contract Maintenance	reactionary	0.19%	N/A	N/A	0.19%

** Note that in many cases the calculated turnover penalty was so small that the precision of the original net improvement percentages did not allow for the combination of these values. In other words, when the turnover penalty was more than one order of magnitude less than the net improvement number, the turnover penalty was an insignificant contributor to the overall net improvement number.*
*** For the calculation of turnover penalty for super-crews, a factor of 75% was applied to the percent of worker's time affected presented in Table 8-2 to account for the assumption that only 75% of plants shift to a super-crew schedule during outages. This factor is normally applied in a later calculation to obtain the PA value, but was applied earlier in this calculation for this special case.*

These values were combined with generalized benefit figures for each of eight benefit areas in Section 8.2 to obtain a final dollar value for the performance benefit resulting from implementation of the proposed provision.

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8.1.3.3 Productivity Net Improvement

Multiplying the generalized IEP values by the PA values for each type of worker yielded a productivity net improvement value for each job duty group for both at-power and outage conditions. The 60-hour and 70-hour extensive overtime scenarios were considered to be mutually exclusive and therefore, these net improvement values could be summed for the overall productivity net improvement values. The net improvement values for each of these separate scenarios are show in Table 8-10. The final productivity net improvement calculation by worker type is found in Table 8-11. These values were combined with generalized benefit figures for the efficiency productivity benefit area, as will be explained in Section 8.2.7.

Table 8-10
Extensive Overtime Productivity Net Improvement Summary

Job Duty Group and Condition	Performance Applicability (PA)	Improved Efficiency Productivity (IEP)	Productivity Net Improvement
At-Power (60-hour Overtime)			
Operations, HP/Chemistry, Fire Brigade On-Shift	2.3%	64.2	1.48
Operations, HP/Chemistry, Fire Brigade Non-Shift	2.3%	64.2	1.48
Maintenance	2.3%	64.2	1.48
At-Power (70-hour Overtime)			
Operations, HP/Chemistry, Fire Brigade On-Shift	1.1%	142.8	1.57
Operations, HP/Chemistry, Fire Brigade Non-Shift	1.1%	142.8	1.57
Maintenance	1.1%	142.8	1.57

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Table 8-11
Productivity Net Improvement Summary

Job Duty Group and Condition	Performance Applicability (PA)	Improved Efficiency Productivity (IEP)	Productivity Net Improvement
At-Power			
Operations, HP/Chemistry, Fire Brigade On-Shift	See Table 8-10 for Extensive Overtime PA and IEP values		3.05
Operations, HP/Chemistry, Fire Brigade Non-Shift			3.05
Maintenance			3.05
Operations, HP/Chemistry, Fire Brigade Understaffed	12.2%	52.4	6.39
Outage			
Operations, HP/Chemistry, Fire Brigade On-Shift (Overtime)	0.3%	41.5	0.12
Super-Crew Operations, HP/Chemistry, Fire Brigade	0.8%	41.5	0.33
Operations , HP/Chemistry, Fire Brigade Non-Shift	1.1%	41.5	0.45
Staff Maintenance	1.1%	41.5	0.45
Contract Maintenance	1.1%	41.5	0.45

8.2 Relationship between Worker Performance and Benefit Areas

Eight main benefit areas were identified that may be affected by the proposed provision. These benefit areas are described below in relation to their significance to the change in the collective work hour provisions. The net improvement values calculated in the previous sections were used to evaluate the benefits and costs of adopting the proposed provisions. The job duty groups outlined in §26.199(a)(1-5) were considered individually.

8.2.1 Reduction in Frequency of Plant Trips

The benefit addressed by this area is the potential reduction in trip-related human errors and plant trips associated with an improvement in fatigue-related worker performance. The first subsection addresses the applicability of each job duty group and error response type to this benefit area. The next subsection summarizes the plant trip benefits associated with the proposed change.

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8.2.1.1 Applicability of Job Duty Group and Response Type for Plant Trips

This section summarizes the applicability of each job duty group and error response type to a reduction in plant trips. Trip-related human errors are thought to be caused by a lack of vigilance in plant personnel. Once an plant trip has occurred, the changes in reactionary response do not impact this benefit area (but do impact the severe at-power accidents benefit area). Therefore, this analysis only accounted for the Net Improvement percentages in Table 8-9 that refer to a vigilance response type. Additionally, plant trips are attributable only to human errors made by operators on shift and maintenance workers (see Appendix A). Only operators who work shifts and maintenance workers are included in the evaluation of the benefit obtained from a reduction in frequency of plant trips. Further, because plant trips only occur when a plant is at-power, that was the only plant condition evaluated using the at-power Net Improvement percentages from Table 8-9. The applicable Net Improvement percentages from Table 8-9 are summarized in Table 8-12 below.

Table 8-12
Net Improvement Summary (Applicable to Plant Trips)

Job Duty Group and Condition	Response Type	Net Improvement *
At-Power		
On-Shift Operations, HP/Chemistry, Fire Brigade	vigilant	0.24%
Understaffed Operations, HP/Chemistry, Fire Brigade	vigilant	2.1%**
Maintenance	vigilant	0.24%

* *Net Improvement percentages obtained from appropriate items in Table 8-9.*
** *Net Improvement percentage for Understaffed personnel multiplied by 70% to account for the assumption that 70% of all operators are on shift schedules.*

8.2.1.2 Estimated Benefits from the Reduction in Trip Frequency

The Net Improvement percentages by job duty group in Table 8-12 are equivalent to the potential reduction in cost from trips that can attributed to the fatigue-related performance improvement for each job duty group. The average present value maximum attainable benefit (MAB) that could be obtained if all human-related trips were eliminated was also calculated in Appendix A for each applicable job duty group. The total reduction in cost from elimination of plant trips for each job duty group is the average present value MAB multiplied by the potential reduction percentage displayed in Table 8-12. The estimated benefit is presented in Table 8-13.

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Table 8-13
Total Reduction in Trip Costs During At-Power Conditions

Job Duty Group	MAB** (Million)	Net Improvement*	Benefit (Million)
Operators	$196.0	2.34%***	$4.58
Maintenance Workers	$125.3	0.24%	$0.30
Total			$4.89

* *Net Improvement percentages from Table 8-12*
** *MAB for each job duty group calculated in Appendix A*
*** *Net Improvement for operators is equal to the sum of the shift and understaffed worker types in Table 8-12*

The table shows that the present value average benefit to the nuclear industry from a reduction in plant trips is $4.89 million assuming a 48/54-hour average per week.

8.2.2 Reduction in Frequency of Severe Accidents (At Power)

The benefit addressed by this issue is the potential reduction in the frequency of at-power internal event severe accidents that is associated with an improvement in fatigue-related worker performance. This benefit is expressed in terms of the avoided costs associated with on-site cost, off-site cost and replacement power.

The first subsection addresses the applicability of job duty group and error response type to this benefit area. The second subsection estimates the improvement in core damage frequency that results from the improved performance associated with the 48/54-hour average provision and the final subsection summarizes the at-power severe accident benefits associated with 48/54-hour average provision.

8.2.2.1 Applicability of Job Duty Group and Error Response Type on Severe Accidents (At Power)

This section summarizes the applicability of each job duty group and error response type to a reduction in severe accidents at power. Human-related errors that result in core damage (at-power severe accidents) are thought to be caused by both a lack of vigilance and a lessened reactionary response in plant personnel. Actions that lead to core damage have response elements of vigilance (i.e., monitoring instrumentation for indications of an abnormal condition) and reactionary elements (i.e., taking the appropriate actions once an abnormal condition is determined). Therefore, this analysis accounted for the Net Improvement percentages in Table 8-9 that refer to both vigilance and reactionary response types. Additionally, core damage is attributable only to human errors made by operators on shift and maintenance workers (see Appendix B). Only operators who work shifts and maintenance workers were included in the evaluation of the benefit obtained from a reduction in core damage frequency. Because this benefit area is only applicable for personnel working under at-power conditions, this was the only plant condition evaluated using the at-power Net Improvement percentages from Table 8-9. The applicable Net Improvement percentages from Table 8-9 are summarized in Table 8-14.

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Table 8-14
Net Improvement Summary (Applicable to At-Power Severe Accidents)

Job Duty Group and Condition	Response Type	Net Improvement *
At-Power		
On- Shift Operations, HP/Chemistry, Fire Brigade	vigilant	0.24%
On-Shift Operations, HP/Chemistry, Fire Brigade	reactionary	0.12%
Understaffed Operations, HP/Chemistry, Fire Brigade	vigilant	2.10% **
Understaffed Operations, HP/Chemistry, Fire Brigade	reactionary	1.05% **
Maintenance	vigilant	0.24%

* *Net Improvement percentages obtained from appropriate items in Table 8-9.*
** *Net Improvement percentage for understaffed personnel multiplied by 70% to account for the assumption that 70% of all operators are on shift schedules.*

8.2.2.2 Functional Benefit of a Reduction in At-Power Severe Accidents

The risk of at-power severe accidents was quantified using Standardized Plant Analysis Risk (SPAR) models developed for analysis of at-power internal event risk. The Net Improvement percentages in Table 8-14 were the input for the model. The analysis resulted in an improvement in core damage frequency (CDF) percentage that would be a result of the fatigue-related performance improvement due to implementation of the proposed provision (See Appendix B). The overall improvement in CDF, using the Net Improvement percentages for the applicable job duty groups, was calculated by the model to be 1.12%. Separate SPAR model runs also calculated the percent of this improved CDF that is attributable to each job duty group (See Appendix B). The results of the model runs are summarized in Table 8-15:

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Table 8-15
Improvement in Core Damage Frequency (CDF) (Applicable to At-Power Severe Accidents)

Job Duty Group and Condition	Response Type	Percent of Attributable CDF *	Improvement in CDF **
At-Power			
On-Shift Operations	vigilant	0.6%	0.01%
On-Shift Operations	reactionary	7.3%	0.08%
Understaffed Operations	vigilant	5.5%	0.06%
Understaffed Operations	reactionary	63.8%	0.71%
Maintenance	vigilant	22.8%	0.26%
		100%	1.12%

* *Percent of Attributable CDF obtained from assumptions outlined in Appendix B.*
** *Note that the Total Improvement in CDF is the result of a SPAR model run, while Improvement in CDF per job duty group was based on assumptions outlined in Appendix B.*

8.2.2.3 Estimated Benefits from the Reduction in At-Power Severe Accidents

The Improvement in CDF percentages by job duty group in Table 8-15 are equivalent to the potential reduction in cost from elimination of severe accidents that can attributed to the fatigue-related performance improvement for each job duty group. The average present value maximum attainable benefit (MAB) that could be obtained if all human-related severe accidents were eliminated for the entire nuclear industry was calculated in Appendix B. A total reduction in cost from elimination of severe accidents for each job duty group was obtained by multiplying the average present value MAB by the potential reduction percentage displayed in Table 8-15. CDF percentages by response type in Table 8-15 for operators (shift) were added together in Table 8-16, because the improvements due to each error response type are thought to be mutually exclusive. The results are summarized in Table 8-16.

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Table 8-16
Total Reduction in Severe Accident Costs During At-Power Conditions

Job Duty Group	MAB** (Million)	Improvement in CDF*	Benefit
Operators	$153.1	0.86% ***	$1,316,660
Maintenance		0.24%	$398,060
Total			$1,714,720

* *Improvement in CDF percentages from Table 8-15*
** *MAB for entire nuclear industry calculated in Appendix B*
*** *Improvement in CDF for operators is equal to the sum of the vigilance and reactionary response type CDFs for both shift and understaffed worker types in Table 8-15*

The table shows that the present value average benefit to the nuclear industry from a reduction in at-power severe accidents would be $1.7 million assuming a 48/54-hour average per week.

8.2.3 Reduction in Frequency of Shutdown Risk

The benefit addressed by this issue was the potential reduction in the frequency of internal events during shutdown that would be associated with an improvement in fatigue-related worker performance. This benefit is expressed in terms of the avoided costs associated with on-site cost, off-site cost and replacement power.

The first subsection addresses the applicability of job duty group and error response type to this benefit area. The second subsection estimates the improvement in core damage frequency that would result from the improved performance associated with the 48/54-hour average provision and the final subsection summarizes the shutdown severe accident benefits associated with 48/54-hour average provision.

8.2.3.1 Applicability of Job Duty Group and Error Response Type on Severe Accidents (Shutdown)

This section summarizes the applicability of each job duty group and error response type to a reduction in severe accidents during shutdown conditions. The analysis assumed that actions that lead to core damage during shutdown have the same response elements as severe accidents. Further, the job duty groups that contribute to core damage risk during shutdown conditions would be the same as severe accidents. Therefore, this analysis accounted for the Net Improvement percentages in Table 8-9 that refer to both vigilant and reactionary response types and is applicable to shift and super-crew operators and maintenance workers (see Section 5.3 for a further discussion). Because this benefit area is only applicable for personnel working under outage conditions, this was the only plant condition evaluated using the outage Net Improvement percentages from Table 8-9. The applicable Net Improvement percentages from Table 8-9 are summarized in Table 8-17.

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Table 8-17
Net Improvement Summary (Applicable to Severe Accidents During Shutdown)

Job Duty Group and Condition	Response Type	Net Improvement *
Outage		
On-Shift (Overtime) Operations, HP/Chemistry, Fire Brigade	vigilant	0.10%
On-Shift (Overtime) Operations, HP/Chemistry, Fire Brigade	reactionary	0.05%
Super-Crew Operations, HP/Chemistry, Fire Brigade	vigilant	0.28%
Super-Crew Operations, HP/Chemistry, Fire Brigade	reactionary	0.14%
Staff Maintenance	vigilant	0.34%
Contract Maintenance	vigilant	0.34%

* *Net Improvement percentages obtained from appropriate items in Table 8-9.*

8.2.3.2 Functional Benefit of a Reduction in Shutdown Accidents

The risk of at-power severe accidents was quantified using Standardized Plant Analysis Risk (SPAR) models developed for analysis of at-power internal event risk. The Net Improvement percentages in Table 8-17 were the input for the model. The analysis resulted in an improvement in core damage frequency (CDF) percentage that would result from the fatigue-related performance improvement due to implementation of the proposed provision (see Appendix B). The analysis assumed that the ratio between the Net Improvement percentages and Improvement in CDF percentages during at-power conditions would be the same as that for shutdown conditions (See Appendix C). For example, the Net Improvement for shift operators (reactionary) during at-power conditions is 0.12%. This resulted in an improvement in CDF of 0.08%. Therefore, the improvement in CDF for super-crew operators (reactionary) during shutdown is the outage Net Improvement percentage of 0.14% multiplied by the quantity (0.08%/0.12%). This resulted in an improvement in CDF for maintenance (vigilance) during shutdown of 0.09%. This calculation was performed for all applicable job duty groups. The results are displayed in Table 8-18.

Proposed §26.199(f), 48/54-Hour Collective Average Limit for Job Duty Groups

Table 8-18
Improvement in Core Damage Frequency (CDF) (Applicable to Severe Accidents During Shutdown)

Job Duty Group and Condition	Response Type	Improvement in CDF*
Outage		
Shift (Overtime) Operations, HP/Chemistry, Fire Brigade	vigilant	0.00%
Shift (Overtime) Operations, HP/Chemistry, Fire Brigade	reactionary	0.03%
Super-Crew Operations, HP/Chemistry, Fire Brigade	vigilant	0.01%
Super-Crew Operations, HP/Chemistry, Fire Brigade	reactionary	0.09%
Staff Maintenance	vigilant	0.37%
Contract Maintenance	vigilant	0.37%

8.2.3.3 Estimated Benefits from the Reduction in Shutdown Severe Accidents

The Improvement in CDF percentages by job duty group presented in the last section is equivalent to the potential reduction in cost from elimination of severe accidents that could attributed to the fatigue-related performance improvement for each job duty group. The average present value maximum attainable benefit (MAB) that could be obtained if all human-related severe accidents were eliminated for the entire nuclear industry was calculated in Appendix B. The analysis assumed that the MAB of severe accidents during shutdown is equivalent to that during at-power conditions. A total reduction in cost from elimination of severe accidents was obtained by multiplying the average present value MAB by the potential reduction percentage. The MAB of severe accidents was calculated to be $153.1 million. CDF percentages by response type in Table 8-18 for operators (super-crew) were added together in Table 8-19, because the improvements due to each error response type were thought to be mutually exclusive. The benefit for staff and contract maintenance personnel was multiplied by 75% and 25%, respectively, to account for the proper plant population proportions during outages. The calculations are summarized in Table 8-19.

Proposed §26.199(f), 48/54-Hour Collective Average Limit for Job Duty Groups

Table 8-19
Total Reduction in Severe Accident Costs During Shutdown Conditions

Job Duty Group	MAB** (Million)	Improvement in CDF*	Contractor Weighting	Benefit
Operators	$153.1	0.13% ***	N/A	$199,030
Staff Maintenance		0.37%	75%	$424,853****
Contract Maintenance		0.37%	25%	$141,618****
Total				$765,500

* *Improvement in CDF percentages from Table 8-18*
** *Methodology for selecting an MAB for shutdown accidents outlined in Appendix C, the MAB for entire nuclear industry used in Table 8-19 was calculated in Appendix B*
*** *Improvement in CDF for operators is equal to the sum of the vigilance and reactionary response type CDFs, as well as both shift and super-crew worker types in Table 8-18*
**** *The benefit for staff and contract maintenance personnel have been multiplied by 75% and 25%, respectively.*

The table shows that the present value average benefit to the nuclear industry from a reduction in shutdown severe accidents is $765,500 for the 48/54-hour average provision.

8.2.4 Improved Fire Protection

The benefit addressed by this issue was the potential reduction in cost due to fire events that are associated with an improvement in fatigue-related worker performance. Attachment 1 to SECY-99-140 suggests that, "...The reported core damage frequency (CDF) contribution from fire events can, in some cases, approach (or even exceed) that from internal events." (see Appendix D). The fire events analysis assumed on the basis of this statement that the benefit attributed to operators and maintenance from improved fire protection due to the proposed 48/54-hour collective average provision would be equal to the operator and maintenance benefit associated with severe accidents at-power and during shutdown (internal event risk). In addition, fire risk can be attributed to a lessened reactionary response by fire brigade members. While important, the improvement in CDF attributable to fire brigade was assumed to be less than that of the operator and is estimated to have 50% of the impact. Further, fire brigade members would only be important in association with an improvement of reactionary error responses. In this way, the improvement in CDF from operators and maintenance and the MAB to the nuclear industry would be the same as the sum of that for severe accidents at-power and during shutdown (outage), while the CDF improvement for fire brigade was calculated explicitly for this section. The reduction in fire events costs are shown in Table 8-20.

Proposed §26.199(f), 48/54-Hour Collective Average Limit for Job Duty Groups

Table 8-20
Total Reduction in Fire Events Cost During At-Power Conditions

Job Duty Group	MAB** (Million)	Improvement in CDF*	Contractor Weighting	Benefit
At-Power				
Operators	$153.1	0.13%***	N/A	$199,030
Maintenance Workers		0.26%		$398,060
Fire Brigade		0.40% ****		$612,400
Outage				
Operators	$153.1	0.86%***	N/A	$1,316,660
Staff Maintenance		0.37%	75%	$424,853 *****
Contract Maintenance		0.37%	25%	$141,618 *****
Fire Brigade		0.07% ****	N/A	$107,170
Total				$3,199,790

* *Improvement in CDF percentages from Table 8-15 for at-power and in Table 8-18 for outages*

** *Methodology for selecting an MAB for fire events outlined in Appendix D, this MAB for entire nuclear industry calculated in Appendix B*

*** *Improvement in CDF for operators is equal to the sum of the vigilance and reactionary response type CDFs, as well as both shift and understaffed worker scenarios in Table 8-15 for at-power conditions and in Table 8-18 for outage conditions*

**** *Improvement in CDF for on-shift fire brigade is equal to 50 percent of the sum of the on-shift and understaffed operator (reactionary) CDF improvement calculated for at-power severe accidents (shown in Table 8-15)*

***** *The benefits for staff and contract maintenance personnel have been multiplied by 75% and 25%, respectively.*

The table shows that the present value average benefit to the nuclear industry from a reduction in fire events is $3.2 million assuming a 48/54-hour average per week.

8.2.5 Reduction in Frequency of Lost and Restricted Work Cases

The benefit addressed by this issue is the potential reduction in industrial injury cost associated with an improvement in fatigue-related worker performance. The first subsection addresses the applicability of each job duty group and error response type to this benefit area. The next subsection summarizes the industrial injury benefits associated with the proposed provision.

8.2.5.1 Applicability of Job Duty Group and Response Type for Industrial Injuries

This section summarizes the applicability of each job duty group and error response type to a reduction in lost and restricted work cases. Industrial injuries are thought to be caused by a lack of vigilance in plant personnel. Therefore, this analysis only accounted for the Net Improvement percentages in Table 8-9 that refer to a vigilant response type. Additionally, a reduction in industrial injuries is thought to be attributable to all job duty groups, because all workers are subject to injuries. All job duty groups in Table 3-1 were included in the evaluation

of the benefit obtained from a reduction in lost and restricted work cases. The benefits for staff and contract maintenance were considered explicitly. The applicable Net Improvement percentages from Table 8-9 are summarized in Table 8-21 below.

Table 8-21
Net Improvement Summary (Applicable to Industrial Injuries)

Job Duty Group and Condition	Response Type	Net Improvement *
At-Power		
On-Shift Operations, HP/Chemistry, Fire Brigade	vigilant	0.2%
Non-Shift Operations, HP/Chemistry, Fire Brigade	vigilant	0.2%
Understaff Operations, HP/Chemistry, Fire Brigade	vigilant	3.0%
Maintenance	vigilant	0.2%
Outage		
On-Shift (Overtime) Operations, HP/Chemistry, Fire Brigade	vigilant	0.10%
Super-Crew (Overtime) Operations, HP/Chemistry, Fire Brigade	vigilant	0.28%
Non-Shift Operations, HP/Chemistry, Fire Brigade	vigilant	0.38%
Staff Maintenance	vigilant	0.34%
Contract Maintenance	vigilant	0.34%

* *Net Improvement percentages obtained from appropriate items in Table 8-9.*

8.2.5.2 Estimated Benefits from the Reduction in Lost and Restricted Work Cases

The Net Improvement percentages by job duty group and plant condition in Table 8-21 are equivalent to the potential reduction in injury cost that can be attributed to the fatigue-related performance improvement for each scenario and job duty group. The average present value maximum attainable benefit (MAB) that could be obtained if all industrial injuries were eliminated was calculated for each job duty group in Appendix E. The total reduction in injury cost for each job duty group and scenario is the average present value MAB multiplied by the potential reduction percentage displayed in Table 8-21. The calculations are summarized in Tables 8-22 and 8-23.

Proposed §26.199(f), 48/54-Hour Collective Average Limit for Job Duty Groups

Table 8-22
Total Reduction in Injury Costs During Outage Conditions

Job Duty Group	MAB** (In Millions)	Net Improvement*	Benefit
Shift (Overtime) Operators	$7.18	0.10%	$7,183
Super-Crew Operators	$7.18	0.28%	$20,113
Non-Shift Operators	$3.08	0.38%	$11,698
Staff Maintenance	$17.7	0.34%	$60,649
Contract Maintenance	$63.9	0.34%	$218,406
Shift (Overtime) HP/Chemistry	$3.56	0.10%	$3,557
Super-Crew HP/Chemistry	$3.56	0.28%	$9,959
Non-Shift HP/Chemistry	$1.52	0.38%	$5,792
Shift (Overtime) Fire Brigade	$0.70	0.10%	$697
Super-Crew Fire Brigade	$0.70	0.28%	$1,953
Non-Shift Fire Brigade	$0.30	0.38%	$1,136
Total			$341,143

Table 8-23
Total Reduction in Injury Costs Under At-Power Conditions

Job duty group	MAB (In Millions)**	Net Improvement *	Benefit
On-Shift Operators	$7.18	0.2%	$17,240
Understaff Operators	$10.3	3.0%	$307,849
Non-Shift Operators	$3.08	0.2%	$6,157
Maintenance	$17.7	0.2%	$42,561
On-Shift HP/Chemistry	$3.56	0.2%	$8,536
Understaff HP/Chemistry	$5.08	3.0%	$152,430
Non-Shift HP/Chemistry	$1.52	0.2%	$3,049
Understaff Fire Brigade	$0.99	3.0%	$29,888
On-Shift Fire Brigade	$0.70	0.2%	$1,674
Non-Shift Fire Brigade	$0.30	0.2%	$598
Total			$569,982

* *Net Improvement percentages from Table 8-21*
** *MAB for each job duty group calculated in Appendix E*

The final benefit to the industry separated by job duty group and plant condition and then combined, is shown in Table 8-24.

Proposed §26.199(f), 48/54-Hour Collective Average Limit for Job Duty Groups

Table 8-24
Benefit to Nuclear Industry Per Year For Reduction in Lost and Restricted Work Cases

	Outage	At-Power	Total
Operators	$38,994	$331,246	$370,240
Staff Maintenance	$60,649	$42,561	$103,210
Contract Maintenance	$218,406	N/A	$218,406
HP/Chemistry	$19,308	$164,015	$183,323
Fire Brigade	$3,786	$32,160	$35,946
Total	$341,143	$569,982	$911,125

The table shows that the present value average benefit to the nuclear industry from a reduction in lost and restricted work cases would be $911,125 assuming a 48/54-hour average per week.

8.2.6 Improved Security

Information relevant to the security force baseline work schedules and the nature of the security threat is considered safeguards information. Therefore, the estimated benefit of this provision for the security force was determined differently from that of other job duty groups included in this analysis. Rather than directly assessing the work schedules and security force human performance, the benefits were estimated by considering the role of security to be equal to the performance role of operations. The operator-related benefits were then adjusted as necessary to derive the benefits for the security force. The details of this approach are discussed in Appendix F. As a result of this approach, the work schedules for the security force are not addressed and the benefits for the security force are shown only at the summary level.

8.2.7 Improved Worker Productivity - Efficiency

The benefit addressed by this area was the potential improvement in worker efficiency associated with an improvement in fatigue-related worker productivity. This efficiency improvement considered the increase in productive output hours for every labor hour of input, which would lead to a reduction in the cost of labor. The first subsection addresses the applicability of each job duty group. The next subsection summarizes the efficiency benefit associated with the proposed provision change.

8.2.7.1 Functional Benefit

This section summarizes the applicability of each job duty group to an improvement in worker productivity. Improvement in productivity is thought to be attributable to super-crew and non-shift staff operators and HP/chemistry personnel, as well as staff and contract maintenance personnel. The productivity of these personnel may be improved, as they have the potential to save operations and maintenance costs by saving time. The applicable Productivity Net Improvement values from Table 8-11 have been summarized in Table 8-25 below.

Proposed §26.199(f), 48/54-Hour Collective Average Limit for Job Duty Groups

Table 8-25
Productivity Net Improvement Summary (Applicable to Efficiency)

Job Duty Group and Condition	Productivity Net Improvement *
Outage Conditions	
Operations, HP/Chemistry, On-Shift (Overtime)	0.12
Operations, HP/Chemistry Super-Crew	0.33
Operations, HP/Chemistry Non-Shift	0.45
Staff Maintenance	0.45
Contract Maintenance	0.45
At-Power	
Operations, HP/Chemistry, On-Shift	N/A
Operations, HP/Chemistry Non-Shift	3.05
Operations, HP/Chemistry Understaff	6.39
Staff Maintenance	3.05

* *Productivity Net Improvement values obtained from appropriate items in Table 8-11. Note if Net Improvement is N/A, it is removed from further tables.*

8.2.7.2 Estimated Benefit from a Improvement in Efficiency

The Productivity Net Improvement values by job duty group in Table 8-25 are equivalent to the potential reduction in labor cost that can attributed to the fatigue-related productivity improvement for each job duty group. The average present value maximum attainable benefit (MAB) of increased efficiency that can be obtained for each additional productive labor hour that is realized was also calculated in Appendix G for each job duty group. The total improvement in efficiency cost for each job duty group is the average present value MAB per hour multiplied by the potential improvement value (in labor hours) displayed in Table 8-25. The calculations are summarized in Table 8-26.

Proposed §26.199(f), 48/54-Hour Collective Average Limit for Job Duty Groups

Table 8-26
Total Improvement in Efficiency Costs

Job Duty Group and Condition	MAB **	Productivity Net Improvement *	Benefit (In Millions)
Outage Conditions			
Operations, Shift (Overtime)	$57,171	0.12	$0.00
Operations, Super-Crew	$171,515	0.33	$0.06
Operations, Non-Shift	$98,008	0.45	$0.04
Staff Maintenance	$1,411,453	0.45	$0.64
HP/Chemistry, Shift (Overtime)	$28,308	0.12	$0.00
HP/Chemistry, Super-Crew	$84,925	0.33	$0.03
HP/Chemistry, Non-Shift	$48,528	0.45	$0.02
Contract Maintenance	$5,082,817	0.45	$2.29
At-Power Conditions			
Operations, Understaff	$326,695	6.39	$2.09
Operations, Non-Shift	$98,008	3.35	$0.30
Staff Maintenance	$1,411,453	3.35	$4.30
HP/Chemistry, Understaffed	$161,762	6.39	$1.03
HP/Chemistry, Non-Shift	$48,528	3.35	$0.15

* *Productivity Net Improvement values from Table 8-25*
** *MAB for each job duty group calculated in Appendix G, Table G-2*

The productivity benefit to the industry separated by job duty group and plant condition and in total for the improvement in worker efficiency are shown in Table 8-27.

Proposed §26.199(f), 48/54-Hour Collective Average Limit for Job Duty Groups

Table 8-27
Productivity Benefit to Nuclear Industry Per Year For Improvement in Worker Efficiency

	Outage Conditions (In Millions)	At-Power Conditions (In Millions)	Total (In Millions)
Operators	$0.11	$2.39	$2.49
Staff Maintenance	$0.64	$4.30	$4.94
Contract Maintenance	$2.29	N/A	$2.29
HP/Chemistry	$0.05	$1.18	$1.23
Total	**$3.08**	**$7.87**	**$10.96**

Table 8-27 shows that the present value average benefit to the nuclear industry from an improvement in worker efficiency was estimated as $10.96 million for the proposed collective work hours provision.

8.2.8 Improved Worker Productivity - Reduction in Rework

This benefit area addressed the benefit which could be expected from improvements in productivity of workers due to mitigation of fatigue. The benefit quantifies the benefit related to the elimination of fatigue related mistakes in the performance of tasks assigned to workers included in the proposed provisions. The first subsection addresses the applicability of each job duty group. The next subsection summarizes the efficiency benefit associated with the proposed change.

8.2.8.1 Functional Benefit

This section summarizes the applicability of each job duty group to an improvement in worker productivity. Improvement in productivity is thought to be attributable to super-crew and non-shift staff operators and HP/chemistry personnel, as well as staff and contract maintenance personnel. The productivity of these personnel may be improved, as they have the potential to rectify mistakes committed during operations an maintenance activities. A detailed discussion of job type applicability is presented in Appendix H. The benefits for staff and contract maintenance were considered explicitly. The applicable Net Improvement percentages from Table 8-9 have been summarized in Table 8-28 below.

Proposed §26.199(f), 48/54-Hour Collective Average Limit for Job Duty Groups

Table 8-28
Net Improvement Summary Applicable to Reduction in Rework At Power

Job Type	Applicable Net Improvement *
Understaff Operations	3.0%
Non-Shift Operations	0.2%
Understaff HP/Chemistry	3.0%
Non-Shift HP/Chemistry	0.2%
Staff Maintenance	0.2%

** Productivity Net Improvement percentages obtained from appropriate items in Table 8-9.*

Table 8-29
Net Improvement Summary Applicable to Reduction in Rework During Outage Conditions

Job Type	Applicable Net Improvement *
Shift Operations (Overtime)	0.10%
Non-Shift Operations	0.38%
Super-Crew Operations	0.28%
Shift HP/Chemistry (Overtime)	0.10%
Non-Shift HP/Chemistry	0.38%
Super-Crew HP/Chemistry	0.28%
Staff Maintenance	0.34%
Contract Maintenance	0.34%

** Productivity Net Improvement percentages obtained from appropriate items in Table 8-9.*

8.2.8.2 Estimated Benefit from a Reduction in Rework

The net improvement percentages in Table 8-29 indicate the portion of rework costs which are expected to be saved by implementation of the proposed provisions. The maximum attainable benefit (MAB) which could be realized by the elimination of rework was calculated in Appendix H. Table 8-30 and Table 8-31 present the benefit expected by job duty type and plant condition.

Proposed §26.199(f), 48/54-Hour Collective Average Limit for Job Duty Groups

Table 8-30
Total Reduced Rework Benefit At Power

Job Type	Applicable Net Improvement *	MAB (in Millions)	Benefit (in Millions)
Understaff Operations	3.0%	$47.00	$1.41
Non-Shift Operations	0.2%	$47.00	$0.09
Understaff HP/Chemistry	3.0%	$23.30	$0.70
Non-Shift HP/Chemistry	0.2%	$23.30	$0.05
Staff Maintenance	0.2%	$271.00	$0.65
Total			$2.90

Table 8-31
Total Reduced Rework Benefit During Outage Conditions

Job Type	Applicable Net Improvement *	MAB (in Millions)	Benefit (in Millions)
Shift Operations (Overtime)	0.10%	$25.60	$0.03
Non-Shift Operations	0.38%	$43.80	$0.17
Super-Crew Operations	0.28%	$76.70	$0.21
Shift HP/Chemistry (Overtime)	0.10%	$12.70	$0.01
Non-Shift HP/Chemistry	0.38%	$21.70	$0.08
Super-Crew HP/Chemistry	0.28%	$38.00	$0.11
Staff Maintenance	0.34%	$252.00	$0.86
Contract Maintenance	0.34%	$909.00	$3.11
Total			$4.58

The total benefit expected due to the reduction of rework by the proposed provision is sum of the benefit for each worker type, $7.48 million.

Proposed §26.199(f), 48/54-Hour Collective Average Limit for Job Duty Groups

8.3 Conclusion

The proposed 48/54-hour average provisions are expected to be beneficial in mitigating cumulative fatigue in nuclear power industry workers. The assessment presented here demonstrates that the prevention of cumulative fatigue improves worker performance and productivity and that decreasing fatigue-induced errors would result in safer plant operations. The present value benefit for the eight benefit areas by job duty group using a 7 and 3 percent discount rate are summarized in Tables 8-32 and 8-33, respectively.

Table 8-32
Total Benefit of Proposed 54-hour Average Provision Change Using a 7 Percent Discount Rate (In Millions)

	Plant Trips	Severe Accidents	Shut-down Risk	Fire	Injury Cost	Security	Total Safety Benefit	Efficiency	Rework	Total Benefit
Operations	$4.59	$1.32	$0.20	$1.52	$0.37	N/A	$7.99	$2.49	$1.91	$12.4
Staff Maintenance [1]	$0.30	$0.40	$0.42 [1]	$0.82	$0.10	N/A	$2.05	$4.94	$1.51	$8.5
Contract Maintenance [1]	N/A	N/A	$0.14 [1]	$0.14	$0.22	N/A	$0.50	$2.29	$3.11	$5.9
HP/Chemistry	N/A	N/A	N/A	N/A	$0.18	N/A	$0.18	$1.23	$0.95	$2.4
Fire Brigade	N/A	N/A	N/A	$0.72	$0.04	N/A	$0.76	N/A	N/A	$0.8
Security (Before order EA-03-038)[3]	See Appendix F					$7.99 [4]	$7.99	N/A	N/A	$8.0[4]
Total	$4.89	$1.71	$0.77	$3.20	$0.91	$7.99	$19.47	$10.96	$7.48	$37.9

Proposed §26.199(f), 48/54-Hour Collective Average Limit for Job Duty Groups

Table 8-33
Total Benefit of Proposed 54-hour Average Provision Change Using a 3 Percent Discount Rate (In Millions)

	Trips	Severe Accidents	Shut-down Risk	Fire	Injury Cost	Security	Total Safety Benefit	Efficiency	Rework	Total Benefit
Operations	$7.44	$2.14	$0.32	$2.46	$0.60	N/A	$12.96	$4.05	$3.10	$20.1
Staff Maintenance [1]	$0.49	$0.65	$0.69 [1]	$1.34	$0.17	N/A	$3.33	$8.01	$2.46	$13.8
Contract Maintenance [1]	N/A	N/A	$0.23 [1]	$0.23	$0.35	N/A	$0.81	$3.71	$5.04	$9.6
HP/Chemistry	N/A	N/A	N/A	N/A	$0.30	N/A	$0.30	$2.00	$1.54	$3.8
Fire Brigade	N/A	N/A	N/A	$1.17	$0.06	N/A	$1.23	N/A	N/A	$1.2
Security (Before order EA-03-038)[3]	See Appendix F					$12.96 [4]	$12.96	N/A	N/A	$13.0[4]
Total	$7.93	$2.78	$1.24	$5.19	$1.48	$12.96	$31.58	$17.78	$12.14	$61.5

[1] The title "staff maintenance" here reflects the assumption that of the total "maintenance" benefit, 75% of the outage benefit is attributable to staff and 25% is attributable to contract personnel.

[3] There were no NRC specific requirements limiting work hours for the security force prior to the issuance of order EA-03-038 limiting their work hours. Order EA-03-038 established compensatory measures in the aftermath of the events of September 11, 2001. The requirements contained in order EA-03-038 are similar to those of the proposed provisions with the exception of the new provisions associated with a 24-hour break in any 7-day period and a 48-hour break in any 14 day period.

[4] The security force benefit was estimated by using the applicable benefits from operations. This is considered an estimate given the uncertainty of the security threat. It essentially assumed that the role of security is equal to the role (performance only) of operations in preventing core damage. See Appendix F, for a qualitative discussion on security.

9. BENEFIT ANALYSIS OF PROPOSED §26.199(d)(2)(ii-iii), 24-HOUR BREAK EVERY SEVEN DAYS AND 48-HOUR BREAK EVERY 14 DAYS

The following analysis assessed the impact that the new required break provisions in §26.199(d)(2)(ii-iii) would have on both regular plant staff and contract worker performance and productivity. In this evaluation, all other work control requirements being analyzed (specifically §26.199(d)(1)(i-iii), §26.199(d)(2)(i) and §26.199(f)) have already been incorporated (the baseline condition). This ensured that the final benefit analysis would not double count the benefit of any individual provision. Table 9-1 shows the evaluation order used in this analysis.

Table 9-1
Proposed Provision Reference Table

Tier		Description
Base		Current industry practices concerning work scheduling and worker fatigue
1	§26.199(d)(3)	Licensees may grant a waiver of the individual work hour controls in §26.199(d)(1-2) only if it is necessary for the safety or security of the plant and the worker has been judged fit to work the additional hours
	§26.199(a)(1-5)	Specifies the individuals subject to work hour controls: (1) operations, (2) maintenance, (3) health physics and chemistry, (4) fire brigade and (5) security
	§26.199(d)(1)(i-iii)	Individual work hours should not exceed: (i)16 hours in any 24-hour period, (ii) 26 hours in any 48-hour period and (iii) 72 hours in any 7-day period
2	§26.199(d)(2)(i)	Individuals must receive a 10-hour rest break between successive work periods
3	§26.199(f)	Collective work hours of each job duty group cannot exceed an average of 48 hours per person per week in any 13-week averaging period except (1) during the first 8 weeks of a plant outage for job duty groups specified in (a)(1-4) and (2) under circumstances that cannot be reasonably controlled, the group average cannot exceed 54 hours per person per week
4	§26.199(d)(2)(ii-iii)	Individuals must receive: (ii) a 24-hour rest break in any 7-day period and (iii) a 48-hour rest break in any 14-day period (except during the first 14 days of an outage)

* The analysis of tier 4 calculates the estimated marginal benefit from the previous tier(s) to the proposed tier.

9.1 Performance and Productivity Improvement Resulting from Proposed Provision

9.1.1 Applicability to Plant Conditions

Applicability to plant conditions is divided into two sections below. The evaluation consisted of one outage and two at-power analyses. The at-power condition contains two analyses, one to evaluate the 24-hour break in any 7 days provision and one to evaluate the 48-hour break in any 14 days provision. The 24-break provision analysis built off of the scenario presented in the collective work hours provision that assumed personnel may work extensive overtime of seven 10-hour days per week at power on rare occasions. The 48-hour provision built off of the scenario presented in the collective work hours provision that assumed personnel may work extensive overtime of six 10-hour days per week at power on other rare occasions. Note that this assumption already implies a 24-hour break every 7 days by default. The outage analysis assumed a baseline work schedule such that the collective work hours provision of 54-hours per person per week has already been met. This schedule, consisting of a percentage of personnel working six 12-hour days and another percentage working five 8-hour days (to achieve an overall 54-hour average), also implies a 24-hour break by default. Assumptions are noted with bullets throughout this section.

9.1.1.1 Under Outage Conditions

Proposed §§26.199(d)(2)(ii) and (iii) were assessed to quantify the impact of the proposed required break provisions on fatigue-related worker performance in Pressurized Water Reactor (PWR) and Boiling Water Reactor (BWR) units under plant outage conditions and guidelines. Section 26.199(d)(2)(iii) would provide an exception to the 48-hour break provision during the first 14 days of any plant outage. Additionally, there currently exists the *implication* of a 24-hour break in any 7-day period during outage conditions. This is based on the assumptions that:

- Under the baseline schedule (which meets the 54-hour average collective average limit), all personnel would expend all of the 72 allowable hours of work within the first 6 days (working six 12-hour days) for the first 8 weeks (which is the period of the collective work hour limit exception during outages).

- After the first 8 weeks, essential personnel would remain on 72-hour schedules while a percentage of personnel (most likely the nonessential workers) would change to a 40-hour week (five 8-hour shifts) to achieve the required 54-hour average. The percentage of personnel who would work 40-hour weeks was assumed to be 60%.

Therefore, fatigue-related worker performance was compared from the baseline conditions (assuming a 24-hour break every 7 days and a 54-hour average) to the proposed provision (requiring the 54-hour average and a 48-hour break every 14 days in addition to the 24-hour break every 7 days) for outage lengths up to 175 days[6]. Note that the 54-hour average

[6] The simulation of outage conditions up to a length of 175 days was chosen because historical outage data used for this analysis did not show any durations of a greater length, with the exception of a few long duration shutdowns (~ 1 year) that are considered atypical.

requirement was treated as part of the baseline conditions. In other words, the analysis assumed that any overtime worked during a normal outage (of up to 175 days) would be limited to a sub-set of the job duty group such that it would not affect the overall average enough to increase it above 54-hours per week.

For this evaluation, the 'mean lapses' data described in Section 2.3.1 was extrapolated for 175 days, to simulate the compounding effect of cumulative fatigue on workers during a plant outage. The analysis assumed that an increase in 'mean lapses' is proportional to a degradation in worker performance. Figure 9-1 displays the results of this extrapolation, relating outage length to worker performance. A large worker performance number equates to a worsening in performance. The analysis further assumed:

- Licensees would meet the proposed conditions by requiring the essential plant personnel who work six 12-hour shifts per week to instead work alternating weeks of five 12-hour shifts and six 12-hour shifts. Personnel working 40-hour weeks would remain on the same schedule.

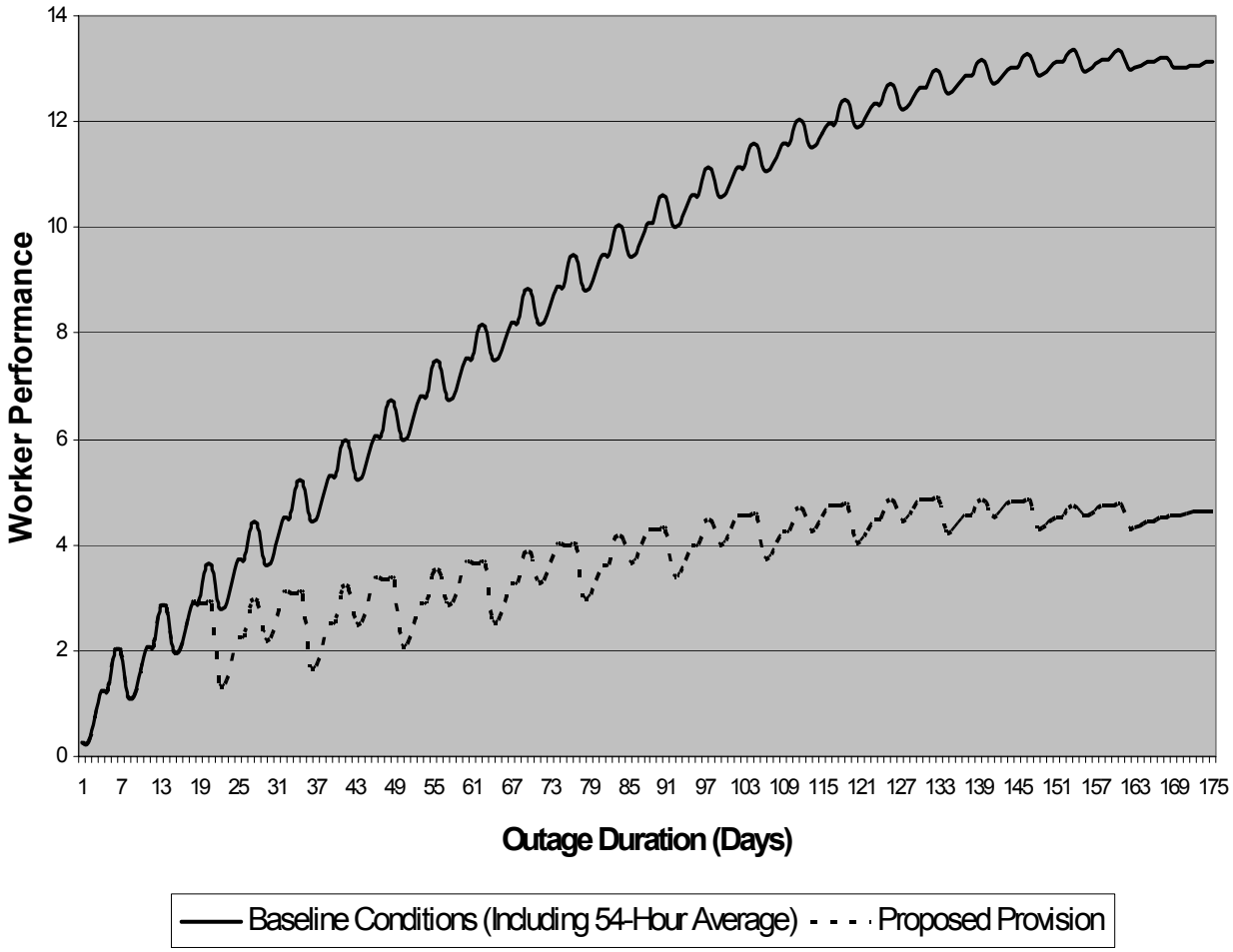
- The degradation seen in worker performance between each sleep day in the study's data would eventually lessen, as a worker's propensity to become fatigued would likely saturate (Monk 2004). The level of fatigue at this saturation point would be characterized by poor health and a "burned-out" effect.

- Additionally, the analysis assumed that an individual may recover from fatigue acquired during consecutive workdays when given a 48-hour break. This assumption is justified by the observation in the Dinges study that, "…recovery from these [sleep] deficits appeared to require two full nights of sleep." This recovery may be partial or full (to baseline performance level) based on the relationship presented in Section 2.2.

This assumption of a 'weighted 2-day full fatigue recovery' does not account for variability between workers associated with necessary rest or outside obligations that may keep a worker from effectively receiving their full 48 hour break. Therefore, some personnel may not fully recover in 48 hours, but may instead need up to 72 hours. This variation in individual need was not evaluated in the present analysis. However, the use of a reset saturation, the weighted manner in which the full recovery was analyzed and the inclusion of an accumulating 'rest debt' were all employed to account for some of this uncertainty.

Proposed §26.199(d)(2)(ii-iii) - 24 & 48-Hour Breaks

Figure 9-1
Fatigue Impact of Proposed Provision



The solid line in Figure 9-1 displays the extrapolation of worker performance under the baseline schedule of six 12-hour shifts per week, given that an individual's fatigue saturates after 180 days (6 months). As expected with saturation, the worker performance degradation curve begins to level off around 145 days. Note that the 72-hour work schedule is only applicable to a percentage of the population. The proposed provision of a 48-hour break every 14 days, shown as the dotted line in Figure 9-1, is not applicable during the first 2 weeks (14 days) of an outage. Therefore, this analysis accounted for this provision from day 14 to day 175.

Figure 9-1 assumed a "weighted 2-day full fatigue recovery". Therefore, the initial parts of the two lines look very similar. The dotted line, however, includes the effects of the 48-hour break provision. Thus, differences between the two lines begin to become evident shortly after 2 weeks (14 days), at which point the exception expires. At that time, workers begin alternating five and six 12-hour shifts per week. The extra day of rest allows the worker performance numbers to oscillate at low (good) levels.

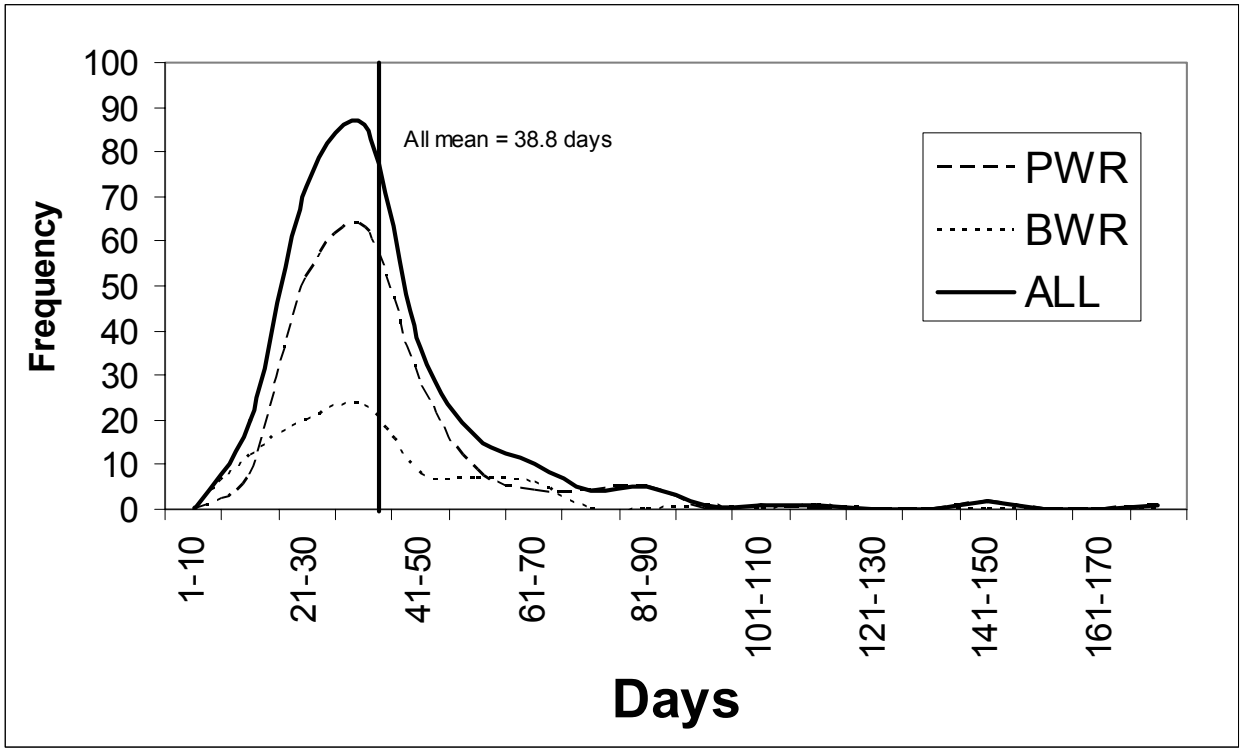
Proposed §26.199(d)(2)(ii-iii) - 24 & 48-Hour Breaks

The percent improvement in worker performance for the proposed provision was calculated by comparing the performance under the proposed provision to that under the baseline conditions. Note that only 40% of this improvement was used in the overall percent improvement calculation after the first 8 weeks (the exception period of the collective work hour controls), as the schedule change from six 12-hour shifts to alternating six and five 12-hour shifts was assumed to only affect 40% of personnel.

Further analysis of these improvement percentages was performed in conjunction with plant refueling outage duration data for PWR and BWR nuclear units for the years 1999 through 2002. The distribution of the outage durations for PWR units and BWR units separately and together is illustrated in Figure 9-2. The distributions of the PWR and BWR unit outage lengths are similar in shape, so the data were pooled together for analyses purposes. The majority of outage durations occurred in the period between 20 and 50 days. The mean outage duration for all PWR and BWR units combined is 38.8 days and is displayed as a vertical line on the distribution graph.

The distribution of outage durations was used to weight the worker performance improvement calculations to emphasize the fatigue impact that corresponds to the most typical outage durations, and thus to reflect the expected worker performance change based on this historical data. The mean percent change in worker performance under outage conditions due to the change from the baseline conditions to proposed §26.199(d)(2)(ii-iii) would be 21.0%.

Figure 9-2
Outage Duration Distribution



This IHP percentage of 21.0% for outage conditions is used in Section 9.1.2.

9.1.1.2 At-Power Conditions

Proposed §26.199(d)(2)(ii) and (iii) were assessed to quantify the impact of the proposed break provisions on fatigue-related worker performance in nuclear plants under at-power conditions. Fatigue-related worker performance was compared from the baseline conditions (described in the following paragraphs) to proposed §§26.199(d)(2)(ii) and (iii) (requiring a 48-hour break every 14 days and a 24-hour break every 7 days).

9.1.1.2.1 Assessment of the 24-hour Break (Using a 70-hour Week Extensive Overtime Scenario)

Data to quantify the performance assessment of the 24-hour break were taken from Belenky et al. (2003) (see Section 2.3.1). The 7- and 9- hour sleep mean lapse data were extrapolated for a 13-week period. While the benefit of the 24-hour break provision on fatigue-related performance is observed beginning after 7 days, the benefit of this provision in combination with the 48/54-hour average provision could only be fully observed if the entire13-week averaging period was used as the exposure period. Therefore:

- A 13-week exposure period would account for the benefit of both provisions.
- Similar to the outage conditions assessment, the "at-power" worker performance extrapolation was designed to simulate the compounding effect of cumulative fatigue on workers during these time periods.
- The assumption of a 2-day weighted fatigue recovery is also the same as that made for the outage conditions assessment.

The baseline conditions used in this analysis only account for the 10-hour break and 48/54-hour average provisions. The 70-hour week/54-hour average baseline scenario conditions allow for no 24-hour breaks in the first part of the 13-week time period. Breaks are forced towards the end of the 13-week period to meet the 54-hour average requirement. Key assumptions made in this analysis include:

- The conditions described above are only expected to occur in rare situations that would require extensive overtime, thus plant personnel are assumed to work at full capacity under these baseline conditions.
- As detailed in the 48/54-hour average provision (70-hour week extensive overtime scenario), personnel are expected to work seven 10-hour shifts in the initial portion of the averaging period and then, to achieve a 54-hour average, work 40-hours per week (five 8-hour shifts, with a 48-hour break) toward the end of the averaging period.
- As will be shown in Section 9.1.2, this is considered to occur very rarely.

The proposed provision of a 24-hour break every 7-days changes the baseline schedule, explained in the previous paragraph, to a schedule of six 10-hour days per week in the first part

of the 13-week time period followed by five 8-hour days per week towards the end of the time period to achieve the 54-hour average.

The percent improvement in worker performance under the proposed provision to that under the baseline conditions was calculated by comparing the cumulative performance (mean lapses) at the end of the 13-week exposure period. Assuming that an individual's fatigue saturates after 180 days, the percent change in worker performance under 70-hour extensive overtime at-power conditions due to the proposed provision would be 49.9%. Therefore, the IHP percentage, defined in Section 1.4, would be 49.9%. These percentages were used in Section 9.2, as explained later in that section, to calculate the benefit obtained from the proposed provision.

9.1.1.2.2 Assessment of the 48-hour Break (Using a 60-hour Week Extensive Overtime Scenario)

The assessment of the 48-hour break was performed in a similar manner to that of the 24-hour break. The benefit of the 48-hour break provision on fatigue-related performance would be observed beginning after 14 days. Yet, the benefit of this provision in combination with the 48/54-hour average provision could only be fully observed if the entire13-week averaging period was used as the exposure period.

The baseline conditions used in this 48-hour break analysis only accounted for the 10-hour break, 48/54-hour average and 24-hour break provisions. The conditions used, then, allow for no 48-hour breaks in a 13- week time period unless forced by the 48/54-hour average requirement. Key assumptions made in this analysis included:

- The conditions described above are only expected to occur in rare situations that would require extensive overtime, thus plant personnel were assumed to work at full capacity under these baseline conditions.

- As detailed in the 48/54-hour average provision (60-hour week extensive overtime scenario), personnel are expected to work six 10-hour shifts in the initial portion of the averaging period and then, to achieve a 54-hour average, work 40-hours per week (five 8-hour shifts, with a 48-hour break) toward the end of the averaging period.

The proposed provision of a 48-hour break every 14-days changes the baseline schedule, explained in the previous paragraph, to an alternating schedule of six 10-hour days per week and five 10-hour days per week in the first part of the 13-week time period followed by five 8-hour days per week towards the end of the time period to achieve the 54-hour average.

The percent improvement in worker performance under the proposed provision to that under the baseline conditions was calculated by comparing the cumulative performance (mean lapses) at the end of the 13-week exposure period. Assuming that an individual's fatigue saturates after 180 days, the percent change in worker performance under at-power conditions due to the proposed provision would be 31.9%. Therefore, the IHP percentage, defined in Section 1.4, would be 31.9%. These percentages were used in Section 9.2, as will be explained in that section, to calculate the benefit obtained from the proposed provision.

9.1.1.3 Efficiency Productivity Under Outage Conditions

Another analysis, similar to the performance evaluations presented in the previous sections, was performed to account for the change in worker efficiency due to the individual break provisions. The percent productivity data from the NECA study was extrapolated for 175 days for the productivity evaluation, to simulate the effect that cumulative fatigue has on the efficiency of workers during a plant outage. For outage conditions, the NECA productivity data for the work schedules of six 12-hour shifts per week and five 12-hour shifts per week were used.

The evaluation used the data to estimate the difference in labor output between a schedule that meets a 54-hour average (this work schedule is outlined in Section 9.1.1.1) to the proposed conditions of a 48-hour break every 14 days (after the first 14 days of an outage). For instance, one hour of labor in the first week of an outage by a worker on a schedule of six 12-hour shifts per week would equal 0.8 hours of output or 9.6 hours of output per day according to the NECA data, while one hour of labor for a worker on a schedule of five 8-hour shifts per week would equal 1 hour of output or 8 hours of output per day. When normalized to a 12-hour shift length, this 8 hours of output equals: 8 output hours x (12-hour shift/ 8-hour shift) = 12 hours of output. Therefore, the absolute change for this one day of labor would be 12 output hours (a normalized quantity representing the 8-hour shift) - 9.6 output hours (representing a 12-hour shift) = 2.4. Therefore, the absolute change for this one day of labor would be 12 - 9.6 = 2.4 hours of output.

The assumption that a weighted fatigue recovery only occurs after a 48-hour break is also used in this evaluation in a similar manner to the previous sections. In the NECA data, the output labor hours naturally decrease over the entire 16-week observation period. This efficiency analysis allows for the output hours to reset to their original ‘week 1' value after a worker fully recovers. This full recovery in fatigue-related productivity is justified by Dinges et al. (1997).

The absolute change in cumulative output hours was calculated for each day of the 175-day exposure period, normalized on a weekly basis (the sum of the output hours for an entire week) and weighted with the distribution of outage durations, similar to that described in Section 9.1.1.1. This resulted in a mean absolute change in worker efficiency (IEP value) under outage conditions due to Proposed §26.199(d)(ii-iii) of 16.9 output hours per worker per outage.

9.1.1.4 Efficiency Productivity During At-Power Conditions (54-hour Average)

Similar to the productivity analysis in Section 9.1.1.3, proposed §26.199(d)(ii-iii) was assessed to quantify the impact of the proposed individual work hour control provisions on fatigue-related worker productivity in nuclear power plants under at-power conditions. The percent productivity data was taken from the NECA study for a 13-week period, to obtain an absolute change in output hour for the entire 13-week averaging period.

9.1.1.4.1 Efficiency Productivity Assessment for 24-Hour Break

The baseline conditions were treated in the same manner as the performance analysis (meeting the 54-hour average requirement, but with seven 10-hour days towards the beginning of the 13-week period). The proposed conditions of the 24-hour break in any 7 days were treated using the same application as outlined in Section 9.1.1.2.1. For at-power conditions, the NECA

productivity data for the work schedules of seven 10-hour shifts per week and six 10-hour shifts per week were used. While these schedules show a productivity level less than 100%, the analysis assumed that a work schedule of five 8-hour shifts per week remains at 100% for every consecutive week. Further, the assumption that full fatigue recovery occurs only after a 48-hour break was also used in this evaluation in a similar manner to the previous sections.

The improvement in worker efficiency under the proposed provision compared to the baseline was calculated as an absolute change in the cumulative output labor hours (after normalization, as described in the Section 9.1.1.3) at the end of the13-week period. This resulted in a mean absolute change in worker efficiency (IEP value) during at-power conditions due to the proposed 24-hour break of 53.1 output hours per worker per year.

9.1.1.4.2 Efficiency Productivity Assessment for 48-Hour Break

The baseline conditions were treated in the same manner as the performance analysis (meeting the 54-hour average requirement with six 10-hour days per week towards the beginning of the 13-week period). The proposed conditions of the 48-hour break in any 14 days were treated using the same application as outlined in Section 9.1.1.2.2. For at-power conditions, the NECA productivity data for the work schedules of six 10-hour shifts per week and five 10-hour shifts per week were used. While these schedules show a productivity level less than 100%, the analysis assumed that a work schedule of five 8-hour shifts per week remains at 100% for every consecutive week. Further, the assumption that full fatigue recovery occurs only after a 48-hour break was also used in this evaluation in a similar manner to the previous sections.

The improvement in worker efficiency under the proposed provision compared to the baseline conditions was calculated as an absolute change in the cumulative output labor hours (after normalization, as described in the Section 9.1.1.3) at the end of the 13-week period. This resulted in a mean absolute change in worker efficiency (IEP value) during at-power conditions due to the proposed 48-hour break of 94.9 output hours per worker per 13-week period.

9.1.2 Performance Applicability

9.1.2.1 Operations and Maintenance

The analysis assumed that under outage conditions both operators and maintenance workers would be working at full capacity, most likely up to the 72-hour a week limit in 6 days. The proposed change is expected to affect shift (overtime) operators, super-crew operators, non-shift staff operators and staff and contract maintenance workers 100 percent of the time under outage conditions. See Section 3.2.2 for a further discussion of these assumptions.

For at-power conditions involving the 70-hour week baseline scenario, with a proposed schedule including a 24-hour break, the analysis assumed a very rare percentage of time that personnel would be affected by the proposed change. The percentage of time in which plant personnel work a 70-hour work week (seven 10-hour shifts) during at-power conditions is most rare for operators who work shifts. These shift operators would be least affected by the proposed provision (which would require a 24-hour break every 7 days). Similar to the frequencies that were chosen for at-power conditions under the 48/54-hour average provisions, the analysis assumed that on average, there is only one 13-week period in every 30 years

(0.83%) in which any one shift operator currently works without a 24-hour break for the entire 13-week period (unless forced by the 54-hour average). The non-shift operators and maintenance workers are affected by the proposed provision to a greater extent than shift workers during at-power conditions (one 13-week period in 20 years, 1.25%).

Under at-power conditions, the analysis assumed that the 48-hour break provision would have a lesser effect overall on operators and maintenance workers than during outages. In the previous section, a 13-week exposure period was identified to evaluate worker performance improvement for the provision change. The percentage of time in which plant personnel work a 60-hour work week (six 10-hour shifts) during at-power conditions is thought to be very rare, and it is the most rare for operators who work shifts. These shift operators would be least affected by the proposed provision (which would not allow for these scenarios without a 48-hour break every 14 days).

As the benefit associated with the proposed 48-hour break provision (which includes the individual breaks, as well as the previous 48/54-hour average and 10-hour break provisions) can only be fully realized if a 13-week exposure period is observed, this duration acts as the basis for the PA value. Similar to the frequencies that were chosen for at-power conditions under the 48/54-hour average provisions, the analysis assumed that on average, there is only one 13-week period in every 20 years (1.25%) in which any one shift operator currently works without a 48-hour break for the entire 13-week period (but does have one 24-hour break in every 7 days - explained in Section 9.1.1.2). To illustrate this assumption, if there are 100 shift operators who work at a specific nuclear power plant and 103 plants in the U.S. nuclear industry, this assumption would calculate that currently, (100 operators) X (103 plants) X (one 13-week period) / (20 years, or 80 13-week periods) = 129 operators per year in the nuclear industry would work 13 weeks straight without a 48-hour break.

The non-shift operators and maintenance workers would be affected by the proposed 48-hour break provision to a greater extent than shift workers during at-power conditions (one 13-week period in 10 years, 2.5%). The outage and at-power assumptions are summarized in Table 9-2.

Table 9-2
Percent of Workers' Time Affected by Proposed Provision

	At-power Conditions (24-hour Break)	At-power Conditions (48-hour Break)	Outage Conditions
On-Shift Operators	0.83%	1.25%	100%
Super-Crew Operators	N/A	N/A	100%
Non-Shift Operators	1.25%	2.5%	100%
Staff Maintenance	1.25%	2.5%	100%
Contract Maintenance	N/A	N/A	100%

To obtain the actual percent of population with Performance Applicability (PA), the average percentage of time that a plant is in outage or at-power conditions was considered. Plants were assumed to be in outage conditions 10% of the time, and at power 90% of the time. As the percentage of time that a plant is under outage conditions was already considered as part of the

outage distribution weighting system presented in Section 9.1.1, the 10% figure did not need to be accounted in this provision's PA calculation. Instead, the probability (per year) that any one unit would actually experience a refueling outage was considered. This probability was calculated to be 57.1% using outage data from the NEI website. Additionally, the analysis assumed that 75% of plants shift to a super-crew schedule during outages (with 100% of all personnel shifting to the super-crew schedule at these plants). (The super-crew consideration is only applicable during outage conditions.) The PA value is the product of the time in/probability of a plant condition, the percent of workers (or plants) that would be shifting to a super-crew schedule, and the percent of workers' time affected by the provision. The PA percentages for outage conditions are displayed in Table 9-3. The PA percentages for at-power conditions are displayed in Table 9-4. The reasoning behind this differentiation is explained in Section 3.3.3.

Table 9-3
Percent of Population with Performance Applicability for Outage Conditions

	% Time Affected	Probability of Outage	% Supercrew Weighting	PA Percentage
On-Shift Operators (Overtime)	N/A	57.1%	25%	14.3%
Super-Crew Operators	100%	57.1%	75%	42.8%
Non-Shift Operators	100%	57.1%	N/A *	57.1%
Staff Maintenance	100%	57.1%	N/A *	57.1%
Contract Maintenance	100%	57.1%	N/A	57.1%

** Although 75% of non-shift operators and maintenance workers were assumed to shift to super-crew schedules, the impact on the analysis for each job duty group during outages would be the same whether they are on super-crews or working outages under the assumed conditions specified in Sections 3.2 and 3.3 (because both have a baseline schedule duration of six 12-hour shifts). Therefore, differentiating the PA percentage by this criteria for these job duty groups was unnecessary.*

Table 9-4
Percent of Population with Performance Applicability for At-Power Conditions

	24-Hour Break	48-Hour Break
On-Shift Operators	0.83%	1.25%
Super-Crew Operators	N/A	N/A
Non-Shift Operators	1.25%	2.5%
Staff Maintenance	1.25%	2.5%
Contract Maintenance	N/A	N/A

9.1.2.2 HP/Chemistry

HP/chemistry personnel were assumed to be on a shift rotation similar to the shift operating crew. Therefore, the analysis assumed that the percent of population with Performance Applicability (PA) of HP/chemistry shift personnel would be the same as that for shift operators

(explained in Section 9.1.2.1) during both outages and at-power (24- and 48-hour break scenarios) conditions. Some HP/chemistry personnel also may provide backup or rotational support, but typically work a normal business schedule of five workdays a week. The analysis assumed that these non-shift HP/chemistry personnel would have similar PA percentages as those outlined for non-shift operators in Section 9.1.2.1. Further, HP/chemistry personnel were assumed to shift to a super-crew schedule during outage conditions if applicable at their specific plant. These super-crew HP/chemistry personnel would then have similar PA percentages to those outlined for super-crew operators in Section 9.1.2.1. Assuming that plants are in outage conditions 10% of the time, at-power 90% of the time and that 75% of plants are on super-crew schedules during outages, the PA value is the product of the time in a plant condition, the percent of workers (or plants) that would be shifting to a super-crew schedule, and the percent of workers' time affected by the provision change. The results of this calculation are summarized in Table 9-5.

Table 9-5
Percent of Population with Performance Applicability (PA)

	At-power Conditions (24-Hour Break)	At-power Conditions (48-Hour Break)	Outage Conditions
On-Shift Chemistry/HP	0.7%	1.1%	14.3%
Super-Crew Chemistry/HP	N/A	N/A	42.8%
Non-Shift Chemistry/HP	1.1%	2.3%	57.1%

9.1.2.3 Fire Brigade

Fire brigade personnel were assumed to be on a shift rotation similar to the operating crew. Therefore, the analysis assumed that the percent of population with Performance Applicability (PA) of fire brigade shift personnel would be the same as that for shift operators (explained in Section 9.1.2.1) during both outages and at-power (24- and 48-hour break scenarios) conditions. Some fire brigade personnel may also provide backup or rotational support, but typically work a normal business schedule of five workdays a week. It was assumed that these non-shift fire brigade personnel would then have similar PA percentages to those outlined for non-shift operators in Section 9.1.2.1. Further, fire brigade personnel were assumed to shift to a super-crew schedule during outage conditions if applicable at their specific plant. These super-crew fire brigade personnel would then have similar PA percentages to those outlined for super-crew operators in Section 9.1.2.1. Assuming that plants are in outage conditions 10% of the time, at-power 90% of the time, and that 75% of plants are on super-crew schedules during outages, the Performance Applicability is the product of the time in a plant condition, the percent of workers (or plants) that would be shifting to a super-crew schedule and the percent of workers' time affected by the provision change. The results of this calculation are summarized in Table 9-6.

Proposed §26.199(d)(2)(ii-iii) - 24 & 48-Hour Breaks

Table 9-6
Percent of Population with Performance Applicability (PA)

	At-power Conditions (24-Hour Break)	At-power Conditions (48-Hour Break)	Outage Conditions
On-Shift Fire Brigade	0.7%	1.1%	14.3%
Super-Crew Fire Brigade	N/A	N/A	42.8%
Non-Shift Fire Brigade	1.1%	2.3%	57.1%

9.1.2.4 Security

Information relevant to the security force baseline work schedules and the nature of the security threat is considered safeguards information. Therefore, the estimated benefit of this provision for the security force was determined differently from that of other job duty groups included in this analysis. Rather than directly assessing the work schedules and security force human performance, the benefits were estimated by considering the role of security to be equal to the performance role of operations. The operator-related benefits were then adjusted as necessary to derive the benefits for the security force. The details of this approach are discussed in Appendix F. As a result of this approach, the work schedules for the security force are not addressed and the benefits for the security force are shown only at the summary level.

9.1.3 Improved Human Performance and Productivity Summary

9.1.3.1 Initial Performance Net Improvement Calculation

Multiplying the generalized IHP percentages by the PA values for each type of worker yields performance net improvement percentages for each job duty group, for outage and at-power conditions. The benefit from the 24-hour break and the 48-hour break were considered to be mutually exclusive and therefore, the net improvement percentages for each were summed to obtain an overall performance net improvement percentage. The net improvement percentages for each of these separate scenarios are shown in Table 9-7. The overall performance net improvement percentages by job duty group, plant condition and response type are summarized in Table 9-8.

Proposed §26.199(d)(2)(ii-iii) - 24 & 48-Hour Breaks

Table 9-7
Performance Net Improvement Summary for 24- and 48-Hour Break Scenarios

Item	Job Duty Group and Condition	Response Type	Performance Applicability (PA)	Improved Human Performance (IHP)	Performance Net Improvement
At-Power (24-Hour Break)					
1	On-Shift Operations, HP/Chemistry, Fire Brigade	vigilant	0.7%	50%	0.3%
2	On-Shift Operations, HP/Chemistry, Fire Brigade	reactionary	0.7%	25%	0.2%
3	Non-Shift Operations, HP/Chemistry, Fire Brigade	vigilant	1.1%	50%	0.5%
4	Non-Shift Operations, HP/Chemistry, Fire Brigade	reactionary	1.1%	25%	0.3%
5	Maintenance	vigilant	1.1%	50%	0.5%
6	Maintenance	reactionary	1.1%	25%	0.3%
At-Power (48-Hour Break)					
1	On-Shift Operations, HP/Chemistry, Fire Brigade	vigilant	1.1%	32%	0.4%
2	On-Shift Operations, HP/Chemistry, Fire Brigade	reactionary	1.1%	16%	0.2%
3	Non-Shift Operations, HP/Chemistry, Fire Brigade	vigilant	2.3%	32%	0.7%
4	Non-Shift Operations, HP/Chemistry, Fire Brigade	reactionary	2.3%	16%	0.4%
5	Maintenance	vigilant	2.3%	32%	0.7%
6	Maintenance	reactionary	2.3%	16%	0.4%

Proposed §26.199(d)(2)(ii-iii) - 24 & 48-Hour Breaks

Table 9-8
Performance Net Improvement Summary

Item	Job Duty Group and Condition	Response Type	Performance Applicability (PA)	Improved Human Performance (IHP)	Performance Net Improvement
At-Power					
1	On-Shift Operations, HP/Chemistry, Fire Brigade	vigilant	See Table 9-7 for 24- and 48-Hour Break PA and IHP percentages		0.7%
2	On-Shift Operations, HP/Chemistry, Fire Brigade	reactionary			0.4%
3	Non-Shift Operations, HP/Chemistry, Fire Brigade	vigilant			1.2%
4	Non-Shift Operations, HP/Chemistry, Fire Brigade	reactionary			0.6%
5	Maintenance	vigilant			1.2%
6	Maintenance	reactionary			0.6%
Outage					
7	On-Shift Operations, HP/Chemistry, Fire Brigade (Overtime)	vigilant	14.3%	21.0%	3.0%
8	On-Shift Operations, HP/Chemistry, Fire Brigade (Overtime)	reactionary	14.3%	11.5%	1.5%
9	Super-Crew Operations, HP/Chemistry, Fire Brigade	vigilant	42.8%	21.0%	9.0%
10	Super-Crew Operations, HP/Chemistry, Fire Brigade	reactionary	42.8%	11.5%	4.5%

Proposed §26.199(d)(2)(ii-iii) - 24 & 48-Hour Breaks

Item	Job Duty Group and Condition	Response Type	Performance Applicability (PA)	Improved Human Performance (IHP)	Performance Net Improvement
11	Non-Shift Operations, HP/Chemistry, Fire Brigade	vigilant	57.1%	21.0%	12.0%
12	Non-Shift Operations, HP/Chemistry, Fire Brigade	reactionary	57.1%	11.5%	6.0%
13	Staff Maintenance	vigilant	57.1%	21.0%	12.0%
14	Staff Maintenance	reactionary	57.1%	11.5%	6.0%
15	Contract Maintenance	vigilant	57.1%	21.0%	12.0%
16	Contract Maintenance	reactionary	57.1%	11.5%	6.0%

9.1.3.2 Final Performance Net Improvement with Penalty for Increased Turnovers

The individual break provisions, while not directly increasing the number of shift turnovers (this provision does not shorten the scheduled shift times), would cause an increase in shift turnovers that include interactions with new workers unfamiliar with the specific status of the work being performed. These unfamiliar worker interactions are thought to be analogous to shift turnovers that involve a complex evolution such that both situations are more susceptible to communication errors that can lead to plant errors. Each turnover involving an unfamiliar worker interaction has a risk in producing a plant error. The risk that a turnover involving a complex evolution causes a plant error was calculated in Section 3.7 to be approximately 3 errors for every 3383.6 turnovers involving a complex evolution. This is assumed to be equal to the risk that a turnover involving an unfamiliar worker interaction causes a plant error. As the number of unfamiliar worker interactions increase, so will this risk. However, as fatigue-related worker performance improves, the risk of errors becomes less. Therefore, both factors were considered and the net improvement percentages presented in Section 9.1.2.1 were adjusted as described below.

An example of how these factors were considered for maintenance personnel (vigilance error response) during at-power conditions follows:

Using the baseline number of unfamiliar turnovers of 3383.6, it was assumed that the individual break provisions would increase this number by 2.5%. This factor is the percent of worker's time affected presented in Table 9-2. This percentage likely underestimates the increase in unfamiliar turnovers due to the provision, because multiple workers are normally involved in a shift turnover (with a complex evolution). Applying this percentage yields a new number of

unfamiliar turnovers involving a complex evolution of 3468.1. This increase in unfamiliar turnovers equates to a larger error number of (3 errors) X (3468.1 new turnovers) / (3383.6 turnovers) = 3.075 new errors. Accounting for the improvement in performance due to fatigue mitigation, these new errors decrease to (3.075 new errors) X (1 - 1.2% improvement) = 3.038 final errors. The improvement percentage of 1.2% was obtained from the net improvement shown in Table 9-8. Therefore, the change in errors would be 3 - 3.038 = -0.038. Normalizing this by the original number of turnovers considered, a (-0.038) / (3383.6) = -0.001% penalty in fatigue-related worker performance (net improvement) was obtained. Incorporating this penalty with the net improvement percentage of 1.2% presented in Table 9-8 gave the final net improvement of 1.2% - 0.001% = 1.2%. In this case, the calculated turnover penalty was so small that the precision of the original net improvement percentages did not allow for the combination of these values. In other words, the turnover penalty was more than one order of magnitude less than the net improvement number. Therefore, it is thought that the turnover penalty is an insignificant contributor to the overall net improvement number.

These calculations were performed for all job duty groups and both plant conditions. Note that the turnover penalty is only warranted for the vigilance error response type, as complex evolution turnovers would most likely not occur under conditions in which a reactionary error response would be applicable (during uncommon plant events, etc.). After this calculation, the outage net improvement percentages for maintenance vigilance errors were reduced by a factor of 10%. This accounts for the assumption that 10% of the total improvement is actually for latent outage errors that would only be realized under at-power conditions. Therefore, this portion of improvement (i.e. 10% of the outage net improvement percentage (vigilant)) was added to the at-power net improvement percentage (vigilant). The results are presented in Table 9-9.

These values were combined in Section 9.2 with generalized benefit figures for each of the benefit areas to obtain a final dollar value for the performance benefit resulting from implementation of the proposed provision.

Table 9-9
Final Performance Net Improvement (Including Turnover Penalty and Latent Outage Errors)

Item	Job Duty Group and Condition	Response Type	Performance Net Improvement	Turnover Penalty	Latent Outage Errors Adjustment	Final Performance Net * Improvement
At-Power						
1	On-Shift Operations, HP/Chemistry, Fire Brigade	vigilant	0.7%	-0.001%	N/A	0.7%
2	On-Shift Operations, HP/Chemistry, Fire Brigade	reactionary	0.4%	N/A	N/A	0.4%

Proposed §26.199(d)(2)(ii-iii) - 24 & 48-Hour Breaks

Item	Job Duty Group and Condition	Response Type	Performance Net Improvement	Turnover Penalty	Latent Outage Errors Adjustment	Final Performance Net * Improvement
3	Non-Shift Operations, HP/Chemistry, Fire Brigade	vigilant	1.2%	-0.001%	N/A	1.2%
4	Non-Shift Operations, HP/Chemistry, Fire Brigade	reactionary	0.6%	N/A	N/A	0.6%
5	Maintenance	vigilant	1.2%	-0.001%	1.2%	2.4%
6	Maintenance	reactionary	0.6%	N/A	N/A	0.6%
Outage						
7	On-Shift Operations, HP/Chemistry, Fire Brigade (Overtime)	vigilant	3.0%	-0.02%	N/A	3.0%
8	On-Shift Operations, HP/Chemistry, Fire Brigade (Overtime)	reactionary	1.5%	N/A	N/A	1.5%
9	Super-Crew Operations, HP/Chemistry, Fire Brigade	vigilant	9.0%	-0.05% **	N/A	9.0%
10	Super-Crew Operations, HP/Chemistry, Fire Brigade	reactionary	4.5%	N/A	N/A	4.5%
11	Non-Shift Operations , HP/Chemistry, Fire Brigade	vigilant	12.0%	-0.07%	N/A	11.9%
12	Non-Shift Operations, HP/Chemistry, Fire Brigade	reactionary	6.0%	N/A	N/A	6.0%
13	Staff Maintenance	vigilant	12.0%	-0.07%	-1.2%	10.7%
14	Staff Maintenance	reactionary	6.0%	N/A	N/A	6.0%
15	Contract Maintenance	vigilant	12.0%	-0.07%	-1.2%	10.7%

Proposed §26.199(d)(2)(ii-iii) - 24 & 48-Hour Breaks

Item	Job Duty Group and Condition	Response Type	Performance Net Improvement	Turnover Penalty	Latent Outage Errors Adjustment	Final Performance Net * Improvement
16	Contract Maintenance	reactionary	6.0%	N/A	N/A	6.0%

** Note that the calculated turnover penalty was so small that the precision of the original net improvement percentages did not allow for the combination of these values. In other words, when the turnover penalty was more than one order of magnitude less than the net improvement number, the turnover penalty was an insignificant contributor to the overall net improvement number.*
*** For the calculation of turnover penalty for super-crews, a factor of 75% was applied to the percent of worker's time affected presented in Table 9-2 to account for the assumption that only 75% of plants shift to a super-crew schedule during outages. This factor is normally applied in a later calculation to obtain the PA value, but was applied earlier in this calculation for this special case.*

9.1.3.3 Productivity Net Improvement

Multiplying the generalized IEP values by the PA values for each type of worker yielded a productivity net improvement value for each job duty group for both at-power and outage conditions. The benefit from the 24-hour break and the 48-hour break were considered to be mutually exclusive and therefore, the productivity net improvement value for each were summed to obtain an overall productivity net improvement value. The net improvement values for each of these separate scenarios are shown in Table 9-10. The productivity net improvement calculation by worker type is found in Table 9-11. These values were combined with generalized benefit figures for the efficiency productivity benefit area, as explained later in Section 9.2.7.

Proposed §26.199(d)(2)(ii-iii) - 24 & 48-Hour Breaks

Table 9-10
Productivity Net Improvement Summary

Job Duty Group and Condition	Performance Applicability (PA)	Improved Efficiency Productivity	Productivity Net Improvement
At-Power (24-Hour Break)			
On-Shift Operations, HP/Chemistry, Fire Brigade	0.7%	53.1	0.37
Non-Shift Operations, HP/Chemistry, Fire Brigade	1.1%	53.1	0.58
Maintenance	1.1%	53.1	0.58
At-Power (48-Hour Break)			
On-Shift Operations, HP/Chemistry, Fire Brigade	1.1%	94.9	1.04
Non-Shift Operations, HP/Chemistry, Fire Brigade	2.3%	94.9	2.18
Maintenance	2.3%	94.9	2.18

Proposed §26.199(d)(2)(ii-iii) - 24 & 48-Hour Breaks

Table 9-11
Productivity Net Improvement Summary

Job Duty Group and Condition	Performance Applicability (PA)	Improved Efficiency Productivity	Productivity Net Improvement
At-Power			
On-Shift Operations, HP/Chemistry, Fire Brigade	See Table 9-10 for 24- and 48-Hour Break PA and IEP Values		1.41
Non-Shift Operations, HP/Chemistry, Fire Brigade			2.76
Maintenance			2.76
Outage			
On-Shift Operations, HP/Chemistry, Fire Brigade (Overtime)	14.3%	16.9	2.4
Super-Crew Operations, HP/Chemistry, Fire Brigade	42.8%	16.9	7.2
Non-Shift Operations , HP/Chemistry, Fire Brigade	57.1%	16.9	9.6
Staff Maintenance	57.1%	16.9	9.6
Contract Maintenance	57.1%	16.9	9.6

9.2 Relationship Between Worker Performance and Benefit Areas

The eight main benefit areas that were identified that may be affected by the proposed provisions are described below in relation to their significance to the change in work-break provisions. The "Net Improvement" values calculated in the previous sections were used to evaluate the benefits and costs of adopting the proposed provisions. Each of the job duty groups specified in §§26.199(a)(1-5) were considered individually.

9.2.1 Reduction in Frequency of Plant Trips

The benefit addressed by this area was the potential reduction in trip-related human errors and in turn, plant trips, associated with an improvement in fatigue-related worker performance. The first subsection addresses the applicability of each job duty group and error response type to

this benefit area. The next subsection summarizes the plant trip benefits associated with the proposed provision.

9.2.1.1 Applicability of Job Duty Group and Response Type for Plant Trips

This section summarizes the applicability of each job duty group and error response type to a reduction in plant trips. Trip-related human errors are thought to be caused by a lack of vigilance in plant personnel. Once an plant trip has occurred, the changes in reactionary response do not impact this benefit area (but do impact the severe at-power accidents benefit area). Therefore, this analysis only accounted for the Net Improvement percentages in Table 9-9 that refer to a vigilance response type. Additionally, plant trips are attributable only to human errors made by operators on shift and maintenance workers (see Appendix A). Only operators who work shifts and maintenance workers were included in the evaluation of the benefit obtained from a reduction in frequency of plant trips. Because plant trips only occur at-power, this was the only plant condition evaluated using the at-power Net Improvement percentages from Table 9-9. The applicable Net Improvement percentages from Table 9-9 are summarized in Table 9-12 below.

Table 9-12
Net Improvement Summary (Applicable to Plant Trips)

Job Duty Group and Condition	Response Type	Net Improvement *
At-Power		
On-Shift Operations, HP/Chemistry, Fire Brigade	vigilant	0.7%
Maintenance	vigilant	2.4%

* *Net Improvement percentages obtained from appropriate items in Table 9-9.*

9.2.1.2 Estimated Benefits from the Reduction in Trip Frequency

The Net Improvement percentages by job duty group in Table 9-12 were equivalent to the potential reduction in cost from trips that could be attributed to the fatigue-related performance improvement for each job duty group. The average present value maximum attainable benefit (MAB) that could be obtained if all human-related errors were eliminated was also calculated in Appendix A for each applicable job duty group. The total reduction in cost from elimination of plant trips for each job duty group is the average present value MAB multiplied by the potential reduction percentage displayed in Table 9-12. The calculations are summarized in Table 9-13.

Proposed §26.199(d)(2)(ii-iii) - 24 & 48-Hour Breaks

Table 9-13
Total Reduction in Trip Costs During At-Power Conditions

Job Duty Group	MAB** (Million)	Net Improvement*	Benefit (Million)
On-Shift Operators	$196.0	0.7%	$1.37
Maintenance	$125.3	2.4%	$2.99
Total			$4.37

* *Net Improvement percentages from Table 9-12*
** *MAB for each job duty group calculated in Appendix A*

The table shows that the present value average benefit to the nuclear industry from a reduction in plant trips would be $4.37 million for the individual work hour control break provisions.

9.2.2 Reduction in Frequency of Severe Accidents (At Power)

The benefit addressed by this issue is the potential reduction in the frequency of at-power internal event severe accidents that would be associated with an improvement in fatigue-related worker performance. This benefit is expressed in terms of the avoided costs associated with on-site cost, off-site cost and replacement power as they relate to at-power severe accidents.

The first subsection addresses the applicability of job duty group and error response type to this benefit area. The second subsection estimates the improvement in core damage frequency that results from the improved performance associated with the individual break provisions and the final subsection summarizes the at-power severe accident benefits associated with individual break provisions.

9.2.2.1 Applicability of Job Duty Group and Response Type on Severe Accidents At Power

This section summarizes the applicability of each job duty group and error response type to a reduction in severe accidents. Human-related errors that result in core damage (at-power severe accidents) are thought to be caused by both a lack of vigilance and a lessened reactionary response in plant personnel. Actions that lead to core damage have vigilance response elements (i.e., monitoring indications for evidence of an abnormal condition) and reactionary response elements (i.e., taking the appropriate actions once an abnormal condition is determined). Therefore, this analysis accounts for the Net Improvement percentages in Table 9-9 that refer to both vigilance and reactionary response types. Additionally, core damage is attributable only to human errors made by operators on shift and maintenance workers (see Appendix B). Only operators who work shifts and maintenance workers were included in the evaluation of the benefit obtained from a reduction in core damage frequency. Because this benefit area is only applicable for personnel working under at-power conditions, this was the only plant condition evaluated using the at-power Net Improvement percentages from Table 9-9. The applicable Net Improvement percentages from Table 9-9 are summarized in Table 9-14 below.

Proposed §26.199(d)(2)(ii-iii) - 24 & 48-Hour Breaks

Table 9-14
Net Improvement Summary (Applicable to At-Power Severe Accidents)

Job Duty Group and Condition	Response Type	Net Improvement *
At-Power		
On-Shift Operations, HP/Chemistry, Fire Brigade	vigilant	0.7%
On-Shift Operations, HP/Chemistry, Fire Brigade	reactionary	0.35%
Maintenance	vigilant	2.4%

* *Net Improvement percentages obtained from appropriate items in Table 9-9.*

9.2.2.2 Functional Benefit of a Reduction in At-Power Severe Accidents

The risk of at-power severe accidents was quantified using Standardized Plant Analysis Risk (SPAR) models developed for analysis of at-power internal event risk. The Net Improvement percentages in Table 9-9 were the input for the model. The analysis resulted in an improvement in core damage frequency (CDF) percentage that represents the fatigue-related performance improvement due to implementation of the proposed provision (See Appendix B). The overall improvement in CDF, using the Net Improvement percentages for the applicable job duty groups, was calculated by the model to be 1.10%. Separate SPAR model runs also calculated the percent of this improved CDF that is attributable to each job duty group (See Appendix B). The results of the model runs are summarized in Table 9-15.

Proposed §26.199(d)(2)(ii-iii) - 24 & 48-Hour Breaks

Table 9-15
Improvement in Core Damage Frequency (CDF)
(Applicable to At-Power Severe Accidents)

Job Duty Group and Condition	Response Type	Percent of Attributable CDF *	Improvement in CDF **
At-Power			
On-Shift Operations	vigilant	3.6%	0.04%
On-Shift Operations	reactionary	73.0%	0.80%
Maintenance	vigilant	23.4%	0.26%
Total		100%	1.10%

* *Percent of Attributable CDF obtained from assumptions outlined in Appendix B.*

** *Note that the Total Improvement in CDF is the result of a SPAR model run, while Improvement in CDF per job duty group is based on assumptions outlined in Appendix B.*

9.2.2.3 Estimated Benefits from the Reduction in At-Power Severe Accidents

The improvement in CDF percentages by job duty group in Table 9-15 are equivalent to the potential reduction in cost from elimination of severe accidents that could be attributed to the fatigue-related performance improvement for each job duty group. The average present value maximum attainable benefit (MAB) that could be obtained if all human-related severe accidents were eliminated for the entire nuclear industry was calculated in Appendix B. A total reduction in cost from elimination of severe accidents for each job duty group was obtained by multiplying the average present value MAB by the potential reduction percentage displayed in Table 9-14. Note that CDF percentages by response type in Table 9-15 for on-shift operators were added together in Table 9-16, because the improvements due to each error response type were thought to be mutually exclusive. The calculations are summarized in Table 9-16.

Proposed §26.199(d)(2)(ii-iii) - 24 & 48-Hour Breaks

Table 9-16
Total Reduction in Severe Accidents Costs During At-Power Conditions

Job Duty Group	MAB** (Million)	Improvement in CDF*	Benefit
On-Shift Operators	$153.1	0.84% ***	$1,286,040
Maintenance		0.26%	$398,060
Total			$1,684,100

* *Improvement in CDF percentages from Table 9-15*
** *MAB for entire nuclear industry calculated in Appendix B*
*** *Improvement in CDF for operators (shift) is equal to the sum of the vigilance and reactionary response type CDFs in Table 9-15*

The table shows that the present value average benefit to the nuclear industry from a reduction in at-power severe accidents would be $1.7 million for the individual work hour control break provisions.

9.2.3 Reduction in Frequency of Severe Accidents While Shutdown

The benefit addressed by this issue was the potential reduction in the frequency of internal events during shutdown that would be associated with an improvement in fatigue-related worker performance. This benefit was expressed in terms of the avoided costs associated with on-site cost, off-site cost and replacement power.

The first subsection addresses the applicability of job duty group and error response type to this benefit area. The second subsection estimates the improvement in core damage frequency that results from the improved performance associated with the individual work hour control break provisions and the final subsection summarizes the severe (shutdown) accident benefits associated with individual work hour control break provisions.

9.2.3.1 Applicability of Job Duty Group and Error Response Type on Severe Accidents (Shutdown)

This section summarizes the applicability of each job duty group and error response type to a reduction in severe accidents during shutdown conditions. The analysis assumed that actions that lead to core damage during shutdown have the same response elements as those during severe accidents. Further, the job duty groups that contribute to core damage risk during shutdown conditions would be the same as during severe accidents. Therefore, this analysis accounts for the Net Improvement percentages in Table 9-9 that refer to both vigilance and reactionary response types and is applicable to shift and super-crew operators and staff and contract maintenance workers (see Section 5.3 for a further discussion). Because this benefit area is only applicable for personnel working under outage conditions, this was the only plant condition evaluated using the outage Net Improvement percentages from Table 9-9. The applicable Net Improvement percentages from Table 9-9 are summarized in Table 9-17 below.

Proposed §26.199(d)(2)(ii-iii) - 24 & 48-Hour Breaks

Table 9-17
Net Improvement Summary (Applicable to Severe Accidents During Shutdown)

Job Duty Group and Condition	Response Type	Net Improvement *
Outage		
On-Shift (Overtime) Operations, HP/Chemistry, Fire Brigade	vigilant	3.0%
On-Shift (Overtime) Operations, HP/Chemistry, Fire Brigade	reactionary	1.5%
Super-Crew Operations, HP/Chemistry, Fire Brigade	vigilant	9.0%
Super-Crew Operations, HP/Chemistry, Fire Brigade	reactionary	4.5%
Staff Maintenance	vigilant	10.7%
Contract Maintenance	vigilant	10.7%

* *Net Improvement percentages obtained from appropriate items in Table 9-9.*

9.2.3.2 Functional Benefit of a Reduction in Shutdown Accidents

The risk of at-power severe accidents was quantified using Standardized Plant Analysis Risk (SPAR) models developed for analysis of at-power internal event risk. The Net Improvement percentages in Table 9-17 were the input for the model. The analysis resulted in an improvement in core damage frequency (CDF) percentage that would be a result of the fatigue-related performance improvement (See Appendix B). It was assumed that the ratio between the Net Improvement percentages and Improvement in CDF percentages (by job duty group and error response type) during at-power conditions are the same as that for shutdown conditions (See Appendix C). For example, the Net Improvement for shift operators (reactionary) during at-power conditions would be 0.35%. This would result in an improvement in CDF of 0.80%. Therefore, the improvement in CDF for super-crew operators (reactionary) during shutdown is the outage Net Improvement percentage of 4.5% multiplied by the quantity (0.80%/0.35%). This would result in an improvement in CDF for super-crew operators (reactionary) during shutdown of 10.3%. This calculation was performed for all applicable job duty groups. The results are displayed in Table 9-18 below.

Proposed §26.199(d)(2)(ii-iii) - 24 & 48-Hour Breaks

Table 9-18
Net Improvement Summary (Applicable to Severe Accidents During Shutdown)

Job Duty Group and Condition	Response Type	Improvement in CDF
Outage		
On-Shift (Overtime) Operations, HP/Chemistry, Fire Brigade	vigilant	0.2%
On-Shift (Overtime) Operations, HP/Chemistry, Fire Brigade	reactionary	3.4%
Super-Crew Operations, HP/Chemistry, Fire Brigade	vigilant	0.5%
Super-Crew Operations, HP/Chemistry, Fire Brigade	reactionary	10.3%
Staff Maintenance	vigilant	1.2%
Contract Maintenance	vigilant	1.2%

9.2.3.3 Estimated Benefits from the Reduction in Shutdown Severe Accidents

The Improvement in CDF percentages by job duty group presented in Section 9.2.3.2 is equivalent to the potential reduction in cost from elimination of severe accidents that can attributed to the fatigue-related performance improvement for each job duty group. The average present value maximum attainable benefit (MAB) that could be obtained if all human-related severe accidents were eliminated for the entire nuclear industry was calculated in Appendix B. It is assumed that the MAB of severe accidents during shutdown is equivalent to that during at-power conditions. A total reduction in cost from elimination of severe accidents was then obtained by multiplying the average present value MAB by the potential reduction percentage. The MAB of severe accidents was calculated to be $153.1 million. CDF percentages by response type in Table 9-18 for operators (super-crew) were added together in Table 9-19, because the improvements due to each error response type were thought to be mutually exclusive. The benefit for staff and contract maintenance personnel was multiplied by 75% and 25%, respectively, to account for the proper plant population proportions during outages. The calculations are summarized in Table 9-19.

Proposed §26.199(d)(2)(ii-iii) - 24 & 48-Hour Breaks

Table 9-19
Total Reduction in Severe Accident Costs During Shutdown Conditions

Job Duty Group	MAB** (Million)	Improvement in CDF*	Contractor Weighting	Benefit
Operators	$153.1	14.4% ***	N/A	$22,046,400
Staff Maintenance		1.2%	75%	$1,377,900****
Contract Maintenance		1.2%	25%	$459,300****
Total				$23,883,600

* *Improvement in CDF percentages from Table 9-18*
** *Methodology for selecting an MAB for shutdown accidents outlined in Appendix C, the MAB for entire nuclear industry used in Table 9-19 was calculated in Appendix B*
*** *Improvement in CDF for operators (super-crew) is equal to the sum of the vigilance and reactionary response type CDFs, as well as both shift (overtime) and super-crew worker types in Table 9-18*
**** *The benefit for staff and contract maintenance personnel have been multiplied by 75% and 25%.*

The table shows that the present value average benefit to the nuclear industry from a reduction in shutdown severe accidents would be $23.9 million for the individual break provisions.

9.2.4 Improved Fire Protection

The benefit addressed by this issue was the potential reduction in cost due to fire events that are associated with an improvement in fatigue-related worker performance. SECY-99-140, Attachment 1 states that, "...The reported core damage frequency (CDF) contribution from fire events can, in some cases, approach (or even exceed) that from internal events." (see Appendix D). Basing the fire events analysis on this statement, it was assumed that the benefit attributed to operators and maintenance from improved fire protection due to the proposed 24- and 48-hour break provision would be equal to the operator and maintenance benefit associated with severe accidents at-power and shutdown. In addition, fire risk can be attributed to a lessened reactionary response by fire brigade members. While important, the improvement in CDF attributable to fire brigade personnel was assumed to be less than that of the operator and was estimated to have 50% of the impact. Further, fire brigade members would only be important in association with an improvement of reactionary error responses. Thus, the improvement in CDF from operators and maintenance and the MAB to the nuclear industry was assumed to be the same as the sum of that for severe accidents at-power and during shutdown (outage), while the CDF improvement for fire brigade was calculated explicitly for this section. The summary table displaying the reduction in fire events costs are shown in Table 9-20.

Proposed §26.199(d)(2)(ii-iii) - 24 & 48-Hour Breaks

Table 9-20
Total Reduction in Fire Events Cost During At-Power Conditions

Job Duty Group	MAB** (Million)	Improvement in CDF*	Contractor Weighting	Benefit
At-Power				
Operators	$153.1	0.84% ***	N/A	$1,286,040
Maintenance		0.26%		$398,060
Fire Brigade		0.40% ****		$612,400
Outage				
Operators	$153.1	14.4% ***	N/A	$22,046,400
Staff Maintenance		1.2%	75%	$1,377,900 *****
Contract Maintenance		1.2%	25%	$459,300 *****
Fire Brigade		6.85% ****	N/A	$10,487,350
Total				$36,667,450

* *Improvement in CDF percentages from Table 9-15 for at-power conditions and in Table 9-18 for outage conditions*

** *Methodology for selecting an MAB for fire events outlined in Appendix C, this MAB for entire nuclear industry calculated in Appendix B*

*** *Improvement in CDF for operators (shift) is equal to the sum of the vigilance and reactionary response type CDFs in Table 9-15 for at-power conditions and in Table 9-18 for outage conditions*

**** *Improvement in CDF for fire brigade is equal to 50 percent of the operator (reactionary) CDF improvement calculated for at-power and shutdown severe accidents*

***** *The benefit for staff and contract maintenance personnel were multiplied by 75% and 25%, respectively.*

The table shows that the present value average benefit to the nuclear industry from a reduction in fire events would be $36.7 million for the individual break provisions.

9.2.5 Lost and Restricted Work

The benefit addressed by this issue was the potential reduction in industrial injury cost associated with an improvement in fatigue-related worker performance. The first subsection addresses the applicability of each job duty group and error response type to this benefit area. The next subsection summarizes the industrial injury benefits associated with the proposed provision.

9.2.5.1 Applicability of Job Duty Group and Response Type for Industrial Injuries

This section summarizes the applicability of each job duty group and error response type to a reduction in lost and restricted work cases. Industrial injuries are thought to be caused by a lack of vigilance in plant personnel. Therefore, this analysis only accounted for the Net Improvement percentages in Table 9-9 that refer to a vigilance response type. Additionally, a reduction in industrial injuries was thought to be attributable to all job duty groups, because all workers are subject to injuries. All job duty groups in Table 3-1 were included in the evaluation

of the benefit obtained from a reduction in lost and restricted work cases. The benefits for staff and contract maintenance were considered separately. The applicable Net Improvement percentages from Table 9-9 are summarized in Table 9-21.

Table 9-21
Net Improvement Summary (Applicable to Industrial Injuries)

Job Duty Group and Condition	Response Type	Net Improvement *
At-Power		
On-Shift Operations, HP/Chemistry, Fire Brigade	vigilant	0.7%
Non-Shift Operations, HP/Chemistry, Fire Brigade	vigilant	1.2%
Maintenance	vigilant	2.4%
Outage		
On-Shift (Overtime) Operations, HP/Chemistry, Fire Brigade	vigilant	3.0%
Super-Crew Operations, HP/Chemistry, Fire Brigade	vigilant	9.0%
Non-Shift Operations, HP/Chemistry, Fire Brigade	vigilant	11.9%
Staff Maintenance	vigilant	10.7%
Contract Maintenance	vigilant	10.7%

* *Net Improvement percentages obtained from appropriate items in Table 9-18.*

9.2.5.2 Estimated Benefits from the Reduction in Lost and Restricted Work Cases

The Net Improvement percentages by job duty group and plant condition in Table 9-21 are equivalent to the potential reduction in injury cost that could be attributed to the fatigue-related performance improvement for each scenario and job duty group. The average present value maximum attainable benefit (MAB) that could be obtained if all industrial injuries were eliminated was also calculated in Appendix E for each job duty group. The total reduction in injury cost for each job duty group and scenario is the average present value MAB multiplied by the potential reduction percentage displayed in Table 9-21. The calculations are summarized in Tables 9-22 and 9-23.

Proposed §26.199(d)(2)(ii-iii) - 24 & 48-Hour Breaks

Table 9-22
Total Reduction in Injury Costs During Outage Conditions

Job Duty Group	MAB (In Millions)**	Net Improvement *	Benefit
Shift (Overtime) Operators	$7.18	3.0%	$215,495
Super-Crew Operators	$7.18	9.0%	$646,484
Non-Shift Operators	$3.08	11.9%	$367,264
Staff Maintenance	$17.7	10.7%	$1,904,069
Contract Maintenance	$63.9	10.7%	$6,856,789
Shift (Overtime) HP/Chemistry	$3.56	3.0%	$106,701
Super-Crew HP/Chemistry	$3.56	9.0%	$320,104
Non-Shift HP/Chemistry	$1.52	11.9%	$181,849
Shift (Overtime) Fire Brigade	$0.70	3.0%	$20,922
Super-Crew Fire Brigade	$0.70	9.0%	$62,765
Non-Shift Fire Brigade	$0.30	11.9%	$35,657
Total			$10,718,099

Table 9-23
Total Reduction in Injury Costs Under At-Power Conditions

Job Duty Group	MAB (In Millions)**	Net Improvement *	Benefit
On-Shift Operators	$7.18	0.7%	$50,282
Non-Shift Operators	$3.08	1.2%	$36,942
Maintenance	$17.7	2.4%	$423,836
On-Shift HP/Chemistry	$3.56	0.7%	$24,897
Non-Shift HP/Chemistry	$1.52	1.2%	$18,292
On-Shift Fire Brigade	$0.70	0.7%	$4,882
Non-Shift Fire Brigade	$0.30	1.2%	$3,587
Total			$562,717

* *Net Improvement percentages from Table 9-21*
** *MAB for each job duty group calculated in Appendix* E

The final benefit to the industry, by job duty group and plant condition, and in total, is shown in Table 9-24.

Proposed §26.199(d)(2)(ii-iii) - 24 & 48-Hour Breaks

Table 9-24
Benefit to Nuclear Industry Per Year For Reduction in Lost and Restricted Work Cases

	Outage	At-Power	Total
Operators	$1,229,243	$87,224	$1,316,467
Maintenance	$1,904,069	$423,836	$2,327,905
Contract Maintenance	$6,856,789	N/A	$6,856,789
HP/Chemistry	$608,654	$43,189	$651,843
Fire Brigade	$119,344	$8,468	$127,812
Total	$10,718,099	$562,717	$11,280,816

The table shows that the present value average benefit to the nuclear industry from a reduction in lost and restricted work cases would be $11.3 million for the individual work hours break provisions.

9.2.6 Improved Security

Information relevant to the security force baseline work schedules and the nature of the security threat is considered safeguards information. Therefore, the estimated benefit of this provision for the security force was determined differently from that of other job duty groups included in this analysis. Rather than directly assessing the work schedules and security force human performance, the benefits were estimated by considering the role of security to be equal to the performance role of operations. The operator-related benefits were then adjusted as necessary to derive the benefits for the security force. The details of this approach are discussed in Appendix F. As a result of this approach, the work schedules for the security force are not addressed and the benefits for the security force are shown only at the summary level.

9.2.7 Improved Worker Productivity - Efficiency

The benefit addressed by this area was the potential improvement in worker efficiency associated with an improvement in fatigue-related worker productivity. This efficiency improvement considers the increase in productive output hours for every labor hour of input, which leads to a reduction in the cost of labor. The first subsection addresses the applicability of each job duty group. The next subsection summarizes the efficiency benefit associated with the proposed provision change.

9.2.7.1 Functional Benefit

This section summarizes the applicability of each job duty group to an improvement in worker productivity. Improvement in productivity is thought to be attributable to shift (overtime), super-crew and non-shift staff operators and HP/chemistry personnel, as well as staff and contract maintenance personnel. The productivity of these personnel may be improved, as they have the potential to save operations and maintenance costs by saving time. The applicable Productivity Net Improvement values from Table 9-11 are summarized in Table 9-25 below.

Proposed §26.199(d)(2)(ii-iii) - 24 & 48-Hour Breaks

Table 9-25
Productivity Net Improvement Summary (Applicable to Efficiency)

Job Duty Group and Condition	Productivity Net Improvement *
Outage Conditions	
Operations, HP/Chemistry, On-Shift (Overtime)	2.4
Operations, HP/Chemistry Super-Crew	7.2
Operations, HP/Chemistry Non-Shift	9.6
Staff Maintenance	9.6
Contract Maintenance	9.6
At-Power	
Operations, HP/Chemistry, On-Shift	N/A
Operations, HP/Chemistry Non-Shift	2.76
Staff Maintenance	2.76

* *Productivity Net Improvement values obtained from appropriate items in Table 9-11.*

9.2.7.2 Estimated Benefit from a Improvement in Efficiency

The Productivity Net Improvement values by job duty group in Table 9-25 are equivalent to the potential reduction in labor cost that can attributed to the fatigue-related productivity improvement for each job duty group. The average present value maximum attainable benefit (MAB) of increased efficiency that can be obtained for each additional productive labor hour that is realized was also calculated in Appendix G for each job duty group. The total improvement in efficiency cost for each job duty group is the average present value MAB per hour multiplied by the potential improvement value (in labor hours) displayed in Table 9-25. The calculations are summarized in Table 9-26.

Proposed §26.199(d)(2)(ii-iii) - 24 & 48-Hour Breaks

Table 9-26
Total Improvement in Efficiency Costs

Job Duty Group and Condition	MAB **	Productivity Net Improvement *	Benefit (In Millions)
Outage Conditions			
Operations, Shift (Overtime)	$57,171	2.4	$0.14
Operations, Super-Crew	$171,515	7.2	$1.23
Operations, Non-Shift	$98,008	9.6	$0.94
Staff Maintenance	$1,411,453	9.6	$13.55
HP/Chemistry, Shift (Overtime)	$28,308	2.4	$0.07
HP/Chemistry, Super-Crew	$84,925	7.2	$0.61
HP/Chemistry, Non-Shift	$48,528	9.6	$0.47
Contract Maintenance	$5,082,817	9.6	$48.80
At-Power Conditions			
Operations, Non-Shift	$98,008	2.76	$0.27
Staff Maintenance	$1,411,453	2.76	$3.90
HP/Chemistry, Non-Shift	$48,528	2.76	$0.13

* *Productivity Net Improvement values from Table 9-25*
** *MAB for each job duty group calculated in Appendix G, Table G-2*

The productivity benefits to the industry separated by job duty group and plant condition and in total for the improvement in worker efficiency are shown in Table 9-27.

Proposed §26.199(d)(2)(ii-iii) - 24 & 48-Hour Breaks

Table 9-27
Productivity Benefit to Nuclear Industry Per Year For Improvement in Worker Efficiency

	Outage Conditions (In Millions)	At-Power Conditions (In Millions)	Total (In Millions)
Operators	$2.31	$0.27	$2.58
Staff Maintenance	$13.55	$3.90	$17.45
Contract Maintenance	$48.80	N/A	$48.80
HP/Chemistry	$1.15	$0.13	$1.28
Total	**$65.80**	**$4.30**	**$70.10**

Table 9-27 shows that the present value average benefit to the nuclear industry from an improvement in worker efficiency was estimated as $70.1 million for the proposed 24 and 48 hour break provisions.

9.2.8 Improved Worker Productivity - Reduction in Rework

This benefit area addressed the benefit which can be expected from improvements in productivity of workers due to mitigation of fatigue. The benefit quantifies the benefit related to the elimination of fatigue related mistakes in the performance of tasks assigned to workers included in the proposed provisions. The first subsection addresses the applicability of each job duty group. The next subsection summarizes the efficiency benefit associated with the proposed provision change.

9.2.8.1 Functional Benefit

This section summarizes the applicability of each job duty group to an improvement in worker productivity. Improvement in productivity is thought to be attributable to shift (overtime), super-crew and non-shift staff operators and HP/chemistry personnel, as well as staff and contract maintenance personnel. The productivity of these personnel may be improved, as they have the potential to rectify mistakes committed during operations an maintenance activities. A detailed discussion of job type applicability is presented in Appendix H. The applicable Net Improvement percentages from Table 9-9 have been summarized in Table 9-28 below.

Proposed §26.199(d)(2)(ii-iii) - 24 & 48-Hour Breaks

Table 9-28
Net Improvement Summary Applicable to Reduction in Rework At Power

Job Type	**Applicable Net Improvement** *
Non-Shift Operations	1.2%
Non-Shift HP/Chemistry	1.2%
Staff Maintenance	2.4%

** Productivity Net Improvement percentages obtained from appropriate items in Table 9-9.*

Table 9-29
Net Improvement Summary Applicable to Reduction in Rework During Outage Conditions

Job Type	**Applicable Net Improvement** *
Shift (Overtime) Operations	3.0%
Non-Shift Operations	11.9%
Super-Crew Operations	9.0%
Shift (Overtime) HP/Chemistry	3.0%
Non-Shift HP/Chemistry	11.9%
Super-Crew HP/Chemistry	9.0%
Staff Maintenance	10.7%
Contract Maintenance	10.7%

** Productivity Net Improvement percentages obtained from appropriate items in Table 9-9.*

9.2.8.2 Estimated Benefit from a Reduction in Rework

The net improvement percentages in Table 9-28 indicate the portion of rework costs which are expected to be saved by implementation of the proposed provisions. The maximum attainable benefit (MAB) which could be realized by the elimination of rework was calculated in Appendix H. Table 9-30 and Table 9-31 presents the benefit expected by job duty type and plant condition.

Proposed §26.199(d)(2)(ii-iii) - 24 & 48-Hour Breaks

Table 9-30
Total Reduced Rework Benefit At Power

Job Type	Applicable Net Improvement *	MAB (in Millions)	Benefit (in Millions)
Non-Shift Operations	1.2%	$47.00	$0.56
Non-Shift HP/Chemistry	1.2%	$23.30	$0.28
Staff Maintenance	2.4%	$271.00	$6.48
Total			$7.32

Table 9-31
Total Reduced Rework Benefit During Outage Conditions

Job Type	Applicable Net Improvement *	MAB (in Millions)	Benefit (in Millions)
Shift (Overtime) Operations	3.0%	$25.60	$0.77
Non-Shift Operations	11.9%	$43.80	$5.23
Super-Crew Operations	9.0%	$76.70	$6.90
Shift (Overtime) HP/Chemistry	3.0%	$12.70	$0.38
Non-Shift HP/Chemistry	11.9%	$21.70	$2.59
Super-Crew HP/Chemistry	9.0%	$38.00	$3.42
Staff Maintenance	10.7%	$252.00	$27.11
Contract Maintenance	10.7%	$909.00	$97.61
Total			$144.00

The total benefit expected due to the reduction of rework by the proposed provision is sum of the benefit for each worker type, $151 million.

9.3 Conclusion

The present value benefit for the eight benefit areas by job duty group using 7 and 3 percent discount rates are summarized in Tables 9-32 and 9-33, respectively.

Proposed §26.199(d)(2)(ii-iii) - 24 & 48-Hour Breaks

Table 9-32
Total Benefit of Proposed Break Provisions Using a 7 Percent Discount Rate (In Millions)

	Trips	Severe Accidents	Shut-down Risk	Fire	Injury Cost	Security	Total Safety Benefit	Efficiency	Rework	Total Benefit
Operations	$1.37	$1.29	$22.05	$23.33	$1.32	N/A	$49.35	$2.58	$13.46	$65.4
Staff Maintenance	$2.99	$0.40	$1.38	$1.78	$2.33	N/A	$8.87	$17.45	$33.58	$59.9
Contract Maintenance	N/A	N/A	$0.46	N/A	$6.86	N/A	$7.78	$48.80	$97.61	$154.2
HP/Chemistry	N/A	N/A	N/A	N/A	$0.65	N/A	$0.65	$1.28	$6.67	$8.6
Fire Brigade	N/A	N/A	N/A	$11.10	$0.13	N/A	$11.23	N/A	N/A	$11.2
Security (Before order EA-03-038)[1]	See Appendix F					$49.35 [2]	$49.35	N/A	N/A	$49.4 [2]
Security (After order EA-03-038)[1]	See Appendix F					$4.03 [2]	$4.03	N/A	N/A	$4.03 [2]
Total (Before order EA-03-038)[1]	$4.37	$1.68	$23.88	$36.67	$11.28	$49.35	$127.24	$70.10	$151.32	$348.7
Total (After order EA-03-038)[1]	$4.37	$1.68	$23.88	$36.67	$11.28	$4.03	$81.9	$70.10	$151.32	$303.3

Proposed §26.199(d)(2)(ii-iii) - 24 & 48-Hour Breaks

Table 9-33
Total Benefit of Proposed Break Provisions Using a 3 Percent Discount Rate (In Millions)

	Trips	Severe Accidents	Shut-down Risk	Fire	Injury Cost	Security	Total Safety Benefit	Efficiency	Rework	Total Benefit
Operations	$2.23	$2.09	$35.77	$37.86	$2.14	N/A	$80.08	$4.19	$21.84	$106.1
Staff Maintenance	$4.86	$0.65	$2.24	$2.88	$3.78	N/A	$14.40	$28.31	$54.49	$97.2
Contract Maintenance	N/A	N/A	$0.75	$0.75	$11.13	N/A	$12.62	$79.17	$158.38	$250.2
HP/Chemistry	N/A	N/A	N/A	N/A	$1.06	N/A	$1.06	$2.08	$10.82	$13.9
Fire Brigade	N/A	N/A	N/A	$18.01	$0.21	N/A	$18.22	N/A	N/A	$18.2
Security (Before order EA-03-038)[1]	See Appendix F					$80.08 [2]	$80.08	N/A	N/A	$80.1[2]
Security (After order EA-03-038)[1]	See Appendix F					$6.54 [2]	$6.54	N/A	N/A	$6.5[2]
Total (Before order EA-03-038)[1]	$7.08	$2.73	$38.75	$59.49	$18.30	$80.08	$206.44	$113.74	$245.52	$565.7
Total (After order EA-03-038)[1]	$7.08	$2.73	$38.75	$59.49	$18.30	$6.54	$132.91	$113.74	$245.52	$492.2

[1] There were no NRC specific requirements limiting work hours for the security force prior to the issuance of order EA-03-038 limiting their work hours. Order EA-03-038 established compensatory measures in the aftermath of the events of September 11, 2001. The requirements contained in order EA-03-038 are similar to those of the proposed provisions with the exception of the new provisions associated with a 24-hour break in any 7-day period and a 48-hour break in any 14 day period.

[2] The security force benefit was estimated by using the applicable benefits from operations. This is considered an estimate given the uncertainty of the security threat. It essentially assumed that the role of security is equal to the role (performance only) of operations in preventing core damage. Because order EA-03-038 included a requirement for a 60-hour average during outages, the benefit from the 24- and 48-hour break provisions was conservatively assumed to be 0. The break provisions are expected to result in savings during outages that were not quantified, as some sub-sets of the security force may work over 60 hours a week, and not receive the breaks. However, the analysis conservatively assumed no outage benefit. See the Improved Security Benefit Area, Appendix F, for a qualitative discussion on security and a further discussion on the assumptions for the security force.

10. CONCLUSIONS

This evaluation assessed the four key provisions of the proposed worker fatigue provisions by:

1) quantifying the correlation between human performance studies and worker performance and productivity,

2) applying this correlation to explicitly model the change in worker performance/productivity due to the implementation of these four proposed provisions

3) equating the improvement in worker performance/productivity due to a decrease in fatigue-induced human errors in plants, and by

4) quantifying the benefit associated with this decrease in human errors.

The estimated benefit in each of the eight benefit areas was addressed in each analysis of the four separate proposed fatigue management provisions. Benefits were evaluated for each of the job duty groups that would be included under the scope of the proposed provisions. A summary of these benefits, using both 7 and 3 percent discount rates, follows in Tables 10-1 through 10-4.

Conclusions

Table 10-1
Benefit of the Proposed Provisions By Job Duty Group Using 7 Percent Discount Rate (In Millions)*

Job Duty Group	§26.199 (d)(1)(i-iii) and (d)(3) Waiver Provisions	§26.199 (d)(2)(i) 10-Hour Break Provision	§26.199(f) 48/54-Hour Average Provisions	§26.199 (d)(2)(ii-iii) Individual 24 & 48-Hour Break Provisions	Total
Operators	$0.81	$3.49	$7.99	$49.35	$61.6
Staff Maintenance	$0.36	$3.72	$2.05	$8.87	$15.0
Contract Maintenance	$0.13	$0.18	$0.50	$7.78	$8.6
HP/Chemistry	$0.10	$0.04	$0.18	$0.65	$1.0
Fire Brigade	$0.19	$0.60	$0.76	$11.23	$12.8
Security (before order EA-03-038)[1]	$0.81 [2]	$3.49 [3]	$7.99 [3]	$49.35 [3]	$61.6
Security (after order EA-03-038)[1]	$0 [4]	$0 [4]	$0 [4]	$4.03 [4]	$4.03
Total (before order EA-03-038)[1]	**$2.4**	**$11.5**	**$19.47**	**$127.2**	**$161****
Total (after order EA-03-038)[1]	**$1.6**	**$8.0**	**$11.5**	**$81.9**	**$103****

* *Footnotes follow Table 10-4*

** *Consideration of productivity related issues of efficiency and rework could add as much as $290 million in additional benefit.*

Conclusions

Table 10-2
Benefit of the Proposed Provisions By Job Duty Group Using 3 Percent Discount Rate
(In Millions)*

Job Duty Group	§26.199 (d)(1)(i-iii) and (d)(3) Waiver Provisions	§26.199 (d)(2)(i) 10-Hour Break Provision	§26.199(f) 48/54-Hour Average Provisions	§26.199 (d)(2)(ii-iii) Individual 24 & 48-Hour Break Provisions	Total
Operators	$1.32	$5.66	$12.96	$80.08	$100.0
Staff Maintenance	$0.58	$6.03	$3.33	$14.40	$24.3
Contract Maintenance	$0.21	$0.29	$0.81	$12.62	$13.9
HP/Chemistry	$0.16	$0.06	$0.30	$1.06	$1.6
Fire Brigade	$0.30	$0.98	$1.23	$18.22	$20.7
Security (before order EA-03-038)[1]	$1.32 [2]	$5.66 [3]	$12.96 [3]	$80.08 [3]	$100.0
Security (after order EA-03-038)[1]	$0 [4]	$0 [4]	$0 [4]	$6.54 [4]	$6.5
Total (before order EA-03-038)[1]	**$3.9**	**$18.7**	**$31.6**	**$206.4**	**$261****
Total (after order EA-03-038)[1]	**$2.6**	**$13.0**	**$18.6**	**$132.9**	**$167****

* *Footnotes follow Table 10-4*

** *Consideration of productivity related issues of efficiency and rework could add as much as $471 million in additional benefit.*

Conclusions

Table 10-3
Benefit of the Proposed Provision By Benefit Area Using 7 Percent Discount Rate
(In Millions)*

Benefit Area	§26.199 (d)(1)(i-iii) and (d)(3) Waiver Provisions	§26.199 (d)(2)(i) 10-Hour Break Provision	§26.199(f) 48/54-Hour Average Provisions	§26.199 (d)(2)(ii-iii) Individual 24 & 48-Hour Break Provisions	Total
Trips	$0.08	$2.38	$4.89	$4.37	$11.7
At-Power Severe Accidents	$0.01	$1.99	$1.71	$1.68	$5.4
Shutdown Accidents	$0.52	$0.28	$0.77	$23.88	$25.5
Fire	$0.70	$2.87	$3.20	$36.67	$43.4
Lost Work Cases	$0.27	$0.50	$0.91	$11.28	$13.0
Security (before order EA-03-038)[1]	$0.81 [2]	$3.49 [3]	$7.99 [3]	$49.35 [3]	$61.6
Security (after order EA-03-038)[1]	$0 [4]	$0 [4]	$0 [4]	$4.03 [4]	$4.03
Total (before order EA-03-038)[1]	**$2.4**	**$11.5**	**$19.5**	**$127.2**	**$161****
Total (after order EA-03-038)[1]	**$1.6**	**$8.0**	**$11.5**	**$81.9**	**$103****

* *Footnotes follow Table 10-4*
** *Consideration of productivity related issues of efficiency and rework could add as much as $290 million in additional benefit.*

Conclusions

Table 10-4
Benefit of the Proposed Provision By Benefit Area Using 3 Percent Discount Rate (In Millions)

Benefit Area	§26.199 (d)(1)(i-iii) and (d)(3) Waiver Provisions	§26.199 (d)(2)(i) 10-Hour Break Provision	§26.199(f) 48/54-Hour Average Provisions	§26.199 (d)(2)(ii-iii) Individual 24 & 48-Hour Break Provisions	Total
Trips	$0.13	$3.87	$7.93	$7.08	$19.0
At-Power Severe Accidents	$0.02	$3.23	$2.78	$2.73	$8.8
Shutdown Accidents	$0.84	$0.46	$1.24	$38.75	$41.3
Fire	$1.14	$4.66	$5.19	$59.49	$70.5
Lost Work Cases	$0.44	$0.82	$1.48	$18.30	$21.0
Security (before order EA-03-038)[1]	$1.32 [2]	$5.66 [3]	$12.96 [3]	$80.08 [3]	$100.0
Security (after order EA-03-038)[1]	$0 [4]	$0 [4]	$0 [4]	$6.54 [4]	$6.5
Total (before order EA-03-038)[1]	**$3.9**	**$18.7**	**$31.6**	**$206.4**	**$261****
Total (after order EA-03-038)[1]	**$2.6**	**$13.0**	**$18.6**	**$132.9**	**$167****

** *Consideration of productivity related issues of efficiency and rework could add as much as $471 million in additional benefit.*

Footnote 1: Security Order

There were no NRC -specific requirements limiting work hours for security force personnel prior to the April 29, 2003, issuance of order EA-03-038 limiting their work hours. Order EA-03-038 established compensatory measures in the aftermath of the events of September 11, 2001. The requirements contained in order EA-03-038 are similar to those of the proposed provisions, with the exception of the new provisions associated with a 24-hour break in any 7-day period and a 48-hour break in any 14-day period.

Footnote 2: Waivers

Order EA-03-038 noted that work hour demands on security force personnel had increased substantially over the preceding 18 months, and the current terrorist threat environment continued to required heightened security measures. While security forces had no NRC-specific work hour limits prior to order EA-03-038, security work hours were generally within the technical specification limits for operations personnel. Therefore, this estimate is based on the assumption that the role of security is equal to the performance role of operations.

Conclusions

Footnote 3: Work Hour Provisions - Before Order EA-03-038

The security force benefit was estimated by using the applicable performance benefits from operations, with the exception of the benefit from the waiver provisions (See Footnote 2). This estimate is considered to have large uncertainty, given the unknown likelihood of future security events. The role of security was assumed to be equal to the role of operations in preventing core damage. See the Improved Security Benefit Area, Appendix F.

Footnote 4: Work Hour Provisions - After Order EA-03-038

The requirements contained in order EA-03-038 are similar to those of the proposed provisions, with the exception of the proposed provisions associated with a 24-hour break in any 7-day period and a 48-hour break in any 14-day period. Therefore, because order EA-03-038 has already been implemented, only the individual break provisions would provide further benefit. Because order EA-03-038 included a requirement for a 60-hour average during outages, the benefit from the 24- and 48-hour break provisions was conservatively assumed to be 0. The break provisions are expected to result in savings during outages that were not quantified, as some sub-sets of the security force may work over 60 hours a week, and not receive the breaks. However, the analysis conservatively assumed no outage benefit. See the Improved Security Benefit Area, Appendix F, for a qualitative discussion on security and a further discussion on the assumptions for the security force.

10.1 Insights

1. The 24- and 48-hour individual break provisions provide the largest benefit.

The 24- and 48-hour individual break provisions provide the highest benefit of all the fatigue provisions analyzed, with the 48-hour break accounting for a majority of that benefit.

These provisions were evaluated assuming implementation of the new waiver authorization requirements, the 10-hour break provision, and the 48/54-hour collective average work-hours provisions. The calculated benefit therefore represents the marginal benefit of the 24- and 48-hour break provision given the implementation of the other fatigue provisions. The fact that it provides a significant benefit shows that there is limited redundancy between this provision and the other worker fatigue management provisions.

The vast majority of the calculated benefit from this provision was derived from the 48-hour break analysis. The significant improvement in human performance that is estimated for the 48-hour break provisions is primarily due to the assumption of '2-day weighted full recovery.' The significant applicability for the 48-hour break provisions is due to the substantial scheduling changes that are assumed to occur following implementation and its broad applicability to most job duty groups, schedules and plant conditions. For example, outage schedules that have six 12-hour day work weeks would require adjustment to accommodate the 48-hour break every 14 days after the first two weeks of the outage.

2. The new waiver provisions are significant to ensuring a benefit is achieved for the 24/48-hour break requirements.

The safety benefit areas have a small contribution to the overall benefit of the new waiver provisions. This is due to several reasons.

The impact on safety is primarily limited to outage periods which eliminates the safety contributions associated with trip reduction and at-power severe accident mitigation (except for a small contribution from maintenance latent outage errors). This focus on

outages also reduces the applicability of the safety benefits to a small portion (10%) of the operating cycle.

The majority of the reviewed waivers were associated with the 72-hour provision and were for outage support. Human performance studies show that only a partial fatigue recovery is achieved during a single off day, yielding a limited performance improvement for this requirement.

Finally, outage-related waivers do not improve two important benefit areas that are associated with at-power operation: reducing trip frequencies and improving at-power severe accident mitigation.

If the waiver provision was evaluated considering the proposed work-hour provisions, then an even more significant impact would result, especially for the 48-hour break in 14 days provision. All benefits estimated for the proposed provisions addressed by this analysis assume no waivers are permitted. Therefore, a reduction in benefits would result if these new provisions were subjected to the waiver practice of the current guidance, and a continued high use of waivers. Because the 24/48-hour break provision yields the largest benefit, waiving this provision would have a significant impact on the overall calculated benefit.

3. The provision of a 10-hour break between successive work periods produced a relatively small benefit.

The analysis of the 10-hour break provision estimated that this provision would result in moderately large improvements in worker performance, but these improvements were dampened significantly by the estimated small applicability of this performance improvement to the current workforce. A review of available waiver data showed a limited number of waivers for the current 8-hour waiver provision. Approximately twice as many waivers were associated with the 24-hours worked in 48 hours provision; the second group of waivers is likely to be more indicative of the applicability of the 10-hour provision since exceeding the 24-hours in 48 hour provision by 4-hours would probably challenge the 10-hour provision (48 – (2 * 10 hour breaks) = 28 hours). However, although the number of waivers written was large, neither group of waivers was nearly as significant as the day-to-day work scheduling practices for the majority of workers during most work shifts.

It should also be noted that the analysis assumed it would be unlikely that an individual would be subjected to a series of short breaks. Short breaks are often due to emergent work where additional resources are not immediately available but can be brought to bear for the following day. Therefore, the impact of multiple short breaks was not evaluated. As a result, this analysis underestimates the benefit since there is some potential for multiple breaks that are less than 10-hours.

4. The impact of the job turnover penalty was found to be very small.

Job turnover refers to the handoff of an in-progress job from one worker or group of workers to another worker or group of workers. The adverse impact or ‘penalty’ is primarily concerned with communication errors that could result due to an expected increase in

number of job turnovers. The analysis found this issue to be a small negative contributor to the overall benefit analysis. This was due in part to the small increase in the estimated number of turnovers. Potential turnover errors were determined based on a review of plant trip performance data. The small increase in the number of turnovers yields a small increase in the number of opportunities for communication errors. The improvement in human performance expected as a result of well-rested workers (which would decrease communication errors) also played a minor role in reducing the impact of this issue. Essentially, the improvement in the communication error rate resulting from well-rested workers competed with the increased errors caused by more turnovers involving a complex evolution. The small increase in turnovers coupled with well-rested employees resulted in a very small negative benefit, but was an insignificant contributor to the overall positive benefit determined for each provision.

5. Productivity improvements may account for an additional benefit of greater than one and half times that of the safety benefit.

Two aspects of productivity were assessed in this analysis: efficiency and rework. Approximately 60% of the productivity benefit was derived from the rework analysis. Therefore, if the rework benefit area was included in the total benefit calculation, it would provide the largest contribution to the total calculated benefit. The other 40% of the productivity benefit is provided by benefits associated with increased efficiency. The total productivity benefit from efficiency and rework yielded a value over 150% greater than the performance benefit.

Contract maintenance provides the largest contribution to productivity improvement with large calculated benefits from the new waiver provisions. The contribution is large for several reasons:

The realized gain resulting from efficiency improvements assumed for contract maintenance is 25%. This is higher than the 10% assumed for operations and results in increased contractor maintenance benefit. Realized gain is discussed in Appendix G.

The effective number of contract maintenance workers is a factor of 3.6 larger than that of staff maintenance workers, based on data collected from one plant in 2003. Therefore, much of the efficiency and rework benefit would be gained from contract maintenance workers during outages.

For the 24/48-hour break provisions, both staff and contract maintenance are expected to be 100% impacted by the new 48-hour break in 14 days requirement. Note that this requirement is only applicable after the first two weeks of the outage. The 100% impacted assumption coupled with the ‘2-day weighted recovery’ results in large productivity benefits for both contract and staff maintenance workers. The difference in benefits between these two groups is a result of two factors: the average number of effective workers, as discussed above, and the applicability of the provisions during power operation, when the only maintenance workers were assumed to be staff workers. The difference in the number of staff vs. contractor workers during outages increased the benefit of contract workers more than the reduction that resulted from the fact that contract maintenance workers were assumed to only work outages. This resulted in a

higher contract maintenance benefit, compared to the staff maintenance benefit for the 24/48-hour break provisions.

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Appendix A
Reduction in the Frequency of Plant Trips

Appendix A
Reduction in the Frequency of Plant Trips

This appendix describes the analysis undertaken to estimate the maximum attainable benefit due to a reduction in plant trips that could result from the elimination of all trip-related human errors. Although worker fatigue is only one of the many contributors to human error, this estimated maximum attainable benefit provides insight as to the upper limit that could be achieved. The benefit of implementing the worker fatigue provisions cannot exceed this maximum obtainable benefit and would likely be a fraction of this benefit due to the other human error performance factors. These other performance factors include, but are not limited to, procedure quality, time constraints, communications, training, and man-machine interfaces. The benefit addressed by this issue was that associated with plant reliability and was focused on replacement energy cost. The benefit of trip reduction that impacts plant safety through a reduction in plant challenges and therefore a reduction in plant risk was addressed separately.

Plant Trip Data

Plant trips in which human performance was the primary cause for fiscal years 2001, 2002 and 2003 were identified by the Idaho National Engineering and Environmental Laboratory (INEEL). Both automatic and manual trips were included. These three years represent recent industry performance and were used as an estimate of the current trip performance. The associated outage duration for each trip was also determined. A total of 33 human-error related trips occurred during fiscal years 2001, 2002 and 2003. These trips resulted in outage durations of 1.3 to 159 hours, with an average duration of 46.2 hours. The trips were also examined and classified according to which type of personnel caused the trip. Trips that resulted from improper operation in the plant were classified as operations errors. Operations errors accounted for 61% of the trips caused by personnel. Trips caused by human errors in repair and up-keep of machinery were classified as maintenance errors. Maintenance errors accounted for 39% of the trips caused by personnel. Because a trip is nearly always the first action taken when an abnormal condition becomes an emergency, trips are solely dependent on the vigilance of operators and maintenance technicians.

The other groups of workers subject to the proposed fatigue management provision changes do not represent a quantifiable impact on the frequency of plant trips. Health physics and chemistry worker activities address continuing plant conditions that do not change quickly enough to cause an unplanned trip. Fire brigade personnel have no direct control over the normally operating machinery in the plant, so these workers would normally neither cause nor prevent a trip. In addition, some portions of operations personnel do not normally perform duties in direct control of plant systems. These include operations workers assigned to administrative and training duties.

Human Performance Connection to Trips

Every day that the plant is at power, personnel contribute to the risk that the plant will suffer a trip caused by human error. The risk of a trip caused by human error was assumed to be proportional to the state of fatigue of any one worker in the plant, since any worker could commit an error that would result in a trip. Therefore, the rate at which trips occur would be directly proportional to the degree of fatigue and the time period in which the plant is exposed to the

fatigue state. The change in the trip rate is simply the change in human performance multiplied by the exposure period of the fatigue condition.

Replacement Energy Cost

On those occasions that a trip occurs, the licensee is responsible for providing replacement power to the licensees' customers. Therefore, the immediate cost of the plant trip is the cost of replacement power. Other costs can be expected to accompany a trip, for example replacement parts for broken machinery, retraining costs to prevent a future occurrence of the same trip, administrative costs of reporting and tracking trips in the industry, among others. However, those costs can be planned for prior to the trip and would be present before the trip occurs and are therefore not included. As the replacement power would be drawn from the electric grid, the price of the power will be determined from the spot market during the period of the trip. The spot market in electricity is highly volatile and the price can be expected to vary widely through a year. The Energy Information Administration (EIA) at DOE published the Wholesale Spot Market Electricity Prices in the 1999 Electric Power Annual on Table 6. This is the last year that the EIA recorded spot market prices for publication. It included the day ahead price at CalPX, and the spot market prices through the year at PJM and ISO NE. The monthly data in the second part of the chart is reproduced here.

Table A-1
EIA Wholesale Spot Market Electricity Prices

	CalPX (Day Ahead)		PJM (Spot Market)		ISO NE (Spot Market)	
Month	**Average**	**Max**	**Average**	**Max**	**Average**	**Max**
January	$20.96	$39.01	$19.92	$61.52		
February	$19.03	$32.60	$16.51	$47.47		
March	$18.83	$35.00	$19.59	$64.04		
April	$24.03	$50.01	$21.44	$56.66	$19.94	$47.67
May	$23.64	$50.75	$22.50	$69.68	$28.20	$72.04
June	$23.53	$131.05	$36.93	$850.00	$49.18	$1,000.21
July	$28.92	$153.83	$89.96	$999.00	$41.14	$572.54
August	$32.31	$225.00	$31.78	$1,077.31	$29.25	$80.39
September	$33.91	$199.24	$21.59	$85.92	$28.42	$81.34
October	$47.64	$156.05	$19.84	$70.68	$24.78	$188.07
November	$36.91	$120.88	$16.55	$71.01	$24.90	$109.04
December	$29.66	$55.51	$18.13	$88.10	$24.33	$49.37
Average	$28.28	$104.08	$27.90	$295.12	$30.02	$244.52

National Average	
Average	$28.61
Maximum	$211.85

All prices in dollars per MegaWatt-hour

Appendix A
Reduction in Frequency of Plant Trips

The price of any one trip would also be dependent on the length of the outages due to trips and the power produced by that plant. Combining the costs of the personnel based trips in the sample enabled an estimate of the cost of a typical trip in 2007. In addition, the data available made it possible to calculate a reasonable estimate of the maximum cost of replacement power in 2007. The data collected is presented here in two tables. The first states the assumption about inflation rate and the projection of spot market prices in 2007. The second table calculated the expected spot market prices in 2007 of each trip which was included in the trips attributed to personnel when the provisions are expected to take effect.

Appendix A
Reduction in Frequency of Plant Trips

Table A-2
Expected Market Prices in 2007

1999 National Average Spot Market Rate	$28.61
1999 National Maximum Spot Market Rate	$211.85
PV (2007) Average Spot Market Rate ($/MWh)	$49.16
PV (2007) National Spot Market Rate ($/MWh)	$364.00
Inflation Rate	7%
1999-2007 time	8
Present Value Formula	$F=P(1+i)^N$

Plant	Electric Power Production (September 2004, NEI Performance Report) (MegaWatts)	Outage length (hours)	2007 National Average Cost	2007 National Maximum Cost
Vogtle 1	1148	1.3	$73,362.36	$543,230.23
Vogtle 2	1149	4.6	$259,816.03	$1,923,873.67
Arkansas Nuclear One 2	930	35.2	$1,609,213.59	$11,915,830.09
Braidwood 2	1177	40.7	$2,354,826.70	$17,436,911.44
Calvert Cliffs 2	840	31.5	$1,300,702.33	$9,631,380.26
Catawba 1	1129	38	$2,108,946.77	$15,616,231.14
Catawba 1	1129	37.1	$2,058,998.03	$15,246,373.03
Clinton	1017	32.3	$1,614,773.28	$11,956,998.23
Diablo Canyon 1	1087	42.8	$2,286,974.87	$16,934,485.36
Dresden 2	850	29	$1,211,727.61	$8,972,544.35
Dresden 2 (Hours	850	20	$835,674.21	$6,187,961.62
Farley 1	833	33.6	$1,375,854.02	$10,187,860.01
Farley 1	833	47	$1,924,557.71	$14,250,875.60
Farley 2	842	36.9	$1,527,307.68	$11,309,337.05
LaSalle 2	1130	27.4	$1,522,008.53	$11,270,098.09
Limerick 1	1134	87.9	$4,899,931.50	$36,282,785.35
McGuire 2	1100	61.2	$3,309,269.88	$24,504,328.00
McGuire 2	1100	43.4	$2,346,769.82	$17,377,252.21
Monticello	597	56.7	$1,663,969.91	$12,321,287.17
Oyster Creek	605	20.5	$609,673.50	$4,514,482.00
Palo Verde 2	1243	28.18	$1,721,869.35	$12,750,018.27
Palo Verde 3	1247	53.4	$3,273,375.22	$24,238,536.85

Peach Bottom 2	1093	137	$7,360,864.25	$54,505,385.91
Pilgrim	667	34.3	$1,124,625.78	$8,327,576.75
Salem 1	1110	20	$1,091,292.21	$8,080,749.88
San Onofre 2	1070	37	$1,946,137.77	$14,410,670.61
San Onofre 3	1080	65	$3,450,842.92	$25,552,641.50
South Texas Project 2	1265	41.3	$2,568,198.90	$19,016,880.04
Surry1	810	27.7	$1,102,942.49	$8,167,017.34
Susquehanna 1	1105	159	$8,636,692.98	$63,952,583.32
Turkey Point 3	693	136.4	$4,646,604.24	$34,406,959.38
Watts Bar	1138	33.3	$1,862,835.80	$13,793,840.04
Wolf Creek	1170	25.1	$1,443,602.62	$10,689,521.70
			Average	**Maximum**
	Expected Cost of Trip		$2,276,492.21	$16,856,863.83

This analysis did not assume any significant improvement in the performance of the mechanical systems among U.S. nuclear power plants. The average cost represents the expected cost of a personnel based plant trip in 2007 and is the expected highest cost of a plant trip in that year. Using the trips identified by INEEL as personnel-based, 11 trips per year would be expected. Multiplying these 11 trips by the average of $2.27 million per trip, yielded an expected loss to the industry of $25 million per year (in 2007 dollars) due to human error-related trips.

The analysis next calculated the present dollar value equivalent to correspond to the remaining life of a nuclear plant. The average shutdown date of all 103 plants is August 1, 2039 (assuming that licenses are not renewed in 2039). Estimating that the dollar values used in this analysis for trip costs are present values as of January 1, 2007, a 32.67-year period was accounted for in the trip cost to obtain a present dollar value equivalent as follows:

The present value conversion factor based on a 32.67-year period with a 7 percent discount rate is 12.83 and was calculated by:

Conversion Factor = $(1 - e^{-rt}) / r$

where *r* is the discount rate and *t* is the plant life period in years. The present value conversion factor was simply multiplied by the industrial injuries cost to obtain the present dollar value equivalent. The average total estimated nuclear industry cost of industrial injuries at the present dollar value equivalent resulting for a 32.67-year average plant life period would be $25.0 million x 12.83 = $321.3 million.

The present dollar value equivalent was also found using a 3 percent discount rate. This resulted in a 32.67-year plant life conversion factor of 20.82. The change in discount rate resulted in a new average cost of $25.0 million x 20.82 = $521.4 million.

Appendix A
Reduction in Frequency of Plant Trips

Maximum Attainable Benefit by Job Duty Group

The average nuclear industry cost for plant trips of $321.3 million (using 7 percent) and $521.4 million (using 3 percent), calculated in the previous section, is equivalent to the maximum attainable benefit (MAB) that could be obtained by the nuclear industry if all trips were eliminated. It is possible to separate the MAB according to job duty group. As detailed previously, 61% of trips were attributable to operators who work a shift schedule and 39% were due to maintenance. These percentages provide a population weighting factor that, when multiplied by the average MAB, would result in a MAB for each job duty group. The results of these calculations, shown below, were used in the evaluation of each proposed provision.

Table A-3
MAB (in millions) by Job Duty Group (Using a 7 Percent Discount Rate)

	Percent of Trips Attributable	Total MAB (In Millions)	MAB by Job Duty Group (In Millions)
Operations (shift)	61%	$321.3	$196.0
Maintenance	39%		$125.3

Table A-4
MAB (in millions) by Job Duty Group (Using a 3 Percent Discount Rate)

	Percent of Trips Attributable	Total MAB (In Millions)	MAB by Job Duty Group (In Millions)
Operations (shift)	61%	$521.4	$318.1
Maintenance	39%		$203.3

This analysis assumed that the reduction in error rate that would result from the work restrictions provided in the proposed provisions would directly translate into a reduction in these costs.

References:
Electric Power Annual, Volume 1, August 2000, Energy Information Administration, Office of Coal, Nuclear, Electric and Alternate Fuels
http://tonto.eia.doe.gov/FTPROOT/electricity/0348991.pdf [12/7/2004]

Appendix B
Reduction in the Frequency of At-Power Severe Accidents

Appendix B
Reduction in Frequency of At-Power Severe Accidents

Introduction

This appendix estimates the avoided cost resulting from a reduction in the frequency of at-power severe accidents due to implementation of the proposed provisions. The avoided costs are those associated with on-site cost, off-site cost and replacement power.

Plant Selection

A representative set of plants was selected for sensitivity analyses. These included one B&W plant, one GE plant and one Westinghouse three-loop plant and one Westinghouse four-loop plant as shown below.

Table B-1
Representative U.S Plants

Supplier	Type	Plants	Representative Plant
B&W	PWR	7	Oconee (Selected)
C-E	PWR w/ PORVs	7	Millstone
C-E	PWR w/o PORVs	7	Palo Verde
GE	BWR/2 Mark 1	2	Oyster Creek
GE	BWR/3 Mark 1	6	Dresden
GE	BWR/4 Mark 1	14	Hatch (Selected)
GE	BWR/4 Mark 2	4	Limerick
GE	BWR/5 Mark 2	4	LaSalle
GE	BWR/5 Mark 3	1	Grand Gulf
GE	BWR/6 Mark 3	3	River Bend
Westinghouse	PWR/2 Loops	6	Point Beach
Westinghouse	PWR/3 Loops	13	Surry (Selected)
Westinghouse	PWR/4 Loops/Large Dry	20	Watts Bar (Selected)
Westinghouse	PWR/4 Loops/Ice Condenser	9	Catawba
	Total	**103**	

Appendix B
Reduction in Frequency of At-Power Severe Accidents

Modeling Technique

Human errors documented in licensee event reports or inspection reports typically do not identify fatigue as a contributor to the error and often, do not identify any causal factors for the human errors. Therefore, it is likely that the impact of worker fatigue is under-reported. This analysis did not attempt to identify fatigue-related errors. Instead, it assessed the impact of human errors on key benefit areas and independently assessed the impact of fatigue on these human errors through the use of SPAR models and fatigue-related performance shaping factors (PSF).

Specifically, the risk of severe accidents was modeled in this analysis using the SAPHIRE computer program developed by INEEL. This program calculates the frequency of core damage accidents. NRC has developed specific models, called SPAR models, for every plant in the United States, of which the plants selected above are considered representative of the industry.

The SPAR models are composed of basic events that could occur in a plant during an abnormal situation. SAPHIRE combines the basic events using fault trees to determine the likelihood that an abnormal condition will lead to damage in the reactor core. The likelihood is then converted into a frequency of core damage events, which the model reports. Most of the basic events involve malfunctions in machinery components in the plant. However, some of the events represent actions by personnel operating the plant, called human actions in this analysis. The failure probability for these events are determined using the SPAR-H Method.

The SPAR-H Method uses PSFs to modify the nominal or base human action failure rates to reflect the conditions under which the action is being performed. The method uses eight PSFs: available time, stress, complexity, experience and training, procedures, ergonomics, fitness for duty, and work processes. This analysis assumed that all PSFs, with the exception of fitness for duty, are unchanged from their initial value. For the fitness for duty PSF, a modified approach from that used in the SPAR-H Method was employed. The fitness for duty PSF was changed based on the expected net improvement in performance derived from human performance studies and was applied based on applicability of that performance to the action being assessed.

The human actions in each SPAR model are divided into two categories, pre-initiators and post-initiators. Pre-initiator actions are those actions that occur prior to the event (i.e., maintenance, test and calibration actions). Post-initiator actions are actions that are performed in response to an event. This analysis categorizes pre-initiators as a vigilance state, in which operators should perceive the indications of an abnormal condition before the plant proceeds into the abnormal condition. For example, lowering water level in a steam generator could be indicative of a larger problem. Operators should perceive lower steam generator level early and investigate before the steam generator is unrecoverable. Post-initiators are categorized as a reactionary state, in which an abnormal condition already exists and must be correctly eliminated or mitigated. One example of reactionary action is the need to keep the water sources available following actuation of High Pressure Coolant Injection. Human actions are further parsed by types of workers. Operations personnel perform significantly different types of duties compared to maintenance workers. Operators monitor and control the state of the plant and perform the actions to change the state of the plant (start-up, shutdown, at-power operations). Maintenance workers perform the routine up-keep and repair of machinery components in the plant. Both types of workers

have the potential to impact the ability of the plant to defend against core damage, but in very different ways.

The three other groups of concern in the plant, health physics/chemistry (HP/C), fire brigade, and security personnel are not considered. Although HP/C personnel have some effect on the condition of the plant, the effect has a very limited scope in the immediate ability of the plant to defend itself from severe accidents. In addition, the SPAR models do not account for the effects of plant chemical and radiological concerns. The importance of fire brigade members to safely and completely assess the effects of a fire and fire suppressants on safe shutdown capability is essential to the overall success of fire mitigation. However, the SPAR models do not address fire ignition and mitigation. Therefore, fire brigade actions are addressed separately in Appendix D. Fire brigade actions are not represented in the SPAR models because they are part of a secondary level of defense during a fire in the plant. Security personnel have no direct impact on the ability of the plant to defend itself against core damage resulting from plant events.

Errors of Commission

Human errors of commission are the performance of actions that lead to an adverse condition (e.g., stopping a pump before its fulfills its mission). Unlike errors of omission where there is a failure to perform an action, errors of commission are not typically modeled in PRAs. Therefore, the benefit associated with reduced errors of commission is not evaluated.

SPAR Model Analysis

Four types of changes are made to the selected SPAR models in order to reflect the improved human performance resulting from the proposed work hour control provisions. Each change is described below. Due to the interactions between these changes, all model changes (initiating event frequency, pre- and post-initiator actions, and equipment unavailability) are made for a given job duty group and work-hour control provision and then the SPAR models are re-quantified to determine the magnitude of the change.

Figures B-1 through B-3 are provided to illustrate the role of operation and maintenance personnel and the different types of human responses when the values are changed while holding the other variables constant. These figures are not directly used in the benefit calculations.

Initiating Event Frequency

The transient initiating event frequency is adjusted to reflect the improved human performance in reducing reactor trip frequency as discussed in Appendix A. The transient initiating event reflects a plant challenge where no specific equipment deficiency has occurred other the human error that initiated or contributed to the trip. Other initiating events such as loss of offsite power and loss of coolant accidents have higher conditional core damage frequencies and therefore would result in a larger improvement in plant risk for a given change in human performance. However, these more significant events are not consistent with the types of events identified during the review of plant trips performed in support of Appendix A and therefore were not adjusted.

Appendix B
Reduction in Frequency of At-Power Severe Accidents

Pre-initiator Actions

Pre-initiator actions are those actions that occur prior to the event (i.e., maintenance, test and calibration actions). All pre-initiator actions were designated as having a vigilant response type and are considered to be directly applicable to improvement measured in the Belenky study. See Section 2.3 for additional information on vigilant actions.

Operations pre-initiators are not explicitly accounted for in the SPAR Models (with very few exceptions), however they are implicitly considered as part of the trip frequency. Therefore pre-initiator performance improvement by operators is primarily addressed through the reduction in the initiating event frequency as discussed above.

Maintenance, test and calibration errors are explicitly included in the SPAR models. These mistakes can make equipment unavailable during an abnormal condition, reducing the mitigation capability of the plant. As with the operator pre-initiator actions, these actions are also designated as having a vigilant response type.

Both outage and at-power performance is considered for the impact the maintenance job duty group on at-power severe accidents. Latent errors that occur during shutdown and manifest themselves at-power are discussed in Section 3.8.

Post-initiator Actions

Post-initiator actions are actions that are performed in response to an event. All post-initiator actions were designated as having a reactionary response type. The applicability of the Belenky study was reduced by 50% for this action type as described in Section 2.3.

Maintenance personnel also provide a response role to initiating events, often in support of equipment recovery or repair. However, the SPAR models provide limited credit for such actions. Therefore, due to their limited credit within the SPAR models and their likely low contribution to accident mitigation, improvements in maintenance related recovery and repair actions were not considered in this analysis.

Equipment Unavailability

This change evaluated the improvement in equipment unavailability that results from improved work efficiency and reduced rework. As part of incorporating this improvement, this analysis assumed that only 50% of the current unavailability is considered applicable for this improvement. The other 50% was used to account for activities that would likely be less sensitive or that are insensitive to efficiency changes such as post maintenance testing, equipment cool down activities, equipment drain down activities, etc. Therefore, improvements in efficiency were applied to 50% of each unavailability event included within the SPAR models.

Appendix B
Reduction in Frequency of At-Power Severe Accidents

Figure B-1
Change in Core Damage Frequency

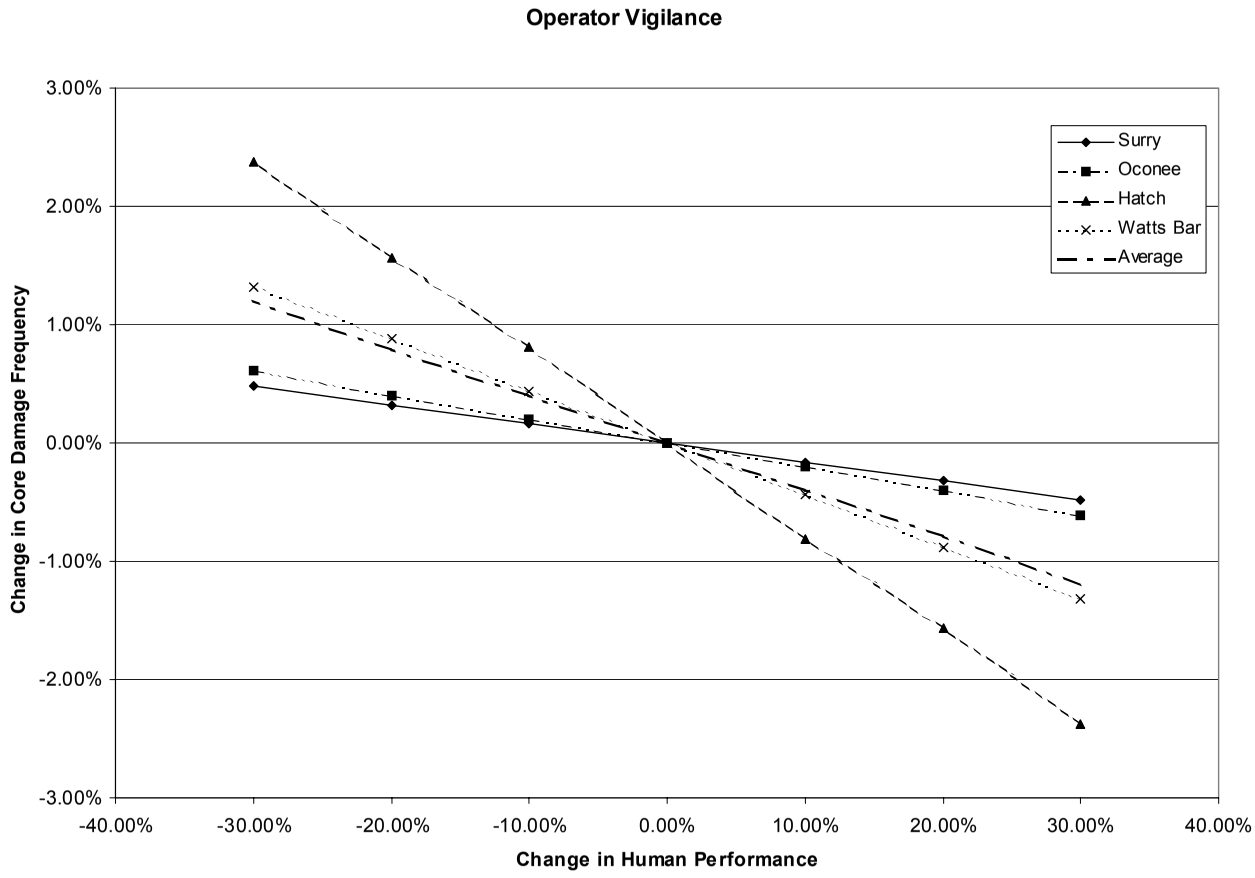
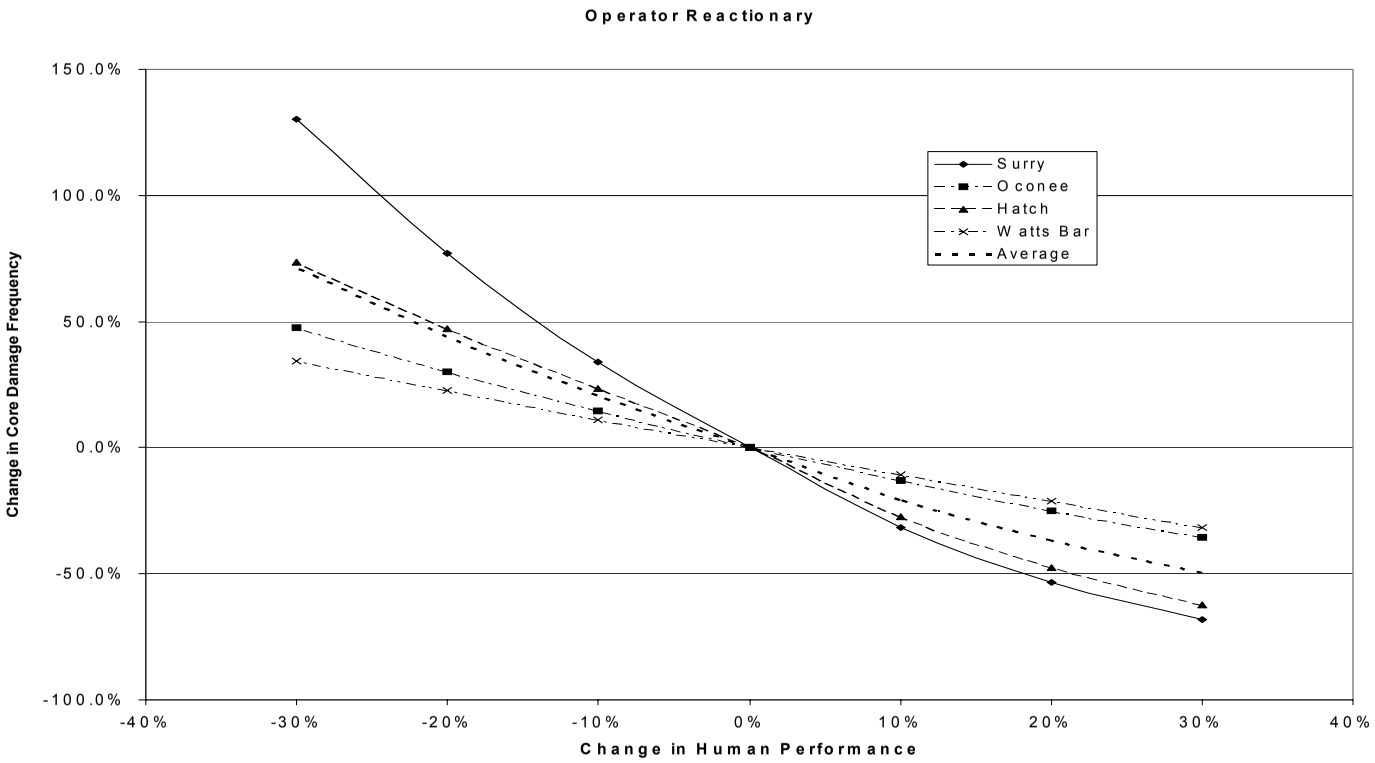
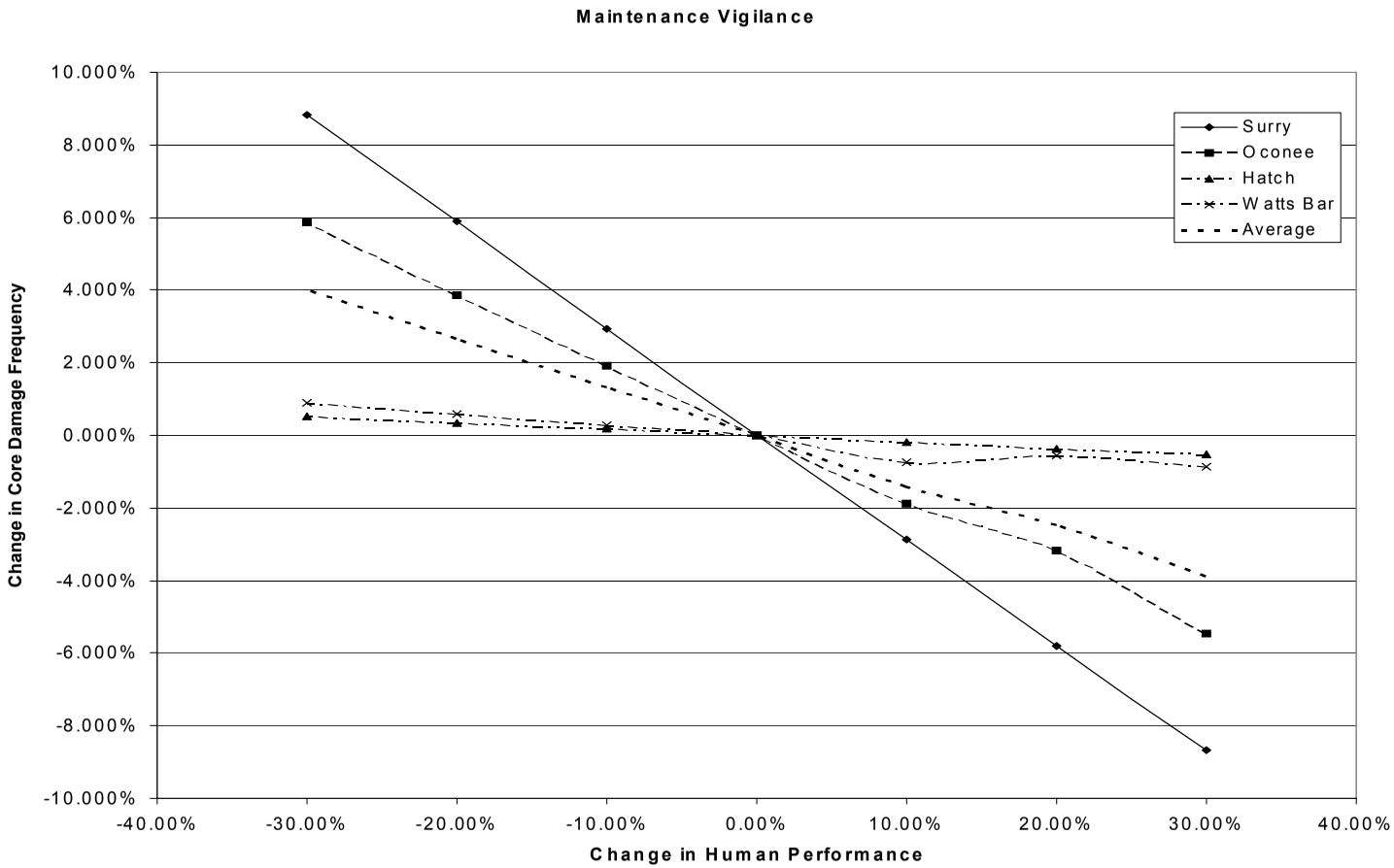


Figure B-2
Change in Core Damage Frequency



Appendix B
Reduction in Frequency of At-Power Severe Accidents

Figure B-3
Change in Core Damage Frequency



Appendix B
Reduction in Frequency of At-Power Severe Accidents

Although the sensitivity analyses above provide considerable useful information in the interpretation of the effects of fatigue on workers in a plant, the effects described are not cumulative. That is, runs of the models with all the workers' improvements considered simultaneously show that the workers' behaviors in the models interact in such a way that the combined effect is greater than the summed effects for each job duty group. The improved performance of the workers was combined into one model run, which shows the change in benefit of all workers' improvement.

Maximum Attainable Benefit for the Elimination of All At-Power Severe Accidents

A representative set of 23 plants was selected and data and calculations from each plant's most recent Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS) Supplement, Severe Accident Mitigation Alternatives (SAMA) analysis was used to obtain the maximum avoided cost (MAC) at the present dollar value equivalent. The MAC, which assumes the elimination of all severe accidents, was calculated for each plant as follows:

MAC=APE+AOC+AOE+AOSC

where APE = present value of averted public exposure
AOC = present value of averted offsite property damage costs
AOE = present value of averted occupational exposure costs
AOSC = present value of averted onsite costs (this includes long-term replacement power costs (RPC))

The MACs calculated by each plant were then averaged to obtain an average MAC across the nuclear industry resulting from the elimination of at-power severe accidents. The average MAC value is $1,246,217. This average MAC, though, was calculated using a present value conversion factor that is based on a 20-year plant licensing renewal period. The present value conversion factor is a multiplicative factor applied to all of the summed components (e.g. APE, AOC) that add up to the MAC.

For this analysis, the MAC was calculated to correspond to the average remaining plant life for all 103 plants. The average shutdown date of all 103 plants, is August 1, 2039. Estimating that the dollar value used in this analysis for MAC is a present value as of January 1, 2007, a 32.67-year period was used as the average remaining life of a plant. The 32.67-year period was accounted for in the MAC as follows:

The present value conversion factor based on a 20-year period with a 7 percent discount rate is 10.76 and is calculated by:

Conversion Factor = $(1 - e^{-rt}) / r$

where *r* is the discount rate and *t* is the plant life period in years. Recalculating the conversion factor with a 32.67-year plant life period yields a value of 12.82. Since the present value conversion factor is simply a multiplicative factor in the MAC equation, the average MAC value for a 20-year period can be converted to a 32.67-year period by multiplying the average MAC value by (12.82/10.76)=1.192.

Appendix B
Reduction in Frequency of At-Power Severe Accidents

The maximum averted cost for a plant at the present dollar value equivalent resulting from the elimination of all at-power severe accidents for a 32.67-year average plant life period is $1,246,217 x 1.192 = $1,485,490. This $1.49 million figure can be equated to the maximum attainable benefit (MAB) for the elimination of all at-power severe accidents. Then, the MAB for the 103 reactor U.S. nuclear industry is 103 X $1.49 million = $153.1 million.

The present dollar value equivalent was also found using a 3 percent discount rate. This resulted in a 32.67-year plant life conversion factor of 20.82. The change in discount rate results in a new average MAC value of (20.82/10.76)($1,246,217)= $2,411,360. Then, the MAB for the 103 reactor U.S. Fleet is 103 X $2.41 million = $248.4 million.

Appendix C
Reduction in the Frequency of Severe Accidents During Shutdown

Appendix C
Reduction in Frequency of Severe Accidents During Shutdown

Introduction

This appendix describes the approach used to estimate the maximum attainable benefit for shutdown severe accident mitigation. It provides information on the current state of knowledge associated with shutdown probabilistic risk assessment (PRA) and applies this information to derive the maximum attainable benefit. Although some fire risk information is included in this appendix, the benefits associated with shutdown fire risk are assessed in Appendix D.

Shutdown PWR Risk

Appendix B of NUREG-1753 reviewed risk contributions associated with shutdown operation in support of the development of risk-based performance indicators. It found that the core damage frequency during a typical outage can vary by several orders of magnitude and that the cumulative risk caused by the entry into risk-significant configurations represents a significant portion of the total average risk. A summary of the shutdown PRA results for PWRs is reproduced from NUREG-1753 and shown in Table C-1.

Appendix C
Reduction in Frequency of Severe Accidents During Shutdown

Table C-1
Shutdown PRA Results

	PRA Study (PWR)	CDF (per calendar year)
1	NSAC-84	1.8E-05
2	NUREG/CR-5015	5.2E-05
3	Seabrook	4.5E-05
4	Sequoyah	7.5E-05
5	Safety Monitor for a generic Westinghouse plant (zero maintenance assumption)	3.1E-05
6	NUREG/CR-6144 (mid loop)	5.0E-06
7	NUREG/CR-6616 (zero maintenance assumption)	1.2E-05
8	Sequoyah SPAR model	1,0E-04
9	Surry (RES study; cold shutdown only; zero maintenance)	3.2E-06
10	Surry (RES study; cold shutdown only, with maintenance)	4.4E-05
11	STP (1RE08; projected)	5.6E-05
12	STP (2RE06)	5.3E-05
13	STP (1RE07)	5.3E-05
14	IN 2000-13, Review of Refueling Outage Risk	1.7E-4 range:[2.8E-6, 8.9E-4]

Reproduced from NUREG-1753 Table B-1

NUREG-1753 states that the cumulative mean core damage probability (CDP) is approximately 1.2E-04 for an outage. It also found that the mean value of PWR peak risk was 1.6E-06/hr.

NUREG/CR-6144, Shutdown PRA for the Surry Plant

NUREG/CR-6144 documented the approach and results of the shutdown PRA developed for the Surry plant. The Surry PRA used a two-phased approach. Phase 1 was a coarse screening analysis that examined accidents initiated by internal events (including internal fire and flood) for all shutdown plant operational states. In Phase 2, mid-loop operation was selected as the operational state to analyze. The Phase 2 study performed a detailed analysis of the potential accident scenarios that may occur during mid-loop operation, and compared the results with those of NUREG-1150. The following results shown in Table C-2 were presented:

Table C-2
Shutdown PRA results for Surry Plant

Initiating Events	Mean
Internal Events	5E-06
Internal Fires	2E-05
Internal Floods	5E-06
Seismic Events EPRA Hazard Curves	9E-08
Seismic Events LLNL Hazard Curves	4E-07

These results can be compared with the mean core damage frequency from internal events of 4E-05 per year estimated in the NUREG-1150 and are found to be comparable.

NUREG/CR-6144 states with regards to risk during mid-loop operation that the mean core damage frequency of accidents initiated by internal events is about an order of magnitude lower than the mean frequency of accidents during full power operation. It also states "Accident sequences in which the operators did not correctly diagnose the situation or take proper actions were the largest contributor (approximately two-thirds of the total) to the mean core damage frequency for mid-loop operation. Accident sequences that lead to station blackout during mid-loop operation (loss of the 4 kV Bus is similar to a station blackout) contribute about 10 percent to the mean CDF. Other accidents were identified that resulted in loss of core cooling after depletion of the refueling water storage tank and failures of recirculation."

The Role of Human Performance

NUREG/CR-6144 states "We found that operator failure is the dominant cause of core damage, In particular, failure to diagnose, such that the correct actions are not taken to prevent core damage, is the most important operator error. It occurs in many different initiating events, time windows, and POSs [Plant Operating States], and contributes to approximately 56% of the total core-damage frequency. Failure to diagnose is assumed to lead directly to core damage. It represents the inability of the operator to use the information available and determine the proper corrective actions."

Shutdown BWR Risk

NUREG-1753 states that relatively little published information is available for BWR shutdown risk. It states that the following results are provided in IN 2000-13.

"Similar to the PWR data, a wide range of values existed in the cumulative and peak risk estimates associated with the BWR outage observations. Notwithstanding these issues related to data quality, the mean actual risk was estimated to be approximately 8.6.E-07 with a high and low of 1.7E-06 and 2.0E-08 respectively. The peak risk was estimated at about 1.2E-08/hr with a range of 3.3E-10/hr to 3.1E-08/hr."

Appendix C
Reduction in Frequency of Severe Accidents During Shutdown

The Grand Gulf shutdown PRA is one of the few published studies of shutdown risk for a BWR that is available. The annualized CDF indicated by that study is 4E-6 per calendar year.

In Phase 2 of the Grand Gulf study, the annual CDF associated with Plant Operational State (POS) 5 (consisting mainly of cold shutdown operating condition) is estimated to be 2.1E-6 per reactor year. Based on the Phase 1 study, approximately 60% of the SDF occurs in POS 5.

NUREG/CR-6143, Shutdown PRA for Grand Gulf

NUREG/CR-6143 evaluated the risks of severe accidents initiated during plant low power and shutdown operations Grand Gulf. This analysis was performed in two phases. Phase 1 developed the plant operational states and included a coarse screening analysis for all POSs, including seismic and internal fire and flood for some POSs. Phase 2 evaluated POS 5 (approximately cold shutdown as defines by Grand Gulf Technical Specifications) as a result of the phase 1 review.

The following results shown in Table C-3 were presented:

Table C-3
Shutdown PRA Results for Grand Gulf

Initiating Events	Mean
Internal Events	2E-06
Internal Fires	<1E-08
Internal Floods	2E-08
Seismic Events EPRA Hazard Curves	3E-09
Seismic Events LLNL Hazard Curves	7E-09

NUREG/CR-6143 concluded the following:

"The risk associated with Grand Gulf as it operates in POS 5 during a refueling outage was shown to be comparable with the risk associated with full power operation, In NUREG-1150 the risk from full power operation of Grand Gulf was shown to be quite low. While the risk associated with POS 5 is low, there are very few features of the plant that are available to attenuate a release should one occur, the most likely accidents in POS 5 have an open containment, the suppression pool is bypassed, the containment sprays are not available, and the vessel fails, releasing the core debris into the containment. The low values for risk given the high conditional releases are, in part, due to the extremely low core damage frequency and the sparse population around the plant."

Appendix C
Reduction in Frequency of Severe Accidents During Shutdown

Estimated Maximum Attainable Benefit

Due to the limited availability of shutdown risk assessments and the similarity in magnitude of shutdown risk to at-power risk, the maximum attainable benefit obtained from the at-power PRAs as found in Appendix B was used as a surrogate for the maximum benefit from low power and shutdown operation.

Shutdown SPAR Models

Two recently issued shutdown operation models (Peach Bottom Units 2&3 and River Bend) were reviewed to determine if their results would be consistent with the use of the at-power PRA as a surrogate. The magnitude of their core damage frequencies for shutdown events contained in these models was found to be comparable, on a per unit time bases, to their respected at-power core damage frequencies. A sensitivity analysis of the response of core damage frequency to changes in human performance revealed that these shutdown models have a larger change in CDF for a given improvement in human performance. This indicates that the use of the at-power SPAR models has a potential to slightly underestimate the impact of improved human performance.

References

Hamzehee et. al, “Risk-Based Performance Indicators: Results of Phase 1 Development,” NUREG-1753, April 2002

Chu, T.L. et. al, “Evaluation of Potential Severe Accidents During Low Power and Shutdown Operations at Surry, Unit 1,” Brookhaven National Laboratory, NUREG/CR-6144, June 1994 (Main report; appendices published at later dates).

Whitehead, D., et.al., “Evaluation of Potential Severe Accidents During Low Power and Shutdown Operations at Grand Gulf, Unit 1,” Sandia National Laboratories, NUREG/CR-6143, June 1994 (Main report; appendices published at later dates).

Appendix D
Improved Fire Mitigation

Appendix D
Improved Fire Mitigation

Introduction

Fire risk has often been identified as a significant contributor to severe accident risk at nuclear power plants. Attachment 1 to SECY-99-140, 'Recommendation for Reactor Fire Protection Inspections,' dated May 20, 1999, states that "based on IPEEE results, fire events are important contributors to the reported core damage frequency (CDF) for a majority of plants. The reported CDF contribution from fire events can, in some cases, approach (or even exceed) that from internal events."

It has been argued by the industry that fire risk may well be overstated due to the fact that many plants calculated plant fire risk using the EPRI Fire-Induced Vulnerability Evaluation (FIVE) analysis method. The industry has stated that this method is "a vulnerability analysis rather than a true calculation of risk." In contrast to this position, there is also evidence that there are areas where fire risk assessments could be expanded or improved and may result in additional risk contributions. NUREG/CR-6738 provides insights gained from the review of fire incidents and identifies potential areas for improvement.

This appendix provides several key assumptions that are used for determining the estimated benefits that could be achieved as a result of implementing the proposed worker fatigue provisions. Note that the benefits associated with improved fire mitigation for both at-power and shutdown conditions were included in this benefit area.

EPRI FIVE Analysis Method

The FIVE methodology states that it is oriented toward uncovering limiting plant design or operating characteristics (vulnerabilities) that make certain fire-initiated events more likely than others. It provides a combination of deterministic and probabilistic techniques for examining a power plant's fire probability and protection characteristics. FIVE employs a screening methodology that focuses on evaluating the availability of Appendix R Safe Shutdown equipment. The FIVE methodology states that fire compartments that do not screen can be evaluated by three explicitly stated approaches or by other approaches employed by a utility.

The NRC found the FIVE methodology to be acceptable for use in the IPEEE evaluations. It concluded that the FIVE methodology is comparable to the simplified fire PRA procedures as described in NUREG/CR-4840.

It should be noted that in response to Generic Letter 88-20 Supplement 4, most utilities chose to use the FIVE methodology in conjunction with some other method to quantify risk. NUREG-1742 evaluated the perspectives gained from the IPEEE program. It observed the following:

"... it should also be noted that FIVE in and of itself is largely equivalent to a fire area/zone screening analysis. It is not intended to produce a detailed quantification of fire CDF but, rather, to identify those plant areas/zones that might represent important fire CDF contributors."

NUREG-1742 states that the "majority of the submittals that used FIVE (about 70% of this group) elected to augment the methodology with data or methods from the FPRAIG [EPRI Fire PRA

Implementation Guide] or general fire PRA." It also noted that most FIVE-based submittals used the fire modeling worksheets in FIVE.

In summary, the screening process employed by the FIVE methodology systematically removes fire areas and compartments from consideration based on what can be described as conservative screening rules. It should be noted that the screened-out areas are assumed to provide no fire risk contribution. The areas that remain can be evaluated by several different options as described in FIVE. One option would be to use the calculated values associated with the FIVE process for the rooms that remain screened-in. This choice would likely be conservative. NUREG-1742 identified that only 21% of the submittals using FIVE indicated little or no departure from the methodology. This suggests that most utilities used other methods to determine the risk associated with the areas that remain screened-in.

Regardless of the option used to address the remaining rooms, it is likely that the most important aspect of the degree of conservatism associated with the fire evaluation is the quality used in applying the selected methodology. The staff's SER states: "The staff wants to emphasize that, as with the internal events analysis IPE, the quality and comprehensiveness of the results derived from application of the FIVE methodology will depend on the vigor with which each utility applies the method of examination and on the utility's commitment so that the intent of the IPEEE will be met through its application."

Insights Gained from Fire Incidents

NUREG/CR-6738 documents the review of selected nuclear power plant fire events and provides insights on current fire PRA models and methods. Of interest to this discussion, the report identified areas where improved fire PRA methods and data may provide added benefits. It states that "Turbine building fires and fires involving non-safety-related areas of the plant are generally screened out in the initial stages of a fire PRA. Reviewed incidents indicate that complications from such fires (e.g., smoke propagation and operator error during plant shutdown) may lead into event sequences otherwise considered as very unlikely. There is a potential that such sequences, which are typically screened out in the internal event analysis, may not be picked up in a fire PRA."

NUREG/CR-6738 continues "The review has also identified some gaps in current fire PRA methodology. In particular, current methods do not address the possibility of multiple initial fires, secondary fires and multiple initiating events. Several fire incidents involved multiple fires ignited at different locations of the plant due to a single root cause (multiple initial fires). In a few cases, additional fires ignited due to damage caused by the original fire (secondary fires)."

The NUREG also notes that for the larger fires addressed in this study, one to 17 hours was required to control the fires. The report states that this time "is generally well beyond the maximum probable fire duration typically assumed in a fire PRA."

With regard to fire detection and suppression, NUREG/CR-6738 identified empirical observations associated with the use of ineffective extinguishing media, delay in fire fighting activities, and poor decision making or distraction from ongoing events. It states that "Significant equipment losses may occur early in a fire (e.g., well before fire control or final fire extinguishment), but may

also occur after a prolonged time. Hence, it is important for fire PRAs to consider a range of possible fire durations including long duration fires (i.e., in excess of one hour). PRAs that fail to consider long duration fires, and as a result limit the assumed extent of fire damage, may miss significant fire risk contributors."

The findings contained in NUREG/CR-6738 indicate that although current fire modeling techniques may be conservative in what they model, they may be non-conservative in the complexity and durations of the fires that are modeled. This is the very area where the impact of the fire brigade would be the strongest.

Role of the Fire Brigade

The role of the fire brigade is often not seen as a significant contributor in fire PRAs. The FIVE methodology requires that before credit is taken for fire brigade fire fighting activities, one must first be able to demonstrate that the fire can be detected, and the fire brigade can respond to the scene and control the fire before damage to the safe shutdown components. Since this timing is typically short, the calculated fire brigade benefit is small.

NUREG/CR-6850 documents state-of-the-art methods, tools, and data for performing a fire probabilistic risk assessment. It includes two appendices that speak to the potential importance of the fire brigade. Appendix O addresses turbine generator fires. Although this appendix does not address the role of the fire brigade in these fires, it does identify that these fires have the potential of becoming severe (e.g., Vandellos and Narora fires) and that durations of actual fires have been as long as 17 hours. This is consistent with the insights of NUREG/CR-6738. Appendix P, Detection and Suppression Analysis, shows manual suppression curves for times up to 100 minutes for turbine generator fires, high energy arcing faults, outdoor transformer fires and flammable gas fires.

If a more complete consideration of these long duration events were included in fire risk analyses, the role of the fire brigade would be greater.

The proposed fatigue provisions specifically address the fire brigade members that have the knowledge of plant safety-related systems to understand the effects of fire and fire suppressants on safe shutdown capability. This is similar to the Appendix R requirement for plant knowledgeable personnel.

Fire brigade members must retain the cognitive ability to be able to make decisions concerning smoke ventilation to prevent the fire effects from affecting other plant operations, they must be able to think and determine the best way to suppress a fire to prevent additional damage to safety related equipment, they must be able to evaluate equipment affected by a fire to report to control room operators concerning equipment availability, and they must be able to coordinate all activities with control room operators. As a consequence, ensuring that the ability of fire brigade members to safely and competently assess the effects of a fire and fire suppressants on safe shutdown capability is essential to the overall success of the fire mitigation strategy and the protection of public health and safety.

Appendix D
Improved Fire Mitigation

The fire brigade is the last barrier in the plant's defense against fire and as such is an integral part of defense-in-depth protection.

Role of the Operator

A PRA developed for internal events (e.g., loss of main feedwater, loss of off-site power, etc.) is often used as a base model or key building block when assessing the risk associated with fire. It is modified to reflect the fire ignition sources and fire impacts. The internal events operator actions, also referred to as human actions, are typically adjusted to reflect fire location scenario-induced changes such as the impact of smoke, erratic instrumentation, added confusion and the potential impact due to limited access to critical areas. New actions are typically added to reflect actions unique to fire-related scenarios. Therefore, many operator actions that are important in internal event mitigation are also important in the mitigation of fires. Their importance may even be greater when the command and control aspects which are critical for effective mitigation of the often dynamic nature of fire events are considered. This is especially true for main control room related events that could result in the loss of the control room and remote plant shutdown.

Due to the challenges that may be present during a fire event reflected by the above discussion, it is believed that the importance of operator actions in fire mitigation is similar to or potentially greater than their internal events importance.

Estimated Benefit

The three job duty groups that have direct impact in mitigating the fire effects are the operators, maintenance personnel and the system-knowledgeable fire brigade members. However, the ability to perform an analysis of the importance of operators, maintenance and the fire brigade's role in fire mitigation is limited due to the unavailability of detailed fire models. Therefore, some simplifying assumptions were made in order to obtain a reasonable estimate of the benefit that would result from the implementation of the proposed worker fatigue provisions.

First, based on the observation that the reported CDF contribution from fire events can, in some cases, approach (or even exceed) that from internal events (see SECY-99-140, "Recommendation for Reactor Fire Protection Inspections," May 20, 1999), the analysis assumed that fire risk is equal to the overall core damage frequency from the risk associated with at-power operation from internal events. For shutdown events, this analysis also used the risk associated with at-power operation as a surrogate for shutdown fire risk (see Appendix C for a discussion on shutdown risk).

Second, the importance of operator and maintenance personnel actions in fire mitigation is assumed to be similar to the importance of operator and maintenance actions used in internal event mitigation. Although fire events are significantly different from internal events (e.g., loss of feedwater, loss of offsite power, etc.), the internal events model is often used as a key building block in the construction of a fire PRA. Therefore, many of the same operating and maintenance actions are considered in both models. In addition, fire PRAs often include additional actions specific to fire mitigation especially for those actions associated with control room fire and the potential for remote shutdown. The command and control functions associated with these actions are considered critical for the successful mitigation of a fire event.

Third, the importance of the system-knowledgeable fire brigade members is assumed to be less than that of the operator and is estimated to have 50% of the impact. This estimate is likely greater than what would be found in current fire PRAs because these analyses typically have limitations associated with fire complexities and durations. However, this estimate recognizes that control room command and control is essential for effective fire mitigation. Applying the correct extinguishing media, timely fire fighting response and good decision making are also critical for this last line of defense.

References

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NUREG/CR-6738, "Risk Methods Insights Gained From Fire Incidents," September 2001.

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Appendix E
Reduction in Lost and Restricted Work Cases

Appendix E
Reduction in Lost and Restricted Work Cases

This appendix provides an estimate of the overall cost of industry injuries and provides the approach for estimating the benefit for each job duty group listed in proposed §26.199(a) given a change in fatigued behavior that results from the proposed work hour control implementation.

Background on Accident Statistics

This analysis secured data on accidents from two sources, The Bureau of Labor Statistics (BLS) and The Nuclear Energy Institute (NEI). The BLS annually reports on the number of workplace injuries, illnesses, and fatalities. The BLS safety and health statistical system, therefore, presents three distinct types of data.

1. Summary data, which reports on the number and rate of injuries and illnesses by industry.
2. Case and demographic data, which provides additional details on the worker injured, the nature of the disabling condition, and the event and source producing that condition for those cases that involve one or more days away from work.
3. Fatality data, which provides information on 28 separate data elements including information on the worker, the fatal incident, and the machinery or equipment involved.

Their data were used to determine the number of days lost due to injuries at nuclear power plants. The Standard Industrial Classification (SIC) of “Electric Services” was selected as the category for evaluation. The SIC does not contain a specific category for nuclear power plants. However, these plants are included in the Electric Services category. These data were further refined by BLS through a custom query that targeted only accident job codes that are applicable to power production. Although these categories are associated with all types of electric power production, their selection results in the elimination of most non-power plant activities from the data. The custom query provided information on the breakdown of the number of days away from work that result from the reported injuries.

NEI (Reference 18) has collected data on the annual number of nuclear industrial injuries from 1998 to 2003 as a performance indicator for the industry. These numbers, reported in the NEI’s 2003 performance indicator summary, were used to determine the average injury rate at nuclear power plants. They are presented in the graph below.

Appendix E
Reduction in Lost and Restricted Work Cases

Figure E-1
NEI Industrial Industry Data

This indicator tracks how many industrial accidents per 200,000 worker hours result in lost work time, restricted work, or fatality. Industrial accident data were taken for years 1998 - 2003.

Appendix E
Reduction in Lost and Restricted Work Cases

Evaluation

The total cost of industrial injuries was determined by estimating the cost of the replacement labor and of the medical treatment associated with the injury. This information is included in Enclosure 1 (later in this appendix). The following assumptions were made:

- 65 nuclear sites are within the scope of the proposed provisions
- an average of 388 staff members are within scope per site (estimated using 2003 data from six representative nuclear plants)
- an additional 641 contract personnel support plant outages (estimated using 2003 data from one nuclear plant)
- the average wage is $38.02 per hour

In addition, a range of medical costs was estimated at $500 per day (low), $1400 per day (average) and $5000 per day (high). The average cost of $1400 per day was obtained from 2001 national data of average hospital costs per day (Reference 19). The Lost and Restricted Work Cases Maximum Attainable Benefit assumes that a lost day of work will always include the costs accrued during a day of hospitalization. A lost day of work may not always include a day of hospitalization. This simplification overestimates the MAB.

It should be noted that the BLS data do not break out injury causes such as fatigue. Therefore, the impact of fatigue can not be directly determined. However, fatigue is likely a contributing cause to the overall human error rate that is often a significant contributor to worker injuries.

This evaluation resulted in a total estimated nuclear industry cost per year of industrial injuries of:

Low	$3.6 Million
Average	$8.0 Million
High	$25.7 Million

The present dollar value equivalent was calculated to correspond to the remaining life of a nuclear plant. The average shutdown date of all 103 plants is August 1, 2039. Estimating that the dollar values used in this analysis for lost and restricted work cases are present values as of January 1, 2007, a 32.67-year period was accounted for in the industrial industry cost to obtain a present dollar value equivalent as follows:

The present value conversion factor based on a 32.67-year period with a 7 percent discount rate is 12.83 and is calculated by:

$$\text{Conversion Factor} = (1 - e^{-rt}) / r$$

where *r* is the discount rate and *t* is the plant life period in years. The present value conversion factor was multiplied by the industrial injuries cost to obtain the present dollar value equivalent. The average total estimated nuclear industry cost of industrial injuries at the present dollar value equivalent resulting for a 32.67-year average plant life period would be $5.6 million x 12.83 = $71.9 million. The following are present dollar values for nuclear industry cost:

Appendix E
Reduction in Lost and Restricted Work Cases

Low	$46.4 Million
Average	$102.5 Million
High	$329.9 Million

The present dollar value equivalent was also found using a 3 percent discount rate. This resulted in a 32.67-year plant life conversion factor of 20.82. The change in discount rate results in a new average cost of $8.0 million x 20.82 = $166.3 million. The following are present dollar values for nuclear industry cost assuming a 3 percent discount rate:

Low	$75.3 Million
Average	$166.3 Million
High	$535.2 Million

Maximum Attainable Benefit by Job Duty Group
The average nuclear industry cost for industrial injuries of $102.5 (7 percent) and $166.3 million (3 percent) calculated in the previous section is equivalent to the maximum attainable benefit (MAB) that could be obtained by the nuclear industry if all industrial injuries by staff were eliminated. To separate the MAB according to job duty group, the average percentage of workers under each job duty group in proposed §26.199(a)(1-5) was estimated using 2003 data from six representative nuclear plants. The results of these estimates are presented in the following table.

Table E-1
Average Percent of Workers Under Each Job Duty Group

Operations	10.0%
Staff Maintenance	17.3%
Contract Maintenance	62.3%
HP/Chemistry	5.0%
Fire Brigade	1.0%

The analysis also assumed that of the operators, HP/chemistry and fire brigade, 70% work on a shift schedule and 30% are non-shift workers. These percentages provide a population weighting factor that when multiplied by the average MAB results in a MAB for each job duty group. For example, the MAB for operators who work shifts is:

10.0% (percent of job duty group) X 70% (percent of operators who work shifts) X $102.5 million (7 percent MAB for nuclear industry) = $7.18 million (7 percent MAB for operators on shift)

The MAB for each job duty group was calculated in a similar manner. As the original MAB calculation did not account for contract maintenance personnel, the analysis assumed that the MAB for staff maintenance personnel was equivalent to contract personnel. Staff and contract

maintenance were considered explicitly. This is only the case under outage conditions. The results of these calculations, shown below, were used in the evaluation of each proposed.

Table E-2
MAB (in millions) by Job Duty Group

	7 percent		3 percent	
	Shift	Non-Shift	Shift	Non-Shift
Operations	$7.2	$3.1	$11.7	$5.0
Staff Maintenance	N/A	$17.7	N/A	$28.7
Contract Maintenance*	N/A	$63.9	N/A	$103.7
HP/Chemistry	$3.6	$1.5	$5.8	$2.4
Fire Brigade	$0.7	$0.3	$1.1	$0.5

* *For outage conditions only.*

Appendix E
Reduction in Lost and Restricted Work Cases

Enclosure 1
Cost Estimate

Hourly Rate	$38.02
Estimated Plant Staff Per Plant	1029
Number of Sites	65
Accident Rate (Accidents per worker per year) (NEI)	0.00281
Accidents (# Staff x # Sites x Accident rate)	187.77

Estimated Medical Cost - Per Day		
Low	**Average**	**High**
$500.00	$1,400.00	$5,000.00

			Assumed Number of Days			**Estimated Cost - Replacement Labor**		
Number of Days Lost	**Rate**	**Percentage**	**Low**	**Average**	**High**	**Low**	**Average**	**High**
1	12.5	11.75%	0.2	0.6	1	$4,026	$12,077	$20,129
2	8.6	8.08%	1.2	1.6	2	$16,618	$22,158	$27,697
3 to 5	16.5	15.51%	2.2	3.6	5	$58,454	$95,651	$132,849
6 to 10	11.3	10.62%	5.2	7.6	10	$94,621	$138,292	$181,849
11 to 20	14.9	14.00%	10.2	15.1	20	$244,732	$362,299	$479,867
21 to 30	9.5	8.93%	20.2	25.1	30	$309,015	$383,974	$458,933
31 or more	33.1	31.11%	30.2	40.1	50	$1,609,679	$2,137,356	$2,665,032
	106.4	**100.00%**				**$2,337,145**	**$3,151,807**	**$3,966,469**

Appendix E
Reduction in Lost and Restricted Work Cases

						Estimated Cost - Lost Labor & Medical		
Number of Days Lost						**Low**	**Average**	**High**
1						$6,232	$30,607	$130,425
2						$25,724	$56,154	$179,465
3 to 5						$90,484	$242,407	$860,805
6 to 10						$146,469	$350,470	$1,179,042
11 to 20						$378,835	$918,168	$3,109,332
21 to 30						$478,342	$973,098	$2,973,690
31 or more						$2,491,715	$5,416,658	$17,268,268
Total						**$3,617,800**	**$7,987,562**	**$25,701,025**

Discount Rate	Present Value Factor	Present Value		
0.07	12.83	**$46,432,864**	**$102,516,837**	**$329,861,322**
0.03	20.82	**$75,337,706**	**$166,334,704**	**$535,203,656**

Appendix E
Reduction in Lost and Restricted Work Cases

References

Nuclear Energy Institute. "2003 Industry Performance Remains Strong While Addressing Challenges." Washington, D.C.
http://www.nei.org/documents/Wano_Performance_Indicators_2003.pdf [December 23, 2004]

Healthcare Cost and Utilization Project (HCUP) of the Agency for Healthcare Research and Quality. "H-CUPnet: 2001 National Statistics" Rockville, MD. 2001.
http://hcup.ahrq.gov/HCUPnet.asp [December 23, 2004]

Appendix F
Improved Security Performance

Appendix F
Improved Security Performance

Introduction

This appendix provides the basis for the quantitative assessment of the benefit associated with the proposed work hour control provisions for nuclear security officers. It addresses three conditions: work hour controls prior to the April 29, 2003, order EA-03-038 for compensatory measures related to fitness-for-duties enhancements applicable to nuclear facility security force personnel (referred to in this document as order EA-03-038) (Reference1), work hour controls following order EA-03-038 and the proposed work hour controls that were addressed by this analysis.

Approach

Information relevant to the security force baseline work schedules and the nature of the security threat is considered safeguards information. Therefore, the estimated benefit of the work hour control provisions for the security force was determined differently from that of other job duty groups included in this analysis. Rather than directly assessing the work schedules and security force human performance, the benefits were estimated by considering the role of security to be equal to the performance role of operations. The operator-related benefits were then adjusted as necessary to derive the benefits for the security force. As a result of this approach, the work schedules for the security force are not addressed in Section 3 and the benefits for the security force are shown only at the summary level.

Reduction in the Frequency of Trips

This benefit area addresses the potential benefit from a reduction in plant trips as a result of a reduction in human errors that could cause trips. The relationship between operations personnel and the security force in the reduction in the frequency of trips is the area of greatest difference. This analysis does not attempt to remove this contribution from the work control benefits for the security force. Removing this contribution would enhance the applicability of operator benefits to the security force. See Appendix A for additional discussion on this benefit area.

Reduction in the Frequency of At-Power Severe Accidents

The benefit addressed by this area is the potential reduction in the frequency of at-power internal event severe accidents that is estimated to result from the reduction in human errors. See Appendix B for additional discussion on this benefit area. Two key attributes were considered when comparing the security force with operations: the applicability of the Maximum Achievable Benefit and the applicability of the improved human performance. These are discussed below.

Applicability of the Maximum Achievable Benefit (MAB)

The security force MAB was estimated by assuming its value was equivalent to that obtained from the at-power internal event severe accident benefit area (Appendix B). Internal events typically refer to those accidents associated with systemic type failures such as the loss of feedwater.
This MAB assumption equated the frequency and severity of terrorist attacks to the frequency and severity of at-power severe accidents. It should be noted that analyses for at-power severe

accidents consider a variety of plant challenges: from the occasional non-complicated reactor trip to infrequent accidents like a large break loss of coolant accident. This range of challenges could be considered analogous to the variations in security threats that range from minor infractions to those associated with the design basis threat. In addition, the severity of a terrorist event could be as or more damaging than accidents associated with the at-power analysis.

Approach for Determining the Applicable Performance (PA)

The security force PA was estimated by assuming that the role of the security officers in mitigating a security threat is a similar role to an operator mitigating an internal event at-power accident. Both the security officer and the operator practice similar vigilance on station in monitoring the plant. The operator monitors operational parameters where effective vigilance can avoid a plant challenge. The security officer monitors access where effective vigilance can avoid injury to plant personnel and damage to plant equipment, including critical plant systems. Both the security officer and the operator require effective reactionary response once a threat is realized and both rely on their extensive training and established guidance to rapidly respond to challenges.

Reduction in Frequency of Shutdown Accidents

The benefit addressed by this area is the potential reduction in the frequency of shutdown severe accidents that is estimated to result from the reduction in human errors. See Appendix C for an additional discussion on this benefit area. Similar to the discussion for at-power accidents, the security threat is not expected to change as a result of changes in the plant mode of operation.

Improved Fire Mitigation

Fire risk has been identified as a significant contributor to severe accident risk at nuclear power plants. See Appendix D for additional discussion on this benefit area. A security threat can expose the plant to fire hazards in which the security force would be critical to support effective mitigation.

Lost and Restricted Work Cases

The benefit addressed by this issue is the potential reduction in industrial injury cost associated with an improvement in fatigue-related worker performance. Appendix E summarizes the approach used to determine the maximum attainable benefit. This analysis assumed that the security force is of comparable size and is subjected to a comparable industry hazard.

Work Hour Controls - Prior to Order EA-03-038

Nuclear security officers were not subjected to fatigue-related work hour controls prior to the April 29, 2003, order concerning the nuclear security officers.

Appendix F
Improved Security Performance

Work Hour Controls - Order EA-03-038

The work hour controls included in order EA-03-038 adopted the approach taken in GL 82-12 with few exceptions. The group limits were modified from the initial proposal as a result of external stakeholder feedback received during public meeting conducted on January 23 and February 21, 2003. The most significant change was the development of a 60-hour per week average limit for security force personnel for plant outages and planned security system outages which can last up to 8 weeks. Order EA-03-038 does not impose restrictions on group work hours for unplanned security system outages or increased threat conditions which can last up to 8 weeks. The 60-hour limit was intended to provide reasonable assurance that the effects of fatigue would not adversely impact the readiness of security force personnel, given their unique job-specific demands, if an extended plant outage and increased threat condition occurred sequentially. After the first 8-week period of a plant outage or planned security system outage, collective work hour limits for security personnel reduce to a 48-hour per week average.

Work Hour Controls - Change from Pre-Order Condition

This section evaluates the work hour control changes between the pre-order condition and the four proposed provisions this analysis evaluated.

Waiver Provision

Order EA-03-038 indicated that work hour demands on security force personnel had increased substantially over the preceding 18 months, and the current terrorist threat environment continued to required heightened security measures. While security forces had no NRC-specific work hour limits prior to order EA-03-038, security work hours were generally within the technical specification limits for operations personnel. Therefore, it is assumed that bringing the security force in conformance with the proposed waiver provision would result in the same benefit as that obtained from implementing the proposed waiver provision for operators.

10-hour Break Provision

The proposed 10-hour break provision was estimated to have the same benefit for the security force as that determined for operators. Both job functions start from the same baseline as discussed in the waiver provision above.

48/54-Hour Average Provisions

The proposed 48/54-hour average provisions were estimated to have the same benefit for the security force as that determined for operators. See discussion above.

Individual Break Provisions

The proposed individual break provisions were estimated to have the same benefit for the security force as that determined for operators. See discussion above.

Appendix F
Improved Security Performance

Work Hour Controls - Change from Post-Order Condition

This section evaluates the work hour control changes between post-order condition and the proposed provisions.

Waiver Provision

The provisions in order EA-03-038 and the proposed waiver provision have similar requirements. Therefore the benefit for implementing the proposed waiver provision was assumed to be zero.

10-hour Break Provision

The provisions in order EA-03-038 and the proposed 10-hour break provision have similar requirements. Therefore the benefit for implementing the proposed 10-hour break provision is assumed to be zero.

*48/54-Collective Average Work Hour Limit*s

The provisions in order EA-03-038 include 48/60 collective average work hour limits. The proposed provisions include 48/54 collective average work hour limits. Due to similarities with the 48-hour collective average limit, zero benefit was assessed. The difference between the 54- and 60-hour collective average limits was not assessed.

Individual Break Provision

This provision was not included in order EA-03-038. However, the order did include a requirement for the security force to maintain a 60-hour average during the first 120 days of an outage. The proposed individual break provisions were estimated to have the same benefit for the security force as that determined for operators while at power. However, the analysis conservatively assumed no benefit during outages, since if all security force personnel worked 60 hours per week (five 12-hour shifts), then a 48-hour break would naturally result. The 48-hour break provision would be expected to result in a benefit, as some licensees may work a sub-set of the security force extra shifts each week, and compensate by reducing the number of shifts that other security force personnel work. In such a case, the 48-hour break provision would provide substantial benefit beyond that calculated by this analysis.

Appendix F
Improved Security Performance

References

Letter dated April 29, 2003, Issuance of Order for Compensatory Measures Related to Fitness-For-Duty Enhancements Applicable to Nuclear Facility Security force Personnel, from Samuel J. Collins, Director, Office of Nuclear Reactor Regulation, Nuclear Regulatory Commission

Appendix G
Improved Worker Productivity-Efficiency

Appendix G
Improved Worker Productivity-Efficiency

Introduction

This appendix estimates the maximum attainable benefit (MAB) of realized productivity improvement for each applicable job duty group. Realized productivity improvement refers to the increase in productive output for a given input and it recognizes that not all job duty groups are expected to yield the same productivity improvement for a corresponding performance improvement. The MAB was determined on a per hour basis for each job duty group. Therefore, the MAB represents the benefit if every worker of a given job duty group in all the United States commercial nuclear power plants were to save one hour due to improved performance. The MAB was used as a basic value in the analysis of each rule provision.

This appendix does not include the impact of improved worker performance on increasing productivity that results from a reduced worker error rate. The impact of a reduced error rate on productivity is addressed by Appendix H.

Approach

The productivity MAB for each job duty group is determined by the following steps:

Determine the work hours per job duty group per hour

$$[\text{work-hours}]_{\text{Per Hour}} = [\text{number of workers per plant}] \times [\text{1 hour}]$$

Estimate the "Realized Gain" by job duty type

Determine the maximum productivity gain per hour per plant

$$[\text{Productivity Gain}]_{\text{Per Plant}} = [\text{work-hours}]_{\text{Per Hour}} \times [\text{Realized Gain}]$$

Determine the maximum productivity gain per hour for industry

$$MAB_{\text{Per Hour}} = [\text{Productivity Gain}]_{\text{Per Plant}} \times [\text{Average Wage per hour}] \times [\text{Number of Sites}]$$

The present value equivalent of the MAB was then calculated. This value was used in the evaluation of the four fatigue provisions of the proposed rule addressed by this analysis.

Average Number of Workers

The average number of workers for each job duty group as derived from plant specific data. The data for the plant workers were used to derive an average number of workers per job duty group for each site with a total of 65 sites.

Appendix G
Improved Worker Productivity-Efficiency

Realized Gain

"Realized Gain" is the estimated maximum increased productive output for each job duty group. It reflects the expected yield that a given performance improvement would have on productivity improvement. A low percentage means that productivity improvement has a low sensitivity to worker performance. A 100% value means that a given improvement in performance results in a 1:1 improvement in productivity. Three values are used in this analysis: 10%, 50% and 90%.

A realized gain of 10% is used for operations, health physics and chemistry. This percentage reflects the fact that improvements in these job duty groups would be unlikely to result in staff reductions, because many of their tasks are driven by minimum manning requirements, operational flexibility, training and other activities that would not directly benefit from improved productivity. However, activities such as procedure development, testing, clearance tagging and operation maintenance coordination would likely benefit.

A realized gain of 25% was used for staff and contract maintenance. Efficiencies gained from the more effective execution of maintenance activities are likely to result in reduced maintenance backlog, higher materiel condition, and the reduced need for staff augmentation. The 25% value was selected to reflect that the diversity of craft skills that is needed to maintain the plant's materiel condition and plant contingency needs may not result in the full productivity advantage from improved human performance. Note that in this analysis contract maintenance was only considered during refueling outages.

Maximum Productivity

This section determines the maximum productivity per site per hour for each job duty group. Table G-1 shows the maximum productivity gain for each job duty group. The first row in Table G-1 is used to illustrate the approach. This row shows that there is an average of 30.9 non-shift operations workers at a power plant. Using the 10% realized gain, the results show that there are 3.09 man-hours of productivity saved per hour for every 30.9 average man-hours (3.09 workers multiplied by 1 hour) that could potentially be saved by this job duty group. The productivity gain was then multiplied by the average wage of a U.S. nuclear worker and the number of sites in the United States. The MAB represents the benefit of one saved man-hour at every site in the United States.

Appendix G
Improved Worker Productivity-Efficiency

Table G-1
Productivity Improvement by Worker Type

Worker type	Average Wage per Hour	Number of US Sites	Average Number of Workers per Plant	Realized Gain	Maximum Attainable Benefit
Shift Operations	$38.02	65	18.03	10%	$4,455
Non-Shift Operations			30.9	10%	$7,636
Operations Super-Crew			54.08	10%	$13,364
Staff Maintenance			178	25%	$109,973
Contract Maintenance			641	25%	$396,026
Shift Health Physics and Chemistry			8.93	10%	$2,206
Non-Shift Health Physics and Chemistry			15.3	10%	$3,781
Health Physics and Chemistry Super-Crew			26.78	10%	$6,617

Appendix G
Improved Worker Productivity-Efficiency

Present Value Calculation

To consider these costs as part of the proposed rule change implementation, the present dollar value equivalent was calculated to correspond to the remaining life of a nuclear plant. The average shutdown date of all 65 plants is August 1, 2039. Estimating that the dollar values used in this analysis for lost and restricted work cases are present values as of January 1, 2007, a 32.67-year period was accounted for in the industrial industry cost to obtain a present dollar value equivalent as follows:

The present value conversion factor based on a 32.67-year period with a 7 percent discount rate is 12.83 and is calculated by:

$$\text{Conversion Factor} = (1 - e^{-rt}) / r$$

where *r* is the discount rate and *t* is the plant life period in years. The present value conversion factor is simply multiplied by the industrial injuries cost to obtain the present dollar value equivalent.

A sensitivity analysis was performed on the present value conversion factor such that the discount rate was changed from 7 to 3 percent. This resulted in a 32.67-year plant life conversion factor of 20.82.

The present value of the MAB values in Table G-1 is detailed in Table G-2.

Appendix G
Improved Worker Productivity-Efficiency

Table G-2
Present Value of the Maximum Attainable Benefit

Worker type	Maximum Attainable Benefit	7% Discount Rate Factor	7% Discount Rate Present Value MAB	3% Discount Rate Factor	3% Discount Rate Present Value MAB
Shift Operations	$4,455	12.83	$57,172	$20.83	$92,762
Non-Shift Operations	$7,636		$98,009		$159,020
Operations Super-Crew	$13,364		$171,515		$278,286
Staff Maintenance	$109,973		$1,411,453		$2,290,098
Contract Maintenance	$396,026		$5,082,817		$8,246,927
Shift Health Physics and Chemistry	$2,206		$28,308		$45,931
Non-Shift Health Physics and Chemistry	$3,781		$48,529		$78,738
Health Physics and Chemistry Super-Crew	$6,617		$84,925		$137,792

Appendix H
Improved Worker Productivity-Reduction in Rework

Appendix H
Improved Worker Productivity-Reduction in Rework

Introduction

This appendix estimates the maximum attainable benefit (MAB) of productivity improvement that could result from reduced rework for each applicable job duty group. Rework in this analysis refers to the repetitive performance of a task as a result of human performance errors. This appendix addresses only the productivity aspect of rework. The MAB was determined on a per year basis for each job duty group.

This appendix does not include the impact of improved worker performance on increasing productivity that results from increased efficiency. The impact of increased efficiency was addressed by Appendix G.

Approach

The approach to estimate the benefit associated with a reduction in rework was to first determine the total Operations and Maintenance (O&M) associated with refueling outages and at-power operation. Forced outages were not considered. These O&M estimates provide a framework for the overall industry operation and maintenance costs. Once these values were determined, a small percentage of each value was assumed to be associated with rework and, for refueling outages, an even smaller value was assumed to be associated with rework that results in outage extensions.

Outage Rework Costs

An NEI letter commenting on the proposed fatigue management provisions stated that each day that an outage is extended beyond it's scheduled completion costs a plant $1 million. This analysis assumed that this cost includes the following elements:

$600,000 per day for replacement power

> Assuming that the cost of replacement power during an outage is $0.03 per kilowatt-hour and that the average power delivery of a U.S. plant is 20 million kW-Hrs per day (763.7 billion kW-Hrs/(103 plants x 365 days per year)), the average cost of replacement power is $600,000 per plant-day.

$250,000 per day for plant staff

$50,000 per day for additional outage staff

$100,000 per day for materials

Based on the above breakdown, the cost of labor and materials were estimated to be $400,000 per day. A small portion of this estimated cost is associated with rework.

Appendix H
Improved Worker Productivity-Reduction in Rework

Average Number of Refueling Outages per Unit per Year

The NEI web site states that plants have been in refueling outages every 18 to 24 months, or every 21 months. This indicates that in an average year, 57.1% (1/21 months x 12 months/year) of plants will engage in a refueling outage. Therefore, the yearly cost of refueling outages to the industry is the O&M cost of an outage multiplied by the number of plants in the United States multiplied by 57.1%.

Rework Cost Associated with Labor and Material

The estimated average O&M cost of an outage for the U.S. nuclear industry is $23.53 million per day ($400,000 x 103 plants x 57.1%). Assuming that 1% of the costs allocated to O&M is due to rework costs results in a rework cost of $4,000 per outage day, or an estimated average of $2.35 million per day for the industry. Since the estimated refueling outage duration is explicitly addressed in the main report's analysis as the percent of the cost per year, the $2.35 million per day number was converted to an $85.9 million per year value.

Cost of Rework that Results in Outage Extensions

Some portion of rework requirements will have the effect of extending the time required for an outage. Assuming that the cost of these delays is 0.25% of the costs allocated to O&M, the maximum attainable benefit would be $21.47 million per year to the nuclear industry.

Total Reduced Rework Benefit

Adding benefit attainable as a result of reduced labor cost of $85.9 million per year to the benefit from avoided outage extensions of $21.47 million per year results in an estimated total reduced rework benefit of $107.37 million per year.

Present Value Calculation for Outage Rework

The average shutdown date of all 103 plants is August 1, 2039. Estimating that the dollar values used in this analysis for outage rework are present values as of January 1, 2007, a 32.67-year period was accounted for in the industrial industry cost to obtain a present dollar value equivalent as follows:

The present value conversion factor based on a 32.67-year period with a 7 percent discount rate is 12.83 and is calculated by:

$$\text{Conversion Factor} = (1 - e^{-rt}) / r$$

where *r* is the discount rate and *t* is the plant life period in years. The present value conversion factor is simply multiplied by the outage rework cost to obtain the present dollar value equivalent. Therefore, the average total estimated nuclear industry cost of outage rework at the present dollar value equivalent resulting for a 32.67-year average plant life period is $107.37 million x 12.83 = $1.38 billion over the remaining licensing period of the industry.

Appendix H
Improved Worker Productivity-Reduction in Rework

A sensitivity analysis was performed on the present value conversion factor by changing the discount rate from 7 to 3 percent. This resulted in a 32.67-year plant life conversion factor of 20.82. This change in discount rate results in a new average cost of $56.39 million x 20.82 = $2.2 billion.

Benefit from Reduction in Outage Rework by Worker Type

The analysis excludes several job duty types from contributing to the reduced rework benefit. On-shift operators, on-shift health physics and chemistry workers, fire brigade personnel, and security officers are not expected to have a significant impact on rework cost. Mistakes by control room staff (non-shift operators), super-crew and shift (working overtime) operators are evaluated for their impact on plant safety. Errors by security officers are evaluated for their effectiveness in preventing and mitigating plant security challenges. The routine activities of health physics and chemistry workers are typically associated with monitoring activities that are in support of maintenance and operational activities and were evaluated as having no impact on rework. Fire brigade personnel only perform their duties in exceptional circumstances and for the mitigation of fire.

The remaining job duty types contribute to the reduced rework benefit in a manner weighted according to the relative size of each population. The share of MAB from each job type is summarized in Table H-1. The population size of each group was based on plant specific information that was extrapolated to represent the industry population for each job duty group.

Table H-1
Maximum Attainable Benefit By Worker Type (7% Discount Rate)

Worker Type	Proportion of workers	Maximum Attainable Benefit (In Millions)
Non-Shift Operations	3.2%	$43.83
Shift (Overtime) Operations	1.9%	$25.56
Super-Crew Operations	5.6%	$76.69
Non-Shift HP/Chemistry	1.6%	$21.70
Shift (Overtime) HP/Chemistry	0.9%	$12.66
Super-Crew HP/Chemistry	2.8%	$37.97
Staff Maintenance	18.3%	$252.46
Contract Maintenance	65.9%	$909.13
Total	100%	$1,380.00

Appendix H
Improved Worker Productivity-Reduction in Rework

Table H-2
Maximum Attainable Benefit By Worker Type (3% Discount Rate)

Worker Type	**Proportion of workers**	**Maximum Attainable Benefit (In Millions)**
Non-Shift Operations	3.2%	$71.13
Shift (Overtime) Operations	1.9%	$41.48
Super-Crew Operations	5.6%	$124.47
Non-Shift HP/Chemistry	1.6%	$35.22
Shift (Overtime) HP/Chemistry	0.9%	$20.54
Super-Crew HP/Chemistry	2.8%	$61.63
Staff Maintenance	18.3%	$409.74
Contract Maintenance	65.9%	$1,475.52
Total	100%	$2,239.74

Rework Costs While At-Power

Overall Cost of Maintenance and Operations

A chart published on the Nuclear Energy Institute (NEI) website titled "Average US Nuclear Industry Non-Fuel O&M Costs (1981-2003)" indicates that the average operations and maintenance costs in 2003 were 1.28 cents per kiloWatt-Hour. The site also published the amount of electricity delivered by the industry in a chart titled "Nuclear's Share of Total U.S. Electricity Generation (1973-2003)". The chart indicates that 763.7 billion kiloWatt-Hours were delivered. Multiplying the two values together shows that the cost of non-fuel Operations and Maintenance was $9.78 billion in 2003. Assuming that 30% of that cost is assigned to major maintenance expenditures, $6.85 billion was used as the labor cost for the industry.

Estimated At-Power O&M Cost

The cost of operations and maintenance (O&M) while a plant is at power is the cost of O&M while the plant is in outage subtracted from the total cost of O&M. Using the cost of O&M derived in the outage section above, O&M is expected to represent $400,000 per plant-day. The NEI website states that the average refueling outage in the United States was 37 days long in 2001. Therefore, outages are expected to cost $14.8 million per year-plant. The NEI website also states that plants can be expected to refuel every 18 to 24 months, or every 21 months. This indicates that in an average year, 57.1% of plants will engage in a refueling outage. Therefore, the yearly cost of refueling to the industry is the O&M cost of an outage multiplied by the number of plants in the United States multiplied by 57.1%. The calculation results in a

$870.4 million per year cost to the nuclear industry. This indicates that the cost of O&M while the plant is at-power is $6.85 billion minus $870.4 million, or $5.98 billion per year. Assuming that 60% of this cost is due to fixed cost of engineering, administration, and management, the craft portion of O&M is $2.39 billion per year. The cost per day is $7.29 million per day to the nuclear industry. Adjusting the cost for a hypothetical one year period with no outages, the cost to the industry of O&M is $2.66 billion per year.

Estimated At-power Rework Cost

Assuming that 1% of the total at-power O&M cost of $2.66 billion is the result of rework, the cost of rework is $26.6 million per year.

Present Value Calculation for At-power Rework

To consider these costs as part of the proposed action, the present dollar value equivalent was calculated to correspond to the remaining life of a nuclear plant. The average shutdown date of all 103 plants is August 1, 2039. Estimating that the dollar values used in this analysis for at-power rework are present values as of January 1, 2007, a 32.67-year period was accounted for in the industrial industry cost to obtain a present dollar value equivalent as follows:

The present value conversion factor based on a 32.67-year period with a 7 percent discount rate is 12.83 and is calculated by:

$$\text{Conversion Factor} = (1 - e^{-rt}) / r$$

where *r* is the discount rate and *t* is the plant life period in years. The present value conversion factor is simply multiplied by the industrial injuries cost to obtain the present dollar value equivalent. Therefore, the average total estimated nuclear industry cost of at-power rework at the present dollar value equivalent resulting for a 32.67-year average plant life period is $26.6 million x 12.83 = $341.3 million over the remaining licensing period.

A second analysis was performed on the present value conversion factor such that the discount rate was changed from 7 to 3 percent. This resulted in a 32.67-year plant life conversion factor of 20.82. The change in discount rate results in a new average cost of $26.6 million x 20.82 = $554.2 million.

Benefit from Reduction in At-Power Rework by Worker Type

This analysis assumed that several job duty types would not contribute to the reduced rework benefit. On-shift operators, on-shift health physics and chemistry workers, fire brigade personnel, and security officers are not expected to have a significant impact on rework cost. Mistakes by control room staff (on-shift operators) are evaluated for their impact on plant safety. Errors by security officers are evaluated for their effectiveness in preventing and mitigating plant security challenges. The routine activities of health physics and chemistry workers are typically associated with monitoring activities that are in support of maintenance and operational activities and were evaluated as having no impact on rework. Fire brigade personnel only perform their

duties in exceptional circumstance and the mitigation of fire. In addition, the super-crew schedule is not utilized while at-power and contract maintenance are assumed not applicable while at-power. Therefore, those workers are not applicable to this benefit.

The remaining job duty types were evaluated as contributing to the reduced rework benefit area weighted by the relative population size of each group. The share is summarized in Table H-3 and H-4. The MAB valued displayed in Table H-3 are the key values used in the main body of this analysis.

Table H-3
Maximum Attainable Benefit By Worker Type (7% Discount Rate)

Worker Type	**Proportion of workers**	**Maximum Attainable Benefit (in Millions)**
Non-Shift Operations	13.8%	$43.83
Non-Shift HP/Chemistry	6.8%	$21.70
Staff Maintenance	79.4%	$252.46
Total	100%	$341.0

Table H-4
Maximum Attainable Benefit By Worker Type (3% Discount Rate)

Worker Type	**Proportion of workers**	**Maximum Attainable Benefit (in Millions)**
Non-Shift Operations	13.8%	$71.14
Non-Shift HP/Chemistry	6.8%	$35.22
Staff Maintenance	79.4%	$409.74
Total	100%	$553.4

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