

## 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.

### 26.201 Applicability

This section of the final rule indicates that Subpart I applies 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. Subpart I does not apply to material licensees. This section also states that the requirements in §§ 26.203 and 26.207 through 26.211 apply to the individuals identified in § 26.4(a) through (c). The final language also specifies that the requirements in § 26.205 apply to the individuals identified in § 26.4(a). Incremental costs associated with the new provisions of this Subpart are addressed in the relevant paragraphs.

### 26.203 General Provisions

#### Paragraph 26.203(a)-(b)

These paragraphs of the final rule require licensees to establish a policy and develop, implement, and maintain procedures for the management of fatigue in accordance with the final rule. Procedures must address self-declarations, work hour controls, fatigue assessments, and disciplinary actions. 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 disciplinary actions, includes the sum of the following factors:

- One-time cost 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 is 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 cost 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) is calculated as follows:

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

Parameter	Description
HOURS <sub>Clerical</sub>	One-time hours of clerical personnel to support revision of policies and procedures per program (described in assumptions below)
HOURS <sub>Manager</sub>	One-time hours of labor of various managers to review and approve policies and procedures for fatigue per program (described in assumptions below)
HOURS <sub>FFD_Staff</sub>	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 <sub>Legal</sub>	One-time hours of legal assistance to review and revise policies and procedures for provisions per program (described in assumptions below)
HOURS <sub>Supervisor</sub>	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 <sub>Facilities</sub>	Number of facilities (described in Appendix 2, Exhibit A2-14)
WAGE <sub>Manager</sub>	FFD program manager wage rate (described in Appendix 2, Exhibit A2-11)
WAGE <sub>FFD_Staff</sub>	FFD staff wage rate (described in Appendix 2, Exhibit A2-11)
WAGE <sub>Legal</sub>	Legal consultant wage rate (described in Appendix 2, Exhibit A2-11)
WAGE <sub>Clerical</sub>	Clerical personnel wage rate (described in Appendix 2, Exhibit A2-11)
WAGE <sub>Supervisor</sub>	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 26.203(c)**

This paragraph of the final rule requires licensees and C/Vs to incorporate the fatigue-related knowledge and abilities (KAs) into the training that is required in final paragraph 26.29(a) and the comprehensive examination required in final 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 final provision will require licensees to revise their training programs to address the fatigue-related KAs presented in final 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 <sub>Consultant</sub>	Hours of industry consultant time per program to develop generic training materials for use by the entire industry (described in assumptions below)
HOURS <sub>Manager</sub>	One-time hours of FFD program manager time per program to revise the training materials to address fatigue KAs (described in assumptions below)
HOURS <sub>Clerical</sub>	One-time hours of clerical personnel to support the revision of the training materials to include fatigue KAs (described in assumptions below)
HOURS <sub>Trainer</sub>	One-time hours of trainer time per program to revise the training materials to address fatigue KAs (described in assumptions below)
HOURS <sub>Training_Manager</sub>	One-time hours of training manager time per program to revise the training materials to address fatigue KAs (described in assumptions below)
WAGE <sub>Manager</sub>	FFD program manager wage rate (described in Appendix 2, Exhibit A2-11)
WAGE <sub>Clerical</sub>	Clerical personnel wage rate (described in Appendix 2, Exhibit A2-11)
WAGE <sub>Consultant</sub>	Consultant wage rate (described in Appendix 2, Exhibit A2-15)

Parameter	Description
WAGE <sub>Trainer</sub>	Trainer wage rate (described in Appendix 2, Exhibit A2-11)
WAGE <sub>Training_Manager</sub>	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 cost per program to retrain existing employees on the fatigue-related KAs is calculated as follows:

$$NUM_{Employees} \times (HOURS_{Training-Fatigue} + HOURS_{Examination-Fatigue}) \times WAGE_{Worker} \times NUM_{Units}$$

- One-time cost per program for trainers to administer the training on the fatigue-related KAs is calculated as follows:<sup>1</sup>

$$NUM_{Sessions} \times (HOURS_{Training-Fatigue} + HOURS_{Examination-Fatigue} + HOURS_{Preparation-Fatigue}) \times$$

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<sup>1</sup> 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.

$$WAGE_{Trainer} \times NUM_{Units}$$

Parameter	Description
HOURS <sub>Training-Fatigue</sub>	Length of training increment addressing the fatigue-related KAs (described in assumptions below)
HOURS <sub>Examination-Fatigue</sub>	Length of comprehensive examination increment addressing the fatigue-related KAs (described in assumptions below)
HOURS <sub>Preparation-Fatigue</sub>	Hours of incremental preparation and examination grading per session addressing the fatigue-related KAs (described in assumptions below)
NUM <sub>Employees</sub>	Number of employees per unit covered by FFD program requirements (described in Appendix 2, Exhibit A2-14)
NUM <sub>Units</sub>	Number of units per program (described in Appendix 2, Exhibit A2-14)
NUM <sub>Sessions</sub>	Number of training sessions per facility (described in assumptions below)
WAGE <sub>Worker</sub>	Utility worker wage rate (described in Appendix 2, Exhibit A2-11)
WAGE <sub>Trainer</sub>	Trainer wage rate (described in Appendix 2, Exhibit A2-11)

*Assumptions:*

- Length of training addressing the fatigue-related KAs per session: 1 hour.
- 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:

$$NUM_{Applicants} \times HOURS_{Training-Fatigue} \times WAGE_{Worker} \times NUM_{Units}$$

- Annual cost per program for trainers to administer the training course increment for fatigue-related KAs is calculated as follows:<sup>2</sup>

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<sup>2</sup> 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.

$$NUM_{Sessions} \times HOURS_{Training-Fatigue} \times WAGE_{Trainer} \times NUM_{Units}$$

Parameter	Description
$HOURS_{Training-Fatigue}$	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.
- 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 cost per program* results from the sum of the following costs:

- Annual cost per program for employees to take the refresher training increment addressing fatigue-related KAs is calculated as follows:

$$NUM_{Employees} \times PER_{Refresher} \times HOURS_{Fatigue\ Training} \times WAGE_{Worker} \times NUM_{Units}$$

- Annual cost per program for trainers to administer the refresher training increment addressing fatigue-related KAs is calculated as follows:<sup>3</sup>

$$NUM_{Sessions} \times (HOURS_{Fatigue\ Training} + HOURS_{Preparation-Fatigue}) \times WAGE_{Trainer} \times NUM_{Units}$$

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<sup>3</sup> 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.

<b>Parameter</b>	<b>Description</b>
HOURS <sub>Preparation-Fatigue</sub>	Hours of training preparation and examination grading for fatigue-related training (described in assumptions below)
HOURS <sub>Fatigue Training</sub>	Length of fatigue-related refresher training course (described in assumptions below)
NUM <sub>Employees</sub>	Number of employees per program covered by FFD program requirements (described in Appendix 2, Exhibit A2-14)
NUM <sub>Sessions</sub>	Annual number of additional refresher training sessions per facility (described in assumptions below)
NUM <sub>Units</sub>	Number of units per program (described in Appendix 2, Exhibit A2-14)
PER <sub>Refresher</sub>	Percentage of employees taking refresher training (described in assumptions below)
WAGE <sub>Worker</sub>	Utility worker wage rate (described in Appendix 2, Exhibit A2-11)
WAGE <sub>Trainer</sub>	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 26.203(d)**

This paragraph of the final rule [including subparagraphs 26.203(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 final paragraph 26.205, (2) documentation of shift schedules and shift cycles of individuals who are subject to the work hour controls in final paragraph 26.205, (3) documentation of waivers required under final subparagraph 26.205(a)(4), (4) documentation of work hour reviews conducted in accordance with final subparagraphs 26.205(e)(3) and (e)(4), and (5) documentation of any fatigue assessments conducted in accordance with final paragraph 26.211(g). 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., 26.211(f) 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 26.203(d)(1), (2),(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 <sub>Work_Hours</sub>	Annual number of hours per facility to store individuals' work hours under final rule (described in assumptions below)
HOURS <sub>Reviews</sub>	Annual number of hours per facility to store work hour reviews under final rule (described in assumptions below)
HOURS <sub>Assessments</sub>	Annual number of hours per facility to store fatigue assessment documentation under final rule (described in assumptions below)
WAGE <sub>Clerical</sub>	Utility clerical wage rate (described in Appendix 2, Exhibit A2-11)
NUM <sub>Facilities</sub>	Number of facilities per program (described in Appendix 2, Exhibit A2-14)

*Assumptions:*

- Annual number of hours per facility to store individuals' work hours under final rule: 40 hours.
- Annual number of hours per facility to store work hour reviews under final rule: 4 hours.
- Annual number of hours per facility to store fatigue assessment documentation under final rule: 10 hours.

Subparagraph 26.203(d)(3) of the final rule requires licensees to document waivers as required in final subparagraph 26.203(d)(5)(v). 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 final rule takes effect.

The *annual saving per program* is 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 <sub>WaiverTS</sub>	Annual number of hours per facility to file deviation authorizations under existing licensee technical specifications (described in assumptions below)
HOURS <sub>WaiverNew</sub>	Annual number of hours per facility to file waivers under final rule (described in



Parameter	Description
	assumptions below)
NUM <sub>Facilities</sub>	Number of facilities per program (described in Appendix 2, Exhibit A2-14)
WAGE <sub>Clerical</sub>	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 final rule: 1 hour.

**Paragraph 26.203(e)**

This paragraph of the final rule specifies the fatigue-related information that licensees must include in the annual FFD program performance report required under Section 26.717. 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 § 26.717. Under the former 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 <sub>NRC_Staff</sub>	NRC staff hours per year to review and summarize the additional information addressing fatigue (described in assumptions below)
WAGE <sub>NRC_Staff</sub>	NRC staff wage rate (described in Appendix 2, Exhibit A2-11)
HOURS <sub>Clerical</sub>	NRC clerical hours per year to assist in reviewing and summarizing the additional information addressing fatigue (described in assumptions below)
WAGE <sub>Clerical</sub>	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 26.203(e)(1)**

This subparagraph of the final rule requires licensees to include, within the annual FFD program performance report required under § 26.717, a summary for each nuclear power plant site of all instances during the previous calendar year when the licensee waived the work hour controls specified in § 26.205(d)(1) through (d)(5)(i). Licensees must report the number of instances each applicable work hour control was waived during operating and outage periods. In addition, the licensee must report a summary that shows the distribution of waiver use among the individuals in each category identified in paragraph 26.4(a).

This analysis assumes that licensees will incur an annual cost to review their waiver documentation, categorize the instances of waivers as required, and report the data and frequency distribution 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 <sub>Clerical</sub>	Annual hours of clerical worker labor per facility to tally the annual number of waivers of each type, separate operating waivers from outage waivers, produce a summary of the distribution, and report these data in the FFD program report (described in assumptions below)
HOURS <sub>Manager</sub>	Annual hours of managerial labor per facility to review the waivers data included in the FFD program report (described in assumptions below)
WAGE <sub>Manager</sub>	Utility managerial wage rate (described in Appendix 2, Exhibit A2-11)
WAGE <sub>Clerical</sub>	Utility clerical wage rate (described in Appendix 2, Exhibit A2-11)
NUM <sub>Facilities</sub>	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, separate operating waivers from outage waivers, produce a summary of the distribution, and report these data in the FFD program report: 25 hours.
- Hours of managerial labor to review the waivers data included in the FFD program report: 25 hours.

**Subparagraph 26.203(e)(2)**

This subparagraph of the final rule requires licensees to include, within the annual FFD program performance report required under § 26.717, a summary of corrective actions, if any, resulting from the analyses of the data required under subparagraph 26.203(e)(1), including fatigue assessments. Licensees with effective fatigue management programs will not need to report any

corrective actions. However, licensees that have implemented corrective actions will incur an annual cost to summarize corrective actions resulting from analysis of the fatigue program performance data. This analysis estimates the incremental cost based on the average number of hours (i.e., the average for all licensees, including the majority that have no corrective actions to report) needed to complete the summary.

This provision does not establish or modify requirements for evaluating the program, implementing corrective actions, or documenting individual corrective actions, all of which are covered under other requirements. The summary required by this subparagraph will draw primarily on three sources of documentation: (1) as required under paragraphs 26.41 and 26.203(f), the documented FFD program audit results (including recommended corrective actions); (2) as required by subparagraph 26.203(e)(1), the summary of all instances during the previous calendar year when the licensee waived work hour controls; and (3) as required by paragraph 26.211(g), the summary of instances of fatigue assessments conducted during the previous calendar year.

The *annual cost per program* is calculated as follows:

$$[(HOURS_{FFD\ Staff} \times WAGE_{FFD\ Staff}) + (HOURS_{Clerical} \times WAGE_{Clerical}) + (HOURS_{Manager} \times WAGE_{Manager})] \times NUM_{Facilities}$$

Parameter	Description
HOURS <sub>Clerical</sub>	Annual hours of clerical worker labor per facility to type and format a summary of corrective actions and report this information in the FFD program report (described in assumptions below)
HOURS <sub>FFD Staff</sub>	Annual hours of technical staff labor per facility to produce a summary of corrective actions and report this information in the FFD program report (described in assumptions below)
HOURS <sub>Manager</sub>	Annual hours of managerial labor per facility to review and summarize corrective actions included in the FFD program report (described in assumptions below)
WAGE <sub>Manager</sub>	Utility managerial wage rate (described in Appendix 2, Exhibit A2-11)
WAGE <sub>FFD Staff</sub>	Utility technical staff wage rate (described in Appendix 2, Exhibit A2-11)
WAGE <sub>Clerical</sub>	Utility clerical wage rate (described in Appendix 2, Exhibit A2-11)
NUM <sub>Facilities</sub>	Number of facilities per program (described in Appendix 2, Exhibit A2-14)

*Assumptions:*

- Hours of technical staff labor per facility to produce a summary of corrective actions and report this information in the FFD program report: 4 hours.
- Hours of clerical worker labor per facility to type and format a summary of corrective actions and report this information in the FFD program report: 1 hour.

- Hours of managerial labor to review and summarize corrective actions included in the FFD program report: 1 hour.

**Paragraph 26.203(f)**

This paragraph of the final rule requires licensees to audit the management of worker fatigue. The audits must be conducted as part of the overall FFD program audit required by paragraph 26.41 of the final rule. Under the former rule, FFD program audits do not address the fatigue requirements. Licensees, therefore, will incur an ongoing implementation cost to audit worker fatigue management.

The *annual cost per program* is calculated as follows:

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

<b>Parameter</b>	<b>Description</b>
HOURS <sub>Auditor</sub>	Annual hours of auditor labor per facility to audit the management of worker fatigue (described in assumptions below)
HOURS <sub>Clerical</sub>	Annual hours of clerical labor per facility to assist with the audit of fatigue management program (described in assumptions below)
HOURS <sub>Manager</sub>	Annual hours of manager labor per facility to assist with the audit of fatigue management program (described in assumptions below)
NUM <sub>Facilities</sub>	Number of facilities per program (described in Appendix 2, Exhibit A2-14)
PER <sub>Annualized</sub>	Percentage multiplier to yield annualized savings (as described in assumptions below)
WAGE <sub>Auditor</sub>	Contract auditor wage rate (as described in Appendix 2, Exhibit A2-11)
WAGE <sub>Clerical</sub>	Utility clerical wage rate (described in Appendix 2, Exhibit A2-11)
WAGE <sub>Manager</sub>	Utility manager wage rate (described in Appendix 2, Exhibit A2-11)

*Assumptions:*

- Hours of auditor labor per facility to audit the management of worker fatigue: 40 hours.
- Hours of clerical labor per facility to assist with the audit of fatigue management program: 16 hours.
- Hours for manager per facility to review the summary information to be documented: 16 hours.
- Percentage multiplier to yield annualized savings is 50% because the audits occur every 2 years.

## **26.205 Work Hours**

### **Paragraph 26.205(a)**

This paragraph of the final rule describes the individuals subject to the work hour controls of § 26.205. 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 final paragraph requires 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 paragraphs 26.205(b)-(e) of the final rule. 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.<sup>4</sup> NRC believes these savings might be as high as one-third of all fatigue management costs incurred under the former requirements. These savings have not been quantified, however, because of a lack of data.

### **Paragraph 26.205(b)**

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<sup>4</sup> Relative to Generic Letter 82-12 and existing plant work hour technical specifications, the final 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.

This final paragraph, including subparagraphs (1) - (5), specifies the work hours to be included when calculating individual 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 26.205.<sup>5</sup>

Licensees will incur a one-time cost to modify their existing timekeeping systems in order to record, track, and document the actual hours worked and rest breaks and days off received by individuals covered under the individual work hour controls of paragraph 26.205(d) of the final rule. The *one-time cost per program* results 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, including filing or backing up work hour records. The *annual cost per program* results from the following:

$$[(HOURS_{Supervisor} \times WAGE_{Supervisor}) + (HOURS_{Clerical} \times WAGE_{Clerical})] \times NUM_{Facilities}$$

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 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 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

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<sup>5</sup> 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.

worked by individuals, 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, 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 § 26.205, 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 work hour limits. These timekeeping systems are inadequate, however, with respect to conducting the tracking necessary to implement the rest break and day-off provisions required under § 26.205(d)(2)-(3). 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 26.205(c)**

This final paragraph requires licensees to schedule the work hours of individuals who are subject to § 26.205 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 cost per program* is 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 final rule. *Annual cost per program* is calculated as follows:

$$HOURS_{Scheduler} \times WAGE_{Scheduler} \times NUM_{Facilities}$$

Parameter	Description
HOURS <sub>Scheduler</sub>	Annual hours needed for workers to support supervisors in reviewing, analyzing, and modifying schedules (described in the assumptions below)
HOURS <sub>Management</sub>	One-time hours needed for licensee management to work with union representatives in collective bargaining (described in the assumptions below)

<b>Parameter</b>	<b>Description</b>
HOURS <sub>Legal</sub>	One-time hours needed for licensee legal staff to work with union representatives in collective bargaining (described in the assumptions below)
NUM <sub>Facilities</sub>	Number of facilities per program (described in Appendix 2, Exhibit A2-14)
PER <sub>Negotiation</sub>	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 <sub>Scheduler</sub>	Utility worker wage rate (described in Appendix 2, Exhibit A2-11)
WAGE <sub>Management</sub>	Licensee management wage rate (described in Appendix 2, Exhibit A2-11)
WAGE <sub>Legal</sub>	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  $\frac{1}{2}$  FTE per site will be needed to prepare and maintain all worker schedules in a manner that complies with new fatigue requirements, including the break and day-off requirements in the final rule. This level of effort includes any necessary work associated with special scheduling during a unit outage, security system outage, or increased threat condition. This analysis assumes that the additional work is not occurring on a routine basis, and instead covers instances, for example, where individuals are call in for work on weekends.

*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 final 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 work hour limits. These schedules may not be adequate, however, with respect to implementing the break and day-off provisions required under § 26.205(d)(2)-(3). 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 26.205(d)**

***Subparagraph 26.205(d)(1)***

This subparagraph of the final rule establishes work hour limits for individuals subject to § 26.205. Except as allowed by the waiver provisions of paragraph 26.207 of the final rule, 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 final 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 subparagraph 26.207 of the final rule. Order EA-03-038 imposed the requirements in § 26.205(d)(1) of the final rule on security personnel. Therefore, the 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 § 26.205(d)(1) of the final rule. For those workers, the final rule results in savings because licensees are no longer required to complete paperwork when necessary to waive the individual work hour limits. These savings also are accounted for under § 26.207.

#### *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 final 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 individual work hour limits in the final rule. A 72-hour work week consisting of six 12-hour days, for example, would meet the limits in the final rule, 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 26.205(d)(2)***

This subparagraph of the final rule revises and amends requirements related to mandatory rest breaks. Licensee 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 other required break. The final rule extends 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). The final rule also introduces a 34-hour break in any 9-day period.

NRC expects that licensees will be able to meet the break provisions in the final rule at no

incremental cost other than the scheduling cost described under paragraph 26.205(c) of the final rule, except under unusual circumstances, as addressed under paragraph 26.207 of the final rule. 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. NRC came to this conclusion based on analysis of sample shift schedules provided by industry and on related industry comments.

#### *Sensitivity Analysis Note - Pre-Order Baseline*

Relative to the requirements that were in effect before the NRC issued Order EA-03-038, the final subparagraph also establishes mandatory breaks for security personnel. NRC expects that licensees will be able to meet the break provisions of the final rule at no incremental cost other than the scheduling cost described under paragraph 26.205(c) of the final rule and the calculation and monitoring cost described under paragraph 26.205(b) of the final rule, except under unusual circumstances, as addressed under paragraph 26.207 of the final rule.

#### ***Subparagraph 26.205(d)(3)***

Under the final subparagraph, licensees must ensure that individuals have, at a minimum, the number of days off specified in this subparagraph. The final language defines a day off as a day during which an individual does not start a work shift. The final language introduces the following mandatory days off for affected workers:

- For individuals working 8-hour shift schedules, at least 1 day off per week, averaged over a shift cycle
- For individuals working 10-hour shift schedules, at least 2 days off per week, averaged over a shift cycle
- For individuals who are not security or maintenance personnel working 12-hour shift schedules, at least 2 ½ days off per week, averaged over a shift cycle
- For maintenance personnel working 12-hour shift schedules, at least 2 days off per week, averaged over a shift cycle
- For security personnel working 12-hour shift schedules, at least 3 days off per week, averaged over a shift cycle

The final rule also specifies that a shift cycle may not exceed six weeks.

NRC expects that licensees will be able to meet the day-off provisions at no incremental cost other than the scheduling cost described under paragraph 26.205(c) of the final rule, except under unusual circumstances, as addressed under paragraph 26.207 of the final rule. 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. NRC came to this conclusion based on analysis of sample shift schedules provided by industry and on related industry comments.

#### ***Subparagraphs 26.205(d)(4)-(6)***

Subparagraphs 26.205(d)(4)-(6) provide exceptions to the days-off requirements in paragraph 26.205(d)(3) of the final rule.

For non-security personnel, licensees do not need to meet the days-off requirements in § 26.205(d)(3) during the first 60 days of a unit outage. For security personnel, licensees do not need to meet the days-off requirements in § 26.205(d)(3) during the first 60 days of a unit outage, security system outage, or increased threat condition. Instead, during these periods, licensees must ensure that:

- Operators, health physics, and chemistry personnel receive at least three days off in each successive (i.e., non-rolling) 15-day period during the first 60 days of a unit outage;
- Maintenance personnel receive at least 1 day off in any 7-day period during the first 60 days of a unit outage;
- Security personnel receive at least four days off in each successive (i.e., non-rolling) 15-day period during the first 60 days of a unit outage or planned security system outage; and
- Security personnel need not meet the requirements of paragraphs 26.205(d)(3) and 26.205(d)(5)(i) during unplanned security system outages or increased threat conditions.

Subparagraph 26.205(d)(6) of the final rule allows licensees to extend these days-off provisions beyond the first 60 days of a unit or security system outage or increased threat condition. Licensees may extend these provisions for an individual for seven days for each independent seven-day period in which the individual has worked less than 48 hours during the unit or security system outage or increased threat condition.

NRC expects that licensees will incur incremental costs and savings in order to meet the days-off provisions of the final rule during unit outages. This conclusion is based on analysis of sample shift schedules provided by industry, related industry comments, and an information collection completed by NRC staff. These incremental costs and savings are described below, and under paragraphs 26.205(c) and 26.207 of the final rule.

NRC expects that licensees using “super crew” 12-hour shifts during outages will incur incremental costs associated with drawing upon additional workers in order to continue obtaining the same level of effort during post-rule outage periods as during baseline outage periods (thereby avoiding extending the length of the outage). This analysis assumes that these staff will be temporary contract staff hired to work during the outage as follows:

- Operators - the analysis assumes that operators, in the baseline, work 72 hours per week during an outage although only during the very beginning and end of a unit outage are most of these hours spent on activities that must be conducted specifically by an operator. During all other portions of the outage, the analysis assumes that many hours currently worked by operators could be worked by other types of workers. Therefore, licensees will be able to meet the days-off

requirements for operators by hiring contract maintenance and engineering workers to replace lost operator work hours. The reduction in operator hours also results in overtime savings for ROs and NLOs (but not for the salaried SROs).

- Maintenance - the analysis assumes that licensees will be able to meet the days-off requirements for maintenance personnel during outages without incurring any incremental cost, with one exception. Under the final rule, maintenance personnel must have at least 1 day off in any 7-day period. Current super crew 12-hour shift schedules meet this requirement. However, at multi-unit sites, this analysis estimates the costs associated with maintenance personnel who work on both the outage unit and operating unit (at the operating unit they are limited to 60 hours per week).
- Health Physics/Chemistry Emergency Response (HP/Chem) - the analysis assumes that additional health physics/chemistry emergency response staff will be needed during outage periods to comply with the rule. The hired individuals are assumed to be contract labor. The transfer of some HP/Chem hours to contract HP/Chem staff also results in overtime savings associated with permanent HP/Chem staff.
- 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 requirement for four days off in any successive 15-day period during an plant outage, security system outage, or increased threat condition. 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. Licensees do not need to modify a typical 60-hour schedule of five 12-hour days, and other possible schedules (e.g., six 10-hour days) could be adjusted (e.g., to five 12-hour days) without changing staffing levels.

Based on industry comments, NRC is aware that the days-off requirements during outages will affect single unit sites and multi-unit sites differently. Therefore, the analysis considers incremental costs for single unit sites separately from multi-unit sites.

### Single Unit Sites

Under the final rule, operators, permanent HP/Chem personnel, and temporary HP/Chem personnel will be limited to working 67.2 hours per week on average during an outage,<sup>6</sup> which is less than the current practice of 72 hours per week. As a result, licensees are assumed to hire

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<sup>6</sup> 67.2 hours per week represents the maximum average number of weekly work hours that comply with the outage days off requirements for operators and HP/Chem staff. This average is calculated by taking the proportion of days worked in a 15 day period, assuming the required 3 days off (i.e.,  $12 / 15 = 0.8$ ) and assuming 12-hour work days (i.e.,  $0.8 * 7 \text{ days per week} * 12 \text{ hours per day} = 67.2 \text{ hours per week}$ ).

additional staff to compensate for the lost work hours. The licensees also will incur annual savings related to the reduced overtime wages paid to baseline operators and permanent HP/Chem staff (i.e., current staff will work less overtime during outages due to the hiring of additional temporary staff). These savings offset the added cost of paying contract workers' wages during the outage. Therefore, for baseline operators and permanent HP/Chem staff, this analysis calculates only the in-processing cost associated with the outage days-off requirements. In contrast, the analysis does not assume any offsetting saving from reduced OT wages paid to baseline contract staff. Therefore, the analysis calculates the cost of wages paid to contract HP/Chem workers hired to replace the lost work hours from baseline contract HP/Chem workers.<sup>7</sup>

The *annual cost per program* associated with the program's single unit sites results from the following:

- Licensees will incur an annual cost to pay for in-processing of additional contract maintenance and engineering staff during outages to replace lost outage work hours from permanent operator staff:

$$\frac{[(HOURS_{Outage\_Pre-rule} - HOURS_{Outage\_Post-rule}) \times NUM_{Baseline\ Operators}] \div HOURS_{Outage\_Post-rule} \times COST_{Process\_Maintenance/Engineering} \times FACTOR_{Single\ Unit\ Site\ Outage} \times NUM_{Single\ Unit\ Facilities}}$$

- Licensees will incur an annual cost to pay for in-processing of additional contract HP/Chem staff during outages to replace lost outage work hours from permanent HP/Chem staff:

$$\frac{[(HOURS_{Outage\_Pre-rule} - HOURS_{Outage\_Post-rule}) \times NUM_{Baseline\ HP/Chem}] \div HOURS_{Outage\_Post-rule} \times COST_{Process\_HP/Chem} \times FACTOR_{Single\ Unit\ Site\ Outage} \times NUM_{Single\ Unit\ Facilities}}$$

- Licensees will incur an annual cost to pay for in-processing of additional contract HP/Chem staff during outages to replace lost outage work hours from baseline contract HP/Chem workers that licensees regularly employ during outages:

$$\frac{[(HOURS_{Outage\_Pre-rule} - HOURS_{Outage\_Post-rule}) \times NUM_{Baseline\ Contract\_HP/Chem}] \div HOURS_{Outage\_Post-rule} \times COST_{Process\_HP/Chem} \times FACTOR_{Single\ Unit\ Site\ Outage} \times NUM_{Single\ Unit\ Facilities}}$$

- Licensees will incur an annual cost to pay for these additional contract HP/Chem staff to replace lost outage work hours from baseline contract HP/Chem workers that licensees regularly employ during outages:

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<sup>7</sup> The analysis assumes that contract HP/Chem workers employed during outages in the baseline will, post-rule, earn a wage-rate that is precisely high enough to fully compensate them for the wages they otherwise would lose due to hour cutbacks caused by the rule.

$$\frac{((HOURS_{Outage\_Pre-rule} - HOURS_{Outage\_Post-rule}) \times NUM_{Baseline\ Contract\_HP/Chem}) \div HOURS_{Outage\_Post-rule}] \times WEEKS_{Outage} \times WCOST_{Contract\_HP/Chem} \times FACTOR_{Single\ Unit\ Site\ Outage} \times NUM_{Single\ Unit\ Facilities}$$

Parameter	Description
COST <sub>Process_Maintenance/Engineering</sub>	The average cost to conduct in-processing of one contract maintenance or engineering worker (described in Appendix 2, Exhibit A2-15)
COST <sub>Process_HP/Chem</sub>	The average cost to conduct in-processing of one contract HP/Chem worker (described in Appendix 2, Exhibit A2-15)
FACTOR <sub>Single Unit Site Outage</sub>	Adjustment factor to annualize modeled outages that do not occur annually (described in the assumptions below)
HOURS <sub>Outage_Pre-rule</sub>	The average number of weekly work hours allowed before the rule (described in Appendix 2, Exhibit A2-15)
HOURS <sub>Outage_Post-rule</sub>	The average number of weekly work hours allowed under the final rule for operators, health physics, and chemistry personnel (described in Appendix 2, Exhibit A2-15)
NUM <sub>Baseline Contract_HP/Chem</sub>	The average number of current contract HP/Chem employees in the baseline (described in Appendix 2, Exhibit A2-15)
NUM <sub>Baseline HP/Chem</sub>	The average number of current HP/Chem employees in the baseline (described in Appendix A2-15)
NUM <sub>Baseline Operators</sub>	Number of current operator employees in the baseline(described in Appendix 2, Exhibit A2-15)
NUM <sub>Single Unit Facilities</sub>	Number of single unit facilities per program (described in Appendix 2, Exhibit A2-15)

*Assumptions:*

- The analysis assumes that all temporary workers employed during outages in the baseline will, post-rule, earn a wage-rate that is precisely high enough to fully compensate them for the wages they otherwise would lose due to hour cutbacks caused by the rule.
- Significant outages (refueling outages) are assumed to occur only once every 18 months at some single unit sites and once every 24 months at other single unit sites. Based on a review of single unit site refueling outages between 2002 and 2007, the analysis assumes that each single unit site experiences one significant outage every 22 months. Therefore, the analysis applies an annual outage factor of 0.55 (1/22 months x 12 months) as a means of annualizing outage-specific costs.

Multi-Unit Sites

For multi-unit sites, the analysis estimates the costs associated with the outage days-off

requirements in three discrete parts:

(1) Costs associated with staff who, when all units are operating, normally have the outage unit as their “home base.”<sup>8</sup> These staff are assumed to contribute 72 hours per week to the outage in the baseline, but post-rule will be able to contribute only 67.2 hours per week, on average, to the outage.

(2) Costs associated with temporary staff who are hired (or temporarily transferred from other corporate locations) to work on the unit while it is in outage. These staff are assumed to contribute 72 hours per week to the outage in the baseline, but post-rule will be able to contribute only 67.2 hours per week, on average, to the outage.

(3) Costs associated with staff who, when both units are operating, normally have the operating unit as their “home base.” The analysis assumes that, during an outage at a co-located unit, work activities at the operating unit(s) will decrease to a level consistent with past practices. The remaining work is assumed to be performed by a minimized “skeleton crew” that is fully dedicated to the operating unit(s).<sup>9</sup> As a consequence of the rulemaking, the hours per person worked by the skeleton crew decreases and the size of the skeleton crew increases relative to the baseline.<sup>10</sup> Because more staff will be committed to the operating unit skeleton crew post-rule, fewer staff will be available to subsidize the outage. Therefore, licensees will need to hire additional workers in order to replace lost outage unit work hours. In addition, licensees will need to hire additional workers because non-skeleton crew staff that previously supported the outage will contribute fewer hours due to the days-off requirements.

*(1) Costs associated with staff who, when all units are operating, normally have the outage unit as their “home base”*

The analysis assumes that operators and permanent HP/Chem personnel who have the outage unit as their home base work solely on the outage unit. Therefore, licensees will lose a certain number of hours per week to ensure that these individuals comply with the new days-off requirements. The licensees also will incur annual savings related to the reduced overtime wages paid to baseline operators and permanent HP/Chem staff (i.e., current staff will work less overtime during outages due to the hiring of additional temporary staff). These savings offset the added cost of paying contract workers’ wages during the outage. Therefore, for baseline operators and permanent HP/Chem staff, this analysis calculates only the in-processing cost

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<sup>8</sup> This is a theoretical argument to simplify the cost analysis. It is not necessarily the case that staff at multi-unit sites actually are assigned to one of the units as a “home base.”

<sup>9</sup> This is a theoretical argument to simplify the cost analysis. It is not necessarily the case that licensees operate units with “skeleton crews” while a co-located unit is experiencing an outage.

<sup>10</sup> During an outage at one unit of a multi-unit site, a common industry practice has staff at all units at the site (i.e., at both the outage unit and the operating unit or units) working super crew 12-hour shifts for the duration of the outage. This is inconsistent with the intent of NRC’s current fatigue management policy, particularly with respect to the hours worked by staff at the operating unit(s). Although industry costs associated with reducing work hours at the operating unit from outage levels to more normal operating levels meet the criteria for the “industry practices baseline” (see Section 3.2.1 for a discussion of the baselines), this analysis assigns these costs to the main analysis. This approach reflects the variability in how fatigue management is addressed in licensee technical specifications and results in a more conservative analysis.



associated with the outage days-off requirements.

The *annual cost per program* associated with the program’s multi-unit sites results from the following:

- Licensees will incur an annual cost to pay for in-processing of additional contract maintenance and engineering staff during outages to replace lost outage work hours from permanent operator staff:

$$\frac{[(HOURS_{Outage\_Pre-rule} - HOURS_{Outage\_Post-rule}) \times NUM_{Baseline\ Operators\_Outage\ Unit}] \div HOURS_{Outage\_Post-rule} \times COST_{Process\_Maintenance/Engineering} \times FACTOR_{Dual-Unit\ Site\ Outage} \times NUM_{Dual-Unit\ Facilities} + [(HOURS_{Outage\_Pre-rule} - HOURS_{Outage\_Post-rule}) \times NUM_{Baseline\ Operators\_Outage\ Unit}] \div HOURS_{Outage\_Post-rule} \times COST_{Process\_Maintenance/Engineering} \times FACTOR_{Triple-Unit\ Site\ Outage} \times NUM_{Triple-Unit\ Facilities}}$$

- Licensees will incur an annual cost to pay for in-processing of additional contract HP/Chem staff during outages to replace lost outage work hours from permanent HP/Chem staff:

$$\frac{[(HOURS_{Outage\_Pre-rule} - HOURS_{Outage\_Post-rule}) \times NUM_{Baseline\ HP/Chem\_OutageUnit}] \div HOURS_{Outage\_Post-rule} \times COST_{Process\_HP/Chem} \times FACTOR_{Dual-Unit\ Site\ Outage} \times NUM_{Dual-Unit\ Facilities} + [(HOURS_{Outage\_Pre-rule} - HOURS_{Outage\_Post-rule}) \times NUM_{Baseline\ HP/Chem\_OutageUnit}] \div HOURS_{Outage\_Post-rule} \times COST_{Process\_HP/Chem} \times FACTOR_{Triple-Unit\ Site\ Outage} \times NUM_{Triple-Unit\ Facilities}}$$

(2) *Temporary staff who are hired (or temporarily transferred from other corporate locations) to work on the unit while it is in outage*

Under the final rule, temporary HP/Chem personnel will be limited to working 67.2 hours per week on average during an outage, which is less than the current practice of 72 hours per week. As a result, licensees are assumed to hire additional staff to compensate for the lost work hours. The analysis does not assume any offsetting saving from reduced overtime wages paid to baseline contract staff.<sup>11</sup>

The *annual cost per program* associated with the program’s multi-unit sites results from the following:

- Licensees will incur an annual cost to pay for in-processing of additional contract HP/Chem staff during outages to replace lost outage work hours from baseline contract HP/Chem workers that licensees regularly employ during outages:

$$[(HOURS_{Outage\_Pre-rule} - HOURS_{Outage\_Post-rule}) \times NUM_{Baseline\ Contract\_HP/Chem\_OutageUnit}] \div$$

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<sup>11</sup> The analysis assumes that contract workers employed during outages in the baseline will, post-rule, earn a wage-rate that is precisely high enough to fully compensate them for the wages they otherwise would lose due to hour cutbacks caused by the rule.

$$\begin{aligned} & HOURS_{Outage\_Post-rule}] \times COST_{Process\_HP/Chem} \times FACTOR_{Dual-Unit\ Site\ Outage} \times \\ & NUM_{Dual-Unit\ Facilities} + [((HOURS_{Outage\_Pre-rule} - HOURS_{Outage\_Post-rule}) \times \\ & NUM_{Baseline\ Contract\_HP/Chem\_OutageUnit}) \div HOURS_{Outage\_Post-rule}] \times COST_{Process\_HP/Chem} \times \\ & FACTOR_{Triple-Unit\ Site\ Outage} \times NUM_{Triple-Unit\ Facilities} \end{aligned}$$

- Licensees will incur an annual cost to pay for these additional contract HP/Chem staff during outages:

$$\begin{aligned} & [((HOURS_{Outage\_Pre-rule} - HOURS_{Outage\_Post-rule}) \times NUM_{Baseline\ Contract\_HP/Chem\_OutageUnit}) \div \\ & HOURS_{Outage\_Post-rule}] \times WEEKS_{Outage} \times WCOST_{Contract\_HP/Chem} \times \\ & FACTOR_{Dual-Unit\ Site\ Outage} \times NUM_{Dual-Unit\ Facilities} + [((HOURS_{Outage\_Pre-rule} - \\ & HOURS_{Outage\_Post-rule}) \times NUM_{Baseline\ Contract\_HP/Chem\_OutageUnit}) \div HOURS_{Outage\_Post-rule}] \times \\ & WEEKS_{Outage} \times WCOST_{Contract\_HP/Chem} \times FACTOR_{Triple-Unit\ Site\ Outage} \times NUM_{Triple-Unit\ Facilities} \end{aligned}$$

(3) *Staff who, when both units are operating, normally have the operating unit as their “home base”*

The analysis assumes that some individuals who have the operating unit(s) as their home base work on the outage unit during the outage. As a result of the rule, these staff will contribute fewer hours to the outage for two reasons (as previously noted). First, the minimum size of the skeleton crew needed to run the operating reactor will increase. Second, the operating unit’s non-skeleton crew staff that continues (post-rule) to support the outage will contribute fewer hours. The licensees also will incur annual savings related to the reduced overtime wages paid to baseline operators, baseline permanent maintenance workers, and permanent HP/Chem staff (i.e., current staff will work less overtime during outages due to the hiring of additional temporary staff). These savings offset the added cost of paying contract workers’ wages during the outage. Therefore, for baseline operators, baseline maintenance workers, and baseline permanent HP/Chem staff, this analysis calculates only the in-processing cost associated with the outage days-off requirements.

The *annual cost per program* associated with the program’s multi-unit sites results from the following:

- Licensees will incur an annual cost to pay for in-processing of additional contract maintenance and engineering staff during outages to replace lost outage work hours from permanent operator staff who are added to the skeleton crew for the operating unit:

$$\begin{aligned} & NUM_{Replacements\ for\ Operators\_Outage\ Unit} \times COST_{Process\_Maintenance/Engineering} \times \\ & FACTOR_{Dual-Unit\ Site\ Outage} \times NUM_{Dual-Unit\ Facilities} + NUM_{Replacements\ for\ Operators\_Outage\ Unit} \times \\ & COST_{Process\_Maintenance/Engineering} \times FACTOR_{Triple-Unit\ Site\ Outage} \times NUM_{Triple-Unit\ Facilities} \end{aligned}$$

- Licensees will incur an annual cost to pay for in-processing of additional contract maintenance staff during outages to replace lost outage work hours from permanent maintenance staff who are added to the skeleton crew for the operating

unit:

$$NUM_{\text{Replacements for Maintenance\_Outage Unit}} \times COST_{\text{Process\_Maintenance}} \times FACTOR_{\text{Dual-Unit Site Outage}} \times NUM_{\text{Dual-Unit Facilities}} + NUM_{\text{Replacements for Maintenance\_Outage Unit}} \times COST_{\text{Process\_Maintenance}} \times FACTOR_{\text{Triple-Unit Site Outage}} \times NUM_{\text{Triple-Unit Facilities}}$$

- Licensees will incur an annual cost to pay for in-processing of additional contract HP/Chem staff during outages to replace lost outage work hours from permanent HP/Chem staff who are added to the skeleton crew for the operating unit:

$$NUM_{\text{Replacements for HP/Chem\_Outage Unit}} \times COST_{\text{Process\_HP/Chem}} \times FACTOR_{\text{Dual-Unit Site Outage}} \times NUM_{\text{Dual-Unit Facilities}} + NUM_{\text{Replacements for HP/Chem\_Outage Unit}} \times COST_{\text{Process\_HP/Chem}} \times FACTOR_{\text{Triple-Unit Site Outage}} \times NUM_{\text{Triple-Unit Facilities}}$$

- Licensees will incur an annual cost to pay for in-processing of additional contract maintenance and engineering staff during outages to replace lost outage work hours from permanent operator staff who are part of the non-skeleton crew staff that continues (post-rule) to support the outage:

$$\frac{[(HOURS_{\text{Outage\_Pre-rule}} - HOURS_{\text{Outage\_Post-rule}}) \times NUM_{\text{Baseline Operators\_Non-Skeleton Crew}}] \div HOURS_{\text{Outage\_Post-rule}} \times COST_{\text{Process\_Maintenance/Engineering}} \times FACTOR_{\text{Dual-Unit Site Outage}} \times NUM_{\text{Dual-Unit Facilities}} + [(HOURS_{\text{Outage\_Pre-rule}} - HOURS_{\text{Outage\_Post-rule}}) \times NUM_{\text{Baseline Operators\_Non-Skeleton Crew}}] \div HOURS_{\text{Outage\_Post-rule}} \times COST_{\text{Process\_Maintenance/Engineering}} \times FACTOR_{\text{Triple-Unit Site Outage}} \times NUM_{\text{Triple-Unit Facilities}}}$$

- Licensees will incur an annual cost to pay for in-processing of additional contract HP/Chem staff during outages to replace lost outage work hours from permanent HP/Chem staff who are part of the non-skeleton crew staff that continues (post-rule) to support the outage:

$$\frac{[(HOURS_{\text{Outage\_Pre-rule}} - HOURS_{\text{Outage\_Post-rule}}) \times NUM_{\text{Baseline HP/Chem\_Non-Skeleton Crew}}] \div HOURS_{\text{Outage\_Post-rule}} \times COST_{\text{Process\_HP/Chem}} \times FACTOR_{\text{Dual-Unit Site Outage}} \times NUM_{\text{Dual-Unit Facilities}} + [(HOURS_{\text{Outage\_Pre-rule}} - HOURS_{\text{Outage\_Post-rule}}) \times NUM_{\text{Baseline HP/Chem\_Non-Skeleton Crew}}] \div HOURS_{\text{Outage\_Post-rule}} \times COST_{\text{Process\_HP/Chem}} \times FACTOR_{\text{Triple-Unit Site Outage}} \times NUM_{\text{Triple-Unit Facilities}}}$$

Parameter	Description
COST <sub>Process_HP/Chem</sub>	The average cost to conduct in-processing of one contract HP/Chem worker (described in Appendix 2, Exhibit A2-15)
COST <sub>Process_Maintenance/Engineering</sub>	The average cost to conduct in-processing of one contract maintenance or engineering worker (described in Appendix 2, Exhibit A2-15)
FACTOR <sub>Dual-Unit Site Outage</sub>	Adjustment factor to annualize modeled dual-unit site outages that do not occur annually (described in the assumptions)

<b>Parameter</b>	<b>Description</b>
	below)
FACTOR <sub>Triple-Unit Site Outage</sub>	Adjustment factor to annualize modeled triple-unit site outages that do not occur annually (described in the assumptions below)
HOURS <sub>Outage_Pre-rule</sub>	For operators, health physics, and chemistry personnel, the average number of weekly work hours allowed before the rule (described in Appendix 2, Exhibit A2-15)
HOURS <sub>Operating_Post-rule</sub>	For operators, health physics, and chemistry personnel, the average number of weekly work hours allowed while working on the operating unit under the final rule (described in Appendix 2, Exhibit A2-15)
HOURS <sub>Outage_Post-rule</sub>	For operators, health physics, and chemistry personnel, the average number of weekly work hours during outages allowed under the final rule (described in Appendix 2, Exhibit A2-15)
HOURS <sub>Mnt_Outage_Pre-rule</sub>	For maintenance employees, the average number of weekly work hours allowed before the rule (described in Appendix 2, Exhibit A2-15)
HOURS <sub>Mnt_Operating_Post-rule</sub>	For maintenance employees, the average number of weekly work hours during outages allowed under the final rule (described in Appendix 2, Exhibit A2-15)
NUM <sub>Baseline Contract_HP/Chem_Outage Unit</sub>	The average number of contract HP/Chem employees at an outage unit (described in Appendix 2, Exhibit A2-15)
NUM <sub>Baseline HP/Chem_Outage Unit</sub>	The average number of current HP/Chem employees at an outage unit (described in Appendix 2, Exhibit A2-15)
NUM <sub>Baseline Maintenance_Skeleton Crew</sub>	The average number of current maintenance staff on the skeleton crew (described in Appendix 2, Exhibit A2-15)
NUM <sub>Baseline Operators_Outage Unit</sub>	The average number of current operator employees at an outage unit (described in Appendix 2, Exhibit A2-15)
NUM <sub>Dual-Unit Facilities</sub>	The average number of dual-unit facilities per program (described in Appendix 2, Exhibit A2-15)
NUM <sub>Replacements for Operators_Outage Unit</sub>	The number of replacement workers needed to replace lost outage work hours from permanent operator staff who are added to the skeleton crew for the operating unit (described in Appendix 2, Exhibit A2-15)
NUM <sub>Replacements for Maintenance_Outage Unit</sub>	The number of replacement workers needed to replace lost outage work hours from permanent maintenance staff who are added to the skeleton crew for the operating unit (described in Appendix 2, Exhibit A2-15)
NUM <sub>Replacements for HP/Chem_Outage Unit</sub>	The number of replacement workers needed to replace lost outage work hours from permanent HP/Chem staff who are added to the skeleton crew for the operating unit (described in Appendix 2, Exhibit A2-15)
NUM <sub>Baseline Operators_Non-Skeleton Crew</sub>	The number of non-skeleton crew operators working on the outage unit (described in Appendix 2, Exhibit A2-15)
NUM <sub>Baseline HP/Chem_Non-Skeleton Crew</sub>	The number of non-skeleton crew HP/Chem staff working on

Parameter	Description
	the outage unit (described in Appendix 2, Exhibit A2-15)
NUM <sub>Triple-Unit Facilities</sub>	The average number of triple-unit facilities per program (described in Appendix 2, Exhibit A2-15)

*Assumptions:*

- The analysis assumes that all temporary workers employed during outages in the baseline will, post-rule, earn a wage-rate that is precisely high enough to fully compensate them for the wages they otherwise would lose due to hour cutbacks caused by the rule.
- Refueling outages typically occur every 18 to 24 months per unit. Based on a review of dual-unit site refueling outages between 2002 and 2007, the analysis assumes that each dual-unit site experiences one significant outage every 11 months. Therefore, the analysis applies an outage factor of 1.1 (1/11 months x 12 months) as a means of annualizing outage-specific costs.
- Based on a review of triple-unit site refueling outages between 2002 and 2007, the analysis assumes that each triple-unit site experiences one significant outage every 6 months. Therefore, the analysis applies an outage factor of 2.0 (1/6 months x 12 months) as a means of annualizing outage-specific costs.

*Sensitivity Analysis Note - Pre-Order Baseline*

Relative to the requirements that were in effect before the NRC issued EA-03-038, the final subparagraphs also result in additional incremental costs and savings related to security personnel. NRC expects that with respect to the provision requiring four days off every 15 days, licensees will have to pay for additional security staff during refueling outages.<sup>12</sup> The licensees also will incur annual savings related to the reduced overtime wages paid to baseline security staff (i.e., current staff will work less overtime during outages due to the hiring of additional staff). These savings offset the added cost of paying additional workers' wages during the outage. Therefore, this analysis calculates the in-processing cost associated with the outage days-off requirements.

The *annual cost per program* results from the following:

- Licensees will incur an annual cost to pay for in-processing of additional outage security staff at the time of a refueling outage:

$$\frac{[(HOURS_{Sec\_Outage\_Pre-Order} - HOURS_{Sec\_Outage\_Post-rule}) \times NUM_{Perm\_Sec}] \div HOURS_{Sec\_Outage\_Post-rule}}{\times COST_{Process\_Sec} \times FACTOR_{Outage} \times NUM_{Facilities}}$$

<sup>12</sup> The maximum number of weekly work hours that comply with the security staff days-off requirements in the final rule is 61.6 hours per week. However, this analysis assumes that security will work 60 hours per week, in accordance with licensee's current (i.e., post-order) scheduling practices.

<b>Parameter</b>	<b>Description</b>
$COST_{Process\_Sec}$	The average cost to conduct in-processing of one security staff person (described in Appendix 2, Exhibit A2-15)
$FACTOR_{Outage}$	Adjustment factor to annualize modeled outages that do not occur annually (described in the assumptions below)
$HOURS_{Sec\_Outage\_pre-Order}$	The average number of weekly work hours allowed before the Order for security personnel (described in Appendix 2, Exhibit A2-15)
$HOURS_{Sec\_Outage\_post-rule}$	The average number of weekly work hours allowed under the final rule for security personnel (described in Appendix 2, Exhibit A2-15)
$NUM_{Perm\_Sec}$	The average pre-order number of affected permanent security staff per facility (described in Appendix 2, Exhibit A2-15)
$NUM_{Facilities}$	Number of facilities per program (described in Appendix 2, Exhibit 2-14)

*Assumptions:*

- Based on a review of single, dual, and triple-unit site refueling outages between 2002 and 2007, the analysis assumes that the average site experiences one significant outage approximately every 13 months. Therefore, the analysis applies an outage factor of 0.9 (1/13 months x 12 months) as a means of annualizing outage-specific costs.

**Paragraph 26.205(e)**

This paragraph of the final rule requires licensees to review once per year the control of work hours for individuals who are subject to this section. 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 cost per program* to conduct work hour control reviews includes the following:

$$[((NUM_{Reviews} \times HOURS_{Review} \times NUM_{Managers}) \times WAGE_{Manager}) - (HOURS_{Current\_Review} \times WAGE_{Manager})] \times NUM_{Facilities}$$

<b>Parameter</b>	<b>Description</b>
$HOURS_{Review}$	Time per participating supervisor to review overtime hours under final 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-

<b>Parameter</b>	<b>Description</b>
	14)
NUM <sub>Manager</sub>	Number of manager participating in the review (described in assumptions below)
NUM <sub>Reviews</sub>	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 <sub>Manager</sub>	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: 1.
- Annual hours for participating managers to review work hours under final 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.

## **26.207 Waivers and Exceptions**

### **Paragraph 26.207(a)**

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 final subparagraph, licensees may grant a waiver of the individual work hour controls contained in paragraphs (d)(1)-(5)(i) 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 site security, 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 final 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 final rule, incremental costs arise from the need to conduct and document a fatigue assessment. This cost is calculated under § 26.205 and § 26.211.

The *annual cost per program* is calculated as follows:



$$[(WEEKS_{Outage} \times WEEKLYCOSTS_{Outage}) + (WEEKS_{Power} \times WEEKLYCOSTS_{Power})] \times NUM_{Facilities}$$

<b>Parameter</b>	<b>Description</b>
NUM <sub>Facilities</sub>	Number of facilities per program (described in Appendix 2, Exhibit 2-14)
WEEKS <sub>Outage</sub>	Number of weeks per year during which facilities experience outage conditions (described in assumptions below)
WEEKS <sub>Power</sub>	Number of weeks per year during which facilities experience full power conditions (described in assumptions below)
WEEKLYCOSTS <sub>Outage</sub>	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 <sub>Power</sub>	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 26.207(b)**

Under this final paragraph, when calculating an individual's number of days off, licensees may exclude shifts worked by security personnel during the actual conduct of NRC-evaluated force-on-force tactical exercises. This provision will result in savings to licensees. This analysis does not quantify these savings, however, because the amount would be a relatively small value compared to others in this analysis.

### **Paragraph 26.207(c)**

This paragraph states that when informed in writing by the NRC that the requirements of section 26.205 are waived for security personnel to ensure the common defense and security, licensees need not meet the specified requirements of section 26.205 for the duration of 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 26.207(d)**

This paragraph states that licensees need not meet the requirements of paragraphs 26.205(c) and (d) 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.

### **26.209 Self-Declarations**

This final paragraph requires licensees to stop any individual from performing any duties listed in paragraph 26.4(a) if the individual is performing, or being assessed for, work under a waiver of the requirements contained in 26.205(d)(1)-(5)(i) 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 final 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 is 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:

$$NUM_{Waivers} \times PER_{Self-Declare} \times (HOURS_{Supervisor} \times WAGE_{Supervisor}) \times NUM_{Facilities}$$

- 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:

$$NUM_{Waivers} \times PER_{Self-Declare} \times (HOURS_{Turnover} \times WAGE_{Worker}) \times NUM_{Facilities}$$

- Licensees also will incur incremental labor costs associated with the replacement worker:<sup>13</sup>

$$NUM_{Waivers} \times PER_{Self-Declare} \times (HOURS_{Substitute} \times WAGE_{Worker}) \times NUM_{Facilities}$$

Parameter	Description
HOURS <sub>Supervisor</sub>	Supervisor hour expended to identify and call in a replacement worker (described in the assumptions below)
HOURS <sub>Turnover</sub>	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 <sub>Substituted</sub>	Average number of hours worked by the replacement worker per incident (described in the assumptions below)
NUM <sub>Facilities</sub>	Number of facilities per program (described in Appendix 2, Exhibit A2-14)
NUM <sub>Waivers</sub>	Total annual number of persons, per site, granted waivers from the requirements contained in 26.205(d)(1) and (2) (described in Appendix 3)
PER <sub>Self-Declare</sub>	Percentage of NUM <sub>Waivers</sub> that self-declare to a condition of fatigue (described in the assumptions below)
WAGE <sub>Worker</sub>	Utility worker wage rate (described in Appendix 2, Exhibit A2-11)

*Assumptions:*

- Total annual number of persons, per site, granted waivers from the requirements contained in 26.205(d)(1) - (5)(i) of the final rule: 15.
- Percentage of NUM<sub>Waivers</sub> that self-declare to a condition of fatigue: 10 percent.

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<sup>13</sup> 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.

- 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.

## 26.211 Fatigue Assessments

### Paragraph 26.211(a)–(d)

These 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. Only supervisors and FFD program personnel, trained in accordance with the requirements of §§ 26.29 and 26.203(c), may conduct the fatigue assessment. The fatigue assessment must be 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 § 26.203(b)(1)(iii). Incremental costs associated with these fatigue assessments are addressed below.

The *annual cost per program* results from the following factors:

- Licensees must conduct a fatigue assessment for cause, for self-declarations, post-event, and follow-up.<sup>14</sup>

$$[NUM_{Assessments} \times HOURS_{Assessment} \times (WAGE_{Worker} + WAGE_{Supervisor})] \times NUM_{Facilities}$$

- 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:

$$(NUM_{Self-Declarations} \times PER_{Not\_Fatigued} \times PER_{Object}) \times [(HOURS_{Worker} \times WAGE_{Worker}) + (HOURS_{ECM} \times WAGE_{ECM}) + (HOURS_{Supervisor} \times WAGE_{Supervisor})] \times NUM_{Facilities}$$

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<sup>14</sup> 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 paragraph 26.201(e) of the final rule.

<b>Parameter</b>	<b>Description</b>
HOURS <sub>Worker</sub>	Amount of worker time to raise and resolve one incident (described in assumptions below)
HOURS <sub>ECM</sub>	Number of hours of Employee Concerns Manager time to raise and resolve one incident (described in assumptions below)
HOURS <sub>Supervisor</sub>	Number of hours of supervisor time to raise and resolve one incident (described in assumptions below)
HOURS <sub>Assessment</sub>	Hours needed to complete one fatigue assessment (described in the assumptions below)
NUM <sub>Facilities</sub>	Number of facilities per program (described in Appendix 2, Exhibit A2-14)
NUM <sub>Assessments</sub>	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 <sub>Self-Declarations</sub>	Annual number of self-declarations of fatigue per facility (described in assumptions below)
PER <sub>Not_Fatigued</sub>	Percent of NUM <sub>Self_Declarations</sub> where the results of the fatigue assessment are negative (described in assumptions below)
PER <sub>Object</sub>	Percent of negative fatigue assessment results that are challenged by workers (described in assumptions below)
WAGE <sub>Worker</sub>	Average hourly wage of worker (described in Appendix 2, Exhibit A2-11)
WAGE <sub>ECM</sub>	Average hourly wage of Employee Concerns Manager (described in Appendix 2, Exhibit A2-11)
WAGE <sub>Supervisor</sub>	Average hourly wage of supervisor (described in Appendix 2, Exhibit A2-11)
WAGE <sub>Worker</sub>	Utility worker wage rate (described in Appendix A2-11)
WAGE <sub>Supervisor</sub>	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 § 26.207.]
- Time needed to conduct a fatigue assessment (including supervisor transit to the worker): 0.5 hours.
- Percent of NUM<sub>Self\_Declarations</sub> 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 26.211(e)**

This paragraph requires licensees, following a fatigue assessment [the cost of which is calculated under subparagraph 26.211(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.

<i>Results of Fatigue Assessment</i>	<i>Modeled Licensee Actions</i>
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 § 26.207, 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 final 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 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:<sup>15</sup>

$$NUM_{Assessments} \times PER_{Fatigue} \times (HOURS_{Substituted} \times WAGE_{Worker}) \times NUM_{Facilities}$$

Parameter	Description
HOURS <sub>Supervisor</sub>	Supervisory hour expended to identify and call in a replacement worker (described in assumptions below)
HOURS <sub>Turnover</sub>	Labor hours resulting from an additional turnover due to the replacement of a fatigued worker with a substitute worker (described in assumptions below)
HOURS <sub>Substituted</sub>	Average number of hours worked by the replacement worker per incident (described in assumptions below)
NUM <sub>Assessments</sub>	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 <sub>Facilities</sub>	Number of facilities per program (described in Appendix 2, Exhibit A2-14)
PER <sub>Fatigue</sub>	Percentage of fatigue assessments that result in a finding of fatigue (described in assumptions below)
WAGE <sub>Worker</sub>	Utility worker wage rate (described in Appendix A2-11)

<sup>15</sup> 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.

Parameter	Description
WAGE <sub>Supervisor</sub>	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 § 26.207.]
- Percentage of fatigue assessments that result in a finding of fatigue: 37.5%<sup>16</sup>.
- 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 26.211(f)**

This 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 cost per program* results from the following:

$$NUM_{Assessments} \times HOURS_{Document} \times WAGE_{Supervisor} \times NUM_{Facilities}$$

Parameter	Description
HOURS <sub>Document</sub>	Time needed to document a fatigue assessment (described in the assumptions below)
NUM <sub>Assessments</sub>	Total annual number of fatigue assessments per unit (described in assumptions)
NUM <sub>Facilities</sub>	Number of facilities per program (described in Appendix 2, Exhibit A2-14)

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<sup>16</sup> 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 § 26.207 - 25%.



Parameter	Description
WAGE <sub>Supervisor</sub>	Utility supervisory wage rate (described in Appendix A2-11)

*Assumptions:*

- 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 § 26.207.]

**Paragraph 26.211(g)**

This paragraph of the final rule requires licensees to report a summary for each nuclear power plant site of the instances of fatigue assessments conducted during the previous calendar year, including: the conditions under which each fatigue assessment was conducted (i.e., self-declaration, for cause, post-event, follow-up); a statement of whether the individual was working on outage activities at the time of the fatigue assessment; the category of duties the individual was performing if the individual was performing one of the duties described in the 26.4(a)(1) through (a)(5) of the final rule; and the management actions, if any, resulting from each fatigue assessment. This information should be readily available based on documentation prepared under 26.211(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 <sub>Clerical</sub>	Annual hours of clerical labor per facility to summarize instances of fatigue assessments conducted during the previous calendar year to be included in the FFD program report (described in assumptions below)
HOURS <sub>Manager</sub>	Annual hours of manager labor per facility to review the summary information to be sent to NRC (described in assumptions below)
NUM <sub>Facilities</sub>	Number of facilities per program (described in Appendix 2, Exhibit A2-14)
WAGE <sub>Clerical</sub>	Utility clerical wage rate (described in Appendix 2, Exhibit A2-11)
WAGE <sub>Manager</sub>	Utility manager wage rate (described in Appendix 2, Exhibit A2-11)

*Assumptions:*

- Hours of clerical labor per facility to summarize instances of fatigue assessments conducted during the previous calendar year to be included in the FFD program report: 20 hours.

- Hours for manager per facility to review the summary information to be sent to NRC : 10 hours.