



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, DC 20555 - 0001

January 10, 2003

MEMORANDUM TO: Theodore R. Quay, Chief
Equipment and Human Performance Branch
Division of Inspection Program Management
Office of Nuclear Reactor Regulation
/RA/

FROM: David C. Trimble, Chief
Operator Licensing and Human Performance Section
Equipment and Human Performance Branch
Division of Inspection Program Management
Office of Nuclear Reactor Regulation

SUBJECT: SUMMARY OF THE DECEMBER 5, 2002, PUBLIC MEETING TO
DISCUSS THE DEVELOPMENT OF A PROPOSED WORKER FATIGUE
RULE

On December 5, 2002, the staff held the seventh in a series of public meetings regarding the development of a proposed rule concerning worker fatigue at nuclear power plants. The rulemaking has been proposed as an amendment to 10 CFR 26, "Fitness for Duty Programs." The meeting participants (see Attachment 1) included representatives from the Electric Power Research Institute (EPRI), the Institute for Nuclear Power Plant Operations (INPO), the Nuclear Energy Institute (NEI), and members of the public. The meeting agenda is provided as Attachment 2. The following is a summary of discussions for each of the major agenda topics:

Status of Regulatory Analysis - The staff reported that contractor progress in developing the regulatory analysis had been delayed by technical challenges in developing an acceptable methodology for assessing the risk benefit of the proposed rule and repeated hospitalization of the project lead for the contract firm developing the analysis. The contractor was due to provide a proposal for staff review within two weeks of the public meeting.

Scope of Fire Watch and Fire Brigade Functions Subject to Work Scheduling Controls - The industry task force provided white papers which set forth rationales for not including fire watch functions (Attachment 3) and fire brigade functions (Attachment 4) within the scope of the work scheduling controls. Neither the Union of Concerned Scientists, which has proposed the inclusion of fire watch function, nor NRC staff with technical expertise in fire protection were present for discussion of this matter. The NRC project manager for the proposed rule noted that he would provide the white papers to the appropriate NRC technical staff for consideration in development of the proposed rule.

Scope of Maintenance Functions Subject to Work Scheduling Controls - The industry task force provided proposed wording for the scope of maintenance functions to be subject to work scheduling controls (Attachment 5). The proposed wording would limit the scope to those systems, structures, and components (SSCs) that a risk informed evaluation process has

shown to be significant to public health and safety. Steve Alexander (NRC) reported on an informal survey he conducted on this matter of members of the Maintenance Rule Users Group. Whereas the majority of the individuals he surveyed favored a scope that would be limited to maintenance functions associated with high safety-significant SSCs, as defined in a licensee's maintenance rule program, the staff noted that the proposal from the survey was consistent with the proposal from the industry task force and the staff's scope proposal.

Work Scheduling Controls for Long Duration Outages - The staff has proposed in previous public meetings that controls should be established to address the potential for cumulative fatigue that could result if the proposed limits for outages are used for periods greater than the 3-4 weeks that are typical of current refueling outages. The industry task force presented a white paper (Attachment 6) which proposes that no longer term limits are necessary, asserting that the reactor oversight process "requires management to take the actions necessary to obtain the desired performance outcome." The staff noted that it was not clear how the revised oversight process would adequately address the cumulative fatigue concerns but acknowledged that an appropriate means to address this concern should take into consideration, as suggested by the task force, that the extensive use of overtime in long duration outages may not be continuous for all workers but rather it may shift between various groups of outage workers.

Criteria for Authorizing Deviations from Work Scheduling Controls - The staff began this discussion by responding to the position presented by the industry task force at the October 3, 2002, stakeholder meeting that authorizations to exceed the work scheduling thresholds should be acceptable for economic reasons if such deviations were "safety neutral." The staff noted that the potential for worker fatigue above the proposed thresholds was sufficient to seriously question whether a "safety neutral" determination could be made and that the proposed criteria would introduce substantial subjectivity and potential for abuse. The staff reiterated its earlier proposal that the acceptable bases for exceeding a work scheduling threshold should be limited to situations in which the worker is determined to be fit for duty and (1) the scope of the work and responsibilities will not require functions subject to work scheduling controls, or (2) working in excess of the threshold is necessary to: (a) comply with other NRC regulations, or (b) avoid a forced shutdown, or (c) maintain or enhance immediate capability for responding to challenges to plant safety.

The industry task force provided a white paper and model form for approving work hour extensions (Attachment 7). The industry task force proposed that any measures that the proposed rule may require to address the potential for, and consequences of, fatigue-related errors should supplement, not duplicate, the processes that implement the Maintenance Rule (i.e., 10 CFR 50.65, Requirements for monitoring the effectiveness of maintenance at nuclear power plants). Accordingly, the task force proposed that the measures should focus on worker performance (e.g., peer checks, post-maintenance checks) rather than plant configuration. The staff noted that whereas it was not the staff's expectation that licensee's would alter plant configuration as a compensatory measure for exceeding a work scheduling threshold, under the proposed rule the staff would expect that approvals to exceed thresholds would include consideration of plant risk associated with the current plant configuration and the specific work to be performed.

Treatment of Turnover Time Relative to Work Scheduling Controls - The industry task force presented a white paper (Attachment 8) which presented a proposed definition of turnover time

and implementation guidance for excluding turnover time from the work scheduling controls. The staff noted general agreement with the proposed definition and guidance.

Program Effectiveness Measures - The industry task force provided a white paper (Attachment 9) which presents the position that the reactor oversight process (ROP) is the seminal vehicle for evaluating the effectiveness of any industry program and that it is sufficient to assess any fatigue issues through performance indicators and through inspections in areas such as problem identification and resolution. The staff noted that inspections of problem identification and resolution were focused on review of licensee activities, such as audits, and that 10 CFR 26, Fitness for Duty Programs, currently has a requirement to audit program effectiveness. Should the Commission approve a fatigue management amendment to Part 26, it is the staff's expectation that licensees will be assessing the effectiveness of their fatigue management measures, but it is not clear how licensees would conduct such audits. As a consequence, the staff noted the need for applicable guidance. The staff also noted that it will be reviewing how well the ROP can be expected to address the effectiveness of the proposed fatigue management requirements, including the implementation of licensee program effectiveness audits.

Behavioral Observation - Mr. Davis (NEI) proposed that the process for handling observation of excessive worker fatigue be different than the process required by Part 26 for for-cause testing. Mr. Davis noted that the current for-cause process, if applied to instances of perceived excessive fatigue, would be a significant disincentive to reporting fatigue concerns. The staff agreed to consider development of requirements that would be responsive to this concern while maintaining the integrity of the current for-cause testing requirements.

Self-Declarations - The industry task force provided a white paper (Attachment 10) addressing the matter of individuals self-declaring that they are not fit for duty because of excessive fatigue. Specifically the task force proposed that records of such instances should not be maintained because the declarations may not provide meaningful information concerning fatigue from work scheduling and maintaining such records may cause a chilling effect, discouraging workers from reporting their fatigue concern. Discussion of the task forces position was deferred to the next stakeholder meeting because of schedule constraints.

The staff closed the meeting with a commitment to begin drafting language for the proposed rule for discussion at the next meeting which would be planned for mid-January 2003.

Attachments: As stated

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DATE	1/8/03	1/8/03	1/10/03				

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Public Meeting to Discuss Development of a Proposed Rule Concerning
Worker Fatigue at Nuclear Power Plants

December 5, 2002

Attendance List

NAME	AFFILIATION
David Trimble	NRC/NRR
David Desaulniers	NRC/NRR
Ralph Mullis	Progress Energy
Clare Goodman	NRC
Autumn Szabo	NRC/RES
Bob Evans	NEI
Mark Burzynski	TVA
Bryan Dolan	Duke Energy
James Davis	NEI
David Ziebell	EPRI
Terry Matlosz	SCE&G
Martin Humphrey	FENOC
Clair Goddard	INPO
Alan Roecklein	NRC/NRR
Clare Bleau	Nuclear Management Co.
Patrick Shaffer	SCE / San Onofre Nuclear Gen. Station
Marjorie Rothschild	NRC/OGC

MEETING WITH STAKEHOLDERS TO DISCUSS DEVELOPMENT OF A
PROPOSED RULE CONCERNING WORKER FATIGUE
AT NUCLEAR POWER PLANTS

December 5, 2002

AGENDA

- 8:30-8:40 Introductions and Opening Remarks
- 8:40-8:50 Summary of 11/12/02 and 11/26/02 Teleconference Meetings
- 8:50-9:00 Status of Regulatory Analysis
- 8:45-9:30 Personnel Scope - Open Items
 Fire Watch
 Application of 10 CFR50.65(a)(4) scope to maintenance functions
- 9:30-10:15 Work Scheduling Controls - Open Items
 Outage duration
 Criteria for authorizing deviations from work scheduling controls
- 10:15-10:30 Break
- 10:30-11:15 Self-declaration of fatigue
 Role in Fatigue Management
 Concerns and Recommendations
- 11:15-12:00 Behavioral Observation
 Role in Fatigue Management
 Concerns and Recommendations
- 12:00-1:00 Lunch
- 1:00- 2:30 Program Effectiveness Measures
 Objectives
 Program Audits
 Reactor Oversight Process
- 2:30-2:45 Break
- 2:45-4:45 Develop Strategy for Resolving Open Items
- 4:45-5:00 Meeting Summary and Future Schedule

Note: This is a Category 3 Meeting. The public is invited to participate in this meeting by providing comments and asking questions throughout the meeting.

FIRE WATCHES

Fire watches should not be included within the scope of the work-hours portion of the worker fatigue rulemaking.

Fire watches do not have a significant nexus to safety and risk. Fire watches are associated with a specific fire scenario, which has a risk level well below the cumulative risk from fires (sum of all scenarios).

Fire watch personnel do not have the same link to fatigue-related issues (i.e., alertness and/or decision making), as cited operations and maintenance personnel do. Fire watch personnel are not tasked with critical decision-making in the performance of their duties. Fires, though localized, are inherently self-annunciating. Thus the role of the fire watch is to scan the affected area frequently enough for the fire to announce itself. In addition, their alertness is assisted by the use of all their senses. They are not restricted to visual acuity only, they may respond to smell, sound, and temperature as well. As such, both their required vigilance levels and cognitive demands are less than those for personnel who have to maintain exceptional levels of visual and auditory vigilance, watching and listening for the unexpected (e.g., plant operators and security compensatory posts).

The arguments proffered by UCS are not risk-informed. They argue that, because fire watches are used in a regulatory sense (e.g., for technical specification compliance); they must be covered by the rule. A risk-informed perspective would focus the most significant controls (i.e., work hour limitations) on the most risk-significant tasks. Other tasks, while of less risk significance, are still important and would be covered by the more general fitness for duty requirements of Part 26.

The Nature of fire watch work is such that work hour controls are basically irrelevant. A relevant issue with fire watches is that the work is inherently boring and industry experience indicates that keeping people awake even during routine work hours needs special consideration. As such, the industry has put in place numerous effective methods to ensure that posted fire watches are awake, even during normal work hours. Because of these considerations, as well as others, there is no reason to add fire watch personnel to the scope of a rule designed to control work hours.

Fire Brigade Coverage

The Work Hours Task Force does not believe the Fire Brigade should be covered by the work-hours portion of the Worker Fatigue Rule for the following reasons.

Overall Fire Risk

There is a common perception that fire risk is a major contributor to total plant risk. This perception is often used to justify conservative regulatory treatment of fire protection issues. While the perception is sometimes valid, there are other considerations to keep in mind:

- The total plant risk may be small (E-6 or less), so a large contributor to a small risk is still a small risk.
- Many plants calculated plant fire risk during the IPEEE (Individual Plant Examination for External Events) process using the EPRI FIVE analysis method. This method was a vulnerability analysis rather than a true calculation of risk, so risk numbers deriving from this method are frequently higher than the actual risk. On an industry-wide basis, therefore, the contribution of fire risk may well be overstated.

Because of the defense-in-depth principles incorporated into fire protection, there are a number of contributors to fire risk:

- Fire ignition frequency
- Fire growth probability (fuel type and quantity)
- Probability that fire detection will fail
- Probability that automatic suppression will fail
- Probability that manual suppression will fail
- Probability that a fire-damaged component or cable will fail
- Probability that a fire-induced failure will result in core damage

All of these failures must occur for a fire to result in core damage. Hence, each contributes some fraction to the overall fire risk.

Fire Brigade Contribution to Fire Risk

As noted above, it would be incorrect to equate any single factor to the overall fire risk. For instance, one should not assume that a failure of the fire brigade by itself is critical to plant fire risk, since other failures also have to occur. The impact on overall fire risk of a fire brigade failure is plant-specific, depending on the type and

location of the fire. In many cases the impact on overall risk is small. For others the fire brigade contribution is greater, but other failures still must occur for a fire brigade failure to have a high impact on plant fire risk.

Two examples illustrate fire events where brigade response plays little or no role in mitigating fire risk.

- For some types of fires the brigade can help minimize economic loss, but cannot prevent damage to the equipment itself no matter how rapid the intervention. Examples are: (1) Switchgear fire; (2) Diesel generator fire; (3) Large turbine generator fire.
- A large fraction of plant fires are very small ones that are detected and extinguished immediately by an individual with a fire extinguisher, not even requiring brigade response.

For these reasons it would not be correct to assume that a fire brigade performance failure (due to fatigue or other factors) has a significant impact on plant safety. In addition, fatigue is likely to cause, at worst, a degraded response by the fire brigade instead of an ineffective response. Thus, fire brigade fatigue is not likely to have a significant impact on plant safety. If one considers further that at many plants, fire brigade members are already under work hour restrictions for operational duties unrelated to fire protection, the imposition of additional restrictions seems quite unlikely to significantly improve plant risk. In additions, the inherent physical characteristics that result from responding to a fire are sufficient to overcome the potential and transient effects of fatigue.

Bases for Scoping Maintenance Functions:

To effectively manage the adverse effects of fatigue on maintenance to the extent practicable, the work hours of all maintenance personnel who are working on SSCs that a risk-informed evaluation process has determined to be significant to the public health and safety should be controlled in accordance with the work hours control provisions of 10 CFR Part 26.

Outage Scheduling Practices

The final outcome will involve both rule language and implementation guidance. For the rule, during outages, work can be scheduled for up to 72 hours per week with a minimum of 10 hours off between shifts.

The revised oversight process requires management to take the actions necessary to obtain the desired performance outcome. Management assesses situations on an ongoing basis and responds accordingly. Therefore, outage duration limits are not necessary. Implementation guidance could discuss the process of management assessment of work hours during outages, and could ensure the proper attention is brought to bear without specifying particular actions in terms of calendar time.

In addition, comment three in the January 10, 2002 SRM states that, "The staff must give serious consideration to the need for management flexibility to deal with unforeseen and emergent work at their plants, while they proceed with the rulemaking." And, in keeping with the sixth comment from the same SRM, the current policy limits are inadequate because they have been eclipsed by recent risk informed and performance based procedures. The Reactor Oversight Process was not available to inform Generic Letter 82.12, and therefore crediting management prerogatives was not necessarily in the formal regulatory lexicon.

Work Hour Extension Error Management Measures

Prior to approval of work hour extensions, consideration should be given to additional prudent measures to manage the potential for and consequences of fatigue related errors. The focus of these measures is on the individual. These measures are intended to supplement, not duplicate, the measures that have been taken as a result of the management of the risk of the plant configuration. Plant configuration risk is managed by licensee processes that implement the Maintenance Rule.

The difference between these processes can be illustrated by example. Examples of measures that may be taken to manage plant configuration risk include protection of additional trains of the same system and prevention of work on other plant SSCs that contribute to prevention or mitigation of important accident sequences. These measures are governed by the Maintenance Rule and are focused on the configuration of the plant at the time. Examples of measures that may be taken to manage the potential for and consequences of fatigue related errors by the individual(s) approved for extended work hours include supervisor observation of work in progress, peer checks, QC checks, and post maintenance tests. These measures are governed by the proposed rule and are focused on the individual(s) working the extended hours.

[To address granting work hour extensions in rule space, a “formal approval process for work hours extensions is required.” An example of an implementation procedure to address the rule language is found in Appendix A.]

DRAFT APPENDIX A

Work Hour Extension

Date _____

Time _____

Employee: _____

Work hour limits to be exceeded: _____

Approved number of hours to be worked: _____

Worker Fatigue Evaluation Completed:

Name _____ **Title** _____

Work Scope Evaluation Completed:

- **Task description** _____
- **Reason(s)for continuance** _____
- **Reason(s) for personnel selection** _____
- **Specific fatigue management strategies in place** _____

Name _____ **Title** _____

Overall Continuance Authorization: (Plant Manager or designee)

Name _____ **Title** _____

Turnover Considerations

Definition of Turnover: (Rule Space)

Turnover includes activities needed to safely hand off responsibilities between two or more individuals between shift periods. Examples include discussions of the status of the plant equipment, and status of ongoing activities such as operation of tests of SSCs. Turnover is meant to apply to handoffs between shifts, not handoffs between individuals within a shift period due to rotations or relief within a shift. [Example activities not meant to be included in turnovers would be shift holdovers to cover for late arrivals of incoming shift members, early arrival of individuals for meetings, training or pre-shift briefings for special evolutions, and holdovers for interviews needed for event investigations].

Treatment of Turnover: (Implementation Space)

Turnovers are not counted toward work hours limits in order to prevent placing any time pressures on the turnover process. Normal turnovers should be accomplished within 30-45 minutes. It is recognized that turnover duration is related to the amount and complexity of information that must be transferred. Turnovers associated with transients, high risk activities , or full work schedules may result in occasional turnovers that exceed the guidelines.

Proposed Attributes of Program Effectiveness Measures

The Task Force, after extensive research, is convinced that the Reactor Oversight Program is the most potent performance-based vehicle for evaluating the effectiveness of any industry program. The Reactor Oversight Process (ROP) is a risk-informed, performance-based system of objective outcomes (performance indicators and inspection findings) which aids the NRC in determining how and where to assign its inspection resources beyond a baseline level of inspection. Specifically, the ROP does not focus on causes of performance outcomes until a performance threshold is exceeded. The ROP, while requiring compliance with the regulations and licensee commitments, provides flexibility to licensees in how best to correct deficiencies of very low safety significance. In fact, the system includes four graduated levels of performance, ranging from outcomes of very low safety significance (green, risk less than $1E-6$ of core damage); low to moderate safety significance (white, risk of core damage between $1E-6$ and $1E-5$); substantial safety significance (yellow, risk of core damage between $1E-5$ and $1E-4$); and high safety significance (red, risk of core damage greater than $1E-4$). Inspection findings which are of very low safety significance do not require additional NRC supplemental inspection; they need only be corrected. As performance outcomes decline, NRC inspection intensifies and becomes more involved in the underlying root causes and the work processes. This graduated system provides an early warning system of problems as performance declines.

Performance is assessed in seven cornerstones of safety. Underlying the performance indicators and findings related to the seven cornerstones are “cross cutting” issues. The most important of these relate to human performance, for example, problem identification and resolution, and safety conscious work environment. Licensees have the flexibility to develop management tools and performance indicators on a plant specific basis to monitor their performance in these cross cutting areas. There is baseline inspection in problem identification and resolution, but licensees are expected to develop their own management systems as appropriate to their culture and individual needs. NRC acknowledges that human systems differ at each plant, and therefore trying to develop industry common human performance indicators is problematic.

With respect to the issue of fatigue, the philosophy of the ROP is that it is a subset of the human performance cross cutting issue, in that it is a potential cause of a performance outcome, but not an outcome itself. If performance is in the Licensee Response Band (all green, no issues of greater than very minor safety significance), the NRC conducts baseline inspections which would assess

the potential for fatigue issues in at least two areas: the problem identification and resolution module which looks at the corrective action programs ability to identify causes and to trend them, and the fitness for duty module, which includes the behavior observation program, which should include assessment of fatigue. If the ROP performance indicators or inspection findings demonstrate some declining performance with more than minor safety significance, the licensee must perform a root cause analysis and determine the cause. Among all the potential causes, one may be fatigue. NRC supplemental inspection is used to determine whether the root cause analysis and corrective action are appropriate. Should performance continue to decline, the NRC broadens its supplemental inspection activities appropriately. Thus any fatigue issues that arise should either be addressed by existing inspection, or by supplemental inspection.

NRC manages its inspection resources based on performance outcomes of safety significance. Licensees apply management tools to maintain performance in the green band. These management tools include plant specific performance indicators as appropriate to the plant culture and needs. When performance outcomes decline, licensees determine the causes and the NRC inspects the licensees' actions.

If fatigue is a safety issue, it will be manifest in declining performance outcomes and identified through root cause analysis. If a fatigue issue is discovered and is of very low safety significance, it should be entered in the licensee's corrective action program and trended. NRC need not waste its resources on issue of very low safety significance.

Fatigue, to our knowledge, has not been identified as the root cause for safety performance declines in the ROP. Even if it were, ROP processes are adequate to assess fatigue issues at an appropriate level and to correct them. Licensees shall continue to monitor fatigue issues through the cause analysis and trending programs in corrective action programs, and through their fitness for duty behavior observation programs. Unless there is an observed problem with safety significance beyond very minor, or a safety significant trend in fatigue issues, the NRC should allow licensees to manage their own human resources without wasteful NRC regulation.

Self Declarations

The Task Force encourages self declaration in accordance with NRC Regulatory Issue Summary 2002-07. Maintaining a record of self declarations has been evaluated and found potentially counter productive to the two goals articulated in the opening paragraph of this section, for the following reasons. If an individual comes to work and self declares based on feeling ill or tired, and it is unrelated to work hours, then how would collecting that information help the industry with respect to work hours? Industry personnel would certainly want to work with the individual on time off to ensure he or she returns fit for duty, but the task force does not see the value in collecting information on self declarations. Additionally, the task force would not want to discourage self declarations because they are being counted and records are being maintained (potential "chilling effect").