

**Written Statement of Joseph H. Boardman,
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before the
Subcommittee on Railroads, Pipelines, and Hazardous Materials,
Committee on Transportation and Infrastructure,
U.S. House of Representatives**

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Chairwoman Brown, Ranking Member Shuster, and other members of the Subcommittee, I am very pleased to be here today, on behalf of the Secretary of Transportation, to testify regarding the issue of fatigue and its relationship to the safety of railroad operations. In my testimony last July 25th regarding the broader topic of railroad safety human factors, I outlined eight requirements that must be addressed in order to maximize safety and minimize risks:

1. The worker's task needs to be well defined, and the rules and procedures for its accomplishment must be effective, clear, and unambiguous.
2. Rules and procedures must be well understood, and skills must be practiced.
3. Everyone must be accountable.
4. The organization must nourish a positive safety culture.
5. All personnel must learn how to work constructively together.
6. Individual employees must be fit for duty—rested, free of alcohol and drugs that could impair their faculties, and free of other disabling medical conditions.
7. Technology must be part of the solution, not part of the problem.
8. Impediments to working safely must be identified and removed.

Clearly, these elements are not mutually exclusive, and none can be satisfied with full assurance at any given point in time. Our institutions and our people, including ourselves, are imperfect, and given to occasional error. But each of us can do better if we are provided an appropriate work environment, and we can put in place supporting structures that will catch us when we fall. Since I testified on human factors last July, the Federal Railroad Administration (FRA) has been busy with a variety of human-factor initiatives, among them publication of a proposed rule addressing key railroad operating rules and the management of programs of operational tests. Indeed, one of the pillars of FRA's National Rail Safety Action Plan is the reduction of accidents caused by human factors, and that involves addressing the serious problem of fatigue among railroad employees.

It is particularly timely that the Subcommittee should call for testimony on the subject of fatigue. We have progress to report, and we intend to submit to Congress a rail safety reauthorization bill that will include an important new provision on hours of service reform.

Background

For each of us to be fully effective in our work, we need to be well rested and alert. The issue of fatigue is particularly critical to the safe discharge of duties in railroad operations. This was first recognized by the Congress 100 years ago, with passage of the Hours of Service Act.

What is “fatigue”? In order to be scientifically sound, we will use the definition found in the Department of Transportation’s (DOT) March 1999 policy statement on fatigue: “a complex state characterized by a lack of alertness and reduced mental and physical performance, often accompanied by drowsiness.” Fatigue certainly includes lack of alertness (i.e., sleepiness), but also involves compromised attention to detail and diminished ability to reason rapidly and clearly in order to respond to changing circumstances. The DOT policy statement goes on to summarize the sources of fatigue.

Fatigue may be caused or exacerbated by any or all of the following: lack of sleep, disruptive work/rest cycles, neurological conditions, excess mental or physical workload, exposure to extreme physical conditions, emotional stress, the use of drugs or alcohol, illness, and/or monotony.

FRA has sought to promote railroad employees’ fitness for duty through enforcement of the hours of service laws (which, since 1994, have been codified as positive law at 49 U.S.C. 21101 et seq.), as well as through joint efforts with railroads and employee organizations, research, analysis, and participation in the North American Rail Alertness Partnership (NARAP). In addition, both FRA and the National Transportation Safety Board (NTSB) have sought to understand the role of fatigue in significant rail accidents.

When I appeared before the Subcommittee last July, I reviewed some of the programs in which we were participating that were directed at risk reduction with respect to fatigue. Today, I’d like to review with you the culmination of rapid developments that have occurred over the past several years that have improved our understanding of the origins and dimensions of fatigue and that have provided better tools for fatigue prevention and mitigation. Then I’d like to describe some of the new efforts underway to address fatigue, and finally I’d like to ask for your consideration of the hours of service reform provision that FRA intends to submit.

Growing Knowledge of Fatigue, Better Tools to Prevent and Mitigate It

Both railroads and employee organizations are heavily invested in their work practices and collective bargaining agreements. Railroads owe their shareholders a duty to make a reasonable profit, and they owe their customers reliable service. Labor organizations must consider the interest of some members in maximizing earnings. Neither labor nor management is inclined to undertake or sustain initiatives that, however well intentioned, do not contribute to the overall well-being of the industry in a way that

can be clearly established. Railroads operate 24 hours each day, and the demands of the market are constantly shifting. Take these factors together, and they describe a situation that is hostile to fatigue management. Let me be clear that it is not the railroad executives, or the rail labor executives, or their colleagues who are hostile. Quite the contrary; rather, it is the institutional situation.

Accordingly, it has been critically important that we clearly understand the true dimensions of the fatigue problem and that we formulate approaches that can effectively address the problem while avoiding unnecessary disruptions of stakeholder expectations and transportation service.

Over the past two decades, significant progress has been made in sleep science and in our understanding of the role of fatigue in our daily lives. The NTSB has played a salutary role in calling out fatigue as a factor in at least 18 rail accidents since 1984. FRA-funded research has used an integrated strategic planning and evaluation strategy of field data collection, laboratory simulations, and analysis and evaluation of Fatigue Management Systems to enrich our knowledge of fatigue as it affects employees in a wide range of railroad occupations. This multi-faceted research has resulted in a strategic fatigue roadmap for FRA that identifies work scheduling as one of the top policy issues, and a key starting point for addressing the fatigue problem in the rail industry today.

FRA's analysis of data gathered by our Switching Operations Fatality Analysis (SOFA) Working Group indicates that fatigue (largely related to biological rhythms or time of day) was likely responsible for more than 22 percent of the risk of SOFA severe incidents from 1997 through 2003. Last July, FRA released the Collision Analysis Report, which identified compromised alertness as a likely significant factor in 29 percent of the collisions reviewed in detail by a panel of railroad subject matter experts representing labor, management, and the Federal government.

On November 29, 2006, we announced the release of an important new study entitled Validation and Calibration of a Fatigue Assessment Tool for Railroad Work Schedules (the Validation Study), which confirmed the applicability of a Department of Defense fatigue model to railroad operations. The Summary Report from that study described the relationship between fatigue and human-factor train accidents. The study is the largest and most rigorous of its kind, based on review of 30-day work histories of locomotive crews involved in 400 human-factor and 1,000 other train accidents. The data from the model validation study showed that there is a reliable relationship between the time of day of human-factor accidents and the expected, normal circadian rhythm. This circadian pattern was not reliably present for accidents not caused by human factors. The risk of a human-factor accident was increased by 20 percent by working during the hours from midnight to 3 a.m.

The results of this accident analysis study indicated that a fatigue model could predict an increased risk of human-factor accidents under certain conditions that cause fatigue. A bio-mathematical fatigue model, known as SAFTE (Sleep, Activity, Fatigue, and Task Effectiveness), was used to estimate crew cognitive effectiveness based entirely

on work schedule information and opportunities to obtain sleep. Effectiveness is a metric that tracks speed of performance on a simple reaction-time test and is strongly related to overall cognitive speed, vigilance, and the probability of lapses. The model rates effectiveness on a scale from 0 to 100. There was a reliable linear relationship between crew effectiveness (fatigue) and the risk of a human-factor accident: as crew effectiveness declined, human-factor accident risk went up. No such relationship was found for accidents not caused by human factors. This result satisfied the criteria for model validation. The risk of human-factor accidents was elevated at any effectiveness score below 90 and increased progressively with reduced effectiveness. There was a reliable time-of-day variation in human-factor accidents, but not in accidents not caused by human factors. Human-factor accident risk increased reliably when effectiveness was below 70, a value that is the rough equivalent of a 0.08 blood alcohol level or being awake for 21 hours following an eight-hour sleep period the previous night. Below an effectiveness score of 70, accident cause codes (codes defined by FRA that indicate the factors that caused the accident, such as passing a stop signal or exceeding authorized speed) were of the sort expected in situations involving fatigue, confirming that the relationship between accident risk and effectiveness was meaningful. If an individual had an effectiveness score of less than or equal to 50, his or her chance of having a human-factor accident was increased 65 percent.

Although the Validation Study was designed to test a fatigue model rather than determine the role of fatigue in specific accidents, the data from the study necessarily imply two conclusions:

- From the data available, the majority of human-factor train accidents do not involve fatigue.
- However, a significant number of the most serious accidents (e.g., violation of a mandatory directive or failure to comply with a stop signal) do appear to include fatigue as a significant factor.

FRA has explored the dimensions of the fatigue issue in the working lives of not only train crew members but also other categories of railroad employees. In a final report dated October 2006, entitled Work Schedules and Sleep Patterns of Railroad Signalmen, FRA posits that signal maintainers could be adversely affected by unscheduled trouble calls on top of their normal eight-hour workdays. This survey-based study was facilitated by the Brotherhood of Railroad Signalmen. In a final report published in December 2006, entitled Work Schedules and Sleep Patterns of Railroad Maintenance of Way Workers, FRA researchers described the challenges that track workers face in remaining well rested. This report was facilitated by the Brotherhood of Maintenance of Way Employees Division. It is important to note that neither of these studies described any situation of egregiously overscheduled employees. Rather, the studies provide an enhanced foundation for fatigue management in those occupations.

The Collision Avoidance Working Group (CAWG), which produced the Collision Analysis Report referred to above, examined 65 main-track train collisions in which

human-factor causes contributed to trains exceeding their authority by passing a stop signal, failing to comply with a restricted speed signal, or entering territory without authority. CAWG found that 19 of the 65 accidents (29 percent) involved “impaired alertness” (defined as failing to take appropriate actions to avoid the accident). In the accident sample for the model validation study, 38 percent of similar accidents had effectiveness scores of 70 or below. Nearly all of the 19 CAWG collisions occurred between midnight and eight in the morning, which indicates a strong circadian effect.

Industry, FRA, and Joint Fatigue Management Efforts

In the railroad safety effort, our common perception of the problem of fatigue is perhaps best exemplified by the service crisis of 2004. In that year, a major Western railroad found itself with too few employees and more traffic than it could efficiently handle. The result was clogged main lines, hundreds of “recrews” daily (as legal limits on hours of service stopped trains en route), confusion and delays in getting crews off trains, and some serious accidents that may have arisen from fatigue. Other carriers faced challenges as well. Some local labor agreements that might have acted as a check on the problem had been abandoned, either by the railroad or the labor organizations. FRA tried to help through the Safety Assurance and Compliance Program, but solutions did not take effect for some time. All concerned will freely concede that it was not their finest hour.

We are past that period of time, but we know that over-scheduling can and does occur, and the future will have its own challenges. The national rail system is very robust and capable, but it is subject to disruptions from natural disasters, unexpected service demands, and infrastructure needs that are not promptly addressed. These circumstances, and everyday difficulties, present the risk that work schedules may not be effectively managed.

Even given the best work-scheduling practices, fatigue remains a concern in any transportation mode because opportunities for rest must be effectively utilized, and individual employees may be prevented from taking advantage of these opportunities by sleep disorders, poor sleep hygiene, the demands of normal family life, or other factors. It is critically important that employees know how to get effective rest and that they appreciate the importance of doing so. As will be discussed below, FRA has provided tools and funding to assist the railroad industry in evaluating work schedules, and these efforts are sure to continue.

Over the past decade, labor and management, supported by FRA, have made significant efforts to address these needs. At the national level, NARAP serves as an ongoing forum for dialogue regarding present challenges, results of research, and products of voluntary efforts. Railroads and rail labor organizations have made significant efforts to deliver fatigue training programs and ensure ongoing awareness. Major railroads have adopted policies to permit individual crew members to take restorative short naps on board trains while stopped.

Railroads, sometimes in concert with labor organizations, have tried a remarkable variety of scheduling options to prevent fatigue. Among the options implemented by the carriers are assigned workdays (e.g., either seven days on and one day off, or eight days on and two days off); minimum undisturbed rest hours (normally 10 hours); automatic markups (employees returning from extended absences not assigned duty until the next day);¹ and use of “call windows,” in which employees are assigned a specific time period for reporting for duty.²

While the industry has taken significant steps toward addressing fatigue issues, the various mitigation measures implemented have resulted in only limited success at either the industry-wide or carrier-system-wide level. This variance is due to a number of factors ranging from operating idiosyncrasies (market demands), to staffing and retention issues, and provisions in collective bargaining agreements. While programs related to minimum undisturbed rest are common throughout the industry, implementation varies significantly between carriers and even among specific locations within one carrier’s organization. For example, a carrier’s policies related to minimum undisturbed rest hours at one location may be mandatory, while at another location the policies are optional. This dichotomy also exists for other fatigue mitigation measures.

As evidenced by analysis of data in the Validation Study, which included the worst of the service crisis, these efforts have had some success. The Validation Study clearly reflects the fact that, assuming that the railroad operating employees have taken advantage of sleep opportunities, most of these employees work at a high level of effectiveness most of the time. However, given the very uneven application of fatigue countermeasures in the industry, we cannot say that the threat of fatigue-caused accidents and injuries has abated. Clearly, then, more comprehensive responses are warranted.

Given the availability of the recently validated and calibrated SAFTE fatigue model, there are new opportunities to schedule the work of railroad operating employees more carefully. To hasten the implementation of corporate fatigue risk management strategies, FRA has initiated a complementary effort to develop a workforce fatigue risk management tool called the Schedule Fatigue Risk Management (SFRM) Tool. This tool uses the same methodology as the Validation Study but is able to process work schedule data from an entire workforce and provide standardized reports to assist a company in evaluating levels of work schedule-induced fatigue that exist at specific work sites or

¹ Automatic markup procedures help to ensure that employees returning from extended leave have the opportunity to obtain adequate rest prior to a duty assignment. Prior to implementation of these procedures, employees returning to work could be assigned duties commencing at midnight regardless of their sleep patterns during leave. In the absence of these procedures, employees could experience symptoms of fatigue in the form of performance degradation and diminished cognitive abilities. The collision between Union Pacific Railroad Company (Union Pacific) trains near Delia, Kansas on July 2, 1997 (RAR-99/04) resulted, in part, from the absence of adequate markup procedures

² The use of call windows is intended to provide an employee a predictability indicator, within a specific period of time, of his or her next scheduled duty assignment. Call windows are normally four-hour periods, e.g., 8:00 a.m. to noon, and the selection of a specific call window is governed by collective bargaining agreements, including seniority rights.

within certain work groups. By incorporating the features of SFRM and SAFTE under a single “umbrella,” the railroad industry will have the ability to assess the impact of fatigue from both a systemic and individual perspective.

With funding from FRA, Union Pacific has entered into a cooperative arrangement with the Institutes for Behavior Resources (IBR) and the developer of the SAFTE model to share work schedule information on employee work groups within the Union Pacific system. IBR will provide Union Pacific with detailed fatigue evaluations across work groups and geographic locations as part of a comprehensive system-wide fatigue analysis using SFRM. Following this initial evaluation, IBR will design a program that the Union Pacific crew management department can use to routinely evaluate fatigue using the SAFTE model. We believe other major railroads will take advantage of this developing analytical capability, but we will be certain only as we see the tools matured and applied.

FRA’s Office of Research and Development and Office of Safety are currently working to establish a state-of-the-art educational website that employees and small railroads can utilize to provide fatigue management information and tools. The website will include items such as sleep disorder screening that are tailored to the railroad workplace. The major freight railroads are working separately with the University of Denver on a website that will provide additional, and updated, fatigue training curricula for use by railroad training departments.

The NTSB has emphasized the role of sleep disorders in transportation accidents, and we recognize that providing fatigue management information alone may not be sufficient. In October 2004, FRA published a safety advisory in the Federal Register, urging railroads to address sleep disorders through progressive company policies. This past September, FRA’s Railroad Safety Advisory Committee adopted a task to develop recommendations on medical standards for safety-critical railroad employees. Management of sleep disorders is among the important elements of that effort, which is now well underway.

It is important to remind ourselves that fatigue affecting individuals occurs in a larger context. As we noted in reciting the discussion of fatigue in DOT’s policy statement, reduced effectiveness associated with fatigue may derive, in part, from more than simply unfavorable work schedules. For instance, depression can adversely affect sleep and contribute to fatigue. In 2006, FRA entered into two contracts with a Class I carrier to study the symptoms of sleep disorders and depression within the industry. Findings from these studies will be available in mid-2007. Another year-long contract will soon be awarded to study the role of stress in performance and safety. Objectives of these studies include identifying employees with medical ailments, establishing screening and diagnostic protocols, and implementing comprehensive programs of intervention. The target audiences for these studies are primarily employees in the operating crafts (e.g., engineers and conductors). Participation in the studies is voluntary, and the cooperation and support of labor officials are essential.

Finally, we know that not all risk associated with fatigue and other human performance challenges can be eliminated. For example, the Validation Study called attention to the fact that, even under the best of circumstances, those working in the early morning hours are not as effective as they would be working during other periods. Accordingly, it is important that we fashion strategies that guard against the consequences of reduced effectiveness. Crew Resource Management (CRM) techniques, which encourage employees to watch out for one another and to challenge one another to work safely, have been applied somewhat sparingly in the training of railroad employees. FRA has been working with the BNSF Railway Company (BNSF) to develop more effective CRM training. This year, we will also publish a study by the Texas Transportation Institute addressing the business case for CRM.

Innovative programs such as the Close Call Confidential Reporting System, which is proposed in the 2008 budget, promise new insights into the causes of human-factor accidents and incidents, and FRA looks forward to harvesting insights from the first pilot project, which is now underway, and from subsequent implementations.

With respect to train operations, Positive Train Control (PTC) systems offer significant promise of providing a safety net for occasional errors associated with fatigue. In December, FRA approved the first Product Safety Plan for a PTC system designed to serve the freight railroad industry—BNSF’s Electronic Train Management System. We are working aggressively to facilitate introduction of this technology.

Taken together with other literature, the Validation Study provides a scientific basis for managing the work schedules of railroad operating employees. As noted above, that study indicates that most train and engine crews have ample opportunity to gain rest and remain effective most of the time. Coupled with more refined tools to deal with those schedules that do present excessive risk, this realization provides a foundation for optimism that the railroads and labor organizations will deal with this issue in ways that do not interfere significantly with settled expectations regarding availability of crews and the opportunity to achieve earnings.

If the Subcommittee would like more detailed information regarding FRA’s fatigue research efforts and fatigue management initiatives, we would be happy to schedule a briefing.

Role for Legislation

The Secretary intends to submit to the Congress the Bush Administration’s rail safety reauthorization bill, the Federal Railroad Safety Accountability and Improvement Act. This bill would reauthorize appropriations for FRA to carry out its rail safety mission for four years and proposes a number of other measures that would significantly advance rail safety, primarily by fostering railroads’ accountability for their safety performance, by reducing the fatigue of safety-critical workers, and by preventing

collisions at highway-rail crossings. Given the subject of this hearing, I will focus only on the fatigue provision of the bill.

To help improve the alertness of railroad operating personnel, the bill would permit FRA, as the Secretary's delegate, to replace the hours of service laws with scientifically based regulations, after first seeking consensus recommendations from the agency's Railroad Safety Advisory Committee. The hours of service laws, first enacted in 1907 and currently delegated to FRA to administer, contain no substantive rulemaking authority over duty hours. FRA's lack of regulatory authority over duty hours, unique to FRA among all the safety regulatory agencies in the Department, precludes FRA from making use of almost a century of scientific learning on the issue of sleep-wake cycles and fatigue-induced performance failures. FRA's general safety rulemaking power under chapter 201 of title 49 would provide ample authority to deal with the entire subject of maximum work periods and minimum rest periods in light of current research on those subjects; however, the hours of service laws effectively bar such a rational regulatory initiative because the chapter 201 authority may be used only to supplement the pre-1970 railroad safety statutes, not to supplant them. Where the hours of service laws set a rigid requirement, e.g., maximum on-duty and minimum off-duty periods for train crews, a regulation could not lawfully vary from them. FRA would refrain from adopting new requirements relating to fatigue if the agency determines that voluntary activities are adequately addressing topics of concern, and the agency would be authorized to allow a railroad to comply with an approved fatigue management plan as an alternative to compliance with the usual regulatory regimen. The regulations that would be issued under the provision would be subject to review under the Congressional Review Act (5 U.S.C. 801) as the sole and exclusive means of review.

Conclusion

Fatigue presents risk in any mode of transportation, as well as in other industrial workplaces. The railroad industry and its employees understand the factors that cause fatigue, and they have made significant strides in addressing them. Nevertheless, fatigue continues to contribute to railroad accidents and personal injuries. We must do better in preventing and managing it.

I think a reasonable person could look at the objective situation and find much basis for optimism. Consider these points:

- Although, by all accounts, fatigue is still a problem, it is not at epidemic levels in the industry. This means that we should be able to address the fatigue that does remain, at an affordable cost to employers and employees.
- Thanks to the growing body of knowledge regarding accident causation, we know that we have an issue that we cannot avoid. The time to hesitate, if there was such a time, is certainly over now.

- The Validation Study and other work now confirm our ability to create models that can undergird future crew scheduling, and a major railroad is already working with FRA to make use of it. We have the potential to manage this issue using a performance-based approach.
- Leaders of rail labor organizations are showing courage by taking on this issue, and this Congress has shown a bipartisan interest in addressing fatigue in the railroad industry.
- The Department of Transportation intends to offer an important hours of service reform proposal that promises real change in this safety-critical area.

When you put all of this discussion together, it is good news for safer rail transportation and for the people who provide it. We can do better in helping to keep rail employees alert and effective through careful scheduling of work, and we can help those employees contribute through training, awareness efforts, and management of sleep disorders. We are eager to move forward with all of the efforts I have described. Thank you for the opportunity to address this important issue.