



A BLET Reference Manual of Railroad Worker Fatigue

A Report Prepared for the

Brotherhood of Locomotive Engineers & Trainmen

A Division of the Railway Conference of the

International Brotherhood of Teamsters

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## Executive Summary

This reference manual was produced for BLET leaders as a resource to use when addressing fatigue issues in the railroad industry. The reference manual provides background information for fatigue.

After introducing the utility of fatigue management plans around the world for reducing railroad worker fatigue, a BLET fatigue management plan is outlined. The five major elements of the BLET fatigue management plan include Education, Medical Aspects of Fatigue, Critical Aspects of Fatigue, Chronic Aspects of Fatigue, and Evaluation.

The reference manual concludes with three strategies for resolving railroad worker fatigue. The three strategies are 1) a preferred non-prescriptive approach using the BLET fatigue management plan; 2) a prescriptive approach through the FRA RSAC process again using the BLET fatigue management plan as a template; and 3) a statute achieved through a Congressional mandate of four elements that addresses the 5 major aspects envisioned by the BLET fatigue management plan.

A toolbox of fatigue countermeasures divided into the five major elements of the BLET plan for possible implementation in receptive railroad operations is provided as an appendix.

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## INTRODUCTION

The purpose of this reference guide is to provide leaders of the Brotherhood of Locomotive Engineers & Trainmen with an update of research, issues, and strategies effecting railroad worker fatigue. Starting with a short background of recent efforts to resolve fatigue issues for engineers and trainmen, the guide goes on to outline the fatigue issue and ongoing efforts to provide a solution for members of the BLET.

Efforts to resolve fatigue are explored first and foremost with a focus on non-prescriptive solutions intended to resolve the fatigue issue without prescriptive intervention by government, either by regulation or statute. Non-prescriptive efforts involve cooperation between labor and management to forge effective fatigue management plans for each railroad in the US. Railroads in the US frequently operate jointly or overlap each others rail operations. A single railroad solution will be useless if a railroad jointly operating track is free to ignore the fatigue problem within its own operation. Further, an effective Fatigue Management Plan necessarily must include all sorts of railroad operations and include all railroad workers on a given railroad.

A timeline for resolving railroad worker fatigue using non-prescriptive efforts suggests that the BLET adopt a deadline for a successful solution of these efforts. At some point in time, the BLET must determine if a non-prescriptive approach to resolving railroad worker fatigue is feasible based on:

- effectiveness---do they work to reduce worker fatigue
- comprehensiveness---do they address all aspects of railroad worker fatigue
- inclusiveness---are all railroads in the US participating in the solution

Finally, in the absence of a satisfactory non-prescriptive fatigue resolution, two prescriptive strategies are discussed: a regulatory effort through the FRA and a Federal statute passed by the US Congress. All three prescriptive and non-prescriptive efforts are focused on mitigating the three “Aspects of Fatigue” that concern engineers and trainmen: medical aspects, critical aspects, and chronic aspects of fatigue.

### **Background: The 2002 BLE Proposal – E.I.E.**

In September 2002, the BLET, formerly the Brotherhood of Locomotive Engineers, proposed a solution to fatigue in the railroad industry. The proposed solution was based on a belief that if the railroads, government, and labor would come together in good faith, the problem of railroad worker fatigue could be resolved.

More than just a Pollyanna suggestion, the proposal entitled Education, Information, and Empowerment (E.I.E.), envisioned using a “systems” approach to mitigate serious fatigue plaguing the railroad industry. Railroad worker fatigue results in millions of dollars of damage from accidents each year and has been identified by the National Transportation Safety Board (NTSB) as a contributing cause of railroad worker fatalities. Generally, the 2002 BLE fatigue proposal suggested that if:

- 1) railroad workers were educated about fatigue and how to avoid it, and
- 2) if Management and Labor would work together exchanging information about improving schedules and other work practices that contributed to fatigue, and

- 3) if railroad workers were permitted to absent themselves from duty if their individual fatigue interfered with their ability to safely perform their duties;

then fatigue in the railroad industry could be resolved for the good of management and labor. In this suggested proposal, government was seen as an arbiter and a facilitator to ensure success of the overall process, but the solution would be non-prescriptive (no government regulation.)

The E.I.E. initiative met with indifference from both management of the nations railroads and the government agencies mandated to address railroad worker safety. Throughout 2003, railroad management continued to “pay lip” service to resolving worker fatigue and the Federal Railroad Administration (FRA) acquiesced to railroad management indifference to the fatigue problem.

However, railroad safety bills introduced in Congress included sections mandating the Department of Transportation (DOT) to address railroad worker fatigue by requiring railroads to institute individual fatigue management plans. In addition, the NTSB is applying pressure to the railroad industry to address railroad worker fatigue after investigating recent railroad accidents. Researchers are nearing completion of computer programs that they argue can be used to identify railroad worker fatigue in post-accident analysis. The FRA, responding to public and political concerns, are preparing to support the validation of the computer fatigue models in order to move toward a resolution of unsafe levels of fatigue in the railroad industry.

In addition, on September 21, 2004, the FRA issued an advisory to the railroad industry based upon NTSB recommendations that attempts to encourage the industry to adopt fatigue countermeasures for “sleep apnea.” The recommendation is a very narrow response to the NTSB recommendations. It encourages action by the railroads on part of the fatigue issue. The BLET concerns with fatigue go far beyond the NTSB recommendations and the FRA advisory.

With these pressures, the industry has made tentative moves toward mitigating the problem of railroad worker fatigue. The industry has begun to re-energize the Work / Rest Task Force that began looking for an industry solution in the late 1990’s. However, railroad efforts can be described as tentative, uneven, and at times intended to delay a solution to the railroad worker fatigue issue.

### **The Fatigue Problem in the Railroad Industry**

Railroad worker fatigue has plagued the industry from the founding of railroads. Signs and symptoms of fatigue include forgetfulness, poor communication, a bad mood, poor decision-making, fixating, nodding off, slowed reaction time, apathy, itchy eyes, reduced attention, lethargy, and/or a need to sit or rest (5). However, there is no scientific definition of fatigue accepted by the US railroad industry.

Beginning in the late 1980’s, the NTSB identified railroad worker fatigue in several severe railroad accidents. By the early 1990’s, the NTSB focused on fatigue as one of its top concerns to improve safety in the railroad industry.

Since that time, several proposals from labor and management have resulted in minor changes, some successful pilot projects that were never expanded, and considerable resistance from government, management, and even some labor to resolve

railroad worker fatigue. Attempting to overcome this resistance and resolve railroad worker fatigue are concerned families, safety experts, and some government officials.

Understanding the resistance to change in the most oversimplified terms means addressing the tensions each group is experiencing. For labor, a tension exists between earning potential and fatigue from overworking. This tension exists with a host of qualifications given the individual's personal experience, but generally includes family commitments, personal commitments, and social needs. However, in a recent survey by the BLET, 89.1% of BLET members responding said work/rest cycles were important or extremely important. Also, 88.3% of BLET members responding identified layoff provisions as important or extremely important. BLET members are asking with gusto for a solution to the fatigue problem.

For Management, railroad worker fatigue exists in a tension between defined employee availability and economic corporate self-interest. This tension is mitigated by scientific advances that may result in legal liability for using fatigued workers in railroad operations. For example, New Jersey is the first state to define fatigue as failing to sleep in the previous 24 hour period. This law imposes legal liability to the fatigued individual; however, the Insurance Journal (7) reports that industries that mandate irregular and excessive work schedules may soon face new liability issues from fatigued workers.

For Government, railroad worker fatigue exists in a tension between addressing railroad worker and public safety while at the same time avoiding government intervention into the "free markets" of railroad operations. This tension exists within a political environment that could potentially change drastically in the near future.

Within this shrinking acceptance of railroad worker fatigue, there exists a small window of opportunity to comprehensively address railroad worker fatigue from a scientific formulation without government intervention. The Work/Rest Task force is pursuing this non-prescriptive effort in order to avoid the mandates of federal regulation. The Work/Rest Task Force believes that federal mandates will entirely eliminate options enjoyed by railroad workers and railroads alike. For example, mandated 7 days available for work followed by 3 days of rest (7 & 3) might be acceptable to workers on one railroad while at the same time entirely unacceptable to railroad workers on another railroad. This is one prescriptive solution advocated by some interests in the railroad industry. Therefore, in order to provide a framework that comprehensively addresses railroad worker fatigue in the US, while at the same time retaining as many options for a diverse worker population, the work/rest task force is pursuing the concept of "Fatigue Management Plans."

## **FATIGUE MANAGEMENT PLANS**

### **Around the World**

In Europe, a social compact has resulted in a work ethic that prescribes a certain maximum expectation on the number of hours and days worked by industrial workers. Processes have been introduced that define the acceptable or society norm for work and rest in many European countries. These processes have led to a foundation or definition of acceptable and unsafe levels of fatigue in the work place.

Australia on the other hand, has attempted to incorporate scientific research of worker fatigue as a basis for prescribing a process that is designed to mitigate fatigue

resulting in railroad operations. This “outcome” orientation suggests that the process is variable within the confines of the Australian legal system, however the outcome must be to eliminate unsafe levels of railroad worker fatigue. The Australian model mandates individual responsibility by railroad workers for their fatigue and prescribes penalties for the failure of railroad workers to be rested while performing railroad service.

Canada has employed a hybrid model of scientific and social processes in order to develop “Fatigue Management Plans” that mandate fatigue mitigation for every railroad schedule within a railroad operation. Using a process model involving labor, government and management working together to resolve complex fatigue issues that is distinct to the Canadian political/legal system, Canadian railroads operate with individually fashioned written fatigue management plans that are designed to address the unsafe levels of railroad worker fatigue.

According to one Canadian railroad source, railroad workers average 35 hours per week on duty. However, many workers also reach the newly developed Canadian maximum of 64 hours in a 7 day period.

### **Fatigue Management Plans in the US**

Several US Class 1 and short-line railroads with operations in Canada are required to submit fatigue management plans conforming to Canadian law for those operations within Canada. These railroads have successfully implemented fatigue management plans, though the efficacies of these plans are still in question. A common failure of these plans, though mandated in the Canadian process, is an effective and complete evaluation process.

Yet, railroads presently voice a level of comfort with fatigue management plans having some experience with the Canadian model. Translating the Canadian “process model” into the US culture is somewhat problematic however. Canadian law incorporates mandates that require cooperation between labor, management, and government. There exists no similar US mandate at the time of this writing.

In order to progress a non-prescriptive solution to fatigue that will effectively resolve engineer and trainmen issues, a framework must be designed and a collaborative process invoked to achieve the results other countries have achieved recognizing that both labor and/or management may choose to sabotage this non-prescriptive effort. Sabotage from any quarter might necessarily invoke action from government as described above.

### **A BLET Fatigue Management Plan**

An effective fatigue management plan in the US will require a plan that incorporates education, addresses medical aspects of fatigue, critical aspects of fatigue, chronic aspects of fatigue, and establishes a method of evaluation that feeds-back into the process to determine if fatigue in the work place has been reduced. The corrective intervention resulting from the evaluation requires ongoing collaborative efforts by labor and management to ensure that the desired goal of mitigating unsafe levels of railroad worker fatigue is accomplished. Further, effective fatigue management as described above is an iterative process that in the railroad industry can become quite tiresome for labor and management representatives.

Success using fatigue management plans might be measured and incremental, not revolutionary, as many workers, managers and government agencies may desire. Yet, successful mitigation of fatigue may produce a process born from trust that could be advantageous in future management/labor negotiations. An outline of fatigue management that addresses the scientific, social, and organizational concerns of the BLET is described below.

#### *Education Aspects of Fatigue a Management Plan*

Education to resolve fatigue is necessary for successful mitigation of engineer and trainmen concerns. However, education needs to be focused for three different strata of railroad workers. For example, the sort of education necessary to successfully mitigate personal levels of fatigue in an engineer or trainmen is different from the education necessary to convince a railroad chief executive or chief operating officer of the necessity of incorporating a fatigue mitigation plan in that executive's railroad work place.

**Senior Management** Educating Senior Management for effective fatigue management in the railroad industry requires a focus on the options that a fatigue management plan provides for a US railroad operation. For the current railroad manager, there is considerable resistance at present to acknowledge the magnitude of fatigue experienced by railroad workers and the resulting safety hazards. In addition, US railroad operators deny the possibility that change is coming to the industry arguing that workers have complained about fatigue for generations, the NTSB has recommended changes for decades, Congress has tinkered with the hours of service before, but the industry continues to proceed unchanged and unfettered by all of these groups.

Yet, management is reporting a need for 80,000 railroad workers in the next five years. In addition, new workers tend not to accept the fatiguing schedules the railroads have relied upon for decades.

At the same time, pressure on Congress from interest groups has heightened the urgency to resolve fatigue related concerns. Also, accidents that might previously been attributed to other causes are now including the impact of fatigue in the accident when completed in a root cause analysis process.

Management has historically relied on labor to be divided over solutions to resolve fatigue, thereby doing nothing. Labor has identified several scientific issues that corroborate longstanding experience in railroad operations, thus providing new leverage for solution to fatiguing railroad schedules. In addition, some scientific advances such as "computer based fatigue modeling" (see below) suggest that an objective base for legally determining responsibility for fatigued railroad workers is not far away.

Bringing all of these ideas into a single education piece that will convince railroad executives to support the application of fatigue management plans will be necessary before these plans can be implemented in the industry. At present, this education piece has not been designed, produced or implemented in the railroad industry. Both the North American Rail Alertness Partnership (NARAP) and the Work/Rest group have discussed this issue, but no action plan has developed.

**Railroad Supervisors** While it is necessary to educate senior managers of the need and efficacy of a successful fatigue management plan, middle and first line supervisors need



to be educated about the importance of supporting and incorporating the iterative process of managing railroad worker fatigue into the daily regimen of railroad operations.

Many railroad managers effectively argue that workers use fatigue as a method to avoid work. In many cases managers suggest, with negligible expert experience, that a particular worker is not fatigued because he/she is returning from vacation or was granted more “rest” than the hours of service law requires. Inevitably, management at times choose to interpret limited personal scientific knowledge about transportation worker fatigue to justify failed scheduling, abusive working conditions, and unjustified demands by corporate cultures ill prepared to integrate management school “mental models” (1) into the demanding real world of railroading.

In addition to certain management assumptions that contribute to unsafe levels of fatigue in the railroad industry, some supervisors of engineers and trainmen themselves are experiencing unsafe levels of fatigue. The symptoms of fatigue such as irritability, inability to concentrate, and impaired judgment can lead to unsafe levels of stress in the supervisor/labor working relationship. For example, in an actigraph (discussed below) study, one manager was supervising engineers and trainmen with just 1 hour of sleep in a 24-hour period.

Clearly, a candid discussion of educational deficiencies of railroad supervisors on the issue of worker fatigue as discussed above would be resisted in current railroad operations. Further, it is not the responsibility of labor to advocate for management working conditions. Yet, in order to address unsafe levels of fatigue in the railroad industry, fatigue management planners must pay attention to this group contributing to fatigue in the railroad’s system. Overcoming the issues discussed above in order to create a culture that encourages fatigue management plans is both daunting and necessary in order for a non-prescriptive effort to succeed.

At present, this educational piece of the fatigue management plan process has not been fully discussed, let alone designed, produced, or implemented. Considerable effort by the Work/Rest group, with perhaps technical assistance by NARAP, will be necessary for this important piece of the puzzle to be integrated into effective fatigue management plans.

**Railroad Workers** For railroad workers, education has occurred for many years about the hazards of fatigue in the industry and how to mitigate fatigue to reduce those hazards. At the same time, new workers need to be educated about the effects of fatigue, how to mitigate fatigue in a busy railroad life, and what to do if mitigation efforts fail. In addition, existing railroad workers must be kept informed about advances in mitigating fatigue in the work place for shift workers and unconventional work schedules.

An effective educational tool would necessarily include recent research around fatigue mitigation, important lessons from recent sleep research, as well as health and fitness information designed to mitigate unsafe levels of fatigue. Further, any education tool must be multifaceted in order to achieve both goals of easy accessibility and frequently updated information. It does no good to provide Internet access as a tool to a working population that may be Internet illiterate or too fatigued to access the information. Yet, pamphlets, booklets, and posters cannot be relied solely upon to meet the educational needs of adult railroad workers.

Current adult education techniques should be employed, as well as, multi-faceted tools integrated into the culture in order for education to be maximally effective in mitigating railroad worker fatigue.

At present, both NARAP and the Work/Rest task force are seeking out options to fully address the concerns raised above for the benefit of railroad workers. A proposal for a web based education process accessible to railroad labor and management and managed by the Work/Rest Task Force is under consideration. Costs might be shared by the affected railroads and labor organizations.

**Individual Responsibility** Mitigating unsafe levels of railroad worker fatigue ultimately relies heavily on individual railroad workers taking responsibility for their personal work and sleep habits. However, in order for individuals to exercise personal responsibility for managing fatigue, those individuals must be provided with the tools necessary to implement personal fatigue mitigation efforts. These tools include education, information, but most importantly *the time to sleep and recuperate from fatiguing schedules*. Once all of these tools are made available to the railroad worker, it is necessary to rely on all existing cultural tools possessed by labor and management to ensure that fatigued workers are absent from the work place.

Resolving worker fatigue is not just an effort by unions to get railroads to address the numerous issues contributing to the problem, railroad workers themselves must be accountable for using the tools available to become properly rested to perform railroad service. A safer railroad environment requires an effort by all parties to participate as they are able, to ensure a rested railroad work force.

Currently, successful efforts by operation red block/operation stop have been employed by railroad workers to assist each other in the process of eradicating drugs and alcohol from the work place. The E.I.E. proposal offered by the BLET envisioned a peer oversight process to discourage fatigued workers from performing railroad service. History suggests that as part of an effective nationwide “systems” solution to railroad worker fatigue, individual responsibility and peer support may well emerge as integrated aspects supporting the goal of reducing unsafe levels of railroad worker fatigue.

At present, the Work/Rest Task Force is considering peer intervention as *part of a total* solution to fatigue in the railroad industry. It is not logical to suggest that this element can be incorporated as a stand alone process without the accompanying tools necessary for individual railroad workers to use to mitigate their personal fatigue. Toward that end, the Work/Rest Task force is developing a toolbox of available options to help mitigate unsafe levels of railroad worker fatigue (see appendix). Ideally, each railroad’s management and on property labor representatives (General Committees of Adjustment) might draw from this toolbox to create an effective fatigue management plan. The toolbox is not inclusive however, and individual railroad management and labor leaders may evolve new ideas from the toolbox primer.

#### *Medical Aspects of a Fatigue Management Plan*

According to the National Institutes of Health (NIH), in the general population in the US, up to 40% of adults report at least occasional difficulty sleeping, while chronic and/or severe insomnia affects about 10-15% of adults. Anecdotal reports suggest that the railroad is experiencing fatigue from medical aspects at a rate greater than the general

population. There is no confirmative research providing information about this disparity. However, the NTSB asserted medical problems resulting in fatigue as a contributing cause in the November 15, 2001, Clarkston, Michigan accident, with both the engineer and conductor suffering from either diagnosed or undiagnosed sleep apnea.

Sleep apnea, a breathing disorder characterized by brief interruptions of breathing during sleep, affects as many as 18 million people, according to the National Institute of Health. Collectively, excessive daytime sleepiness, insomnia, sleep apnea, narcolepsy, restless legs syndrome, periodic limb movements and parasomnias represent sleep disorders with medically approved treatments. At last count, nearly 90 fatigue related medical disorders have been identified by researchers. When the medical treatments are observed, research shows that unsafe levels of fatigue can be removed from the workplace.

The good news is that with proper diagnoses and treatment, greater than 90% of all fatigue resulting from medical issues can be effectively resolved without interfering with an employee's ability to work as a railroad engineer or trainmen. Getting the railroads to act upon this information in a sensitive and supportive manner that will serve to reduce the medical aspects of fatigue in the railroad industry is the overall goal of this section.

One last note, in September of 2004, the FRA issued an advisory to the "railroad community" recommending:

- Establish training and educational programs to inform employees of the potential for performance impairment as a result of fatigue...and document when employees have received the training. Incorporate elements that encourage self-assessment, peer-to-peer communication, and co-worker identification accompanied by policies consistent with these recommendations.
- Ensure that employees' medical examination include assessment and screening for possible sleep disorders...Develop standard screening tools...and provide an appropriate list of certified sleep disorder centers...
- Develop and implement rules that request employees in safety-sensitive positions to *voluntarily* report any sleep disorder that could incapacitate, or seriously impair, their performance.
- Develop and implement policies such that, when a railroad becomes aware that an employee in a safety-sensitive position has an incapacitating or performance-impairing medical condition related to sleep, the railroad prohibits that employee from performing any safety-sensitive duties until that medical condition appropriately responds to treatment.
- Implement policies, procedures, and any necessary agreements to—(a) Promote self-reporting of sleep-related medical conditions...; (b) Encourage employees with diagnosed sleep disorders to participate in recommended evaluation and treatment; and (c) Establish dispute resolution mechanisms...

Most or all of these recommendations have been addressed by the Work/Rest Task Force with recommended solutions for management and labor to act upon. Implementation intended to respond to these recommendations awaits completion of the overall Fatigue Management Plans by the individual railroads in cooperation with the General Committees of Adjustment. As stated above, railroad officers, not labor leaders are at present delaying resolution of the fatigue issue in the railroad industry.

**Railroad Policies on Medical Aspects of Fatigue** Instituting a policy or collective bargaining agreement that acknowledges and treats fatigue from medical problems just as it would any other medical issue is necessary for effective implementation and resolution of fatigue resulting from medical problems.

Succinctly, a policy as worded below may effectively address the medical aspects of fatigue as experienced in railroads today and satisfy the concerns of the NTSB and FRA as outlined in the report noted above.

*A sleep disorder will be addressed similar to any medical condition that may impair an employee's ability to safely perform essential job functions, with or without reasonable accommodation. Sleep disorders will be evaluated on an individualized basis by a health professional to determine the employee's medical fitness for service. (This does not infringe upon an employee's rights under an existing collective bargaining provision.)*

Supporting a policy like this is the Family and Medical Leave Act (FMLA). With FMLA as a safeguard, it may not be necessary to turn the railroad policy into a collective bargaining agreement. Each General Committee of Adjustment will need to make this final determination. Once the policies are in place on the nation's railroads, it will be necessary to address logistical issues.

**Medical Provider Education** Not all medical doctors are properly trained to diagnose fatigue related illnesses. Specialists, particularly in outlying railroad communities that are distant from specialty practitioners, must be identified and a list of these specialists must be provided as a necessary tool to the railroad worker. The most effective person for collecting this information and providing it to the railroad worker is the fatigue management specialist on the railroads. Other federal agencies may be sought out to supplement this railroad produced list of medical providers. Providing a list of medical professionals for engineers and trainmen to access is not an invitation for railroad management to interfere with, or unnecessarily intrude into, an individual's medically prescribed treatment.

**Individual Responsibility** Once the policy is in place, labor and management working together can forge education and/or peer intervention efforts to encourage railroad workers to receive medical evaluations for possible fatigue related problems before they result in an accident. With the reassurance that railroads will not punitively interfere with employees efforts to support their families, individuals will have the tools necessary to resolve personally with their private physician a medical intervention that will ensure their ability to work properly rested and free from medical problems resulting in fatigue.

As discussed above, ultimate responsibility for addressing fatigue from medical problems reside within the individual. The railroads have the responsibility however, to provide the tools to the employee, as discussed above, in order to ensure “a safe working environment.”

At present, the Work/Rest task force has developed the general wording for the nation’s railroads to adapt into company policies. Various class one railroads are in the process of developing these policies and developing strategies to address the logistics of implementing these policies. This is an opportunity for General Committees of Adjustment to input the policy process on the individual railroad properties. No short-line properties have reported any movement toward implementing the medical policy stated above. However, the short-line railroads are part of and contributing to the progress made by the Work/Rest Task Force.

#### *Critical Fatigue Aspects of a Fatigue Management Plan*

Critical aspects of fatigue result from the unique demands of working in the railroad industry. For example, working on call 24 hours a day seven days a week often without reasonable forecasting of schedules or lineups may result in a severe short term loss of sleep. These situations can occur immediately following extended rest periods such as vacation, days off or long layovers. Often times, they result from the vagaries of the system that fails to forecast with any effectiveness the movement of trains in the US. Some railroads have mitigated these vagaries by attempting to schedule railroad operations. Other roads have attempted to use lineups to forecast the need for workers. Both of these efforts have shown success and failure.

When attempts to mitigate critical aspects of fatigue fail and a railroad worker is identified as experiencing a lack of sleep, what is provided by the railroads to mitigate this safety hazard?

**Short Term Sleep Loss** Short term sleep loss research spanning many years and originating in Australia has identified a correlation between the amount of sleep an individual gets and his/her fitness to perform certain safety related transportation duties. Dawson (2) argues that a “Prior Sleep and Wake Model (PSWM)” provides a better determinate of fitness for duty than a prescriptive model that relies on the traditional hours of service. In Dawson’s original formulation, implemented on one class one railroad, a person minimally needed five hours of sleep in the previous 24 hour period. Additionally, Dawson suggested that in the previous 48 hours, a person required a minimum of 12 hours of sleep. Barring this, mitigation efforts were necessary from caffeine use to not performing service, depending on the severity of sleep loss beyond the identified parameters.

In 2004, Dawson (3) reported on a study of 61 NTSB “fatigue-related” heavy vehicle accidents that were single-vehicle accidents with no evidence of corrective action by the operator to avoid the accident and no other obvious cause for the accident. These data were compared with 44 NTSB control accidents that involved multiple-vehicles, demonstrated attempts at corrective action and/or identified other known causes rather than fatigue. This research suggested a common determinate in over 2/3 of the fatigue-related accidents resulted from operators receiving less than 6.5 hours of sleep in the previous 24 hour period.

Sleep researchers have often advocated eight hours of sleep each night for individuals. Dinges (4) suggests that individuals require a minimum of 7.5 hours of sleep per day. Today Americans average 6.9 hours of sleep on weeknights and 7.5 hours per night on weekends according to the 2003 poll of the National Sleep Foundation (NSF). From Dawson's research, 6.5 hours of sleep correlates to a threshold that may result in accidents. Under the Hours of Service law in the US, railroad workers are minimally required to have 8 hours off duty. However, these 8 hours off duty do not translate into 6.5 hours of sleep. With personal hygiene, transportation to and from work, eating and other disruptions, railroad workers are reporting 4 hours or less of sleep during an 8 hour off duty time period.

These calculations contribute to part of the experience of critical fatigue in the railroad industry.

**Circadian Rhythms** Short term sleep loss does not entirely explain the experience of critical fatigue in the railroad industry. Research dating back decades have identified biological cycles conforming generally to the 24 hour day. Between 3-5 am and to a lesser degree between 3-5 pm, the human body experiences "down cycles" when our bodies physically demand sleep. These circadian rhythms exist as unalterable difficulties in ever changing railroad operations.

During these periods, shift workers often experience a debilitating need to sleep. Mitigating these biological needs may be complimentary to mitigating short term sleep loss, or the solutions may involve separate fatigue mitigation efforts. However, short term sleep loss coupled with biological down cycles either individually or together creates a critical fatigue concern in the railroad industry.

**Possible practical solutions to critical fatigue** The National Sleep Foundation has identified the following possible solutions for mitigating circadian sleep loss:

- Short breaks throughout the shift.
- Working in groups. (Note: Avoid single man operations.)
- Try to exercise during breaks.
- Try to eat three normal meals per day.
- Drink a caffeinated beverage early in the shift, e.g. before 3 a.m. for the night worker.
- Don't leave the most tedious or boring tasks to the end of the shift.

While the National Sleep Foundation provides ideas based on traditional shift worker research, railroad worker experiences, particularly from short term sleep loss may require making additional opportunities or mitigation efforts possible for railroad workers. Thus in addition to NSF recommendations to make opportunities available for the recommended stop gap measures above, other successful solutions to critical fatigue include:

- Opportunity naps lasting 20-40 minutes

- Allowing the worker to absent themselves from duty when they have not gotten the minimal amount of sleep necessary to safely perform a shift.
- Creating rest periods that exceed the minimum eight hours rest provided by federal law and allowing workers to optionally book these extend rest periods as needed.

Combinations of these tools may effectively mitigate critical fatigue in the railroad work place. For a more complete, but not exclusive, list of options see the tool box in the appendix.

At present, various Class One railroads are experimenting with various combinations of the above mitigation efforts for critical aspects of fatigue. However, no railroad in the US has adopted a comprehensive plan on their entire system that addresses the critical aspects of fatigue by all engineers and trainmen working for that railroad. Many of these efforts have developed with cooperation and leadership from the General Committees of Adjustment of the BLET. Future non-prescriptive solutions to critical fatigue may develop with additional leadership from the General Committees of Adjustment working with Management on the individual railroads.

#### *Chronic Fatigue Aspects of a Fatigue Management Plan*

**Sleep Debt Research** While addressing critical fatigue is necessary, it does not necessarily relieve railroad workers from chronic aspects of fatigue. Chronic fatigue describes accumulated fatiguing factors that build over the course of a work week. For example, researchers have found that if an individual sleeps extensively on his/her first rest day, the individual's body may be recovering from sleep debt that has accumulated during the work week. Dinges (4) argues persuasively that sleep debt research is relevant to addressing chronic worker fatigue.

According to the National Sleep Foundation, working more than 60 hours a week increases your risk of driving drowsy by 40%. Kraus, at one time researching for the Association of American Railroads (AAR), reported that engineers "working more than 50 hours a week have a significantly higher rate of accidents than those working fewer hours." This research raised additional concerns about yard service engineers working the overnight time frames.

According to the US Department of Transportation (DOT)(5), fatigue results from "the combination of long work periods and other non-duty factors that contribute to on-the-job fatigue, by limiting the available time for recreation, rest, and sleep. Over extended working periods, repeated inadequate sleep periods can result in accumulated sleep debt and associated operator fatigue." While the US DOT and the railroads may choose to emphasize off duty contributions to fatigue, all waking hours contribute to the accumulation of sleep debt, since there are only 24 hours in any day. Therefore, the railroads requiring 12-23 hours of work in a 24 hour period necessarily must respond to accumulated sleep loss. While the federal "Hours of Service" limits work to 12 hours, one railroad territory reported over 900 times railroad workers were on duty in excess of 15 hours in a single month in 2004.

**Health Aspects contributing to fatigue** In addition to acquired sleep debt from working extended hours, health aspects may contribute to fatigue. Several health issues are associated with chronic fatigue in the general population. Weight issues have been related to interrupted sleep. Exercise, properly scheduled with work and sleep has been identified as mitigating chronic fatigue, though incorrectly scheduled can actually contribute to critical fatigue.

For railroad workers, unpredictable schedules can result in the best efforts by an individual to address health aspects of fatigue resulting in higher levels of fatigue. For example, exercise too close to sleep can disturb normal sleep patterns. Eating too close to sleep is counter productive. Yet, with eight hours rest mandated by law, addressing health aspects of fatigue is virtually impossible without mitigation during work hours.

**Possible practical solutions to chronic fatigue** Research indicates that in order to overcome a sleep debt, workers need time of extended undisturbed rest. In addition, a single sleep episode fails to restore an accumulated sleep deficit. Often, a minimum of 48 hours of rest or more is necessary in order for the individual to experience more than one sleep period that will satisfactorily restore an accumulated sleep deficit.

Examples used in the industry include work / rest cycles such as 7 & 3, 8 & 3, or 10 & 5. In other words, a worker on a 7 & 3 schedule is available for duty to the railroad for 7 days and then is provided the option of up to 3 days of undisturbed rest.

Reports from railroad workers suggest that initially there is resistance to work / rest scheduling, particularly if the rest periods are mandatory. However, over time optional work / rest cycles are accepted and individuals often report significant relief from fatigue.

Negative reports from railroad workers suggest that the 7-10 day work availability can be excessive for many workers from a fatigue standpoint. For these, a 4 days available, 2 days off, 3 days available, 1 day off schedule (4 & 2, 3 & 1) might relieve fatigue concerns and provide another option for railroads and workers alike.

Other options to address chronic aspects of fatigue may include:

- Scheduled meal periods during work shifts
- Exercise options in the work place
- Scheduling trains and using assigned crews rather than using extra, pool service, or irregular service

For a more complete, but not exclusive, list of options see the tool box in the appendix.

At present, several Class One railroads are experimenting with various combinations of the above mitigation efforts for chronic aspects of fatigue. However, no railroad in the US has adopted a comprehensive plan on their entire system that addresses the chronic aspects of fatigue experienced by all engineers and trainmen working for that railroad. Many of these efforts have developed with cooperation and leadership from the General Committees of Adjustment of the BLET. Future non-prescriptive solutions to chronic fatigue may develop with additional leadership from the General Committees of Adjustment in cooperation with railroad management on the individual railroads.



### *Evaluation of a Fatigue Management Plan*

Once labor and management have agreed to a fatigue plan on an individual railroad, how will railroad workers know if the efforts are successful beyond their individual experience? Railroad workers realize that not just personal or “my” level of fatigue is hazardous to my safety, but my coworker’s level of fatigue can be even more hazardous to my safety. Evaluating each railroad’s fatigue management plan is necessary to move the fatigue issue from talk into action.

Methods of evaluation can take two forms: direct measures and proxy measures. In addition, no single measuring tool will effectively determine if fatigue has been reduced in the work place. Further, the measuring tool will necessarily respond to the solutions implemented by the various railroads. However, in all cases, management and labor will be determining whether medical, critical, and chronic aspects of fatigue have been reduced in the railroad workplace.

**Direct Measures of Railroad Worker Fatigue** Direct measures of fatigue describe tools that directly report a variable that has been theoretically related to fatigue. For example, actigraphs are a “wristwatch” type of device that measures an individual’s activity or inactivity based on the person’s movement. Extremely reduced periods of activity are *assumed* to indicate the person is sleeping. Measuring the total sleep accumulated in 24 hours, and using a standard assumption that a minimum of 5-8 hours of sleep is necessary in that 24-hour period provide a direct measure of fatigue to the user.

Other direct measures of fatigue include Electro Encephalogram, Multiple Sleep Latency Test, Stanford Sleepiness Scale, and sleep diaries. It should be noted that all of the direct measures of fatigue are fallible. Actigraphs must be constantly worn to be effective; if removed in any 24 hour period the report is not accurate. Tests that have been developed for the individual to report their personal level of fatigue have been shown to “under-report” the true level of the worker’s fatigue. In other words, we are often more fatigued than we are prepared to admit. Finally, many direct measures require expert analysis, resulting in a cumbersome or complicated process that is not suitable for railroad operations.

**Proxy Measures of Railroad worker Fatigue** Proxy measures of railroad worker fatigue measure variables that are assumed to directly correlate with fatigue. For example, it might be argued that fatigued workers are less efficient in handling trains thus causing increased fuel consumption. Thus, by calculating fuel efficiency a railroad might arguably be able to track railroad worker fatigue. However, proxy measures tend to exist as a second order or intermediate variable that can be affected by other issues. In this example, personnel issues unrelated to fatigue, such as attitude, can affect fuel efficiency. Also, fuel efficiency can be affected by environmental variables such as wind, snow or rain. Finally, mechanical issues such as clogged fuel filters, continuous wheel slip, or inaccurate train tonnage can affect fuel efficiency.

Proxy measures can be made with effort to approximate a level of fatigue experienced by railroad workers. Generally, direct measures tend to more accurately address the BLET’s concerns of reducing railroad worker fatigue.

**How to Use Measures of Railroad Worker Fatigue** Either direct or proxy, the measures chosen by management and labor on the individual railroads provide a tool to initiate a “continuous improvement process.” Ultimately, each iteration of the improvement process will contribute to an eventual “best practice” for consideration or adoption by other General Committees of Adjustment or other railroad operations.

Finally, a solution to fatigue can also be a measure of fatigue in the workplace. For example, if railroad workers are allowed to absence themselves from railroad service when they are fatigued without interference from management, the tracking of these requests becomes a valuable tool for measuring fatigue in the workplace. In addition, the absence of these requests also is a measure of a work place not suffering from debilitating fatigue.

At present, no railroad has implemented a systemic program in cooperation with labor that measures railroad worker fatigue. Without this effort, it is difficult for any railroad in the US to scientifically argue that they are addressing railroad worker fatigue. Integral to the measuring process, BLET General Committees of Adjustment must have full access to all data collected on fatigue, and all data collection should be in accordance with the BLET’s written research policy.

#### **Where does the Fatigue Plan Apply?**

For the fatigue plans to effectively resolve railroad worker fatigue in the US, they need to be adopted for each railroad that is part of the general rail system. In other words, all railroads in the US.

Further, the plans must be applicable to all railroad operations. Figure 1 below provides an outline of the BLET proposed fatigue management plan as it would apply on any single railroad in the US. The plan identifies assigned service and unassigned service. This outline takes into account jobs that may work 5, 6, or 7 days in a week. The plan also addresses 8 hour days or 8-12 hour days as well as the time of day the assignment goes to work. With each of these considerations, the medical, critical, and chronic aspects of fatigue are analyzed to provide the relevant concerns from a scientific standpoint for each assignment utilized by a railroad operation.

Figure 1

### Scientific Concerns of Fatigue in the Railroad Industry

		Assigned Service		
		5 Day / 8 hour day		
		7:00 AM	3:00 PM	11:00 PM
	Start Time			
<b>Education</b>		X	X	X
<b>Medical</b>		X	X	X
<b>Critical Fatigue</b>	<i>Short Term Sleep Loss</i>			X
	<i>Circadian Rhythm</i>			X
<b>Chronic Fatigue</b>	<i>Sleep Debt</i>			X
	<i>Health Aspect</i>			X
<b>Evaluation</b>	<i>Aspects of Plan</i>	X	X	X
		Assigned Service		
		5, 6, or 7 days / 8-12 hour day		
		7:00 AM	3:00 PM	7:00 PM
	Start Time			
<b>Education</b>		X	X	X
<b>Medical</b>		X	X	X
<b>Critical Fatigue</b>	<i>Short Term Sleep Loss</i>		X	X
	<i>Circadian Rhythm</i>			X
<b>Chronic Fatigue</b>	<i>Sleep Debt</i>	X	X	X
	<i>Health Aspect</i>	X	X	X
<b>Evaluation</b>	<i>Aspects of Plan</i>	X	X	X

		<b>Unassigned Service</b>		
		Work Train	Extr Brd	Pool Sevice
		Any Time	Any Time	Any Time
	<b>Start Time</b>			
<b>Education</b>		X	X	X
<b>Medical</b>		X	X	X
<b>Critical Fatigue</b>	<i>Short Term Sleep Loss</i>	X	X	X
	<i>Circadian Rhythm</i>	X	X	X
<b>Chronic Fatigue</b>	<i>Sleep Debt</i>	X	X	X
	<i>Health Aspect</i>	X	X	X
<b>Evaluation</b>	<i>Aspects of Plan</i>	X	X	X

		<b>Management</b>		
		Senior Any Time	Middle Any Time	Front Line Any Time
	<b>Start Time</b>			
<b>Education</b>		X	X	X
<b>Medical</b>				X
<b>Critical Fatigue</b>	<i>Short Term Sleep Loss</i>			X
	<i>Circadian Rhythm</i>			X
<b>Chronic Fatigue</b>	<i>Sleep Debt</i>			X
	<i>Health Aspect</i>			X
<b>Evaluation</b>	<i>Aspects of Plan</i>			X

**COMPUTER MODELING OF FATIGUE**

Finally, it is worth noting that several researchers are attempting to provide the railroad industry with a computer-generated model that arguably identifies fatiguing schedules in the railroad workplace. At present, *these models are not a scientifically reliable indicator of railroad worker fatigue.* None of the models have demonstrated a level of accuracy necessary to impose restrictions on a railroad worker due to fatigue. Further, none of the models are accurate enough to capture all experiences of railroad

worker fatigue. These models are nearly as likely to report a fatigue incident when one did not exist as they are to ignore fatigue as a contributing factor when it is applicable.

Further, the computer models envisioned by the FRA would provide a scheduling tool for railroads to predict fatigue. At the same time, NTSB suggests creating a model that effectively provides reliable evidence of railroad worker fatigue in a post accident investigation. At present, the model envisioned by the FRA does not address the issues important to locomotive engineers and trainmen---namely identifying and reducing railroad worker fatigue accurately and without capitulation to railroad's self interest.

### **What use are models**

Certain railroads have utilized models to provide workers with a tool to create work schedules that address fatigue within the constraints of railroad operations. These railroads intend for the models to provide new ideas to mitigate railroad worker fatigue. These models have been met with mixed results from railroad workers. However, on occasion these models have proven successful education tools for work groups to develop effective mitigation in local work environments.

### **Predictive Ability**

For any tool, such as a computer model, to be effective it must be able to reliably predict worker fatigue. In this regard, reliability requires direct measures of fatigue from the individual worker and a scientifically validated computer model. In this manner, a predictive model can be implemented to address fatigue predictions for railroad workers as well as post accident analysis and testing. Current government sponsored research does not yet appear likely to produce this sort of computer model for fatigue.

### **Application Suitability based on reliability**

Based on the current level of research, computer models of fatigue are not ready for wide use in the railroad industry for mitigating worker fatigue. As a "toy," these models can provide a basis for users to understand the complexity of railroad worker fatigue. *Significantly the models at present are not a significant threat to BLET interests.* They may actually evolve into a valuable tool at some future date to progress the interests of BLET members.

## **STRATEGIES AND TIMELINES FOR RESOLVING FATIGUE IN THE RAILROAD INDUSTRY**

The BLET has participated in ongoing efforts to resolve railroad worker fatigue using non-prescriptive cooperative efforts for nearly a decade. At some point, the BLET must determine if these efforts have adequately met the safety interests of BLET members. Toward that end, an arbitrary date might accomplish the goals of the BLET. It must be remembered, that under the current BLET leadership at least two major nation wide efforts to forge a fatigue solution in the railroad industry have been attempted. Without leadership from the railroads and/or prodding from government, non-prescriptive efforts to resolve fatigue are doomed to failure.

### **Non-prescriptive Approach**

It is not unreasonable to expect that by January 1, 2005, the railroads must commit to accept the premise that voluntary fatigue management plans created between individual railroads and the on property representatives of railroad workers is the desired course of action for resolving railroad worker fatigue. Failing a commitment by senior railroad management and senior labor executives by that date suggests that a non-prescriptive solution to railroad worker fatigue is not obtainable within a time frame that addresses the safety concerns of BLET members.

Failing a successful non-prescriptive solution of fatigue, there are two possible avenues for government-imposed solutions to railroad worker fatigue: a Congressional mandate and/or a regulatory mandate from the FRA. Each possible solution depends on the events discussed in the “**Problem**” section above and the outcome of the 2004 election. A favorable election result may permit the BLET to seriously consider a prescriptive resolution of the fatigue issue, if the membership demands it, with a realistic expectation that a positive mandate may result. Without the benefit of knowing in advance the results of the election, the following discussion outlines the possible strategic direction for the BLET failing an acceptable non-prescriptive solution.

### **Prescriptive Approach Using Federal Regulation**

If either the US Congress mandates or the FRA chooses to move toward a regulation to address fatigue in the railroad industry using fatigue management plans, the strategy and goals outlined above for a non-prescriptive solution would generally meet the needs of the BLET under a regulatory solution. This assumes that the FRA does not approve exemptions to the federal hours of service as current laws allow. This also assumes that Congress does not impose changes to the federal hours of service law. This process would be attainable through a Rail Safety Advisory Committee or RSAC. The BLET has witnessed several concerns of its members either totally ignored, or seriously downplayed by the FRA to conform to “Railroad interests” during RSAC processes in the past. The BLET may not be any more successful addressing fatigue through regulation than other issues brought to the FRA for consideration.

### **Prescriptive Approach Using Congressional Mandate**

Should the US Congress choose to address fatigue with a federal law that ignores the RSAC process, the BLET needs four mandates that effectively resolves the issues of medical, critical and chronic fatigue described above.

- 1) Congress would need to address the medical aspects of fatigue either by using existing federal law or implementing the basic statement proposed as a principle in the non-prescriptive solution above.
- 2) In order to address the Critical aspects of fatigue, a mandate should be included that addresses an individual’s right to absence him/herself from duty if they are too fatigued to safely perform their railroad job. Language can be adopted from the Federal Motors Carrier Act, as was proposed in the E.I.E. initiative of the BLE in 2002.
- 3) In addition to language about railroad workers absenting themselves from duty if they are fatigued, language should be developed that mandates

immediate transportation to the final terminal upon completion of 12 hours on duty. This is a necessary step to reduce the critical and chronic fatigue aspects from the abuse of "Limbo Time."

- 4) Finally, in order to mitigate chronic fatigue, a Mandate that allows a minimum of 48 hours of undisturbed rest in any 7 day period would afford railroad workers the option of getting two full sleep cycles in order to relieve accumulated sleep debt.

With these four mandates, and the existing federal hours of service, the most difficult fatigue issues experienced by railroad workers could be addressed in federal law. Again, these efforts would be dependent on a favorable political environment in Washington, DC.

## Appendix A

### A TOOLBOX OF FATIGUE COUNTERMEASURES

This toolbox is not designed to be a “best practices” cookbook for safety improvements that will guarantee elimination of railroad worker fatigue. Rather, this toolbox is a collection of options for the railroads and BLET leaders to draw from to address the serious fatigue issues on individual properties or at specific locations. The ideas developed below have been tried in either railroad operations or other modes of transportation and have proven to be successful. However, success in other locations does not guarantee success in the railroad industry at every location. Only evaluation and continuous improvement will provide the successful resolution that engineers and trainmen in the US deserve.

#### Education Aspects of Fatigue

- **Sleep hygiene** Educating individuals about developing good sleep habits or countermeasures to employ when sleep habits are compromised
- **Sleep Disorders** Providing useful information about sleep illnesses and opportunities for medical intervention.
- **Alertness Strategies** Providing useful strategies that can mitigate fatigue for railroad workers short of the need to not performing duty due to unsafe fatigue levels.
- **Focused Education** Materials need to be focused for the target audiences of Senior Management, Middle/Frontline Management, new-hires, and Engineers & Trainmen generally.

#### Medical Aspects of Fatigue

- **Policy** A statement developed assuring non-punitive treatment for railroad workers suffering from a fatigue related illness. On some roads this may become a collectively bargained agreement.
- **List of Doctors** Providing a list of specialists capable of addressing sleep disorders particularly at outlying points on the railroad’s system.

#### Critical Aspects of Fatigue

- **Book Rest** The ability to request 10-14 hours of rest at the completion of a tour of duty provides engineers and trainmen an opportunity to overcome a critical fatigue situation.
- **Optional Rest** Allowing the worker to absent themselves from duty when they have not gotten the minimal amount of sleep necessary to safely perform a duty shift.
- **Mandatory Rest** Some railroads have negotiated extended undisturbed rest at the home terminal. For example, crews are guaranteed not to be called before 10 hours off duty at the home terminal, but are called out on their legal rest at the



away from home terminal. This increases the quality sleep that many individuals experience in their own beds and reduces the substandard sleep experienced by some railroad workers at the away from home terminal.

- **Mandatory Rest** Is there a maximum number of hours that railroad workers can work? Some railroads argue for a limit to the maximum hours worked, but the research is not yet conclusive on this question.
- **Alertness Strategies** Opportunity napping, employee empowerment, strategic use of caffeine, three meals per day, short breaks during shifts, exercise during breaks, and refraining from leaving tedious or boring tasks to the end of the shift have been shown to be effective countermeasures for worker fatigue in some cases.
- **Undisturbed Rest** Provisions that restrict the need for contacting or being contacted by the railroads during legal rest periods serve to lesson the interference with sleep cycles.
- **Managing Rest Periods** Both at the home and the away from home terminal, plans that manage rest to maximize sleep opportunities are preferred. For example, following events such as “Dead Head” trips, working trips, vacations, and extended absences, different practices can be invoked to minimize fatiguing schedule starts such as AM mark-up policies.
- **Discretionary Time-off For Fatigue** Occasionally, life’s circumstances such as a sick baby can result in fatigue. Providing opportunities to address these issues can mitigate unsafe levels of critical fatigue.
- **Scheduling** Using schedules for train operations introduces predictability for railroad workers.
- **Lineups & Calling times** Efforts to improve lineups and calling practices can also contribute to predictability for railroad workers.
- **Post Duty** Upon completion of duty, efforts to relieve crews immediately upon expiration of 12-Hours for those crews expiring under the Hours of Service, crew hauling issues that can result in delays, and expedited arrival policies at rest facilities can all contribute to reducing critical fatigue.
- **Work Environment** Occasionally, quiet rooms, air conditioned cabs, or improved seating have helped to reduce critical fatigue.
- **Adequate Sleep** In all cases, efforts to increase the opportunity for getting sufficient sleep is the goal of mitigation efforts. Some research describes this as anchor sleep.
- **Work in Groups** Avoid single man operations of trains where practicable.

### Chronic Aspects of Fatigue

- **Optional Rest** Allowing the worker to absent themselves from duty when they have not gotten the minimal amount of sleep necessary, or are suffering a sleep debt, and can not safely perform a duty shift.
- **Mandatory Time-Off** Historically, fatigue was addressed using mileage or hour agreements that limited the number of days or hours in a month an engineer or trainmen could work.

- **Optional Scheduled Rest Days** Railroads have used 7&3, 8&3, 11&4, 10&5, or 4&2/3&1 work/rest cycles in order to provide an opportunity to mitigate sleep debt resulting in chronic fatigue.
- **Shift Predictability** Through scheduling or using lineups, efforts to increase work predictability may contribute to reducing chronic fatigue.
- **Peer Intervention Program** On the job fatigue poses a safety issue and an *Operation Red Block* – type program could be used to elevate the importance of mitigating unsafe levels of fatigue between peers in the railroad industry.

## Evaluation

- **Continuous Improvement Review Process** This incorporates an evaluation of pre-agreed to measures of fatigue in an iterative process designed to narrow the large issue of fatigue into ever smaller issues reaching an effective solution that meets the needs of the entire group. The process has been utilized in the railroad industry, as well as many other work settings outside the railroad industry, to effectively reach an organization's goal. Essentially, the process establishes goals and then measures the success of individuals, groups, and/or organizations to reach those goals.
- **Physiological Measures** Electro Encephalogram and Multiple Sleep Latency Tests have been described as accurate and objective but impractical and expensive for use in the railroad industry.(6)
- **Behavioral Measures** The Actigraph has been described as accurate and objective but moderately expensive.(6)
- **Self Reports** The Stanford Sleepiness scale, Individual Sleep Diaries, or other survey instruments designed to self report levels of fatigue are fairly inexpensive but are arguably less accurate. (6) Without a doubt, there is little argument with an individual that says he/she is tired. There is no basis in science that can dispute this individual's assertion without an expensive medical test.
- **Performance Measures** Performance Assessment Battery (PAB), Psychomotor Vigilance Test (PVT) and the Denver Fatigue Inventory are indirect measures of fatigue using correlated variables that require an expert to administer and score.(6)

Resources:

- 1) National Sleep Foundation <http://www.sleepfoundation.org/>
- 2) National Sleep Foundation <http://www.drowsydriving.org/>
- 3) American Academy of Sleep Medicine <http://www.aasmnet.org/>
- 4) Associated Professional Sleep Societies  
<http://www.journalsleep.org/currenttoc.asp>
- 5) American Insomnia Association  
<http://www.americaninsomniaassociation.org/home.asp>
- 6) American Board of Sleep Medicine <http://www.absm.org/>
- 7) Sleep Research Society <http://www.sleepresearchsociety.org/site/>

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