PREPARED STATEMENT OF JOSEPH H. BOARDMAN,
FEDERAL RAILROAD ADMINISTRATOR,
BEFORE THE SUBCOMMITTEE ON RAILROADS,
HOUSE COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE

July 25, 2006

Good morning, Mr. Chairman, Ranking Member Brown, and other members of the Subcommittee. Thank you, on behalf of the U.S. Department of Transportation, for holding this hearing on the issue of human factors, a subject of critical importance to the Federal Railroad Administration's (FRA) safety program. Last month we testified, first, about current issues in the transportation of hazardous materials by rail and, second, about implementation of our May 2005 National Rail Safety Action Plan as well as recent passenger safety initiatives. This hearing provides an important opportunity to focus more sharply on human factors affecting rail safety and what FRA is doing to understand and address them.

In the context of industrial safety, the term "human factors" refers broadly to the role of human participation in any system and to the ways in which human beings contribute toward system performance, both positively and negatively. Central to any discussion of human factors is the role of the individual, but it is seldom possible to discuss the actions of the individual without reference to involvement with peers, management structures, and supervisory personnel, established rules and procedures, training, technology required to accomplish a task, and technology that may be used to monitor a task and compensate for deviations from rules or procedures. None of us really does his or her job alone, and that is particularly true in the inherently risky and highly choreographed field of rail transportation.

Human factors are present in all areas of railroading. For instance, car repair employees need to be alert to a wide range of hazards when inspecting rolling stock. Production gangs performing track maintenance need to take care to leave track in the proper geometry. Signal employees must exercise good judgment and follow the software management plan when replacing failed circuit boards.

However, our principal focus today will be on a critically important, but somewhat narrower aspect of human factors--the role of operating employees--those engaged in making up, breaking up, and operating trains. Decades of work by the railroads, labor organizations, suppliers, and government have sought to make the railroad as safe a place to work as possible and to keep railroad operations from adversely affecting the communities abutting railroad facilities. We have come a long way, but we have a good way to go.

Statistics on Railroad Accidents Caused by Human Factors

Before I review with you the data regarding human factors accidents, please note five points.[1] First, a railroad must report to FRA on each of its accidents/incidents. The term "accident/incident" means—

> (1) "[a]ny impact between railroad on-track equipment and [a motor vehicle], bicycle, farm vehicle or pedestrian at a highway-rail grade crossing";
>
> (2) "[a]ny collision, derailment, fire, explosion, act of God, or other event involving operation of railroad on-track equipment (standing or moving) that results in reportable damages greater than the current reporting threshold . . . "; and
>
> (3) "[a]ny event or exposure arising from the operation of a railroad, if the event or exposure is a discernable cause of . . ." (a) death to any person, (b) injury to any person that results in medical treatment, (c) injury to a railroad employee, or occupational illness of a railroad employee, that results in a day away from work, restricted work activity or job transfer, or loss of consciousness, (d) occupational illness of a railroad employee that results in medical treatment, (e) "significant injury" or "significant illness" of a railroad employee, or (f) injury or illness of a railroad employee that meets certain "specific case criteria."[2]

Second, it is important to emphasize that the second category of occurrence, which we call a "train accident," is defined as an event involving on-track equipment that results in railroad property damage exceeding the reporting threshold. For the years 2003 through 2005, for reasons related to a statutory mandate, FRA made no inflation adjustments to the train accident reporting threshold. That threshold was increased from $6,700 (the inflation-adjusted figure for the year 2002, carried over through 2005) to $7,700 for the year 2006. Accordingly, there was probably a slight upward drift in all of the train accident numbers as a result of the growth of railroad costs during that period. At the same time, the results for 2006 will probably appear a little more favorable than those for 2005 because a single, rather large adjustment to the reporting threshold was made all at once.

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[1] The numbers plotted in the charts in this testimony reflect accident reports from the railroads, which are submitted to FRA pursuant to a Federal statute and FRA regulations. 49 U.S.C. 20901; 49 CFR section 1.49 and part 225. After audit checks for consistency, the reported data are entered in the Railroad Accident/Incident Reporting System (RAIRS). FRA periodically audits the reporting process, particularly for the larger railroads that generate a large percentage of railroad activity; however, careful examination of data sometimes detects individual events reported under cause codes other than those FRA might have chosen. Whenever we are examining any subject matter within the field of railroad safety, FRA consults all of the available data, including results of its own investigations, reports of the National Transportation Safety Board (NTSB), and other available information, as well as data from the RAIRS.

[2] See 49 C.F.R. 225.11, the definition of "accident/incident" at 49 C.F.R. 225.5, and the primary groups of accidents/incidents at 49 C.F.R. 225.19.

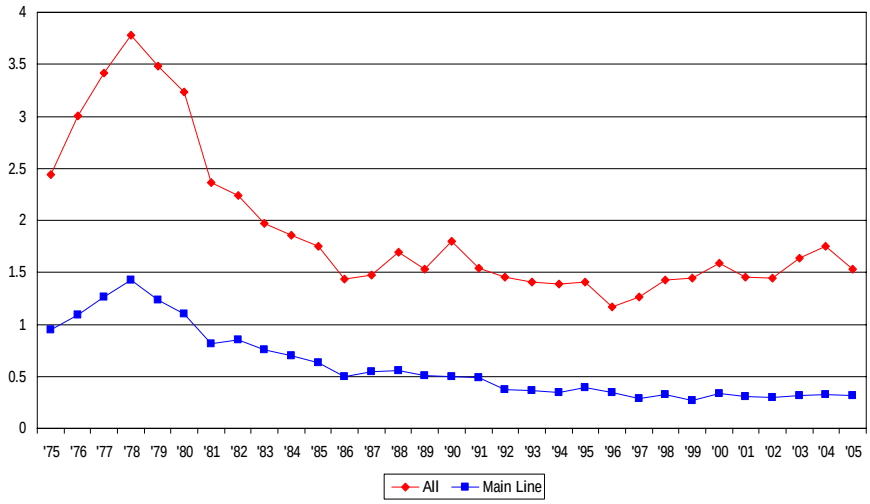
Third, the results for 2005 remain tentative. FRA has been conducting reporting audits of major railroads that may result in some late-filed or corrected reports, and railroads are filing ordinary updates. These processes seldom result in major changes to the national numbers, but the numbers will change slightly as we move toward a "final" status later this year.

Fourth, it is critical, as we look at these charts, that we recognize the difference between simple counts and rates. Simple counts represent the number of events reported without adjustment. When we report on a rate basis, we normalize the results by using an activity-based divisor. When the data in question are employee on-duty casualties, the accepted divisor is 200,000 work hours. When the data in question are train accidents, the accepted divisor is a million train miles (although in some contexts use of railroad ton miles may be justified).

Fifth, we should note that on some of the charts, two different vertical scales are used (one for injuries and another for fatalities). This is done to allow the reader to view trends. On the second chart, for example, the injuries-only scale is from one to 100,000, and the fatalities scale is from zero to 500.

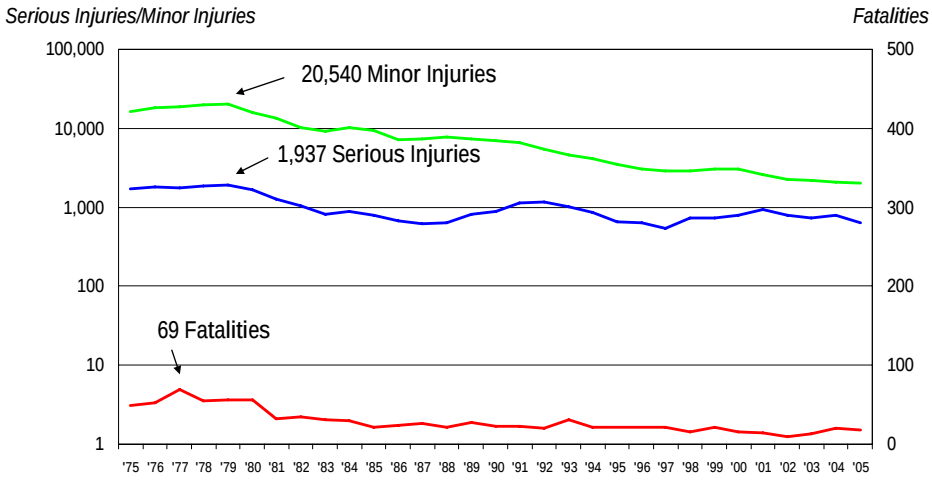
With that background, let's look at the long-term trend in train accidents caused by human factors and in the on-duty injuries of train and engine employees.

All Human-Factor-Related Accidents
Rate Per Million Train Miles (1975-2005)



Note: Main line train miles are not reported to FRA; therefore, to calculate main line train miles FRA used the total train miles minus yard switching miles, which equals main line train miles

All Train & Engine Employee
Serious Injuries/Minor Injuries/Fatalities (1975-2005)

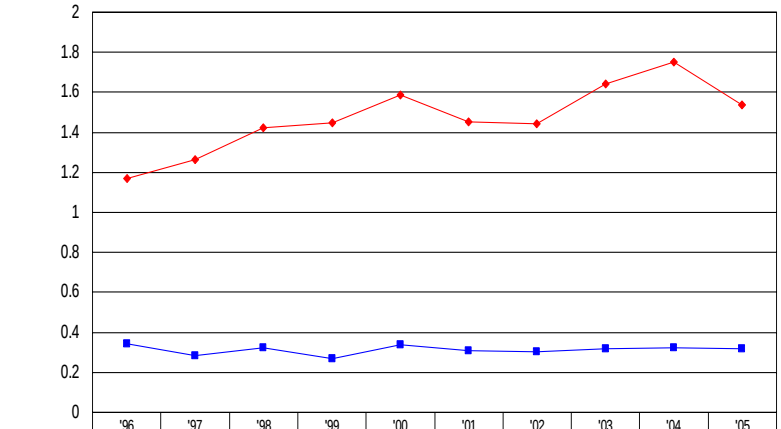


Note: A serious condition is one that meets the SOFA criteria for serious injuries, causes employees to lose 180 days from work, or causes serious harm to body, e.g. fracture, amputation, internal injury, concussion, etc.

These results indicate a general longer-term decline in these measures since FRA began keeping this information in this format in 1975.

However, when we focus more sharply on results for the past ten years, we see a less encouraging picture.

All Human-Factor-Related Accidents
Rate Per Million Train Miles (1996-2005)

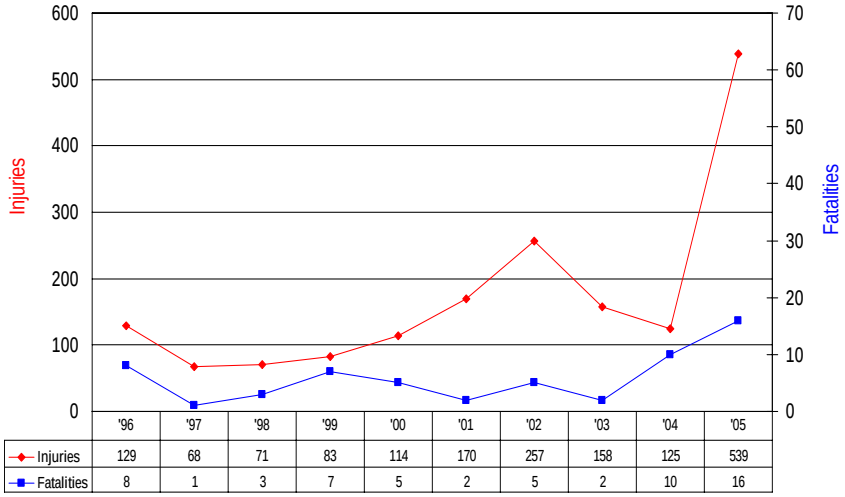


	'96	'97	'98	'99	'00	'01	'02	'03	'04	'05
All	1.167	1.263	1.422	1.447	1.587	1.455	1.441	1.641	1.752	1.535
Main Line	0.343	0.286	0.325	0.269	0.339	0.31	0.301	0.317	0.325	0.32

Note: Main line train miles are not reported to FRA; therefore, to calculate main line train miles FRA used the total train miles minus yard switching miles, which equals main line train miles

The chart above shows human factor train accidents, and, as you can see, there was some increase in the rate over the period of the decade. Essentially all of the increase is in the yards and on the industry tracks, while human factor train accidents on main line tracks have remained stable.

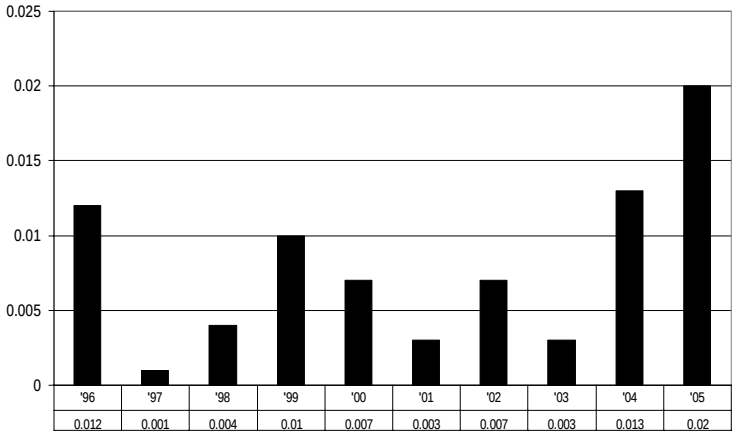
All Human-Factor-Related Accident Injuries & Fatalities (1996-2005)



	'96	'97	'98	'99	'00	'01	'02	'03	'04	'05
Injuries	129	68	71	83	114	170	257	158	125	539
Fatalities	8	1	3	7	5	2	5	2	10	16

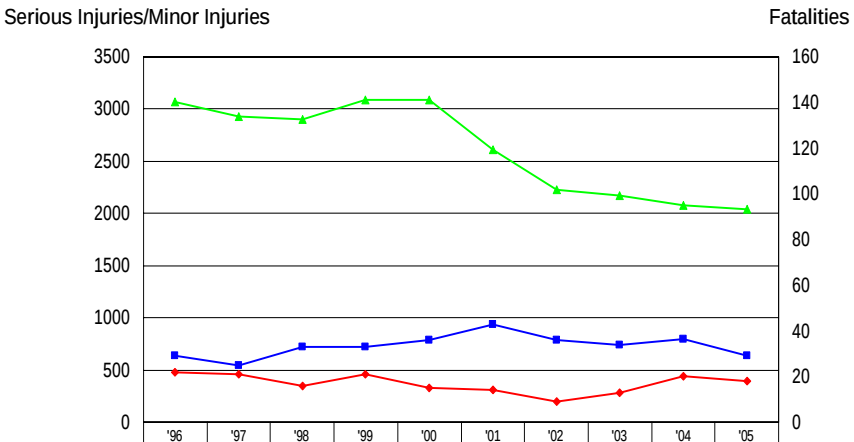
The chart above describes the human consequences of human factor train accidents. This information is displayed on a total count basis. These casualties are to railroad personnel and to the public. Again, please note that two different vertical scales are used, to permit the reader to view trends. Further, the spike in 2005 derives largely from one event, the collision with release of chlorine at Graniteville, South Carolina, on January 6, 2005, which claimed nine lives and resulted in over 292 reported injuries.

All Human-Factor-Related Accident Fatalities Rate Per Million Train Miles (1996-2005)



This chart shows the fatality rate for human-factor train accidents per million train miles. Again, because the fatalities are few in number, individual events powerfully influence the results. In 2004, for example, in Macdona, Texas, a Union Pacific Railroad Company (UP) train and a Burlington Northern and Santa Fe Railway Company (BNSF) train collided. The westward UP freight train, operating at an estimated 45 mph, failed to stop and struck the side of an eastward BNSF freight train while it was entering the siding. A chlorine leak from a tank car ensued, an evacuation was ordered, and the UP conductor and two members of the general public were found dead at the scene. This accident resulted in 30 percent of all fatalities due to human-factor-related train accidents reported in 2004.

All Train & Engine Employee
Serious Injuries/Minor Injuries/Fatalities (1996-2005)



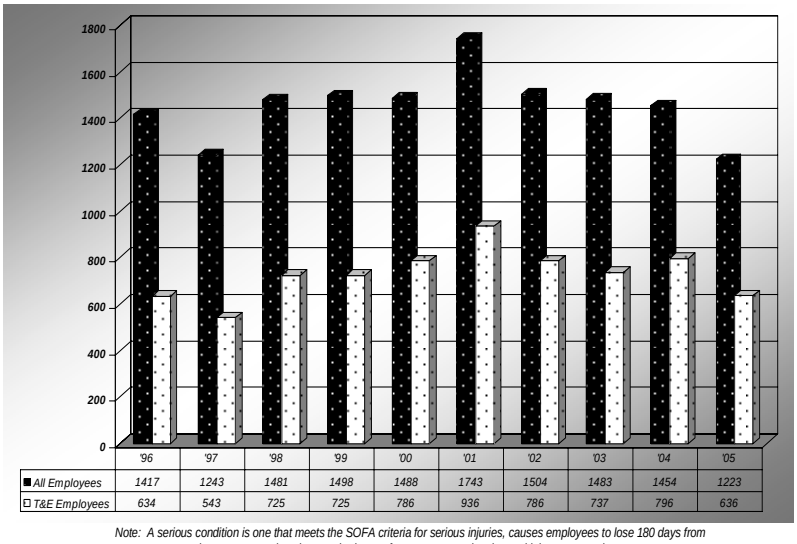
	'96	'97	'98	'99	'00	'01	'02	'03	'04	'05
Serious Injuries	634	543	725	725	786	936	786	737	796	636
Minor Injuries	3,070	2,925	2,901	3,089	3,092	2,611	2,227	2,174	2,077	2,039
Fatalities	22	21	16	21	15	14	9	13	20	18

Note: A serious condition is one that meets the SOFA criteria for serious injuries, causes employees to lose 180 days from work, or causes serious harm to body, e.g. fracture, amputation, internal injury, concussion, etc.

The chart above is limited to train and engine employee casualties that involve minor injuries, serious injuries, or fatalities. These can result from train accidents, from train incidents (not involving damage above the reporting threshold), from non-train incidents (such as motor vehicle accidents while employees are on duty), or from highway-rail collisions where the employee suffers injuries. For purpose of this display, a "serious injury" is an injury that causes an employee to lose 180 days from work or that causes serious harm to his or her body (e.g., fracture, dislocation, amputation, internal injury, concussion, hernia, or loss of eye).

It is very disappointing to us that fatalities in this category have failed to decline despite the heavy emphasis placed on the "SOFA [Switching Operations Fatality Analysis] Lifesavers." These are basic safety lessons derived by a labor-management-FRA working group conducting Switching Operations Fatality Analysis. At the same time, the fatality numbers reflect the significant volatility associated with very low absolute numbers and unusual events that affect them.

All Employees On-Duty Serious Injuries vs.
All Train & Engine Employees Serious Injuries
(1996-2005)



	'96	'97	'98	'99	'00	'01	'02	'03	'04	'05
■ All Employees	1417	1243	1481	1498	1488	1743	1504	1483	1454	1223
□ T&E Employees	634	543	725	725	786	936	786	737	796	636

Note: A serious condition is one that meets the SOFA criteria for serious injuries, causes employees to lose 180 days from work, or causes serious harm to body, e.g. fracture, amputation, internal injury, concussion, etc.

This final graph shows the relationship, again on a non-normalized basis, between serious injuries to train and engine personnel compared to total serious injuries to all railroad employees. There is some hope here that this metric may point to a decline in risk going forward if we can build on some of the efforts put in place over the past few years. This is particularly true because train miles and ton miles grew throughout the decade, and train and engine employment began to rise in 2004-2005, so the generally positive direction of movement for this indicator is encouraging.

As you know from prior hearings and from review of the National Rail Safety Action Plan, over one-third of train accidents are reported as having resulted from human factors. (Attachment 1 sets out the human factor cause codes and the distribution of derailments, collisions, and other train accidents (excluding highway-rail crossing accidents) that occurred in 2001-2005 and were caused by human factors.) It is generally accepted that human factors contribute in some way to a majority of events resulting in personal injury to railroad employees on duty, although of course in many cases the circumstances may be wholly outside the control of the employee who is injured (e.g., injury to locomotive cab occupants in highway-rail grade crossing accidents or injuries resulting from improperly maintained equipment).

What Is Needed to Prevent Railroad Accidents Caused by Human Factors

The temptation in approaching this subject matter is to say that "people are going to make mistakes" or "accidents happen." But the real situation is neither that simple nor, happily, that hopeless. In fact, we can conduct complex transportation processes safely if we go at it with devotion, knowledge and creativity. In the discussion that follows, I would like to set out what is needed to accomplish that, and I will report some of the actions underway or planned to address those needs.

1. The task needs to be well defined, and the rules and procedures for its accomplishment must be effective, clear, and unambiguous.

Over-the-road railroading requires precise adherence to the safety and operating rules that make it possible to control the movement of heavy trains in anticipation of conditions at locations not yet in view, and that account for factors such as grade, curvature, and speed limitations over diverging routes. Management of in-train forces is sometimes a major challenge.

Maintaining safety in yard and industry switching operations is also a considerable trial. At any given time, multiple movements may be underway within a confined yard or terminal environment, and each movement will typically be required to move at restricted speed (prepared to stop within one-half the range of vision). Particularly in older facilities, close clearances may present an additional demand on crews, and railroad radio frequencies may be filled with instructions and acknowledgments involving a significant number of personnel. These are merely examples.

Railroads handle these kinds of challenges by establishing a wide range of requirements contained in railroad operating rules, safety rules, train handling rules, power brake instructions, timetable special instructions, and bulletins. FRA's role has been to verify that these requirements are suitable and to reinforce the message of key requirements by adopting them as Federal regulations.

FRA rules directly governing railroad operating practices include—

- Specific requirements to keep trains out of work areas, including protection of workers when on, under, or between rolling stock (49 C.F.R. part 218) and protection of roadway workers (49 C.F.R. part 214, subpart C);
- Requirements for radio communications (49 C.F.R. part 220);
- Specific prohibitions on violation of cardinal rules applicable to the duties of locomotive engineers, such as observing speed restrictions and following signal indications (49 C.F.R. part 240); and
- Explicit requirements for the conduct of brake tests and for securement of equipment (49 C.F.R. part 232).

As I have previously noted before this Subcommittee, FRA is developing proposed rules that would "Federalize" additional key operating rules. An important part of that activity is to ensure that these rules as adopted are clear and that their observance is not eroded due to vague exceptions that may tend to weaken their impact. I think the extensive discussion that our staff undertook with the agency's Railroad Safety Advisory Committee (RSAC) Working Group helped clarify some of these issues. Our proposed rule is now in clearance, and we expect to publish it in September.

2. Rules and procedures must be well understood, and skills must be practiced.

When the public looks at railroads and their roots in the 19th century, the impression often taken is that the duties of railroad employees are simple. The reality is different. While certain tasks are relatively straightforward, in fact the inherent difficulty associated with operating rail equipment safely translates into extensive and often complex requirements that must be internalized by the work force and reinforced by supervisors. The pace of change in railroad operations raises the degree of difficulty.

Hence, effective training and operational testing are critical to successful safety outcomes. Shortly after enactment of the Federal Railroad Safety Act of 1970, FRA issued rules requiring railroads to instruct their employees in the railroad's operating rules and to conduct periodic operational (efficiency) tests and inspections to determine the extent of compliance with the railroad's operating rules. When the time came to require certification of locomotive engineers, FRA required submission of written training programs for FRA review; and virtually every major regulatory project that FRA has launched over the past decade has included a strong element devoted to training.

At the last hearing you heard questions raised concerning the adequacy of training. The precise issues currently presented in the industry are the rapidity with which employees are promoted to conductor, the process for qualifying conductors as remote control locomotive operators (a form of locomotive engineer service), and the process for certifying locomotive engineers for over-the-road service. In effect, apprentice positions and the former normal career progression of employees from train service (brakemen, switchmen, and conductors) to engine service (firemen and engineers) have disappeared, and training must be accelerated. Broadened seniority rights, together with more extensive joint operations, also contribute to concerns regarding familiarity with the territory over which crewmembers operate.

This situation did not happen overnight. It followed from several rounds of collective bargaining in which those now declaring a crisis fully participated. The situation has been made more urgent by a wave of retirements made possible by Railroad Retirement Act amendments that flowed from a labor-management agreement and by an increase in rail traffic. This situation has left railroads strapped for operating employees. Along the way, railroad employment has become comparatively less favored by the younger generations in the workforce, because it involves long

hours and often unpredictable schedules. As a result, retention of younger employees has declined.

Accordingly, efforts to strengthen training must negotiate these strong currents that labor, management, the economy, and the changed expectations of younger workers have unleashed over the past years. FRA has endeavored to address this situation through its review of locomotive engineer training programs, which now affect most new operating employees. In fact, as representatives of the United Transportation Union and the Association of American Railroads (AAR) pointed out at the last hearing, FRA had scheduled for today the beginning of a conference to work out strengthened training requirements for new employees. The beginning of that conference has been deferred to this afternoon, since several participants needed to be here this morning.

FRA takes seriously its responsibility for promoting the safety of railroad operations; and effective training, including recurrent training that addresses new challenges, is essential for safety. Let me point out, however, that railroad operations vary considerably across the Nation; and training requirements will vary, as well. Railroads need to conduct training by starting with task analysis and building curricula and test instruments that work in those different environments. Hands-on acquisition of skills and reinforcement of those skills are necessary elements of any training program. Introduction of new technology needs to be accompanied by suitable training. Taken altogether, this is a big job, and railroads make strong efforts, most of the time and in most respects, to address this need. When rail labor or FRA identifies apparent deficits in the quality or breadth of training, FRA needs to take a positive role by describing the deficit and suggesting practical means of addressing it.

I have appended to this testimony a brief description of minimum training, testing, qualification, and certification requirements applicable to railroad operating employees, as provided by FRA and Pipeline and Hazardous Materials Safety Administration regulations (Attachment 2). As always, we will be pleased to answer any specific questions that the Subcommittee may have about these requirements or their oversight.

3. Everyone must be accountable.

Good discipline is not the final answer to all questions about safety. As I will discuss further in a minute, many accidents are caused by mistakes that are wholly unintended. However, if we do not start with basic accountability for following the rules, we have no place to go but down on any rating of safety performance.

We cannot talk about employees being accountable without talking about everyone else doing his or her job, as well. FRA needs to set reasonable expectations and diligently verify that they are being met. Carrier officers, who have the very difficult job of putting programs in place and making sure that they maintain their integrity in the midst of changing circumstances, must ascertain that commands issued at the system level get executed down in the yards and terminals.

Line officers need to model safe behaviors and hold employees accountable—not encourage shortcuts or ignore rule violations when things get busy.

While developing a proposed rule to strengthen compliance with the railroad operating rules, in conversation with labor and management through the RSAC, FRA has discussed how we might establish systems that ensure accountability up and down the line. I hope that you will see clear evidence of that in our forthcoming notice of proposed rulemaking.

4. The organization must nourish a positive safety culture.

Over the past several decades, the railroad industry has progressed from a time when nominally strict rules and stern enforcement constituted the major component of any safety program to the present, more constructive environment, in which everyone--from the railroad's chief executive officer to the most junior employee--recognizes his or her role in contributing to the safety of co-workers and the communities through which the railroad conduct operations. This progression is what is known as "building a strong safety culture."

An organization with a positive safety culture treats safety as more than a slogan and more than the responsibility of the safety department. The organization tries to design a workplace that is conducive to safety and to engender an atmosphere of trust that empowers every worker to identify hazards and suggest remedies. Particularly in an industry with a strong union presence, a positive safety culture requires constructive engagement between labor and management, not only at the organizational level, but also at the interface between the worker and that person's supervisor.

FRA has tried to contribute to the emergence of a positive safety culture in the railroad industry by opening clogged lines of communication and helping to facilitate solutions to specific safety issues. For the period of about a decade (1995-2005), FRA employed the Safety Assurance and Compliance Program (SACP) model to draw management and labor closer together; and the program had notable successes. I think the effort was worthwhile, but last year we took stock and decided that SACP purposes had been largely fulfilled and that we should be more selective in the meetings we attend and the issues we take on—taking to heart the recommendations regarding resource allocation provided by the Department's Office of the Inspector General.

FRA continues to respond to requests for assistance in bridging the gap between management and labor and addressing areas of concern not subject to regulation. We have assigned a Railroad System Oversight Manager to each of the major freight railroads and to Amtrak, and we can provide facilitation services on request. The major industry associations, including the AAR, the American Short Line and Regional Railroad Association, and the American Public Transportation Association also play a strong role in helping their members build sound safety programs. Each of the rail labor organizations views promoting safety as a vital part of their service to their members. All of these parties join together in the RSAC to share experiences and to help determine future directions for the industry working together.

FRA supports advances in safety culture by supporting human factors research and demonstration programs. One example of an FRA-sponsored human factors demonstration program is called "Changing At-risk Behavior." This pilot project was begun in cooperation with UP in April 2005 in the UP's San Antonio Service Unit to demonstrate an exposure-reduction strategy that FRA has entitled, "Clear Signal for Action." Key driving forces of the Clear Signal for Action method include proactive safety leadership by carrier management, confidential peer-to-peer feedback by labor, and strong labor-management relations in continuous improvement efforts. Changing At-risk Behavior grew out of a collaborative, exposure-prevention effort called "Cab Red Zone," which had been initiated by UP management and local labor unions early in 2004. The Cab Red Zone initiative focused attention on improving safety practices in the locomotive cab, such as conducting proper radio communications, calling signals, and maintaining vigilance. In May 2004, FRA funded a consultant to 1) evaluate the Cab Red Zone rules and the targeted at-risk practices; 2) support the development of a Clear Signal for Action process, focused on Cab Red Zone rules and practices; and 3) evaluate its implementation and impact for potential applications across the railroad industry. The Changing At-risk Behavior demonstration project at UP is in the implementation phase. Evaluation activity is also underway to assess its overall impact on safety and safety culture and its potential benefit and application to the railroad industry. The evaluation process is systematically identifying opportunities for improvements as each step of the implementation is carried out in addition to assessing impacts at the conclusion of the study. Results of the evaluation will be published and, if appropriate, FRA will support further implementation of this Clear Signal for Action method in the industry. In a moment, I will talk about another program—the "close call" system—which is intended to strengthen safety culture through employee-driven successes.

5. All personnel must learn how to work constructively together.

Rail transportation operations are a complex interaction between technology and human performance. This relationship between technology and human performance is defined by a rules-based environment that is highly dependent upon operators' and employees' adherence to specific policies, procedures, and rules. Tragically, many rail accidents are the result of human errors that can be divided into three basic categories: skill-based errors; rule-based errors; and knowledge-based errors.

The rail industry, like other transportation modes, has increased the use of automation to reduce the probability of human error. However, the dependency on human operators has, to a large degree, resulted in a shift in the type of errors being committed. Automation has been advanced to the largest extent by the aviation industry, where a recent study by the University of Texas indicates that 31 percent of the human errors being committed are related to the use of the very automation put in place to reduce human error. Although we must continue to encourage advancements in technology, we must also focus our efforts on the actions and behaviors of the humans operating within the various transportation systems.

One method that has been found to be effective in reducing human errors within complex operating systems is Crew Resource Management (CRM). This method has been effective in

reducing human errors by improving how workers interact with each other, how information is shared, and how decisions are made within the operating environment. CRM focuses on improving skills in the areas of decision-making, assertiveness, mission or task analysis, communications, leadership, adaptability and flexibility, and situational awareness. These factors serve to produce a shared vision of reality, thereby decreasing the probability of human error. Furthermore, these essential operating elements have been found to be effective in reducing human error in such diverse operating environments as the aviation and maritime industries, hospitals and surgery rooms, nuclear power plant operations, oil drilling and recovery operations, as well as a wide array of military operations.

FRA has actively been encouraging the incorporation of CRM into rail operations for several years. FRA has worked with the academic and research community and other transportation modes to adapt the concepts of CRM to the railroad environment. To date, FRA has produced a series of CRM training programs for railroad operating crews, mechanical personnel, and engineering and maintenance employees. These programs will soon be available for use by the industry. We have also developed a business case for CRM that demonstrates that CRM is not only effective in improving safety, but also decreases the operational cost to those organizations that provide their employees with CRM training. Furthermore, we are currently in discussions with a major Class I railroad about the possibility of beginning a CRM demonstration project to establish the viability of CRM in the rail industry.

6. Individual employees must be fit for duty.

Presenting ourselves fit for duty is a basic responsibility that each of us must discharge in any work setting. For a railroader, a single slip can lead to the loss of a limb or worse, and a brief unplanned period of sleep can result in disaster for the railroader and the public in the surrounding community. Thus, we all have a stake in railroad operating employees' being fit for duty. For a railroad operating employee, being fit for duty means that the employee is rested, free from impairing substances, and free from any disabling medical conditions. What follows is a brief survey of threats to fitness.

a. Fatigue

(1) Fatigue in general

Each of us requires sleep of an appropriate quality and quantity (about eight hours per day for most of us) to function at peak physical and mental performance. In order to sleep well, we need to have appropriate physical circumstances (e.g., darkness and quiet) and avoid circumstances and conditions that interfere with sound sleep (e.g., disorders such as sleep apnea, clinical depression, and excessive use of alcohol). Factors that threaten our ability to receive adequate rest (apart from too little time to take our rest while addressing other necessary activities of life) include lack of information needed to schedule rest appropriately and biological rhythms (particularly attempting to sleep during periods of the day when our body clock causes us to be wakeful).

When adequate sleep is not achieved, employees' alertness on the job may be compromised. Alertness can be compromised by extended periods of wakefulness, but studies in the area have generally not shown long hours on duty in a single work shift to be a major issue by itself (given the constraints of current law). Of greater concern would be acute fatigue aggravated by other factors (e.g., inability to plan rest) or cumulative fatigue[3]—particularly combined with the effects of biological rhythms.

(2) The limits of the Federal hours of service law

The hours of service law,[4] which was originally enacted in 1907 and last amended as to the hours of railroad operating employees in 1969, deals only with acute fatigue, not with cumulative fatigue. The specified maximum hours on duty and minimum periods off duty, coupled with provisions related to "limbo time,"[5] clearly function to permit the occurrence of cumulative fatigue. Let us be clear that the hours of service law does not *cause* cumulative fatigue, but neither does it prevent it. (The law permits working 11 hours and 59 minutes followed by eight hours off duty and another 11 hours and 59 minutes on duty, perpetually.) Because science related to biological rhythms had not been applied to the railroad workplace when the Congress last addressed this issue, the hours of service law simply does not deal with the issue.

The NTSB has identified fatigue as a causal or contributing factor to at least 14 major rail accidents since 1984. FRA's analysis of data gathered by the 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. Today, FRA is officially publishing the Collision Analysis Report, which also identifies compromised alertness as a significant factor in the problem of train-to-train collisions. (The report is being posted to FRA's Web site, which is at http://www.fra.dot.gov.)

The Department of Transportation has on four occasions formally submitted legislation to repeal or reform the hours of service law or at least supplement it with fatigue management requirements. The 1991 rail safety reauthorization bill proposed to repeal the hours of service statute and to authorize the Secretary (or the Secretary's delegate, FRA) to prescribe regulations on fatigue in light of current scientific knowledge. Currently, the statute contains 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 49 U.S.C. 20103

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[3] If a person gets less sleep than is required, he or she begins to acquire a "sleep debt." If the sleep debt becomes an issue with respect to performance, we refer to it as "cumulative fatigue."

[4] In 1994, Public Law No. 103-272 repealed the Hours of Service Act and revised and reenacted its provisions without substantive change as positive law at 49 U.S.C. 21101 et seq.

[5] This is time scored as neither "on duty" nor "off duty" time. It includes time waiting for transportation at the end of the duty tour and time in deadhead transportation. See 49 U.S.C. 21103(b)(4) and 516 U.S. 952 (1996).

provides 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 preclude 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, signal maintainers, and dispatchers, a regulation could not lawfully vary from it. Despite the need for reform, the 1991 proposal was vigorously opposed by both rail labor and management and was not enacted.

The Department's 1994, 1998, and 1999 bills did not seek repeal of the hours of service statute. Instead the agency proposed to keep the statute in place, except for comparatively minor adjustments. FRA's 1994 bill, which was enacted, authorized FRA's waiver of the statute for two-year periods upon joint labor-management petition; however, only one formal petition was received, and it became moot. In the 1998 and 1999 bills, in addition to fairly minor proposed amendments, FRA also sought to add a new provision intended to supplement the statutory protections by requiring each major passenger and freight railroad to develop, adopt, and comply with a comprehensive "fatigue management plan." Both the 1998 and 1999 bills required that the railroad describe the means by which it would reduce the fatigue of its employees subject to the hours of service laws. Each plan had to discuss specified topics, such as employee training on factors affecting fatigue, identification of sleep disorders, scheduling practices, work-rest cycles, alertness strategies, and lodging facilities; however, the approaches selected were left to the railroads, in consultation with their employees, to devise. To encourage rail-management cooperation, the bills proposed to authorize the Secretary to grant waivers of the statute for any specified time period upon joint petition by labor and management. During Congressional hearings, the 1998 bill was primarily attacked as too prescriptive and likely to stifle creative, voluntary efforts to develop fatigue countermeasures, including the efforts of the FRA-sponsored clearinghouse on fatigue, the North American Rail Alertness Partnership. Based on dialogue with rail labor, rail management, Hill staffs, and others, FRA reworked the 1998 provisions in an effort to develop a more acceptable bill. Nevertheless, the 1999 bill was also rejected. No hearings on the 1999 bill were held, so it is difficult to know the exact reasoning for the opposition, beyond economic concerns.

Chastened by the reaction my predecessors encountered, I do not have a fresh approach for you today, but I will note that FRA does enjoy authority to "follow the data" in other areas of our work. Other comparable agencies, such as the Federal Aviation Administration and the Federal Motor Carrier Safety Administration, do have plenary authority to regulate in this field.

I want to quickly add that this is an issue that requires more than legislation to address effectively and that any new approach to crew scheduling—whether approached from the public or private sector—will need to recognize the wide variety of circumstances under which operating employees do their work.

(3) Voluntary efforts to address fatigue

Significant progress has been made in the railroad industry in communicating to employees the basics of sleep hygiene and stressing their responsibility to take advantage of opportunities for rest. Railroads and labor organizations have also aggressively explored various options for ensuring that employees have the ability to prevent the accumulation of an excessive sleep debt. Some of these experiments have held, but most have fallen by the wayside, either because of express objections from the companies or the labor organizations. Others have simply not been utilized, as labor organizations and employees have sought to maximize earnings and total employee compensation rather than taking more rest.

Several railroads have tried with some success to schedule their operations in a way that creates predictability with respect to reporting times, and, in at least one case, efforts have been made to swap crews on the line of road so that crews return daily to their home terminals. Sleep that we get in our own beds tends to be of higher quality.

At any given time it is difficult to know precisely the degree of fatigue prevalent in the industry, in part because we cannot know how most employees spend their off-duty time. However, snapshots that we have taken in joint labor-management-FRA projects, certain data available at the railroad system level, and information collected anecdotally following train accidents, provide a rather more hopeful picture than one would suspect from the extreme (but nevertheless valid) examples of unacceptably long hours and extreme fatigue. That may mean that finding remedies for the fatigue that remains is very feasible if we are well enough informed and if railroad management systems can be made to function more acceptably.

FRA is working with several railroads to encourage further non-regulatory action**,** such as the pilot Fatigue Risk Management System (FRMS) by UP, which is designed to reduce fatigue-related risk. This risk-based system includes varying levels of controls for mitigating fatigue, with shared responsibilities for both employees and the company, to ensure safe levels of alertness when operating trains. Some of the controls for mitigating fatigue include policy development, system wide monitoring of critical factors that provide adequate sleep opportunities, such as the use of fatigue modeling software, self-assessment methods for identifying individual sleep disorders with accompanying provisions for alternatives to discipline, and measures of effectiveness.

The conceptual framework of the FRMS was presented to a scientific review committee for critical analysis and recommendations for enhancement in November 2005. Senior representatives of FRA, the Brotherhood of Locomotive Engineers and Trainmen, AAR, the United Transportation Union, and the NTSB present at this meeting offered comments and suggestions for improvement. The stakeholders *generally* agreed that its conceptual framework appeared, on the surface, to be a practical, innovative, and evidence-based program that supports both organizational goals and scientific goals alike, while operating within the boundaries of the current hours of service statute. However, concerns were raised regarding the validity of implementation plans to measure adequately the success of FRMS from a scientific perspective.

This pilot, risk-based approach to fatigue is being considered for implementation by at least one other carrier, and may serve as a possible model FMRS for the entire railroad industry to follow. FRA has pledged to support the implementation of this fatigue risk management process in whatever ways it can. In April 2006, the Executive Vice-President, Operations of UP issued a policy statement supporting the FRMS and applicable implementation plan.

(4) FRA-sponsored research to develop fatigue models that could be used to improve the scheduling of work by train crews and the investigation of railroad accidents

Currently, FRA is completing a research study that attempts to find out whether a fatigue model that was originally developed for the U.S. Army and U.S. Air Force to predict and manage the fatigue of military personnel should be used to predict and manage the fatigue of railroad workers, and if so, to what extent the original model should be adapted to deal with the special circumstances of various types of railroad operations. A fatigue model offers the possibility of objectively assessing and forecasting fatigue so that employees and employers can schedule work and rest to avoid fatigue. The fatigue model used for this study--the Sleep, Activity, Fatigue, and Task Effectiveness (SAFTE) model--predicts potential fatigue based on an analysis of work schedules. The model has been adopted by the Department of Defense as the standard warfighter fatigue model and has been incorporated by the U.S. Air Force Research Laboratory into a useful fatigue assessment tool called the Fatigue Avoidance Scheduling Tool (FAST), which takes information about a person's work schedule and typical sleep habits and estimates the amount of sleep that would occur under the schedule and the effects of that sleep pattern on cognitive effectiveness.

A useful fatigue model needs to be calibrated to the demands of a particular job so that the numbers from the model can be related to the risk of meaningful failures of human performance. One important part of calibration of a fatigue model for use as a fatigue management tool is an assessment of whether the tool can predict an increased likelihood of making a human factors error or causing an accident. FRA's study, in partnership with five Class I freight railroads, examines two-and-a-half years of data on accidents to attempt to make this connection. The study is collecting 30-day work histories prior to a sampling of accidents reported as caused by a human factor, with comparison to a control group of work histories prior to accidents reported as caused by something other than a human factor. An objective of the study is to analyze all work histories to determine, based solely on the model, the predicted effectiveness of the operators at the time of the accidents. The results so far from the two-and-a-half years of data are revealing that low levels of cognitive effectiveness are related to an elevated likelihood of human factor accidents.

The virtue of having a validated fatigue model (especially if it is calibrated so that we know how to relate the model to accident likelihood) is that it could be used by a carrier to do a self-assessment of fatigue across its system. By evaluating work histories on a terminal-by-terminal basis and using the scores from the model as a metric, the carrier could determine which terminals are experiencing schedules that might be generating fatigue in the operators. Perhaps none of the terminals have a problem; perhaps just a few. In any case, the carrier would be in a position to use this objective assessment as a way to focus its fatigue management efforts where

there would be the greatest payoff. Further, after changes are made in operations or crew calling to reduce schedule induced fatigue, the carrier could revisit that terminal to assess whether the initiatives have been productive in eliminating or reducing the problem. For the first time, an objective tool could be applied to solve this elusive but safety-related problem. From the industry's perspective, it would be a non-prescriptive, performance-based approach that would not impose a "one-size-fits-all" regulatory solution and could, therefore, enhance productivity. From the public's perspective, it would have the promise of actually making a difference for the safety of the industry and the public.

A final report regarding the validation and calibration of the FAST model is anticipated by later this summer. It is inherent in the study design that products of this effort will be tools to assess the rough order of magnitude of fatigue as a contributing factor in accidents.

If FRA is successful, this model can be embodied in a scheduling tool that railroads can use to better plan their crew-calling practices and evaluate their staffing needs. The model can also be used with greater confidence for accident investigation purposes. FRA is indebted to the cooperation of the railroads and labor organizations in structuring this study, supported by the human factors staff of the NTSB.

(5) FRA and industry action to address sleep disorders

No amount of good scheduling or attention to limiting hours of service will completely ameliorate the fatigue issue if employees are subject to sleep disorders. FRA has issued a Safety Advisory on sleep disorders that emphasizes early screening and diagnosis facilitated by appropriate reassurances to employees asked to declare their own symptoms. Peer involvement would also be encouraged. (See Notice of Safety Advisory 2004-04; Effect of Sleep Disorders on Safety of Railroad Operations (Oct. 1, 2004; 69 Fed. Reg. 58995).) Every major railroad has taken some form of action consistent with the Advisory, but none has embraced it entirely and in an aggressive manner**.** However, FRA is cooperating with a major carrier in the development of screening protocols for identifying and treating employees in safety-sensitive positions (locomotive engineers) with sleep disorders. At the same time, we are also working with this carrier in addressing the problems associated with depression and diminished performance. In both cases, FRA's support includes funding assistance.

FRA is taking a number of additional actions to develop tools addressing fatigue that space limitations do not permit us to address in this prepared statement. I would encourage Subcommittee staff to set aside time for a detailed briefing.

b. Impairment by Alcohol and Other Drugs

When FRA issued its regulations on Prohibition of Alcohol and Drug Use in Railroad Operations in 1986, the agency became the first to require pre-employment, post-accident, and "reasonable suspicion" chemical testing, prompting litigation that went all the way to the U.S. Supreme Court. (See 49 C.F.R. part 219.) Shortly thereafter, random testing was added to the

arsenal. FRA continues to aggressively administer this program, under which considerable progress has been made. It has since been largely replicated by other modes of transportation and improved in material respects under the leadership of the Office of the Secretary of Transportation.

Nevertheless, prohibited substances continue to show up in occasional post-accident tests, and FRA continues to encourage railroads to pursue education and awareness programs, including cooperative programs designed for employees to "bypass" discipline and receive access to an employee assistance program where an individual affected by a substance abuse disorder self-reports or is referred by a co-worker.

More recently, FRA has tasked its contract post-accident laboratory to conduct a blind study of samples collected for post-accident toxicology to determine if drugs other than those on the current panel for reporting are present in archived specimens. The FRA post-accident toxicology panel includes the five drug groups tested in most occupational programs (marijuana, cocaine, phencyclidine (PCP), amphetamines, and opiates) and certain other controlled substances that have a high potential for abuse and for compromise of alertness (benzodiazepines and barbiturates). There are many additional compounds, including many not considered controlled substances, that are known to have a potential to adversely affect performance. Some of these "other drugs" are dispensed by prescription, while others are sold over the counter. All of them have legitimate medical uses, but they have primary or secondary effects that may be inimical to safety.

Results of this blind study indicated that 11 percent of the urine specimens tested in all post-accident events for the period surveyed tested positive for these other drugs. The compounds varied from the powerful synthetic narcotic oxycodone to common over-the-counter drugs such as diphenhydramine (the generic name for a sedating type of antihistamine). These findings should neither be ignored nor taken out of context. Some of these positives appear to have involved other than human factor accidents, while in other cases the employee who was positive may have done nothing to contribute to the occurrence of the accident. In some cases, the drugs involved may have been taken under careful regulation by a treating physician who was well aware of the employee's occupation. FRA and the railroads have made efforts to address this issue (see, e.g., Safety Advisory: Safe Use of Prescription and Over-the-Counter Drugs (Dec. 24, 1998; 63 Fed. Reg. 71334)). But, given the prevalence of therapeutic drug use and the potential for abuse, we need to consider what additional actions may be appropriate.

c. Impairment by Other Medical Conditions

FRA's regulations for Qualification and Certification of Locomotive Engineers (49 C.F.R. part 240) require engineers to pass periodic visual and hearing acuity tests. Engineers must be free of active substance-abuse disorders. However, apart from these requirements and the prohibitions on alcohol and drug use described above, FRA—unlike the Federal Aviation Administration, the Federal Motor Carrier Safety Administration, or railroad regulatory agencies

in Canada and Mexico—does not have a requirement for broad medical standards programs for safety-critical railroad employees.

The reasons for this are rooted in a strong tradition of industry action. Railroads for many years maintained vital medical programs that included pre-employment, return-to-work and periodic medical examinations. The programs were adequately staffed, and there appeared to be no need to duplicate this effort with FRA-imposed requirements. However, over the past decade, many of the railroads' medical functions have been outsourced, and periodic medical examinations have been largely discontinued. The AAR abolished its medical committee, so that individual railroads were left to act independently. Further, passage of the Americans with Disabilities Act has raised questions (given the absence of Federal medical standards) regarding the line-drawing that is necessary for this function.

Recognizing these developing trends, FRA commissioned a study that resulted in the report entitled "Medical Standards for Railroad Workers," which was introduced to the RSAC in January of 2005. FRA noted at that time that effective management of medical conditions that can affect safety (which include such disparate conditions as sleep apnea and seizure disorders) should be undertaken within the framework of a mature medical program. FRA asked RSAC member organizations to consider the study's findings and engage FRA in a dialogue regarding further steps. We have recently been advised that the major railroads are prepared to initiate that dialogue, and we will be seeking the cooperation of other RSAC parties to get it underway.

7. Technology must be part of the solution, not part of the problem.

a. Human-Centered Design

The first rule of medical science is "do no harm," and the same notion should be applied to technology deployment. Very often we think that if a technology is "new," it must be an improvement. Applying the principles of human-centered design will make it more likely that this is the case. Failure to do so may set traps that defeat the user and defeat the purposes the design was intended to serve.

Through our Office of Research and Development and with the assistance of the Department's Volpe National Transportation Systems Center, FRA has been on the forefront of this issue, providing extensive guidance materials for use by the railroads and the supply community. Recent results include a simple tool for evaluation of any new human-machine interface by our Office of Safety and other users.

b. Positive Train Control Migration

Technology can also be a tremendous aid to safety, providing a safety net when human beings err or become incapacitated. Since the 1920s, train control systems providing speed control functions, in-cab signal indications, and continuous or intermittent train stop functions have contributed significantly to safety in the territories where they were installed. Contemporary

positive train control (PTC) systems can provide even more advanced functions, including prevention of train collisions (with positive stop protection), prevention of overspeed derailments, and protection of roadway workers within their authorities; and they can do this at less cost.

As traffic levels rise and traffic densities increase (particularly in non-signaled territory), the risk of collisions will rise. If PTC systems are built to be interoperable and are integrated into other business systems, we believe they can be an affordable response that will contribute to increased safety. In March 2005, we issued a final rule setting out Performance Standards for Processor-Based Signal and Train Control Systems that provides a means for qualifying new technology and facilitating the migration to safer train operations. (See 49 C.F.R. part 236.) The response is already strong. We have given approval to Railroad Safety Program Plans for two railroads, and we have the first Product Safety Plan under review (BNSF Railway's (BNSF) Electronic Train Management System).

As we move toward wider application of PTC, we need to garner as many of the benefits as possible using forward-looking, compatible technology—i.e., technology that will become part of the PTC system. Determining that switches are properly positioned is a high priority in light of the tragic Graniteville, South Carolina, accident in January 2005 and other events. In order to address this need, FRA initiated with BNSF a pilot project to demonstrate a Switch Position Monitoring System (SPMS). The SPMS project began in September 2005, and work was completed in early November 2005 to equip 49 switches on 174 miles of the Avard Subdivision in Oklahoma, which extends between Avard and Tulsa. At this writing, the system is functioning as intended, promptly providing dispatchers with warnings for misalignment or maladjustment. We believe that this technology should be extended to other non-signaled territory where risks are high because of train speeds and hazardous materials shipments.

c. Electronically Controlled Pneumatic (ECP) Brakes

In 2005, 14 percent of main track, human factor accidents involved improper train handling or misuse of the automatic braking system. A significant number of these events might have been avoided if locomotive engineers were given a more suitable train air brake system to use as a tool. Current railroad instructions to crews discourage use of the Federally-mandated automatic brake in favor of newer extended-range dynamic brakes because of the inherent limitations of the automatic brake related to fuel consumption, train handling, and the possibility of undesired emergency applications (which themselves may cause derailment).

During the 1990s, the AAR led an industry effort to develop ECP brakes, which use an electronic train line to command brake applications and releases. ECP brakes apply uniformly and virtually instantaneously throughout the train, provide health status information on the condition of brakes on each car, respond to commands for graduated releases, and entirely avoid runaway accidents caused by depletion of train line air pressure. ECP brakes shorten stopping distances on the order of 40 to 60 percent, depending on train length and route conditions. In turn, shortened stopping distances mean that some accidents that occur today might be avoided entirely, and some others might be reduced in severity (e.g., giving a person in a stalled motor

vehicle crucial seconds to exit the vehicle and get clear of the grade crossing before the train arrives). Without question, this system will provide new and improved train-handling options that are expected to reduce the number of derailments now charged to the actions of locomotive engineers.

As the freight railroads have hesitated to implement this powerful but initially costly technology, the question has become, "where to start?" FRA set out to answer that question, and the answer is very timely in light of current capacity constraints affecting some market segments.

FRA is preparing to release a study entitled, "ECP Brake System for Freight Service," which was prepared for our Office of Safety by the firm of Booz Allen Hamilton, in consultation with an expert panel drawn from the community of railroads and shippers that have implementation of this technology under consideration. The report identifies and quantifies significant business benefits that could be realized with this technology and suggests a migration plan that would start with unit train operations, logically focused initially on the Powder River Basin coal service. Yesterday I met with the board of the National Coal Transportation Association (NCTA) at their request, to begin the discussion regarding how we promote this important transition to more capable technology. The value that ECP brake technology can add across the rail transportation sector is clearly evidenced by NCTA's interest in this opportunity. Coal shippers want to seize this opportunity because it will improve their service and the utilization of their coal cars. Railroads and their suppliers created the technology for similar reasons. The Nation can benefit as well, both in terms of service and safety. As major markets are served using the technology, it will also contribute materially to optimization of system capacity.

8. Impediments to working safely must be identified and removed.

Most of us agree that people generally want to perform their work well. Sometimes we are guilty of sloth or carelessness that comes from the desire to cut corners or from a poor attitude toward work. But in a very large number of cases, mishaps occur because of other factors. In most cases, the mishaps will have been preceded by many errors that did not result in harm. Perhaps machinery does not respond as anticipated, or distractions cause one to lose situational awareness. Perhaps skills taught in training some months ago have not been practiced, and performance suffers. Again, most of the time these lapses will ***not*** result in serious harm, and that presents an opportunity. We can learn from our mistakes before the mishap occurs.

"Close calls" are unsafe events that do not result in a reportable accident but could have done so. FRA is working to better understand these phenomena. In March 2005, FRA completed an overarching Memorandum of Understanding (MOU) with railroad labor organizations and management to develop pilot programs to document the occurrence of close calls. In other industries, such as aviation, adoption of close-call reporting systems that shield the reporting employee from discipline (and the employer from punitive regulatory sanctions) has contributed to major reductions in accidents. In August 2005, FRA and DOT's Bureau of Transportation

Statistics (BTS) entered into an MOU stipulating that BTS will act as a neutral party to receive the close-call reports and maintain the confidentiality of the person making the report. In October 2005, a contract to evaluate the close-call data was awarded to Altarum Institute of Alexandria, Virginia. Four railroads have expressed interest in taking part in this project. Educational efforts are under way to ensure that key stakeholders (local rail management and labor) at each potential site understand the purpose of the program and what would be required of them. Specifically, participating railroads will be expected to develop corrective actions to address the problems that may be revealed. Aggregated data from these projects may also provide guidance for program development at the national level. An Implementing MOU involving the first site is awaiting signature by all parties, and data collection is expected to begin in the near future.

Note on Railroad Staffing

At the June 27th hearing, I was asked about the current issue in collective bargaining with respect to one-person freight crews. Apart from expressing greater or lesser degrees of commitment to positive train control (depending on the railroad), railroads have not shared with FRA how they would meet all of the safety requirements that are addressed currently by conductors. Accordingly, FRA is not in a position to comment on the merits of this proposal; nor should we wade into the deep and murky waters of a collective bargaining matter.

I think all of us need to take this issue as it comes, paying careful attention but being sure not to prejudge. Some of our staff still working at FRA came to the agency at a time when the five-person crew was standard. As time went on, remaining fireman positions were eliminated, dropping the engine crew to a single person. Then the caboose was eliminated, and with it went a brakeman; the conductor moved up front. Soon the front brakeman was gone, as well. Through all of this change, safety improved, although not always in the seamless way one would have liked. We acknowledge that FRA took too long to require two-way end-of-train telemetry to ensure that a brake application could be initiated from the rear if the train line was blocked. The Congress had to prod the agency and the railroads to get that done, and in the meantime we had some spectacular runaways.

For a government agency, we are still fairly young, but we can learn from experience. So you can expect that FRA will be carefully looking at the issue with safety as our lodestar, should the railroads gain additional flexibility in the current round of talks or thereafter. In the meantime, the railroads need to maintain a strong focus on crew resource management, stressing the positive role that the conductor needs to play in over-the-road operations today and encouraging the locomotive engineer and conductor to function as a team, in concert with the dispatcher and others who contribute to the safety of operations. The various branches of labor, management, and FRA should also strive to keep our voices at a moderate volume so that we can listen to one another and strive to create an environment in which safety is truly our highest value.

Conclusion

Human factors have to do with people, organizations, and processes and the ways that technology is used to undermine or support human performance. Issues like maintaining freight cars to stay on track, or determining track geometry that will support high-speed passenger operations, are surprisingly complex, but they cannot compare in complexity to management of human factors issues. As a railroad safety community, we can do better in this field of endeavor, and we are taking a broad range of actions that will support that outcome.

Thanks again for the opportunity to testify on this important topic. I would be happy to respond to any questions from the Subcommittee.

Attachments

Attachment 1:

Train Accidents Caused by Human Factors, by Most Frequently Reported Cause

Note: The column headed "Acc %" shows the accumulated percentage. See also all train accident cause codes by category and subcategory in the FRA Guide to Preparing Accident/Incident Reports, Appendix C, "Train Accident Cause Codes," including "Train Operation – Human Factors."

	Cause	Total	% Of Total	Acc %	2001	2002	2003	2004	2005
1	Switch improperly lined	965	16.44	16.44	156	168	225	218	198
2	Shoving movement, absence of man	658	11.21	27.65	111	89	147	171	140
3	Shoving movement, failure to control	268	4.57	32.22	33	42	54	67	72
4	Buff/slack action excess, trn handling	255	4.34	36.57	54	37	75	58	31
5	Cars left foul	242	4.12	40.69	47	49	50	46	50
6	Switch previously run through	238	4.06	44.74	37	36	47	68	50
7	Fail to secure car hnd brk -rr emp	201	3.42	48.17	48	36	40	42	35
8	Fail to apply suff. hand brakes -rr emp	201	3.42	51.59	34	51	42	41	33
9	Passed couplers	180	3.07	54.66	36	28	38	38	40
10	Derail, failure to apply or remove	157	2.68	57.34	28	40	27	36	26
11	Other general switching rules	125	2.13	59.46	24	25	26	23	27
12	Coupling speed excessive	121	2.06	61.53	29	28	23	18	23
13	Failure to comply with restricted speed	102	1.74	63.26	24	35	11	12	20
14	Switch not latched or locked	98	1.67	64.93	25	11	15	25	22
15	Fail to apply car hnd brks -rr emp	96	1.64	66.57	9	20	14	25	28
16	Failure to comply with restricted speed or its equivalent not in connection with a block or interlocking signal.	91	1.55	68.12	0	0	21	35	35
17	Failure to couple	89	1.52	69.64	15	16	15	25	18
18	Other train operation/human factors	80	1.36	71.00	16	20	20	11	13
19	Kicking or dropping cars, inadequate precautions	79	1.35	72.35	0	0	8	32	39
20	Independent brake, improper use	68	1.16	73.50	12	14	16	16	10
21	Instruction to trn/yd crew improper	67	1.14	74.65	13	11	19	18	6
22	Buff/slack action excess, trn make-up	66	1.12	75.77	9	16	11	17	13
23	Car(s) shoved out & left out of clear	59	1.01	76.78	9	12	13	16	9
24	Failure to secure engine- rr empl	53	0.90	77.68	12	9	8	13	11
25	Failure to stop train in clear	50	0.85	78.53	15	10	7	9	9
26	Lat DB force on curve xcess trn hndlng	50	0.85	79.38	9	11	10	10	10
27	Radio communication, failure to comply	48	0.82	80.20	9	13	7	8	11
28	Other train handling/makeup	40	0.68	80.88	7	12	6	8	7
29	Excessive horsepower	39	0.66	81.55	9	6	9	10	5
30	Motor car/on-trk rules, fail to comply	38	0.65	82.19	16	4	8	4	6
31	Switch movement, excessive speed	38	0.65	82.84	6	11	7	10	4

	Cause	Total	% Of Total	Acc %	2001	2002	2003	2004	2005
32	Retarder, improper manual operation	37	0.63	83.47	7	13	6	9	2
33	Throttle (power), improper use	37	0.63	84.10	9	12	7	5	4
34	Lat drawbar force-short/long car combo	36	0.61	84.72	12	4	10	5	5
35	Automatic block or interlocking signal displaying a stop indication - failure to comply.*	35	0.60	85.31	0	0	10	12	13
36	Fail to release hand brk - rr emp	32	0.55	85.86	5	5	8	7	7
37	Use of brakes, other	32	0.55	86.40	5	5	7	8	7
38	Failure to stretch cars before shoving	31	0.53	86.93	3	5	6	11	6
39	Lat DB force on curve excess, make-up	31	0.53	87.46	4	4	8	7	8
40	Speed, other	31	0.53	87.99	8	5	5	4	9
41	Other main track authority causes	27	0.46	88.45	8	11	6	2	0
42	Fail to secure equip - not rr emp	24	0.41	88.86	5	5	2	3	9
43	Improper train make-up	24	0.41	89.27	2	10	6	3	3
44	Spring Swtch not clear before reverse	24	0.41	89.67	2	5	3	6	8
45	Human factors - track	24	0.41	90.08	9	5	4	4	2
46	Skate, failure to remove or place	23	0.39	90.48	3	3	3	8	6
47	Fail to allow air brks to release	23	0.39	90.87	3	2	3	6	9
48	Human factors -motive power & equipment	23	0.39	91.26	6	3	3	8	3
49	Fail to ctrl car spd use hnd brk-r emp	22	0.37	91.63	5	7	5	2	3
50	Fail to comply with trn order, etc.	22	0.37	92.01	4	2	2	9	5
51	Use of switches, other	21	0.36	92.37	5	6	2	4	4
52	Radio communication, improper	20	0.34	92.71	5	3	4	4	4
53	Radio comm., failure to give/receive	20	0.34	93.05	4	6	5	3	2
54	Block signal, failure to comply	19	0.32	93.37	8	9	2	0	0
55	Improper train inspection	18	0.31	93.68	3	4	2	2	7
56	Train outside yd limits(nonblk),exc spd	18	0.31	93.99	2	5	2	3	6
57	Employee asleep	17	0.29	94.28	6	5	3	1	2
58	Dynamic brake, too rapid adjustment	16	0.27	94.55	2	6	1	5	2
59	Motor car or other on-track equipment rules (other than main track authority) - Failure to Comply.	16	0.27	94.82	0	0	7	4	5
60	Failure to comply with failed equipment detector warning or with applicable train inspection rules.	15	0.26	95.08	0	0	4	4	7
61	Movement without authority - rr emp	15	0.26	95.33	2	3	4	4	2

	Cause	Total	% Of Total	Acc %	2001	2002	2003	2004	2005
62	Train inside yard limits, excess speed	15	0.26	95.59	5	2	5	1	2
63	Manual intervention of classification yard automatic control system modes by operator	14	0.24	95.83	0	0	1	5	8
64	Bottling the Air	12	0.20	96.03	4	2	2	2	2
65	Moving cars-load ramp,etc, not in pos	12	0.20	96.23	2	2	3	2	3
66	Improper train make-up at init term	12	0.20	96.44	0	1	3	7	1
67	Interlocking signal, failure to comply	11	0.19	96.63	6	2	3	0	0
68	Fixed signal (other than automatic block or interlocking signal), failure to comply.	11	0.19	96.81	0	0	2	6	3
69	Automatic brake, excessive	11	0.19	97.00	0	3	2	3	3
70	Train outside yd limits, excess speed	11	0.19	97.19	1	2	1	4	3
71	Fixed signal, failure to comply	10	0.17	97.36	7	3	0	0	0
72	Automatic brake, other improper use	10	0.17	97.53	3	4	0	1	2
73	Automatic block or interlocking signal displaying other than a stop indication - failure to comply.*	9	0.15	97.68	0	0	0	5	4
74	Dynamic brake, excessive	9	0.15	97.84	2	2	1	3	1
75	Human factors - signal	9	0.15	97.99	1	3	3	0	2
76	Throttle (power), too rapid adjustment	8	0.14	98.13	1	1	3	1	2
77	Failure to actuate off independent brk	8	0.14	98.26	2	0	1	2	3
78	Oversized loads or Excess Height/Width cars, mis-routed or switched.	8	0.14	98.40	0	0	2	4	2
79	Trn orders, trk warrants, radio error	7	0.12	98.52	0	0	3	2	2
80	Dynamic brake, other improper use	7	0.12	98.64	1	1	2	1	2
81	Humping or cutting off in motion equipment susceptible to damage, or to cause damage to other equipment	6	0.10	98.74	0	0	3	2	1
82	Switch improperly lined, radio controlled	6	0.10	98.84	0	0	0	1	5
83	Absence of fixed signal (Blue Signal)	5	0.09	98.93	0	1	2	2	0
84	Dynamic brake, excessive axles	5	0.09	99.01	1	0	2	0	2
85	Impairment because of drugs or alcohol	4	0.07	99.08	0	0	2	1	1
86	Flagging, improper or failure to flag	4	0.07	99.15	0	0	1	3	0
87	Hand signal, failure to comply	4	0.07	99.22	3	1	0	0	0
88	Portable derail, improperly applied	4	0.07	99.28	1	0	1	0	2
89	Trn orders, trk warrants, written err	4	0.07	99.35	0	0	2	2	0
90	Improper placement of cars in train	4	0.07	99.42	0	1	1	2	0

	Cause	Total	% Of Total	Acc %	2001	2002	2003	2004	2005
91	Automatic brake, insufficient	4	0.07	99.49	1	0	1	2	0
92	Hand signal, failure to give/receive	3	0.05	99.54	1	1	0	0	1
93	Fail to obs hand sig at wayside insp	3	0.05	99.59	1	2	0	0	0
94	Other signal causes	3	0.05	99.64	0	0	3	0	0
95	Retarder yard skate improperly applied	3	0.05	99.69	1	1	0	1	0
96	Moveable point trk frog improper lined	3	0.05	99.74	0	1	0	0	2
97	Flagging signal, failure to comply	2	0.03	99.78	0	1	1	0	0
98	Fail to cut-in brake valves-loco	2	0.03	99.81	0	0	2	0	0
99	Tampering - safety/protective device	2	0.03	99.85	1	0	1	0	0
100	Hand signal improper	1	0.02	99.86	0	0	0	0	1
101	Fixed signal (other than automatic block or interlocking signal), improperly displayed.	1	0.02	99.88	0	0	0	1	0
102	Hazmat regs, failure to comply	1	0.02	99.90	0	0	1	0	0
103	Auto brake, fail to use split reduction	1	0.02	99.91	0	0	0	0	1
104	Fail to cut-out brake valves-loco	1	0.02	99.93	0	0	0	1	0
105	Automatic cab signal, fail to comply	1	0.02	99.95	1	0	0	0	0
106	Op. of loco by uncert/unqual person	1	0.02	99.97	0	0	1	0	0
107	Human Factor - Signal - Train Control - Operator Input On-board computer incorrect data provided	1	0.02	99.98	0	0	0	0	1
108	Computer system configuration/management error (non vendor)	1	0.02	100.00	0	0	0	0	1
		5,869	**100.00**	**9294.5**	**1,035**	**1,050**	**1,220**	**1,350**	**1,214**

Attachment 2

Federal Railroad Administration (FRA) and
Pipeline and Hazardous Materials Administration (PHMSA)
Regulations Requiring Training, Testing, Qualification, or Certification
of Certain Railroad Employees

I. Overview

The following chart provides an overview of FRA and PHMSA regulations that establish minimum requirements for the training, testing, qualification, or certification of railroad employees who make up trains, break up trains, or operate trains or locomotives (collectively, "railroad operating employees"). FRA is the primary agency of the U.S. Department of Transportation (DOT) responsible for enforcing PHMSA's regulations in the rail mode, including the PHMSA regulations cited below. 49 C.F.R. 1.49. (Please see applicability section of each regulation, e.g., 49 C.F.R. 217.3, for further details as to railroads covered. The FRA regulations cited are limited to railroads that operate on the general railroad system of transportation. See discussion of FRA jurisdiction at 49 C.F.R. part 209, appendix A. Also, many of the FRA requirements cited apply not only to railroad operating employees but also to certain additional railroad employees and to certain additional non-railroad employees.)

DOT agency that issued cited regulation	49 C.F.R. part or section	Type of training, testing, qualification, or certification required
FRA	sec. 217.9, 217.11	Each railroad is required to have a written program of instruction concerning the meaning and application of the railroad's operating rules and to instruct periodically each of the railroad's employees who is governed by those rules in accordance with that program. Each railroad is also required to conduct periodic operational tests and inspections to determine the extent of each such employee's compliance with those rules.

FRA	part 219	Control of alcohol and drug use in railroad operations. Applies to railroad employees who perform service covered by the hours of service law (including railroad operating employees). Prohibits such employees from being impaired by alcohol or drugs while on duty. Sec. 219.101. Prohibits the use of controlled substances at any time, with exceptions. Sec. 219.102. Requires removal from covered service for violating either prohibition. Sec. 219.104. Requires disqualification for unlawful refusal to provide breath or body fluid specimen or specimens when required by the railroad under a mandatory provision of the part. Sec. 219.107. Requires consent to certain alcohol and drug tests as a condition of continued service. Sec. 219.11. Requires passage of return-to-service test if suspended from service pursuant to part 219. Requires pre-employment drug tests. Sec. 219.501. Requires that railroad supervisors be trained to recognize the signs and symptoms of alcohol and drug influence in employees. Sec. 219.11(g).
FRA	sec. 220.25	Instruction and operational testing on the use of radio communication in a railroad operation. Each employee whom the railroad authorizes to use a radio in connection with a railroad operation must be--(1) provided with a copy of the railroad operating rules governing the use of radio communication in a railroad operation; (2) instructed in the proper use of radio communication as part of the program of instruction under sec. 217.11; and (3) periodically tested under the operational testing requirements of sec. 217.9.
FRA	sec. 232.203	Training, qualification, and designation program for employees and contractors that perform brake system inspections, tests, or maintenance.

FRA	sec. 236.921, sec. 236.923, sec. 236.927	Training and qualification program, general; Task analysis and basic requirements; Training specific to locomotive engineers and other operating personnel Persons who operate trains or serve as a train or engine crew member subject to instruction under 49 C.F.R. part 217 on a train operating in territory where a train control system subject to 49 C.F.R. part 236, subpart H, "Standards for Processor-Based Signal and Train Control Systems," is in use must be trained by their employers in accordance with the Product Safety Plan for the product involved. The training component of the Plan must address six specified topics, including familiarization with train control equipment on the locomotive.
FRA	sec. 238.109	Training, qualification, and designation program for employees and contractors who perform inspections, tests, or maintenance of passenger equipment.
FRA	sec. 239.101 (a)(2)	Employee training and qualification on passenger train emergency preparedness. Train crewmembers must be trained initially and then periodically every two years on the applicable plan provisions. At a minimum, training must include the following subjects: rail equipment familiarization; situational awareness; passenger evacuation; coordination of functions; and "hands-on" instruction concerning the location, function, and operation of on-board emergency equipment.
FRA	part 240	Qualification and certification of locomotive engineers. Prescribes numerous requirements applicable to railroad operating employees who operate a locomotive or train. See also discussion at Section II of this Attachment 2.

PHMSA (Technically, the cited regulations were issued by the Research and Special Programs Administration, PHMSA's predecessor agency.)	part 172, subpart H	Safety and security training program for employees involved in hazardous material transportation (including railroad operating employees involved in hazardous material transportation). Two types of safety training are required: general awareness and function-specific. Employers that handle certain types and quantities of hazardous material are required to give their employees two types of security training: security awareness training and in-depth security training. Training is also recurrent; employees must get the required training at least every three years.
FRA	part 209, subpart D	Disqualification procedures. Provides for disqualification of individuals in safety-sensitive service, after notice and opportunity for a hearing, for violation of a railroad safety regulation, order, or statute that demonstrates unfitness for safety-sensitive service. A willful violation triggers a rebuttable presumption of unfitness; however, willfulness need not be shown as a predicate for disqualification.
		Prohibits individuals who are subject to a disqualification order from working for any railroad in a manner inconsistent with the order. Prohibits railroads from employing a person subject to a disqualification order in any manner inconsistent with that order. (In other words, if the order prohibits the individual from serving as an operating employee for a specified time period, the individual may not serve as an operating employee for any railroad for that period.)

II. More detailed discussion of FRA's minimum training, testing, qualification, and certification requirements for locomotive engineers (49 C.F.R. part 240)

- Each railroad must have a written program to certify the qualifications of its employees who operate a locomotive or a train. The program, and any subsequent material modification to the program, must be approved by FRA. See 49 C.F.R. part 240, subpart B.

- The program must provide for certain initial and continuing training. 49 C.F.R. 240.123. For example, a railroad that chooses to train a previously untrained person must provide initial training that covers personal safety, railroad operating rules, mechanical condition of equipment, train handling procedures, familiarization with physical characteristics [of a territory] including train handling, and compliance with Federal regulations. This training must be under the supervision of a qualified instructor engineer and permit the student to acquire familiarity with the physical characteristics of a territory.

- Through the program, each railroad must make four principal determinations in certifying a person as qualified to operate a locomotive or a train. Each person must have the requisite–

  (1) visual and hearing acuity, as demonstrated by passage of a test or a medical officer's decision;
  (2) knowledge, as demonstrated by passage of a written exam;
  (3) skills, as demonstrated by passage of a performance skills test; and
  (4) background, as demonstrated by past conduct concerning the operation of both a train/locomotive and a highway motor vehicle.

  See 49 C.F.R. part 240, subpart B.

- In particular, the skills performance test must address the person's application of knowledge of the railroad's operating practices, equipment inspection practices, train handling practices, and compliance with Federal railroad safety laws. 49 C.F.R. 240.127.

- Once certified, a locomotive engineer must be given at least one operational monitoring observation by a qualified supervisor of locomotive engineers annually and at least one unannounced compliance test annually. 49 C.F.R. 240.303.

- A certified locomotive engineer is subject to revocation of his or her certification and civil penalties for violating any one of five, cardinal operating rules. Generally stated, these fundamental operating rules concern--

  (1) failing to obey a stop signal;
  (2) exceeding a speed limit by at least 10 mph;
  (3) failing to adhere to certain procedures for the safe use of train or engine brakes;
  (4) occupying main track without authority; or

(5) tampering with a locomotive safety device.

See 49 C.F.R. 240.117 and 240.305.

- A certified locomotive engineer is also subject to revocation of his or her certification for violating Federal alcohol and drug use prohibitions. Generally, these prohibitions concern use, possession, or impairment while on duty. See 49 C.F.R. 240.117(e)(6) and 219.101.

- A person who has an active substance abuse disorder shall not be currently certified as a locomotive engineer. See 49 C.F.R. 240.119(b).

- A locomotive engineer may petition FRA's Locomotive Engineer Review Board (LERB) in response to a decision by a railroad to revoke his or her certification. 49 C.F.R. part 240, subpart E. A person who is a candidate to become a locomotive engineer may also challenge a decision by the railroad to deny certification. The LERB reviews the record of the railroad's decision to determine whether the revocation or denial of certification was proper under FRA's regulations. The LERB may overturn or uphold the railroad's decision. Either party may request a *de novo* hearing on the matter before an administrative hearing officer. The decision of the administrative hearing officer may be appealed to the FRA Administrator. The final decision of the Administrator may be reviewed in the appropriate U.S. Court of Appeals. 49 U.S.C. 20114(c).